Updated U.S. English sole stock assessment: Status of the resource in 2007

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Executive Summary

Stock

This assessment updates the status of the English sole (*Parophrys vetulus*) resource off the coast of the United States from the Mexican Border to the Canadian border. As in the 2005 assessment, data sources are treated separately for a southern (INPFC Conception and Monterey) and a northern (INPFC Eureka, Columbia and U.S. Vancouver) area, however the English sole population is modeled as a single stock.

The biggest obstacle to modeling the English sole population in the southern and northern areas separately is a lack of data; specifically the length frequency of discarded fish (to reliably estimate selectivity separately for each fleet), current maturity observations and sufficient age data (mainly from the south) to allow estimation of the growth curve for each area as well as model changes in growth over time. Without these data and more spatially complex models, it is difficult to speculate on whether regional management is appropriate for English sole, as relatively large historical catches of similar magnitude have been removed from both areas, albeit over different portions of the historical record.

Catches

This updated assessment uses historical landings reconstructed from a variety of sources for the 2005 assessment describing the fishery removals over the period 1876 to 1980. Landings from 1981 to 2006 have been updated to reflect the best available estimates as of May, 2007. Peak landings from the southern area occurred in the 1920s with a maximum of 3,976 metric tons (mt) of English sole landed in 1929. Peak landings from the northern area occurred from the 1940s to the 1960s with a maximum of 4,008 mt landed in 1948. Landings in both areas have generally declined since the mid 1960s and are at historical lows in recent years. Model estimates of discarding average 24% by weight over the time-series since 1940, with higher discards corresponding to periods of large recruitment and due to the associated increase in catch of smaller unmarketable English sole due to modeled changes in selectivity and growth.

Table a. Recent commercial fishery landings by INPFC area and fleet.

Year	Conception	Monterey	South total	Eureka	Columbia	US Vancouver	North total
1997	12	453	466	185	454	301	941
1998	5	224	229	198	330	264	792
1999	9	219	227	158	296	172	626
2000	9	173	182	125	227	200	552
2001	29	170	199	223	340	180	742
2002	6	95	102	271	342	439	1,052
2003	3	114	117	68	171	432	670
2004	31	66	97	205	242	372	819
2005	15	55	70	183	290	345	818
2006	1	56	57	238	338	254	829

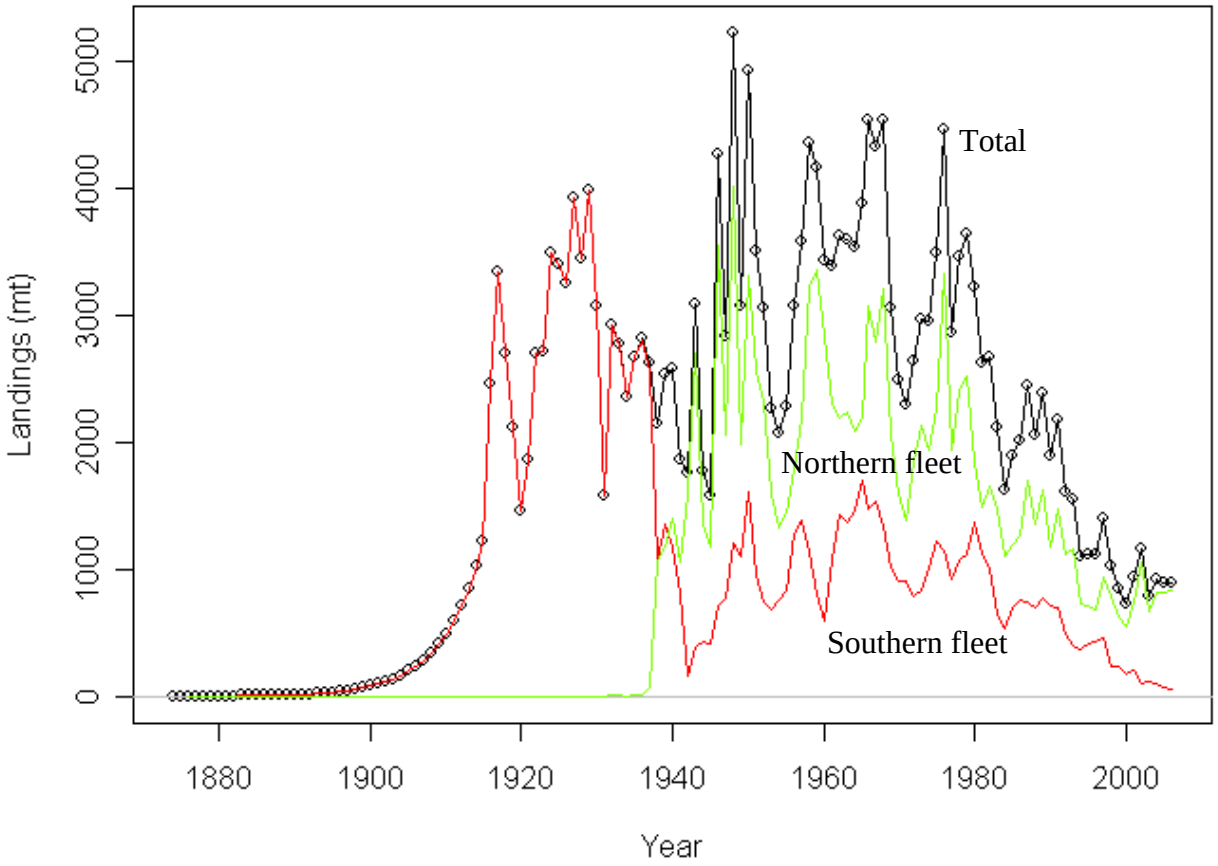

Figure a. Reconstructed historical landings (mt) by year and fleet, 1876-2006.

Data and assessment

The most recent assessment for English sole was performed in 2005. The 2005 assessment used an early version (1.19) of the Stock Synthesis 2 modeling framework to estimate model parameters and management quantities. That assessment modeled the coast-wide English sole population (U.S. only), including both males and females. Fishery independent data included the NMFS triennial groundfish survey index of abundance (1980-2004), maturity observations, length-weight relationships as well as survey length-frequency and age-frequency data. Length and age data from commercial fishery landings are included from 1948-2004, as well as fishery discard information from three separate observer programs, 1950-1961, 1985-1987 and 2001-2004.

This document updates the 2005 assessment using the newest version of SS2 available, 2.00e (Methot 2007). The methods for summarizing the raw data and the modeling approach are maintained. The recent landings series have been updated for 1981-2006, and a large quantity of fishery length and age data (primarily from Washington) that was previously unavailable is now included. These new data provide substantially improved information regarding recent year class strengths and current stock status.

Stock biomass

As in 2005, English sole spawning biomass was found to be increasing rapidly over the last 15 years after a period of poor recruitments from the mid 1970s to the early

1990s, which left the stock at nearly historically low levels. The spawning biomass at the beginning of 2007 was estimated to be 41,906 mt (~ 95% confidence interval: 31,046-52,766), which corresponds to 116% (83-149%) of the unexploited equilibrium level. This value reflects the accelerated maturity schedule estimated from the 1990's relative to historical conditions and therefore does not necessarily correspond to the same age structure in the population as implied by unexploited conditions. Historical depletion levels were estimated to have reached minima as low as 20% in 1953 and, more recently, 23% in 1992. Current (2006) total catches were estimated to be 1,078 mt, of which 886 mt were landed. These results are very similar to the 2005 assessment, although the recent trend shows a slightly larger increase in stock size.

Table b. Recent trend in English sole spawning biomass and depletion level.

Year	Estimated spawning biomass (mt)	~95% confidence interval	Estimated depletion	~95% confidence interval
1998	11,022	7,920-14,124	31%	NA
1999	13,290	9,756-16,824	37%	NA
2000	16,006	11,924-20,088	44%	NA
2001	20,120	15,201-25,039	56%	NA
2002	26,545	20,167-32,923	74%	NA
2003	33,548	25,386-41,710	93%	NA
2004	38,534	29,057-48,011	107%	NA
2005	41,029	30,767-51,289	114%	NA
2006	42,193	31,445-52,939	117%	83-151%
2007	41,907	31,046-52,766	116%	83-149%

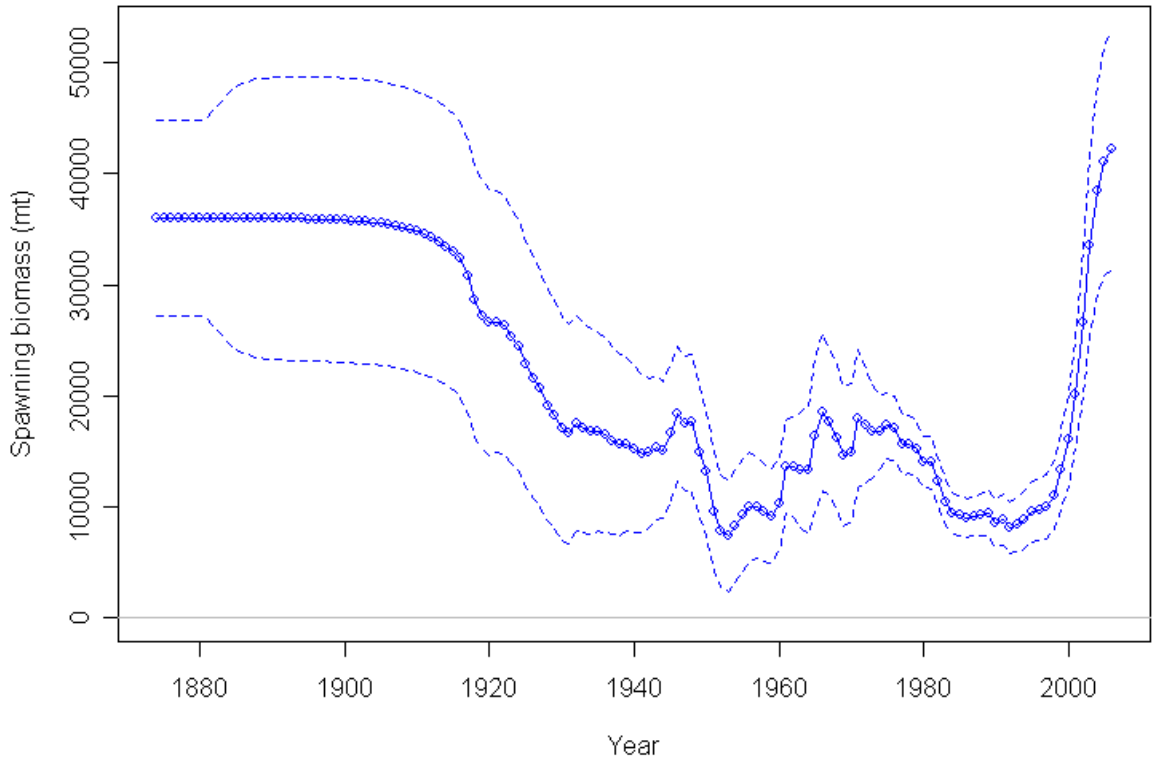

Figure b. Estimated spawning biomass time-series with approximate asymptotic 95% confidence interval.

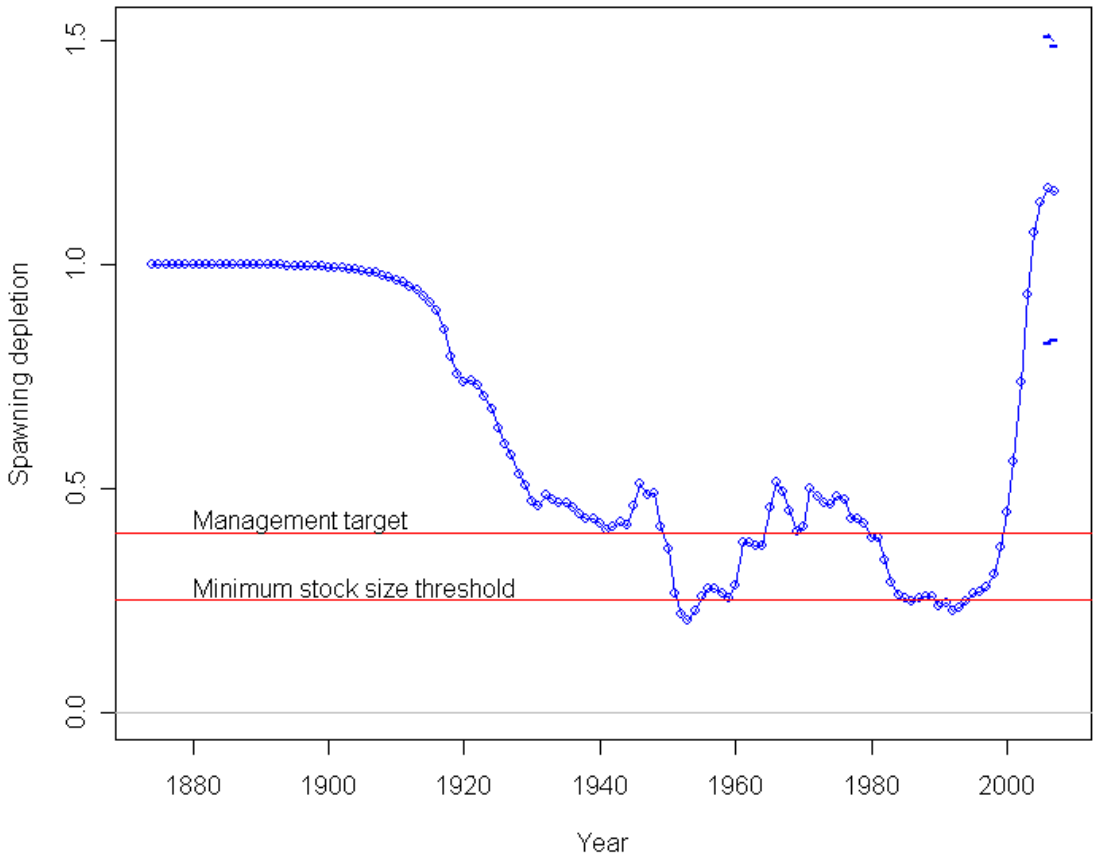

Figure c. Time-series of estimated depletion level, 1876-2007 with approximate asymptotic 95% confidence interval for 2006 and 2007.

Recruitment

Following two decades of low recruitments, strong year classes were estimated for 1995, 1998-2000, and 2002. The data indicate that the 1999 year class is the largest in the time-series, and the magnitude of this event is now much more certain than in the 2005 assessment; the coefficient of variation (CV) of this estimate has dropped from 25% (in 2005) to 19%. This change is mainly due to the large quantity of age data now available through 2006. These large recent recruitment estimates are larger than those from the 2005 assessment, resulting in the estimate of relatively higher current stock size. The recruitment deviations for 2004 and later years are informed primarily by the stock-recruitment function and this is reflected in the increased relative uncertainty of these estimates.

Table c. Recent estimated trend in English sole recruitment.

Year	Estimated recruitment (1000s)	~95% confidence interval
1998	284,960	195,739-414,849
1999	403,290	279,399-582,116
2000	274,080	172,836-434,631
2001	111,850	57,834-216,315
2002	209,360	109,931-398,721
2003	140,690	58,711-337,140
2004	118,760	50,558-278,965
2005	115,140	49,545-267,577
2006	114,440	49,350-265,380
2007	124,990	54,067-288,949

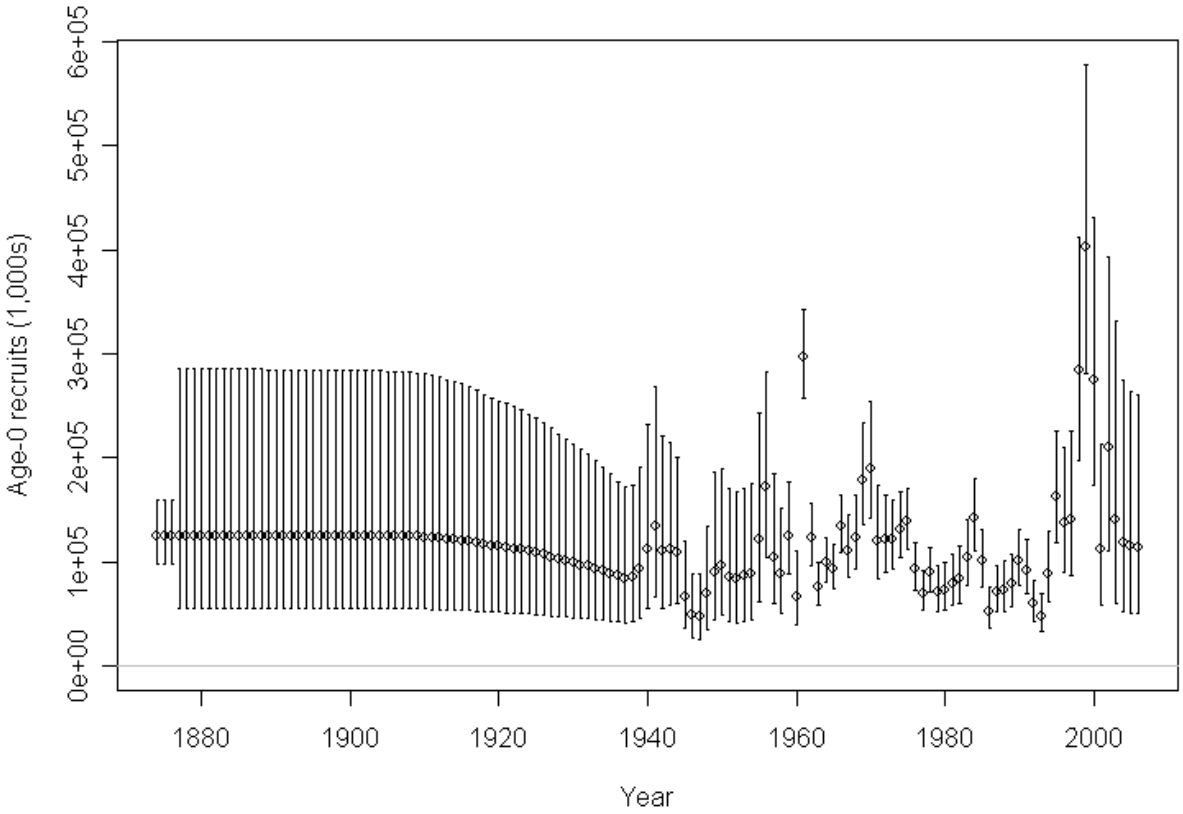

Figure d. Time-series of estimated English sole recruitments with approximate asymptotic 95% confidence interval.

Reference points

As was the case in the 2005 assessment, there are two types of reference points reported in this assessment: those based on the growth and maturity parameters at the beginning of the modeled time period and those based on the most recent time period in a 'forward projection' mode of calculation. All strictly biological reference points (e.g.,

unexploited spawning biomass) are calculated based on the unexploited conditions at the start of the model, whereas management quantities (*MSY*, SB_{msy}, etc.) are based on the current growth and maturity schedules and are marked throughout this document with an asterisk (*).

Unexploited equilibrium English sole spawning biomass (SB_0) was estimated to be 36,012 mt (~ 95% confidence interval: 27,219-44,805), with a mean expected recruitment of 124,990 thousand age-0 English sole. The $SB_{40\%}$ management proxy for target spawning biomass was estimated to be 14,405 mt (10,888-17,922), producing a landed catch of 2,523 and a total yield of 3,452 mt (2,986-3,918). The model-based estimate of retained *MSY* was 2,487* mt, which corresponds to a total mortality of 4,252 mt (~ 95% confidence interval: 2,687-5,816). The apparent increased discard rate at *MSY* is due to the interaction of size-based retention and the truncation of the size structure of the modeled population. The estimate of *MSY* is only slightly larger than the average estimated total catch from the period 1916-1991 of 3,701 mt, indicating the stock has been exploited at near optimal levels for most of the time-series, but levels have been much lower in recent years. The spawning stock biomass expected to produce *MSY* catch levels was 6,526* mt (*1*-13,654, the symmetric approximation of the 95% confidence interval included zero and was therefore rounded up), or 18.1% of SB_0. This level of exploitation was estimated to result in a spawning potential ratio (SPR) of 25.9%*. The overfished threshold for English sole was estimated to be 9,003 mt. These reference point estimates are very close to the values reported in the 2005 assessment.

Exploitation status

The estimated spawning potential ratio (SPR) for English sole fluctuated above and below the proxy target of 40% for flatfish from the late 1940s to the early 1990s. Since 1992 the intensity of exploitation has been less than that of the target, resulting in higher SPR levels. This corresponds to a relative exploitation rate (catch/biomass of age 3 and older fish) history that is high from the late 1940s to the early 1990s, and steadily declining to very low levels over the last 15 years. The stock appears to have never been exploited at the rate (0.27) that would reduce the stock to SPR levels estimated to produce *MSY*, 0.259, during the time-series. The fishery has exceeded the relative exploitation rate that results in fishing at the SPR target of 40% of 0.17 in only a few years of the historical series.

Table d. Recent trend in spawning potential ratio (SPR) and relative exploitation rate (catch/biomass of age 3 and older fish).

Year	Estimated SPR	Relative exploitation rate
1997	0.55	0.11
1998	0.63	0.07
1999	0.69	0.05
2000	0.76	0.04
2001	0.76	0.04
2002	0.76	0.03
2003	0.86	0.02
2004	0.87	0.02
2005	0.89	0.02
2006	0.90	0.02

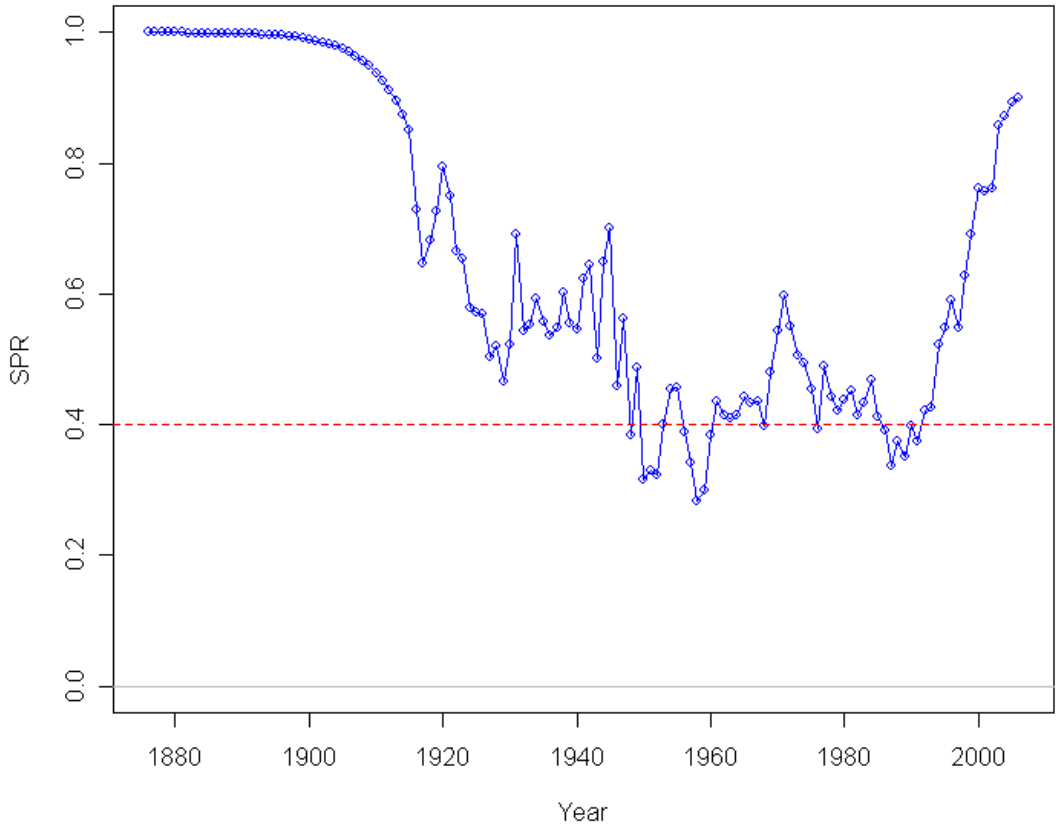

Figure e. Time-series of estimated spawning potential ratio 1876-2006.

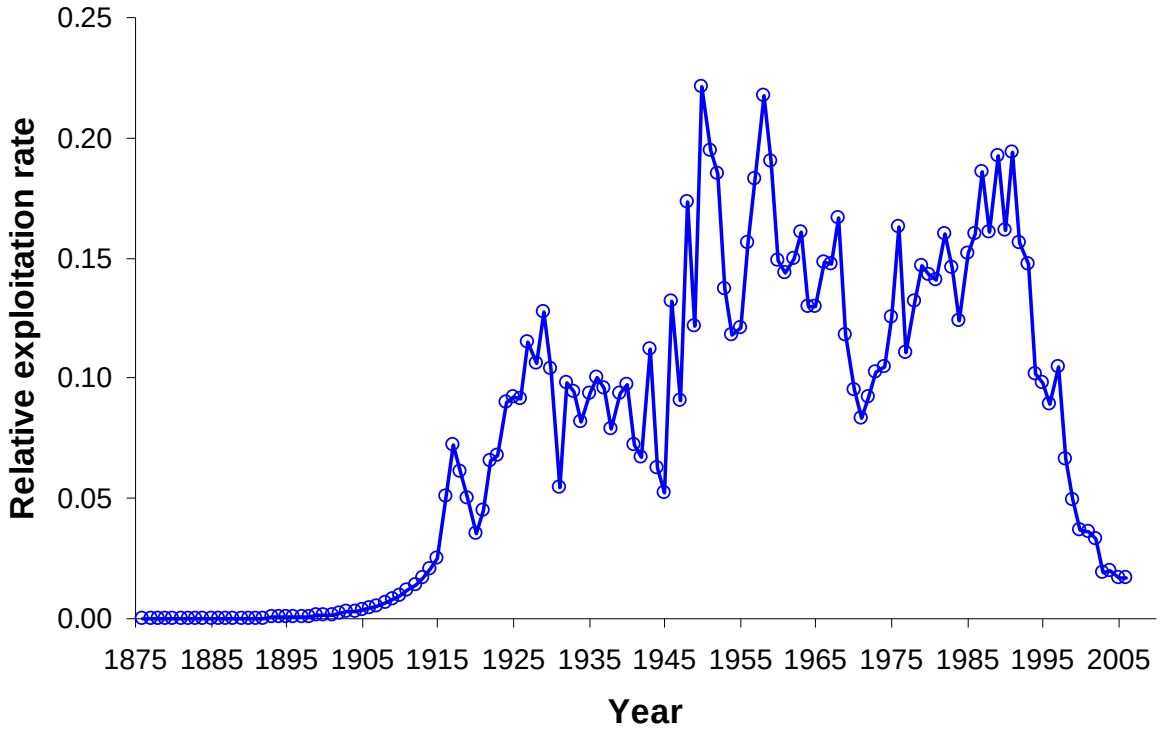

Figure f. Time-series of relative exploitation rate (catch/biomass of age 3 and older fish) 1876-2006.

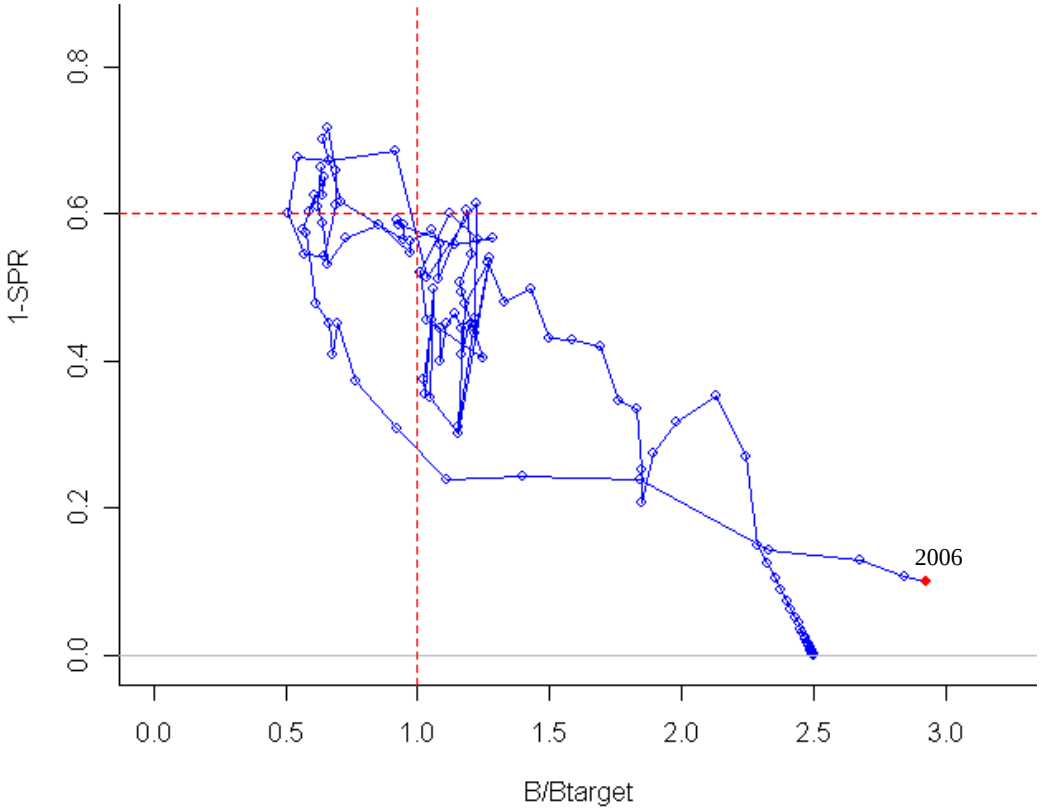

Figure g. Estimated spawning potential ratio relative to the proxy target of 40% vs. estimated spawning biomass relative to the proxy 40% level. Higher biomass occurs on the left side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

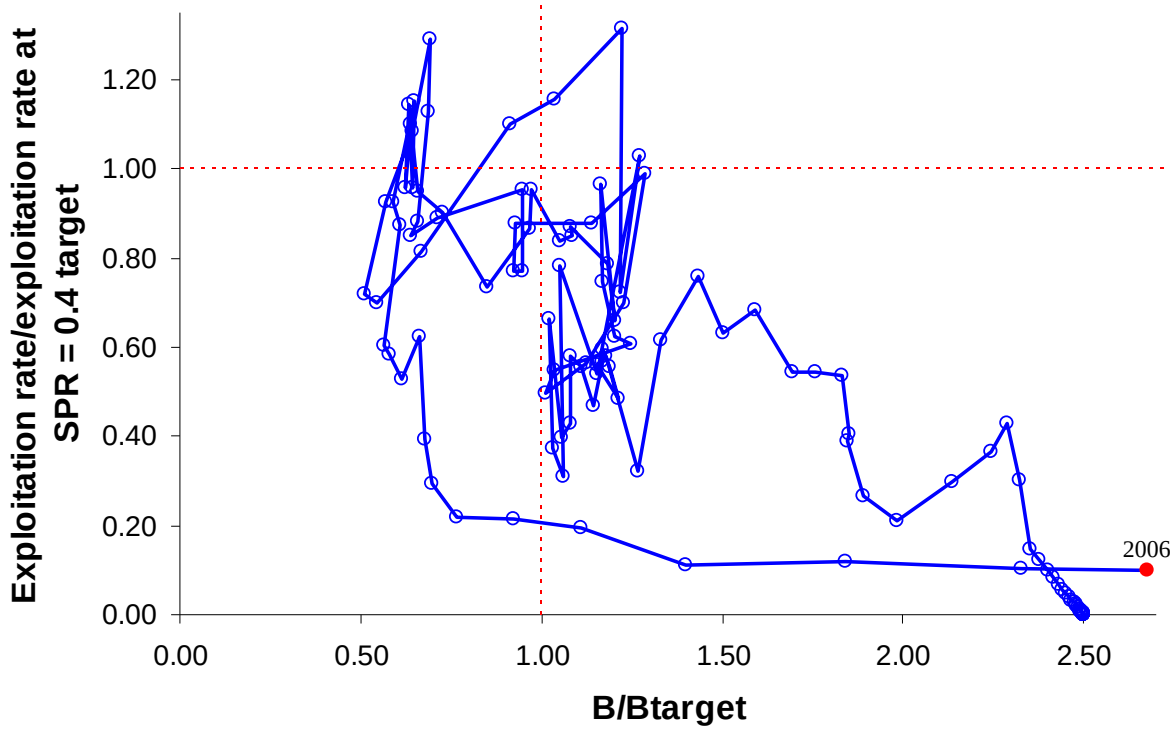

Figure h. Relative exploitation rate/exploitation rate at SPR = 0.4 target vs. estimated spawning biomass relative to the proxy 40% level.

Management performance

Recent English sole landings and estimated discards have been below both the coast-wide ABC of 3,100 mt and the estimated *MSY* harvest level of 4,080 mt.

Table e. Recent trend in estimated total English sole catch and landings (mt)

Year	Landings (mt)	Estimated total catch (mt)	Coast-wide ABC
1997	1,406	1,911	3,100
1998	1,021	1,441	3,100
1999	853	1,245	3,100
2000	734	1,061	3,100
2001	942	1,363	3,100
2002	1,154	1,683	3,100
2003	787	1,125	3,100
2004	916	1,218	3,100
2005	888	1,115	3,100
2006	886	1,078	3,100

Unresolved problems and major uncertainties

This update uses the same approach to address uncertainty as the 2005 assessment: asymptotic variance estimates, sensitivity testing and retrospective analysis of the maximum likelihood estimates for parameters and predictions of stock status. Confidence intervals for population parameters were generally wide, indicating substantial uncertainty in the time-series of spawning biomass, recruitment and relative depletion level for English sole. Three specific areas of uncertainty were selected to

reflect new sensitivity testing for this update using all available data in 2007, while maintaining those areas still relevant from the 2005 assessment:

1) This assessment allows the maturity schedule to change over time to match the large reduction in the length at 50% maturity observed between samples from the 1950s and 1995. Although it is likely that maturity does change over time, it is not clear whether these two values represent endpoints of a relatively smooth decline (as modeled), stochastic, or environmentally driven variability. With only two observations, there is little ability to explore these hypotheses in detail, so two sensitivities were performed using only the 1950s maturity curve and only the 1995 curve.
2) Because this is an update assessment, the NWFSC survey data, including indices of abundance, length- and age-frequency data for both the north and the south could not be included in the base case. A sensitivity analysis of the effect of adding these data was performed.
3) Changes in fishery selectivity and retention appear to have occurred over time and between fleets. Selectivity was allowed to change over time in the base case model (as in the 2005 assessment), however, sparse data on the discarded fraction of the catch and for the landed catch over certain time periods results in the need for the modeled patterns of fishery selectivity and retention to be very simple, likely underestimating the uncertainty in population dynamics. An effort was made to explore these simple assumptions through sensitivity testing, but further analysis should be done during the next full assessment.

As was concluded in the 2005 assessment, current spawning biomass is estimated to exceed the target level ($B_{40\%}$) throughout exploration of these major sources of uncertainty, as well as other sensitivity analyses included.

Forecasts

Forecasts were generated assuming the average landings over the period 2004-2006 would be removed in 2007 and 2008 before the results of this updated assessment would be used for management. This value was 897 metric tons, of which 79 mt would be landed in the south (Conception and Monterey areas) and 818 mt in the north (Eureka, Columbia and Vancouver areas). Beginning in 2009, the maximum potential catch would be removed under the 40:10 harvest control rule. A 10-year average of the relative F contribution from the southern and northern fleets was used for this projection. This ratio was 8.8% for the southern fleet to 91.2% for the northern fleet. An extremely large potential catch (>13 times recent average values) is predicted to be possible in 2009 based on the ABC from the $F_{40\%}$ harvest rate proxy because the stock is projected to be above unexploited spawning biomass level. Subsequent landings remain very high relative to those observed in the historical time-series for the duration of the 10-year projection. Due to the implausibility of the removals in this forecast scenario, alternates are used for the decision table analysis presented below.

Table f. Projection of potential English sole catch, landings, spawning biomass and depletion for the base case model under the 40:10 harvest control rule.

Year	Total catch (mt)	~95% interval	Total landings (mt)	Age 3+ biomass (mt)	Spawning biomass (mt)	~95% interval	Depletion	~95% interval
2007	1,069	NA	897	62,172	41,907	31,046-52,766	116%	83-149%
2008	1,053	NA	897	59,444	40,559	29,827-51,291	113%	82-143%
2009	14,326	10,473-18,179	12,303	56,494	38,711	28,203-49,219	107%	79-136%
2010	9,745	7,049-12,441	8,057	42,894	26,321	28,203-49,219	73%	54-92%
2011	7,158	5,042-9,275	5,616	35,259	19,585	18,839-33,803	54%	39-70%
2012	5,790	3,913-7,667	4,315	31,137	16,136	13,474-25,696	45%	31-59%
2013	5,095	3,307-6,882	3,660	28,843	14,420	10,528-21,742	40%	26-54%
2014	4,630	2,516-6,743	3,263	27,429	13,523	9,016-19,822	38%	24-52%
2015	4,388	2,484-6,293	3,072	26,517	13,053	8,307-18,739	36%	23-49%
2016	4,235	2,476-5,994	2,960	25,850	12,749	8,319-17,787	35%	23-48%
2017	4,122	2,461-5,784	2,880	25,335	12,527	8,364-17,134	35%	22-48%
2018	4,036	2,435-5,637	2,819	24940	12,362	8,387-16,668	34%	21-47%

Decision table

In the 2005 assessment, the strength of recent year classes was identified the primary "axis of uncertainty" was therefore selected for inclusion in the decision table. This choice reflected the lack of age data from fishery or survey sources with which to reliably estimate the strength of those year classes. Because there is now much more data informing large recruitment estimates from 1998-2000, sensitivity analysis was performed to update the dominant sources of uncertainty for inclusion in the decision table. Those sensitivity runs that appeared to show the greatest uncertainty in current stock status and recent trend included: 1) modeling the stock as if the maturity schedule had not changed since the 1950s, and 2) for comparative purposes only (because this is an update assessment) including the NWFSC trawl survey index, length and age information (2003-2006). As in 2005, given the large current stock size, the focus of the decision table is on an alternate model with a lower stock size than the base case. The spawning biomass estimated from the base case model was 41,907 mt at the beginning of 2007, with an approximate 95% confidence interval including the range of 31,046-52,766 mt. Constraining the maturity schedule to the values observed in the 1950s resulted in an estimate of current spawning biomass reduced to 28,610 mt. Including the NWFSC trawl

survey data resulted in an estimated 2007 spawning biomass of 46,140 mt. Together, these two alternate models represent "much less likely" and "less likely" scenarios bracketing the 2007 base case results. The relative probability is also described via the location in the approximate probability distribution (via the asymptotic approximation) for the base case model result. In this context, the estimate of current spawning biomass from the 1950s maturity schedule sensitivity was smaller than all but 1% of the density from the base case, while the sensitivity with NWFSC survey data resulted in a spawning biomass larger than all but 22% of the density from the base case. The English sole stock is predicted to remain above the 40% spawning biomass target for all states of nature and management options presented for the next 5 years and close to it as far into the future as 2018.

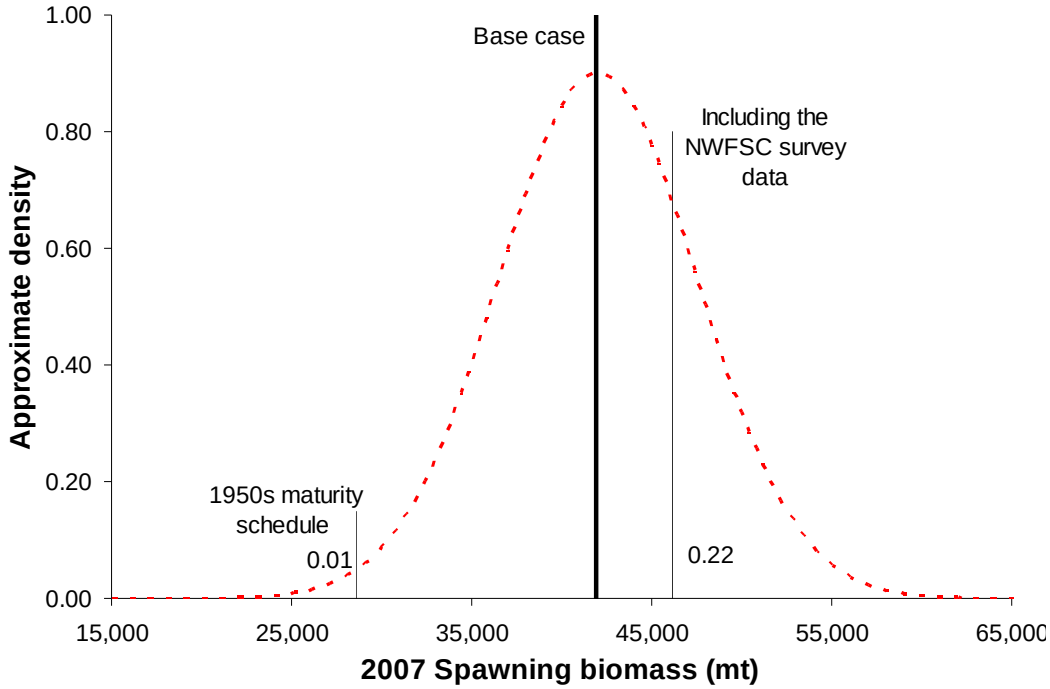

Figure i. Approximate distribution of uncertainty in estimated 2007 spawning biomass from the base case model (dashed line) density function based on the normal approximation. Bold vertical line indicates the maximum likelihood estimate from the base case, light lines the less likely alternate model including the 1950s maturity and, for comparative purposes, the alternate including NWFSC survey data.

Table g. Decision table of 10-year projections (years 1-5, 10 shown) for alternate models (columns) and management options (rows) beginning in 2009. Landings for 2007-2008 are the average in 2004-2006. The alternate model including the NWFSC survey data is presented for comparative purposes only.

			State of nature		**Comparison only**
			1950s maturity	Base case	With NWFSC survey data
Relative probability			Less likely	Most likely	Less likely
~ probability state of nature is > base case			0.01	0.5	0.78
Management decision	**Quantity**	**Year**			
3-year average landings (2004-2006) South = 79 mt, North = 818 mt	Depletion	2009	85%	107%	117%
		2010	81%	102%	111%
		2011	76%	98%	105%
		2012	71%	94%	101%
		2013	67%	90%	97%
		2014	64%	88%	94%
		2018	56%	81%	85%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	26,220	36,822	41,001
		2011	24,585	35,147	39,009
		2012	23,067	33,724	37,270
		2013	21,776	32,541	35,800
		2014	20,717	31,571	34,583
		2018	18,191	29,183	31,607
200% of 3-year average landings (2004-2006) South = 158 mt, North = 1,636 mt	Depletion	2009	85%	107%	117%
		2010	78%	100%	109%
		2011	72%	93%	101%
		2012	65%	88%	95%
		2013	60%	83%	90%
		2014	55%	79%	86%
		2018	45%	70%	75%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	25,506	35,997	40,183
		2011	23,239	33,618	37,494
		2012	21,185	31,607	35,177
		2013	19,449	29,936	33,231
		2014	18,024	28,560	31,625
		2018	14,562	25,062	27,580
3,100 mt total catch (current ABC; requested by GMT in 2005) South = 273 mt, North = 2,827 mt	Depletion	2009	85%	107%	117%
		2010	76%	98%	106%
		2011	67%	89%	97%
		2012	60%	82%	90%
		2013	53%	76%	83%
		2014	48%	72%	78%
		2018	36%	60%	65%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	24,806	35,197	39,382
		2011	21,929	32,146	36,011
		2012	19,379	29,593	33,142
		2013	17,260	27,498	30,763
		2014	15,549	25,792	28,822
		2018	11,539	21,522	23,980
	Landings (mt)	2009	2,674	2,662	2,672
		2010	2,664	2,653	2,673
		2011	2,638	2,628	2,655
		2012	2,603	2,597	2,628
		2013	2,568	2,566	2,600
		2014	2,534	2,538	2,573
		2018	2,429	2,457	2,497

Research and data needs

The following research would substantially improve the ability of this assessment to reliably and precisely model English sole population dynamics in the future. In order of priority (author's personal opinion):

1) Collection of maturity data on an ongoing basis from survey or fishery sources that could be used to track future changes affecting modeled spawning stock biomass.
2) This assessment contains little data on the length frequency of the discarded portion of the commercial catch of English sole. This would be valuable data to add to the discard fractions and average individual weights currently being collected. Based on changes to sampling protocols beginning with 2006, observer data will soon be available in much greater quantities and should be used in the next full assessment.
3) Because the U.S.-Canada border does not appear to be a meaningful biological boundary for the English sole population, extension of this assessment to include Canadian waters may be necessary to better capture population trends. Further, the use of explicitly spatial models for English sole (e.g., Stewart 2006) should be explored to better account for regional differences in recruitment and exploitation intensity.
4) The next full assessment can make use of the recently completed cross-method study of ageing comparing interopercular bones and otoliths that will allow revision of the ageing error matrix. This will be necessary, as otoliths are now being collected on a routine basis by the NWFSC survey and Oregon port samplers.
5) Despite much effort in the 2005 assessment, there is still uncertainty in some parts of the historical landings series. Specifically needed are: 1) a method for reconstructing landings in Washington prior to 1956 from U.S. waters, 2) landings data from Oregon from 1954-1955 and 3) a thorough study of the mink food fishery in Oregon and California including estimates of the total volume and length- or age-structure of catches associated with this fishery.
6) As part of the next full assessment, a re-evaluation of the weighting of data sources should be performed, perhaps weighting by a function of the number of fish and samples instead of just the un-tuned number of samples following the method of Stewart and Miller presented at the 2006 Data and Modeling workshop (NWFSC 2007).
7) Based on the relatively poor and biased fit to the age-at-length data from the 1995 triennial survey, the next full assessment should either find a way to fit these data better or remove them from the assessment.
8) The evaluation of uncertainty performed for the 2005 assessment and maintained in this update relies heavily on asymptotic variance estimates and sensitivity testing. A more thorough Bayesian approach to parameter and model uncertainty could be completed.
9) As recommended by the 2005 STAR panel, sex-specific natural mortality rates and selectivity curves should be explored in the next full assessment.

Rebuilding projections

The stock of English sole off the United States was not found to be currently overfished, and therefore does not require rebuilding projections.

Table h. Summary of recent trends in English sole exploitation and stock levels; all values reported at the beginning of the year. Quantities based on the current growth and maturity schedules and are marked with an asterisk (*) and are not comparable to those based on unfished conditions.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Landings (mt)	1,021	853	734	942	1,154	787	916	888	886	NA
Estimated discards (mt)	420	392	327	421	529	338	302	227	192	NA
Estimated total catch (mt)	1,441	1,245	1,061	1,363	1,683	1,125	1,218	1,115	1,078	NA
ABC (mt)	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100
OY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SPR*	0.63	0.69	0.76	0.76	0.76	0.86	0.87	0.89	0.90	NA
Exploitation rate (catch/age 3+ biomass)	0.07	0.05	0.04	0.04	0.03	0.02	0.02	0.02	0.02	NA
Age 3+ biomass (mt)	21,727	25,113	28,627	37,538	51,026	59,605	61,226	64,401	64,165	62,172
Spawning biomass (mt)	11,022	13,290	16,006	20,120	26,545	33,548	38,534	41,029	42,193	41,907
~95% interval	7,920-14,124	9,756-16,824	11,924-20,088	15,201-25,039	20,167-32,923	25,386-41,710	29,057-48,011	30,767-51,289	31,445-52,939	31,046-52,766
Recruitment (1000s)	284,960	403,290	274,080	111,850	209,360	140,690	118,760	115,140	114,440	124,990
~95% interval	195,739-414,849	279,399-582,116	172,836-434,631	57,834-216,315	109,931-398,721	58,711-337,140	50,558-278,965	49,545-267,577	49,350-265,380	54,067-288,949
Depletion	31%	37%	44%	56%	74%	93%	107%	114%	117%	116%
~95% interval	NA	NA	NA	NA	NA	NA	NA	NA	83-151%	83-149%

Table i. Summary of English sole reference points. Quantities based on the current growth and maturity schedules and are marked with an asterisk (*) and are not comparable to those based on unfished conditions. The symmetric approximation of the 95% confidence interval included zero for some quantities, the lower limit is therefore rounded up and in italics.

Quantity	Estimate	~95% Confidence interval
Unfished spawning stock biomass (SB_0, mt)	36,012	27,219-44,805
Unfished 3+ biomass (mt)	59,944	NA
Unfished recruitment (R_0, thousands)	124,990	97,519-160,199
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Stock Biomass ($SB_{40\%}$)	14,405	10,888-17,922
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.49	0.38-0.60
Exploitation rate resulting in $SB_{40\%}$	0.13	NA
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	3,452	2,986-3,918
Reference points based on SPR proxy for MSY		
Spawning Stock Biomass at SPR (SB_{SPR})(mt)	11,411	10,157-12,665
$SPR_{MSY\text{-}proxy}$	0.40	NA
Exploitation rate corresponding to SPR	0.17	NA
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	3,877	3,443-4,311
Reference points based on estimated MSY values		
Spawning Stock Biomass at *MSY* (SB_{MSY}) (mt)	6,526	*1*-13,654
SPR_{MSY}	0.26	*0.01*-0.54
Exploitation Rate corresponding to SPR_{MSY}	0.27	NA
MSY (mt)	4,252	2,687-5,816

1. Introduction

1.1 Preface

This assessment is intended to provide an update of the 2005 English sole stock assessment, maintaining continuity in the modeling approach, fixed parameter values, major assumptions, and treatment of the input data. Where new data has become available, existing data sources are supplemented, but no new sources are included in the base case model. Uncertainty analysis largely focuses on sources of uncertainty identified in the 2005 assessment, although some further exploratory work is presented here for comparative purposes. It is the intent of these supplementary analyses to provide a context for the updated results that considers all available information while still adhering to the 2007-2008 terms of reference.

1.2 Species biology and history

English sole (*Parophrys vetulus*) is a common flatfish species off the U.S West Coast. They grow quickly and mature as early as age three. English sole are relatively small bodied for a commercial species, with most individuals attaining lengths of 30 to 40 cm in the retained catch. English sole display highly sexually dimorphic growth, with females growing nearly twice as large as males; maximum lengths are less than 60 cm for the largest individuals. Because of this dimorphic growth, only a small fraction of the commercial landings are comprised of males, while survey catches are much closer to 50:50 in sex-ratio (Stewart 2005).

Very few English sole occur near the U.S.-Mexico border; therefore this boundary is a reasonable proxy for the southern extent of the coastal stock. Analysis of tagging data show very little exchange between English sole found in Puget Sound and those off the open coast. This assessment does not include the portion of the population found in these inland waters. To the north, English sole are relatively abundant at the U.S.-Canada border and there appears to be no discontinuity in abundance that would indicate a biological boundary. However, to maintain consistency with the management of the Pacific Council this assessment does not include waters outside the exclusive economic zone of the U.S.

English sole are captured almost exclusively by bottom trawl gear and have been caught by the fishery operating off the western coast of North America for over a century. This update uses the historical catch reconstruction (1876-1980) performed for the 2005 stock assessment without further modification. This reconstruction used a variety of sources to trace the landings of English sole back to the 1920s, assigned a ratio of unspecified “sole” landings to English sole before that time. Landings prior to 1926 were extrapolated based on documented fishery activity (Stewart 2005). Landings from have generally declined since the mid-1960s and are at nearly historical lows in recent years (Figure 1, Table 1), well below the ABC. Because they are captured with a mix of other shelf rockfish and flatfish species and do not form dense spawning aggregations there is little opportunity, or market for drastically increased catch levels. Actual harvests have not exceeded the ABCs since they were first specified for English sole in 1983. English sole have been grouped into the “other flatfish” category with respect to trip-limits

imposed by the Pacific Council. Regulatory limits on the landings of this category have only been specified since 2000. However, it should be noted that processor-imposed landing restrictions (relating to both fish length and landing amount) have also affected retention/discarding patterns in recent decades.

2. Documentation of updated data sources

As was done in the 2005 assessment, both survey and fishery input data are delineated into 'northern' and 'southern' areas or fleets. The southern area includes English sole from the U.S.-Mexico border to the north edge of the Monterey INPFC area and the northern area includes English sole from the southern border of the Eureka INPFC area to the U.S.-Canada border (Figure 2). This assessment treats data from both areas together, modeling the U.S. English sole resource as a single population.

Age-frequency data in this assessment have been treated as conditional to the length bin of the fish from they were collected. This approach addresses two issues with the use of both length and age data: use of ages collected through length-stratified sampling and the use of both length- and age-frequency distributions in the same model where they are generally obtained from the same individual fish. To avoid arbitrary weighting of the length and age likelihood components as a means of addressing this problem, this assessment treats all age information as an extension of length frequency by sex. To do this, all age data were compiled as conditional age-frequencies for each length bin within each source (survey or fishery), area, and year. With this approach, the likelihoods are no longer double counting similar information (sex- and length-distribution information does not occur in the conditional age-frequency-at-length observations) and the growth curve (including the CV of length-at-age) can be estimated internal to the stock assessment model avoiding potentially substantial bias arising from selectivity and retention effects on sample collection.

2.1 Fishery independent data

The primary fishery independent data source for this assessment is the triennial bottom trawl survey conducted by the AFSC (Alaska Fisheries Science Center), 1977-2001 and NWFSC (Northwest Fisheries Science Center), 2004. As in the 2005 assessment, the 1977 data were not used due to the large proportion of water hauls and uncertainty in gear performance on those hauls that did capture appreciable quantities of benthic species. The standard deviation (SD) applied to the annual indices of abundance was doubled in that assessment to account for observation error in excess of the design-based estimates and this to is unchanged. Full documentation of the methods and summary of the data were provided in the 2005 assessment document (Stewart 2005). Divided into northern and southern series, there are nine observations of relative abundance (1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004), six length-frequency distributions per sex (1989, 1992, 1995, 1998, 2001, 2004) and some very limited age-at-length data from 1995. Sample sizes used for compositional data in this assessment are the number of tows sampled for survey length and age frequencies.

Maturity observations collected from the triennial survey as part of a special project conducted during the 1995 survey season (subsequently published in: Sampson and Al-Jufaily 1999), were used to fit a logistic maturity curve for female English sole in

the 2005 assessment. The length at 50% maturity from that study (23.3 cm) differs substantially from observations by Harry (1959), who found that 50% of female English sole were mature at 31 cm. This was, and continues to be, a source of uncertainty that is addressed through sensitivity testing.

The weight-length relationship, based on survey observations, has not been altered from the parameter values used in the 2005 assessment.

2.2 Fishery dependent data

The reconstructed landings series continues to be an important source of fishery dependent information in this stock assessment model. Building on the reconstruction performed in the 2005 assessment, landings were updated from the Pacific coast Fisheries Information Network (PacFIN) on May 5, 2007. These landings were generally quite close to those used in the 2005 assessment for those years prior to 2005; however, there were some differences, notably increases in the annual landings for the northern area. Landings dropped by 53 metric tons (mt) in the south in 2003 compared to those used in the 2005 assessment and went up by 238 mt in the north in 1983. The net result of these changes was a 1,347 mt increase in the total landings spread relatively evenly over 1981-2004.

Discarding continues to be modeled inside the assessment, based on discard rates, mean individual body weight of the discarded fish and limited length-frequency data from the discard. The sources for this information remain unchanged. Historical discard data rates originate from a study in the 1950s and 1960s (Herrman and Harry 1963). These are supplemented with limited rate and length-frequency data from the Pikitch study in the mid 1980s. Both of these sources were fully documented and discussed in the 2005 assessment document. Discard rates and mean individual weights were added for 2004-2006 based on the most recent NMFS West Coast Groundfish Observer Program (WCGOP) sampling (Table 2). These rates (discard weight/total estimated weight of the catch) have varied from 31-52% in the south and 15-26% in the north over the period 2001-2005. Average individual body weights of the discarded fish tend to be larger in the north (0.20-0.2 3kg) than in the south (0.17-0.19 kg).

A limited quantity of historical biological information from the commercial fishery during the years 1948-1965 was published in Demory and Bailey (1967). These data are again included with more recent data, unchanged from the 2005 approach.

More recent biological information from the commercial fishery was extracted from PacFIN in May 2007. These were combined with California Cooperative Survey (CalCOM) data used in the 2005 stock assessment that are not available from PacFIN. Compositional data were catch weighed, as is standard among west coast assessments and was done in the 2005 assessment. Length and age data was unchanged in the south, except for the addition of 23 trips sampled for length in 2004 and 2005 combined (Table 3, 4).

There was an extensive quantity of new data available for northern area, including the Eureka, Columbia and U.S. Vancouver areas. These updated data include between 1 and 61 new length samples in most years from 1965 to 2006 (Table 3, Figure 3). A similar, but slightly lower number of age samples were added (exclusively in the north) over that period (Table 4, Figure 3). These new samples come primarily from an extensive set of historical data from the Washington Department of Fish and Wildlife that

was only partially included in PacFIN at the time of the 2005 assessment. No new historical or recent ages have been added in the South (from California Department of Fish and Game; Table 4). Sample sizes used in this assessment are the number of trips sampled for commercial samples.

The ageing error matrix was developed primarily from double-reads of commercial samples of English sole interopercular bones. Age-reading via break-and-burn of these structures was assumed to be unbiased but have a non-linear increase in SD with age in the 2005 assessment. This relationship has not been revisited in this update.

3. Description of model structure

3.1 Modeling software

This assessment used the Stock Synthesis 2 modeling framework written by Dr. Richard Methot at the NWFSC. The most recent version 2.00e was used for all analyses since it included many improvements and corrections to the older version (1.19) used during the 2005 assessment (Methot 2007). The change in SS2 version required a reparameterization of the selectivity function, moving from the very generic double logistic to a somewhat simpler and more stable double-normal curve. For the selectivity shapes modeled in this assessment, there was very little change due to the version and selectivity upgrade.

3.2 Model structure

Following the rationale in the 2005 assessment, the fundamental model structure remains unchanged in this update. The English sole population is assumed to be a single stock, but spatial considerations are addressed through separation of data from northern and southern areas. The assessment model includes four fleets: two commercial fisheries, north and south, and two triennial survey series, split on the same geographic boundary. The surveys are forced to occur instantaneously at the middle of July throughout the time-series.

The model includes males and females as separate sexes in both the underlying dynamics and in all data sources where this was possible. The accumulator age for the internal dynamics of the population model was set to 30 yrs, well above the asymptote for growth and the oldest age observations in the data. The years explicitly modeled were 1876-2006. No initial equilibrium fishing mortality was estimated and the spawning biomass was assumed equal to SB_0 in 1876.

There were 18 length bins used to summarize the data and underlying population dynamics; 2 cm bins from 11-45 cm. Age data were aggregated into 1-year bins from age 1-20.

3.3 Estimated and fixed parameters

Selectivity is assumed to be length-based for all fleets, and to have an asymptotic shape. Due to the SS2 version change, the double logistic parameterization for selectivity that was used in the 2005 assessment was no longer available. Instead the double normal (option # 24) was used as a substitute (Methot 2007). For each of the survey series, the ascending width parameter and the length at peak selectivity are freely estimated. This change represents a net loss of one estimated parameter for each fleet (since the

ascending limb of the double-normal selectivity function does not have an ascending inflection as the double-logistic did).

The northern and southern commercial fleets are assumed to have the identical length-based selectivity, with the ascending width and peak of selectivity estimated. Length-based retention is explicitly modeled throughout the time-series, requiring a retention curve (logistic) for the commercial fishing fleets. The slope of this curve is externally estimated, but the inflection is estimated separately for each fleet. The asymptote of these curves is fixed at 1.0

Maturity of female English sole is assumed to be logistic in shape and a function of length. Following the method of the 2005 assessment, a series of fixed blocks were used to transition from the observed length at 50% maturity of 31 cm in 1955 to 23.3 cm in 1995. This change was modeled as a step function, with equal change over the periods 1961-1970, 1971-1980, 1981-1990 and 1991-2006. Fecundity is assumed to be a function only of mass.

Individual growth is modeled via the von Bertalanffy growth equation. Length at age 2 is assumed to be equal for females and males, but separate von Bertalanffy K and length at age 20 parameters are estimated for males and females. It is assumed that the variability in length of individuals at each age in the population increases with increasing age through use of a constant (but estimated) CV for each sex. As in the 2005 model, this update allowed growth to differ between blocks of time, based on freely estimating the K parameter for the following blocks: 1876-1960, 1961-1970, 1971-1980, 1981-1990 and 1991-2006.

Natural mortality is assumed to be age- and time-independent and equal to 0.26. The stock-recruitment function was a Beverton-Holt parameterization, with the log of mean unexploited recruitment estimated, along with the steepness (h) of the stock recruit function. Year-specific recruitment deviations are estimated from 1877 to 2006. The constraint and bias correction standard deviation, σ_r, is treated as a fixed input quantity in SS2. In the 2005 assessment, a value of 0.36 was arrived at by fitting the base case model, externally calculating the root mean squared error (RMSE) of the predicted recruitment deviations over the time period in which they were variable (~1940+) and comparing this value to the input σ_r. These values converged to 0.36 after a small number of iterations, although the RMSE varied slightly depending on exactly which years were used to calculate it. This exercise ensured that the approximate bias-correction term would be appropriate and internally consistent for the variability in predicted recruitment actually estimated in the model. In this update, with new data informing recruitments, σ_r was iterated to a value 0.42.

Noninformative priors were used for all model parameters; as in the 2005 assessment, a diffuse normal prior with the mean in the plausible range of the parameter space and SD = 50 were used throughout. Parameter bounds were selected to be sufficiently wide to avoid truncating the searching procedure during maximum likelihood estimation. All parameter bounds and priors were provided in table 40 of the 2005 assessment. This information is provided again in Table 5 of this document.

Emphasis factors (lambdas) for each likelihood component are set equal to 1.0 for all data sources. The 2005 assessment was not iteratively re-weighted beyond the doubling of the input standard errors for the survey index. This choice reflected the result that most data sources fit as well or better than would be expected based on input sample

sizes and that the survey index should not be further down-weighted. This update does not make any changes to this tuning approach.

4. Base run results

4.1 Link from 2005 assessment to the 2007 base case model.

Beginning with the results from the 2005 English sole stock assessment, there was very little change in either the estimated spawning biomass or recruitment time-series associated with the shift to the newest version (2.00e) of SS2 (Figure 4, 5). Despite the large quantity of new biological data and the additional landings from the commercial fisheries, there was also little change associated with the introduction of fully updated data sources through 2007 (Figure 4, 5). The biggest change at this step was an increase in current spawning biomass attributable to the upward-revised estimates for recent large recruitments informed by recent fishery ages that were not available in 2005. The only further change that was made to achieve the 2007 base case model was to re-tune the iterated value for σ_r. In order to be consistent with the 2005 approach, the year in which the full bias correction was applied to estimated recruitment deviations was set to be 1876. However, this was only a temporary solution in 2005, with a new option to allow a linear-ramp in the bias correction from a value of zero when there is no specific information with which to inform recruitment deviations to a full bias correction at the beginning of the window used to tune σ_r (1940 in this case). See the SS2 user manual (2007) for a thorough description of this topic and the solution found in the current (2007 and later) versions. When this bias correction fix was competed and σ_r re-iterated to a value of 0.42, the decline in spawning biomass prior to the 1930s was somewhat less pronounced, but the rest of the historical time-series of spawning biomass and recruitments was largely unchanged. The increase in σ_r allowed for, and was in part caused by, larger recent year class estimates for 1998, 1999, 2000 and 2002. These values contribute to a slightly larger estimate of current spawning biomass (Figure 4, 5). A full list of estimated model parameters and management quantities for both the 2005 assessment and the updated base case are provided in Table 6.

4.2 Documentation of the 2007 base case results

The use of conditional age-at-length data allows estimation of growth parameters as well as the CV of length at age. Table 7 gives estimates and asymptotic standard deviations for all growth parameters. These parameters produce very reasonable growth trajectories for the underlying population, showing the strongly sexually dimorphic growth pattern present for English sole. Both sexes grow rapidly, and show a large amount of variability about the mean trajectory with females achieving a maximum length of just over 40 cm and males just under 24 cm (Figure 6 shows the recent growth curves). Figure 7 shows the effect of reduced growth rate (K) on the mean length at age for females over the time-series. The dramatic change in maturity at length between the 1950s and 1990s (Figure 8) results in much smaller fish contributing to current spawning biomass.

Estimated selectivity and retention curves for the commercial fishing fleets are shown in Figure 9, and survey fleets in Figure 10. The shape of these curves appears quite reasonable; small English sole less than 15 cm are not selected by any fleet as most

will be in or near the estuaries until reaching this length. Selectivity for English sole between 15 and 25 cm is much higher for the survey fleets reflecting the small mesh trawls used and, potentially, spatial differences between the fishery and survey. The change in selectivity can also be evaluated via a contour plot (Figure 11), showing a reduction in the length of fish selected by the fishery during the 1980s and a recent increase from 1990 to present.

The model fits to the length-frequency distributions for both of the survey fleets show reasonable predictions given the observed data (Figures 12 and 13) with some apparent bias in the fit to the recent length frequency of the larger male English sole in the southern survey area. A comparison of observed and calculated effective sample size for the survey length-frequency data shows no clear relationship, but generally commensurate values with the model fitting slightly better than the input values would suggest (Figure 14). The fit to the 1995 survey age-at-length bin data was generally poor (as was the case in the 2005 assessment), showing the model predicting a younger age distribution for a given length than was observed in the data; this lack of fit is also evident in the comparison of observed and calculated effective sample sizes and Pearson residuals (Figure 15).

The model was able to capture the general trend in the northern and southern survey indices of relative abundance, but not the degree of interannual variation seen in the data (Figure 16). In addition, the base case model was unable to reproduce the very low index observed in 1980 in both the north and the south. This pattern was also evident in the 2005 assessment and could be due to gear performance or other process error in survey catchability. The estimated catchability (Q) was about one third as large for the southern survey as the northern survey (Table 8) reflecting the fact that most of the English sole biomass occurs in the northern area and the Qs in this model are relative to coast-wide biomass.

The commercial fishery length frequencies from both the northern and southern fleets appeared to fit the data somewhat better than expected given the relationship between the relative observed and calculated expected sample sizes (Figure 17). Due to the smaller samples sizes, the observed length frequencies from the southern commercial fleet were irregular in some years and the sex ratio, most evident in the lack of fit to the male frequencies, was quite variable (Figures 18 and 19).

The northern commercial fleet had far more length-frequency data than the southern fleet. The model was able to adequately predict length frequencies for many years that closely matched those in the observed data (Figures 20 and 21). In recent years, especially since 1980, model predictions of 35+ cm females are larger than observed frequencies. This lack of fit was the subject of much exploration during the 2005 assessment and cannot be resolved in the course of an updated assessment, although an alternate to time-varying selectivity is presented below.

Fits to conditional age-at-length bins resulted in the observed and calculated effective sample sizes for these observations showing reasonable correspondence for both sexes in the southern and northern commercial data, and fitting slightly better than expected (Figures 22, 23). Because displaying the entire fit to conditional age-at-length represents a large number of age-length keys, the fits are summarized via the marginal fit to age frequency across all lengths for each fleet, year and sex. This provides a similar style of figure to length-frequency data or catch-at-age output and allows direct

observation of observed and predicted cohort and temporal effects. These 'implied' fits to the margin are not contributing to the likelihood and are for graphical purposes only. The data from the southern fishing fleet are again much noisier than in the north, but the model reproduces the observed marginal age distributions quite well via fitting the conditional age distribution at each length (Figures 24-26).

The discard fraction and mean individual weight in the discard observations from both the southern and northern fleets were fit well by model predictions (Figures 27, 28) and the assumed CVs appeared to be appropriate. The paucity of discard observations throughout much of the time-series precluded more realistic alternate models such as time-varying retention or completely separate retention curves by fleet.

The base case model predicts a population trajectory for English sole showing rapid exploitation that reduced the spawning biomass to target levels by the early 1930s, variable population size from that point through the mid-1990s, and a rapid increase in biomass in recent years (Figure 29, Table 9). The lowest levels of spawning biomass have occurred following periods of below average recruitment in the 1940s and 1980s, but very large recruitments were estimated in 1961 and 1999 (Figure 30). There is little evidence for a strong stock-recruitment relationship, with some of the largest recruitments occurring at moderate levels of spawning biomass (Figure 31). This corresponds to the relatively high estimate of steepness (h) of 0.80 (Table 8). In general, recruitment deviations are well informed by the data between 1940 and 2000, and this was the period over which σ_r was iterated (Figure 32). Relative depletion level at the beginning of 2007 was found to be 116% of the unexploited level (Figure 33), with a spawning biomass of 41,906 mt. These results are very similar to the 2005 assessment, although the recent trend shows a slightly larger increase in stock size.

Total catches from both commercial fleets have been substantially larger than landings, and the absolute volume of discards has been as large as 1,665 mt in 1987 (Figures 34 and 35). The estimated discard fraction by weight has increased over the time-series due to changes in relative abundance of small fish and changes in growth (Figure 36). The total catches have generated historical fishing mortality rates above 0.20 and 0.30 for the southern and northern fleets, respectively (Figure 37). Current (2006) total catches were estimated to be 1,078 mt, of which 886 mt were landed.

In aggregate, the base case model seemed to be sufficiently parameterized to fit to observed data, while still maintaining reasonable parameter values and parsimonious explanations for the underlying model processes. The results were very consistent with those from the 2005 assessment. Table 6 provides a full list of maximum likelihood estimates for all model parameters in the 2007 base case model.

5. Uncertainty and sensitivity analysis

5.1 Asymptotic confidence intervals

The primary method of assessing uncertainty in this assessment was through the use of asymptotic variance estimates for model parameters and derived quantities of interest. Asymptotic variance estimates for spawning biomass and recruitments were quite wide, indicating a large amount of uncertainty regarding current population status (Figure 29, 30 and Table 10). This is reflected in the wide interval about current depletion level ranging from 83-149% (Figure 33). This approach to assessing the uncertainty in model results encompasses only parameter uncertainty and is therefore limited by the

combination of estimation methods, available data, and the specific hypotheses of population and observation process represented by the base case model.

5.2 Sensitivity analysis

Sensitivity analysis was used to explore structural and data choices that are not able to be easily captured as parameter uncertainty with the asymptotic methods described above. Many preliminary alternate models were evaluated during the 2005 assessment in order to assess the sensitivity of the assessment results to the specific model configuration used in the base case. An attempt was made in this update to carry forward the most important sensitivity analysis from the 2005 assessment, while also re-evaluating the current state of information regarding English sole in 2007.

The following alternate models are considered:

a) Use only the 1950s maturity ogive for the entire time-series (from 2005)
b) Use only the 1990s maturity ogive for the entire time-series (from 2005)
c) Force selectivity to be time-invariant (no blocks, from 2005)
d) Add the 2003-2006 NWFSC survey data (for comparison only)

Table 6 reports parameter estimates and summary statistics for each alternate model. In aggregate, these sensitivities indicate that modeled population trends using the 2007 base case model are robust to alternate model and data assumptions.

The first two alternate models were intended to reflect the great uncertainty in the process driving English sole maturity and our ability to understand it with only two maturity observations separated by almost 50 years. Because the change in maturity and growth parameters over time has the potential to alter biological reference points, one alternate model with no change in from the 1950s value of these parameters was considered (sensitivity a). This resulted in a much lower recent and current spawning biomass despite a very similar recruitment time-series to the base case result (Figure 38, 39, Table 6). In the second alternate model (sensitivity b), the value for length at 50% maturity estimated in 1995 was assumed to apply throughout the time-series. This sensitivity run produced higher unexploited and historical spawning biomass levels as well as a small increase in the estimate of current spawning biomass.

The third alternate model, also carried forward from the 2005 assessment, allowed no change in selectivity over time. The results from this model showed little change from the base case for spawning biomass and recruitment time-series' (Figure 38, 39), but did not fit the data as well (Table 6).

The fourth alternate model included data from a new source: the NWFSC shelf and slope trawl survey. Because the use of these data has not been independently reviewed for English sole they were not included in the base case model in order to conform to the terms of reference for updated stock assessments. Instead they are included in the sensitivity analysis for comparative purposes only. The data available from this survey and the basic assumptions necessary to model them in the English sole assessment are described in Appendix A. The results from the alternate model including these data showed an increase in current spawning biomass and some alteration of recent recruitment strengths (Figure 38, 39, Table 6). The estimate of steepness decreased, mainly due to the reduction in the magnitude of the 1999 year-class. Although this year-

class was reduced, the 1998, 2000 and 2002 recruitment events were estimated to be larger, resulting in the increase in current spawning biomass over the base case model.

5.3 Retrospective analysis

A retrospective analysis was performed using the built-in retrospective capability in SS2. This approach does not require re-dimensioning the data and control files, it just eliminates the contribution to the likelihood for data from one or more terminal years in the model (Methot 2007). The retrospective done in this way can be interpreted as the assessment result that would have been obtained if the current estimates were generated one or more years in the past. For this update, a retrospective analysis for the most recent five years was performed. The results for spawning biomass show very little evidence of change, or retrospective bias (Figure 40). The estimates of recent recruitment strengths are also quite consistent, and show that the primary signal for the large recent recruitments is found in the 2004 data; when the retrospective in 2004 is conducted (including data only through 2003) these large recruitment estimates are uninformed by the data and come from the stock-recruit curve expectation (Figure 40, 41). This change in estimated recruitments is consistent with the contribution of these events to the biomass time-series, and so the retrospective results for spawning biomass follow the base case model result quite closely. All retrospective fits fell well within the confidence interval from the base case model, indicating that there was no substantial change in conclusion attributable to the most recent four years of data included in the model.

5.4 Likelihood profiles

In order to illustrate the uncertainty in steepness (h) of the stock-recruit function, and facilitate future meta-analysis, a likelihood profile was computed for this parameter. The maximum likelihood estimate for steepness was slightly lower in the 2007 base case model than in the 2005 assessment, but the distribution was quite similar over the range of 0.5 to 1.0 (Figure 42). Little change was observed in the total negative log-likelihood for steepness values over a broad range from 0.6 to 1.0 (Table 11). Although this was adequately reflected in the asymptotic variance estimates for steepness (SD=0.16), the non-symmetric nature of the uncertainty is better captured via the likelihood profile.

6. Rebuilding parameters

Because the population of English sole in US waters was not found to be overfished, no rebuilding parameters are required from this assessment.

7. Reference points

As was the case in the 2005 assessment, there are two types of reference points reported in this assessment: those based on the growth and maturity parameters at the beginning of the modeled time period and those based on the most recent time period in a 'forward projection' mode of calculation. All strictly biological reference points (e.g., unexploited spawning biomass) are calculated based on the unexploited conditions at the start of the model, whereas management quantities (MSY, SB_{msy}, etc.) are based on the current growth and maturity schedules and are marked throughout this document with an asterisk (*).

Unexploited equilibrium English sole spawning biomass (SB_0) was estimated to be 36,012 mt (~ 95% confidence interval: 27,219-44,805), with a mean expected recruitment of 124,990 thousand age-0 English sole. The $SB_{40\%}$ management proxy for target spawning biomass was estimated to be 14,405 mt (10,888-17,922), producing a landed catch of 2,523 and a total yield of 3,452 mt (2,986-3,918). The model-based estimate of retained *MSY* was 2,487* mt, which corresponds to a total mortality of 4,252 mt (~ 95% confidence interval: 2,687-5,816). The apparent increased discard rate at *MSY* is due to the interaction of size-based retention and the truncation of the size structure of the modeled population. The estimate of *MSY* is only slightly larger than the average estimated total catch from the period 1916-1991 of 3,701 mt, indicating the stock has been exploited at near optimal levels for most of the time-series, but levels have been much lower in recent years. The spawning stock biomass expected to produce *MSY* catch levels was 6,526* mt (*1*-13,654, the symmetric approximation of the 95% confidence interval included zero and was therefore rounded up), or 18.1% of SB_0. This level of exploitation was estimated to result in a spawning potential ratio (SPR) of 25.9%*. The overfished threshold for English sole was estimated to be 9,003 mt. These reference point estimates are very close to the values reported in the 2005 assessment.

The estimated spawning potential ratio (SPR) for English sole fluctuated above and below the proxy target of 40% for flatfish from the late 1940s to the early 1990s. Since 1992 the intensity of exploitation has been less than that of the target, resulting in higher SPR levels (Figure 43, 44). This corresponds to a relative exploitation rate (catch/biomass of age 3 and older fish) history that is high from the late 1940s to the early 1990s, and steadily declining to very low levels over the last 15 years (Figure 45, 46). The stock appears to have never been exploited at the rate (0.27) that would reduce the stock to SPR levels estimated to produce *MSY*, 0.259, during the time-series. The fishery has exceeded the relative exploitation rate that results in fishing at the SPR target of 40% of 0.17 in only a few years of the historical series.

8. Harvest projections and decision tables

8.1 Forecasts under the 40:10 rule

Forecasts were generated assuming the average landings over the period 2004-2006 would be removed in 2007 and 2008 before the results of this updated assessment would be used for management. This value was 897 metric tons, of which 79 mt would be landed in the south (Conception and Monterey areas) and 818 mt in the north (Eureka, Columbia and Vancouver areas). Beginning in 2009, the maximum potential catch would be removed under the 40:10 harvest control rule. A 10-year average of the relative F contribution from the southern and northern fleets was used for this projection. This ratio was 8.8% for the southern fleet to 91.2% for the northern fleet. An extremely large potential catch (>13 times recent average values) is predicted to be possible in 2009 based on the ABC from the $F_{40\%}$ harvest rate proxy because the stock is projected to be above unexploited spawning biomass level. Subsequent landings remain very high relative to those observed in the historical time-series for the duration of the 10-year projection (Table 12). Due to the implausibility of the removals in this forecast scenario, alternates are used for the decision table analysis presented below.

8.2 Decision table analysis

In the 2005 assessment, the strength of recent year classes was identified the primary "axis of uncertainty" was therefore selected for inclusion in the decision table. This choice reflected the lack of age data from fishery or survey sources with which to reliably estimate the strength of those year classes. Because there is now much more data informing large recruitment estimates from 1998-2000, sensitivity analysis was performed to update the dominant sources of uncertainty for inclusion in the decision table. Those sensitivity runs that appeared to show the greatest uncertainty in current stock status and recent trend included: 1) modeling the stock as if the maturity schedule had not changed since the 1950s, and 2) for comparative purposes only (because this is an update assessment) including the NWFSC trawl survey index, length and age information (2003-2006). As in 2005, given the large current stock size, the focus of the decision table is on an alternate model with a lower stock size than the base case. The spawning biomass estimated from the base case model was 41,907 mt at the beginning of 2007, with an approximate 95% confidence interval including the range of 31,046-52,766 mt (Figure 47). Constraining the maturity schedule to the values observed in the 1950s resulted in an estimate of current spawning biomass reduced to 28,610 mt. Including the NWFSC trawl survey data resulted in an estimated 2007 spawning biomass of 46,140 mt. Together, these two alternate models represent "much less likely" and "less likely" scenarios bracketing the 2007 base case results. The relative probability is also described via the location in the approximate probability distribution (via the asymptotic approximation) for the base case model result. In this context, the estimate of current spawning biomass from the 1950s maturity schedule sensitivity was smaller than all but 1% of the density from the base case, while the sensitivity with NWFSC survey data resulted in a spawning biomass larger than all but 22% of the density from the base case. The English sole stock is predicted to remain above the 40% spawning biomass target for all states of nature and management options presented for the next 5 years and close to it as far into the future as 2018 (Table 13).

9. Research needs

The following research would substantially improve the ability of this assessment to reliably and precisely model English sole population dynamics in the future. In order of priority (author's personal opinion):

1) Collection of maturity data on an ongoing basis from survey or fishery sources that could be used to track future changes affecting modeled spawning stock biomass.
2) This assessment contains little data on the length frequency of the discarded portion of the commercial catch of English sole. This would be valuable data to add to the discard fractions and average individual weights currently being collected. Based on changes to sampling protocols beginning with 2006, observer data will soon be available in much greater quantities and should be used in the next full assessment.
3) Because the U.S.-Canada border does not appear to be a meaningful biological boundary for the English sole population, extension of this assessment to include Canadian waters may be necessary to better capture population trends. Further, the use of explicitly spatial models for English

sole (e.g., Stewart 2006) should be explored to better account for regional differences in recruitment and exploitation intensity.

4) The next full assessment can make use of the recently completed cross-method study of ageing comparing interopercular bones and otoliths that will allow revision of the ageing error matrix. This will be necessary, as otoliths are now being collected on a routine basis by the NWFSC survey and Oregon port samplers.
5) Despite much effort in the 2005 assessment, there is still uncertainty in some parts of the historical landings series. Specifically needed are: 1) a method for reconstructing landings in Washington prior to 1956 from U.S. waters, 2) landings data from Oregon from 1954-1955 and 3) a thorough study of the mink food fishery in Oregon and California including estimates of the total volume and length- or age-structure of catches associated with this fishery.
6) As part of the next full assessment, a re-evaluation of the weighting of data sources should be performed, perhaps weighting by a function of the number of fish and samples instead of just the un-tuned number of samples following the method of Stewart and Miller presented at the 2006 Data and Modeling workshop (NWFSC 2007).
7) Based on the relatively poor and biased fit to the age-at-length data from the 1995 triennial survey, the next full assessment should either find a way to fit these data better or remove them from the assessment.
8) The evaluation of uncertainty performed for the 2005 assessment and maintained in this update relies heavily on asymptotic variance estimates and sensitivity testing. A more thorough Bayesian approach to parameter and model uncertainty could be completed.
9) As recommended by the 2005 STAR panel, sex-specific natural mortality rates and selectivity curves should be explored in the next full assessment.

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12. Tables

Table 1. Recent commercial landings (mt) of English sole for all fishing gears combined by INPFC area and year (source: PacFIN, 5 May, 2007).

	INPFC area					Model fleet	
Year	Conception	Monterey	Eureka	Columbia	US Vancouver	South Total	North Total
1981	208	925	579	723	191	1,133	1,492
1982	148	861	457	941	255	1,009	1,653
1983	57	584	542	691	244	641	1,477
1984	32	497	423	360	314	529	1,097
1985	55	639	369	518	311	694	1,197
1986	51	705	326	649	284	757	1,258
1987	73	673	576	712	410	747	1,697
1988	83	621	363	560	428	704	1,350
1989	65	703	285	690	647	768	1,622
1990	45	667	180	488	512	712	1,180
1991	39	653	119	861	496	693	1,477
1992	21	467	87	711	318	488	1,116
1993	17	378	79	682	398	395	1,159
1994	12	359	92	301	336	371	729
1995	11	399	90	289	327	410	706
1996	11	423	147	356	182	434	685
1997	12	453	185	454	301	466	941
1998	5	224	198	330	264	229	792
1999	9	219	158	296	172	227	626
2000	9	173	125	227	200	182	552
2001	29	170	223	340	180	199	742
2002	6	95	271	342	439	102	1,052
2003	3	114	68	171	432	117	670
2004	31	66	205	242	372	97	819
2005	15	55	183	290	345	70	818
2006	1	56	238	338	254	57	829

Table 2. Discard fraction (discard/total catch by weight) and average individual weight of discarded fish for English sole from the West coast groundfish observer program[1].

Model Fleet	Year	Fraction discarded	Average weight (kg)
South	2001	0.323	0.174
	2002	0.387	0.194
	2003	0.516	0.169
	2004	0.309	0.177
	2005	0.441	0.170
	2006	NA	0.175
North	2001	0.256	0.216
	2002	0.252	0.198
	2003	0.297	0.225
	2004	0.153	0.208
	2005	0.242	0.232
	2006	NA	0.201

[1]These discard data are being fit by the model, not used externally to adjust landings to total catches, therefore model-estimated rates may differ from the observations in this table.

Table 3. Summary of data used to produce fishery length frequencies.

	Number of samples				Number of fish			
	Model fleet		Change from 2005 (+)		Model fleet		Change from 2005 (+)	
Year	South	North	South	North	South	North	South	North
1965	0	6	0	6	0	2,157	0	2,157
1966	13	33	0	5	387	2,595	0	994
1967	10	48	0	48	233	3,151	0	3,151
1968	9	51	0	7	258	4,716	0	2,433
1969	16	53	0	53	636	4,142	0	4,142
1970	2	53	0	4	75	3,489	0	925
1971	0	4	0	0	0	400	0	0
1972	4	25	0	4	125	2,599	0	923
1973	7	24	0	0	175	1,741	0	0
1974	8	21	0	0	200	1,446	0	0
1975	7	27	0	7	174	4,025	0	2,386
1976	2	18	0	6	49	2,461	0	1,895
1977	1	29	0	1	50	2,567	0	99
1978	0	26	0	0	0	2,417	0	0
1979	0	21	0	5	0	2,049	0	498
1980	9	96	0	26	425	7,533	0	2,742
1981	0	90	0	13	0	7,158	0	1,366
1982	2	72	0	16	51	6,407	0	1,797
1983	2	52	0	12	99	3,669	0	1,335
1984	1	27	0	12	49	2,043	0	1,282
1985	11	38	0	16	550	2,823	0	1,710
1986	0	29	0	7	0	1,843	0	733
1987	0	55	0	12	0	3,326	0	1,226
1988	0	35	0	11	0	2,325	0	1,121
1989	0	43	0	10	0	2,664	0	1,013
1990	0	30	0	0	0	1,908	0	0
1991	0	28	0	0	0	2,309	0	0
1992	0	21	0	0	0	1,845	0	0
1993	0	22	0	0	0	1,883	0	0
1994	0	21	0	0	0	1,849	0	0
1995	0	20	0	0	0	1,797	0	0
1996	0	18	0	0	0	1,561	0	0
1997	0	40	0	0	0	3,370	0	0
1998	0	37	0	0	0	3,049	0	0
1999	0	35	0	0	0	2,821	0	0
2000	0	33	0	0	0	2,611	0	50
2001	4	49	0	0	122	3,521	0	0
2002	5	46	0	1	116	2,933	0	50
2003	21	48	0	17	308	2,782	0	850
2004	14	52	14	27	434	2,797	434	1,375
2005	9	61	9	61	438	3,410	438	3,410
2006	0	44	0	44	0	3,202	0	3,202

Table 4. Summary of data used to produce fishery age frequencies.

	Number of samples				Number of fish			
	Model fleet		Change from 2005 (+)		Model fleet		Change from 2005 (+)	
Year	South	North	South	North	South	North	South	North
1965	0	26	0	0	0	0	0	0
1966	0	40	0	40	0	1,398	0	1
1967	6	43	0	0	0	1,999	0	1,999
1968	14	47	0	47	145	2,231	0	0
1969	1	51	0	3	407	2,344	0	2,344
1970	0	4	0	0	25	2,920	0	409
1971	4	17	0	0	0	399	0	0
1972	7	13	0	0	100	1,555	0	1
1973	8	9	0	0	175	1,296	0	0
1974	7	11	0	0	200	879	0	0
1975	0	0	0	0	168	1,099	0	0
1976	0	19	0	0	0	0	0	0
1977	0	21	0	0	0	1,842	0	0
1978	0	14	0	3	0	2,084	0	0
1979	1	44	0	17	0	1,384	0	299
1980	0	49	0	10	25	4,099	0	1,487
1981	1	52	0	14	0	4,670	0	945
1982	2	28	0	4	25	4,840	0	1,336
1983	1	26	0	12	47	1,724	0	305
1984	9	36	0	14	24	1,749	0	1,088
1985	0	12	0	6	225	2,417	0	1,366
1986	0	10	0	10	0	891	0	588
1987	0	10	0	10	0	988	0	988
1988	0	33	0	9	0	926	0	926
1989	0	29	0	0	0	1,925	0	760
1990	0	25	0	0	0	1,828	0	0
1991	0	9	0	9	0	1,992	0	0
1992	0	12	0	0	0	891	0	891
1993	0	18	0	3	0	1,031	0	0
1994	0	20	0	1	0	1,521	0	289
1995	0	16	0	5	0	1,705	0	99
1996	0	33	0	10	0	1,391	0	492
1997	0	19	0	13	0	2,787	0	967
1998	0	10	0	10	0	1,731	0	1,270
1999	0	10	0	9	0	987	0	987
2000	0	15	0	15	0	994	0	895
2001	0	11	0	11	0	1,188	0	1,188
2002	0	19	0	19	0	597	0	597
2003	0	18	0	18	0	1,005	0	1,005
2004	0	20	0	20	0	806	0	806
2005	0	17	0	17	0	992	0	992
2006	0	26	0	0	0	783	0	783

Table 5. Description of model parameters in the base case assessment model.

Parameter	Number estimated	Bounds (low, high)	Prior (Mean, SD)
Natural mortality	-	NA	Fixed at 0.26
	Stock and recruitment		
Ln(R_0)	1	(5,25)	~N(13,50)
Steepness (h)	1	(0.2,1.0)	~N(0.80,50)
σ_r	-	NA	Iterated to 0.42
Ln(Recruitment deviations): 1877-2006	130	(-10, 10)	~Ln(N(0, σ_r))
	Catchability		
Ln(Survey south)	1	(-5,0.0)	~N(-1,50)
Ln(Survey north)	1	(-5,0.0)	~N(-1,50)
	Selectivity (double normal) and retention (Logistic)		
North and South Fisheries:			
Length at peak selectivity	1	(14,46)	~N(29,50)
Width of top (as logistic)	-	NA	Fixed at 6.0
Ascending width (as ln[width])	1	(-1,10)	~N(4,50)
Descending width (as ln[width])	-	NA	Fixed at 1.0
Initial selectivity (as logistic)	-	NA	Fixed at -10.0
Final selectivity (as logistic)	-	NA	Fixed at 50
Inflection of retention	2	(25-35)	~N(30,50)
Slope of retention	-	NA	Fixed at 1.42
Asymptote of retention	-	NA	Fixed at 1.0
Block exp. offsets for peak selectivity (1981-1985,1986-1990,1991-1995,1996-2006)	4	(-10,10)	~N(0,50)
North and South Surveys:			
Length at peak selectivity	2	(14,46)	~N(29,50)
Width of top (as logistic)	-	NA	Fixed at 6.0
Ascending width (as ln[width])	2	(-1,10)	~N(4,50)
Descending width (as ln[width])	-	NA	Fixed at 1.0
Initial selectivity (as logistic)	-	NA	Fixed at -10.0
Final selectivity (as logistic)	-	NA	Fixed at 50
	Individual growth		
Females:			
Length at age 2	1	(5,25)	~N(10,50)
Length at age 20	1	(25,55)	~N(35,50)
von Bertalanffy K	1	(0.01,1.5)	~N(0.12,50)
CV of length at age 2	1	(0.01,0.9)	~N(0.11,50)
Males:			
Length at age 2 offset to females	-	NA	Fixed at 0.0
Length at age 20 offset to females	1	(-5,5)	~N(0.0,50)
von Bertalanffy K offset to females	1	(-5,5)	~N(0.0,50)
CV of length at age 2 offset to Females	1	(-5,5)	~N(0.0,50)
Both sexes:			
Block exp. offsets for von Bertalanffy K (1961-1970,1971-1980,1981-1990,1991-2006)	4	(-10,10)	~N(-0.1,50)
Total: 27 + 130 recruitment deviations = 157 estimated parameters			

Table 6. Summary results of sensitivity analyses; see text for description of each.

Model	2005	2007	a	b	c	d
Description	Base case	Base case	1950s Maturity	1990s Maturity	Time-invariant selectivity	Including NWFSC survey data
Convergence						
Maximum gradient component	0.0104	0.0202	0.0486	0.0167	0.0009	0.0081
Likelihood penalties	0.0	0.0	0.0	0.0	0.0	0.0
Negative log-likelihoods						
Total	2,257.0	2,903.9	2,904.4	2,904.4	2,913.0	3,673.2
Indices	41.8	38.8	39.0	39.0	36.9	68.6
Discard rates	24.9	46.4	46.7	46.6	43.4	46.3
Length-frequency data	323.9	358.5	358.3	358.4	372.3	432.9
Age-frequency data	1,831.9	2,423.0	2,422.6	2,422.7	2,423.9	3,087.1
Mean body weights	1.1	3.9	4.0	3.9	3.4	3.6
Recruitment	27.6	33.2	33.8	33.6	33.2	34.7
Priors	0.1	0.0	0.0	0.0	0.0	0.0
Parameters						
Stock-recruit function						
R_0	122,811	124,992	112,151	115,324	126,652	132,125
Steepness (h)	0.834	0.798	0.994	0.929	0.784	0.741
Catchability, selectivity and retention						
South survey catchability (Q)	0.187	0.180	0.182	0.182	0.176	0.182
North survey catchability (Q)	0.582	0.574	0.579	0.579	0.559	0.582
Fishery peak selectivity	NA	36.689	36.677	36.678	36.106	36.792
Fishery selectivity ascending width	NA	4.069	4.071	4.071	4.129	4.041
South fishery retention inflection	30.528	31.032	31.033	31.032	30.971	31.013
North fishery retention inflection	30.385	30.188	30.192	30.190	30.126	30.163
South survey peak	NA	27.699	27.697	27.697	27.343	27.967
South survey ascending width	NA	3.661	3.661	3.661	3.599	3.719
North survey peak	NA	30.616	30.617	30.618	30.346	30.847
North survey ascending width	NA	3.814	3.815	3.815	3.784	3.853
Fishery peak selectivity 1981-1985	NA	34.387	34.400	34.399	36.106	34.501
Fishery peak selectivity 1986-1990	NA	34.963	34.954	34.961	36.106	34.935
Fishery peak selectivity 1991-1995	NA	34.801	34.671	34.715	36.106	34.856
Fishery peak selectivity 1996-2006	NA	36.342	36.350	36.350	36.106	36.350
Individual growth						
Female and male length at age 2	16.232	17.339	17.333	17.334	17.294	17.450
Female mean length at age 20	39.768	40.562	40.561	40.561	40.495	40.163
Female von Bertalanffy K < 1961	0.397	0.357	0.360	0.359	0.374	0.359
Female CV of length-at-age	0.101	0.103	0.103	0.103	0.102	0.107
Male mean length at age 20	23.869	23.985	23.972	23.973	23.933	23.719
Male K < 1961	0.484	0.480	0.483	0.483	0.482	0.485
Male CV	0.195	0.183	0.184	0.183	0.186	0.186
VBK 1961-1970 (Female/Male)	0.353/0.430	0.338/0.455	0.338/0.455	0.338/0.455	0.344/0.443	0.337/0.455
VBK 1971-1980 (Female/Male)	0.279/0.340	0.242/0.326	0.243/0.326	0.243/0.326	0.245/0.316	0.242/0.327
VBK 1981-1990 (Female/Male)	0.239/0.291	0.216/0.290	0.216/0.290	0.216/0.290	0.216/0.278	0.215/0.290
VBK 1991-2006 (Female/Male)	0.2330.284	0.217/0.292	0.217/0.291	0.217/0.292	0.222/0.286	0.224/0.302
Management quantities						
SB_0	34,312	36,012	32,499	41,101	37,558	36,983
2007 Spawning biomass	NA	41,907	28,610	40,624	41,081	46,140
2007 Depletion	NA	1.164	0.880	0.988	1.094	1.248
2006 *SPR*	NA	0.900	0.869	0.898	0.898	0.904
2006 Exploitation rate: yield/age 2+ B	NA	0.017	0.017	0.017	0.017	0.016
SB_{msy}	5,696	6,526	1,965	4,120	7,086	7,819
SPR_{msy}	0.238	0.259	0.096	0.161	0.277	0.302
Exploitation rate at *MSY*	0.288	0.271	0.307	0.413	0.254	0.237
Retained *MSY*	NA	2,487	2,762	2,286	2,451	2,608
SB_{msy} / SB_0	0.191	0.181	0.060	0.100	0.189	0.211

Table 7. Estimated English sole growth parameters.

Parameter	Value	SD
Females:		
Length at age 2 (cm)	17.339	0.344
Length at age 20 (cm)	40.562	0.346
Von Bertalanffy K:		
1876-1960	0.357	0.028
1961-1970	0.338	NA
1971-1980	0.242	NA
1981-1990	0.216	NA
1991-2004	0.217	NA
CV of length at age	0.103	0.002
Males:		
Length at age 2 (cm)	17.339	0.344
Length at age 20 (cm)	23.985	NA
Von Bertalanffy K:		
1876-1960	0.480	NA
1961-1970	0.455	NA
1971-1980	0.326	NA
1981-1990	0.290	NA
1991-2004	0.292	NA
CV of length at age	0.183	NA

Table 8. Estimated English sole stock-recruitment and catchability parameters.

Parameter	Value	SD
Catchability:		
Southern survey catchability (Q)	0.180	NA
Northern survey catchability (Q)	0.574	NA
Stock-recruitment:		
R_0	124,990	15,570
Steepness (h)	0.798	0.155

Table 9. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	Total landings (mt)	SPR	Relative exploitation rate
1876	68,161	36,012	100%	124,992	1	1	1.00	0.00
1877	68,160	36,011	100%	124,993	1	1	1.00	0.00
1878	68,160	36,010	100%	124,993	1	1	1.00	0.00
1879	68,159	36,010	100%	124,992	2	2	1.00	0.00
1880	68,157	36,008	100%	124,992	2	2	1.00	0.00
1881	68,156	36,007	100%	124,991	2	2	1.00	0.00
1882	68,155	36,006	100%	124,990	3	3	1.00	0.00
1883	68,153	36,005	100%	124,989	5	4	1.00	0.00
1884	68,151	36,003	100%	124,988	5	4	1.00	0.00
1885	68,149	36,001	100%	124,986	6	5	1.00	0.00
1886	68,146	35,998	100%	124,985	7	6	1.00	0.00
1887	68,142	35,995	100%	124,982	8	7	1.00	0.00
1888	68,138	35,992	100%	124,980	10	9	1.00	0.00
1889	68,133	35,988	100%	124,976	13	11	1.00	0.00
1890	68,126	35,982	100%	124,972	15	13	1.00	0.00
1891	68,119	35,976	100%	124,967	17	15	1.00	0.00
1892	68,110	35,968	100%	124,961	21	18	1.00	0.00
1893	68,100	35,960	100%	124,953	25	22	1.00	0.00
1894	68,087	35,949	100%	124,944	31	27	1.00	0.00
1895	68,070	35,936	100%	124,932	37	32	1.00	0.00
1896	68,052	35,920	100%	124,918	43	38	1.00	0.00
1897	68,029	35,901	100%	124,901	53	46	0.99	0.00
1898	68,002	35,879	100%	124,881	63	55	0.99	0.00
1899	67,969	35,852	100%	124,855	75	66	0.99	0.00
1900	67,930	35,819	99%	124,825	90	79	0.99	0.00
1901	67,883	35,781	99%	124,787	109	95	0.99	0.00
1902	67,826	35,734	99%	124,742	130	114	0.99	0.00
1903	67,757	35,678	99%	124,686	157	137	0.98	0.00
1904	67,675	35,610	99%	124,620	189	165	0.98	0.00
1905	67,575	35,528	99%	124,538	226	198	0.97	0.00
1906	67,455	35,430	98%	124,440	271	237	0.97	0.00
1907	67,312	35,313	98%	124,322	326	285	0.96	0.01
1908	67,138	35,171	98%	124,180	391	342	0.96	0.01
1909	66,930	35,002	97%	124,012	469	410	0.95	0.01
1910	66,681	34,798	97%	123,815	564	492	0.94	0.01
1911	66,376	34,554	96%	123,227	677	591	0.93	0.01
1912	66,003	34,260	95%	122,607	813	709	0.91	0.01
1913	65,548	33,907	94%	121,945	977	851	0.89	0.02
1914	64,990	33,482	93%	121,217	1,173	1,021	0.87	0.02
1915	64,308	32,967	92%	120,409	1,409	1,225	0.85	0.03
1916	63,481	32,338	90%	119,527	2,826	2,454	0.73	0.05
1917	61,513	30,738	85%	118,350	3,865	3,343	0.65	0.07
1918	58,897	28,575	79%	116,941	3,132	2,692	0.68	0.06
1919	57,260	27,245	76%	115,700	2,475	2,118	0.73	0.05
1920	56,400	26,614	74%	114,634	1,715	1,464	0.79	0.04

Table 9 continued. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	Total landings (mt)	SPR	Relative exploitation rate
1921	56,274	26,652	74%	113,758	2,184	1,866	0.75	0.04
1922	55,702	26,354	73%	112,717	3,159	2,698	0.66	0.07
1923	54,293	25,348	70%	111,399	3,186	2,714	0.65	0.07
1924	52,979	24,397	68%	110,050	4,110	3,491	0.58	0.09
1925	50,988	22,882	64%	108,371	4,018	3,393	0.57	0.09
1926	49,283	21,611	60%	106,650	3,865	3,247	0.57	0.09
1927	47,876	20,615	57%	104,880	4,690	3,923	0.50	0.11
1928	45,876	19,168	53%	102,829	4,143	3,442	0.52	0.11
1929	44,519	18,264	51%	101,051	4,811	3,979	0.47	0.13
1930	42,677	17,001	47%	98,858	3,732	3,066	0.52	0.10
1931	41,883	16,604	46%	97,102	1,928	1,581	0.69	0.05
1932	42,622	17,480	49%	96,028	3,540	2,925	0.54	0.10
1933	41,759	17,127	48%	93,885	3,346	2,766	0.55	0.09
1934	40,995	16,822	47%	91,383	2,845	2,352	0.59	0.08
1935	40,596	16,807	47%	88,844	3,226	2,672	0.56	0.09
1936	39,757	16,466	46%	86,328	3,404	2,819	0.54	0.10
1937	38,697	15,958	44%	84,522	3,159	2,616	0.55	0.10
1938	37,845	15,585	43%	85,517	2,543	2,146	0.60	0.08
1939	37,632	15,591	43%	93,782	2,991	2,527	0.56	0.09
1940	37,333	15,195	42%	112,814	3,038	2,574	0.54	0.10
1941	37,560	14,715	41%	133,753	2,202	1,862	0.62	0.07
1942	38,670	14,857	41%	110,810	2,064	1,763	0.64	0.07
1943	40,453	15,285	42%	111,831	3,638	3,079	0.50	0.11
1944	41,281	15,103	42%	109,364	2,141	1,779	0.65	0.06
1945	42,610	16,625	46%	65,761	1,887	1,582	0.70	0.05
1946	43,304	18,342	51%	49,556	4,998	4,261	0.46	0.13
1947	40,425	17,526	49%	47,349	3,334	2,832	0.56	0.09
1948	38,287	17,586	49%	68,971	6,030	5,216	0.39	0.17
1949	33,413	14,890	41%	90,650	3,546	3,070	0.49	0.12
1950	31,037	13,155	37%	96,384	5,673	4,918	0.31	0.22
1951	27,513	9,600	27%	85,125	4,189	3,505	0.33	0.19
1952	26,560	7,824	22%	83,492	3,824	3,061	0.32	0.19
1953	26,749	7,364	20%	86,186	2,911	2,271	0.40	0.14
1954	27,888	8,197	23%	87,802	2,623	2,071	0.46	0.12
1955	29,672	9,266	26%	122,412	2,829	2,276	0.46	0.12
1956	32,081	9,982	28%	172,017	3,787	3,068	0.39	0.16
1957	33,070	9,922	28%	104,962	4,436	3,580	0.34	0.18
1958	34,013	9,503	26%	88,161	5,520	4,357	0.28	0.22
1959	35,373	9,176	25%	124,701	5,427	4,158	0.30	0.19
1960	35,360	10,227	28%	66,412	4,338	3,423	0.38	0.15
1961	38,862	13,630	38%	296,282	4,188	3,383	0.43	0.14
1962	39,918	13,616	38%	122,720	4,496	3,621	0.41	0.15
1963	40,360	13,321	37%	76,260	4,489	3,597	0.41	0.16
1964	43,184	13,332	37%	99,622	4,742	3,538	0.41	0.13
1965	44,505	16,408	46%	93,026	5,043	3,883	0.44	0.13
1966	44,257	18,508	51%	133,642	5,522	4,538	0.43	0.15

Table 9 continued. Time-series of population estimates from the base case model.

Year	Total biomass (mt)	Spawning biomass (mt)	Depletion	Age-0 recruits (1000s)	Total catch (mt)	Total landings (mt)	SPR	Relative exploitation rate
1967	42,412	17,699	49%	111,174	5,192	4,326	0.44	0.15
1968	40,937	16,185	45%	123,887	5,468	4,539	0.40	0.17
1969	40,768	14,551	40%	177,995	3,788	3,061	0.48	0.12
1970	42,876	14,948	42%	189,993	3,102	2,495	0.54	0.10
1971	45,200	17,939	50%	120,195	2,851	2,292	0.60	0.08
1972	44,294	17,307	48%	121,746	3,300	2,643	0.55	0.09
1973	44,722	16,835	47%	121,644	3,773	2,970	0.51	0.10
1974	44,883	16,734	46%	131,585	3,858	2,946	0.49	0.11
1975	44,942	17,329	48%	139,062	4,579	3,494	0.45	0.13
1976	43,584	17,049	47%	92,748	5,755	4,466	0.39	0.16
1977	40,769	15,572	43%	70,179	3,735	2,867	0.49	0.11
1978	39,688	15,616	43%	89,653	4,511	3,463	0.44	0.13
1979	37,158	15,137	42%	71,116	4,710	3,631	0.42	0.15
1980	34,150	14,026	39%	73,279	4,143	3,213	0.44	0.14
1981	31,652	13,965	39%	79,324	3,780	2,625	0.45	0.14
1982	28,855	12,266	34%	83,042	3,833	2,662	0.42	0.16
1983	26,890	10,472	29%	104,705	3,091	2,118	0.43	0.15
1984	26,681	9,451	26%	141,393	2,458	1,626	0.47	0.12
1985	27,055	9,210	26%	100,431	2,955	1,891	0.41	0.15
1986	26,750	8,951	25%	52,193	3,153	2,015	0.39	0.16
1987	26,579	9,116	25%	70,998	3,979	2,443	0.34	0.19
1988	25,387	9,229	26%	72,116	3,422	2,055	0.37	0.16
1989	24,412	9,349	26%	78,517	3,780	2,390	0.35	0.19
1990	23,344	8,469	24%	100,673	2,907	1,892	0.40	0.16
1991	23,044	8,796	24%	92,108	3,339	2,169	0.38	0.19
1992	22,182	8,112	23%	59,505	2,556	1,604	0.42	0.16
1993	21,903	8,356	23%	48,217	2,534	1,554	0.43	0.15
1994	22,043	8,853	25%	89,081	1,818	1,100	0.52	0.10
1995	23,741	9,558	27%	163,063	1,762	1,116	0.55	0.10
1996	25,436	9,734	27%	137,837	1,540	1,119	0.59	0.09
1997	28,021	10,031	28%	139,925	1,911	1,406	0.55	0.11
1998	33,139	11,022	31%	284,960	1,441	1,021	0.63	0.07
1999	41,449	13,290	37%	403,289	1,245	853	0.69	0.05
2000	49,640	16,006	44%	274,077	1,061	734	0.76	0.04
2001	56,798	20,120	56%	111,853	1,363	942	0.76	0.04
2002	64,667	26,545	74%	209,356	1,683	1,154	0.76	0.03
2003	69,430	33,548	93%	140,694	1,125	787	0.86	0.02
2004	72,145	38,534	107%	118,759	1,218	916	0.87	0.02
2005	72,795	41,029	114%	115,137	1,115	888	0.89	0.02
2006	71,830	42,193	117%	114,442	1,078	886	0.90	0.02
2007	69,882	41,907	116%	124,992	NA	NA	NA	NA

Table 10. Asymptotic standard deviation estimates for spawning biomass and recruitment.

Year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)	Year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)	Year	SD Spawning biomass (mt)	SD Age-0 recruits (1000s)
1876	4,486	15,570	1920	6,100	48,747	1964	2,937	10,523
1877	4,486	54,977	1921	6,028	48,239	1965	3,493	10,734
1878	4,486	54,976	1922	5,947	47,642	1966	3,610	13,897
1879	4,486	54,976	1923	5,855	46,905	1967	3,455	15,222
1880	4,491	54,975	1924	5,756	46,152	1968	3,308	17,915
1881	4,615	54,975	1925	5,654	45,240	1969	3,188	24,806
1882	4,985	54,976	1926	5,553	44,310	1970	3,167	28,249
1883	5,417	54,977	1927	5,455	43,349	1971	3,198	22,816
1884	5,777	54,977	1928	5,356	42,275	1972	2,634	18,874
1885	6,036	54,977	1929	5,258	41,319	1973	2,132	16,917
1886	6,213	54,977	1930	5,156	40,176	1974	1,690	15,994
1887	6,329	54,975	1931	5,055	39,166	1975	1,523	14,837
1888	6,406	54,973	1932	4,954	38,364	1976	1,458	11,513
1889	6,456	54,970	1933	4,835	37,107	1977	1,391	9,852
1890	6,488	54,966	1934	4,716	35,654	1978	1,326	11,117
1891	6,509	54,961	1935	4,593	34,168	1979	1,266	10,925
1892	6,523	54,956	1936	4,458	32,719	1980	1,207	11,368
1893	6,532	54,949	1937	4,316	31,605	1981	1,197	12,163
1894	6,537	54,940	1938	4,164	31,788	1982	1,116	13,862
1895	6,541	54,930	1939	3,995	35,129	1983	1,037	16,001
1896	6,542	54,917	1940	3,810	43,080	1984	964	17,389
1897	6,543	54,902	1941	3,619	48,898	1985	909	13,969
1898	6,542	54,883	1942	3,433	40,505	1986	883	9,921
1899	6,541	54,861	1943	3,264	38,497	1987	898	11,228
1900	6,540	54,834	1944	3,144	34,633	1988	963	12,464
1901	6,538	54,801	1945	3,105	20,813	1989	1,037	12,447
1902	6,535	54,762	1946	3,114	15,135	1990	1,095	13,850
1903	6,531	54,715	1947	3,115	15,287	1991	1,188	12,972
1904	6,527	54,658	1948	3,105	24,274	1992	1,210	9,682
1905	6,521	54,590	1949	3,021	34,530	1993	1,251	9,357
1906	6,515	54,509	1950	2,862	34,313	1994	1,326	16,917
1907	6,507	54,413	1951	2,681	31,323	1995	1,397	27,304
1908	6,498	54,300	1952	2,572	30,677	1996	1,438	29,975
1909	6,487	54,167	1953	2,542	31,074	1997	1,466	34,793
1910	6,475	54,013	1954	2,591	31,829	1998	1,583	53,986
1911	6,459	53,682	1955	2,591	44,395	1999	1,803	74,634
1912	6,441	53,330	1956	2,494	44,445	2000	2,083	64,035
1913	6,420	52,950	1957	2,356	31,141	2001	2,510	37,913
1914	6,396	52,527	1958	2,243	25,025	2002	3,254	69,223
1915	6,366	52,053	1959	2,197	22,476	2003	4,165	64,532
1916	6,331	51,536	1960	2,113	17,798	2004	4,835	53,111
1917	6,287	50,852	1961	2,153	21,773	2005	5,235	50,786
1918	6,232	50,051	1962	2,386	15,473	2006	5,483	50,337
1919	6,168	49,352	1963	2,661	10,653	2007	5,541	54,757

Table 11. Total negative log-likelihood values for the profile on steepness (h) for use in future meta-analyses.

Steepness (h)	Negative log-likelihood
0.24	2,973.41
0.28	2,950.09
0.32	2,934.75
0.36	2,924.53
0.40	2,917.67
0.44	2,913.04
0.48	2,909.90
0.52	2,907.77
0.56	2,906.32
0.60	2,905.34
0.64	2,904.70
0.68	2,904.28
0.72	2,904.04
0.76	2,903.92
0.80	2,903.89
0.84	2,903.92
0.88	2,904.00
0.92	2,904.12
0.96	2,904.26
1.00	2,904.42

Table 12. Projection of potential English sole catch, landings, spawning biomass and depletion for the base case model under the 40:10 harvest control rule.

Year	Total catch (mt)	~95% interval	Total landings (mt)	Age 3+ biomass (mt)	Spawning biomass (mt)	~95% interval	Depletion	~95% interval
2007	1,069	NA	897	62,172	41,907	31,046-52,766	116%	83-149%
2008	1,053	NA	897	59,444	40,559	29,827-51,291	113%	82-143%
2009	14,326	10,473-18,179	12,303	56,494	38,711	28,203-49,219	107%	79-136%
2010	9,745	7,049-12,441	8,057	42,894	26,321	28,203-49,219	73%	54-92%
2011	7,158	5,042-9,275	5,616	35,259	19,585	18,839-33,803	54%	39-70%
2012	5,790	3,913-7,667	4,315	31,137	16,136	13,474-25,696	45%	31-59%
2013	5,095	3,307-6,882	3,660	28,843	14,420	10,528-21,742	40%	26-54%
2014	4,630	2,516-6,743	3,263	27,429	13,523	9,016-19,822	38%	24-52%
2015	4,388	2,484-6,293	3,072	26,517	13,053	8,307-18,739	36%	23-49%
2016	4,235	2,476-5,994	2,960	25,850	12,749	8,319-17,787	35%	23-48%
2017	4,122	2,461-5,784	2,880	25,335	12,527	8,364-17,134	35%	22-48%
2018	4,036	2,435-5,637	2,819	24,940	12,362	8,387-16,668	34%	21-47%

Table 13. Decision table of 10-year projections (years 1-5, 10 shown) for alternate models (columns) and management options (rows) beginning in 2009. Landings for 2007-2008 are the average in 2004-2006. The alternate model including NWFSC survey data is presented for comparative purposes only.

			State of nature		**Comparison only**
			1950s maturity	Base case	With NWFSC survey data
Relative probability			Less likely	Most likely	Less likely
~ probability state of nature is > base case			0.01	0.5	0.78
Management decision	**Quantity**	**Year**			
3-year average landings (2004-2006) South = 79 mt, North = 818 mt	Depletion	2009	85%	107%	117%
		2010	81%	102%	111%
		2011	76%	98%	105%
		2012	71%	94%	101%
		2013	67%	90%	97%
		2014	64%	88%	94%
		2018	56%	81%	85%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	26,220	36,822	41,001
		2011	24,585	35,147	39,009
		2012	23,067	33,724	37,270
		2013	21,776	32,541	35,800
		2014	20,717	31,571	34,583
		2018	18,191	29,183	31,607
200% of 3-year average landings (2004-2006) South = 158 mt, North = 1,636 mt	Depletion	2009	85%	107%	117%
		2010	78%	100%	109%
		2011	72%	93%	101%
		2012	65%	88%	95%
		2013	60%	83%	90%
		2014	55%	79%	86%
		2018	45%	70%	75%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	25,506	35,997	40,183
		2011	23,239	33,618	37,494
		2012	21,185	31,607	35,177
		2013	19,449	29,936	33,231
		2014	18,024	28,560	31,625
		2018	14,562	25,062	27,580
3,100 mt total catch (current ABC; requested by GMT in 2005) South = 273 mt, North = 2,827 mt	Depletion	2009	85%	107%	117%
		2010	76%	98%	106%
		2011	67%	89%	97%
		2012	60%	82%	90%
		2013	53%	76%	83%
		2014	48%	72%	78%
		2018	36%	60%	65%
	Spawning biomass (1000s mt)	2009	27,696	38,711	43,165
		2010	24,806	35,197	39,382
		2011	21,929	32,146	36,011
		2012	19,379	29,593	33,142
		2013	17,260	27,498	30,763
		2014	15,549	25,792	28,822
		2018	11,539	21,522	23,980
	Landings (mt)	2009	2,674	2,662	2,672
		2010	2,664	2,653	2,673
		2011	2,638	2,628	2,655
		2012	2,603	2,597	2,628
		2013	2,568	2,566	2,600
		2014	2,534	2,538	2,573
		2018	2,429	2,457	2,497

13. Figures

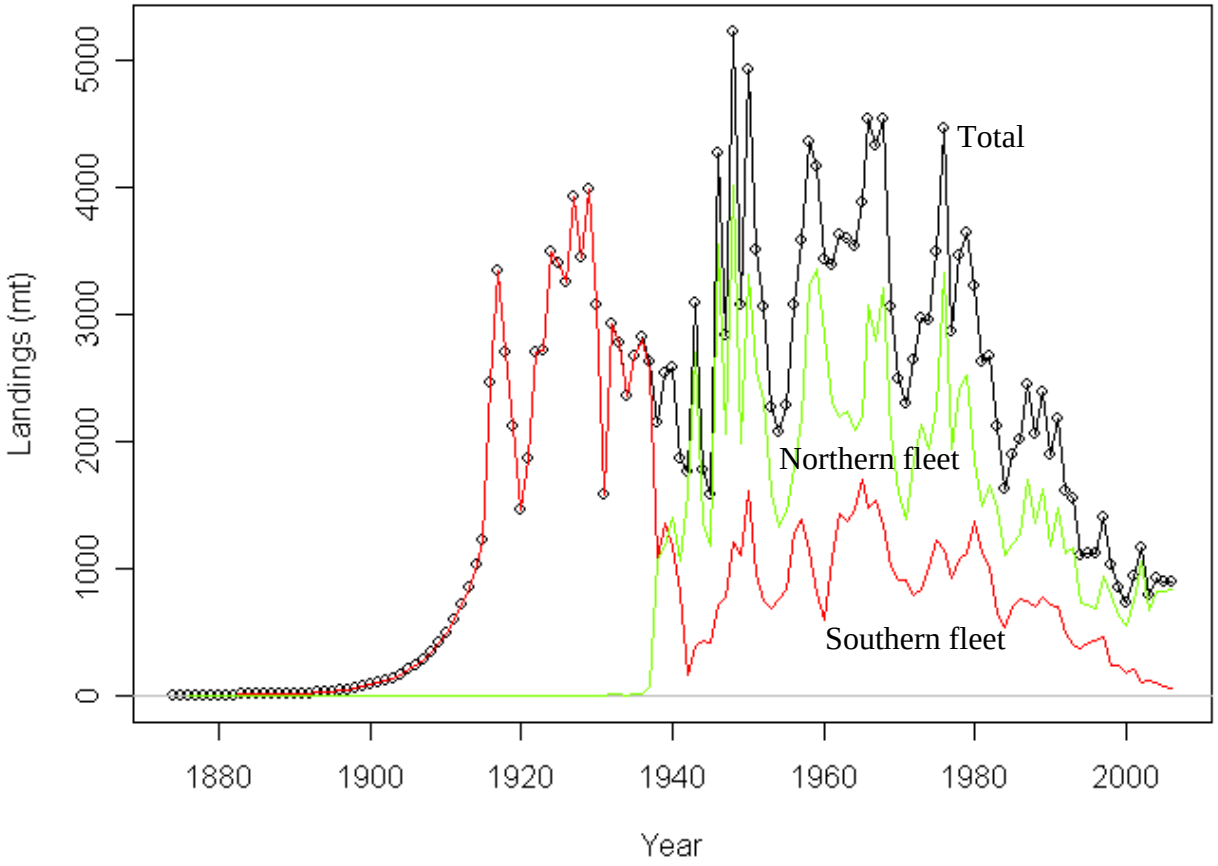

Figure 1. Reconstructed historical landings by year and area used in the base case run, 1876-2006.

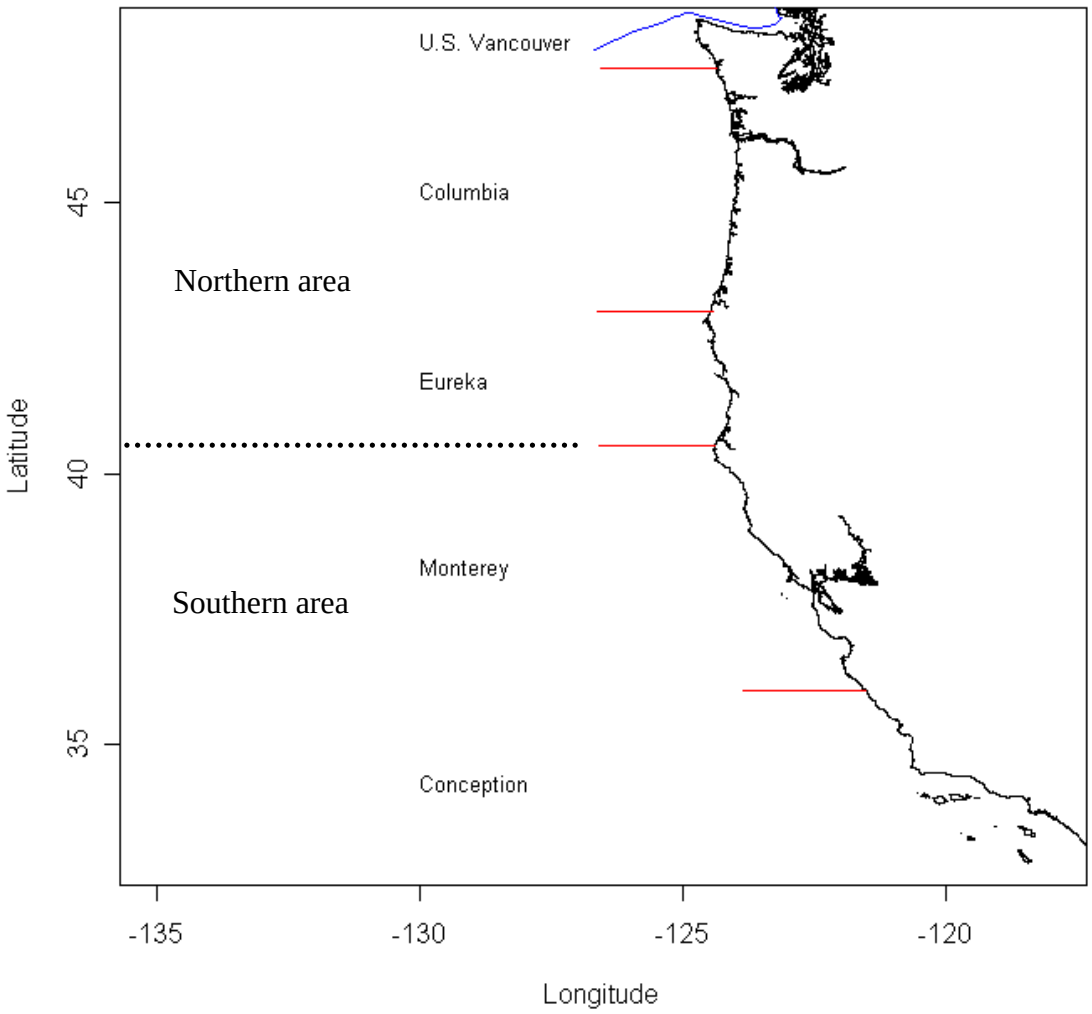

Figure 2. INPFC and data areas used in the 2005 assessment and this update.

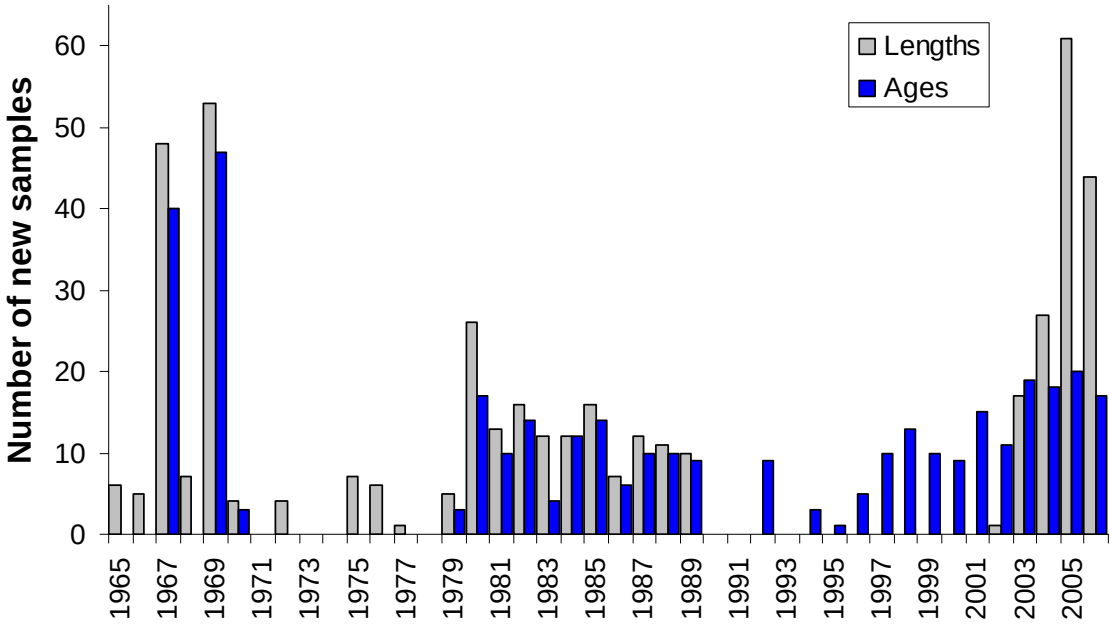

Figure 3. New length and age samples available since the 2005 assessment (historical samples were primarily added by WDFW) and used in this 2007 updated assessment.

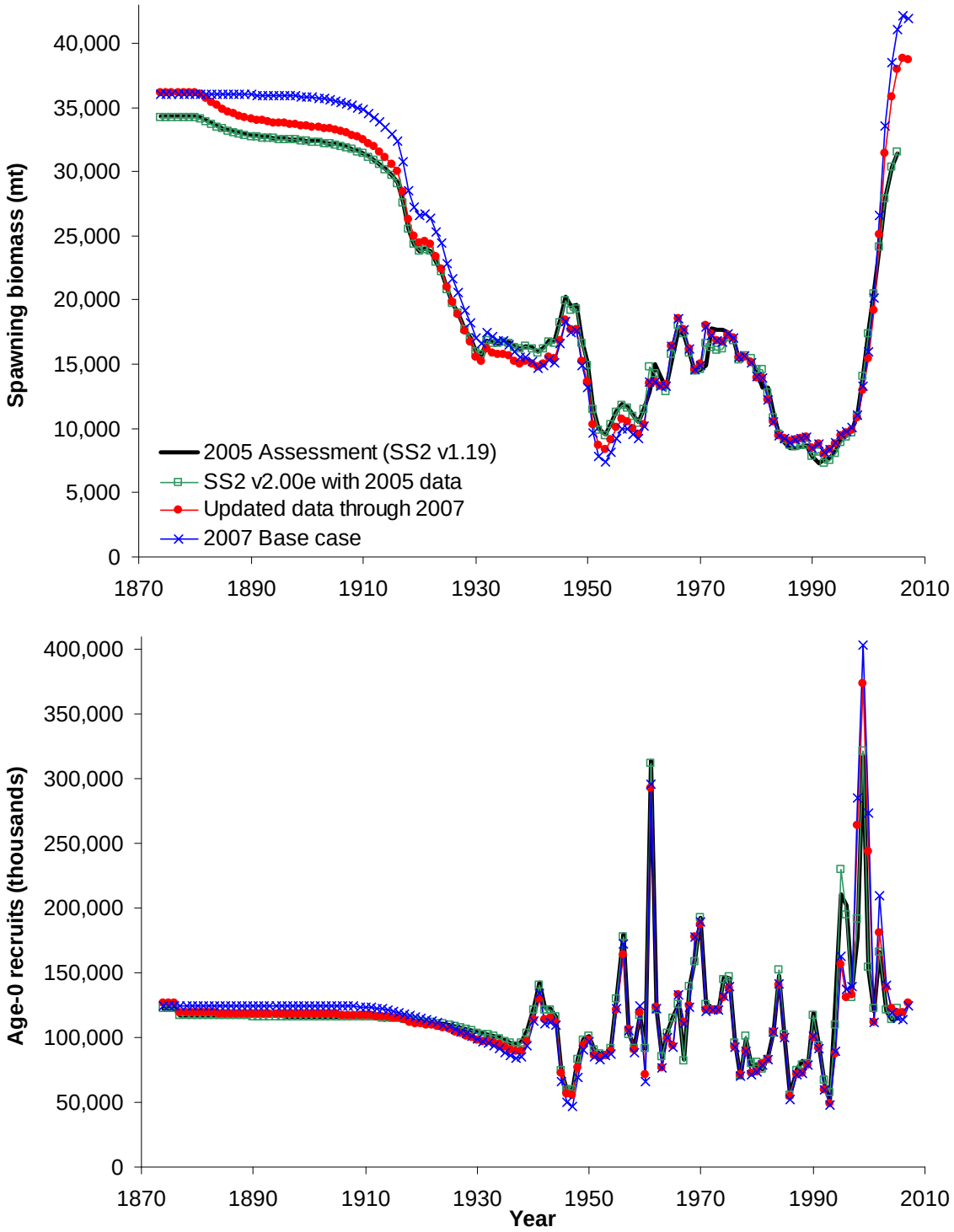

Figure 4. Link from 2005 base case assessment results through SS2 version update, data update and re-tuning of bias correction to 2007 base case.

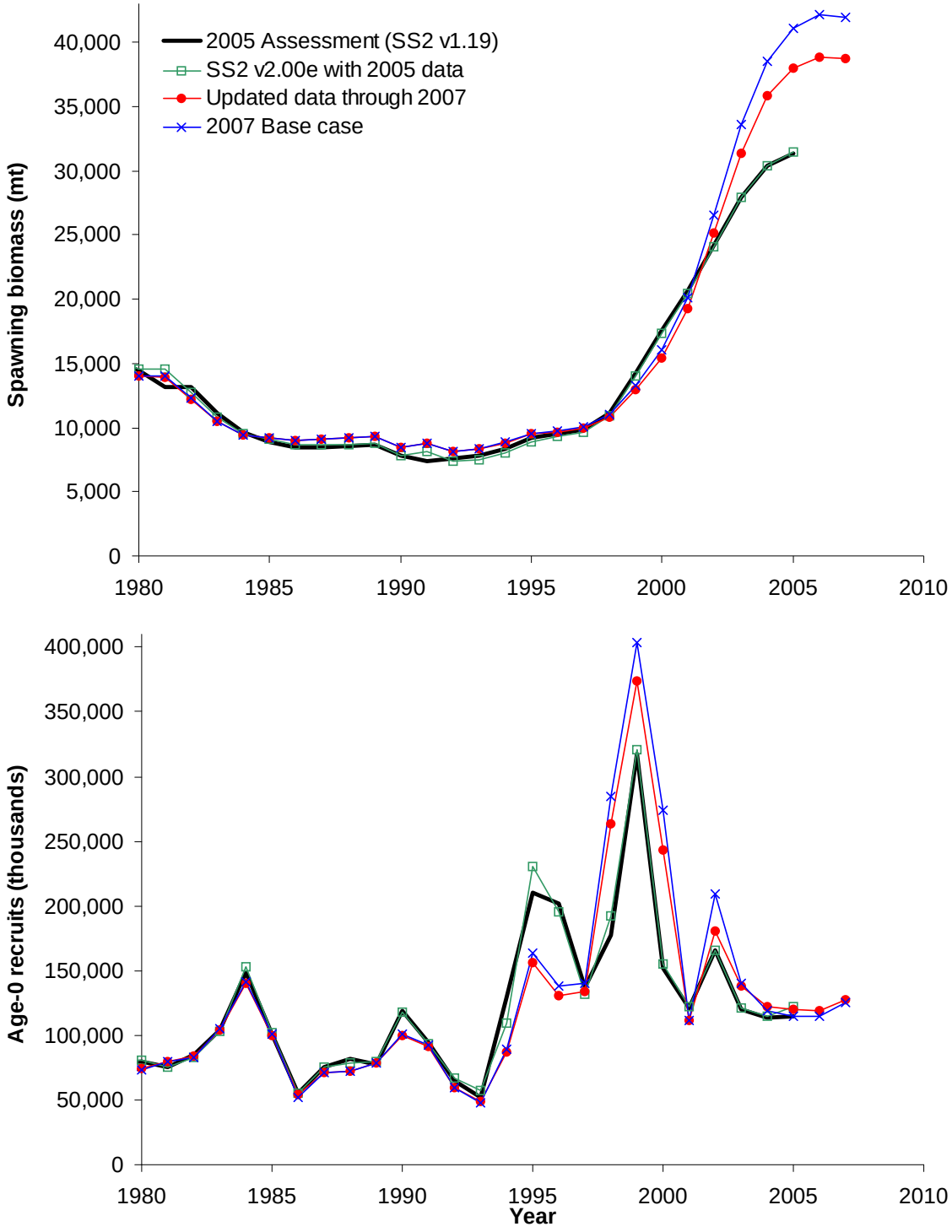

Figure 5. Recent results from the 2005 base case assessment results through SS2 version update, data update and re-tuning of bias correction to 2007 base case.

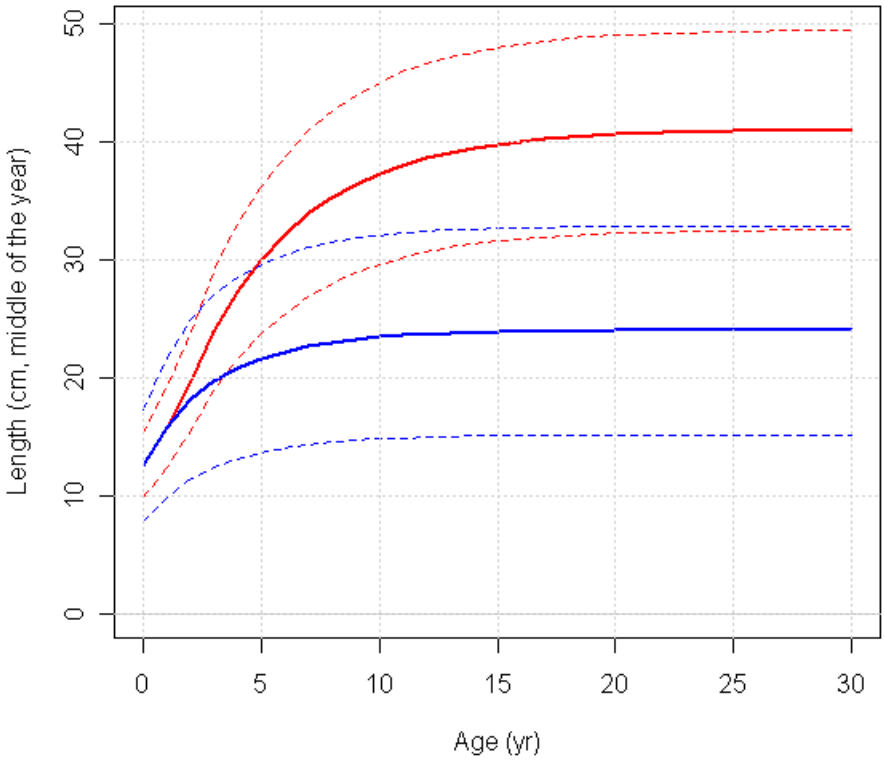

Figure 6. Growth curve for females (upper line) and males with ~95% interval for individual variability in length-at-age for the last year of the model.

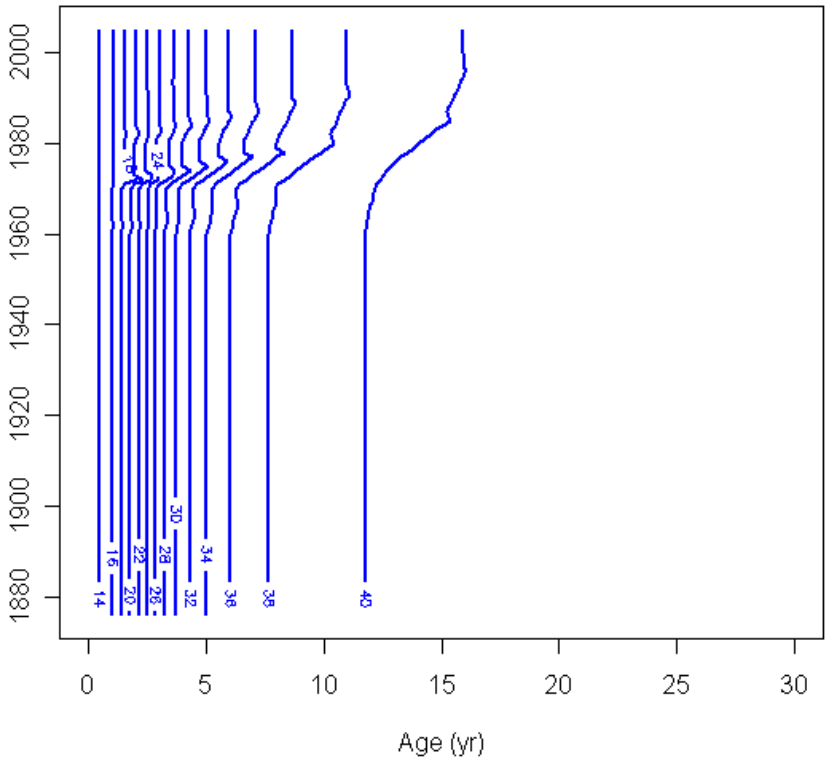

Figure 7. Contour of length for each age for female English sole, showing the effect of reduced estimates of the growth rate (*K*) over time. Because males are offset from females they show a very similar pattern, although the specific values differ.

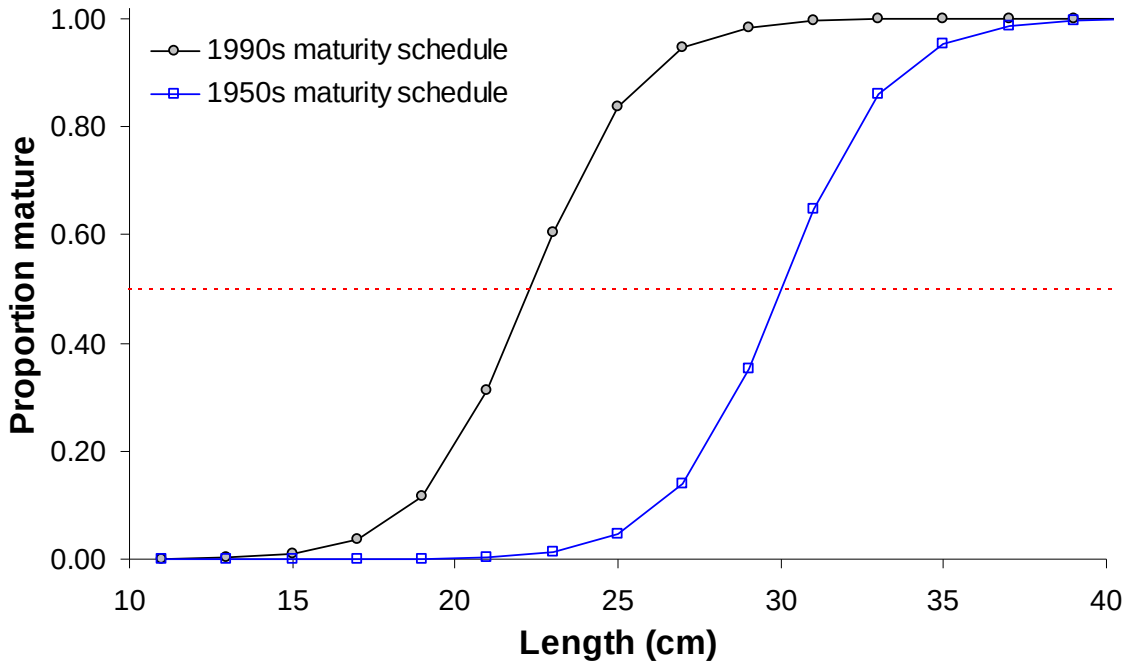

Figure 8. Historical and recent maturity schedules used in the base case model and for sensitivity testing. Dashed reference line indicates 50% mature individuals.

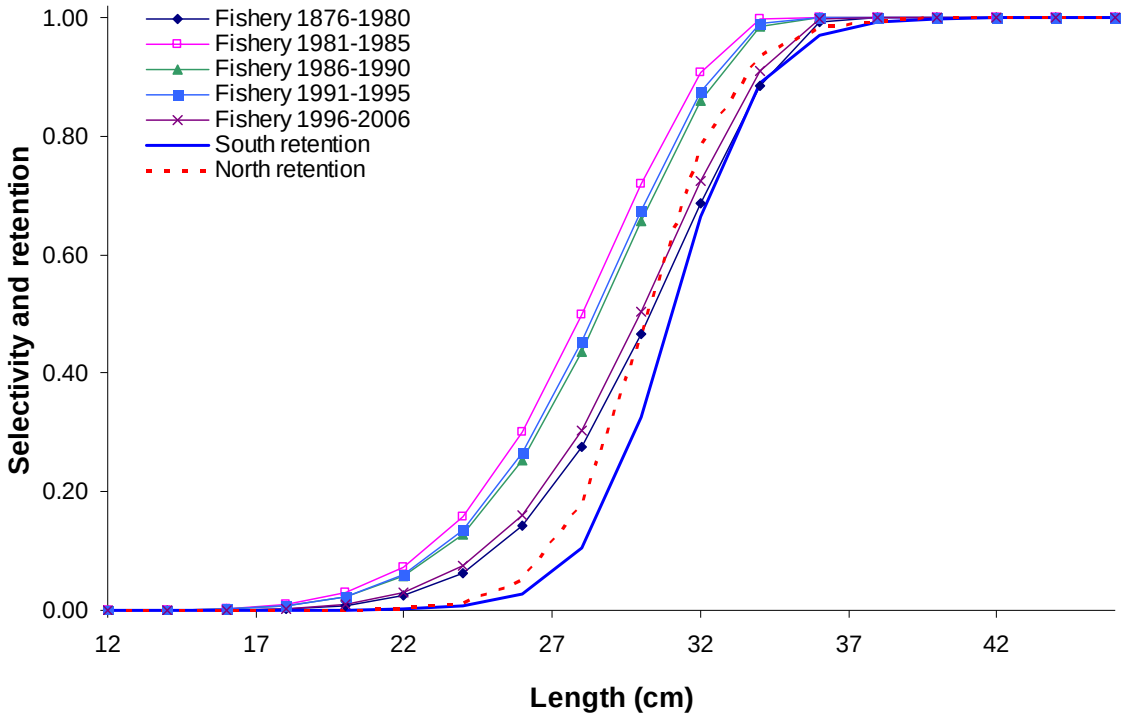

Figure 9. Estimated fishery selectivity and retention curves for the base case model. Note that both fisheries have the same time-varying selectivity curve, but the retention curves are separate and time-invariant.

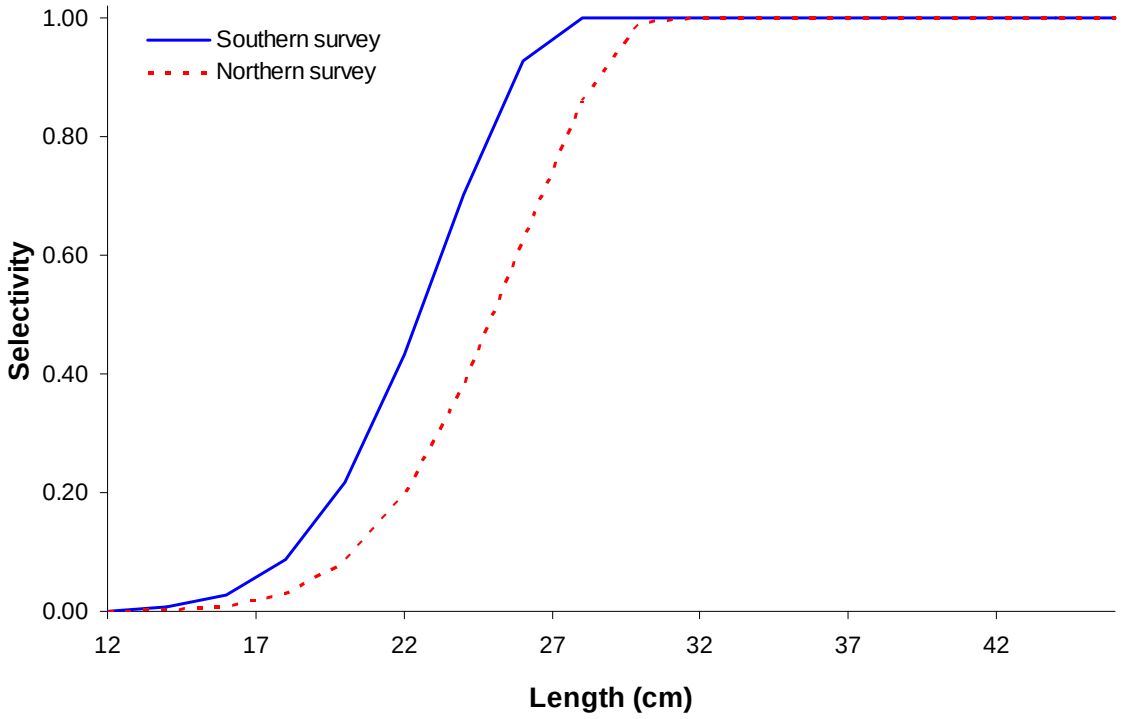

Figure 10. Estimated survey selectivity curves for the southern and northern areas.

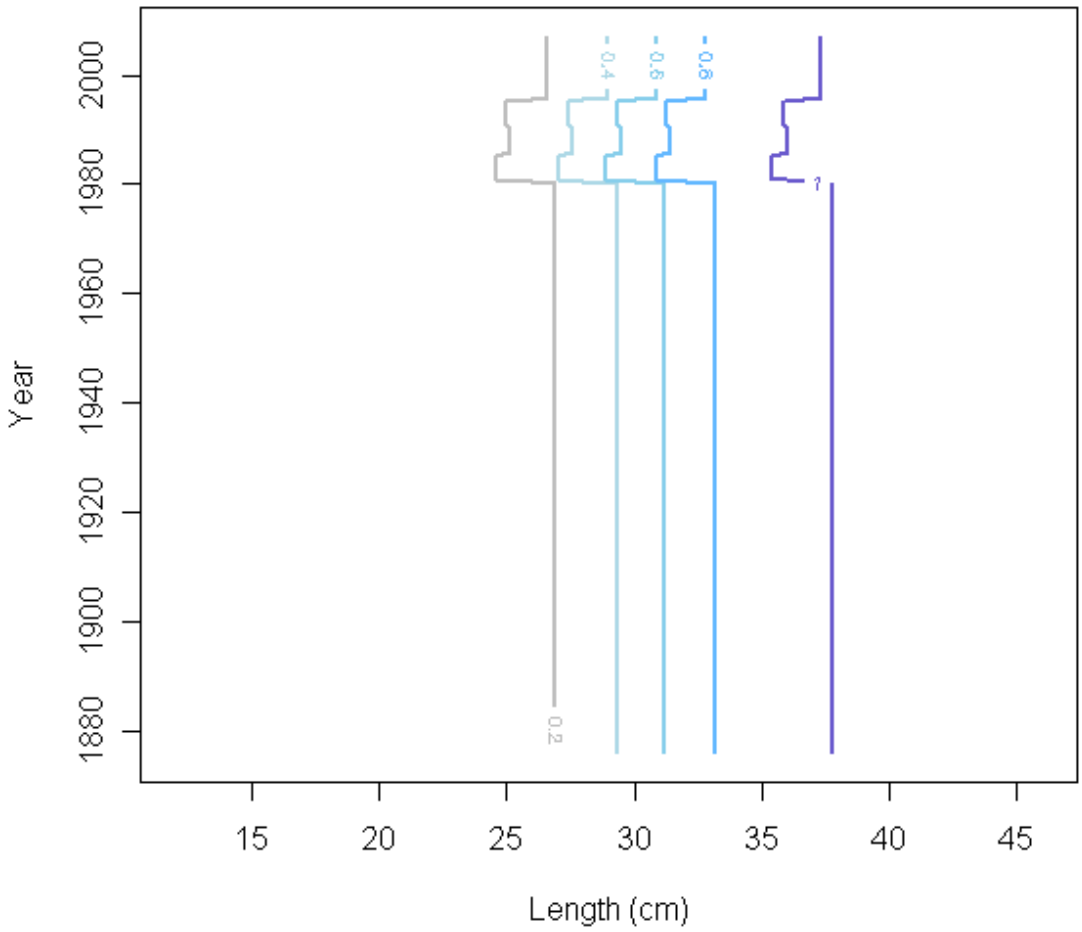

Figure 11. Modeled change in selectivity over time for the southern and northern fishing fleets.

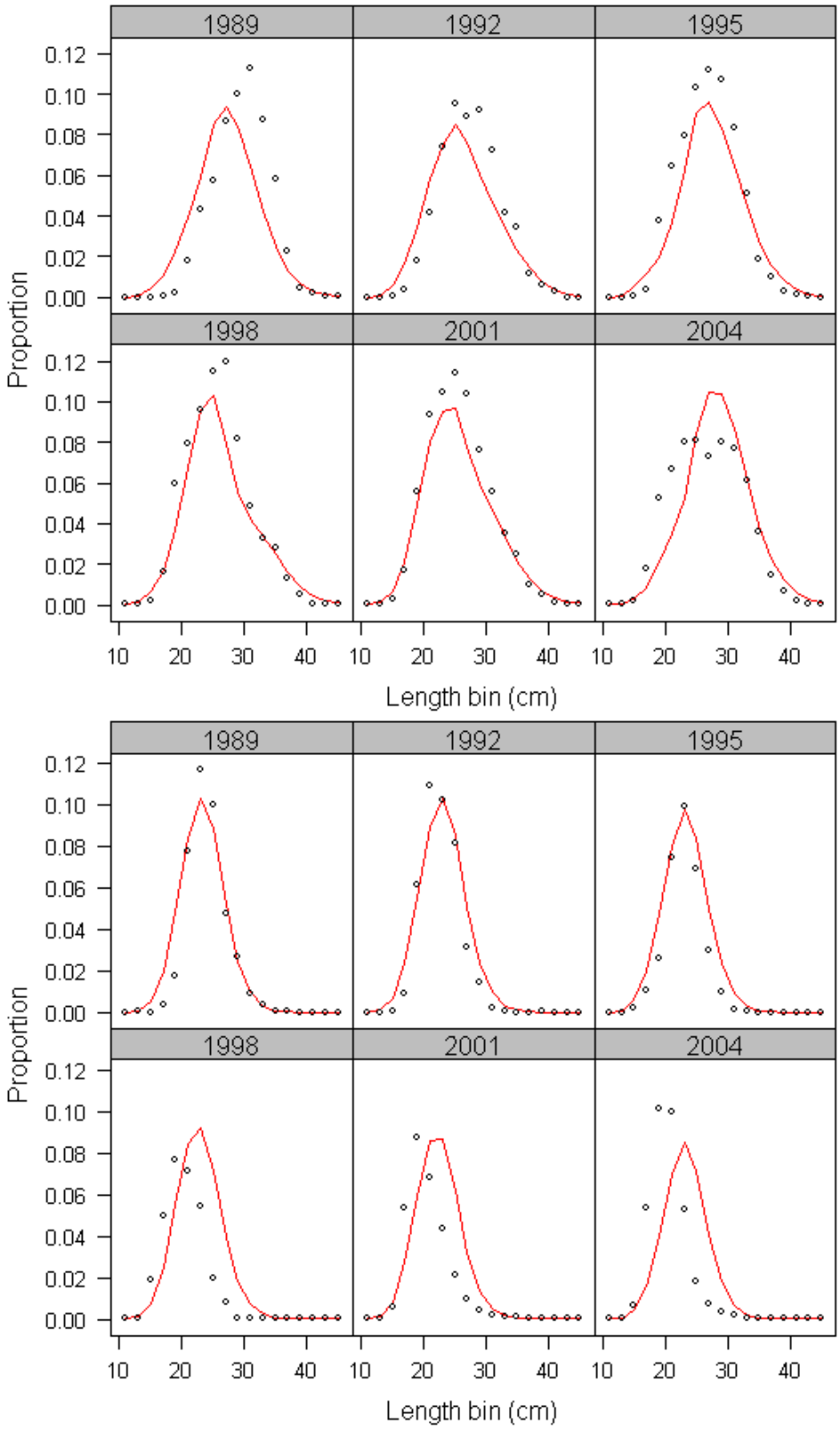

Figure 12. Fit to the southern survey female (upper panel) and male (lower panel) length-frequencies.

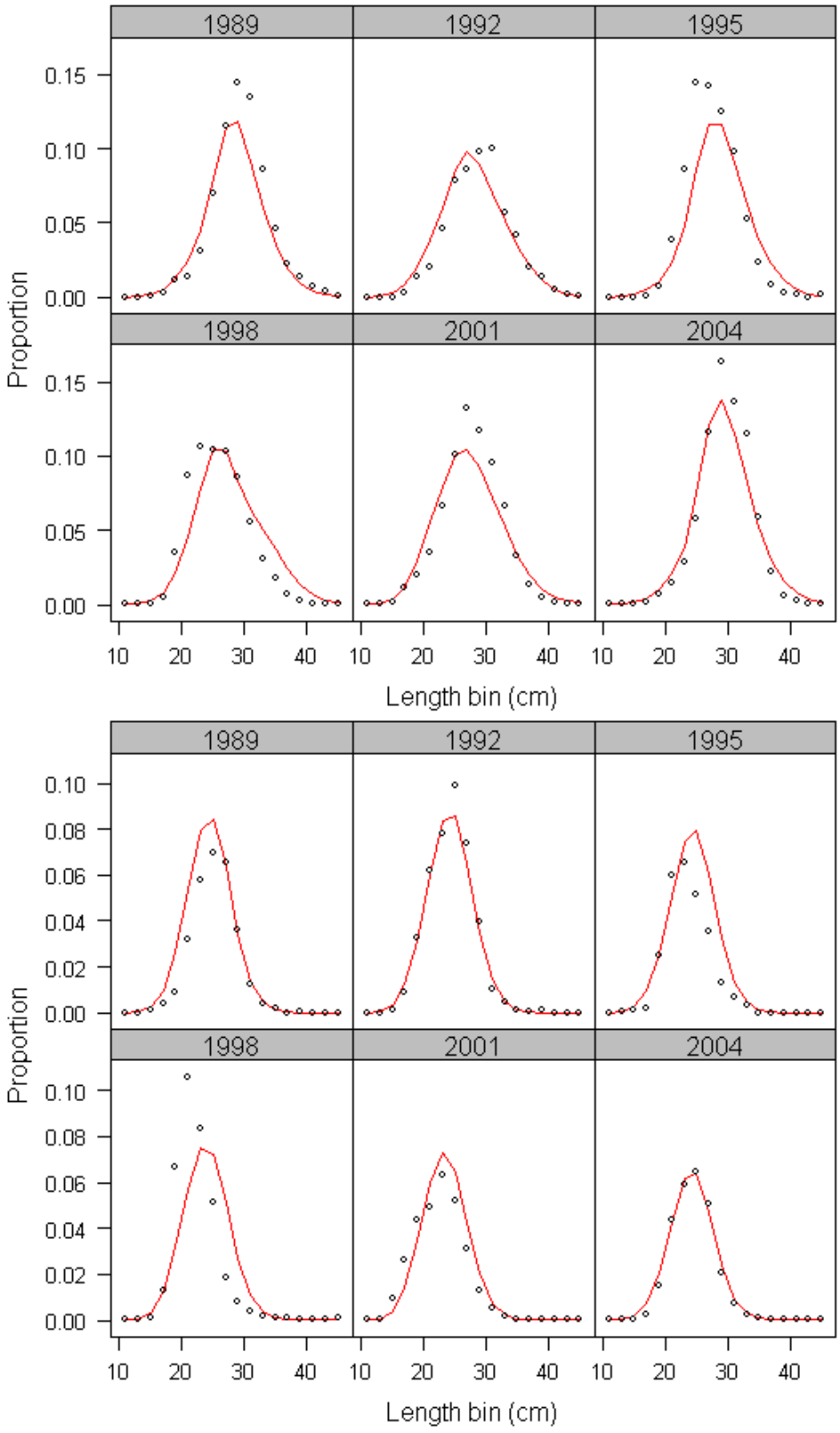

Figure 13. Fit to the northern survey female (upper panel) and male (lower panel) length-frequencies.

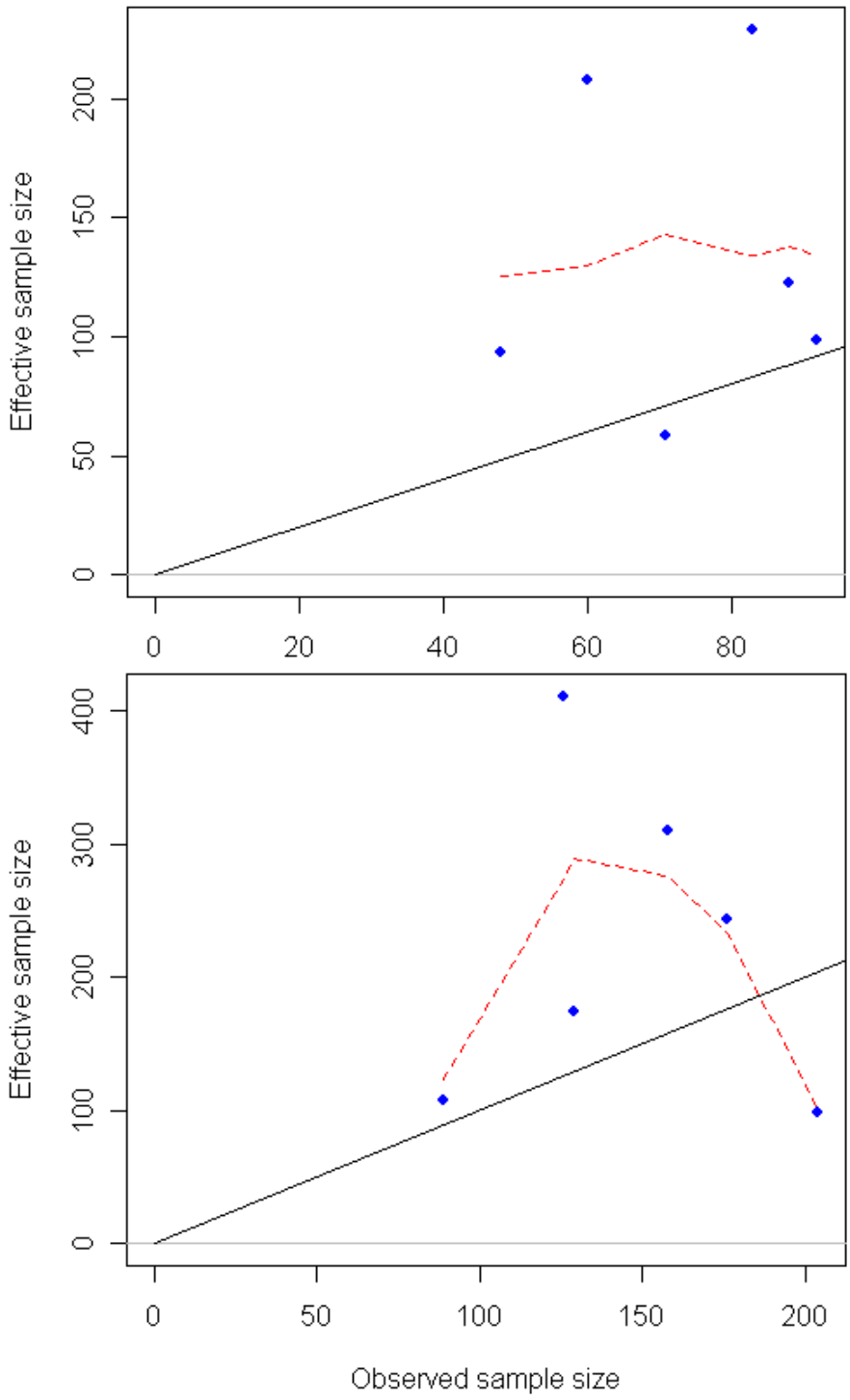

Figure 14. Observed and effective sample sizes for the southern (upper panel) and northern (lower panel) survey length-frequencies (sexes combined).

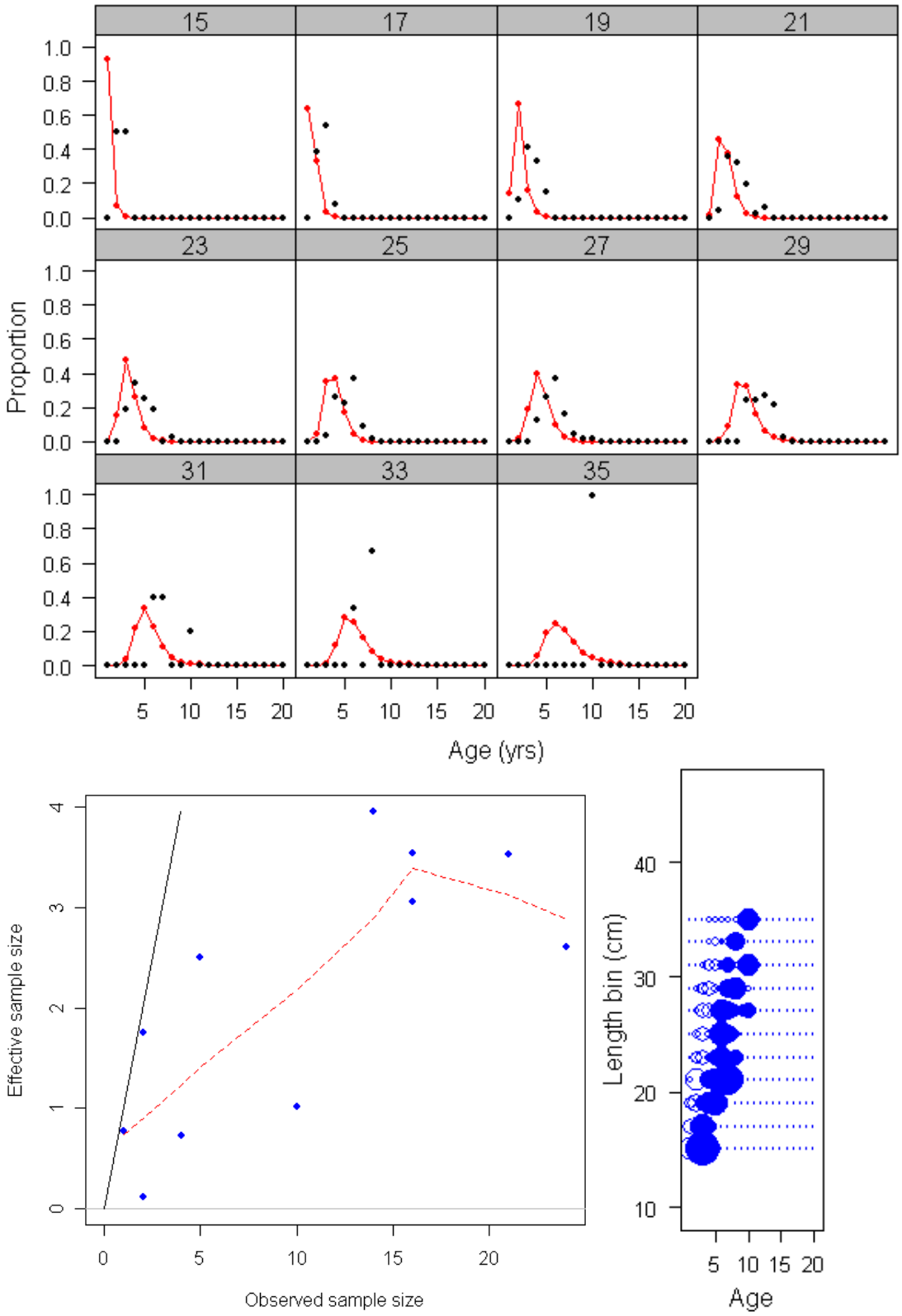

Figure 15. Fit to age-at-length bin observations from the triennial survey project in 1995, observed vs. effective sample sizes and Pearson residuals.

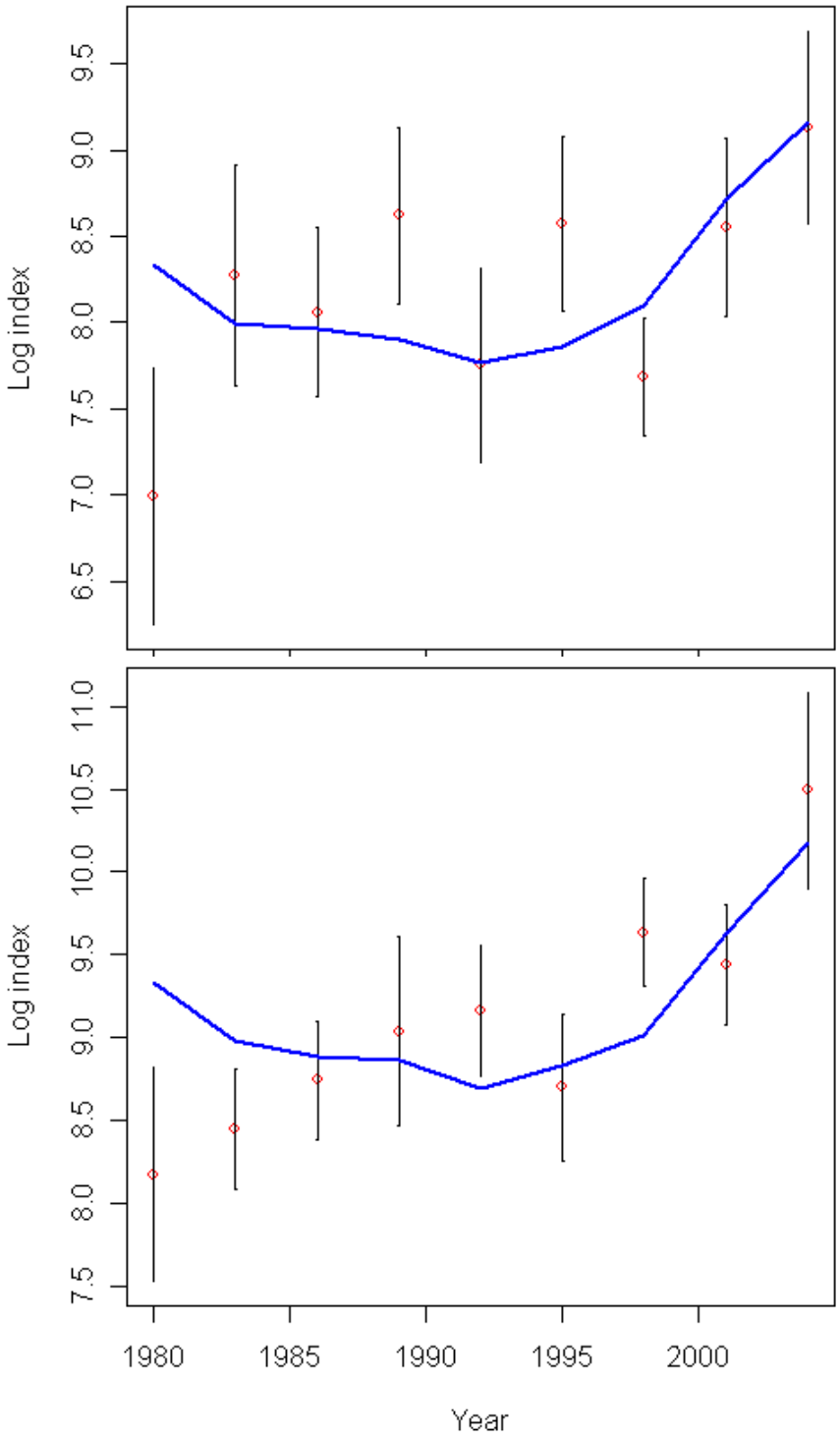

Figure 16. Model fit to southern (top panel) and northern (bottom panel) log survey indices of abundance.

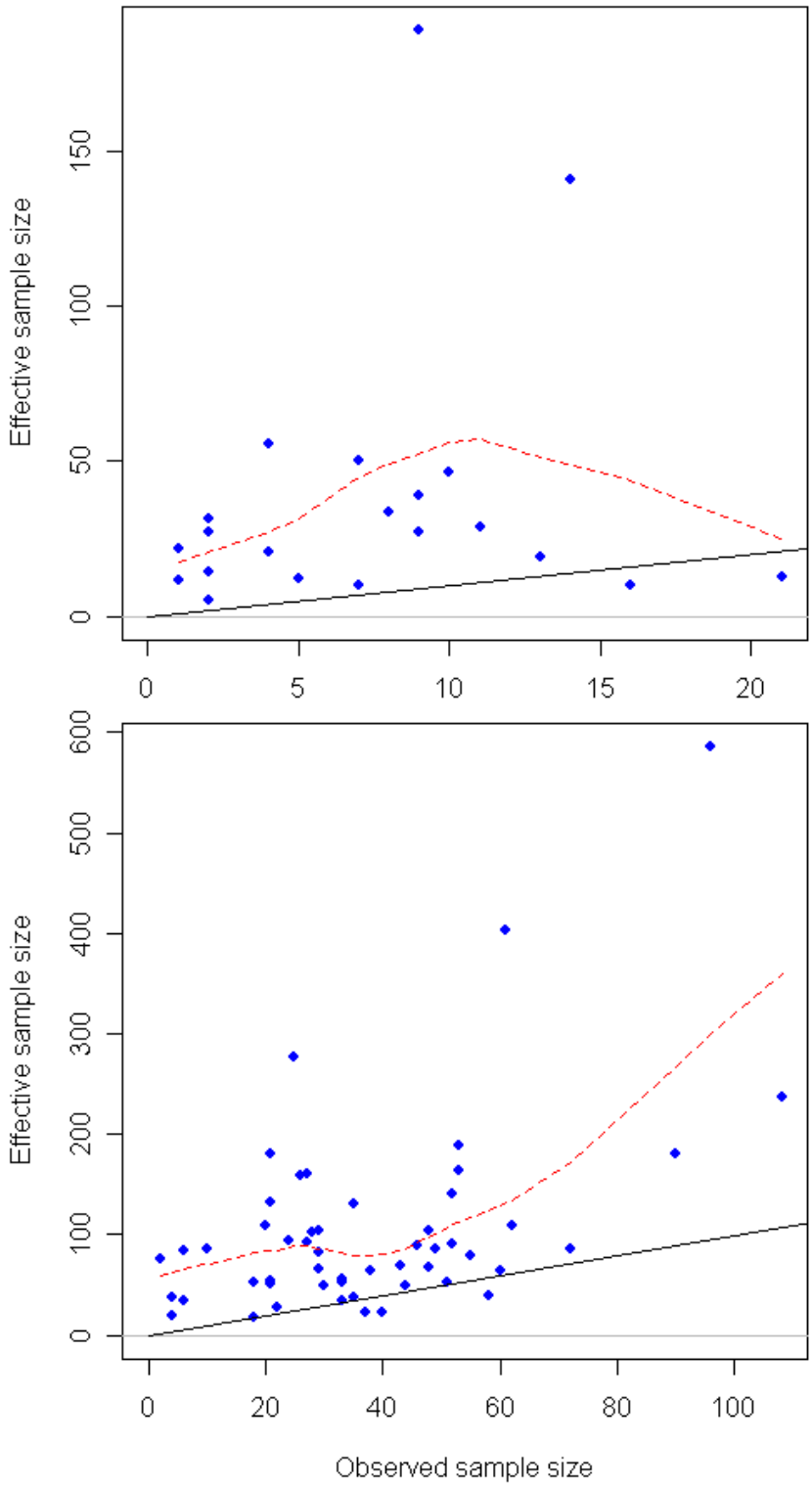

Figure 17. Observed and effective sample sizes for length frequencies from the southern (top panel) and northern (bottom panel) fishing fleets. Lines indicates 1:1 relationship, dashed lines are loess smoothers to aid in visualizing the points (some points may be overlapping).

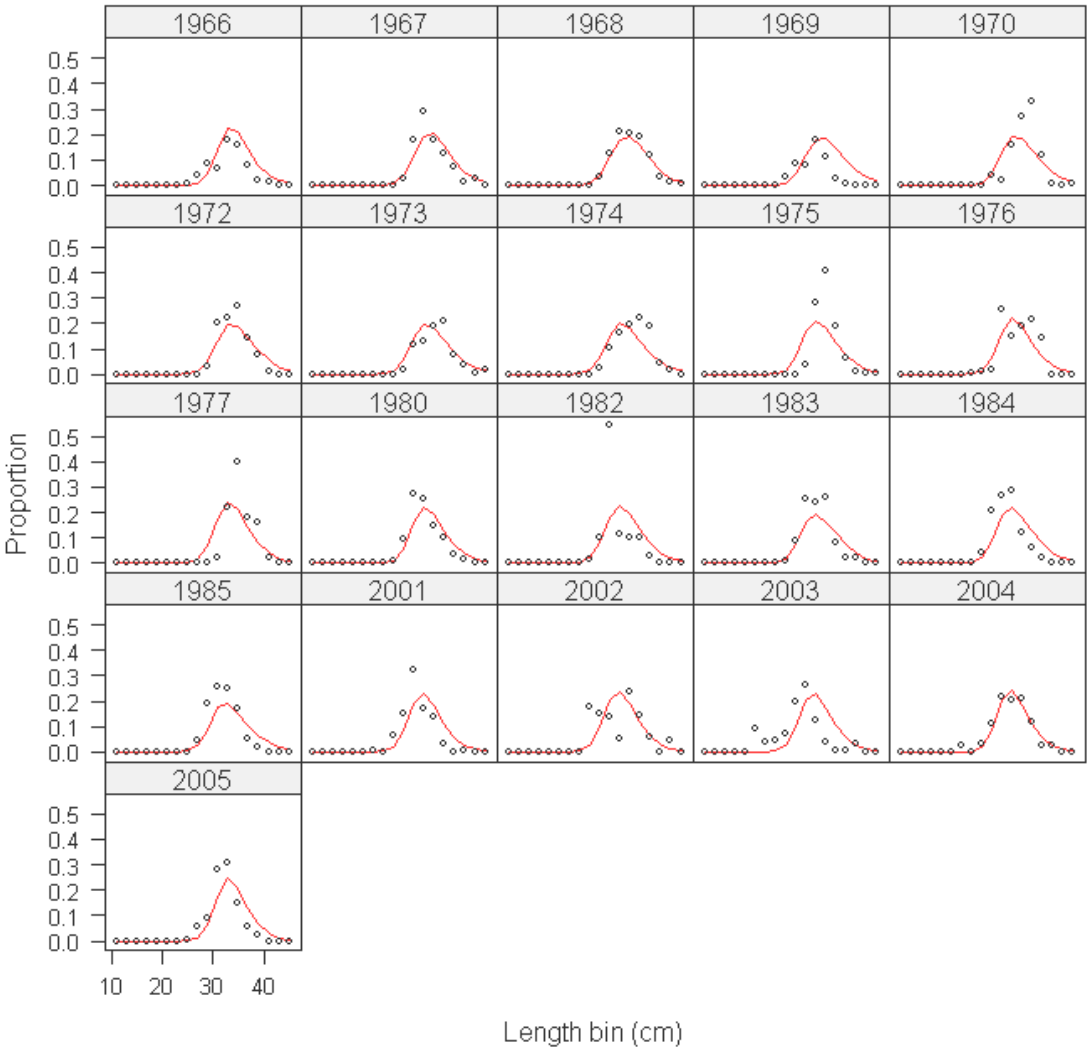

Figure 18. Fit to length-frequency data for females from the southern commercial fishery fleet.

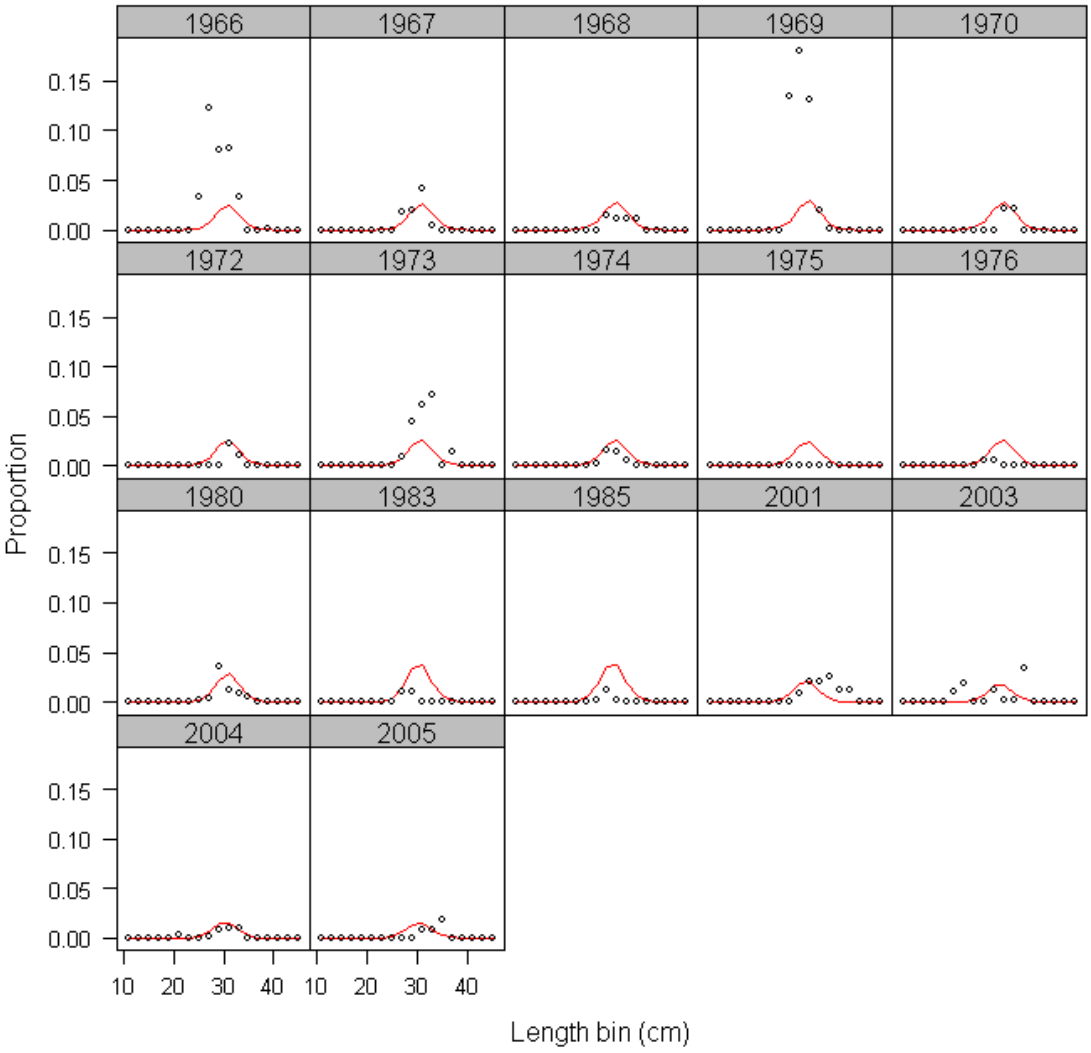

Figure 19. Fit to length-frequency data for males from the southern commercial fishery fleet.

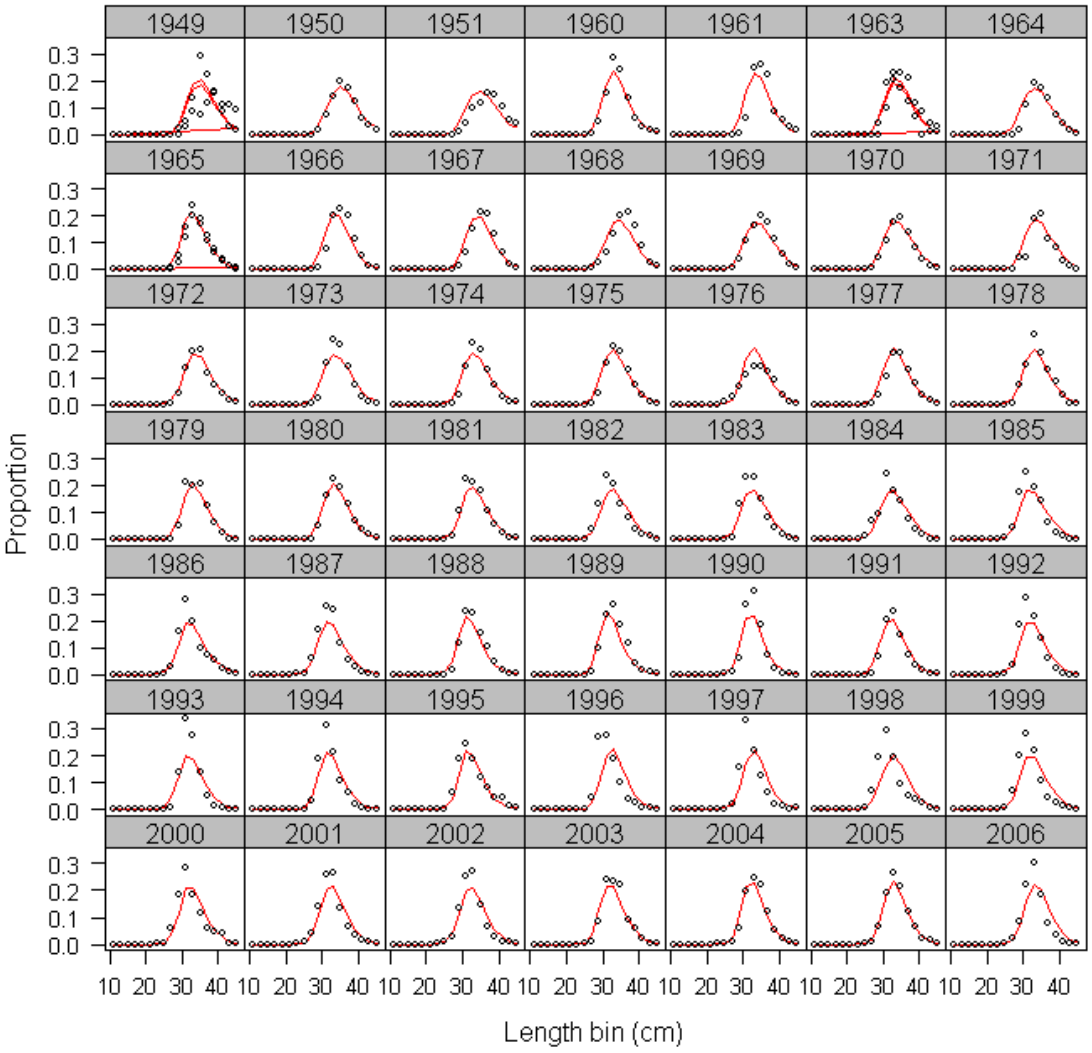

Figure 20. Fit to female length frequency observations from the northern commercial fishery fleet.

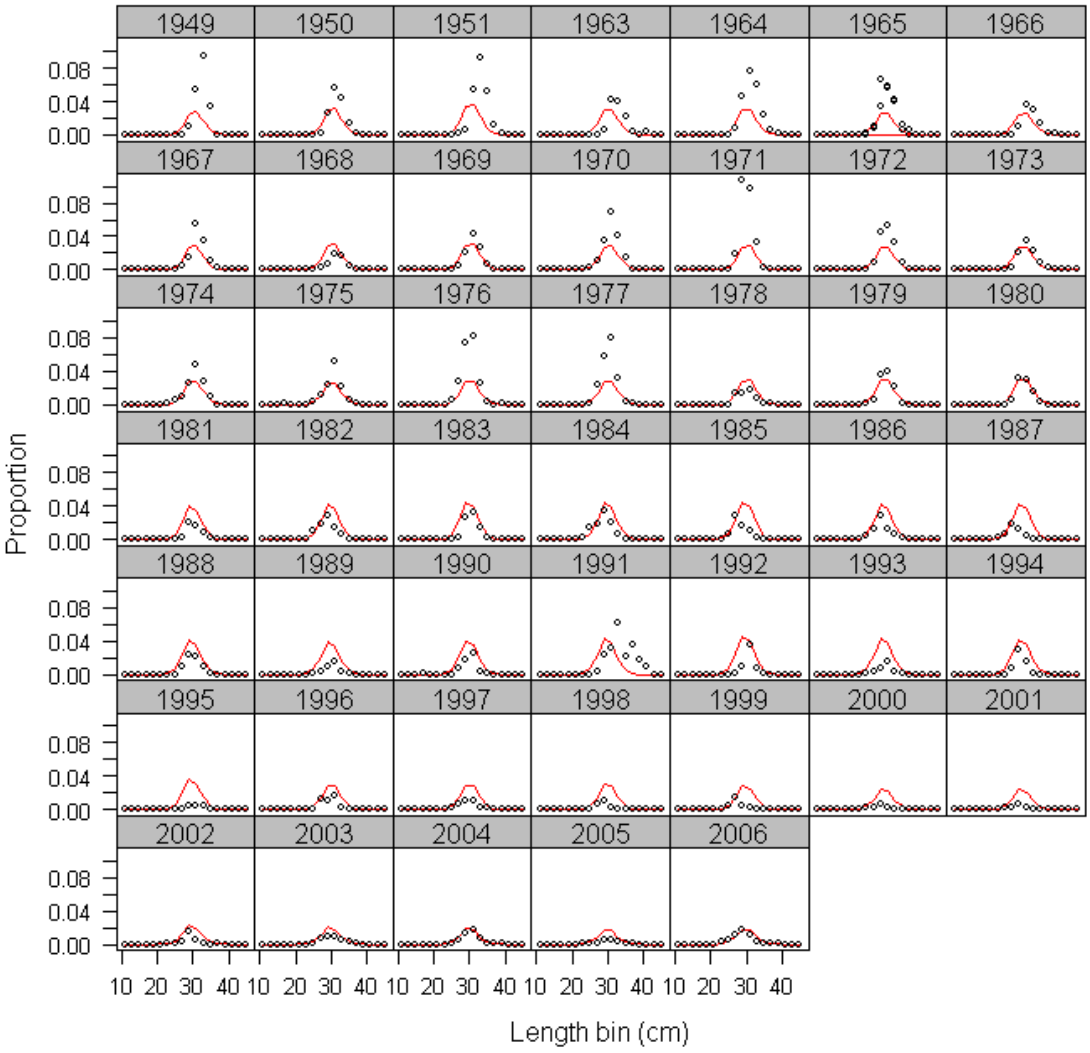

Figure 21. Fit to male length frequency observations from the northern commercial fishery fleet.

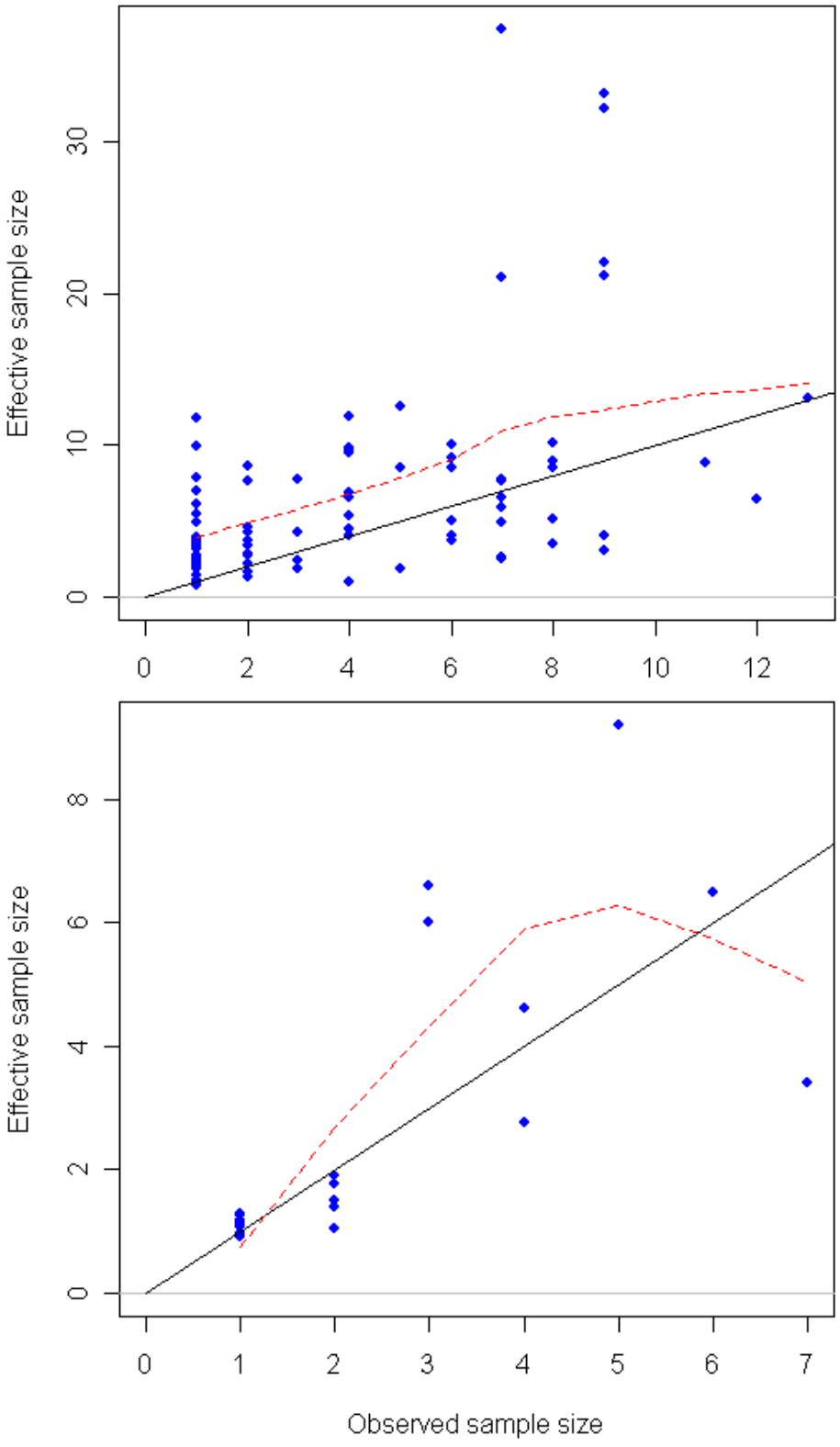

Figure 22. Observed and effective sample sizes for conditional age-at-length observations for females (upper panel) and males (lower panel) from the southern fishing fleet.

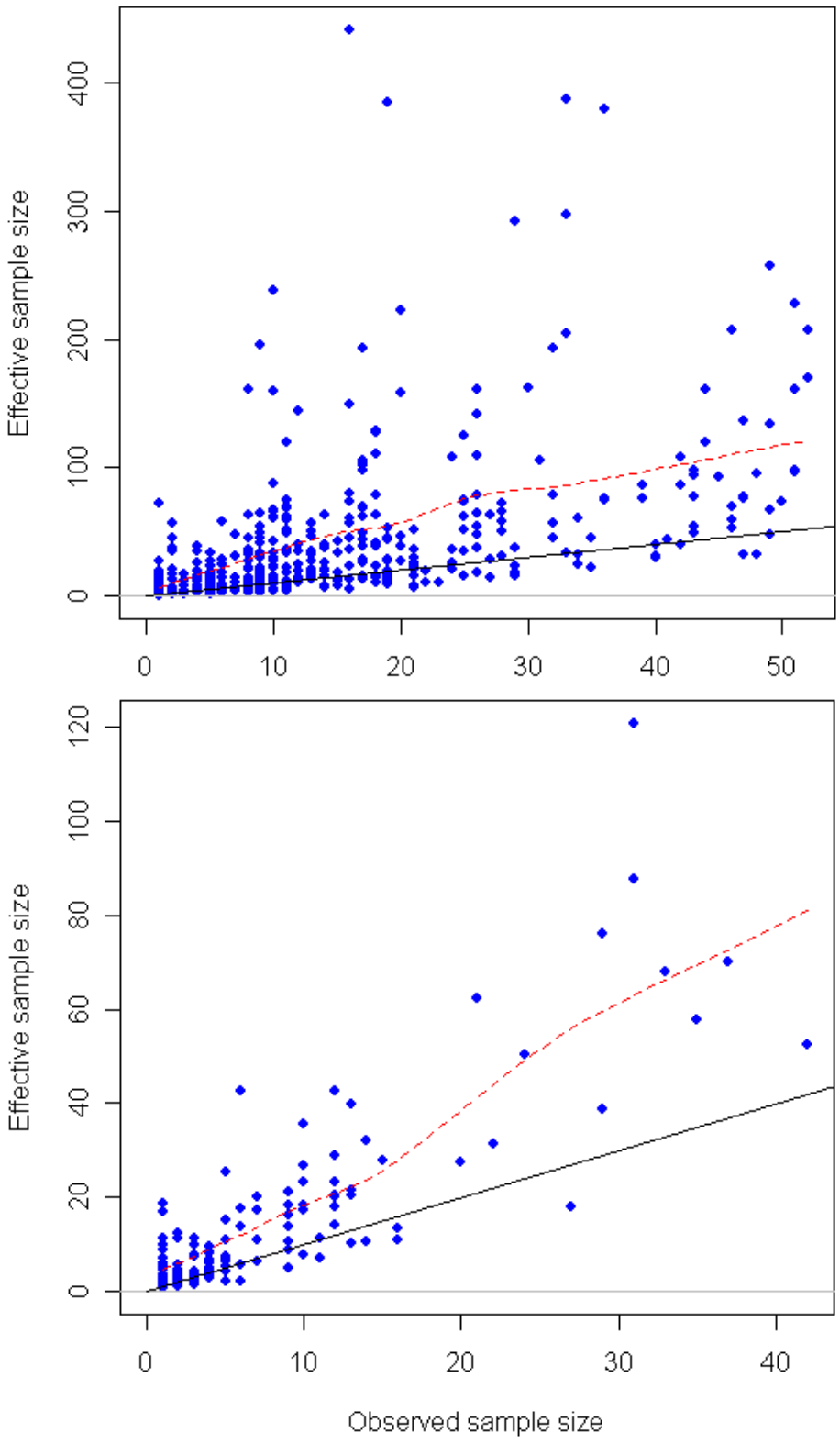

Figure 23. Observed and effective sample sizes for conditional age-at-length observations for females (upper panel) and males (lower panel) from the northern fishing fleet.

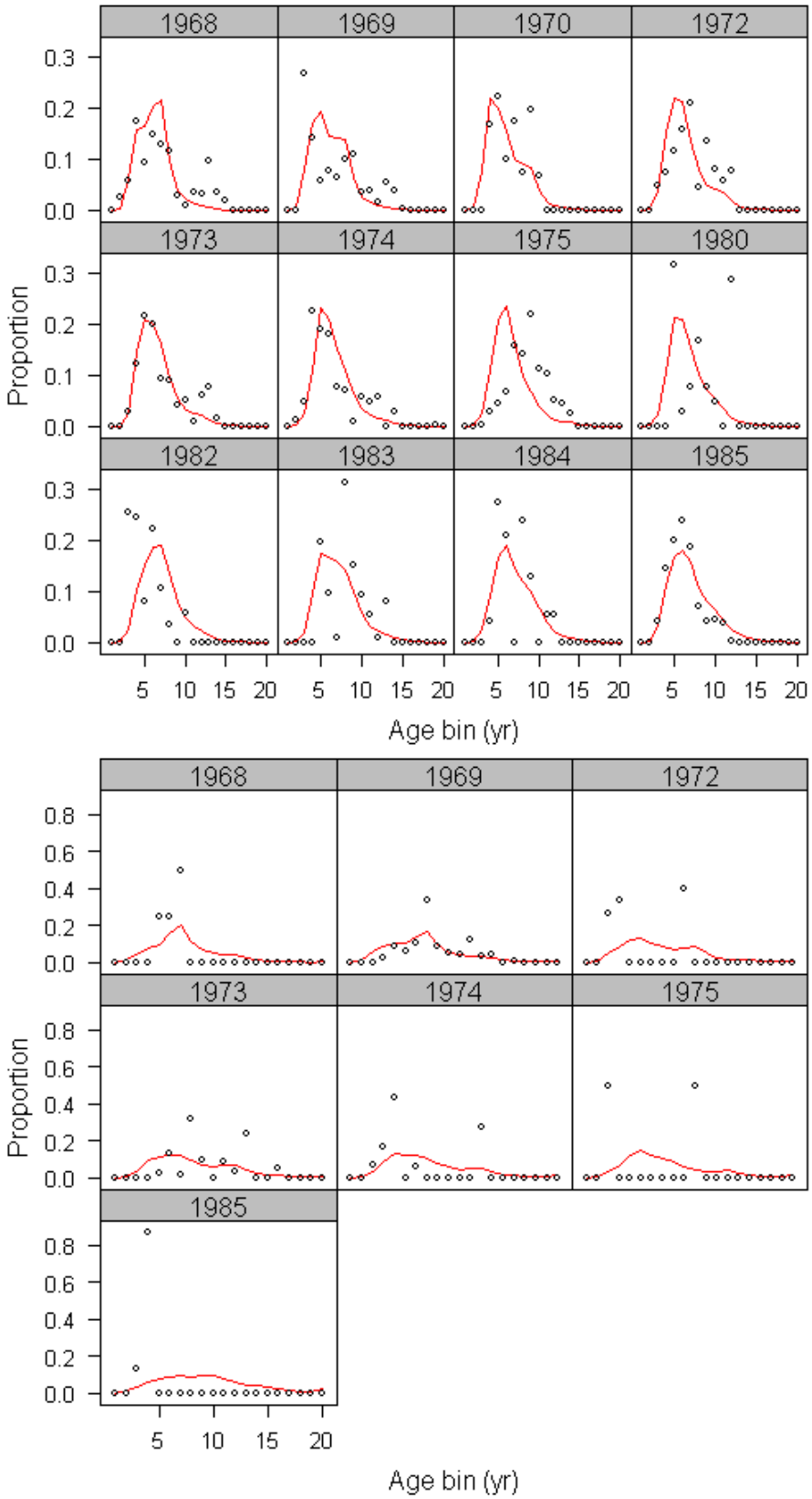

Figure 24. Implied fit to the marginal age-frequency distributions for females (upper panel) and males (lower panel) in the southern fishery.

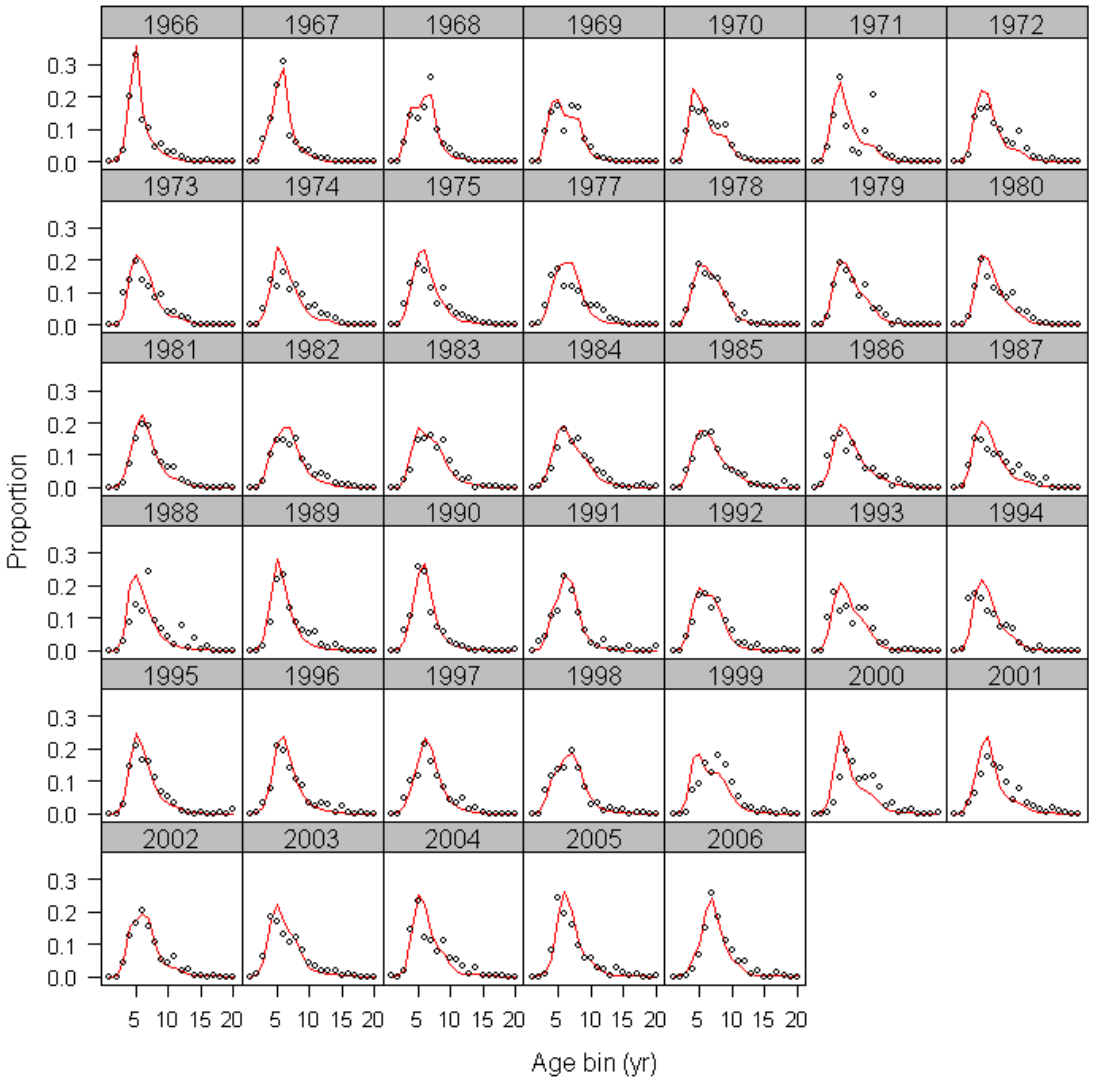

Figure 25. Implied fit to the marginal age-frequency distributions for females in the northern fishery.

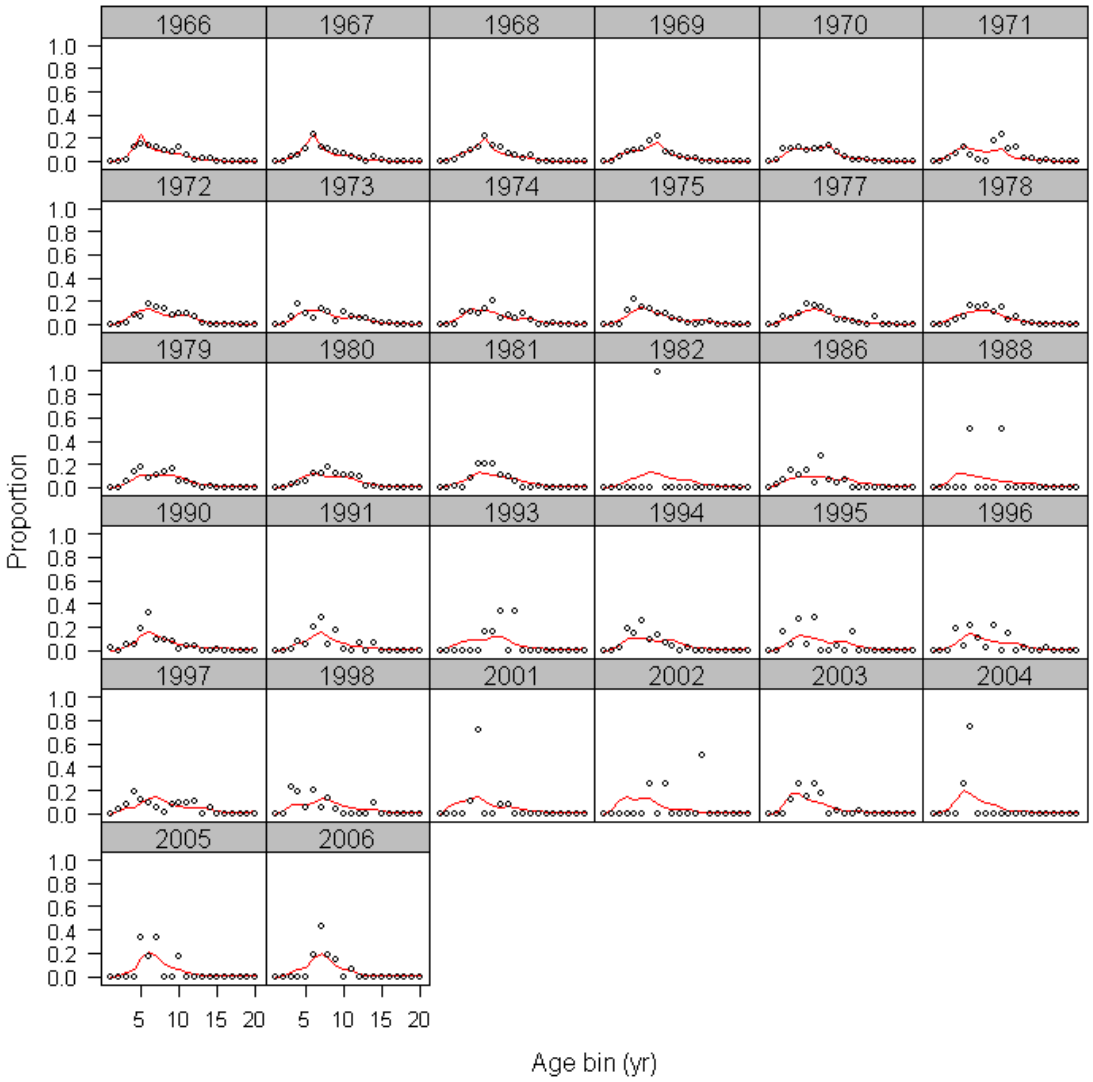

Figure 26. Implied fit to the marginal age-frequency distributions for males in the northern fishery.

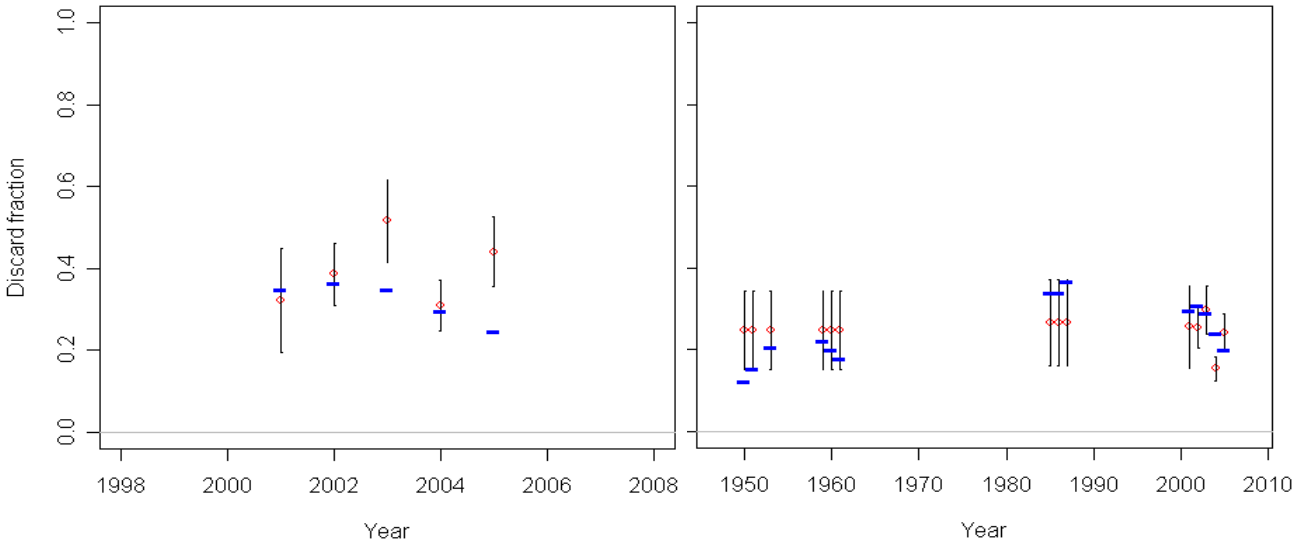

Figure 27. Fit to discard fraction data for the southern (left panel) and northern (right panel) fishing fleets. Observed values are the points, vertical lines represent ~95% confidence intervals and model predictions are the horizontal bars.

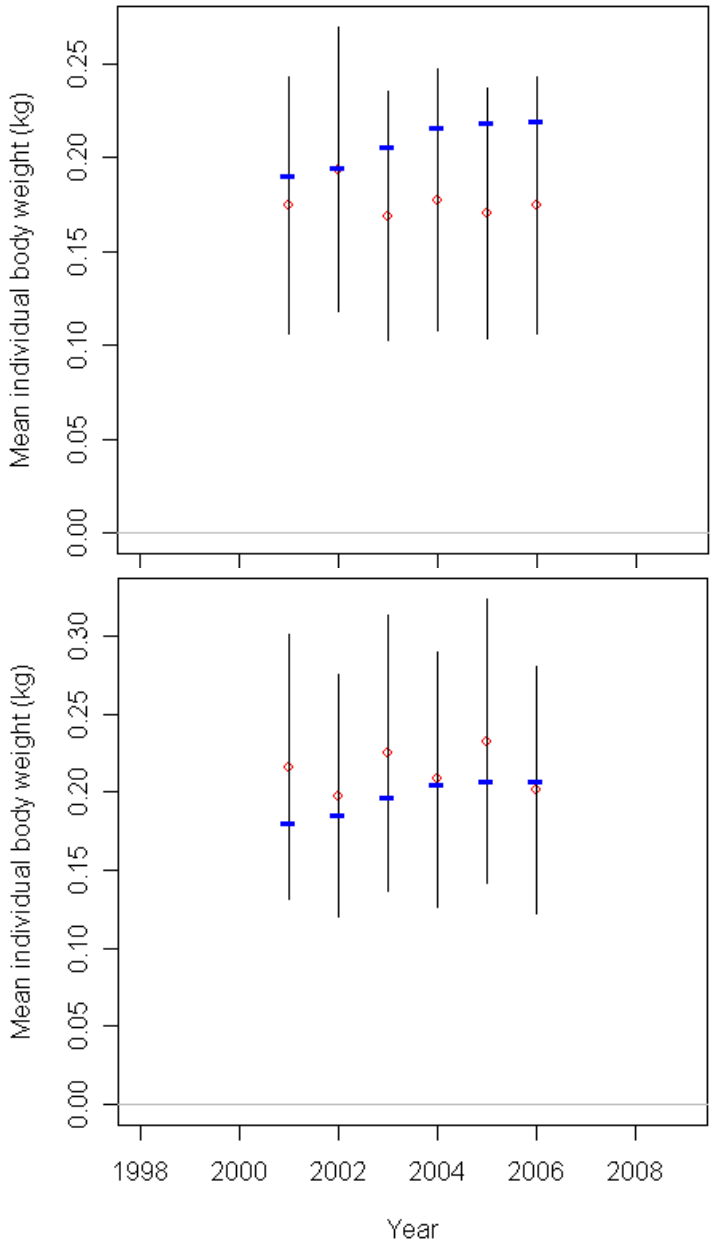

Figure 28. Fit to mean body weight data for the southern (upper panel) and northern (lower panel) fishing fleets. Observed values are the points, vertical lines represent ~95% confidence intervals and model predictions are the horizontal bars.

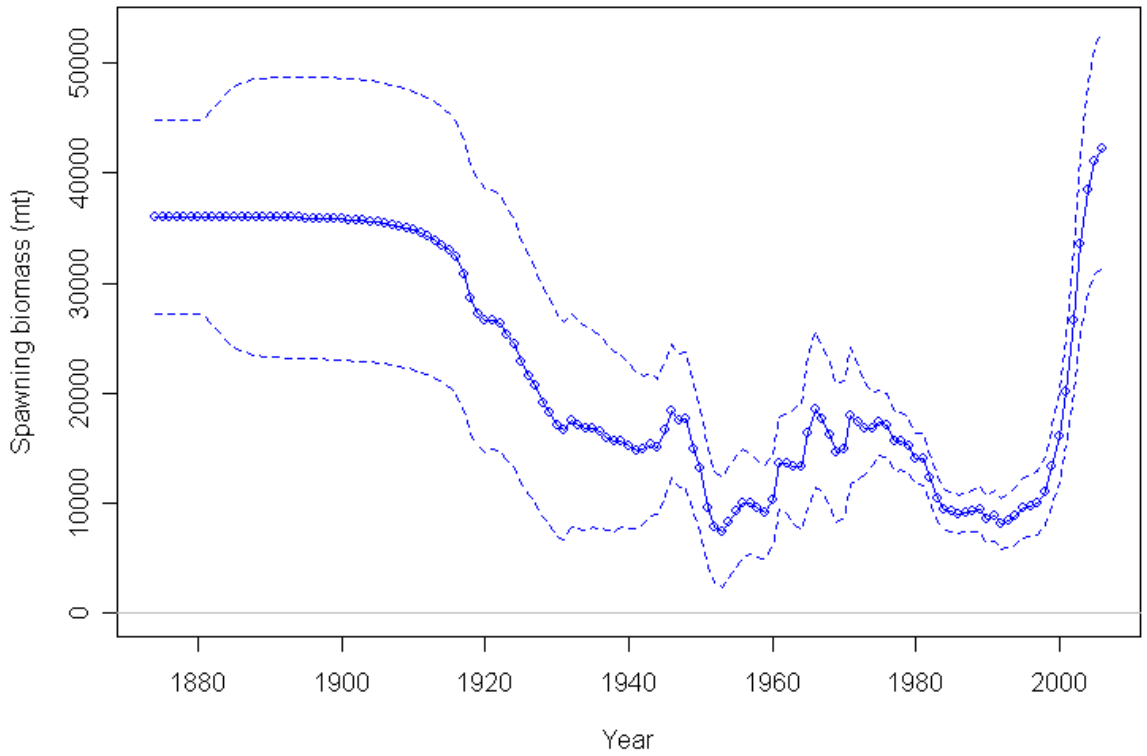

Figure 29. Estimated spawning biomass time-series with approximate asymptotic 95% confidence interval.

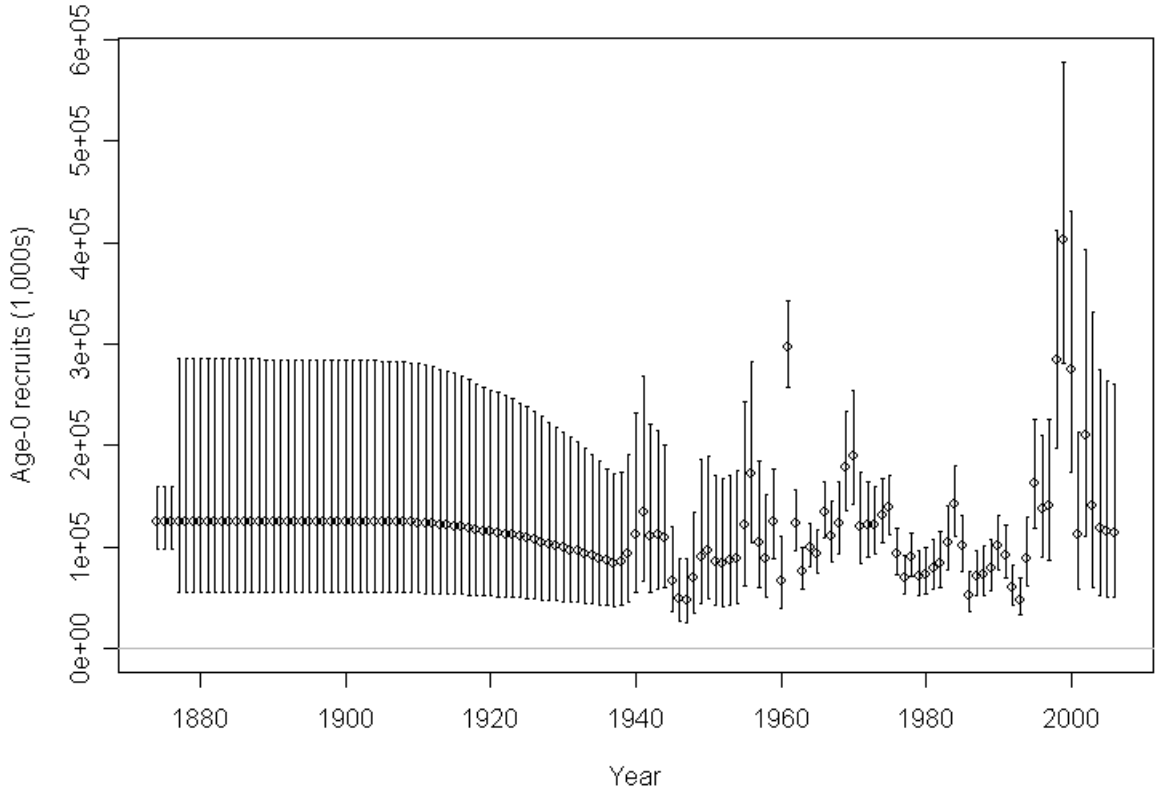

Figure 30. Time-series of estimated English sole recruitments with approximate asymptotic 95% confidence interval.

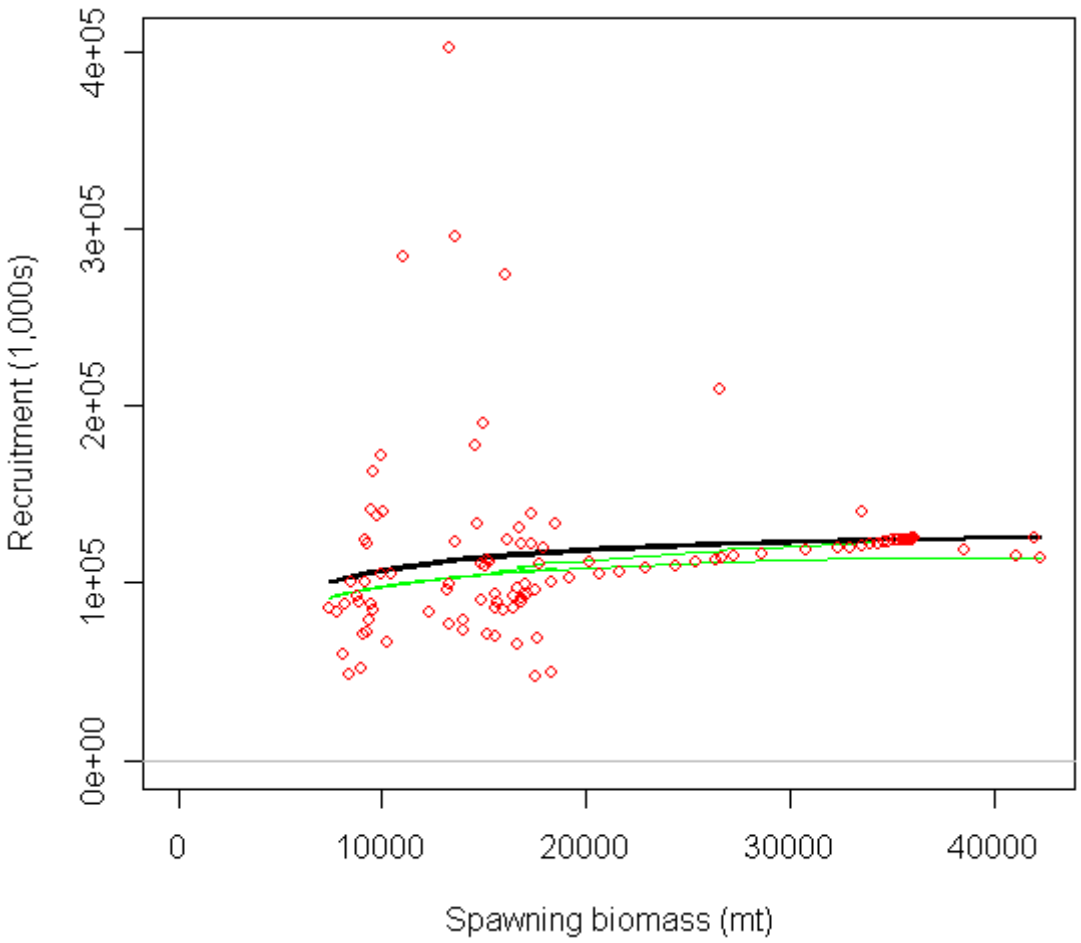

Figure 31. Stock-recruit function with predicted recruitments (points) and bias-corrected expectation (light line).

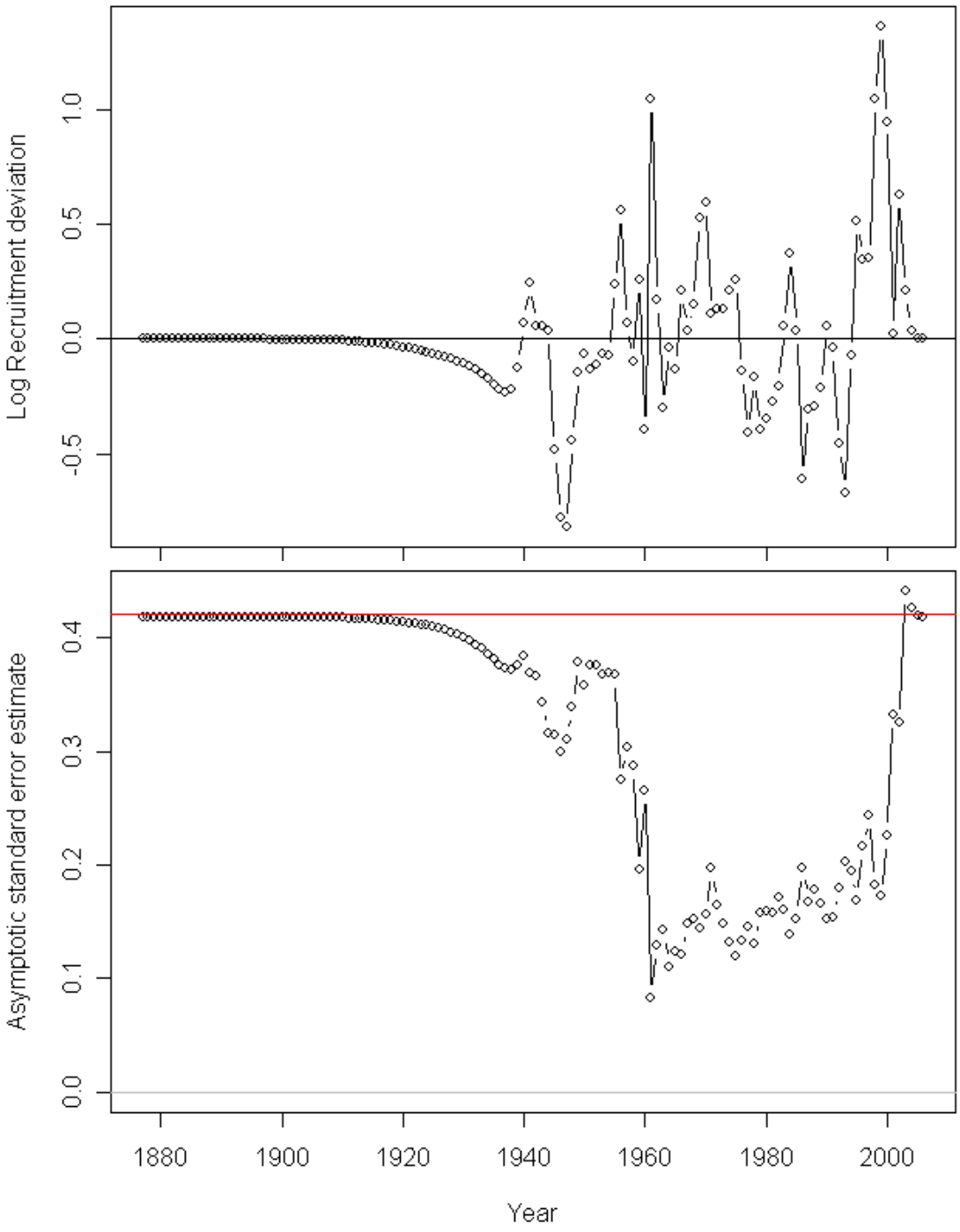

Figure 32. Log recruitment deviations (upper panel) and standard deviations of the recruitment deviations (lower panel) from the base case model run.

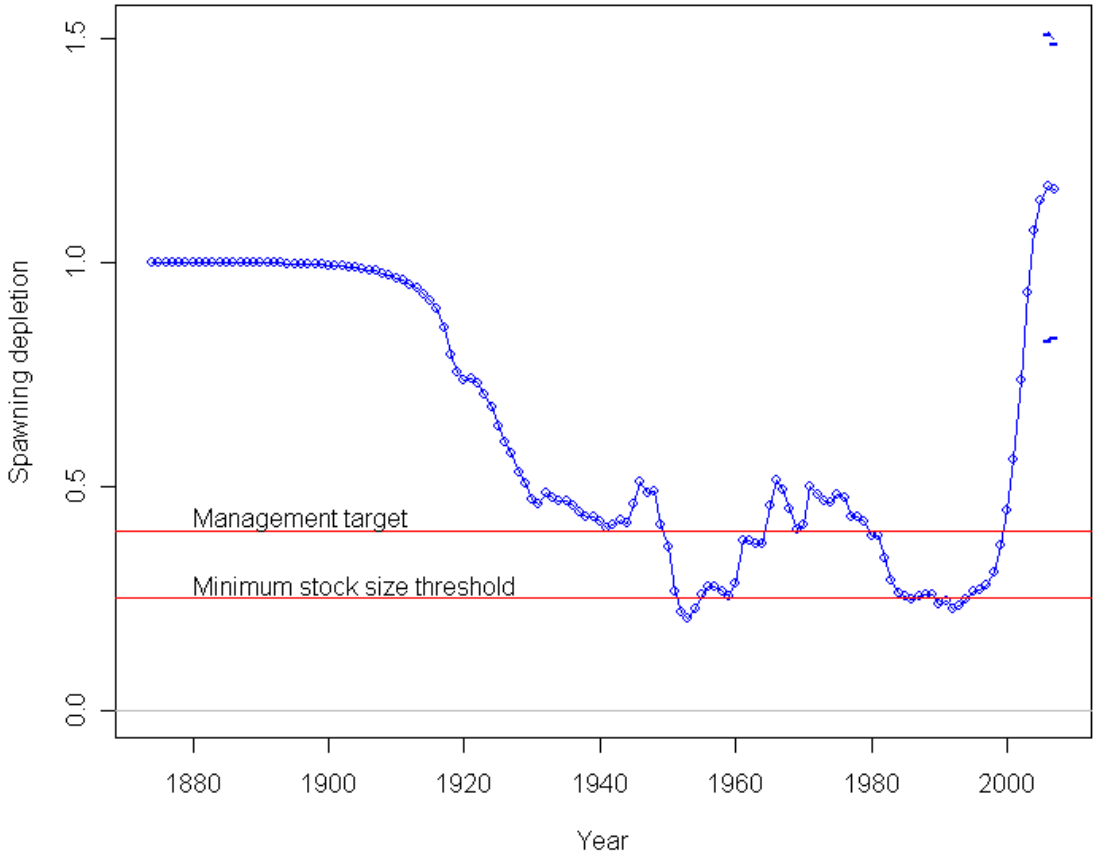

Figure 33. Time-series of estimated depletion level, 1876-2007 with approximate asymptotic 95% confidence interval for 2006 and 2007.

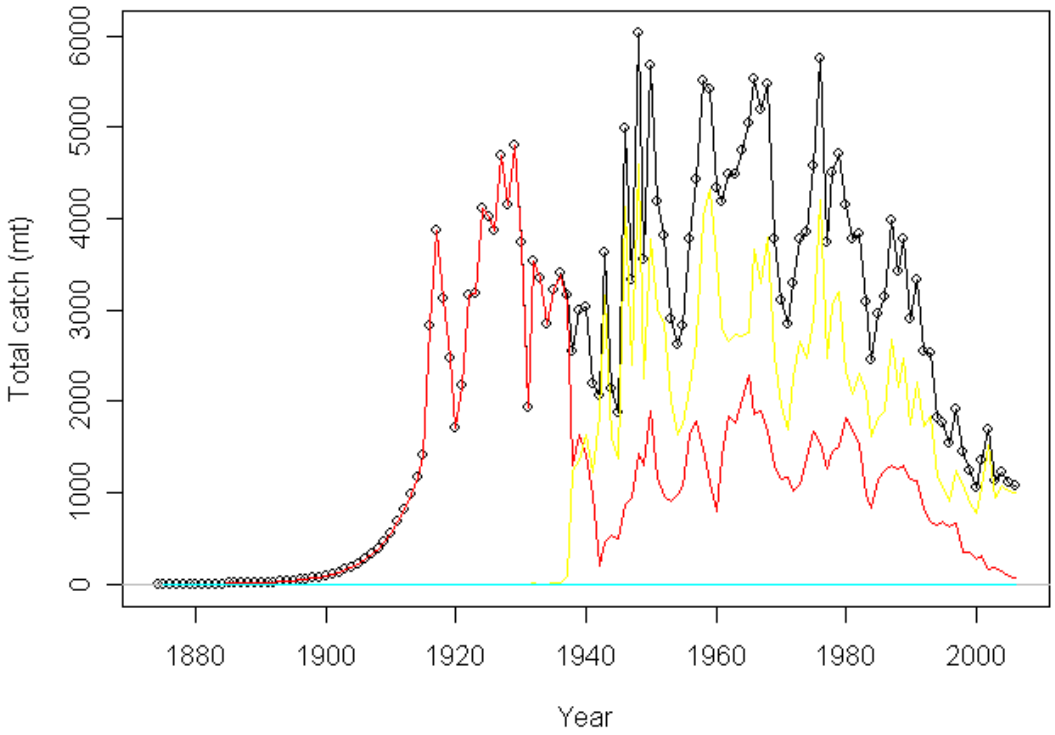

Figure 34. Time-series of estimated total catch (line with points). Northern and southern fleets shown as light lines; southern fleet is the lower line over the period 1940+.

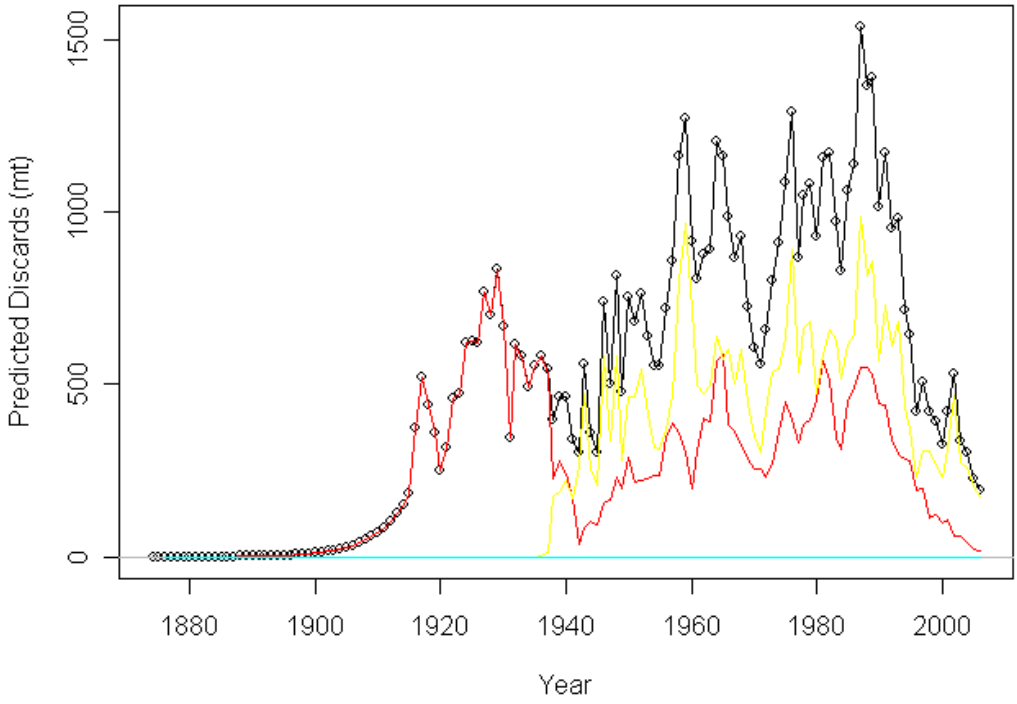

Figure 35. Time-series of total estimated discards (line with points). Northern and southern fleets shown as light lines; southern fleet is the lower line over the period 1940+.

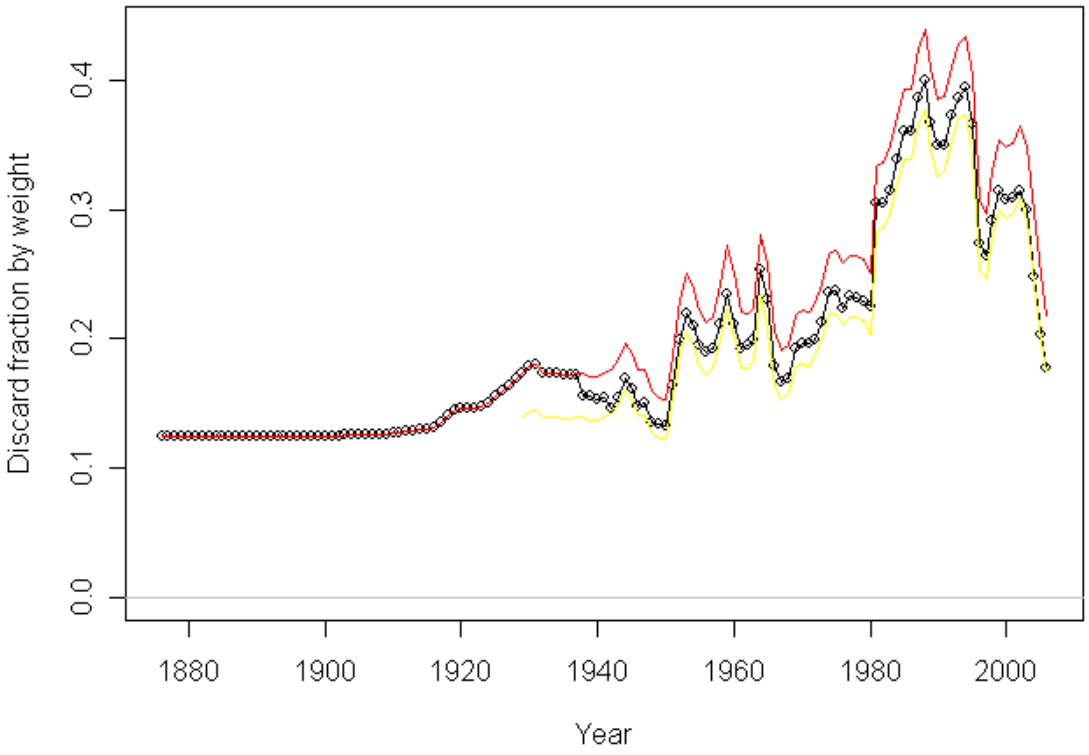

Figure 36. Time-series of estimated discard fraction by weight, plotted are total (line with markers), southern (upper thin line) and northern (lower thin line) fleets separately.

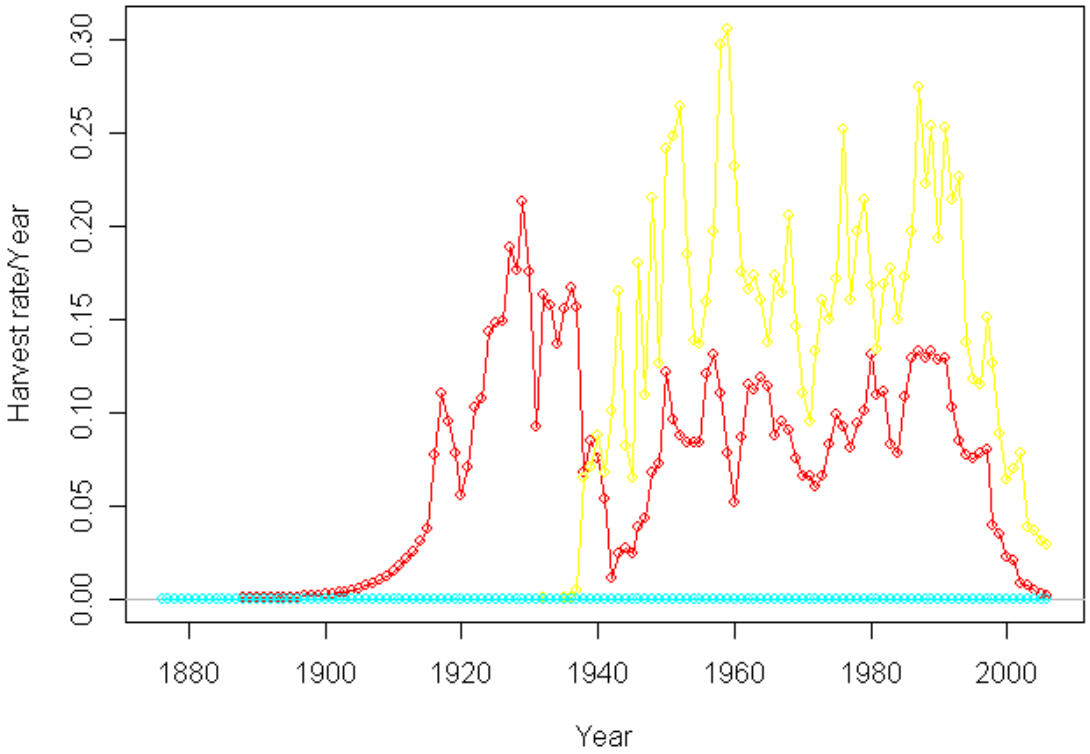

Figure 37. Time-series of harvest rate per year (F) for the northern and southern fishing fleets; southern fleet is the lower line over the period 1940+.

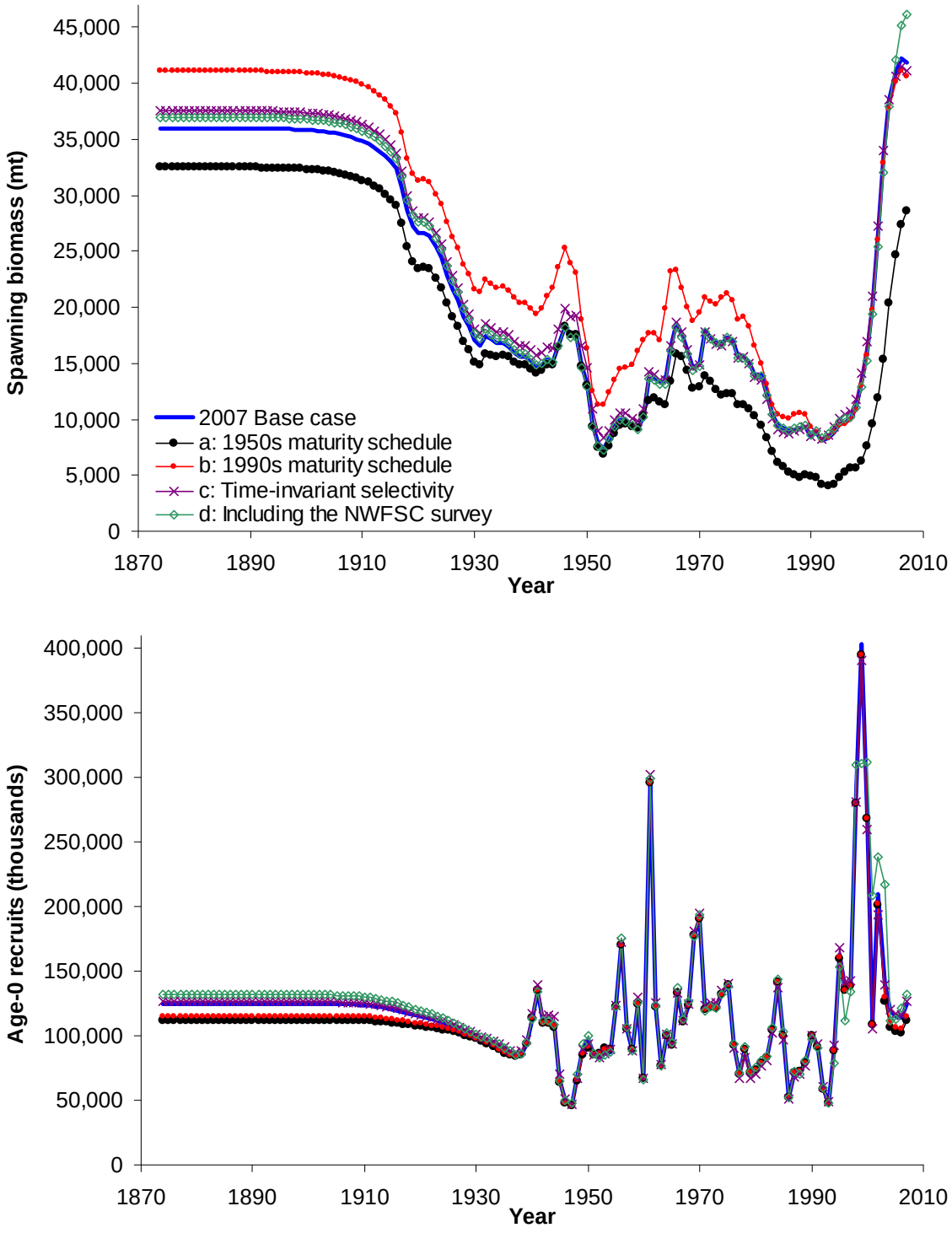

Figure 38. Comparison of the base case model results with the four alternate sensitivity models.

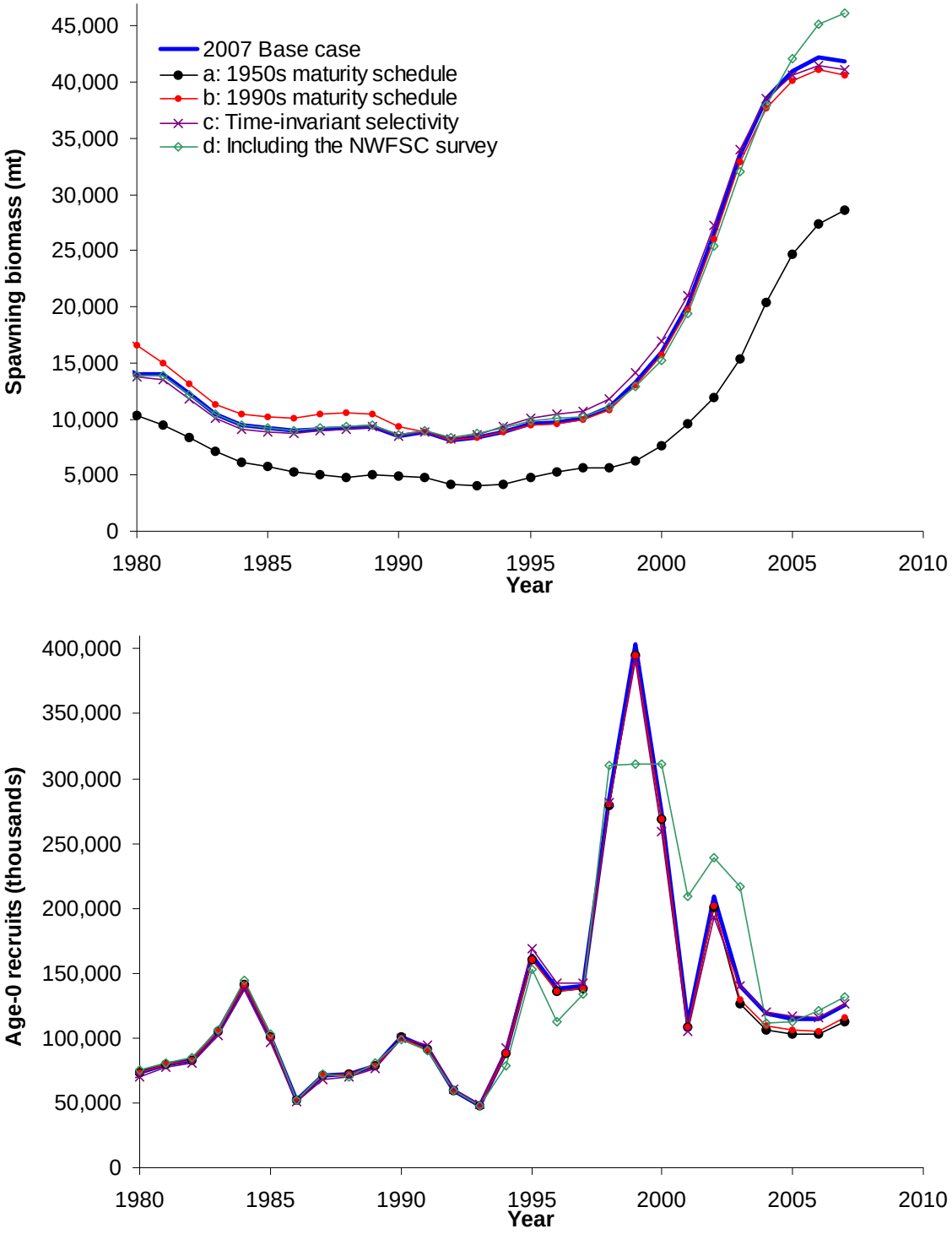

Figure 39. Comparison of the recent base case model results with the four alternate sensitivity models.

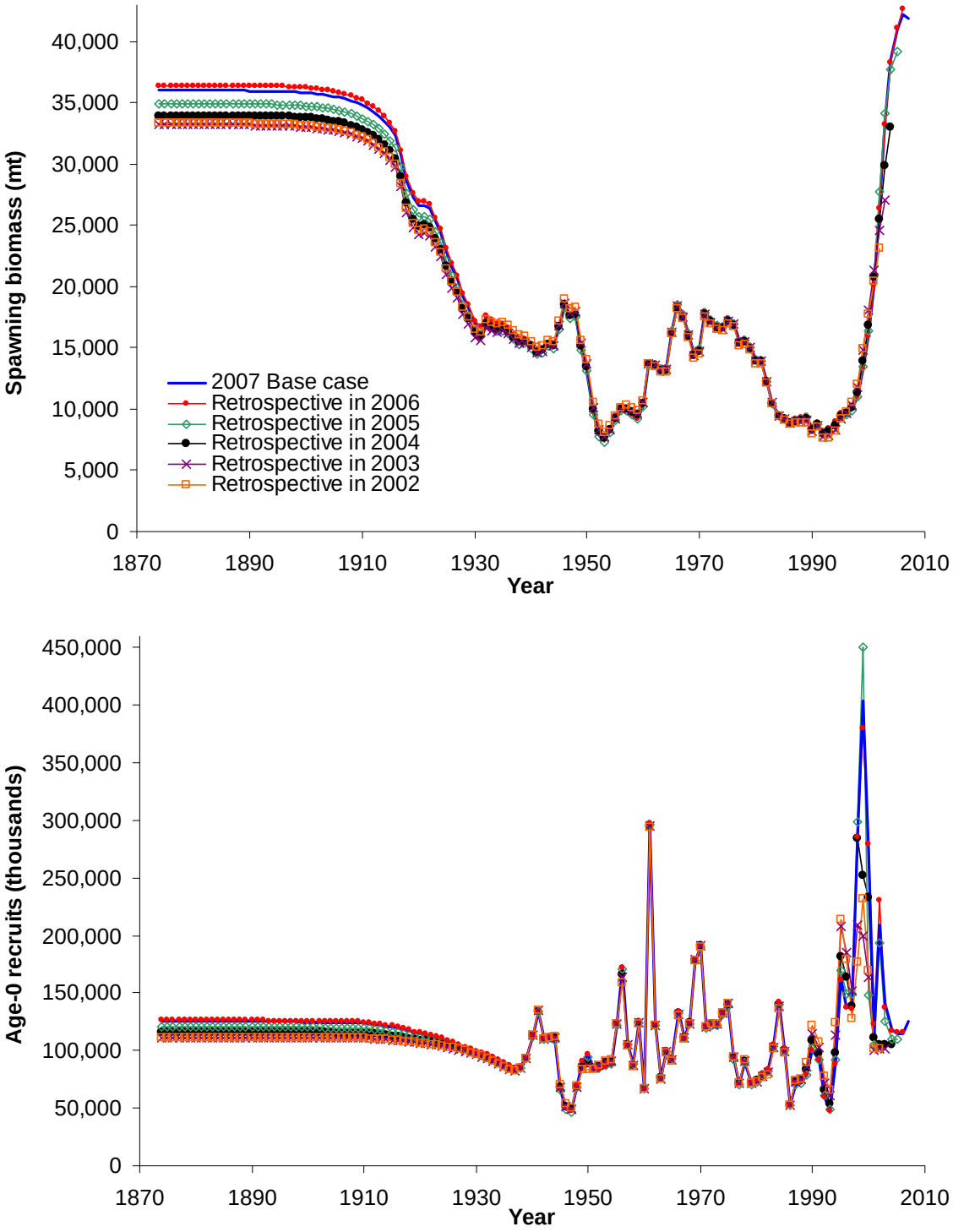

Figure 40. Results from a 5-year retrospective analysis. Each year of retrospective is performed as if the assessment were conducted in that year (i.e., retrospective in 2006 includes data through 2005).

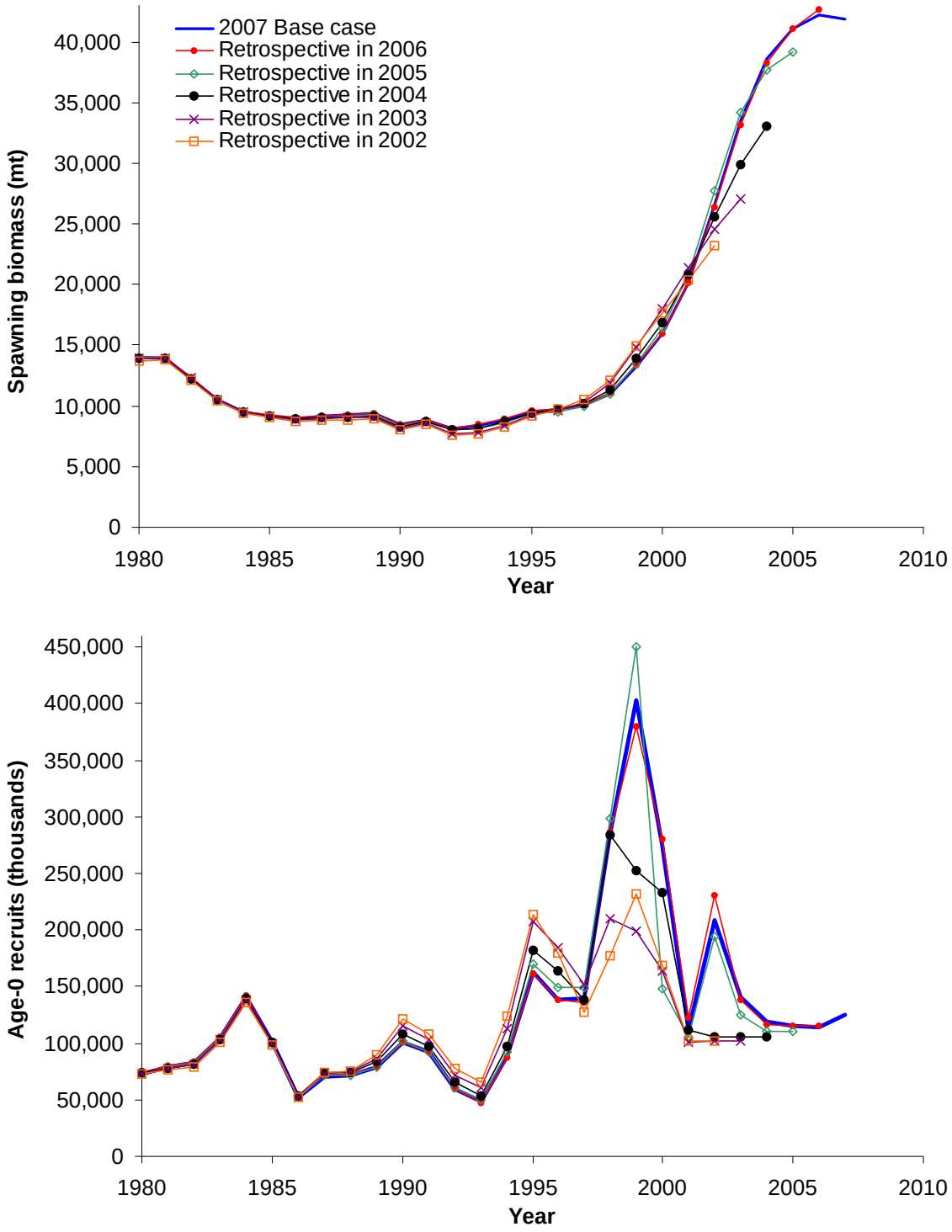

Figure 41. Recent recruitment and spawning biomass estimates from retrospective analysis showing that the signal for the 1999 and 2002 year-classes is largely found in the 2004 data (the retrospective in 2004 does not detect the full magnitude of these recruitments).

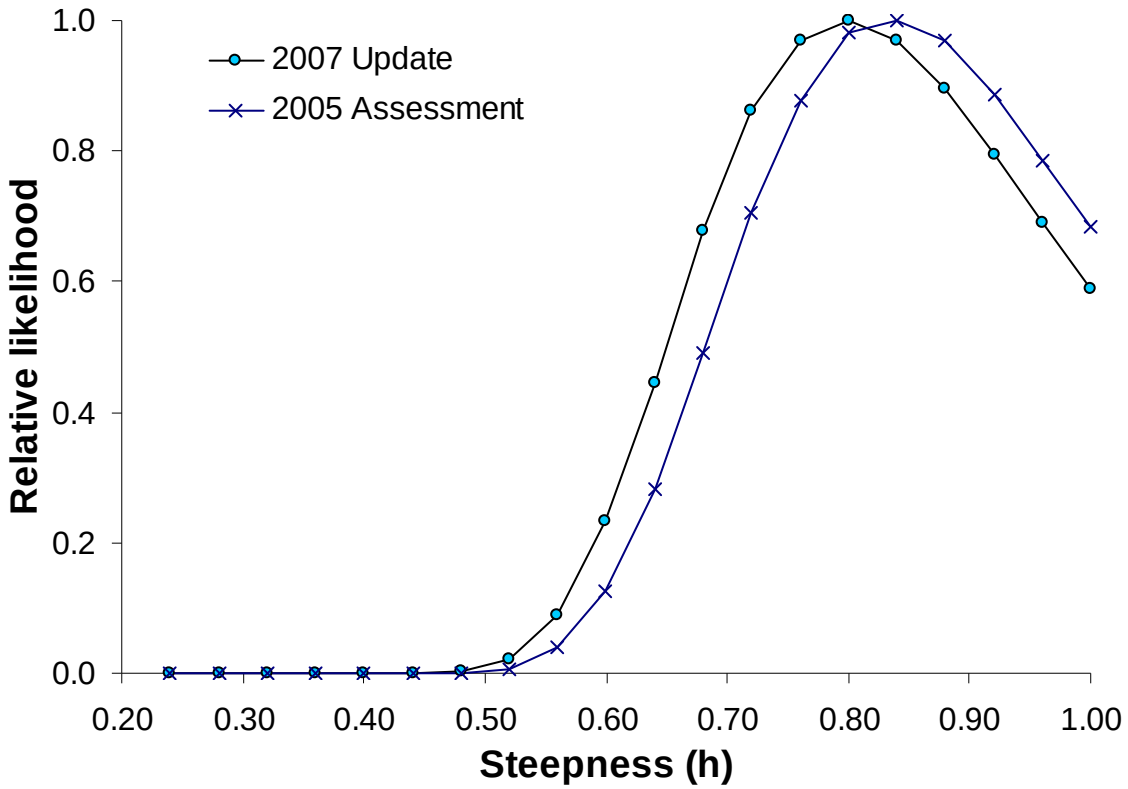

Figure 42. Likelihood profile on steepness (*h*) from current 2007 updated assessment compared with the 2005 assessment.

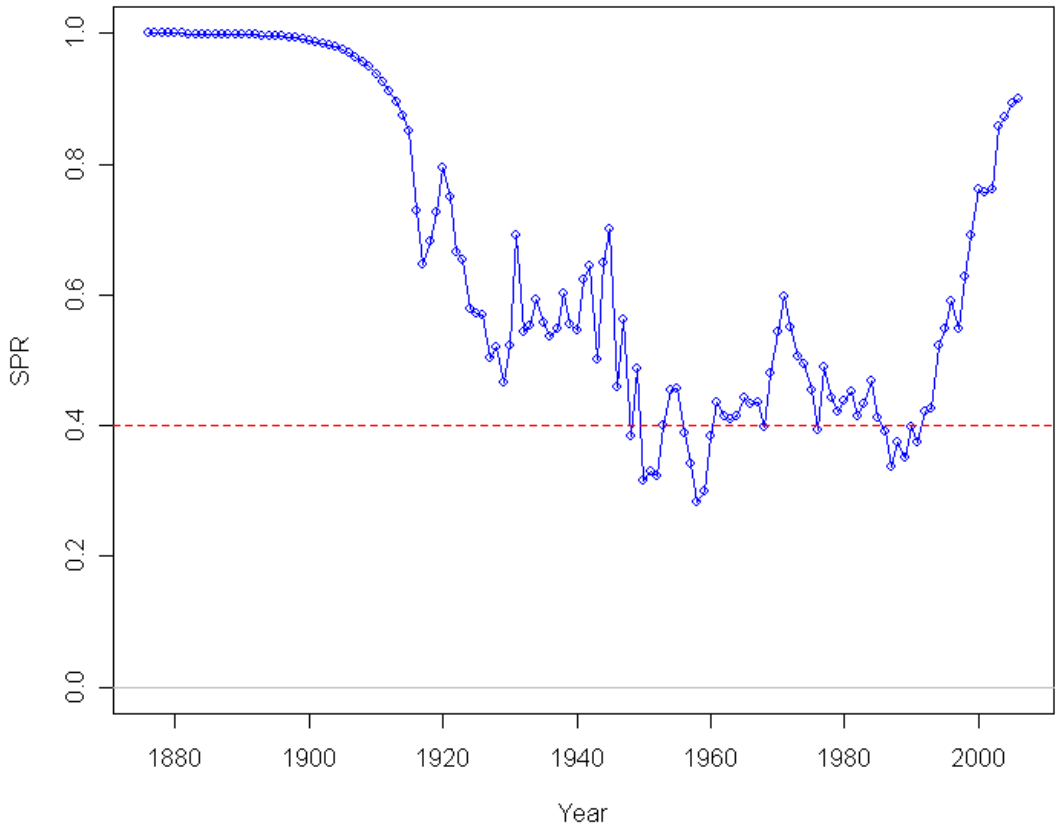

Figure 43. Time-series of estimated spawning potential ratio (1876-2006) from the base case model.

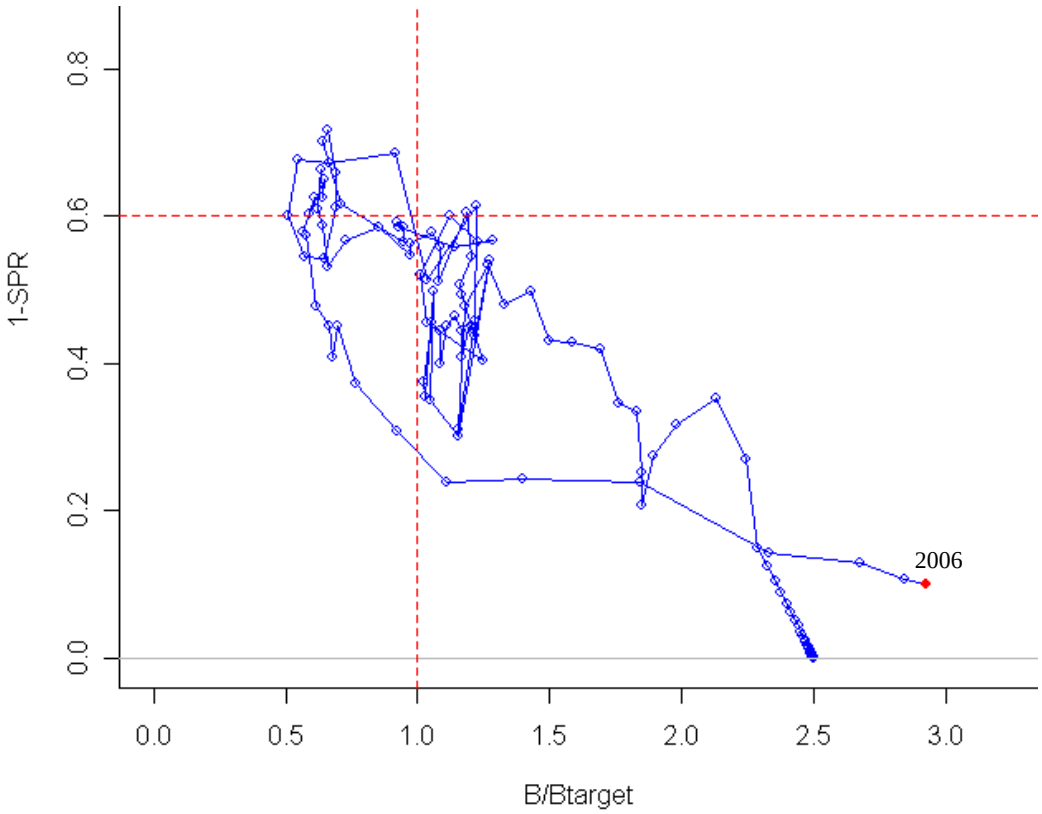

Figure 44. Estimated spawning potential ratio relative to the proxy target of 40% vs. estimated spawning biomass relative to the proxy 40% level. Higher biomass occurs on the left side of the x-axis, higher exploitation rates occur on the upper side of the y-axis.

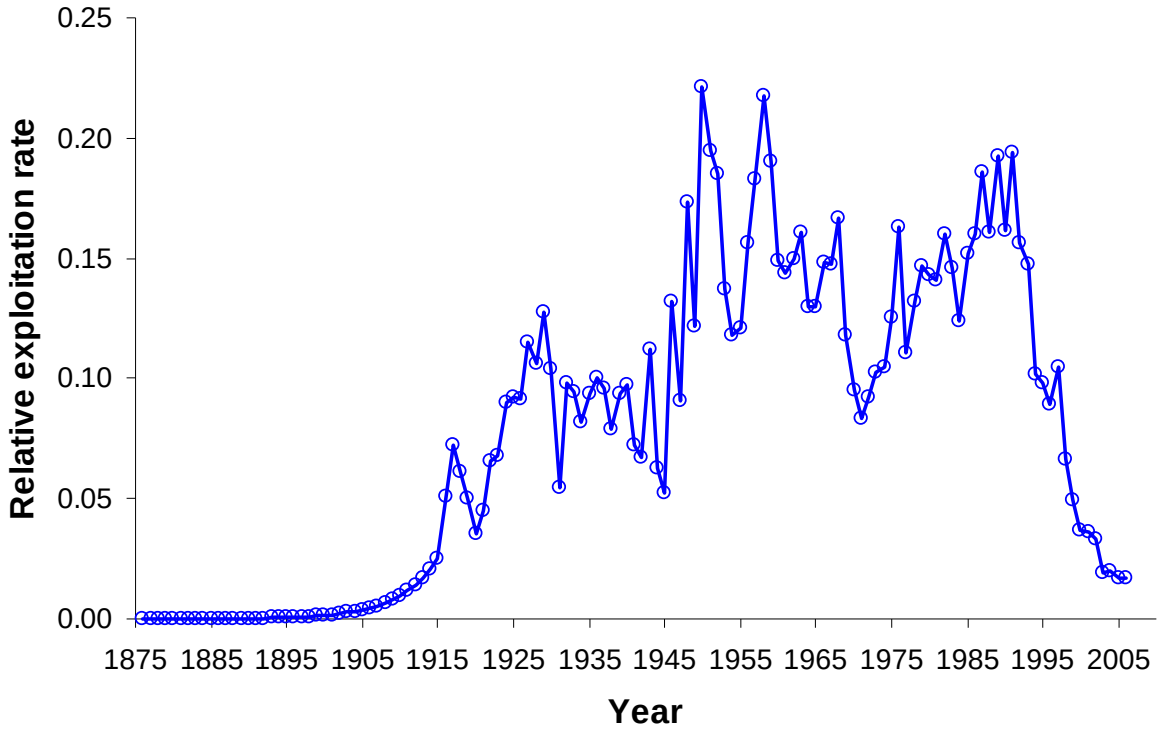

Figure 45. Time-series of relative exploitation rate (catch/biomass of age 3 and older fish) 1876-2006.

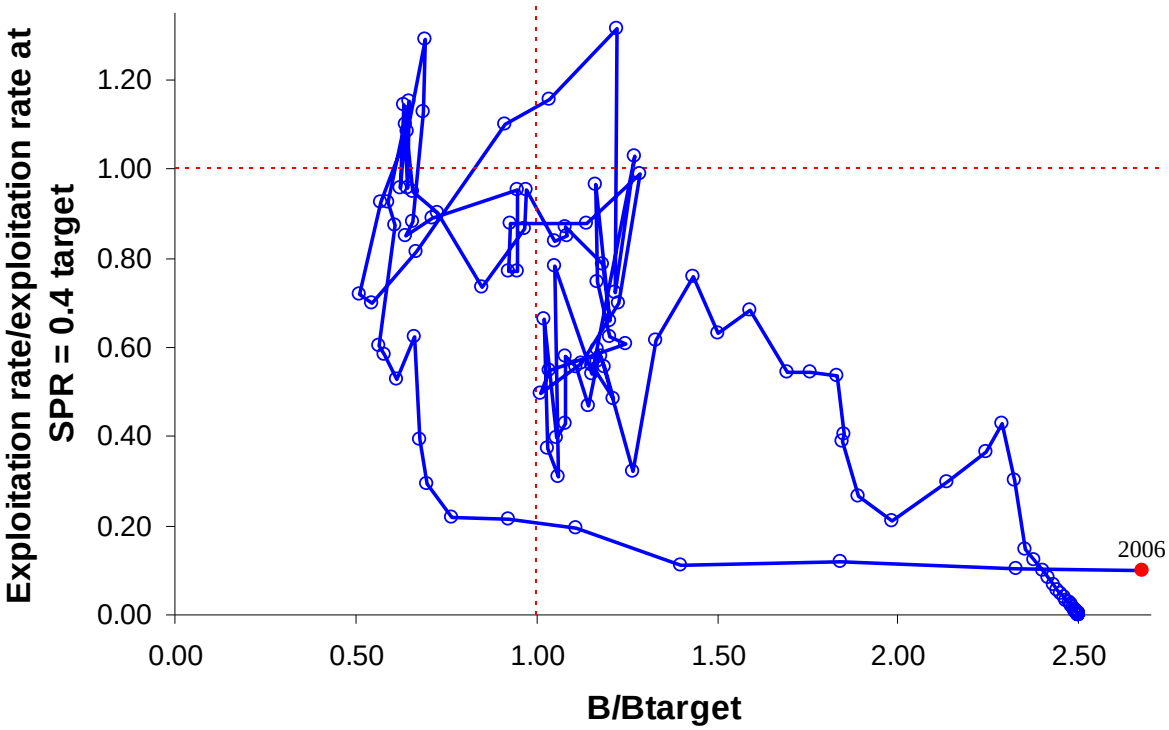

Figure 46. Relative exploitation rate/exploitation rate at SPR = 0.4 target vs. estimated spawning biomass relative to the proxy 40% level.

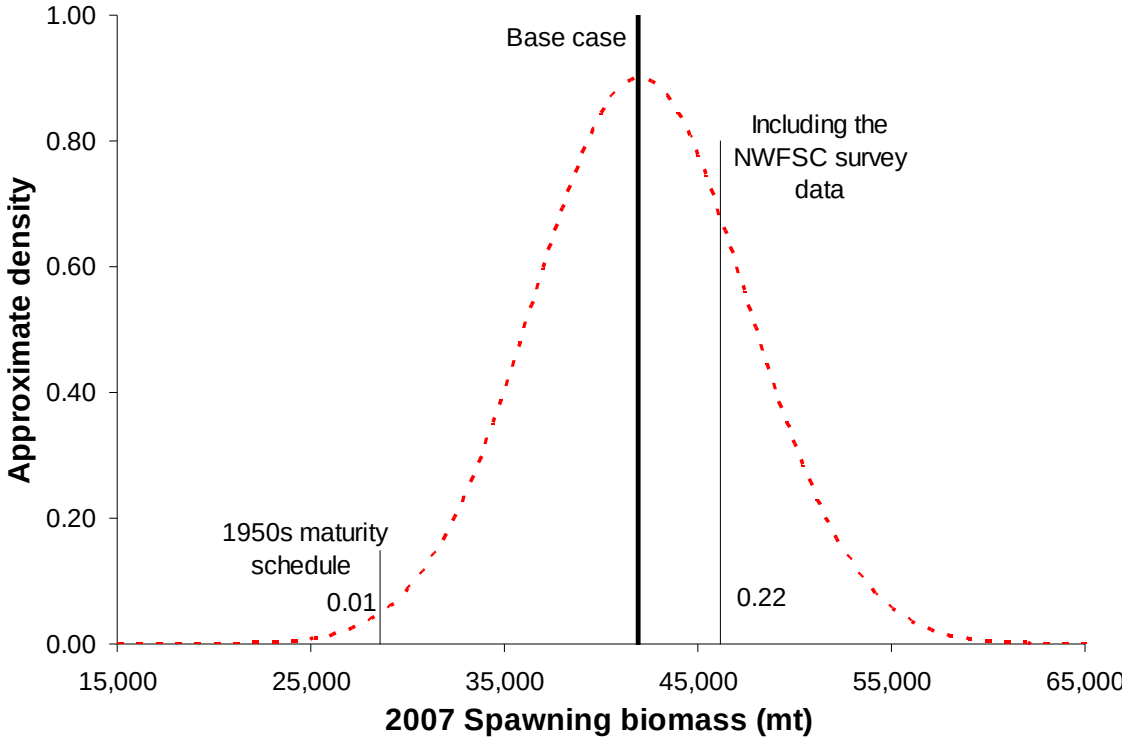

Figure 47. Approximate distribution of uncertainty in estimated 2007 spawning biomass from the base case model (dashed line) density function based on the normal approximation. Bold vertical line indicates the maximum likelihood estimate from the base case, light lines the less likely alternate model including the 1950s maturity and, for comparative purposes, the alternate including NWFSC survey data.

14. Appendix A: A comparative exploration of NWFSC trawl survey data 2003-2006

14.1 Data available

Since the completion of the 2005 English sole stock assessment a large quantity of data from a new source, the NWFSC shelf and slope trawl survey has become available. Because the use of these data has not been independently reviewed for English sole, they were not included in the base case model in order to conform to the terms of reference for updated stock assessments. Instead they are included in the sensitivity analysis for comparative purposes only. The intent of this appendix is to describe the data available from this survey and the basic assumptions necessary to model them in the English sole assessment. These data will certainly be included in the next full assessment.

Three sources of information were available from this survey: indices of relative abundance, length-frequency distributions, and age-at-length observations. Since English sole are only found on the continental shelf, only those years in which the NWFSC survey included the shelf depths are considered here (2003-2006).

Although the Generalized Linear Mixed Model (GLMM) approach was endorsed by the trawl survey workshop for use in west coast stock assessments, the current analysis uses the standard design-based estimates of biomass a due to three reasons: 1) a desire to keep the analysis as simple as possible, since it represented only a comparative exercise in the context of this update, and 2) English sole are encountered by the survey relatively frequently over the depths at which they live and so the design- and model-based estimators give similar results and 3) the Triennial survey indices already included in this update are based on standard estimators of biomass, so this approach provided the most consistency possible. The biomass index for both the northern and southern areas shows similar trends of flat but slightly decreasing biomass over the period 2003-2006 (Table A.1). Standard errors are quite small for trawl survey indices, reflecting the high proportion of positive observations in these data and the relative homogeneity of English sole density off the west coast of the U.S. (Table A.1). Design-based standard errors were not inflated for use in sensitivity analysis as this would have required a full re-evaluation of model tuning and variance assumptions. This will likely be the subject of substantial exploration during the next full English sole assessment.

Table A.1. NWFSC survey indices and standard errors (log-space) used in sensitivity analysis.

	South		North	
Year	Index	SE (log-space)	Index	SE (log-space)
2003	14,847	0.15	21,307	0.16
2004	12,099	0.16	34,650	0.13
2005	11,988	0.16	18,728	0.09
2006	6,033	0.13	14,944	0.27

Length- and age-frequency distributions were based on relatively large numbers of samples (> 50 tows/year for ages, > 100 tows/year for lengths). These samples included thousands of individual lengths and hundreds of age observations (Table A.2). Age-structures from 2006 were collected, and will be available for future assessments,

but have not yet been read. These raw observations were catch-weighted within each haul and expanded over survey strata to produce northern and southern length and age-at-length distributions that were comparable to those calculated for the triennial survey data as part of the 2005 assessment.

Table A.2. Summary of data used to produce NWFSC survey length and age-at-length frequencies.

	Length data				Age-at-length data			
	Number of samples		Number of fish		Number of samples		Number of Fish	
Year	South	North	South	North	South	North	South	North
2003	104	124	3,557	4,823	52	61	87	105
2004	106	119	3,683	5,014	91	100	189	199
2005	137	172	3,542	5,243	127	124	201	192
2006	108	126	2,260	3,269	0	0	0	0

The age structures collected by the NWFSC are otoliths, which although apparently unbiased, may have slightly different properties of age-reading variability than do interopercular bones which are the source of all other age data in the current English sole updated assessment. It was beyond the scope of this limited sensitivity analysis to develop a new ageing-error matrix for application to otolith-based ages, but this will be an area for development in the next full assessment. For the current sensitivity analysis, ages from otoliths are assumed to have the same variability in age-determination used for interopercular bones.

14.2 Sensitivity model structure

An effort was made to treat the NWFSC data in the same manner as the Triennial data in the assessment model. Therefore, separate catchability (Q) was allowed for northern and southern areas. Length-based selectivity used the same double-normal parameterization with two estimated parameters for each fleet (the ascending width and length at peak selectivity) resulting in an asymptotic-shaped curve.

The numbers of tows contributing to each compositional observation were used as input sample sizes, and no iterative re-weighting was performed. All other data and assumptions remained unchanged from the 2007 base case model.

14.3 Sensitivity model results

The assessment model derived little new information from the limited amount of information added by the NWFSC survey data. This somewhat expected result was the reason for excluding the survey series in 2005, when it had only two years of data. The 2007 model fit the indices of abundance relatively poorly (Figure A.1) suggesting it had little influence on the total likelihood. Although the model did not catch the decrease in the 2006 index values for both the north and the south, it should be noted that the model does predict a decrease in biomass beginning in 2007 as the large recent recruitments begin to succumb to natural mortality. Future evaluation of the fit to these data will be much easier when a longer time-series is available and the relative magnitude of observation error vs. lack-of-fit of model predictions will be easier to discern.

The fit to NWFSC length-frequency data was somewhat better than expected based on comparison of input and effective sample sizes (Figure A.2). The quality of the fit to these data appeared to be similar to that of the length data from the Triennial survey series, with the most apparent lack of fit occurring in the descending limb of the male length-distributions in the south (Figures A.3, A.4). Whether this pattern is due to area or temporal variation in growth or misspecification of selectivity is uncertain.

The fit to the age-at-length data from the NWFSC was similar to, but slightly less than expected based on an input and effective sample size comparison (Figures A.5, A.6). Some apparent ageing error is visible in large outliers found in the Pearson residuals for the age-at-length matrices (Figures A.7, A.8). These suggest that further evaluation of the ageing error matrices might be warranted in a future full assessment. Differences in the Pearson residuals by area (especially in 2003) could be a result of unequal distribution of the recent recruitments between the northern and southern areas. To evaluate this type of phenomena an explicitly spatial assessment would have to be explored. This continues to be an area of recommended future research.

The results from this sensitivity model showed a small increase in current spawning biomass (Figure 38, 39, Table 6). The estimate of steepness decreased, mainly due to the reduction in the magnitude of the 1999 year-class. Although this year-class was reduced, the 1998, and 2000-2003 recruitment events were estimated to be larger, resulting in the increase in current spawning biomass over the base case model.

There are many data and modeling issues that need to be resolved to fully evaluate the influence of the NWFSC data on the English sole stock assessment results. This sensitivity analysis is only intended to present these issues for comparison with 2007 assessment results, not fully explore each of them, as that would be beyond the scope of an updated assessment.

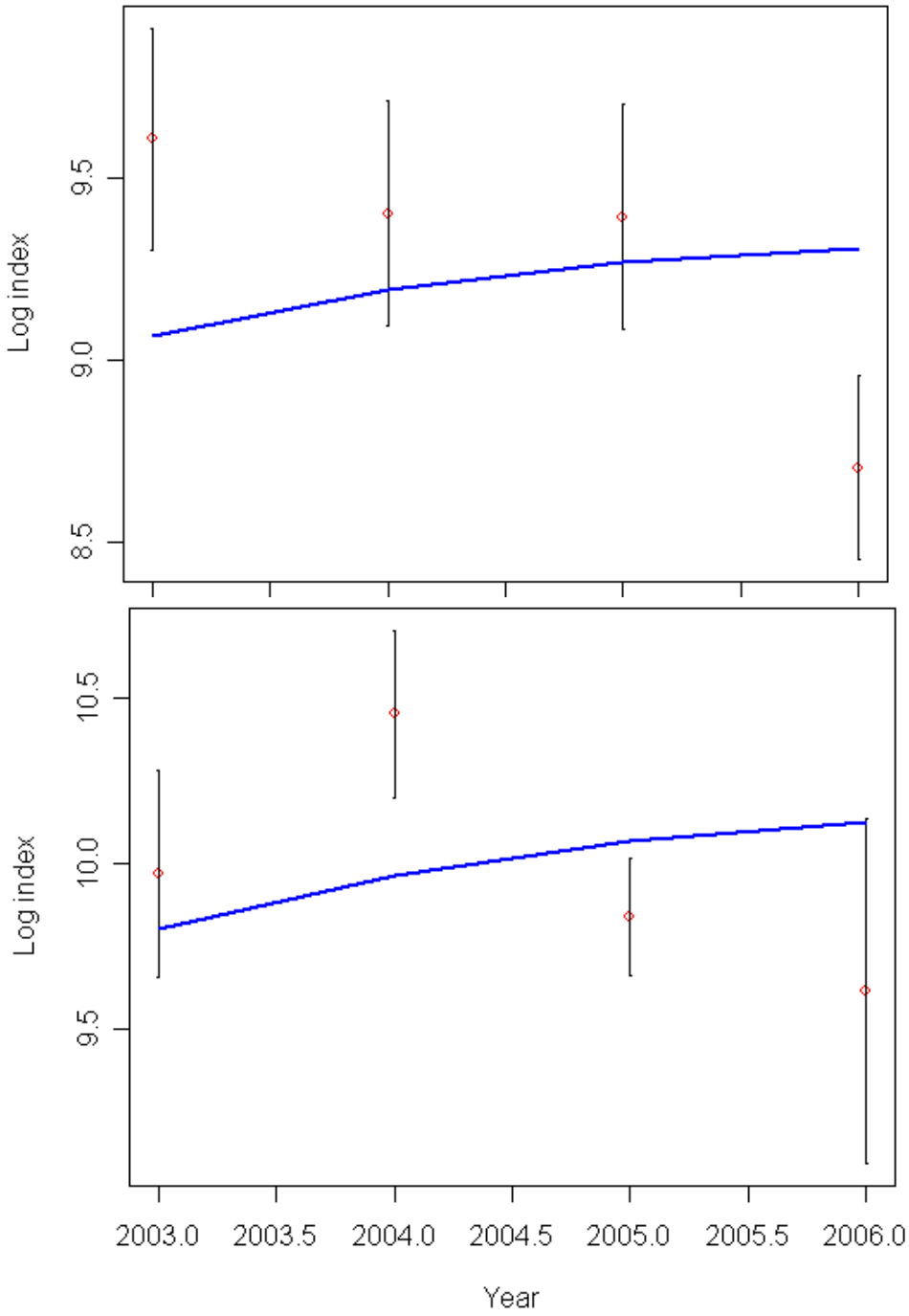

Figure A.1. Fit to log indices from the NWFSC trawl survey in the south (upper panel) and north (lower panel).

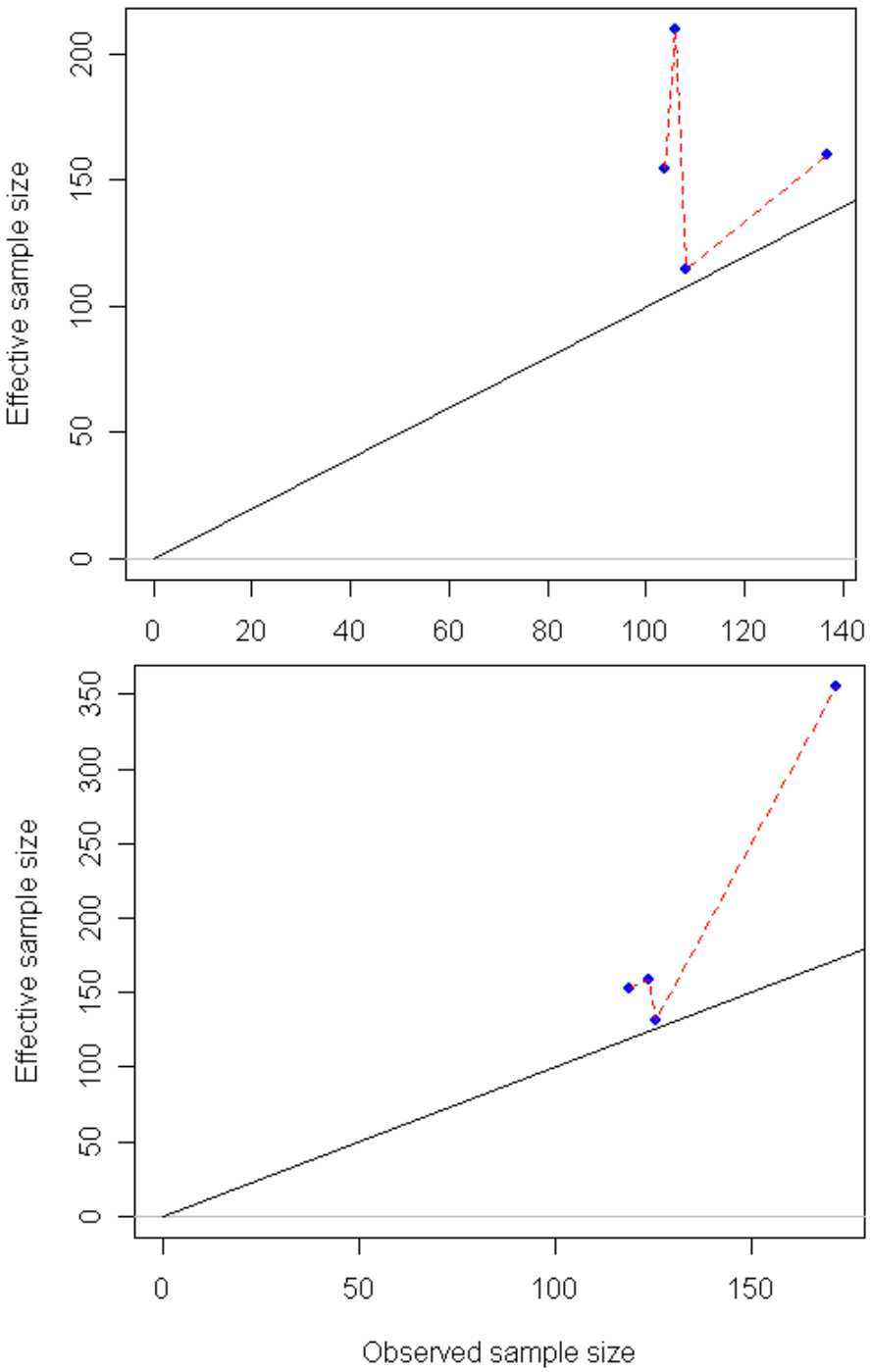

Figure A.2. Comparison of observed and effective sample sizes from the model fit to length-frequency data from the NWFSC trawl survey in the south (upper panel) and north (lower panel).

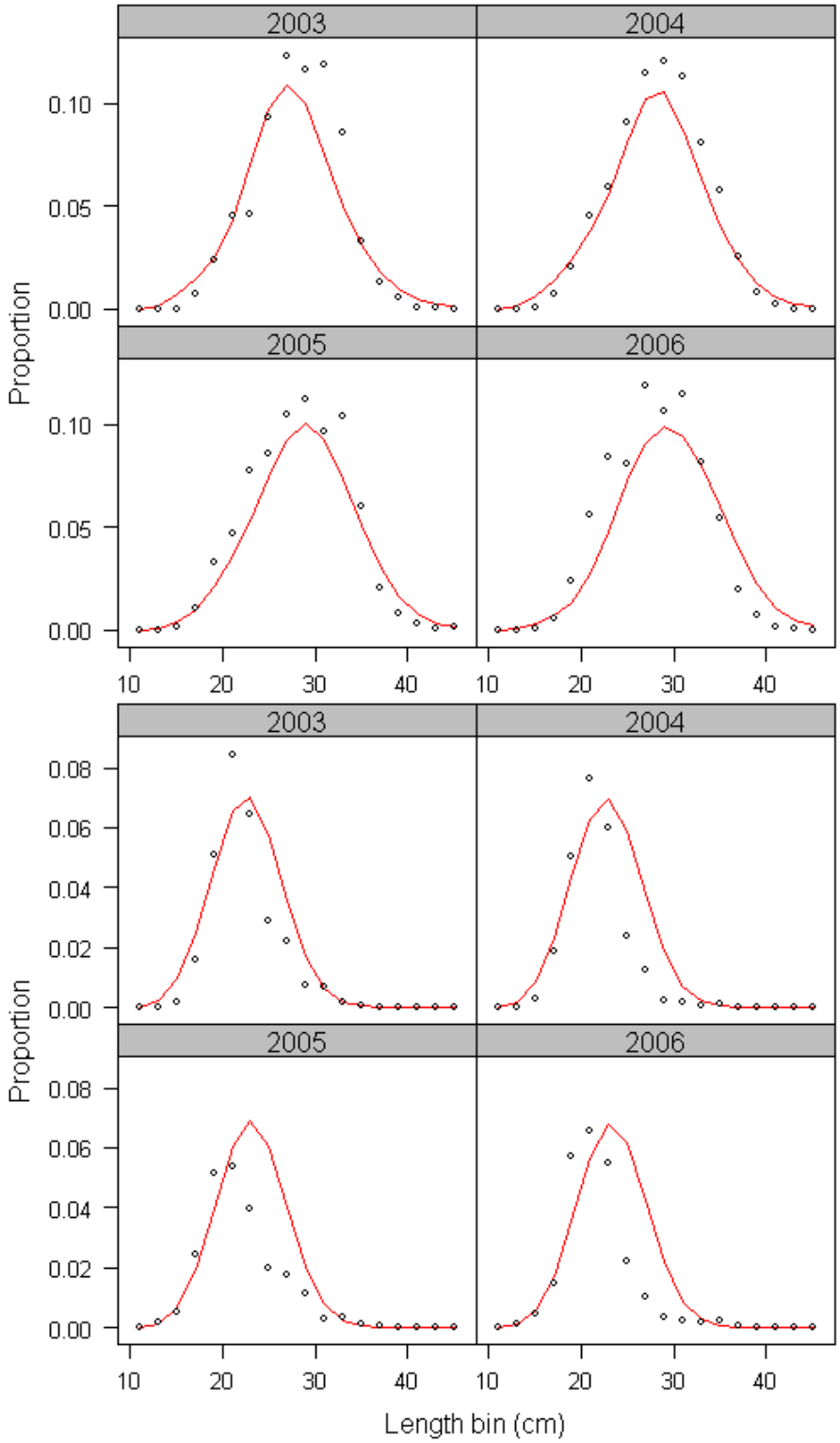

Figure A.3. Fit to length-frequency distributions for females (upper panel) and males (lower panel) from the NWFSC trawl survey in the south.

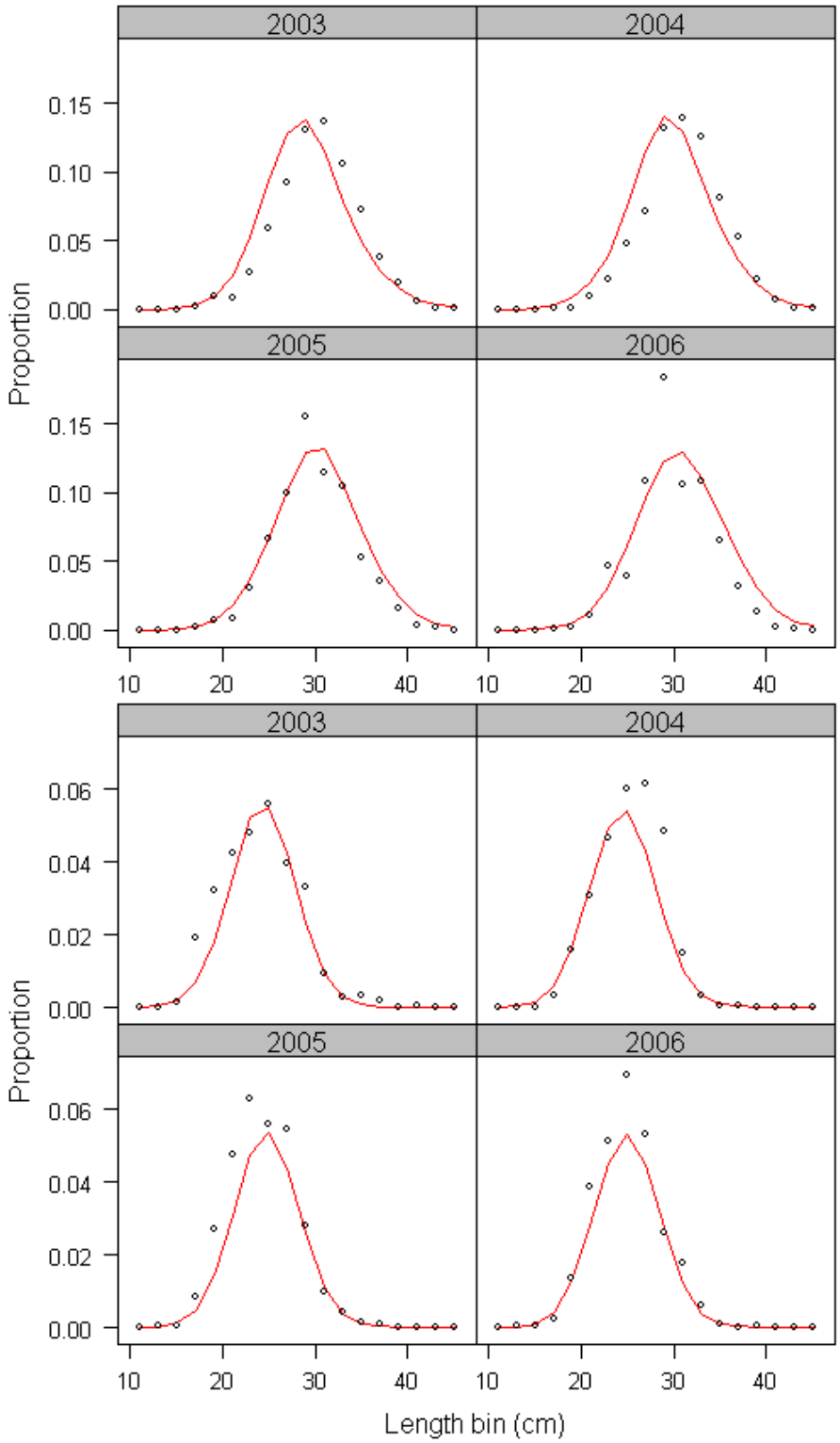

Figure A.4. Fit to length-frequency distributions for females (upper panel) and males (lower panel) from the NWFSC trawl survey in the north.

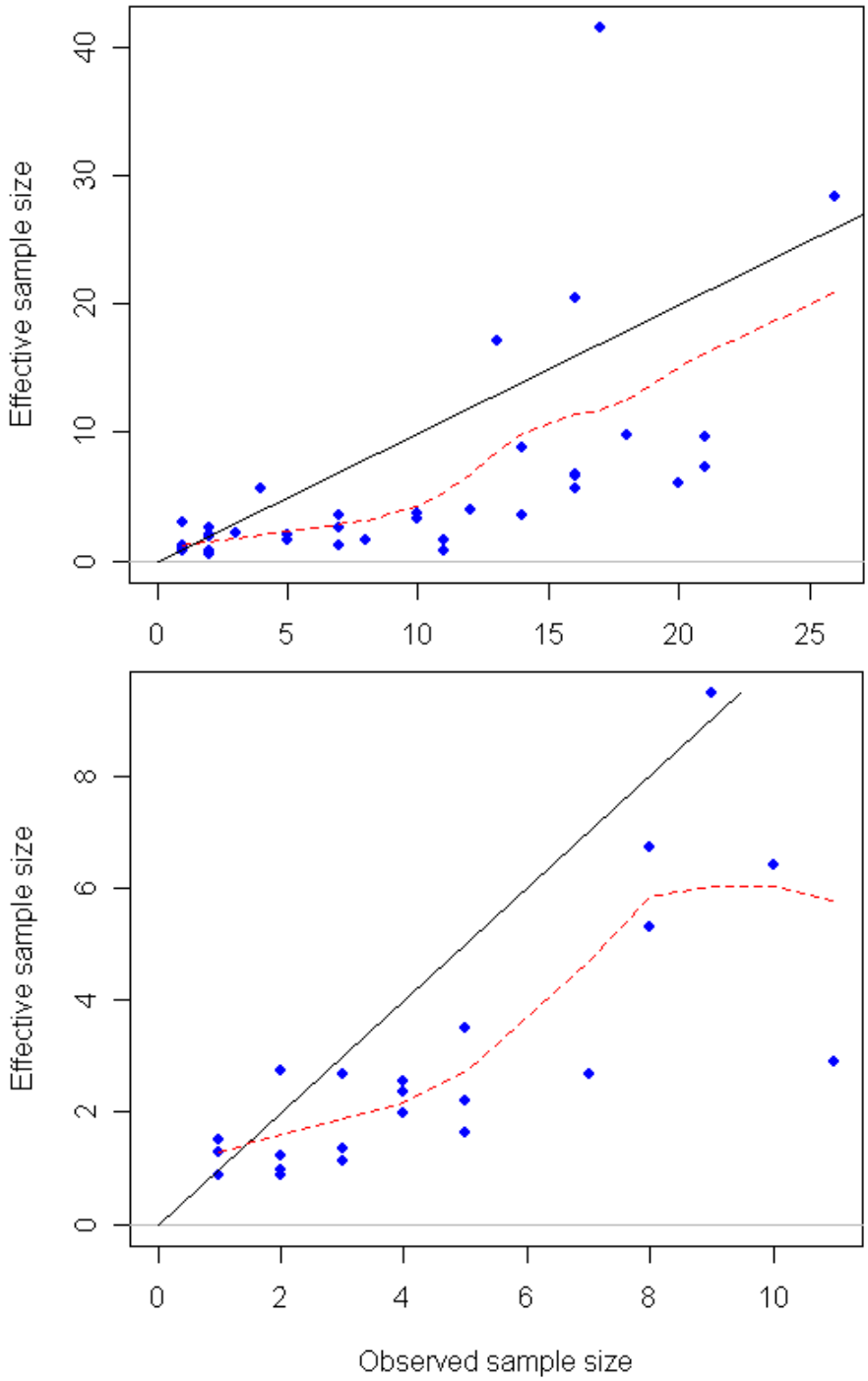

Figure A.5. Observed and effective sample sizes for conditional age-at-length observations for females (upper panel) and males (lower panel) from the NWFSC trawl survey in the south.

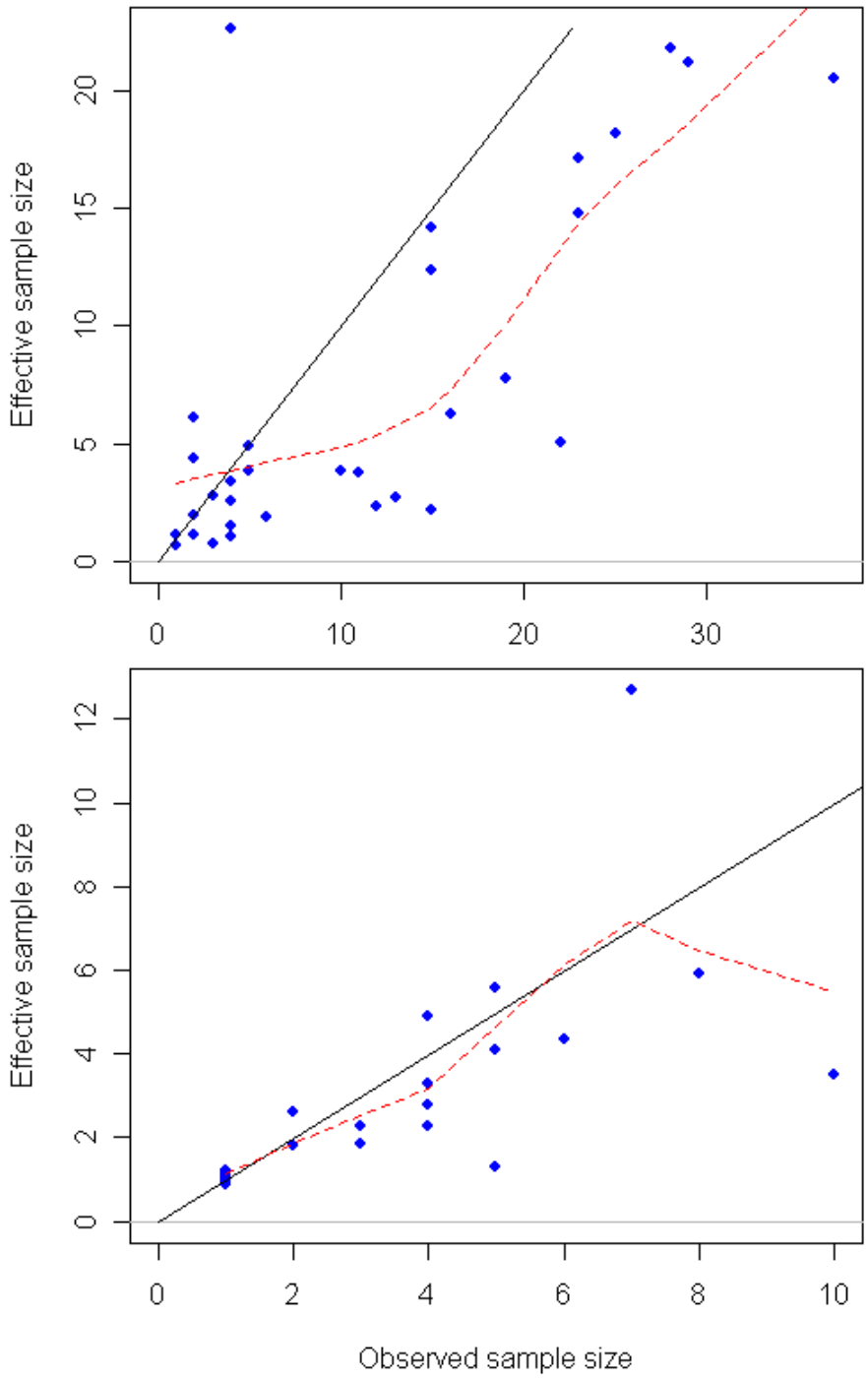

Figure A.5. Observed and effective sample sizes for conditional age-at-length observations for females (upper panel) and males (lower panel) from the NWFSC trawl survey in the north.

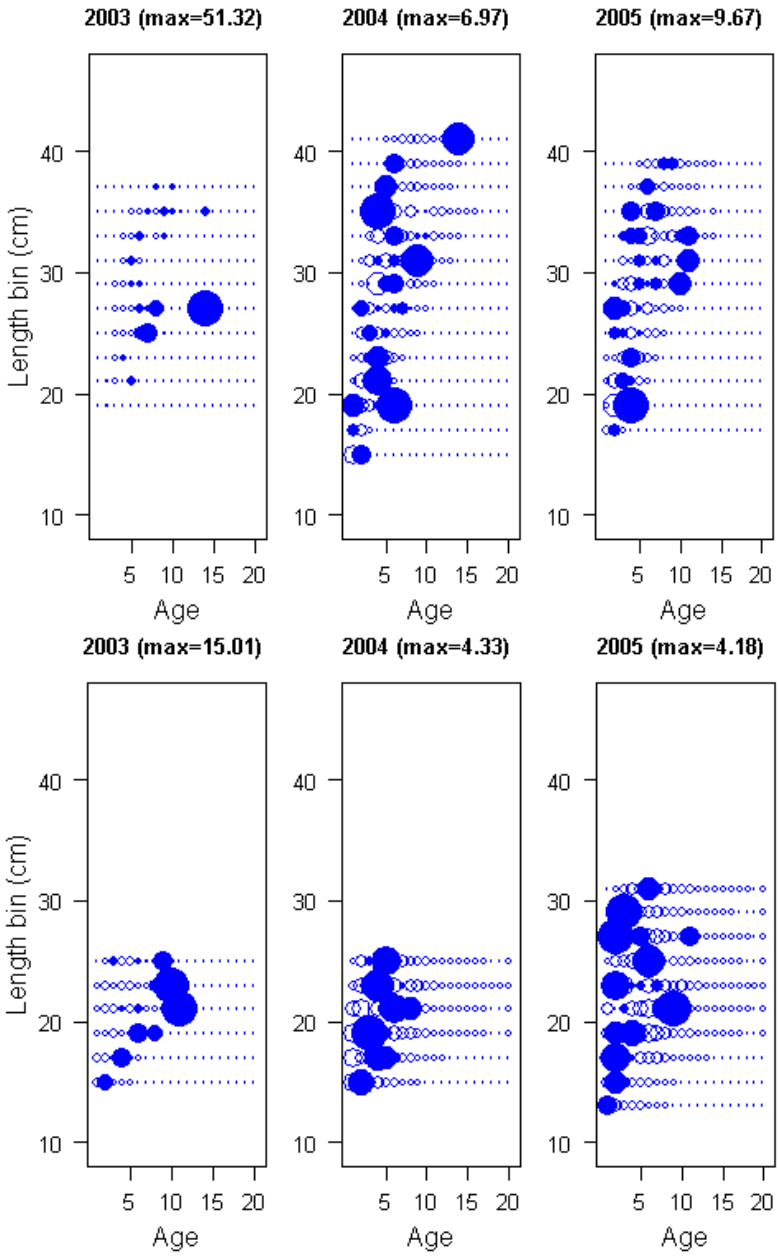

Figure A.6. Pearson residuals for conditional age-at-length observations for females (upper panel) and males (lower panel) from the NWFSC trawl survey in the south.

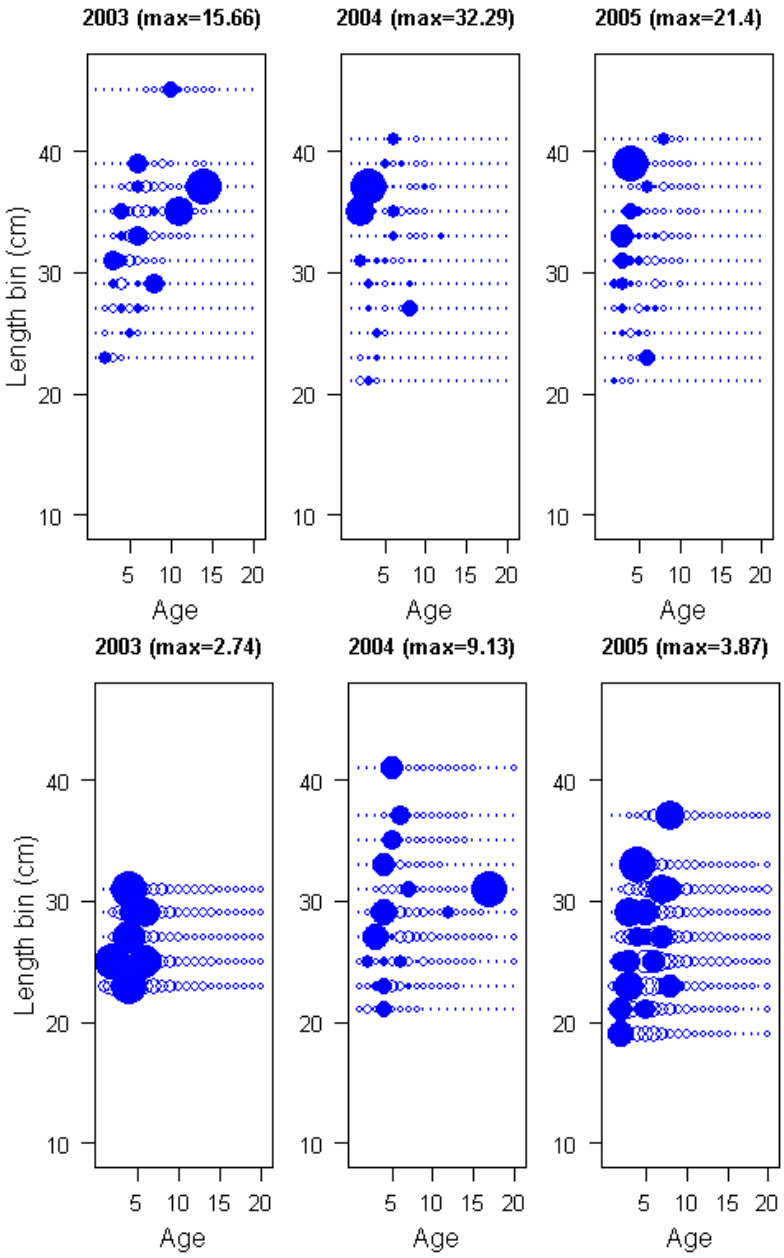

Figure A.7. Pearson residuals for conditional age-at-length observations for females (upper panels) and males (lower panels) from the NWFSC trawl survey in the north.

15. Appendix B: SS2 data file

```
# .dat file for 2007 English sole updated assessment
# Ian Stewart, NWFSC
# SS2 version 2.00e
# May, 2007

### Global model specifications ###
1876      # Start year
2006      # End year
1         # Number of seasons/year
12        # Number of months/season (vector, by season)
1         # Spawning occurs at beginning of season
4         # Number of fishing fleets
2         # Number of surveys
# Fleet names (separated by "%")
South_fishery%North_fishery%southghost%northghost%South_survey%North_survey
# Fleet timing (proportion of season)
0.5417  # South fishery (middle of july)
0.5417  # North fishery
0.5417 # South ghost
0.5417 # North ghost
0.5417  # South survey
0.5417  # North survey
2         # Number of genders (1/2)
30        # Accumulator age

### Catch section ###
# Initial equilibrium catch (landings + discard in mt) by fishing fleet
 0        # Fleet 1
 0        # Fleet 2
 0 # South ghost
 0 # North ghost
# Base case landings series
# Landed catch (only) time-series (mt) by fleet: current on Feb 1, 2005
# South fishery   North fishery     #         Year
1         0         0         0         #         1876
1         0         0         0         #         1877
1         0         0         0         #         1878
2         0         0         0         #         1879
2         0         0         0         #         1880
2         0         0         0         #         1881
3         0         0         0         #         1882
4         0         0         0         #         1883
4         0         0         0         #         1884
5         0         0         0         #         1885
6         0         0         0         #         1886
7         0         0         0         #         1887
9         0         0         0         #         1888
11        0         0         0         #         1889
13        0         0         0         #         1890
15        0         0         0         #         1891
18        0         0         0         #         1892
22        0         0         0         #         1893
```

27	0	0	0	#	1894
32	0	0	0	#	1895
38	0	0	0	#	1896
46	0	0	0	#	1897
55	0	0	0	#	1898
66	0	0	0	#	1899
79	0	0	0	#	1900
95	0	0	0	#	1901
114	0	0	0	#	1902
137	0	0	0	#	1903
165	0	0	0	#	1904
198	0	0	0	#	1905
237	0	0	0	#	1906
285	0	0	0	#	1907
342	0	0	0	#	1908
410	0	0	0	#	1909
492	0	0	0	#	1910
591	0	0	0	#	1911
709	0	0	0	#	1912
851	0	0	0	#	1913
1021	0	0	0	#	1914
1225	0	0	0	#	1915
2454	0	0	0	#	1916
3343	0	0	0	#	1917
2692	0	0	0	#	1918
2118	0	0	0	#	1919
1464	0	0	0	#	1920
1866	0	0	0	#	1921
2698	0	0	0	#	1922
2714	0	0	0	#	1923
3491	0	0	0	#	1924
3393	0	0	0	#	1925
3247	0	0	0	#	1926
3923	0	0	0	#	1927
3442	0	0	0	#	1928
3976	3	0	0	#	1929
3065	1	0	0	#	1930
1580	1	0	0	#	1931
2919	6	0	0	#	1932
2762	4	0	0	#	1933
2350	2	0	0	#	1934
2667	5	0	0	#	1935
2801	18	0	0	#	1936
2547	69	0	0	#	1937
1076	1070	0	0	#	1938
1351	1176	0	0	#	1939
1169	1405	0	0	#	1940
808	1054	0	0	#	1941
163	1600	0	0	#	1942
382	2697	0	0	#	1943
429	1350	0	0	#	1944
412	1170	0	0	#	1945
717	3544	0	0	#	1946
776	2056	0	0	#	1947
1208	4008	0	0	#	1948
1093	1977	0	0	#	1949

1607	3311	0	0	#	1950
947	2558	0	0	#	1951
736	2325	0	0	#	1952
681	1590	0	0	#	1953
750	1321	0	0	#	1954
837	1439	0	0	#	1955
1285	1783	0	0	#	1956
1390	2190	0	0	#	1957
1132	3225	0	0	#	1958
808	3350	0	0	#	1959
594	2829	0	0	#	1960
1082	2301	0	0	#	1961
1436	2185	0	0	#	1962
1367	2230	0	0	#	1963
1453	2085	0	0	#	1964
1696	2187	0	0	#	1965
1470	3068	0	0	#	1966
1540	2786	0	0	#	1967
1339	3200	0	0	#	1968
1012	2049	0	0	#	1969
902	1593	0	0	#	1970
909	1383	0	0	#	1971
793	1850	0	0	#	1972
836	2134	0	0	#	1973
1012	1934	0	0	#	1974
1227	2267	0	0	#	1975
1143	3323	0	0	#	1976
927	1940	0	0	#	1977
1070	2393	0	0	#	1978
1115	2516	0	0	#	1979
1362	1851	0	0	#	1980
1132.57	1492.32	0	0	#	1981
1009.32	1652.83	0	0	#	1982
640.81	1476.81	0	0	#	1983
529.47	1096.72	0	0	#	1984
693.63	1197.3	0	0	#	1985
756.78	1258.15	0	0	#	1986
746.56	1696.82	0	0	#	1987
704.39	1350.35	0	0	#	1988
768.19	1622.03	0	0	#	1989
712.5	1179.5	0	0	#	1990
692.54	1476.56	0	0	#	1991
487.71	1116.27	0	0	#	1992
395.48	1158.61	0	0	#	1993
371.06	729.3	0	0	#	1994
410.39	705.94	0	0	#	1995
433.92	684.58	0	0	#	1996
465.58	940.52	0	0	#	1997
229.24	791.81	0	0	#	1998
227.42	626.02	0	0	#	1999
181.74	552.29	0	0	#	2000
199.1	742.44	0	0	#	2001
101.71	1051.88	0	0	#	2002
116.9	670.31	0	0	#	2003
96.75	818.83	0	0	#	2004
69.5	818	0	0	#	2005

57.14 829.19 0 0 # 2006

Abundance indices
18 # Total number of observations (all fleets)
South triennial survey series (N=9) doubled variance estimates
# Year	Seas	Type	Value	s(log space)
1980	1	5	1084.54	0.38051708
1983	1	5	3927.4	0.3262809
1986	1	5	3161.12	0.25073778
1989	1	5	5547.05	0.26028458
1992	1	5	2326.31	0.28554624
1995	1	5	5309.03	0.25781002
1998	1	5	2169.77	0.17551974
2001	1	5	5201.79	0.26424808
2004	1	5	9283.2	0.28494962

North triennial survey series (N=9) doubled variance estimates
# Year	Seas	Type	Value	s(log space)
1980	1	6	3543.76	0.3308871
1983	1	6	4651.16	0.1851065
1986	1	6	6254.23	0.18143098
1989	1	6	8395.31	0.291573
1992	1	6	9509.6	0.20274062
1995	1	6	5992.32	0.22419568
1998	1	6	15312.2	0.16765022
2001	1	6	12550.52	0.18482484
2004	1	6	36112.9	0.30253094

Discard section
Discard observation setup
2 # Type: 1 = biomass (mt),2 = fraction (D/(D+R)) by weight
19 # Total number of discard observations all fleets and years
# Year	Season	Type	Value	CV
# Herrman and Harry				
1950	1	2	0.247776	0.2
1951	1	2	0.247776	0.2
1953	1	2	0.247776	0.2
1959	1	2	0.247776	0.2
1960	1	2	0.247776	0.2
1961	1	2	0.247776	0.2
# Pikitch				
1985	1	2	0.266101	0.2
1986	1	2	0.266101	0.2
1987	1	2	0.266101	0.2
# WCGOP				
2001	1	1	0.322514	0.2
2001	1	2	0.256417	0.2
2002	1	1	0.386503	0.1
2002	1	2	0.252199	0.1
2003	1	1	0.516129	0.1
2003	1	2	0.297193	0.1
2004	1	1	0.309281	0.1
2004	1	2	0.153317	0.1
2005	1	1	0.440912	0.1
2005	1	2	0.241808	0.1

Mean body weight observations

12 # Total number of mean body weight observations
Partition: 1=discarded catch, 2=retained catch, 0=whole catch (R+D)

# Year	Seas	Type	Partition	Value (kg)	CV	
2001	1	2	1	0.216064	0.2	# North
2001	1	1	1	0.174273	0.2	# South
2002	1	2	1	0.197522	0.2	# North
2002	1	1	1	0.193660	0.2	# South
2003	1	2	1	0.225127	0.2	# North
2003	1	1	1	0.168816	0.2	# South
2004	1	1	1	0.177486	0.2	# South
2004	1	2	1	0.2083981	0.2	# North
2005	1	1	1	0.1700870	0.2	# South
2005	1	2	1	0.2324425	0.2	# North
2006	1	1	1	0.1747244	0.2	# South
2006	1	2	1	0.2011629	0.2	# North

-1 # Minimum proportion for compressing tails of observed compositional data
0.0001 # Constant added to expected frequencies

18 # Number of length bins for data inputs
Lower edge of length bins by bin

11	13	15	17	19	21	23	25	27	29	31	33
	35	37	39	41	43	45					

86 # Total number of length observations all fleets and years
Gender: 0=sexes combined into length bins, 1=females only (0s male bins), 2=males only (0s for female bins), 3=both males and females, total should sum to 1.0

Survey length data for the south (N=6)

# Year	Seas	Type	Gender	Partition	Nsamp	Data: females then males				
1989	1	5	3	0		92	0	0	9.0593E-05	
	0.000543558	0.001882805	0.017690798	0.043032522	0.05740095					
	0.086522499	0.099978647	0.112685463	0.087397378	0.058144033					
	0.022712904	0.00470682	0.001997912	0.000215643	0.000362943	0				
	0.000271779	0	0.003816385	0.017461519	0.077863095	0.117018195				
	0.100298085	0.047523997	0.026590702	0.009099757	0.003385488					
	0.000687416	0.000618113	0	0	0	0				
1992	1	5	3	0		83	0	0	0.000709075	
	0.004018089	0.018290575	0.041913472	0.074019795	0.095752434					
	0.089234429	0.092693326	0.072448716	0.042045624	0.034634168					
	0.011855165	0.005987782	0.002768271	0	0	0	0			
	0.000472716	0.009165093	0.061705911	0.109878009	0.10237328					
	0.081626761	0.031179904	0.014389128	0.002048266	0.000553654	0				
	0	0.000236358	0	0	0					
1995	1	5	3	0		60	0	0	0.000369845	
	0.003608979	0.037434326	0.064605332	0.079816026	0.103606205					
	0.112234338	0.10780415	0.083694642	0.051006802	0.018805137					
	0.009819756	0.002592208	0.001152464	0.000263412	0	0	0			
	0.002124794	0.01070435	0.025734117	0.074687528	0.099265818					
	0.069597155	0.029722568	0.009463339	0.001524483	0.000362228	0				
	0	0	0	0	0					
1998	1	5	3	0		48	0	0	0.001643203	
	0.016224501	0.059462041	0.079856283	0.096493625	0.11563298					
	0.119971335	0.082227827	0.048622211	0.032886529	0.028206564					
	0.012898205	0.004895907	0	0	0	0	0.000547734			
	0.018896838	0.049702636	0.07674426	0.071820043	0.054585234					

0.019674855 0.007760518 0.000623335 0.000623335 0 0 0
0 0 0 0
2001 1 5 3 0 88 0 0 0.002584248
0.017094995 0.055457738 0.09387469 0.104852024 0.114530704
0.104450125 0.076034623 0.055928952 0.034813796 0.025232426
0.010028357 0.004798327 0.001395712 0.000386404 9.2333E-05 0
0.000275023 0.005535617 0.054015703 0.0874694 0.06849439
0.043602578 0.02132164 0.009456799 0.004501565 0.001621893
0.000775647 0.000890185 0.000340248 0.000143858 0 0 0
2004 1 5 3 0 71 0 0 0.001683594
0.017802739 0.052502596 0.06651942 0.080579359 0.080997636
0.073139101 0.080201267 0.077080755 0.061542448 0.036309612
0.01486525 0.006501602 0.001935215 0.000376271 0.000138364 0
7.42559E-05 0.006875097 0.053734703 0.101652412 0.100287227
0.052678281 0.018237181 0.007644036 0.003092956 0.001630937
0.000637952 0.000570831 0.000423487 0.000285416 0 0 0

Survey length data for the north (N=6)
Year Seas Type Gender Partition Nsamp Data: females then males
1989 1 6 3 0 129 0 8.48359E-05 0.001093002
0.002672045 0.011299104 0.013525611 0.031282953 0.07020961
0.115576671 0.144904208 0.134982615 0.086023082 0.046439598
0.02292265 0.013228431 0.007649961 0.00385482 0.000691735 0
0 0.001093002 0.004260209 0.008768149 0.031815373 0.058159954
0.069637743 0.065663243 0.036385814 0.0123338 0.003621121
0.001588045 7.55025E-05 0.000157111 0 0 0
1992 1 6 3 0 126 0 0 0 0.002929655
0.01326888 0.02047313 0.046059307 0.079203921 0.085944669
0.09808213 0.100882175 0.057225573 0.041764258 0.020433095
0.01359351 0.005265782 0.001652169 0.000833518 0 3.23438E-05
0.001377011 0.008863454 0.032626791 0.062041854 0.077903864
0.099238363 0.074099575 0.039509259 0.010232545 0.004360946
0.00093805 0.00016613 0.000998041 0 0 0
1995 1 6 3 0 89 0 0 4.9166E-05
0.000965118 0.007423183 0.038455658 0.086626206 0.144685143
0.142331412 0.125595742 0.098745792 0.053099166 0.023269908
0.008241572 0.003336421 0.002004675 9.8332E-05 0.001488045 0
0.000182527 0.001414367 0.00201552 0.024755217 0.05972357
0.065325399 0.051520561 0.035168752 0.013395084 0.006914826
0.003075651 9.29858E-05 0 0 0 0 0
1998 1 6 3 0 204 0 0 0.00070698
0.004726735 0.035293332 0.08701707 0.106776942 0.104809801
0.103097165 0.086028795 0.05534553 0.031271021 0.017991773
0.006469067 0.002238109 0.000924187 0.00027375 3.12008E-05 0
0.000121053 0.001062274 0.012798197 0.066871353 0.106051552
0.083448037 0.051276637 0.018710711 0.007953769 0.003572276
0.001371374 0.001295737 0.000772575 0.00017326 0.00013141
0.000320383 0.001067944
2001 1 6 3 0 176 0 0.000179413 0.001870202
0.010891118 0.019558364 0.035304413 0.066135938 0.101249019
0.133245854 0.117782676 0.095376783 0.067132429 0.033303745
0.013944654 0.004653144 0.001868397 0.00085079 0.000376384 0
0.000164483 0.009706475 0.026136267 0.0440181 0.049207914
0.063255887 0.052120029 0.031083111 0.012726195 0.005233086
0.001657857 0.000347316 0.000511864 0 0 0 0

2004 1 6 3 0 158 0 0 0.000190083
0.001158237 0.006508908 0.014560214 0.028699945 0.058134695
0.116224176 0.164183128 0.136589405 0.115406718 0.058604694
0.022664915 0.006218393 0.002273437 0.000596889 0.000408828 0
0 0 0.002538751 0.015176722 0.044008563 0.058849114
0.064818935 0.050896126 0.020486649 0.006958786 0.002143725
0.001030113 0.000444921 0.000224928 0 0 0

Fishery length data for the south (N=21)
Year Seas Type Gender Partition Nsamp Data: females then males
1966 1 1 3 2 13 0 0 0 0 0 0
0 0.010607436 0.038161767 0.086263561 0.066428276 0.176553162
0.158431476 0.078419986 0.019039408 0.013394351 0.000111291
0.000333873 0 0 0 0 0 0 0 0.033938235
0.1222925 0.080633331 0.081629846 0.033371981 0 0
0.000389519 0 0 0

1967 1 1 3 2 10 0 0 0 0 0 0
0 0 0 0.024546112 0.176346335 0.290402633 0.176215142
0.129626353 0.075362418 0.015785784 0.027012708 0.000538939 0
0 0 0 0 0 0 0 0.017530921 0.020222219
0.041739629 0.004670806 0 0 0 0 0 0
1968 1 1 3 2 9 0 0 0 0 0 0
0 0 0 0.037236577 0.126660417 0.213758019 0.207508638
0.193871176 0.118744315 0.032428144 0.015769191 0.006160661 0
0 0 0 0 0 0 0 0 0.014756803
0.011290712 0.011290712 0.010524635 0 0 0 0 0
1969 1 1 3 2 16 0 0 0 0 0 0
0 0 0.035727698 0.085724305 0.077301371 0.179771059
0.116516961 0.026249729 0.008325402 0.003135378 0.000192444 0
0 0 0 0 0 0 0 0 0.134489816
0.180720433 0.131318713 0.01936231 0.001164383 0 0 0
0 0
1970 1 1 3 2 2 0 0 0 0 0 0
0 0 0 0.037862594 0.018931297 0.160000001 0.27053435
0.331603053 0.119999992 0.009465653 0 0.009465653 0 0
0 0 0 0 0 0 0 0 0.021068703
0.021068703 0 0 0 0 0 0
1972 1 1 3 2 4 0 0 0 0 0 0
0 0 0 0.034345885 0.201838121 0.222055512 0.269116848
0.14498059 0.080456134 0.013975155 0 0 0 0 0
0 0 0 0 0 0 0 0.022598991 0.010632764
0 0 0 0 0 0
1973 1 1 3 2 7 0 0 0 0 0 0
0 0 0 0.017961646 0.114368039 0.130427896 0.193238272
0.206826937 0.07835061 0.035517212 0.003414131 0.019089967 0
0 0 0 0 0 0 0 0.009544983 0.043879876
0.06126344 0.071479316 0 0.014637674 0 0 0 0
1974 1 1 3 2 8 0 0 0 0 0 0
0 0 0 0.024254155 0.104070662 0.162554991 0.194718726
0.22322011 0.191412222 0.043177798 0.016160568 0.001428438 0
0 0 0 0 0 0 0 0.002958906 0.015054915
0.014857655 0.006130854 0 0 0 0 0 0
1975 1 1 3 2 7 0 0 0 0 0 0
0 0 0 0 0.038883815 0.281605388 0.406505073
0.189856129 0.066752285 0.008825705 0.00384879 0.001729793 0

	0	0	0	0	0	0	0	0	0.001128126	0	
	0.000864897	0	0	0	0	0	0				
1976	1	1	3	2	2	0	0	0	0	0	0
	0	0.006213925	0.012427849	0.018641771	0.253919189	0.14856638					
	0.188814935	0.216635646	0.142352456	0	0	0	0	0			
	0	0	0	0	0	0	0.006213925	0.006213925	0		
	0	0	0	0	0	0	0				
1977	1	1	1	2	1	0	0	0	0	0	0
	0	0	0	0	0.019999999	0.22	0.4	0.18	0.160000001		
	0.019999999	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
1980	1	1	3	2	9	0	0	0	0	0	0
	0	0	0.006359144	0.091780051	0.276280825	0.255473239					
	0.150941949	0.102065136	0.033350636	0.01509522	0.002768222	0					
	0	0	0	0	0	0	0	0.001340749	0.003352362		
	0.035277712	0.011421153	0.008958662	0.00553494	0	0	0				
	0	0									
1982	1	1	1	2	2	0	0	0	0	0	0
	0	0	0.012747559	0.101980474	0.541087867	0.114728033					
	0.101980474	0.101980474	0.025495118	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0						
1983	1	1	3	2	2	0	0	0	0	0	0
	0	0	0.01010101	0.090909091	0.252525253	0.242424242					
	0.262626263	0.080808081	0.02020202	0.02020202	0	0	0				
	0	0	0	0	0	0	0	0.01010101	0.01010101		
	0	0	0	0	0	0	0	0			
1984	1	1	1	2	1	0	0	0	0	0	0
	0	0	0.040816327	0.204081633	0.265306122	0.285714285					
	0.12244898	0.06122449	0.020408163	0	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0						
1985	1	1	3	2	11	0	0	0	0	0	0
	0	0.000433257	0.043925308	0.190977069	0.258208311	0.251713258					
	0.16868985	0.050088443	0.017616238	0	0.00074324	0.000433257					
	0	0	0	0	0	0	0.00074324	0	0.002607729		
	0.011479376	0.002341425	0	0	0	0	0	0	0		
2001	1	1	3	2	4	0	0	0	0	0	0
	0.007853185	0	0.066898002	0.151474997	0.3246029	0.171179446					
	0.140944193	0.031935509	0	0.004204471	0	0	0	0			
	0	0	0	0	0	0	0	0.008408942	0.021022354		
	0.021022354	0.025226825	0.012613412	0.012613412	0	0	0				
2002	1	1	1	2	5	0	0	0	0	0	0
	0	0	0.175815908	0.150938246	0.136623906	0.052401914					
	0.234800435	0.144040069	0.059954234	0.000348683	0.045076606	0					
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0				
2003	1	1	3	2	21	0	0	0	0	0	
	0.089983444	0.039176842	0.048971053	0.070143673	0.19687961						
	0.263146326	0.127876008	0.041354769	0.005728116	0.00365284						
	0.034137932	0	0	0	0	0	0	0	0.009794211		
	0.019588421	0	0	0.011775987	0.00182642	0.00182642					
	0.034137932	0	0	0	0	0					
2004	1	1	3	2	14	0	0	0	0	0	0
	0.028405463	0.000398392	0.031654493	0.112334616	0.214931382						
	0.201929851	0.21247277	0.117079665	0.026026386	0.022932704						

9.7381E-05 0 0 0 0 0 0 0.003214821 0
0 0.001526636 0.007706513 0.009644463 0.009644463 0 0
0 0 0 0
2005 1 1 3 2 9 0 0 0 0 0 0
0 0.002589159 0.054182597 0.088970747 0.283259282 0.308991958
0.146660695 0.058454859 0.020896034 0 0 0 0 0
0 0 0 0 0 0 0 0 0.008998667
0.008998667 0.017997334 0 0 0 0 0

Historical fishery length data for the north (N=10)
Year Seas Type Gender Partition Nsamp Data: females then males
1949 1 2 1 2 6 0 0 0 0 0
0 0 0 0 0 0.027777778 0.138888889 0.295138889
0.225694444 0.152777778 0.111111111 0.03125 0.017361111 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1949 1 2 3 2 4 0 0 0 0 0
0 0 0 0 0.024875622 0.049751244 0.084577114
0.074626866 0.119402985 0.15920398 0.084577114 0.114427861
0.094527363 0 0 0 0 0 0 0 0 0
0.009950249 0.054726368 0.094527363 0.034825871 0 0 0
0 0
1950 1 2 3 2 108 0 0 0 0 0
0 0 0 0.199261931 1.693141553 7.731118752 15.81278816
21.58992282 18.58255077 13.76922621 6.820251798 4.029640979
2.095430929 0 0 0 0 0 0 0 0.019966265
0.259320702 2.810948015 6.042003313 4.729101148 1.456526941
0.258984547 0.079848923 0.019966265 0 0
1951 1 2 3 2 58 0 0 0 0 0
0 0 0.039775188 0.119325564 0.676178104 2.426511
5.630211858 6.884141796 8.917846972 8.54178122 6.234933002
3.228421948 2.472693468 0 0 0 0 0 0 0
0 0.139213158 0.358089056 3.104824914 5.39796801 3.070108088
0.63842627 0.079775184 0.039775188 0 0
1960 1 2 1 2 29 0 0 0 0 0
0 0 0.01988637 0.218750007 1.371928735 4.450859949
8.270730946 7.106495696 3.901950247 1.80205773 0.870162779
0.612791757 0.374385755 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1961 1 2 1 2 33 0 0 0 0 0
0 0 0 0.019947969 0.183597239 2.00737298 8.176118801
8.691460255 7.432069471 2.936539634 1.886668821 1.037674019
0.628550798 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1963 1 2 1 2 2 0 0 0 0 0
0 0 0 0 0.04040404 0.191919192 0.232323232
0.232323232 0.212121212 0.070707071 0 0.01010101 0.01010101
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1963 1 2 3 2 10 0 0 0 0 0
0 0 0 0 0.002 0.098 0.208 0.172 0.124 0.118 0.086
0.044 0.03 0 0 0 0 0 0 0 0 0
0.006 0.042 0.04 0.022 0.004 0 0.004 0 0
1964 1 2 3 2 60 0 0 0 0 0
0 0 0 0.099594252 1.09278436 6.712720434 11.59026733
10.59351992 8.043128558 4.568716122 2.42723038 1.072060604

0.495218902 0 0 0 0 0 0 0 0.03983769
0.497283156 2.743984646 4.601789892 3.574474146 1.389606614
0.298548972 0.13931505 0.019918872 0 0
1965 1 2 3 2 62 0 0 0 0 0 0 0
0 0.060165952 1.8049239 9.686058118 14.99917012 11.71037345
6.556265558 3.929460598 2.00508991 0.942378974 0.521438444 0
0 0 0 0 0 0 0.100276606 0.581604454
2.105809132 3.649294588 2.565975084 0.681659752 0.040055298 0.04
0 0.02 0

Fishery length data for the north (N=42)
Year Seas Type Gender Partition Nsamp Data: females then males
1965 1 2 3 2 6 0 0 0 0 0 0
0 0 0.01096286 0.052599683 0.120714778 0.20188699
0.173525272 0.127299572 0.079457154 0.036901066 0.012428452
0.002971889 0 0 0 0 0 0 0 0
0.006976566 0.065698673 0.057141229 0.040970685 0.005560106
0.004905025 0 0 0 0
1966 1 2 3 2 33 0 0 0 0 0 0
0.000603268 0 0.000292572 0.007397917 0.079019613 0.2010677
0.227325569 0.201018777 0.112987421 0.055088063 0.013051811
0.008825737 0 0 0 0 0 0 0 0
0.000399933 0.009054416 0.036472113 0.030289025 0.01326638
0.002244061 0.001069675 0.000525948 0 0
1967 1 2 3 2 48 0 0 0 0 0 0
0 0 0.000563327 0.012743417 0.065113952 0.150003274
0.215994388 0.206578387 0.135757875 0.062575078 0.019884379
0.007662803 0 0 0 0 0 0 0 0
0.00405838 0.015752734 0.055948555 0.03539901 0.00996358
0.00200086 0 0 0 0
1968 1 2 3 2 51 0 0 0 0 0
0.000188439 0 0.001507514 0.006419619 0.024580848 0.067634446
0.132013467 0.203453917 0.217777285 0.162628169 0.089508492
0.027491926 0.013407281 0 0 0 0 0 0 0
0.000565318 0.002993621 0.007356092 0.019524975 0.017537438
0.004809248 0.000601905 0 0 0 0
1969 1 2 3 2 53 0 0 0 0 0 0
0 0 0.005716005 0.039891236 0.110378667 0.164578533
0.201065974 0.178870859 0.111738219 0.056139418 0.02222964
0.005942052 0 0 0 0 0 0 0 0
0.004240244 0.019942457 0.04344073 0.026536287 0.007436872
0.001251486 0.000601322 0 0 0

1970 1 2 3 2 53 0 0 0 0 0 0
0 0 0.007326205 0.044053619 0.108077703 0.17930859
0.197780271 0.137984666 0.082419026 0.04225981 0.016343102
0.006544866 0 0 0 0 0 0 0.000198431
0.002851929 0.010658611 0.035443341 0.070115142 0.041318588
0.014967681 0.001641691 0.000706728 0 0 0
1971 1 2 3 2 4 0 0 0 0 0 0
0 0 0 0.044522047 0.04428985 0.18802982 0.206149033
0.11411457 0.085022842 0.035304949 0.015325082 0.003639708 0
0 0 0 0 0 0 0 0.019080877 0.108124971
0.097892775 0.033792177 0.003467105 0.001244194 0 0 0
0

1972	1	2	3	2	25	0	0	0	0	0	0
	0.000229881	5.33071E-05	0.005408195	0.045316529	0.137696008						
	0.198300851	0.20293489	0.115191656	0.075518217	0.040601224						
	0.019894926	0.008783872	0	0	0	0	0	0	0		
	0.000919523	0.008708065	0.045881082	0.052094608	0.032160156						
	0.009233723	0.000317572	0	0	0	0.000755715					
1973	1	2	3	2	24	0	0	0	0	0	0
	0.000573556	0	0.002873478	0.026838477	0.152695022	0.241182094					
	0.224812174	0.141116222	0.076285533	0.027717494	0.008833354						
	0.004906492	0	0	0	0	0	0	0	0		
	0.003236731	0.020288348	0.035339133	0.022119665	0.008256934						
	0.002925295	0	0	0	0						
1974	1	2	3	2	21	0	0	0	0	0	0
	0	0.000616385	0.002906278	0.038463704	0.14141633	0.227042739					
	0.206887425	0.127406575	0.076641955	0.028632782	0.012493276						
	0.008842979	0	0	0	0	0	0	0.000850979			
	0.006632058	0.010463454	0.025821047	0.04796345	0.027519149						
	0.008897128	0.000502307	0	0	0	0					
1975	1	2	3	2	27	0	0	0.000459817	0	0	
	0.000428442	0.000163417	0.001150743	0.007864986	0.042661653						
	0.153716442	0.216346284	0.196922329	0.130168055	0.076381102						
	0.036084327	0.011460089	0.006442221	0	0	0.000459817					
	0.000878876	0	0	0	0.003218841	0.012643583	0.022784091				
	0.051530633	0.02137652	0.006190016	0.000667716	0	0	0				
	0										
1976	1	2	3	2	18	0	0	0	0	0	0
	0.001541257	0.013672222	0.031989236	0.06598602	0.109566217						
	0.145226186	0.14120358	0.124675047	0.089629434	0.038919826						
	0.011990446	0.006113054	0	0	0	0	0	0.00018703			
	0.000385314	0.00464104	0.028657899	0.073686519	0.08121944						
	0.026607551	0.002913537	0.000445098	0.000744043	0	0	0				
1977	1	2	3	2	29	0	0	0	0	0	0
	0.00037349	0.00112047	0.003949028	0.034866343	0.106760439						
	0.193148168	0.190529961	0.127126645	0.08269352	0.039351651						
	0.015892706	0.004128376	0	0	0	0	0	0.000186745			
	0.000415237	0.001702693	0.022835857	0.058546326	0.08100652						
	0.031339218	0.003171079	0.000723465	0.000132063	0	0	0				
1978	1	2	3	2	26	0	0	0	0	0	0
	0	0	0.004749049	0.071634056	0.148106568	0.263338503					
	0.189751257	0.133035992	0.086802197	0.03615061	0.005295061						
	0.004647629	0	0	0	0	0	0	0.000128496			
	0.000270406	0.013920917	0.013643153	0.018547683	0.007390638						
	0.001543518	0.001044267	0	0	0	0					
1979	1	2	3	2	21	0	0	0	0	0	0
	0.000635899	0	0.003946223	0.0505798	0.212494456	0.202020985					
	0.208096049	0.125082736	0.064697405	0.023477827	0.004514373						
	0.001635618	0	0	0	0	0	0	0.000153195			
	0.000919167	0.004757827	0.034864345	0.039288664	0.021612434						
	0.001222998	0	0	0	0	0					
1980	1	2	3	2	96	0	0	0	0	0	
	0.000399012	5.41096E-05	0.000123977	0.004237815	0.052566727						
	0.165317449	0.225800778	0.192667478	0.13121961	0.068691179						
	0.040273634	0.02081415	0.010614277	0	0	0	0.000145275				
	0	0	1.33408E-05	0.00060195	0.005412043	0.030834598					
	0.030233561	0.015727406	0.003681839	0.000253719	0.000202724						
	4.64745E-05	5.30763E-05	1.37983E-05								

1981	1	2	3	2	90	0	0	0	0	0	0
	0	8.46452E-06	0.014737121	0.106361691	0.224036459	0.215543929					
	0.180591119	0.106952784	0.058123393	0.026515868	0.009252078						
	0.005555769	0	0	0	0	0	1.68718E-05	0.000113633			
	0.000284937	0.003301773	0.021241746	0.016771245	0.008367162						
	0.001850416	0.000373541	0	0	0	0					
1982	1	2	3	2	72	0	0	0	0	0	0
	1.41938E-05	0.003943077	0.040716148	0.13590158	0.239963969						
	0.205528435	0.132684484	0.084877094	0.04134826	0.019395639						
	0.011425815	0.003783099	0	0	0	0	0	0	0		
	0.010438095	0.019107543	0.02881698	0.01431887	0.007252369						
	0.000304204	0.000180147	0	0	0	0					
1983	1	2	3	2	52	0	0	0	0	0	
	0.00065268	0.000521936	0.00061898	0.010713674	0.129744497						
	0.23125774	0.231362521	0.152552744	0.081992041	0.044712999						
	0.022400882	0.008789814	0.002677807	0	0	0	0	0			
	0	0.000266789	0.00147795	0.002519396	0.026842696	0.032631291					
	0.014144715	0.003275131	0.000684728	0.000158988	0	0	0				
1984	1	2	3	2	27	0	0	0	0	0	0
	0.002828755	0.014569754	0.068396944	0.098350482	0.246577998						
	0.183571609	0.148171579	0.077385946	0.036317327	0.021229615						
	0.002950647	0.001680985	0	0	0	0	0.000764723	0			
	0.001618668	0.013863571	0.019317346	0.035428236	0.021001669						
	0.005667738	0.000148526	0	0.00015788	0	0	0				
1985	1	2	3	2	38	0	0	0	0	0	0
	0	0.008367562	0.044721389	0.175618209	0.253191957	0.19425432					
	0.14517473	0.065397034	0.028703555	0.010952338	0.004572689						
	0.002734915	0	0	0	0	0	0	0	0.006821479		
	0.028041302	0.017548159	0.010826906	0.002516919	0.000556537	0					
	0	0	0	0							
1986	1	2	3	2	29	0	0	0	0	0	0
	0.000209251	0.002906965	0.028569553	0.162966211	0.279059404						
	0.199005701	0.096986418	0.071116386	0.052452668	0.026040021						
	0.008999864	0.003770017	0	0	0	0	0	0	0		
	0.003558414	0.011906814	0.028713582	0.013320214	0.00719794						
	0.002680128	0	0.000540449	0	0	0					
1987	1	2	3	2	55	0	0	0	0	0	0
	0.001834559	0.005411018	0.058825987	0.169711542	0.2521228						
	0.244033658	0.11876438	0.054724301	0.030650917	0.013437313						
	0.00296528	0.00079941	0	0	0	0	0	0			
	0.00168707	0.006719052	0.019265864	0.012157974	0.0053616						
	0.001199617	0.000284472	4.31871E-05	0	0	0	0				
1988	1	2	3	2	35	0	0	0	0	0	0
	7.4873E-05	0	0.017022261	0.119866615	0.235457633	0.229546871					
	0.156687727	0.101502154	0.046798662	0.018494256	0.006785628						
	0.002427448	0	0	0	0	0	0	0	5.06129E-05		
	0.009715787	0.023186709	0.021743211	0.008632338	0.001812419						
	0.000194794	0	0	0	0						
1989	1	2	3	2	43	0	0	0	0	0	0
	9.96346E-05	0.000408028	0.009832825	0.097702668	0.221839299						
	0.258189825	0.187155164	0.116313377	0.043459105	0.019127751						
	0.007347933	0.002846672	0	0	0	0	0	0	0		
	0.000454882	0.003827674	0.009851649	0.016060436	0.004175547						
	0.001307529	0	0	0	0	0					

1990	1	2	3	2	30	0	0	0	0	0	0
	0	0.004547253	0.010476676	0.063210655	0.261361837	0.312337082					
	0.185810548	0.071551452	0.025143441	0.006628959	0.002026375						
	1.38518E-05	0	0	0	0.002181956	0	0	0			
	0.000299373	0.006761049	0.018449149	0.025995003	0.002573759						
	0.000498295	0.000133285	0	0	0	0					
1991	1	2	3	2	28	0	0	0	0	0	0
	0.000940693	0.000977635	0.007163611	0.067564764	0.202563702						
	0.234260836	0.150080135	0.073123172	0.035731803	0.018184946						
	0.004082394	0.002066846	0	0	0	0	0	0			
	1.8471E-05	7.94853E-05	0.004057344	0.022548586	0.030582743						
	0.062227646	0.022174102	0.036038582	0.016452372	0.009080133	0					
	0										
1992	1	2	3	2	21	0	0	0	0	0	0
	0	0.002407874	0.036314467	0.185065284	0.285542816	0.214115455					
	0.133610007	0.060167742	0.021464356	0.007088049	0.000794205						
	0.000712378	0	0	0	0	0	0	0	0		
	0.000458901	0.008610391	0.035180452	0.007849557	0.000460882						
	0.000157185	0	0	0	0						
1993	1	2	3	2	22	0	0	0	0	0	0
	0	0.000601167	0.007218626	0.139624218	0.335863946	0.278140984					
	0.137964901	0.04875387	0.014195039	0.005178021	0.001783377	0					
	0	0	0	0	0	0	0	0.000354397	0.002904492		
	0.008079384	0.015798328	0.002698441	0.000840808	0	0	0				
	0	0									
1994	1	2	3	2	21	0	0	0	0	0	0
	0	0.002137115	0.029157857	0.186018195	0.313799571	0.213849617					
	0.108125966	0.06257897	0.018626261	0.00791339	0.002680106						
	0.001617793	0	0	0	0	0	0	0	0		
	0.006737657	0.029750234	0.016190522	0.000816747	0	0	0				
	0	0	0								
1995	1	2	3	2	20	0	0	0	0	0	0
	0	0.001502724	0.061299375	0.186478758	0.246878921	0.189067255					
	0.11731893	0.078855238	0.044269296	0.042373049	0.014136644						
	0.004543246	0	0	0	0	0	0	0	0	0	
	0.004629825	0.003680474	0.003887622	0	0.001078643	0	0				
	0	0									
1996	1	2	3	2	18	0	0	0	0	0	0
	0	0.00044543	0.047038636	0.268216279	0.278697522	0.188946289					
	0.100013697	0.035573687	0.023786277	0.00906365	0.005467049						
	0.000898376	0	0	0	0	0	0	0	0		
	0.012297653	0.011143707	0.016249138	0.002162608	0	0	0				
	0	0	0								
1997	1	2	3	2	40	0	0	0	0	0	0
	0.000192329	0.001731081	0.022333182	0.159394573	0.330567451						
	0.220952672	0.12381618	0.063847688	0.02050488	0.0159703						
	0.001554958	0.00668534	0	0	0	0	0	0			
	0.000221685	0.001482771	0.005479235	0.01053022	0.009547939						
	0.002830857	0.001610093	0.000746564	0	0	0	0				
1998	1	2	3	2	37	0	0	0	0	0	0
	0	0.007391966	0.070227592	0.192390275	0.293016341	0.196006876					
	0.096590977	0.048213386	0.040886787	0.023285777	0.009675704						
	0.002922598	0	0	0	0	0	0	0	0.000226295		
	0.005374806	0.009986447	0.002837493	0	0.00096668	0	0				
	0	0	0								

1999 1 2 3 2 35 0 0 0 0 0 0
0.000682277 0.005391107 0.067698266 0.198826638 0.279481468
0.220994686 0.106725397 0.046259193 0.027052238 0.014366442
0.005285951 0.001634723 0 0 0 0 0 0
0.000586684 0.004530313 0.013504101 0.005166917 0.001813598 0
0 0 0 0 0 0
2000 1 2 3 2 33 0 0 0 0 0 0
0.000504918 0.006184874 0.058114405 0.18314248 0.283925386
0.186373196 0.116372685 0.057539218 0.046368923 0.039970078
0.006235402 0.002454506 0 0 0 0 0 0 0
0.002823965 0.001939429 0.006774113 0.001276422 0 0 0
0 0 0 0
2001 1 2 3 2 49 0 0 0 0 0 0
0.001738129 0.00795245 0.041666957 0.140580238 0.262206851
0.2653922 0.135927244 0.068574764 0.036220938 0.013585091
0.007986748 0.002955995 0 0 0 0 0 0 0
0.001422977 0.002744777 0.007256365 0.002192428 0.000349765
0.000623042 0 0.000623042 0 0 0
2002 1 2 3 2 46 0 0 0 0 0 0
0.001687341 0.008272415 0.029620483 0.133311235 0.255602268
0.2745696 0.149090082 0.068077281 0.029052928 0.011689766
0.007364727 0.003214296 0 0 0 0 0 0
0.000978314 0.001250991 0.003766073 0.015733532 0.004330626
0.001954346 2.99886E-05 0.000368277 0 3.54295E-05 0 0
2003 1 2 3 2 48 0 0 0 0 0
0.000152865 0.000186271 0.000362202 0.012145359 0.083135773
0.238185604 0.234950223 0.221713064 0.091092575 0.056568337
0.023661207 0.002804266 0.000452148 0 0 0 0 0
0 7.0615E-05 0.000152865 0.007020509 0.009193755 0.009877372
0.005391503 0.002730624 0.000152865 0 0 0 0
2004 1 2 3 2 52 0 0 0 0 0 0
0.000860949 0.001568636 0.011537914 0.06263769 0.199065525
0.247624105 0.221957264 0.119409183 0.051575568 0.022212403
0.011927575 0.005104303 0 0 0 0 0 0 0
0.000757232 0.004713668 0.013255508 0.016201961 0.006695091
0.001369098 0.001194659 0.000331667 0 0 0
2005 1 2 3 2 61 0 0 0 0 0 0
0 0.002719397 0.011264153 0.066498358 0.190142131 0.267624898
0.21576137 0.119964412 0.062958286 0.02473284 0.01369818
0.006345727 0 0 0 0 0 0 0.000470762
0.001341528 0.001402551 0.006046072 0.0055714 0.00220038
0.00091417 0.000343385 0 0 0 0
2006 1 2 3 2 44 0 0 0 0 0 0
0 0.004443007 0.021729796 0.084583314 0.219549629 0.302599028
0.185669087 0.080946714 0.032875594 0.011084047 0.002882127
0.001658653 0 0 0 0 0 0 0.002510069
0.00532874 0.010948757 0.017449638 0.011697114 0.002116469
0.000474242 0.001314834 0.000139141 0 0 0

Pikitch discard observation (n=1)
1986 1 2 0 1 62 0 0 0.007194245
0.026378897 0.086330935 0.191846523 0.225419664 0.201438849
0.139088729 0.105515588 0.016786571 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

```
20          # Number of age bins for data inputs
# Lower edge of age bins (first is a minus group, last is a plus group)
1 2 3 4   5 6 7 8   9 10 11  12 13 14 15 16 17 18 19 20

1           # Number of ageing error types
# Vectors of: Average age at true age (to accumulator age)
#            SD of ageing precision at true age
# Type 1: opercular ages
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
0.001   0.001   0.2336773       0.3703697       0.4673546       0.5425818       0.604047
        0.6560151       0.7010318       0.7407394       0.7762591       0.8083906
        0.8377243       0.8647087       0.8896923       0.9129516       0.9347091
        0.9551472       0.9744167       0.9926441       1.0099364       1.0263848
        1.0420678       1.0570536       1.0714015       1.0851637       1.098386
        1.1111092       1.1233696       1.1351998       1.1466288

847         # Total number of age observations

# Survey north: age-at-length bin observations (N=11), females only from Sampson's grad student
# Year  Season  Type    Gender  Partition ageerr  Lbin_lo Lbin_hi Nsamps  Data: females then males
 1995   1               6               1               0                       1
        3               3               2               0       0.5     0.5     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       0
 1995   1               6               1               0                       1
        4               4               4               0       0.384615385     0.538461538
        0.076923077     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
 1995   1               6               1               0                       1
        5               5               10              0       0.102564103     0.41025641
        0.333333333     0.153846154     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
 1995   1               6               1               0                       1
        6               6               24              0       0.04    0.36    0.32    0.2
        0.02    0.06    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
 1995   1               6               1               0                       1
        7               7               14              0       0       0.191489362
        0.340425532     0.255319149     0.191489362     0       0.021276596     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
 1995   1               6               1               0                       1
        8               8               16              0       0       0.037037037
        0.259259259     0.222222222     0.37037037      0.092592593     0.018518519     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
1995 1 6 1 0 1
9 9 21 0 0 0 0.12244898
0.265306122 0.367346939 0.163265306 0.040816327 0.020408163
0.020408163 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
1995 1 6 1 0 1
10 10 16 0 0 0
0.243243243 0.243243243 0.27027027 0.216216216 0.027027027 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
1995 1 6 1 0 1
11 11 5 0 0 0 0 0
0.4 0.4 0 0 0.2 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
0 0
1995 1 6 1 0 1
12 12 2 0 0 0 0 0
0.333333333 0 0.666666667 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
1995 1 6 1 0 1
13 13 1 0 0 0 0 0
0 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
0 0

Fishery south: sorted by year, gender, age-at-length bin observations (N=117)

# Year	Season	Type	Gender	Partition	ageerr	Lbin_lo	Lbin_hi	Nsamp	Data: females then males
1968	1		1		1		2		1
	10		10		1		0	0.5	0.5 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	0							
1968	1		1		1		2		1
	11		11		4		0	0.081638518	0.347723141
	0.55692938		0.013708961		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			
1968	1		1		1		2		1
	12		12		4		0	0	0.024252414
	0.319689118		0.514976383		0.141082085		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		
1968	1		1		1		2		1
	13		13		6		0	0	0 0.299804874
	0.021166499		0.373431101		0.106772949		0.101942515		0.011160602 0

	0	0	0.08572146	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	
1968	1		1		1		2		1	
	14		14		6		0	0	0	0.0611623
	0.110442834		0.075327502		0.170052408		0.184994334		0.14572114	
	0.018818652		0.006223491		0.110442834		0.00637167		0	0.110442834
	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							
1968	1		1		1		2		1	
	15		15		6		0	0	0	0.035470056
	0.049659407		0.084499298		0.095326928		0.289628043		0.011085431	
	0.039206333		0.192148438		0.01082763		0	0.192148438	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								
1968	1		1		1		2		1	
	16		16		3		0	0	0	0	0
	0.412507201		0.412507201		0	0	0	0	0.069269328	
	0.105716271		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			
1968	1		1		1		2		1	
	17		17		2		0	0	0	0	0
	0	0.461271057		0	0	0	0	0.077457887		0.461271057	
	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					
1968	1		1		1		2		1	
	18		18		2		0	0	0	0	0
	0	0	0.23811223		0	0	0	0	0.76188777		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						
1968	1		1		2		2		1	
	10		10		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	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0								
1968	1		1		2		2		1	
	11		11		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	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0								
1968	1		1		2		2		1	
	12		12		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	1	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0								
1968	1		1		2		2		1	
	13		13		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	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1969	1		1		1		2			1	
	9		9		1		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	0	0	0	0	0	0	0
	0	0									
1969	1		1		1		2			1	
	10		10		5		0	0	0.938946686		
	0.061053314		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						
1969	1		1		1		2			1	
	11		11		9		0	0	0.647157763		
	0.221332223		0.036523636		0.077179139		0.017807238		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			
1969	1		1		1		2			1	
	12		12		13		0	0	0.29212643		
	0.303153735		0.204392721		0.073175115		0.117884614		0.007837187		
	0.001383809		4.64E-05		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										
1969	1		1		1		2			1	
	13		13		12		0	0	0.264356342		
	0.283193279		0.016571803		0.096883907		0.163555479		0.078012639		
	0.074786617		0.01637002		0.003134957		0	0.003134957		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								
1969	1		1		1		2			1	
	14		14		11		0	0	0.005733499		0
	0.040264112		0.210444575		0.055306471		0.320958321		0.24836934		
	0.015234787		0.042957141		0.010516252		0.002422677		0.047792826		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								
1969	1		1		1		2			1	
	15		15		9		0	0	0	0.011540898	
	0.047726999		0.023682497		0.00570295		0.058399635		0.352252342		
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9 9 3 0 0 0 0 0
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0 0 0 0 0 0 0
1969 1 1 2 2 1
10 10 5 0 0 0 0 0
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1969 1 1 2 2 1
11 11 7 0 0 0 0 0
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0 0.002597366 0 0 0 0 0 0
1969 1 1 2 2 1
12 12 6 0 0 0 0 0
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0 0.032778443 0.018790686 0.167533376 0.167533376 0.155515945
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1969 1 1 2 2 1
13 13 2 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0.078912549 0 0 0.921087451 0 0 0 0
0 0 0 0
1970 1 1 1 2 1
10 10 1 0 0 0 1 0
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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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11 11 1 0 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 0 0 0 0 0
0 0
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0.2 0.4 0.2 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 0 0
0 0
1970 1 1 1 2 1
13 13 1 0 0 0 0 0

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	0	0	0	0	0					
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	0	0	0	0	0	0	0			
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	0	0	0	0	0	0	0	0	0	0
	0	0	0	0						
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	0	0	0	0	0					
1972	1	1	1	2			1			
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	0	0	0	0	0	0	0			
1972	1	1	1	2			1			
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	0.172552155	0.226893816	0.334139005	0.107402542	0.062575246	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		
1972	1	1	1	2			1			
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	0.189845986	0.146384389	0.141855548	0.040834797	0.24119634					
	0.092185151	0.070087795	0	0	0	0	0	0	0	
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1972	1	1	1	2			1			
	14	14	4	0	0	0	0.053679451			
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	0									
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	0	0	0	0	0	0				
1972	1	1	1	2			1			
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1972	1		1		2		2			1	
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1973	1		1		1		2			1	
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1973	1		1		1		2			1	
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	0	0	0	0	0	0	0	0	0	0	0
	0	0									
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	14		14		7		0	0	0	0.115152871	
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	0	0	0								
1973	1		1		1		2			1	
	15		15		6		0	0	0	0	
	0.121434769		0.060717385		0.042424326		0.165399028		0.169591157		
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1973	1		1		1		2			1	
	16		16		6		0	0	0	0	0

	0.096126108		0.105373901		0	0	0.133941934		0.016313441		
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	0	0	0	0	0	0	0	0	0	0	
1973	1		1		1		2			1	
	17		17		1		0	0	0	0	0
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	0	0									
1973	1		1		1		2			1	
	18		18		1		0	0	0	0	0.5
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	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1973	1		1		2		2			1	
	9		9		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
	1	0	0	0	0	0	0	0	0	0	0
	0	0									
1973	1		1		2		2			1	
	10		10		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	0.077806314		0
	0	0.551110441		0	0	0.293276931		0.077806314	0		0
	0	0	0	0	0	0					
1973	1		1		2		2			1	
	11		11		4		0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0.23345453	
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	0	0	0	0	0	0					
1973	1		1		2		2			1	
	12		12		3		0	0	0	0	0
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	0	0	0.204781956		0	0	0				
1973	1		1		2		2			1	
	14		14		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	0	1	0	0	0	0	0
	0	0									
1974	1		1		1		2			1	
	10		10		2		0	0.252775406		0.249074868	
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1974	1		1		1		2			1	
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1974	1		1		1		2			1	
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1974	1		1		1		2			1	
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	0.379051525		0.329253749		0.178124479		0.062120421	0	0	0	
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	0	0	0	0	0	0	0	0			
1974	1		1		1		2			1	
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	0										
1974	1		1		1		2			1	
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1974	1		1		1		2			1	
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1974	1		1		1		2			1	
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	0	0	0	0	0	0					
1974	1		1		1		2			1	
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1974	1		1		2		2			1	
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1975	1		1		1		2			1	
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	0	0	0	0	0	0	0	0	0	0	0
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	0										
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	0	0									
1975	1		1		1		2			1	
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1975	1		1		1		2			1	
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1975	1		1		1		2			1	
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	0	0	0	0	0	0	0	0	0	0	0
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1975	1		1		2		2			1	
	12		12		1		0	0	0	0	0
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	0	0	0	1	0	0	0	0	0	0	0
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1980	1		1		1		2			1	
	11		11		1		0	0	0	0	1
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	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1980	1		1		1		2			1	
	13		13		1		0	0	0	0	0.25
	0	0.25	0.25	0.25	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									
1980	1		1		1		2			1	
	14		14		1		0	0	0	0	0
	0	0.285714286		0.428571429		0.285714286		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						
1980	1		1		1		2			1	
	15		15		1		0	0	0	0	
	0.166666667		0	0	0.5	0	0.333333333		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						
1980	1		1		1		2			1	
	16		16		1		0	0	0	0	0
	0	0	0	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									

1980	1		1		1		2			1	
	17		17		1		0	0	0	0	0
	0	0	0	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									
1982	1		1		1		2			1	
	9		9		1		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	0	0	0	0	0	0	0
	0	0									
1982	1		1		1		2			1	
	10		10		1		0	0	0.5	0.166666667	
	0.166666667		0.166666667		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						
1982	1		1		1		2			1	
	11		11		1		0	0	0.285714286		
	0.285714286		0.142857143		0.142857143		0	0	0	0.142857143	
	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			
1982	1		1		1		2			1	
	12		12		1		0	0	0	0.25	0
	0.25	0.25	0.25	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									
1982	1		1		1		2			1	
	13		13		1		0	0	0	0	0.25
	0	0.5	0	0	0.25	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									
1982	1		1		1		2			1	
	14		14		1		0	0	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	0	0	0	0
	0	0									
1982	1		1		1		2			1	
	15		15		1		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	0	0	0	0	0	0
	0	0									
1983	1		1		1		2			1	
	9		9		1		0	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	0	0	0	0	0
	0	0									
1983	1		1		1		2			1	
	10		10		2		0	0	0	0	

	0.253246748	0.246753252	0	0	0.5	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							
1983	1	1	1		2			1		
	11	11	2		0	0	0	0		
	0.378640778	0.245954696	0	0.249190937		0.126213589		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					
1983	1	1	1		2			1		
	12	12	2		0	0	0	0		
	0.182897859	0.185273161	0	0.361045132		0.180522566		0.090261283		
	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				
1983	1	1	1		2			1		
	13	13	2		0	0	0	0		
	0.063311686	0	0.063311686	0.561688318		0	0.061688312			
	0.124999999	0.063311686	0.061688312	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	
1983	1	1	1		2			1		
	14	14	2		0	0	0	0	0	
	0 0	0.5	0.253246748	0	0.246753252		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								
1983	1	1	1		2			1		
	15	15	2		0	0	0	0	0	
	0 0	0.506493497	0	0.493506503		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								
1983	1	1	1		2			1		
	16	16	1		0	0	0	0	0	
	0 0	0 0	0	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 0									
1984	1	1	1		2			1		
	9	9	1		0	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	0	0	0	0	0	0	0	0
	0 0									
1984	1	1	1		2			1		
	10	10	1		0	0	0	0.25	0.5	
	0.25 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 0									
1984	1	1	1		2			1		
	11	11	1		0	0	0	0	0	
	0.571428571	0	0.142857143	0.285714286		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						
1984	1		1		1		2			1	
	12		12		1		0	0	0	0	
	0.142857143		0.428571429		0	0.285714286		0.142857143		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				
1984	1		1		1		2			1	
	13		13		1		0	0	0	0	0
	0	0	0	0.333333333		0	0.333333333		0.333333333		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						
1984	1		1		1		2			1	
	14		14		1		0	0	0	0	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	0	0
	0	0									
1985	1		1		1		2			1	
	9		9		4		0	0	0.065683289		
	0.387254321		0.188648178		0.358414212		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				
1985	1		1		1		2			1	
	10		10		9		0	0	0.133605475		
	0.426584917		0.247035259		0.061721697		0.068908393		0.029031871		
	0.033112387		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
1985	1		1		1		2			1	
	11		11		9		0	0	0.066326226		
	0.090127561		0.267012013		0.281215882		0.259040712		0	0	0
	0.018138803		0.018138803		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	
1985	1		1		1		2			1	
	12		12		9		0	0	0	0.076914119	
	0.304818461		0.328947886		0.187001463		0.032376661		0.025928328		
	0.022978718		0.021034365		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
1985	1		1		1		2			1	
	13		13		9		0	0	0.007892154		
	0.010752554		0.066347868		0.122392647		0.380611955		0.173330287		
	0.13448968		0.037859128		0.063463327		0	0	0	0	
	0.0028604		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1985	1		1		1		2			1	
	14		14		8		0	0	0	0.082377018	
	0.082377018		0.354149119		0.186303252		0.077084333		0	0.21770926	
	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
1985 1 1 1 2 1
15 15 4 0 0 0 0
0.285353213 0.285353213 0.078560568 0 0.090579815 0
0.260153191 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
1985 1 1 1 2 1
17 17 1 0 0 0 0 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 0 0
0 0
1985 1 1 2 2 1
9 9 1 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
1985 1 1 2 2 1
10 10 2 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0.194163605 0.805836395 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0

Historical fishery north: sorted by year, gender, age-at-length bin observations (N=42)

# Year	Season	Type	Gender	Partition	ageerr	Lbin_lo	Lbin_hi	Nsamp	Data: females then males	
1948	1		2		1		2		1	
	8		8		1		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	0	0	0	0	0	0
	0	0									
1948	1		2		1		2		1		
	9		9		1		0	0	0.666666667		
	0.333333333		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						
1948	1		2		1		2		1		
	10		10		1		0	0	0.380952381		
	0.380952381		0.19047619		0.047619048		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				
1948	1		2		1		2		1		
	11		11		1		0	0	0.186046512		
	0.488372093		0.279069767		0.023255814		0.023255814		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			
1948	1		2		1		2		1		
	11		11		1		0	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 0 0 0 0 0
0 0
1948 1 2 1 2 1
12 12 2 0 0 0.051948052
0.285714286 0.363636364 0.207792208 0.090909091 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
1948 1 2 1 2 1
12 12 1 0 0 0.25 0.25 0.25
0 0.25 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
1948 1 2 1 2 1
13 13 2 0 0 0 0.131578947
0.289473684 0.302631579 0.197368421 0.065789474 0.013157895 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
1948 1 2 1 2 1
13 13 1 0 0 0 0 0
0.166666667 0.333333333 0 0.333333333 0.166666667 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
1948 1 2 1 2 1
14 14 2 0 0 0 0.085106383
0.14893617 0.319148936 0.244680851 0.170212766 0.021276596 0
0.010638298 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
1948 1 2 1 2 1
14 14 1 0 0 0 0
0.333333333 0 0.666666667 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
1948 1 2 1 2 1
15 15 2 0 0 0 0
0.032786885 0.262295082 0.37704918 0.196721311 0.081967213
0.016393443 0.032786885 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
1948 1 2 1 2 1
15 15 1 0 0 0 0 0
0 0.333333333 0.666666667 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
1948 1 2 1 2 1
16 16 2 0 0 0 0.016949153
0.06779661 0.06779661 0.338983051 0.152542373 0.220338983
0.084745763 0 0.033898305 0.016949153 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										
1948	1		2		1		2			1	
	16		16		1		0	0	0	0	0
	0.666666667		0	0.333333333		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							
1948	1		2		1		2			1	
	17		17		1		0	0	0	0	0
	0.042553191		0.276595745		0.255319149		0.276595745		0.085106383		
	0.063829787		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		
1948	1		2		1		2			1	
	18		18		1		0	0	0	0	0
	0.066666667		0.133333333		0.066666667		0.2		0.266666667	0.2	
	0.066666667		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			
1948	1		2		1		2			1	
	18		18		1		0	0	0	0	0
	0	0.5	0.5	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									
1948	1		2		2		2			1	
	9		9		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1948	1		2		2		2			1	
	10		10		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.333333333		0.333333333	
	0.333333333		0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1948	1		2		2		2			1	
	11		11		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0.1	0.25	0.3	0.25	0.05
	0	0	0.05	0	0	0	0	0	0	0	0
	0	0									
1948	1		2		2		2			1	
	12		12		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.181818182		0.272727273	
	0.181818182		0.181818182		0.181818182		0	0	0	0	0
	0	0	0	0	0	0	0				
1948	1		2		2		2			1	
	13		13		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	0.166666667	
	0.166666667		0.333333333		0.333333333		0	0	0	0	0
	0	0	0	0	0	0					

1948	1		2		2		2			1	
	14		14		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	
	0.333333333		0.333333333		0.333333333		0	0	0	0	0
	0	0	0	0	0	0					
1949	1		2		1		2			1	
	9		9		1		0	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	0	0	0	0	0
	0	0									
1949	1		2		1		2			1	
	10		10		1		0	0.111111111		0	
	0.555555556		0.222222222		0.111111111		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				
1949	1		2		1		2			1	
	11		11		1		0	0	0	0.333333333	
	0.333333333		0.333333333		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						
1949	1		2		1		2			1	
	12		12		1		0	0	0	0.0625	0.28125
	0.4375	0.1875	0	0	0.03125	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									
1949	1		2		1		2			1	
	13		13		2		0	0	0	0.037037037	
	0.12962963		0.537037037		0.203703704		0.092592593		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				
1949	1		2		1		2			1	
	14		14		2		0	0	0	0.028571429	
	0.157142857		0.214285714		0.271428571		0.2	0.1	0.028571429		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				
1949	1		2		1		2			1	
	15		15		1		0	0	0	0	0.1
	0.12	0.38	0.24	0.14	0	0.02	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									
1949	1		2		1		2			1	
	16		16		1		0	0	0	0	0
	0.1	0.225	0.35	0.225	0.05	0.05	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									
1949	1		2		1		2			1	
	17		17		1		0	0	0	0	0

	0.057142857		0.171428571		0.114285714		0.285714286		0.285714286		
	0.057142857		0.028571429		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	
1949	1		2		1		2			1	
	18		18		1		0	0	0	0	0
	0	0.0625	0.15625	0.21875	0.25	0.1875	0.09375	0.03125	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									
1949	1		2		2		2			1	
	8		8		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1949	1		2		2		2			1	
	9		9		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.25	0.25	0.25	0.25
	0	0	0	0	0	0	0	0	0	0	0
	0	0									
1949	1		2		2		2			1	
	10		10		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.2	0.533333333		0.2
	0	0.066666667		0	0	0	0	0	0	0	0
	0	0	0	0							
1949	1		2		2		2			1	
	11		11		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.137931034		0.24137931	
	0.275862069		0.206896552		0.103448276		0.034482759		0	0	0
	0	0	0	0	0	0	0	0			
1949	1		2		2		2			1	
	12		12		1		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.05	0.25	0.25	0.25
	0.1	0.075	0.025	0	0	0	0	0	0	0	0
	0	0									
1949	1		2		2		2			1	
	13		13		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	0.1	0.5	0.3
	0.1	0	0	0	0	0	0	0	0	0	0
	0	0									
1949	1		2		2		2			1	
	14		14		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
	0.5	0.5	0	0	0	0	0	0	0	0	0
	0	0									
1949	1		2		2		2			1	
	16		16		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

```
        1       0       0       0       0       0       0       0       0       0       0
        0       0

# Fishery north: sorted by year, gender, age-at-length bin observations (N=586)
# Year  Season  Type    Gender  Partition ageerr  Lbin_lo Lbin_hi Nsamp   Data: females then males
1966    1       2       1       2       1       9       9       1       0       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       0       0       0
        0       0       0       0
1966    1       2       1       2       1       10      10      5       0       0.202530156
        0.098306969     0.361471473     0.230709142     0       0.10698226      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
1966    1       2       1       2       1       11      11      25      0       0.009674694
        0.125328598     0.411226251     0.382385963     0.061163589     0.010220904     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
1966    1       2       1       2       1       12      12      26      0       0
        0.063907841     0.377001348     0.449609901     0.073329271     0.03266526
        0.003486379     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
1966    1       2       1       2       1       13      13      26      0       0.003787342
        0.015091426     0.27314657      0.48352735      0.13045378      0.071038673
        0.010826934     0.008615465     0.003512461     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
1966    1       2       1       2       1       14      14      26      0       0
        0.004577976     0.123162949     0.458837867     0.176406559     0.127624054
        0.043999574     0.035378501     0.01962731      0.01038521      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
1966    1       2       1       2       1       15      15      26      0       0       0
        0.101165422     0.279559021     0.243217874     0.116768725     0.139190743
        0.04743197      0.020212106     0.029933487     0.015873513     0.006647136     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
1966    1       2       1       2       1       16      16      21      0       0       0
        0.027835617     0.060539908     0.178627497     0.301640242     0.106948437
        0.08691382      0.090071492     0.040206269     0.040206269     0.053608358     0
        0.01340209      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
1966    1       2       1       2       1       17      17      11      0       0       0
        0       0.061443814     0.068356594     0.140032515     0.075116835     0.302658808
        0.160136811     0.048063656     0.048063656     0       0.048063656     0
        0.048063656     0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0
```

1966 1 2 1 2 1 18 18 8 0 0 0
0 0.104002681 0 0.100950039 0 0.221717716 0.098088505
0.320285198 0.078966907 0 0 0 0.075988955 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1966 1 2 2 2 1 9 9 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
1966 1 2 2 2 1 10 10 10 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0.062731881 0.068200926
0.23440661 0.386375171 0.114254095 0 0.134031317 0 0
0 0 0 0 0 0 0 0 0 0
1966 1 2 2 2 1 11 11 21 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.032359389
0.132757035 0.188126728 0.197698349 0.160087169 0.074653903
0.075924168 0.10409044 0.01733181 0.016971008 0 0 0
0 0 0 0 0
1966 1 2 2 2 1 12 12 20 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.092753418
0.108585269 0.050342928 0.131646736 0.133944743 0.145590027
0.16054206 0.063172986 0.018677239 0.056086263 0.018228278
0.020430052 0 0 0 0 0
1966 1 2 2 2 1 13 13 13 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.045493071
0.095258678 0.143662889 0.125423053 0 0.095258678 0.174460073
0.181792991 0.049992185 0.048925083 0.039733299 0 0 0
0 0 0
1966 1 2 2 2 1 14 14 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
0.25756542 0.300956633 0 0 0 0 0 0.172649698
0.268828248 0 0 0 0 0 0
1966 1 2 2 2 1 15 15 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
0.512888961 0 0 0 0.487111039 0 0 0 0
0 0 0 0 0 0
1966 1 2 2 2 1 16 16 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 1 0 0 0 0 0 0 0 0
0 0 0 0
1967 1 2 1 2 1 10 10 8 0 0
0.404934208 0.399992321 0.195073471 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
1967 1 2 1 2 1 11 11 29 0 0.009467862
0.286283856 0.311750201 0.203938357 0.188559724 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
1967 1 2 1 2 1 12 12 40 0 0.009295945
0.129905528 0.261513833 0.3362275 0.232892179 0.017547948
0.006013761 0 0.003289863 0.003313445 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
1967 1 2 1 2 1 13 13 40 0 0
0.02623162 0.152609388 0.367283818 0.363945178 0.042735426
0.031555844 0.00619476 0.005696338 0.001762684 0.001984943 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
1967 1 2 1 2 1 14 14 40 0 0
0.014423889 0.085325339 0.285778053 0.471996836 0.074163675
0.05587094 0.001835282 0.00628382 0.004322166 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
1967 1 2 1 2 1 15 15 39 0 0
0.003613526 0.067305618 0.186752515 0.416389474 0.143443714
0.111881442 0.030777374 0.018311887 0.014651985 0.003386854 0
0 0.00348561 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
1967 1 2 1 2 1 16 16 32 0 0 0
0.009155925 0.122122559 0.415513416 0.157416204 0.14478157
0.038961744 0.081961261 0.010270102 0.01981722 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
1967 1 2 1 2 1 17 17 24 0 0 0
0 0.168845622 0.096471483 0.156908269 0.129036703 0.131546252
0.130908473 0.054863237 0.07448437 0.05693559 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
1967 1 2 1 2 1 18 18 11 0 0 0
0 0 0.076905277 0.06829399 0 0.304039385 0.235853293
0.083608059 0 0.163006006 0 0 0.06829399 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1967 1 2 2 2 1 9 9 7 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.063557737
0.074770449 0.283573508 0.369583371 0.133744487 0.074770449 0
0 0 0 0 0 0 0 0 0 0 0
1967 1 2 2 2 1 10 10 12 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.133888812 0
0.213294898 0.334468444 0.183905715 0.134442131 0 0 0
0 0 0 0 0 0 0 0 0
1967 1 2 2 2 1 11 11 31 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0.029219374 0.059852694

	0.072564281	0.131216419	0.2534012	0.096622184	0.091988516						
	0.116941854	0.06004103	0.028256354	0.04669066	0	0					
	0.013205434	0	0	0	0	0					
1967	1	2	2	2	1	12	12	33	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.028693867		
	0.062287354	0.07604233	0.244954013	0.12731843	0.117115283						
	0.109076366	0.061786883	0.089931291	0	0.018097644	0.06469654					
	0	0	0	0	0	0					
1967	1	2	2	2	1	13	13	14	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
	0.086781365	0.15101951	0.176032014	0.091796798	0.22030862						
	0.048201723	0.047123777	0	0.132729056	0.046007136	0	0				
	0	0	0								
1967	1	2	2	2	1	14	14	3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.195433173	
	0	0	0	0	0.193994344	0	0	0.416578139	0		
	0	0	0	0.193994344	0	0	0				
1968	1	2	1	2	1	9	9	5	0	0	
	0.660880659	0.339119341	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				
1968	1	2	1	2	1	10	10	6	0	0	
	0.504197724	0.495802276	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				
1968	1	2	1	2	1	11	11	35	0	0.014439284	
	0.16986628	0.49390669	0.246340964	0.058079725	0.017367057	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		
1968	1	2	1	2	1	12	12	43	0	0	
	0.098964734	0.284015847	0.277837761	0.186236215	0.136291661						
	0.011507178	0.002641604	0	0.002505	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								
1968	1	2	1	2	1	13	13	43	0	0.003819952	
	0.026846838	0.133439772	0.210647161	0.296920264	0.278006833						
	0.03239057	0.011477233	0	0.002881188	0.001952142	0.001618047					
	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						
1968	1	2	1	2	1	14	14	43	0	0	
	0.009344038	0.050814425	0.114702536	0.2732023	0.391835414						
	0.087551502	0.045239373	0.009579291	0.008195425	0.004385802						
	0.005149894	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				
1968	1	2	1	2	1	15	15	43	0	0	0
	0.014140671	0.076127741	0.18667307	0.406274531	0.169646628						
	0.081407519	0.037069073	0.021142063	0.001941258	0.005577446	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
1968 1 2 1 2 1 16 16 42 0 0 0
0.006667737 0.046212172 0.147535501 0.367597356 0.174639799
0.101072433 0.084011686 0.040090696 0.026888177 0.005284443 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
1968 1 2 1 2 1 17 17 28 0 0 0
0 0 0.073762747 0.265521841 0.254212167 0.173155745
0.098883297 0.08566212 0.030328406 0.018473677 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
1968 1 2 1 2 1 18 18 13 0 0 0
0 0 0 0.193002413 0.144390515 0.054095195 0.242600242
0.060625732 0.160750307 0.072267798 0.072267798 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
1968 1 2 2 2 1 9 9 2 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.327874746 0
0 0.344250508 0.327874746 0 0 0 0 0 0
0 0 0 0 0 0 0
1968 1 2 2 2 1 10 10 10 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.10238361
0.247136727 0.171123608 0.184937158 0.174533642 0 0
0.05848694 0 0.061398313 0 0 0 0 0 0
0
1968 1 2 2 2 1 11 11 31 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.013723074
0.072215315 0.142688443 0.145426212 0.239582912 0.132197432
0.127888171 0.024591241 0.027529898 0.062061551 0.012095749 0
0 0 0 0 0 0
1968 1 2 2 2 1 12 12 29 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.022620048
0.034464746 0.059289111 0.079352748 0.24049526 0.153381936
0.11010949 0.160747408 0.033009368 0.023881931 0.047275719
0.023814147 0 0.011558087 0 0 0 0
1968 1 2 2 2 1 13 13 16 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.045631885
0.047742744 0.046428567 0.170751501 0.028304447 0.229751706
0.040506993 0.171016507 0.041269894 0.178595756 0 0 0
0 0 0 0
1968 1 2 2 2 1 14 14 3 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
0.319481375 0 0.680518625 0 0 0 0 0 0
0 0 0 0 0 0

1969 1 2 1 2 1 9 9 4 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 0 0 0 0 0
0 0 0 0
1969 1 2 1 2 1 10 10 20 0 0
0.513806653 0.329201139 0.113495231 0 0 0.021748488 0
0.021748488 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
1969 1 2 1 2 1 11 11 46 0 0.004179211
0.219746598 0.437689452 0.224688948 0.050596662 0.03034899
0.032750138 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
1969 1 2 1 2 1 12 12 46 0 0
0.117255877 0.300975029 0.3363237 0.138708896 0.058845245
0.038090864 0.003266797 0.003266797 0.003266797 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
1969 1 2 1 2 1 13 13 47 0 0
0.011950115 0.138168962 0.308045725 0.147751 0.213155138
0.126644206 0.025907374 0.016015001 0.006197965 0.004108957
0.002055557 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
1969 1 2 1 2 1 14 14 47 0 0
0.005072282 0.035883406 0.176623638 0.162829133 0.28287342
0.204552821 0.08671762 0.031605471 0.002263538 0.002399403
0.007034949 0.002144321 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
1969 1 2 1 2 1 15 15 47 0 0 0
0.014214697 0.072924791 0.096778078 0.329804464 0.308481793
0.093338504 0.06295435 0.014686566 0.003158665 0 0.003658093
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
1969 1 2 1 2 1 16 16 39 0 0 0
0 0.035113324 0.077901772 0.244886471 0.340091487 0.143425998
0.082708422 0.040827943 0.02137183 0.00666147 0.007011285 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
1969 1 2 1 2 1 17 17 26 0 0 0
0.018486722 0.037040757 0.016628394 0.067864419 0.266057325
0.235890299 0.142812587 0.055262181 0.09489427 0.048160787
0.016902259 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
1969 1 2 1 2 1 18 18 9 0 0 0
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1969 1 2 2 2 1 9 9 6 0 0 0
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0 0 0 0 0 0 0 0 0.229266053
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0 0 0 0 0 0 0 0 0
1969 1 2 2 2 1 10 10 22 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.019245729
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0.0647701 0.04454893 0 0 0 0 0 0 0
0 0 0
1969 1 2 2 2 1 11 11 35 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.04056353
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0.006896854 0 0 0 0
1969 1 2 2 2 1 12 12 29 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.078454356
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0.024579937 0.01159605 0 0 0 0 0
1969 1 2 2 2 1 13 13 12 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.047247503
0.115075185 0.085386791 0.180976875 0.229274041 0.041971664
0.084854799 0.087492063 0 0.12772108 0 0 0 0
0 0 0
1969 1 2 2 2 1 14 14 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 0.210201373 0.357805352 0.212474005 0 0 0
0.21951927 0 0 0 0 0 0 0
1969 1 2 2 2 1 15 15 3 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0
1970 1 2 1 2 1 9 9 4 0 0
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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
1970 1 2 1 2 1 10 10 27 0 0
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0
1970 1 2 1 2 1 11 11 47 0 0
0.241195719 0.379511182 0.22208529 0.110154618 0.032484365
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0 0 0 0 0 0 0 0 0 0 0

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	0	0									
1970	1	2	1	2	1	12	12	51	0	0.006787883	
	0.125864783		0.337368655		0.222880862		0.157880541		0.068134488		
	0.038414773		0.030667996		0.006605695		0.003513127		0	0	
	0.001881195	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					
1970	1	2	1	2	1	13	13	51	0	0	
	0.044476739		0.204629243		0.312638956		0.178486887		0.08959787		
	0.068292959		0.063780138		0.024046865		0.01087108		0.003179263	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						
1970	1	2	1	2	1	14	14	51	0	0	
	0.001878664		0.071802845		0.178615244		0.277828051		0.179814836		
	0.112548602		0.117069165		0.032666349		0.012621663		0.003428744		
	0.007986044		0.001871369		0.001868425		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		
1970	1	2	1	2	1	15	15	48	0	0	0
	0.0011407		0.072536222		0.226105972		0.294984754		0.141469929		
	0.155840605		0.068993577		0.021747109		0.008549127		0.002851352	0	
	0.002929301		0.002851352		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
1970	1	2	1	2	1	16	16	45	0	0	0
	0.030790259		0.012410699		0.156144078		0.197358633		0.228475766		
	0.173710449		0.120704943		0.024190269		0.02719469		0.011984261		
	0.005596358		0.005843237		0	0	0	0	0.005596358	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1970	1	2	1	2	1	17	17	25	0	0	0
	0	0	0.042103007		0.051423905		0.167820676		0.412524778		
	0.160227861		0.124935344		0.027769713		0.013194715		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									
1970	1	2	1	2	1	18	18	16	0	0	0
	0	0	0	0.04642029		0.355495125		0.271366139		0.079731226	
	0.088432605		0.047285042		0.071889166		0.039380407		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										
1970	1	2	2	2	1	8	8	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1970	1	2	2	2	1	9	9	9	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.124064428		0.496257711	
	0.085315691		0.157300167		0.061504953		0.033203738		0.042353312	0	
	0	0	0	0	0	0	0	0	0	0	0
1970	1	2	2	2	1	10	10	27	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

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0.201798903 0.14508192 0.112313654 0.06312552 0.075254847
0.076141555 0.006758534 0 0.008154529 0 0 0 0
0 0 0 0
1970 1 2 2 2 1 11 11 42 0 0 0
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0.004489109 0.004478142 0.003720607 0 0 0 0
1970 1 2 2 2 1 12 12 37 0 0 0
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0 0 0 0 0 0 0 0 0.036257682
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0.223971505 0.108438025 0.050291762 0.018539636 0.004780679
0.013127266 0.005804299 0 0 0 0 0
1970 1 2 2 2 1 13 13 24 0 0 0
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0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0
1970 1 2 2 2 1 14 14 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 0.519184638 0.133159119 0.107248562 0.107248562 0
0.133159119 0 0 0 0 0 0 0
1970 1 2 2 2 1 15 15 3 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 0.306090003 0 0.35491419 0 0.338995807 0
0 0 0 0 0 0 0
1971 1 2 1 2 1 10 10 1 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1971 1 2 1 2 1 11 11 4 0 0
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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
1971 1 2 1 2 1 12 12 4 0 0
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0.005965466 0.006822446 0 0 0.006610642 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
1971 1 2 1 2 1 13 13 4 0 0
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0 0 0
1971 1 2 1 2 1 14 14 4 0 0
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0.078891851 0.009920807 0.353663791 0 0.01099376 0 0
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0 0 0 0
1971 1 2 1 2 1 15 15 4 0 0 0
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0.304110673 0.169560117 0.114059104 0.039490287 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
1971 1 2 1 2 1 16 16 3 0 0 0
0 0.035140041 0.035140041 0.035140041 0 0.035140041
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0 0 0 0 0 0 0 0 0 0 0
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0 0
1971 1 2 1 2 1 17 17 3 0 0 0
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0.145773439 0.080769549 0.07288672 0 0.07288672 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
1971 1 2 1 2 1 18 18 3 0 0 0
0 0.351698661 0 0 0 0.307521186 0.340780152 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
1971 1 2 2 2 1 9 9 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.333333333
0.666666667 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1971 1 2 2 2 1 10 10 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
0.176470588 0.294117646 0.05882353 0.05882353 0 0.294117646
0.05882353 0 0 0 0 0.05882353 0 0 0
0
1971 1 2 2 2 1 11 11 2 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.064972032
0 0.129944062 0.064972032 0 0.129944062 0.285307654
0.194916094 0.064972032 0.064972032 0 0 0 0 0
0 0
1971 1 2 2 2 1 12 12 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
0.037960556 0 0 0 0.412840296 0.412840289 0 0
0.033192265 0.066384528 0 0.036782067 0 0 0 0
1971 1 2 2 2 1 13 13 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 0 0 0.356530777 0.643469223 0 0
0 0 0 0 0 0
1971 1 2 2 2 1 14 14 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0

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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1972	1	2	1	2	1	9	9	2	0	0	0
	0.193313973		0.806686027		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					
1972	1	2	1	2	1	10	10	9	0	0	
	0.139798786		0.613586513		0.055902723		0.055645792		0.082519311		
	0.034060649	0	0.018486226		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									
1972	1	2	1	2	1	11	11	16	0	0	
	0.07535246		0.355749622		0.250322236		0.197746935		0.029105763		
	0.028239369		0.028986506		0.017094683		0.011253876		0	0	0
	0	0.00614855		0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1972	1	2	1	2	1	12	12	17	0	0	
	0.024532284		0.204473668		0.364613824		0.256482473		0.0686858		
	0.022644874		0.013108179		0.006485728		0.026319629		0.004190399		
	0.004609942	0	0.003853199		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			
1972	1	2	1	2	1	13	13	17	0	0	
	0.003268689		0.112323538		0.272792825		0.342125929		0.166982712		
	0.038011385		0.020856464		0.009885837		0.028629726		0.003612936		
	0.001509958	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				
1972	1	2	1	2	1	14	14	17	0	0	
	0.002674076		0.062459727		0.138415892		0.260559306		0.216343736		
	0.1674695		0.095417465		0.028324648		0.016924632		0.008464054	0	
	0	0	0.002946964	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0					
1972	1	2	1	2	1	15	15	17	0	0	0
	0.004846861		0.061493185		0.146669872		0.274203467		0.272521972		
	0.095559905		0.03003691		0.085051084		0.023480239		0.006136504	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							
1972	1	2	1	2	1	16	16	16	0	0	0
	0.006629741	0	0.05487635		0.130518804		0.093512311		0.152824001		
	0.190487911		0.278034139		0.006622179		0.042843912		0.037020909		
	0.006629741	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0						
1972	1	2	1	2	1	17	17	11	0	0	0
	0	0.066249448	0	0	0.063456839		0.102547165		0.205718897		
	0.340062164		0.051475859		0.090892216		0.013347964		0	0.066249448	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0									

1972 1 2 1 2 1 18 18 9 0 0 0
0 0 0.057489843 0 0.189663249 0.042448724 0.039218035
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0
1972 1 2 2 2 1 9 9 4 0 0 0
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0 0 0 0
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1973 1 2 1 2 1 11 11 13 0 0
0.221028275 0.314323464 0.314551164 0.071737179 0.054490709
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0 0 0

1973 1 2 1 2 1 12 12 13 0 0
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0 0 0
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0 0 0
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0 0 0 0
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0 0 0
1973 1 2 1 2 1 16 16 12 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0
1973 1 2 1 2 1 17 17 8 0 0 0
0 0.072768004 0 0 0.079098974 0.451196179 0.15908327
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0 0 0 0 0 0 0 0 0 0
1973 1 2 1 2 1 18 18 4 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1973 1 2 2 2 1 9 9 2 0 0 0
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0 0 0.527655737 0 0 0 0 0 0 0
0 0 0 0 0 0
1973 1 2 2 2 1 10 10 9 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.084169865
0.239564047 0.155641342 0.043889849 0.28864774 0 0
0.049029347 0.049029347 0.049029347 0 0 0 0.040999117
0 0 0 0
1973 1 2 2 2 1 11 11 12 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.133799396
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0.055790674 0.082032732 0.060966961 0.041018626 0.086562034
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1973 1 2 2 2 1 12 12 12 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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1973 1 2 2 2 1 13 13 7 0 0 0
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0 0 0 0
1974 1 2 1 2 1 9 9 2 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1974 1 2 1 2 1 10 10 4 0 0
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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
1974 1 2 1 2 1 11 11 9 0 0.009633765
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0.027956152 0.028049075 0 0.009633765 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
1974 1 2 1 2 1 12 12 9 0 0
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0.094500709 0.049613781 0.019387492 0 0 0.0059986 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
1974 1 2 1 2 1 13 13 9 0 0 0
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0.06790844 0.029070549 0.015250364 0.009832194 0.014748292
0.004916097 0 0.004916097 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1974 1 2 1 2 1 14 14 9 0.006080224 0
0.008007511 0.044870553 0.114966566 0.199540316 0.143809703
0.268111289 0.066400123 0.046328562 0.053663537 0.014070574
0.014070574 0.00669349 0.01338698 0 0 0 0 0

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1974 1 2 1 2 1 15 15 8 0 0 0
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0.020553736 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
1974 1 2 1 2 1 16 16 9 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0
1974 1 2 1 2 1 17 17 6 0 0 0
0 0.065754305 0.062330114 0.124660227 0.124660227 0.209271023
0.074676731 0.199170656 0 0.073086497 0 0.066390219 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
1974 1 2 1 2 1 18 18 5 0 0 0
0 0 0.141339221 0.166141323 0.07066961 0.091589379
0.159941091 0.14594255 0.07527294 0 0.149103887 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
1974 1 2 2 2 1 7 7 1 0 0 0
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0 1 0 0 0 0 0 0 0 0 0
0 0 0 0
1974 1 2 2 2 1 8 8 1 0 0 0
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0 0 0 0 0 0 0 0.142857143 0
0.142857143 0.142857143 0 0.285714283 0.285714287 0 0
0 0 0 0 0 0 0 0 0 0
1974 1 2 2 2 1 9 9 3 0 0 0
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0 0 0 0 0 0 0 0 0 0.150785255
0 0.068169017 0.08910959 0.602826548 0 0.08910959 0
0 0 0 0 0 0 0 0 0
1974 1 2 2 2 1 10 10 3 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.11573951
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0 0 0 0 0 0 0 0 0
1974 1 2 2 2 1 11 11 7 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.210616161
0.137576353 0.068788176 0.057500136 0.135308645 0 0.137576355
0.083076745 0.117825827 0 0 0 0.051731601 0 0
0 0
1974 1 2 2 2 1 12 12 6 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.071023727
0.054801324 0.065656606 0.151212238 0.178828941 0.124027618

	0.054801324	0.109602645	0.131674565	0.058371011	0	0	0			
	0	0	0	0						
1974	1	2	2	2	1	13	13	3	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
	0.213911281	0	0	0.17854443	0.17854443	0	0.250455429				
	0.17854443	0	0	0	0	0	0	0			
1974	1	2	2	2	1	14	14	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	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1975	1	2	1	2	1	3	3	1	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	0	0	0	0	0
	0	0	0	0							
1975	1	2	1	2	1	8	8	2	0	0	
	0.313845765	0.343077117	0.343077117	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			
1975	1	2	1	2	1	9	9	3	0	0	
	0.801875352	0.198124648	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	0	0				
1975	1	2	1	2	1	10	10	8	0	0	0
	0.285147237	0.359935396	0.233435525	0.061260847	0.03511401	0					
	0.025106984	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	
1975	1	2	1	2	1	11	11	11	0	0	
	0.09141835	0.234801775	0.347816905	0.185775599	0.078287176						
	0.043837667	0.01160954	0.006452987	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								
1975	1	2	1	2	1	12	12	11	0	0	
	0.033874218	0.146218309	0.344009261	0.208694157	0.140666727						
	0.057057571	0.045278451	0.007444847	0.012013421	0.004743039	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						
1975	1	2	1	2	1	13	13	11	0	0	
	0.003814887	0.091642569	0.258705083	0.235251721	0.212222616						
	0.089830326	0.051954481	0.027495448	0.009569964	0.006804707						
	0.004784982	0.007923216	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			
1975	1	2	1	2	1	14	14	11	0	0	0
	0.066728707	0.169228196	0.214186368	0.182123135	0.092195138						
	0.125696142	0.077335369	0.018288513	0.03024255	0.011987941						
	0.00599397	0.00599397	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				

1975 1 2 1 2 1 15 15 10 0 0
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0.108122044 0.260070662 0.073384458 0.061720651 0.02080253
0.034341436 0.009948649 0 0.010457539 0.019897297 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
1975 1 2 1 2 1 16 16 9 0 0 0
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0.17902103 0.109167287 0.063818897 0.126968476 0 0.061464774
0.038300826 0.038300826 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1975 1 2 1 2 1 17 17 9 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
1975 1 2 1 2 1 18 18 5 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1975 1 2 2 2 1 3 3 1 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
1975 1 2 2 2 1 4 4 2 0 0 0
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1975 1 2 2 2 1 8 8 3 0 0 0
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1975 1 2 2 2 1 9 9 3 0 0 0
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0 0 0
1975 1 2 2 2 1 11 11 10 0 0 0
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0 0 0 0

1975 1 2 2 2 1 12 12 9 0 0 0
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0 0 0 0 0 0 0 0 0 0.125777242
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1975 1 2 2 2 1 13 13 2 0 0 0
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0 0.482518907 0 0 0 0 0 0 0
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1977 1 2 1 2 1 7 7 1 0 1 0
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0 0 0 0
1977 1 2 1 2 1 8 8 1 0 0 0.5
0.5 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
1977 1 2 1 2 1 9 9 8 0 0
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1977 1 2 1 2 1 10 10 13 0 0
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1977 1 2 1 2 1 11 11 19 0 0
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1977 1 2 1 2 1 12 12 19 0 0
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1977 1 2 1 2 1 13 13 18 0 0 0
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1977 1 2 1 2 1 14 14 18 0 0 0
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1977 1 2 1 2 1 16 16 18 0 0 0
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1978 1 2 1 2 1 9 9 10 0 0
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1978 1 2 1 2 1 10 10 18 0 0
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1978 1 2 1 2 1 11 11 21 0 0
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1978 1 2 1 2 1 13 13 21 0 0 0
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1978 1 2 2 2 1 13 13 1 0 0 0
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0 0 0 0
1979 1 2 1 2 1 9 9 4 0 0
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1979 1 2 1 2 1 10 10 13 0 0
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1979 1 2 1 2 1 11 11 14 0 0
0.028789805 0.240419631 0.477264042 0.21539963 0.018205919
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1979 1 2 1 2 1 12 12 14 0 0 0
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1979 1 2 1 2 1 13 13 14 0 0 0
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1979 1 2 1 2 1 14 14 14 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1979 1 2 1 2 1 15 15 14 0 0 0
0 0.058417434 0.073059629 0.14423692 0.136690617 0.291240135
0.133511677 0.119462163 0.043381425 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
1979 1 2 1 2 1 16 16 13 0 0 0
0 0 0.087536221 0.144654891 0.258404049 0.237297101
0.222367016 0.03458327 0.015157452 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
1979 1 2 1 2 1 17 17 7 0 0 0
0 0 0 0.044131868 0.189912093 0.543747893 0
0.149695826 0.033386319 0.039126003 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
1979 1 2 1 2 1 18 18 6 0 0 0
0 0 0 0 0 0 0.081282718 0.369413298
0.379416273 0 0.169887711 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
1979 1 2 2 2 1 9 9 4 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.313515002

0.321793009 0 0.123304025 0 0.123304025 0.118083939 0
0 0 0 0 0 0 0 0 0 0
1979 1 2 2 2 1 10 10 9 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.042143669
0.364744929 0.218397556 0.01365979 0.04130969 0.079396408
0.103701457 0.032945044 0.026732851 0.076968606 0 0 0
0 0 0 0 0
1979 1 2 2 2 1 11 11 10 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.406893515 0.065092352 0.049097877 0.166555053 0.144931049
0.143795517 0.023634639 0 0 0 0 0 0 0
0 0
1979 1 2 2 2 1 12 12 9 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.022326019
0 0.160240588 0.117878696 0.194681101 0.284572997 0.019155136
0.125800074 0.031652321 0 0.043693069 0 0 0 0
0 0
1979 1 2 2 2 1 13 13 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 0.944219276 0 0 0.055780724 0 0 0 0
0 0 0 0 0 0
1980 1 2 1 2 1 8 8 1 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 0 0 0 0
0 0 0 0
1980 1 2 1 2 1 9 9 8 0 0
0.048567148 0.328978849 0.622454003 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
1980 1 2 1 2 1 10 10 34 0 0
0.123725088 0.417288031 0.38413537 0.055117869 0.017763149
0.000409592 0 0 0.0015609 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
1980 1 2 1 2 1 11 11 42 0 0
0.049435556 0.264914709 0.425699454 0.19677078 0.040030734
0.013863243 0.005866176 0.001921531 0.001497818 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
1980 1 2 1 2 1 12 12 43 0 0
0.018977827 0.120307036 0.341918518 0.293628617 0.154187334
0.040477481 0.022986499 0.006859464 0.00025603 0.000401194 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
1980 1 2 1 2 1 13 13 44 0 0
0.009419174 0.090081316 0.224397566 0.290464878 0.200861128
0.090396038 0.040617605 0.031923155 0.008873195 0.011167908

0.001798037 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
1980 1 2 1 2 1 14 14 44 0 0 0
0.037302053 0.118488084 0.199256914 0.204445417 0.164486263
0.169256867 0.06810123 0.015363335 0.013579209 0.008246794
0.001473834 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
1980 1 2 1 2 1 15 15 42 0 0 0
0 0.027464458 0.088628721 0.190187767 0.226935559 0.152133586
0.159481226 0.080364433 0.040224844 0.010348017 0.008746861
0.005476505 0.006634988 0.002140158 0 0.001232877 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1980 1 2 1 2 1 16 16 34 0 0 0
0 0.040389484 0.047111968 0.075381639 0.225735623 0.198572336
0.189224656 0.070109276 0.054544584 0.031440439 0.008299638
0.01769722 0.008299638 0.023074797 0.007728123 0.002390579 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1980 1 2 1 2 1 17 17 27 0 0 0
0 0 0.011992815 0.046700269 0.007177771 0.125285628
0.260185437 0.158045084 0.241810211 0.100780423 0.008388831
0.008388831 0.007233519 0 0.01562235 0 0.008388831 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1980 1 2 1 2 1 18 18 19 0 0 0
0 0 0 0.01729772 0.085213597 0.079327077 0.394224382
0.16995045 0.071492782 0.088009488 0.018473768 0.052310768
0.008705269 0.00265942 0 0.012335277 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1980 1 2 2 2 1 9 9 4 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.135794697
0.440158697 0.11191477 0.11191477 0.088302297 0.11191477 0
0 0 0 0 0 0 0 0 0 0 0
1980 1 2 2 2 1 10 10 14 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.038687242
0.014970727 0.149597403 0.164490135 0.157618624 0.20945628
0.094571839 0.137697175 0.004596234 0.023718106 0 0.004596234
0 0 0 0 0 0
1980 1 2 2 2 1 11 11 12 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.008919658
0.015957392 0.008919658 0.21231815 0.076355039 0.089904256
0.251992115 0.212176537 0.001567327 0.046047586 0.035080849
0.040761432 0 0 0 0 0 0
1980 1 2 2 2 1 12 12 13 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.01309356
0 0.002933394 0.185212533 0.317066633 0.168125212 0.115634939
0.01498727 0.151782469 0.015581995 0.015581995 0 0 0
0 0 0

1980 1 2 2 2 1 13 13 6 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.020557713 0 0.046251484 0 0 0 0.684245337
0.221935156 0 0.027010309 0 0 0 0 0 0
1980 1 2 2 2 1 14 14 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 1 0 0 0 0 0
0 0 0 0
1980 1 2 2 2 1 17 17 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
0.700150605 0 0.299849395 0 0 0 0 0 0
0 0 0 0 0 0
1980 1 2 2 2 1 18 18 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 0 0 0 0
0 0 0 0
1981 1 2 1 2 1 9 9 21 0 0
0.04685742 0.423069826 0.406513031 0.10040156 0.023158163 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
1981 1 2 1 2 1 10 10 41 0 0
0.079538179 0.208366481 0.261006923 0.264640543 0.160462932
0.02570193 0 0.000283012 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
1981 1 2 1 2 1 11 11 49 0 0
0.01689952 0.086579928 0.284332465 0.320345935 0.201297093
0.062163271 0.012893224 0.000239143 0.00547944 0.009377111 0
0.000392869 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
1981 1 2 1 2 1 12 12 49 0 0
0.020466176 0.051738895 0.192346182 0.315347599 0.229562831
0.106857604 0.054233787 0.023036363 0.002097486 0.004177554
0.000135523 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
1981 1 2 1 2 1 13 13 49 0 0
5.65499E-05 0.047348664 0.131038542 0.28681318 0.24865385
0.157040057 0.077344871 0.029660757 0.0166081 0.004829947
0.000126328 0 0.000479153 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
1981 1 2 1 2 1 14 14 49 0 0
0.001054574 0.003546636 0.104285514 0.16328645 0.315111082
0.195109618 0.090395857 0.059416097 0.059654306 0.007132518
0.000748042 0 0 0.000259307 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0

1981 1 2 1 2 1 15 15 46 0 0 0
0.0010609 0.0651593 0.16065251 0.21585725 0.143633051
0.105081089 0.11647637 0.087004906 0.04981534 0.021674389
0.032596566 0 0.000494165 0.000494165 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1981 1 2 1 2 1 16 16 34 0 0 0
0.004251124 0.010174013 0.006382953 0.144214882 0.132862895
0.219643 0.208546188 0.087254494 0.048976272 0.004251124
0.010844535 0.061299259 0 0 0 0.061299259 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1981 1 2 1 2 1 17 17 22 0 0 0
0 0 0 0.05971397 0.138616374 0.117437568 0.11105242
0.407988671 0.125990738 0.019397263 0.003278035 0.012468431 0
0.00405653 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0
1981 1 2 1 2 1 18 18 15 0 0 0
0 0 0 0 0.009338898 0.183964414 0.210320347
0.275323743 0.031255544 0.259563903 0 0.006629829 0 0
0 0 0.023603322 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
1981 1 2 2 2 1 9 9 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
0.428571433 0 0.142857142 0 0.285714283 0.142857142 0
0 0 0 0 0 0 0 0
1981 1 2 2 2 1 10 10 5 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0.146846605 0 0.321081288 0.364325728 0.023963768 0.047927536
0.095855075 0 0 0 0 0 0 0 0 0
1981 1 2 2 2 1 11 11 2 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.104598756 0
0.104598756 0.104598756 0.145401245 0.104598756 0.040802487
0.29080249 0 0 0 0.104598756 0 0 0 0
0 0
1981 1 2 2 2 1 12 12 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
0.819509655 0.180490345 0 0 0 0 0 0 0
0 0 0 0 0 0
1981 1 2 2 2 1 14 14 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 1 0 0 0 0 0 0 0
0 0 0 0
1982 1 2 1 2 1 8 8 4 0 0
0.315905359 0.368189283 0.315905359 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

1982 1 2 1 2 1 9 9 27 0 0
0.15349915 0.450648465 0.251009316 0.108381084 0.007953842
0.022580513 0.00592763 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
1982 1 2 1 2 1 10 10 48 0 0
0.039573628 0.321707949 0.32311772 0.154716919 0.08767442
0.052348672 0.012336352 0.008524341 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
1982 1 2 1 2 1 11 11 51 0 0
0.011315752 0.144139472 0.304245468 0.238643321 0.149555435
0.112092192 0.036195429 0.002619031 0.001193901 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
1982 1 2 1 2 1 12 12 52 0 0
0.000124775 0.064828274 0.214558998 0.238477057 0.207256414
0.184293157 0.063365269 0.023599914 0.001678046 0.001818096 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
1982 1 2 1 2 1 13 13 52 0 0 0
0.012666277 0.115745707 0.234916631 0.218425603 0.212349257
0.121853847 0.047735182 0.019754713 0.010790575 0.003885652
0.001006127 0.000870429 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
1982 1 2 1 2 1 14 14 50 0 0 0
0 0.032605188 0.140710045 0.203549677 0.282097625 0.15529117
0.0743223 0.061925314 0.014004318 0.023761228 0.001422703
0.00384011 0.001422703 0 0.005047619 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1982 1 2 1 2 1 15 15 46 0 0 0
0 0.00729439 0.049859558 0.130954424 0.198949801 0.197786015
0.160370177 0.074042066 0.072018897 0.045224193 0.025626561
0.020571269 0.008073145 0.004075271 0.005154232 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0
1982 1 2 1 2 1 16 16 33 0 0 0
0 0 0.040211308 0.054926958 0.142233668 0.165652527
0.183826418 0.164187257 0.134891608 0.073204065 0.015880971
0.007625997 0 0.006891769 0 0.010467454 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1982 1 2 1 2 1 17 17 23 0 0 0
0 0 0 0.019414765 0.093154464 0.022173678 0.140745836
0.102552929 0.271815919 0.202087371 0.059917229 0.088137809 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
1982 1 2 1 2 1 18 18 14 0 0 0
0 0.037773004 0 0 0.00501221 0 0.026527612

	0.0157772		0.129269666		0.168352826		0.227023183		0.037453838		
	0.198958041		0.153852419		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1982	1	2	2	2	1	12	12	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	1	0	0	0	0	0	0	0	0
	0	0	0	0							
1983	1	2	1	2	1	7	7	1	0	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	0	0	0
	0	0	0	0							
1983	1	2	1	2	1	8	8	2	0	0	
	0.558116069		0		0.441883931		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				
1983	1	2	1	2	1	9	9	9	0	0	
	0.262458456		0.150134137		0.210036718		0.248386801		0.046314307		
	0.04133479		0.04133479		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									
1983	1	2	1	2	1	10	10	25	0	0	
	0.038223012		0.190763441		0.324250667		0.222369436		0.13598001		
	0.043614023		0.026167913		0.00707882		0.000797762		0.000797762		
	0.009957154		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				
1983	1	2	1	2	1	11	11	28	0	0	
	0.002389382		0.101179153		0.276788173		0.263033575		0.199717549		
	0.072277563		0.058273831		0.011648506		0.002439047		0.000424568		
	0.003767344		0.002762118		0		0.005299191	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
1983	1	2	1	2	1	12	12	28	0	0	0
	0.039535012		0.182748669		0.242912413		0.243376804		0.131341693		
	0.128067337		0.028083495		0.001967288		0.001967288		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								
1983	1	2	1	2	1	13	13	28	0	0	0
	0.019098217		0.11046504		0.149769209		0.209644175		0.183583864		
	0.210863898		0.096768233		0.009521077		0.005606226		0	0	0
	0.004680061		0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1983	1	2	1	2	1	14	14	25	0	0	0
	0		0.055047017		0.112213369		0.19628684		0.192333333		0.254886482
	0.088833748		0.061366505		0.015228135		0.023804571		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									

1983 1 2 1 2 1 15 15 20 0 0 0
0.008073837 0.003208354 0.029410649 0.099625848 0.221407113
0.32286293 0.161714074 0.075743882 0.024407028 0.041095013 0
0 0 0 0.012451271 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1983 1 2 1 2 1 16 16 19 0 0 0
0 0 0.03222203 0.139725783 0.151890748 0.129730545
0.146060493 0.1768865 0.06766501 0.098639863 0 0.031566662
0 0.025612365 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
1983 1 2 1 2 1 17 17 8 0 0 0
0 0 0 0 0.02035726 0.230091058 0.159747935
0.176186734 0.092785557 0.218388654 0 0 0.102442802 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
1983 1 2 1 2 1 18 18 5 0 0 0
0 0 0 0 0 0 0.535410735 0.126493655
0.262510331 0.075585279 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
1984 1 2 1 2 1 7 7 1 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 0 0 0 0 0
0 0 0 0
1984 1 2 1 2 1 8 8 3 0 0.109984159
0.346365185 0.480710314 0.062940342 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
1984 1 2 1 2 1 9 9 10 0 0.035773885
0.142326593 0.31098455 0.353416214 0.117699897 0.039798861 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
1984 1 2 1 2 1 10 10 24 0 0
0.032938227 0.210192339 0.265441676 0.336660007 0.069490429
0.079666799 0.00258817 0.003022355 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
1984 1 2 1 2 1 11 11 26 0 0
0.013664527 0.071542091 0.304688837 0.295435939 0.154445751
0.073337042 0.051491114 0.026065403 0.000281951 0.007748012 0
0.001299333 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
1984 1 2 1 2 1 12 12 26 0 0.010323393
0 0.015923571 0.13144304 0.29972774 0.243847348 0.129868908
0.101853686 0.05903658 0.003122256 0.001391034 0.001731222
0.001731222 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

1984 1 2 1 2 1 13 13 26 0 0 0
0.005177645 0.098930143 0.275091327 0.179799825 0.173061367
0.130621977 0.097135447 0.031467001 0.004882766 0.001322046 0
0.002510456 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
1984 1 2 1 2 1 14 14 25 0 0 0
0 0.002630779 0.147012441 0.258705495 0.254136178 0.142509671
0.115145739 0.041467303 0.029506757 0.008885637 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
1984 1 2 1 2 1 15 15 22 0 0 0
0 0.005700321 0.013809148 0.141105759 0.297481281 0.130859383
0.082693657 0.221315419 0.049541593 0.029816617 0.005442939 0
0.003441621 0.018792261 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1984 1 2 1 2 1 16 16 21 0 0 0
0 0 0 0.060521964 0.159675991 0.186911988 0.345283836
0.106633229 0.085487013 0.011717772 0.03247419 0.005258002 0
0.006036016 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0
1984 1 2 1 2 1 17 17 11 0 0 0
0 0 0 0 0.251450778 0.082369036 0 0.110932909
0.3263853 0.104063306 0 0 0 0 0.082369036 0
0.042429635 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
1984 1 2 1 2 1 18 18 5 0 0 0
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	0.137821673	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0						
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	0										
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	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	0	0	0	0	0
	0	0	0	0							
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
1988	1	2	1	2	1	10	10	6	0	0.012498925	
	0.049801475	0.292497297	0.304074543	0.153071055	0.145523484						
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	0	0	0	0	0	0	0	0	0	0	0
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	0	0									
1988	1	2	1	2	1	11	11	10	0	0	
	0.114598313	0.151520224	0.252035913	0.240310907	0.147975629						
	0.028623664	0.030832072	0.000225998	0.024442895	0.008915964						
	0.000518421	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0						
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	0	0	0	0	0	0	0	0	0	0	0
	0.916282892		0.004358603		0.079358506		0	0	0	0	0
	0	0	0	0	0	0	0				
1990	1	2	2	2	1	13	13	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	1	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1990	1	2	2	2	1	14	14	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1991	1	2	1	2	1	7	7	1	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	0	0	0	0	0	0
	0	0	0	0							
1991	1	2	1	2	1	8	8	2	0	0.961674137	
	0	0.038325863		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					
1991	1	2	1	2	1	9	9	5	0	0.205263009	
	0.237790322		0.556946669		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				
1991	1	2	1	2	1	10	10	18	0	0.063589824	
	0.189434889		0.298933199		0.167387438		0.143347094		0.123254076		0
	0.01405348		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
1991	1	2	1	2	1	11	11	25	0	0	
	0.069302199		0.239156533		0.274305037		0.257067326		0.112599449		
	0.034880118		0.008758693		0.002953604		0	0	0	0.000977041	
	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							

1991 1 2 1 2 1 12 12 25 0 0
0.016555583 0.095000464 0.212316975 0.343808982 0.260784971
0.052031003 0.015385692 0.003286594 0.000298053 0.000531682 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
1991 1 2 1 2 1 13 13 25 0 0
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0.000105776 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
1991 1 2 1 2 1 14 14 24 0 0 0
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0.07114248 0.019767573 0.00177594 0.016969052 0.001112556 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
1991 1 2 1 2 1 15 15 21 0 0 0
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0.101682095 0.083949844 0.030356113 0.001700948 0.000944455 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
1991 1 2 1 2 1 16 16 12 0 0 0
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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
1991 1 2 1 2 1 17 17 6 0 0 0
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0.193594679 0.039088129 0.112383735 0 0.193594679 0 0
0 0.344074392 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
1991 1 2 1 2 1 18 18 3 0 0 0
0 0 0.425308727 0 0 0 0.165312795 0 0
0 0 0 0.409378478 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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1991 1 2 2 2 1 9 9 1 0 0 0
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0 0.428571429 0.428571429 0 0 0 0 0 0
0 0 0 0 0 0 0
1991 1 2 2 2 1 10 10 6 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.223207397
0.128585012 0.114784091 0.149468273 0.126063648 0.257891579 0
0 0 0 0 0 0 0 0 0 0
1991 1 2 2 2 1 11 11 5 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 0.294577769 0.032098911 0.253696631 0.022028288 0
0.198799201 0 0.198799201 0 0 0 0 0 0

1991 1 2 2 2 1 12 12 4 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0
1992 1 2 1 2 1 13 13 9 0 0 0
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1992 1 2 1 2 1 15 15 9 0 0 0
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1992 1 2 1 2 1 16 16 7 0 0 0
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1992 1 2 1 2 1 18 18 2 0 0 0
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1993 1 2 1 2 1 8 8 2 0 0 0
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1993 1 2 1 2 1 13 13 12 0 0
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0 0 0 0
1993 1 2 2 2 1 11 11 1 0 0 0
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1994 1 2 1 2 1 9 9 10 0 0
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1994 1 2 1 2 1 10 10 16 0 0.040675827
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1994 1 2 1 2 1 14 14 17 0 0 0
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1994 1 2 1 2 1 15 15 13 0 0 0
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1994 1 2 1 2 1 16 16 7 0 0 0
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1994 1 2 1 2 1 17 17 4 0 0 0
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1994 1 2 2 2 1 12 12 1 0 0 0
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1995 1 2 1 2 1 11 11 19 0 0.006303487
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1995 1 2 1 2 1 12 12 20 0 0
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1995 1 2 1 2 1 13 13 20 0 0 0
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1995 1 2 1 2 1 14 14 19 0 0
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1995 1 2 1 2 1 16 16 12 0 0 0
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1995 1 2 1 2 1 17 17 10 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0

1995	1	2	1	2	1	18	18	4	0	0	0
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	0.014309897	0	0	0.080812471	0	0	0	0			
	0.404911845	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
1995	1	2	2	2	1	10	10	5	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0.322487594	0	
	0.058791467	0	0.23688474	0	0	0.066325508	0				
	0.315510691	0	0	0	0	0	0	0	0		
1995	1	2	2	2	1	11	11	3	0	0	0
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	0	0	0	0	0	0	0	0	0	0	
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	0	0	0	0	0	0	0				
1995	1	2	2	2	1	12	12	1	0	0	0
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	0	0	0	0	0	0	0	0	0	0.5	0
	0.5	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1995	1	2	2	2	1	14	14	1	0	0	0
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	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1996	1	2	1	2	1	8	8	2	0	0.02141608	
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
1996	1	2	1	2	1	9	9	8	0	0.034465721	
	0.070568755	0.411076539	0.252832039	0.191586109	0	0	0				
	0	0	0.039470837	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	
1996	1	2	1	2	1	10	10	16	0	0	
	0.05299741	0.178717701	0.380834784	0.256942447	0.054884018						
	0.02947859	0.024129408	0.014839752	0.007175888	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							
1996	1	2	1	2	1	11	11	16	0.006811092		
	4.48882E-05	0.025543016	0.065050028	0.32680877	0.263343333						
	0.201235696	0.072799996	0.02736029	0.002779437	0.004996987						
	0.003226465	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			
1996	1	2	1	2	1	12	12	16	0	0	0
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	0.064817981	0.050450271	0.015040516	0.020025029	0	0.001292363					
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0							
1996	1	2	1	2	1	13	13	16	0	0	
	0.008449219	0.031385011	0.165949301	0.291554142	0.238602357						
	0.117005721	0.057558824	0.038224719	0.035451632	0.011023536						

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1996 1 2 1 2 1 15 15 11 0 0 0
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2003 1 2 1 2 1 10 10 9 0 0.055889894
0.086522241 0.075328475 0.177529728 0.185353714 0.155073872
0.128603483 0.057281745 0.014090069 0.057281745 0.007045035 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
2003 1 2 1 2 1 11 11 17 0 0.004209304
0.218703582 0.2167912 0.14673548 0.172434853 0.084046224
0.073725053 0.061105955 0.003132971 0.00944252 0 0.005957009
0.003715848 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
2003 1 2 1 2 1 12 12 18 0 0
0.045253346 0.246597749 0.228560959 0.141211023 0.150812228
0.087560001 0.073189107 0.024167134 0.001049736 0 0
0.001598717 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
2003 1 2 1 2 1 13 13 19 0 0.007051897
0.046806463 0.291684817 0.185403262 0.092857202 0.122174271
0.120547564 0.05839646 0.035631801 0.023167378 0.011745398 0
0.001673657 0 0.002859831 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
2003 1 2 1 2 1 14 14 19 0 0
0.044646866 0.172107669 0.188101303 0.104187686 0.160959477
0.125514457 0.096515325 0.079425944 0.028541272 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
2003 1 2 1 2 1 15 15 15 0 0 0
0.246053004 0.167477142 0.145445092 0.086603856 0.13073246
0.127786337 0.021539016 0.041923397 0.008575997 0.014409321
0.009454378 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
2003 1 2 1 2 1 16 16 13 0 0 0
0.020495853 0.089015444 0.206767628 0.029583205 0.287355278
0.059405071 0.062450699 0.070983401 0.04840059 0 0.058852863
0.005916641 0.060773327 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
2003 1 2 1 2 1 17 17 6 0 0 0
0.089194803 0 0 0 0.050933054 0.208981371 0.050933054
0.072395357 0.194684808 0.172783692 0.072395357 0 0
0.087698505 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0
2003 1 2 1 2 1 18 18 2 0 0 0
0 0 0 0 0 0 0.260229273 0 0
0.369885363 0.369885363 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			
2003	1	2	2	2	1	9	9	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.5	0
	0	0	0.5	0	0	0	0	0	0	0	0
	0	0	0	0							
2003	1	2	2	2	1	11	11	3	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0.341498029		0.191221923		0.341498029		0.06289101		0	0.031445504	
	0	0	0.031445504	0	0	0	0	0	0	0	
2004	1	2	1	2	1	10	10	5	0	0	
	0.116383699		0.312679768		0.538306303		0.032630229		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		
2004	1	2	1	2	1	11	11	13	0	0	
	0.04376793		0.308560514		0.34971352		0.094701528		0.026127034		
	0.054327767		0.122801707		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									
2004	1	2	1	2	1	12	12	17	0	0	
	0.021868992		0.178361356		0.350914575		0.176524573		0.144497184		
	0.049091441		0.043004935		0.015313787		0.018157743		0	0	
	0.002265413		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					
2004	1	2	1	2	1	13	13	17	0.007540311		0
	0.007214833		0.193938904		0.270310385		0.118369462		0.247889223		
	0.066566684		0.042426664		0.034489693		0.011253841		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							
2004	1	2	1	2	1	14	14	18	0	0	0
	0.162272998		0.231542273		0.180357045		0.11996582		0.068170659		
	0.105350078		0.052634898		0.032922638		0.011634031		0.02416541		
	0.010984148		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					
2004	1	2	1	2	1	15	15	13	0	0	0
	0.047397983		0.134816847		0.124567151		0.120103467		0.133334128		
	0.105333122		0.095169264		0.11167313		0.08226792		0.038403339		0
	0	0.006933649		0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2004	1	2	1	2	1	16	16	11	0	0	0
	0	0.083700481		0.114845361		0.037528568		0.142213981		0.275598085	
	0.016902537		0.074450768		0.134080113		0		0.089860547	0	0
	0.01540978		0.01540978		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2004	1	2	1	2	1	17	17	6	0	0	0
	0	0	0	0	0.117084849		0.375312962		0.160609379		
	0.105722978		0.129957137		0		0.062844377		0.024234159	0	0

	0.024234159	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	0	0									
2004	1	2	1	2	1	18	18	5	0	0	0
	0	0	0.004037764		0.063906186		0	0.004037764		0.403841654	
	0.256701156	0	0		0.267475476		0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0		
2004	1	2	2	2	1	11	11	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0.5
	0.5	0	0	0	0	0	0	0	0	0	
	0	0	0	0							
2004	1	2	2	2	1	15	15	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	
	1	0	0	0	0	0	0	0	0	0	
	0	0	0	0							
2005	1	2	1	2	1	8	8	1	0	0	
	0.333333333	0.666666667			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				
2005	1	2	1	2	1	9	9	3	0	0	
	0.054135119	0.219376305			0.726488576		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			
2005	1	2	1	2	1	10	10	10	0	0	
	0.058505574	0.305868626			0.569274723		0.066351077		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		
2005	1	2	1	2	1	11	11	17	0	0	
	0.005592876	0.144311929			0.475048276		0.182084403		0.125557194		
	0.05207051	0.005329324			0.005002744		0.005002744		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							
2005	1	2	1	2	1	12	12	18	0	0	
	0.005260803	0.066768979			0.249255192		0.26596089		0.213077633		
	0.138508804	0.046879173			0.008201605		0.006086921		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							
2005	1	2	1	2	1	13	13	20	0	0	0
	0.049650298	0.233130157			0.19539268		0.218501295		0.122808529		
	0.071587029	0.05671758			0.018842369		0.033370063		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								
2005	1	2	1	2	1	14	14	19	0	0	0
	0.010247408	0.177327292			0.352592711		0.156021625		0.075694766		
	0.072109649	0.050999386			0.06659808		0.025101289		0	0.003425151	
	0	0	0	0	0	0.009882642		0	0	0	

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2005	1	2	1	2	1	15	15	15	0	0	0
	0.022754749		0.101269256		0.1961282		0.172114295		0.213898096		
	0.154966313		0.030935832		0.035763643		0.011566895		0.044275143		
	0.004760685		0.009524877		0.002042018		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
2005	1	2	1	2	1	16	16	10	0	0	0
	0	0.045687374		0.186219324		0.271533249		0.052089638		0.059681617	
	0.255037921		0.084738103		0.02446545		0.001071288		0	0	
	0.006595979		0.012880059		0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2005	1	2	1	2	1	17	17	8	0	0	0
	0.096296799		0		0.072370964		0	0.146380228		0.02182265	
	0.219897964		0.001675704		0.085287171		0	0.272657051		0.083611467	
	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								
2005	1	2	1	2	1	18	18	5	0	0	0
	0	0	0	0.286646439		0	0.040405288		0	0	
	0.167685238		0	0.200668426		0.167685238		0	0.136909371		0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
2005	1	2	2	2	1	10	10	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	1
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	2	2	2	1	11	11	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
	0.5	0	0	0	0.5	0	0	0	0	0	0
	0	0	0	0							
2005	1	2	2	2	1	12	12	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	1	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2006	1	2	1	2	1	9	9	1	0	0	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	0	0
	0	0	0	0							
2006	1	2	1	2	1	10	10	5	0	0	0
	0.271121571		0.334047478		0.244878863		0.149952088		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			
2006	1	2	1	2	1	11	11	14	0	0	
	0.033102414		0.053192989		0.124655276		0.309532705		0.309043785		
	0.092394605		0.003021576		0.07505665		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								

2006 1 2 1 2 1 12 12 17 0 0
0.002710596 0.00539683 0.042392419 0.193854638 0.278942528
0.285818681 0.133690391 0.048306832 0.00133269 0.003167298 0
0.004387098 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
2006 1 2 1 2 1 13 13 17 0 0 0
0 0.027771468 0.119633781 0.293232593 0.217801328 0.1501606
0.090101256 0.057589517 0.043709456 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
2006 1 2 1 2 1 14 14 17 0 0 0
0 0.002349959 0.109647681 0.24714569 0.221040635 0.150131161
0.086352676 0.062247248 0.075260856 0.013976872 0.03184722 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0
2006 1 2 1 2 1 15 15 16 0 0 0
0 0 0.100396349 0.216488198 0.26073091 0.084722499
0.172121215 0.058949588 0.057766609 0.021558709 0.027265922 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0
2006 1 2 1 2 1 16 16 7 0 0 0
0 0.062519558 0 0.54444404 0.068590793 0.01214247
0.01214247 0.050025818 0.212251502 0.037883349 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
2006 1 2 1 2 1 17 17 8 0 0 0
0 0.224424434 0 0.077185649 0.098177988 0.113912121
0.077185649 0.162024864 0 0 0.07596425 0 0
0.138662049 0.032462995 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
0 0 0 0
2006 1 2 1 2 1 18 18 2 0 0 0
0 0 0 0 0 0.843287891 0 0 0.156712109
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
2006 1 2 2 2 1 11 11 5 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
0.355358409 0.241379789 0.264813693 0 0 0.138448109 0
0 0 0 0 0 0 0 0
2006 1 2 2 2 1 12 12 5 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 0.479335993 0.178469689 0.342194318 0 0 0 0
0 0 0 0 0 0 0
2006 1 2 2 2 1 13 13 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
0.211590213 0.788409787 0 0 0 0 0 0 0
0 0 0 0 0 0

Ghost marginals (n=91)

1968	1	3	1	2	1	-1	-1	1	0	0.826554072
	1.98790222	5.885097372	3.202353816	5.001397349	4.392977427					
	3.935613812	1.007803038	0.34814991	1.190231574	1.090346542					
	3.316025247	1.152890628	0.662657004	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	
1969	1	3	1	2	1	-1	-1	1	0	0
	18.55214148	9.740442562	4.057127956	5.417918205	4.340054217					
	6.924530493	7.437523391	2.309900376	2.571008852	0.995984083					
	3.80715316	2.617338969	0.169642852	0.059233549	0	0	0			
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	
1970	1	3	1	2	1	-1	-1	1	0	0	0
	1	1.325000014	0.599999963	1.049999992	0.450000029	1.175000039				
	0.399999963	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	
1972	1	3	1	2	1	-1	-1	1	0	0
	1.073086839	1.70905656	2.6918042	3.63664336	4.817657866					
	1.022384964	3.140141116	1.819248913	1.332777041	1.757199142	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					
1973	1	3	1	2	1	-1	-1	1	0	0
	1.2211451	5.415866574	9.468681699	8.754995625	4.055237953					
	3.898027912	1.787841516	2.289434377	0.3720365	2.717167669					
	3.340548733	0.659406444	0.019609898	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	
1974	1	3	1	2	1	-1	-1	1	0	0.550159182
	2.359103882	11.51589447	9.713419592	9.138430016	3.925888292					
	3.534734136	0.465540268	2.954186561	2.408728357	2.875400251	0				
	1.412895042	0	0	0	0	0.145619952	0	0	0	
	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0			
1975	1	3	1	2	1	-1	-1	1	0	0
	0.125051828	1.122438967	1.884637725	2.710939301	6.516728521					
	5.803818228	9.000429424	4.629268395	4.206245236	2.069862984					
	1.849436445	1.081142956	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		
1980	1	3	1	2	1	-1	-1	1	0	0	0
	0	2.216666667	0.2	0.535714286	1.178571429	0.535714286				
	0.333333333	0	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	
1982	1	3	1	2	1	-1	-1	1	0	0
	1.785714286	1.702380953	0.55952381	1.55952381	0.75	0.25	0			
	0.392857143	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	
1983	1	3	1	2	1	-1	-1	1	0	0	0
	0	2.756194142	1.355962218	0.126623372	4.356835768	2.119965806				
	1.290912196	0.743506502	0.126623372	1.123376624	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									
1984	1	3	1	2	1	-1	-1	1	0	0	0
	0.25	1.642857143	1.25	0	1.428571429	0.761904762	0				
	0.333333333	0.333333333	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	
1985	1	3	1	2	1	-1	-1	1	0	0	
	2.133147851	7.647445787	10.52194412	12.55676566	9.864730995						
	3.729324035	2.104092815	2.289214694	1.964341219	0.163249227	0					
	0	0	0.0257436	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
1968	1	3	2	2	1	-1	-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	1
	1	2	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1969	1	3	2	2	1	-1	-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	0.54889288	
	2.05927445	1.386299925	2.405277874	7.646125813	1.954070498						
	1.149989116	1.058133171	2.871379305	0.844713648	0.951277232	0					
	0.124566072	0	0	0	0						
1972	1	3	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.79312624	1	
	0	0	0	0	0	1.20687376	0	0	0	0	
	0	0	0	0	0	0					
1973	1	3	2	2	1	-1	-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	
	0.311225256	1.747826393	0.199662408	4.1601618	1.235563892	0					
	1.173107724	0.454516974	3.103589688	0	0	0.614345868	0				
	0	0	0								
1974	1	3	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.393081754	1	
	2.606918246	0	0.371747204	0	0	0	0	0			
	1.628252796	0	0	0	0	0	0	0			
1975	1	3	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0							
1985	1	3	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.38832721		
	2.61167279	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0				
1966	1	4	1	2	1	-1	-1	1	0	1.352989022	
	5.797758113	35.40894511	57.95232387	22.24078428	18.52335147						
	8.207296742	9.305253172	5.564863095	4.983599571	2.417478459						
	1.298601054	0.528700216	0.28144389	1.136611856	0	0	0				

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1967	1	4	1	2	1	-1	-1	1	0	0.646405798	
	18.50507448	35.1365455	62.28993986	80.91849215	20.52653768						
	15.83088915	9.269838357	9.68391436	3.512408816	2.633260946						
	3.159520226	0	0.13593879	0.75123389	0	0	0	0	0		
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1968	1	4	1	2	1	-1	-1	1	0	0.669632876	
	18.08660067	42.98085021	39.77339852	50.84500784	78.12414174						
	29.27701168	15.84956693	11.45690593	6.363601176	4.424258479						
	2.209542577	0.939481374	0	0	0	0	0	0	0		
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1969	1	4	1	2	1	-1	-1	1	0	0.192243706	
	30.57829957	49.89179573	56.61589098	31.32439894	56.81350058						
	55.74103234	23.22510104	14.66800452	5.269786387	3.755102565						
	1.939231574	0.985612307	0	0	0	0	0	0	0		
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	0	0	0	0	0	0	0	0			
1970	1	4	1	2	1	-1	-1	1	0	0.346182033	
	34.78219577	59.67753026	56.38644379	56.62645485	43.81040099						
	38.81882139	41.0960271	17.46159917	8.048027987	3.421931						
	2.563539416	1.073303386	0.498841788	0.136864896	0	0	0	0	0		
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	0	0	0	0	0	0	0	0	0	0	0
1971	1	4	1	2	1	-1	-1	1	0	0	
	1.395325062	4.283321929	7.764062079	3.261746027	1.089012831						
	0.774917596	2.837649485	6.211322985	1.178951185	0.576107526						
	0.40892313	0	0.21866016	0	0	0	0	0	0	0	
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1972	1	4	1	2	1	-1	-1	1	0	0	
	2.981904267	18.23674087	21.08476361	22.15943214	15.64233403						
	13.17057862	8.243039664	7.374030811	12.48256091	5.13069429						
	1.893675836	1.125817862	0.171580239	1.302846774	0	0	0	0	0		
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1973	1	4	1	2	1	-1	-1	1	0	0	
	9.818174741	13.57022413	19.29331326	13.4909865	11.67003986						
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	2.140875902	0	0	0	0	0	0.066780207	0	0		
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	0	0	0	0	0	0	0	0			
1974	1	4	1	2	1	-1	-1	1	0.054722016		
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	0										
1975	1	4	1	2	1	-1	-1	1	0	0	
	5.693758711	11.50304903	17.10357922	15.35479317	10.42701901						
	5.825181104	10.06033894	5.034338995	3.03252332	2.5118129						
	1.876417903	1.518290779	0.410641104	0.449282824	0.19897297	0					

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1977	1	4	1	2	1	-1	-1	1	0	1	
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	15.72927772		9.320067732		8.601016584		9.137750643		6.957863045		
	2.635005471		2.596105624		0.785488463		0.114436333		0.406213819		
	0.114436333	0	0	0	0	0	0	0	0	0	0
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1978	1	4	1	2	1	-1	-1	1	0	0	
	6.975421372		19.3339768		30.48369207		25.71431149		24.20164582		
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	0.631834631		0.355626353		0.636742041		0.028321571		0.208598334	0	
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1979	1	4	1	2	1	-1	-1	1	0	0	
	2.993565541		13.9711167		21.82137452		18.65429344		15.6807812		
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	6.338815897		1.291904579		2.052121719		0.921562312		0.924958714		
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1981	1	4	1	2	1	-1	-1	1	0	0	
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	5.511243198		1.959523577		2.48140622		0.035437633		0.11197525	0	
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1982	1	4	1	2	1	-1	-1	1	0	0	
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	0	0	0								
1983	1	4	1	2	1	-1	-1	1	0	0	
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	24.58930892		29.28298225		16.18428875		8.861757498		4.453205582		
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1984	1	4	1	2	1	-1	-1	1	0	0.956099545	
	4.608156635		12.00531856		24.19637245		35.86258158		27.93910025		
	30.71210042		19.38825541		16.75957419		10.27183301		8.435742126		
	4.364955115		0.880497078		0.544021973		0.304294792		0.540186078		
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1985	1	4	1	2	1	-1	-1	1	0	0.16715769
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	31.31564962	16.62327108	14.79212643	11.29176757	10.0375412					
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	0	0	0							
1986	1	4	1	2	1	-1	-1	1	0	0.705221364
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1987	1	4	1	2	1	-1	-1	1	0	0.497515908
	5.112148821	11.76448465	11.40798565	9.117101142	8.065314286					
	7.781559127	5.882247737	3.741911236	5.399832579	3.06810686					
	2.103162959	0.809588727	2.233019627	0.0160207	0	0	0			
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1988	1	4	1	2	1	-1	-1	1	0	0.07499355
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	7.44009206	5.35126335	3.297454549	1.67029585	6.114735023					
	0.715496142	2.973561489	0.333208558	1.269073947	0.10503903					
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	0	0	0	0	0	0	0	0	0	0
	0	0	0							
1989	1	4	1	2	1	-1	-1	1	0	0.004050849
	3.235112371	17.53117387	44.62328169	47.720233	27.38754911					
	18.27583592	13.05806464	11.30089192	11.56499587	3.6982326					
	1.920669072	3.610597059	0.533783206	0.305442826	0.110448612					
	0.017533164	0	0.102104268	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0
	0	0	0							
1990	1	4	1	2	1	-1	-1	1	0	0
	10.89283326	18.9993307	45.92690472	43.11897878	20.27404433					
	12.50102035	10.35776353	5.074769854	3.036442711	2.419936603					
	0.880892478	0.27855477	0.974475214	0.153449172	0.11060348	0				
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	0	0	0	0	0	0	0	0	0	0
1991	1	4	1	2	1	-1	-1	1	0	5.094280151
	6.877930712	18.24623748	20.37333911	37.97591094	30.82886457					
	19.17621124	10.66057155	4.297097791	2.423302358	5.199751377					
	0.66560393	0.71856199	0.008186964	2.389703508	0	0	0			
	2.064446352	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0
1992	1	4	1	2	1	-1	-1	1	0	0
	3.030873241	6.316731102	12.31912309	12.67927776	9.51504516					
	11.21041877	6.475183301	4.442607212	1.730759739	1.754185815					
	0.574967196	1.410513192	0.07920711	0	0	0.461107283	0			
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	0	0	0	0	0	0	0	0	0	
1993	1	4	1	2	1	-1	-1	1	0	0.13785534
	8.518095832	15.22610124	10.3993324	11.77501031	7.064592115					
	11.09356497	11.0191543	5.594868356	1.868452248	1.929601542					
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1994	1	4	1	2	1	-1	-1	1	0	0.81855831	
	20.36690722	21.80702973	20.14885423	15.541347	14.21604766						
	9.324871167	9.669420443	8.751685095	2.896817008	0.505982912						
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1995	1	4	1	2	1	-1	-1	1	0	0.145587706	
	4.159305197	21.53812052	31.24365801	24.4972416	23.80822438						
	16.56664319	9.794136441	8.006617451	4.552699671	1.279866847						
	0.341595766	0.062897518	0.786318487	0.06593134	0	0.531508439					
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	0										
1996	1	4	1	2	1	-1	-1	1	0.108977472		
	0.319276139	3.9135522	8.282990008	23.24269306	21.35030778						
	15.39902698	12.05105789	9.499247911	3.913145138	2.659101663						
	3.513640086	3.139130164	0.258814448	2.303722435	0.631277844	0					
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1997	1	4	1	2	1	-1	-1	1	0.043894815		
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	11.11426202	3.076162389	3.642310801	0.556055314	0.036520894	0					
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	0	0	0								
1998	1	4	1	2	1	-1	-1	1	0	0.104888145	
	10.01076782	15.99603452	18.38261663	18.84940574	26.15091175						
	19.31300158	11.10981854	4.126727273	4.300287094	1.394753861						
	2.769364026	1.26173992	1.503250982	0	0.215746905	0.510685241					
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	0	0	0	0	0	0	0	0	0	0	0
1999	1	4	1	2	1	-1	-1	1	0	0.00600903	
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	11.83875174	9.896438417	6.477204503	3.469297913	1.61453963						
	1.100584616	0.264902754	0.80510172	0.213808126	0	0.502191923					
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	0										
2000	1	4	1	2	1	-1	-1	1	0	0	
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	7.824816625	7.846827625	8.38512617	5.804917274	1.660834532						
	2.22099723	0.386744751	0.553691374	1.100091919	0.006980148	0					
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	0										
2001	1	4	1	2	1	-1	-1	1	0	0	
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	14.04108221	9.516259698	4.418359242	7.733801192	3.465307092						
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2002 1 4 1 2 1 -1 -1 1 0 0.024977337
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12.17313792 7.034166038 7.109615874 3.234063433 3.083207234
0.674840025 3.321086682 1.650191081 0.09659006 0.813347445 0
0 0.187770198 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
2006 1 4 1 2 1 -1 -1 1 0 0
0.509513928 2.192055811 6.881179014 15.35750747 26.89723186
19.05000943 11.45842867 8.32814801 4.649453781 4.799789846
0.847729611 1.659952158 0 0 1.109296392 0.25970396 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
1966 1 4 2 2 1 -1 -1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0.62731881 1.361556429
8.578442118 11.22448119 10.224722 8.82909149 6.586939993
5.744570882 8.638943467 3.990736613 1.379834353 2.448350131
1.956411439 0.40860104 0 0 0 0 0
1967 1 4 2 2 1 -1 -1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0.905800594 4.853901028
5.414668055 11.12165921 23.75456366 12.45414902 11.31759525
9.091855756 6.984559749 4.518503699 3.356877755 0.597222252
3.993192604 1.053468358 0 0.581983032 0 0 0
1968 1 4 2 2 1 -1 -1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 1.737146178
4.992098659 9.377977126 10.91048056 19.6385779 12.78595998
10.83373581 6.072115191 5.131832022 3.276802384 5.217479296
0.690610263 0 0.335184523 0 0 0 0
1969 1 4 2 2 1 -1 -1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 5.49390223
9.01018509 11.17555071 12.32024672 19.60528165 24.35746833
9.051841076 8.078527991 4.839438275 2.961883418 2.815180976
0.712818173 0.33628545 0.24138989 0 0 0 0

1970	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	2.61014301	16.40592832		
	16.74721324	18.09136208	15.3332058	15.74333996	17.22051188						
	19.85325569	11.91522279	5.652565042	3.050555954	2.417164385						
	1.40042518	0.402841027	0.156265494	0	0	0	0				
1971	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.333333333		
	0.796610731	1.328312812	0.55400577	0.188767594	0.05882353						
	1.911249308	2.51609411	1.161717272	1.41688251	0.262713124						
	0.265538112	0	0.205951798	0	0	0	0				
1972	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.447398925		
	4.535867947	3.719185831	9.240509079	7.486033787	6.827648811						
	4.442036978	5.279631632	5.076078667	3.819680953	0.841872762						
	0.284054653	0	0	0	0	0	0				
1973	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	3.100545213		
	7.530252339	3.939513282	2.724035241	5.819582096	4.923558187						
	1.04052564	4.666880949	3.086924157	2.337705423	2.534107237						
	1.128205331	0.346718232	0.821446677	0	0	0	0				
1974	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.142857143	0		
	2.842886927	2.889877666	2.5537668	3.317995541	5.024684308						
	1.279798998	2.094804489	1.239153085	2.366194466	0.885859356	0					
	0	0.362121207	0	0	0	0					
1975	1	4	2	2	1	-1	-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	4.428130404	
	7.559379908	5.415846042	5.035124148	3.583441743	3.512203663						
	1.939384844	1.468045312	0.52951949	0	0.49396226	1.034962186					
	0	0	0	0	0						
1977	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	3.773342894		
	3.204522289	5.280093879	10.0211161	9.204796083	8.54040882						
	6.346045063	2.484462364	2.541968794	1.884918492	0.689756418	0					
	4.028568816	0	0	0	0	0					
1978	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.171309321		
	1.883178569	2.953548387	6.987842278	6.16321723	6.790332313						
	4.262872261	6.333445087	1.624286099	2.766843506	0.534285182						
	0.52883979	0	0	0	0	0	0				
1979	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1.633353029		
	4.770810568	6.034513154	2.709243022	3.812112796	4.625464211						
	5.416116332	2.018418238	1.609142715	0.977588343	0	0.393237621					
	0	0	0	0	0	0					
1980	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	1.191836072		
	2.33192995		2.772404896		6.736774102		6.161402225		9.180463091		
	6.533538882		5.977133101		5.383461732		5.189407549		0.623536123		
	0.918112249	0	0	0	0	0	0				
1981	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.209197512	0	
	0.943430537		2.276788255		2.25718962		2.173683294		1.201423814		
	1.106956943		0.622132517		0	0	0.209197512		0	0	0
	0	0	0								
1982	1	4	2	2	1	-1	-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	0
	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0							
1986	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.347228862		0.841925054	
	1.809989473		1.349324695		1.82730404		0.45744529		3.281093099		
	0.77980107		0.468064419		0.83782399		0	0	0	0	0
	0	0	0	0							
1988	1	4	2	2	1	-1	-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	0
	1	0	0	0	1	0	0	0	0	0	0
	0	0	0	0							
1990	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	2.073886098		
	2.070121596		6.730314374		11.72306823		3.262813432		3.21652198		
	2.782229208		0.230743273		1.353980069		1.353980069		0	0	
	0.202341659	0	0	0	0	0					
1991	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.142857143		
	1.339244382		0.90549694		3.260413115		4.521145908		0.916876443		
	2.815832629		0.11014144		0	0.993996005		0	0.993996005		0
	0	0	0	0	0						
1993	1	4	2	2	1	-1	-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	0
	0	0.5	0.5	1	0	1	0	0	0	0	0
	0	0	0	0							
1994	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.340650105		
	2.291311346		1.777210243		3.058537831		1.1285168		1.681300205		
	0.861236733		0.520586633		0	0.340650105		0	0	0	0
	0	0	0	0							
1995	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	1.61243797	0.5	
	2.705138522		0.5	2.773242513		0	0	0.33162754	0		
	1.577553455		0	0	0	0	0	0	0		
1996	1	4	2	2	1	-1	-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	2.846801731
	0.557830564	3.16959945	1.663454307	0.420478432	3.193634186	0				
	2.290017033	0	0.420478432	0	0	0.437705856	0	0		
	0	0								
1997	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.6264979	1.488588504		
	3.348751621	2.023284258	1.749439397	0.904671827	0.1264979						
	1.487841194	1.686249924	1.74233473	1.829483852	0	0.98635889					
	0	0	0	0	0	0					
1998	1	4	2	2	1	-1	-1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	2.340036091		
	1.922378331	0.526317308	2.053884743	0.518324361	1.3613644						
	0.330329385	0	0	0	0	0.947365384	0	0	0		
	0	0	0								
2001	1	4	2	2	1	-1	-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	
	0.333333333	2.166666667	0	0	0.25	0.25	0	0	0		
	0	0	0	0	0	0	0				
2002	1	4	2	2	1	-1	-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	0
	0	0.5	0	0.5	0	0	0	0	1	0	0
	0	0	0	0							
2003	1	4	2	2	1	-1	-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	0.5	
	1.024494087	0.573665769	1.024494087	0.68867303	0	0.094336512					
	0	0	0.094336512	0	0	0	0	0	0	0	
2004	1	4	2	2	1	-1	-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	0.5
	1.5	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
2005	1	4	2	2	1	-1	-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	1
	0.5	1	0	0	0.5	0	0	0	0	0	0
	0	0	0	0							
2006	1	4	2	2	1	-1	-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	0
	2.199972471	5.180398484	2.21641691	1.71097159	0	0.692240545					
	0	0	0	0	0	0	0	0	0		

0 # Total number of size-at-age observations
0 # Total number of environmental variables
0 # Total number of environmental observations
999 # End file marker

16. Appendix C: SS2 control file

```
# Morph and area setup
1          # N growth patterns
1          # N sub morphs
1          # N Areas
1 1 1 1   1 1 # Area for each fleet
1          # rec dist design
0          # rec interaction
0          # Do migration: 0=no migration, 1=for nareas>1 models
0 0 0      # migration matrix

# Time block setup
2          # Number of time block designs for time varying parameters
4          # Blocks in design 1
4          # Blocks in design 2
1981 1985 # Block design 1
1986 1990
1991 1995
1996 2006
1961 1970 # Block desin 2
1971 1980
1981 1990
1991 2006

# Mortality and growth specifications
0.5        # Fraction female at birth
1000       # Ratio of between to within growth morph variance
-1         # Vector of submorph distribution (-1=normal approx)
4          # Last age for M young
10         # First age for M old
2          # Age for growth Lmin
20         # Age for growth Lmax
0.1        # SD constant added to LAA (0.1 mimics v1.xx for compatibility only)
0          # Variability about growth: 0=CV~f(LAA) [mimic v1.xx], 1=CV~f(A), 2=SD~f(LAA),
3=SD~f(A)
1          # maturity option: 1=length logistic, 2=age logistic, 3=read maturity at age for each growth pattern
1          # First age allowed to mature
3          # mg parm offset option: 1=direct assignment, 2=each pat. x gender offset from pat. 1 gender 1,
3=offsets as SS2 V1.xx with M old and CV old offset from young values
1          # mg parm adjust method 1=do V1.23 approach, 2=use new logistic approach
-50        # Mortality and growth parameter dev phase

# Mortality and growth parameters
# Lo      Hi      Init    Prior   Prior   Prior   Param   Env     Use     Dev     Dev     Dev
          Block   block
# bnd     bnd     value   mean    type    SD      phase   var     dev     minyr   maxyr   SD
          design  switch
# Females
 0.01     0.8     0.26    0.26    0       50      -50     0       0       0       0       0
          0       0       # M young
 -5       5       0       0       0       50      -50     0       0       0       0       0
          0       0       # M old: exp offset to M young
 5        25      16.37   10      0       50      2       0       0       0       0       0
          0       0       # Lmin
```

```
 25      55      39.814  35.0    0       50      2       0       0       0       0       0
         0       0       # Lmax
 0.01    1.5     0.39273 0.39    0       50      2       0       0       0       0       0
         2       0       # VBK
 0.01    0.9     0.10145 0.05    0       50      2       0       0       0       0       0
         0       0       # CV young
 -5      5       0       0       0       50      -50     0       0       0       0       0
         0       0       # CV old: exp offset to CV young
# Males
 -5      5       0       0       0       50      -50     0       0       0       0       0
         0       0       # M young: exp offset to morph 1
 -5      5       0       0       0       50      -50     0       0       0       0       0
         0       0       # M old: exp offset to young
 -5      5       0       0       0       50      -50     0       0       0       0       0
         0       0       # Lmin: exp offset to morph 1
 -5      5       -0.509 00       50      2       0       0       0       0       0       0
         0       # Lmax: exp offset to morph 1
 -5      5       0.1973 0        0       50      2       0       0       0       0       0
         0       0       # VBK: exp offset to morph 1
 -5      5       0.6431 0        0       50      2       0       0       0       0       0
         0       0       # CV young: exp offset to morph 1
 -5      5       0       0       0       50      -50     0       0       0       0       0
         0       0       # CV old: exp offset to CV young

# Weight-Length relationship parameters (L in cm, W in kg)
# Lo    Hi      Init    Prior   Prior   Prior   Param   Env     Use     Dev     Dev     Dev
        Block   block
# bnd   bnd     value   mean    type    SD      phase   var     dev     minyr   maxyr   SD
        design  switch
# Females
 0      0.5     0.00000547424 0 0       50      -50     0       0       0       0       0
         0       0       # W-L scale
 0      5       3.15447 3       0       50      -50     0       0       0       0       0
         0       0       # W-L power
 0      50      31      25      0       50      -50     0       0       0       0       0
         2       0       # Maturity to start blocking
 -1     1       -0.6104999 -0.5 0       50      -50     0       0       0       0       0
         0       0       # Maturity slope
 0      1       1       1       0       50      -50     0       0       0       0       0
         0       0       # intercept eggs/kg
 0      1       0       0       0       50      -50     0       0       0       0       0
         0       0       # slope eggs/kg
# Males
 0      0.5     0.00000727969 0 0       50      -50     0       0       0       0       0
         0       0       # W-L scale
 0      5       3.0728  3       0       50      -50     0       0       0       0       0
         0       0       # W-L power

# Distribute recruitment among growth pattern x area x season
 0      1       1       1       0       50      -50     0       0       0       0       0
         0       0       #
 0      1       1       1       0       50      -50     0       0       0       0       0
         0       0       #
 0      1       1       1       0       50      -50     0       0       0       0       0
         0       0       #
# Cohort growth deviation parameter
```

```
 0       1       1       1       0       50      -50     0       0       0       0       0
         0       0       #
0 # Custom environmental linkage setup for mg parameters: 0=Read one line apply all, 1=read one line
each parameter
1 # Custom block setup for mg parameters: 0=Read one line apply all, 1=read one line each parameter
# Lo    Hi      Init            Prior   P_type  SD      Phase
-10     10      -0.11825        0       0       50      2   # MG block
 -10    10      -0.3546         0       0       50      2   # MG block
 -10    10      -0.51194        0       0       50      2   # MG block
 -10    10      -0.53988        0       0       50      2   # MG block
 -10    10      -0.06411        0       0       50      -50  # maturity block
 -10    10      -0.13261        0       0       50      -50  # maturity block
 -10    10      -0.20615        0       0       50      -50  # maturity block
 -10    10      -0.28553        0       0       50      -50  # maturity block
# Spawner-recruit parameters
1       # S-R function: 1=B-H w/flat top, 2=Ricker, 3=standard B-H, 4=no steepness or bias adjustment
# Lo    Hi      Init    Prior   Prior   Prior   Param
# bnd   bnd     value   mean    type    SD      phase
 5      25    12.50     13      0       50      1               # Ln(R0)
 0.2    1       0.835   0.6     0       50      2               # Steepness w/ diffuse prior
 0      2       0.42    0       0       50      -50             # Sigma R
 -5     5       0       0       0       50      -50             # Environmental link coefficient
 -5     5       0       0       0       50      -50             # Initial equilibrium offset to virgin
 0      2       0       1       0       50      -50     # Autocorrelation placeholder (Future
implementation)
0 # index of environmental variable to be used
1 # env target parameter: 1=rec devs, 2=R0, 3=steepness
1 # rec dev type: 0=none, 1=devvector (zero-sum), 2=simple deviations (no sum constraint)
# Recruitment residuals
1877    # Start year recruitment residuals
2006    # End year recruitment residuals
-10     # Lower bound
10      # Upper bound
1       # Phase
1940    # first year of full bias correction (linear ramp up from this year minus the plus-age to this year)

# Initial F setup by fleet
# Lo    Hi      Init    Prior   P_type  SD      Phase
0       1       0       0.01    0       50      -50     # Fleet 1: south fishery
0       1       0       0.01    0       50      -50     # Fleet 2: north fishery
0       1       0       0.01    0       50      -50     # South ghost
0       1       0       0.01    0       50      -50     # North ghost

# Catchability (Q) setup
# A=do power: 0=skip, survey is prop. to abundance, 1= add par for non-linearity
# B=env. link: 0=skip, 1= add par for env. effect on Q
# C=extra SD: 0=skip, 1= add par. for additive constant to input SE (in ln space)
# D=type: <0=mirror lower abs(#) fleet, 0=no par Q is median unbiased, 1=no par 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
# E=Units: 0=numbers, 1=biomass
# F=err_type 0=lognormal, >0=T-dist. DF=input value
# A B C D E F
  0 0 0   0 1 0     # Fleet 1: south fishery
  0 0 0   0 1 0     # Fleet 2: north fishery
  0 0 0   -1 1 0  # South ghost
```

```
 0 0 0    -2 1 0   # North ghost
 0 0 0    2 1 0     # Survey 1: survey south
 0 0 0    2 1 0     # Survey 2: survey north
# Catchability (Q) parameters
# Lo     Hi       Init      Prior     P_type   SD       Phase
 -5      0        -1.6659   -1        0        50       2       # Ln(Q) Survey 1 south
 -5      0        -0.528    -1        0        50       2       # Ln(Q) Survey 2 north

# Selectivity section
# Size-based setup
# A=Selex option: 1-24
# B=Do_retention: 0=no, 1=yes
# C=Male offset to female: 0=no, 1=yes
# D=Mirror selex (#)
# A  B C D
 24 1 0 0          # Fleet 1:
 5  1 0 1# Fleet 2: mirror
 5  1 0 1     # South ghost mirror
 5  1 0 1     # North ghost mirror
 24 0 0 0          # Fleet 3:
 24 0 0 0          # Fleet 4:
# Age-based setup
 10 0 0 0          # Fleet 1: fishery south, 10 = flat (0 params)
 10 0 0 0          # Fleet 2: fishery north, 10 = flat (0 params)
 10 0 0 0     # South ghost
 10 0 0 0     # North ghost
 10 0 0 0          # Fleet 3: survey south, 10 = flat (0 params)
 10 0 0 0          # Fleet 4: survey north, 10 = flat (0 params)
# Selectivity and retention parameters
# Lo     Hi       Init      Prior     Prior     Prior     Param     Env       Use       Dev       Dev       Dev
          Block    block
# bnd    bnd      value     mean      type      SD        phase     var       dev       minyr     maxyr     SD
          design   switch
# Fleet 1 size based selectivity (using option 24)
 14       46       36.40     29.5      0         50        2         0         0         0         0         0
          1        0         # peak
 -6.0     6.0      6.0       6.0       0         50        -50       0         0         0         0         0
          0        0         # width
 -1.0     10.0     4.09      4.0       0         50        2         0         0         0         0         0
          0        0         # var-ascending
 -5.0     9.0      1.0       1.0       0         50        -50       0         0         0         0         0
          0        0         # var-descending
 -10.0    10.0     -10.0     -10.0     0         50        -50       0         0         0         0         0
          0        0         # initial
 0.0      50.0     50.0      50.0      0         50        -50       0         0         0         0         0
          0        0         # final
# Fleet 1 retention parameters
 25       35       30.42     27        0         50        3         0         0         0         0         0
          0        0         # Inflection
 1        2        1.42386   1.0       0         50        -50       0         0         0         0         0
          0        0         # Slope
 0.8      1        1.0       1         0         50        -50       0         0         0         0         0
          0        0         # Asymptote
 -10      10       0         0         0         50        -50       0         0         0         0         0
          0        0         # Male offset on inflection
# Fleet 2 as mirror
```

```
 1      45     1      44     0      50     -50    0      0      0      0      0
        0      0      # min bin mirror
 1      45     18     18     0      50     -50    0      0      0      0      0
        0      0      # max bin mirror
# Fleet 2 retention parameters
 23     35     30.54  27     0      50     3      0      0      0      0      0
        0      0      # Inflection
 0      4      1.42386 1.4   0      50     -50    0      0      0      0      0
        0      0      # Slope
 0.8    1      1.0    1      0      50     -50    0      0      0      0      0
        0      0      # Asymptote
-10     10     0      0      0      50     -50    0      0      0      0      0
        0      0      # Male offset on inflection
# South mirror
 1      45     1      44     0      50     -50    0      0      0      0      0
        0      0      # min bin mirror
 1      45     18     18     0      50     -50    0      0      0      0      0
        0      0      # max bin mirror
# South mirror retention parameters
 23     35     31.0320353034 27      0      50     -50    0      0      0      0
        0      0      0      # Inflection
 0      4      1.42386 1.4   0      50     -50    0      0      0      0      0
        0      0      # Slope
 0.8    1      1.0    1      0      50     -50    0      0      0      0      0
        0      0      # Asymptote
-10     10     0      0      0      50     -50    0      0      0      0      0
        0      0      # Male offset on inflection
# North mirror
 1      45     1      44     0      50     -50    0      0      0      0      0
        0      0      # min bin mirror
 1      45     18     18     0      50     -50    0      0      0      0      0
        0      0      # max bin mirror
# North mirror retention parameters
 23     35     30.1875977639 27      0      50     -50    0      0      0      0
        0      0      0      # Inflection
 0      4      1.42386 1.4   0      50     -50    0      0      0      0      0
        0      0      # Slope
 0.8    1      1.0    1      0      50     -50    0      0      0      0      0
        0      0      # Asymptote
-10     10     0      0      0      50     -50    0      0      0      0      0
        0      0      # Male offset on inflection
# Survey south size based selectivity (using option 24)
 14     46     27.41  29.5   0      50     2      0      0      0      0      0
        0      0      # peak
-6.0    6.0    6.0    6.0    0      50     -50    0      0      0      0      0
        0      0      # width
-1.0    10.0   3.58   4.0    0      50     2      0      0      0      0      0
        0      0      # var-ascending
-5.0    9.0    1.0    1.0    0      50     -50    0      0      0      0      0
        0      0      # var-descending
-10.0   10.0   -10.0  -10.0  0      50     -50    0      0      0      0      0
        0      0      # initial
 0.0    50.0   50.0   50.0   0      50     -50    0      0      0      0      0
        0      0      # final
# Survey north size based selectivity (using option 24)
```

```
 14      46      30.76   29.5    0       50      2       0       0       0       0       0
         0       0       # peak
-6.0     6.0     6.0     6.0     0       50      -50     0       0       0       0       0
         0       0       # width
-1.0     10.0    3.76    4.0     0       50      2       0       0       0       0       0
         0       0       # var-ascending
-5.0     9.0     1.0     1.0     0       50      -50     0       0       0       0       0
         0       0       # var-descending
-10.0    10.0    -10.0   -10.0   0       50      -50     0       0       0       0       0
         0       0       # initial
 0.0     50.0    50.0    50.0    0       50      -50     0       0       0       0       0
         0       0       # final
1       # Selex parm adjust method 1=do V1.23 approach, 2=use new logistic approach
0       # Selex environmental setup: 0=Read one line apply all, 1=read one line each parameter
1       # Selex block setup: 0=Read one line apply all, 1=read one line each parameter
# Lo    Hi      Init            Prior   P_type  SD      Phase
 -5     5       -0.078          0       0       50      2       # block par 81-85
 -5     5       -0.071          0       0       50      2       # block par 86-90
 -5     5       -0.046          0       0       50      2       # block par 91-95
 -5     5       -0.036          0       0       50      2       # block par 96-06

-50     # Phase for selex parameter deviations

### Likelihood related quantities ###
# variance/sample size adjustment by fleet
0 0 0 0 0 0 # constant added to survey CV
0 0 0 0 0 0 # constant added to discard SD
0 0 0 0 0 0 # constant added to body weight SD
1 1 1 1 1 1 # multiplicative scalar for length comps
1 1 1 1 1 1 # multiplicative scalar for agecomps
1 1 1 1 1 1 # multiplicative scalar for length at age obs
1000    # df discard
1000    # df weight
1       # Max number of lambda phases: read this number of values for each component below
0       # SD offset (CPUE, discard, mean body weight, recruitment devs): 0=omit log(s) term, 1=include
# Lambda values by fleet
0 0 0 0 1 1         # CPUE lambdas
1 1 0 0 0 0 # Discard lambdas
1       # Mean body weight data lambda
1 1 0 0 1 1 # Length frequency lambdas
1 1 0 0 0 1 # Age frequency lambdas
0 0 0 0 0 0 # Size at age lamdas
0       # Initial F lambda
1       # Recruitment residual lambda
1       # Parameter prior lambda
1       # Parameter deviation lambda
10      # crashpen lambda
1.2     # max F threshold
999 # end file marker
```

17. Appendix D: SS2 starter file

```
english.dat # .dat file to read in
english.ctl # .ctl file to read in
0         # read SS2.PAR: 0=no, 1=yes
1         # output to console: 0=none, 1=most, 2=all
1         # rep file detail: 0=minimum, 1=normal
0         # N bootstrap datafiles to create
25        # last phase to estimate
English_mod   # prefix for output string in rep
1       # burn in for mcmc chain
1       # thinning interval for mcmc chain
0.00      # jitter for initial parameter values
0.00      # push initial parameter values away from bounds
-1        # min year for spbio sd_report (neg val = styr-2, virgin state)
-1        # max year for spbio sd_report (neg val = endyr+1)
0.0001  # ending convergence criteria
0         # retro year relative to endyr
1         # 1=keep catches; 0=set catches to nil
0.1     # F ballpark
1999    # F ballpark year
1       # F method: 1=Pope, 2=continuous
3         # summary age for biomass reporting
1     # Forecast_opt: 0=none, 1=use F(spr), 2=use F(msy), 3=use F(btarget), 4=use endyrF
2       # MSY opt: 0=none, 1=F(spr), 2=calc F(msy), 3=F(btarget), 4=endyr F
0       # do Punt-style rebuilder file: 0=no, 1=yes
-1      # first year for which catch could have been set to zero (Ydecl)(-1 to set to 1999)
-1      # year for current age structure (Yinit) (-1 to set to endyear+1)
```

18. Appendix E: SS2 forecast file

```
# forecast specifications
0.4  # target SPR to use in forecasts
12   # total number of forecast years
12   # number of forecast years with SD
1    # emphasis for sigmaR for recruitments occuring prior to end year + 1
1.0  # fraction of the bias adjustment to use prior to endyr+1
0.0  # fraction of the bias-correction to use in purely forecast years
0.4  # topend of 40:10 option; set to 0.0 for no 40:10
0.1  # bottomend of 40:10 option
1.0  # scalar for taking catches relative to the OY
2004 # first yr for average fish selex to use in MSY and forecast
2006 # last yr for average fish selex to use in MSY and forecast
2    # set relative forecast F: 1=from endyr, 2=use relative F read below
   # fleet1 fleet2
0.087971542 0.912028458  0 0 # relative Fs for forecast
999  # end input harvest rates
   # specified forecast landings (negative values ignored)
   # South North
        79 818 -1 -1    # 2007
        79 818 -1 -1    # 2008
        -1 -1 -1 -1     # 2009
        -1 -1 -1 -1     # 2010
        -1 -1 -1 -1     # 2011
        -1 -1 -1 -1     # 2012
        -1 -1 -1 -1     # 2013
        -1 -1 -1 -1     # 2014
        -1 -1 -1 -1     # 2015
        -1 -1 -1 -1     # 2016
        -1 -1 -1 -1     # 2017
        -1 -1 -1 -1     # 2018
```