Status and Future Prospects for the Shortspine Thornyhead Resource in Waters off Washington, Oregon, and California as Assessed in 2005

by

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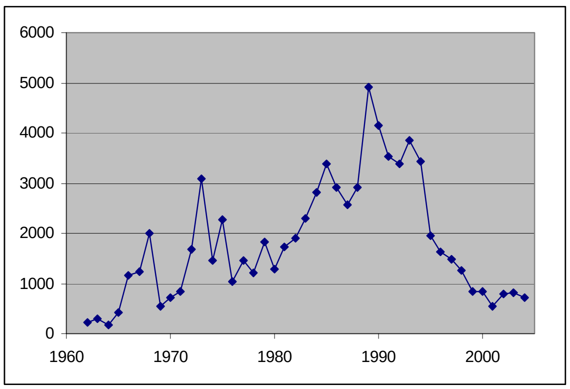
This assessment applies to shortspine thornyhead (*Sebastolobus alascanus*) off of the west coast of the United States. Landings are characterized by relatively large removals of 2,500 to 5,000 mt during the mid-1980s to mid 1990s. After institution of separate trip limits for shortspine and longspine thornyheads, the fishery proceeded with more moderate removals of between 1,000 and 2,000 mt per year from 1995 through 1998. Management measures further reduced landings to below 1,000 mt by 1999, with subsequent landings remaining below that level through 2004.

Landings history from 1962-2005



Landings estimates for the past 10 years

Year	*Landings*
1995	*1961*
1996	*1628*
1997	*1491*
1998	*1250*
1999	*834*
2000	*849*
2001	*551*
2002	*785*
2003	*827*
2004	*705*

This assessment uses the Synthesis 2 model, version 1.19 (Methot, 2005), with data from two fisheries: North (US Vancouver and Columbia INPFC areas), with landings data from 1964-2004 and South (Eureka, Monterey and Conception), with landings data from 1962 to 2004 and estimated landing equivalents from 1901-1961; and four surveys: the Triennial Shelf survey from 55-366 meters (1980-2004), the Triennial shelf survey from 366-500 meters (1995-2004), the Alaska Fisheries Science Center (AFSC) slope survey (1997, 1999-2001), and the Northwest Fisheries Science Center (NWFSC) slope survey (1998-2004).

New data and changes to the data used in the previous assessment include new or updated data as follows. Domestic landings data for 1962 to 1978 are unchanged from last assessment. Landings equivalents for the period 1901-1961, which was not considered in the previous assessment, were assumed to be 30% of the reconstructed sablefish trawl landings from that period (Schirripa, this volume). Foreign catch data for 1966-1976 were updated based upon Rogers (2003), with new total foreign catch estimated at 7,439 mt compared to 19,466 mt in the 2001 shortspine assessment. 1979 and 1980 southern catch was updated from the CALCOM database, and 1981 to 2004 catch was recalculated using PacFIN data and allocating catch from unspecified thornyheads to shortspine and longspine based upon the ratio of specified thornyheads landings in each year. Fishery length compositions were recalculated for the years 1981-2004 based upon updated PacFIN data. Triennial survey biomass indices were calculated from adjusted data, with water hauls removed from 1980 through 1995, and were limited to the depths 55-366 meters in all years. A second triennial survey index was calculated for the years 1995, 1998, 2001 and 2004 for the depth range 366-500 meters. AFSC slope survey indices (1997, 1999-2001) and NWFSC slope survey indices (1998-2004) were calculated by Tom Helser using a GLMM model (Helser, 2005). Length compositions for the triennial shelf and NWFSC slope surveys were newly calculated for this assessment. A computational error in previous derivations of the discard rate from the 1996 EDCP data was corrected, though the 1995 and 1997-1999 values were unchanged. New discard rates and mean weights were calculated based upon the west coast groundfish observer program data for 2002 and 2003.

The largest changes from the previous assessment are that the current assessment encompasses the entire west coast and the slope surveys are modeled as having dome-shaped selectivity. The previous assessment excluded those areas south of Pt. Conception, and the inclusion of the entire Conception area results in a larger basis for unfished biomass. Analysis of the 2002 NWFSC slope survey showed no diminution of shortspine density within the Conception area with latitude.

Dome-shaped selectivity is assumed for all surveys and fisheries based upon comparisons of camera sled and trawl survey length composition estimates (Lauth et al. 2004), as well as due to evidence of the continued presences of shortspine thornyhead beyond the scope of the slope surveys (deeper than 700 fathoms). This results in an increase in the estimate of relative numbers of large fish in the population.

Sensitivity analyses based upon alternative model structures / data set choices were conducted in order to explore the range of uncertainty. Other sources of uncertainty not explicitly explored include the effect of the PDO, ENSO and other climatic variables on recruitment, growth and survival of shortspine thornyhead; gender differences in survival; and the effect of local depletion on local or coastwide recruitment.

A relatively simple reference case was chosen in which the slope survey Qs were set equal to 1 (but due to dome-shaped selectivity, full selectivity for the slope surveys occurred only near 23 cm), males and females were modeled as separate growth morphs, and three time blocks were defined for retention. Natural mortality *M* was set to 0.05 and steepness *h* to 0.6.

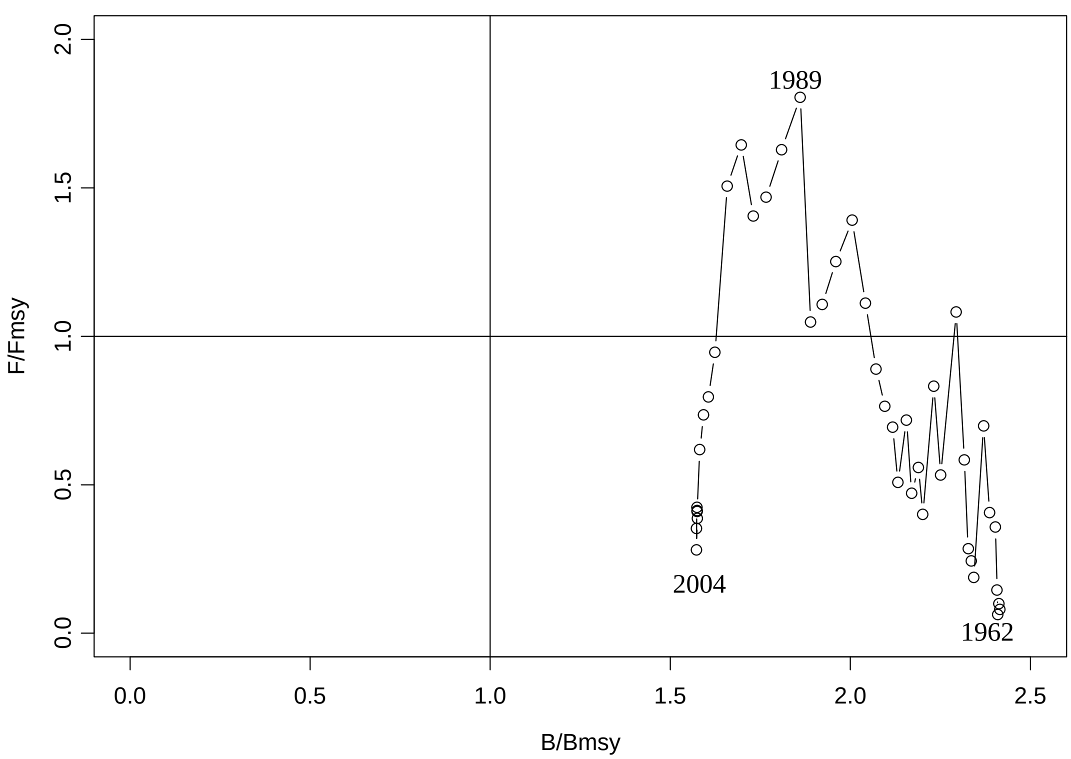
Retrospective of past 10 years

Year	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
Total Catch	2,336	1,944	1,783	1,498	1,001	1,037	676	960	1,014	867		
Discards	375	316	292	248	167	188	125	175	187	162		
Landings	1,961	1,628	1,491	1,250	834	849	551	785	827	705		
ABC	1,000	1,000	1,000	1,000	1,261	1,261	880	1,004	1,004	1,030	1,055	1,077
OY (HG)	1,500	1,500	1,500	1,177	805	970	751	955	955	983	999	1,018
Fspr	0.023	0.019	0.017	0.015	0.010	0.010	0.007	0.009	0.010	0.008		
Expl. Rate	0.016	0.013	0.012	0.010	0.007	0.007	0.005	0.007	0.007	0.006		
2+ Biomass	149,240	147,603	146,399	145,383	144,686	144,529	144,357	144,582	144,528	144,439	144,513	
Sp Biomass	84,871	83,916	83,223	82,661	82,298	82,244	82,181	82,320	82,281	82,185	82,151	
Sp Bio. sd	7,276	7,268	7,259	7,251	7,243	7,236	7,227	7,219	7,209	7,197	7,185	
Sp Bio. cv	0.086	0.087	0.087	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.087	
Recruitment	10,939	11,029	12,910	16,181	18,482	20,592	19,407	21,178	18,235	18,197	18,653	
Rec. sd	3782	3871	4654	6172	7435	8490	9057	10639	8887	8860	9404	
Rec. cv	0.346	0.351	0.360	0.381	0.402	0.412	0.467	0.502	0.487	0.487	0.504	
Depletion	0.650	0.642	0.637	0.633	0.630	0.630	0.629	0.630	0.630	0.629	0.629	

The point estimate (maximum of the posterior density function, MPD) for the depletion of the spawning biomass at the start of 2005 is 62.9%. The ABC for 2007 from the base model is 2,488 mt resulting in a landed catch of 2,029 mt. For West Coast rockfish, a stock is considered overfished when it is below 25% of unfished spawning biomass, and recovered when it reaches 40% of unfished spawning biomass. Overfishing is considered to be occurring when F is above Fmsy. Shortspine is not considered to be overfished, nor is overfishing suspected to have occurred since 1994, according the base model in this assessment.

Major quantities from the assessment

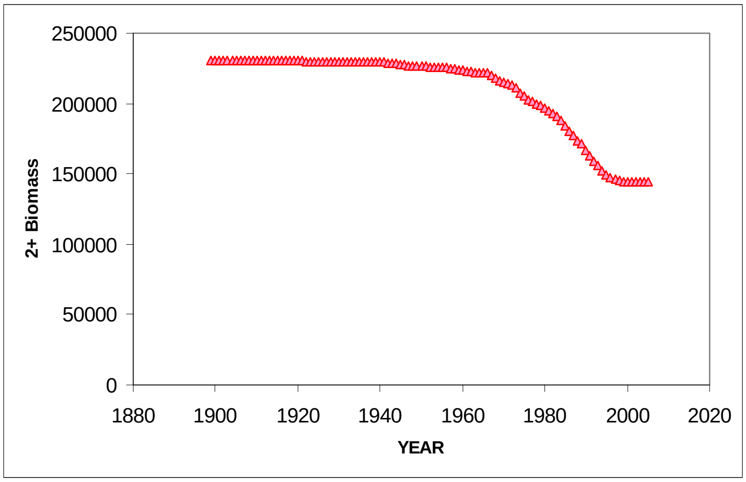
	Value	*sd*	*cv*
SB_0	130,646	7,490	0.57
B_0	230,500		
R_0	20,489	1,175	0.057
SBmsy	52,258		
Fmsy	0.0238		
Basis for above	Fspr = 50%		
Exploitation rate at MSY	0.0184		
MSY	1720		



F/Fmsy versus B/Bmsy for 1962-2004

The point estimates of current biomass are relatively flat over the past 6 years, with a small decrease in the 4 years previous to that.

2+ Biomass Levels from 1901 to 2005

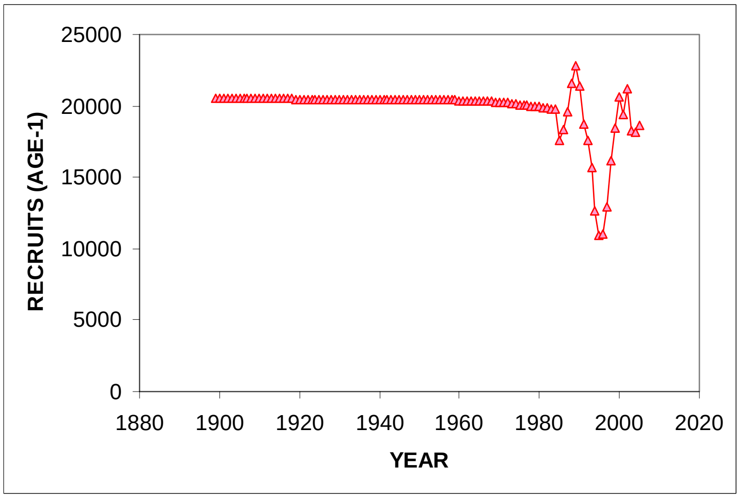


Biomass estimates for the past 11 years

Year	*Total 2+ biomass(mt)*
1995	149,240
1996	147,603
1997	146,399
1998	145,383
1999	144,686
2000	144,529
2001	144,357
2002	144,582
2003	144,528
2004	144,439
2005	144,513

The recruitment pattern for shortspine thornyhead is based on length data only, with low survey selectivity for lengths corresponding to the first few ages. The slow growth of shortspine, however, with continuous length increases on the order of 1 cm year^{-1}, suggests that the data may be able to fit a general pattern of recruitment if there is adequate contrast between years, or especially between groups of years. The first year for which there are length composition data to support the estimate of recruitment is 1978, however the data are relatively poor early on and so recruitments are estimated in this model for the years 1985 through 2000. It appears that the resulting pattern may represent smoothed recruitment over time, with good recruitment around the 1988-1990 period and poor recruitment around the 1994-1997 period.

Recruitment estimates (1935-2002)

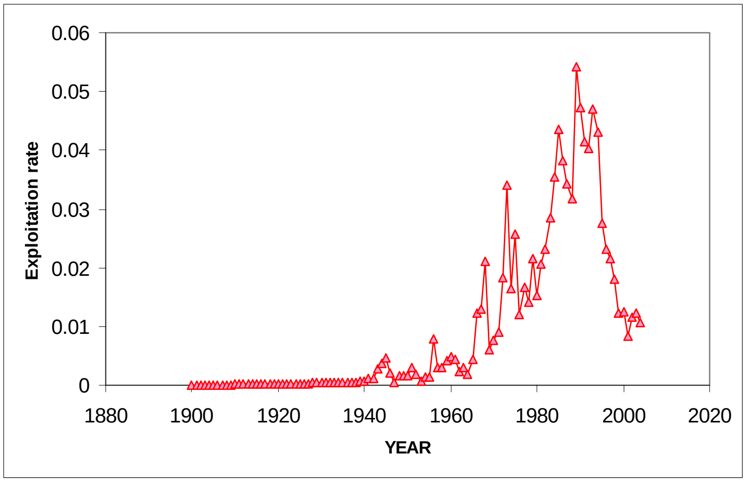


Recruitment estimates for the past 11 years (millions of recruits)

Year	*Recruitment*
1995	10,939
1996	11,029
1997	12,910
1998	16,181
1999	18,482
2000	20,592
2001	19,407
2002	21,178
2003	18,235
2004	18,197
2005	18,563

The coastwide exploitation rate (percent of 2+ biomass taken) peaked near 3% in 1989. Over the past 10 years the exploitation rate has fallen from around 1.6% to 0.6%.

Exploitation rate estimates (1901-2004)



Exploitation estimates for the past 10 years

Year	*Exploitation rate*
1995	0.0157
1996	0.0132
1997	0.0122
1998	0.0103
1999	0.0069
2000	0.0072
2001	0.0047
2002	0.0066
2003	0.0070
2004	0.0060

With the extension of the current assessment to the Mexican border, and given the large areal extent of the Conception INPFC and similar shortspine thornyhead densities observed within the Conception area north and south of Pt. Conception, one would expect an large increase in the total biomass estimate. In fact, about 34% of the current exploitable and spawning biomass is estimated to be south of Pt. Conception. Since little exploitation of shortspine thornyhead has historically taken place in the Conception area, and especially south of Pt. Conception, the overall depletion and status provides a much rosier outlook than would an assessment covering the only the four INPFC areas to its north. Only 22% of the virgin exploitable and spawning biomasses are estimated to have been in the area south of Pt. Conception. Splitting up the coast in to two areas at Pt. Conception (but still assuming complete mixing for recruitment purposes) results in current depletion estimates of 53.3% north of Pt. Conception and 96.6% south of Pt. Conception. Even in the absence of multiple genetically distinct shortspine stocks along the West Coast, genetic mixing is likely incomplete. Given the long lifespan of thornyheads and uncertainty in what drives recruitment variability from year to year and location to location, regional management for shortspine thornyhead should be considered.

Research and data needs for future assessments include information on the relationship of individual female age and size to survival of offspring; information on the accuracy of shortspine ageing that was used to create the growth curve; better methods for production ageing of shortspine; information on the relative density of shortspine thornyhead in trawlable and untrawlable areas and in areas deeper than 700 fathoms and difference in age and length compositions between those areas; more survey work south of Pt. Conception, including possibly camera tows in the cowcod exclusion area.; research on possible differences in growth along the coast; and length frequencies of discards.

Three possible states of nature were chosen that represent the uncertainty about the base case. These were created by varying the catchability, q, or the slope surveys (1 in the base case) and the steepness (h) (0.6 in the base case). The “Low” state of nature was assigned a slope survey catchability of 1.33 and a steepness of 0.3, while the “High” state of nature was assigned a slope survey catchability of 0.75 and a steepness of 0.9.

Decision Table				Low state (less likely)		Middle state (more likely)		High state (less likely)	
	Year	***Catch***	***Landings***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***
Low Catch	2005	999	815	67,221	0.559	82,151	0.629	104,634	0.687
	2006	1016	830	66,848	0.556	82,030	0.628	104,579	0.686
	2007	734	600	66,463	0.553	81,904	0.627	104,518	0.686
	2008	731	600	66,250	0.551	81,963	0.627	104,644	0.687
	2009	729	600	66,054	0.549	82,052	0.628	104,806	0.688
	2010	726	600	65,877	0.548	82,175	0.629	105,001	0.689
	2011	723	600	65,720	0.547	82,324	0.630	105,223	0.691
	2012	720	600	65,576	0.545	82,492	0.631	105,468	0.692
	2013	718	600	65,439	0.544	82,672	0.633	105,730	0.694
	2014	716	600	65,308	0.543	82,862	0.634	106,009	0.696
	2015	715	600	65,179	0.542	83,061	0.636	106,302	0.698
	2016	715	600	65,055	0.541	83,269	0.637	106,608	0.700
	Year	***Catch***	***Landings***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***
Moderate Catch	2005	1000	815	67,221	0.559	82,151	0.629	104,603	0.687
	2006	1018	830	66,848	0.556	82,030	0.628	104,548	0.686
	2007	2488	2029	66,463	0.553	81,904	0.627	104,487	0.686
	2008	2463	2014	65,226	0.543	80,955	0.620	103,605	0.680
	2009	2437	1998	64,028	0.533	80,042	0.613	102,762	0.675
	2010	2411	1983	62,859	0.523	79,169	0.606	101,961	0.669
	2011	2384	1968	61,719	0.513	78,332	0.600	101,197	0.664
	2012	2358	1952	60,602	0.504	77,524	0.593	100,465	0.660
	2013	2333	1935	59,507	0.495	76,740	0.587	99,765	0.655
	2014	2310	1917	58,430	0.486	75,979	0.582	99,093	0.651
	2015	2287	1898	57,371	0.477	75,241	0.576	98,451	0.646
	2016	2266	1879	56,330	0.469	74,526	0.570	97,839	0.642
	Year	***Catch***	***Landings***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***	***Sp. Bio***	***Depletion***
High Catch	2005	1000	815	67,221	0.559	82,151	0.629	104,633	0.687
	2006	1018	830	66,848	0.556	82,030	0.628	104,578	0.686
	2007	3158	2576	66,463	0.553	81,904	0.627	104,517	0.686
	2008	3123	2553	64,858	0.539	80,571	0.617	103,249	0.678
	2009	3087	2530	63,280	0.526	79,276	0.607	102,024	0.670
	2010	3051	2508	61,732	0.513	78,024	0.597	100,844	0.662
	2011	3014	2486	60,218	0.501	76,812	0.588	99,705	0.654
	2012	2978	2463	58,732	0.488	75,633	0.579	98,603	0.647
	2013	2943	2439	57,272	0.476	74,483	0.570	97,537	0.640
	2014	2910	2414	55,835	0.464	73,361	0.562	96,505	0.633
	2015	2878	2388	54,421	0.453	72,266	0.553	95,509	0.627
	2016	2849	2361	53,029	0.441	71,200	0.545	94,547	0.621

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1.1 INTRODUCTION

Distribution and species associations

Shortspine thornyhead (*Sebastolobus alascanus*) are found in the waters off of the West Coast of the United States from northern Baja California to the Bering Sea. Along the West Coast, they are most often associated with longspine thornyhead (*Sebastolobus altivelis*), as well as with Sablefish (*Anoplopoma fimbria*) and Dover sole (*Microstomus pacificus*).

Shortspine thornyhead are found from 20 to over 1,500 meters in depth, are most abundant in the range of 180 to 450 meters, while the majority of the spawning biomass occurs in the oxygen minimum zone between 600 and 1,400 meters, where longspine thornyheads are most abundant (Jacobson and Vetter 1996). Shortspine tend to settle at around 100-200 meters and move ontogentically down the slope, although large individuals are found across the depth range.

Shortspine thornyhead do not appear to be distributed evenly across the West Coast, with higher densities (kg/ha) of thornyheads in shallower areas (under 400 meters) off of Oregon and Washington, and higher densities in deeper areas off of California. Thus the length distributions are centered around smaller fish in the North than in the South. The density of the largest thornyheads is greatest off of northern California.

Thornyheads have been reported to be spaced randomly across the sea floor (Wakefield 1990), indicating a lack of either schooling or territoriality.

Stock structure

Genetic studies of stock structure do not suggest separate stocks along the west coast. Siebenaller (1978) and Stepien (1995) found few genetic differences among shortspine thornyheads along the Pacific coast. Stepien (1995), however, did suggest that there may be a separate population of shortspine thornyhead in the isolated area around Cortes Bank off San Diego, California. Stepien (1995) also suggested that juvenile dispersion might be limited in the area where the Alaska and California currents split. This occurs towards the northern boundary of the assessment area, near 48º N. More recently, Stepien et al. (2000), using a more discerning genetic material (mtDNA), found evidence of a pattern of genetic divergence corresponding to geographic distance in samples collected from southern California to Alaska. However, this analysis did not identify a clear difference between stocks even at the extremes of the range. No such pattern was seen in longspine thornyhead, which suggests that the shorter pelagic stage (~1 yr vs. ~2 yrs) of shortspine may contribute to an increased genetic separation with distance.

Bathymetric demography and life history

Shortspine thornyheads along the West Coast spawn pelagic, gelatinous masses between December and May (Pearson and Gunderson, 2003). Juveniles settle at around 1 year of age (22-27 mm in length), likely in the range of 100-200 m (Vetter and Lynn 1997), and migrate down the slope with age and size, although large individuals are found across the depth range.

Estimates of natural mortality for shortspine thornyhead range from 0.013-.017 (Pearson and Gunderson 2003) to .05-.07 (Kline 1996). However, Pearson and Gunderson's estimate is based upon a regression, using the gonadosomatic index as a proxy, and is highly uncertain. Butler et al. (1995) estimated M to be 0.05 based upon a maximum lifespan of over 100 years for shortspine thornyhead. Butler et al. also suggested that M is lower for older, larger shortspine thornyhead residing in the oxygen minimum zone due to lack of predators.

Shortspine thornyhead grow very slowly, but may continue growing throughout their lives, reaching maximum lengths of over 70 cm. Females appear to reach larger sizes than do males. Maturity in females occurs near 18 cm, at 8-10 years of age (Pearson and Gunderson 2003).

Fishery history

There was little market for thornyheads in the early part of the century. Landings were minimal until the 1930's when thornyheads started to be landed as incidental catch from the sablefish fishery off California. The first significant market for thornyheads began in northern California in the early 1960's. At first, larger (30-35 cm) thornyhead were sold as "ocean catfish". The minimum size decreased to 25 cm by the early 1980's. In the late 1980's a market for small thornyheads (~20 cm) developed because of the depletion of a related species (*Sebastolobus machrochir*) off of Japan. The fishery started moving into deeper waters with the demand for smaller (and thus longspine) thornyheads increased over time. This can be seen as the proportion of shortspine in the total thornyhead catch decreased from around 90% in 1981 to 40% in 1994 (before regulation lowered it even more in 1995) (Figure 2).

In the southern area (Eureka, Monterey and (minimally) Conception INPFC areas) landings reached 1,000 mt in the south in 1972, and peaked around 3,500 mt in 1989.
In the northern area off of Oregon and Washington, the fishery became significant in the early 1980's, with landings peaking in 1991 at around 2200 mt.

The foreign fishery off of the West Coast is estimated to have caught approximately 7,400 mt of shortspine thornyhead during the 11 year period from 1966-1976 (Rogers, 2003), which is on the order of the estimate of domestic catch (~8,600 mt) during that same period.

Since 1995, regulations have severely reduced landings of shortspine thornyhead, such that landings have been below 1,000 mt since 1999 (see Table 1).

Management History

Beginning in 1989, both thornyhead species were managed as part of the deepwater complex with sablefish and Dover sole (DTS). In 1991, the Pacific Management Council first adopted separate ABC levels for thornyheads and catch limits were imposed on the thornyhead group. Harvest guidelines (HG) were instituted in 1992. In 1995 separate catch limits were placed on shortspine and longspine thornyheads and trip limits became more restrictive. Trip limits have often been adjusted during the year since 1995 in order to not exceed the HG or OY for that year. At first, the HG for shortspine thornyhead was set higher than the ABC (1,500 vs. 1,000 mt in 1995-1997) in order to allow a greater catch of longspine thornyhead which was considered relatively undepleted. In 1999 the OY was set at less than 1,000 mt and has remained below that level through 2005.

Management performance

Landings of shortspine thornyhead have been below the ABC since 1999; however total catch was estimated to be slightly above the ABC in 2003.

1.2. Data

Removals

Catch history

Landings data from the northern (north of 43º N) and southern shortspine thornyhead fishery off the west coast of the continental United States are available from 1962 to the present (Figure 1; Table 2). Removals peaked in 1973, from a combination of the foreign and domestic fisheries, at around 3,100 mt, and again in 1988, when the domestic fleet alone landed around 4,900 mt. During the period 1966-68, the foreign fleets accounted for the bulk of the shortspine thornyhead removals, while they accounted for a little more than half the removals in 1973.

To reconstruct estimated landings in the southern area before 1962, we compared recent domestic catches of sablefish and shortspine thornyhead, with shortspine averaging about 44% the catch of sablefish from 1962 through 2004. We assumed shortspine virtual landings to be 30% of the reconstructed catch series for sablefish in the trawl fishery from 1901 to 1961 (M. Schirripa, pers. comm.) (Table 3). These values do not reach 100 mt until 1941, and remain below 500 mt in all year except 1956 (775 mt).

The foreign fishery ended in 1977 following the passage of the MSCFA. Foreign catch estimates for the years 1966-76 are taken from Rogers (2003).

PacFIN data from 1981-present was used to estimate landings in the north and south. All landings reported for the shortspine and nominal shortspine categories were considered shortspine, whereas landings placed in the thornyheads category were split between longspine and shortspine by the ratio of categorized longspine and shortspine landings for the entire coast. The values of this ratio from 1981-2004 are shown in Figure 2.

CALCOM data from 1978 to present showed lower landings in most years than did the PacFIN data for Eureka, Monterey and Conception INPFC areas combined. Eureka includes part of Oregon, so that the three INPFC areas combined are expected to have slightly greater landings. Thus for the years 1981 to present there was no obvious reason to change the PacFIN numbers. However, for 1979 and 1980 the CALCOM landing estimates were higher than those used in the previous assessment, and therefore the CALCOM numbers are used for the southern fishery for those two years.

The pattern of landings from 1962 to present is considerably different than that put forth in the previous assessment (Figure 1). This is due to (a) very different estimates of foreign catch, especially in 1967 and 1968, (b) the inclusion of a fraction of the unspecified thornyhead category in PacFIN as shortspine thornyhead catch based upon the ratio of categorized shortspine to categorized shortspine and longspine (Figure 2), which makes the largest difference between the years 1983 and 1987, and the substitution of CALCOM data for the southern fishery in 1979-1980.

Fishery size composition

Fishery size-composition data were obtained from PacFIN for 1981-2004. Length composition data from individual trips were scaled up by a factor of 1-25 based upon the number sampled and the total number estimated to be caught in the trip. Scaling up was done by no more than the number sampled, and also by no more than the total number estimated to be caught divided by 20. Fishery size composition data for the years 1978-1980 are identical the 2001 assessment. Effective sample size was set equal to the number of trips.

No age composition data was used for this assessment as thornyheads have proven very difficult to age with large inter reader differences even in directed studies such as those done by Kline (1996) and Butler et al. (1995), and therefore no production ageing of thornyheads is undertaken at this time for the West Coast.

Surveys

NMFS Cruises

Research surveys have been used to provide fishery-independent information about the abundance, distribution, and biological characteristics of west coast groundfish. A coast–wide survey of the rockfish resource was conducted in 1977 (Gunderson and Sample 1980) with the objective of defining the distribution and measuring the abundance of the major species taken in bottom trawls. The 1977 coast wide shelf survey has since been repeated every three years, yielding fishery-independent indices of the resource size every three years from 1977-2004.

Two slope surveys have been conducted on the west coast in recent years, one using the research vessel Millar Freeman, conducted by the Alaska Fisheries Science Center (AFSC), which ended in 2001, and another a cooperative survey using commercial fishing vessels, conducted by the Northwest Fisheries Science Center (NWFSC) which began in 1998.

The results from these three (nominally four) fishery-independent surveys are used in this assessment (Figure 8; Tables 6-9).

1-2. The triennial shelf survey that was conducted every third year from 1980-2004 (The 1977 triennial survey biomass index was not be used due to incomplete coverage). As the survey was expanded beyond 366 meters to 500 meters in 1995, the survey between those depths is treated as a separate survey for the last four years of the triennial survey.
3. The AFSC slope survey for the years 1997 and 1999-2001.
4. The NWFSC slope survey for the years 1998-2004.

Size composition data were available for each year of each survey. The NWFSC slope survey length compositions were calculated by weighting length compositions in each tow by the estimated catch per unit effort (in terms of numbers rather than biomass) and then weighting the length composition in each INPFC and depth (shallow vs. deep) stratum by the biomass indices from Helser (2005). Triennial survey length compositions were calculated from data with the assumed water hauls removed from the data base. Triennial survey years 1980, 1983, 1986 and 1992 are given lower sample sizes in this assessment due to coverage concerns

A list of data used in this assessment is given in Table 11.

Natural mortality and longevity

Butler et al. (1995) estimated the lifespan of shortspine thornyhead to exceed 100 years, and suggested that M was likely less than 0.05. M may decrease with age as shortspine migrate ontogenetically down the slope to the oxygen minimum zone which is largely devoid of predators.

Maturation and fecundity

Pearson and Gunderson (2003) estimated length at 50% maturity to be 18.2 cm on the West coast, with most females transitioning to maturity between 17 and 19 cm, this sharp maturity ogive has a logistic b = -2.3.

Fecundity of shortspine thornyhead was estimated by Cooper et al. (2005) in a regression vs. weight to be equal to 223,000*Weight – 63,000 eggs, with weight in kg. They also estimated a power function in length, estimating number of eggs to be proportional to $L^{3.978}$, which is a slightly higher power than the length to weight relationship (below), which indicates there may be an increase in fecundity per unit mass with size, such that fecundity α $Weight^{1.22}$.

Length-weight relationship
The length-weight relationship for shortspine thornyhead is based on Jacobson (1990).

$$W(L) = 4.9 \cdot 10^{-6} L^{3.264}$$

where L is length in cm and W is weight in kg.

Length at age

Size at age was recalculated from the Kline (1996) data, while accounting for differences in maximum size between the sexes by setting asymptotic length of males to be 90% of that of females. For the base model the Von Bertalanffy K is set to 0.018, which is below that used in the last model (0.03) which was calculated by Butler et al. (1995), though larger than that calculated by Kline (0.0169) or Jacobson (1991) (0.0145). It fits the data well, while accounting for biases towards larger individuals among the younger ages (Figure 3). Nominal asymptotic length is set at 89 and 80.1 for females and males, and t_0 is set at 2.5 and 3.0 respectively, so length at age 2 is 7 cm for both males and females, and average length at age 100 is 75 cm and 67.5 cm respectively. The plus group is set at age 101, so that maximum mean length at age is approximately 75 and 67.5 cm for females and males respectively.

1.2.4 Changes in data from the 2001 assessment

Catch and length composition data from 1981 through 2004 were updated from PacFIN.
This data was extracted on May 3, 2005. The 1979 and 1980 landings for the southern fishery were taken from CALCOM numbers.

This assessment includes the biomass index and length-composition data for the 2004 triennial shelf survey. In addition, “water” hauls in the original 1980-1995 triennial shelf survey data were removed and both the biomass indices and length compositions were recomputed. The biomass indices and length data were limited in all years to a range of 55 to 366 meters, which was the limit of the survey in most years through 1992. A second series of indices and length compositions were used from 1995-2004 for the 366-500 meter depth range. These data were extracted on March 28, 2005.

Biomass indices and length compositions for the AFSC slope survey (1997, 1999-2001) were used in this assessment. Biomass indices and length compositions for the NWFSC slope survey (1998-2004) were used in the assessment. The entire time series of each slope survey index was re-calculated using GLM and GLMM modeling by Helser (2005), while the length composition data were constructed by the author. The NWFSC length composition data were extracted on March 28, 2005.

1.3. Assessment model

1.3.1 Stock Delineation

For the purposes of this assessment, the shortspine thornyhead population off of the west coast of the United States was considered to be a single, continuous stock from US-Mexico border to the US-Canada border. This decision pushed further south the southern boundary of the assessment area, which was at Point Conception in the 2001 assessment, and at the boundary of the Monterey and Conception INPFC areas (36º N) in the 1997 and 1998 assessments.

1.3.1. Past assessment methods

Previous stock assessments for shortspine thornyhead were conducted by Jacobson (1990,1991), Ianelli et al. (1994), Rogers et al. (1997,1998) and Piner and Methot (2001).

This first stock assessments for thornyheads along the west coast (Jacobson, 1990 and 1991) utilized trends in mean length of shortspine and longspine thornyheads collected in port sample, and trends in catch rates of thornyhead (combined) calculated from commercial logbooks. This assessment covered the US-Vancouver through Monterey INPFC areas. Swept-area and video biomass estimates were used to infer average biomass levels and exploitation rates for thornyheads. While there was some evidence of declines in commercial catch rates from logbook data, the most important factor affecting catch rates was depth of fishing. Results from the logbook catch rate analysis have not been used in subsequent assessment because of difficulties separating out longspine from shortspine and changes in fishing practices including targeting and discard that confounded the analysis and produced inconsistent results.

The 1994 assessment (Ianelli et al. 1994), used general additive models of survey catch rates with depth as a covariate and areas as factors, filling in missing data by year to get a complete view of the trend in relative abundance over time. A second approach involved using “super years”- combining estimates from different areas and years to get a coastwide index of abundance.

The 1997 assessment (Rogers et al., 1997) used three different methods for assessing shortspine thornyhead. One used an M = F approach and the 1996 slope survey trawl index, the second used “basic” stock synthesis model with 1 fishery, no discard, time-invariant selectivity and no logbook CPUE, while the third, more complex synthesis model included two fisheries with time-varying selectivity, size limit and trip limit induced discard, and logbook CPUE data. Fishery selectivities were estimated empirically from estimates of fishing effort by depth and year in the northern and southern fishing areas, while discard was estimated by adjusting the few years of discard data based on price changes.

The 1998 assessment (Rogers et al. 1998) was much like the 1997 assessment, but with retention a function of minimum market size, recruitment was estimated in two tiers (pre and post 1977), and an estimate of foreign catch from the mid-1960’s to the mid-1970’s was included.

The 2001 assessment used the slope survey index as the primary information about biomass, while assuming the slope survey to have asymptotic selectivity so the Von Bertalanffy K and Linf could be estimated within the model. Discard was modeled as a separate fishery along with the north and south fisheries, and the two sexes were modeled separately. All three fisheries along with the triennial survey were modeled as having dome-shaped selectivities. Fishery selectivity was estimated for two periods, the latter period starting in 1996 in the south and 1997 in the north. Catchability (Q), growth rate (K) and natural mortality (M) were considered the greatest uncertainties in the model.

1.3.2. Changes between the 2001 assessment model and the current model

The current model extends the southern border of the assessment area from Pt. Conception to the Mexican border (32.5ºN). This adds a considerable area of shelf and slope habitat and results in a much larger basis for both unfished and current biomass. The other considerable change is that the slope surveys are modeled with dome-shaped selectivity based upon Lauth et al. (2004). The AFSC and NWFSC surveys are treated separately, and the super year data is omitted as neither super year covers the Conception area, which is estimated to contain nearly half of the shortspine biomass for the West Coast. The Von Bertalanffy parameters are fixed as the fishery and surveys are modeled with dome-shaped selectivity. In the base case a single fishery selectivity curve is fit, based on the hypothesis that larger shortspine thornyhead were caught at moderate depths in earlier years, but have been largely fished out. Retention fit in blocks up through 1987, 1988-1994,and 1995-2004 (for the southern fishery), and 1995-2000 and 2000-2004 (for the northern fishery).

1.3.3. Current modelling approach

This assessment was performed using the Stock Synthesis 2 model, version 1.19, compiled April 29, 2005, an updated version of the Synthesis model (Methot, 2000).

Likelihood components consist of

1. Survey biomass index likelihoods for each of the four surveys. The two triennial survey biomass indices are weighted at $\lambda = 0.75$ so as to reduce the weight for double use of the same survey, whereas the two slope survey indices are each given weight $\lambda = 1$.
2. The likelihood of the discard percentage and discard mean weight data
3. Length composition likelihoods from all five fleets
4. Recruitment likelihoods
5. Parameter likelihoods given priors, most of which were quite flat. These include priors on Q (for the triennial surveys in the base model), on selectivity and retention parameters, and on $R_{0.}$

The model was assumed to have converged when the largest gradient component of the objective function in the final phase was less than $10^{-?}$. Issues of model convergence were assessed in several ways.

1. The Hessian matrix was inverted to ensure that it was positive definite; a non-positive definite Hessian matrix is an indication of a poorly converged or over-parameterized model.
2. The estimation was always initiated with starting values that were far from the final solution.
3. The estimation was conducted in several phases to avoid problems when highly non-linear models (such as that used here) enter biologically unreasonable regions (e.g., stock sizes smaller than the total catch or stock sizes several orders of magnitude too high).

Some parameters for the selectivities and retention were fixed at reasonable values in order for the model to produce a positive definite hessian.

Q for the slope surveys is fixed at 1 for the base model, as Lauth et al. (2004) found catchabilities of around 1 for thornyheads around 24 cm in length at both 450 and 750 meters depth, where shortspine thornyhead of that length are found. While catchability of ~24 cm thornyheads was < 1 at 1150 meters, thornyheads of that length at that depth are exclusively longspine thornyheads.

Q for the triennial surveys were fit by the model

Natural mortality M is assumed to be 0.05 instead of 0.06 for the base case.

Dome-shaped selectivity functions modeled with the double logistic were chosen for all fleets. For the two slope surveys this was done based primarily on Lauth et al. (2004). For the AFSC slope survey, the fit was improved substantially by assuming dome-shaped selectivity.

No age data was used in this assessment except in fitting the growth curve and natural mortality estimation.

Catch estimates were reconstructed back to 1901 by assuming shortspine thornyheads landings to be 30% of the reconstructed sablefish trawl catch through 1961 (Schirripa, pers. comm.). The 30% figure was arrived at by comparing domestic catches of sablefish and shortspine thornyhead through from 1962 through 2004. The average ratio of shortspine to sablefish catch for this time period was 44%. The catch rates are relatively small throughout this period. Sensitivity analyses include assuming no catch through 1961.

Fishery length data does not suggest an increase in the catch rates of relatively large individuals over the past 25 years except for the largest thornyheads, of greater than 55 or 60 cm. It is not clear, however, what shape the selectivity of the foreign fleets took while they were operating from 1966 through 1976. Also there is evidence from the triennial shelf survey that there used to be more larger thornyheads at shallower depths even in 1977 and 1980, which indicates that even more may have been there before significant fishing. The fishery length data is variable enough that it is not reasonable fit the separate selectivity curves across multiple periods. For parsimony, therefore, the base model includes a single fishery selectivity throughout the time series. As a possible sensitivity analysis, two selectivity periods for the fishery were allowed, 1901-1989 and 1990-2004. Freely estimating the downslope of the dome-shape selectivity produced estimates of less selectivity on larger fish post-1990, which is unlikely to be true.

Discard rate CV's are based upon sample sizes for the EDCP data, and concerns about the 1991 data not covering shallower areas where more discard would be expected. For most years of data, the CV's are set to 0.15.

Retention curves are fit to three time periods, prior to 1989, 1989-1995, and 1996-2004. These time periods were based on changes in depth of fishing and management, and also upon discard data availability. The point of inflection (length of 50% retention) was estimated separately for each of the time periods, but the slope of the curve was the same for all three in the base model.

Recruitment was modeled with a Beverton-Holt spawner-recruit relationship with steepness of 0.6 for the base case. For most years and for the forecasting, recruitment was set equal to the bias-corrected mean estimate for the spawning biomass level. Recruitment was estimated for years 1985-2000, for which years the best subsequent length data was available. σ_R was assumed to be 0.5 for the years in which recruitment was estimated.

Sensitivity Analysis

In consideration of uncertainty, a number of sensitivity runs were undertaken. These include runs with the following changes to the base model:

1. Slope survey Qs set to (a) 0.75, (b) 1.33 instead of 1.
2. Steepness h set at (a) 0.3 or (b) 0.9 instead of 0.6.
3. Assessment limited to the area north of Pt. Conception.

1.4 Results

Base model results indicate that the spawning stock biomass was depleted to 62.9% of its unfished equilibrium level of 130,646 mt in 2005 (Table 15). The estimate of *MSY,* based upon F50%, is 1,720 mt, which is smaller than estimated annual catches (including discard) in 1968, 1972-1975, 1977, 1979, and 1981-1997. Overfishing ($F > F_{MSY}$) occurred in all years from 1984-1994 although the fishing mortality in 2004 was less than F_{MSY}. MSY is estimated to occur at a spawning biomass level of 52,258 mt or 40% of SB0.

Fishery selectivity is estimated to reach 0.05 at 17-19cm and .5 at 23-25 cm. Full selection (>0.99)is reached by 27 cm in the North and 35cm in the South with significant declines starting at 45 cm in the North and 65 cm in the South, with a return to below 0.1 for the largest length classes. Fishery retention shows length at 50% retention at 40-43 cm before 1989, 28-30 cm between 1989 and 1995, and 32-35 cm after 1995.

Triennial survey selectivities are distinctly dome-shaped with peak selectivities in the range of 21-25 cm and reaching below 0.05 by 40 cm.

Both slope surveys selectivities show a pronounced dome shape, with peak selectivities for fish of length 21-25 cm, and substantially lower selectivities for the largest fish. The AFSC slope survey shows a rapid decline to 0.40 by 39 cm, but is about 0.25 the largest fish. The NWFSC slope survey shows a slower decline, reaching 0.55 by 39 cm, and 0.17 for the largest fish. These differences are likely due to differences in length of tow and fishing gear between the two surveys.

Research recommendations

Research and data needs for future assessments include the following:

1) Better age information is needed for this stock. As well as more samples, research is needed on how to age this species accurately.

2) A survey using a towed camera to assess the abundance in deeper water. The proportion of the stock and its size range in deeper water is unknown.

3) More tows or visual surveys south of 34.5 deg. N. lat. including the area closed for cowcod. Because the southern Conception Area is a large potential habitat for thornyheads, more effort is required to define their distribution in this area.

4) Length frequencies for discards would be very helpful.

5) Better data on growth, particularly differences in male and female growth and differences in growth rates up and down the coast.

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TABLES

Table 1: Management history

Jan 1989 Defined the deepwater complex as sablefish, dover sole, arrowtooth flounder and thornyheads
Apr 1989 Weekly trip limit on deepwater complex of only 1 landing above 4,000lbs, not to exceed 30,000lbs
Oct 1989 Removed overall poundage and trip limits for deepwater complex
Oct 1990 15,000 lb trip limit on deepwater complex, with only 1 landing per week above 1,000lbs.
Jan 1991 Coastwide weekly limit for thornyheads set at 7,500 lbs. Only 1 landing of deepwater complex above 4,000 lbs.
July 1991 Increased weekly trip limit for thornyheads to 12,500lbs
Jan 1992 Established a cumulative landing limit per specified 2 week period of 25,000 lbs thornyhead and an ABC of 1,900 mt for shortspine, and a harvest guideline of 7,000 mt for thornyheads combined.
May 1992 Minimum cod end mesh size for roller gear north of pt Arena, Ca increased from 3-4.5 in.
Jul 1992 Reduced cumulative 2 week landing limit for thornyhead from 25,000 to 20,000 lbs
Oct 1992 Reduced the cumulative 2 week landing limit to 15,000 lbs
Jan 1993 Two-week limit for Thornyheads set at 20,000lbs
Apr 1993 Reduced the thornyhead limit to 35,000lbs per 4-week period
Jan 1994 Reduce thornyhead limit to 30,000lbs per month
July 1994 Reduce thornyhead limit to 8,000lbs per 4 weeks
Dec 1994 Reduce thornyhead limit to 1,500 lbs per 4 weeks North of 36 deg North
Jan 1995 Monthly cumulative limit for thornyheads set at 20,000lbs of which no more than 4,000lbs may be shortspine, with an ABC of 1,000 mt and a harvest guideline oft 1,500 mt for shortspine
Apr 1995 Reduced the thornyhead limit to 15,000lbs, with no more than 3,000 lbs shortspine
Sep 1995 Reduced the thornyhead limit to 8,000 lbs, with no more than 1,500 lbs shortspine
Nov 1995 prohibited further landing of thornyhead
Jan 1996 Two-month cumulative limit for thornyhead set a 20,000 lbs, of which no more than 4,000 lbs may be shortspine
May 1996 Prohibited open access landing north of Pt. Conception
January 1997 Harvest guideline for landed catch for shortspine set at 1,380 mt
May 1997 Two-month cumulative limit for thornyhead set at 15,000 lbs, of which no more than 3,000 lbs may be shortspine
January 1998 Harvest guideline (landed) set at 1,300 mt, of which 123 mt is for conception N of Pt. Conc.
1999 Less than or equal 3000lbs from (Jan-Mar), less or equal 2000lbs/2mon (April-Sept) and 1000 lbs/mon (Oct-Dec), ABC 1,261 mt, HG 1,150mt, expected landed catch 805 mt.
2000 Fixed gear 1000lbs/month, Trawl 3000lbs/2months trip limit (Jan-Apr), 1000lbs/2mon (May-Oct) and 1500lbs/2mon (Nov-Dec), ABC 1,261 mt, OY 970 mt including discard.
2002: 2600 lbs/2m (S all year, N Jan-Apr, July-Oct), 2000 lbs/2m (N May-Jun),1500 lbs/2m (N Nov-Dec),
2003: ABC of 1,004 mt and OY of 955 mt.
2004: ABC of 1,030 mt and OY of 983 mt.
2005: North large and small footrope gear - 3500 lbs/2m (Nov-Apr), 4900 lbs/2m (May-Oct), North selective footrope gear – 1000 lbs/2m (Nov-Apr), 3000 lbs/2m (May-Oct), South – 4200 lbs/2months, ABC of 1,055 mt and OY of 999 mt.
2006: ABC of 1,077 mt and OY of 1,018 mt

Table 2. Shortspine thornyhead landings in metric tons from the north and south fisheries by foreign and domestic vessels.

Year	*North foreign*	*North domestic*	*South foreign*	*South domestic*	*Total Landings*
1962				230	230
1963				285	285
1964		12		172	184
1965		20		400	420
1966	604	8	270	273	1155
1967	354	15	735	129	1233
1968	144	15	1702	133	2002
1969	45	110	20	380	555
1970	52	97	5	552	706
1971	179	81		582	842
1972	318	71	205	1092	1686
1973	645	67	987	1390	3089
1974	191	24	40	1204	1459
1975	259	146	366	1501	2272
1976	49	3	269	723	1044
1977		91		1359	1450
1978		76		1136	1212
1979		109		1720	1829
1980		87		1192	1279
1981		94		1633	1727
1982		252		1660	1912
1983		728		1564	2292
1984		845		1960	2805
1985		813		2574	3387
1986		472		2442	2914
1987		580		1976	2556
1988		720		2190	2910
1989		1373		3529	4902
1990		1903		2244	4147
1991		2218		1316	3534
1992		1721		1655	3376
1993		2064		1788	3852
1994		1860		1575	3435
1995		841		1120	1961
1996		710		918	1628
1997		656		835	1491
1998		522		728	1250
1999		337		497	834
2000		303		546	849
2001		253		298	551
2002		246		539	785
2003		299		528	827
2004		298		407	705

Table 3. Virtual landings reconstruction 1901-1961

Year	"landings"	Year	"landings"
1901	1	1931	39
1902	3	1932	40
1903	4	1933	49
1904	5	1934	49
1905	6	1935	49
1906	8	1936	51
1907	9	1937	48
1908	10	1938	53
1909	11	1939	63
1910	13	1940	76
1911	14	1941	109
1912	15	1942	122
1913	16	1943	268
1914	18	1944	380
1915	19	1945	453
1916	20	1946	216
1917	21	1947	48
1918	23	1948	152
1919	24	1949	168
1920	25	1950	153
1921	26	1951	305
1922	28	1952	176
1923	29	1953	68
1924	30	1954	128
1925	31	1955	128
1926	33	1956	775
1927	34	1957	286
1928	35	1958	296
1929	36	1959	398
1930	38	1960	472
		1961	436

Table 4. Survey indices

Year	Triennial 55-366 m	CV	Triennial 366-500 m	CV	AFSC	CV	NWFSC	CV
1980	2113	0.145						
1983	2405	0.108						
1986	1893	0.168						
1989	1934	0.141						
1992	1934	0.151						
1995	2519	0.166	4078	0.144				
1997					52,736	0.148		
1998	2453	0.193	3132	0.104			45,210	0.163
1999					51,708	0.140	49,705	0.166
2000					62,310	0.136	52,744	0.160
2001	2622	0.126	4092	0.094	56,808	0.125	51,618	0.162
2002							67,882	0.112
2003							49,449	0.129
2004	3149	0.156	4881	0.21			50,459	0.121

Table 5. Discard rate data

Year	Source	Fishery	Discard rate	Assumed CV	Avg Ret. Weight	Assumed CV	Avg Dis. Weight	Assumed CV
1986	Pikitch		0.28	0.1				
1991	Pikitch		0.03	1				
1995	EDCP		0.132	0.4				
1996	EDCP		0.155	0.2				
1997	EDCP		0.201	0.21				
1998	EDCP		0.136	0.22				
1999	EDCP		0.252	0.3				
2002	WCGOP	N	0.2552	0.1	0.7417	0.2	0.1848	0.2
2003	WCGOP	N	0.3162	0.1	0.6396	0.2	0.1880	0.2
2002	WCGOP	S	0.1699	0.1	1.5924	0.2	0.5098	0.2
2003	WCGOP	S	0.1589	0.1	1.5202	0.2	0.4352	0.2

Table 6 Length compositions from the Northern and Southern Fisheries

Year	Fishery	Trips	Fish	Nom. Eff. N	Sex	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	46	50	54	58	62	66	70	74
1978	S			10	All	0	0	0	0	0	0	0	0	0	3	1	11	3	5	3	7	6	5	4	16	10	13	8	3	2	0	1
1979	S			10	All	0	0	0	0	0	0	0	0	0	0	0	1	3	2	2	3	4	7	9	19	22	10	10	4	1	2	0
1980	S	16	217	16	All	0	0	0	0	0	0	0	0	2	9	18	3	5	3	3	2	11	8	2	11	17	2	2	1	0	0	0
1981	N	6	180	6	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0034	0.0000	0.0067	0.0202	0.0506	0.0776	0.0798	0.0502	0.0300	0.0202	0.0135	0.0692	0.0629	0.0135	0.0034	0.0232	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0034	0.0135	0.0202	0.0603	0.0667	0.0928	0.1059	0.0532	0.0266	0.0000	0.0000	0.0000	0.0329	0.0000	0.0000
1981	S	12	88	12	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0409	0.0132	0.0077	0.0151	0.0055	0.0101	0.0620	0.0058	0.0114	0.0064	0.0427	0.0540	0.1115	0.0424	0.0373	0.0000	0.0000	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0050	0.0132	0.1001	0.0460	0.0106	0.0106	0.0060	0.0510	0.0778	0.0576	0.0937	0.0510	0.0050	0.0005	0.0054	0.0000	0.0000	0.0000
1982	N	8	180	8	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0047	0.0000	0.0000	0.0141	0.0560	0.0137	0.0625	0.0546	0.0310	0.0147	0.0269	0.0311	0.0239	0.0456	0.0409	0.0109	0.0085	0.0057	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0064	0.0047	0.0141	0.0425	0.1153	0.0881	0.0840	0.0454	0.0727	0.0234	0.0427	0.0066	0.0019	0.0009	0.0000	0.0064	0.0000	0.0000
1982	S	33	405	33	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014	0.0073	0.0112	0.0291	0.0410	0.0423	0.0260	0.0450	0.0237	0.0622	0.0527	0.0372	0.0627	0.0668	0.0347	0.0078	0.0107	0.0000	0.0000	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0028	0.0158	0.0189	0.0495	0.0356	0.0221	0.0454	0.0282	0.0474	0.0406	0.0660	0.0279	0.0128	0.0127	0.0125	0.0000	0.0000	0.0000
1983	S	92	1230	92	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0125	0.0066	0.0248	0.0314	0.0266	0.0264	0.0323	0.0300	0.0304	0.0426	0.0470	0.0646	0.0473	0.0501	0.0369	0.0116	0.0059	0.0009	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016	0.0027	0.0204	0.0242	0.0279	0.0201	0.0243	0.0180	0.0304	0.0265	0.0484	0.0494	0.0815	0.0507	0.0348	0.0046	0.0028	0.0038	0.0000	0.0000
1984	S	124	2755	124	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0014	0.0043	0.0216	0.0275	0.0191	0.0266	0.0339	0.0298	0.0361	0.0369	0.0455	0.0419	0.0562	0.0454	0.0387	0.0322	0.0160	0.0085	0.0011	0.0015
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0082	0.0250	0.0210	0.0283	0.0213	0.0195	0.0201	0.0401	0.0458	0.0392	0.0518	0.0894	0.0365	0.0228	0.0048	0.0007	0.0009	0.0000	0.0000
1985	S	143	3208	143	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0017	0.0046	0.0176	0.0370	0.0559	0.0262	0.0250	0.0236	0.0277	0.0283	0.0268	0.0282	0.0271	0.0516	0.0459	0.0389	0.0364	0.0236	0.0042	0.0015	0.0004
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0025	0.0136	0.0353	0.0481	0.0273	0.0246	0.0154	0.0235	0.0263	0.0299	0.0306	0.0402	0.0840	0.0314	0.0181	0.0137	0.0032	0.0001	0.0000	0.0000
1986	S	51	987	51	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0128	0.0138	0.0118	0.0343	0.0439	0.0217	0.0173	0.0197	0.0189	0.0222	0.0242	0.0208	0.0514	0.0359	0.0392	0.0293	0.0084	0.0037	0.0062	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0032	0.0089	0.0215	0.0483	0.0430	0.0259	0.0194	0.0229	0.0153	0.0356	0.0586	0.0414	0.1279	0.0577	0.0244	0.0070	0.0030	0.0000	0.0000	0.0000
1987	S	105	397	105	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0449	0.0366	0.0384	0.0488	0.0083	0.0100	0.0197	0.0120	0.0172	0.0073	0.0226	0.0148	0.0218	0.0668	0.0471	0.0041	0.0169	0.0007	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007	0.0007	0.0163	0.0530	0.0594	0.0163	0.0176	0.0105	0.0212	0.0133	0.0336	0.0579	0.0419	0.0899	0.0740	0.0192	0.0244	0.0003	0.0112	0.0000	0.0000
1988	S	23	148	23	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0131	0.0109	0.0059	0.0084	0.0249	0.0160	0.0564	0.0250	0.0343	0.0565	0.0123	0.0962	0.0415	0.0000	0.0397	0.0397	0.0000	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0097	0.0092	0.0062	0.0093	0.0070	0.0136	0.0104	0.0581	0.0512	0.0084	0.1651	0.0843	0.0795	0.0000	0.0000	0.0000	0.0000	0.0000
1989	S	77	759	77	F	0.0000	0.0000	0.0014	0.0014	0.0029	0.0014	0.0029	0.0077	0.0235	0.0550	0.0578	0.0305	0.0072	0.0074	0.0108	0.0078	0.0164	0.0091	0.0105	0.0454	0.0412	0.0498	0.0147	0.0220	0.0014	0.0000	0.0005
					M	0.0000	0.0000	0.0014	0.0014	0.0019	0.0014	0.0019	0.0058	0.0364	0.0470	0.0558	0.0230	0.0226	0.0202	0.0074	0.0123	0.0290	0.0553	0.0750	0.0846	0.0549	0.0266	0.0067	0.0000	0.0000	0.0000	0.0005
1990	N	91	482	91	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.0037	0.0125	0.0314	0.0392	0.0361	0.0294	0.0119	0.0066	0.0013	0.0041	0.0053	0.0066	0.0112	0.0226	0.0150	0.0346	0.0388	0.0468	0.0222	0.0088	0.0013
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037	0.0078	0.0578	0.0605	0.0818	0.0251	0.0217	0.0178	0.0144	0.0056	0.0436	0.0235	0.0430	0.0820	0.0686	0.0288	0.0137	0.0054	0.0024	0.0000	0.0000
1990	S	82	569	82	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0011	0.0275	0.0461	0.0427	0.0201	0.0163	0.0188	0.0163	0.0149	0.0080	0.0241	0.0147	0.0503	0.0503	0.0533	0.0298	0.0315	0.0022	0.0000	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0040	0.0208	0.0414	0.0365	0.0426	0.0391	0.0138	0.0229	0.0244	0.0113	0.0207	0.0747	0.0426	0.0846	0.0368	0.0054	0.0087	0.0000	0.0000	0.0000	0.0000

1991	N	49	1021	49	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0151	0.0504	0.0542	0.0604	0.0517	0.0343	0.0265	0.0123	0.0087	0.0166	0.0100	0.0130	0.0239	0.0123	0.0165	0.0249	0.0106	0.0082	0.0059
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0034	0.0337	0.0658	0.0566	0.0419	0.0349	0.0577	0.0366	0.0372	0.0247	0.0354	0.0422	0.0289	0.0196	0.0088	0.0099	0.0048	0.0000	0.0000
1991	S	44	571	44	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014	0.0036	0.0212	0.0652	0.0615	0.0642	0.0441	0.0520	0.0316	0.0316	0.0118	0.0121	0.0225	0.0265	0.0140	0.0122	0.0110	0.0074	0.0000	0.0021	0.0021
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014	0.0066	0.0215	0.0662	0.0869	0.0727	0.0666	0.0264	0.0320	0.0167	0.0150	0.0136	0.0223	0.0265	0.0152	0.0096	0.0000	0.0017	0.0007	0.0000	0.0000
1992	N	71	1102	71	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0034	0.0032	0.0201	0.0451	0.0499	0.0721	0.0368	0.0267	0.0294	0.0243	0.0115	0.0095	0.0140	0.0080	0.0123	0.0169	0.0144	0.0148	0.0117	0.0101	0.0020	0.0028
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0069	0.0157	0.0127	0.0414	0.0546	0.0904	0.0494	0.0394	0.0440	0.0194	0.0350	0.0233	0.0194	0.0191	0.0175	0.0422	0.0164	0.0072	0.0049	0.0021	0.0000	0.0000
1992	S	123	648	123	F	0.0000	0.0000	0.0022	0.0000	0.0000	0.0005	0.0007	0.0274	0.0552	0.0473	0.0482	0.0547	0.0331	0.0265	0.0230	0.0325	0.0101	0.0210	0.0129	0.0416	0.0224	0.0191	0.0120	0.0112	0.0080	0.0013	0.0000
					M	0.0000	0.0000	0.0022	0.0000	0.0000	0.0005	0.0032	0.0023	0.0428	0.0538	0.0377	0.0557	0.0295	0.0226	0.0196	0.0368	0.0136	0.0373	0.0242	0.0513	0.0284	0.0177	0.0049	0.0053	0.0000	0.0000	0.0000
1993	N	58	350	58	F	0.0000	0.0038	0.0153	0.0038	0.0229	0.0306	0.0280	0.0260	0.0886	0.0548	0.0942	0.0365	0.0044	0.0045	0.0049	0.0055	0.0054	0.0030	0.0000	0.0049	0.0055	0.0036	0.0073	0.0147	0.0066	0.0027	0.0047
					M	0.0000	0.0038	0.0000	0.0115	0.0115	0.0229	0.0363	0.0519	0.0331	0.0844	0.1217	0.0358	0.0095	0.0051	0.0184	0.0050	0.0043	0.0022	0.0119	0.0168	0.0127	0.0036	0.0119	0.0000	0.0007	0.0029	0.0000
1993	S	65	1112	65	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0113	0.0276	0.0294	0.0540	0.0755	0.0363	0.0267	0.0200	0.0219	0.0225	0.0186	0.0097	0.0111	0.0280	0.0267	0.0187	0.0168	0.0078	0.0037	0.0023	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0074	0.0243	0.0431	0.0626	0.0878	0.0390	0.0404	0.0187	0.0263	0.0159	0.0193	0.0125	0.0197	0.0450	0.0329	0.0172	0.0142	0.0023	0.0000	0.0015	0.0000
1994	S	84	1453	84	F	0.0000	0.0000	0.0030	0.0091	0.0010	0.0166	0.0154	0.0318	0.0303	0.0520	0.0600	0.0402	0.0341	0.0277	0.0234	0.0216	0.0210	0.0150	0.0156	0.0397	0.0196	0.0149	0.0187	0.0052	0.0047	0.0003	0.0006
					M	0.0000	0.0000	0.0030	0.0001	0.0000	0.0071	0.0109	0.0214	0.0345	0.0531	0.0648	0.0332	0.0307	0.0258	0.0244	0.0191	0.0185	0.0170	0.0148	0.0374	0.0243	0.0149	0.0145	0.0041	0.0043	0.0003	0.0006
1995	S	125	2308	125	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030	0.0065	0.0157	0.0397	0.0611	0.0629	0.0511	0.0472	0.0271	0.0288	0.0167	0.0146	0.0143	0.0158	0.0267	0.0238	0.0185	0.0181	0.0111	0.0045	0.0010	0.0002
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0027	0.0039	0.0138	0.0263	0.0562	0.0583	0.0617	0.0396	0.0293	0.0264	0.0153	0.0187	0.0176	0.0188	0.0352	0.0268	0.0204	0.0127	0.0061	0.0019	0.0000	0.0000
1996	N	12	372	12	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0009	0.0099	0.0098	0.0287	0.0230	0.0216	0.0506	0.0538	0.0612	0.0740	0.0437	0.0097	0.0226	0.0324	0.0135	0.0194	0.0230	0.0037	0.0009	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0033	0.0101	0.0063	0.0182	0.0343	0.0316	0.0220	0.0583	0.0324	0.0596	0.0643	0.0662	0.0115	0.0601	0.0139	0.0048	0.0000	0.0000	0.0000	0.0000	0.0000
1996	S	100	2377	100	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0128	0.0321	0.0776	0.0504	0.0486	0.0312	0.0379	0.0243	0.0165	0.0138	0.0153	0.0159	0.0137	0.0303	0.0253	0.0191	0.0212	0.0074	0.0038	0.0015	0.0004
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0058	0.0156	0.0745	0.0576	0.0511	0.0413	0.0347	0.0297	0.0180	0.0125	0.0139	0.0181	0.0162	0.0411	0.0287	0.0178	0.0120	0.0037	0.0022	0.0011	0.0001
1997	N	44	1943	44	F	0.0000	0.0000	0.0000	0.0000	0.0009	0.0014	0.0119	0.0147	0.0409	0.0529	0.0457	0.0400	0.0211	0.0226	0.0235	0.0232	0.0255	0.0205	0.0179	0.0314	0.0334	0.0257	0.0194	0.0182	0.0061	0.0025	0.0006
					M	0.0000	0.0000	0.0000	0.0000	0.0009	0.0014	0.0119	0.0147	0.0409	0.0529	0.0457	0.0400	0.0211	0.0226	0.0235	0.0232	0.0255	0.0205	0.0179	0.0314	0.0334	0.0257	0.0194	0.0182	0.0061	0.0025	0.0006
1997	S	124	2135	124	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0034	0.0091	0.0269	0.0292	0.0422	0.0431	0.0321	0.0303	0.0137	0.0186	0.0174	0.0208	0.0418	0.0469	0.0415	0.0370	0.0211	0.0113	0.0020	0.0013
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0030	0.0108	0.0258	0.0295	0.0411	0.0425	0.0304	0.0282	0.0147	0.0191	0.0240	0.0293	0.0627	0.0545	0.0431	0.0296	0.0145	0.0061	0.0007	0.0007
1998	N	44	727	44	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0054	0.0224	0.0326	0.0764	0.0710	0.0638	0.0358	0.0347	0.0299	0.0379	0.0260	0.0154	0.0447	0.0280	0.0162	0.0219	0.0206	0.0080	0.0026	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0032	0.0111	0.0336	0.0309	0.0462	0.0344	0.0445	0.0319	0.0147	0.0220	0.0205	0.0140	0.0152	0.0285	0.0229	0.0153	0.0097	0.0049	0.0016	0.0016	0.0000
1998	S	73	1530	73	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0191	0.0345	0.0503	0.0685	0.0650	0.0418	0.0434	0.0285	0.0176	0.0141	0.0120	0.0111	0.0271	0.0262	0.0217	0.0157	0.0107	0.0033	0.0024	0.0008
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0184	0.0220	0.0536	0.0670	0.0502	0.0416	0.0345	0.0261	0.0194	0.0163	0.0143	0.0127	0.0329	0.0327	0.0199	0.0164	0.0064	0.0009	0.0004	0.0001
1999	N	24	719	24	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0061	0.0323	0.0298	0.0617	0.0569	0.0325	0.0300	0.0405	0.0304	0.0308	0.0198	0.0328	0.0317	0.0287	0.0322	0.0298	0.0085	0.0035	0.0000
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0024	0.0153	0.0253	0.0274	0.0382	0.0486	0.0330	0.0210	0.0419	0.0384	0.0286	0.0285	0.0554	0.0269	0.0109	0.0107	0.0061	0.0012	0.0000	0.0000
1999	S	136	3041	136	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0033	0.0045	0.0063	0.0210	0.0339	0.0271	0.0359	0.0363	0.0370	0.0371	0.0346	0.0262	0.0216	0.0356	0.0336	0.0373	0.0332	0.0288	0.0132	0.0070	0.0026
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0029	0.0041	0.0057	0.0222	0.0312	0.0283	0.0355	0.0322	0.0367	0.0394	0.0343	0.0255	0.0243	0.0471	0.0445	0.0353	0.0191	0.0102	0.0029	0.0004	0.0006

2000	N	36	614	36	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0091	0.0151	0.0231	0.0414	0.0284	0.0264	0.0278	0.0326	0.0332	0.0315	0.0220	0.0427	0.0369	0.0293	0.0430	0.0480	0.0252	0.0068	0.0027
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0064	0.0070	0.0186	0.0386	0.0302	0.0214	0.0324	0.0208	0.0465	0.0323	0.0310	0.0189	0.0656	0.0427	0.0273	0.0229	0.0082	0.0027	0.0014	0.0000
2000	S	103	1879	103	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014	0.0022	0.0076	0.0260	0.0214	0.0319	0.0350	0.0356	0.0299	0.0236	0.0230	0.0218	0.0426	0.0513	0.0560	0.0588	0.0356	0.0207	0.0103	0.0040
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0018	0.0085	0.0206	0.0238	0.0382	0.0371	0.0356	0.0262	0.0206	0.0232	0.0215	0.0525	0.0568	0.0511	0.0241	0.0105	0.0030	0.0042	0.0000
2001	N	37	1353	37	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0015	0.0015	0.0057	0.0246	0.0399	0.0346	0.0515	0.0415	0.0360	0.0302	0.0279	0.0196	0.0180	0.0415	0.0377	0.0458	0.0462	0.0428	0.0127	0.0077	0.0017
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0005	0.0042	0.0091	0.0349	0.0317	0.0458	0.0301	0.0252	0.0277	0.0290	0.0367	0.0158	0.0230	0.0403	0.0376	0.0220	0.0110	0.0042	0.0008	0.0008	0.0000
2001	S	94	1944	94	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009	0.0065	0.0078	0.0150	0.0250	0.0377	0.0476	0.0486	0.0388	0.0179	0.0127	0.0093	0.0086	0.0112	0.0261	0.0262	0.0406	0.0441	0.0262	0.0123	0.0064	0.0004
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	0.0042	0.0090	0.0154	0.0281	0.0381	0.0586	0.0717	0.0525	0.0293	0.0173	0.0110	0.0119	0.0199	0.0421	0.0468	0.0336	0.0253	0.0100	0.0025	0.0010	0.0004
2002	N	55	1963	55	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0010	0.0027	0.0117	0.0261	0.0497	0.0600	0.0629	0.0434	0.0454	0.0170	0.0215	0.0184	0.0242	0.0227	0.0215	0.0240	0.0309	0.0216	0.0141	0.0055	0.0011
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0005	0.0056	0.0173	0.0294	0.0608	0.0695	0.0525	0.0470	0.0278	0.0301	0.0185	0.0195	0.0154	0.0357	0.0174	0.0175	0.0068	0.0007	0.0010	0.0000	0.0000
2002	S	188	3706	188	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0026	0.0084	0.0200	0.0302	0.0362	0.0405	0.0365	0.0337	0.0276	0.0228	0.0174	0.0218	0.0349	0.0408	0.0420	0.0453	0.0241	0.0105	0.0040	0.0021
					M	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0013	0.0058	0.0092	0.0180	0.0249	0.0410	0.0382	0.0452	0.0387	0.0321	0.0280	0.0231	0.0247	0.0509	0.0480	0.0351	0.0231	0.0090	0.0015	0.0004	0.0000
2003	N	60	1952	60	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0010	0.0037	0.0108	0.0164	0.0390	0.0294	0.0641	0.0458	0.0389	0.0324	0.0269	0.0202	0.0330	0.0266	0.0174	0.0240	0.0278	0.0265	0.0127	0.0063	0.0042
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0004	0.0047	0.0130	0.0317	0.0304	0.0583	0.0494	0.0480	0.0482	0.0491	0.0329	0.0307	0.0200	0.0392	0.0136	0.0111	0.0074	0.0032	0.0006	0.0006	0.0000
2003	S	130	3383	130	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0002	0.0004	0.0041	0.0106	0.0291	0.0358	0.0410	0.0360	0.0309	0.0262	0.0246	0.0194	0.0158	0.0478	0.0552	0.0341	0.0378	0.0204	0.0105	0.0028	0.0025
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000	0.0009	0.0061	0.0135	0.0315	0.0470	0.0426	0.0372	0.0381	0.0294	0.0258	0.0243	0.0222	0.0646	0.0662	0.0367	0.0179	0.0080	0.0023	0.0002	0.0000
2004	N	74	1169	74	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0065	0.0106	0.0428	0.1031	0.0532	0.0504	0.0518	0.0369	0.0274	0.0151	0.0138	0.0057	0.0301	0.0174	0.0142	0.0228	0.0159	0.0119	0.0025	0.0019
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0021	0.0191	0.0370	0.0832	0.0576	0.0574	0.0561	0.0320	0.0246	0.0138	0.0182	0.0106	0.0194	0.0133	0.0128	0.0052	0.0028	0.0004	0.0000	0.0000
2004	S	97	1560	97	F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0016	0.0023	0.0235	0.0318	0.0317	0.0423	0.0393	0.0278	0.0212	0.0173	0.0208	0.0437	0.0901	0.0520	0.0456	0.0158	0.0083	0.0041	0.0008
					M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0017	0.0089	0.0259	0.0390	0.0350	0.0444	0.0447	0.0276	0.0289	0.0355	0.0215	0.0523	0.0491	0.0287	0.0214	0.0103	0.0028	0.0018	0.0000

Table 7. Triennial survey 55-366 meter length compositions.

Year	N	Sex	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	46	50	54	58	62	66	70	74
1980	50	F	0.0000	0.0033	0.0033	0.0131	0.0098	0.0229	0.0229	0.0425	0.0621	0.0261	0.0719	0.0392	0.0654	0.0196	0.0327	0.0261	0.0327	0.0261	0.0000	0.0065	0.0065	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0000	0.0033	0.0033	0.0131	0.0098	0.0229	0.0229	0.0490	0.0490	0.0261	0.0850	0.0392	0.0327	0.0131	0.0458	0.0065	0.0131	0.0065	0.0196	0.0065	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1983	50	F	0.0000	0.0000	0.0000	0.0000	0.0128	0.0128	0.0641	0.0256	0.0769	0.0897	0.0385	0.0256	0.0385	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0000	0.0000	0.0000	0.0000	0.0513	0.0641	0.0641	0.1154	0.1923	0.0385	0.0256	0.0513	0.0128	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1986	50	F	0.0000	0.0000	0.0000	0.0000	0.0012	0.0093	0.0012	0.0313	0.0389	0.0380	0.1014	0.0918	0.0793	0.0207	0.0145	0.0006	0.0093	0.0000	0.0436	0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0000	0.0000	0.0004	0.0004	0.0101	0.0194	0.0109	0.0500	0.0742	0.0521	0.0883	0.0506	0.0081	0.0631	0.0301	0.0549	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1989	150	F	0.0003	0.0002	0.0014	0.0042	0.0089	0.0192	0.0322	0.0617	0.0856	0.0963	0.0974	0.0659	0.0227	0.0167	0.0098	0.0028	0.0022	0.0005	0.0003	0.0009	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0003	0.0004	0.0029	0.0054	0.0150	0.0291	0.0327	0.0695	0.0892	0.0927	0.0598	0.0411	0.0189	0.0071	0.0034	0.0007	0.0014	0.0002	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1992	100	F	0.0004	0.0013	0.0051	0.0053	0.0241	0.0267	0.0598	0.0398	0.0662	0.1029	0.0993	0.0359	0.0069	0.0043	0.0244	0.0007	0.0120	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0004	0.0013	0.0069	0.0065	0.0148	0.0345	0.0271	0.0480	0.0525	0.0977	0.0907	0.0700	0.0292	0.0025	0.0017	0.0002	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1995	150	F	0.0002	0.0048	0.0114	0.0269	0.0328	0.0450	0.0642	0.0714	0.0834	0.0666	0.0420	0.0305	0.0183	0.0102	0.0053	0.0020	0.0019	0.0003	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0002	0.0048	0.0114	0.0264	0.0367	0.0513	0.0725	0.0765	0.0786	0.0535	0.0362	0.0205	0.0078	0.0027	0.0011	0.0013	0.0000	0.0005	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1998	150	F	0.0003	0.0023	0.0072	0.0172	0.0230	0.0436	0.0768	0.0941	0.0889	0.0747	0.0429	0.0297	0.0115	0.0062	0.0044	0.0019	0.0006	0.0002	0.0001	0.0006	0.0005	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
		M	0.0003	0.0023	0.0080	0.0174	0.0278	0.0579	0.0760	0.0936	0.0737	0.0497	0.0376	0.0160	0.0063	0.0037	0.0017	0.0005	0.0004	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2001	150	F	0.0000	0.0021	0.0059	0.0184	0.0255	0.0522	0.0506	0.0825	0.0846	0.0828	0.0472	0.0378	0.0167	0.0070	0.0034	0.0039	0.0007	0.0009	0.0018	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
		M	0.0000	0.0019	0.0045	0.0175	0.0247	0.0504	0.0744	0.0890	0.0719	0.0591	0.0389	0.0261	0.0087	0.0024	0.0018	0.0011	0.0013	0.0001	0.0008	0.0004	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2004	150	F	0.0003	0.0040	0.0094	0.0187	0.0233	0.0303	0.0306	0.0665	0.0653	0.0801	0.0644	0.0537	0.0386	0.0214	0.0141	0.0061	0.0038	0.0015	0.0004	0.0012	0.0007	0.0001	0.0007	0.0000	0.0000	0.0000	0.0000
		M	0.0003	0.0040	0.0094	0.0185	0.0234	0.0325	0.0390	0.0552	0.0725	0.0818	0.0563	0.0288	0.0196	0.0118	0.0047	0.0021	0.0028	0.0007	0.0004	0.0001	0.0001	0.0000	0.0009	0.0000	0.0000	0.0000	0.0000

Table 8. Triennial survey 366-500 meter length compositions.

Year	N	Sex	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	46	50	54	58	62	66	70	74
1995	150	F	0.0013	0.0074	0.0236	0.0463	0.0504	0.0470	0.0487	0.0633	0.0607	0.0464	0.0260	0.0149	0.0068	0.0048	0.0033	0.0062	0.0024	0.0014	0.0004	0.0007	0.0011	0.0004	0.0000	0.0005	0.0002	0.0000	0.0000
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1998	150	F	0.0016	0.0080	0.0200	0.0406	0.0562	0.0569	0.0564	0.0502	0.0495	0.0454	0.0187	0.0105	0.0092	0.0083	0.0060	0.0049	0.0020	0.0015	0.0016	0.0018	0.0006	0.0008	0.0008	0.0001	0.0001	0.0000	0.0000
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2001	150	F	0.0005	0.0022	0.0075	0.0155	0.0414	0.0625	0.0878	0.0738	0.0661	0.0420	0.0345	0.0147	0.0097	0.0067	0.0043	0.0047	0.0027	0.0027	0.0011	0.0017	0.0011	0.0005	0.0003	0.0003	0.0000	0.0000	0.0000
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2004	150	F	0.0047	0.0121	0.0137	0.0250	0.0245	0.0307	0.0365	0.0620	0.0816	0.0854	0.0426	0.0256	0.0103	0.0059	0.0037	0.0025	0.0023	0.0014	0.0008	0.0015	0.0010	0.0003	0.0003	0.0006	0.0000	0.0000	0.0001
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 9. Length composition data from the AFSC slope survey

Year	N	Sex	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	46	50	54	58	62	66	70	74
1997	200	F	0.0002	0.0026	0.0131	0.0206	0.0309	0.0344	0.0382	0.0628	0.0527	0.0428	0.0293	0.0202	0.0186	0.0144	0.0105	0.0083	0.0072	0.0058	0.0052	0.0099	0.0112	0.0107	0.0115	0.0061	0.0027	0.0008	0.0001
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1999	200	F	0.0000	0.0015	0.0094	0.0218	0.0299	0.0367	0.0513	0.0673	0.0671	0.0439	0.0301	0.0210	0.0154	0.0134	0.0090	0.0080	0.0074	0.0068	0.0074	0.0094	0.0099	0.0104	0.0092	0.0068	0.0021	0.0008	0.0002
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2000	200	F	0.0009	0.0033	0.0027	0.0128	0.0198	0.0321	0.0496	0.0667	0.0705	0.0506	0.0303	0.0214	0.0162	0.0101	0.0092	0.0087	0.0056	0.0064	0.0062	0.0105	0.0093	0.0089	0.0099	0.0071	0.0032	0.0014	0.0004
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2001	200	F	0.0004	0.0028	0.0092	0.0108	0.0195	0.0386	0.0435	0.0670	0.0624	0.0523	0.0372	0.0278	0.0175	0.0125	0.0104	0.0103	0.0080	0.0063	0.0048	0.0084	0.0107	0.0107	0.0104	0.0080	0.0030	0.0010	0.0001
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 10. Length composition data from the NWFSC slope survey.

Year	N	Sex	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	46	50	54	58	62	66	70	74
1998	200	All	0.0005	0.0045	0.0112	0.0216	0.0363	0.0669	0.1013	0.1167	0.1008	0.0819	0.0689	0.0600	0.0570	0.0529	0.0322	0.0249	0.0203	0.0267	0.0151	0.0398	0.0233	0.0228	0.0102	0.0034	0.0006	0.0002	0.0001
1999	200	All	0.0005	0.0027	0.0140	0.0286	0.0480	0.0597	0.0745	0.0890	0.0961	0.0737	0.0654	0.0653	0.0669	0.0577	0.0443	0.0326	0.0355	0.0190	0.0241	0.0338	0.0257	0.0203	0.0145	0.0047	0.0027	0.0007	0.0000
2000	200	All	0.0011	0.0041	0.0086	0.0238	0.0439	0.0676	0.0808	0.1056	0.0962	0.0837	0.0769	0.0571	0.0491	0.0499	0.0368	0.0325	0.0227	0.0232	0.0262	0.0385	0.0325	0.0153	0.0127	0.0062	0.0034	0.0013	0.0000
2001	200	All	0.0011	0.0043	0.0137	0.0173	0.0325	0.0530	0.0800	0.0927	0.0870	0.0828	0.0759	0.0605	0.0636	0.0539	0.0519	0.0348	0.0320	0.0251	0.0216	0.0425	0.0310	0.0208	0.0119	0.0061	0.0027	0.0006	0.0002
2002	200	All	0.0023	0.0027	0.0083	0.0066	0.0150	0.0372	0.0755	0.1184	0.1464	0.1150	0.0835	0.0732	0.0543	0.0470	0.0341	0.0308	0.0225	0.0227	0.0212	0.0308	0.0221	0.0167	0.0075	0.0034	0.0019	0.0005	0.0003
2003	200	All	0.0018	0.0032	0.0094	0.0151	0.0289	0.0340	0.0563	0.1036	0.1026	0.1077	0.0889	0.0683	0.0544	0.0521	0.0430	0.0411	0.0351	0.0326	0.0230	0.0401	0.0274	0.0149	0.0087	0.0065	0.0009	0.0004	0.0001
2004	200	F	0.0009	0.0055	0.0109	0.0147	0.0185	0.0184	0.0225	0.0463	0.0577	0.0651	0.0491	0.0328	0.0299	0.0219	0.0165	0.0124	0.0116	0.0099	0.0091	0.0137	0.0140	0.0085	0.0043	0.0020	0.0010	0.0008	0.0002
		M	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 11. List of the data sources and associated time periods used in present assessment.

Data Source	Years
Fishery Catch: Virtual from Sablefish catch	1901-1961
Domestic from 2001 assessment	1962-1980
Foreign from Rogers (2003)	1966-1976
Southern from CALCOM	1979-1980
PacFIN	1981-2004
Fishery length-composition data	1978-2004
Survey biomass indices and length compositions	
Triennial survey 55-366 m	1980,1983,1986,1989,1992,1995,1998,2001,2004
Triennial survey 366-500 m	1995, 1998, 2001, 2004
AFSC slope survey	1997, 1999-2001
NWFSC slope survey	1998-2004

Table 12. Double logistic selectivity parameters for all fleets, logistic retention parameters for the fishery and catchabilites (Qs) for surveys for the base model

Northern Fishery					Southern Fishery				
	Value	Mean	sd	Block		Value	Mean	sd	Block
Peak	26.301	26	10		Peak	37.952	26	10	2
						41.868			2
Initial 1901	4.12E-05	0	99	2	Initial 1901	1.21E-06	0	99	2
Initial 1988	5.17E-03			2	Initial 1988	0.000669			2
Inflection	1.77931	0	3		Inflect 1901	0.5532	0	3	2
					Inflect 1988	0.0842			2
Slope	0.3	fixed			Slope	0.5	fixed		
Final 1901	-0.00816	9	99	2	Final 1901	-2.54559	9	99	2
Final 1988	-2.76498			2	Final 1988	-2.48274			2
Inflection	1.05845	0.1	3		Inflection	-0.62812	0.1	3	
Slope	0.1	fixed			Slope 1901	0.0200	fixed		2
					Slope 1988	0.1137			2
Width 1901	48.2742	4	99	2	Width	20.5454	4	99	
Width 1988	0.031529			2					
Retention					Retention				
50% 1901	42.6912	27	99	3	50% 1901	39.6138	27	99	1
50% 1988	28.2006			3	50% 1988	29.4335			1
50% 1995	32.0656			3	50% 1995	34.7488			1
50% 2000	33.5623			3					
Slope	2	fixed			Slope	2	fixed		
Final	0.999	fixed			Final	0.999	fixed		
Male offset	0	fixed			Male offset	0	fixed		
Triennial 55-366 m					Triennial 366-500 m				
	Value	Mean	sd			Value	Mean	sd	
Peak	26.2242	22	10		Peak	20.5945	22	10	
Initial	0.0001	fixed			Initial	0.0001	fixed		
Inflection	0.43594	0	3		Inflection	0.296683	0	3	
Slope	0.338176	0.3	99		Slope	0.3	fixed		
Final	-4.97727	-7	99		Final	-3.80412	-7	99	
Inflection	-2.54985	0	3		Inflection	-2.75628	0	3	
Slope	0.3	fixed			Slope	0.3	fixed		
Width	0	fixed			Width	4.34979	4	99	
AFSC					NWFSC				
	Value	Mean	sd			Value	Mean	sd	
Peak	20.9455	26	10		Peak	23.9303	26	10	
Initial	0.0001	fixed			Initial	0.0001	fixed		
Inflection	0.571837	0	3		Inflection	0.608559	0	3	
Slope	0.3	fixed			Slope	0.3	fixed		
Final	-1.11047	9	99		Final	-1.5683	9	1	
Inflection	-4.26608	0	3		Inflection	-1.2067	0	3	
Slope	0.006876	0.3	99		Slope	6.25E-05	0.3	1	
Width	5.77066	4	99		Width	1	fixed		

Table 13. Other parameters used in the base model.

parameter	Value	mean	sd
Natural mortality	0.05	fixed	
size at age 2	7	fixed	
F size at age 100	75	fixed	
M size at age 100	67.5	fixed	
V-B K	0.018	fixed	
cv L at Age	0.125	fixed	
wt-at length a	4.90E-06	fixed	
wt-at L exp.	3.264	fixed	
Mean L at Maturity	18.2	fixed	
slope param. Maturity at length	-2.3	fixed	
log (R0)	9.93	10.30	10
Steepness	0.6	fixed	
Sigma R	0.5	fixed	

Table 14. Estimated Recruitment devs.

Year	Value
1985	0.01282
1986	0.05933
1987	0.12798
1988	0.22791
1989	0.28944
1990	0.22817
1991	0.10313
1992	0.04240
1993	-0.06642
1994	-0.27683
1995	-0.41646
1996	-0.40559
1997	-0.24614
1998	-0.01870
1999	0.11534
2000	0.22361

Table 15. Estimated base and sensitivity model parameters, output statistics and fit diagnostics.

	Base: H 0.6 Q 1	Low: H 0.3 Q 1.33	High: H 0.9 Q 0.75	H 0.3 Q 1	H 0.9 Q 1		North of Pt. Conc.	South of Pt. Conc.
Depletion	0.629	0.559	0.687	0.618	0.634		0.533	0.966
2005 SB	82,151	67,221	104,633	84,329	81,889		54,200	27,951
SB0	130,646	120,253	152,347	136,320	129,230		101,724	28,922
Bmsy	52,258	53,901	73,997	61,095	64,115		40,690	11,568
MSY	1,720	577	2,427	657	2,115		1,358	362
MSYL	0.40	*0.45*	0.49	*0.45*	0.49		0.40	0.40
Fmsy	0.0238	0.0084	0.0239	0.0085	0.0236		0.0235	------------ The above calculated by subtraction (assuming no catch in this area, such that the depletion is only due to fewer recruits due to assumed complete mixing of recruits from the two areas). ------------
Expl.msy	0.0184	0.0061	0.0184	0.0061	0.0185		0.0187	
F_{2004}/F_{msy}	0.35	1.45	0.32	0.98	0.35		0.52	
Likelih.	648.52	651.70	638.94	644.33	649.33		678.60	
indices	-26.83	-22.87	-28.59	-25.74	-27.39		-20.54	
discard	-45.41	-45.38	-45.48	-45.61	-45.24		-44.45	
Lcomps	676.68	678.17	670.08	671.21	678.98		698.91	
Weight	5.06	5.07	5.24	5.03	5.24		4.92	
Recruits	-9.56	-14.27	-9.45	-9.51	-9.56		-9.64	
Priors	59.65	60.68	58.23	59.99	58.38		60.44	
Forecast	-11.05	-9.70	-11.09	-11.05	-11.09		-11.04	
M	0.05	0.05	0.05	0.05	0.05		0.05	
h	0.6	0.3	0.9	0.3	0.9		0.6	
Q tri 1	0.131	0.170	0.118	0.134	0.131		0.174	
Q tri 2	0.213	0.279	0.173	0.221	0.207		0.293	
Q afsc	1	1.33	0.75	1	1		1	
Q nwfsc	1	1.33	0.75	1	1		1	

Figure 1. Comparison of landings estimates from the previous and current assessments. The large deviations in 1967 and 1968 are due to very large foreign catch assumptions in those years.

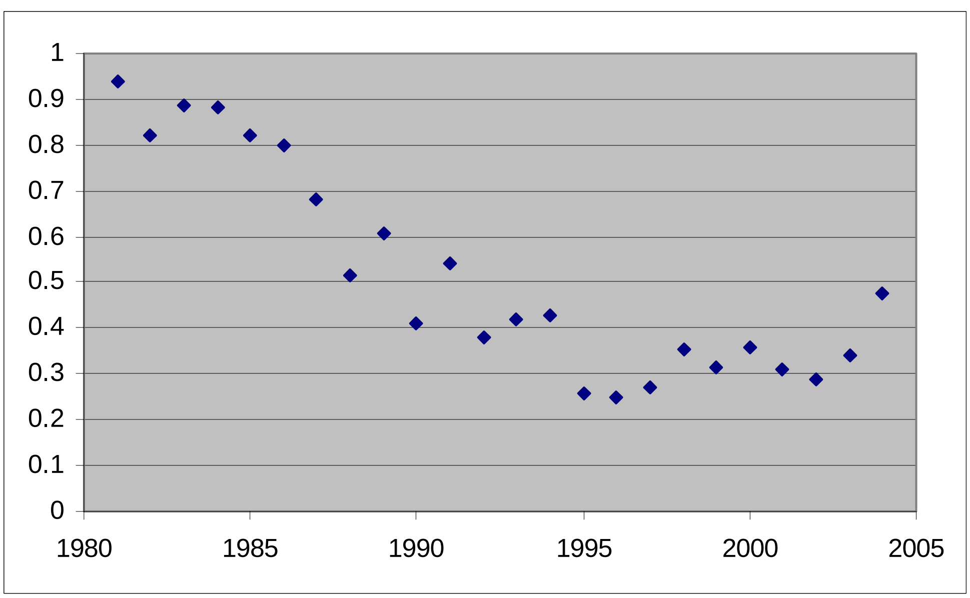
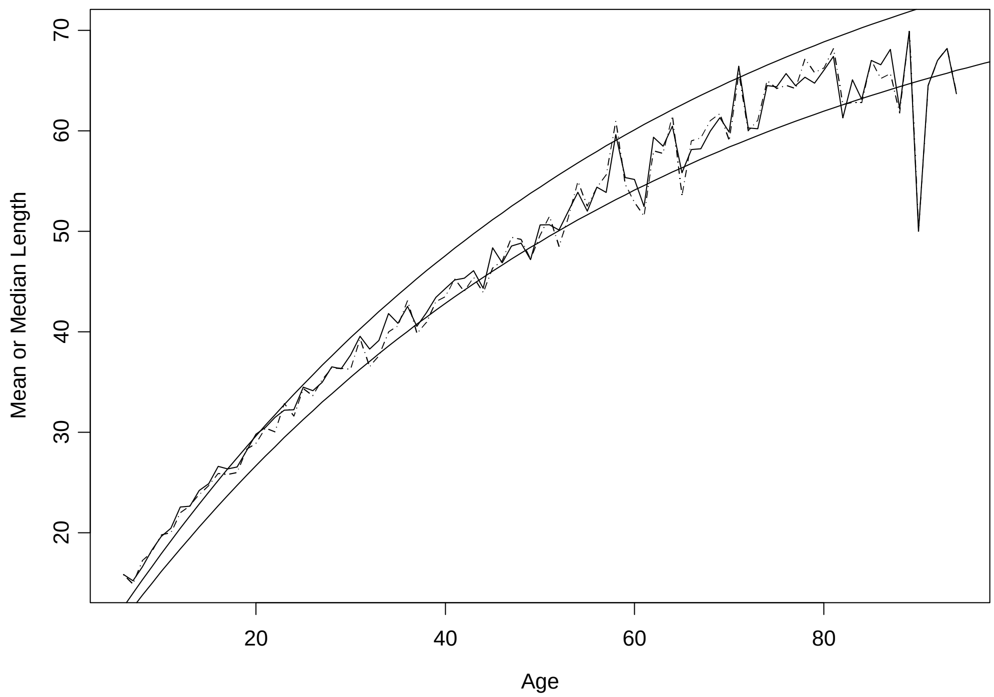


Figure 2. Ratio of shortspine thornyhead landings to combined (shortspine and longspine) landings from PacFIN data for the years 1981-2004.



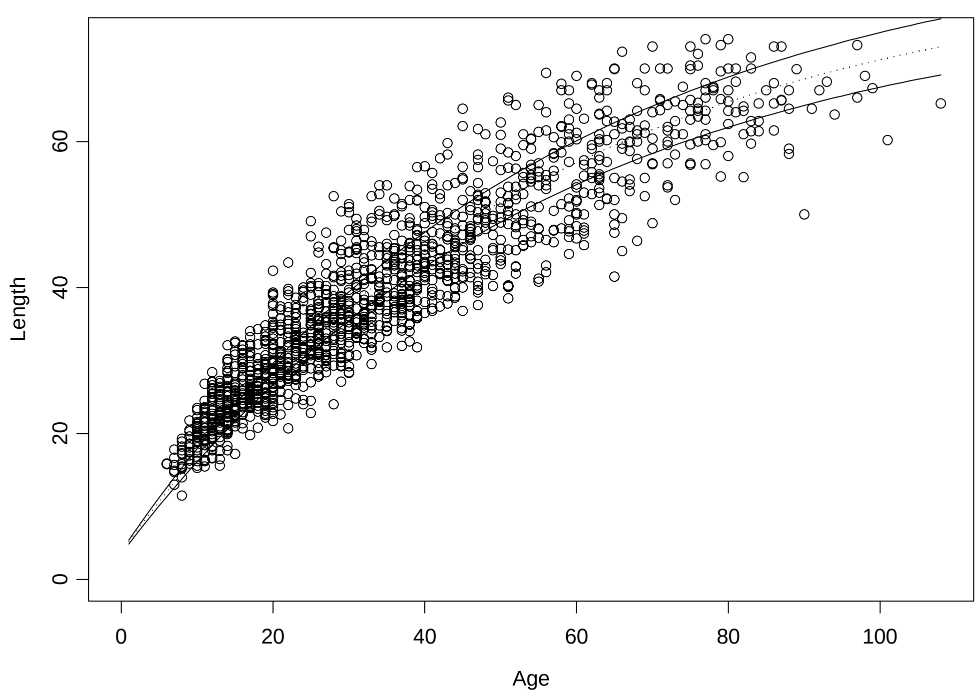


Figure 3. (a) Length at age for Females (top curve) and Males (bottom curve) assumed in the base model, and mean and median length (dotted line) at estimated age from data from Kline (1996). The assumed curves are below the data at early ages based on the assumption that the fish used in the ageing were highly size selected for the youngest fish. (b) Raw data from Kline (1996) and assumed mean length at age for females and males, with combined curve as dotted line.

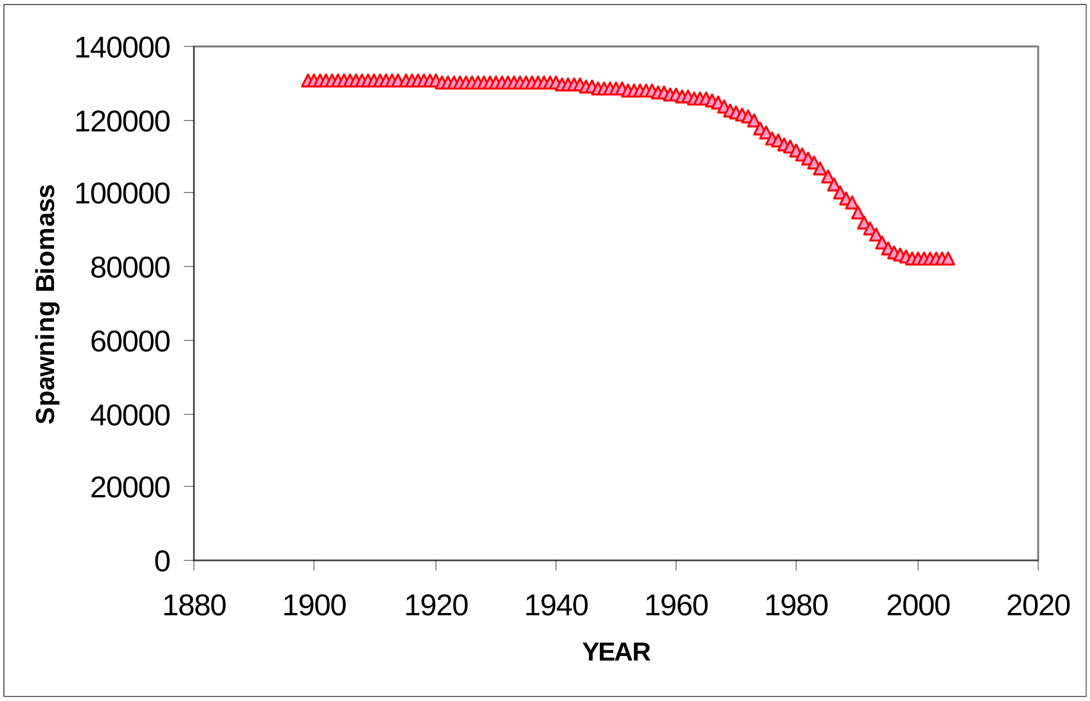


Figure 4. Time trajectory of spawning biomass.

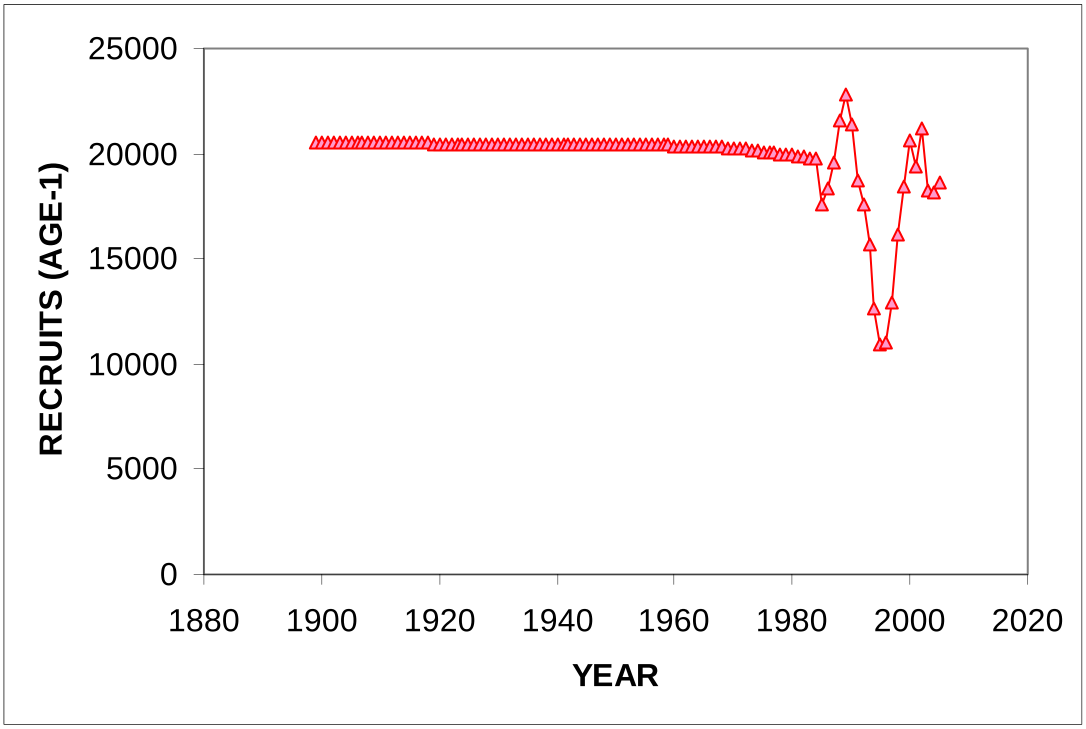


Figure 5. Time trajectory of estimated recruitments.

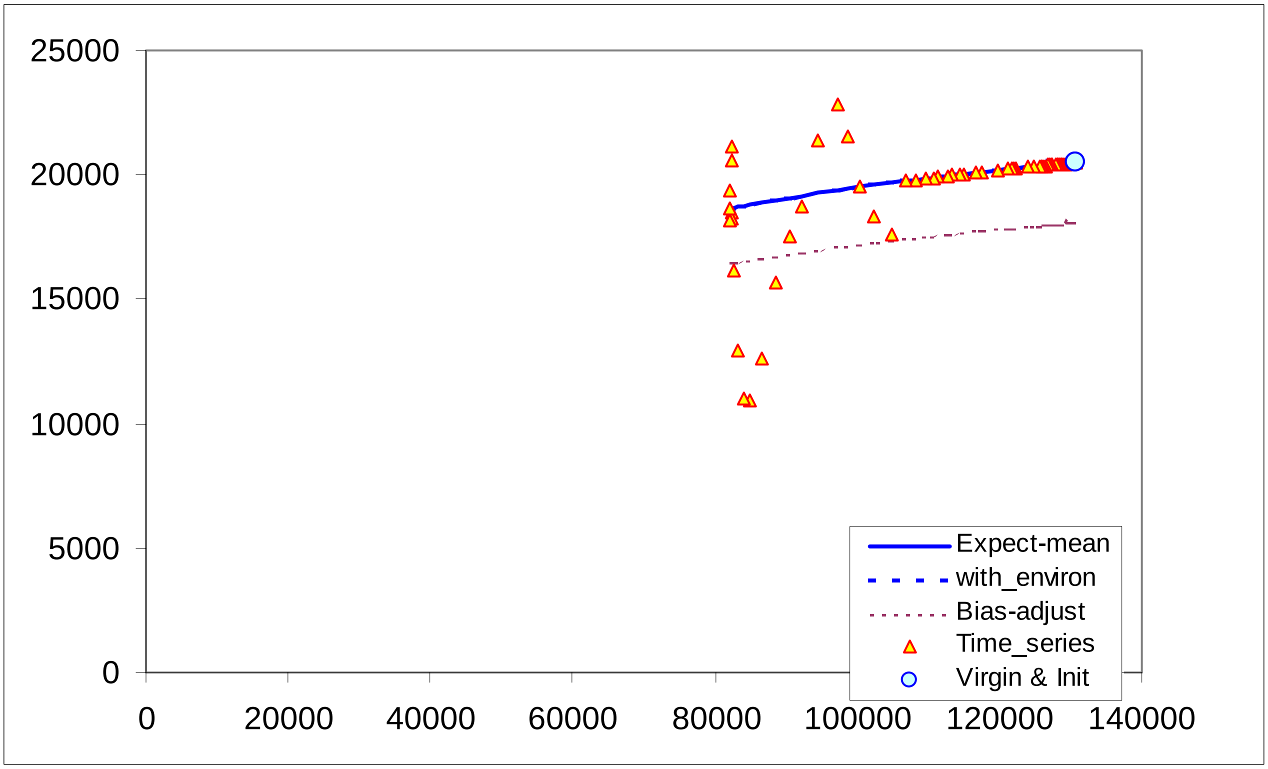


Figure 6. Spawner recruit relationship.

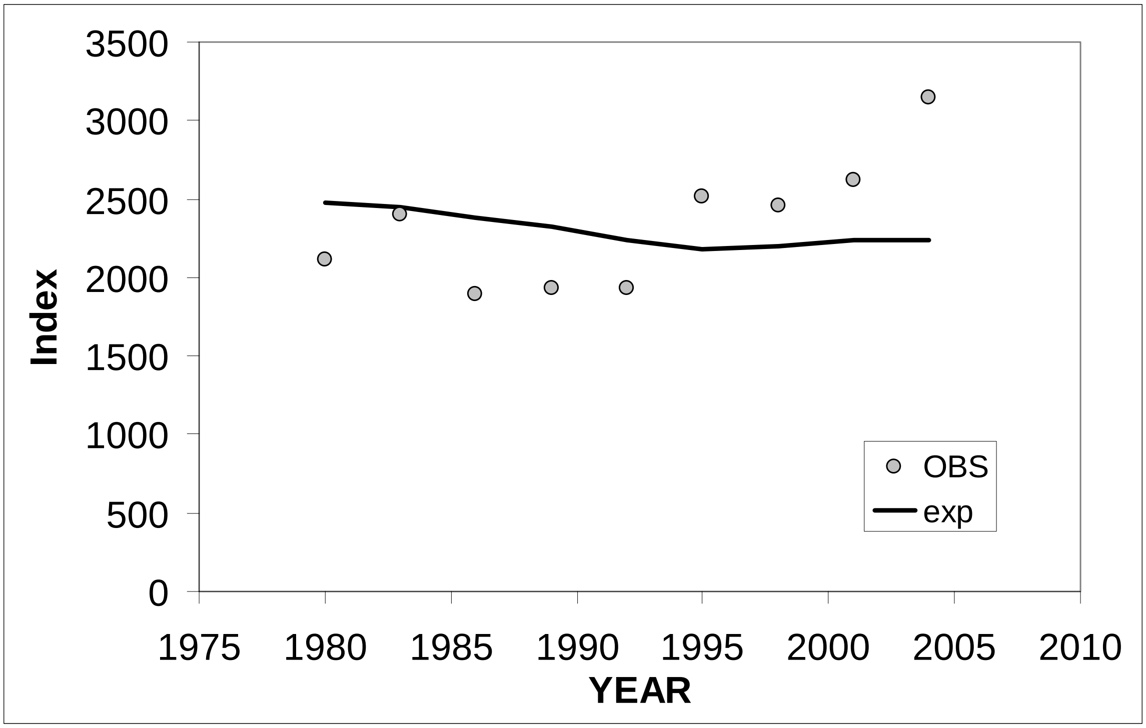


Figure 7. Fit of the model to the Triennial survey (55-366 meters) biomass indices.

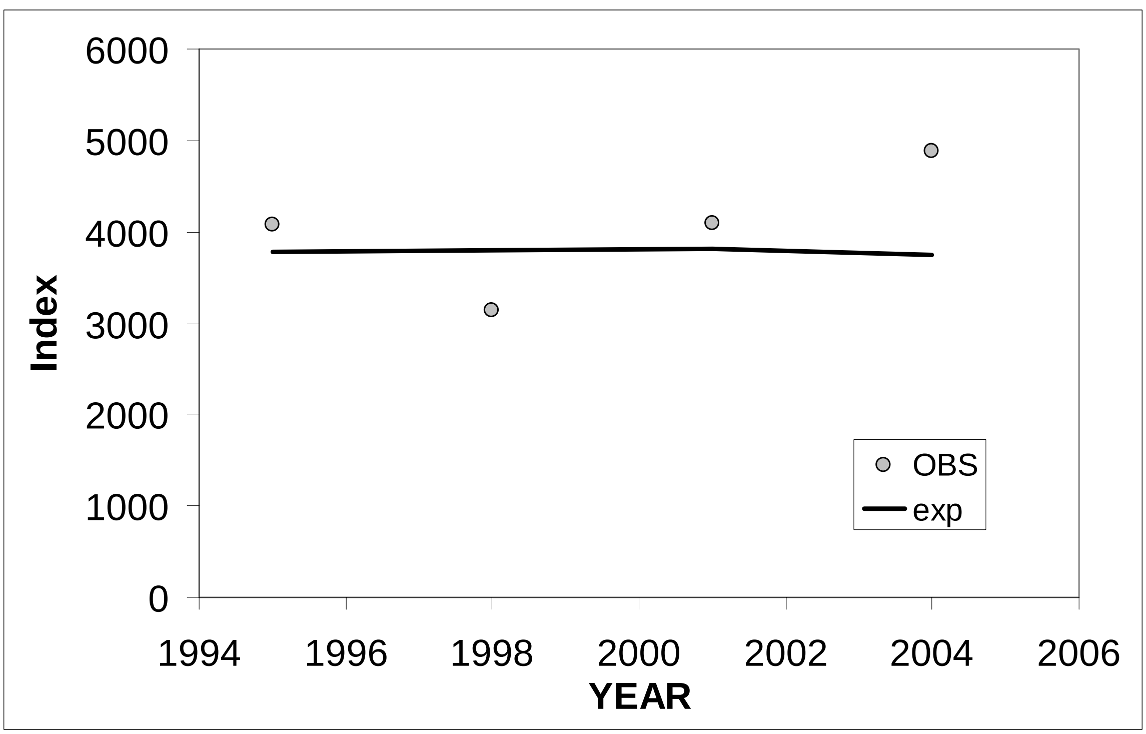


Figure 8. Fit of the model to the Triennial survey (366-500 meters) biomass indices.

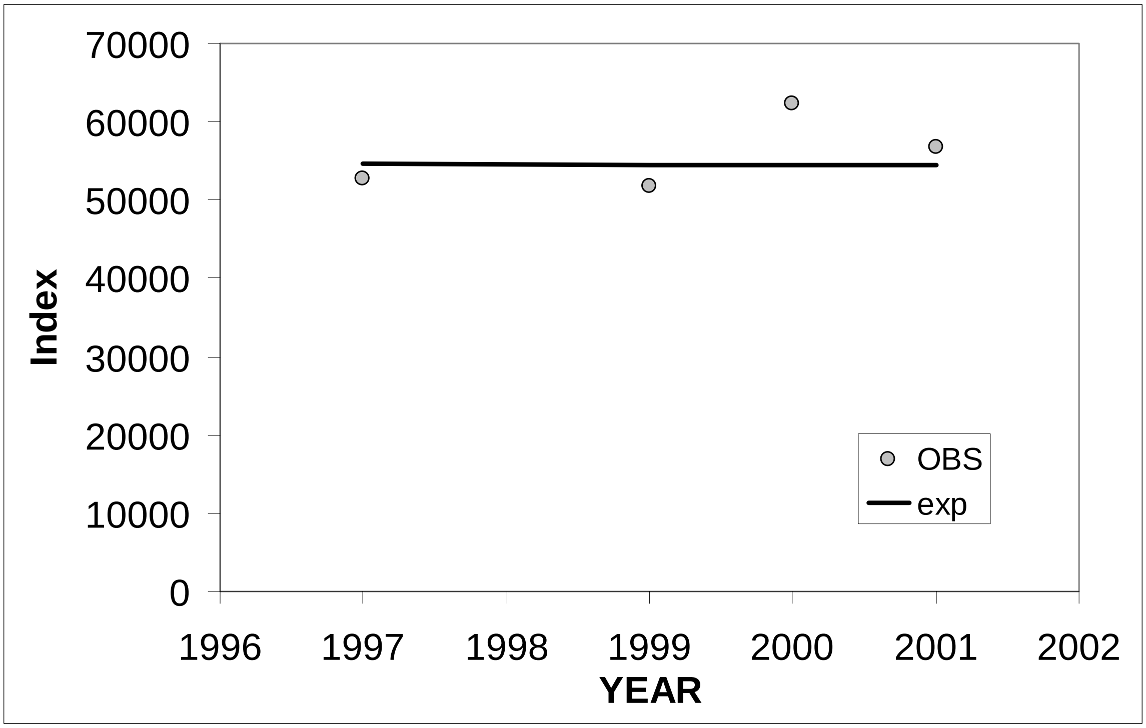


Figure 9. Fit of the model to the AFSC slope survey biomass indices.

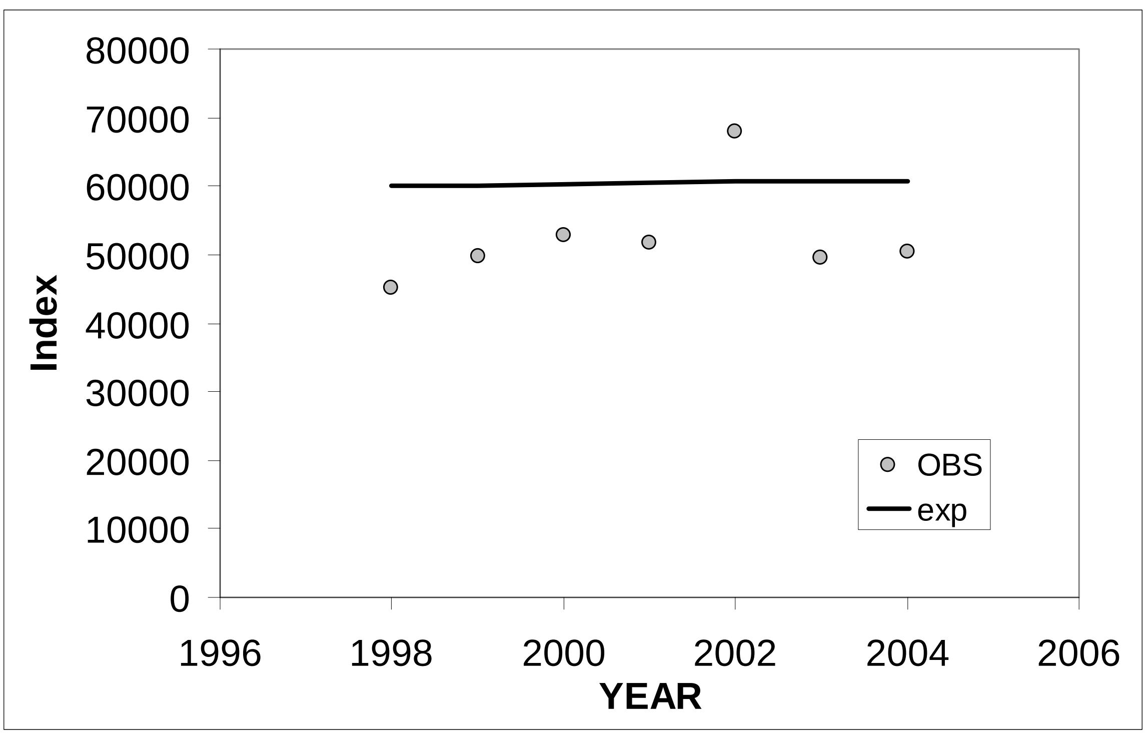


Figure 10. Fit of the model to the NWFSC slope survey biomass indices.

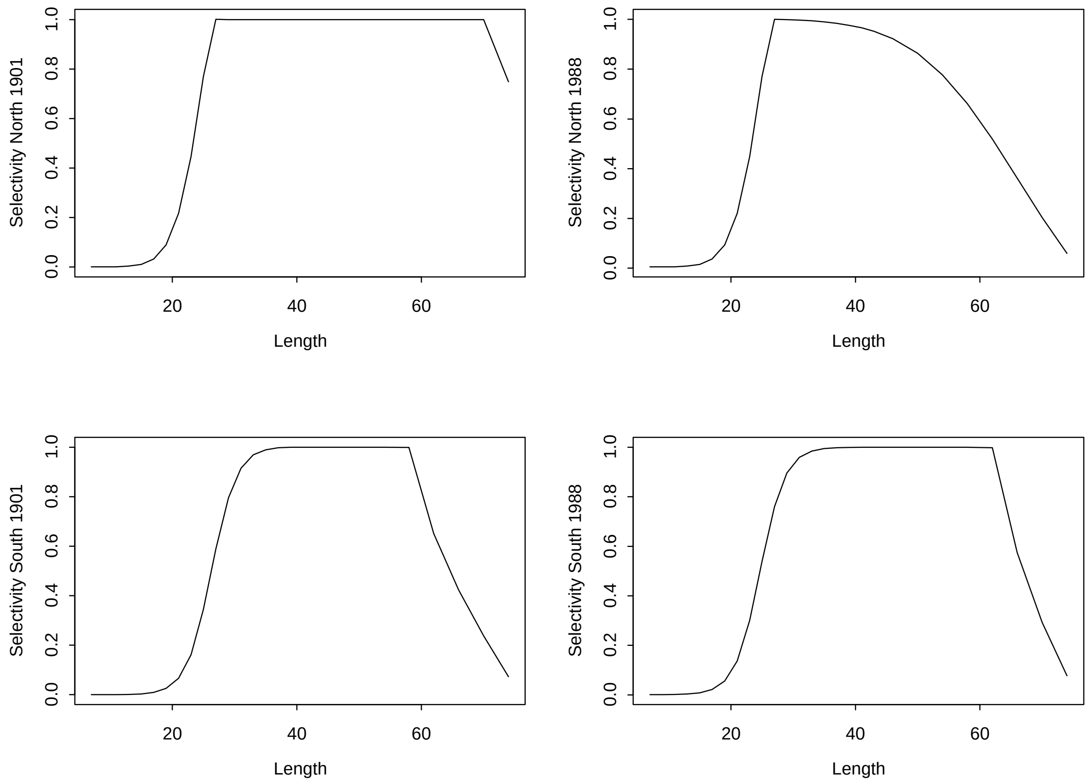


Figure 11. Fishery selectivity

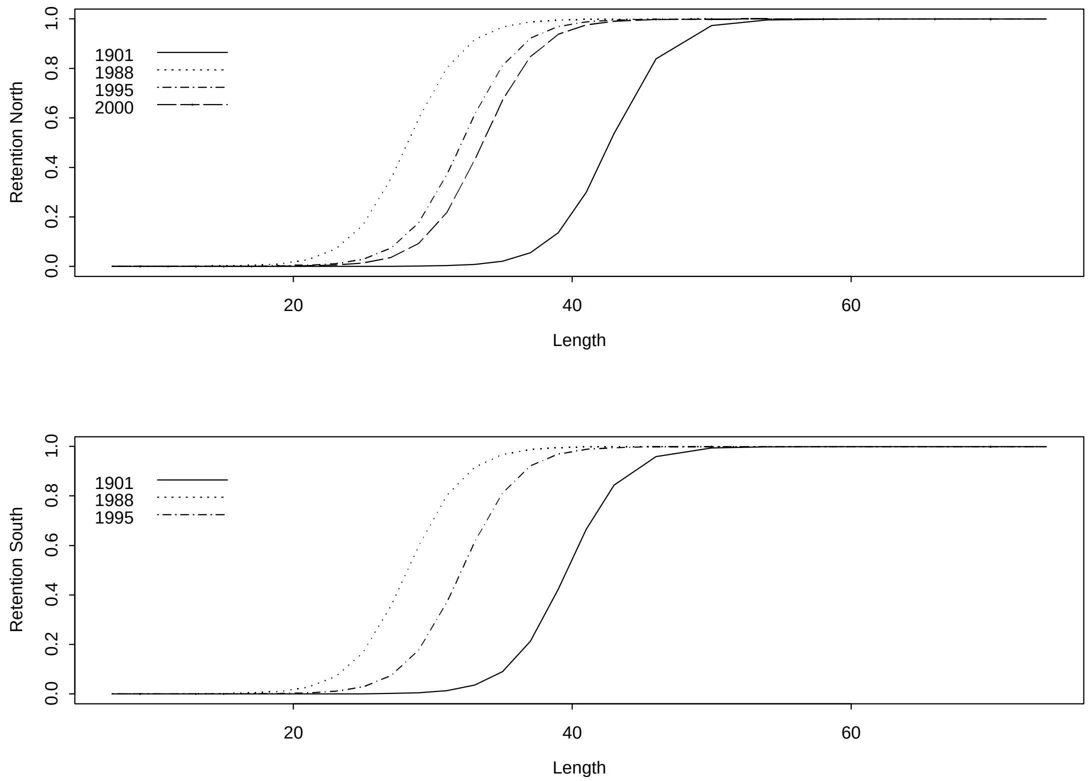


Figure 12. Retention estimated for three time periods – pre-1989 (squares), 1989-1995 (triangles), 1996-2004 (circles).

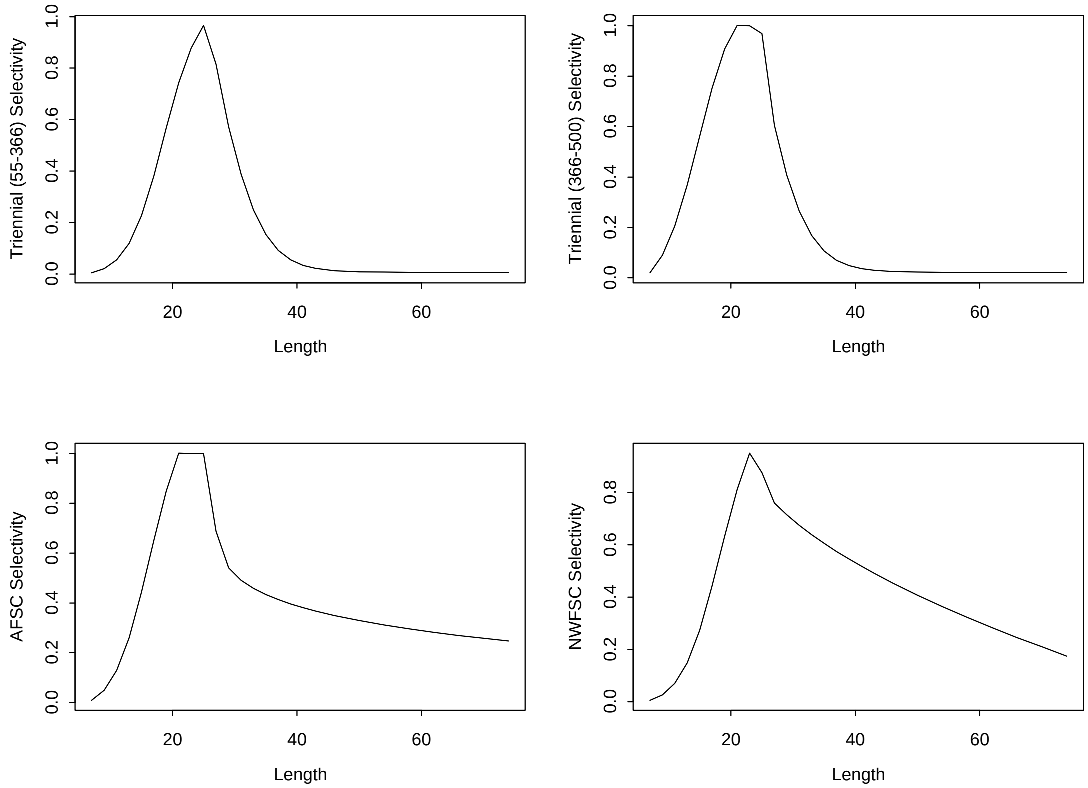


Figure 13. Selectivities for the four surveys: Triennial shelf survey 55-366 meters (a), Triennial shelf survey 366-500 meters (b), AFSC slope survey (c), NWFSC slope survey (d).

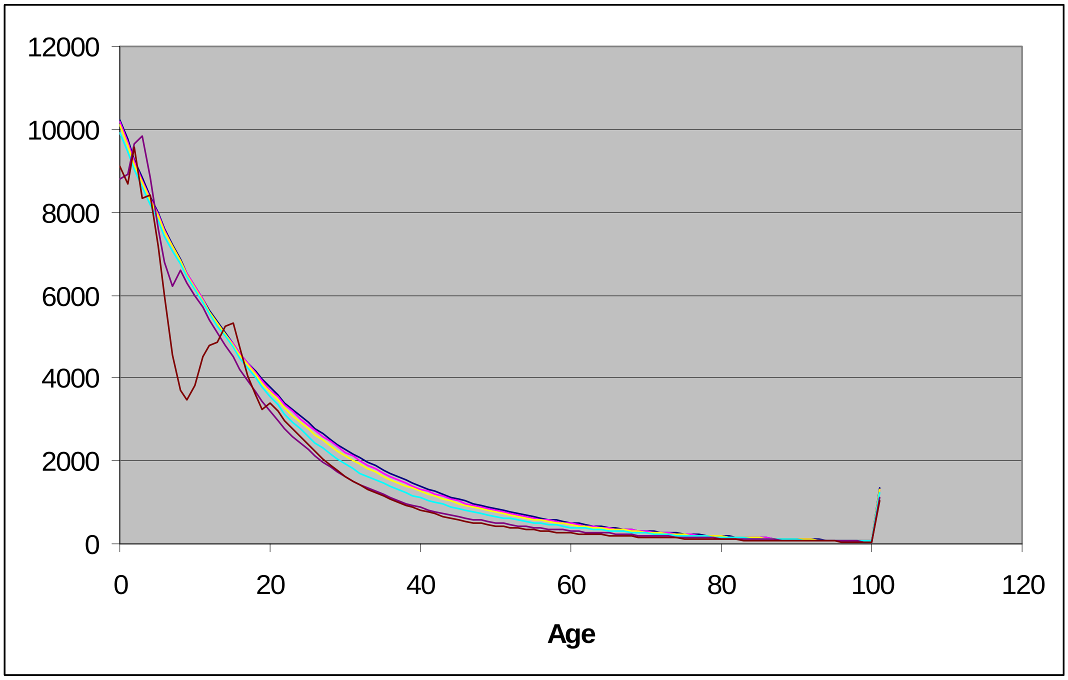


Figure 14. Estimates of numbers at age for females for years 1900, 1962, 1972, 1982, 1992 and 2004. Above age 35 for all years the numbers at age diminish with each successively displayed year.

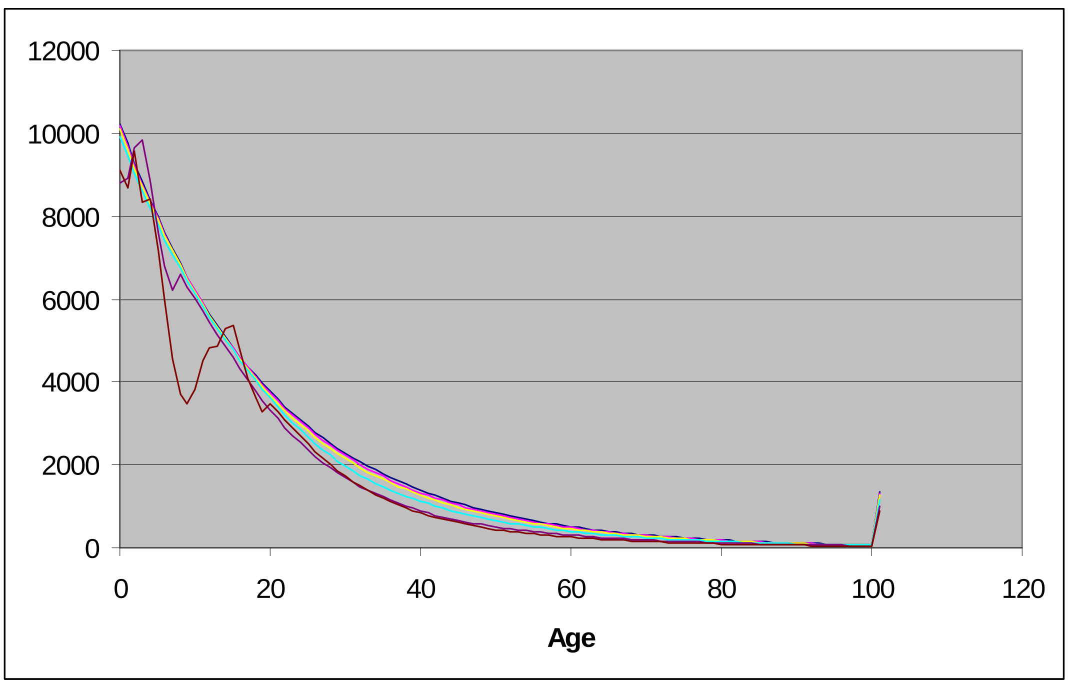


Figure 15. Estimates of numbers at age for males for years 1900, 1962, 1972, 1982, 1992 and 2004. Above age 35 for all years the numbers at age diminish with each successively displayed year.

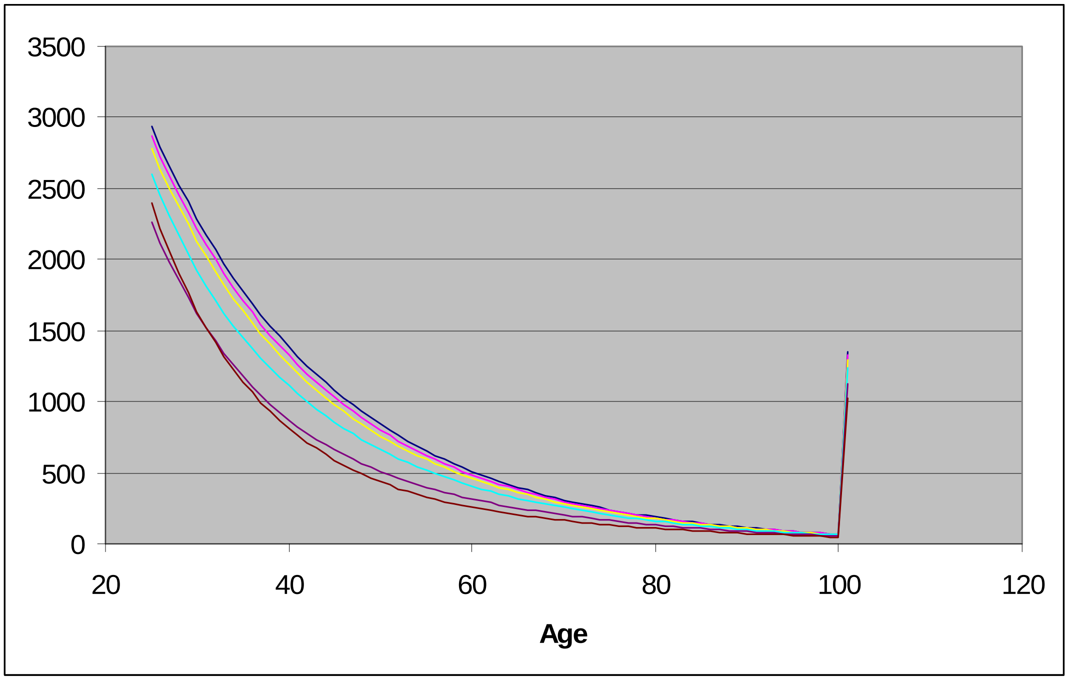


Figure 16. Estimates of numbers at age for females ages 25 – 101+ for years 1900, 1962, 1972, 1982, 1992 and 2004. For each progressive year, the numbers at age are lower (except for ages less than 35 in 2004 due to variable recruitment).

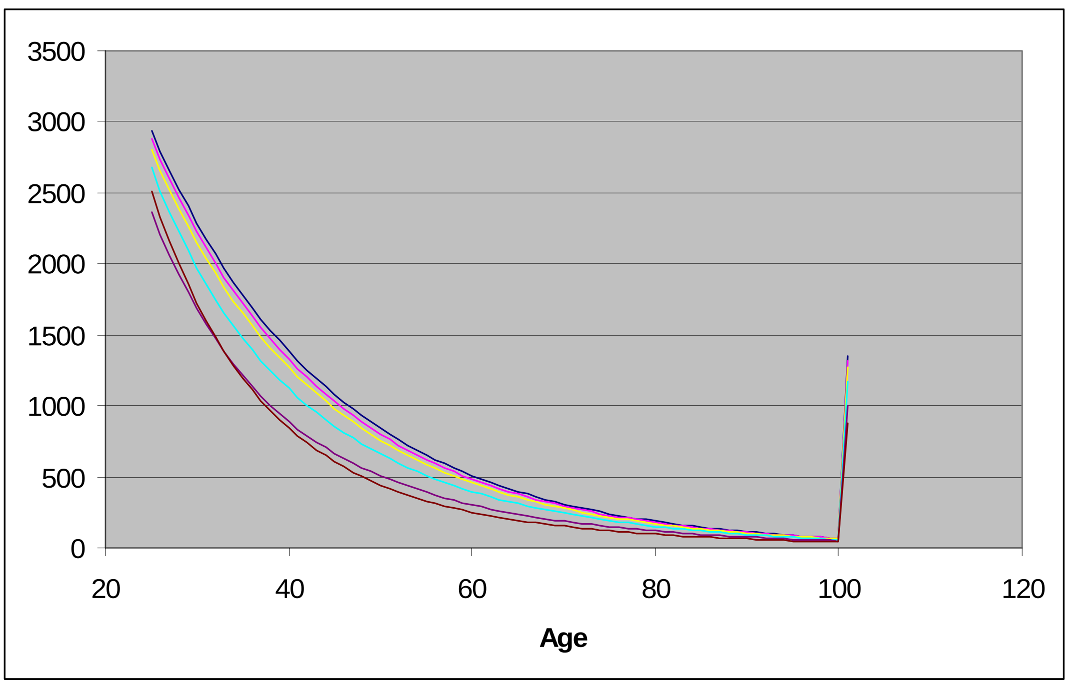
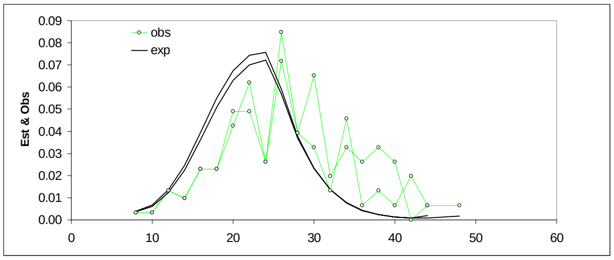
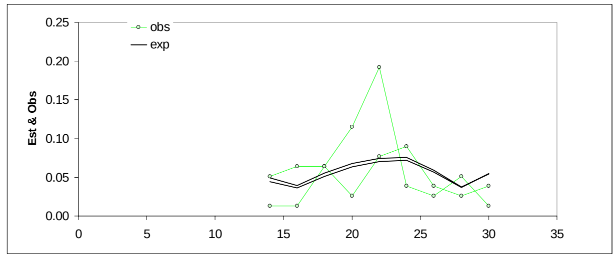


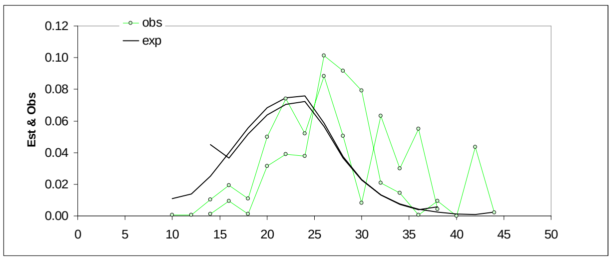
Figure 17. Estimates of numbers at age for males ages 25 – 101+ for years 1900, 1962, 1972, 1982, 1992 and 2004. For each progressive year, the numbers at age are lower (except for ages less than 35 in 2004 due to variable recruitment).



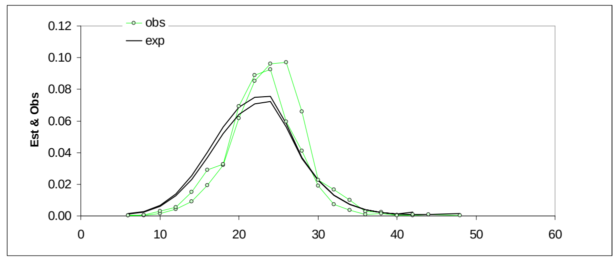
1980



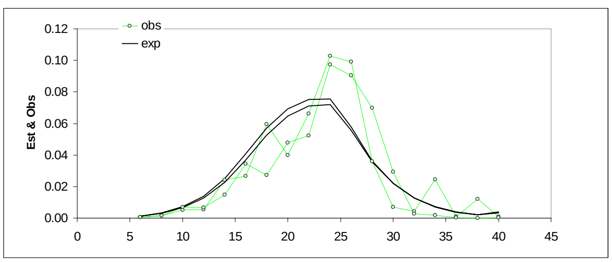
1983



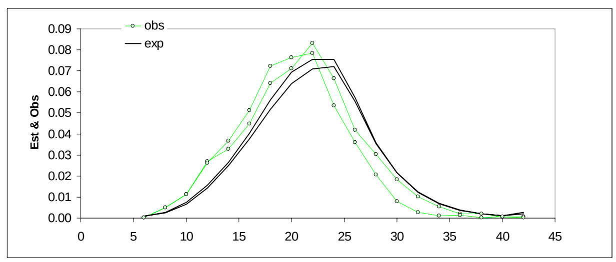
1986



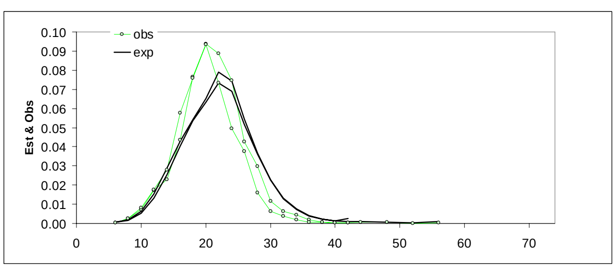
1989



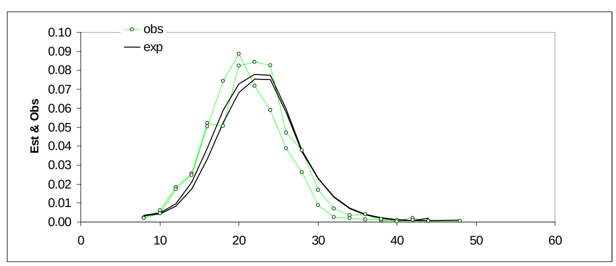
1992



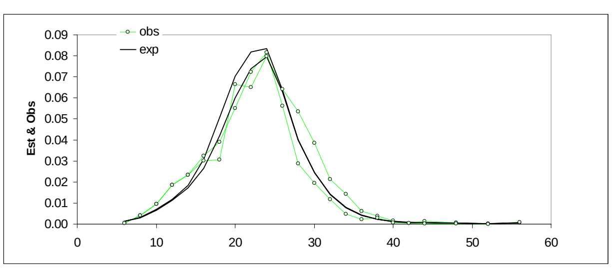
1995



1998

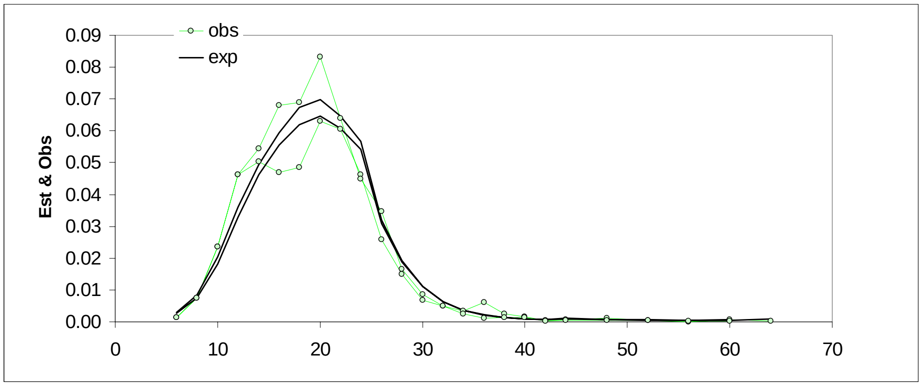


2001

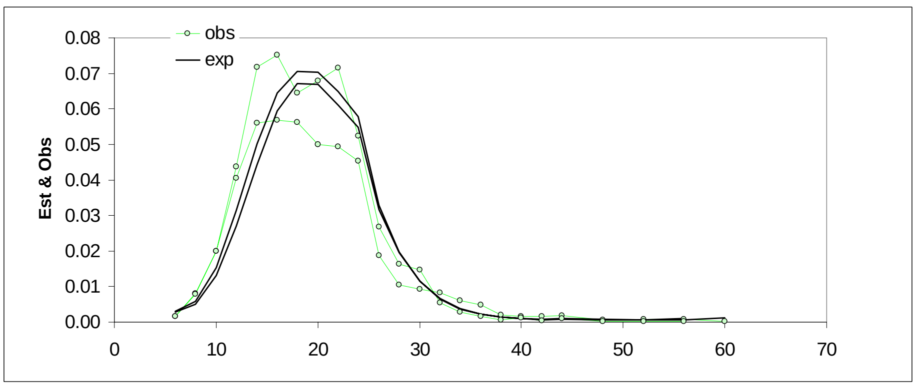


2004

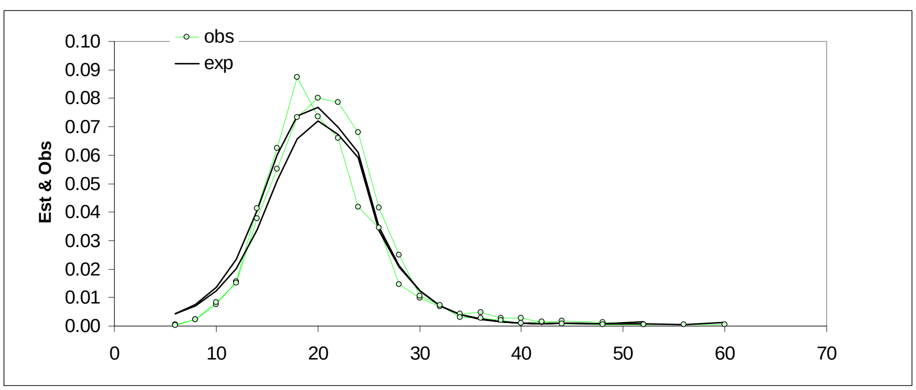
Figure 18. Fits to Triennial survey 55-366 length compositions.



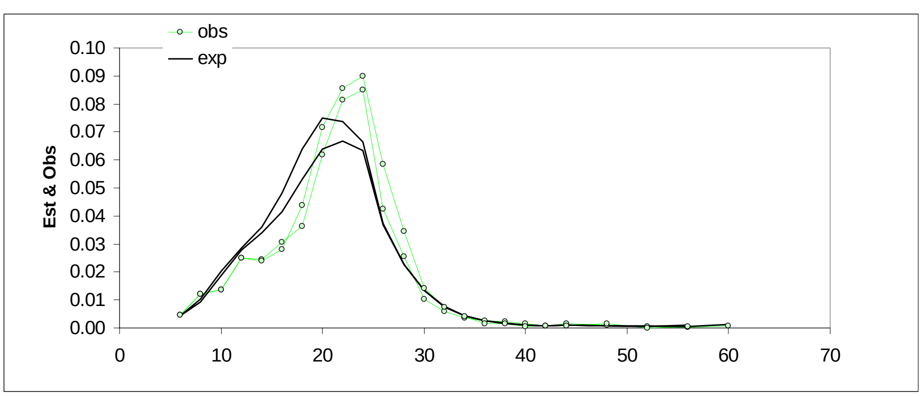
1995



1998

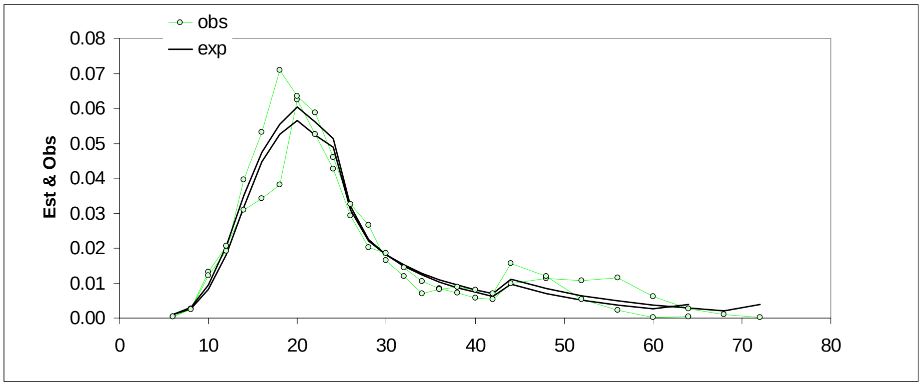


2001

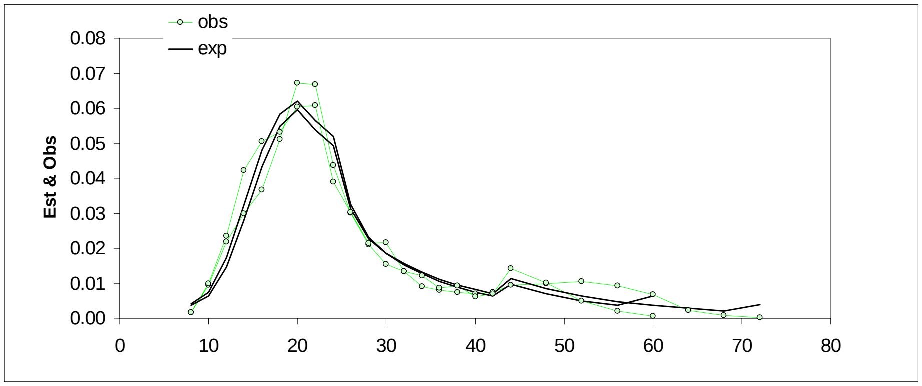


2004

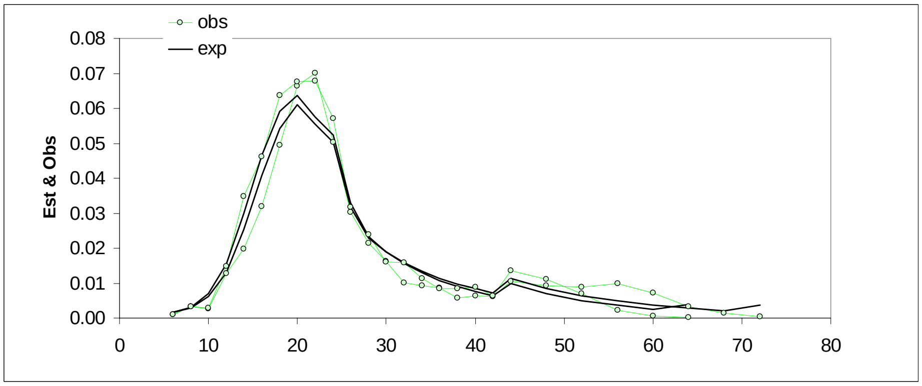
Figure 19. Fits to Triennial survey 366-500 length compositions.



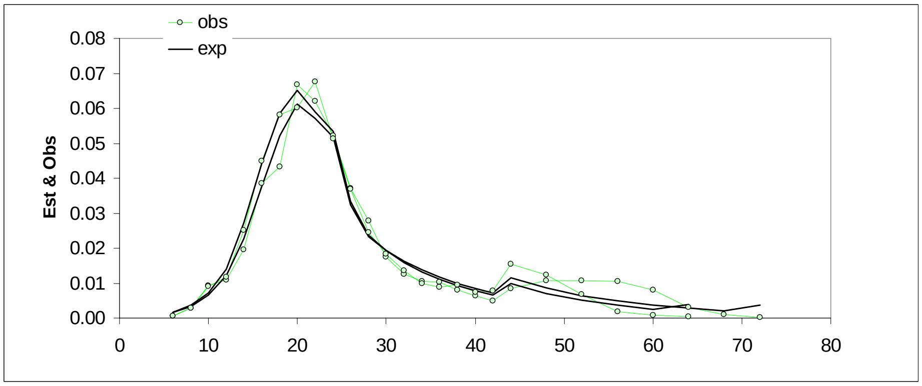
1997



1999

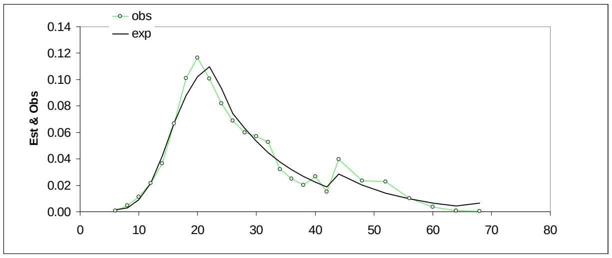


2000

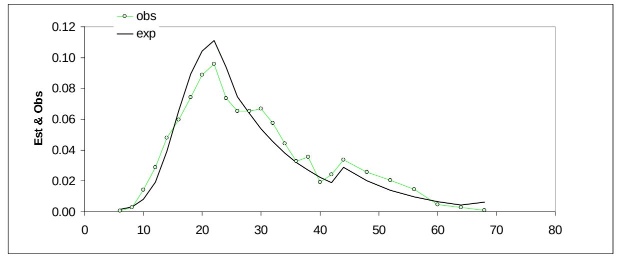


2001

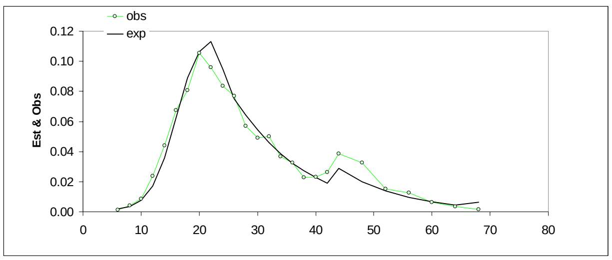
Figure 20. Fits to AFSC slope survey length composition data.



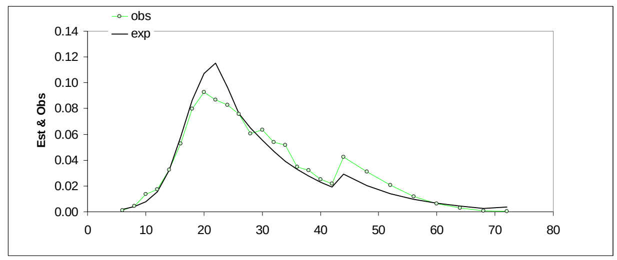
1998



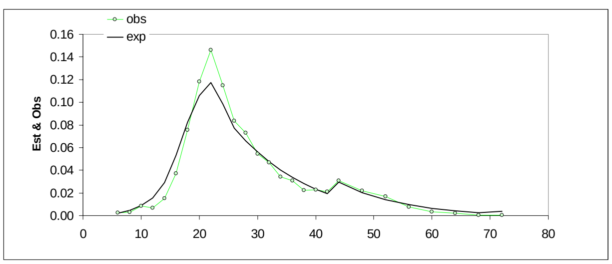
1999



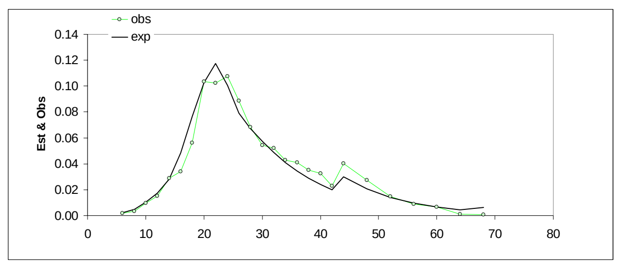
2000



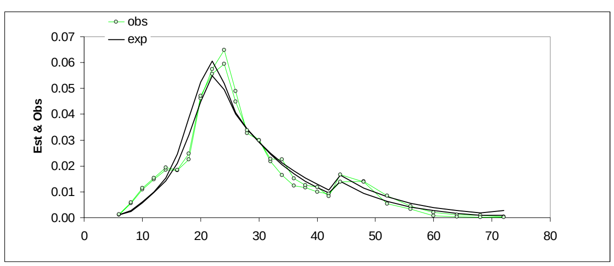
2001



2002

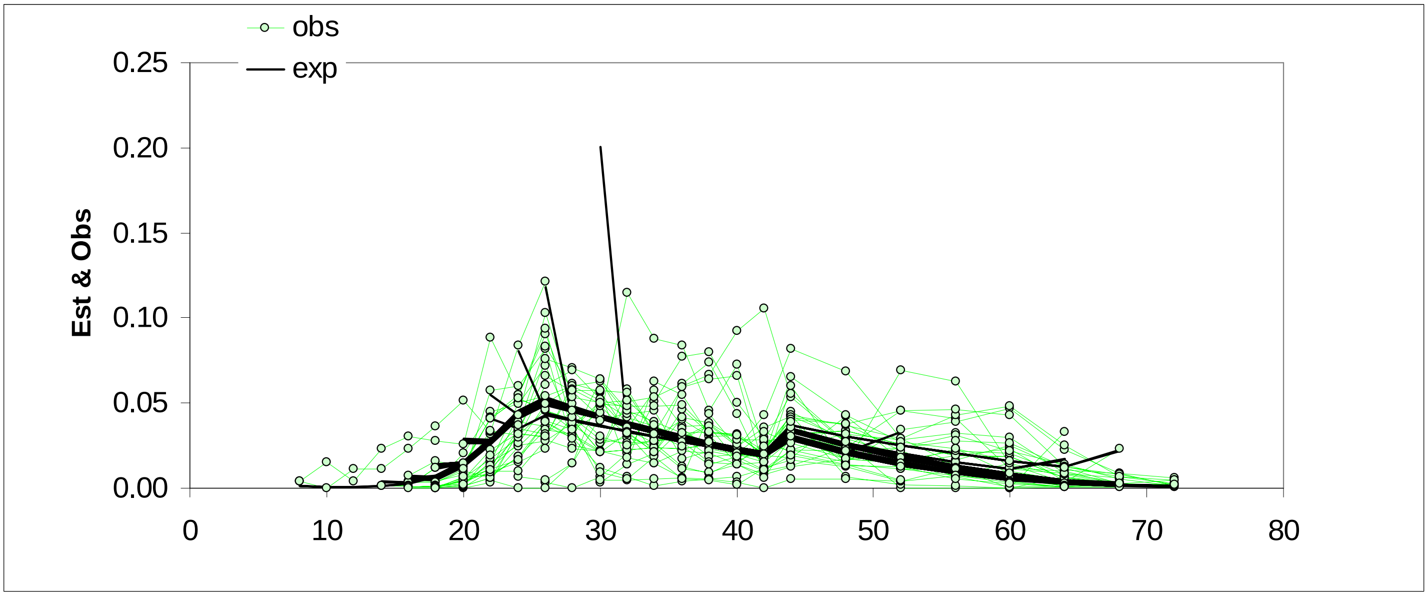


2003



2004

Figure 21. Fits to NWFSC slope survey length composition data



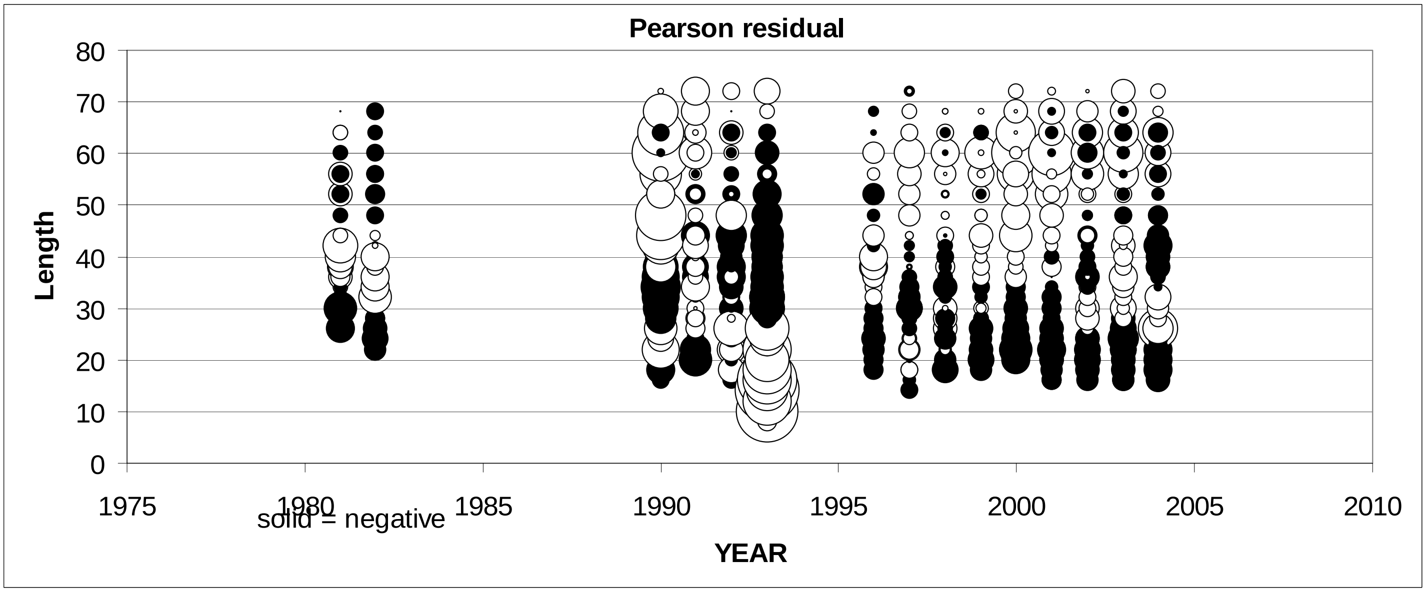
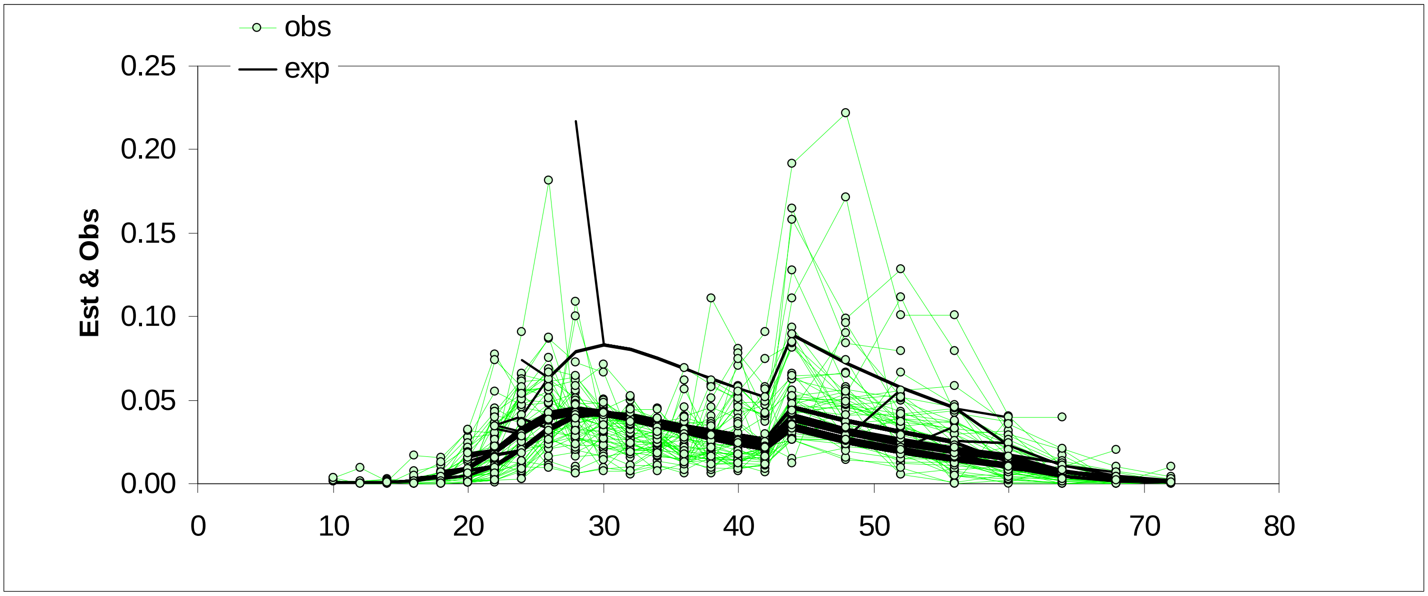


Figure 22.Observed and expected length compositions for the Northern Fishery, and Pearson residuals (Solid circles = more than expected, Clear circles = less than expected).



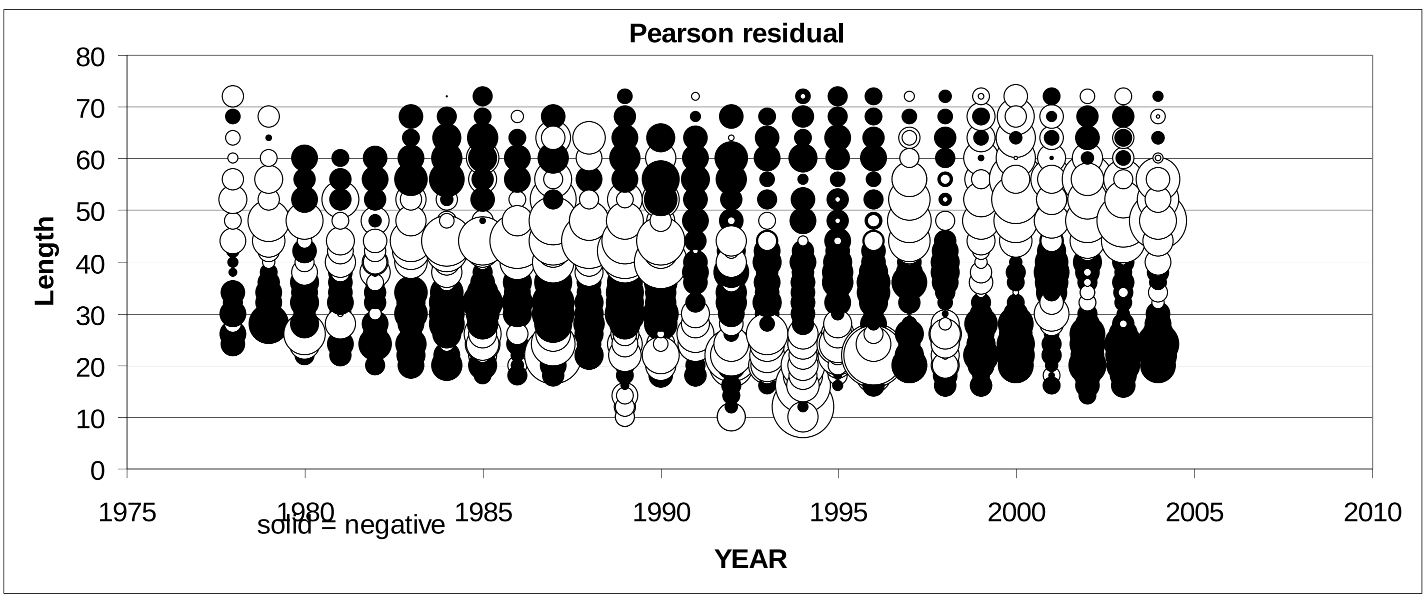


Figure 23.Observed and expected length compositions for the Southern Fishery, and Pearson residuals (Solid circles = more than expected, Clear circles = less than expected).

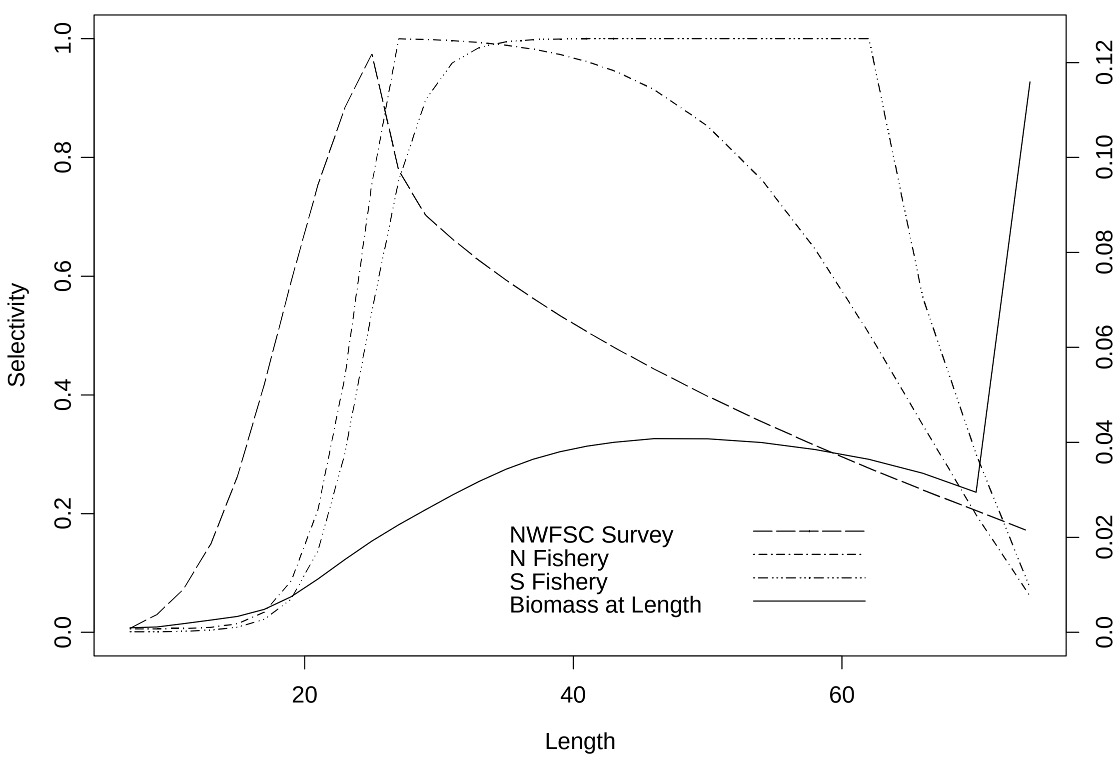


Figure 24. Recent (1988 to present) estimate of size selectivity for southern fishery and biomass at size for 2005.

Appendix: Input Files

Data File:

```
#8.31.05 SST Dat file

#     MODEL DIMENSIONS

1901  #     start_year
2004  #     end_year
1     #     N_seasons_per_year
12    #     vector_with_N_months_in_each_season
1     #     spawning_season_-
_spawning_will_occur_at_beginning_of_this_season
2     #     N_fishing_fleets
4     #
      N_surveys;_data_type_numbers_below_must_be_sequential_with_the_N_
fisheries
NorthTrawl%SouthTrawl%Triennial55to366%Triennail366to500%AFSCslope%NWFS
Cslope

0.5   0.5   0.5   0.5   0.5   0.5

2     #     Number of genders
101   #     Number of ages

#     catch (mt)  "North,"    South #Year
0     0     #     # initial_equilibrium
0     2           # 1901
0     2
0     4
0     5
0     6
0     8
0     9
0     10
0     11
0     13
0     14
0     15
0     17
0     17
0     19
0     20
0     21
0     23
0     24
0     25
0     26
0     28
0     29
0     30
0     32
0     32
0     34
0     35
0     36
0     38
0     39
```

```
0     40
0     49
0     49
0     49
0     51
0     47
0     53
0     63
0     76
0     109
0     122   #     1942
0     269
0     380
0     453
0     216
0     48
0     152
0     168
0     153
0     305
0     176   #     1952
0     68
0     128
0     128
0     776
0     286
0     296
0     398
0     472
0     437
0     230   #     1962
0     285   #     1963
12    172   #     1964
20    400   #     1965
612   543   #     1966  Here to 1976 recalculated based upon final
Rogers allocation of foriegn catch.
369   864   #     1967
168   1835  #     1968
155   400   #     1969
149   557   #     1970
260   582   #     1971
389   1297  #     1972
712   2377  #     1973
215   1244  #     1974
405   1867  #     1975
52    992   #     1976
91    1359  #     1977
76    1136  #     1978
109   1720  #     1979 South from Calcom (pacfin - 1587)
87    1192  #     1980 South from Calcom (pacfin - 1118)
94    1633  #     1981 Here and after new from PACfin 4.2005
252   1660  #     1982 (Calcom numbers between +5 and -365 compared to
pacfin -
728   1564  #     1983  the smaller numbers at least partially due to
incomplete EUK)
845   1960  #     1984
813   2574  #     1985
472   2442  #     1986
580   1976  #     1987
720   2190  #     1988
1373  3529  #     1989
```

```
1903  2244  #     1990
2218  1316  #     1991
1721  1655  #     1992
2064  1788  #     1993
1860  1575  #     1994
841   1120  #     1995
710   918   #     1996
656   835   #     1997
522   728   #     1998
337   497   #     1999
303   546   #     2000
253   298   #     2001
246   539   #     2002
299   528   #     2003
298   407   #     2004

24    #     #_Abundance_Indices
      #_N_observations
#     #Year   Seas    Type    Value   CV

#     # 1977      1     3     1719  0.104
1980  1     3     2113  0.145 #     Triennial   USV-MON     55-366
      only
1983  1     3     2405  0.108
1986  1     3     1893  0.168
1989  1     3     1934  0.141
1992  1     3     1934  0.151
1995  1     3     2519  0.166
1998  1     3     2453  0.193
2001  1     3     2622  0.126
2004  1     3     3149  0.156
1995  1     4     4078  0.144 #     Triennial   USV-Con     366-500
1998  1     4     3132  0.104
2001  1     4     4092  0.094
2004  1     4     4881  0.21
1997  1     5     52736.34475 0.147990306 #     AFSC slope
1999  1     5     51707.68632 0.140064776
2000  1     5     62309.95366 0.13598909
2001  1     5     56808.09364 0.12490558
1998  1     6     45209.81408 0.163325875 #     NWFSC slope
1999  1     6     49705.25479 0.166424468
2000  1     6     52744.28438 0.160058804
2001  1     6     51618.19583 0.16202009
2002  1     6     67881.96287 0.111637119
2003  1     6     49448.50149 0.129479762
2004  1     6     50459.31976 0.120698645

2     #     #_Discard_Biomass #_(1=biomass;_2=fraction)

18    #     #_N_observations
#     #Year Seas  Type  Value CV
1986  1     1     0.28  0.1
1991  1     1     0.08  1
1995  1     1     0.132 0.4
1996  1     1     0.155 0.2
1997  1     1     0.201 0.21
1998  1     1     0.136 0.22
1999  1     1     0.252 0.3
1986  1     2     0.28  0.1
1991  1     2     0.08  1
1995  1     2     0.132 0.4
```

```
1996  1     2     0.155 0.2
1997  1     2     0.201 0.21
1998  1     2     0.136 0.22
1999  1     2     0.252 0.3
#     #WCGOP
2002  1     1     0.2552      0.1
2002  1     2     0.1661      0.1
2003  1     1     0.3162      0.1
2003  1     2     0.1807      0.1
8     #     # number of observations - need to revisit
#     #Year   Seas    Type    Mkt     Value   CV
2002  1     1     1     0.1848      0.2
2002  1     1     2     0.7417      0.2
2002  1     2     1     0.5098      0.2
2002  1     2     2     1.5924      0.2
2003  1     1     1     0.188 0.2
2003  1     1     2     0.6396      0.2
2003  1     2     1     0.4352      0.2
2003  1     2     2     1.5202      0.2

0.0001      #
      #min_proportion_for_compressing_tails_of_observed_composition
                  frequencies

0.0001      #     #_constant  added to    expected


27    #     #_N_length_bins

#     #_lower_edge_of_length_bins

6     8     10    12    14    16    18    20    22    24    26    28
      30    32    34    36    38    40    42    44    48    52    56
      60    64    68    72

66    #N_observations                       Nsamp begin
#     #Year Seas  Fleet sexes Mkt                 data:
#     #Old Southern fleet Data from 2001 survey

1978  1     2     0     0     10    0     0     0     0     0     0
      0     0     0     3     1     11    3     5     3     7     6
      5     4     16    10    13    8     3     2     0     1     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0
1979  1     2     0     0     10    0     0     0     0     0     0
      0     0     0     0     0     1     3     2     2     3     4
      7     9     19    22    10    10    4     1     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
1980  1     2     0     0     16    0     0     0     0     0     0
      0     0     2     9     18    3     5     3     3     2     11
      8     2     11    17    2     2     1     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0

#     "# New Fishery length comps May, 2005"
      1981  1     1     3     0     6     0     0     0     0     0
      0     0     0     0     0     0.003374987 0     0.006749973
```

0.020249919 0.050624798 0.07762469 0.079750081 0.050208266
0.029958347 0.020249919 0.013499946 0.06920859 0.062875148
0.013499946 0.003374987 0.023208374 0 0 0 0 0
0 0 0 0 0 0 0 0 0.003374987
0.013499946 0.020249919 0.060333225 0.066666667 0.092833495
0.105916909 0.053166721 0.02658336 0 0 0 0.032916802
0 0
1981 1 2 3 0 12 0 0 0 0 0 0
0 0 0.000439889 0.040948715 0.013151676 0.0077488
0.015142087 0.005487251 0.010094725 0.061971063 0.005842764
0.011405008 0.006357646 0.042696608 0.054017241 0.111478805
0.042378591 0.037293732 0 0 0 0 0 0 0
0 0 0 0 0 0.005047362 0.013151676 0.100096469
0.045996078 0.01057211 0.01057211 0.006002132 0.05104344
0.077802559 0.057634727 0.093655673 0.05104344 0.005047362
0.000477385 0.005402876 0 0 0
1982 1 1 3 0 8 0 0 0 0 0 0
0 0 0.004711743 0 0 0.014135228 0.055979575
0.013719499 0.062494182 0.054624101 0.031035713 0.014673475
0.026944657 0.031056971 0.023921677 0.045592686 0.040892773
0.010903879 0.008480328 0.005653889 0 0 0 0 0
0 0 0 0 0 0.006400506 0.004711743 0.014135228
0.04253763 0.11529176 0.088120888 0.084004138 0.045386718
0.072663273 0.023371601 0.042744989 0.006596035 0.001884293
0.000942146 0 0.006388676 0 0
1982 1 2 3 0 33 0 0 0 0 0 0
0 0.001379219 0.007257377 0.011211613 0.029127571 0.040961385
0.042325893 0.025957332 0.045021429 0.023737405 0.062154511
0.052715264 0.037219117 0.062680268 0.066784246 0.034662258
0.007756731 0.010704539 0 0 0 0 0 0 0
0 0 0 0 0 0.002792557 0.015783187 0.018910344
0.049534154 0.035582193 0.02207022 0.04542885 0.02820928
0.047428982 0.040637344 0.065970096 0.027922097 0.012838923
0.012704332 0.012531285 0 0 0
1983 1 2 3 0 92 0 0 0 0 0 0
0 0 0.012524574 0.006584824 0.024822994 0.031410952
0.026619001 0.026351492 0.032273714 0.029952559 0.030413907
0.04255463 0.0469575 0.064610338 0.047332329 0.05014577
0.036902306 0.01157486 0.005945668 0.000880626 0 0 0
0 0 0 0 0 0.001567346 0.002694359 0.020403536
0.024238274 0.027927058 0.020122515 0.024306766 0.017977687
0.030371107 0.026458933 0.048436775 0.049398841 0.081529749
0.050671424 0.034840827 0.004640278 0.002794849 0.00376163 0
0
1984 1 2 3 0 124 0 0 0 0 0 0
8.13E-05 0.001362068 0.004283016 0.021563814 0.027504243
0.019082375 0.026581345 0.033862652 0.029788508 0.036065411
0.036892652 0.045518289 0.041864732 0.056193442 0.045444995
0.038749216 0.032195241 0.016006812 0.008530132 0.001109635
0.001534908 0 0 0 0 0 0 0 0.000337158
0.008201505 0.02499472 0.02103272 0.028268074 0.021298556
0.01952312 0.020147523 0.040087511 0.045836955 0.039210899
0.051792052 0.089357747 0.036535002 0.022792047 0.004769416
0.000739944 0.000860228 0 0
1985 1 2 3 0 143 0 0 0 0 0 0
0.001699358 0.004559847 0.017567818 0.037036034 0.055880612
0.026229552 0.025002448 0.023626979 0.027745155 0.028288794
0.026849628 0.02822741 0.027060802 0.051626882 0.045931557
0.038850398 0.036413008 0.023588725 0.004157015 0.001502845
0.000372097 0 0 0 0 0 0 0 0.002455071
0.013577848 0.035329915 0.048133083 0.027250358 0.024594289

```
          0.015442619 0.023459116 0.026347586 0.029901188 0.030576538
          0.040151372 0.084037372 0.031393067 0.018116529 0.01370805
          0.003196859 0.000112176 0     0
1986      1     2     3     0     51    0     0     0     0     0     0
          0     0.012841841 0.013765053 0.011842545 0.034321709 0.043880969
          0.021663004 0.017322475 0.019687082 0.018888217 0.022198718
          0.024189146 0.020754467 0.051449697 0.035858663 0.039157324
          0.029334732 0.00839584  0.003677714 0.006242896 0     0     0
          0     0     0     0     0.000293057 0.003200241 0.008944495
          0.021549033 0.048304228 0.042977953 0.025941157 0.019365821
          0.022881045 0.015318485 0.035554963 0.058649059 0.041441283
          0.127898234 0.05774792  0.02444465  0.006983926 0.003032357 0
          0     0
1987      1     2     3     0     105   0     0     0     0     0     0
          0     0.000736577 0.044940745 0.03658262  0.038367319 0.048804363
          0.008336882 0.010034346 0.01965653  0.011958026 0.017155134
          0.007311409 0.022618338 0.014848116 0.021793168 0.066774842
          0.047062588 0.004098236 0.016913288 0.000684139 0     0     0
          0     0     0     0     0.000736577 0.000736577 0.016253536
          0.053042733 0.059369288 0.016258025 0.017639484 0.010494243
          0.021178395 0.013288561 0.033573243 0.057903495 0.041946337
          0.089863506 0.074015319 0.01916689  0.02437589  0.00032939
          0.011151843 0     0
1988      1     2     3     0     23    0     0     0     0     0     0
          0     0     0.003516916 0.013132521 0.010943767 0.005854131
          0.008385376 0.024939237 0.016044519 0.056354891 0.025040998
          0.034300544 0.056541804 0.012324667 0.096159522 0.041453846 0
          0.039732664 0.039732664 0     0     0     0     0     0     0
          0     0     0     0.003516916 0.009690156 0.009222585 0.006173241
          0.009325265 0.007033832 0.013600092 0.010374435 0.058076073
          0.051218554 0.008431158 0.165103896 0.084310406 0.079465327 0
          0     0     0     0
1989      1     2     3     0     77    0     0     0.001428643 0.001428643
          0.002857286 0.001428643 0.002914432 0.007716015 0.023450513
          0.05503424  0.057836625 0.030535378 0.007199646 0.007364565
          0.010809074 0.007811755 0.01644034  0.009102727 0.010500543
          0.045377217 0.041218891 0.04975739  0.014678314 0.021962234
          0.001430145 0     0.000476214 0     0     0.001428643 0.001428643
          0.001904857 0.001428643 0.001904857 0.005754012 0.036437856
          0.047010039 0.055786164 0.023003882 0.022578478 0.020219527
          0.007355851 0.012346084 0.029021704 0.055332935 0.075016286
          0.084619403 0.054864729 0.026592494 0.006729226 0     0     0
          0.000476214
1990      1     1     3     0     91    0     0     0     0     0
          0.003726404 0.003726404 0.012480537 0.031382394 0.039200105
          0.036140284 0.02940473  0.01185207  0.006598895 0.001256932
          0.00408503  0.005341963 0.006598895 0.011150933 0.022560479
          0.015030815 0.034613669 0.038756597 0.046759627 0.022192734
          0.008829099 0.001256932 0     0     0     0     0     0
          0.003726404 0.00776704  0.057781452 0.060472891 0.081755433
          0.025148402 0.021704392 0.017835053 0.014378489 0.005618079
          0.04356405  0.023502039 0.042967295 0.082029135 0.068550843
          0.028753512 0.013747696 0.005399861 0.002352406 0     0
1990      1     2     3     0     82    0     0     0     0     0     0
          0.001954224 0.00108374  0.027461826 0.046070078 0.042701241
          0.02006878  0.016344814 0.018797982 0.016303601 0.014945297
          0.007989838 0.024095173 0.01467668  0.050309565 0.050280265
          0.053296677 0.029780802 0.031539896 0.00218528  0     0     0
          0     0     0     0     0     0.004006347 0.020760163 0.041361154
          0.036472274 0.04259199  0.0390625   0.013774101 0.022918647
          0.024410141 0.011327282 0.020713094 0.074695463 0.042600588
```

0.084637681 0.036767394 0.005350093 0.008665326 0 0 0
0
1991 1 1 3 0 49 0 0 0 0 0 0
1.77E-05 0.001912088 0.015132652 0.050381789 0.054238966
0.060418449 0.051679117 0.034313398 0.026524473 0.012288184
0.00874376 0.016635998 0.009962915 0.013045895 0.023937495
0.012289089 0.016521188 0.024897661 0.010627103 0.00821562
0.005935911 0 0 0 0 0 0 0 0.000159304
0.003445156 0.033724543 0.065847055 0.056559977 0.04188082
0.03487107 0.057697801 0.036592267 0.037177535 0.02468941
0.035361156 0.042245375 0.028936565 0.019593935 0.008766227
0.009923839 0.004808564 0 0
1991 1 2 3 0 44 0 0 0 0 0 0
0.001390975 0.003646932 0.021198521 0.065242848 0.061513126
0.064213644 0.04411921 0.052022355 0.031631186 0.031591477
0.011756932 0.012103484 0.022463601 0.0265456 0.014012857
0.012161503 0.010994082 0.007418067 0 0.002132058 0.002132058
0 0 0 0 0 0 0.001390975 0.006587473
0.021529996 0.06620154 0.086885186 0.072725335 0.066617572
0.026410082 0.031988221 0.016723723 0.015043745 0.013631443
0.022280285 0.026478315 0.015209871 0.009649053 0 0.001658267
0.000698401 0 0
1992 1 1 3 0 71 0 0 0 0 0
0.003393454 0.003162782 0.020123681 0.045066026 0.049852419
0.072065852 0.036769804 0.026703914 0.029447026 0.024289549
0.011484018 0.009497416 0.01396818 0.007999479 0.012277382
0.016932018 0.014435699 0.014831097 0.011749258 0.010097798
0.002027052 0.002818549 0 0 0 0 0 0.006904951
0.01568734 0.012715644 0.041375769 0.054640357 0.090425322
0.049416789 0.039404737 0.04401661 0.019382875 0.034978184
0.023268752 0.019446127 0.019081048 0.017519862 0.042228441
0.016389966 0.007211517 0.004863056 0.002050203 0 0
1992 1 2 3 0 123 0 0 0.002150858 0 0
0.000483187 0.000698273 0.027436526 0.055163223 0.047343223
0.048205128 0.054688424 0.033051145 0.026480739 0.022963983
0.032542118 0.010051854 0.020980154 0.012863975 0.041558342
0.02237292 0.019143372 0.011967016 0.011191397 0.007954176
0.001324605 0 0 0 0.002150858 0 0 0.000483187
0.003226288 0.002340193 0.042824523 0.053810046 0.037681248
0.055689567 0.029478127 0.022562044 0.01964229 0.03683204
0.013602633 0.037324897 0.024157221 0.051334416 0.028385501
0.017710721 0.00489752 0.005252046 0 0 0
1993 1 1 3 0 58 0 0.003820654 0.015282615
0.003820654 0.022923922 0.030565229 0.028006277 0.026030201
0.08859411 0.054817783 0.094236938 0.036533492 0.004358967
0.004503514 0.004923489 0.005539768 0.005442204 0.003037537 0
0.004888961 0.005467313 0.003629676 0.007255186 0.014677245
0.006551933 0.00267448 0.004744013 0 0.003820654 0
0.011461961 0.011461961 0.022923922 0.036262106 0.051938362
0.033056987 0.084430716 0.121655395 0.035752534 0.009480084
0.005059243 0.01844739 0.004955716 0.00433781 0.002158541
0.011941246 0.016780364 0.012692687 0.00360963 0.011861327 0
0.000692254 0.002892947 0
1993 1 2 3 0 65 0 0 0 0 0 0
0.011334642 0.027613873 0.029440379 0.053998097 0.075490089
0.036273919 0.026652902 0.020030245 0.021871406 0.022510722
0.018565491 0.009673627 0.011053245 0.028040714 0.026651505
0.018735559 0.016848422 0.007763797 0.00367091 0.002327928 0
0 0 0 0 0 0.001186206 0.007435756 0.024277095
0.043050749 0.062619276 0.087849836 0.039011299 0.040438129
0.018687488 0.026348572 0.015865491 0.019255486 0.012535826

0.019716885 0.045002699 0.032926363 0.017181672 0.014205182
0.002320718 0 0.001537801 0
1994 1 2 3 0 84 0 0 0.003002507 0.009138615
0.000974962 0.01658556 0.015360732 0.031783907 0.030319359
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1996 1 1 3 0 12 0 0 0 0 0 0
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0 0
1996 1 2 3 0 100 0 0 0 0 0
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0.000112265
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0 0 0 0 0 0 0.003011703 0.010755004

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1999 1 2 3 0 136 0 0 0 0 0
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2000 1 1 3 0 36 0 0 0 0 0 0
0 0 0.009068946 0.015064333 0.023052417 0.041420947
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2000 1 2 3 0 103 0 0 0 0 0 0
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0 0 0 0 0 0 0.001851512 0.001780196

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      0.003033411 0.004213271 0
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      0.000424763 0.001511115 0.001503007 0.005717961 0.02464411
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      0.036658829 0.015797239 0.02298941  0.04034247  0.037604062
      0.022024255 0.011043833 0.004187964 0.000849526 0.000849526 0
2001  1     2     3     0     94    0     0     0     0     0
      0.000945367 0.00649789  0.007832983 0.014984316 0.025010487
      0.037720056 0.04763685  0.048609273 0.038818917 0.01789099
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      0.026231456 0.040584291 0.044056003 0.026159072 0.012263108
      0.00637982  0.000378147 0     0     0     0     0     0.001323514
      0.00422901  0.009004926 0.015362463 0.028123166 0.038123204
      0.058606232 0.071702863 0.052526773 0.029251019 0.017301962
      0.011044091 0.011856627 0.019920463 0.042117715 0.046839269
      0.033591094 0.025276157 0.009978939 0.002532391 0.001023496
      0.000378147
2002  1     1     3     0     55    0     0     0     0     0
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      0.016972241 0.02153345  0.018386232 0.024155091 0.0226919
      0.021525746 0.024007038 0.030917262 0.021555827 0.014109077
      0.005458645 0.001072025 0     0     0     0     0     0.000778606
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      0.017548127 0.006793283 0.000703892 0.000963427 0     0
2002  1     2     3     0     188   0     0     0     0     0     0
      0     0.002590809 0.008394128 0.020010474 0.030246053 0.036166743
      0.040498685 0.036493665 0.033666298 0.027606039 0.022834408
      0.017407664 0.021823918 0.034917891 0.04075228  0.041970156
      0.04533063  0.02412395  0.010512067 0.003971801 0.002146573 0
      0     0     0     0.000423991 0     0.001271972 0.005780322
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      0.008977039 0.001524721 0.000390154 0
2003  1     1     3     0     60    0     0     0     0     0
      0.000266176 0.000975978 0.003707911 0.010844623 0.016362338
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      0.011108486 0.007439827 0.003170434 0.000565536 0.000565536 0
2003  1     2     3     0     130   0     0     0     0     0
      0.000169876 0.000204104 0.000408208 0.004134285 0.010591666
      0.029123532 0.035849485 0.040960688 0.035958462 0.030922393
      0.026237359 0.024596143 0.019424958 0.015849154 0.047799678
      0.05517602  0.034099673 0.037754999 0.020379912 0.010488075
      0.002848011 0.002452587 0     0     0     0     0     0.000169876
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      0     0.000870771 0.006117264 0.013531201 0.031451134 0.046979803
      0.04256294  0.037197773 0.038080462 0.029414627 0.025757732
      0.024334783 0.022162194 0.064603766 0.066212117 0.036740075
      0.017902657 0.007957179 0.002320272 0.000204104 0
2004  1     1     3     0     74    0     0     0     0     0
      0.000134328 0.000223879 0.006460243 0.010625973 0.042766666
      0.103072159 0.053228698 0.050360311 0.051789134 0.03692834
      0.027385838 0.015082181 0.013752514 0.005705395 0.030132635
      0.017360065 0.014160114 0.022806459 0.015885106 0.011929222
      0.002506404 0.001927426 0     0     0     0     0     4.48E-05
      0.000134328 0.002096564 0.019058271 0.037019121 0.083228538
      0.057615435 0.057354984 0.056143777 0.031994328 0.024645624
      0.013844261 0.018155854 0.010618235 0.019370002 0.013251356
      0.012788111 0.005246289 0.002750906 0.000416152 0     0
2004  1     2     3     0     97    0     0     0     0     0     0
      0     0.000261438 0.001615484 0.002339264 0.023543483 0.031754085
      0.031709774 0.042282726 0.039264441 0.027778738 0.021231489
      0.017289617 0.020759825 0.043713973 0.090057056 0.052026318
      0.045644946 0.015788738 0.008270566 0.004090401 0.000820721 0
      0     0     0     0     0     0     0.000261438 0.001679105
      0.008921024 0.025914027 0.038991954 0.034968308 0.044379713
      0.044738618 0.027643208 0.028880877 0.035484468 0.021484906
      0.052291151 0.049089201 0.028705234 0.021408763 0.010283332
      0.002812182 0.001819411 0

#     # Triennial length comps 55-366 meters

#     #1977 1     2     3     0     1     0     0     0     0     0
      0     0.012048573 0.012048573 0.024097147 0.03614572  0.048194294
      0.084329482 0.060242867 0.048194294 0.024097147 0.048194294
      0.03614572  0.03614572  0.012048573 0.03614572  0.048194294
      0.03614572  0.012048573 0     0     0     0     0     0     0
      0     0     0     0     0.012048573 0.024097147 0.072280909
      0.060232335 0.048194294 0.012048573 0.012048573 0     0.048194294
      0.024097147 0.03614572  0.012048573 0.024097147 0     0     0
      0     0     0     0
1980  1     3     3     0     50    0     0.003268087 0.003268087
      0.013071994 0.009803908 0.022875902 0.022875902 0.042483366
      0.062091533 0.026143989 0.071895089 0.039215631 0.065358916
      0.019607816 0.032679458 0.026143285 0.032679458 0.026143989 0
      0.006536173 0.006536173 0     0     0     0     0     0     0
      0.003268087 0.003268087 0.013071994 0.009803908 0.022875902
      0.022875902 0.049019539 0.049019891 0.026143989 0.084967435
      0.039215631 0.032679458 0.013072346 0.0457511   0.006536173
      0.013071642 0.006536173 0.019607816 0.006536173 0     0     0
      0     0     0     0
1983  1     3     3     0     50    0     0     0     0     0.012820772
      0.012820772 0.064102556 0.025641544 0.076922675 0.089743447
      0.038461664 0.025640892 0.038461664 0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0.051282436 0.064102556 0.064102556 0.115384339
      0.192307014 0.038461664 0.025640892 0.051281783 0.012820772 0
      0     0     0     0     0     0     0     0     0     0     0
      0     0
1986  1     3     3     0     50    0     0     0     0     0.001186804
      0.009330198 0.001186804 0.031325606 0.038867488 0.037950013
      0.101443173 0.091780792 0.079324421 0.020713478 0.014532264
      0.000567212 0.009330198 0     0.043552693 0.002069979 0     0
      0     0     0     0     0     0     0     0.000400276 0.000386083
      0.010116557 0.019432561 0.010917446 0.049971639 0.07422255
      0.052058515 0.088324293 0.050648847 0.00809186  0.063131746
```

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      0.030060403 0.054936143 0.004139958 0     0     0     0     0
      0     0     0     0     0
1989  1     3     3     0     150   0.000295365 0.000165586 0.001433707
      0.00417214  0.008881721 0.019245102 0.032185407 0.061683065
      0.085616986 0.096309018 0.097352084 0.065906268 0.022696102
      0.016742692 0.009841364 0.002770416 0.002242642 0.000450865
      0.000264265 0.00090753  0.000264265 0     0     0     0     0
      0     0.000295365 0.000407157 0.002857328 0.00538571  0.014999751
      0.02908613  0.03266838  0.069512683 0.089227857 0.092725801
      0.059799165 0.041060614 0.018928723 0.007075655 0.003413344
      0.00069647  0.001353856 0.00017189  0.00090753  0     0     0
      0     0     0     0     0
1992  1     3     3     0     100   0.000416737 0.00131757  0.005090295
      0.005257108 0.024122939 0.026718727 0.059759897 0.039808357
      0.066219531 0.10293494  0.099301719 0.035912793 0.006856265
      0.004288432 0.024446727 0.000690583 0.011968817 0.0007466   0
      0     0     0     0     0     0     0     0     0.000416737
      0.00131757  0.006884327 0.006469257 0.014831839 0.034455236
      0.027105413 0.047951281 0.052452704 0.097687993 0.090728296
      0.069950379 0.0291777   0.002498808 0.001733823 0.000240301 0
      0.000240301 0     0     0     0     0     0     0     0     0
1995  1     3     3     0     150   0.000232041 0.004808146 0.011390386
      0.026891366 0.032789369 0.044991157 0.064237514 0.071400247
      0.083399131 0.066630618 0.041950986 0.030472005 0.018255958
      0.010154496 0.005334868 0.002024193 0.001938589 0.000348452
      0.000534807 0     0     0     0     0     0     0     0
      0.000232041 0.004808146 0.011390386 0.026365615 0.036717274
      0.051308365 0.072506627 0.076491188 0.07861686  0.05353557
      0.036165351 0.020519605 0.007762767 0.002679536 0.001077647
      0.001306157 3.63E-05    0.000476211 0.000219993 0     0     0
      0     0     0     0     0
1998  1     3     3     0     150   0.00029324  0.002301781 0.007248871
      0.017156223 0.022959576 0.043618404 0.076790681 0.094068787
      0.088901087 0.074723388 0.042868378 0.02969544  0.011475597
      0.006196843 0.004439308 0.001917652 0.000582561 0.000168988
      0.000149885 0.000633285 0.000509251 0     0.000149885 0     0
      0     0     0.00029324  0.002301781 0.007950622 0.017377132
      0.02778187  0.057918694 0.075990584 0.093567482 0.073695552
      0.049672165 0.037633926 0.015976133 0.006328551 0.003697718
      0.001736799 0.000459562 0.000445466 0.000168988 0.00015462  0
      0     0     0     0     0     0     0
2001  1     3     3     0     150   0     0.002139514 0.005949557
      0.018352049 0.025521109 0.052218577 0.050629131 0.082478761
      0.08457607  0.082832487 0.047227881 0.03781449  0.016739433
      0.006963912 0.003354803 0.003904012 0.000651877 0.000895015
      0.001823268 0.000359499 0     0     0     0     0     0     0
      0     0.001889288 0.004525201 0.017468257 0.024725326 0.050432145
      0.074394549 0.088984426 0.071881924 0.059068733 0.038932346
      0.026142191 0.008656429 0.002440994 0.001816932 0.001061636
      0.00131213  0.000117596 0.000842124 0.000400899 0.00047543  0
      0     0     0     0     0
2004  1     3     3     0     150   0.000320865 0.004017822 0.009422821
      0.018668286 0.023271436 0.030254662 0.030576156 0.066542304
      0.06526273  0.080055302 0.064363655 0.05369971  0.038610143
      0.021387438 0.014139406 0.006053877 0.003764737 0.001480772
      0.000436645 0.001161965 0.000652794 0.00013762  0.000654538 0
      0     0     0     0.000320865 0.004017822 0.009422821 0.018547819
      0.023443647 0.032459612 0.038989326 0.055182855 0.072524169
      0.081779868 0.056290447 0.028849561 0.019560672 0.011836945
      0.004727677 0.002134424 0.002778299 0.000674892 0.000434929
      0.0001267   9.03E-05    0     0.000870716 0     0     0     0
```

```
#     #Triennial length comps 366-500 meters

1995  1     4     3     0     150   0.001282177 0.007389284 0.02356379
      0.046340114 0.05036078  0.046975394 0.048734154 0.063339214
      0.060664748 0.046394958 0.025955248 0.014946167 0.006818758
      0.004831571 0.003298347 0.00616455  0.002426323 0.001398375
      0.000404781 0.000683703 0.001079728 0.000390625 0     0.000494622
      0.000151837 0     0     0.001282177 0.007389284 0.023630339
      0.046366004 0.054649364 0.068228855 0.06912388  0.083468815
      0.064244615 0.045070517 0.034770183 0.016467015 0.008576351
      0.005005182 0.002415902 0.000947695 0.00136151  0.001255645
      0.000222735 0.000454255 0.00027936  0.000408722 0.000183418
      0.00010893  0     0     0
1998  1     4     3     0     150   0.001615709 0.008010892 0.0199616
      0.040628609 0.056219766 0.056911205 0.056371076 0.050195873
      0.049509966 0.045384677 0.018667321 0.010515205 0.009219319
      0.008285999 0.00601706  0.004857457 0.001982587 0.001527335
      0.00157203  0.001805106 0.000582709 0.000760841 0.000769341
      6.89E-05    6.89E-05    0     0     0.001615709 0.007847768
      0.019891934 0.043796339 0.072049713 0.07547608  0.064647193
      0.068057048 0.071748781 0.052557111 0.02684636  0.016324852
      0.014601247 0.005414667 0.002712722 0.001579717 0.000530815
      0.001186242 0.00032938  0.000845514 0.000185411 6.89E-05
      0.00010814  0     0     6.89E-05    0
2001  1     4     3     0     150   0.000468511 0.002167699 0.007451765
      0.015502212 0.041421435 0.062536664 0.087777601 0.073818412
      0.066148236 0.042013961 0.034477787 0.014657534 0.009683746
      0.006695379 0.004262959 0.004695233 0.002745878 0.002689992
      0.001059327 0.001657171 0.001075812 0.00052007  0.000333329
      0.000342392 0     0     0     0.000155361 0.002066531 0.008152248
      0.015207702 0.037856395 0.055438322 0.073601677 0.080414948
      0.078876747 0.068129468 0.041577668 0.024964365 0.010516555
      0.007338848 0.002984502 0.002774607 0.002022376 0.000835477
      0.001463966 0.00070062  0.000423998 0.000236778 5.77E-05    0
      0     0     0
2004  1     4     3     0     150   0.004688184 0.012097951 0.013688165
      0.025041163 0.024511919 0.030686909 0.036512645 0.061950806
      0.081614073 0.085446708 0.042606395 0.025624691 0.010262525
      0.0059135   0.003651021 0.002535929 0.002306458 0.001411895
      0.000771957 0.001478919 0.001019425 0.00030998  0.000272671
      0.000560986 0     0     6.66E-05    0.004688184 0.012097951
      0.013688165 0.025041163 0.023958495 0.028035725 0.043934421
      0.07183532  0.085810502 0.090144401 0.058757542 0.034650523
      0.014179693 0.007337226 0.003923043 0.001538883 0.001467672
      0.000509623 0.00077371  0.000668533 0.001406929 2.03E-05
      0.000443135 5.74E-05    0     0     0

#     "# New AFSC slope survey data May, 2005"

1997  1     5     3     0     200   0.000213549 0.002649998 0.013078776
      0.020622529 0.030906876 0.034403312 0.038228835 0.062766776
      0.052714729 0.042753822 0.029312618 0.020229384 0.018577078
      0.014389382 0.010497372 0.00833536  0.007177347 0.00577807
      0.005189662 0.009925748 0.011205268 0.010725472 0.011512139
      0.006099841 0.002685985 0.000847804 0.000113148 0.000213549
      0.002334688 0.012093366 0.019176046 0.039674935 0.05346051
      0.071166167 0.063755807 0.059066092 0.046182135 0.032592126
      0.026631479 0.016579243 0.011822966 0.00697462  0.008094634
      0.008714055 0.007986722 0.006960083 0.015726768 0.011886257
      0.005380638 0.002148766 0.000208233 0.000229231 0     0
```

```
1999  1     5     3     0     200   0.0000445   0.001512405 0.009384626
      0.021798317 0.029931018 0.036691622 0.051343647 0.067349458
      0.067095771 0.043928342 0.030109013 0.020996923 0.015401093
      0.013352239 0.00900989  0.008019841 0.007384172 0.00684233
      0.007407869 0.00936876  0.009893874 0.01044537  0.009206488
      0.006817491 0.002099882 0.000802107 0.000173731 4.45E-05
      0.001512405 0.009888027 0.02358257  0.042376395 0.050705927
      0.053258299 0.060529228 0.061045491 0.03902867  0.030435789
      0.021533665 0.021670955 0.013326647 0.012219099 0.008608415
      0.009190733 0.00621908  0.006908633 0.014257194 0.01007072
      0.004812567 0.001940205 0.00042394  0     0     0
2000  1     5     3     0     200   0.000926494 0.003301955 0.002669275
      0.012840267 0.019827729 0.032088514 0.049636777 0.066655167
      0.070459308 0.050572621 0.030302571 0.021356096 0.016192198
      0.010149012 0.009179068 0.008670534 0.005618873 0.006422339
      0.00621788  0.010545881 0.009327937 0.008885033 0.009940785
      0.007117141 0.003174997 0.001362451 0.000404902 0.000926494
      0.003301955 0.002746856 0.014787021 0.034997017 0.046263557
      0.06401739  0.067865456 0.068110568 0.057309799 0.031799294
      0.023879789 0.016124873 0.015958082 0.011327657 0.008442517
      0.008476677 0.008885692 0.006293453 0.013664726 0.011181174
      0.006995456 0.002205625 0.000448669 0.0000705   0     0.0000739
2001  1     5     3     0     200   0.000436896 0.002825893 0.009208376
      0.010802184 0.0195098   0.038632105 0.043471807 0.067018356
      0.062353353 0.052331882 0.037225153 0.027834862 0.017462827
      0.012461144 0.010376621 0.010336922 0.007951224 0.006256639
      0.004811649 0.008399832 0.010662761 0.010668912 0.010414888
      0.007996484 0.0029789   0.001017675 0.000147699 0.000436896
      0.002825893 0.009016585 0.011783013 0.025255621 0.045006999
      0.058313353 0.060394963 0.067935598 0.051457668 0.036939554
      0.024534541 0.018256379 0.013645104 0.00980363  0.008824643
      0.009355599 0.007386803 0.007832656 0.015390811 0.012420903
      0.006650694 0.001812671 0.000799751 0.000240206 0.0000846   0


#     "#New NWFSC survey length comps May, 2005"

1998  1     6     0     0     200   0.000538621 0.004486531 0.011239901
      0.021599222 0.036338126 0.066944471 0.101267241 0.116684392
      0.100751991 0.081895096 0.068854787 0.059979907 0.057023404
      0.052863206 0.032184207 0.024884643 0.02026803  0.026654742
      0.015149605 0.039823075 0.023280326 0.022819114 0.010173301
      0.003369051 0.000567725 0.000230291 5.22E-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
1999  1     6     0     0     200   0.000450757 0.002678138 0.014044037
      0.028585739 0.047971439 0.059690485 0.074458212 0.089025152
      0.096070864 0.073697587 0.065409187 0.065273947 0.066854717
      0.057675372 0.0443074   0.032643269 0.03554598  0.019009764
      0.024088092 0.033825362 0.025671171 0.020282996 0.014541187
      0.004694801 0.002697011 0.000693064 0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0     0     0     0     0     0     0     0     0     0     0
      0
2000  1     6     0     0     200   0.001066413 0.004127181 0.008604622
      0.02384511  0.043882083 0.067551086 0.080796104 0.10561751
      0.096153083 0.083668548 0.076877388 0.057141931 0.049054077
      0.04989548  0.036819198 0.032521899 0.022654958 0.023152311
      0.026169186 0.038538376 0.032541463 0.015286951 0.012709956
      0.006236814 0.00335212  0.001341987 0     0     0     0     0
```

```
     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0
     0
2001 1     6     0     0     200   0.00106039  0.004329764 0.013724931
     0.017322042 0.032517543 0.052956044 0.079971116 0.092703755
     0.086961396 0.082800798 0.075881859 0.060502993 0.0635949
     0.053921047 0.051859388 0.0348018   0.032042315 0.025116236
     0.021572757 0.042483093 0.031044531 0.020803852 0.01189705
     0.006113427 0.00272101  0.000641607 0.000180735 0     0     0
     0     0     0     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0     0     0     0
     0     0
2002 1     6     0     0     200   0.002323233 0.002708133 0.008298127
     0.006591527 0.015015455 0.037236128 0.075533593 0.118377185
     0.146371172 0.114952886 0.083504108 0.073228666 0.054346861
     0.046987878 0.03413932  0.030836739 0.022460583 0.022678014
     0.021158325 0.030805707 0.022066267 0.016685953 0.007492195
     0.003418619 0.00188248  0.000469997 0.000253064 0     0     0
     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     6     0     0     200   0.00181425  0.003182516 0.009385307
     0.015081208 0.028890623 0.033964905 0.056292496 0.103589324
     0.102565048 0.10769637  0.088894676 0.068291639 0.054441382
     0.052133503 0.043004129 0.041110913 0.035069541 0.032564739
     0.022979839 0.040104998 0.027446123 0.014892595 0.008650561
     0.006499489 0.000934357 0.000429056 9.04E-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
2004 1     6     3     0     200   0.000930551 0.005486327 0.010923912
     0.014701186 0.018486457 0.018353254 0.022501525 0.046323971
     0.057672713 0.065096133 0.049143745 0.032778416 0.029931971
     0.021878795 0.016491089 0.01239202  0.011583352 0.00994301
     0.009123383 0.013725763 0.013998099 0.008519493 0.004302266
     0.002007349 0.001048917 0.00078827  0.000215318 0.001116907
     0.005921157 0.01148298  0.015342961 0.019402019 0.01841427
     0.024819803 0.047260921 0.055709007 0.059601717 0.044976873
     0.033823857 0.030015887 0.022803289 0.022488806 0.015091458
     0.012429573 0.011833352 0.008227941 0.016541134 0.013849014
     0.005287159 0.003329342 0.00063043  0.000312471 0.000112047
     0.000103271
0    #     #_N_age'_bins

0    #     #_number_of_ageerr_types


0    #     #_N_age_observations
0    #     #_N_size@age_observations;_values_on_row1;_N_on_row2
0    #     #_environmental_data    N_variables
0    #     #_environmental_data    N_observations
999  #     #end  of file
```

Parameter File:

```
#  sst.ctl 8.31.2005
2     # _N_growthmorphs

# assign_sex_to   each_morph_(1=female;_2=male)
1     # Females
2     # Males

1     # N_Areas_(populations)

# each_fleet/survey_operates_in_just_one_area

# but_different_fleets/surveys_can be
assigned_to_share_same_selex(FUTURE_coding)
1     # North Trawl
1     # South Trawl
1     # Triennial survey 55-366 m
1     # Triennial survey 366-500 m
1     # AFSC slope survey
1     # NWFSC slope survey

0     # do_migration_(0/1)

3     # N_Block_Designs
2     1     3     # N_Blocks_per_Design(Block_1_always_starts_in_styr)
1988  1994  # block design 1
1995  2004
1988  2004  # block design 2
1988  1994  # block design 3
1995  1999
2000  2004
# Natural_mortality_and_growth_parameters_for_each_morph

20    # Last age for M young
40    # First age for M old
2     # Age for growth Lmin
100   # Age for growth Lmax
-4    # Mortality and growth parameter deviance phase

#     LO    HI    INIT  PRIOR PR_type     SD    PHASE env-variable
use_dev     dev_minyr   dev_maxyr   dev_stddev
      0.03  0.08  0.05  0.05  0     0.15  -3    0     0     0     0
      0.5   0     0     # F_natM_young
      -3    3     0     0     0     0.2   -3    0     0     0     0
      0.5   0     0     # F_natM_old_as_exponential_offset(rel_young)
      3     10    7     9     0     2     -2    0     0     0     0
      0.5   0     0     # F_Lmin
      55    95    75    70    0     5     -2    0     0     0     0
      0.5   0     0     # F_Lmax
      0.01  0.03  0.018 0.017 0     0.8   -3    0     0     0     0
      0.5   0     0     # F_VBK
      0.05  0.25  0.125 0.1   0     0.8   -3    0     0     0     0
      0.5   0     0     # F_CV-young
      -3    3     0     0     0     0.8   -3    0     0     0     0
      0.5   0     0     # F_CV-old_as_exponential_offset(rel_young)
      -3    3     0     0     0     0.8   -3    0     0     0     0
      0.5   0     0     #
M_natM_young_as_exponential_offset(rel_morph_1)
```

```
      -3    3     0     0     0     0.8   -3    0     0     0     0
      0.5   0     0     # M_natM_old_as_exponential_offset(rel_young)
      -3    3     0     0     0     0.8   -3    0     0     0     0
      0.5   0     0     # M_Lmin_as_exponential_offset
      -3    3     -0.1053605  -.1   0     0.8   -2    0     0     0
      0     0.5   0     0     # M_Lmax_as_exponential_offset
      -3    3     0     0     0     0.8   -3    0     0     0     0
      0.5   0     0     #M_VBK_as_exponential_offset
      -3    3     0.    0     0     0.8   -3    0     0     0     0
      0.5   0     0     #M_CV-young_as_exponential_offset(rel_CV-
young_for_morph_1)
      -3    3     0.    0.    0     0.8   -3    0     0     0     0
      0.5   0     0     #M_CV-old_as_exponential_offset(rel_CV-young)

# Add 2+2*gender lines to read the wt-Len and mat-Len parameters
      -3    3     4.9E-06     4.9E-06     0     0.8   -3    0     0
      0     0     0.5   0     0     #Female wt-len-1
      -3    3     3.264 3.264 0     0.8   -3    0     0     0     0
      0.5   0     0     #Female wt-len-2
      -3    3     18.2  22    0     0.8   -3    0     0     0     0
      0.5   0     0     #Female mat-len-1
      -3    3     -2.3  -0.4  0     0.8   -3    0     0     0     0
      0.5   0     0     #Female mat-len-2
      -3    3     1.    1.    0     0.8   -3    0     0     0     0
      0.5   0     0     #Female eggs/gm intercept
      -3    3     0.    0.    0     0.8   -3    0     0     0     0
      0.5   0     0     #Female eggs/gm slope
      -3    3     4.9E-06     4.9E-06     0     0.8   -3    0     0
      0     0     0.5   0     0     #Male wt-len-1
      -3    3     3.264 3.264 0     0.8   -3    0     0     0     0
      0.5   0     0     #Male wt-len-2

# pop*gmorph lines For the proportion of each morph in each area
0     1     0.5   0.2   0     9.8   -3    0     0     0     0     0.5
      0     0 # frac to morph 1 in area 1

0     1     0.5   0.2   0     9.8   -3    0     0     0     0     0.5
      0     0

# pop lines For the proportion assigned to each area
0     1     1     1     0     0.8   -3    0     0     0     0     0.5
      0     0     #frac to area 1

#_custom-env_read
0     #_    0=read_one_setup_and_apply_to_all_env_fxns;
#1=read_a_setup_line_for_each_MGparm_with_Env-var>0

#_custom-block_read
0     #_    0=read_one_setup_and_apply_to_all_MG-blocks;
      #1=read_a_setup_line_for_each_block x MGparm_with_block>0

#     LO    HI    INIT  PRIOR Pr_type     SD    PHASE

#_Spawner-Recruitment_parameters
1     # SR_fxn:  1=Beverton-Holt
#LO   HI    INIT  PRIOR Pr_type     SD    PHASE
3     31    10.1  10.3  0     10    1     #Ln(R0)
0.2   1     0.6   0.6   2     0.2   -4    #steepness
0     2     0.5   0.5   0     0.8   -4    #SD_recruitments
-5    5     0     0     0     1     -3    #Env_link
-5    5     0     0     0     1     -4    #init_eq
```

```
0     #env-var_for_link
#     recruitment_residuals
#     start_rec_year    end_rec_year      Lower_limit Upper_limit phase
      1985  2000  -15   15    1

#init_F_setupforeachfleet
#LO   HI    INIT  PRIOR PR_type     SD    PHASE
0     1     0.00  0.01  0     99    -1
0     1     0.00  0.01  0     99    -1

#_Qsetup
#_add_parm_row_for_each_positive_entry_below(row_then_column)
#-Float(0/1)      #Do-power(0/1)    #Do-env(0/1)      #Do-dev(0/1)
#env-Var    #Num/Bio(0/1)     for   each  fleet and   survey
0     0     0     0     0     1
0     0     0     0     0     1
1     0     0     0     0     1
1     0     0     0     0     1
1     0     0     0     0     1
1     0     0     0     0     1
#LO   HI    INIT  PRIOR PR_type     SD    PHASE env-variable
-3    3     -.5   -.5   0     2     2     # Q for triennial 55-366
survey
-3    3     -.5   -.5   0     2     2     # Q for triennial 366-500
survey
#-2   2     -.2231436   0.01  0     2     -2    # Q for AFSC slope
survey
#-2   2     -.2231436   0.01  0     2     -2    # Q for NWFSC slope
survey
-2    2     0     0.01  0     2     -2    # Q for AFSC slope survey
-2    2     0     0.01  0     2     -2    # Q for NWFSC slope survey

#_SELEX_&_RETENTION_PARAMETERS
#Pattern    Retention(0/1)    Male(0/1)   Special
# Size_selex
7     1     0     0     #_North_Trawl
7     1     0     0     #_South_Trawl
7     0     0     0     #_Triennial
7     0     0     0     #_Triennial 2
7     0     0     0     #_AFSC Slope survey
7     0     0     0     #_NWFSC Slope survey
#_Age_selex
10    0     0     0     #_Trawl
10    0     0     0     #_Trawl
10    0     0     0
10    0     0     0
10    0     0     0     #_AFSC Slope survey
10    0     0     0     #_NWFSC Slope survey

#LO   HI    INIT  PRIOR PR_type     SD    PHASE env-variable
      use_dev     dev_minyr   dev_maxyr   dev_stddev  Block_Pattern
#Size-Selectivity for North Trawl (double logistic)
#5    70    24    45    0     99    4     0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    5     15    0     99    4     0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     65    26    26    0     10    4     0     0     0     0     0.5
      0     0     #peak
0.0000      0.1   0.001 0     0     99    4     0     0     0     0
      0.5   2     0     #init
```

```
-10.     50.      0.0   0.0   0     3     4     0     0     0     0
      0.5   0     0     #infl
0.0000001   10    0.3   0.3   0     99    -4    0     0     0     0
      0.5   0     0     #slope
-5    15    -3.   9     0     99    4     0     0     0     0     0.5
      2     0     #final
-10.   5    0.0   0.1   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.1   .3    0     99    -4    0     0     0     0
      0.5   0     0     #slope2
0.    50    10    4     0     99    4     0     0     0     0     0.5
      2     0     #width of top
#Retention for North Trawl
5     70    27    27    0     99    5     0     0     0     0     0.5
      3     0     #infl_for_logistic
0.00001     60    2     15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic
0.0001      1.    .999  0.9   0     99    -5    0     0     0     0
      0.5   0     0     #final
-10.   5    0.0   0.0   0     3     -4    0     0     0     0     0.5
      0     0

#Size-Selectivity for South Trawl (double logistic)
#5    70    24    45    0     99    4     0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    5     15    0     99    4     0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     65    26    26    0     10    4     0     0     0     0     0.5
      2     0     #peak
0.0000      0.1   0.001 0     0     99    4     0     0     0     0
      0.5   2     0     #init
-10.     50.      0.0   0.0   0     3     4     0     0     0     0
      0.5   2     0     #infl
0.0000001   10    0.5   0.3   0     99    -4    0     0     0     0
      0.5   0     0     #slope
-5    15    -3.   9     0     99    4     0     0     0     0     0.5
      2     0     #final
-10.   5    0.0   0.1   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.02  .3    0     99    -4    0     0     0     0
      0.5   2     0     #slope2
0.    50    10    4     0     99    4     0     0     0     0     0.5
      0     0     #width of top
#Retention for North Trawl
5     70    27    27    0     99    5     0     0     0     0     0.5
      1     0     #infl_for_logistic
0.00001     60    2     15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic
0.0001      1.    .999  0.9   0     99    -5    0     0     0     0
      0.5   0     0     #final
-10.   5    0.0   0.0   0     3     -4    0     0     0     0     0.5
      0     0
#Size-Selectivity for triennial  survey 55-366 (double logistic)
#5    70    24    45    0     99    -4    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    5     15    0     99    -4    0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     65    22    22    0     10    4     0     0     0     0     0.5
      0     0     #peak
0.00001     0.1   0.0001      0     0     99    -4    0     0     0
      0     0.5   0     0     #init
```

```
-10.    50.     0.0   0.0   0     3     4     0     0     0     0
      0.5   0     0     #infl
0.0000001   10    0.3   0.3   0     99    4     0     0     0     0
      0.5   0     0     #slope
-15   15    -8    -7    0     99    4     0     0     0     0     0.5
      0     0     #final
-10.   5    0.0   0.0   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.3   .3    0     99    -4    0     0     0     0
      0.5   0     0     #slope2
0.    10    0.    4     0     99    -4    0     0     0     0     0.5
      0     0     #width of top
#Size-Selectivity for triennial  survey 366-500 (double logistic)
#5    70    24    45    0     99    -4    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    5     15    0     99    -4    0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     65    22    22    0     10    4     0     0     0     0     0.5
      0     0     #peak
0.00001     0.1   0.0001      0     0     99    -4    0     0     0
      0     0.5   0     0     #init
-10.    50.     0.0   0.0   0     3     4     0     0     0     0
      0.5   0     0     #infl
0.0000001   10    0.3   0.3   0     99    -4    0     0     0     0
      0.5   0     0     #slope
-15   15    -8    -7    0     99    4     0     0     0     0     0.5
      0     0     #final
-10.   5    0.0   0.0   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.3   .3    0     99    -4    0     0     0     0
      0.5   0     0     #slope2
0.    10    0.    4     0     99    4     0     0     0     0     0.5
      0     0     #width of top
#Size-Selectivity for AFSC Slope survey (double logistic)
#5    70    24    45    0     99    4     0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    75    5     15    0     99    4     0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     75    26    26    0     10    4     0     0     0     0     0.5
      0     0     #peak
0.00001     0.1   0.0001      0.0001      0     99    -4    0     0
      0     0     0.5   0     0     #init
-10.    50.     0.0   0.0   0     3     4     0     0     0     0
      0.5   0     0     #infl
0.0000001   10    0.3   0.3   0     99    -4    0     0     0     0
      0.5   0     0     #slope
-5    15    -0.5  9     0     99    4     0     0     0     0     0.5
      0     0           #final
-10.   5    0.0   0.0   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.3   .3    0     99    4     0     0     0     0
      0.5   0     0     #slope2
0.    10    0.    4     0     99    4     0     0     0     0     0.5
      0     0     #width of top
#Size-Selectivity for NWFSC Slope survey (double logistic)
#1    27    1     2     0     3     -4    0     0     0     0     0
      0     0
#1    27    27    26    0     3     -4    0     0     0     0     0
      0     0
#5    70    24    45    0     99    4     0     0     0     0     0.5
      0     0     #infl_for_logistic
```

```
#0.00001    75    5     15    0     99    4     0     0     0     0
      0.5   0     0     #95%width_for_logistic
5     75    26    26    0     10    4     0     0     0     0     0.5
      0     0     #peak
0.00001     0.1   0.0001      0.0001      0     99    -4    0     0
      0     0     0.5   0     0     #init
-10.     50.      0.0   0.0   0     3     4     0     0     0     0
      0.5   0     0     #infl
0.0000001   10    0.3   0.3   0     99    -4    0     0     0     0
      0.5   0     0     #slope
-5    15    -1    9     0     1     4     0     0     0     0     0.5
      0     0     #final
-10.   5    0.0   0.0   0     3     4     0     0     0     0     0.5
      0     0     #infl2
0.00001     10    0.3   .3    0     1     4     0     0     0     0
      0.5   0     0     #slope2
0.    10    1     2     0     99    -4    0     0     0     0     0.5
      0     0     #width of top
#Age selectivity for North trawl
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic#Size-Selectivity for
Combined Slope survey (logistic)
#Age selectivity for South trawl
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic#Size-Selectivity for
Combined Slope survey (logistic)
#Age selectivity for Triennial 55-366 survey
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic
#Age selectivity for triennial 366-500 survey
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic
#Age selectivity for AFSCsurvey
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic
#Age selectivity for NWFSC survey
#0.01 10    1     25    0     99    -5    0     0     0     0     0.5
      0     0     #infl_for_logistic
#0.00001    60    70    15    0     99    -5    0     0     0     0
      0.5   0     0     #95%width_for_logistic


#_custom-env_read
0
#_0=read_one_setup_and_apply_to_all;_1=Custom_so_read_1_each;

#_custom-block_read
0
      #_0=read_one_setup_and_apply_to_all;_1=Custom_so_see_detailed_ins
tructions_for_N_rows_in_Custom_setup
-10 10 0 0 0 99 6
```

```
#      LO    HI    INIT  PRIOR PR_type     SD    PHASE

-4    #_phase_for_selex_parm_devs

1
      #_max_lambda_phases:_read_this_Number_of_values_for_each_componen
txtype_below
1     #_include (1) or not (0) the constant offset For Log(s) in the
Log(like) calculation
#_survey_lambdas
      0     0     .75   .75   1     1
#_discard_lambdas
      1     1     0     0     0     0
#_meanbodywt
1
#_lenfreq_lambdas
      1     1     1     1     1     1
#_age_freq_lambdas
      0     0     0     0     0     0
#_size@age_lambdas
      0     0     0     0     0     0
#_initial_equil_catch
0
#_recruitment_lambda
1
#_parm_prior_lambda
1
#_parm_dev_timeseries_lambda
0
# crashpen lambda
100
#max F
0.9

999   #_end-of-file
```

Names file:

```
#5.27.2005
SST.dat
SST.ctl
1      # run number:  used to identify lines in the "ss2-report.txt"
cumulative output file
1       # 0=no Parameter read; use the init values in the CTL file;
1=use SS2.PAR
1       # Show_run_progress_on_console_(0/1/2)
1       # Produce_detailed_.rep_file_(0/1)
0       # Number of bootstrap datafiles to crease in nudata.dat
10      #_turn off estimation after this phase
Code_version_:_ # String containing prefix for output of version number
10      # burn in for mcmc chain
2       # thinning interval for mcmc chain
0.0  # Jitter initial parm values (proportion)
0.01    # push inital values away from bounds (proportion)
-1      # Min year for sd-report (-1 sets to styr-2, virgin level)
-1      # Max year for sd-report (-1 sets to endyr+1)
```

Forecast file:

```
2     # summary age for biomass reporting
1     # 0=skip forecast; 1=normal; 2=force without sdreport required
2     # Do_MSY:  0=skip; 1=calculate; 2=set to Fspr; 3=set to
endyear(only useful if set relative F from endyr)
0.5     # target SPR
12    # number of forecast years
12    # number of forecast years with stddev
1     # emphasis for the forecast recrutment devs that occur prior to
endyyr+1
0     # fraction of bias adjustment to use with
forecast_recruitment_devs before endyr+1
0     # fraction of bias adjustment to use with
forecast_recruitment_devs after endyr
0.40  # topend of 40:10 option; set to 0.0 for no 40:10
0.10  # bottomend of 40:10 option
1.0   # OY scalar relative to ABC
1     # for forecast:  1=set relative F from endyr; 2=use relative F
read below
1.    1.    # relative F for forecast when using F;  seasons; fleets
within season
999   # verification read for end of the correct number of relative F
reads
305   510
310   520
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
-1    -1
```