Status of the Sablefish Resource off the Continental U.S. Pacific Coasts in 2005

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EXECUTIVE SUMMARY

Stock: Sablefish, or blackcod, (*Anoplopoma fimbria*) are distributed in the Northeastern Pacific Ocean from the southern tip of Baja California, northward to the north-central Bering Sea and in the Northwestern Pacific Ocean from Kamchatka, southward to the northeastern coast of Japan. In this assessment, we assumed a single sablefish population that extends from the southern border of the Conception INPFC area through the northern border of the U.S. Vancouver INPFC area.

Catch: Catches of sablefish from Oregon, Washington, and California were classified into three gear types: hook and line, pot, and trawl. Catch estimates by gear type were available starting in 1915. Catches in the assessment model began at zero in the year 1900 and were increased linearly through the year 1915. Data were generally available for the years from 1916 through 1932, though landings were estimated through interpolation for years without data.. Landings in 1933 were reported to be approximately 2000 metric tons and stayed at this level until approximately 1967 when they began increasing to more recent levels.

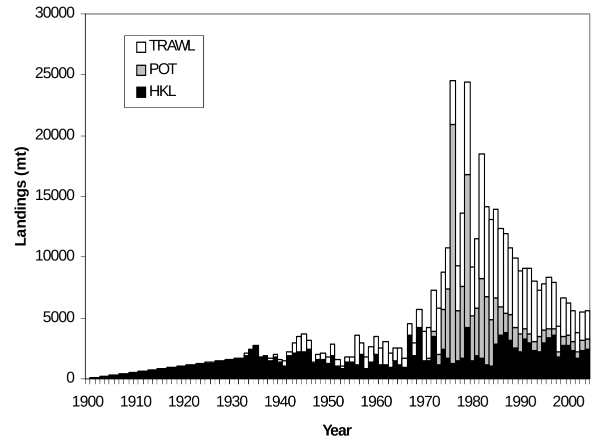

Figure ES-1. *Historical landings (mt) by year and year for sablefish, 1900-2004. The years 1900-1930 were either partially or fully reconstructed.*

Table ES-1. Recent sablefish catches (mt) by INPFC area and gear type

	Vancouver-Col			Eureka - Mont			Conception			Combined			
Year	HKL	POT	TWL	HKL	POT	TWL	HKL	POT	TWL	HKL	POT	TWL	Total
1990	1,553	698	2,438	558	647	2,376	93	139	380	2,204	1,492	5,196	8,980
1991	2,305	412	2,497	823	333	2,269	111	100	199	3,239	845	4,965	9,093
1992	1,943	323	2,596	953	222	2,501	91	187	299	2,987	732	5,399	9,175
1993	1,701	581	2,678	488	180	1,968	86	55	265	2,275	816	4,911	8,010
1994	1,417	990	2,052	707	312	1,582	112	0	159	2,236	1,302	3,793	7,353
1995	1,981	748	1,870	879	311	1,756	111	2	211	2,971	1,061	3,837	7,885
1996	1,915	520	2,123	1,309	224	1,871	125	0	213	3,349	744	4,207	8,301
1997	2,106	355	1,870	1,370	227	1,735	107	0	153	3,583	582	3,761	7,927
1998	1,189	384	1,089	465	63	974	98	0	111	1,752	447	2,175	4,378
1999	1,908	628	1,726	712	124	1,356	93	0	83	2,713	752	3,165	6,630
2000	1,983	618	1,444	685	189	1,130	81	0	34	2,749	807	2,701	6,257
2001	1,633	510	1,641	611	161	941	109	0	27	2,353	671	2,619	5,643
2002	1,170	306	828	438	153	715	126	11	50	1,734	470	1,596	3,801
2003	1,584	580	1,304	608	216	937	126	11	78	2,318	807	2,319	5,444
2004	1,925	527	1,529	477	260	684	74	12	65	2,476	799	2,278	5,555

Table ES-2. *Recent trend in sablefish spawning biomass and depletion level.*

Year	SSB	95% CI	Depletion	95% CI
1995	86,629	69271 - 164571	38.7%	NA
1996	84,641	65751 - 160651	37.1%	NA
1997	81,218	60996 - 154712	35.7%	NA
1998	78,101	56581 - 149137	35.1%	NA
1999	76,817	54011 - 145699	33.9%	NA
2000	74,223	50165 - 140969	32.7%	NA
2001	71,502	46260 - 136008	31.7%	NA
2002	69,334	42842 - 131638	32.1%	NA
2003	70,167	41395 - 131919	33.1%	NA
2004	72,419	40189 - 135065	34.3%	16.5%
2005	75,070	39119 - 138539	35.2%	16.3%

Data and Assessment. Landings, age, and length composition data for this assessment were obtained from the Sablefish Port (SPORT) database, maintained by the North West Fisheries Science Center (NWFSC). Historic landings were derived from Pacific Marine Fisheries Commission, Bulletin Number 3. As in past assessments, this year's assessment (2005) utilized several indices of abundance: the 1980-2004 AFSC Triennial shelf survey; the 1971-1991 AFSC pot survey; the 1997-2001 AFSC slope survey; the 1998-2004 NWFSC slope survey; the 1978-1988 Logbook CPUE index of abundance. Based on observed differences in length and age compositions, this assessment incorporates the AFSC and NWFSC slope surveys data as two separate surveys. Environmental data used include sea surface temperature (SST) and sea level height. Sea-surface temperature was used to estimate release mortality of discarded sablefish, and sea level height was used to model recruitment deviations from the stock-recruitment function. These multiple data sources were combined in a maximum likelihood statistical setting using the Stock Synthesis Model 2 (SS2), version 1.19, April 27, 2005.

Stock Biomass. As modeled here, sablefish spawning stock biomass (SSB) has steadily declined since 1900. Although two recent and strong year classes (1999 and 2000) can be seen recruiting into the fishery, there is little evidence that this level of recruitment continued during the 2001-2005 period. As a result, biomass projections indicate a short-term increase, followed by a continued decline.

Recruitment. Sablefish recruitment has declined over the past ten years, punctuated by only two strong year classes, one in 1999 and another in 2000. The 1999 year class was more prevalent in the Eureka, Monterey, and Conception INPFC areas, while the 2000 more prevalent in the Columbia and Vancouver area. Information from the 2004 Triennial shelf survey suggests that these two cohorts may have remained in shallow depths (50-100 fathom) instead of making the usual ontogenetic shift to deeper water. Information from the 2004 Triennial survey, the Shoreside Hake Monitoring Program, as well recent environmental data indicates that sablefish recruitment has been relatively weak since the strong 2000 year class.

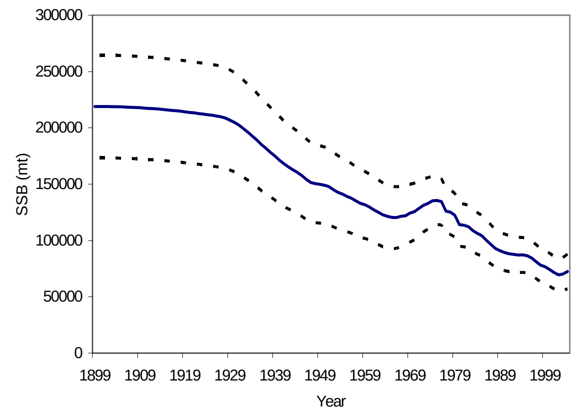

Figure ES-2. *Estimated spawning stock biomass for sablefish with approximate 95% confidence intervals.*

__Table ES-3.__ Recent estimated trend in sablefish recruitment.

Year	Recruitment (1000s)	95% CI
1995	10,044	0 - 7731
1996	2,661	1948 - 4749
1997	1,374	2761 - 4404
1998	6,925	0 - 5605
1999	17,655	0 - 11693
2000	18,442	0 - 12408
2001	12,434	0 - 9247
2002	7,772	0 - 6479
2003	2,908	0 - 4333
2004	7,446	0 - 8596
2005	4,922	0 - 7290

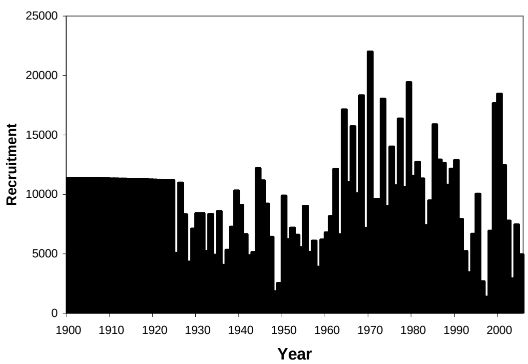

Figure ES-3. *Estimated recruitment for sablefish.*

A significant relation was observed between second quarter (April, May, and June) sea level in the northern coast (44-48 degrees latitude) and age-0 sablefish survivorship, as depicted by deviations from the estimated spawner-recruit function. If this relationship also existed historically back to 1925, then the following additional inferences can be drawn with regard to survivorship and recruitment: (1) since 1925 sablefish survivorship has experienced two stanzas, a lower survivorship period from 1925 to 1961 when sea levels were on average higher, and a higher survivorship period from 1961 to 2000, when sea levels were on average lower; (2) since the late 1960's. recruitment in sablefish has shown a gradual decline, with the exception of the strong 1999 and 2000 year classes.

Reference Points. The estimate of maximum sustainable yield (MSY) for sablefish is 2,784 mt (~95% CI: 1,313-4,237). These values are based on a model estimated steepness of 0.34. The model based estimate of steepness is based on prior of 0.40 (as was used in the previous assessment) and a standard deviation of 0.06. The estimated spawning stock biomass at MSY is 90,803 mt. The exploitation rate corresponding to SPRmsy is 0.05. For sablefish, the proxy for B_{MSY} is calculated as 40% of the unfished SSB. The stock is declared overfished if the current SSB is estimated to be below 25% of the unfished SSB. The MSY-proxy harvest rate for sablefish is SPR = $F_{45\%}$.

Exploitation Status: The baseline model for sablefish produces an estimated unfished SSB of 218,860 mt (~95% confidence interval: 298,610-399,530) with a mean expected recruitment of 11,359 thousand age-0 fish. The current SSB is estimated to be 75,070 mt (~95% CI: 58,794 - 91,346). Therefore, with this model configuration, the current depletion level for the year 2005 is estimated to be 34.3% (~95% CI: 25.3-45.2). The current exploitation level is estimated to be 59.2%.

Management Performance. Sablefish catch (landings plus estimated discards) has been below the ABC for the past eight years.

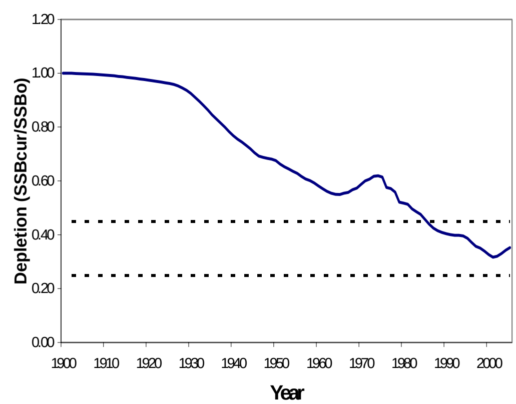

Figure ES-4. *Estimated depletion level for sablefish from base case model.*

Table ES-4. *Recent trend in sablefish SPR.*

Year	SPR	~95% CI
1995	40.6%	NA
1996	37.3%	NA
1997	34.7%	NA
1998	31.9%	NA
1999	50.9%	NA
2000	35.4%	NA
2001	35.8%	NA
2002	40.1%	NA
2003	55.3%	NA
2004	47.5%	NA
2005	48.6%	NA

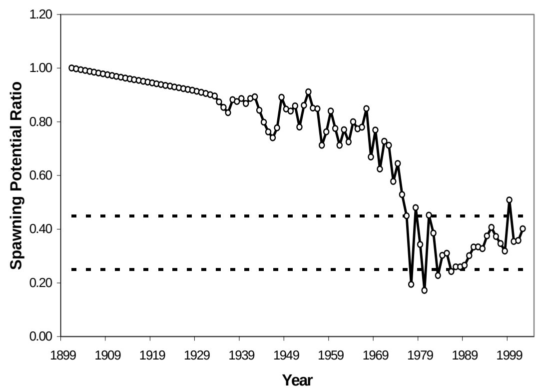

Figure ES-5. *Time series of estimated SPR for sablefish*

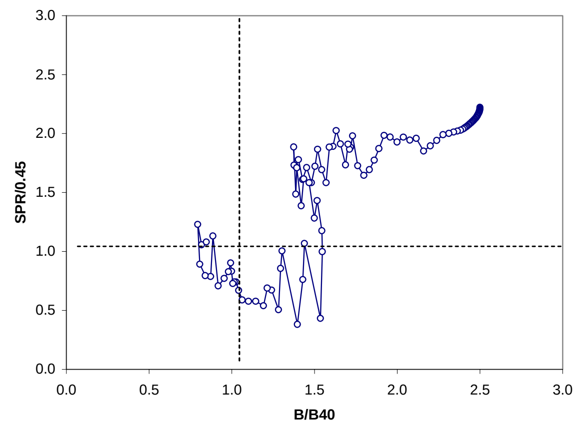

Figure ES-6. *Temporal pattern of estimated SPR relative to the proxy target of 45% vs. estiamted spawning biomass relative to the proxy 40% level.*

Unresolved Problems and Major Uncertainties. The major sources of uncertainty in the this stock assessment are very inter-related. The overall problem is the uncertainty that is centered around the annual depth distribution of age-1 sablefish. This uncertainty manifests itself in several aspects of the model. They include:

(1) Selectivity of young fish (< age 4) in the two slope surveys. These parameters have a great influence on the overall catchability of the slope surveys and, as a result, the estimate of ending biomass. It is not likely that this is a fixed rate, but rather one that varies depending on the depth distribution of the young fish.

(2) Overall catchability coefficient (*Q*) of the two slope surveys. The model remains relatively insensitive to a large range of values. As a consequence, there is considerable uncertainty with regard to the size of the biomass.

(3) Reconciling the 2001 shelf survey lengths with the 2001 shelf survey biomass estimates. The current model configuration is capable of fitting either of these two data sets, but not both simultaneously. The basis for this conflict remains unclear but seems to be a product of the overall problem mentioned above.

(4) Steepness of the stock-recruitment function. The baseline run has an estimated steepness of 0.34, which is a relatively low value. This low steepness dictates that, in order to accommodate historical removals, a large amount of biomass must have been present at the beginning of the time period (the unfished level). Since the unfished biomass determines the current level of depletion, low steepness values drive down the current level of depletion. Higher steepness values, by increasing the overall productivity of the stock, do not require such large unfished stock sizes and consequently tend to produce higher current biomasses relative to the unfished state. The previous assessment fixed the value of steepness at 0.40. However, that assessment did not include the use of an environmental covariate to account for some of the extreme recruitment variability observed in the recent years. As such, the functional effects of identical steepness values in models that do and do not include environmental covariates are likely to be different.

Forecasts. Forecasts of the possible future status of the sablefish stock were generated for the base-case model arrived upon at the STAR Panel meeting. In this model steepness is assigned a prior of 0.4 (sd = 0.06), M a prior of 0.07 (sd = 0.007), and a prior on the NWFSC Combined survey ln(*Q*) = 0.95, sd = 0.095 (Q = 0.387, from previous assessment). To maintain consistency

Table ES-5. *Projected potential sablefish catch, landings, spawning stock biomass and depletion for the base model with (OY and withouter (ABC) the 40:10 rule.*

Year	ABC Catch	ABC Landings	OY Catch	OY Landings	SSB	95% CI	Depletion	95% CI
2006	6452	6294	5698	5553	77174	59980 -94367	0.353	0.253 -0.452
2007	6210	6055	5998	5848	78369	60312 -96424	0.358	0.253 -0.463
2008	6058	5899	5869	5715	78689	60677 -96701	0.360	0.253 -0.466
2009	5858	5699	5656	5503	77751	60034 -95466	0.355	0.249 -0.461
2010	5712	5554	5489	5338	76543	59165 -93920	0.350	0.244 -0.455
2011	5562	5406	5308	5160	74905	57969 -91841	0.342	0.238 -0.447
2012	5442	5288	5176	5030	73950	57247 -90651	0.338	0.234 -0.442
2013	5319	5167	5033	4890	72664	56278 -89049	0.332	0.229 -0.435
2014	5204	5054	4899	4759	71413	55310 -87514	0.326	0.223 -0.429
2015	5096	4949	4774	4636	70210	54358 - 86061	0.321	0.219 - 0.423
2016	4994	4849	4656	4522	69052	53423 - 84679	0.316	0.214 - 0.417
2017	4898	4755	4548	4416	68003	52554 - 83451	0.311	0.209 - 0.412

with the previous sablefish assessment and update, these forecasts used both the logbook index and the pot survey (large fish)

Decision Table. The decision table is based on the forecasts described above. It should be noted that all forecasts and decision table results are based on the model where the steepness parameter was estimated to be 0.20. With this level steepness, the stock cannot support a long-term fishery in the absence of favorable environmental conditions. Consequently, each forecast shows a trend of increased depletion and decreased catch. It is unlikely that 0.2 is an accurate estimate of steepness for sablefish, given the longevity of the fishery.

Research and Data Needs. Despite a long history of scientific investigations, there remains questions with regard to sablefish biology and the possible current and future status of the stock:

(1) Reconciling the data from the historic shelf- and slope-specific trawl surveys is key to using both sets of data. The ability to do so rests upon an understanding of sablefish movements between zones that are covered by one, both, or neither of these surveys. This knowledge would useful in specifying the form and variability of survey selectivities within the model. If maintained, the current annual combined shelf-slope survey conducted by the NWFSC should reduce problems created by the non-integrated historical surveys. However, modeling of data from that survey will be improved by better understanding of sablefish movement between waters deeper than 700 fathoms and the shallower depths covered by the survey, as well as mechanisms that influence movement across the U.S.-Canadian border.

(2) While a strong correlation between sea level and sablefish age-0 survival can be demonstrated, the underlying mechanism is not yet clear. Investigations into the ecology of age-0 fish, especially during the spring months, could help with this understanding.
(3) A simulation study that seeks to determine the best way in which to incorporate environmental data into the SS2 (or similar type) model would be very beneficial. Further exploring the possibilities of divergent steepness values over time would also be helpful.

Rebuilding Projections. The stock of sablefish of the Continental United States was not found to be currently overfished, and therefore does not require rebuilding projections.

Regional Management Concerns. While sablefish growth has been shown to differ from Washington to California, it is doubtful that a significant enough amount of effort in the south warrants managing the stock as two separate stocks. More interesting is the possibility of a transboundary stock between the U.S. west coast and the southern Vancouver Island in Canada. Many of the recent recruitment trends observed in each area show a great deal of similarity.

Table ES-6. *Decision table based on three states of nature which assume varying degrees of stock size and productivity*

			Low Stock/Production h = 0.26 Q = 0.37		Base Case h = 0.34 Q = 0.33		High Stock/Production h = 0.43 Q = 0.30	
Management Decision	**Year**	**TOTAL**	**SSB**	**Depletion**	**SSB**	**Depletion**	**SSB**	**Depletion**
	2006	5694	67400	27%	77174	35%	88041	41%
	2007	4634	67662	27%	78369	36%	89949	42%
	2008	4513	67718	27%	79283	36%	91535	42%
Low Catch	2009	4315	66702	26%	78962	36%	91757	43%
	2010	4149	65452	26%	78385	36%	91685	43%
40:10	2011	3969	63853	25%	77370	35%	91121	42%
Low Stock / Production	2012	3834	62832	25%	77080	35%	91348	42%
	2013	3689	61550	24%	76449	35%	91198	42%
	2014	3553	60311	24%	75862	35%	91072	42%
	2015	3425	59120	23%	75330	34%	90998	42%
	2016	3305	57976	23%	74851	34%	90976	42%
	2017	3194	56933	22%	74496	34%	91092	42%
	2006	5698	67400	27%	77174	35%	88041	41%
	2007	5998	67662	27%	78369	36%	89949	42%
	2008	5869	67013	26%	78689	36%	91535	42%
Base Case Catch	2009	5656	65256	26%	77751	36%	91757	43%
	2010	5489	63249	25%	76543	35%	91685	43%
40:10	2011	5308	60902	24%	74905	34%	91121	42%
Base Case / Production	2012	5176	59082	23%	73950	34%	91348	42%
	2013	5033	57015	22%	72664	33%	91198	42%
	2014	4899	54978	22%	71413	33%	91072	42%
	2015	4774	52983	21%	70210	32%	90998	42%
	2016	4656	51029	20%	69052	32%	90976	42%
	2017	4548	49159	19%	68003	31%	91092	42%
	2006	5695	67401	27%	77171	35%	88041	41%
	2007	6775	67664	27%	78366	36%	89949	42%
	2008	6629	66640	26%	78249	36%	90577	42%
High Catch	2009	6436	64498	25%	76852	35%	89800	42%
	2010	6296	62085	24%	75156	34%	88690	41%
40:10	2011	6157	59323	23%	73018	33%	87085	40%
High Stock / Production	2012	6048	57038	23%	71505	33%	86181	40%
	2013	5908	54501	22%	69656	32%	84906	39%
	2014	5778	51984	21%	67831	31%	83643	39%
	2015	5657	49502	20%	66046	30%	82425	38%
	2016	5544	47053	19%	64300	29%	81253	38%
	2017	5442	44676	18%	62650	29%	80199	37%

Table ES-7 . Summary of recent trends in sablefish exploitation and stock levels; all values reported at the beginning of the year

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total catch (mt)	8,947	9,449	8,953	4,968	7,494	6,994	6,358	4,237	6,077	6,181	5,687
Estimated discards (mt)	1,078	1,149	1,027	594	864	737	715	437	633	628	134
Landings (mt)	7,885	8,300	7,926	4,374	6,630	6,257	5,643	3,800	5,444	5,553	5,553
ABC (mt)	9,100	9,100	9,100	5,200	9,700	9,700	7,895	4,977	8,460	8,487	8,368
OY	7,800	7,800	7,800	5,200	7,900	7,900	7,011	4,596	6,794	7,786	7,761
SPR	37.3%	34.7%	31.9%	50.9%	35.4%	35.8%	40.1%	55.3%	47.5%	48.6%	50.3%
Total biomass (mt)	181,706	174,654	165,574	247,769	187,840	182,881	196,302	263,197	237,960	238,422	234,255
Spawning biomass (mt)	86,629	84,641	81,218	78,101	76,817	74,223	71,502	69,334	70,167	72,419	75,070
~95% interval	71170	69322	66122	63233	62092	59635	57028	54936	55509	57071	58794
	102,088	99,960	96,314	92,969	91,542	88,811	85,976	83,732	84,825	87,767	91,346
Recruitment (1000s)	10,044	2,661	1,374	6,925	17,655	18,442	12,434	7,772	2,908	7,446	4,922
~95% interval	8,133	1,981	946	5,080	13,695	13,635	8,235	4,553	1,605	3,001	1,909
	11,955	3,341	1,802	8,769	21,615	23,249	16,633	10,992	4,211	11,892	7,935
Depletion	39.6%	38.7%	37.1%	35.7%	35.1%	33.9%	32.7%	31.7%	32.1%	33.1%	34.3%
~95% interval	NA	NA	NA	NA	NA	NA	NA	NA	NA	24.9%	25.3%
										43.7%	45.2%

Table ES-8. Summary of sablefish reference points. Because of the lower bound steepness parameter, estimates of MSY-based had no reliable calculation (NRC). Any use of MSY was based on either the B40% or F45% proxy.

Quantity	Estimate	~95% Confidence Interval
steepness used in calculations	0.34	
Unfished sapwning stock biomass (*SBo* , mt)	218,860	298,610 - 399,530
Unfished total biomass (*Bo* , mt)	428,085	NA
Unfished recruitment (*Ro* , thousands)	11,359	24,701 - 32,603
Spawning stock biomass at MSY (*SBmsy*)	90,803	NA
Basis for *SBmsy*	B40% proxy	NA
SPRmsy	45%	NA
Basis for *SPRmsy*	F45% proxy	NA
Exploitation rate corresponding to *SPRmsy*	0.050	NA
MSY (mt)	2784	1,313 - 4,237

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INTRODUCTION

Distribution

Sablefish, or black cod, (*Anoplopoma fimbria*) are distributed in the Northeastern Pacific Ocean from the southern tip of Baja California, northward to the north-central Bering Sea and in the Northwestern Pacific Ocean from Kamchatka, southward to the northeastern coast of Japan. Although few studies have critically evaluated issues regarding the stock structure of this species, it appears there may exist at least three different stocks of sablefish along the west coast of North America: (1) a stock that exhibits relatively slow growth and small maximum size that is found south of Monterey Bay (Phillips and Imamura 1954; Cailliet et al. 1988); (2) a stock that is characterized by moderately fast growth and large maximum size that occurs from northern California to Washington (Fujiwara and Hankin 1988a; Methot 1994, 1995) the stock addressed in this assessment; and (3) a stock that grows very quickly and contains individuals that reach the largest maximum size of all sablefish in the Northeastern Pacific Ocean, distributed off British Columbia, Canada and in the Gulf of Alaska (Mason et al. 1983; McFarlane and Beamish 1990; Methot 1995).

Henceforth, we use the terms stock and population interchangeably and defined in the broad context of fish stock assessment following Gulland (1983), A group of organisms can be treated as a stock if possible differences within the group and interchanges with other groups can be ignored without making the conclusions reached depart from reality to an unacceptable extent. That is, although most literature supports the hypothesis that sablefish do not exhibit large latitudinal movement (Phillips et al. 1954; Kennedy and Smith 1972; Low et al. 1976; Shaw 1984; McFarlane and Beamish 1990), long migrations have been documented (Fujioka et al. 1988) and thus, in the absence of further research, it would be necessarily difficult to evaluate the degree of mixing between hypothesized stocks. Additionally, only limited information exists concerning the juvenile biology (McFarlane and Beamish 1983a) and post-larval stage (Mason et al. 1983) of this species, which further complicates assessing the extent to which stocks may exchange genetic material (see Stock Structure below). In this assessment we consider as a single population all sablefish from the northern edge of the U.S. Vancouver International North Pacific Fisheries Commission (INPFC) area south to include the Monterey INPFC area. The Conception INPFC area is considered only in some analysis extensions due to limited historical sampling information for this southernmost segment of the population.

Life History

Sablefish off the U.S. Pacific coast exhibit a protracted spawning period from October through April, with peak spawning occurring in January and February. Sablefish spawn along the continental slope in deep waters, generally greater than 500 m (roughly 274 fm). Eggs (2.1 mm in diameter) are buoyant and rise to the surface. After hatching, post-larval sablefish are believed to inhabit surface waters offshore and within a few months begin to migrate inshore, where they may remain until reaching maturity several years later. When mature, fish begin to migrate offshore. The seasonal (within year) migration patterns of sablefish are poorly understood, but it appears substantial numbers of fish remain in relatively deep water (>500 m) following maturation. Length at 50% maturity for males and females is between 55-67 cm, most likely by age 5-7; however, studies have shown there exists considerable variation in maturity schedules for this species (Mason et al. 1983; Parks and Shaw 1987; McDevitt 1987; Fujiwara and Hankin 1988a; Hunter et al. 1989). It is important to note that Methot (1994, 1995) has shown that the ontogenetic movement of sablefish into deep water to spawn is more strongly correlated with age than with size.

Female sablefish generally reach larger sizes and older ages than males. The largest female sablefish analyzed in this assessment was a 102 cm fish and the oldest female was estimated to be between 80 and 92 years old; however, sample data analyzed in this assessment consisted of few females greater than 85 cm in length or greater than 75 years old. The largest male sablefish was 91 cm and the oldest male was 68 years old; however, few males were greater than 70 cm in length or greater than 60 years old. Adult sablefish are top carnivores that feed primarily on fishes, cephalopods, and crustaceans (Low et al. 1976; Shaw 1984).

Commercial Fishery and Management

Sablefish have been commercially harvested from U.S. Pacific coast (west coast) waters for over 100 years. Three periods of growth characterize the history of the west coast groundfish fishery, including the sablefish resource: from the late 1800s to the early 1900s, little or no management was conducted on a disorganized and relatively small commercial fishery; from the early 1900s to the early 1980s, management on a rapidly expanding fishery was the responsibility of the individual coastal states (California, Oregon, and Washington); and, currently, management on a diverse fishery and heavily exploited fish populations is coordinated by the federal government in conjunction with recommendations and support from the coastal states. The first period of growth for west coast groundfish fisheries occurred during the late 1930s, when the United States began to support allies involved in World War II and wartime shortages of red meat created an increased demand for other sources of protein (Browning 1980).

The sablefish fishery began to rapidly develop in the 1970s (Figure 1, Table 2). In the mid-1970s (prior to 1977), landings of sablefish increased significantly, due to foreign fishery regulations in the Gulf of Alaska that most likely spurred a substantial increase in domestic landings of sablefish caught off Washington, Oregon, and California, and in part to substantial catches by foreign fleets, particularly the Republic of Korea (McDevitt 1987). From 1977 to the mid-1980s, commercial fishers from the United States took advantage of their newly protected fishing grounds (i.e., "Fishery Conservation and Management Act" was enacted in 1976, recently renamed to "Magnuson Stevens Fishery Conservation and Management Act")to record high catches of sablefish to meet the demands of flourishing export (primarily Asian countries) and domestic markets. Total landings of sablefish at ports in Washington, Oregon, and California surpassed 5,000 mt in 1972 and reached historic high values in 1976 (24,518 mt), 1979 (24,373 mt), and 1982 (18,548) before steadily declining to annual totals of roughly 8,000 mt from 1993 to 1997 and an expected landed catch of approximately 5,100 mt in 1998.

Prior to 1969, most sablefish were harvested with longline gear. Landings of trawl-caught sablefish began to increase during the early 1970s and today roughly 60% of the catch is harvested by trawls and 40% by fixed gears (primarily longlines and pots). The ex-vessel value of this fishery was nearly $26 million in 1996 (Jacobson 1998).

The first coastwide-established regulations on the sablefish fishery off the U.S. Pacific coast were implemented as trip limits in October 1982 (Table 29 in PFMC 1998). Since 1982, the sablefish fishery has been managed intensively, with limited-entry, open-access, and fishing derby programs used in various manners to limit catches. Management regulations concerning the coastwide catch of sablefish are presented in Table 1. Formal stock assessments of sablefish, which have been coordinated through the Pacific Fishery Management Council (PFMC), began in 1984 and have continued on an inconsistent basis to the present (Francis 1984, 1985; McDevitt 1987; Methot and Hightower 1988, 1989, 1990; Methot 1992, 1994).

Fishery in the 1990s

The harvest guideline for sablefish has ranged from 5,200 to 8,900 mt since 1991, when the first guideline was implemented (Table 1). In 1997, the 7,800 mt harvest guideline was allocated as follows: (1) 780 mt (10% of overall guideline) apportioned to Indian tribes; and of the remaining 7,020 mt (2) 463 mt allocated to vessels without permits (roughly 7%); and (3) 6,557 mt (93%) allotted to the limited entry (permit) program, with 3,803 mt (58%) apportioned for trawl gears and 2,754 mt (42%) for fixed gears (Figure 2). A 22-in size limit on commercial catches of sablefish was implemented in 1983 and has remained in effect, with various modifications over the years, to the present.

Sablefish are the target species of the fixed-gear commercial fleet and the season has shortened as the quota has decreased and the number of fishers has increased. In 1990 the fully open, fixed-gear season (permits are required) was closed in late June. In 1991, the fully open season lasted seven weeks, from April 1 through May 23. In 1992, about 1,300 mt were landed under early season trip limits of up to 1,500 lb/day, and the fully open season lasted from May 12 through May 26. In 1993, there was only a 250 lb/day trip limit prior to the open season on May 12; the open season extended through June 1. In 1994, the fully open season lasted from May 15 through June 3. In 1995, the open season lasted one week, from August 3 to August 13. The open season spanned only six days in 1996, from September 1 to September 6. In 1997, 9 days (August 25 to September 3) were set aside for the open season, with a mop-up period from October 1-15. Sablefish are harvested by the trawl fishery in association with other species, so trip limits have been imposed in efforts to extend the harvest guideline throughout the year and prevent a prohibition on sablefish landings. In addition, there have been various limits on the catch of the total deep-water complex. For example, in 1996, limits of 70,000 lb per two-month period north of Cape Mendocino (40E30' N latitude) and 100,000 lb per two-month period south of Cape Mendocino (12,000 lb of sablefish per two-month period are allowed within the deep-water complex limit). In 1993, a minimum mesh size of 4.5 in was required in all non-pelagic groundfish fisheries.

ASSESSMENT

History of Modeling Approaches

Francis (1984) utilized straightforward trend analysis to evaluate the status of the sablefish resource. This consisted of qualitative examinations of catch-per-unit-effort (CPUE) data generated from the pot survey conducted by NMFS from 1979 to 1983. The 1985 assessment utilized more formal quantitative analyses than those used in the 1984 assessment (Francis 1985). The 1985 assessment was based on a general, age-structured simulation model first introduced by Swartzman et al. (1985). Model parameters that were estimated included natural mortality, average weight-at-age, recruitment, and relative age-specific catchability. Relative age-specific catchability coefficients for trawl and fixed gear were estimated for different market categories (see Market Categories below), small fish (<5 lb), medium fish (5-7 lb), and large fish (>7 lb). Ultimately, simulation runs, based on various fixed/trawl gear scenarios, were conducted to examine critically the maximum long-term average surplus production (maximum sustainable yield, or MSY) associated with the stock. Input data incorporated into the model consisted primarily of research survey data, including slope and trawl surveys and pot surveys, and parameter estimates generated from independent research studies.

The 1987 sablefish assessment utilized additional sample information collected from shelf and slope trawl surveys conducted by NMFS, as well as data from the pot surveys (McDevitt 1987). The primary analysis was based on a modified yield-per-recruit procedure (Funk and Bracken 1984) that examined trends in yield and reproductive potential in accordance with a minimum size limit (22 in) that had been in place since 1983.

The sablefish assessment conducted in 1988 (Methot and Hightower 1988) was the first evaluation to incorporate separable catch-at-age analysis (see Model Description (1998) below) and in particular, the first to use the Stock Synthesis Model (Methot 1989, 1990). All subsequent stock assessments have used the Stock Synthesis Model to evaluate the status of the sablefish population off the U.S. Pacific coast; the model has undergone considerable development since the first program was presented in 1988. The theoretical foundation and parameter estimation techniques utilized in the model are discussed below, see Model Description (1998). The modeling program used in 1988 was based on two types of fisheries (trawl gear and fixed gear) and two years of fishery-related biological data. Auxiliary information included trawl (shelf) and pot survey data, which were used to determine recruitment levels and develop a time series of relative abundance of middle-age sablefish, respectively. Estimates of exploitation rate were based on tag recapture information generated from a tagging study that began in 1971. Age-specific availability (selectivity) to the survey and fishery data was problematic, due largely to the scarcity and high variability of the available age composition information.

In general, the 1989 sablefish stock assessment followed similar modeling protocols as the 1988 assessment (Methot and Hightower 1989). Revisions in the age determination criteria for sablefish caused an increase in the observed proportion of old fish and a decrease in the estimate of natural mortality from 0.15 to 0.09. The modifications made in the 1989 assessment resulted in an increase in the estimate of current biomass, a decrease in the estimates of historical recruitment, and a decrease in the estimate of long-term potential yield.

Two significant changes were made in the 1990 sablefish assessment (Methot and Hightower 1990). First, stock structure assumptions were changed from a previously presumed single-unit stock to a two-stock supposition, a northern population (U.S. Vancouver and Columbia INPFC areas) and a southern population (Eureka, Monterey, and Conception INPFC areas). Information regarding low rates of mixing and differences in growth of sablefish between the two assessment areas supported this assessment revision. Second, greater emphasis was placed on the shelf trawl survey biomass estimates from southern Oregon (northern assessment area), primarily because slope trawl survey information from this general area (1984, 1988, and 1989) allowed a reliable trend to be evaluated and indirectly compared to model results.

In the 1992 sablefish assessment (Methot 1992), a single assessment area (i.e., single population hypothesis) was reinstituted in the modeling process, given that new evidence indicated size-at-age of sablefish was generally similar between the U.S. Vancouver/Columbia area and northern California (Eureka and Monterey INPFC areas). However, the Conception INPFC area was not incorporated in the primary assessment area, primarily due to noticeably smaller size-at-age and delayed maturity of sablefish from those waters. The 1992 assessment was the first evaluation of the sablefish population that utilized slope trawl survey data in an explicit fashion within the model. In previous assessments, slope survey data were used outside of the model itself, primarily to corroborate or refute findings generated from the modeling process. The biomass densities estimated by the slope trawl surveys were extrapolated to the entire assessment area (Monterey through U.S. Vancouver INPFC areas) to provide information that could be compared to model results. Model runs were configured to explore trade-offs in fitting the slope trawl survey biomass and the trend in numbers of medium and large sablefish in the pot survey. Because of the difficulties involved in summarizing biological data collected from the sablefish fishery (see Market Categories below), the assessment model was revised to utilize fishery-related data within market categories. Analysis of depth stratified age- and length-composition data used in the 1992 assessment indicated that the movement of sablefish into deep water was more closely related to their age than size.

The sablefish assessment conducted in 1994 used a similar modeling approach as the previous assessment done in 1992. That is, the model was configured to explore trade-offs in fitting the biomass levels measured in the slope trawl surveys, the trend in numbers of sablefish in the pot surveys, and the trend in recruitments from the shelf trawl surveys (Methot 1994). In this assessment, the pot survey data from the northern survey (U.S. Vancouver and Columbia INPFC areas) and the southern survey (Eureka and Monterey INPFC areas) were combined as pairs of observations so that each estimate of catch-per-unit-effort (number of fish/pot) used in the model reflected annual (two years collapsed into one year) values that were based on coastwide data. Biological data from the pot surveys were not combined because of possible differences of individual year classes. In all previous assessments, the northern and southern pot surveys were treated independently and as different measures of the stock trend, each with its own selectivity characteristics relative to the entire stock. As was the case in the previous assessment (1992), slope trawl survey data were used in the model as absolute measures of biomass; extrapolation techniques were used to derive coastwide estimates. A preliminary model, exploratory migration model, was proposed in this assessment to try to account for the patterns observed in the different survey trends. The hypothesis was that an annual emigration rate of roughly 3% of the total, beginning at age 4, from the '<500-fm' depth stratum to the '>500-fm' stratum could explain the dramatic decline observed in the pot survey, while also estimating a realistic Q (catchability coefficient) for the slope trawl survey. In previous assessments, Q values for the slope trawl survey near 2.0 were necessary to fit the trend in the pot survey. Methot (1994) recommended that further critical evaluation be conducted with this exploratory model before adopting management measures based on its results.

The assessment in 1997 (Crone et al. 1997) was conducted in a similar fashion as was done in 1994. Sample data utilized in the model included both fishery (longline, pot, and trawl) and research survey (trawl and pot) information. Estimates of total biomass and catch-per-unit-effort (CPUE) generated from research survey and commercial fisher logbook data were used to develop relative indices of sablefish abundance; this auxiliary information was used for tuning purposes in the model. Trends derived from the majority of the different sources of survey data generally indicated a declining population from the mid-1980s to the present, although most trends did not follow strictly linear declines and no source of information could be supported definitively on a statistical basis. Modeling focused on exploring trade-offs in fitting the survey trends presented above in accordance with biological information from commercial fisheries and research surveys. As expected, no single model configuration was found that fit all indices well, i.e., model runs were based on the simultaneous examination of all the data, which necessarily required accommodating various discrepancies between the survey indices. Various combinations of the survey indices (configurations) resulted in two broad, opposing interpretations of the state of the stock. The two model scenarios were: (1) a baseline configuration that equally emphasized sample information from each survey; and (2) a configuration that de-emphasized trend indices generated from pot surveys and slope trawl surveys. Collectively, these model scenarios provided a qualitative measure of the uncertainty in the overall assessment and in particular, the magnitude of the variability (bias and sampling error) in the survey data. In general, model runs that included population trends derived from pot and slope trawl survey information (model scenario 1) indicated the stock had not responded favorably to exploitation practices, while runs that de-emphasized these survey data (model scenario 2) suggested the stock had experienced relatively slow rates of decline.

The assessment in 1998 (NMFS/STAT 1998) was conducted in a similar fashion as was done in 1997. Once again, much of the focus of the analysis was centered around the inclusion and exclusion of the pot survey index and the commercial logbook CPUE as an index. The size-based version of the Stock Synthesis model was configured to explore trade-offs in fitting the survey trends in accordance with biological information from commercial fisheries and research surveys. As expected from previous assessments, no single model configuration was found that fit all indices well, and various combinations of the survey indices were found to result in differing interpretations of the state of the stock. However, all attempts to include some indices while excluding others were found to be quite subjective. Consequently, a baseline model configuration was adopted in which all available indices of abundance were used simultaneously. As expected, there was considerable uncertainty associated with the stock size (and other) estimates derived from the baseline model.

The 2001 assessment (Schirripa and Methot 2001) focused on evaluating the sensitivity of the model and the outcomes to changes in the survey data. These changes include the combining of the AFSC slope survey data and the NWFSC Industry Co-operative Survey data using a GLM procedure. This analysis made it possible to extend the southern boundary of the assessment south to Point Conception. Also considered was occurrence of 'water hauls' in the AFSC shelf survey data. As with previous assessments, the inclusion and exclusion of pot survey and logbook indices of abundance were evaluated. This assessment was the first to introduce the possibility that sablefish recruitment may be linked to environmental factors. A seemingly meaningful relationship was demonstrated between changes in northern and southern copepod abundances and sablefish recruitment. This observation led to conditions and projections that considered two competing "states of nature" to calculate the mean virgin recruitment: a "density-dependent" state that used the average of 1975-1991 recruitments, and a "regime shift" state that used the 1975-2000 recruitments.

The 2002 assessment (Schirripa 2002) served as an update to the last full assessment conducted for sablefish in 2001. This update, by definition, sought to document changes in the estimates of the status of the stock by only considering newly available data for 2001 while not considering any new changes in the model structure or model assumptions. The 2001 data was highlighted by two relatively strong incoming cohorts, the 1999 and 2000 year classes. The strength of these two year classes was evident not only in the traditional data sources such as the surveys of the continental shelf and slope, but also in the bycatch of the whiting fishery as documented by the Shoreside Whiting Observer Program. These year classes recruited into the population immediately following ten years of below average recruitment and correspond very well with environmental changes that have taken place in the North Pacific Ocean (often referred to as "regime shift"). A significant relationship between recruitment and sea-level recorded at Crescent City, California was used to strength the previous theory that environmental factors were indeed critical to the recruitment process. The addition of the 2001 data increased the estimate of absolute spawning stock biomass but had little effect on the estimate of spawning stock biomass relative to virgin. While the estimate of B_{cur}/B_0 remained relatively the same as the previous assessment, the catch that would result from applying the '40:10' rule increased. This increase was due to a decrease in the re-estimated value of the slope survey Q, an estimate which has associated with it a high degree of uncertainty. How much the catch could increase was dependent upon the level of future recruitment as well as the value of *Q* for the slope survey.

In this year's full assessment (2005) several changes from the last full assessment were introduced. Landings were either taken from written records or reconstructed back to the year 1900, the assumed model start date of the fishery. Inspection of length compositions from the two surveys lead to the conclusion that the surveys had different gear selectivities. Consequently, a separation of the data was maintained and the surveys used individually. Slope survey years of less than full coast coverage were omitted from the data. Sufficient observer data was available in which to estimate discards from all three fisheries. To compliment these discards rates, a release mortality function based on sea surface temperature was developed from which to estimate dead discards by each of the three fisheries. Sea level data was used as a proxy to describe oceanographic conditions which were used to augment estimates of recruitment deviations starting in 1925.

Model Description (2005)

Overview

Stock Structure

Tag-recovery data support the hypothesis of three populations of sablefish through the North American range Tag recoveries indicate that two of these population mix off southwest Vancouver Island and northwest Washington, and to a lesser extent off southern Washington and Oregon (Kimura et al. 1998). In this assessment, we assumed a single sablefish population extends from the Conception INPFC area through the U.S. Vancouver INPFC area. Including the INPFC area of Conception is new to this year's assessment and was made possible by the more geographically extensive survey data (Helser et al. 2004).

Information regarding the depth-specific patterns associated with this species were used indirectly in this assessment to corroborate or refute particular hypotheses regarding stock dynamics; however, these patterns were not modeled explicitly. In efforts to interpret mixed signals generated from different sources of survey data, Methot (1994) began preliminary work towards incorporating depth-specific findings from pot surveys into an assessment model. Jacobson and Hunter (1993), Jacobson and Vetter (1995), and Jacobson et al. (1997) have also closely evaluated the bathymetric demography associated with slope species, such as Dover sole, thornyheads, and sablefish. It is likely that formal recognition of the bathymetric patterns in the assessment model will provide additional clarity to areas of uncertainty that currently hinder assessment of the stock.

Selectivity

Selectivity parameters used in this assessment are a function of both size and age. Assumptions used to develop size- and age-specific selectivity curves are generally described in Methot (1994). Youngest fish are cast as 100% selected through age 4 for the fisheries and the pot surveys, thus we modeled all the selectivity dynamics for young/small sablefish in terms of size alone for these data sources. Small sablefish have low selectivity to the fishery, thus creating a high observed size-at-age for young fish in the fishery and a low overall selectivity for young sablefish. Older fish tend to diffuse into deep water, where there is low fishing effort until later years. This caused an apparent decrease in selectivity to the fishery with advancing age. This age-specific pattern was extreme for the shelf trawl survey, which only extended to 200 fm, and also occurred for the pot survey, which only extended to 450 fm. The slope trawl survey extended to 700 fm and thus, has 100% selectivity for older sablefish. There is a possibility that male and female sablefish diffuse into deep water at different rates. This possibility was captured by allowing male age selectivity to differ from female age selectivity by a function that ranged from 1.0 at a young age (3-yr old fish) to an estimated factor at the oldest age. Curvature in this function was accommodated by letting the dependent variable equal age raised to an estimated power. There is also a potential for large sablefish to avoid survey and fishery gear, at least to some degree. This possibility was addressed by allowing selectivity to the fisheries, the pot survey, and the slope trawl survey to decline for larger-sized fish.

The most problematic aspect of selectivity to model was for the young/small fish in the slope survey, which extends shoreward only to 100 fm, which is in the midst of the depth range of age-1.75 sablefish (about 35-43 cm). Examination of the data showed that this size mode was apparent in some slope surveys and nearly missing in others. This variability interfered with estimation of selectivity parameters for the slope survey and confounded estimation of consistent recruitment levels. In an effort to capture this variation, age-1 selectivity was allowed to annually deviate for the two slope surveys.

To compliment the above approach, the descending limb of the shelf survey selectivity was allowed to annually deviate as well. The use of this added parameter was especially valuable in 2004 when it was apparent that much of the 1999 and 2000 year class had remained in the shallow (50-100 fathom) depth of the survey. Use of this deviation was the only manner in which the model was able to simultaneously capture the increased biomass estimate in 2004, and the lack of fish between 25 and 45 centimeters.

Some of the fishery selectivity parameters were allowed to change over time to address known changes in the characteristics of the fishery. Changes in market conditions, mesh size, and regulations were expected to change the selectivity of small sablefish to the fishery. These changes could not be calibrated external to the model and thus, the model was allowed to estimate time-varying parameters for the size at 50% selectivity to the fisheries. The movement of the trawl fishery into deep water (Brodziak 1997) was expected to change the apparent selectivity of old fish to the trawl fishery (Jacobson et al. 1997). Similar changes were likely to have occurred for the pot and longline fisheries, but inconsistent availability of logbook data from these fisheries precluded estimating the effect. The parameters that define the level of selectivity for the oldest age were allowed to change over time to track these changes in depth distribution of the fishery. The patterns of selectivity for the trawl fishery were generally similar to results from an independent research study (Jacobson et al. 1997).

Age-determination Error

The percent agreement between age readers (Kimura and Lyons 1990), commonly referred to as "double-read" analysis, was used to develop an 'ageing' error structure that was incorporated into modeling procedures to provide an estimate of precision associated with estimated age compositions. However, possible biases that may arise due to substantial differences in May 21, 2001 ageing criteria used by different laboratories were not accounted for in this assessment. That is, we have assumed that the assigned ages are unbiased estimates of true ages, but that there was substantial variability in the assigned ages.

Otoliths were analyzed by three different laboratories: Age and Growth Task Unit (NMFS, Alaska Fisheries Science Center) determined ages for specimens collected from all pot surveys (1983, 1986, 1989, and 1991) and the slope trawl survey in 1991; Tiburon Laboratory (NMFS, Southwest Fisheries Science Center) determined ages for specimens collected from the commercial fishery from 1987-90; and the Cooperative Ageing Program (NMFS/NWFSC/FRAM and Pacific States Marine Fisheries Commssion) provided age data for fish collected from the commercial fishery from 1991 to 2003 and the slope trawl surveys in 1995 and 2004. In this assessment, we developed an ageing error structure based on percent-agreement distributions from two laboratories (Tiburon and Newport). In general, the percent agreement declines from 54% agreement at age 1, 39% at age 3, to below 10% for fish older than 10 years of age. It is important to note that conservative methods were used to estimate percent-agreement distributions, with 'agreement' defined as two estimated ages (i.e., an otolith that was read twice, each time by a different reader) that were exactly the same, rather than within a specified range, e.g., within two years of one another. Synthesis calculates a level of percent correct that corresponds to the level of observed percent agreement by taking into account the probability that two readers will agree on an age, but both be incorrect. As stated above, sablefish are a particularly difficult species to age definitively, which in effect, complicates the use of these data in age-structured modeling techniques.

Ageing error was used in the model to 'blur' the expected, actual age composition before comparing the result to the observed age composition. Thus, the model may identify a year class as strong, even though the observed age composition reflected a broad mode. Within the model, ageing error also affects the observed size-at-age and is accounted for in the generation of expected values for mean size-at-age (Methot 1990). A separate study was conducted to determine the sensitivity of the model to assumptions of aging error (see Schirripa and Methot 2001, Appendix 1). Overall, the results of the study indicated that estimates of spawning stock biomass were quite insensitive to assumptions of aging error. Furthermore the study indicated that aging error associated with young fish was more critical than on older fish.

Stock-recruit Relationship

A Beverton-Holt stock-recruitment formulation was used to evaluate the degree to which density-dependent factors influence population size and to provide an attractor level for recruitments that were not well defined

by the age and size composition data. The model was allowed to estimate the level of virgin recruitment in order to establish the magnitude of the initial population in the first model year.
Based on this finding, sea level was used as a covariate for recruitment deviations from the fitted stock-recruit relation. The stock-recruit function used the z-score of the sea level index to modify the recruitments coming off the stock-recruit function (Maunder and Watters, 2003; Sinclair and Crawford, 2005). The variance of the stock-recruit function (sigma-R) was estimated through iteration and matching the assumed variance to the resulting residual mean square error. Because sea level was accounting for a portion of the variance in recruitment, sigma-R of the stock-recruit function was somewhat lower (sigma-R = 0.278) than that from the model without the environmental covariate (sigma-R = 0.68). Recruitment deviations were estimated from 1925 to 2005.

Natural Mortality

The estimate of natural mortality (*M*) for sablefish has declined since the 1988 assessment, when the Stock Synthesis Model was first used to assess the population. In the 1988 assessment, it was noted that the observed maximum age indicated that *M* was 0.08. However, *M* of 0.15 was used in the assessment, given higher estimates of natural mortality provided better model fits to the data, along with the hypothesis that fish emigrated to deep water or northern waters. In the 1989 assessment, changes in the model and additional fishery data resulted in a model that had its best fit to the fishery data at a low level of *M* (0.05). No usable age data from surveys were available in 1989. Final results in 1989 were obtained from an *M* of 0.0875, which was midway between two levels (0.075 and 0.100) that provided reasonable fits to some of the survey data. The 1990 assessment also used an *M* of 0.0875, although the maximum age of sablefish continued to suggest a lower value.

The estimate of *M* was reconsidered in the 1992 assessment, because of the availability of more age data from surveys and additional evidence that indicated the oldest fish generally reside in deep water. The maximum ages observed in the 1983, 1986, and 1989 pot surveys and the 1989 slope trawl survey were 51 years for females and 64 years for males.

According to Hoenig (1983), the average relationship between maximum observed age and total mortality is defined as,

$$\ln(Z) = alpha + beta(\ln(t_{max}))$$

where *Z* is the instantaneous rate of total mortality, *alpha* is 1.44 and *beta* is -0.982 (estimated regression coefficients used as constants in the formula), and t_{max} is the maximum age. Thus, the maximum ages indicated that *Z* was roughly 0.09 for females and 0.07 for males. These values for estimated *Z* were considered intermediate between *M* and true *Z*. An *M* of 0.07 has been used since the 1992 assessment.

Additional age data from the recent slope trawl surveys included females that were older than that observed in previous surveys, with a maximum age of 73 years being observed. Maximum ages observed in the commercial fishery data (1987-1997) were 68 years for males and 85 years for females. However, sablefish older than 75 years were very rare in the sample data we evaluated, as well as being uncommon in samples analyzed by other ageing laboratories on the Pacific coast of North America. It is very important to note that age determination of sablefish is extremely difficult and subject to a significant amount of uncertainty, e.g., the 85-yr old female presented above was estimated to be somewhere between 80 and 92 years of age, and possibly older. Utilizing these recent age data resulted in an estimate of *Z* = 0.05 for females (maximum age of 85 years) and *Z* = 0.07 for males (maximum age of 68 years). The long history of sablefish exploitation suggests that the fish may be close to true *Z*. However, the oldest sablefish found in deep water off the U.S. Pacific coast may have experienced little fishing mortality until fairly recently (1990s). An *M* value of 0.07 was used in this assessment, given we: (1) generally support the use of Hoenig=s method above based on the maximum lifespan of a typical sablefish rather than the maximum age of a single specimen observed in the sample data; and (2) felt that changes to *M* based on limited information could compromise our ability to interpret model results from assessment to assessment.

Likelihood Components

The baseline model consisted of the following likelihood components:
(1) longline fishery age distribution; (2) longline fishery size distribution; (3) longline fishery size-at-age; (4) pot fishery age distribution; (5) pot fishery size distribution; (6) pot fishery size-at-age; (7) trawl fishery age distribution; (8) trawl fishery size distribution; (9) trawl fishery size-at-age; (10) fishery discard; (11) shelf trawl survey size distribution; (12) shelf trawl survey age distribution; (13) shelf trawl survey biomass abundance index; (14) northern pot survey age distribution; (15) northern pot survey size distribution; (16) northern pot survey size-at-age; (17) northern pot survey 'medium and large fish' abundance index; (18) southern pot survey age distribution; (19) southern pot survey size distribution;
(20) southern pot survey size-at-age; (21) southern pot survey 'medium and large fish' index; (22) slope trawl survey size distribution; (23) slope trawl survey age distribution; (24) slope trawl survey size-at-age; (25) slope trawl survey biomass index; (26) logbook CPUE index; (27) stock-recruit relationship (annual recruitment); (28) parameter priors; and (29) forecast recruitment.

As stated above, likelihood estimates for the various data components were derived by comparing expected values from the model with the actual observations from the sample data based on 'goodness of fit' procedures in terms of log(L). In general, emphasis levels were set to 1.0 for each of the likelihood components above, except for size-at-age (3, 6, 9, 16, 20, 24), slope trawl survey age distributions (23), and stock-recruit relationship (annual recruitment) (27), which were de-emphasized to 0.1, primarily to minimize possible estimation biases associated with violating assumptions of statistical independence in situations when the same sample data are used to derive estimated likelihoods for more than one component in the model.

Model Parameters

The baseline model included definitions for 315 parameters. Only 164 of these were estimated within the model. The other parameters that were not estimated typically defined either: (1) factors held constant, such as natural mortality; (2) placeholder selectivity patterns for surveys that were not used; or
(3) elements of selectivity patterns that were fixed. The parameter file used in the baseline model is presented as Appendix 1.

Convergence Criterion

The iterative process for determining numerical solutions in the model was continued until the difference between successive likelihood estimates was minimized according to AD-Model Builder criteria. Fidelity of model convergence was briefly explored in a set of 10 model runs in which parameter values were randomly changed from the converged values.

Data Sources

The following sources of information were used in this assessment: (1) commercial landings (1956-2000); (2) fishery-related biological data (1986-2000); (3) commercial fisher logbook data (1978-88); (4) pot survey data (1979-91); (5) shelf trawl survey data (1980-2000); (6) slope trawl survey data (1988-2000); and (7) independent research studies that addressed sablefish growth, maturity, mortality, and fishery-related discard. These data sources are presented under broad categories, I. Fishery-related Data (1-3 above), II. Survey-related Data (4-6 above), and III. Biological Factors (7 above).

I. Fishery-related Data

Commercial Fishery Landings

Catch information used in this analysis consisted of landing data (mt) from 1956 through 1980 that are archived in the Historical Annotated Landings (HAL) database (Lynde 1986), along with landing data from 1981 through 2000 that are maintained in the Pacific Fisheries Information Network (PacFIN) database (Daspit et al. 1997; Daspit 1996). The landing values by INPFC area and major gear (longline, pot, and trawl) presented in Table 2 have changed slightly since the previous assessment was conducted in 1998, because of recent updates to the PacFIN central database (Daspit et al. 1997). The revisions largely reflect landings that were reallocated to different INPFC areas based on new information that was made available regarding actual locales of particular catches. Gears other than longline, pot, and trawl are combined into a single miscellaneous category. Gear codes were not available for landings by foreign vessels prior to 1981. Based on reported historical gear use, the following assignments were made: landings made by Japanese vessels were categorized as longline; Soviet Union (USSR) and Poland landings were classified as trawl; landings made by Korean boats were identified as pot; and all other foreign landings as miscellaneous. In assessment analyses, landings associated with unknown gear information were allocated to one of the major gears in proportion to known-gear totals by year and area (this procedure was also conducted on landings by gear and state described below). This reclassification was primarily necessary for a small amount of the landings from the Eureka, Monterey, and Conception INPFC areas (i.e., California), given gear information has been available for nearly all of the sablefish catch from the Vancouver and Columbia INPFC areas (i.e., Washington and Oregon).

In recent years, pot-caught sablefish have declined and in 1997, <12% of the total catch of sablefish in each state was attributed to pot gear (Figure 2). Longlines have been the preferred gear for catching sablefish in Washington during the 1990s and since 1995, longline-caught sablefish contributed nearly 80% to the total landings of sablefish in this state. Currently, trawl-caught sablefish dominate the landings in Oregon, with these gears accounting for nearly two-thirds of the total landings since 1992. From 1992 to 1997, California landings have been primarily associated with trawl gear (composing from one-half to two-thirds of the total landings), but longline-caught sablefish have continued to be landed in greater amounts since 1993 and now compose roughly 40% of the total landings.

Market Categories

Commercially-caught groundfish are landed primarily at processing facilities (fish dealers) in ports in California, Oregon, and Washington. In general, catches are sorted into individual species or groups of species, commonly referred to as market categories, either by the fishing boat while at sea or at the delivery site. Landing information from fishing trips is documented in fish tickets. Any fish dealer who purchases groundfish from a commercial fisher is required by law to complete a fish ticket indicating the weight and value of the market categories landed. The fish tickets provide important information about catch sizes, species composition, and economic value of the fishery. Biological samples are collected by port biologists at the processing facilities as part of a federally-coordinated sampling program (Bence 1997; Pearson 1997).

For the most part, sablefish are landed in their own market categories. Because the market value for this species is generally dependent on the grade (size, such as small, medium, large, etc.) and condition ('round' or 'dressed') of the fish, landings of sablefish are often further sorted into sub-market categories. Since 1981, landing information for sablefish has been maintained at the sub-market category level (i.e., grade).

The myriad of strata and inconsistencies in the processing operations for landings of sablefish have seriously hindered collection and subsequent analysis of biological sample data. That is, the design used to collect data from the commercial fishery is based on a multistage approach that treats the market categories as the domains of study (Sen 1986; Crone 1995). Estimates (e.g., landings, length and age distributions, etc.) are derived within market categories (in this case, grades) and then summed over the categories to determine means, totals, and their sampling errors. In this sampling design, boat trips are the primary sampling units, baskets of fish represent the secondary sampling units, and the market categories are treated as post-stratification units. Grades are generally defined as 'ocean-run' (not sorted by size), small (3-5 lb, roughly 60-71 cm fork length when round and 52-61 cm when dressed), medium (5-7 lb, approximately 70-77 cm when round and 62-67 cm when dressed), and large (> 7 lb, > 78 cm when round and > 68 cm dressed). Sizes for dressed fish reflect lengths that have been converted from dorsal length to fork length using a conversion factor of 1.7. In addition, in Oregon, much of the catch is landed as extra small (1-2 lb, < 51 cm when round). However, the processing operations for landings of sablefish are not similar across the three states, within a state, or even a port. The problem is compounded in situations when a landing is further processed after it has been sampled. This results in sample information that cannot be easily matched to a corresponding fish ticket, because characteristics of the landing when sampled are not necessarily similar to those recorded on the fish ticket; landing data on fish tickets are commonly used as weighting variables in sample estimators. Ultimately, considerable preliminary analysis and subjective judgement are required to develop accurate length and age distributions from fishery-related data. The problems associated with the biological data collected from the port sampling program were first identified in the 1992 assessment (Methot 1992).

In the 1998 assessment, biological data were further scrutinized on a sample-by-sample basis before the information was analyzed, which resulted in final length compositions that differed from those developed in the previous assessment. The differences are due to the manner in which the samples are weighted. That is, weighting is necessary, given: (1) the non-random sampling across grades that can occur; and more importantly, (2) it is appropriate to emphasize those samples (from sampled boat trips) taken in strata that were associated with larger proportions of the total landings. Weighting variables were constructed by strata based on combinations of state/year/gear/condition/grade. There is no straightforward analysis of biological data collected from commercial landings, given sample information collected in one strata (say Oregon/1997/longline/whole/ocean run) may be further processed and recorded in a different strata in the PacFIN landings database (say Oregon/1997/longline/dressed/ medium). The problem is further complicated because: (1) biological sample information does not consistently contain information regarding grade; (2) grade information may be recorded as a weight interval (say 3-5 lb), which is reflected on the eventual fish ticket as small or medium, or possibly large (weight intervals are not currently maintained on the PacFIN database). Ultimately, the analyst must attempt to match incomplete sample information with its corresponding strata in the PacFIN database. We feel the estimated length compositions presented in this assessment are an improvement over those presented in last year's assessment; however, the analysis is not free of bias, which cannot be alleviated given the current fishery operations and sampling design for sablefish landed at ports along the west coast.

The following issues remain generally unresolved since first identified in the 1992 assessment (Methot 1992). Discussion has begun between the fishing industry and NMFS in efforts to develop collaborative projects to address these processing- and sampling-related problems. We feel it is imperative at this time to begin addressing these problems in the field (i.e., modifications to the manner in which sablefish are landed/processed and revisions to the sampling design), rather than attempting to accommodate these problems at the analysis stage, as has been the general case over the years.

A. The large number of strata creates a logistical problem and results in some strata being severely under-sampled.

B. The different processing operations coastwide result in grades that are not consistently defined and problems when biological samples need to be merged with fish ticket information for appropriate statistical expansions (see discussion above). For example, some samples assigned a grade category 'small' consisted of a broad range of sizes, which negates the advantages of using a stratified sampling technique, namely, units within a stratum should be homogeneous and those between strata, heterogeneous. In Oregon and California, landings can be sorted after biological samples are collected, which greatly complicates a preferred weighted estimation method for deriving size (or age) distributions.

C. In some states (e.g., the Washington longline fishery), collecting biological data at the ports is becoming increasingly difficult, because much of the catch is dressed at sea, which precludes obtaining sex information and otoliths. In these situations, sample data are most often borrowed from other gears and/or areas, which could introduce additional bias in the final estimates.

D. The lack of condition (round or dressed) information for California landings of sablefish is a severe limitation to the interpretation of fishery data in that state.

A major challenge in redesigning the sampling program for the sablefish fishery will be to examine critically the need to maintain grade-level detail with the biological data. That is, size distributions within grades have been relatively constant over time, which does provide additional information that could be explicitly used in future modeling. Sablefish landings by state, gear, condition, and grade for 1981 through 2005 are presented in Tables 3a-3c. Historically, in Washington and Oregon, the condition of the fish landed has been recorded as round or dressed; however, in California, sablefish landings are generally recorded as either dressed or unspecified. In recent years (1990s), the majority of the unspecified landings were fish that were landed whole (round), particularly for trawl- and longline-caught sablefish (personal communication, G. Kobylinsik, Pacific States Marine Fisheries Commission, Sacramento, California, 1997). We allocated unspecified (condition) landings as round for sablefish catches in California. Also, note that landings classified in the PacFIN database as 'unspecified' grades were treated as ocean-run (unsorted) landings in all analyses.

In Washington in 1997, nearly all of the longline and pot catches and roughly two-thirds of the trawl catch were dressed (headed and/or gutted) landings. Whereas in Oregon in 1997, roughly one-half of the longline and pot catches, and 22% of the trawl catch were landed dressed. Details regarding the condition and grade of the sablefish catch by state and gear follow:

Washington longline fishery: From 1981 to 1984, roughly three-quarters of the total amount of longline-caught sablefish (in weight), for both round and dressed fish, was classified as large fish. In 1985, the fishery expanded and the amount of large fish landed began to decline. Small fish have dominated the landings since 1985 and now compose over 80% of the total longline catch. For the most part, all longline sablefish catch have been landed dressed since 1988. The absence of small sablefish during the early 1980s, and the subsequent dramatic shift from large to small fish in the landings beginning in 1985-86 can be attributed to a number of plausible explanations: first, the small fish were avoided by the fleet, possibly due to market conditions; second, the fish were caught and then discarded due to market conditions; or third, the current size structure of the population is a response to reduced numbers of large fish over the years. We have incorporated time-varying selectivity in the model and thus, our assumption is a combination of the first and third above.

Oregon longline fishery: In the 1980s, most longline-caught sablefish were landed round and now in the 1990s, one-half of the catch is dressed. The amount of large fish in the landings has followed a downward trend since 1981 for round and dressed fish. Small and extra-small fish have dominated the landings of dressed fish since 1991, composing about 80% of the total landings each year. There is a preponderance of small fish that are landed round as well; however, a substantial amount of the 1996-97 landings of whole sablefish were unsorted (ocean-run). It is likely that these unsorted fish were also small, given there is an economic incentive to sort a catch if large fish are present.

California longline fishery: Most longline-caught sablefish are landed round. In 1988, the amount of small fish began to increase and the amount of large fish began to decrease in the longline landings. Since 1995, the longline catch has been composed of primarily unsorted landings, with at least one-half classified as ocean-run.

Washington pot fishery: In the early 1980s, a substantial portion of the annual sablefish landings was caught with pot gear, landed round, and these fish were equally distributed across grades. There has been virtually no pot landings of sablefish since the mid-1980s.

Oregon pot fishery: In general, most pot-caught fish were landed round, although in recent years (1994-97), one-half of the pot landings were dressed (in 1994 over two-thirds were dressed). The proportion of large fish in the pot landings has gradually declined over time, with recent landings being dominated by small, extra-small, and unsorted (presumably small) fish.

California pot fishery: Note that there is an indication that at least some of the "unspecified" (condition) landings of pot-caught sablefish were dressed, because sample information does contain data classified as dressed. Any possible biases that may have resulted from inappropriately reclassifying "unspecified" (condition) landings in California as round should be minimal (see above), given that the vast majority of sablefish landings were harvested by trawls and longlines). The majority of the pot landings since 1981 have been composed of small or unsorted fish.

Washington trawl fishery: Nearly all of the trawl catch was landed round through 1992, when dressed fish began to be landed in greater amounts. In general, small sablefish have dominated the trawl landings since 1981, for both round and dressed fish. Small fish now compose over 75% of the trawl catches.

Oregon trawl fishery: Nearly all trawl-caught sablefish have been landed round since 1981, although the amount of dressed fish between 1981-92 was less than 5%, between 1993-98 was roughly 22% and for 1999-2004 was roughly 11% of the total trawl landings in this state. The distribution of trawl-caught sablefish in each of the grades has remained generally constant since 1993.

California trawl fishery: All of the trawl landings of sablefish are presumably landed round (see above) and this assumption is supported by the biological sample data, which are predominately collected from whole fish. Since 1991, roughly 5-10% of the trawl landings each year has been large sablefish. There appears to be a slight increasing trend of medium and large fish in recent years, which may be an indication of high-grading.

Biological Data

Size distributions

Biological data (primarily length, sex, and otoliths) from the commercial fishery have been collected every year since 1986, except in 1992, when only limited sampling was conducted in Washington. The numbers of samples (number of boat trips and total number of specimens) collected for each fishery are presented in Table 4.

Size distributions (fork length in cm) for each year (1986-91 and 1993-97), gear (longline, pot, and trawl), and sex were based on the following "strata" state (California, Oregon, and Washington), condition (round and dressed), and grade (large, medium, small, and ocean-run). Extra-small fish in Oregon were combined with small fish. One observation was generated for combined sexes. Sexes were partitioned into males and females by applying an estimated sex ratio to the combined-sex observations. Sex-ratios were estimated for combinations of year, gear, and size (partitioned into 22 length bins). On occasion, it was necessary to allocate a sex to fish that had not been assigned a sex originally; this occurred most often for fish in the tails of the distributions, i.e., very small or very large fish. We used the following protocols for borrowing sample data to assign sexes: first, for the same year and gear aggregate, sex-ratio information was used from the next larger size bin; and second, if no information was available in the next larger size bin, then sample information was used from the next smaller bin. This procedure was effective for assigning sexes to small fish (< 40 cm); however, not all large fish (>80 cm in length) could be assigned a sex using this method. We classified these fish as females, given that available fishery and survey data indicate that the sex ratio of large sablefish is heavily skewed towards females.

Final size distributions are based on sample data that were weighted by the total landings of sablefish within applicable aggregates of year, gear, state, condition, and grade. Total landing information was determined from fish ticket records maintained in the PacFIN central database. This weighted estimation approach ensured that samples associated with strata that composed large proportions of the total landings of sablefish received more emphasis in deriving overall distributions by gear and year (see Market Categories above for problems associated with developing length compositions from fishery-related data).

Size distributions used in the modeling consisted of 22 length bins: 1 bin for all fish < 34 cm; 15 2-cm bins for fish between 34 and 63 cm; 4, 4-cm bins for fish between 64 and 80 cm; 1, 10-cm bin for fish between 80 and 90 cm; and 1 bin for all fish > 90 cm. For example, the 52-cm bin includes all sablefish that were > 52 cm and < 54 cm in length. For illustrative purposes, estimates for 2-cm length bins from 32 to 90 cm are presented. Note that this procedure was done for display purposes only and all modeling used the actual estimates within the 22 size bins.

Length compositions were re-evaluated since the 1998 assessment due to reasons discussed above (see Market Categories), which resulted in time series of length compositions that, generally speaking, shifted slightly to smaller fish. That is, more thorough evaluations of the biological samples have resulted in a re-emphasis of samples to appropriate strata for weighting purposes, which in effect, indicated fewer large fish in the final length compositions. Not all gear/year length compositions were equally affected by this re-evaluation, but all combinations reflect changes to some degree. These shifts were most noticeable for female sablefish and much less pronounced for male sablefish.

Length distributions from 1986 to 2000 for sablefish catch from the longline fishery reveal no clear trends, although there is some indication in recent years (1995-2000) that the fishery is harvesting larger females over time (Figures 3 and 4). In general, longline-caught sablefish that were large (> 68 cm) were primarily females. There are no definitive trends evident in the length distributions of male sablefish landed in the pot fishery, i.e., the distributions have remained relatively constant over time. There is some evidence that increasing numbers of large female sablefish have been landed in the pot fishery; however, some years (1991-93) are not consistent with this pattern and in particular, 1997 indicated that a significant amount of the pot-related landings consisted of relatively small sablefish (< 52 cm in length). The most significant signal from the fishery length distributions is a clear trend of increasingly larger sablefish being landed by the trawl fishery over time (males and particularly, females) (Figure 4). However, beginning in 1996, a shift to increasingly smaller fish was observed. The pattern observed from 1986 to 1995 is a result of both the demographics of the sablefish population and the fleet itself, as well as economic factors related to high-grading. That is, as the trawl fleet fished deeper water (Brodziak 1997), it exerted increased pressure on a size- and age-segregated, by depth, sablefish population (Methot 1994, 1995). It appears that the fishery's movement to deeper water may not be to target solely on sablefish, but rather to harvest thornyhead (commonly caught with sablefish and Dover sole as part of a deep-water complex), which have gained considerable market value in recent years (B. Fisher, personal communication, retired captain, Newport, Oregon; R. Brown, personal communication, member of the Pacific Fishery Management Council, Portland, Oregon, 1996). The shift to smaller fish in the catches of trawlers is likely due to: (1) the increasing regulations on the fishery and their ability to realize trip-related quotas of sablefish without having to target on them (i.e., fishers catch their limits of sablefish while fishing for species such as thornyhead); and to some degree to (2) reduced amounts of high-grading of this species. The amount of small sablefish (< 50 cm) in the 1997 length composition does correspond with the fishery's communication with NMFS researchers regarding the increased amount of small fish in their hauls during the summer and fall of 1997 (T. Leach and G. Gunnari, personal communication, members of the Coos Bay Trawlers' Association, Inc., Coos Bay, Oregon, 1997).

Age distributions

Otoliths were obtained from sablefish specimens that were collected in the biological sampling program. The numbers of samples (number of boat trips and total number of specimens) collected for each fishery are presented in Table 4. The "break and burn" method for preparing and analyzing otoliths (sagittae) has been used to determine the age of the fish (Beamish and Chilton 1982; McFarlane and Beamish 1983b; Fujiwara and Hankin 1988b). Data from 1987 to 1997 were used to develop age distributions by year, gear, and sex. Age data from 1986 were not used because of concerns regarding criteria used to age the fish, and no otoliths were collected in 1992 (i.e., biological sampling program was discontinued in this year). Age data collected from 1987 through 1990 were analyzed by personnel at the Tiburon Laboratory and otoliths collected from 1991 through 1997 were analyzed by staff at the Newport Fish Ageing Unit (see Age-determination Error above). Data from all grades were combined, given inspection of the data did not indicate any obvious difference in the distribution of age-at-size between the different grades. Also, data from all areas (states) were combined, primarily to utilize effectively the limited age data. However, Methot (1994) did caution that collapsing data across states could introduce additional variability into the final distributions, given the differences in the fishing practices between the three states. For example, in Washington, the trawl fishery has remained in relatively shallow water, where young sablefish predominate, while in Oregon and northern California, the has been a tendency for the fleet to fish deep water, where older animals are found. We generally recognized the need to develop state-stratified distributions, but felt the sample data were unavailable to accomplish this task.

Age-length keys were used to derive age distributions. Each key was based on 22 size bins (see Size distributions above) and 17 age bins: 14, 1-yr bins for ages 1-14; 2, 5-yr bins for ages 15-24; and 1 bin for all fish > 25 years. For illustrative purposes, estimates for the 2, 5-yr bins were divided by 5, so that interpretation of these bins was consistent with the age-1 to age-14 bins. Estimates for the < 25-yr bin were not divided further. Again, this procedure was used for display purposes only and did not affect the estimates for the 17 age bins used in the modeling.

Age (year) distributions from 1987 to 1995 for sablefish catch from the longline fishery reveal no clear trends, although there is some suggestive evidence that the fishery may be catching older females over time (Figure 5), see Size distributions above. Age distributions from the pot survey showed the pot fleet harvested relatively old (>20 years) fish from 1987 through 1991 and in 1993, a dramatic shift to young (<10 years) animals occurred; this phenomenon was evident for both sexes. In 1996, significant numbers of older (>25-yr old fish) fish were landed, but in 1997 a shift to younger animals was observed. The trend in the age distributions for the pot fishery is substantiated with length-distribution data from this fishery. Patterns observed in the length distributions from the trawl fishery (Figures 3 and 4) generally correspond with age-distribution data from this fishery, which indicate that older sablefish have been landed in increasing numbers through 1996, with a clear shift to younger animals in 1997 and again in 2001 (Figure 5-6).

Discard

The size-specific component of discard by trawlers was examined in the 1988 and 1990 assessments (Methot and Hightower 1988, 1990). Data from the Eureka INPFC area in 1984 indicated 50% retention at 42.8 cm (Fujiwara and Hankin 1984), and more extensive data from the Columbia and U.S. Vancouver INPFC areas in 1985-1987 indicated 50% retention at 40.1 cm (E. Pikitch, unpublished data). Estimated fraction of catch retained was estimated as,

$$R = 1/\,(1 + \exp(\mathit{alpha}(L - \mathit{beta})))$$

where R is fraction retained, L is length, and *alpha* and *beta* are estimated regression coefficients used as constants in the formula. For 1971-1984, *alpha* is -1.092 and *beta* is 42.8 and for 1985-1996, *alpha* is -0.526 and *beta* is 40.1. Two retention curves are used in the model for the two time periods (1971-1984 and 1985-1996). The size distributions of the discarded sablefish (from the two studies above) are used in the model to estimate selectivity curves that are consistent with the size distribution of the retained and discarded catch, given the estimated retention function.

Estimation of the magnitude of total, discard associated with the sablefish fishery is problematic, because few studies have addressed this issue. Annual estimates of discard since 1982 are presented in Table 5. Several assumptions from previous sablefish assessment were maintained:

A. In years prior to trip limits (before 1982), we assumed the annual percent discard associated with the total amount of trawl-caught sablefish was 10%. There is no information available to support the estimate for this time period. However, the estimate does not seem unrealistic, given that market conditions for sablefish most likely resulted in some level of high grading, i.e., since at least the early 1950s, fishers have received more money for large than for small sablefish.

D. In 1982, a 3,000-lb trip limit was imposed; however, we maintained the 10% discard estimate for this year as well, given no information was available at that time to justify the use of a different rate.

E. No trip limits were imposed from 1983 to 1984. For these two years, we assumed the annual percent discard associated with the total amount of trawl-caught sablefish was 10% (see C above).

F. Total coastwide discard in 1985-1987 was based on Pikitch et al. (1988). The mean percent discard during these years was estimated to be 23.5% of the total trawl catch and 30.7% of the landed (retained) catch.

G. The assumed level of discard in 1988-1996 was 20% of the total trawl catch (25% of the landed catch), which was the rate measured by Pikitch et al. (1988) when the 6,000-12,000-lb trip limits were imposed.

H. From 1996 to 2000, data from the Extended Data Collection Program (EDCP) was used to estimate trawl fishery discards (Helser 2004).

Discard Mortality

Observer data was used to estimate the total number of sablefish discarded by the three different gear types. Work conducted on sablefish in the lab showed that while hooking and net towing accounted for some portion of the total mortality, temperature was much more important (Davis, et al. 2001). We used observations developed from laboratory experiments to estimate a release mortality function as a function of gear type and temperature. The following table of percent mortality observations was used to build the functions:

Temperature (C˚)	No Gear	Hooked	Towed
12	0	0	35
14	18	50	83
16	100	100	100

We associated the three treatments with the three fisheries as follows: the “no gear” for the pot fishery, “hooked” for the hook-and-line fishery, and “towed” for the trawl fishery. Regression coefficients were estimated between each pair of points to arrive at an estimate of mortality as a function of temperature. Sea surface temperature (SST) was averaged from April-September, and from 44° to 50° latitude for fishing-season average temperature for each year. Gear specific estimates of discards were then modified by the associated release mortalities to arrive at estimates of dead discards (Figure 7).

Years immediately following strong year classes, such as 2000 and 2001, resulted in higher discard rates as the young fish became increasingly available to the gears. Moreover, years of above average SST, such as El Niño years 1983 and 1997, resulted in above average release mortality. Consequently, the highest degree of dead discards should occur in years immediately following strong recruitment years coupled with high SST. Furthermore, there is evidence from survey tows that suggests that small (young) sablefish can be found in deep water while larger (older) sablefish can be found on the shelf. It is not clear what the mechanism behind this observation may be, but discard of small fish could be increased in those years where they are found in deeper water.

Commercial Fisher Logbook Data

Overview

Trawl logbook data have been collected by the states of California (CDFG), Oregon (ODFW), and Washington (WDFW) since the 1970s. These records provide a tow-by-tow account of reported catches of several groundfish species including sablefish. The 1997 sablefish assessment (Crone et al. 1997) considered the use of a time series of standardized catch per unit effort (CPUE) as a tuning index for the stock synthesis assessment model. This standardized CPUE series was based on general linear model (GLM) analyses described in Brodziak (1997). Crone et al. (1997) discussed some of the advantages and disadvantages of using standardized commercial CPUE as a measure of relative abundance for the sablefish stock. In comparison to the shelf, triennial, and fish pot surveys, the main advantages of the logbook index are larger sample sizes and more synoptic spatial and temporal coverage. In contrast, primary disadvantages include potential biases due to: (1) inaccurate catch or effort reporting; (2) changes in fisher behavior due to changes in market conditions and management regulations; (3) changes in fishing power of trawlers during 1978-97; and (4) existence of a nonlinear relationship between reported CPUE and relative abundance of sablefish. The relative importance of the trade-off between higher precision and potential bias of the commercial trawl logbook index is unknown.

Commercial trawl logbook index

In this assessment, a revised commercial logbook index for trawl-caught sablefish is used. This index is based on the positive deep-water catch approach to selecting tows for inclusion in GLM analyses (Brodziak 1997; Crone et al. 1997). Using this approach, tows that captured any of the deep-water complex species (Dover sole, thornyheads, and sablefish) are assumed to represent effective fishing effort directed at sablefish in the context of a multispecies fishery (Tyler et al. 1984). The revised index differs from the sablefish trawl index used in the 1997 assessment in three ways. First, the revised index was estimated with more data. In particular, three more years of data from CDFG have been included (1993-1996), one more year of data from ODFW has been included (1996), and eight years of recently audited data from WDFW have been included (1990-1997). Second, the revised index is estimated for two separate time periods, 1978-1988 and 1989-1997. This separation of the logbook data into two periods reflects the presumed effects of deep-water complex trip limits on behavior of trawl fishers targeting sablefish. In the 1997 assessment, the trawl CPUE index was available for the period 1978-1995. However, only the estimated year coefficients from 1978-1988 were used as a tuning index because the effects of trip limits and increased discard were believed to bias the estimated year coefficients after 1988. This belief was based on the observation that trip limits on sablefish and on the deep-water complex changed frequently during the late-1980s and 1990s. As a result, the revised index is comprised of two separated indices to reflect likely changes in trawl fishery discard and targeting behavior due to the imposition of trip limits on the deep-water complex beginning in 1989. An independent study of the discard behavior of trawl fishers off Eureka, California conducted by Humboldt State University and reported in Brodziak et al. (1998) suggested that sablefish discard rates increased from about 10% to roughly 30% when trip limits were in effect. This study provided additional support for the assumption that trip limits had an appreciable effect on sablefish catch rates. The third difference between the revised index and the one used in the 1997 assessment was the exclusion of first-order interactions in the GLM analysis to compute the revised index. First-order interactions were excluded because they did not appreciably improve the model fit or affect the time trend of the CPUE index. In particular, the addition of 744 first-order interaction parameters to the 138 parameters present in the main effects GLM reduced model mean square error by a minor amount (12%) and did not appreciably affect the trend of the estimated year coefficients. Furthermore, rigorous interpretation of the significance of the first-order interaction effects was complicated because the trawl logbook data were unbalanced and contained some empty cells (Searle 1987; Large 1992).

The revised commercial trawl logbook index was based on nominal CPUE from a total of 50,234 tows during 1978-1988 and a total of 32,932 tows during 1989-97. Both GLM models were highly significant ($p < 0.0001$) and explained a reasonable proportion of the total variation in CPUE (43% for 1978-1988 and 37% for 1989-1997). Estimated year effect coefficients from the GLM analyses were used to compute two separate time series of standardized CPUE for the trawl fishery (Figure 8). During 1978-1988, standardized CPUE varied considerably and had a moderate increasing trend. After deep-water complex trip limits were imposed in 1989, standardized CPUE declined from 1989 to 1992 and then increased during 1993-1995. There was another decline in 1996 followed by a moderate increase in standardized CPUE in 1997 and a return in 1998 to a level above that of 1989. The substantial increase in standardized CPUE in 1998 should be interpreted very cautiously because data from ODFW and CDFG logbook programs were not available in 1997 and because the year coefficient for 1997 has a much larger standard deviation than any other year due to low sample size. While standardized CPUE during 1978-1988 was used to model the time trend in relative sablefish biomass, the time series from 1989-1998 was not used because reported sablefish catch rates were likely biased due to trip limits and discarding practices (Figure 8).

Nominal estimates of the annual standard deviation of standardized CPUE during 1978-1988 were increased when this time series was used as a tuning index for relative biomass within the stock synthesis model. Before being included in model, each annual standard deviation was multiplied by a constant factor that ensured that the average coefficient of variation of standardized CPUE was 30%. This modeling choice was ad hoc, but reflected the belief that the nominal estimates of variance were unrealistically low in comparison to other tuning indices.

II. Survey-related Data

Pot Surveys

Overview

Pot surveys were conducted by NMFS in 1979-1981, 1983, 1985, 1987, and 1989 in northern INPFC areas (U.S. Vancouver and Columbia) and in 1984, 1986, 1988, and 1991 in southern INPFC areas (Eureka, Monterey, and Conception) (Figure 9). No pot survey data are available after 1991. Catch information (number of fish/pot) and biological data were collected according to grade-specific categories: large fish (> 67 cm); medium (62-67 cm); small (52-61 cm); and extra-small (< 52 cm). Specific details concerning survey methods are described in Parks and Hughes (1981), Parks and Shaw (1983, 1985, 1987, 1989, 1990), and Kimura and Balsiger (1985). Estimates of catch rates by year (1979-1991), grade (all grades, medium, and large), and depth (150-600 fm) for the pot surveys are presented in Table 6.

Data from two sampling sites in the Conception INPFC area were omitted from all analyses to be consistent with other analyses that utilized coastwide data, and because of the persistent small, mean size-at-age for sablefish from this extreme southern area. The northern pot surveys routinely sampled at 150, 225, 300, 375, and 450 fm and the southern surveys sampled at 225, 300, 375, 450, and 525 fm. Only samples from common depths to both surveys were used in analyses (225-450 fm). The time series of relative abundance (in numbers of fish/pot) were little changed by deleting the 150-fa samples in the northern surveys and the 525-fm samples from the southern surveys. However, in the latter years of the survey, samples were collected across an extended depth range (150-600 fm) in both the northern (1987 and 1989) and southern surveys (1986, 1988, and 1991). There was no straightforward method for including the 600-fm samples, given this depth was not sampled across the entire range of years in either the northern or southern surveys. Trends were generally similar when the 600-fm samples were included in the final time series, with the exception of medium and large fish (see CPUE index - medium and large fish pot survey below) sampled in 1988 from the southern survey, which produced a historical high estimate before dropping off to the historical low estimate in 1991.

In the assessment model, we utilized the two surveys (northern and southern) as independent measures of the stock trend (see Model Description (1998) above). Also, we filtered the pot survey data and calculated an additional index of abundance based on the medium and large fish in the surveys (henceforth, referred to as the ‘medium and large fish’ pot survey). This index was developed to track the decline in medium and large sablefish, which provided the most consistent signal in the pot surveys. That is, the model’s ability to track this signal when all of the grades were analyzed was hindered by the variability in the more abundant small and extra-small sablefish. From a modeling standpoint, we favored the trend exhibited in the medium and large fish data, primarily because these auxiliary data provided useful information for tuning the model, whereas results from all of the grades included additional noise that may have been confounded with the selective properties of the sampling gear. The dynamics of small (young) sablefish are captured in the analysis of data collected from the shelf trawl surveys, which target habitat preferred by this segment of the population (see Trawl Surveys on the Continental Shelf below). This interpretation of the pot survey data is a combination of methods utilized in previous assessments (e.g., Methot 1992, 1994).

Caution is necessary when interpreting the relative abundance of sablefish from data collected in the pot surveys, given the inherent problems with sampling variability and gear selectivity associated with passive sampling gears (Allen et al. 1960; Welcomme 1975). In particular, variability in fish behavior (i.e., availability) is difficult to address with fixed-gear sample information, can cause large fluctuations in CPUE, and ultimately, hamper interpretation of these data. Again, in this assessment model, we interpreted these data in concert with indices generated from other survey data to examine the status of the sablefish population.

A thorough review of the area- and depth-specific patterns in abundance and associated age and size distributions for the pot surveys are presented in Methot (1992, 1995); pertinent findings are briefly discussed here.

Biological data

Distributions for size (fork length in cm) and age (year) were derived in a similar fashion as was done for the fishery-related biological data (see Size distributions and Age distributions above). The numbers of samples (total number of specimens) collected from the pot surveys are presented in Table 4. Size distributions for both surveys (northern and southern) indicated a slightly increasing trend over time; however, this shift to larger fish was gradual and not particularly strong for females (Figure 10-northern pot survey southern pot survey). These patterns were generally similar to the size distributions from the pot fishery. The size distributions from the northern and southern surveys did not indicate any obvious regional effect. The age distributions were relatively consistent over time for both surveys; however, only two years of age information was available for each of the surveys (Figure 11).

The most significant findings from the pot surveys regarded the bathymetric characteristics exhibited by this species. Methot (1992, 1995) clearly showed that the ontogenetic movement of sablefish into deeper water is more closely related to age than size. The bathymetric increase in mean size for female sablefish was much less dramatic than the increase in mean age, which increased from about 4 years at 150 fm to >20 years for specimens collected deeper than 500 fm. This information generally suggests that the size distribution of sablefish in deep water that would be expected from a size-specific bathymetric pattern is diluted with relatively old animals that are atypically small.

CPUE index - pot survey

Estimates of CPUE (number of fish/pot) based on all grades (sizes) of sablefish were associated with considerable noise in both the northern (Figure 12) and southern pot surveys (Figure 13). In the northern survey, the catch rate declined significantly from 1979 (12.6 fish/pot) through 1981 (5.4 fish/pot), then climbed in 1983 (11.5 fish/pot), before steadily declining through the remainder of the 1980s (< 9 fish/ pot) to 1989 (2.6 fish/pot). In the southern survey, which began in 1984, the catch rates mimicked the northern survey in 1984 and 1986, but the 1988 catch rate was considerably higher in the southern survey (roughly 10 fish/pot) than that observed in the northern survey during the late 1980s. By 1991, the catch rate in the southern survey had dropped off to about 3 fish/pot. The peaks exhibited in both surveys were due to the high catch rates of extra-small and small fish (Table 7).

CPUE index - medium and large fish' pot survey

The decline in the medium and large sablefish was a consistent signal in both of the pot surveys, northern (Figure 12) and southern (Figure 13). In the northern survey, the catch rate declined over 90% during the time period (1979-1989), from 2.6 to 0.2 fish/pot, and in the southern survey, the catch rates steadily declined from 1 fish/pot to 0.3 fish/pot, a 70% decline during the time period (1984-1991).

Trawl Surveys on the Continental Slope

Overview

Since 1984, NMFS has periodically conducted trawl surveys on the continental slope and outer continental shelf (100-700 fm) off the U.S. Pacific coast. Since 1998 NMFS has also participated in the Industry Co-operative Survey. Survey methods are described in Raymore and Weinberg (1990), Parks et al. (1993), and NOAA (1995a). These surveys provide an important source of information, given they are conducted in habitats preferred by this species. However, the available time series for these surveys were significantly reduced in this assessment, given recommendations from an independent review of groundfish stock assessments, particularly those regarding slope-related species (Parma et al. 1995). Possible biases, those arising from non-random sample-selection techniques and incomplete coverage of the target population, associated with these surveys led to the critical review. The primary criticism raised regarded the surveys susceptibility to mud loading and decreased net opening, which could affect (bias) catch rates.

In 1994, an experiment was conducted on a soft mud bottom at depths of 460-490 m off the central Oregon coast to evaluate important gear-related factors, such as door-bridle rigging, ground-gear weight, and scope length, that may influence objective interpretation of slope trawl survey catches (Lauth et al. 1998). In general, the following conclusions were drawn from this experiment: (1) trawl performance was variable for the historically used standard trawl configuration, with improvements observed with the addition of either a 2-bridle door or lighter ground gear; (2) the interaction of door bridle and ground-gear weight had the most effect on trawl performance; and most importantly, (3) although the standard trawl performed erratically, catch rates of all four deep-water complex species were, in general, not significantly different ($p > 0.05$) across the treatments tested. Given that this experiment indicated catch rates from standard trawl operations (gear associated with surveys prior to 1995) were not significantly different ($p > 0.05$) than those from improved trawl operations (gear associated with surveys after 1995), we used these data to develop a relative measure of sablefish population abundance and incorporated this index into modeling procedures in 1998.

It is important to note that a decision to use these data was balanced with an alternative decision of not using the survey information. That is, if another suitable time series of unbiased information existed regarding adult biomass of sablefish, then we would have the option of omitting the current time series without losing an important piece of information in the assessment process. However, an alternative data source does not currently exist and further, objective methods used to explore the usefulness of the current time series support its use in the overall analysis, on at least a cautionary basis.

As was done in the previous assessments, we developed a standardized time series based on similar vessels, gears, and sampling protocols to minimize the impact of possible biases. The time series for slope trawl surveys used in this assessment consisted of ten surveys conducted by the Miller Freeman R/V (1990-1993, 1995-1997, 1999-2001; four years and two "super years"). The survey areas are presented in Figure 14. Catch estimates (biomass in mt) for the individual surveys conducted from 1992 to 2004 are presented in Figure 20 and Table 8 (due to their limited spatial extent, 1989 data were not used). The gears and methods used in these surveys were generally similar, e.g., time period, net types and configurations, ground gear, door types and weights, wire diameters, etc. We recognize that full standardization of surveys from year to year is inherently a difficult task from a pragmatic standpoint, and not possible from a strict, statistical context of sampling theory and design.

We feel the major drawback associated with these surveys was that they have not been conducted over the entire assessment area in a given year, with the exception of the 1997-2001 surveys, which did cover the entire area. Conceptually, the lack of synoptic coverage associated with the surveys is a severe problem. However, in the assessment model we have a single area that includes the Monterey through the U.S. Vancouver INPFC areas, which in effect, is based on the assumption that a single, homogeneous population inhabits this area. Given that the latitudinal dynamics exhibited by the population are generally constant from year to year, allows relative indices from the surveys to be examined on at least a cautionary basis. We recognize that there is information that indicates that multiple stocks may exist along the west coast; however, the limited amounts of data and modeling complexities preclude an assessment at this time that is based on this hypothesis. Given the lack of synoptic coverage associated with these surveys in individual years from 1988 to 1996, we felt the most prudent use of these data was to omit those years that did not have full coverage and use only the years that covered the entire survey area (1997-2001). Given the assumptions necessary to use the previous 'super year' approach, we felt this was the best use of the data.

Biological data

Size distributions (fork length in cm) were calculated following the weighted (CPUE) estimation methods described below for survey indices. Age distributions (year) were derived in a similar fashion as was done for the fishery-related biological data (see Fishery-related Data, Age distributions above). The numbers of samples (total number of specimens) collected from the slope trawl surveys are presented in Table 4. Only size distributions associated with the 'single years' index were used in the analysis, given developing size distributions that correspond with the 'super years' index was expected to result in length compositions that compromise the model's ability to follow size (year) classes across the entire time series. Again, we felt this was the best way to develop the size-distribution time series, given the problems associated with a non-synoptic survey design.

The decision was made to treat the AFSC FRV Miller Freeman and the NWFSC Industry Cooperative Survey as separate surveys. This decision was based largely on the fact that the two surveys had two different selectivities, at least for sablefish. We over-laid the length compositions from the AFSC survey on those from the NWFSC survey and found what we considered enough difference to justify using the surveys separately (Figure 15). Differences in catchability was also described in Helser et al. (2004), who found that the Miller Freeman was more efficient at catching sablefish. This could be due to the larger horsepower of the Miller Freeman, the longer tows made (30 minutes versus 15 minutes), or some other unknown factors.

A slight, increasing trend was observed in the percentage of large fish in the size-distribution data (males and females) collected from AFSC slope trawl surveys (1988-2001); however, this trend was variable across the time series and was not considered a strong signal (Figure 16). The strong 1999 year class observed in several other data sources is apparent as age-1 fish in 2000. Furthermore, a bimodal distribution that year is further evidence of the “missing” year classes of the 1990's. The age distributions for 1991, 1995, 1997, 1998, 1999, 2000, and 2001 AFSC survey generally indicated an increase in the percentage of middle-age (7-20 yr) and older (25 yr) animals in the distributions from 1991 to 1997 (Figure 17). All fish <41 cm were omitted from length distributions (age-0 and age-1 fish) prior to 1997 (the year starting full coast coverage) and all age-1 fish were omitted from age distributions, in order to prevent periodic pulses of small/young fish (e.g., size distribution for 1995) from interfering with the model’s ability to estimate size- and age-specific selectivity patterns for the slope trawl survey (see Selectivity above). These size-selectivity patterns define the degree to which the survey misses small fish that usually are found shallower than 100 fm (lower end of depth range covered by surveys) and the degree to which the survey fails to capture large fish that can avoid a trawl towed at 2-2.3 knots.

Length compositions from the NWFSC survey appeared to be slightly truncated relative to those from the AFSC survey (Figure 18). Even so, evidence of a strong 1999 year class was apparent in the mode of first seen in 2000 and again in 2001 (Figure 19). These same fish were seen as age 2 in 2001, age-3 in 2002, and age-4 in 2003. Age compositions in 2004 suggest that in fact two strong year classes may be present, the 1999 as well as a 2000. Further evidence of this was present in the 2001 shelf survey, which is discussed below.

Biomass Estimates of Sablefish on the Slope

Biomass estimates of sablefish from the two trawl surveys were made separately. Biomass from each survey was estimated using a Delta-GLM method. See Helser et al. (2004) for details on biomass estimation procedures. The results of this analysis are shown in Figure 20 and Tables 8-9. An increase in sablefish biomass was observed in 2004, presumably a result of the strong year classes making their way off of the shelf and onto the slope.

Trawl Surveys on the Continental Shelf

Overview

The shelf trawl surveys conducted by NMFS in 1980, 1983, 1986, 1989, 1992, 1995, 1998, 2001, and 2004 provide valuable information regarding abundance of young sablefish. Survey methods are described in Weinberg et al. (1994) and NOAA (1995b). Sample data collected within the 30- to 200-fm depth stratum from the north Monterey INPFC area (36E48' N. latitude) to the U.S./Canada border were analyzed in this assessment. These depths and areas were similar across the surveys, which allowed trends in biomass to be effectively evaluated (Figure 21).

Biological data

Length distributions (fork length in cm) were calculated following the estimation methods described in Weinberg et al. (1994). The numbers of samples (total number of specimens) collected from the shelf trawl surveys are presented in Table 4. Length distributions are presented for both sexes (Figure 22). The recruitment potential of the sablefish population can be generally assessed by evaluating size-distribution data from the shelf trawl surveys. In general, young sablefish (ages 1 to 3) predominate in shelf trawl survey data (Figure 23). For example, the major modes reflected in each size distribution from 1980 to 1995 consist of young fish, primarily age-1 animals (and some age 2-3 fish) between 32 and 41 cm. The model uses information in the size distributions to estimate the degree to which aspects of selectivity of this survey declined with increasing age.

Unusual in 2004 was the large number of sablefish caught in 55-183 fathom that were between 60 and 70 cm. Based on the progression of modes in the length compositions, these fish appear to be from the 1999-2000 year classes. Why these ‘older’, larger sablefish remained in the shallow depth, especially in the U.S. Vancouver and Columbia INPFC areas, is not clear.

Survey index - shelf trawl survey

We developed an index of stock abundance based on estimates of biomass from the shelf trawl surveys. This index was based on a swept-area estimate of relative biomass from samples in the 30-200 fm depth range. Catch estimates (biomass in mt) by INPFC area and year from the shelf trawl surveys are presented in Figure 24. In the assessment model, estimates (biomass in mt) were treated as relative indices and not considered as absolute values. Biomass estimates were determined following Gunderson and Sample (1980). The trend in estimated biomass declined from 1980 through 1986, then climbed to a high value in 2001 (Figure 24). For analysis of 'water-haul' data from thsi survey, see Zimmermann et al. (2001) for details.

Shoreside Hake Observer Program Data

Although technically a fishery-related ata source, the Shoreside Hake Observer Program (SHOP) data has shown that this fishery tends to catch sablefish very similar to those caught in the AFSC shelf survey. While we did not enough confidence in this data to use it directly in the model, given the annual collection, and similarity to the shelf survey length compositions in common years, we feel it provides valuable information with regard to sablefish recruitment strength. The strong 1999 (and perhaps 2000) year class is evident in the 2001 length compositions (Figure 25). In 2004, both the shelf survey as well as the SHOP data show not only a similar mode at approximately 50 cm, but both also a lack of sablefish between 30 and 40 cm. This size range corresponds to age-1 and, to a lesser extent, age-2 fish. It is quite easy to track the progression of the 1999 year class from 2001 to 2004 and the lack of fish in the size behind this mode seems to indicate weak year classes, perhaps from 2001 to 2003.

III. Biological Factors

Growth

Estimates of the maximum size of sablefish have declined as more size-at-age data have become available. In the 1988 assessment, the growth curve was based on some biased age data from the 1983 and 1985 pot surveys. In that assessment, the estimated mean maximum size was 77.5 cm for females and 64.5 cm for males. Subsequent assessments resulted in a decline in the estimated maximum size as more size-at-age data from the surveys and fisheries were included. Size-at-true age is modeled as a lognormal distribution (Parma and Deriso 1990) around the von Bertalanffy growth model,

$$L_A = L_{inf} + (L_1 - L_{inf})\ exp(K(1.66 - A))$$

where L_A is length (cm) at age A, L_{inf}, asymptotic length, is estimated in the model as 66.2 cm (females) and 55.8 cm (male), L_1, initial length, is 38.4 cm (at age 1.66 in August for both sexes), K is 0.246 (females) and 0.298 (males), and standard deviation of estimated length-at-age 1 is 1.93 (at age 1 in January for both sexes) and standard deviation of length-at-age 25 is 8.16 (females) and 5.74 (males). Actual values for L are based on estimation of length-at-age 25 as a model parameter.

One change from the 1997 assessment is a return to a simpler model approach. There is a prevalence of very large fish in the size compositions observed in the pilot year of the pot survey (1971) and in early years of the longline fishery. In the 1997 assessment, a different L_{inf} value was estimated for 1971-1972 in order to track this observation. This value was estimated to be 4.0 cm greater than L_{inf} for later years. In the current assessment, this offset is not used. Instead the selectivity for the longline fishery is configured to more easily track this targeting on very large sablefish.

Because the exact position of the size mode for the age-1.5 sablefish greatly affected the model fit to the shelf trawl survey size composition, the model was allowed to estimate an offset to the *L1* parameter for several years that exhibited a high abundance of recruitment. These offsets were 0.16 cm in 1980, -0.96 in 1983, -

0.44 in 1986, 2.06 in 1989, 1.06 in 1991, and 0.41 in 1995. Each cohort in the model followed its own growth trajectory, so these offsets at age 1 slightly affected the size-at-age for the identified cohort throughout its lifetime.

Issues regarding the length-age relationship of sablefish were also explored independent of model analysis and are presented in Schirripa and Methot 2001, Appendix B. In general, length-at-age estimates generated within the model were very similar to those observed from the independent analysis.

Maturity

Logistic response functions have been found to be appropriate and effective statistical tools to describe the proportion of sexually mature fish in a population (Hunter et al. 1990). The length of sablefish at 50% maturity was estimated by McDevitt (1987), from data presented in Phillips and Inamura (1954), to be approximately 67 cm. Mason et al. (1983) estimated the size at 50% maturity to be 58.3 cm; these fish were collected off Vancouver Island in 1980. Parks and Shaw (1983) estimated the value to be 56.3 cm for fish collected off California. In this assessment, we used a value of 55.3 cm for size at 50% maturity, which was estimated from female sablefish collected off Oregon and Washington in 1985 (Parks and Shaw 1987). In this assessment, the following logistic function was used to estimate the relationship between maturity and size,

$$M\% = 1 / (1 + \mathit{exp}(-\mathit{beta}(L - L50\%)))$$

where *M%* is the proportion mature, *beta* is 0.2491(estimated regression coefficient used as a constant in the formula), *L* is length (cm), and *L*50% is 55.3 cm (length at 50% maturity).

Length-weight Relationship

The length-weight relationship used in this assessment was based on data collected in the pot surveys. There is no apparent difference in the relationship between sexes (Phillips and Inamura 1954; Klein 1986; Fujiwara and Hankin 1988a). In this assessment, the following power function was used to estimate the relationship between length and weight,

$$W = \mathit{alpha}(L) \wedge \mathit{beta}$$

where *W* is weight (kg), *alpha* is 0.0000024419 and *beta* is 3.3469 (estimated regression coefficients used as constants in the formula), and *L* is length (cm).

Environmental determination of variation in sablefish recruitment

Sablefish recruitment is assumed to follow a Beverton-Holt type spawner-recruit function. We regressed the estimated variation about the curve on potential explanatory variables (Schirripa and Colbert, 2005). We partitioned the range of sablefish in the California Current domain into two regions. We chose these two regions because history of surveys suggests this area is where the majority of recruits are produced.

We considered the northern region to be the coastal ocean between 44˚ N to 50˚ N Latitude and the central region to be between 38˚ N. to 44˚ N Latitude. We created coastal averages for north-south and east-west Ekman transport, sea level pressure, and sea surface temperature by averaging monthly means for coastal 1˚ x 1˚ Latitude-Longitude cells from each region. We found seven sites; Neah Bay and Willapa Bay Washington, Astoria, Newport and Coos Bay Oregon, Crescent City and San Francisco California had consistent long-term historical monthly mean sea level readings. We averaged the first four of these to form the northern region and the last three to form the central region, providing monthly coastal averages. We next considered historical measures of Pacific basin-wide variation that could influence sablefish recruitment. Here we chose the multivariate ENSO index (MEI), Southern Oscillation Index (SOI), Northern Oscillation Index (NOI), and the North Pacific Index (NPI). MEI is a by-monthly average variable while all others were available as monthly averages for each year.

From the monthly average variables we created seasonal variables for winter, spring, summer and fall, as well as quarterly variables for each year where historical data were available. Winter is defined as the last two month of the prior year and the first two months of the current year (November-February), spring is the following two months (March-April), summer is the following four months (May-August), and fall is the following two months (September-October).

Independently, we tested these eight temporal summaries of the four coastal variables and four basin-wide indexes of ocean conditions, looking for significant relationships between these environmental variables and sablefish recruitment. Stepwise regression was used to screen the list of environmental variables with the acceptance and removal levels set at 0.05. All regressions were weighted, using the reciprocal of standard error of estimates for deviations from the assumed Beverton-Holt model as weights. From these initial screening procedures we obtained two variables that can be used to explain variation in the deviations of sablefish recruitment about the assumed spawner-recruit model. Environmental conditions in the second quarter (April-June) were consistently found to provide for highest explanatory power (Figure 26). North-coast (44˚ to 50˚ N) sea level can explain 43.6 % of the variation ($F = 21.66$, $P < 0.0001$) and the North Pacific Index can explain 31.4 % of the variation ($F = 12.82$, $P = 0.0013$). We examined these data for more complex multiple regression models and general additive spline alternatives but found no significant improvement in explaining variation in sablefish recruitment from these environmental variables.

Young-of-year sablefish have matured out of the larval stage, are free swimming and free feeding in late spring and early summer. At this stage they are searching for zooplankton and other food while moving onshore to nursery grounds. Low sea level and low values of the North Pacific Index suggest higher than expected recruitment. The tide gauge sea level data we use are not adjusted for barometric pressure, so they integrate both the atmospheric effects and the large-scale ocean conditions. That is, they integrate both the large-scale northeastern Pacific Ocean conditions with local upwelling and pressure. Sea level is also a good predictor of near-bottom ocean temperature along the shelf. Lower sea level is associated with colder than average water, more upwelling, stronger southward currents and lower salinity. All these factors provide better habitat conditions for young sablefish, as they inhabit the shelf at this time of year. Higher values of NPI are associated with cool regimes or La Niña conditions which have been shown to produce more favorable conditions for northern copepod species and richer food sources for feeding juveniles in the mixed layer over the shelf.

To make use of these results in the 2005 projection, we need an estimate of average sea level for April-June 2005. Given the data available for sea level, we have developed the prediction of this quarterly mean from just the April data that is now available. The April mean sea level for 2005 is 1.39175; using the historical relationship between April and Q2 sea level, the predicted Q2 Mean sea level is 1.3678. While sea level has been quite erratic so far this year, April can be used to provide our best estimate for sablefish recruitment for the current year.

Model Configuration and Evaluation

Several differences exist between the 2001 assessment and the present one, including differences in the slope and shelf survey data and analysis. We considered a total of six indices of abundance, the same five that were chosen as the 'baseline' model in the 1998 sablefish assessment. These were (1) the AFSC shelf survey biomass estimates, 1980-2004; (2) the AFSC slope survey biomass estimates, 1997, 1999-2001;(3) the NWFSC slope survey biomass estimates, 1998-2004; (4) the NMFS northern pot survey for medium and large size sablefish, 1971-1989; (5) the NMFS south pot survey for medium and large size sablefish, 1984-1991; (6) the logbook CPUE as estimated via a GLM procedure, 1978-1988.

Configuration 1

To provide a link to the 2001 assessment, a model run was made in which all data and model assumptions were kept as identical as possible to the previous assessment. The indices used in this configuration were shelf survey biomass, north pot survey for med-large fish, south pot survey for med-large fish, logbook information from 1977-1988, and the AFSC slope survey, and the NWFSC slope survey. It was felt that this would be a useful tool for evaluating the impact of some of the changes made in the 2000 assessment that did not pertain to the new data.

Configuration 2

This model configuration introduced the use of the environmental covariate on recruitment deviations. Recruitment deviation were fit for 1971-2005, with 2005 being preliminary because of the limited availability of second calendar quarter sea level data.

Configuration 3

This model configuration introduced the use of historical landings data back to the year 1900. Actual recorded landings were available starting around 1915. From the 1900 to 1914 landings were linearly ramped up to match the 1915 level. No environmental covariate was used to estimate recruitment deviations.

Configuration 4

These configurations is considered the base model for the assessment. It uses the longer time series of catches (1900-2005) and estimates recruitment deviations for 1925-2005. As with the previous runs, all prior parameter values were given a uniform (least informative) distribution.

Tables 10 and 11 present information for these simulation runs. Table 10 breaks out the Log-Likelihood (LL) estimates for the thirteen model component structures. Table 11 provides annual estimates of the main variables for the base run (Configuration 4), starting with the equilibrium virgin state.

Selectivity Fits

The fit of the various fishery and survey age and length based selectivities are shown in Figure 27-29. Deviation graphs show how the various fisheries have changed their fishing patterns, either by geographical movement or changes in gear. Overall, we are more satisfied with this method then by the previously used one in which years were 'blocked' and parameters estimated separately within each block. Worth noting is the annual change in age-1 selectivity. By allowing this parameter to change annually we hoped to capture the annual variation in location of age-1 fish. While the resulting parameter estimates certainly suggest a change in location (under the assumption that the survey was constant year-to-year), it is not yet clear whether or not we truly captured the biological phenomenah.

Fits to indices

Observed and expected values of biomass for the five indices considered for model configuration 4 are shown in Figures 30-33. It was necessary to deal with a trade-off between fitting either the 2001 shelf survey biomass or the 2001 shelf survey length composition. This is likely due to the parameterization of the age-based selectivity of the survey. More specifically, the descending limb of the curve which is critical to fitting the older ages in the observed lengths. We performed a profile analysis on these data points to compare model performance (see below).

The stock recruitment parameter relating sea level to recruitment deviations was, as expected, indicative of a satisfactory agreement between the two variables (-0.359). Figure 34 shows the relation between the sea level index and recruitment deviations. Recruitment deviations from 1925 to 1973 were driven nearly entirely by sea level data. This is because there was no other data within the model with a strong enough signal to alter the fit. If we assume the same relation observed from 1974 to 2003 held true previous to this period, we can see that perhaps two periods of productivity took place. Our sea level index showed an approximate 30 year cycle of high sea level from 1925-1960 (low sablefish productivity) and lower sea level from 1961 more recent (high sablefish productivity). This leads to two possible conclusions: (1) that steepness for sablefish has changed over the last 100 years and is specific to the current environmental conditions, or (2) that a stock can indeed persist with fishing mortality if environmental conditions are such as to increase survivorship with enough frequency and magnitude.

Profile Analysis

To better understand the trade-off between fitting the 2001 shelf survey biomass and the 2001 shelf survey length compositions, we took the approach of profiling on sample size of the length compositions, ranging from 0-200, to see how results were effected (Figure 35). Total likelihood of the model increased as the sample size on the length composition was increased. While the level of depletion only ranged from 25.5% to 27.5%, the ending year biomass ranged from 86,753 mt to 96,069 mt. So while the sample size on length compositions did not change the current status of the stock to any great degree, it would have a meaningful influence on setting ABC. It was not clear which piece of data was "more correct", or how to compare the variance between the two data. We took an *ad hoc* approach to this discrepancy and increased the sample size on the length compositions until both the biomass and the length compositions were fit equally well (by subjective examination). We settled on a sample size of 10 fo r the length compositions. We are fully aware of the lack of objectivity in this method, but were satisfied with the result given the time frame of the assessment.

The two parameters that contribute most to the estimate of absolute stock biomass are the virgin recruit multiplier and the catchability coefficient (*Q*) of the slope survey. The 1994 assessment (Methot 1994), profiled on the virgin recruit multiplier and the 1998 assessment (NMFS/STAT 1998) profiled on *Q*. These works demonstrated the dependence of the estimate of current biomass on the estimates of the virgin recruit multiplier and Q. In this assessment we did joint profiles on both the virgin recruit multiplier and *Q*. Values of virgin recruit multiplier were held constant at levels 0.2, 0.6, 1.0, 1.4, and 1.8 while *Q* was held constant at levels 0.4, 0.8, 1.2, 1.6, and 2.0. These combinations resulted in a total 25 model fits. Likelihood values for selected indices as well as total likelihood were then plotted as isopleths to determine the shape of the likelihood surface as well as to determine the 'direction' that each of the indices were driving the overall estimate of biomass (Figure 36). The vertical nature of the isopleths suggest that the current depletion level of the stock is more sensitive to changes to *Q* than to changes in virgin recruitment. This is true until the recruitment multiplier reaches either high (>1.75) or low (<0.9) extremes.

To further investigate *Q*, we did a separate profile analysis on *Q* alone (Figure 37). The resulting response surface was somewhat flat, indicating that nearly as low of a likelihood could be found for a range of *Q*'s from 0.3 - 0.6.

Given the importance, as well as the elusive nature of the *Q* parameter, a separate profile analysis was conducted on *Q* alone with total likelihood as the response variable. The best fit estimate of *Q* decreased from an estimate of 0.60 in 2001 to an estimate of 0.46 in 2002, to an estimate of 0.37 this assessment . This resulted in approximately an 26% increase in the estimate of spawning stock biomass. It should be noted that the profile surface is quite flat. For example, between the 2002 values of *Q* = 0.30 and 0.60 there is less than a 2 likelihood units difference between the total likelihoods. However, in the last update in 2001, this range of *Q*'s only differed in likelihood by 1 unit. If we bracket around this range for *Q* (0.3-0.6) we can see that the resulting depletion level ranges from approximately 17-30 percent.

We also profiled on the stock-recruitment steepness parameter (Figure 38). The baseline run has an estimated steepness of 0.20, which is highly unlikely given the long history of exploitation. This low steepness dictates that, in order to reconcile the size of the catches, a large amount of biomass must have been present at the beginning of the time period (virgin level). Since the virgin biomass determines the current level of depletion, low steepness estimates drive down the current level of depletion. Higher steepness values, by increasing the overall productivity of the stock, do not require such large virgin stock sizes and consequently tend to increase the current depletion level. Even a slight increase in the assumed steepness value increased the current estimate of depletion.

Because steepness is such a critical value, we felt it necessary to compare spawning biomass trends across an array of steepness values. In the 2000 assessment, steepness was also estimated at the lower bound of 0.20. Because it is highly unlikely that the historic fishery could persist for so long with such a steepness, both STAT teams fixed the steepness at 0.40 for fits and projections. To compare the latest assessment results to previous results, we ran the model at various steepness values to see how they compared. Higher steepness means a more productive stock, so as steepness was increased the level of virgin biomass necessary to sustain the current catches decreased and the current estimates of spawning stock biomass increased (Figure 39).

This resulted in increased estimates of current depletion levels. We also allowed the model to estimate natural mortality to see it's effect on steepness. When allowed to be estimated with no informative priors, natural mortality was estimated at approximately 0.05, not very different from the fixed value of 0.07. However, the resulting ending biomass increased from approximately 88.8k to 128.5k, with a change in likelihood from 1899 (fixed M) to 1893 (estimate M).

Population Trends

The sablefish stock of the west coast has seemingly trended downward since the fishery began (Figure 40). However, this conclusion is highly dependent on the estimated steepness of the stock-recruitment function. If the productivity of the stock is low and steepness is in fact near 0.20 then the fishery is merely "mining" a large stock of fish at a rate that cannot continue in the future. The estimated depletion level for the base model was 0.257 percent. However, if steepness is even no higher than 0.3 then the current status of the stock is much more positive, with a depletion of 0.42 percent. Nonetheless, the estimate of steepness at 0.20, although at the lower bound, is still the best estimate generated by the model. If natural mortality is allowed to be estimated, the steepness increases to 0.24, and the current depletion level is estimated at 38.5 percent.

Indications from the 2004 shelf survey and the 2002-2004 Shoreside Hake Observer Program data are that recruitment strengths for 2001-2003 are below average. Further more, the sea level index used here was above average for 2004, indicating less than average year class strength for 2004 as well. The only sea level data available for 2005 to include in the recruitment index are the months April-May, which are above average (Figure 41), again suggesting poor recruitment.

RECOMMENDATIONS

As indicated earlier, the most critical need is to determine the current level of absolute population abundance of sablefish. Quantitative assessment of the sablefish resource is hindered by a lack of consistent fishery-independent (e.g., research surveys) and fishery dependent (e.g., commercial fishery samples) data collected over time. Significant improvements in the assessments will require concerted efforts by all parties involved in marine fisheries on the U.S. Pacific coast, including commercial fishers, fish processors, fishery scientists, and fishery managers.

1. Abundance surveys: The "combination" survey presently conducted by the NWFSC should be continued on an annual basis. It is critical that survey procedures, including number and types of vessels used, remain constant year-to-year to minimize variation. Fixed gear surveys (such as pots and/or longline gear) should be used in studies that target non-trawlable habitat to test the assumption that sablefish densities are similar in and out of standard trawl survey areas. The usefulness of ichthyoplankton surveys as indices of spawning stock biomass should also be evaluated.

2. Gear catchability evaluations: Lack of information regarding the catchability (*Q*) of the slope trawl survey gear precludes straightforward interpretation of these fishery-independent data. Survey experiments are needed to: (1) better understand the dynamics of this survey gear; (2) substantiate or refute hypothesized measures of *Q*; and ultimately, (3) develop scientific-based indices of population abundance that lead to reduced uncertainty in the overall assessments. It is important to note that this research area is also applicable to other survey efforts, including the shelf trawl survey and potential fixed-gear surveys, see (1) above. Experience in areas where surveys have been consistently conducted over several years indicate that survey catchability can vary by "30%, or more, from year to year, which confounds determination of the actual catchability coefficient of a specific survey.

3. Biological sampling of commercial catches: The current operations of the sablefish fishery dictate that a revised port sampling program be adopted. That is, it has become increasingly difficult to collect biological data from the sablefish landings, which has confounded straightforward analysis of these data. Solutions to this problem will most likely require cooperation from all parties, including commercial fishers, fish processors, fishery researchers, and fishery managers.

4. Expanded at-sea observer program data collection: Objective determination of the total harvest of

sablefish, including discard-related catch, has been hindered in the past by the lack of information regarding discard rates for this fishery. While estimated discard are currently being address, sampling should be expanded to cover average lengths, weights, and time on deck so that more precise characterization of discards can be achieved.

5. Develop a study to examine the adequacy and accuracy of incorporating environmental factors into an assessment. Attempt to define the most appropriate methods for examining environmental factors that are external to but may have pronounced influences on the population dynamics (internal feedbacks) of the species and its fishery. How best do we accurately incorporate these external influences into the assessment process?

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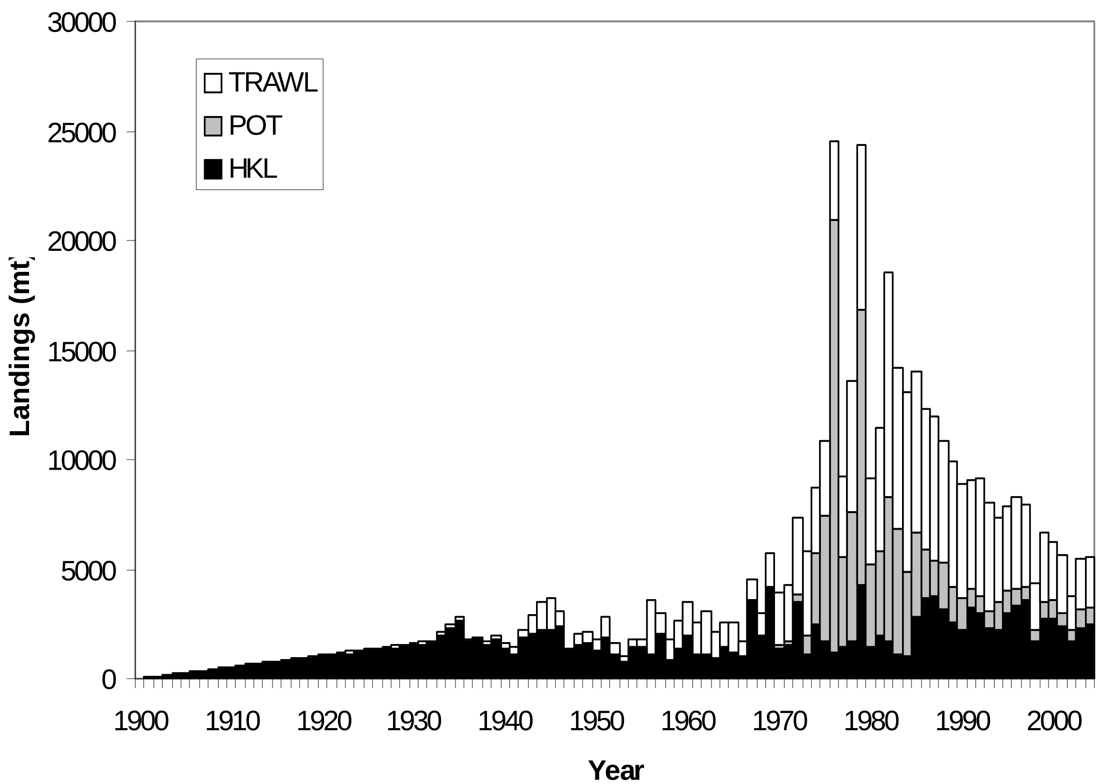


***Figure 1**. Landings, including foreign catch, by year and gear, of west coast sablefish.*

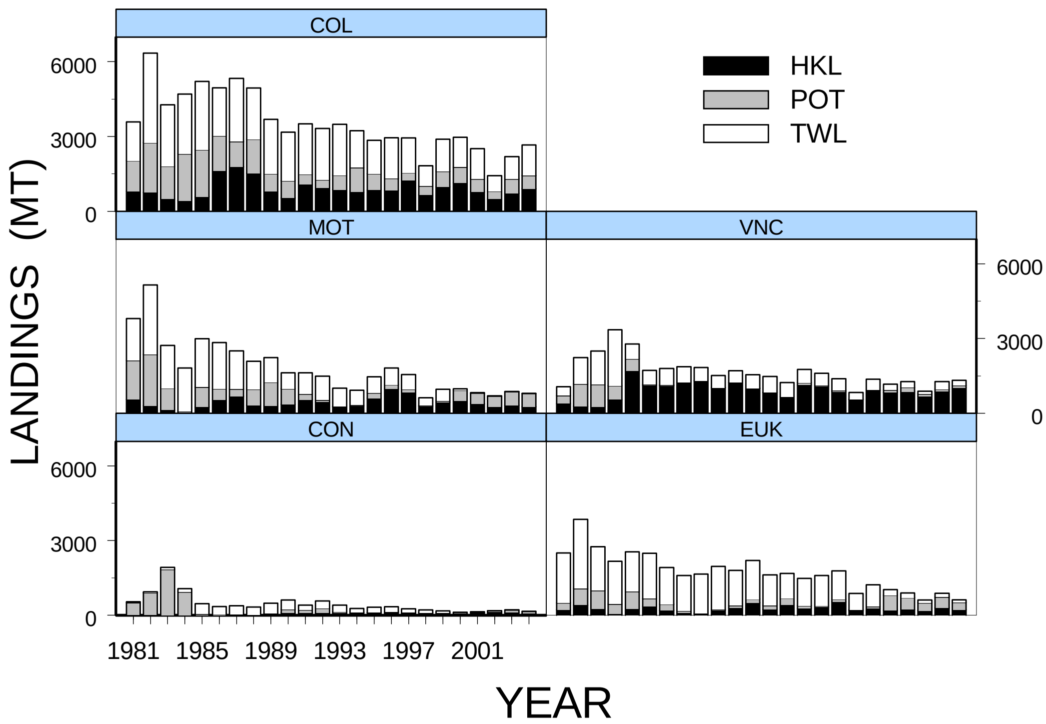


Figure 2. *Landings of west coast sablefish by INPFC area and gear, 1981-2004.*

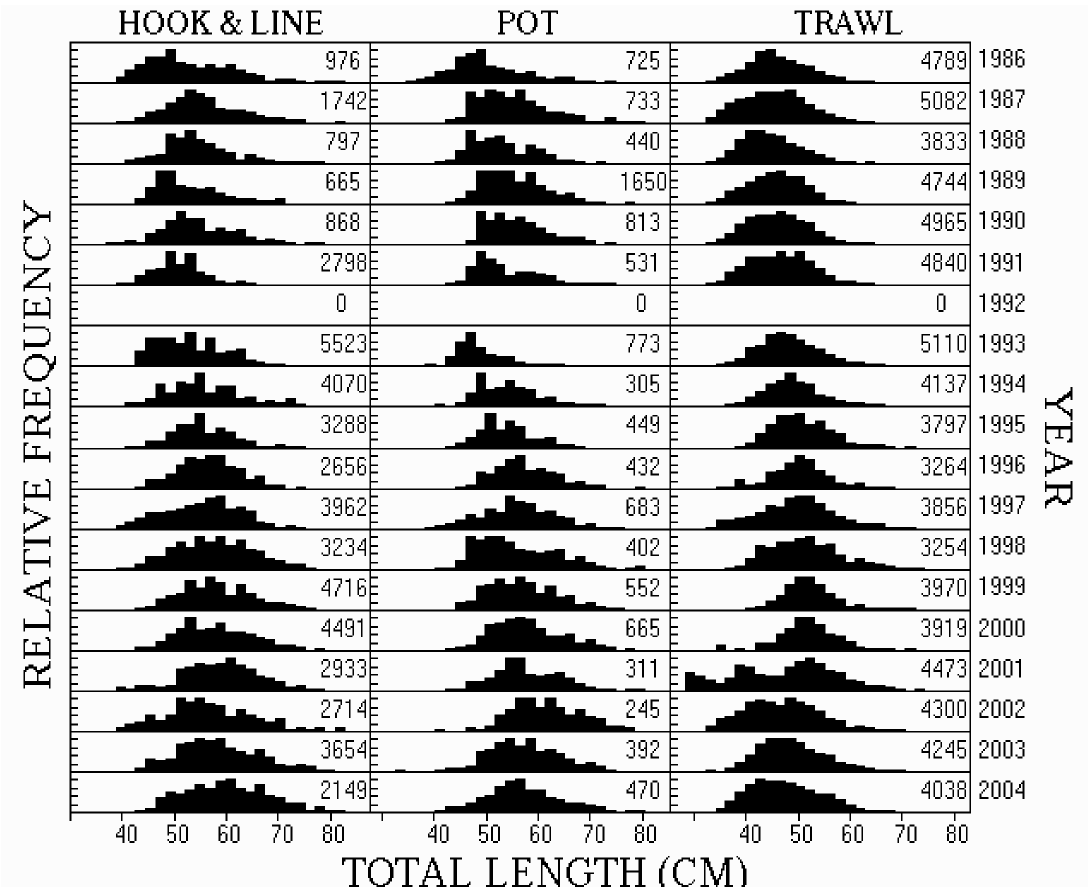


Figure 3. *Length frequencies by gear for female sablefish caught off the U.S. west coast, 1986-2004. Numbers are sizes of both female and male length samples combined.*

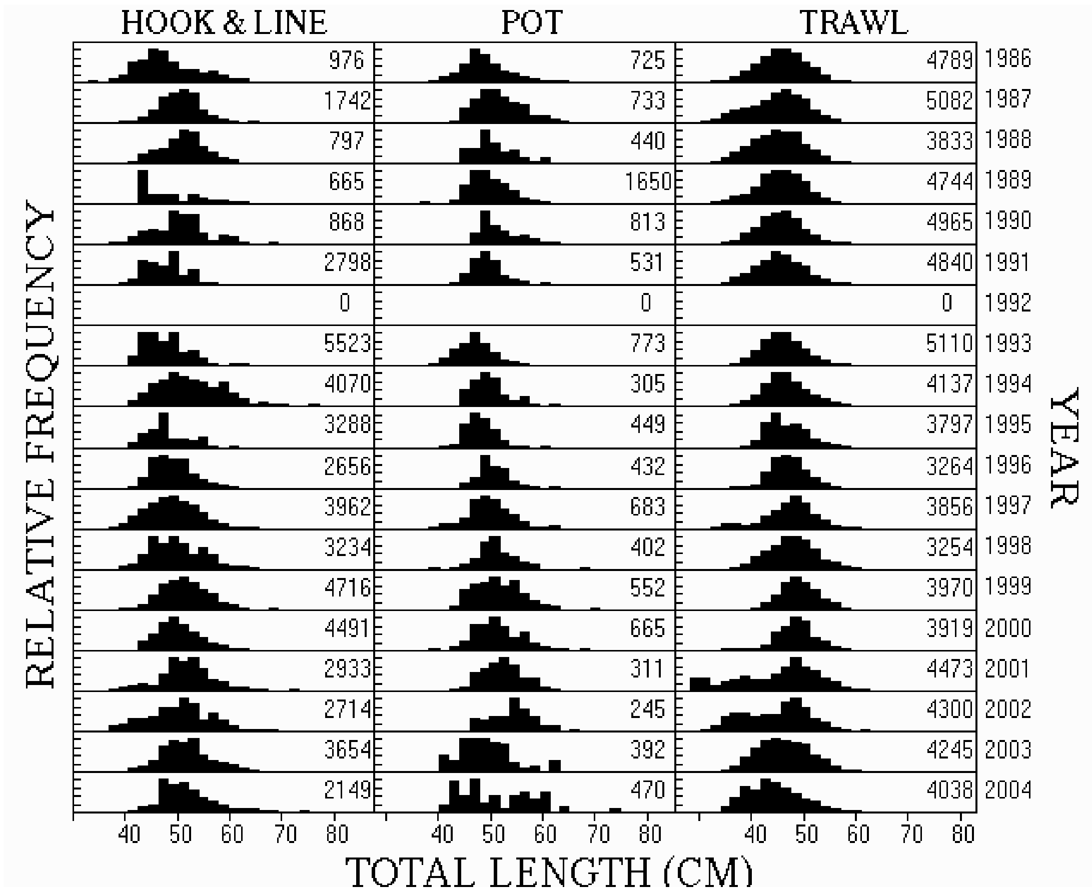


Figure 4. *Length frequencies by gear for male sablefish caught off the U.S. west coast, 1986-2004. Numbers are combined counts of both female and male length samples.*

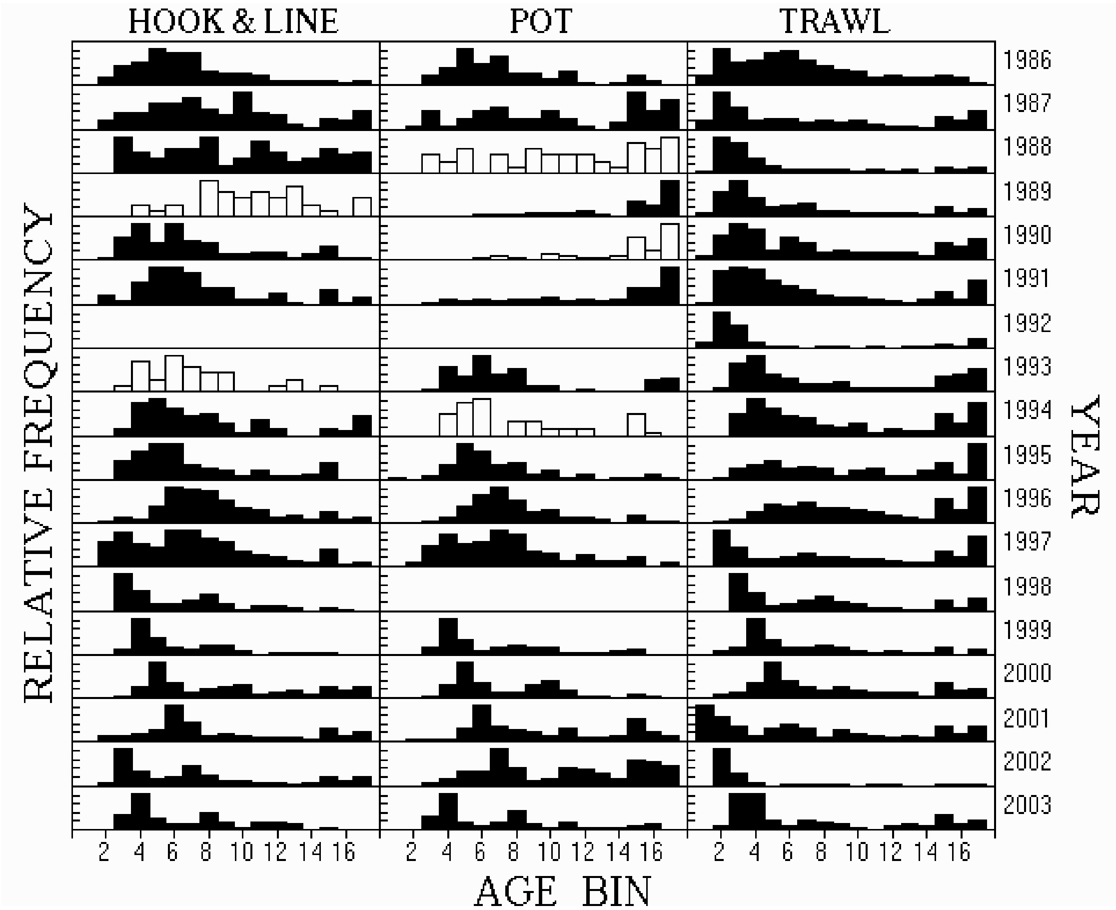


Figure 5. *Age frequencies for female sablefish by gear and year from the U.S. west coast fisheries, 1986-2003. Empty bars are not used in this assessment due to inadequate sample size.*

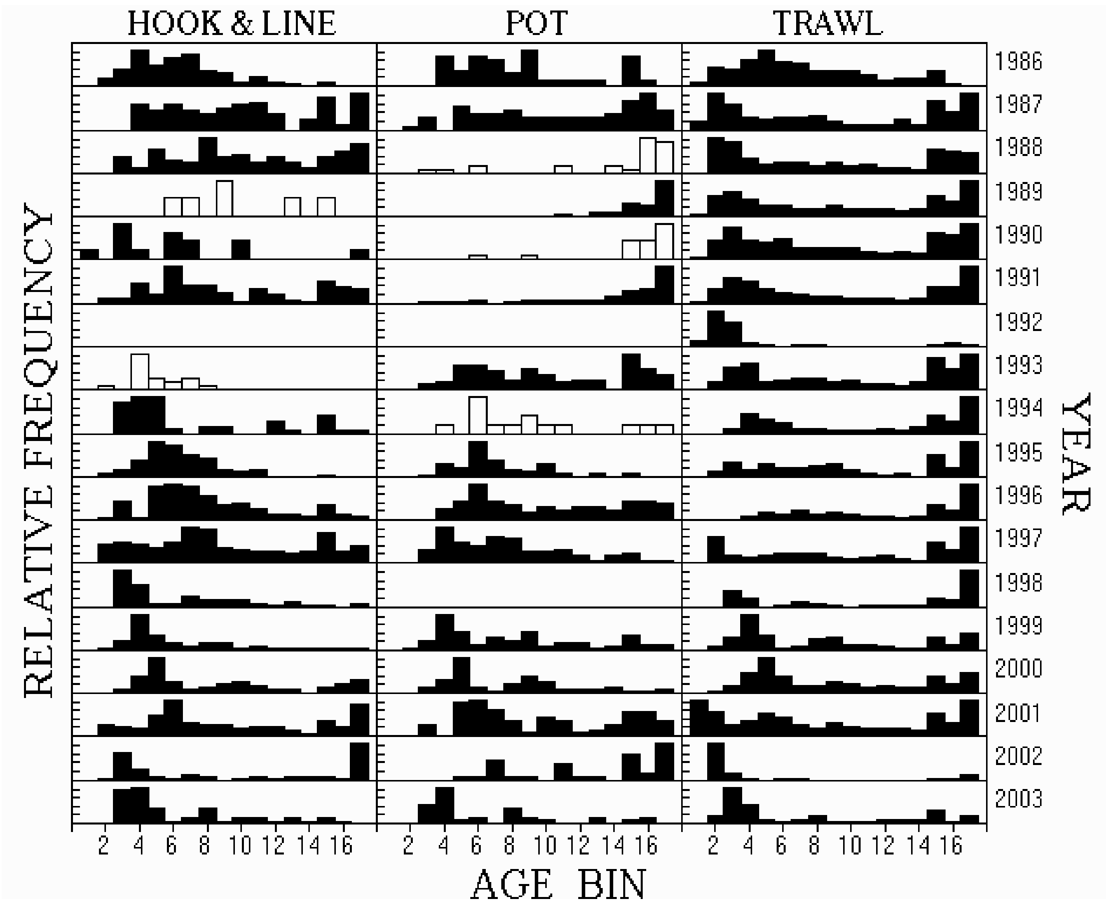
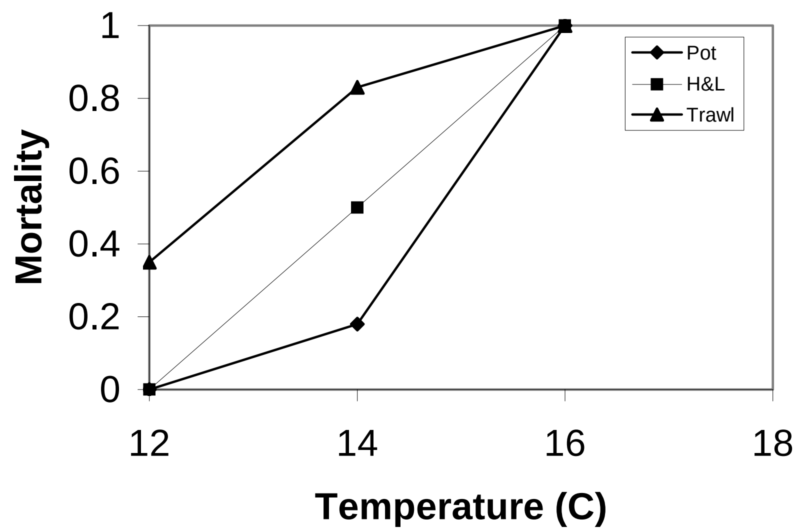


Figure 6. *Age frequencies for male sablefish by gear and year from the U.S. west coast fisheries, 1986-2003. Empty bars are not used in this assessment due to inadequate sample size.*



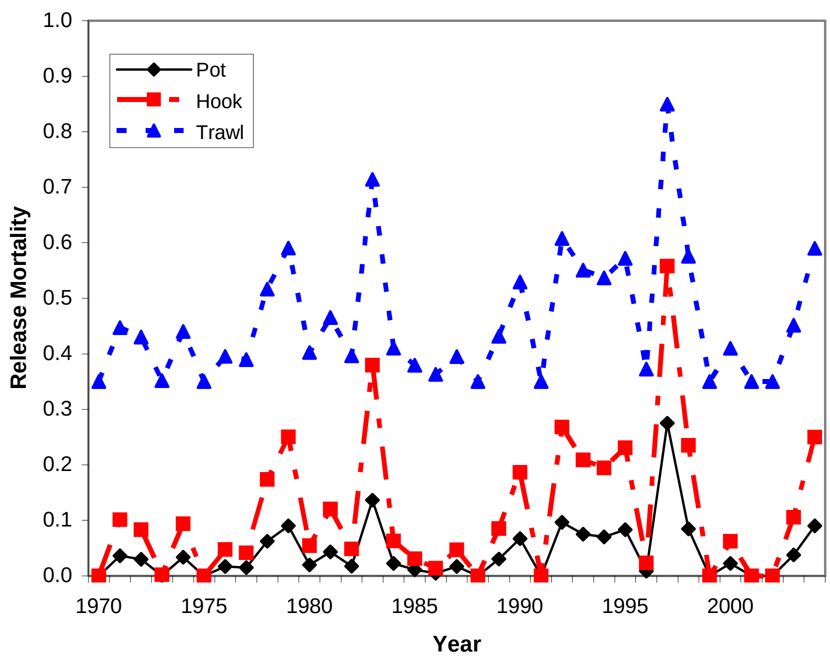


Figure 7. *Mortality rate for sablefish as a function of air temperature for three simulated gear types (upper) , and estimated release mortality based on above functions and sea surface temperature data.*

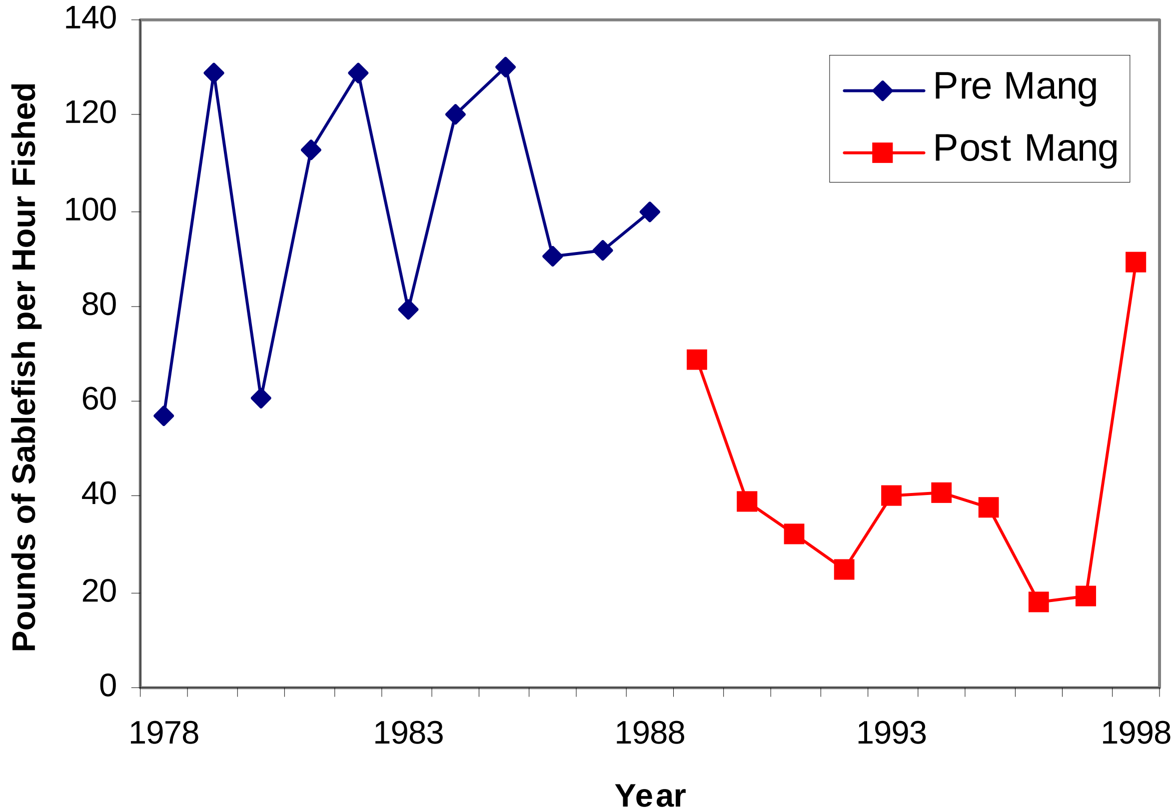


Figure 8. *Estimates of sablefish catch-per-unit-effort (CPUE in lbs/hr) off the U.S. west coast (Monterey to U.S. Vancouver INPFC areas) generated from commercial fisher logbook data collected in Washington, California, and Oregon for two time periods, 1978-88 and 1989-97.*

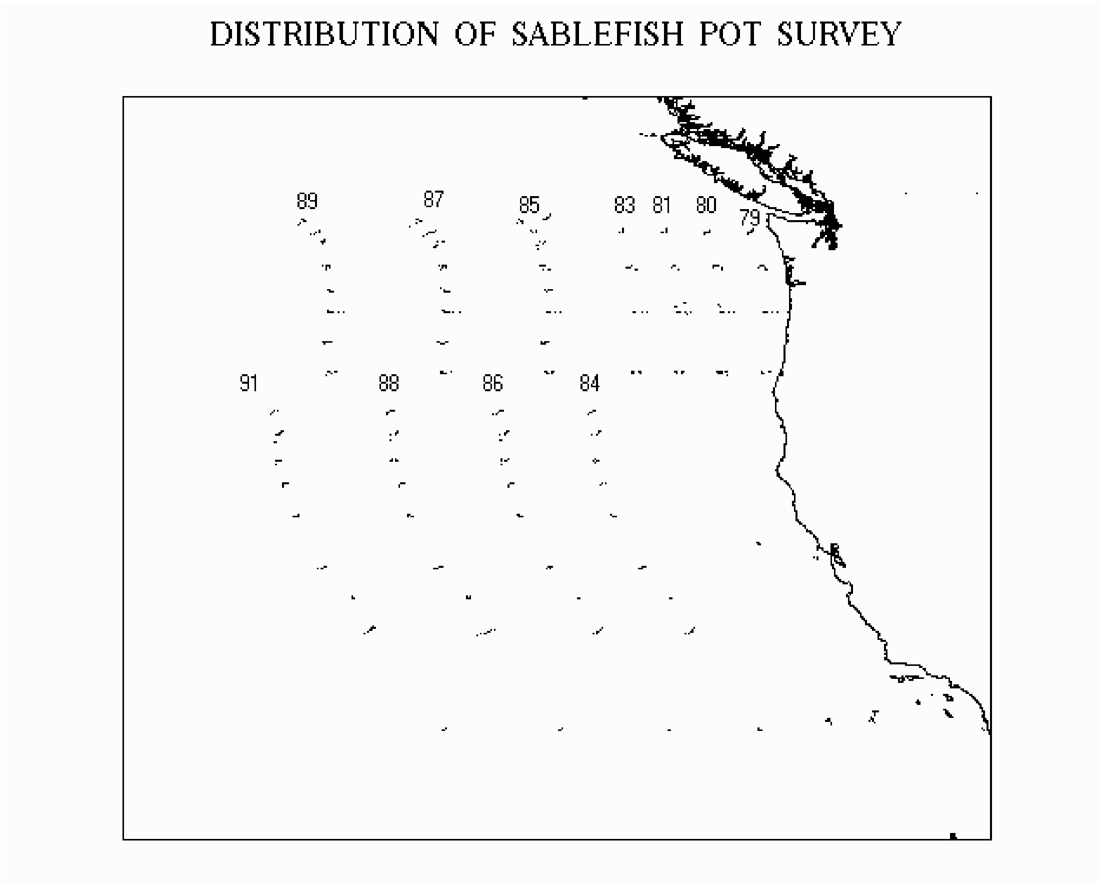


Figure 9. *Latitude of NMFS sablefish pot survey sets, 1979-1991. For clarity these are horizontally spread but all pots were set at depths from 150 to 600 fm (275-1100m) on the slope and shelf break within 100 km of the coast.*

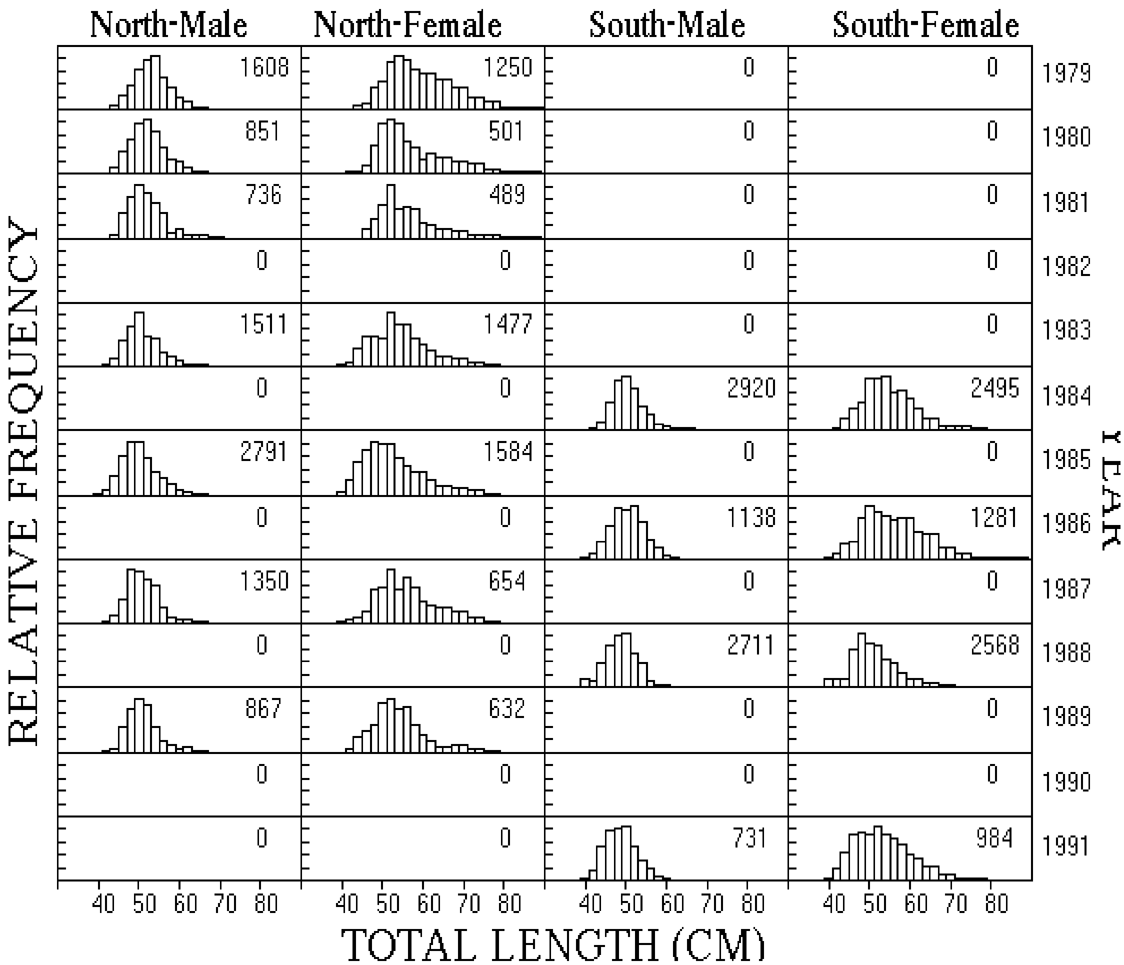


***Figure 10**. Length frequencies of west coast sablefish, by sex and year, caught in the northern (US-Vancouver-Columbia) and southern (Eureka-Monterey) pot surveys, 1979-1991. Number represents sample size of lengths.*

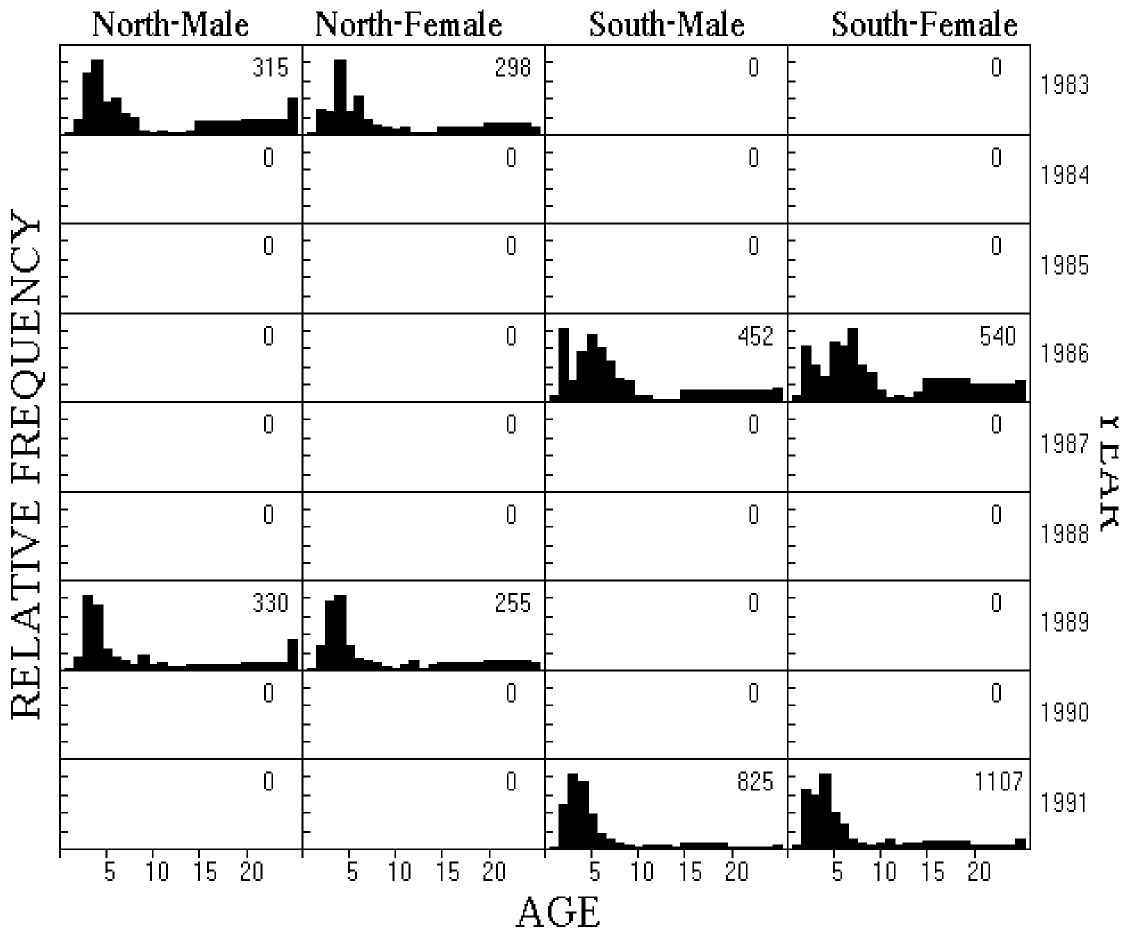


Figure 11. *Age frequencies of west coast sablefish, by sex, location, and year, caught in the northern and southern pot surveys, 1983-1991. Number represents sample size of ages.*

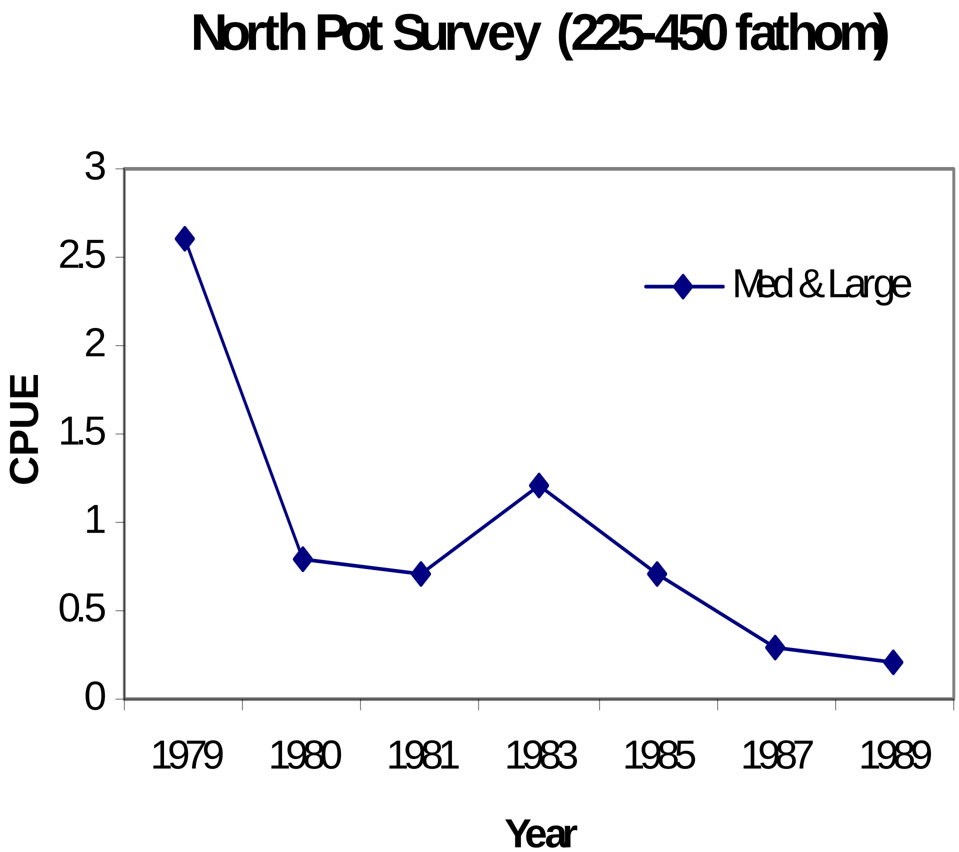


Figure 12*. Estimated west coast sablefish catch-per-unit-effort (mean number/pot) for medium and large fish from the northern pot survey, 1979-1989. Note that years are not consecutive.*

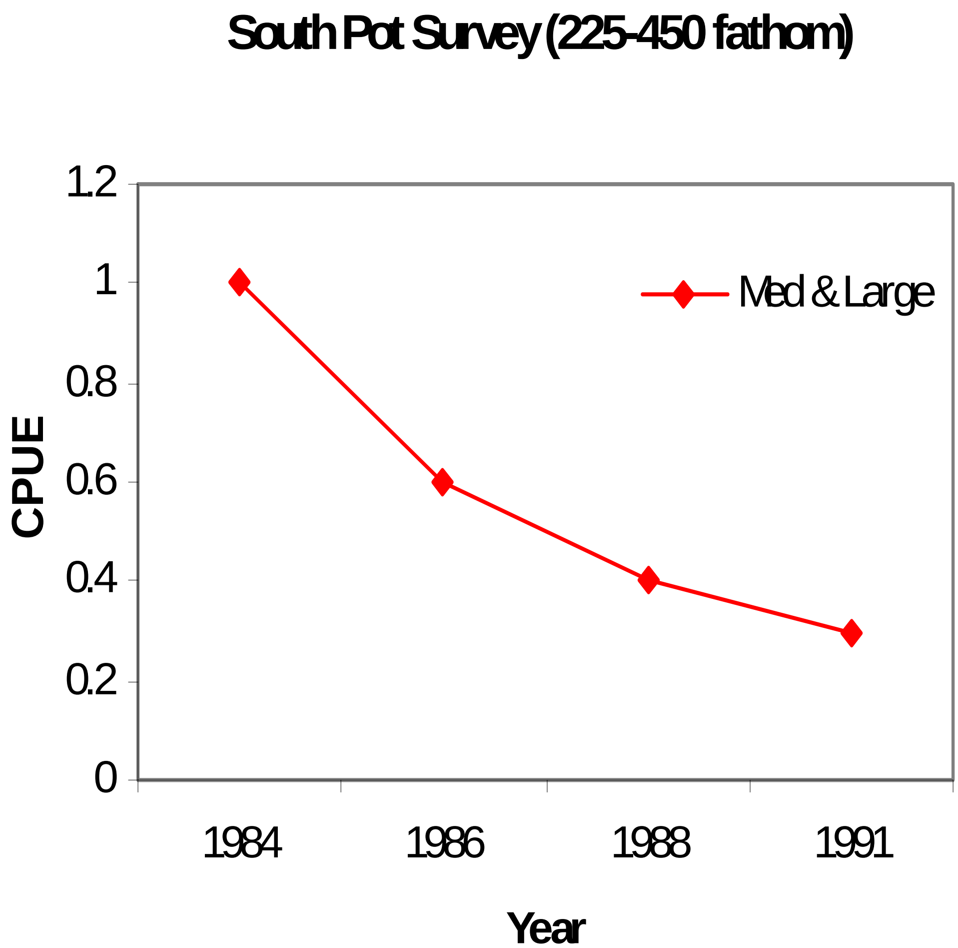


Figure 13. *Estimated west coast sablefish catch-per-unit-effort (mean number/pot) for medium and large fish from the southern pot survey, 1984-1991. Note that years are not consecutive.*

DISTRIBUTION OF ALL AFSC SLOPE SURVEYS

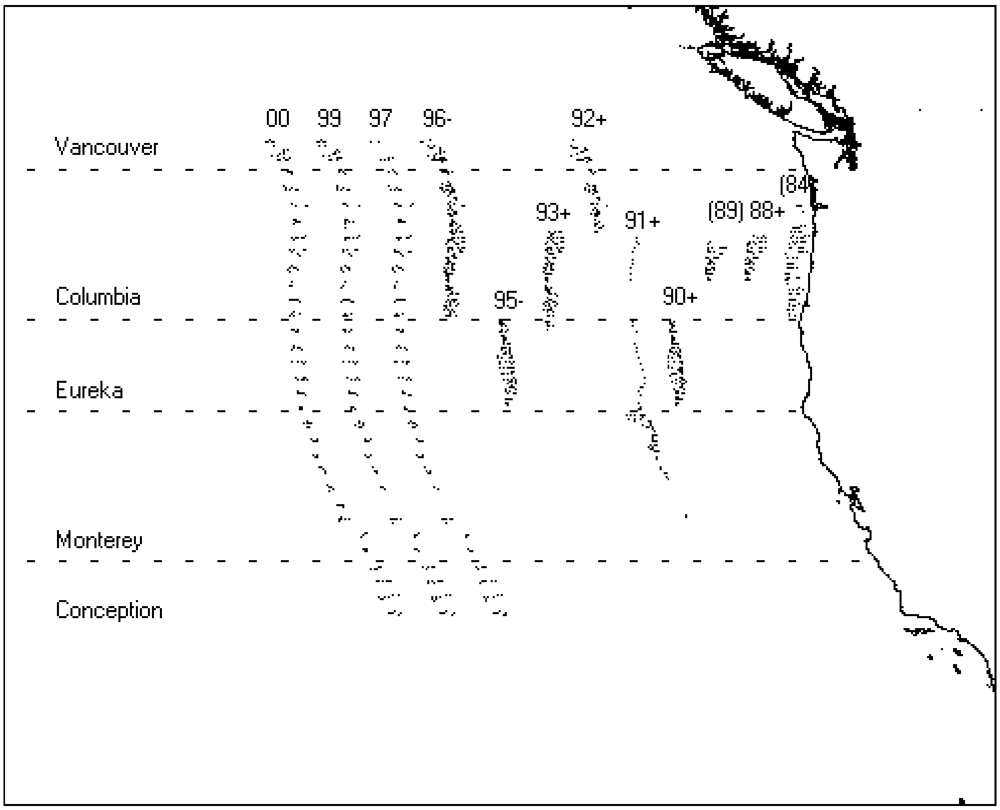


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Figure 14. *Location of AFSC slope survey tows by year and INPFC areas. Years with like symbols were combined to form "super" years; years in parentheses were not considered Year 2001 not shown is similar to 2000. Only years of full coverage were used in model (1997-2001).*

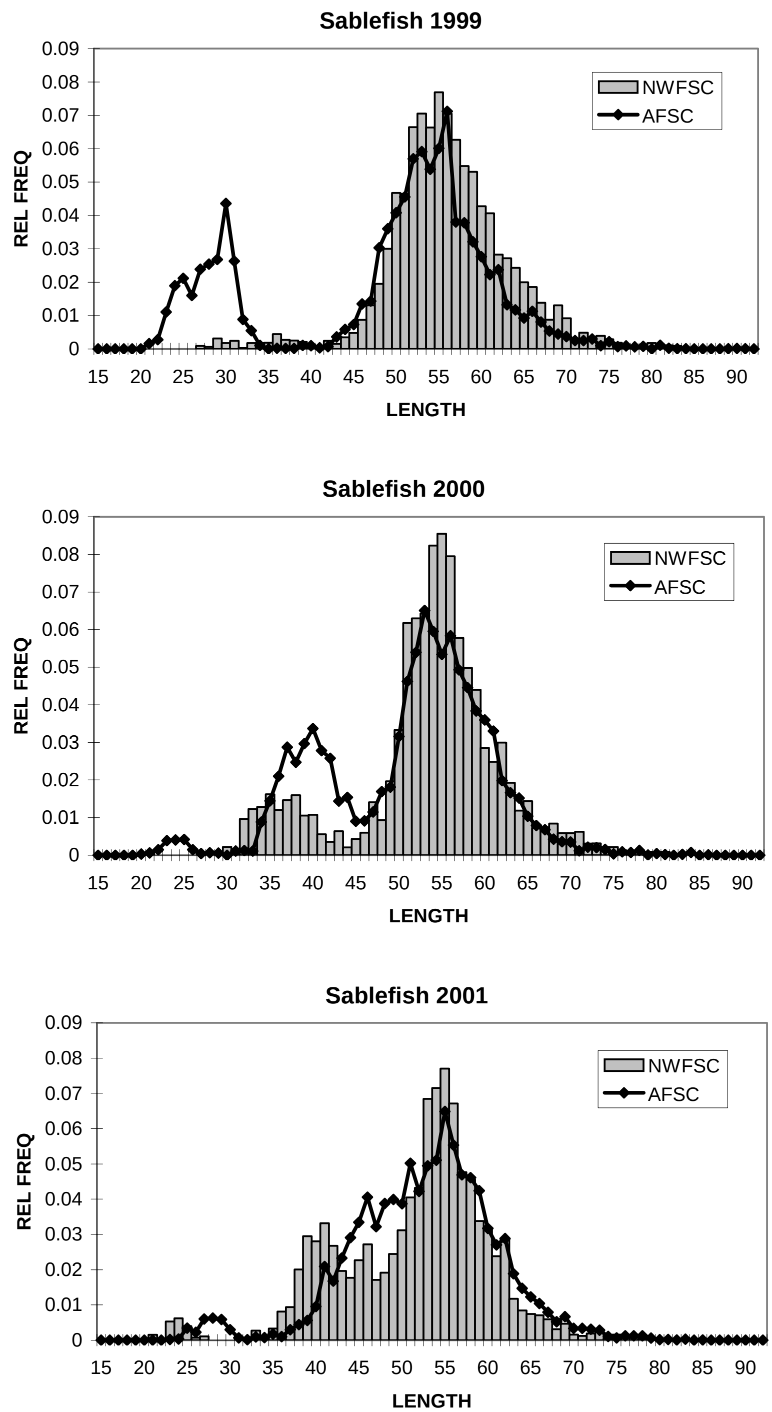

Figure 15*. Length frequency comparison between the AFSC FRV Miller Freeman and the NWFSC Industry Cooperative survey for overlapping years, 1999-2001.*

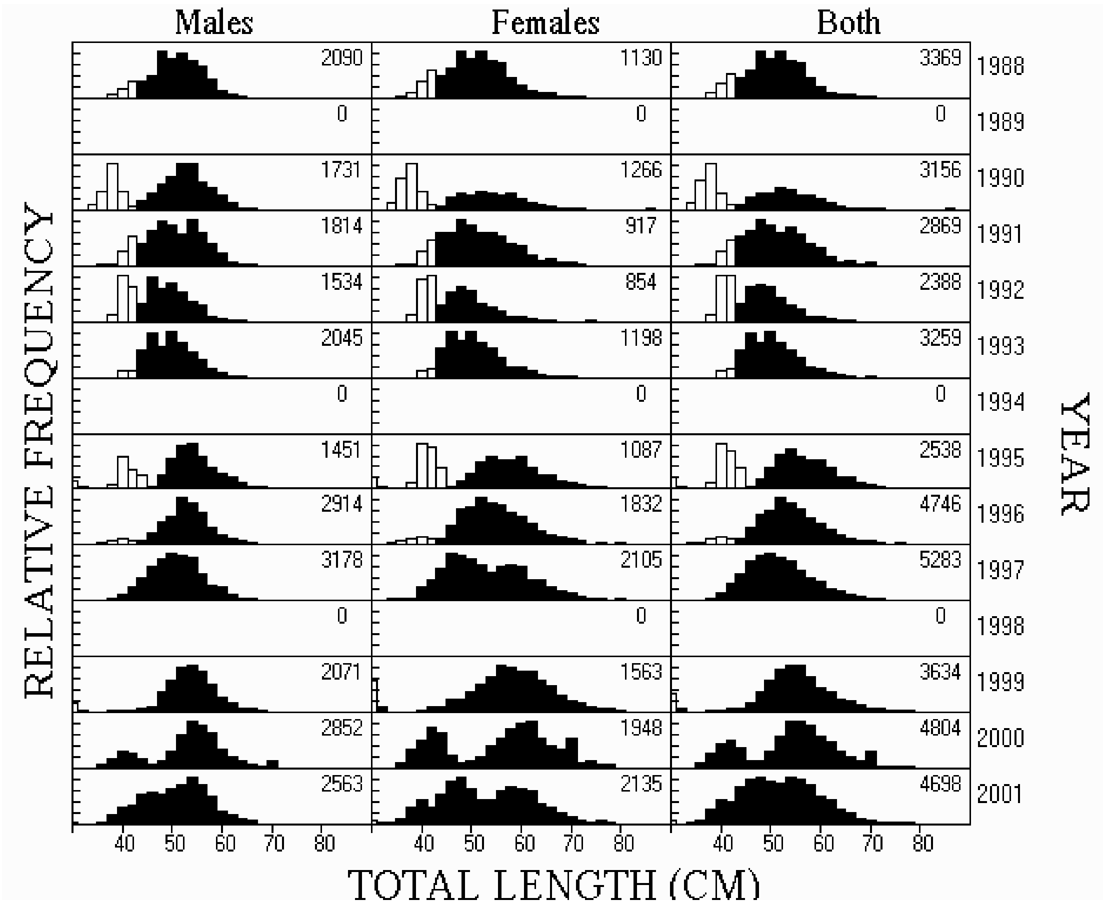

Figure 16. *Length frequencies of west coast sablefish from the AFSC FRV Miller Freeman Slope Survey, 1988-2001. Numbers are sample sizes. Un-shaded (white) bars represent samples < 41cm that were dropped from the analysis.*

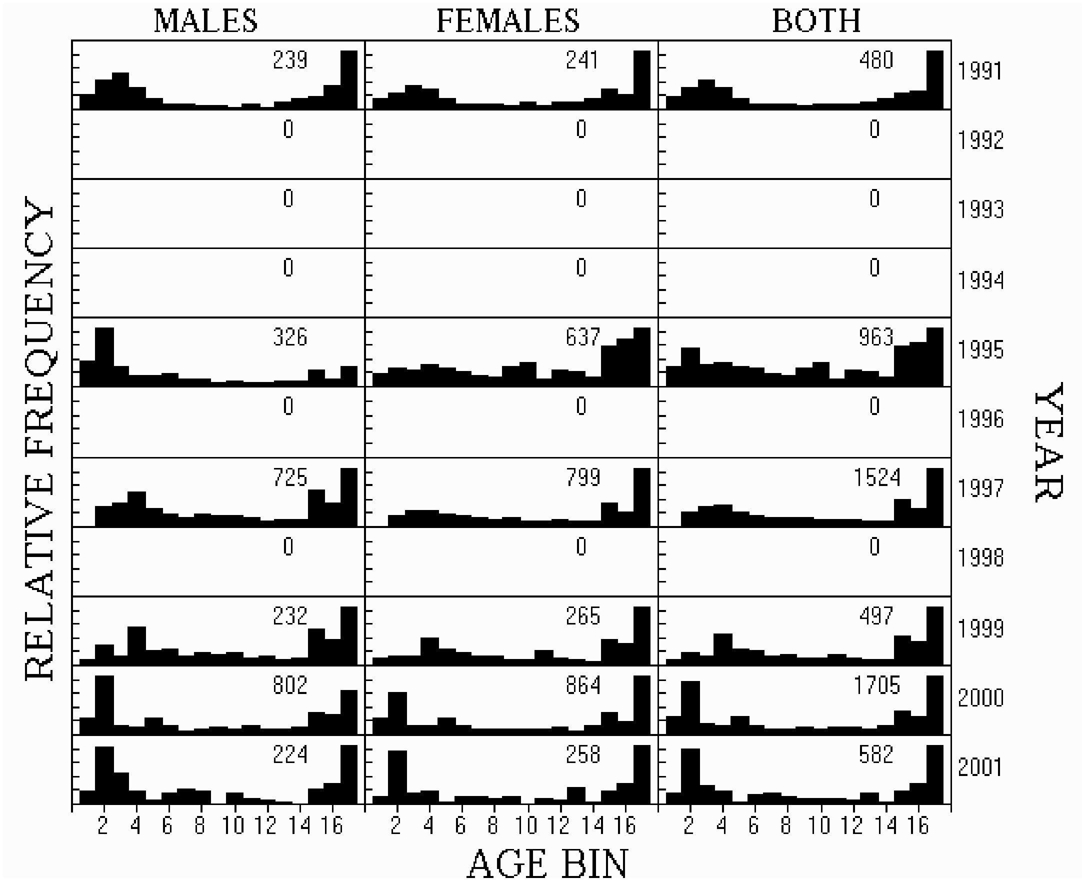

Figure 17. *Age frequencies of west coast sablefish from the AFSC FRV Miller Freeman Slope Survey. Numbers are sample sizes.*

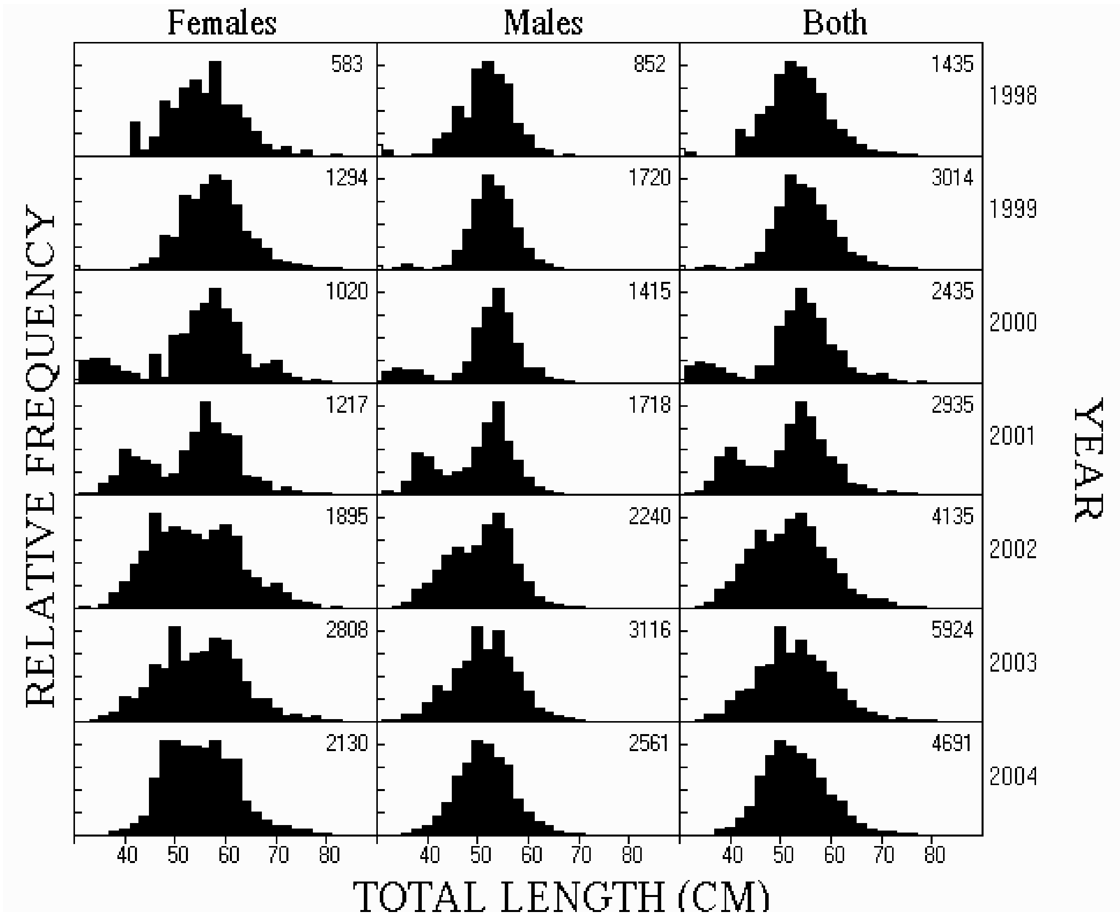

Figure 18. *Length frequency of west coast sablefish caught in the NWRSC Industry Cooperative Slope Survey, 1998-2004. Numbers are sample sizes.*

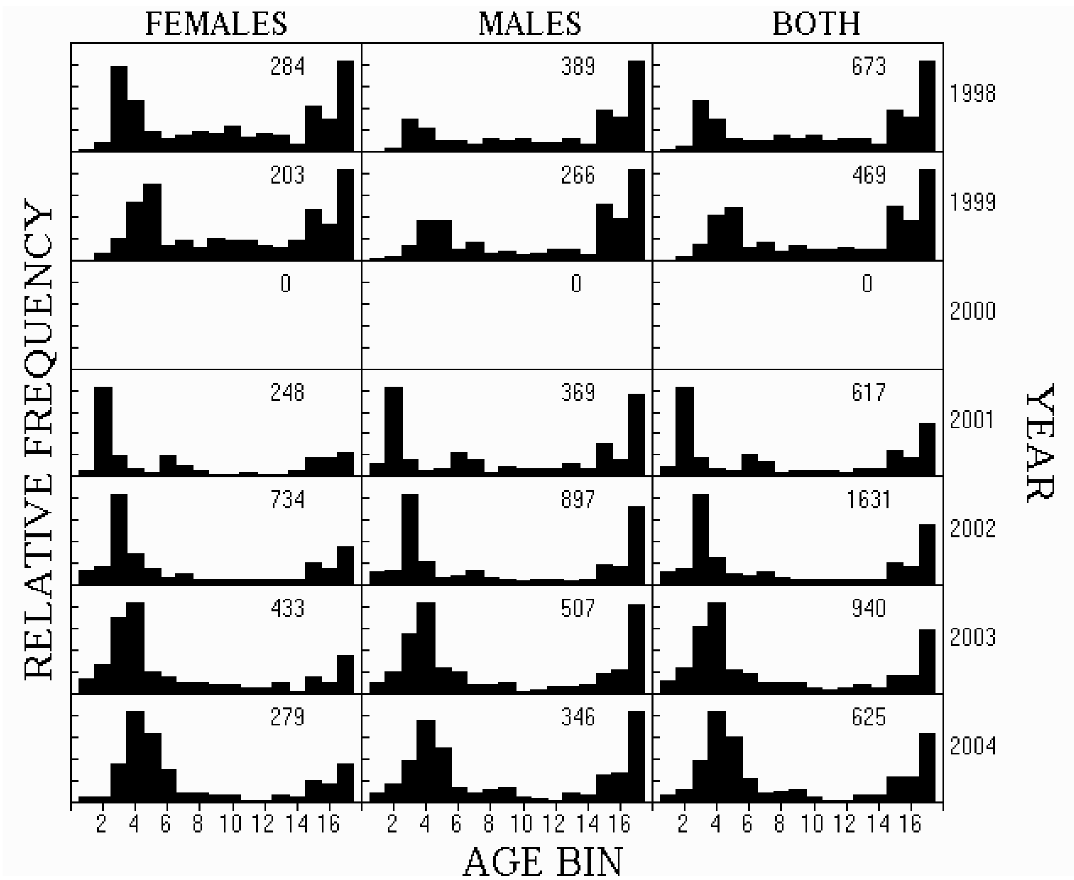

Figure 19. *Age frequencies of west coast sablefish caught in the NWFSC Industry Cooperative Slope Survey, 1998-2004. Numbers are sample sizes.*

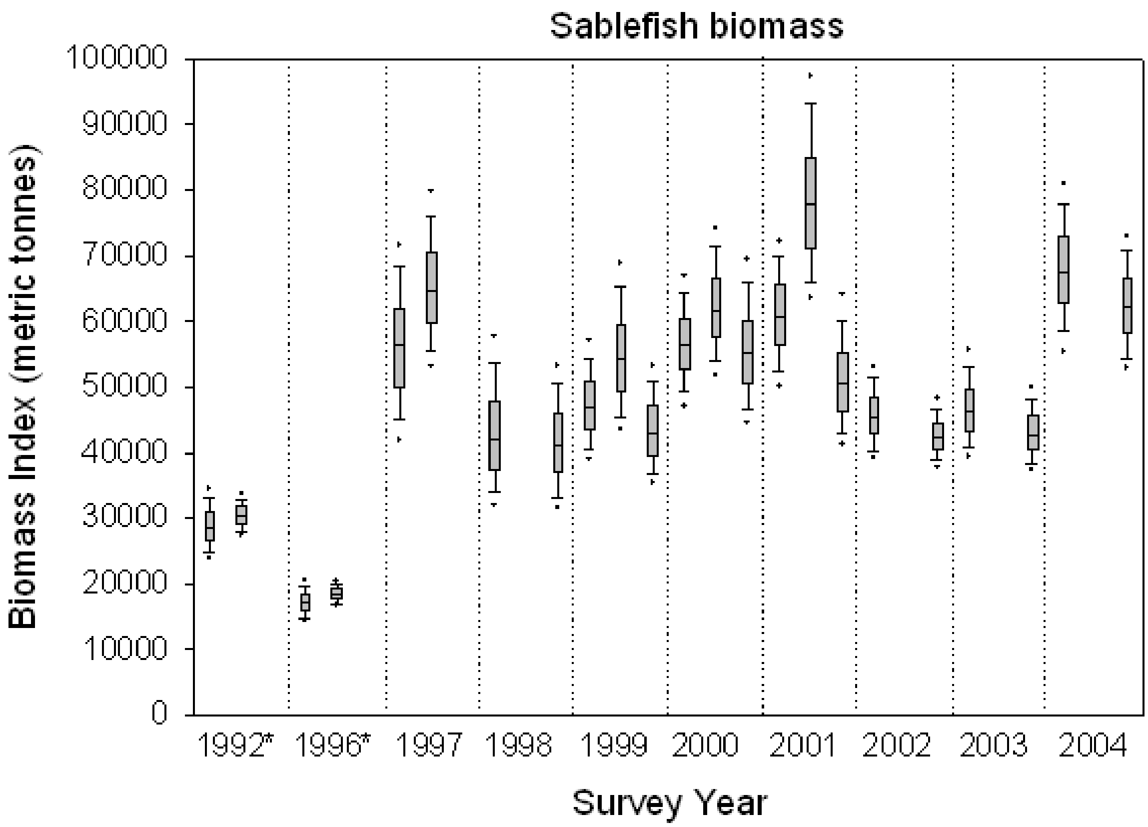

***Figure 20**. Estimates of sablefish biomass from the combined, AFSC FRV Miller Freeman, and NWFSC Industry Cooperative slope surveys from GLM analysis (in that order). Year with stars are "super years".*

DISTRIBUTION OF ALL TRIENNUAL SURVEYS

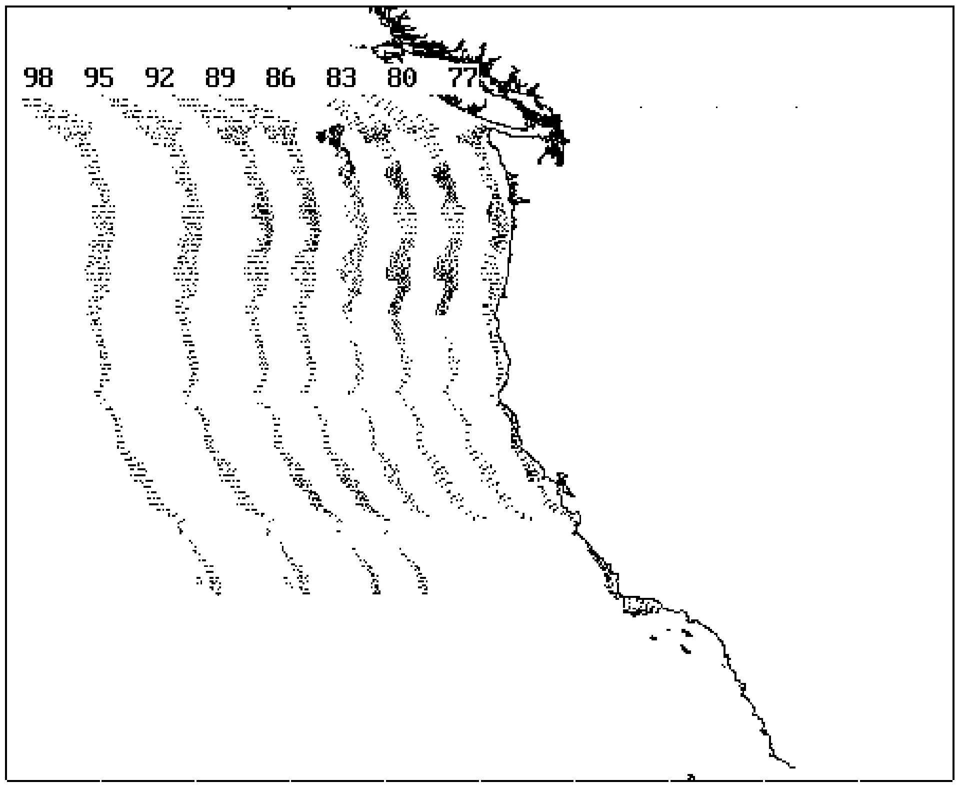

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Figure 21. *Latitude of AFSC Shelf Survey tows by year. Years 2001 and 2004 are similar to 1998.* For clarity, sample years are spread horizontally. All samples were taken from the shelf at distances from the coast paralleling those in 1977.

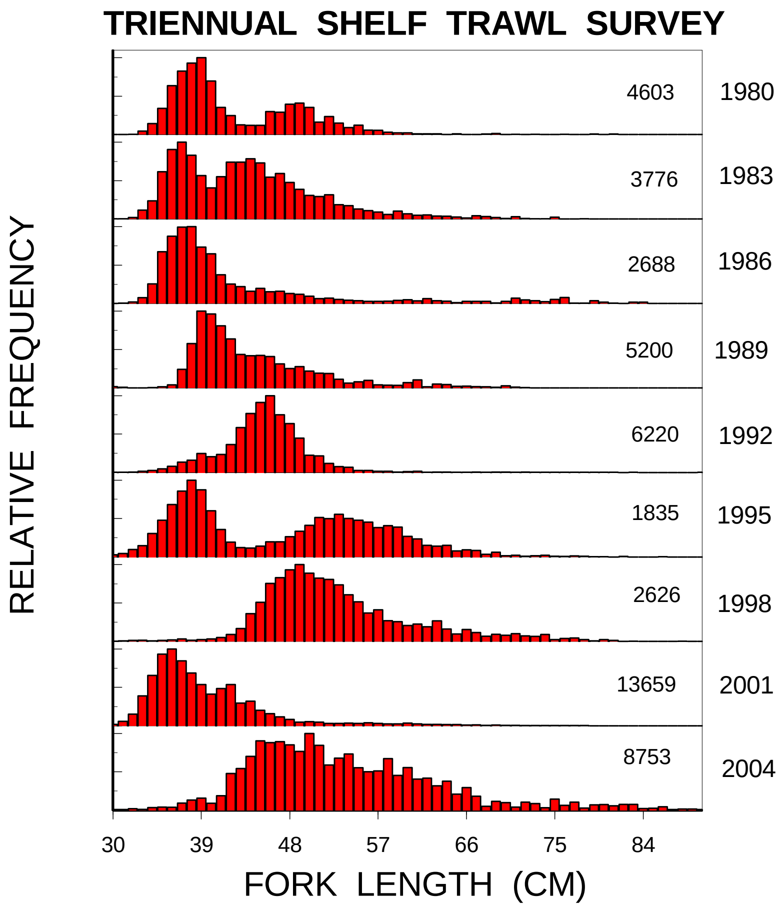

Figure 22. *Length frequency of sablefish caught in the AFSC shelf survey, 1980-2004.*

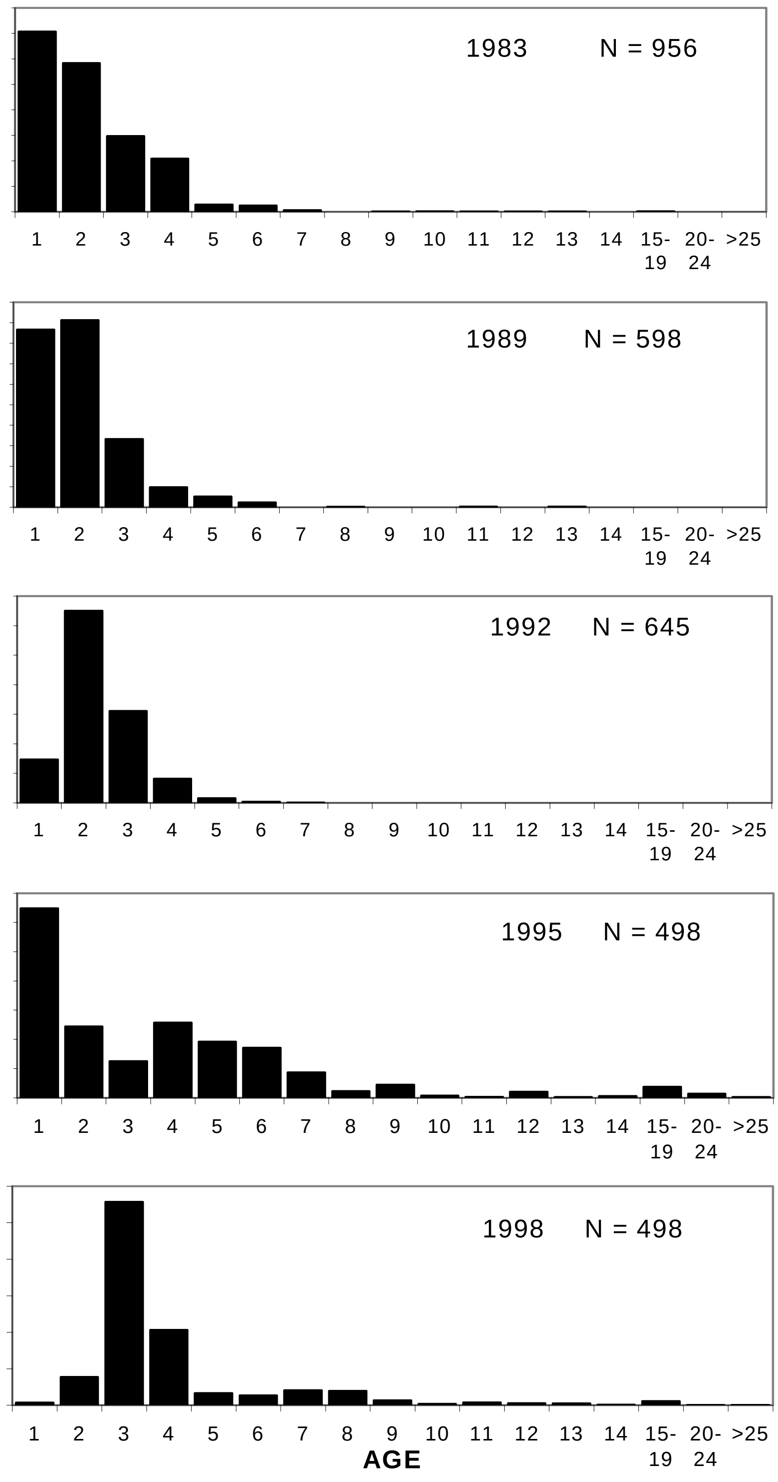

***Figure 23**. Age frequency of sablefish caught from the AFSC shelf survey, 1980-1998.*

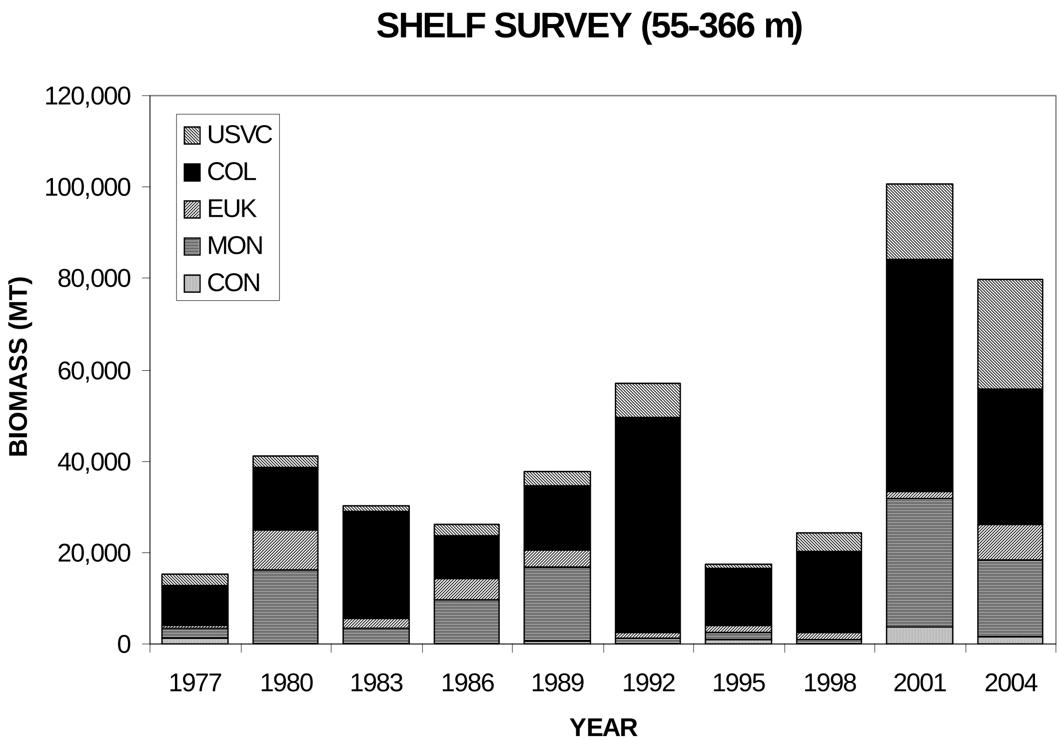

Figure 24. *Estimated biomass of west coast sablefish from AFSC shelf survey, 1980-2004. This plot does not consider "water haul" analysis, as was fit within the assessment model.*

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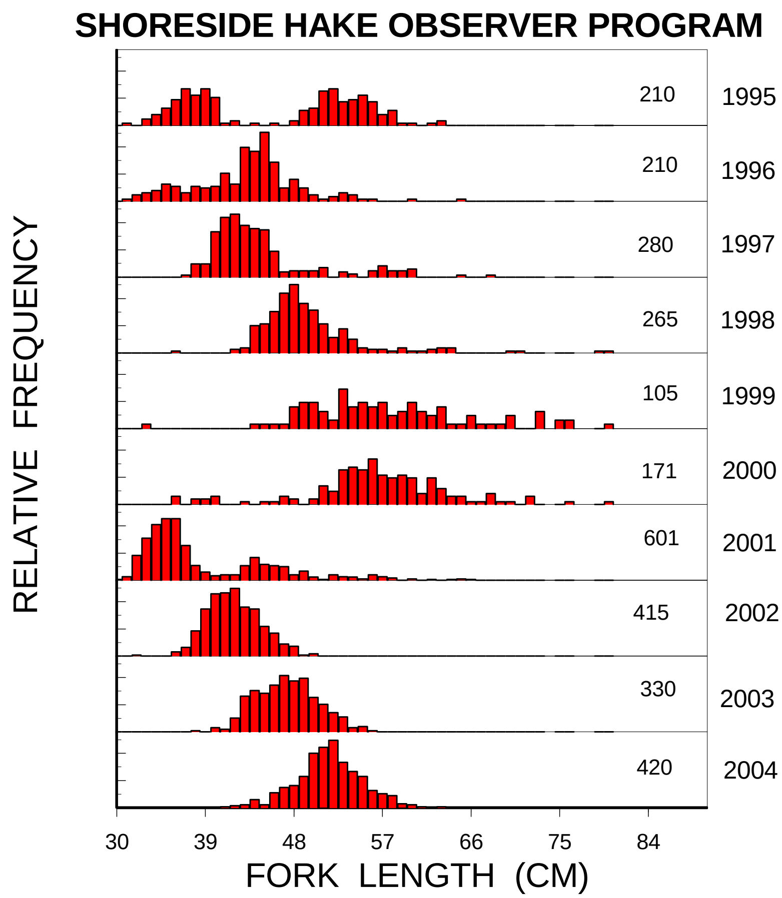

Figure 25. *Length frequency of sablefish caught in the shoreside hake fishery collected from Shoreside Hake Observer Program.*

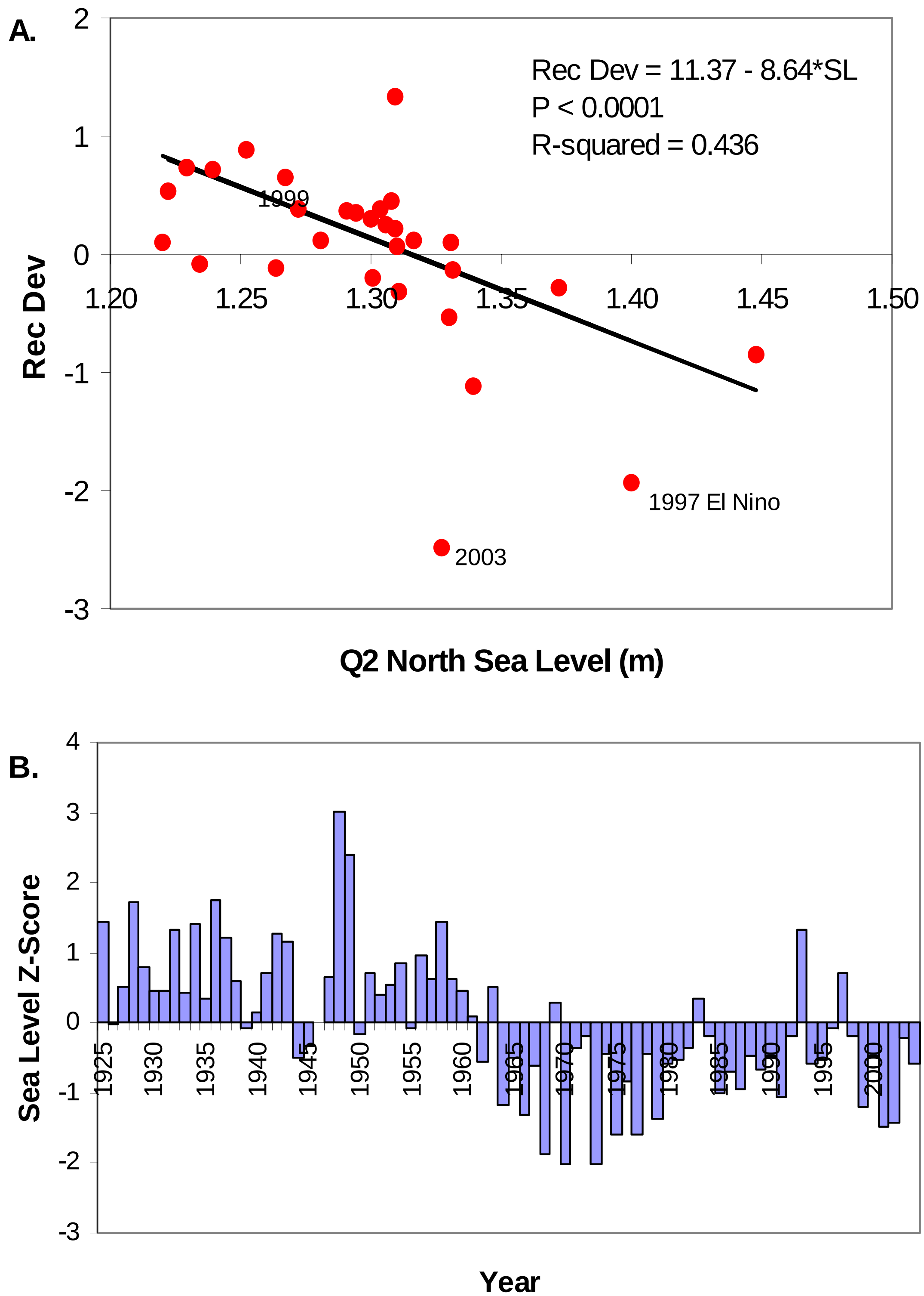

Figure 26. ***A.*** *Relation between average north-coast sea level and recruitment deviations, 1974-2003.* ***B.*** *Z-scores of historical average sea level, 1925-2004.*

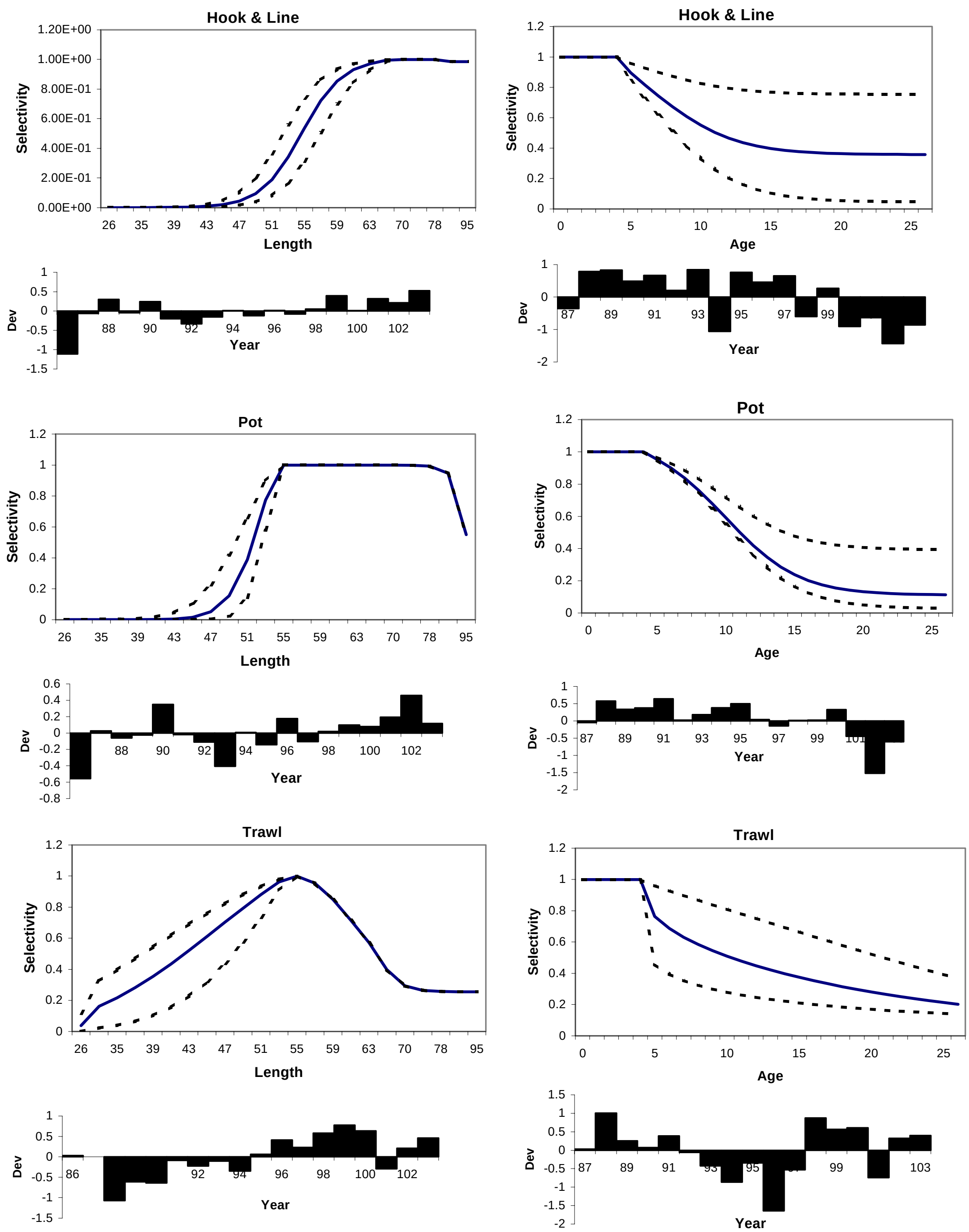

***Figure 27**. Estimated length- and age-based selectivities and annual deviations for commercial sablefish gears. Solid line represents mean and dotted lines the extremes.*

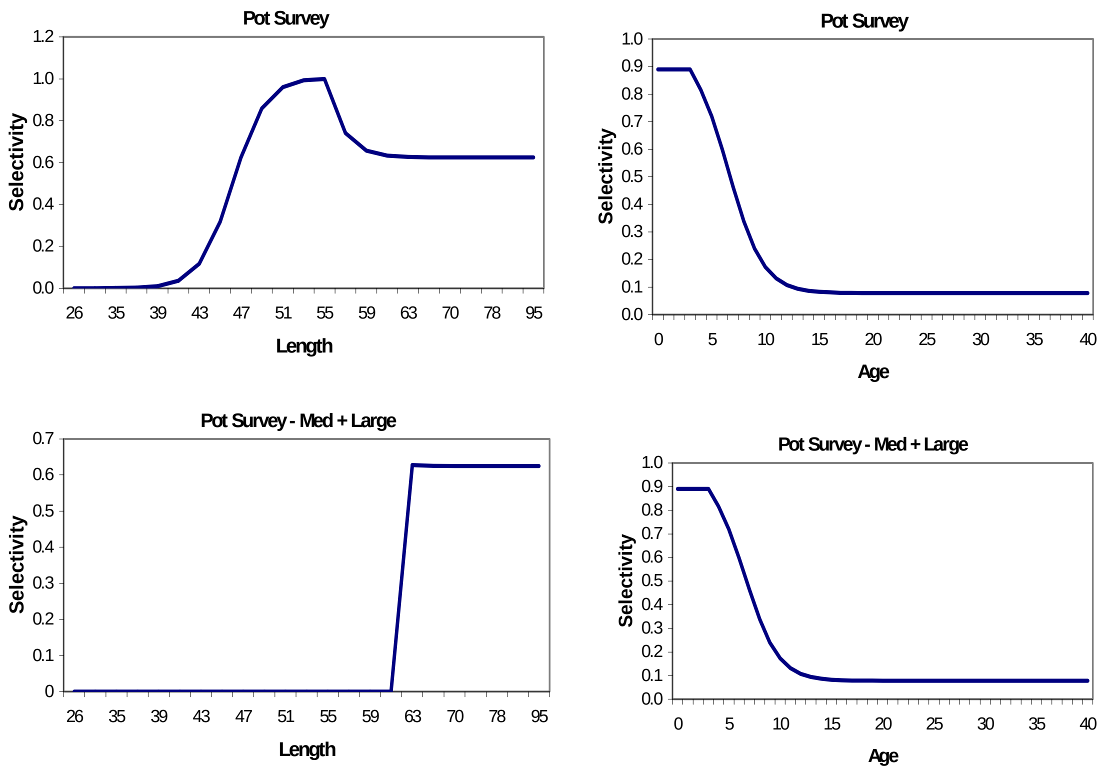

Figure 28. *Estimated length and age based selectivites for AFSC pot survey.*

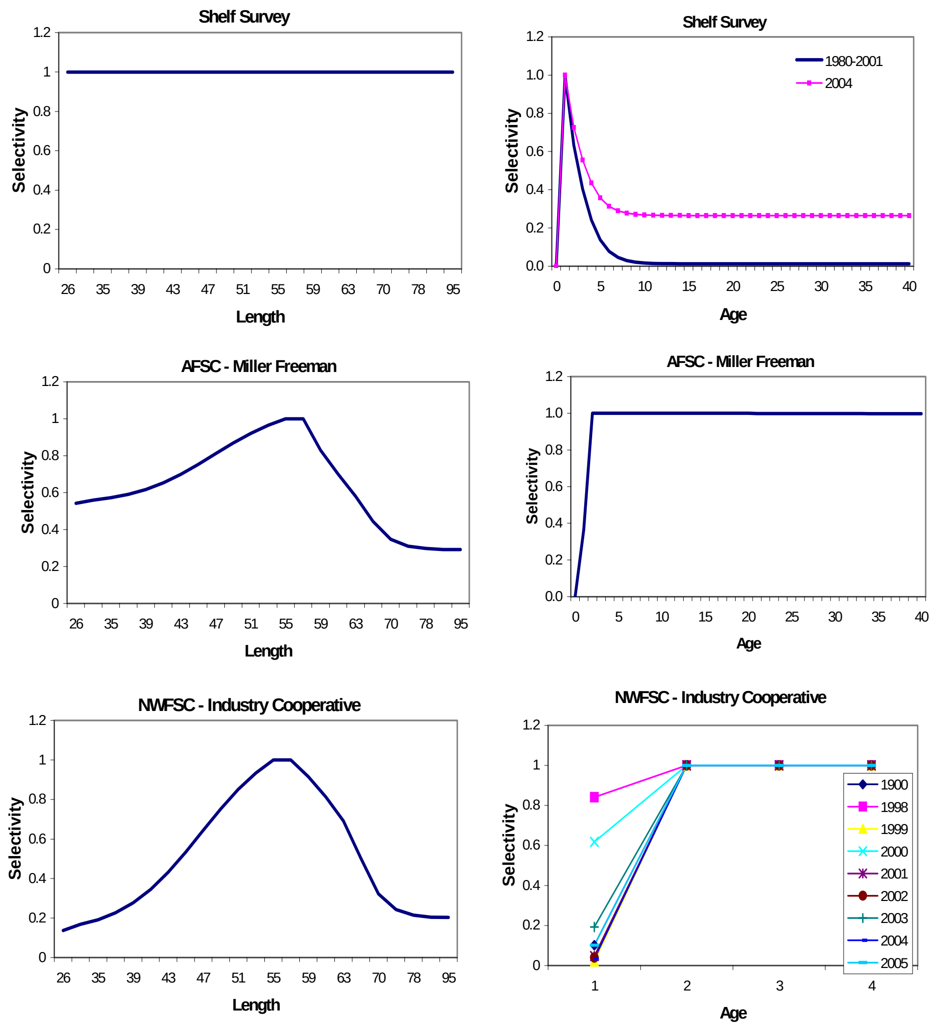

Figure 29*. Estimated length and age based selectivities for the AFSC shelf survey, AFSC Miller Freeman slope survey, and the NWFSC Industry Cooperative slope survey.*

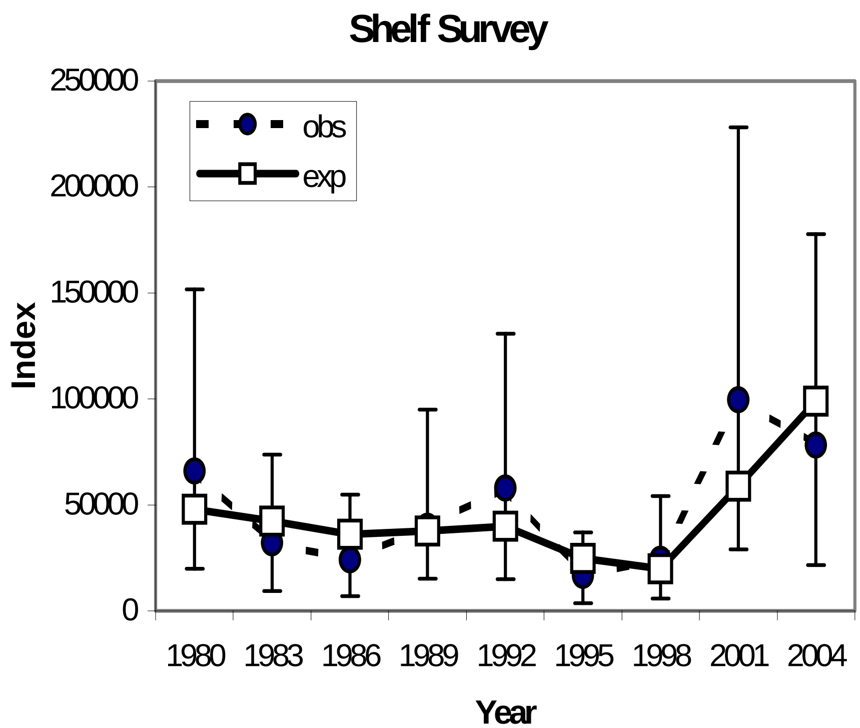

Figure 30*. Observed and expected values for theAFSC shelf survey.*

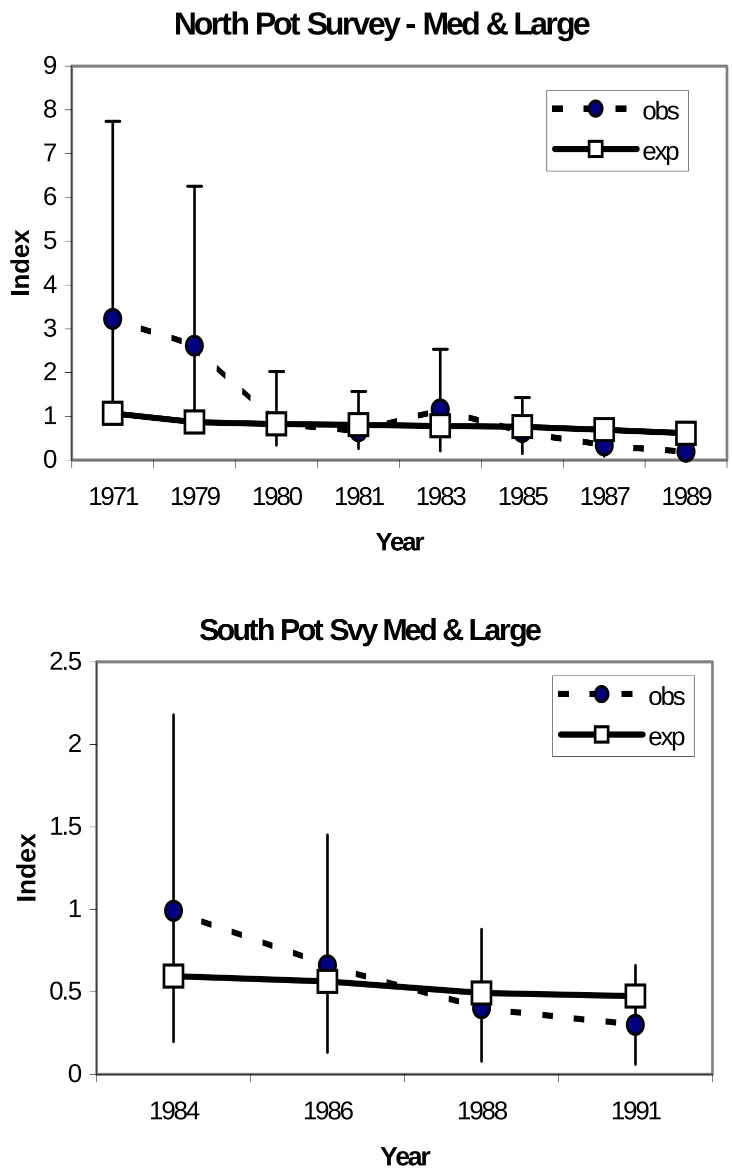

Figure 31*. Observed and expected values for the AFSC sablefish pot survey.*

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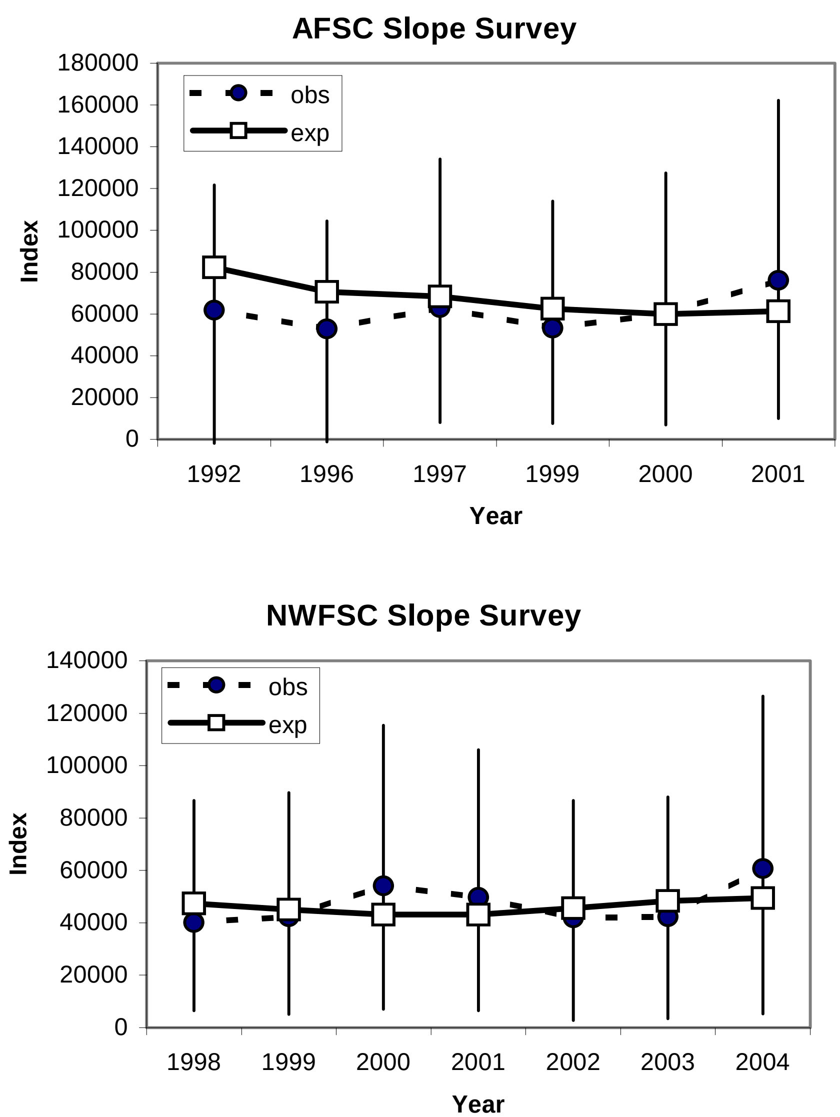


Figure 32*. Observed and expected values for the AFSC slope survey and the NWFSC slope survey.*

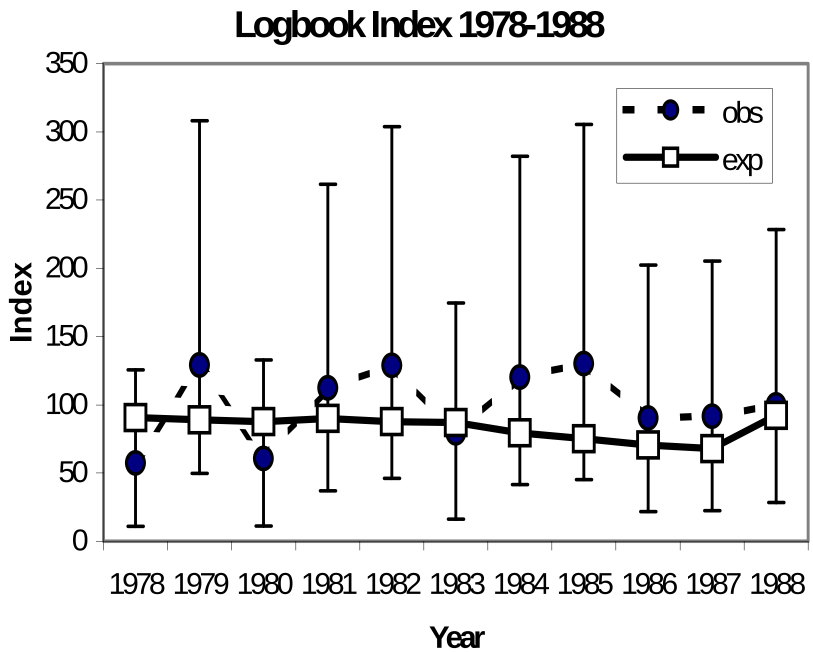


Figure 33. *Observed and expected values for the 1977-1988 (pre-management) trawl logbook index.*

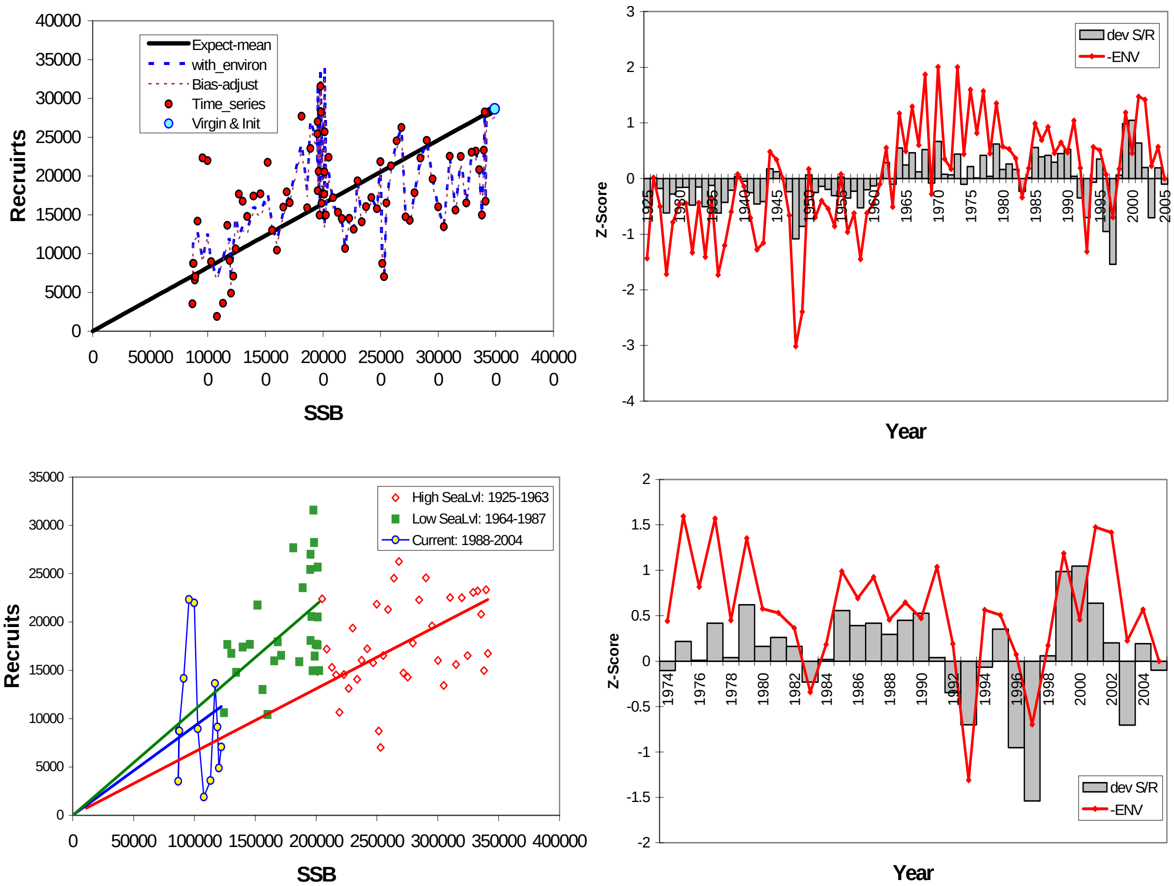


Figure 34. *Relation between stock-recruitment (S/R) function and environmental index (sea level). Sea level is depicted as it's inverse to aid in showing it's relation between recruitment deviations; upper left: predicted recruitment as a function of spawning stock biomass; upper right: recruitment deviations from the S/R curve as a function of the time series of environmental data; lower left: S/R function broken into two periods of prevailing high and low sea levels; lower right: sea level and recruitment deviations for the time period used to fit the environmental function.*

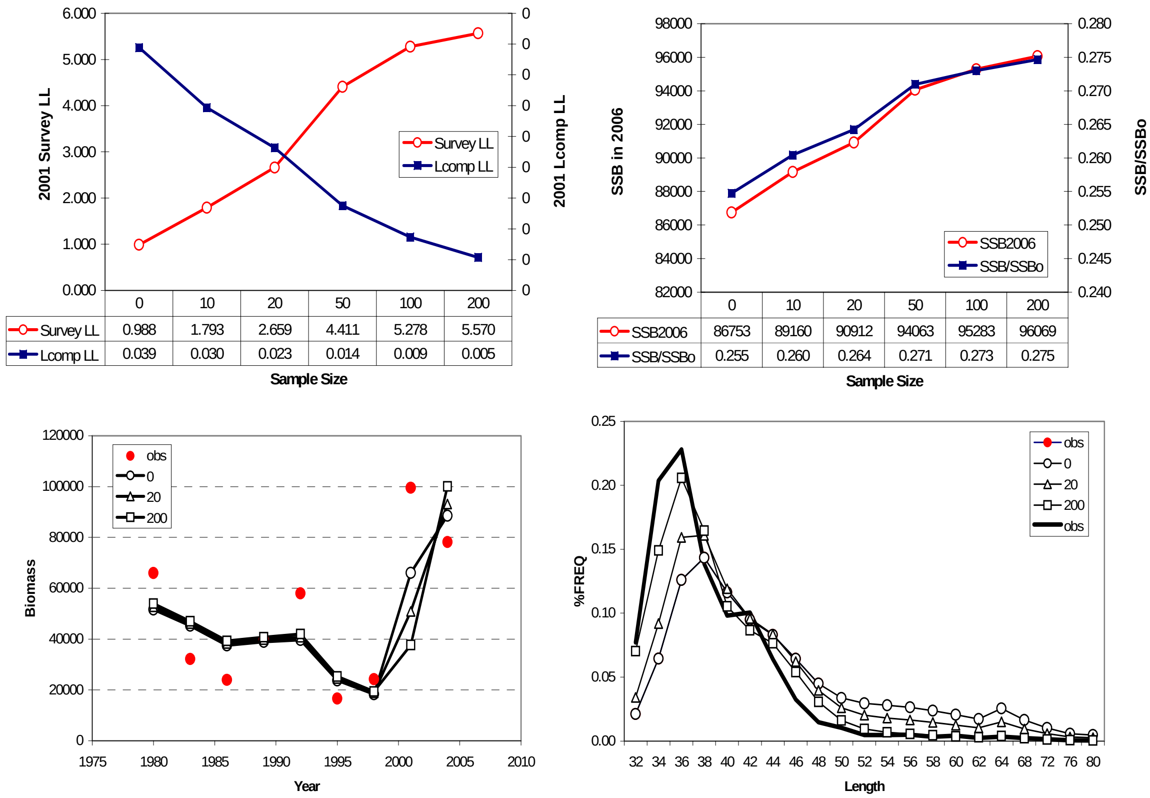


Figure 35. *Trade-off in fitting the 2001 Shelf Survey biomass estimates versus the 2001 Shelf Survey length compositions. Upper left: Log-Likelihood (LL) of fit to lengths and biomass as a function of sample size of lengths (n = 0-200); upper right: SSB and depletion (SSB/SSB virgin) as a function of sample size of lengths; lower left: fit to biomass as a function of sample size of lengths; lower right: fit to length compositions as a function of sample of lengths.*

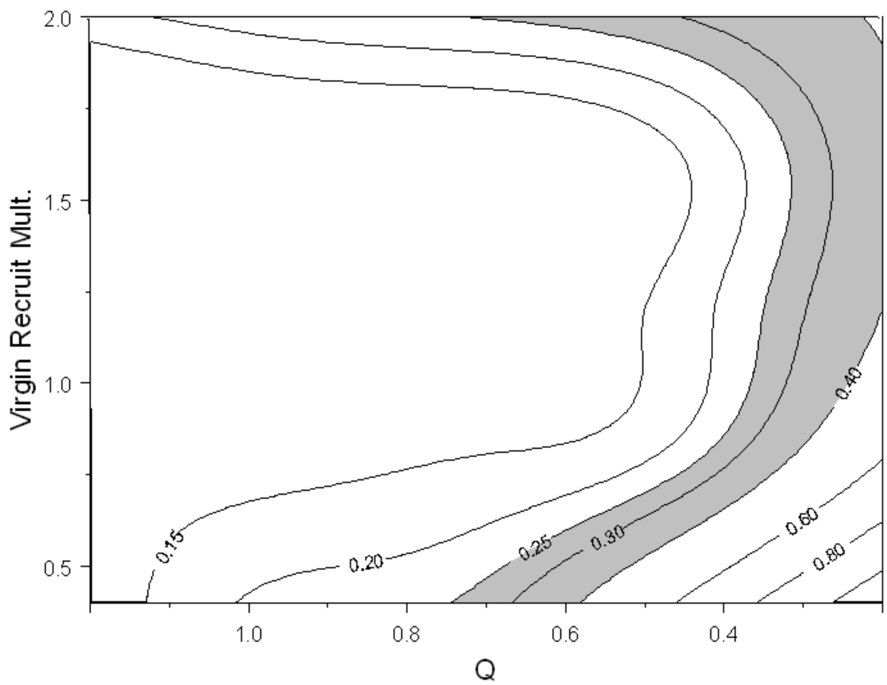
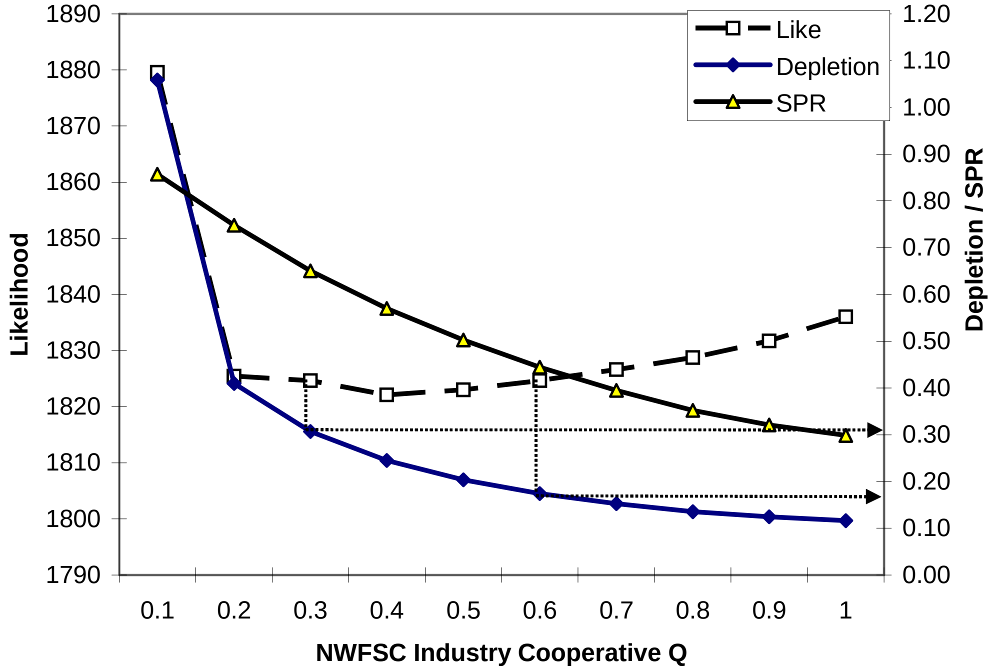


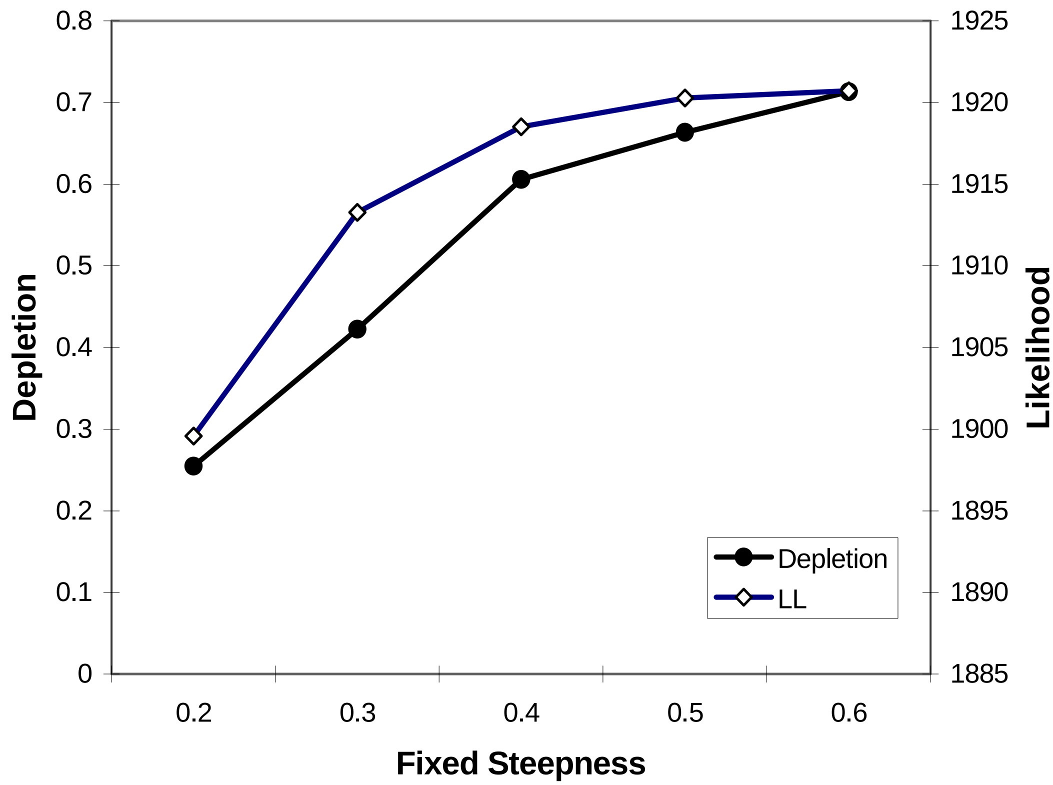
Figure 36. *SSB ratio as a function of Q and virgin recruitment multiplier applied to estimated value. Shaded potion is the area between target (40%) and overfishing (25%).*



Profile on Q

Q	LL	B0	End Yr Bio	Depletion	SPR
0.1	1879.61	315549	334020	1.059	0.857
0.2	1825.45	420840	172351	0.410	0.748
0.3	1824.65	363185	111371	0.307	0.650
0.4	1822.07	336570	82412	0.245	0.570
0.5	1823.00	320104	65147	0.204	0.502
0.6	1824.62	309048	53816	0.174	0.445
0.7	1826.60	301048	45802	0.152	0.395
0.8	1828.76	294994	39834	0.135	0.352
0.9	1831.73	290961	36092	0.124	0.321
1	1836.01	287999	33377	0.116	0.298

***Figure 37**. Profile analysis on NWFSC survey Q. Arrows show the range of depletion for values of Q that have a likelihood difference of only two units.*



Profile on steepness

steepness	LL	Q	SpawnBio	recruit-0	End Yr Bio	Depletion
0.2	1899.58	0.369	349066	28652	88829	0.254
0.3	1913.26	0.295	266058	21875	112440	0.423
0.4	1918.52	0.202	283348	23148	171610	0.606
0.5	1920.28	0.202	261644	21373	173584	0.663
0.6	1920.72	0.202	245316	20039	174906	0.713

Figure 38*. Profile analysis on steepness and resulting parameters.*

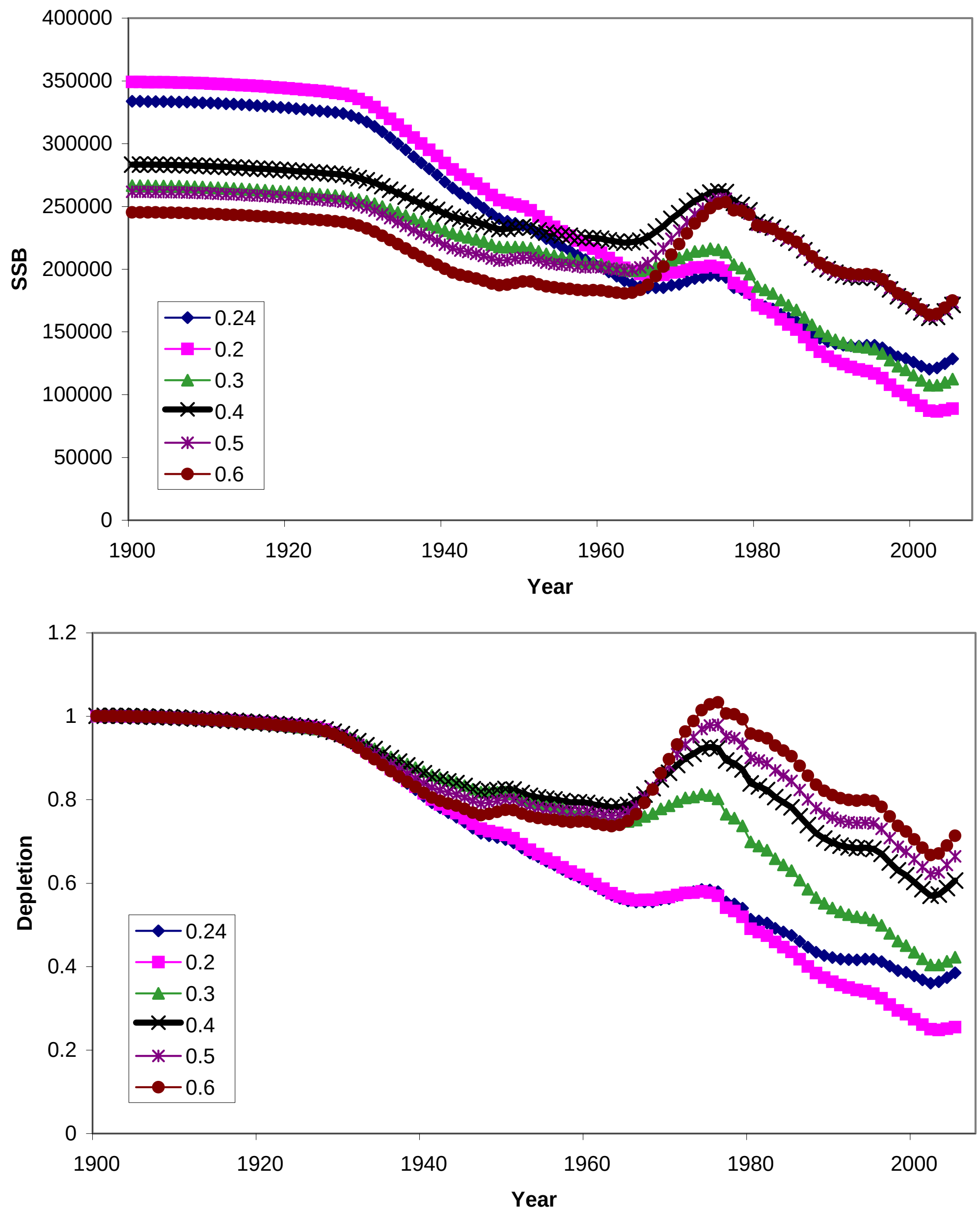


Figure 39. *Trends in spawning stock biomass and depletion as functions of fixed steepness (s = 0.3-0.6), estimated steepness (s = 0.20), and estimated steepness when M is estimated within the model (M about 0.05 and s about 0.24).*

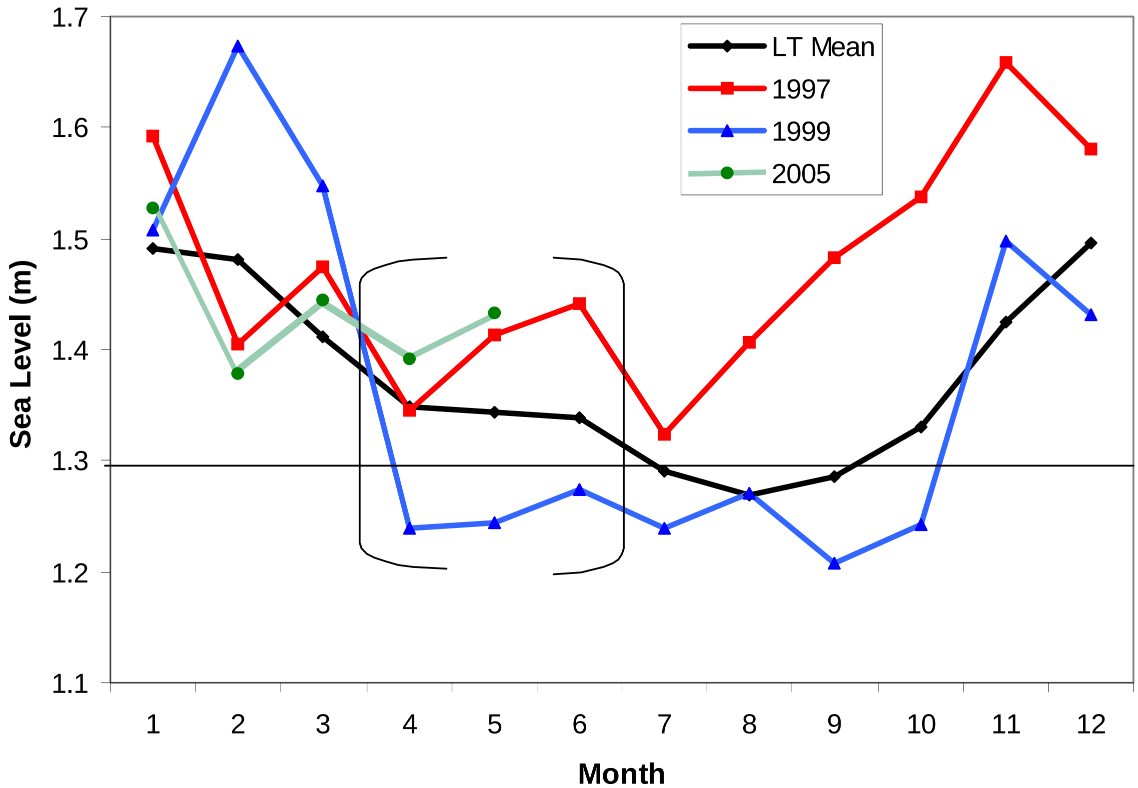


Figure 40. *Monthly sea level for northern stations: long-term mean (1925-2004), 1997 El Niño and weak recruitment, and 1999 La Niña and strong recruitment.*

Table 1. Management regulations (1,000s of mt) and landed catch (1,000s of mt) for the sablefish fishery off the U.S. Pacific coast (1982-97). Table includes specifications for optimum yields (OY), acceptable biological catches (ABC), and harvest guidelines (HG).[a]

Year	OY	ABC	HG	Landed
1982	17.4	13.4	na	18.6
1983b	17.4	13.4	na	14.7
1984b	17.4	13.4	na	14.1
1985b	13.6	12.3	na	14.3
1986	13.6	10.6	na	13.3
1987	12	12	na	12.8
1988	9.2 - 10.8	10	na	10.9
1989c	10.4 - 11.0	9	na	10.5
1990c	8.9	8.9	na	9.2
91c	na	8.9	8.9	9.5
1992c	na	8.9	8.9	9.4
1993c,d	na	5.0 - 7.0	7	8.1
1994c,d	na	7	7	7.6
1995c,e	7.8	9.1	7.8	7.9
1996c,e	7.8	9.1	7.8	8.3
1997c,e	7.8	9.1	7.8	8
1998c,e	5.2	5.2	5.2	4.4
1999c,e	7.9	9.7	7.8	6.7
2000c,e	7.9	9.7	7.8	6.2
2001	7.0	7.9		5.6
2002	4.6	5.0		3.8
2003	6.8	8.5		5.4
2004	7.8	8.5		5.5
2005	7.8	8.4		-
2006	7.6	8.2		-

[a] The abbreviation 'na' is not applicable, i.e., no specifications were in effect for that particular year.

[b] The ABCs for these years include a specific allocation of 2,500 mt for the Monterey INPFC area.

[c] Specifications for Washington Indian tribes are as follows:
1989: 22 mt (included in OY)
1990-94: 300 mt (included in HGs)
1995-97: 780 mt (included in HGs)

[d] Specifications for these years were for all INPFC areas except Conception INPFC area, which was allocated an ABC of 425 mt, with no HG.

[e] The ABCs for these years are based on 8,700 mt allocated to the U.S. Vancouver, Columbia, Eureka, and Monterey INPFC areas, and 425 mt allocated to the Conception INPFC area, with no HG. The ABC includes 900 mt of estimated discard, which along with the 425 mt allocated to the Conception area, were subtracted from 9,100 mt to determine the HG (7,800 mt).

Table 2. Sablefish catch (mt) by INPFC area, gear, and year harvested off the U.S. Pacific coast (1935-2004)

INPFC area [a]

Year	Vancouver-Columbia				Eureka-Monterey				Conception				Unknown				Combined				TOTAL
	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	
1935-52	1047	0	313	0	0	0	0	0	0	0	0	0	0	0	0	0	1047	0	313	0	1360
1956	748	0	1578	0	383	0	884	0	0	0	19	0	0	0	0	0	1131	0	2481	0	3612
1957	1629	0	347	0	423	0	557	0	0	0	10	0	0	0	0	0	2051	0	914	0	2965
1958	712	0	313	0	144	0	634	0	0	0	1	0	0	0	0	0	855	0	948	0	1803
1959	1291	0	507	0	108	0	760	0	0	0	6	0	0	0	0	0	1399	0	1273	0	2672
1960	1851	0	545	0	130	0	954	0	0	0	11	0	0	0	0	0	1980	0	1510	0	3491
1961	997	0	335	0	145	0	942	0	0	0	119	0	0	0	0	0	1142	0	1396	0	2538
1962	954	0	1028	0	156	0	818	0	0	0	101	0	0	0	0	0	1110	0	1947	0	3057
1963	873	0	308	0	67	0	726	0	0	0	167	0	0	0	0	0	940	0	1201	0	2141
1964	959	0	197	0	469	0	738	0	0	0	198	0	0	0	0	0	1428	0	1133	0	2562
1965	632	0	168	0	530	0	1058	0	0	0	147	0	0	0	0	0	1162	0	1373	0	2534
1966	282	0	185	0	717	0	367	0	0	0	139	0	0	0	0	0	999	0	691	0	1691
1967	1611	0	158	0	1963	0	715	0	0	0	60	0	0	0	0	0	3574	0	933	0	4508
1968	972	0	170	0	947	0	831	0	32	0	15	0	0	0	0	0	1951	0	1016	0	2967
1969	3033	0	191	0	1157	0	1288	0	0	0	26	0	0	0	0	0	4200	0	1505	0	5705
1970	1397	114	1099	0	0	0	1312	0	7	0	11	0	0	0	0	0	1404	114	2422	0	3940
1971	914	120	1096	0	598	73	1355	0	0	0	80	0	0	0	0	0	1512	193	2531	0	4236
1972	2137	1	1124	0	1360	353	2309	0	3	3	29	0	0	0	0	0	3500	357	3462	0	7319
1973	876	413	526	0	246	440	3260	0	4	25	14	0	0	0	0	0	1126	878	3800	0	5805
1974	2266	389	462	0	176	2854	2563	0	2	1	22	0	0	0	0	0	2444	3244	3047	0	8735
1975	1737	5280	464	0	0	416	2849	0	0	0	79	0	0	0	0	0	1737	5696	3392	0	10825
1976	1149	7803	609	0	76	9165	2845	0	0	2772	100	0	0	0	0	0	1225	19740	3554	0	24518
1977	1445	552	1164	0	0	2518	2450	0	0	1070	51	0	0	0	0	0	1445	4140	3665	0	9250
1978	1641	591	1752	0	75	2720	4182	0	6	2599	52	0	0	0	0	0	1722	5910	5986	0	13617
1979	3596	4299	2582	0	641	3302	4889	0	1	4971	92	0	0	0	0	0	4238	12572	7563	0	24373
1980	1097	2381	1546	0	298	595	2346	0	45	801	37	0	0	0	0	0	1440	3777	3929	0	9146

Table 2 (cont.). Sablefish catch (mt) by INPFC area, gear, and year harvested off the U.S. Pacific coast (1935-2004)

INPFC area [a]

	Vancouver-Columbia				Eureka-Monterey				Conception				Unknown				Combined				
Year	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	HKL	POT	TWL	MISC	TOTAL
1981	1185	1548	1916	54	761	1850	3680	17	0	502	46	0	1	0	0	0	1947	3900	5642	71	11560
1982	1028	2886	4668	141	708	2722	5563	4	0	904	35	0	0	0	0	0	1736	6512	10266	145	18659
1983	754	2207	3805	192	379	1623	3472	344	0	1839	84	0	0	0	0	0	1133	5669	7361	536	14699
1984	972	2440	4642	375	67	456	3456	601	0	929	139	0	0	0	0	0	1039	3825	8237	976	14077
1985	2292	2365	3322	296	518	1485	3542	45	0	44	423	2	0	0	0	0	2810	3894	7287	343	14334
1986	2736	1447	2491	0	895	748	3676	740	3	43	302	209	0	0	0	0	3634	2238	6469	949	13290
1987	2893	996	3199	0	883	531	3012	47	13	21	347	6	0	36	4	0	3789	1584	6562	53	11988
1988	2759	1375	2672	0	405	733	2545	69	13	14	307	12	0	0	1	0	3177	2122	5525	81	10905
1989	2090	715	2725	0	357	971	2563	119	78	0	412	8	0	0	0	0	2525	1686	5700	127	10038
1990	1553	698	2438	0	558	647	2376	79	93	139	380	7	0	8	2	2	2204	1492	5196	88	8980
1991	2305	412	2497	0	823	333	2269	39	111	100	199	5	0	0	0	0	3239	845	4965	44	9093
1992	1943	323	2596	0	953	222	2501	54	91	187	299	3	0	0	3	0	2987	732	5399	57	9175
1993	1701	581	2678	0	488	180	1968	8	86	55	265	0	0	0	0	0	2275	816	4911	8	8010
1994	1417	990	2052	0	707	312	1582	9	112	0	159	13	0	0	0	0	2236	1302	3793	22	7353
1995	1981	748	1870	0	879	311	1756	16	111	2	211	0	0	0	0	0	2971	1061	3837	16	7885
1996	1915	520	2123	0	1309	224	1871	1	125	0	213	0	0	0	0	0	3349	744	4207	1	8301
1997	2106	355	1870	0	1370	227	1735	1	107	0	153	0	0	0	3	0	3583	582	3761	1	7927
1998	1189	384	1089	2	465	63	974	2	98	0	111	0	0	0	1	0	1752	447	2175	4	4378
1999	1908	628	1726	0	712	124	1356	0	93	0	83	0	0	0	0	0	2713	752	3165	0	6630
2000	1983	618	1444	0	685	189	1130	0	81	0	34	0	0	0	93	0	2749	807	2701	0	6257
2001	1633	510	1641	0	611	161	941	0	109	0	27	0	0	0	10	0	2353	671	2619	0	5643
2002	1170	306	828	0	438	153	715	0	126	11	50	1	0	0	3	0	1734	470	1596	1	3801
2003	1584	580	1304	0	608	216	937	0	126	11	78	0	0	0	0	0	2318	807	2319	0	5444
2004	1925	527	1529	0	477	260	684	2	74	12	65	0	0	0	0	0	2476	799	2278	2	5555

[a] INPFC areas are as follows: Van-Col is U.S. Vancouver-Columbia; Eur-Mon is Eureka-Monterey; Con is Conception; All is all INPFC areas. Gears are as follows: Hkl is hook-and-line (includes trolls); Twl is trawls (includes shrimp trawls); and Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3a. Sablefish catch (mt) by year, gear, cond, and grade landed at ports in California (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Hkl	1981	296	147	128	<1	572	62	31	0	<1	93	665
Hkl	1982	83	60	115	0	259	170	80	0	4	254	513
Hkl	1983	8	5	12	0	25	45	47	<1	0	93	118
Hkl	1984	6	5	3	0	14	0	0	0	0	0	14
Hkl	1985	22	22	35	0	79	39	28	0	5	71	150
Hkl	1986	72	65	75	0	212	30	43	0	0	74	286
Hkl	1987	113	91	46	6	257	3	0	0	8	11	268
Hkl	1988	<1	2	5	0	8	0	0	0	0	0	8
Hkl	1989	<1	<1	0	2	3	<1	<1	<1	24	24	27
Hkl	1990	<1	<1	<1	0	1	3	6	<1	43	52	54
Hkl	1991	6	9	21	5	41	0	21	5	11	37	78
Hkl	1992	4	5	13	1	23	0	0	<1	<1	1	24
Hkl	1993	<1	1	<1	<1	3	0	0	0	5	5	8
Hkl	1994	<1	<1	0	9	9	1	2	9	2	14	23
Hkl	1995	0	0	0	2	2	<1	1	2	34	38	40
Hkl	1996	0	0	0	<1	0	3	28	6	13	50	50
Hkl	1997	0	0	0	0	0	10	36	32	16	95	95
Hkl	1998	0	0	0	<1	0	4	9	8	5	26	26
Hkl	1999	0	0	0	0	0	<1	2	5	4	11	11
Hkl	2000	0	0	0	0	0	7	8	7	27	50	50
Hkl	2001	0	0	0	0	0	8	20	45	32	105	105
Hkl	2002	0	0	0	0	0	2	25	21	19	67	67
Hkl	2003	0	0	0	0	0	4	11	36	25	75	75
Hkl	2004	0	0	0	0	0	3	13	37	11	64	64

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3a (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in California (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Pot	1981	18	17	31	0	67	<1	1	0	2	3	70
Pot	1982	2	1	8	2	13	8	4	0	2	14	26
Pot	1983	1	2	6	0	8	<1	0	0	<1	1	9
Pot	1984	0	0	0	0	0	0	0	0	0	0	0
Pot	1985	<1	<1	<1	34	35	0	<1	0	30	30	65
Pot	1986	<1	<1	0	66	67	0	0	0	31	31	98
Pot	1987	0	0	0	0	0	0	0	0	139	139	139
Pot	1988	<1	<1	<1	0	1	0	0	0	68	68	70
Pot	1989	0	0	0	0	0	0	0	0	288	288	288
Pot	1990	0	0	0	0	0	0	<1	0	44	44	44
Pot	1991	0	0	0	0	0	0	0	0	18	18	18
Pot	1992	<1	<1	<1	74	74	0	0	0	112	112	186
Pot	1993	0	0	0	0	0	0	0	0	0	0	0
Pot	1994	0	0	0	0	0	0	0	0	0	0	0
Pot	1995	0	0	0	0	0	<1	1	2	3	7	7
Pot	1996	0	0	0	0	0	<1	1	2	2	6	6
Pot	1997	0	0	0	0	0	<1	<1	<1	4	4	4
Pot	1998	0	0	0	0	0	<1	<1	<1	<1	1	1
Pot	1999	0	0	0	0	0	<1	<1	<1	<1	0	0
Pot	2000	0	0	0	0	0	0	0	0	0	0	0
Pot	2001	0	0	0	0	0	0	0	0	<1	1	1
Pot	2002	0	0	0	0	0	0	0	0	0	0	0
Pot	2003	0	0	0	0	0	0	0	0	0	0	0
Pot	2004	0	0	0	0	0	0	0	0	<1	0	0

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3a (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in California (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
TWL	1981	27	4	1135	4	1170	2	0	<1	<1	2	1172
TWL	1982	23	3	1411	<1	1437	25	9	0	<1	34	1471
TWL	1983	11	1	407	2	422	5	<1	2	0	8	430
TWL	1984	10	<1	406	<1	416	4	4	0	<1	9	425
TWL	1985	30	10	345	<1	385	4	1	<1	3	8	393
TWL	1986	18	28	217	<1	264	5	5	0	0	10	274
TWL	1987	9	18	155	<1	182	1	0	0	0	1	184
TWL	1988	4	14	108	0	126	<1	0	0	<1	0	127
TWL	1989	<1	11	99	0	110	0	0	0	6	6	117
TWL	1990	1	11	76	0	88	0	0	0	0	0	88
TWL	1991	4	14	79	<1	97	<1	0	<1	0	1	98
TWL	1992	3	9	57	<1	70	0	0	0	0	0	70
TWL	1993	8	16	66	4	93	<1	2	<1	<1	2	96
TWL	1994	<1	7	6	0	14	<1	2	6	4	12	26
TWL	1995	0	0	0	0	0	0	1	2	0	3	3
TWL	1996	0	0	0	0	0	0	0	<1	0	0	0
TWL	1997	0	0	0	0	0	0	0	<1	4	4	4
TWL	1998	0	0	0	0	0	<1	3	6	9	19	19
TWL	1999	0	0	0	0	0	0	<1	0	0	0	0
TWL	2000	0	0	0	0	0	0	<1	0	<1	1	1
TWL	2001	0	0	0	0	0	0	0	<1	3	3	3
TWL	2002	0	0	0	0	0	<1	<1	0	<1	1	1
TWL	2003	0	0	0	0	0	0	0	<1	2	2	2
TWL	2004	0	0	0	0	0	0	0	0	<1	0	0

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3a (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in California (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Misc	1981	10	4	5	0	20	2	1	0	0	3	23
Misc	1982	2	1	2	0	6	12	3	5	0	20	26
Misc	1983	3	3	7	0	13	38	32	0	5	75	89
Misc	1984	6	3	1	0	11	0	0	0	0	0	11
Misc	1985	11	12	11	0	34	0	0	<1	5	6	40
Misc	1986	2	4	26	<1	32	4	7	0	28	39	71
Misc	1987	<1	<1	0	0	0	0	0	0	0	0	0
Misc	1988	0	<1	5	0	6	0	0	0	101	101	107
Misc	1989	<1	0	0	0	0	0	0	0	0	0	0
Misc	1990	0	<1	<1	0	1	0	0	0	143	143	144
Misc	1991	<1	<1	1	0	1	0	0	0	4	4	6
Misc	1992	0	0	0	0	0	0	0	0	1	1	1
Misc	1993	0	0	0	<1	0	0	0	0	0	0	0
Misc	1994	0	<1	0	0	0	0	0	3	5	8	8
Misc	1995	0	0	0	0	0	0	0	0	0	0	0
Misc	1996	0	0	0	0	0	<1	<1	<1	<1	0	0
Misc	1997	0	0	0	0	0	0	0	0	0	0	0
Misc	1998	0	0	0	0	0	0	0	0	0	0	0
Misc	1999	0	0	0	0	0	0	0	0	0	0	0
Misc	2000	0	0	0	0	0	0	0	0	0	0	0
Misc	2001	0	0	0	0	0	0	0	0	0	0	0
Misc	2002	0	0	0	0	0	0	0	0	0	0	0
Misc	2003	0	0	0	0	0	0	0	0	<1	0	0
Misc	2004	0	0	0	0	0	0	0	0	0	0	0

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3b. Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Oregon (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Hkl	1981	339	108	103	21	571	56	12	<1	62	131	701
Hkl	1982	167	66	70	22	325	210	101	5	2	318	642
Hkl	1983	158	121	150	37	466	41	40	4	<1	86	552
Hkl	1984	108	57	41	15	222	4	<1	0	1	6	227
Hkl	1985	154	123	127	29	433	16	16	28	23	83	515
Hkl	1986	251	246	314	36	848	41	57	67	69	233	1081
Hkl	1987	265	270	334	22	890	5	18	89	<1	112	1003
Hkl	1988	141	175	244	23	583	3	9	102	13	126	709
Hkl	1989	105	96	98	55	354	<1	3	62	5	71	425
Hkl	1990	110	74	111	2	297	4	11	82	4	101	398
Hkl	1991	81	99	210	<1	390	7	30	300	10	347	737
Hkl	1992	114	122	243	<1	479	37	60	330	<1	428	907
Hkl	1993	61	85	208	<1	355	21	40	253	2	316	671
Hkl	1994	59	80	224	42	405	7	28	383	12	430	835
Hkl	1995	61	83	197	<1	340	12	28	249	7	297	637
Hkl	1996	7	7	11	266	290	11	33	238	20	301	591
Hkl	1997	38	35	45	242	359	58	82	250	5	394	753
Hkl	1998	16	7	8	137	167	9	28	123	19	179	346
Hkl	1999	15	13	9	233	270	25	71	273	27	396	666
Hkl	2000	19	13	12	319	363	21	60	251	4	336	699
Hkl	2001	25	11	10	183	228	48	90	180	1	319	547
Hkl	2002	20	8	8	90	126	30	43	113	<1	187	313
Hkl	2003	57	34	46	199	335	23	33	110	<1	166	501
Hkl	2004	29	26	23	271	350	21	33	63	99	216	566

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3b (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Oregon (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Pot	1981	64	41	155	10	270	2	2	3	<1	8	278
Pot	1982	323	201	549	163	1236	77	69	22	56	224	1460
Pot	1983	316	259	708	35	1318	1	2	0	0	3	1321
Pot	1984	167	239	612	37	1054	0	0	0	778	778	1832
Pot	1985	286	347	862	56	1552	<1	<1	<1	349	351	1903
Pot	1986	216	331	650	6	1202	18	43	158	5	225	1427
Pot	1987	233	298	484	175	1189	4	23	136	340	504	1693
Pot	1988	148	220	330	223	921	0	0	0	283	283	1203
Pot	1989	146	268	481	1	896	0	0	<1	1	2	898
Pot	1990	103	218	461	0	782	0	0	0	0	0	782
Pot	1991	69	167	357	<1	593	4	11	102	<1	118	711
Pot	1992	41	74	151	0	266	3	15	114	0	132	398
Pot	1993	53	85	245	0	383	6	19	242	<1	268	651
Pot	1994	46	58	196	82	382	12	53	725	3	793	1174
Pot	1995	62	75	195	<1	333	4	17	290	0	311	644
Pot	1996	3	6	20	197	227	9	34	225	13	280	507
Pot	1997	13	15	25	103	156	14	34	121	<1	170	326
Pot	1998	9	10	10	111	139	13	45	150	4	211	351
Pot	1999	6	4	11	214	234	9	55	330	5	399	633
Pot	2000	5	2	2	188	198	16	55	338	<1	409	607
Pot	2001	11	9	5	107	131	31	59	232	<1	322	454
Pot	2002	18	9	6	80	112	25	55	97	21	198	311
Pot	2003	5	3	5	86	99	28	77	204	<1	310	409
Pot	2004	3	4	4	373	383	10	25	62	<1	97	481

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3b (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Oregon (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
TWL	1981	75	29	340	844	1287	21	10	<1	26	56	1343
TWL	1982	163	106	1242	1354	2865	62	32	9	30	133	2998
TWL	1983	204	46	1702	780	2733	18	8	3	16	46	2779
TWL	1984	137	23	1996	616	2773	9	6	0	1	16	2789
TWL	1985	149	40	210	2465	2864	1	<1	<1	<1	2	2866
TWL	1986	163	67	172	1753	2155	<1	<1	0	<1	1	2156
TWL	1987	124	136	1131	1160	2551	1	<1	<1	<1	2	2553
TWL	1988	132	145	1300	587	2165	3	2	2	6	13	2178
TWL	1989	199	249	1479	685	2612	5	2	2	13	21	2634
TWL	1990	213	327	1674	319	2532	<1	<1	<1	<1	0	2533
TWL	1991	325	404	1392	342	2463	1	<1	<1	1	3	2466
TWL	1992	239	294	1772	152	2457	6	14	76	7	103	2560
TWL	1993	223	270	1604	9	2107	8	43	328	36	415	2521
TWL	1994	180	238	1052	11	1481	6	34	463	20	523	2004
TWL	1995	154	269	904	24	1351	3	21	451	35	510	1861
TWL	1996	167	296	851	196	1510	5	26	515	28	573	2083
TWL	1997	198	295	730	222	1445	7	26	361	14	408	1853
TWL	1998	198	206	316	94	814	9	20	201	14	243	1057
TWL	1999	244	352	792	103	1491	1	3	166	17	187	1678
TWL	2000	236	336	727	58	1356	7	8	124	11	151	1507
TWL	2001	202	276	674	153	1306	42	46	141	<1	229	1535
TWL	2002	90	113	383	111	698	16	17	59	<1	92	790
TWL	2003	145	190	767	29	1131	4	9	120	2	134	1265
TWL	2004	100	129	552	69	851	3	6	75	<1	84	934

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3b (cont.). Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Oregon (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Misc	1981	0	0	0	4	4	0	0	0	22	22	26
Misc	1982	0	0	0	0	0	0	0	0	0	0	0
Misc	1983	0	0	0	0	0	0	0	0	0	0	0
Misc	1984	0	0	0	<1	0	0	0	0	0	0	0
Misc	1985	0	0	0	0	0	0	0	0	0	0	0
Misc	1986	0	0	0	0	0	0	0	0	0	0	0
Misc	1987	0	0	0	0	0	0	0	0	0	0	0
Misc	1988	0	0	0	0	0	0	0	0	0	0	0
Misc	1989	0	0	0	0	0	0	0	0	0	0	0
Misc	1990	0	0	0	0	0	0	0	0	0	0	0
Misc	1991	0	0	0	0	0	0	0	0	0	0	0
Misc	1992	0	0	0	0	0	0	0	0	0	0	0
Misc	1993	0	0	0	0	0	0	0	0	0	0	0
Misc	1994	0	0	0	0	0	0	0	0	0	0	0
Misc	1995	0	0	0	0	0	0	0	0	0	0	0
Misc	1996	0	0	0	0	0	0	0	0	0	0	0
Misc	1997	0	0	0	0	0	0	0	0	0	0	0
Misc	1998	0	0	0	0	0	0	0	0	0	0	0
Misc	1999	0	0	0	0	0	0	0	0	0	0	0
Misc	2000	0	0	0	0	0	0	0	0	0	0	0
Misc	2001	0	0	0	0	0	0	0	0	0	0	0
Misc	2002	0	0	0	0	0	0	0	0	0	0	0
Misc	2003	0	0	0	0	0	0	0	0	0	0	0
Misc	2004	0	0	0	0	0	0	0	0	0	0	0

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3c . Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Washington (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Hkl	1981	144	39	18	0	201	197	13	28	48	286	487
Hkl	1982	9	6	7	2	24	199	73	90	<1	362	386
Hkl	1983	14	4	4	<1	22	207	73	54	0	334	356
Hkl	1984	97	33	6	4	140	371	112	149	2	634	774
Hkl	1985	129	105	170	<1	404	298	218	1007	0	1523	1927
Hkl	1986	56	38	165	<1	261	366	132	1013	30	1542	1802
Hkl	1987	19	18	28	<1	65	225	331	1672	0	2228	2293
Hkl	1988	<1	<1	1	<1	2	136	207	1738	0	2081	2083
Hkl	1989	<1	<1	4	0	5	90	191	1391	101	1772	1777
Hkl	1990	<1	<1	3	0	4	44	172	1046	0	1262	1266
Hkl	1991	<1	<1	<1	2	3	31	225	1652	0	1908	1911
Hkl	1992	<1	<1	3	0	3	36	217	1134	0	1387	1390
Hkl	1993	3	0	10	<1	14	48	159	983	0	1191	1204
Hkl	1994	<1	<1	1	0	1	26	110	827	0	963	964
Hkl	1995	<1	<1	2	0	2	74	263	1132	0	1469	1471
Hkl	1996	<1	<1	54	<1	55	42	253	1194	0	1489	1544
Hkl	1997	<1	3	4	<1	7	76	361	1205	0	1641	1648
Hkl	1998	<1	<1	9	0	10	44	210	684	0	938	948
Hkl	1999	<1	2	3	2	7	84	273	1031	11	1399	1406
Hkl	2000	<1	<1	<1	<1	1	61	261	1008	<1	1329	1331
Hkl	2001	2	5	10	<1	17	89	281	822	<1	1192	1209
Hkl	2002	1	3	4	0	8	88	224	606	0	918	926
Hkl	2003	2	1	7	<1	10	138	240	859	0	1237	1247
Hkl	2004	1	2	77	<1	81	119	222	1089	0	1431	1512

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3c (cont.) . Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Washington (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Pot	1981	561	250	371	28	1210	30	34	0	0	64	1274
Pot	1982	591	350	643	0	1584	11	7	18	0	36	1621
Pot	1983	494	423	482	<1	1400	25	0	51	0	76	1476
Pot	1984	269	319	363	4	955	20	24	10	0	55	1010
Pot	1985	87	100	246	27	460	98	0	331	0	430	890
Pot	1986	0	0	0	0	0	2	6	30	0	37	37
Pot	1987	0	0	0	0	0	0	0	0	0	0	0
Pot	1988	4	19	157	0	180	0	0	0	0	0	180
Pot	1989	3	11	149	0	163	0	0	0	0	0	163
Pot	1990	2	7	55	0	63	<1	3	36	0	39	103
Pot	1991	0	0	0	0	0	0	0	0	0	0	0
Pot	1992	0	0	0	0	0	<1	<1	6	0	7	7
Pot	1993	0	0	0	0	0	0	0	<1	0	0	0
Pot	1994	0	0	0	0	0	<1	<1	12	0	13	13
Pot	1995	3	0	0	0	3	9	17	84	0	110	113
Pot	1996	1	<1	2	0	4	<1	1	34	0	36	40
Pot	1997	0	0	0	0	0	1	8	43	0	52	52
Pot	1998	2	4	9	<1	15	1	4	20	0	25	40
Pot	1999	0	0	0	0	0	<1	2	8	<1	10	10
Pot	2000	0	0	0	0	0	1	4	25	0	31	31
Pot	2001	0	2	2	0	3	11	17	28	0	55	59
Pot	2002	0	0	0	0	0	2	5	10	0	18	18
Pot	2003	4	<1	44	<1	48	11	21	106	0	139	187
Pot	2004	<1	<1	<1	0	1	5	10	36	0	51	52

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3c (cont.) . Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Washington (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
TWL	1981	65	4	404	6	479	63	10	20	<1	94	573
TWL	1982	106	132	1373	38	1649	20	30	42	<1	92	1741
TWL	1983	96	85	1027	43	1251	12	9	73	<1	94	1345
TWL	1984	535	30	1631	31	2226	20	6	11	0	36	2263
TWL	1985	113	40	562	2	717	9	8	27	0	45	762
TWL	1986	44	21	453	11	529	16	1	35	0	52	580
TWL	1987	35	75	694	<1	804	10	2	42	0	53	857
TWL	1988	39	26	489	0	555	21	9	97	0	126	681
TWL	1989	40	51	345	<1	436	7	8	30	0	45	481
TWL	1990	36	48	241	<1	325	8	5	22	0	34	359
TWL	1991	49	46	210	<1	306	6	8	11	0	24	330
TWL	1992	37	37	287	<1	362	2	5	27	0	34	396
TWL	1993	22	29	259	2	311	6	28	167	0	201	512
TWL	1994	14	11	69	<1	94	5	35	282	0	321	415
TWL	1995	14	27	65	<1	107	4	32	228	0	265	372
TWL	1996	10	14	53	<1	77	6	32	263	0	301	378
TWL	1997	16	23	84	<1	123	7	39	189	0	235	358
TWL	1998	15	17	37	<1	68	4	20	102	0	127	195
TWL	1999	15	13	39	2	69	7	26	188	<1	222	291
TWL	2000	12	13	31	<1	56	2	23	141	<1	167	223
TWL	2001	11	12	54	<1	77	2	19	185	0	206	283
TWL	2002	2	2	36	2	42	1	11	79	0	91	133
TWL	2003	7	7	29	<1	43	3	9	134	0	146	189
TWL	2004	1	3	33	10	47	<1	5	71	0	76	123

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 3c (cont.) . Sablefish catch (mt) by year, gear, cond, and grade landed at ports in Washington (1981-2004).

		Condition										
		Round					Dressed					Round and Dressed
Gear	Year	L	M	S	U	ALL	L	M	S	U	ALL	All
Misc	1981	20	<1	<1	0	21	8	<1	0	0	8	29
Misc	1982	105	8	26	3	142	0	0	<1	0	0	142
Misc	1983	86	0	48	0	134	53	6	1	0	60	193
Misc	1984	56	26	6	285	372	3	<1	<1	0	4	376
Misc	1985	114	27	9	0	149	140	3	6	0	149	298
Misc	1986	0	0	0	0	0	0	0	0	0	0	0
Misc	1987	0	0	0	0	0	0	0	0	0	0	0
Misc	1988	0	0	0	0	0	0	0	0	0	0	0
Misc	1989	0	0	0	0	0	0	0	0	0	0	0
Misc	1990	0	0	0	0	0	0	0	0	0	0	0
Misc	1991	0	0	0	0	0	0	0	0	0	0	0
Misc	1992	0	0	0	0	0	0	0	0	0	0	0
Misc	1993	0	0	0	0	0	0	0	0	0	0	0
Misc	1994	0	0	0	0	0	0	0	0	0	0	0
Misc	1995	0	0	0	0	0	0	0	0	0	0	0
Misc	1996	0	0	<1	0	0	0	0	0	0	0	0
Misc	1997	0	0	0	0	0	0	0	0	0	0	0
Misc	1998	0	0	0	0	0	<1	<1	<1	0	2	2
Misc	1999	0	0	0	0	0	0	0	0	0	0	0
Misc	2000	0	0	0	0	0	0	0	0	0	0	0
Misc	2001	0	0	0	0	0	0	0	0	0	0	0
Misc	2002	0	0	0	0	0	0	0	0	0	0	0
Misc	2003	0	0	0	0	0	0	0	0	0	0	0
Misc	2004	0	0	0	0	0	0	0	0	0	0	0

[a] Grades are as follows: L is large; M is medium; S is small and extra-small; U is unspecified; All is all grades.

[b] Gears are as follows: Hkl is hook-and-line; Twl is trawls (includes trolls and shrimp trawls); Misc is miscellaneous gears other than Hkl, Pot, or Twl (e.g., net gear).

Table 4. Sample sizes (number of fish sampled) associated with biological data collected from: **A** - commercial fisheries for sablefish (1986-97, with the exception of 1992, for which no biological data were collected); and **B** - research surveys conducted by NMFS (various years between 1979 and 1997). The total number of boat trips that correspond with the number of fish sampled is also presented (in parentheses) in Table **A**. Sample-size information used to derive length and age compositions is presented. Sample data collected in the Conception INPFC area are omitted from this table.

A. Fisheries[a]

		Year[b]																	
Biological Data	Fishery	1986	1987	1988	1989	1990	1991	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Length	Longline	976	1742	797	665	868	2798	5506	4070	3288	2656	3962	3234	4716	4491	2933	2714	3654	2149
		(47)	(83)	(32)	(19	(31)	(74)	(204)	(149)	(108)	(95)	(164)	(142)	(210)	(212)				
	Pot	724	733	440	1650	813	531	773	305	449	432	683	402	573	665	311	245	392	470
		(33)	(36)	(15)	(59)	(35)	(26)	(32)	(15)	(20)	(22)	(33)	(20)	(28)	(33)				
	Trawl	4787	5082	3833	4744	4964	4840	5110	4137	3797	3264	3806	3254	3970	3919	4473	4300	4245	4038
		(166)	(165)	(112)	(145)	(161)	(151)	(176)	(132)	(102)	(103)	(123)	(143)	(169)	(159)				
	Shoreside Obs.									210	210	280	265	105	171	601	415	330	420
Age[c]	Longline	234	371	222	55	101	262	48	97	175	539	1204	291	781	480	619	423	270	0
			(71)	(22)	(7)	(9)	(10)	(2)	(6)	(10)									(0)
	Pot	139	156	72	229	79	309	122	60	143	323	543	0	290	300	224	165	176	0
			(32)	(6)	(25)	(10)	(14)	(6)	(3)	(8)			(0)						(0)
	Trawl	1285	1100	1474	1239	1125	1787	817	657	444	1008	2021	600	750	1605	1528	1046	668	0

Table 4 (Cont.) .

B. Surveys[d]

Biological Data	Survey	Year[b]																									
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Length	Pot-North	2858	1352	1235		2988		4375		2004		1499															
	Pot-South						5415		2419		5279			1715													
	Shelf		4603			3776			2688			5200			6220			1835			2626			13659			8753
	AFSC Slope										3369		3156	2869	2388	3259		2538	4746	5283		3634	4804	4698			
	NWFSC Slope																				1435	3014	2435	2935	4135	5924	4691
Age[c]	Pot-N	613										585															
	Pot-S								992					1932													
	Shelf					956						598			645			498			498						
	AFSC Slope													480				963		1524		497	1705	582			
	NWFSC Slope																				673	469		617	1631	940	625

[a] See Bence (1997) for a description of the sampling design used to collect biological data from sablefish fisheries operating off the U.S. Pacific coast.

[b] Missing cells mean that biological data were: (1) not collected in that particular year; or (2) collected data were considered biased.

[c] Sample sizes for age data reflect samples that have been processed, i.e., currently, there exists a backlog of samples (specimens) that have not been analyzed.

[d] The following documents describe survey design:
(1) Parks and Hughes (1981), Parks and Shaw (1983, 1985, 1987, 1989, 1990), and Kimura and Balsiger (1985) present methods used in northern (Pot-N) and southern pot surveys (Pot-S).
(2) Raymore and Weinberg (1990), Parks et al. (1993), and NOAA (1995b) present methods used in slope trawl surveys (Slope).
(3) Weinberg et al. (1994) and NOAA (1995b) present methods used in shelf trawl surveys (Shelf).

Table 5. Estimates of percent dead discard of total catch, and retained and discarded catch (mt) for the sablefish trawl fishery . See Discard for discussion regarding assumptions used to determine these estimates.

	Year	Percent Dead Discard of total catch	Retained Catch	Discarded Catch	Total Catch
Prior to	1982a	10			
	1982	4.0	18514	386	18900
	1983	7.1	14163	254	14417
	1984	4.1	13101	254	13355
	1985	9.1	13991	2080	16071
	1986	8.7	12341	1938	14279
	1987	9.5	11935	1950	13885
	1988	7.0	10824	1849	12673
	1989	8.6	9911	1735	11646
	1990	10.6	8892	1618	10510
	1991	7.0	9049	1480	10529
	1992	12.2	9118	1514	10632
	1993	11.0	8002	1353	9355
	1994	10.7	7331	1062	8393
	1995	15.4	7869	1078	8947
	1996	12.3	8300	1149	9449
	1997	23.8	7926	1027	8953
	1998	22.4	4374	594	4968
	1999	7.4	6630	864	7494
	2000	14.8	6257	737	6994
	2001	14.4	5643	715	6358
	2002	19.6	3800	437	4237
	2003	16.2	5444	633	6077
	2004	21.2	5553	628	6181

[a] Annual percent discard of total catch landed in 1935-52 and 1956-81 was estimated to be 10% (see Table 2 - ‘All’ trawl catch to determine ‘Total’ catch, i.e., retained plus discarded catch).

Table 6. Sablefish catch rates (mean number per pot) by year, grade, and depth (fm) in the pot surveys conducted by NMFS (1979-91).

		Year [a]										
Grade [b]	**Depth**	79	80	81	83	84	85	86	87	88	89	91
All	150	6.6	10.1	2.6	2.6	na	4.7	2.0	1.4	4.1	1.8	2.3
	225	9.0	6.7	7.9	13.9	15.2	11.7	6.0	3.0	17.5	3.5	5.2
	300	14.5	8.0	4.2	17.4	14.0	10.7	6.4	3.9	12.4	4.0	3.6
	375	12.4	4.1	4.9	9.8	7.8	5.0	3.8	2.4	5.8	1.7	2.8
	450	14.6	5.1	4.7	5.0	6.6	4.9	2.9	3.3	4.5	1.1	1.0
	525	na	na	na	na	4.1	8.0	2.6	2.8	4.8	0.9	1.3
	600	na	na	na	na	na	na	2.4	1.7	3.5	0.7	1.6
	225-450	12.6	6.0	5.4	11.5	10.9	8.1	4.7	3.2	10.1	2.6	3.2
M	150	1.2	0.9	0.4	0.4	na	0.5	0.1	0.2	0.1	0.1	0.1
	225	1.7	0.8	0.6	0.8	1.1	0.5	0.6	0.3	0.5	0.1	0.2
	300	1.4	0.5	0.2	1.3	0.7	0.5	0.4	0.2	0.3	0.2	0.2
	375	1.0	0.3	0.3	0.3	0.6	0.2	0.4	0.2	0.2	0.2	0.3
	450	1.4	0.3	0.3	0.3	0.4	0.3	0.3	0.2	0.3	0.1	0.1
	525	na	na	na	na	0.6	0.6	0.4	0.4	0.5	0.1	0.3
	600	na	na	na	na	na	na	0.8	0.5	1.1	<0.1	0.6
	225-450	1.4	0.4	0.4	0.7	0.7	0.4	0.4	0.2	0.3	0.1	0.2
L [c]	150	1.0	0.7	0.4	0.2	na	0.2	0.1	0.1	<0.1	<0.1	0.1
		(15%)	(7%)	(16%)	(9%)		(4%)	(4%)	(4%)	(1%)	(<1%)	(3%)
	225	1.6	0.7	0.5	0.5	0.3	0.3	0.2	0.1	0.1	<0.1	0.1
		(17%)	(11%)	(7%)	(4%)	(2%)	(2%)	(3%)	(5%)	(1%)	(1%)	(2%)
	300	0.9	0.5	0.2	1.0	0.3	0.3	0.3	0.1	0.1	0.1	0.1
		(6%)	(6%)	(4%)	(6%)	(2%)	(3%)	(4%)	(2%)	(1%)	(3%)	(1%)
	375	1.2	0.2	0.3	0.2	0.3	0.2	0.4	0.2	<0.1	0.1	0.1
		(10%)	(6%)	(6%)	(2%)	(4%)	(4%)	(10%)	(6%)	(1%)	(6%)	(5%)
	450	1.2	0.2	0.2	0.2	0.2	0.3	0.1	0.1	0.1	<0.1	0.1
		(8%)	(3%)	(4%)	(3%)	(2%)	(5%)	(4%)	(3%)	(2%)	(3%)	(11%)
	525	na	na	na	na	0.2	0.2	0.1	0.2	0.1	<0.1	0.1
						(5%)	(2%)	(4%)	(8%)	(3%)	(4%)	(11%)
	600	na	na	na	na	na	na	1.1	0.4	1.1	0.1	0.9
								(47%)	(26%)	(31%)	(16%)	(56%)
	225-450	1.2	0.4	0.3	0.5	0.3	0.3	0.2	0.1	0.1	0.1	0.1
		(10%)	(7%)	(6%)	(4%)	(3%)	(3%)	(5%)	(4%)	(1%)	(3%)	(3%)

[a] Pot surveys conducted in U.S. Vancouver and Columbia INPFC areas in years 1979-81, 1983, 1985, 1987, and 1989, and in Eureka, Monterey, and Conception INPFC areas in 1984, 1986, 1988, and 1991. The abbreviation 'na' is not applicable, i.e., depths that were not part of the survey design for that particular year.

[b] Grades are as follows: All is all grades; L is large; and M is medium.

[c] Percents in parentheses denote percentage (in number) of 'Large' sablefish in the pot survey catches.

Table 7. Sablefish catch rates (mean number per pot) by grade, year, and area in the pot surveys conducted by NMFS (1979-91). Estimates are for the 225-450 fm depth interval.

			Grade[a]					
Year	**Area**[b]	**No. sites**	X-S	S	M	L	M and L	All
1979[c]	N	4	2.9	7.1	1.4	1.2	2.6	12.6
80	N	4	2.1	3.1	0.4	0.4	0.8	6.0
81	N	4	2.1	2.7	0.4	0.3	0.7	5.4
83	N	4	5.0	5.4	0.7	0.5	1.2	11.5
84	S	7	5.0	4.9	0.7	0.3	1.0	10.9
85	N	8	4.5	2.9	0.4	0.3	0.7	8.1
86	S	7	2.0	2.1	0.4	0.2	0.6	4.7
87	N	8	1.4	1.4	0.2	0.1	0.3	3.2
88	S	7	6.4	3.3	0.3	0.1	0.4	10.1
89	N	8	1.2	1.2	0.1	0.1	0.2	2.6
91	S	7	1.7	1.1	0.2	0.1	0.3	3.2
1983-89[d]	N	28	3.0	2.7	0.4	0.2	0.6	6.3
84-91	S	28	3.8	2.9	0.4	0.2	0.6	7.2

[a] Grades are as follows: X-S is extra-small (≤51 cm); S is small (52-61 cm); M is medium (62-67 cm); L is large (≥68 cm); and All is all grades.

[b] Areas are as follows: N is North (U.S. Vancouver and Columbia INPFC areas); and S is South (Eureka and Monterey INPFC areas only, i.e., Conception area is omitted).

[c] Larger mesh was used in pot surveys from 1979-81 than for 1983-91 and thus, estimates for extra-small fish should be interpreted with caution.

[d] Mean estimates are presented for the ranges 1983-89 (i.e., years 1983, 1985, 1987, 1989) and 1984-91 (i.e., years 1984, 1986, 1988, 1991).

Table 8. Predicted proportion positive, catch rate given a positive haul (kg/2 ha) and biomass (1000 mt/2 ha) of sablefish from the Delta-GLM applied to AFSC slope survey.

Predicted proportion positive based on results from the Delta-GLM model

	Vancouver				Columbia				Eureka				Monterey				Conception			
	183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m	
Year	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV
1992*	0.99	0.02	0.99	0.01	0.98	0.02	0.99	0.01	0.96	0.03	0.98	0.02	0.97	0.03	0.99	0.02	-	-	-	-
1996*	0.98	0.03	0.99	0.01	0.98	0.02	0.99	0.01	0.95	0.05	0.98	0.02	-	-	-	-	-	-	-	-
1997	0.96	0.06	0.98	0.03	0.95	0.05	0.98	0.03	0.87	0.10	0.94	0.05	0.89	0.08	0.95	0.04	0.92	0.09	0.96	0.05
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	0.96	0.06	0.98	0.03	0.95	0.05	0.98	0.03	0.87	0.10	0.94	0.05	0.89	0.08	0.95	0.04	0.92	0.09	0.97	0.05
2000	0.99	0.03	1.00	0.01	0.99	0.03	1.00	0.01	0.98	0.06	0.99	0.02	0.98	0.05	0.99	0.02	0.99	0.05	1.00	0.02
2001	0.99	0.03	1.00	0.01	0.99	0.03	1.00	0.01	0.98	0.05	0.99	0.02	0.99	0.04	0.99	0.02	0.99	0.02	1.00	0.03
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Predicted catch rate (kg/2Ha) given positive haul based on results from the Delta-GLM model

	Vancouver				Columbia				Eureka				Monterey				Conception			
	183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m	
Year	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv	mean	cv
1992*	18.7	0.22	13.1	0.18	10.0	0.15	13.2	0.12	11.6	0.18	20.7	0.11	10.2	0.21	16.0	0.17	-	-	-	-
1996*	10.2	0.21	10.5	0.16	10.9	0.15	15.6	0.13	7.0	0.19	15.2	0.13	-	-	-	-	-	-	-	-
1997	14.0	0.38	9.4	0.29	15.1	0.27	22.1	0.22	39.7	0.38	18.9	0.26	8.3	0.30	20.1	0.19	3.2	0.38	16.3	0.27
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	8.8	0.32	11.8	0.22	11.0	0.25	13.1	0.20	3.7	0.41	14.1	0.24	6.1	0.26	12.4	0.18	10.1	0.38	15.4	0.27
2000	14.6	0.36	15.5	0.22	11.5	0.26	14.8	0.20	9.4	0.37	21.2	0.26	12.1	0.24	15.9	0.17	10.0	0.36	13.4	0.26
2001	14.1	0.37	13.7	0.22	14.0	0.24	13.6	0.20	24.8	0.35	14.1	0.25	18.6	0.25	20.5	0.17	8.6	0.17	21.8	0.26
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Predicted biomass (mt) by strata.

	Vancouver				Columbia				Eureka				Monterey				Conception			
	183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m		183-567 m		567-1280 m	
Year	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv	bio.	cv
1992*	2656	0.22	3845	0.18	3510	0.15	3689	0.12	1417	0.18	6624	0.11	1764	0.22	6640	0.17	-	-	-	-
1996*	1437	0.21	3061	0.16	3773	0.15	4335	0.13	852	0.20	4823	0.13	-	-	-	-	-	-	-	-
1997	1898	0.39	2703	0.29	5020	0.27	6047	0.22	4307	0.41	5747	0.26	1321	0.31	8047	0.19	1998	0.40	26005	0.28
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	1205	0.32	3401	0.22	3654	0.26	3572	0.21	406	0.42	4267	0.25	972	0.27	4954	0.19	6325	0.38	24487	0.28
2000	2067	0.37	4553	0.22	4034	0.26	4146	0.20	1151	0.38	6832	0.26	2129	0.24	6660	0.17	6663	0.37	22047	0.26
2001	2006	0.37	4009	0.22	4913	0.25	3808	0.20	3091	0.36	4550	0.25	3276	0.26	8572	0.17	5758	0.17	36156	0.26
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Year designation for a composite of years with differential spatial coverage referred to as "super years."

"1992" = 1990, 1991, 1992, 1993; and "1996" = 1995, 1996.

For the "1992 super-year" category the FRV Miller Freeman only extended as far south as Monterey, and for the "1996 super-year" as far south as Eureka.

Table 9. Predicted proportion positive, catch rate given a positive haul (kg/2 ha) and biomass (1000 mt/2 ha) of sablefish from the Delta-GLM applied to NWFSC slope survey.

Predicted proportion positive based on results from the Delta-GLM model

	Vancouver				**Columbia**				**Eureka**				**Monterey**				**Conception**			
	183-567 m		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**	
Year	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV	fraction pos.	CV
1992*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	0.7	0.07	0.9	0.04	0.9	0.04	0.9	0.02	0.9	0.04	0.9	0.02	0.8	0.05	0.9	0.03	0.5	0.12	0.7	0.07
1999	0.8	0.05	0.9	0.03	0.9	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.9	0.03	0.9	0.02	0.7	0.08	0.8	0.05
2000	0.9	0.04	0.9	0.02	0.9	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.7	0.07	0.9	0.04
2001	0.9	0.03	0.9	0.02	0.9	0.02	1.0	0.01	1.0	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.8	0.01	0.9	0.03
2002	0.9	0.03	0.9	0.02	0.9	0.01	1.0	0.01	1.0	0.01	1.0	0.01	0.9	0.02	1.0	0.01	0.8	0.05	0.9	0.03
2003	0.9	0.04	0.9	0.02	0.9	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.9	0.03	1.0	0.01	0.7	0.06	0.9	0.04
2004	0.8	0.05	0.9	0.03	0.9	0.02	1.0	0.01	0.9	0.02	1.0	0.01	0.9	0.03	0.9	0.02	0.7	0.08	0.8	0.05

Predicted catch rate (kg/2Ha) given positive haul based on results from the Delta-GLM model

	Vancouver				**Columbia**				**Eureka**				**Monterey**				**Conception**			
	183-567 m		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**	
Year	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**	**mean**	**cv**
1992*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	7.1	0.30	10.4	0.26	7.9	0.18	12.9	0.19	7.0	0.23	9.1	0.20	4.5	0.21	8.3	0.15	9.8	0.52	16.7	0.29
1999	8.4	0.26	10.0	0.22	13.5	0.18	16.9	0.17	9.5	0.23	14.0	0.19	9.5	0.18	12.0	0.16	3.7	0.33	11.8	0.29
2000	10.1	0.26	14.8	0.28	16.6	0.19	14.8	0.18	9.6	0.23	13.3	0.18	8.0	0.17	10.3	0.16	10.3	0.28	16.1	0.28
2001	8.7	0.24	12.1	0.23	10.8	0.16	7.3	0.22	14.4	0.20	10.4	0.18	6.8	0.17	12.6	0.14	10.0	0.14	15.9	0.27
2002	8.6	0.24	13.6	0.24	16.1	0.15	8.9	0.18	16.2	0.20	13.1	0.19	11.9	0.15	12.9	0.15	7.0	0.18	8.3	0.16
2003	20.8	0.21	11.3	0.16	21.6	0.22	11.6	0.18	22.5	0.18	13.2	0.18	13.9	0.18	11.4	0.22	4.8	0.18	7.0	0.25
2004	56.7	0.35	18.8	0.30	16.0	0.18	10.8	0.26	57.0	0.30	18.8	0.25	24.0	0.29	13.4	0.24	8.8	0.22	11.2	0.18

Predicted biomass (mt) by strata.

	Vancouver				**Columbia**				**Eureka**				**Monterey**				**Conception**			
	183-567 m		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**		**183-567 m**		**567-1280 m**	
Year	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**	**bio.**	**cv**
1992*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	742	0.31	2632	0.27	2406	0.18	3382	0.19	782	0.23	2779	0.20	648	0.22	3153	0.15	3571	0.56	20040	0.30
1999	998	0.26	2697	0.22	4391	0.18	4581	0.17	1129	0.23	4401	0.19	1511	0.18	4759	0.16	1715	0.34	16164	0.29
2000	1254	0.27	4055	0.28	5513	0.20	4043	0.18	1157	0.23	4234	0.18	1308	0.17	4168	0.16	5269	0.30	23166	0.28
2001	1103	0.24	3381	0.23	3650	0.16	2009	0.22	1750	0.20	3320	0.18	1131	0.17	5132	0.15	5219	0.15	23104	0.27
2002	1094	0.24	3793	0.24	5393	0.15	2449	0.18	1975	0.20	4174	0.19	1965	0.16	5245	0.15	3645	0.19	12199	0.16
2003	2575	0.22	3114	0.16	7219	0.22	3179	0.18	2732	0.18	4210	0.18	2276	0.19	4590	0.22	2396	0.19	9967	0.26
2004	6636	0.35	5014	0.30	5187	0.18	2924	0.26	6758	0.29	5879	0.25	3790	0.29	5315	0.24	3998	0.23	15160	0.18

* Year designation for a composite of years with differential spatial coverage referred to as "super years."

"1992" = 1990, 1991, 1992, 1993; and "1996" = 1995, 1996.

For the "1992 super-year" category the FRV Miller Freeman only extended as far south as Monterey, and for the "1996 super-year" as far south as Eureka.

Table 10. Estimated log Likelihood based on the various model configurations. Run 1: short time series of catch (1971-2004) with no environmental effect on recruitment deviations; Run 2: short time series of catch with environmental effect on recruitment deviations (1971-2005); Run 3: long time series of catch (1900-2004) with no environmental effect on recruitment deviations; Run 4: long time series of catch (1900-2005) with environmental effect on recruitment deviations (1925-2005).

RUN 1 / NoENV

Fleet	surv_lamb	surv_like	disc_lamb	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like	LIKELIHOOD	1873.37	Source
1	1	0	0.1	7.28321	1	219.775	1	101.419	0.1	510.64	indices	-11.0556	mean_body_w
2	1	0	0.1	5.38495	1	111.508	1	61.3337	0.1	481.685	discard	16.7731	Equil_catch
3	1	0	0.1	155.063	1	235.926	1	118.675	0.1	1167.13	length_comps	917.537	Recruitment
4	0	0	0	0	0	0	0	0	0	0	age_comps	497.581	Parm_priors
5	1	-4.67671	0	0	1	159.469	1	69.9003	0.1	0	size-at-age	430.919	Parm_devs
6	0	0	0	0	0	0	0	0	0.1	93.4923	mean_body_wt	1.89222	penalties
7	1	11.4216	0	0	1	0	1	0	0.1	0	Equil_catch	6.25E-06	
8	1	-6.13322	0	0	1	77.6538	1	70.9709	0.1	1209.68	Recruitment	2.20131	
9	1	-7.63091	0	0	1	66.1584	1	48.0067	0.1	691.156	Parm_priors	4.05739	
10	1	-4.87474	0	0	1	0	1	0	0.1	0	Parm_devs	18.4646	
11	0	0	0	0	1	47.0454	1	27.2753	0.1	80.125	penalties	0	
12	1	0.838374	0	0	0	0	0	0	0.1	0	Forecast_Recruitment	-5.0044	
13	0	0	0	0	0	0	0	0	0.1	75.2835			

RUN 2 / ENV

Fleet	surv_lamb	surv_like	disc_lamb	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like	LIKELIHOOD	1870.1	Source
1	1	0	0.1	7.28321	1	221.14	1	103.87	0.1	512.998	indices	-10.6647	mean_body_w
2	1	0	0.1	5.38495	1	112.625	1	61.5131	0.1	477.807	discard	16.7297	Equil_catch
3	1	0	0.1	154.628	1	236.965	1	121.433	0.1	1184.06	length_comps	928.539	Recruitment
4	0	0	0	0	0	0	0	0	0	0	age_comps	501.621	Parm_priors
5	1	-4.015	0	0	1	167.943	1	76.5632	0.1	0	size-at-age	431.769	Parm_devs
6	0	0	0	0	0	0	0	0	0.1	92.6593	mean_body_wt	1.89367	penalties
7	1	10.7213	0	0	1	0	1	0	0.1	0	Equil_catch	2.19E-05	
8	1	-5.63268	0	0	1	75.5744	1	65.1226	0.1	1207.39	Recruitment	-8.98956	
9	1	-7.39227	0	0	1	67.3735	1	43.8513	0.1	687.614	Parm_priors	3.88084	
10	1	-3.8269	0	0	1	0	1	0	0.1	0	Parm_devs	20.6004	
11	0	0	0	0	1	46.9181	1	29.2686	0.1	79.3499	penalties	0	
12	1	-0.51922	0	0	0	0	0	0	0.1	0	Forecast_Recruitment	-15.2756	
13	0	0	0	0	0	0	0	0	0.1	75.8161			

RUN 3 / NoENV

Fleet	surv_lamb	surv_like	disc_lamb	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like	LIKELIHOOD	1870.4	Source
1	1	0	0.1	7.28321	1	219.889	1	101.572	0.1	510.512	indices	-11.0975	mean_body_w
2	1	0	0.1	5.38495	1	111.817	1	61.2866	0.1	481.588	discard	16.6397	Equil_catch
3	1	0	0.1	153.729	1	235.816	1	118.246	0.1	1166.73	length_comps	917.977	Recruitment
4	0	0	0	0	0	0	0	0	0	0	age_comps	497.123	Parm_priors
5	1	-4.65584	0	0	1	159.58	1	69.9345	0.1	0	size-at-age	430.905	Parm_devs
6	0	0	0	0	0	0	0	0	0.1	93.461	mean_body_wt	2.04986	penalties
7	1	11.3025	0	0	1	0	1	0	0.1	0	Equil_catch	0	
8	1	-6.13617	0	0	1	77.622	1	71.0233	0.1	1209.47	Recruitment	-1.08791	
9	1	-7.64023	0	0	1	66.1355	1	47.9774	0.1	691.672	Parm_priors	4.00182	
10	1	-4.8912	0	0	1	0	1	0	0.1	0	Parm_devs	18.5183	
11	0	0	0	0	1	47.1183	1	27.0828	0.1	80.2799	penalties	0	
12	1	0.923393	0	0	0	0	0	0	0.1	0	Forecast_Recruitment	-4.62795	
13	0	0	0	0	0	0	0	0	0.1	75.3319			

RUN 4 / ENV

Fleet	surv_lamb	surv_like	disc_lamb	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like	LIKELIHOOD	1808.83	Source
1	1	0	0.1	7.28321	1	222.417	1	103.348	0.1	512.961	indices	-10.9613	mean_body_w
2	1	0	0.1	5.38495	1	112.191	1	61.5427	0.1	477.888	discard	16.7815	Equil_catch
3	1	0	0.1	155.147	1	236.691	1	118.988	0.1	1182.35	length_comps	929.03	Recruitment
4	0	0	0	0	0	0	0	0	0	0	age_comps	499.095	Parm_priors
5	1	-4.16589	0	0	1	167.104	1	76.3955	0.1	0	size-at-age	432.596	Parm_devs
6	0	0	0	0	0	0	0	0	0.1	92.8399	mean_body_wt	2.03276	penalties
7	1	10.6463	0	0	1	0	1	0	0.1	0	Equil_catch	0	
8	1	-5.72179	0	0	1	76.8902	1	65.5628	0.1	1215.4	Recruitment	-69.0096	
9	1	-7.48498	0	0	1	67.0771	1	44.2186	0.1	689.581	Parm_priors	4.07749	
10	1	-3.72058	0	0	1	0	1	0	0.1	0	Parm_devs	20.5483	
11	0	0	0	0	1	46.6599	1	29.04	0.1	79.2817	penalties	0	
12	1	-0.514388	0	0	0	0	0	0	0.1	0	Forecast_Recruitment	-15.3616	
13	0	0	0	0	0	0	0	0	0.1	75.6589			

Table 11. Base Model (Run 4) time series of beginning year total biomass (ages 1+), beginning year summary biomass (ages 2+), spawning stock biomass, number of recruits, exploitation, yield, depletion, and SPR from the base model.

YEAR	BGTOTBIO	BGSUMBIO	SPAWN	RECRUIT	EXPLOIT	YIELD	DEPLETE	SPR
Virgin	723474	709575	349066	28651.5				
Equil	723474	709575	349066	28651.5				
1950	508385	502397	249836	21851	0.0036	1819	0.716	0.932
1951	499822	490034	246974	15784	0.0058	2890	0.708	0.889
1952	490788	482938	242061	17231	0.0034	1656	0.693	0.932
1953	483469	475271	237464	16037	0.0021	1031	0.680	0.958
1954	477025	469507	233707	14081	0.0038	1834	0.670	0.927
1955	470572	463034	230038	19365	0.0039	1834	0.659	0.926
1956	464353	455794	226691	13122	0.0080	3692	0.649	0.845
1957	456235	449681	222810	14555	0.0066	2993	0.638	0.878
1958	448371	441834	219192	10647	0.0041	1830	0.628	0.919
1959	441230	435548	216386	14521	0.0061	2705	0.620	0.883
1960	433361	426214	212977	15303	0.0082	3533	0.610	0.847
1961	425444	417770	208797	17193	0.0061	2582	0.598	0.880
1962	420119	411083	204942	22409	0.0074	3125	0.587	0.852
1963	415464	405602	201129	14904	0.0053	2189	0.576	0.896
1964	414155	405145	198312	28225	0.0063	2602	0.568	0.882
1965	414492	401827	196257	20571	0.0063	2594	0.562	0.883
1966	416929	406303	195160	25430	0.0041	1719	0.559	0.922
1967	421100	409749	195489	18080	0.0108	4546	0.560	0.816
1968	423954	413991	195499	27005	0.0071	3004	0.560	0.875
1969	427896	416411	197178	14946	0.0135	5765	0.565	0.781
1970	430344	420872	197777	31570	0.0094	4024	0.567	0.839
1971	434163	420709	199636	17706	0.0100	4342	0.572	0.827
1972	436911	428334	201228	17640	0.0170	7448	0.576	0.731
1973	436545	426917	201429	25687	0.0136	5932	0.577	0.773
1974	436426	425407	202539	14969	0.0203	8847	0.580	0.689
1975	433019	425020	201375	20515	0.0253	10942	0.577	0.620
1976	426632	417227	198855	16479	0.0578	24641	0.570	0.346
1977	407906	398972	189010	23549	0.0230	9376	0.541	0.641
1978	402644	392252	186202	15897	0.0344	13855	0.533	0.510
1979	394206	384952	181346	27681	0.0625	24646	0.520	0.310
1980	375481	364526	171261	16549	0.0248	9313	0.491	0.612
1981	372214	364006	168571	17943	0.0315	11726	0.483	0.546
1982	366180	357754	165600	15981	0.0516	18900	0.474	0.375
1983	351663	344780	160090	10433	0.0410	14417	0.459	0.458
1984	339995	334598	155928	13009	0.0393	13355	0.447	0.463
1985	329130	321682	151928	21753	0.0488	16071	0.435	0.389
1986	315218	306504	145757	17687	0.0453	14279	0.418	0.404
1987	305137	296637	139769	17402	0.0455	13885	0.400	0.406
1988	294147	288111	134318	14782	0.0431	12673	0.385	0.406
1989	287633	279787	130329	16744	0.0405	11646	0.373	0.445
1990	281340	273295	127067	17676	0.0374	10510	0.364	0.479
1991	278912	268497	124286	10610	0.0378	10529	0.356	0.475
1992	276129	265736	122065	7081	0.0385	10632	0.350	0.470
1993	266906	260633	120140	4890	0.0350	9355	0.344	0.510
1994	256593	253666	118875	9126	0.0327	8393	0.341	0.548
1995	246663	241858	116921	13643	0.0363	8947	0.335	0.507
1996	236207	230730	113201	3585	0.0400	9449	0.324	0.486
1997	225038	222515	107854	1897	0.0398	8953	0.309	0.453
1998	213256	210782	102859	8955	0.0233	4968	0.295	0.631
1999	205448	201377	99856	21978	0.0365	7494	0.286	0.482
2000	200028	190567	95567	22334	0.0350	6994	0.274	0.485
2001	198175	189723	91135	14167	0.0321	6358	0.261	0.528
2002	199727	193435	87240	8747	0.0212	4237	0.250	0.662
2003	202310	198768	86657	3516	0.0300	6077	0.248	0.586
2004	201944	199543	87628	8718	0.0306	6181	0.251	0.591

APPENDIX I - STAR PANEL REQUESTS

Request: Monday, June 20, 2005

1) To compromise between "infinite prior ignorance," which gives us steepness=0.2, and "infinite prior certainty," which gives us steepness=0.40, we would like an alternative run with informative priors:
a) normal prior on M with mean = 0.07 and standard deviation = 0.021
b) normal prior on steepness with mean = 0.40 and standard deviation = 0.12.

Response: The specified priors were placed on natural mortality (M) and steepness (r). These priors were chosen based on the values used in the previous assessment. However, in the previous assessment these parameters were fixed at these values. Using informative priors decreased the value of M from 0.07 to 0.058 (SD = 0.003), and had little to no effect on the value of steepness, which was estimated at 0.20 (SD = 0.0002). The resulting depletion changed level changed from approximately 25% to approximately 33 percent, while to model likelihood decreased from 1899 to 1995 units.

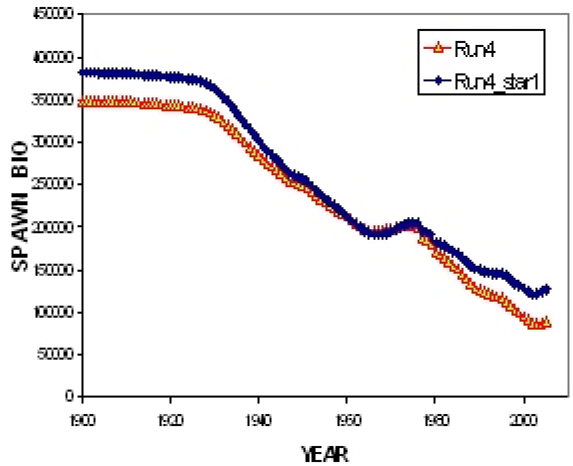


Figure STAR.1. *Spawning stock biomass for Run4 (base run) and Run4_STAR1 where natural mortality and steepness were assigned informative priors.*

RUN4_STAR1

Fleet	surv lambc	surv_like	disc lambc	disc_like	length lam	length_like	age lambd	age_like	sizeage la	sizeage_like
1	1	0	0.1	7.28321	1	220.306	1	102.669	0.1	513.765
2	1	0	0.1	5.38495	1	111.268	1	61.3519	0.1	479.117
3	1	0	0.1	151.965	1	237.866	1	118.534	0.1	1171.26
4	0	0	0	0	0	0	0	0	0	0
5	1	-4.59941	0	0	1	166.369	1	75.2248	0.1	0
6	0	0	0	0	1	67.5943	1	20.6264	0.1	94.1133
7	1	13.0781	0	0	1	0	1	0	0.1	0
8	1	-6.28963	0	0	1	76.6739	1	67.3299	0.1	1204.04
9	1	-8.09447	0	0	1	66.9972	1	45.3182	0.1	689.555
10	1	-5.01316	0	0	1	0	1	0	0.1	0
11	0	0	0	0	1	50.5688	1	29.362	0.1	78.5279
12	1	0.624981	0	0	1	0	1	0	0.1	0
13	0	0	0	0	0	0	0	0	0.1	75.6971

LIKELIHOOD	1895.38
indices	-10.2936
discard	16.4633
length_comps	997.643
age_comps	520.416
size-at-age	430.608
mean_body_wt	2.04632
Equil_catch	0
Recruitment	-70.9529
Parm_priors	5.70811
Parm_devs	19.1055
penalties	0
Forecast_Recruitment	-15.3616

Source	Lambda	Like
mean_body_v	1	2.04632
Equil_catch	1	0
Recruitment	1	-70.9529
Parm_priors	1	5.70811
Parm_devs	1	19.1055
penalties	0	

Request: Monday, June 20, 2005 (cont.)

2) Expanded outputs: A table that shows the key parameters and results (e.g., SSB in current year, R in current year, BO, RO, depletion; error bars on all of the above) for the four model configurations, along the lines of the decision table in the document.

Response: The requested expanded output is provided below. Run1 uses the short time series of catch with no ENV effect on recruitment; RUN2 uses the short times series of catch with ENV effect on recruitment; RUN3 uses the long time series of catch with no ENV effect on recruitment; RUN4 uses the long time series of catch and an ENV effect on recruitment.

RUN 1

	Estimate	SE	LCI	UCI
SSB cur =	165260	59977	45306	285214
R cur =	12557	9284	0	31124.2
B0 =	368270	80954	206362	530178
R0 =	30004	6448	17108	42900
Dep 2005 =	0.449	0.075	0.299	0.599

RUN 2

	Estimate	SE	LCI	UCI
SSB cur =	79117	17205	44707	113527
R cur =	5695	2043	1608.75	9780.75
B0 =	226350	20124	186102	266598
R0 =	18602	1600	15401.2	21802.8
Dep 2005 =	0.350	0.052	0.245	0.454

RUN 3

	Estimate	SE	LCI	UCI
SSB cur =	174700	11042	152616	196784
R cur =	12876	9582	0	32040.2
B0 =	406260	42498	321264	491256
R0 =	33011	3316	26379.6	39642.4
Dep 2005 =	0.430	0.042	0.347	0.514

RUN 4

	Estimate	SE	LCI	UCI
SSB cur =	88829	20429	47971	129687
R cur =	6592	2407	1778	11406
B0 =	349070	25230	298610	399530
R0 =	28652	1975	24701	32603
Dep 2005 =	0.254	0.045	0.165	0.344

Request: Monday, June 20, 2005 (cont.)

3) Plot the growth curve.

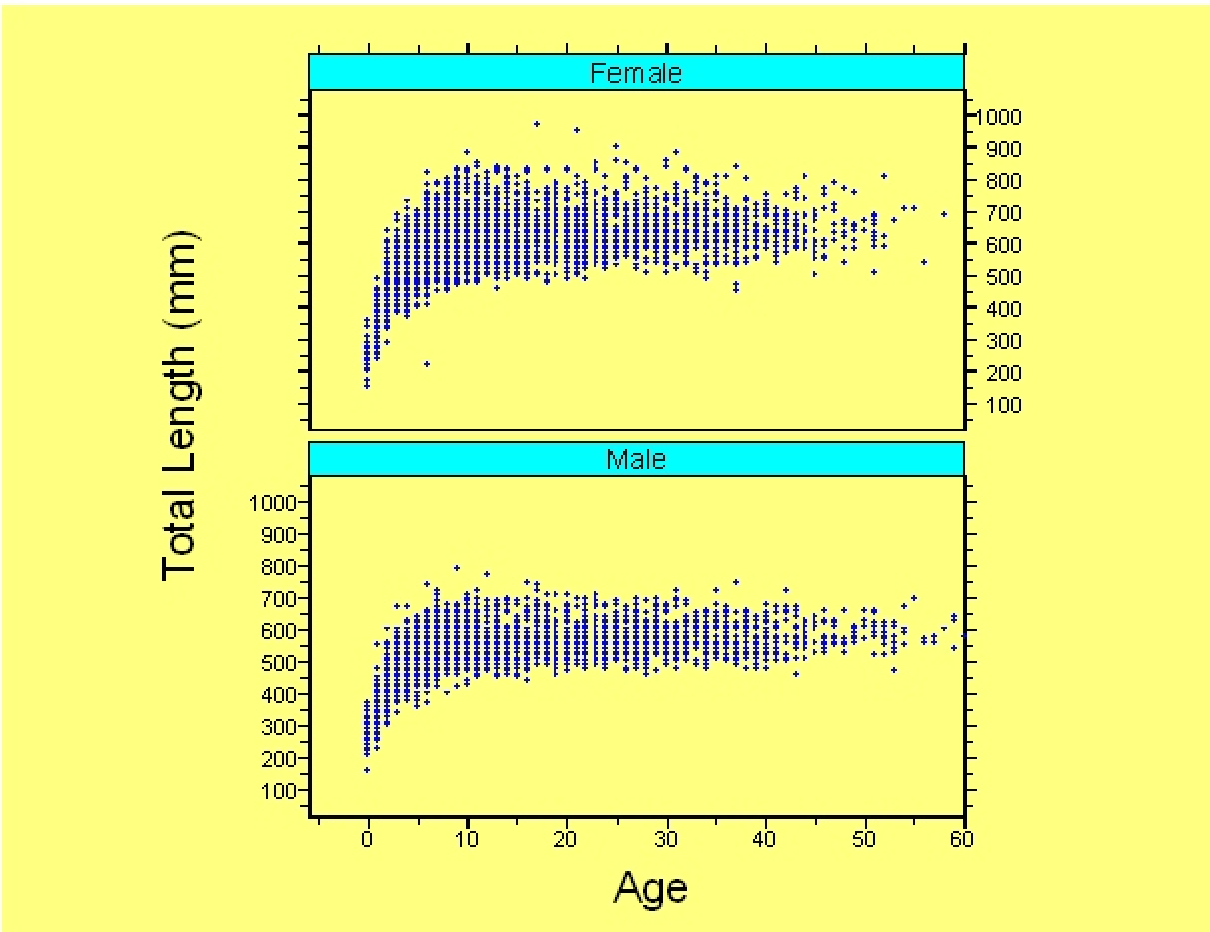


Figure STAR.2. *Size-at-age for female and male sablefish*

Request: Monday, June 20, 2005 (cont.)

4) To test sensitivity of extrapolation beyond the range of the recruitment data, we would like an alternative run with environment "turned off' for the years outside the period within which the environment-stock_recruitment relationship was fit (Michael: this means we would pretend that we have no sea level data prior to 1973 or after 2004).

Response: The response to this request is shown in the accompanying figures. The result of removing any ENV data prior to 1973 was to decrease the level B0 (Figure STAR.3). This was a result of removing the period of relatively low recruitment in the 1940's and 50's.

However, worth noting is Figure STAR.4 that shows the overlap of the range of the data for the two time periods (essentially pre- and post-1973). This figure shows that there is actually considerable overlap in ENV and recruitment deviation for the two time periods.

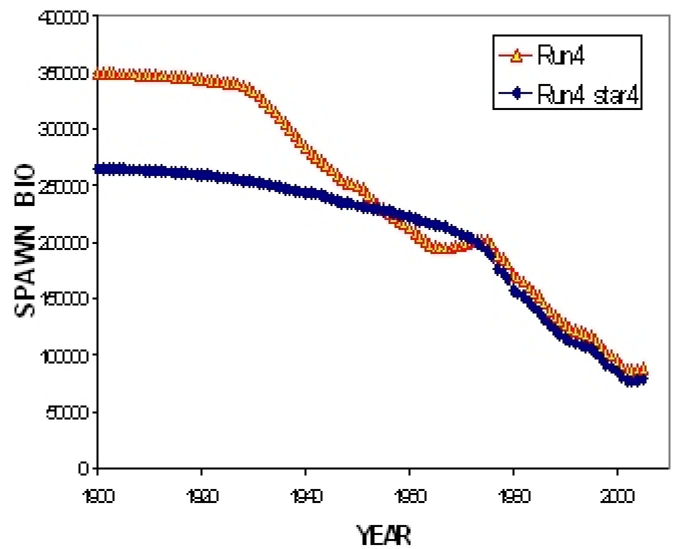


Figure STAR.3. *Spawning stock biomass for Run4 (base run) and Run4_STAR1 where natural mortality and steepness were assigned informative priors.*

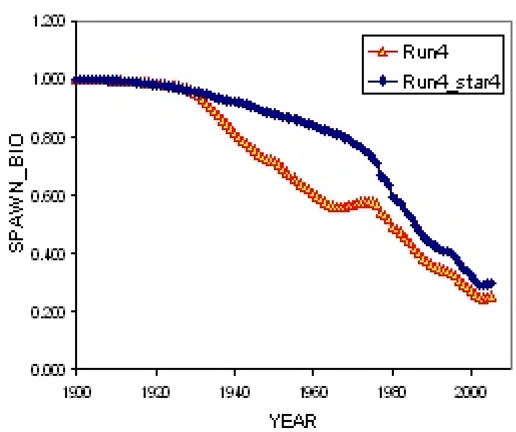


Figure STAR.4. *Depletion for RUN4 (base run) and RUN4_STAR1 where natural mortality and steepness were assigned informative priors.*

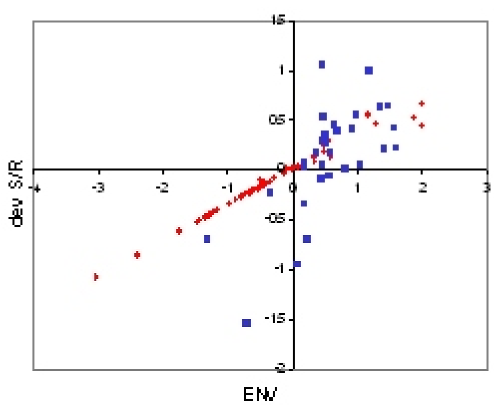


Figure STAR.5. *ENV data versus recruit devs for RUN4. Blue squares represent 1973-2003 data and red circles represent 1924-1972.*

Request: Monday, June 20, 2005 (cont.)

5) To gauge the improvement gained by estimating M and other things we have requested, we would like Michael to "refresh" Table 8 with final likelihoods, including the run with M estimated and any alternative runs requested in this list.

RUN 1 / NoENV

Fleet	surv lambda	surv_like	disc lambda	disc_like	length lam	length_like	age lambda	age_like	sizeage la	sizeage_like	LIKELIHOOD	1963.13
1	1	0	0.1	7.28321	1	219.47	1	101.653	0.1	512.058	indices	-11.0763
2	1	0	0.1	5.38495	1	112.216	1	60.9593	0.1	479.885	discard	16.4571
3	1	0	0.1	151.903	1	237.214	1	118.429	0.1	1155.85	length_comps	989.976
4	0	0	0	0	0	0	0	0	0	0	age_comps	517.601
5	1	-4.7595	0	0	1	161.066	1	69.8703	0.1	0	size-at-age	428.442
6	0	0	0	0	1	66.067	1	19.6864	0.1	94.1787	mean_body_wt	1.89216
7	1	11.8802	0	0	1	0	1	0	0.1	0	Equil_catch	8.78E-06
8	1	-6.11712	0	0	1	76.5812	1	71.1683	0.1	1198.71	Recruitment	2.19564
9	1	-7.67324	0	0	1	66.8699	1	47.4135	0.1	689.119	Parm_priors	4.30768
10	1	-5.14743	0	0	1	0	1	0	0.1	0	Parm_devs	18.3365
11	0	0	0	0	1	50.4909	1	28.4213	0.1	78.9261	penalties	0
12	1	0.740788	0	0	1	0	1	0	0.1	0	Forecast_Recruitment	-5.00305
13	0	0	0	0	0	0	0	0	0.1	75.688		

RUN 2 / ENV

Fleet	surv lambda	surv_like	disc lambda	disc_like	length lam	length_like	age lambda	age_like	sizeage la	sizeage_like	LIKELIHOOD	1960.69
1	1	0	0.1	7.28321	1	221.053	1	103.925	0.1	514.571	indices	-10.7073
2	1	0	0.1	5.38495	1	113.157	1	61.3199	0.1	477.233	discard	16.3231
3	1	0	0.1	150.562	1	238.003	1	121.125	0.1	1172.69	length_comps	1001.62
4	0	0	0	0	0	0	0	0	0	0	age_comps	520.537
5	1	-4.04261	0	0	1	169.152	1	76.2888	0.1	0	size-at-age	430.46
6	0	0	0	0	1	65.5072	1	19.4359	0.1	93.4791	mean_body_wt	1.89358
7	1	10.9036	0	0	1	0	1	0	0.1	0	Equil_catch	8.54E-06
8	1	-5.62356	0	0	1	75.8035	1	65.346	0.1	1204.57	Recruitment	-8.68672
9	1	-7.40806	0	0	1	67.9217	1	43.6079	0.1	687.004	Parm_priors	4.09452
10	1	-4.15144	0	0	1	0	1	0	0.1	0	Parm_devs	20.4335
11	0	0	0	0	1	51.0217	1	29.4884	0.1	78.9999	penalties	0
12	1	-0.385265	0	0	1	0	1	0	0.1	0	Forecast_Recruitment	-15.2756
13	0	0	0	0	0	0	0	0	0.1	76.0521		

RUN 3 / NoENV

Fleet	surv lambda	surv_like	disc lambda	disc_like	length lam	length_like	age lambda	age_like	sizeage la	sizeage_like		1963.858
											LIKELIHOOD	1959.23
1	1	0	0.1	7.28321	1	218.972	1	101.795	0.1	511.893	indices	-11.1938
2	1	0	0.1	5.38495	1	112.767	1	60.7028	0.1	480.227	discard	16.3607
3	1	0	0.1	150.939	1	237.348	1	119.004	0.1	1155.36	length_comps	988.99
4	0	0	0	0	0	0	0	0	0	0	age_comps	518.115
5	1	-4.75887	0	0	1	161.112	1	69.9504	0.1	0	size-at-age	428.527
6	0	0	0	0	1	64.9282	1	19.3646	0.1	94.2183	mean_body_wt	2.06115
7	1	11.8423	0	0	1	0	1	0	0.1	0	Equil_catch	0
8	1	-6.14368	0	0	1	76.5349	1	71.2707	0.1	1199.09	Recruitment	-1.42645
9	1	-7.70028	0	0	1	66.7973	1	47.4674	0.1	689.698	Parm_priors	4.16696
10	1	-5.28096	0	0	1	0	1	0	0.1	0	Parm_devs	18.2612
11	0	0	0	0	1	50.5302	1	28.56	0.1	79.1143	penalties	0
12	1	0.847739	0	0	1	0	1	0	0.1	0	Forecast_Recruitment	-4.62795
13	0	0	0	0	0	0	0	0	0.1	75.6634		

RUN 4 / ENV

Fleet	surv lambda	surv_like	disc lambda	disc_like	length lam	length_like	age lambda	age_like	sizeage la	sizeage_like		1914.942
											LIKELIHOOD	1899.58
1	1	0	0.1	7.28321	1	221.507	1	103.515	0.1	514.309	indices	-10.9426
2	1	0	0.1	5.38495	1	112.542	1	61.3643	0.1	476.849	discard	16.3958
3	1	0	0.1	151.29	1	237.942	1	118.899	0.1	1172.29	length_comps	1001.85
4	0	0	0	0	0	0	0	0	0	0	age_comps	518.585
5	1	-4.20891	0	0	1	168.52	1	76.1789	0.1	0	size-at-age	430.319
6	0	0	0	0	1	66.7927	1	19.9718	0.1	93.5369	mean_body_wt	2.04492
7	1	10.8946	0	0	1	0	1	0	0.1	0	Equil_catch	0
8	1	-5.72049	0	0	1	76.0713	1	65.6389	0.1	1203.56	Recruitment	-67.9062
9	1	-7.48149	0	0	1	67.7387	1	43.9156	0.1	687.844	Parm_priors	4.2736
10	1	-4.1171	0	0	1	0	1	0	0.1	0	Parm_devs	20.3197
11	0	0	0	0	1	50.7383	1	29.1016	0.1	78.765	penalties	0
12	1	-0.309255	0	0	1	0	1	0	0.1	0	Forecast_Recruitment	-15.3616
13	0	0	0	0	0	0	0	0	0.1	76.0341		

RUN 4 / EstM

Fleet	surv lambda	surv_like	disc lambda	disc_like	length lam	length_like	age lambda	age_like	sizeage la	sizeage_like	LIKELIHOOD	1893.72
1	1	0	0.1	7.28321	1	222.302	1	102.757	0.1	517.447	indices	-10.2676
2	1	0	0.1	5.38495	1	114.232	1	60.0139	0.1	469.406	discard	16.1601
3	1	0	0.1	148.933	1	236.409	1	117.72	0.1	1175.24	length_comps	997.294
4	0	0	0	0	0	0	0	0	0	0	age_comps	519.214
5	1	-4.38624	0	0	1	165.921	1	74.5145	0.1	0	size-at-age	431.41
6	0	0	0	0	1	66.8283	1	20.6781	0.1	93.6763	mean_body_wt	2.04058
7	1	13.1413	0	0	1	0	1	0	0.1	0	Equil_catch	0
8	1	-6.45197	0	0	1	75.8112	1	67.0974	0.1	1204.57	Recruitment	-69.4677

Request: Monday, June 20, 2005 (cont.)

6) For the same reason given in (1), we would like another alternative run with bounded normal priors (bounded at zero):
a) M: mean = 0.07 and standard deviation = 0.14
b) steepness: mean = 0.40 and standard deviation = 0.80

Response: This run was similar to RUN4_STAR1. Priors on M and steepness were the same except that they were given a 20% CV (rather than the 30% as in RUN4_STAR1). The resulting parameters estimates from this run were: M = 0.058, SD = 0.003; steepness = 0.20, SD <0.0001. These results were not surprising given the results from RUN4_STAR1. The posteriors estimates were estimated to be nearly identical to those estimate in RUN4_STAR1.

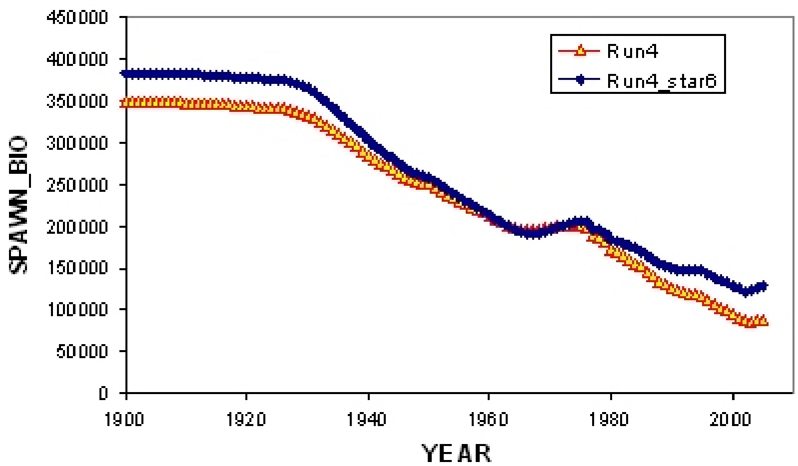


Figure STAR.6. *Spawning stock biomass for Run4 (base run) and Run4_STAR6 where natural mortality and steepness were assigned informative priors.*

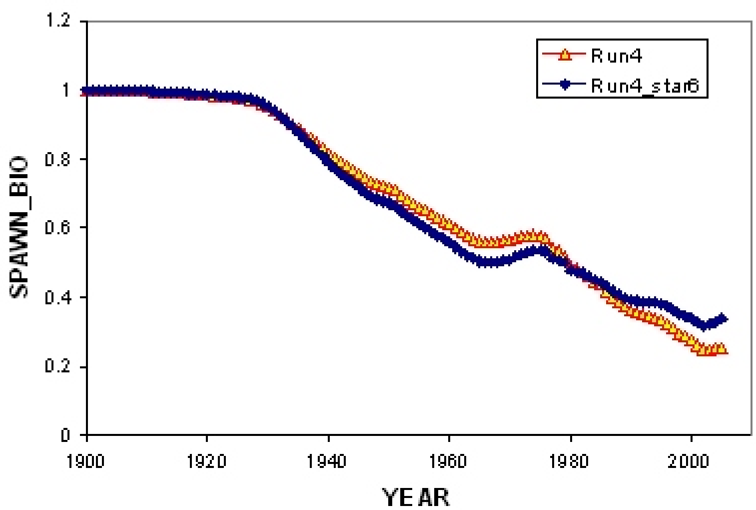


Figure STAR.7. *Depletion for Run4 (base run) and Run4_STAR6 where natural mortality and steepness were assigned informative priors.*

Request: Tuesday, June 21, 2005

Because we are concerned about including the “forecast_recruitment” component in the likelihood, we request that Michael re-run Models 3 and 4 with “forecast_recruitment” turned off, to see if the parameter estimates change.

Response: While forecasting recruitment does indeed effect the calculation of overall likelihood, the remaining components of the likelihood are not effected. This is seen below by subtracting the “Forecast_Recruitm” likelihood from the total LIKELIHOOD in the model with forecasts and arriving at the same total LIKELIHOOD as the modle with no forecast.

RUN 3 / NoENV / FORECAST

Fleet	surv_lamb	surv_like	disc_lambd	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like
1	1	0	0.1	7.28321	1	218.972	1	101.795	0.1	511.893
2	1	0	0.1	5.38495	1	112.767	1	60.7028	0.1	480.227
3	1	0	0.1	150.939	1	237.348	1	119.004	0.1	1155.36
4	0	0	0	0	0	0	0	0	0	0
5	1	-4.75887	0	0	1	161.112	1	69.9504	0.1	0
6	0	0	0	0	1	64.9282	1	19.3646	0.1	94.2183
7	1	11.8423	0	0	1	0	1	0	0.1	0
8	1	-6.14368	0	0	1	76.5349	1	71.2707	0.1	1199.09
10	1	-6.28096	0	0	1	0	1	0	0.1	0
11	0	0	0	0	1	50.5302	1	28.56	0.1	79.1143
12	1	0.847739	0	0	1	0	1	0	0.1	0
13	0	0	0	0	0	0	0	0	0.1	75.6634

LIKELIHOOD	1959.23
Indices	-11.1938
discard	16.3607
length_comps	988.99
age_comps	518.115
size-at-age	428.527
mean_body_wt	2.06115
Equil_catch	0
Recruitment	-1.42645
Parm_devs	18.2612
penalties	0
Forecast_Recruitm	-4.62795

RUN 3 / NoENV / NO FORECAST

Fleet	surv_lamb	surv_like	disc_lambd	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like
1	1	0	0.1	7.28321	1	218.972	1	101.795	0.1	511.893
2	1	0	0.1	5.38495	1	112.767	1	60.7028	0.1	480.227
3	1	0	0.1	150.939	1	237.348	1	119.004	0.1	1155.36
4	0	0	0	0	0	0	0	0	0	0
5	1	-4.75887	0	0	1	161.112	1	69.9504	0.1	0
6	0	0	0	0	1	64.9282	1	19.3646	0.1	94.2183
7	1	11.8423	0	0	1	0	1	0	0.1	0
8	1	-6.14368	0	0	1	76.5349	1	71.2707	0.1	1199.09
9	1	-7.70028	0	0	1	66.7973	1	47.4674	0.1	689.698
10	1	-6.28096	0	0	1	0	1	0	0.1	0
11	0	0	0	0	1	50.5302	1	28.56	0.1	79.1143
12	1	0.847739	0	0	1	0	1	0	0.1	0
13	0	0	0	0	0	0	0	0	0.1	75.6634

LIKELIHOOD	1963.86
Indices	-11.1938
discard	16.3607
length_comps	988.99
age_comps	518.115
size-at-age	428.527
mean_body_wt	2.06115
Equil_catch	0
Recruitment	-1.42645
Parm_priors	4.16696
Parm_devs	18.2612
penalties	0
Forecast Recruitm	0

RUN 4 / ENV / FORECAST

Fleet	surv lamb	surv_like	disc lambd	disc_like	length lam	length_like	age lambd	age_like	sizeage la	sizeage_like
1	1	0	0.1	7.28321	1	221.507	1	103.515	0.1	514.309
2	1	0	0.1	5.38495	1	112.542	1	61.3643	0.1	476.849
3	1	0	0.1	151.29	1	237.942	1	118.899	0.1	1172.29
4	0	0	0	0	0	0	0	0	0	0
5	1	-4.20891	0	0	1	168.52	1	76.1789	0.1	0
6	0	0	0	0	1	66.7927	1	19.9718	0.1	93.5369
7	1	10.8946	0	0	1	0	1	0	0.1	0
8	1	-6.72049	0	0	1	76.0713	1	65.6389	0.1	1203.56
9	1	-7.48149	0	0	1	67.7387	1	43.9156	0.1	687.844
10	1	-4.1171	0	0	1	0	1	0	0.1	0
11	0	0	0	0	1	50.7383	1	29.1016	0.1	78.765
12	1	-0.309255	0	0	1	0	1	0	0.1	0
13	0	0	0	0	0	0	0	0	0.1	76.0341

LIKELIHOOD	1899.58
Indices	-10.9426
discard	16.3958
length_comps	1001.85
age_comps	518.585
size-at-age	430.319
mean_body_wt	2.04492
Equil_catch	0
Recruitment	-67.9062
Parm_priors	4.2736
Parm_devs	20.3197
penalties	0
Forecast Recruitm	-15.3616

RUN 4 / ENV / NO FORECAST

Fleet	surv_lamb	surv_like	disc_lambd	disc_like	length_lam	length_like	age_lambd	age_like	sizeage_la	sizeage_like
1	1	0	0.1	7.28321	1	221.507	1	103.515	0.1	514.309
2	1	0	0.1	5.38495	1	112.542	1	61.3643	0.1	476.849
3	1	0	0.1	151.29	1	237.942	1	118.899	0.1	1172.29
4	0	0	0	0	0	0	0	0	0	0
5	1	-4.20891	0	0	1	168.52	1	76.1789	0.1	0
6	0	0	0	0	1	66.7927	1	19.9718	0.1	93.5369
7	1	10.8946	0	0	1	0	1	0	0.1	0
8	1	-6.72049	0	0	1	76.0713	1	65.6389	0.1	1203.56
9	1	-7.48149	0	0	1	67.7387	1	43.9156	0.1	687.844
10	1	-4.1171	0	0	1	0	1	0	0.1	0
11	0	0	0	0	1	50.7383	1	29.1016	0.1	78.765
12	1	-0.309254	0	0	1	0	1	0	0.1	0
13	0	0	0	0	0	0	0	0	0.1	76.0341

LIKELIHOOD	1914.94
Indices	-10.9426
discard	16.3958
length_comps	1001.85
age_comps	518.585
size-at-age	430.319
mean_body_wt	2.04492
Equil_catch	0
Recruitment	-67.9062
Parm_priors	4.2736
Parm_devs	20.3197
penalties	0
Forecast_Recruitm	0

Tuesday, June 21, 2005 *(cont.)*

Because we are concerned about the way in which the Conception area survey biomass may have been computed, we request that Owen look at the time series of survey catch rates north and south of Point Conception and that Michael re-run Model 4 with the Conception portion of the survey biomass time series removed.

Response: After careful examination of the data, the panel deemed it appropriate to ask Tom Helser to re-evaluate the slope survey biomass estimates. New estimates were made based on a southern boundary of Point Conception. From this point on, all model runs were made using these new biomass estimates.

Tuesday, June 21, 2005 *(cont.)*

Because we would like to compare survey time series in common units, we request that Michael produce a "Q-corrected" plot of the various survey time series.

Response: This plot was made as requested. However, because of the differences in selectivities between the gear types, it was of little use in trying to picture the overall population trend. The figure is given below.

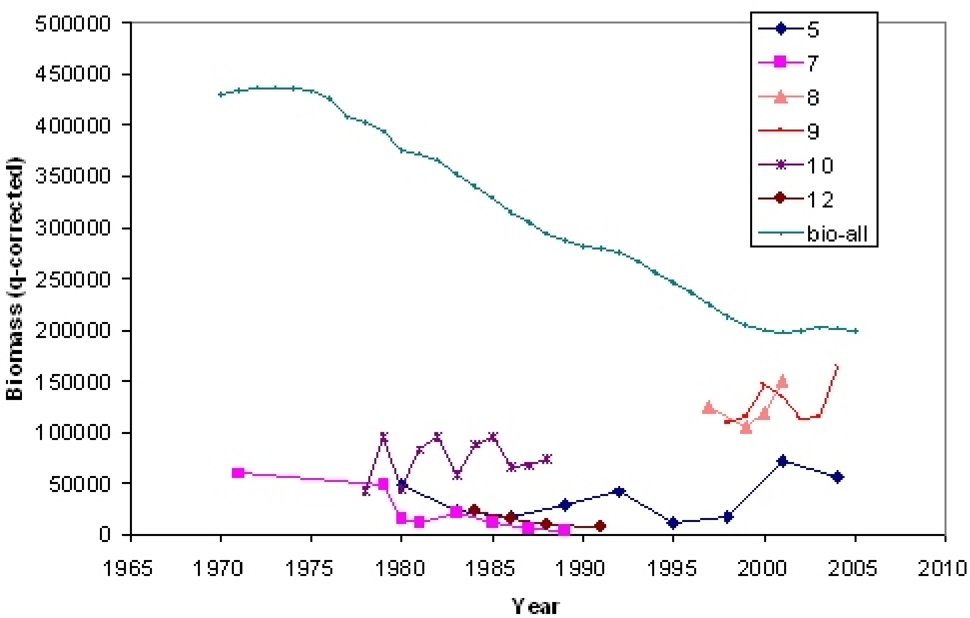


Figure STAR.8. *The "q-corrected" plot of biomass estimates from each survey request by STAR Panel.*

Wednesday, June 22, 2005 (part 1)

We want 3 new runs with no Conception survey biomass and both M and H estimated:

1) No informative priors. We are interested in this run because Michael obtained H greater than 0.2 when he did this before with Conception included.

2) prior on H with mean =0.4, sd=0.06; no informative prior on M. We are interested in this for two reasons: First, the sd of 0.12 used in Star1 does not really correspond to the intended CV of 30% because H is logically bounded at 0.2, not 0. Second, we found it odd that setting priors on H and M did not pull H away from 0.2, but Michael=s Afree M and H@ run did pull H away from 0.2.

3) prior on H with mean =0.4, sd=0.06; prior on M as in Star1. We are interested in this for the same reasons given in (2) above.

Response: Based on the Panel's decision to accept the new NWFSC slope survey biomass estimates, new runs, similar to the ones previously requested, were generated using the revised estimates. As with the previous runs, estimating M and steepness tended to decrease the beginning biomass and estimating steepness tended to increase the current biomass. Furthermore, using the informative priors on M and steepness resulted in higher estimates of current depletion (stock is less depleted).

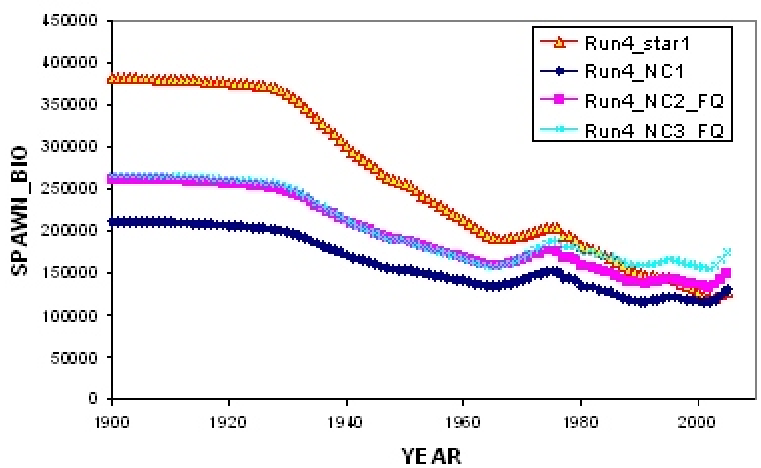


Figure STAR.9. *Spawning stock biomass for the four runs requested by STAR Panel on Wed, part 1.*

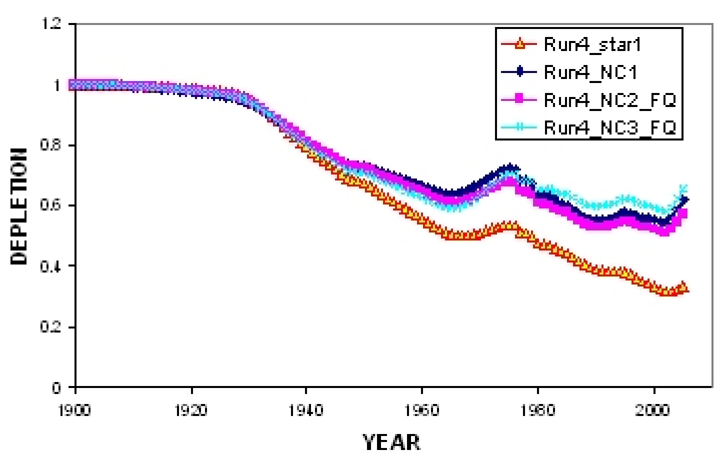


Figure STAR.10. *Depletion for the four runes requested by STAR Panel on Wed, part 1.*

Wednesday, June 22, 2005 (part 2)

We would like Michael to re-run the new Model NC1 with the southern Conception data added back in, so that we can determine how much change is due to the change in data and how much is due to the change in the lower bound on M (this will be run NC0).

Because we would like to understand more fully the differences between today's model runs and the previous assessment, we would like Michael to run a new model (to be called NC4) with H and M fixed at 0.40 and 0.07, as in the previous assessment.

To enable a more complete evaluation of the new model runs, we request that Michael present estimated Q and the values of the individual likelihood components for all the new runs NC0 through NC4.

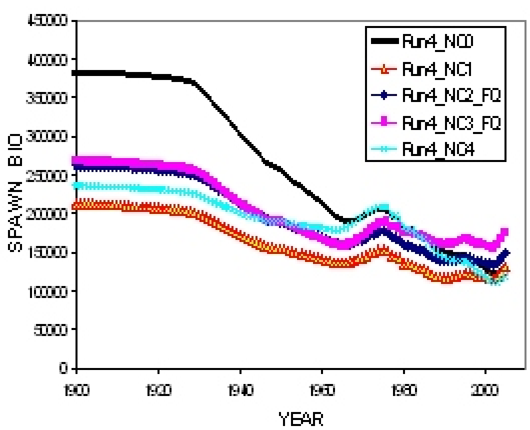


Figure STAR 11. Spawning stock biomass for the four runs requested by STAR Panel on Wed, part 2.

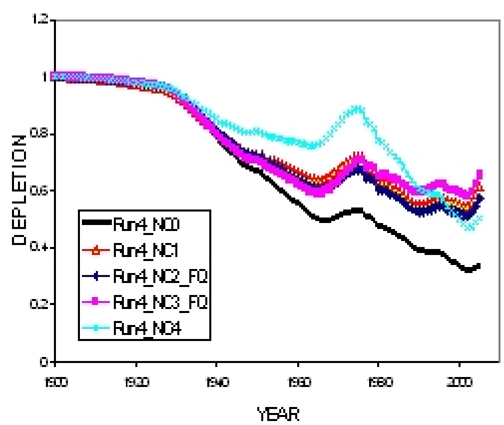


Figure STAR 12. Depletion for the four runs requested by STAR Panel on Wed, part 2.

	NC0	NC1	NC2 FQ	NC3_FQ	NC4
LIKELIHOOD	1909.2	1913.78	1915.1	1917.16	1945.78
indices	-10.2501	-4.01485	-3.19513	-2.62622	-1.7491
discard	16.4673	15.6334	16.0386	16.5106	16.5946
length_comps	997.543	997.53	997.317	998.239	1007.44
age_comps	520.503	518.263	518.012	519.485	520.01
size-at-age	430.615	431.799	431.526	430.472	430.398
mean_body_wt	2.04636	2.04115	2.04372	2.0483	2.05164
Equil_catch	0	0	0	0	0
Recruitment	-70.9672	-69.8319	-69.1322	-70.5187	-54.6726
Parm_priors	4.17092	3.08554	3.32516	4.78125	4.53766
Parm_devs	19.0754	19.2888	19.1686	18.7689	21.1675

Thursday, June 23, 2005 (part 1)

Because we feel that M should stay very close to the value used in the previous assessment, we would like Michael to do a new run with a prior on M with mean=0.07 and CV=0.1 (giving sd=0.007).

Because we are also concerned about the fact that Q is hitting a bound and because we would like to maintain continuity with the previous assessment, we would like another run with the above prior on M and a prior on Q with a CV of 0.2 and a mean equal to the estimate from the previous assessment (0.46) multiplied by the recent average ratio of survey biomass for the total area with the south Conception removed to the survey biomass for the total area (0.84).

NC7	
LIKELIHOOD	1924.47
indices	-0.851783
discard	16.2619
length_comps	998.185
age_comps	520.551
size-at-age	431.156
mean_body_wt	2.05335
Equil_catch	0
Recruitment	-70.1534
Parm_priors	7.64
Parm_devs	19.6255

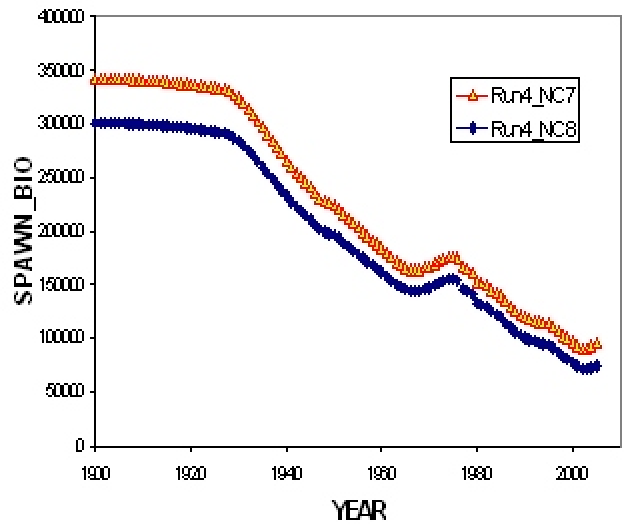


__Figure STAR.12.__ Spawning stock biomass for the two runs requested by STAR Panel on Thursday, part 1.

NC8	
LIKELIHOOD	1927.07
indices	0.417729
discard	16.0082
length_comps	998.683
age_comps	521.683
size-at-age	431.781
mean_body_wt	2.05481
Equil_catch	0
Recruitment	-70.2042
Parm_priors	6.79685
Parm_devs	19.8476

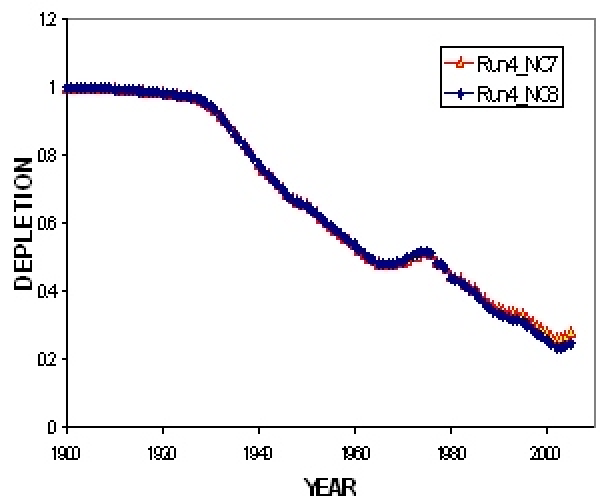
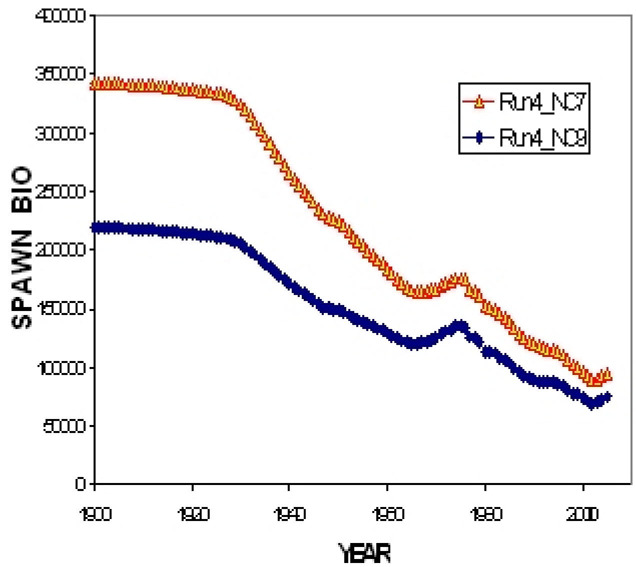


__Figure STAR.13.__ Depletion for the two runds requested by STAR Panel on Thursday, part 1.

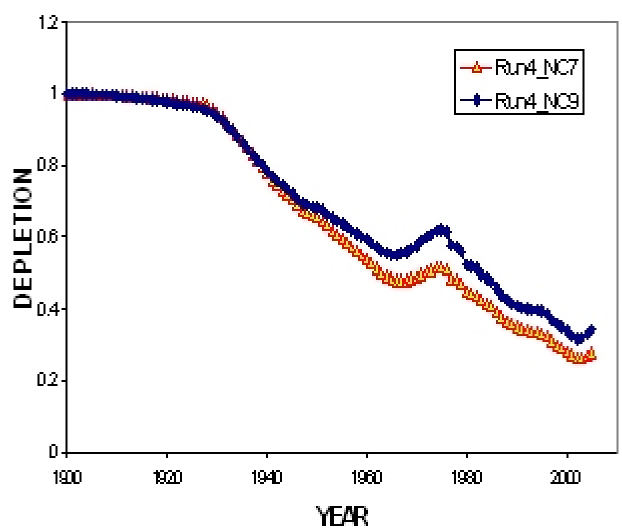
Thursday, June 23, 2005 (part 2)

We request one more run, the same as NC7 but with the prior on H from NC3. This will be NC9. The reason for this request is that we have not yet tried a run with priors on all three key parameters (H, M, and Q) and because H is bounded under NC7.

NC7	
LIKELIHOOD	1924.47
indices	-0.851783
discard	16.2619
length_comps	998.185
age_comps	520.551
size-at-age	431.156
mean_body_wt	2.05335
Equil_catch	0
Recruitment	-70.1534
Parm_priors	7.64
Parm_devs	19.6255



NC9	
LIKELIHOOD	1884.7
indices	-2.39067
discard	15.7349
length_comps	1001.74
age_comps	521.122
size-at-age	431.657
mean_body_wt	2.04822
Equil_catch	0
Recruitment	-69.8539
Parm_priors	0
Parm_devs	0



Thursday, June 23, 2005 (part 3)

For the decision analysis, we would like Michael to estimate the upper and lower 10% quantiles for H and Q and use these, along with the point estimates from NC9, to describe three states of nature: 1) low H, high Q; 2) point estimates of H and Q; 3) high H, low Q.

The management alternatives are to consist of the catch streams corresponding to the 40:10 rule for each of the three states of nature. Other management alternatives may be necessary in the event that the 40:10 rule proves infeasible for one or more states of nature.

We also request that Michael estimate the probability that depletion is less than 25 percent.

	Parameter	Mean	SD	10th	90th	prob of < 25%
1 MGparm[1]	M	4.99E-02	4.23E-03	0.0445	0.0553	
27 SR_parm[2]	h	3.43E-01	6.51E-02	0.2592	0.4260	
112 Q_parm[2]	Q	-1.10E+00	8.69E-02	-1.2123	-0.9895	
531 depletion	dep	3.43E-01	4.68E-02	0.2831	0.4029	0.0233

			Low Stock/Production h = 0.26 Q = 0.37		Base Case h = 0.34 Q = 0.33		High Stock/Production h = 0.43 Q = 0.30	
Management Decision	Year	TOTAL	SSB	Depletion	SSB	Depletion	SSB	Depletion
	2006	5553	67361	27%	77136	35%	88006	41%
	2007	4585	67601	27%	78310	36%	89895	42%
	2008	4466	67625	27%	79240	36%	91499	42%
Low Catch	2009	4271	66580	26%	78945	36%	91749	43%
	2010	4106	65307	26%	78404	36%	91712	43%
40:10	2011	3925	63683	25%	77422	35%	91183	42%
Low Stock / Production	2012	3791	62647	25%	77182	35%	91461	42%
	2013	3646	61351	24%	76598	35%	91357	42%
	2014	3510	60100	24%	76062	35%	91282	42%
	2015	3383	58899	23%	75581	35%	91259	42%
	2016	3263	57747	23%	75153	34%	91288	42%
	2017	3152	56697	22%	74851	34%	91455	42%
	2006	5553	67361	27%	77136	35%	88006	41%
	2007	5912	67601	27%	78310	36%	89895	42%
	2008	5787	66974	26%	78591	36%	90852	42%
Base Case Catch	2009	5581	65254	26%	77618	35%	90422	42%
	2010	5415	63296	25%	76383	35%	89689	42%
40:10	2011	5234	60998	24%	74717	34%	88471	41%
Base Case / Production	2012	5105	59245	23%	73746	34%	88014	41%
	2013	4962	57244	23%	72444	33%	87190	40%
	2014	4829	55279	22%	71181	33%	86390	40%
	2015	4705	53359	21%	69969	32%	85641	40%
	2016	4589	51480	20%	68803	31%	84942	39%
	2017	4482	49687	20%	67747	31%	84372	39%
	2006	5553	67361	27%	77136	35%	88006	41%
	2007	6669	67601	27%	78310	36%	89895	42%
	2008	6530	66605	26%	78222	36%	90483	42%
High Catch	2009	6345	64506	25%	76868	35%	89672	42%
	2010	6209	62148	25%	75230	34%	88534	41%
40:10	2011	6071	59442	23%	73151	33%	86899	40%
High Stock / Production	2012	5961	57235	23%	71717	33%	85978	40%
	2013	5823	54776	22%	69949	32%	84687	39%
	2014	5694	52344	21%	68211	31%	83412	39%
	2015	5575	49952	20%	66519	30%	82186	38%
	2016	5464	47594	19%	64865	30%	81006	38%
	2017	5363	45311	18%	63311	29%	79947	37%

Retrospective and Historic Analysis

A retrospective analysis was conducted on the post-STAR Panel base-case model by successively deleting the last year of data and refitting the model parameters. This was done for five years making the final years of data 2000, 2001, 2002, 2003, 2004, and 2005(2005 being the base-case model). Nearly no monotonic retrospective trend existed when removing data back to 2002 (i.e. final year of model 2001, Figure STAR.17). This is most likely the result of the informative priors that were used on NWFSC Survey Q and steepness. However, when the 2001 data point from the AFSC Shelf Survey was deleted, the model responded by increasing *R*0, which would in turn result in a lower depletion level in the final year.

Historical and current estimates of spawning stock biomass are shown in Figure STAR.18. The observed differences are due mostly to changes in the inclusion and exclusion of the various indices of abundance throughout the history of the sablefish assessments.

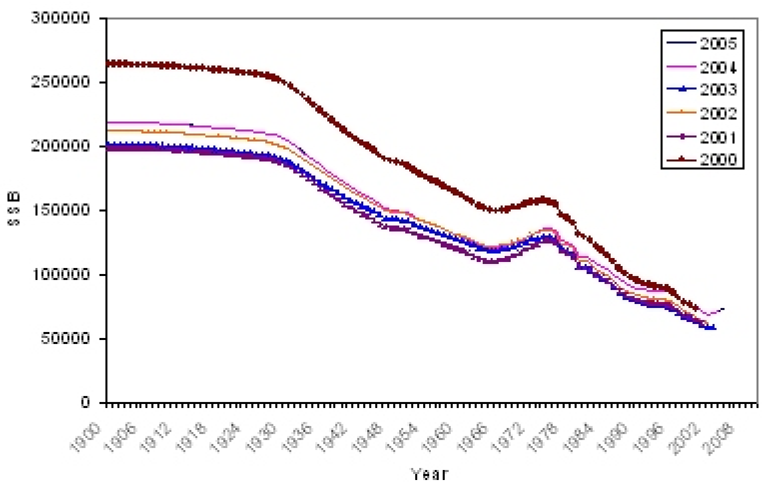


Figure STAR.17. *Retrospective analysis using the post-STAR Panel base-case model.*

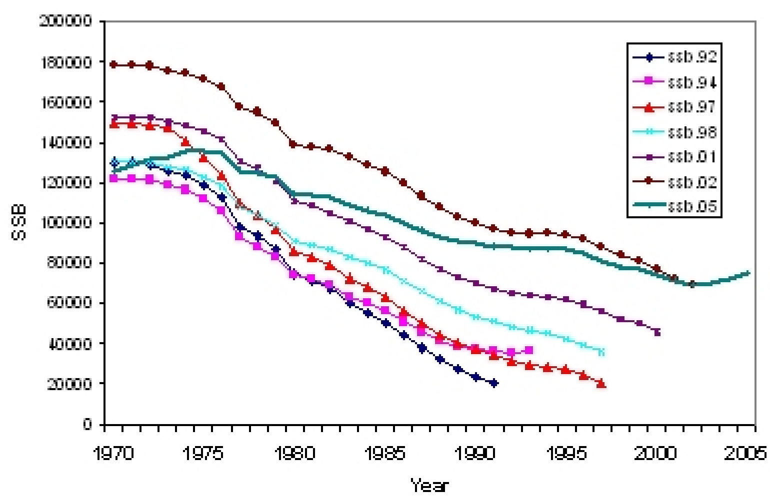


Figure STAR.18. *Historical and current estimates of SSB.*

Population numbers-at-age for females post-STAR Panel base-case model.

Population		1 gmorph	1														
Year	Seas	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1898	E	5679	5403	5140	4889	4651	4425	4209	4004	3809	3624	3447	3280	3120	2968	2823	55158
1899	E	5680	5404	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1900	1	5679	5404	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1901	1	5679	5403	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1902	1	5679	5403	5140	4890	4652	4425	4210	4005	3810	3624	3448	3280	3120	2968	2824	55160
1903	1	5679	5403	5140	4889	4651	4424	4208	4003	3808	3623	3447	3279	3119	2967	2823	55145
1904	1	5678	5402	5140	4889	4649	4423	4207	4002	3807	3621	3445	3277	3118	2966	2822	55122
1905	1	5676	5401	5139	4888	4649	4421	4205	4000	3805	3619	3443	3275	3116	2964	2820	55091
1906	1	5674	5400	5138	4888	4648	4419	4202	3997	3802	3617	3441	3273	3114	2962	2818	55053
1907	1	5672	5398	5136	4886	4647	4418	4201	3994	3800	3614	3438	3270	3111	2960	2815	55007
1908	1	5670	5396	5135	4885	4645	4416	4199	3992	3796	3611	3435	3267	3108	2957	2813	54953
1909	1	5667	5393	5133	4883	4643	4414	4197	3990	3793	3607	3431	3264	3104	2953	2809	54891
1910	1	5664	5391	5130	4881	4641	4411	4194	3987	3791	3604	3427	3260	3101	2950	2806	54822
1911	1	5660	5388	5128	4878	4638	4409	4191	3984	3788	3601	3424	3255	3097	2945	2802	54745
1912	1	5656	5384	5125	4876	4636	4406	4188	3981	3784	3597	3420	3252	3092	2941	2798	54661
1913	1	5652	5381	5122	4873	4633	4402	4184	3977	3780	3594	3416	3248	3088	2936	2793	54569
1914	1	5648	5377	5118	4870	4629	4399	4181	3973	3776	3589	3412	3244	3084	2932	2788	54469
1915	1	5643	5373	5114	4866	4626	4395	4177	3969	3772	3585	3408	3239	3080	2928	2784	54363
1916	1	5638	5368	5110	4862	4622	4391	4173	3965	3768	3581	3403	3235	3075	2923	2779	54249
1917	1	5633	5364	5106	4858	4618	4387	4168	3960	3763	3576	3398	3230	3070	2919	2775	54129
1918	1	5628	5359	5102	4854	4613	4382	4163	3956	3758	3571	3393	3225	3065	2914	2770	54003
1919	1	5622	5354	5097	4849	4609	4377	4159	3951	3753	3566	3388	3220	3060	2908	2764	53871
1920	1	5616	5348	5092	4845	4604	4373	4154	3945	3748	3560	3383	3214	3054	2903	2759	53733
1921	1	5610	5342	5087	4840	4599	4367	4148	3940	3742	3555	3377	3209	3049	2897	2754	53589
1922	1	5603	5336	5081	4834	4594	4362	4143	3934	3737	3549	3371	3203	3043	2892	2748	53439
1923	1	5596	5330	5075	4829	4588	4356	4137	3929	3731	3543	3365	3197	3037	2886	2742	53284
1924	1	5589	5324	5069	4823	4583	4350	4131	3923	3725	3537	3359	3191	3031	2880	2736	53123
1925	1	2532	5317	5063	4817	4577	4344	4125	3916	3718	3531	3353	3184	3025	2873	2730	52956
1926	1	5484	2409	5057	4811	4571	4338	4119	3910	3712	3524	3346	3178	3018	2867	2723	52785
1927	1	4148	5217	2291	4805	4564	4332	4112	3903	3705	3518	3340	3171	3012	2860	2717	52608
1928	1	2164	3946	4961	2176	4558	4325	4105	3896	3698	3511	3333	3164	3005	2854	2710	52426
1929	1	3544	2058	3753	4714	2064	4318	4098	3889	3691	3503	3326	3157	2998	2847	2703	52237
1930	1	4191	3372	1957	3555	4470	1955	4090	3882	3684	3495	3318	3150	2990	2839	2696	52041
1931	1	4194	3987	3206	1859	3380	4232	1852	3874	3676	3488	3310	3142	2983	2832	2689	51839
1932	1	2602	3990	3791	3045	1763	3200	4008	1753	3667	3480	3302	3134	2975	2824	2681	51628
1933	1	4157	2475	3794	3601	2886	1668	3029	3794	1659	3471	3293	3125	2966	2815	2673	51408
1934	1	2453	3954	2353	3602	3409	2728	1577	2864	3586	1568	3281	3113	2954	2804	2661	51131
1935	1	4278	2333	3760	2234	3408	3220	2577	1489	2704	3386	1481	3097	2939	2789	2647	50797
1936	1	2023	4069	2218	3558	2113	3216	3038	2431	1405	2550	3192	1396	2921	2772	2630	50407
1937	1	2659	1925	3869	2106	3379	1997	3042	2873	2299	1328	2411	3019	1321	2762	2621	50170
1938	1	3630	2529	1830	3673	1994	3194	1889	2876	2716	2173	1256	2280	2854	1248	2612	49917
1939	1	5153	3453	2405	1737	3478	1885	3022	1787	2721	2570	2056	1188	2157	2700	1181	49703
1940	1	4537	4902	3283	2282	1643	3284	1782	2856	1688	2571	2428	1943	1123	2038	2552	48099
1941	1	3313	4316	4659	3114	2158	1552	3107	1686	2701	1597	2432	2297	1838	1062	1929	47937
1942	1	2425	3152	4101	4417	2943	2037	1469	2940	1595	2557	1512	2302	2175	1740	1006	47224
1943	1	2566	2307	2995	3886	4167	2771	1922	1386	2774	1505	2413	1427	2173	2053	1643	45543
1944	1	6092	2440	2189	2826	3642	3894	2606	1809	1304	2612	1418	2273	1344	2047	1934	44486
1945	1	5581	5794	2313	2058	2634	3382	3653	2446	1699	1225	2455	1333	2137	1264	1926	43703
1946	1	4597	5307	5485	2169	1910	2434	3167	3423	2294	1594	1150	2305	1252	2008	1188	42930
1947	1	3204	4373	5037	5178	2033	1785	2287	2976	3218	2157	1499	1082	2168	1177	1889	41525
1948	1	913	3048	4158	4782	4904	1923	1689	2164	2816	3044	2041	1418	1024	2052	1114	41088
1949	1	1266	868	2895	3936	4508	4613	1815	1594	2043	2658	2874	1927	1339	967	1938	39672
1950	1	4944	1204	824	2739	3707	4236	4352	1712	1504	1928	2509	2713	1819	1264	913	39490
1951	1	3094	4702	1144	780	2582	3487	4000	4110	1617	1421	1821	2371	2564	1719	1195	38204
1952	1	3589	2943	4457	1076	729	2403	3275	3759	3865	1521	1337	1714	2232	2414	1619	37131
1953	1	3292	3414	2793	4213	1013	684	2268	3094	3552	3652	1438	1264	1621	2110	2283	36661
1954	1	2765	3131	3245	2650	3968	957	648	2149	2930	3365	3460	1362	1198	1536	1999	36908
1955	1	4502	2630	2975	3073	2499	3753	904	612	2029	2767	3177	3268	1287	1131	1451	36766
1956	1	2571	4282	2498	2816	2896	2350	3542	853	577	1915	2613	3000	3086	1215	1068	36109
1957	1	3045	2445	4037	2317	2572	2633	2192	3312	799	541	1797	2454	2819	2901	1143	35034
1958	1	1947	2896	2318	3801	2164	2392	2470	2058	3110	750	509	1689	2306	2651	2728	34047
1959	1	3090	1851	2746	2183	3556	2019	2254	2330	1942	2935	709	481	1596	2180	2505	34788
1960	1	3383	2939	1753	2576	2029	3294	1895	2118	2190	1827	2763	667	453	1503	2053	35167
1961	1	4074	3217	2779	1639	2379	1864	3076	1772	1982	2051	1712	2591	626	425	1411	34978
1962	1	6066	3874	3043	2601	1518	2195	1748	2889	1666	1865	1931	1612	2440	590	400	34331
1963	1	3305	5768	3656	2830	2385	1385	2050	1636	2707	1563	1751	1814	1515	2294	555	32731
1964	1	8560	3143	5460	3431	2632	2211	1302	1929	1541	2551	1473	1651	1711	1429	2165	31444
1965	1	5497	8141	2977	5129	3193	2442	2075	1223	1813	1449	2400	1386	1554	1611	1346	31680
1966	1	7859	5228	7706	2792	4764	2956	2292	1950	1150	1705	1364	2260	1306	1464	1518	31160
1967	1	5038	7475	4961	7279	2623	4467	2789	2163	1841	1086	1611	1288	2135	1234	1384	30899
1968	1	9152	4791	7088	4670	6780	2429	4164	2599	2016	1716	1012	1503	1202	1992	1151	30144
1969	1	3580	8704	4544	6680	4368	6318	2281	3911	2442	1894	1613	952	1413	1130	1874	29456
1970	1	11000	3405	8242	4260	6178	4011	5864	2117	3631	2268	1760	1499	885	1314	1051	29170

Population numbers-at-age for females post-STAR Panel base-case model (cont.)

Population	1 gmorph		1													
Year	Seas	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1971	1	4792	10469	3217	7688	3921	5661	3747	5487	1984	3405	2129	1653	1498	832	1235	28462
1972	1	4795	4657	9878	2997	7063	3585	5281	3502	5135	1858	3193	1997	1551	1323	781	27951
1973	1	9013	4659	4294	9136	2714	6348	3303	4877	3239	4755	1722	2962	1854	1441	1229	26779
1974	1	4487	8568	4291	3962	8255	2436	5867	3065	4635	3017	4435	1608	2769	1735	1350	26327
1975	1	7000	4266	8081	3967	3567	7352	2217	5351	2801	4153	2769	4079	1483	2557	1605	25772
1976	1	5374	6654	4016	7408	3509	3108	6578	1989	4816	2529	3763	2518	3723	1357	2348	25401
1977	1	8177	5108	6252	3590	6092	2769	2514	5339	1626	3974	2109	3174	2148	3210	1182	24936
1978	1	5294	7773	4804	5727	3180	5326	2494	2272	4840	1479	3624	1930	2912	1976	2961	24300
1979	1	9705	5029	7254	4292	4848	2636	4661	2196	2010	4304	1321	3254	1740	2637	1796	25096
1980	1	5772	9222	4867	6298	3388	3666	2137	3807	1808	1670	3608	1118	2779	1499	2289	23947
1981	1	6362	5486	8673	4252	5528	2931	3288	1924	3439	1639	1518	3292	1023	2551	1379	24353
1982	1	5658	6044	5126	7827	3644	4655	2597	2929	1722	3090	1478	1375	2991	933	2331	23758
1983	1	3686	5371	5565	4395	6200	2781	3932	2218	2522	1494	2700	1300	1217	2661	834	23737
1984	1	4731	3501	4991	4900	3629	5006	2408	3430	1947	2228	1327	2411	1167	1097	2410	22579
1985	1	7934	4491	3236	4355	3999	2897	4363	2118	3038	1734	1995	1194	2178	1058	998	23020
1986	1	6464	7539	4132	2779	3466	3082	2476	3769	1843	2662	1528	1767	1062	1947	949	21852
1987	1	6315	6127	6992	3541	2213	2692	2659	2159	3311	1629	2364	1363	1582	954	1753	20771
1988	1	5401	5999	5508	6066	2825	1720	2332	2324	1900	2929	1448	2109	1220	1420	859	20485
1989	1	6073	5051	5448	4802	4948	2211	1437	1970	1987	1645	2567	1283	1888	1102	1292	19879
1990	1	6433	5744	4592	4839	3991	4024	1852	1221	1696	1732	1449	2284	1151	1707	1003	19717
1991	1	3950	6061	5278	4066	4186	3335	3427	1592	1060	1487	1532	1293	2053	1042	1554	19282
1992	1	2606	3695	5501	4701	3399	3460	2823	2941	1384	932	1321	1374	1169	1869	954	19466
1993	1	1707	2383	3325	4940	4015	2855	2959	2449	2579	1224	831	1187	1242	1062	1705	18975
1994	1	3334	1621	2125	2911	4269	3428	2464	2581	2156	2291	1097	750	1078	1134	974	19336
1995	1	5022	3166	1515	1871	2550	3731	3011	2176	2291	1925	2055	989	680	981	1035	18878
1996	1	1330	4773	2974	1376	1564	2133	3178	2593	1893	2015	1710	1843	893	618	897	18621
1997	1	687	1265	4518	2751	1205	1306	1806	2718	2238	1649	1771	1515	1644	802	558	18065
1998	1	3462	648	1180	4103	2358	996	1083	1521	2323	1938	1445	1568	1354	1481	728	17335
1999	1	8827	3294	606	1085	3665	2060	896	977	1381	2118	1774	1328	1446	1252	1372	16872
2000	1	9221	8397	3133	539	934	3070	1766	773	848	1212	1877	1585	1195	1310	1140	16936
2001	1	6217	8772	7979	2965	461	777	2643	1533	676	747	1076	1678	1425	1080	1189	16684
2002	1	3886	5901	8233	7346	2694	390	679	2320	1352	600	667	965	1512	1290	981	16515
2003	1	1464	3696	5583	7704	6720	2445	353	616	2115	1237	550	613	889	1397	1194	16308
2004	1	3723	1383	3507	5218	7012	5966	2195	315	553	1905	1119	499	559	813	1281	16226
2005	1	2461	3533	1295	3237	4741	6326	5424	2000	287	504	1741	1024	458	512	746	16142

Population numbers-at-age for males post-STAR Panel base-case model.

Population		1 gmorph	2														
Year	Seas	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1898	E	5679	5403	5140	4889	4651	4425	4209	4004	3809	3624	3447	3280	3120	2968	2823	55158
1899	E	5680	5404	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1900	1	5679	5404	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1901	1	5679	5403	5141	4890	4652	4426	4210	4005	3810	3625	3448	3280	3120	2968	2824	55168
1902	1	5679	5403	5140	4890	4652	4425	4210	4005	3810	3624	3448	3280	3120	2968	2824	55164
1903	1	5679	5403	5140	4889	4651	4424	4209	4004	3809	3623	3447	3279	3119	2968	2823	55157
1904	1	5678	5402	5139	4889	4650	4424	4208	4003	3808	3622	3446	3278	3118	2967	2822	55146
1905	1	5676	5401	5139	4889	4650	4422	4207	4001	3806	3621	3444	3277	3117	2965	2821	55131
1906	1	5674	5400	5138	4888	4649	4421	4205	4000	3805	3619	3443	3275	3115	2964	2820	55112
1907	1	5672	5398	5136	4887	4648	4420	4204	3998	3803	3617	3441	3273	3114	2962	2818	55089
1908	1	5670	5396	5135	4885	4647	4419	4202	3996	3800	3615	3438	3271	3111	2960	2816	55062
1909	1	5667	5393	5133	4883	4645	4417	4201	3994	3798	3612	3436	3268	3109	2957	2814	55030
1910	1	5664	5391	5130	4881	4643	4415	4198	3992	3796	3610	3433	3266	3106	2955	2811	54995
1911	1	5660	5388	5128	4879	4641	4413	4196	3990	3794	3608	3430	3262	3103	2952	2808	54955
1912	1	5656	5384	5125	4876	4638	4410	4194	3987	3791	3605	3428	3260	3100	2949	2805	54910
1913	1	5652	5381	5122	4873	4635	4407	4191	3985	3789	3602	3425	3257	3097	2945	2802	54862
1914	1	5648	5377	5118	4870	4632	4404	4188	3982	3785	3599	3422	3254	3094	2942	2798	54809
1915	1	5643	5373	5114	4867	4629	4401	4184	3978	3782	3596	3419	3251	3091	2939	2795	54751
1916	1	5638	5368	5110	4863	4625	4397	4181	3975	3779	3592	3415	3247	3087	2936	2792	54690
1917	1	5633	5364	5106	4859	4621	4393	4177	3971	3775	3588	3411	3243	3084	2932	2788	54625
1918	1	5628	5359	5102	4855	4617	4389	4173	3967	3771	3584	3407	3239	3080	2928	2785	54556
1919	1	5622	5353	5097	4850	4613	4385	4169	3963	3766	3580	3403	3235	3076	2924	2781	54484
1920	1	5616	5348	5092	4846	4608	4380	4164	3958	3762	3576	3399	3231	3071	2920	2777	54407
1921	1	5610	5342	5086	4841	4604	4376	4159	3953	3757	3571	3394	3226	3067	2916	2772	54327
1922	1	5603	5336	5081	4836	4599	4371	4154	3948	3753	3566	3390	3222	3062	2911	2768	54243
1923	1	5596	5330	5075	4830	4593	4365	4149	3943	3748	3561	3385	3217	3058	2907	2763	54155
1924	1	5589	5323	5069	4824	4588	4360	4144	3938	3742	3555	3379	3212	3053	2902	2759	54063
1925	1	2532	5317	5063	4819	4582	4354	4138	3933	3737	3551	3374	3206	3047	2897	2754	53968
1926	1	5484	2408	5056	4812	4576	4348	4133	3927	3731	3545	3369	3201	3042	2891	2749	53869
1927	1	4148	5217	2290	4806	4570	4342	4127	3921	3725	3539	3363	3195	3037	2886	2743	53766
1928	1	2164	3946	4961	2177	4564	4336	4121	3915	3719	3534	3357	3190	3031	2881	2738	53659
1929	1	3544	2058	3753	4715	2067	4329	4114	3909	3713	3527	3351	3184	3025	2875	2732	53548
1930	1	4191	3371	1957	3567	4476	1960	4107	3902	3706	3521	3344	3177	3019	2869	2727	53431
1931	1	4194	3987	3206	1860	3386	4245	1860	3895	3699	3514	3338	3171	3012	2862	2720	53310
1932	1	2602	3989	3791	3046	1765	3210	4026	1763	3692	3507	3331	3164	3006	2856	2714	53183
1933	1	4157	2475	3793	3602	2891	1674	3044	3816	1671	3499	3323	3156	2998	2849	2707	53049
1934	1	2453	3954	2353	3604	3417	2738	1586	2883	3614	1582	3313	3146	2989	2840	2698	52887
1935	1	4278	2333	3759	2235	3417	3234	2593	1501	2728	3419	1497	3134	2977	2828	2687	52698
1936	1	2023	4069	2218	3570	2119	3233	3060	2452	1419	2578	3231	1415	2962	2814	2674	52482
1937	1	2659	1925	3869	2107	3386	2007	3064	2899	2323	1344	2442	3060	1340	2806	2666	52326
1938	1	3630	2529	1830	3675	1998	3207	1901	2902	2746	2199	1272	2312	2898	1269	2658	52162
1939	1	5153	3453	2404	1738	3485	1893	3040	1801	2749	2601	2083	1205	2190	2746	1202	52011
1940	1	4537	4902	3283	2283	1647	3298	1792	2878	1705	2602	2462	1972	1141	2074	2600	50462
1941	1	3313	4316	4659	3116	2163	1559	3125	1698	2726	1615	2464	2332	1868	1081	1965	50335
1942	1	2425	3151	4101	4419	2950	2045	1477	2960	1608	2582	1530	2335	2209	1770	1024	49610
1943	1	2566	2307	2994	3888	4180	2784	1934	1396	2799	1520	2441	1446	2207	2089	1674	47973
1944	1	6092	2440	2188	2830	3659	3921	2626	1824	1316	2639	1434	2302	1364	2083	1971	46943
1945	1	5581	5791	2311	2062	2651	3413	3687	2469	1715	1238	2483	1349	2167	1285	1962	46169
1946	1	4597	5304	5481	2173	1925	2462	3204	3462	2319	1611	1164	2333	1269	2038	1209	45371
1947	1	3204	4371	5033	5182	2046	1806	2320	3018	3261	2185	1518	1096	2199	1196	1922	44028
1948	1	913	3047	4156	4781	4916	1938	1712	2199	2860	3090	2070	1438	1039	2084	1133	43604
1949	1	1266	868	2894	3939	4518	4636	1833	1619	2079	2704	2921	1957	1360	982	1971	42386
1950	1	4944	1204	824	2742	3720	4257	4382	1732	1530	1964	2555	2761	1850	1286	929	42013
1951	1	3094	4701	1143	781	2591	3508	4027	4144	1638	1447	1858	2417	2612	1750	1217	40692
1952	1	3589	2941	4456	1078	733	2420	3302	3791	3902	1543	1363	1750	2278	2462	1650	39586
1953	1	3292	3413	2791	4217	1017	689	2288	3122	3585	3690	1459	1289	1656	2155	2329	39062
1954	1	2765	3131	3244	2650	3997	963	654	2170	2960	3398	3498	1383	1222	1570	2044	39288
1955	1	4502	2629	2974	3075	2505	3770	911	618	2051	2799	3213	3308	1308	1156	1485	39162
1956	1	2571	4281	2497	2818	2906	2362	3565	861	584	1939	2646	3038	3128	1237	1093	38510
1957	1	3045	2442	4034	2327	2596	2656	2206	3333	806	547	1817	2481	2850	2935	1161	37201
1958	1	1947	2895	2314	3806	2183	2426	2499	2075	3136	758	515	1710	2335	2684	2765	36222
1959	1	3090	1851	2744	2184	3574	2043	2288	2358	1959	2961	716	486	1616	2207	2536	36878
1960	1	3383	2937	1752	2581	2041	3324	1921	2152	2218	1843	2787	674	458	1522	2080	37190
1961	1	4074	3215	2776	1643	2400	1886	3113	1799	2017	2080	1729	2615	633	430	1430	36958
1962	1	6066	3871	3040	2606	1530	2224	1771	2925	1691	1895	1957	1627	2461	596	405	36195
1963	1	3305	5761	3651	2838	2408	1404	2080	1657	2740	1585	1779	1836	1527	2311	560	34413
1964	1	8560	3141	5453	3434	2653	2241	1321	1958	1551	2581	1494	1677	1731	1440	2180	33022
1965	1	5497	8136	2974	5134	3214	2471	2107	1243	1842	1469	2429	1407	1579	1631	1357	33225
1966	1	7859	5225	7699	2796	4795	2987	2323	1982	1169	1733	1383	2288	1325	1488	1537	32631
1967	1	5038	7472	4958	7282	2636	4507	2822	2195	1873	1105	1638	1307	2163	1253	1407	32352
1968	1	9152	4789	7085	4678	6827	2458	4225	2643	2065	1753	1034	1534	1224	2027	1175	31787
1969	1	3580	8701	4541	6689	4394	6388	2314	3977	2488	1935	1651	974	1445	1153	1910	31135
1970	1	11000	3403	8237	4270	6236	4069	5966	2160	3711	2321	1805	1540	909	1350	1078	31035

Population numbers-at-age for males post-STAR Panel base-case model (cont.)

Population	1 gmorph		2													
Year	Seas	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+
1971	1	4792	10449	3213	7710	3960	5746	3809	5588	2024	3480	2178	1694	1447	854	1269	30223
1972	1	4795	4562	9864	3005	7139	3641	5372	3564	5232	1896	3262	2043	1590	1358	802	29619
1973	1	9013	4563	4287	9172	2755	6476	3373	4980	3305	4856	1761	3032	1900	1480	1265	28444
1974	1	4487	8556	4283	3978	8386	2493	6009	3134	4632	3078	4628	1644	2832	1776	1384	27837
1975	1	7000	4261	8066	3985	3639	7581	2293	5629	2887	4274	2845	4191	1524	2629	1651	27340
1976	1	5374	6645	4009	7460	3604	3229	6890	2086	5038	2637	3914	2612	3858	1406	2432	27036
1977	1	8177	5101	6239	3654	6486	3025	2763	5877	1787	4346	2293	3433	2310	3438	1261	27094
1978	1	5294	7762	4794	5764	3304	5776	2759	2523	5376	1638	3994	2113	3169	2137	3185	26445
1979	1	9705	5017	7235	4342	5040	2819	5146	2464	2260	4832	1478	3616	1919	2888	1952	27302
1980	1	5772	9204	4649	6426	3640	4048	2386	4364	2099	1937	4171	1285	3166	1691	2558	26462
1981	1	6362	5477	8649	4275	5768	3213	3677	2171	3977	1917	1774	3830	1183	2920	1562	26974
1982	1	5658	6030	5111	7892	3768	4975	2887	3311	1959	3600	1741	1616	3497	1083	2678	26355
1983	1	3686	5350	5540	4478	6576	2999	4293	2502	2885	1717	3171	1542	1437	3123	970	26272
1984	1	4731	3490	4964	4960	3843	5495	2644	3797	2222	2572	1537	2853	1392	1302	2837	24967
1985	1	7934	4475	3221	4406	4205	3159	4852	2343	3379	1985	2308	1385	2577	1261	1182	25393
1986	1	6464	7525	4109	2822	3663	3363	2745	4237	2054	2976	1755	2050	1234	2304	1130	24035
1987	1	6315	6103	6968	3595	2343	2938	2926	2400	3723	1812	2636	1561	1828	1104	2065	22750
1988	1	5401	5997	5573	6141	2988	1879	2578	2577	2121	3302	1612	2351	1396	1639	991	22432
1989	1	6073	4984	5437	4825	5177	2434	1622	2236	2250	1866	2928	1440	2115	1263	1489	21552
1990	1	6433	5710	4622	4870	4134	4344	2077	1393	1937	1965	1648	2598	1287	1900	1140	21178
1991	1	3950	6013	5240	4037	4302	3550	3777	1809	1220	1707	1742	1466	2330	1159	1718	20551
1992	1	2606	3658	5547	4725	3490	3670	3061	3280	1581	1075	1516	1558	1320	2109	1053	20555
1993	1	1707	2337	3282	4951	4129	2981	3180	2658	2867	1391	952	1350	1395	1187	1903	19875
1994	1	3334	1617	2077	2917	4379	3601	2599	2789	2339	2539	1239	853	1215	1261	1076	20105
1995	1	5022	3159	1509	1851	2598	3894	3202	2310	2487	2091	2277	1115	770	1100	1144	19569
1996	1	1330	4765	2965	1386	1584	2226	3381	2793	2024	2196	1857	2037	1003	696	999	19170
1997	1	687	1263	4608	2766	1254	1357	1925	2941	2437	1772	1934	1643	1811	895	623	18490
1998	1	3462	642	1177	4145	2461	1080	1144	1644	2539	2122	1555	1711	1464	1622	806	17618
1999	1	8827	3294	600	1095	3804	2213	985	1040	1502	2327	1950	1432	1580	1354	1503	17170
2000	1	9221	8397	3133	548	990	3376	1976	877	921	1341	2092	1762	1300	1439	1237	17275
2001	1	6217	8771	7978	2971	478	860	2991	1751	779	819	1199	1880	1591	1178	1309	17067
2002	1	3886	5585	8227	7379	2733	422	763	2662	1561	696	733	1078	1697	1440	1069	16973
2003	1	1464	3894	5565	7727	6843	2523	385	700	2446	1436	641	677	997	1573	1336	16875
2004	1	3723	1383	3504	5230	7172	6244	2319	349	637	2234	1315	589	623	920	1463	16979
2005	1	2461	3523	1294	3245	4795	6637	5730	2133	321	586	2057	1212	543	575	850	17175

```
SS2 control file for post-STAR Panel base-case model
----------------------------------------------------
2       #_N_growthmorphs
#_assign_sex_to each_morph_(1=female;_2=male)
1       2
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       1       1       1   1   1   1   1   1   1   1    1    1 #area_for_each_fleet/survey
0       #do_migration_(0/1)
12      #_N_Block_Designs;      If      "value=0,"      Then    Do      not     include the     following       lines
3       3       3       2       2       2       2       16      4       1       8    1   #_N_Blocks_per_Design
1900    1985    1986    2003    2004    2004          #_Block_1; HKL small
1900    1985    1986    2003    2004    2004          # block 2  Pot small
1900    1985    1986    2003    2004    2004          # block 3  Twl small
1900    1987    1988    2003                          # block 4  HKL old
1900    1987    1988    2003                          # block 5  Pot Old
1900    1987    1988    2003                          # block 6  twl old
1900    1982    1983    2004
1979    1979    1982    1982    1985    1985    1987    1987    1988    1988    1989    1989    1990    1990    1991    1991    1992
1992    1994    1994    1996    1996    1997    1997    1998    1998    1999    1999    2000    2000    2001    2001 #block8 age0 Size
1985    1995    1996    2000    2001    2001    2002    2004
1985    2004
1900    1994    1995    1995    1996    1996    1997    1997    1998    1998    1999    1999    2000    2000    2001    2004
1980    2004
#Natural_mortality_and_growth_parameters_for_each_morph
4       #_Last_age_for_natmort_young
15      #_First_age_for_natmort_old
1.66    #_age_for_growth_Lmin
25      #_age_for_growth_Lmax
-4      #_MGparm_dev_phase
#       LO      HI      INIT    PRIOR   PR_type  SD      PHASE   env-var use_dev dev_minyr       dev_maxyr       dev_stddev      Block
#Females
        0.01    0.1     0.07    0.07      0      0.007   3       0       0       0       0       0.5     0       0       #M1_natM_young
         -3      3       0       0         0       99      -3      0       0       0       0       0.5     0       0
#M1_natM_old_as_exponential_offset(rel_young)
        10      45      38.29   38.5      0      5       3       0       0       0       0       0.5     8       0       #M1_Lmin
        40      90      65.18   66.795    0      5       3       0       0       0       0       0.5     0       0       #M1_Lmax
        0.05    0.4     0.2495  0.21      0      0.5     4       0       0       0       0       0.5     0       0       #M1_VBK
        0.03    0.25    0.0456  0.05      0      0.5     4       0       0       0       0       0.5     0       0       #M1_CV-young
         -3      3       1.2500  0         0       99      6       0       0       0       0       0.5     0       0
#M1_CV-old_as_exponential_offset(rel_young)
#Male
         -3      3       0       0         0       99      -3      0       0       0       0       0.5     0       0
#M2_natM_young_as_exponential_offset(rel_morph_1)
        -3      3       0       0         0      99      -3      0       0       0       0       0.5     0       0

#M2_natM_old_as_exponential_offset(rel_young)
         -3      3       0       0         0       99      -3      0       0       0       0       0.5     0       0
#M2_Lmin_as_exponential_offset
         -3      3       -0.144  0         0       99      4       0       0       0       0       0.5     0       0
#M2_Lmax_as_exponential_offset
         -3      3       0.3091  0         0       99      4       0       0       0       0       0.5     0       0
#M2_VBK_as_exponential_offset
         -3      3       0       0         0       99      -3      0       0       0       0       0.5     0       0
#M2_CV-young_as_exponential_offset(rel_CV-young_for_morph_1)
         -3      3       0.9908  0         0       99      6       0       0       0       0       0.5     0       0
#M2_CV-old_as_exponential_offset(rel_CV-young)
```

```
# Add 2+2*gender lines to read the wt-Len and mat-Len parameters
        -3      3       2.44E-06 2.44E-06 0    0.8     -3      0       0       0       0       0.5     0       0       #Female wt-len-1
        -3      3       3.34694         3.34694          0     0.8     -3      0       0       0       0       0.5     0       0#Femlewt-len-2
        -3      3       55      55        0     0.8     -3      0       0       0       0       0.5     0       0       #Female mat-len-1
        -3      3       -0.25   -0.25     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       #Fem 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       2.44E-06 2.44E-06 0    0.8     -3      0       0       0       0       0.5     0       0       #Malewt-len-1
        -3      3       3.34694         3.34694          0     0.8     -3      0       0       0       0       0.5     0       0       #Female
wt-len-2
# pop*gmorph lines For the proportion of each morph in each area
        0       1       0.500   0.2       0     9.8     -3      0       0       0       0       0.5     0       0       #frac to morph 1 in area
1
        0       1       0.500   0.2       0     9.8     -3      0       0       0       0       0.5     0       0       #frac to morph 2 in area
1
# 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
0       #_custom-env_read
#       -10     10      0.1     0.2       0      4       3       #Env_link_parameter
#_custom-block_read
0
        -10     10      0       0         0      1       6       #Block-parm_setup
#_Spawner-Recruitment_parameters
1       # SR_fxn:  1=Beverton-Holt 2=Ricker
#LO     HI      INIT    PRIOR  Pr_type        SD      PHASE   use_env_number
 5      15      10.80    9.80  0       99      1       #Ln(R0)
 0.2    1       0.400   0.4    0       0.06    5       #steepness
 0.2    1.5     0.278   0.3    0         1    -3    #SD_recruitments  sigma-R adherence to the S/R curve (don't estiamte this!)
-10     5       0       0      0       99      3      #Env_link_parameter
-5      5       0       0      0        1      3      #init_eq
1  #env-var_for_link
   #  recruitment_residuals
   # start_rec_year  end_rec_year    Lower_limit     Upper_limit     phase
       1925            2005              -15              15            2


#iinit_F_setup,  for     each    fleet
#       LO      HI      INIT    PRIOR    PR_TYPE  SD      PHASE
        0       1         0       0.01       0       1     -1
        0       1         0       0.01       0       1     -2
        0       1         0       0.01       0       1     -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

#Fisheries
0       0       0       0       0       1
0       0       0       0       0       1
0       0       0       0       0       1
#Surveys
0       0       0       0       0       0
0       0       0       0       0       1
0       0       0       0       0       1
0       0       0       0       0       1
1       0       0       0       0       1
1       0       0       0       0       1
0       0       0       0       0       1
0       0       0       0       0       1
```

```
0       0       0       0       0      1
0       0       0       0       0      1
#       LO      HI      INIT    PRIOR   PR_TYPE    SD      PHASE
        -1.6     0     -0.693    -0.693    0       10       2       #exp(Q) (if     float   =       1)
        -2.6     0     -0.95088  -0.95088  0       0.09509  2       #exp(Q) (if     float   =       1)
#       -30     30      0       0          0       10       4       #Q-power
#       -30     30      0       0          0       10       4       #Q-power
#       -30     30      0.01    0          0        1       4       #Q-env
#_SELEX_&_RETENTION_PARAMETERS
#Selex_type     Do_retention(0/1)       Do_male Use_Another_Selex
2       0       0       0       #_fleet_1       BLL-Dbl Logistic
2       0       0       0       #_fleet_2       POT-Dbl Logistic
2       1       0       0       #_fleet_3       TWL-Dbl Logistic
0       0       0       0       #_fleet_4       recruitment index
0       0       0       0       #_fleet_5       Shelf Survey-no estimate
2       0       0       0       #_fleet_6       North Pot Survey-Logistic
5       0       0       6       #_fleet_7       Med + Large Pot Survey pick from Npot#6  bins 16-(62cm   onwards))
2       0       0       0       #_fleet_8       AFSC Slope Survey-dbl-Logistic
2       0       0       0       #_fleet_9       NWFSC Slope Survey-dbl-Logistic
5       0       0       3       #_fleet_10      Logbooks  78-88  Same as trawlfishery  #3
5       0       0       6       #_fleet_11      Southern  Pot Survey-Logistic
5       0       0       6       #_fleet_12      Southern  Big Pot Survey-pick from Spot - bins    16-     (62cm   onwards))
1       0       0       0       #_fleet_13      Deep Pot STudy-Logistic


#_Age   selex
13      0       1       0       #_fleet_1       BLL-Dbl Logistic
13      0       1       0       #_fleet_2       POT-Dbl Logistic
13      0       1       0       #_fleet_3       TWL-Dbl Logistic
11      0       0       0       #_fleet_4       recruitment
13      0       0       0       #_fleet_5       Shelf- Dbl Logistic
13      0       1       0       #_fleet_6       North Pot Survey- Dbl Logistic
15      0       0       6       #_fleet_7       Med + Large Pot Survey-same as Npot #6
13      0       0       0       #_fleet_8       AFSC Slope   Survey- Dbl Logistic
13      0       0       0       #_fleet_9       NWFSC Slope   Survey- Dbl Logistic
15      0       0       3       #_fleet_10      Logbooks 78-88 Same as trawl fishery #3
15      0       0       6       #_fleet_11      Southern Pot Survey- Dbl Logistic
15      0       0       6       #_fleet_12      Southern Big Pot Survey-same as Spot #11
12      0       0       0       #_fleet_13      Deep Pot Study-Logistic
#1L
#_LO    HI       INIT    PRIOR   PR_TYPE      SD      PHASE   env-variable    use_dev dev_minyr       dev_maxyr       dev_stddev
Block_Pattern
20      95      68      68       0          99      -3      0       0       0       0       0.5     0       0       #1      peak_fleet1
 0      0.1     0       0.001    0          99      -3      0       0       0       0       0.5     0       0       #2       init
-5      4.      0.5      1.      0          99       3      0       1      1986    2003     1.0     1       1       #3       infl
0.0001  10      0.4     0.2      0          99       3      0       0       0       0       0.5     0       0       #4       slope
-10     10      8       7        0          99       5      0       0       0       0       0.5     0       0       #5       final
-5.     4.      1.28    1.       0          99       6      0       0       0       0       0.5     0       0       #6       infl
0.0001  10      4.75    0.1      0          99       6      0       0       0       0       0.5     0       0       #7       slope2
0.1     10      4       4        0          99      -4      0       0       0       0       0.5     0       0       #8      width of top
#2L
20      85      54      54       0          99      -3      0       0       0       0       0.5     0       0       #9      peak_fleet2
0       0.1     0.001   0.001    0          99      -3      0       0       0       0       0.5     0       0       #10      init
-5.    4.       0        0       0          99       3      0       1      1986    2003     1.0     2       1       #11      infl
0.0001  10      0.73    0.2      0          99       3      0       0       0       0       0.5     0       0       #12      slope
-10.    10      0.49     .7      0          99       5      0       0       0       0       0.5     0       0       #13      final
-5.    4.       .50      .49     0          99       6      0       0       0       0       0.5     0       0       #14      infl
0.0001  10      .001     .98     0          99      -6      0       0       0       0       0.5     0       0       #15      slope2
```

```
0.1     10      2       2        0         99     -4     0      0      0      0      0.5    0      0      #16     widthoftop
#3L
20      85      54      54       0         99     -3     0      0      0      0      0.5    0      0      #17    peak_fleet3
0.0     0.5     0.      0.001    0         99     -3     0      0      0      0      0.5    0      0      #18     init
-5.   4.        0       0.       0         99      3     0      1      1986   2003   1.0    3      1      #19     infl
0.0001  10      0.2     0.48     0         99      3     0      0      0      0      0.5    0      0      #20     slope
-10.    10      1       .29      0         99      3     0      0      0      0      0.5    0      0      #21     final
-5.   4.        1       .13      0         3       4     0      0      0      0      0.5    0      0      #22     infl
0.0001  10      .1      .57      0         3       4     0      0      0      0      0.5    0      0      #23     slope2
0.1     10      2       2        0         99     -4     0      0      0      0      0.5    0      0      #24     widthoftop
20      70      42.8    40       0         99     -3     0      0      0      0      0      9      0      #25
inflection_for_retention
0.1      10      1.092   1          0          99      -3      0       0       0      0       0       9       0       #26
slope_for_retention
0.001   1        1        1         0          99      -3      0       0       0      0       0       10      0       #27
asymptotic_retention
-10     10      3       0        0          99       -3      0       0       0      0       0       0       0      #28
male_offset_on_inflection
#6L     north   pot     survey
20      85      54      54       0         99     -3     0      0      0      0      0.5    0      0      #29    peak_fleet3
0.0     0.5     0.      0.001    0         99     -3     0      0      0      0      0.5    0      0      #30     init
-5.   4.        .5      1.       0         99     -3     0      0      0      0      0.5    7      0      #31     infl
0.0001  10      0.2     0.2      0         99     3      0      0      0      0      0.5    0      0      #32     slope
-10.    10      1       7        0         99     5      0      0      0      0      0.5    0      0      #33     final
-5.   4.        1.      1.       0         99     6      0      0      0      0      0.5    0      0      #34     infl
0.0001  10      .1      .1       0         99     6      0      0      0      0      0.5    0      0      #35     slope2
0.1     10      2       2        0         99     -4     0      0      0      0      0.5    0      0      #36     widthoftop
#7L     north   -       big                pot
17      17      17      17       0         99     -2     0      0      0      0      0.5    0      0      #37    min Size bin
23      23      23      23       0         99     -2     0      0      0      0      0.5    0      0      #38     Size bin
#8L     AFSC slope   survey
20      65      55      55       0         99     -3     0      0      0      0      0.5    0      0      #39     peak_fleet8
fixed peak
0.0001  1       1       1        0         99     2      0      0      0      0      0.5    0      0      #40     init
-5.   4.        1.      1.       0         99     -3     0      0      0      0      0.5    0      0      #41     infl
0.0001  10      0.2     0.2      0         99     -3     0      0      0      0      0.5    0      0      #42     slope
-10.    10      1       7        0         99     3      0      0      0      0      0.5    0      0      #43     final
-5.   4.        1.      1.       0         99     3      0      0      0      0      0.5    0      0      #44     infl
0.0001  10      .1      .1       0         99     3      0      0      0      0      0.5    0      0      #45     slope2
0.1     10      2       2        0         99     -4     0      0      0      0      0.5    0      0      #46     widthoftop
#9L     NWFSC slope   survey
20      65      55      55       0         99     -3     0      0      0      0      0.5    0      0      #39     peak_fleet8
fixed peak
0.0001  1       1       1        0         99     2      0      0      0      0      0.5    0      0      #40     init
-5.   4.        1.      1.       0         99     -3     0      0      0      0      0.5    0      0      #41     infl
0.0001  10      0.2     0.2      0         99     -3     0      0      0      0      0.5    0      0      #42     slope
-10.    10      1       7        0         99     3      0      0      0      0      0.5    0      0      #43     final
-5.   4.        1.      1.       0         99     3      0      0      0      0      0.5    0      0      #44     infl
0.0001  10      .1      .1       0         99     3      0      0      0      0      0.5    0      0      #45     slope2
0.1     10      2       2        0         99     -4     0      0      0      0      0.5    0      0      #46     widthoftop
#10L
1       1       1       1        0         99     -2     0      0      0      0      0.5    0      0      #49    Min Size bin
23      23      23      23       0         99     -2     0      0      0      0      0.5    0      0      #50    max Size bin


#11L
1       1       1       1        0         99     -2     0      0      0      0      0.5    0      0      #51    MinSize bin
23      23      23      23       0         99     -2     0      0      0      0      0.5    0      0      #52    maxSize bin
```

```
#12L
17      17      17      17       0          99      -2      0       0       0       0       0.5     0       0       #53    minSize bin
23      23      23      23       0          99      -2      0       0       0       0       0.5     0       0       #54    maxSize bin
#13L Simplier Logistic Selex_type = 1
10      60      30      30        0          99      3       0       0       0       0       0.5     0       0       #55      infl
0       60      20      20        0          99      3       0       0       0       0       0.5     0       0       #56      slope
#1A
#LO      HI      INIT    PRIOR     PR_TYPE   SD  PHASE   env-variable use_dev dev_minyr dev_maxyr dev_stddev
0       20      3       10          0        99         -3      0       0       0       0       0.5     0       0       #57     peak_fleet1
   48
0.0001  1       1       1           0        99         -3      0       0       0       0       0.5     0       0       #58     init
-5.    4.       .5      1.          0        99         -3      0       0       0       0       0.5     0       0       #59     infl
0.01    10      0.2     0.2         0        99         -3      0       0       0       0       0.5     0       0       #60     slope
-10.    10      .7      .5          0        99         3       0       1     1987    2003      1.0     4       1       #61     final
-5.    4.     -2.5      1.          0        99         4       0       0       0       0       0.5     0       0       #62     infl
0.01    10     .48      .1          0        99         4       0       0       0       0       0.5     0       0       #63     slope2
0.1     10      1       1           0        99         -4      0       0       0       0       0.5     0       0       #64     width -5
    20      10      0           0        99         -5      0       0       0       0       0.5     0       0       #65     male rel
female-peak-logistic fxn between Lmin and Lmax
-5      5       0       0           0         2         -4      0       0       0       0       0.5     0       0       #66     male rel
female-peak-logistic fxn between Lmin and Lmax
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #67     male rel
female-peak-logistic fxn between Lmin and Lmax
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #68     male rel
female-peak-logistic fxn between Lmin and Lmax
#2A
0       20      3       3           0        99         -3      0       0       0       0       0.5     0       0       #69     peak_fleet1
0.0001  1       1       1           0        99         -3      0       0       0       0       0.5     0       0       #70     init
-5.    4.       .5      1.          0        99         -3      0       0       0       0       0.5     0       0       #71     infl
0.01    10      0.2     0.2         0        99         -3      0       0       0       0       0.5     0       0       #72     slope
-10.    10    -3.47     .5          0        99         3       0       1     1987    2003      1.0     5       1       #73     final
-5.    4.     -1.89     1.          0        99         4       0       0       0       0       0.5     0       0       #74     infl
0.01    10      .21     .1          0        99         4       0       0       0       0       0.5     0       0       #75     slope2
0.1     10      1       1           0        99         -4      0       0       0       0       0.5     0       0       #76     width of
top Change  from    5       to      1
-5      20      10      0           0        99         -5      0       0       0       0       0.5     0       0       #77     male rel
female-peak-logistic fxn between Lmin    and     Lmax
-5      5       0       0           0         2         -4      0       0       0       0       0.5     0       0       #78     male rel
female- Log(sel at Min)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #79     male rel
female  Log(sel at peak)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #80     male

rel female  Log(sel at Max)
#3A
0       20      3       3           0        99         -3      0       0       0       0       0.5     0       0       #81     peak_fleet1
0.0001  1       1       1           0        99         -3      0       0       0       0       0.5     0       0       #82     init
-5.    4.       .5      1.          0        99         -3      0       0       0       0       0.5     0       0       #83     infl
0.01    10      0.2     0.2         0        99         -3      0       0       0       0       0.5     0       0       #84     slope
-10.    10     -2.3     .5          0        99         3       0       0       0       0       0.5     0       0       #85     final
-10.    10     -2.3     .5          0        99         3       0       1     1987    2003      1.0     6       1       #85     final
0.01    10      .41     .1          0        99         4       0       0       0       0       0.5     0       0       #87     slope2
0.1     10      1       1           0        99         -4      0       0       0       0       0.5     0       0       #88     width -5
    20      10      0           0        99         -5      0       0       0       0       0.5     0       0       #89     male rel female
-peak - logistic fxn between Lmin    and     Lmax
-5      5       0       0           0         2         -4      0       0       0       0       0.5     0       0       #90     male rel
female -Log(sel at Min)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #91     male rel
```

```
female Log(sel at peak)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #92     male rel
female Log(sel at Max)
#4A
0       40      0       0           0         99        -1      0       0       0       0       0.5     0       0       #       minage
0       40      0       0           0         99        -1      0       0       0       0       0.5     0       0       #       maxage
#5A
0       40      1       1           0         99        -3      0       0       0       0       0.5     0       0       #93     0
0.1     0       0.001       0         99          -3      0       0       0       0       0.5     0       0               #94     init
-5.     4.      .5      1.          0         99        -3      0       0       0       0       0.5     0       0       #95     infl
0.01    10      0.2     0.2         0         99        -3      0       0       0       0       0.5     0       0       #96     slope
-10.    10      -3      -3          0         99        4       0       1       2001    2004    0.5     0       0       #97     final
-5.     4.      .5      1.          0         99        4       0       0       0       0       0.5     0       0       #98     infl
0.01    10      .1      .1          0         99        4       0       0       0       0       0.5     0       0       #99     slope2
0.1     10      0.1     0.1         0         99        -4      0       0       0       0       0.5     0       0       #100    widoftop
#6A
-5      20      2       5           0         99        -3      0       0       0       0       0.5     0       0       #101    0.0001
1       1       1           0         99          -3      0       0       0       0       0.5     0       0               #102    init
-5.     4.      .5      1.          0         99        -3      0       0       0       0       0.5     0       0       #103    infl
0.01    10      0.2     0.2         0         99        -3      0       0       0       0       0.5     0       0       #104    slope
-10.    10      -0      -0          0         99        4       0       0       0       0       0.5     0       0       #105    final
-5.     4.      .5      1.          0         99        4       0       0       0       0       0.5     0       0       #106    infl
0.01    10      .1      .1          0         99        4       0       0       0       0       0.5     0       0       #107    slope2
0.1     10      1       1           0         99        -4      0       0       0       0       0.5     0       0       #108    width
of      top     Change  from    5       to      1
-5      20      10      0           0         99        -5      0       0       0       0       0.5     0       0       #109    male
rel     female  -       peak    -       logistic        fxn     between Lmin    and     Lmax
-5      5       0       0           0         2         -4      0       0       0       0       0.5     0       0       #110    male
rel     female  -       Log(sel at      Min)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #111    male

rel     female  Log(sel at      peak)
-5      5       0       0           0         2         5       0       0       0       0       0.5     0       0       #112    male
rel     female  Log(sel at      Max)
#7A
# N  bigpot same as Npot For age
#8A  AFSC Slope
 2      20      2       5           0         99        -3      0       0       0       0       0.5     0       0       #113    peak_slope
    survey
 0       1      0       1           0         99        -3      0       0       0       0       0.5     0       0       #114    init
-5      4       0.5     1           0         99        -3      0       0       0       0       0.5     0       0       #115    infl
0.001   10      0.5     0.2         0         99        3       0       0       0       0       0.5     0       0       #116    slope
-10.    10      6       6           0         99        -5      0       0       0       0       0.5     0       0       #117    final
-5.     4.      .5      1.          0         99        -6      0       0       0       0       0.5     0       0       #118
0.01    10      .1      .1          0         99        -6      0       0       0       0       0.5     0       0       #119    slope2
0.1     10      1       1           0         99        -4      0       0       0       0       0.5     0       0       #120    width  of
#9A  NWFSC Slope
 2      20      5       5           0         99        -3      0       0       0       0       0.5     0       0       #113    peak_slope
    survey
#0      1       0       1           0         99        -3      0       0       0       0       0.5     0       0       #114    init
 0      1       0       1           0         99        3       0       1       1998    2004    3.5     0       0       #114    init
-6      4       -5      1           0         99        -3      0       0       0       0       0.5     0       0       #115    infl
0.001   10      0.2     0.2         0         99        3       0       0       0       0       0.5     0       0       #116    slope
-10.    10      6       6           0         99        -5      0       0       0       0       0.5     0       0       #117    final
-5.     4.      .5      1.          0         99        -6      0       0       0       0       0.5     0       0       #118
0.01    10      .1      .1          0         99        -6      0       0       0       0       0.5     0       0       #119    slope2
0.1     10      1       1           0         99        -4      0       0       0       0       0.5     0       0       #120    width  of
#10A
```

```
# same as trawl fishery
#11A
# same as Npot
#12A
# Same as Spot
#13A Simplier Logistic Selex_type = 12
3      60      10      10         0          99      3       0       0       0       0      0.5     0       0       #3      infl
0      60      10      10         0          99      3       0       0       0       0      0.5     0       0       #4      slope
#_custom-env_read
0 # 0=read one setup and apply to all; 1 = custom so read 1 each this must be in because ENV is used at some Point
#       -10     10      0       0       4       4       #Env-parm_setup
#_custom-block_read
1
#LO     HI      INIT  PRIOR  PR_Type  SD      PHASE
-10     10      1       1     0        3       3       #Block-1-1 parm 3 n = block segments
-10     10      1       1     0        3       3       #Block-1-2
-10     10      1       1     0        3       3       #Block-1-3
-10     10      1       1     0        3       3       #Block-2-1 parm 11
-10     10      1       1     0        3       3       #Block-2-2
-10     10      1       1     0        3       3       #Block-2-3

-10     10      1       1     0        3       3       #Block-3-1 parm 19
-10     10      1       1     0        3       3       #Block-3-2
-10     10      1       1     0        3       3       #Block-3-3
-10     10      -0.0651 0     0        3       -4      #Block-9-1a parm 25
-10     10      -0.0651 0     0        3       4       #Block-9-2a parm 25
-10     10      -0.0651 0     0        3       4       #Block-9-2a parm 25
-10     10      -0.0651 0     0        3       4       #Block-9-2a parm 25
-10     10      -0.7304 0     0        3       -4      #Block-9-1b parm 26
-10     10      -0.7304 0     0        3       -4      #Block-9-2b parm 26
-10     10      -0.7304 0     0        3       -4      #Block-9-2b parm 26
-10     10      -0.7304 0     0        3       -4      #Block-9-2b parm 26
-10     10      -0.2414 0     0        3       -6      #Block-10-1 parm 27
-10     10      0       0     0        3       4       #Block-7-1 parm 28
-10     10      0       0     0        3       4       #Block-7-2 parm 28
-10     10      0       0     0        3       4       #Block-4-1 parm 52
-10     10      0       0     0        3       4       #Block-4-2
-10     10      0       0     0        3       4       #Block-5-1 parm 64
-10     10      0       0     0        3       4       #Block-5-2
-10     10      0       0     0        3       4       #Block-6-1 parm 76
-10     10      0       0     0        3       4       #Block-6-2
4      #_phase_for_selex_parm_devs
1       #_max_lambda_phases:_read_this_Number_of_values_for_each_componentxtype_below                                     1
#maximum phase beyond which you'll keep the same lambdas
#_survey_lambdas
#HKL POT TWL    ENV SHELF 6/Nort_Pot  7/N_BIG_POT   SLOPE  NWFSC-SLOPE  10/LOG_78-88 South_Pot 12/S_BIG_POT  DEEP_Pot
 #1    1    1    0    1       0          1            1         0             1           0        1             NA
  1    1    1    0    1       0          1            1         1             1           0        1             0
#_discard_lambdas
  0.1  0.1  0.1  0    0       0          0            0         0             0           0        0             0
#_meanwtlambda(one_for_all_sources)
1
#_lenfreq_lambdas
1      1    1     0   1       1          1            1          1            1           1        1              0
#_age_freq_lambdas
1      1    1     0   1       1          1            1          1            1           1        1              0
#_size@age_lambdas
0.1  0.1  0.1     0   0.1    0.1        0.1          0.1        0.1          0.1         0.1      0.1            0.1
```

```
#_initial_equil_catch
1
#_recruitment_lambda
1
#_parm_prior_lambda
1
#_parm_dev_timeseries_lambda
1
# crashpen lambda
100
#max F
0.9
999     #_end-of-file
```

```
Data file for post-STAR Panel base-case model
---------------------------------------------
#       MODEL   DIMENSIONS

1900    #       start_year
2005    #       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
3       #       N_fishing_fleets
10      #       N_surveys;_data_type_numbers_below_must_be_sequential_with_the_N_fisheries

#_surveytiming_in_season
HKL%POT%TWL%ENV%SHELF%Northern_Pot%N_BIG_POT%AFSC-SLOPE%NWFSC-SLOPE%LOGBOOKS_78-88%Southern_Pot%S_BIG_POT%DEEP_Pot
0.5 0.5 0.5 0.5   0.5         0.5           0.5       0.666        0.5             0.5           0.5          0.5   0.5

2       #_number_of_genders(1/2)
40      #_accumulator_age;_model_always_starts_with_age_0
#       catch   (mt)    #       Year    Season
0        0       0       #       initial_equilibrium
0       0       0       #       1900    1
50      0       4       #       1901    1
100     0       8       #       1902    1
150     0       12      #       1903    1
200     0       16      #       1904    1
250     0       20      #       1905    1
300     0       24      #       1906    1
350     0       28      #       1907    1
400     0       32      #       1908    1
450     0       36      #       1909    1
500     0       40      #       1910    1
550     0       44      #       1911    1
600     0       48      #       1912    1
650     0       52      #       1913    1
700     0       56      #       1914    1
750     0       60      #       1915    1
800     0       64      #       1916    1
850     0       68      #       1917    1
900     0       72      #       1918    1
950     0       76      #       1919    1
1000    0       80      #       1920    1
1050    0       84      #       1921    1
1100    0       88      #       1922    1
1150    0       92      #       1923    1
1200    0       96      #       1924    1
1250    0       100     #       1925    1
1300    0       104     #       1926    1
1350    0       108     #       1927    1
1400    0       112     #       1928    1
1450    0       116     #       1929    1
1500    0       120     #       1930    1
1550    0       124     #       1931    1
1600    0       128     #       1932    1
1951    0       156     #       1933    1
2300    0       156     #       1934    1
2635    0       156     #       1935    1
1670    0       162     #       1936    1
1767    0       152     #       1937    1
1514    0       170     #       1938    1
1753    0       202     #       1939    1
1344    0       243     #       1940    1
1102    0       349     #       1941    1
1862    0       389     #       1942    1
2085    0       859     #       1943    1
2251    0       1216    #       1944    1
2239    0       1449    #       1945    1
2429    0       690     #       1946    1
1240    0       153     #       1947    1
1559    0       486     #       1948    1
1612    0       537     #       1949    1
1319    0       490     #       1950    1
1885    0       976     #       1951    1
1073    0       564     #       1952    1
807     0       217     #       1953    1
1413    0       409     #       1954    1
1413    0       409     #       1955    1
1131    0       2481    #       1956    1
2051    0       914     #       1957    1
855     0       948     #       1958    1
1399    0       1273    #       1959    1
1980    0       1510    #       1960    1
1142    0       1396    #       1961    1
1110    0       1947    #       1962    1
940     0       1201    #       1963    1
1428    0       1133    #       1964    1
1162    0       1373    #       1965    1
999     0       691     #       1966    1
3574    0       933     #       1967    1
1951    0       1016    #       1968    1
4200    0       1505    #       1969    1
1404    114     2422    #       1970    1
1512    193     2531    #       1971    1
3500    357     3462    #       1972    1
1126    878     3800    #       1973    1
2444    3244    3047    #       1974    1
1737    5696    3392    #       1975    1
1225    19740   3554    #       1976    1
1445    4140    3665    #       1977    1
1722    5910    5986    #       1978    1
4238    12572   7563    #       1979    1
1440    3777    3929    #       1980    1
1947     3900    5642   #       1981    1
1736     6512   10266   #       1982    1
1133     5669    7361   #       1983    1
```

```
1039    3825    8237   #       1984    1
2810    3894    7287   #       1985    1
3634    2238    6469   #       1986    1
3789    1584    6562   #       1987    1
3177    2122    5525   #       1988    1
2525    1686    5700   #       1989    1
2204    1492    5196   #       1990    1
3239     845    4965   #       1991    1
2987     732    5399   #       1992    1
2275     816    4911   #       1993    1
2236    1302    3793   #       1994    1
2971    1061    3837   #       1995    1
3349     744    4207   #       1996    1
3583     582    3761   #       1997    1
1752     447    2175   #       1998    1
2713     752    3165   #       1999    1
2749     807    2701   #       2000    1
2353     671    2619   #       2001    1
1734     470    1596   #       2002    1
2318     807    2319   #       2003     1
2476     799    2278   #       2004     1
2476     799    2278   #       2005     1
#_Abundance_Indices

139     #_N_observations

#Year   Seas    Fleet  Value            C       V

1925    1       4       936.36          0.20
1926    1       4       10502.56        0.20
1927    1       4       7076.07         0.20
1928    1       4           0           0.20
1929    1       4       5213.18         0.20
1930    1       4       7341.79         0.20
1931    1       4       7425.71         0.20
1932    1       4       1621.66         0.20
1933    1       4       7512.42         0.20
1934    1       4       1104.19         0.20
1935    1       4       8097.02         0.20
1936    1       4          0.           0.20
1937    1       4       2474.78         0.20
1938    1       4       6446.71         0.20
1939    1       4       10894.15        0.20
1940    1       4       9467.62         0.20
1941    1       4       5719.46         0.20
1942    1       4       1971.30         0.20
1943    1       4       2771.28         0.20
1944    1       4       13551.43        0.20
1945    1       4       12600.41        0.20
1946    1       4       -0.001          -0.20
1947    1       4       6027.14         0.20
1948    1       4          0            0.20
1949    1       4          0            0.20
1950    1       4       11498.33        0.20
1951    1       4       5775.40         0.20
1952    1       4       7755.77         0.20
1953    1       4       6810.34         0.20
1954    1       4       4743.26         0.20
1955    1       4       10894.15        0.20
1956    1       4       4055.16         0.20
1957    1       4       6287.28         0.20
1958    1       4       852.45          0.20
1959    1       4       6306.86         0.20
1960    1       4       7453.68         0.20
1961    1       4       9719.36         0.20
1962    1       4       14012.96        0.20
1963    1       4       7034.11         0.20
1964    1       4       18082.79        0.20
1965    1       4       13621.36        0.20
1966    1       4       18893.96        0.20
1967    1       4       14334.63        0.20
1968    1       4       22693.39        0.20
1969    1       4       8553.89         0.20
1970    1       4       23593.14        0.20
1971    1       4       12702.97        0.20
1972    1       4       11518.85        0.20
1973    1       4       23558.18        0.20
1974    1       4       13283.37        0.20
1975    1       4       20879.92        0.20
1976    1       4       15758.84        0.20
1977    1       4       20712.09        0.20
1978    1       4       13336.98        0.20
1979    1       4       19285.55        0.20
1980    1       4       14173.79        0.20
1981    1       4       13873.10        0.20
1982    1       4       12768.23        0.20
1983    1       4       8138.98         0.20
1984    1       4       11579.45        0.20
1985    1       4       16894.01        0.20
1986    1       4       14936.01        0.20
1987    1       4       16474.44        0.20
1988    1       4       13383.60        0.20
1989    1       4       14635.32        0.20
1990    1       4       13481.50        0.20
1991    1       4       17222.67        0.20
1992    1       4       11628.40        0.20
1993    1       4       1747.53         0.20
1994    1       4       14103.86        0.20
1995    1       4       13712.27        0.20
1996    1       4       10859.19        0.20
1997    1       4       5789.39         0.20
1998    1       4       11516.52        0.20
1999    1       4       18187.68        0.20
2000    1       4       13376.61        0.20
2001    1       4       20082.74        0.20
2002    1       4       19705.12        0.20
2003    1       4       11859.17        0.20
2004    1       4       14124.84        0.20
```

```
1980    1       5       65981   0.3     #       BIOMASS         SHELF   SURVEY
1983    1       5       32176   0.292   #       Adjusted        for     waterhauls
1986    1       5       23987   0.2846  #
1989    1       5       39807   0.3826  #
1992    1       5       58017   0.2555  #
1995    1       5       16677   0.2193  #
1998    1       5       24246   0.2351  #
2001    1       5       99552   0.2911  #
2004     1       5       78191   0.2750  #

1971    1       6       15      0.6     #       NORTH POT SURVEY
1979    1       6       12.61   0.3997  #
1980    1       6       5.96    0.3993  #
1981    1       6       5.41    0.3993  #
1983    1       6       11.52   0.1944  #
1985    1       6       8.08    0.1968  #
1987    1       6       3.16    0.3354  #
1989    1       6       2.56    0.3594  #
1971    1       7       3.225   0.4     #       NORTH POT SURVEY - MEDIUM AND LARGE
1979    1       7       2.608   0.3988  #
1980    1       7       0.841   0.4043  #
1981    1       7       0.653   0.3982  #
1983    1       7       1.16    0.181   #
1985    1       7       0.64    0.2344  #
1987    1       7       0.33    0.2727  #
1989    1       7       0.19    0.3158  #
1992    1       8       -61787.8 -0.02996  #  AFSC SLOPE GLM; include       Conception
1996    1       8       -52875.1 -0.02234  #  Excluding years of non-full coverage        1 9 9 7
        1       8       63092.6         0.12777  #
1999    1       8       53242.7         0.14156  #                                          2 0 0 0
        1       8       60283.5         0.11427  #                                          2 0 0 1
        1       8       76139.3         0.13120  #
1998     1       9       22685  0.0908  #       NWFSC SLOPE SurveyGLM WITHOUT CONCEPTION
1999    1       9       28445   0.0705  #
2000    1       9       32604   0.0749  #
2001    1       9       28205   0.0728  #
2002    1       9       31701   0.0626  #
2003    1       9       35442   0.0827  #
2004    1       9       52440   0.0891  #
1978    1       10      57.3    0.1885  #       Logbooks GLM 78-88
1979    1       10      129.1   0.3857  #
1980    1       10      60.8    0.1842  #
1981    1       10      112.5   0.3271  #
1982    1       10      128.8   0.3587  #
1983    1       10      79.3    0.2043  #
1984    1       10      120.3   0.345   #
1985    1       10      130.2   0.3464  #
1986    1       10      90.4    0.24    #
1987    1       10      91.5    0.2437  #
1988    1       10      100     0.284   #
1984    1       11      10.9    0.1064  #       SOUTH POT SURVEY
1986    1       11      4.74    0.116   #
1988    1       11      10.05   0.1652  #
1991    1       11      3.15    0.1492  #
1984    1       12      0.99    0.2     #       SOUTH POT SURVEY - MEDIUM AND LARGE
1986    1       12      0.66    0.2     #
1988    1       12      0.4     0.2     #
1991    1       12      0.3     0.2     #
2002     1       13      -99     0       #       NWFSC Deep Pot Study
2003     1       13      -99     0       #
#_Discard_Biomass
2       #_(1=biomass;_2=fraction)
44      #_N_observations
2000    1       1       0.00849         0.25
2001    1       1       0.00000         0.25
2002    1       1       0.00000         0.25
2003    1       1       0.01657         0.25
2004    1       1       0.02500         0.25
2000    1       2       0.00486         0.25
2001    1       2       0.00000         0.25
2002    1       2       0.00000         0.25
2003    1       2       0.00407         0.25
2004    1       2       0.02664         0.25
1971    1       3       0.04472         0.25
1972    1       3       0.04300         0.25
1973    1       3       0.03518         0.25
1974    1       3       0.04401         0.25
1975    1       3       0.03500         0.25
1976    1       3       0.03957         0.25
1977    1       3       0.03897         0.25
1978    1       3       0.05166         0.25
```

```
1979	1	3	0.05907		0.25
1980	1	3	0.04022		0.25
1981	1	3	0.04655		0.25
1982	1	3	0.03965		0.25
1983	1	3	0.07141		0.25
1984	1	3	0.04102		0.25
1985	1	3	0.09115		0.25
1986	1	3	0.08718		0.25
1987	1	3	0.09481		0.25
1988	1	3	0.07000		0.25
1989	1	3	0.08633		0.25
1990	1	3	0.10584		0.25
1991	1	3	0.07000		0.25
1992	1	3	0.12151		0.25
1993	1	3	0.11017		0.25
1994	1	3	0.10740		0.25
1995	1	3	0.15439		0.25
1996	1	3	0.12293		0.25
1997	1	3	0.23791		0.25
1998	1	3	0.22444		0.25
1999	1	3	0.07350		0.25
2000	1	3	0.14758		0.25
2001	1	3	0.14350		0.25
2002	1	3	0.19600		0.25
2003	1	3	0.16248		0.25
2004	1	3	0.21240		0.25

#_Mean_BodyWt
2												#Year
	Seas	Type	Mkt	Value	CV2002	1	1	0	0.98	0.95
					2003	1	1	0	1.30	0.950.0001	#min_pr
oportion_for_compressing_tails_of_observed_composition			0.0001	#_constant added
to expected frequencies						23	#_N_length_bins

#_lower_edge_of_length_bins								2	0
	32	34	36	38	40	42	44	46	48	50	52	5	4
	56	58	60	62	64	68	72	76	80	90113	#N_observations
				20	32	34	36	38	40	42	44	4	6
	48	50	52	54	56	58	60	62	64	68	72	7	6
	80	90	20	32	34	36	38	40	42	44	46	4	8
	50	52	54	56	58	60	62	64	68	72	76	8	0
	90


#Year	Seas	Fleet	sexes	Mkt	Nsamp	20	32	34	36	38	40	4	2
	44	46	48	50	52	54	56	58	60	62	64	6	8
	72	76	80	90	20	32	34	36	38	40	42	4	4
	46	48	50	52	54	56	58	60	62	64	68	7	2
	76	80	90#	HKL	Fishery		Lengths
								1971	1	1	0	0
	20	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00463		0.00926		0.00926		0.01389
	0.01273		0.01157		0.02546		0.03819		0.04745		0.14815
	0.17014		0.19329		0.15394		0.14815		0.01389		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		#	early	1950s	Eureka
	longline		SIZE	COMP	1981	1	1	0	0	20	0.00000
	0.00000		0.00000		0.00000		0.00034		0.00017		0.00310
	0.00765		0.01704		0.02203		0.03316		0.04542		0.05445
	0.05106		0.06076		0.05360		0.08228		0.19381		0.17541
	0.08959		0.05973		0.04666		0.00374		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		#	FROM	L-M-S	CATCH	AND	86-87
	SIZE	COMP	IN	EACH	MKT
1982	1	1	0	0	20	0.00000		0.00000		0.00000		0.00000
	0.00067		0.00033		0.00578		0.01427		0.03239		0.04257
	0.06379		0.08516		0.09754		0.08447		0.08306		0.06383
	0.07296		0.13584		0.10426		0.05073		0.03382		0.02642
	0.00211		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
	#	FROM	L-M-S	CATCH	AND	86-87	SIZE	COMP	IN	EACH	MKT

1983	1	1	0	0	21	0.00000		0.00000		0.00000		0.00000
	0.00000		0.00000		0.00280		0.00000		0.01705		0.03215
```

```
        0.03578   0.04585   0.03886   0.03886   0.07884   0.05787
        0.07856   0.13782   0.16606   0.10316   0.05591   0.10763
        0.00280   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        #    1983   KLEIN   HKL   FISHERY   1983   1   1   0
        0    20     0.00000   0.00000   0.00000   0.00000   0.00063
        0.00032   0.00575   0.01421   0.03165   0.04088   0.06154
        0.08438   0.10130   0.08997   0.09023   0.07184   0.07924
        0.13605   0.09385   0.04403   0.02935   0.02293   0.00184
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   #   FROM
        L-M-S   CATCH   AND   86-87   SIZE   COMP   IN   EACH   MKT
1984    1   1   0   0   20   0.00000   0.00000   0.00000   0.00000
        0.00056   0.00028   0.00506   0.01250   0.02799   0.03633
        0.05461   0.07432   0.08809   0.07843   0.08078   0.06514
        0.07855   0.15118   0.11777   0.05760   0.03840   0.03000
        0.00240   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        #   FROM   L-M-S   CATCH   AND   86-87   SIZE   COMP   IN   EACH   MKT

1985    1   1   0   0   20   0.00000   0.00000   0.00000   0.00000
        0.00111   0.00056   0.00894   0.02208   0.05161   0.06962
        0.10364   0.13270   0.14020   0.11253   0.09501   0.06019
        0.04999   0.06827   0.04194   0.01866   0.01244   0.00972
        0.00078   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        #   FROM   L-M-S   CATCH   AND   86-87   SIZE   COMP   IN   EACH   MKT

1986    1   1   3   0   84   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00156   0.00156   0.01251   0.03372   0.04467
        0.06172   0.06107   0.08258   0.04869   0.04295   0.03710
        0.04427   0.07922   0.05383   0.01899   0.01940   0.01610
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00156
        0.00000   0.00469   0.01095   0.03370   0.03698   0.05711
        0.05311   0.03558   0.02107   0.02260   0.01534   0.01910
        0.01976   0.00620   0.00089   0.00000   0.00141   0.00000
                                                1987   1   1   3
        0    112   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00042   0.00210   0.00431   0.01045   0.02497
        0.02714   0.04433   0.05635   0.07268   0.06357   0.05584
        0.06089   0.05161   0.02763   0.01856   0.01182   0.00265
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00126   0.00295   0.00746   0.01469   0.03729   0.07162
        0.08135   0.09127   0.07802   0.03607   0.01950   0.01695
        0.00621   0.00000   0.00000   0.00000   0.00000
                                      1988   1   1   3   0   7   6
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00852   0.01535   0.01937   0.02848
        0.08465   0.07378   0.09668   0.06634   0.05798   0.07607
        0.03647   0.02539   0.01166   0.01515   0.00000   0.00000
        0.00001   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00001   0.00568   0.01947   0.03227   0.03336   0.05638
        0.07919   0.07163   0.03825   0.02527   0.02025   0.00000
        0.00089   0.00146   0.00000   0.00000
                            1989   1   1   3   0   69   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
        0.00020   0.00023   0.02363   0.05982   0.12803   0.12508
        0.07051   0.06629   0.05532   0.06121   0.06491   0.04017
        0.02261   0.02225   0.00278   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00000   0.00027
        0.00116   0.09549   0.02699   0.02378   0.02860   0.00305
        0.02669   0.01386   0.01143   0.01923   0.00640   0.00000
        0.00000   0.00000   0.00000
                  1990   1   1   3   0   79   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00000   0.00671   0.00514
        0.01106   0.00452   0.03577   0.04550   0.07551   0.11052
        0.08362   0.08198   0.04303   0.09415   0.07455   0.03048
        0.01627   0.00956   0.00321   0.00000   0.00000   0.00000
        0.00000   0.00000   0.00000   0.00316   0.00158   0.01106
        0.02069   0.02230   0.01938   0.05125   0.04411   0.04372
        0.01655   0.00507   0.02322   0.00325   0.00310   0.00000
        0.00000   0.00000
        1991   1   1   3   0   142   0.00000   0.00000   0.00000
```

```
     0.00000  0.00000  0.00000  0.00182  0.00338  0.00537  0.02801  0.05143  0.05477
     0.11410  0.07115  0.10324  0.04122  0.03364  0.02350  0.01491  0.00149  0.00032
     0.00031  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00001
     0.00550  0.02014  0.07940  0.07175  0.06510  0.11410  0.03347  0.04860  0.00543
     0.00565  0.00217  0.00000  0.00000  0.00000  0.00000  0.00000

1993 1 1 3 0 200 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00000  0.00000  0.00000  0.03458  0.06406  0.06202  0.06448  0.04925  0.07831
     0.03446  0.06229  0.06236  0.05237  0.01033  0.00680  0.00114  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.02338  0.07815
     0.08043  0.05820  0.07933  0.03156  0.03724  0.01767  0.00518  0.00381  0.00259
     0.00000  0.00000  0.00000  0.00000                                         1994
     1 1 3 0 172 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00000  0.00115  0.00522  0.00647  0.01138  0.03548  0.02258  0.04147  0.03695
     0.05651  0.02257  0.06719  0.02738  0.01667  0.01710  0.00247  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00108  0.01464  0.03210
     0.05567  0.06275  0.08418  0.07356  0.06461  0.05809  0.04525  0.08905  0.02349
     0.01610  0.00551  0.00333  0.00000                                         1995
     1 1 3 0 154 0.00000 0.00000 0.00001 0.00001 0.00002 0.00001
     0.00000  0.00000  0.00422  0.00664  0.02339  0.02569  0.04923  0.07208  0.07680
     0.10947  0.04791  0.11792  0.04846  0.01465  0.01815  0.00772  0.00000  0.00000
     0.00000  0.00001  0.00000  0.00003  0.00002  0.00000  0.00000  0.01692  0.04586
     0.06244  0.11664  0.02760  0.02903  0.02571  0.03708  0.00797  0.00656  0.00175
     0.00000  0.00000  0.00000  0.00000                                         1996
     1 1 3 0 139 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00000  0.00000  0.00073  0.00493  0.02041  0.02185  0.03381  0.05530  0.07086
     0.06781  0.07538  0.12017  0.06239  0.03919  0.00961  0.00456  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00073  0.00445  0.02772
     0.07508  0.08163  0.07061  0.06977  0.03358  0.02153  0.01279  0.01309  0.00159
     0.00000  0.00043  0.00000  0.00000                                         1997
     1 1 3 0 169 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00067  0.00742  0.01678  0.02256  0.03509  0.03458  0.03765  0.04219  0.04688
     0.05300  0.06222  0.10802  0.08124  0.02339  0.01027  0.00544  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00203  0.00944  0.02509  0.03754
     0.05050  0.05966  0.06400  0.05229  0.04483  0.03009  0.01820  0.01251  0.00580
     0.00064  0.00000  0.00000  0.00000                                         1998
     1 1 3 0 153 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00004  0.00368  0.00401  0.00930  0.02363  0.02196  0.03901  0.05026  0.03857
     0.06085  0.04891  0.10330  0.08988  0.05296  0.02563  0.01741  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00736  0.01167  0.02964
     0.06417  0.05061  0.06522  0.04922  0.02915  0.04326  0.02803  0.01758  0.01128
     0.00222  0.00118  0.00000  0.00000                                         1999
     1 1 3 0 185 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00000  0.00147  0.00035  0.00277  0.01111  0.02741  0.03741  0.03971  0.07456
     0.05522  0.08504  0.10373  0.10639  0.04776  0.03479  0.01825  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00005  0.00246  0.00202  0.00920
     0.02531  0.04642  0.05526  0.06160  0.04998  0.03632  0.03166  0.02253  0.00547
     0.00404  0.00065  0.00105  0.00000                                         2000
     1 1 3 0 180 0.00000 0.00000 0.00087 0.00000 0.00000 0.00000
     0.00000  0.00000  0.00109  0.00663  0.00662  0.02034  0.03639  0.04814  0.07606
     0.04670  0.05057  0.10407  0.07808  0.05221  0.02379  0.01645  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00087  0.00000  0.00000  0.00174  0.00239  0.02235
     0.04614  0.07338  0.09026  0.06953  0.04906  0.03214  0.01788  0.02071  0.00480
     0.00072  0.00000  0.00000  0.00000                                         2001
     1 1 3 0 81 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
     0.00195  0.00731  0.00624  0.01160  0.01386  0.00664  0.01482  0.05221  0.05530
     0.06474  0.06148  0.14852  0.11646  0.06400  0.02754  0.02476  0.00124  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00195  0.00526  0.01065  0.01280
     0.01033  0.02854  0.05507  0.04842  0.05650  0.03620  0.01921  0.02286  0.01033
     0.00159  0.00159  0.00000  0.00000                                         2002
     1 1 3 0 150 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
```

```
0.00000     0.01017     0.01670     0.02315     0.03876     0.02487     0.03665     0.07819     0.06940
0.07606     0.06264     0.09703     0.08926     0.05068     0.03199     0.02864     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00727     0.01017     0.01578     0.01703
0.01773     0.02990     0.02889     0.04184     0.03332     0.01364     0.02280     0.02037     0.00367
0.00337     0.00000     0.00000     0.00000                                                     2 0 0 3
1     1     3     0     150   0.00000     0.00000     0.00000     0.00000     0.00000     0 . 0 0 0 0 0
0.00134     0.00189     0.00174     0.00936     0.02866     0.02377     0.03041     0.06126     0.06408
0.07507     0.07180     0.13035     0.08185     0.07925     0.02812     0.03788     0.00000     0.00000
0.00000     0.00000     0.00000     0.00083     0.00104     0.00091     0.00118     0.00619     0.00730
0.01425     0.03519     0.04306     0.04217     0.04701     0.02415     0.01557     0.02220     0.00908
0.00234     0.00070     0.00000     0.00000                                                     2 0 0 4
1     1     3     0     150   0.00000     0.00000     0.00000     0.00000     0.00000     0 . 0 0 0 0 0
0.00000     0.00106     0.00061     0.00407     0.00917     0.03577     0.04606     0.04270     0.05030
0.06508     0.05740     0.15458     0.10784     0.10714     0.05577     0.03990     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00123     0.00591
0.00847     0.04295     0.03631     0.03771     0.02696     0.01987     0.01439     0.01304     0.00845
0.00503     0.00000     0.00224     0.00000                                                     #
Pot   Fishery     Lengths                                                                       1 9 8 1
1     2     0     0     -20   0.00000     0.00000     0.00000     0.00000     0.00075     0 . 0 0 1 5 1
0.00451     0.00978     0.02107     0.03236     0.06082     0.11778     0.11630     0.09274     0.07363
0.06785     0.06358     0.12674     0.09391     0.05864     0.02297     0.03123     0.00383     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000                                                     1 9 8 2
1     2     0     0     -20   0.00000     0.00000     0.00000     0.00000     0.00093     0 . 0 0 1 8 7
0.00560     0.01214     0.02616     0.04017     0.07527     0.14437     0.13883     0.10797     0.07848
0.06303     0.05658     0.09764     0.06826     0.04161     0.01622     0.02216     0.00270     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000                                                     1 9 8 3
1     2     0     0     21    0.00000     0.00000     0.00000     0.00000     0.00000     0 . 0 0 0 0 0
0.00140     0.00140     0.01600     0.04127     0.07777     0.10359     0.13279     0.09377     0.06766
0.09096     0.07019     0.08703     0.08170     0.05025     0.03509     0.04745     0.00168     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     #     1983.00000     KLEIN   POT   FISHERY        1 9 8 3
1     2     0     0     -20   0.00000     0.00000     0.00000     0.00000     0.00098     0 . 0 0 1 9 6
0.00589     0.01276     0.02748     0.04220     0.07907     0.15174     0.14612     0.11379     0.08285
0.06593     0.05894     0.08916     0.05628     0.03271     0.01263     0.01741     0.00210     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000                                                     1 9 8 4
1     2     0     0     -20   0.00000     0.00000     0.00000     0.00000     0.00103     0 . 0 0 2 0 6
0.00617     0.01337     0.02880     0.04423     0.08290     0.15920     0.15362     0.11986     0.08760
0.06934     0.06180     0.08052     0.04361     0.02325     0.00881     0.01236     0.00147     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000                                                     1 9 8 5
1     2     0     0     -20   0.00000     0.00000     0.00000     0.00000     0.00121     0 . 0 0 2 4 2
0.00727     0.01574     0.03391     0.05207     0.09726     0.18465     0.17249     0.13031     0.08445
0.05379     0.04402     0.05375     0.03162     0.01771     0.00678     0.00942     0.00113     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
0.00000     0.00000     0.00000     0.00000                                                     1 9 8 6
1     2     3     0     72    0.00000     0.00000     0.00000     0.00000     0.00000     0 . 0 0 2 6 3
0.01151     0.01205     0.03096     0.03223     0.06470     0.07492     0.08776     0.04529     0.03810
0.03467     0.02376     0.04596     0.02474     0.01793     0.00699     0.00785     0.00000     0.00000
0.00000     0.00000     0.00000     0.00263     0.00263     0.00000     0.00471     0.01672     0.02759
0.05102     0.09721     0.08138     0.05476     0.02930     0.02854     0.01722     0.01580     0.00754
0.00000     0.00087     0.00000     0.00000                                                     1 9 8 7
1     2     3     0     73    0.00000     0.00000     0.00000     0.00000     0.00000     0 . 0 0 0 0 0
```

0.00000	0.00000	0.00000	0.00573	0.01308	0.06247	0.05317	0.06884	0.06288
0.05100	0.06615	0.07862	0.04410	0.03348	0.00964	0.02066	0.00138	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00573
0.03369	0.05203	0.07421	0.07455	0.05661	0.04457	0.03867	0.03388	0.01075
0.00236	0.00000	0.00176	0.00000					1 9 8 8
1 2	3 0	56 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00000	0.00497	0.01331	0.03900	0.10377	0.06978	0.07644	0.08570
0.06064	0.02601	0.09916	0.04242	0.01790	0.00893	0.00223	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.04418	0.04472	0.09654	0.06016	0.03258	0.03594	0.01569	0.01993	0.00000
0.00000	0.00000	0.00000	0.00000					1 9 8 9
1 2	3 0	109 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00001	0.00000	0.00250	0.01039	0.02202	0.06173	0.06162	0.06112
0.05986	0.03972	0.08843	0.04084	0.03053	0.00993	0.00542	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00297	0.00149	0.00151	0.00948
0.05662	0.10738	0.10537	0.07539	0.06538	0.04161	0.01607	0.02109	0.00151
0.00000	0.00000	0.00000	0.00000					1 9 9 0
1 2	3 0	77 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00002	0.00000	0.00007	0.00198	0.00003	0.00999	0.07857	0.05687	0.07092
0.05459	0.06303	0.09187	0.04091	0.03452	0.01059	0.00794	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00303
0.00104	0.05023	0.15652	0.08917	0.06013	0.03761	0.04128	0.03052	0.00679
0.00177	0.00000	0.00000	0.00000					1 9 9 1
1 2	3 0	62 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00000	0.00000	0.00286	0.00892	0.05043	0.09643	0.07419	0.05966
0.02857	0.03726	0.06617	0.03933	0.01272	0.00766	0.00627	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.01145
0.04462	0.11362	0.14589	0.10682	0.03680	0.02489	0.01394	0.00667	0.00360
0.00124	0.00000	0.00000	0.00000					1 9 9 3
1 2	3 0	75 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00525	0.00326	0.04145	0.11095	0.16182	0.08464	0.05537	0.04426
0.04090	0.01837	0.02128	0.01646	0.00684	0.00062	0.00002	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00787	0.02034	0.05279
0.06510	0.10259	0.06598	0.04083	0.01523	0.00984	0.00489	0.00275	0.00019
0.00011	0.00000	0.00000	0.00000					1 9 9 4
1 2	3 0	47 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00000	0.00605	0.00000	0.01491	0.04652	0.11757	0.05981	0.06376
0.09297	0.06633	0.08079	0.04168	0.02318	0.00814	0.00000	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
0.04511	0.07519	0.09661	0.07878	0.03125	0.01698	0.02482	0.00372	0.00583
0.00000	0.00000	0.00000	0.00000					1 9 9 5
1 2	3 0	57 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 2 7 2
0.00000	0.00000	0.00000	0.00543	0.02075	0.04482	0.07066	0.13275	0.07243
0.10385	0.08165	0.06521	0.05431	0.01629	0.00543	0.00001	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00272	0.01086
0.06349	0.09371	0.07610	0.04941	0.01732	0.00482	0.00256	0.00272	0.00000
0.00000	0.00000	0.00000	0.00000					1 9 9 6
1 2	3 0	56 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00000	0.00000	0.00000	0.00617	0.01312	0.04597	0.03989	0.06213
0.08548	0.09709	0.10975	0.09009	0.03943	0.01685	0.00561	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00146
0.01650	0.03942	0.12006	0.07684	0.07181	0.02589	0.01431	0.01253	0.00962
0.00000	0.00000	0.00000	0.00000					1 9 9 7
1 2	3 0	70 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00352	0.01216	0.01659	0.02454	0.03962	0.03289	0.05736	0.04461
0.09516	0.07529	0.12172	0.08720	0.04112	0.01905	0.00934	0.00000	0.00000
0.00000	0.00000	0.00000	0.00000	0.00000	0.00088	0.00264	0.01022	0.01106
0.02266	0.05656	0.06633	0.05785	0.04075	0.02854	0.01280	0.00411	0.00544
0.00000	0.00000	0.00000	0.00000					1 9 9 8
1 2	3 0	54 0.00000	0.00000	0.00000	0.00000	0.00000		0 . 0 0 0 0
0.00000	0.00000	0.00412	0.00427	0.01938	0.06627	0.05985	0.06698	0.06474

```
     0.05304  0.03874  0.06857  0.07893  0.04454  0.02227  0.01273  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00490  0.00249  0.00855
     0.01535  0.03599  0.08749  0.10767  0.05115  0.04010  0.02112  0.01758  0.00000
     0.00318  0.00000  0.00000  0.00000                                      1999
     1  2  3  0  63  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00235  0.00000  0.00000  0.00243  0.01892  0.02543  0.06462  0.06980  0.08472
     0.06741  0.09051  0.11841  0.10153  0.05280  0.03109  0.01408  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00029  0.00463
     0.02657  0.03242  0.03606  0.04289  0.03004  0.03675  0.02037  0.01975  0.00408
     0.00000  0.00205  0.00000  0.00000                                      2000
     1  2  3  0  69  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00470  0.00766  0.01497  0.03635  0.06352  0.06924
     0.08006  0.08484  0.13178  0.07302  0.05876  0.04019  0.01066  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00276  0.00029  0.00701
     0.01843  0.04787  0.04993  0.06385  0.04677  0.02504  0.03330  0.02142  0.00491
     0.00267  0.00000  0.00000  0.00000                                      2001
     1  2  3  0  47  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00775  0.00834  0.02910  0.03004  0.04182  0.06532
     0.10485  0.10783  0.09901  0.11453  0.06132  0.01996  0.01267  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00228
     0.00766  0.03415  0.04050  0.04869  0.05982  0.04693  0.02397  0.03013  0.00333
     0.00000  0.00000  0.00000  0.00000

2002 1  2  3  0  42  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00492  0.00000  0.00000  0.00982  0.00492  0.01591  0.04078
     0.05945  0.08476  0.14638  0.15164  0.10082  0.07378  0.04434  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.02456  0.01967  0.02760  0.02726  0.06485  0.04231  0.04184  0.00982
     0.00456  0.00000  0.00000  0.00000                                      2003
     1  2  3  0  53  0.00000  0.00000  0.00000  0.00000  0.00422  0.00000
     0.00000  0.00000  0.00422  0.00845  0.01196  0.01699  0.06372  0.06765  0.09131
     0.09936  0.07884  0.16083  0.12101  0.06213  0.04646  0.00422  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.01265  0.00845
     0.02487  0.02386  0.02494  0.02156  0.02031  0.00662  0.00333  0.00384  0.00821
     0.00000  0.00000  0.00000  0.00000                                      2004
     1  2  3  0  58  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00329  0.01950  0.01692  0.03249  0.04695  0.05261  0.08623
     0.10433  0.11069  0.14504  0.08954  0.06335  0.04241  0.01493  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00658  0.02696
     0.01448  0.02946  0.00822  0.01436  0.00371  0.01493  0.01743  0.02774  0.00409
     0.00000  0.00000  0.00377  0.00000                                      #
     Trawl  Fishery  Lengths
1983 1  3  0  1  195  0.00000  0.00000  0.00000  0.02830  0.17925  0.34591
     0.35063  0.09591  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  #TWL  sizecomp  discarded  fish  in  Hankin  study
1983 1  3  0  2  -21  0.00000  0.00000  0.00000  0.00000  0.00000  0.01425
     0.02459  0.03186  0.05059  0.05785  0.08133  0.09530  0.08468  0.09111  0.07686
     0.08888  0.06400  0.11403  0.07518  0.04472  0.00279  0.00196  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000
     0.00000  0.00000  0.00000  0.00000  #  1983  KLEIN  TRAWL  FISHERY
1986 1  3  3  0  -20  0.00000  0.00000  0.00000  0.00045  0.00555  0.01303
     0.01810  0.02710  0.04295  0.06250  0.06937  0.05242  0.04704  0.03755  0.03320
     0.02158  0.01389  0.01584  0.00758  0.00289  0.00161  0.00140  0.00000  0.00000
     0.00000  0.00000  0.00043  0.00405  0.00671  0.01604  0.02943  0.04527  0.06406
     0.08424  0.08466  0.07217  0.05265  0.03519  0.01694  0.00625  0.00589  0.00149
     0.00044  0.00006  0.00000  0.00000
1987 1  3  0  1  205  0.00000  0.00000  0.00000  0.00386  0.05792  0.10425
```

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     0.19305   0.10039   0.10425   0.03089   0.04633   0.06564   0.06178   0.09266   0.03861
     0.03475   0.00386   0.02317   0.01158   0.02317   0.00386   0.00000   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   #TWLsizecomp   discarded   fish   in   Pikitch   study
1987 1   3   0   2   55   0.00000   0.00000   0.00075   0.00301   0.00903   0.02107
     0.05643   0.08051   0.10384   0.11964   0.10835   0.10910   0.10233   0.07675   0.06321
     0.05342   0.03236   0.02408   0.01881   0.01129   0.00226   0.00301   0.00075   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   #   TWL   sizecomp   retained   fish   in   Pikitch
     study
1987 1   3   3   2   192   0.00000   0.00000   0.00073   0.00140   0.00765   0.02118
     0.03377   0.04043   0.04137   0.05030   0.05085   0.05128   0.05581   0.04327   0.03041
     0.02239   0.01394   0.01425   0.00611   0.00242   0.00139   0.00156   0.00000   0.00000
     0.00034   0.00000   0.00278   0.00902   0.02040   0.03011   0.03402   0.03960   0.05320
     0.06669   0.07856   0.06225   0.05516   0.03012   0.01694   0.00647   0.00287   0.00064
     0.00031   0.00002   0.00000   0.00000                                           1988
     1   3   3   2   167   0.00000   0.00000   0.00028   0.00129   0.00256   0.00990
     0.02736   0.05115   0.06985   0.07158   0.06231   0.05713   0.04138   0.03353   0.02609
     0.01877   0.01041   0.00756   0.00381   0.00204   0.00109   0.00060   0.00000   0.00000
     0.00000   0.00035   0.00023   0.00250   0.01164   0.02279   0.03805   0.05447   0.06248
     0.07520   0.06781   0.06814   0.04273   0.02940   0.01543   0.00556   0.00347   0.00082
     0.00015   0.00007   0.00000   0.00000                                           1989
     1   3   3   2   185   0.00000   0.00000   0.00018   0.00073   0.00415   0.01162
     0.02626   0.03166   0.04234   0.05165   0.06082   0.06445   0.05199   0.05181   0.03468
     0.02121   0.00745   0.00791   0.00321   0.00107   0.00097   0.00082   0.00004   0.00000
     0.00024   0.00036   0.00010   0.00508   0.00857   0.01893   0.02179   0.04280   0.07530
     0.08620   0.08466   0.07513   0.05505   0.02955   0.01396   0.00430   0.00186   0.00096
     0.00003   0.00007   0.00004   0.00000                                           1990
     1   3   3   2   190   0.00000   0.00000   0.00037   0.00125   0.00459   0.00806
     0.01934   0.03483   0.04691   0.05178   0.05085   0.05801   0.04910   0.04237   0.03757
     0.02236   0.01236   0.00710   0.00359   0.00168   0.00223   0.00207   0.00004   0.00000
     0.00000   0.00000   0.00040   0.00161   0.00496   0.01377   0.03359   0.04821   0.08424
     0.09238   0.10108   0.07535   0.04158   0.02663   0.00974   0.00520   0.00354   0.00092
     0.00030   0.00005   0.00000   0.00000                                           1991
     1   3   3   2   187   0.00000   0.00000   0.00000   0.00000   0.00231   0.00732
     0.02207   0.02972   0.04526   0.04739   0.04612   0.05620   0.04604   0.05545   0.04107
     0.02747   0.01433   0.00931   0.00470   0.00249   0.00115   0.00094   0.00000   0.00000
     0.00000   0.00000   0.00028   0.00061   0.00627   0.02071   0.03321   0.05135   0.06982
     0.09686   0.08675   0.06326   0.05459   0.02706   0.01648   0.00751   0.00432   0.00116
     0.00018   0.00023   0.00000   0.00000                                           1993
     1   3   3   2   192   0.00000   0.00000   0.00000   0.00000   0.00033   0.00213
     0.00695   0.01332   0.03557   0.04057   0.06087   0.06541   0.05929   0.05007   0.03863
     0.03384   0.02270   0.02126   0.00947   0.00526   0.00164   0.00056   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00106   0.00237   0.00612   0.02093   0.04497   0.07675
     0.09933   0.09775   0.07102   0.05108   0.02962   0.01740   0.00780   0.00519   0.00037
     0.00037   0.00000   0.00000   0.00000                                           1994
     1   3   3   2   173   0.00000   0.00000   0.00000   0.00000   0.00021   0.00032
     0.00294   0.00828   0.02109   0.03060   0.04562   0.05391   0.07205   0.05118   0.04649
     0.02550   0.02098   0.01908   0.01026   0.00549   0.00295   0.00144   0.00014   0.00000
     0.00000   0.00000   0.00000   0.00011   0.00074   0.00528   0.01681   0.03837   0.07513
     0.11108   0.10729   0.08019   0.05649   0.03688   0.02209   0.01375   0.00856   0.00490
     0.00214   0.00111   0.00057   0.00000                                           1995
     1   3   3   2   166   0.00000   0.00000   0.00020   0.00049   0.00059   0.00052
     0.00095   0.00432   0.00934   0.02549   0.03923   0.05695   0.05601   0.05918   0.04094
     0.04505   0.03118   0.03420   0.01115   0.01011   0.00342   0.00133   0.00000   0.00000
     0.00000   0.00009   0.00023   0.00036   0.00052   0.00095   0.00989   0.02777   0.09414
     0.12649   0.08131   0.08398   0.06923   0.03147   0.01955   0.01070   0.01153   0.00117
     0.00000   0.00000   0.00000   0.00000
1996 1   3   3   2   154   0.00000   0.00000   0.00000   0.00000   0.00000   0.00465
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     0.00482   0.01453   0.00649   0.00928   0.02794   0.03266   0.04460   0.05905   0.05002
     0.03243   0.02378   0.01802   0.01356   0.00453   0.00116   0.00115   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00233   0.00723   0.00918   0.01783   0.06679
     0.12905   0.13558   0.12639   0.07758   0.04071   0.02540   0.00781   0.00390   0.00098
     0.00057   0.00000   0.00000   0.00000
1997 1    3    3    2    167  0.00000   0.00000   0.00000   0.00000   0.00194   0.01324
     0.01344   0.01604   0.01859   0.02182   0.03378   0.03109   0.04420   0.04521   0.04641
     0.03552   0.02553   0.03159   0.01531   0.01055   0.00395   0.00252   0.00029   0.00000
     0.00045   0.00000   0.00065   0.00452   0.01678   0.01808   0.01489   0.01931   0.04483
     0.06491   0.08868   0.11675   0.08831   0.05233   0.03152   0.01299   0.01105   0.00210
     0.00058   0.00000   0.00026   0.00000
1998 1    3    3    2    154  0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
     0.00330   0.00668   0.02144   0.04392   0.04302   0.05376   0.05207   0.06001   0.06380
     0.04626   0.04702   0.04127   0.03318   0.01561   0.00626   0.00349   0.00000   0.00000
     0.00000   0.00032   0.00032   0.00000   0.00000   0.00317   0.01463   0.02768   0.04162
     0.05461   0.07674   0.07564   0.06503   0.04782   0.02174   0.01722   0.01059   0.00154
     0.00000   0.00028   0.00000   0.00000
1999 1    3    3    2    170  0.00000   0.00017   0.00000   0.00000   0.00096   0.00066
     0.00083   0.00140   0.00281   0.00828   0.01970   0.03596   0.05742   0.07765   0.07684
     0.06127   0.03965   0.03299   0.01742   0.00582   0.00563   0.00310   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00066   0.00112   0.00246   0.00568   0.02420
     0.05592   0.09665   0.12110   0.10200   0.07088   0.03735   0.02328   0.00809   0.00190
     0.00012   0.00000   0.00000   0.00000
2000 1    3    3    2    168  0.00000   0.00000   0.00000   0.00000   0.00000   0.01172
     0.00000   0.00298   0.00168   0.01328   0.01553   0.03229   0.04227   0.06229   0.06490
     0.05008   0.03185   0.04650   0.01298   0.00802   0.00304   0.00157   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.00384   0.00895   0.00464   0.00657   0.02268
     0.07451   0.10159   0.14044   0.11980   0.05165   0.03573   0.01504   0.01132   0.00126
     0.00079   0.00014   0.00007   0.00000
2001 1    3    3    2    180  0.00000   0.01360   0.02352   0.01891   0.01571   0.01017
     0.01590   0.03467   0.03078   0.02089   0.01854   0.01958   0.03131   0.03830   0.04458
     0.03596   0.02691   0.03885   0.01827   0.01198   0.00231   0.00461   0.00000   0.00000
     0.01579   0.02861   0.02813   0.01085   0.01845   0.02568   0.03294   0.02561   0.02514
     0.03465   0.05129   0.07292   0.05281   0.04252   0.02639   0.01805   0.01072   0.00352
     0.00061   0.00000   0.00000   0.00000
2002 1    3    3    2    176  0.00000   0.00048   0.00000   0.00098   0.00955   0.01946
     0.02471   0.03224   0.04773   0.04955   0.04741   0.04230   0.05472   0.04905   0.04054
     0.03393   0.02065   0.02405   0.01274   0.00661   0.00303   0.00091   0.00056   0.00000
     0.00048   0.00000   0.00276   0.01142   0.02994   0.03858   0.04112   0.03117   0.03551
     0.03361   0.06135   0.07244   0.05325   0.02866   0.02128   0.00845   0.00518   0.00251
     0.00068   0.00041   0.00000   0.00000
2003 1    3    3    2    175  0.00000   0.00000   0.00000   0.00000   0.00187   0.00123
     0.00781   0.01576   0.03017   0.04967   0.06125   0.06231   0.05984   0.05296   0.04038
     0.03451   0.03015   0.02791   0.01600   0.00385   0.00412   0.00099   0.00000   0.00000
     0.00000   0.00000   0.00040   0.00187   0.00305   0.01236   0.02950   0.04994   0.06494
     0.07119   0.06409   0.06351   0.05809   0.03451   0.02609   0.01079   0.00795   0.00095
     0.00000   0.00000   0.00000   0.00000
2004 1    3    3    2    171  0.00000   0.00000   0.00000   0.00000   0.00000   0.00635
     0.01531   0.02871   0.03915   0.04691   0.04337   0.04369   0.04074   0.03484   0.03119
     0.02608   0.02445   0.02621   0.00918   0.00657   0.00195   0.00250   0.00000   0.00000
     0.00000   0.00000   0.00000   0.00000   0.01414   0.03968   0.06848   0.06234   0.09248
     0.08197   0.06369   0.05274   0.03392   0.03001   0.01647   0.00878   0.00586   0.00130
     0.00095   0.00000   0.00000   0.00000
#    AFSC Shelf Survey Lengths                                                           1980
     1    5    0    0    200  0    0.00659   0.0634 0.19193   0.25277   0.13542   0.04474
     0.02977   0.07653   0.09567   0.0552 0.02859   0.00853   0.00527   0.00144   0.00087
     0.00124   0.00013   0.00063   0.00059   0.00043   0.00026   0    0    0    0    0
     0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
     0    0
1983 1    5    0    0    200  0    0.01202   0.0732 0.16407   0.12024   0.07849   0.12617
     0.13042   0.09174   0.06745   0.04661   0.03281   0.01961   0.01069   0.00994   0.0047
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        0.00412     0.00384     0.00229     0.00087     0.00051     0.00021     0     0     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0     0
1986    1     5     0     0     200     0     0.01203     0.11218     0.22562     0.2094  0.12351     0.05697
        0.04308     0.03728     0.02978     0.01888     0.01451     0.00962     0.00668     0.00824     0.01005
        0.01192     0.01139     0.01557     0.01941     0.01477     0.00731     0.00178     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0     0     0
1989    1     5     0     0     200     0     0.00102     0.00147     0.03414     0.19964     0.2272  0.13809
        0.1066  0.09469     0.06656     0.05033     0.03738     0.01399     0.00882     0.00203     0.00337
        0.00302     0.0057  0.00431     0.00088     0.00032     0.0002  0.00024     0     0     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0
1992    1     5     0     0     200     0     0.0026  0.00841     0.02824     0.05632     0.05821     0.12816
        0.23114     0.23827     0.14354     0.05705     0.02368     0.00982     0.00425     0.00184     0.00287
        0.00153     0.00148     0.00137     0.00078     0.0001  0.00022     0.0001  0     0     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0
1995    1     5     0     0     200     0     0.01173     0.05784     0.15198     0.23524     0.10283     0.04634
        0.0104  0.01887     0.03027     0.05825     0.06753     0.06389     0.04888     0.03168     0.02363
        0.01394     0.01524     0.00744     0.0021  0.00158     0.00035     0     0     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0
1998    1     5     0     0     200     0     0.0026  0.0015  0.0039  0.00292     0.00657     0.02011     0.0685  0.12483
        0.15229     0.13483     0.12177     0.0884  0.06163     0.04146     0.03371     0.03586     0.04143
        0.02675     0.01934     0.0085  0.0031  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     5     0     0     10     0     0.07712     0.20389     0.2285  0.13872     0.09831     0.10063
        0.06407     0.03248     0.01459     0.01023     0.00452     0.00456     0.00488     0.00324     0.00413
        0.00237     0.00343     0.00217     0.00131     0.00052     0.00034     0.00002     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0     0     0
2003    1     5     0     0     -200     0     0.00779     0.00873     0.01807     0.02119     0.02649     0.02150
        0.02992     0.05142     0.11343     0.17950     0.13930     0.11842     0.08352     0.05703     0.03708
        0.02026     0.02773     0.01963     0.01060     0.00436     0.00343     0.00062 0     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0     0
2004    1     5     0     0     200     0     0.00162     0.00434     0.00742     0.01624     0.01564     0.05768
        0.09026     0.10008     0.09119     0.10392     0.07143     0.07240     0.05703     0.06350     0.05408
        0.04154     0.06027     0.01745     0.02063     0.01524     0.02332     0.00013     0     0     0
        0     0     0     0     0     0     0     0     0     0     0     0     0     0     0     0
        0     0     0
#       Northern     Pot     Survey  Lengths     1971
        1     6     3     0     50     0     0     0     0     0     0     0.00068     0.00177     0.01236
        0.03057     0.04058     0.0627  0.05252     0.04793     0.03041     0.03766     0.03766     0.08106
        0.06869     0.05972     0.04183     0.03317     0.00068     0     0     0     0     0     0     0.00068
        0.00965     0.02045     0.03917     0.05628     0.04475     0.03682     0.04512     0.03432     0.01867
        0.01867     0.0242  0.00767     0.00209     0.00099     0.00047     0     #     1971     N-POT     SURVEY     SIZE
        COMP
1979    1     6     3     0     50     0     0     0     0     0     0     0.00035     0.0029  0.00525     0.01966
        0.02546     0.04421     0.04872     0.04498     0.03624     0.03246     0.03284     0.05582     0.04092
        0.02029     0.01539     0.00944     0.00245     0     0     0     0     0     0.00035     0.00969
        0.03043     0.0496  0.08611     0.10619     0.11217     0.06835     0.04701     0.02665     0.01612
        0.00749     0.00245     0     0     0     0     #     1979     N-POT     SURVEY     SIZE     COMP
1980    1     6     3     0     50     0     0     0     0     0     0.00037     0.00111     0.00163     0.0088
        0.02683     0.04959     0.05225     0.04893     0.03052     0.02579     0.01367     0.01973     0.03245
        0.02358     0.01848     0.00961     0.00665     0.00074     0     0     0     0     0.00037
        0.00111     0.01463     0.05033     0.0796  0.11301     0.12291     0.09889     0.05891     0.03259
        0.02846     0.01205     0.01338     0.00229     0.00074     0     0     0     #     1980     N-POT     SURVEY
        SIZE     COMP
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1981  1        6        3        0        50       0        0        0        0        0        0        0.00082           0.00082           0.01191
      0.02724           0.0447   0.0721   0.03883           0.04176           0.03972           0.02113           0.019    0.02863           0.02072
      0.01223           0.00897           0.0106   0        0        0        0        0        0        0        0.00082           0.0106   0.05905
      0.09429           0.12333           0.10489           0.08271           0.05612           0.01493           0.02374           0.01036           0.01378
      0.0062   0        0        0        0        #        1981     N-POT    SURVEY   SIZE     COMP
1983  1        6        3        0        200      0        0        0        0        0.0008   0.00161           0.00619           0.02529           0.04032
      0.04145           0.0372   0.07203           0.05688           0.05597           0.03901           0.03058           0.02098           0.02623
      0.02088           0.01054           0.00358           0.00475           0        0        0        0        0        0.0008   0.00161           0.00619
      0.01964           0.05845           0.0903   0.12105           0.06959           0.06136           0.03051           0.02268           0.01218
      0.00592           0.00458           0.00043           0        0.0004   0        0        #        1983     N-POT    SURVEY   SIZE     COMP
1985  1        6        3        0        200      0        0        0        0.00023           0.00034           0.00263           0.0128   0.02823
      0.03783           0.04498           0.04229           0.04283           0.03045           0.02391           0.02021           0.01888           0.01269
      0.01502           0.01365           0.00869           0.00297           0.0032   0.00023           0        0        0        0.00023           0.00034
      0.00263           0.01234           0.04286           0.09177           0.12347           0.12069           0.08722           0.05253           0.03872
      0.02848           0.01449           0.0104   0.00761           0.00327           0.00069           0.00023           0        0        #        1985
      N-POT    SURVEY   SIZE     COMP
1987  1        6        3        0        200      0        0        0        0        0.00025           0.002    0.00349           0.00499           0.01058
      0.02939           0.03104           0.04636           0.02999           0.03967           0.03049           0.01951           0.01607           0.02675
      0.02031           0.00948           0.0025   0.00299           0.0005   0        0        0        0        0.00025           0.002    0.00399
      0.02295           0.06178           0.13777           0.13613           0.11582           0.09975           0.03967           0.01742           0.01143
      0.01287           0.00968           0.00215           0        0        0        0        #        1987     N-POT    SURVEY   SIZE     COMP
1989  1        6        3        0        200      0        0        0        0        0        0.00067           0.00467           0.01907           0.025
      0.03233           0.05667           0.06313           0.05153           0.05307           0.0316   0.02167           0.01267           0.01473
      0.01753           0.01     0.00373           0.00373           0        0        0        0        0        0        0.00067           0.00533
      0.01013           0.0612   0.10767           0.13333           0.11493           0.0626   0.02773           0.01967           0.01013           0.0122
      0.0096   0.00167           0.00067           0.00067           0        0        #        1989     N-POT    SURVEY   SIZE     COMP


#     AFSC     Slope    Survey   Lengths                                                                                                   1988
      1        8        3        0        -21      0.00000           0.00000           0.00060           0.00480           0.01820           0.04941
      0.06877           0.03531           0.02592           0.03204           0.02372           0.02081           0.02856           0.02555           0.02308
      0.01844           0.01614           0.01973           0.01264           0.00571           0.00117           0.00060           0.00000           0.00000
      0.00000           0.00082           0.00585           0.03802           0.09084           0.09513           0.05194           0.04851           0.05140
      0.04458           0.04146           0.03499           0.02866           0.01724           0.00978           0.00397           0.00231           0.00321
      0.00009           0.00000           0.00000           0.00000
1990  1        8        3        0        -49      0.00000           0.00000           0.00424           0.03063           0.03110           0.01508
      0.00359           0.01025           0.02438           0.02650           0.02655           0.02855           0.02560           0.03537           0.04055
      0.03331           0.03243           0.03749           0.01754           0.00959           0.00294           0.00183           0.00000           0.00000
      0.00000           0.00921           0.02312           0.03404           0.01710           0.00774           0.02696           0.03609           0.04987
      0.06514           0.07916           0.07471           0.05285           0.03897           0.02312           0.01186           0.00959           0.00227
      0.00000           0.00000           0.00000           0.00000
1991  1        8        3        0        200      0.00000           0.00000           0.00021           0.00021           0.00105           0.00500
      0.00873           0.02956           0.03027           0.06459           0.06150           0.04232           0.03760           0.04881           0.03716
      0.03088           0.01816           0.02007           0.00924           0.01103           0.00058           0.00116           0.00000           0.00000
      0.00000           0.00018           0.00028           0.00132           0.00725           0.01224           0.01806           0.04717           0.06222
      0.11000           0.09252           0.07906           0.05817           0.03201           0.01239           0.00433           0.00312           0.00153
      0.00000           0.00000           0.00000           0.00000
1992  1        8        3        0        -54      0.00000           0.00000           0.00000           0.00000           0.00867           0.02782
      0.02612           0.02769           0.06123           0.07371           0.06456           0.05169           0.03570           0.02981           0.03262
      0.01259           0.01111           0.01659           0.00872           0.00695           0.00679           0.00077           0.00000           0.00000
      0.00000           0.00000           0.00000           0.00000           0.00000           0.00031           0.00092           0.01235           0.05560
      0.11274           0.12292           0.08955           0.05957           0.02317           0.01204           0.00308           0.00216           0.00217
      0.00031           0.00000           0.00000           0.00000
1993  1        8        3        0        -31      0.00000           0.00000           0.00000           0.00000           0.00000           0.00365
      0.00902           0.02294           0.03560           0.04085           0.05131           0.04509           0.06133           0.04712           0.03386
      0.03045           0.02002           0.02316           0.00869           0.00366           0.00119           0.00398           0.00011           0.00000
      0.00000           0.00000           0.00000           0.00076           0.00622           0.02215           0.03572           0.06358           0.07794
      0.08518           0.09609           0.06606           0.05236           0.02170           0.01757           0.00633           0.00595           0.00026
      0.00000           0.00000           0.00006           0.00000
1995  1        8        3        0        -200     0.00000           0.00000           0.00009           0.00056           0.00566           0.02727
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        0.03228    0.01614    0.00278    0.00426    0.00276    0.00949    0.01544    0.01860    0.01924
        0.01945    0.01092    0.01862    0.00937    0.00245    0.00072    0.00054    0.00000    0.00000
        0.00059    0.00000    0.00117    0.00822    0.02642    0.02349    0.01233    0.00879    0.04387
        0.10893    0.13354    0.13634    0.09336    0.06567    0.04144    0.02651    0.02265    0.00369
        0.00000    0.00000    0.00053    0.00000
1996    1    8    3    0    200    0.00000    0.00000    0.00170    0.00395    0.00680    0.00596
        0.00662    0.00697    0.01970    0.02895    0.03070    0.02421    0.02910    0.04087    0.04046
        0.04051    0.02772    0.04716    0.02648    0.01409    0.00745    0.00373    0.00056    0.00000
        0.00095    0.00293    0.00756    0.01159    0.01017    0.00790    0.01461    0.03638    0.05454
        0.07725    0.10090    0.09578    0.07460    0.04252    0.02246    0.01180    0.01095    0.00228
        0.00075    0.00000    0.00039    0.00000
1997    1    8    3    0    200    0.00000    0.00031    0.00070    0.00047    0.00081    0.00721
        0.01417    0.02237    0.03113    0.03101    0.03741    0.04571    0.03595    0.04238    0.04672
        0.03599    0.02195    0.03245    0.01628    0.00504    0.00222    0.00081    0.00000    0.00000
        0.00068    0.00008    0.00137    0.00298    0.01102    0.02536    0.03825    0.05436    0.07082
        0.09117    0.08353    0.07925    0.05152    0.02547    0.01659    0.00812    0.00514    0.00109
        0.00017    0.00000    0.00000    0.00000
1999    1    8    3    0    200    0.00000 0.00527 0.00083 0.00000 0.00014 0.00044 0.00116 0.00463 0.01190 0.01743 0.01837
0.03491 0.04332 0.04631 0.04376 0.03338 0.03396 0.03575 0.01516 0.00970 0.00294 0.00151 0.00029 0.00000 0.01291 0.00000 0.00061 0.00141
0.00113 0.00426 0.01122 0.01995 0.05302 0.07024 0.08719 0.07756 0.06866 0.03585 0.02110 0.01023 0.00946 0.00199 0.00028 0.00010 0.00000
0.00000
2000    1    8    3    0    200    0.00000 0.00104 0.00802 0.02027 0.02604 0.03265 0.02339 0.01864 0.00407 0.00549 0.01142
0.02289 0.02370 0.03914 0.04832 0.05245 0.03048 0.04013 0.01132 0.00683 0.00328 0.00215 0.00000 0.00000 0.00142 0.01786 0.03306 0.02963
0.02877 0.01755 0.00668 0.01631 0.02845 0.06175 0.08678 0.08185 0.06697 0.03908 0.02331 0.01023 0.00635 0.00203 0.00007 0.00000 0.00000
0.00000
2001    1    8    3    0    200    0.00000 0.00079 0.00020 0.00254 0.00436 0.01357 0.01368 0.02525 0.02896 0.03033 0.02196
0.02163 0.03065 0.04116 0.04244 0.04311 0.03701 0.03784 0.01567 0.00734 0.00385 0.00071 0.00000 0.00000 0.00000 0.00268 0.00169 0.00682
0.02011 0.03127 0.03894 0.04483 0.04761 0.06310 0.06614 0.08396 0.06141 0.04679 0.01776 0.01187 0.00836 0.00215 0.00027 0.00000 0.00000
0.00000
#FRAM Slope Survey                    20    32    34    36    38    40    42    44    46    48    50    5    2
        54    56    58    60    62    64    68    72    76    80    90    20    32    34    36    38    4    0
        42    44    46    48    50    52    54    56    58    60    62    64    68    72    76    80    90
1998    1    9    3    0    200    0.00000    0.00000    0.00000    0.00000    0.00000    0.00000
        0.02170    0.00362    0.01171    0.03445    0.02968    0.04291    0.04765    0.03897    0.05988
        0.03222    0.03286    0.03948    0.01101    0.00734    0.00386    0.00179    0.00000    0.00000
        0.00629    0.00094    0.00061    0.00102    0.00102    0.01706    0.02348    0.05011    0.03880
        0.08969    0.09740    0.08449    0.07480    0.03353    0.02074    0.00686    0.00600    0.00200
        0.00000    0.00000    0.00000    0.00000
1999    1    9    3    0    200    0.00000    0.00017    0.00000    0.00000    0.00000    0.00018
        0.00084    0.00293    0.00664    0.02073    0.01996    0.04507    0.04270    0.05186    0.05805
        0.05499    0.03970    0.04178    0.01880    0.00794    0.00275    0.00270    0.00000    0.00000
        0.00103    0.00212    0.00616    0.00265    0.00095    0.00206    0.00531    0.02313    0.04674
        0.08374    0.11204    0.09856    0.08384    0.05026    0.02557    0.01216    0.00885    0.00109
        0.00039    0.00000    0.00000    0.00000
2000    1    9    3    0    200    0.00000    0.01390    0.01428    0.01482    0.01047    0.00720
        0.00596    0.00203    0.01641    0.00354    0.02850    0.02875    0.04218    0.04669    0.05618
        0.04411    0.03608    0.02634    0.02530    0.00938    0.00369    0.00222    0.00000    0.00000
        0.01357    0.01814    0.01583    0.01464    0.00834    0.00286    0.00266    0.01135    0.02437
        0.06452    0.08930    0.11132    0.08238    0.04672    0.01681    0.01749    0.01140    0.00158
        0.00109    0.00000    0.00029    0.00000
2001    1    9    3    0    200    0.00000    0.00072    0.00169    0.00657    0.01187    0.02814
        0.02410    0.02166    0.01898    0.01090    0.01312    0.02704    0.03882    0.05824    0.04502
        0.03792    0.03662    0.02264    0.01002    0.00646    0.00252    0.00071    0.00000    0.00000
        0.00321    0.00298    0.01332    0.04472    0.04072    0.02697    0.02020    0.02316    0.02776
        0.05003    0.07605    0.09880    0.05660    0.03559    0.01906    0.00824    0.00599    0.00111
        0.00035    0.00000    0.00000    0.00000
2002    1    9    3    0    200    0.00000    0.00048    0.00035    0.00171    0.00678    0.01140
        0.01913    0.02519    0.04135    0.03302    0.03533    0.03404    0.03262    0.03005    0.03392
        0.03627    0.03126    0.02979    0.01937    0.00930    0.00383    0.00149    0.00000    0.00000
        0.00011    0.00128    0.00445    0.01511    0.01994    0.03231    0.04393    0.05140    0.04558
        0.05242    0.07047    0.07932    0.06590    0.03718    0.02266    0.01002    0.00789    0.00274
```

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        0.00020         0.00000         0.00000         0.00000
2003    1       9       3       0       200     0.00000         0.00000         0.00108         0.00266         0.00480         0 . 0 1 2 5 9
        0.01152         0.01705         0.02906         0.02660         0.04810         0.03043         0.03458         0.03553         0.04202
        0.04117         0.03186         0.03148         0.01831         0.00731         0.00559         0.00235         0.00022         0.00000
        0.00128         0.00218         0.00684         0.00670         0.01600         0.03050         0.02680         0.04675         0.05210
        0.08209         0.06223         0.07843         0.05617         0.04193         0.02576         0.01228         0.01348         0.00346
        0.00034         0.00008         0.00000         0.00030
2004    1       9       3       0       200     0.00000         0.00000         0.00000         0.00000         0.00141         0 . 0 0 2 3 6
        0.00527         0.00954         0.02743         0.04576         0.04570         0.04301         0.04289         0.04224         0.04581
        0.03647         0.03648         0.02780         0.01263         0.00730         0.00344         0.00183         0.00000         0.00000
        0.00000         0.00000         0.00127         0.00553         0.00815         0.01763         0.02871         0.05413         0.06473
        0.08603         0.08204         0.07051         0.06374         0.03223         0.02012         0.01134         0.01272         0.00254
        0.00121         0.00000         0.00000         0.00000
#       Southern        Pot     Survey                                                                                          1 9 8 4
        1       11      3       0       200     0       0       0       0       0       0.00074         0.00314         0.01497         0.02481
        0.03212         0.0592  0.05935         0.06177         0.04371         0.04626         0.03594         0.02459         0 . 0 2 9 4 6
        0.01165         0.00701         0.00369         0.0024  0       0       0       0       0       0.00018         0.00074         0.00351
        0.0177  0.06288         0.11409         0.12208         0.09387         0.05287         0.03751         0.01484         0 . 0 0 7 4 4
        0.00587         0.00543         0.00017         0       0       0       0       #       1984    S-POT   SURVEY  SIZE    COMP    1 9 8 6
        1       11      3       0       200     0       0       0       0       0.00091         0.00331         0.00669         0 . 0 1 6 9 8
        0.02    0.04587         0.0588  0.0519  0.04893         0.04438         0.04628         0.04698         0.02996         0 . 0 5 6 6 9
        0.02723         0.01149         0.00607         0.00661         0.00041         0       0       0       0       0.00091         0.00223
        0.00888         0.02818         0.05599         0.08244         0.08207         0.08603         0.05983         0.03335         0.01876
        0.00649         0.00227         0.00293         0.00012         0       0       0       0       #       1986    S-POT   SURVEY  S I Z E
        COMP
1988    1       11      3       0       200     0       0       0.00009         0.00047         0.00511         0.01335         0 . 0 1 3 0 7
        0.01195         0.06034         0.08697         0.0722  0.06742         0.04451         0.03867         0.02381         0 . 0 1 3 2 2
        0.01284         0.01439         0.00525         0.00133         0.00057         0.00095         0       0       0       0 . 0 0 0 0 9
        0.00047         0.00511         0.01449         0.01326         0.04638         0.08511         0.10375         0.10621         0.06742
        0.04735         0.01246         0.00555         0.00288         0.00155         0.00133         0.00006         0       0       0
        0       #       1988    S-POT   SURVEY  SIZE    COMP
1991    1       11      3       0       200     0       0       0       0.00082         0.00111         0.00361         0.01597         0.03463
        0.0573  0.06109         0.05707         0.0668  0.05695         0.0531  0.04599         0.03218         0.02769         0 . 0 3 3 8 7
        0.01428         0.00472         0.00297         0.00291         0.00058         0       0       0       0.00082         0 . 0 0 1 1 1
        0.00361         0.01655         0.05165         0.07741         0.08126         0.0826  0.0538  0.02961         0.01778         0.00495
        0.00222         0.00052         0.0021  0.00035         0       0       0       0       #       1991    S-POT
#       Deep Pot Study
2002     1       13      3       0       200     0.00000         0.00000         0.00000         0.00000         0.00000         0 . 0 0 0 0 0
        0.00000         0.00167         0.00167         0.00333         0.01333         0.01333         0.02833         0.06166         0.07166
        0.08000         0.07000         0.05833         0.08000         0.05333         0.03167         0.02833         0.00000         0.00000
        0.00000         0.00000         0.00000         0.00000         0.00000         0.00000         0.00338         0.01000         0.01000
        0.04500         0.09166         0.09833         0.05500         0.03500         0.03000         0.01500         0.00333         0.00500
        0.00167         0.00000         0.00000         0.00000
2003     1       13      3       0       200     0.00000         0.00000         0.00000         0.00000         0.00000         0 . 0 0 0 0 0
        0.00000         0.00193         0.00322         0.00644         0.01740         0.02062         0.02513         0.04961         0.05735
        0.06121         0.05090         0.07603         0.04961         0.05090         0.03544         0.02513         0.00064         0.00000
        0.00000         0.00000         0.00000         0.00000         0.00000         0.00000         0.00322         0.01031         0.01997
        0.04832         0.08634         0.09536         0.07088         0.04253         0.03479         0.01933         0.02771         0.00773
        0.00193         0.00000         0.00000         0.00000

17      #_N_age'_bins
#_lower_age_of_age'_bins                                                                                                        1
        2       3       4       5       6       7       8       9       10      11      12      13      14      15      20      25      2
        #_number_of_ageerr_types                                                                                                #_vecto
r_with_stddev_of        ageing_precision_for_each_AGE_and_type                                                          #_      0
1       2       3       4       5       6       7       8       9       10      11      12      13      14      15      16      17      18
   19      20      21      22      23      24      25      26      27      28      29      30      31      32      33      34      35
  36      37      38      39      40                                                                                            -1
  -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1
 -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1      -1
 -1      -1      -1      -1      -1      -1                                                                                     0.001   0.001
```

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 0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001
0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001   0.001
0.001   0.001   0.001   0.001   0.001                                                                                   0.5     1.5
2.5     3.5     4.5     5.5     6.5     7.5     8.5     9.5     10.5    11.5    12.5    13.5    14.5    15.5    16.5    17.5    18.5
19.5    20.5    21.5    22.5    23.5    24.5    25.5    26.5    27.5    28.5    29.5    30.5    31.5    32.5    33.5    34.5    35.5
36.5    37.5    38.5    39.5    40.5                                                                                    0.5     0.65
0.67    0.7     0.73    0.76    0.8     0.84    0.88    0.92    0.97    1.03    1.09    1.16    1.23    1.32    1.41    1.51    1.62
1.75    1.89    2.05    2.23    2.45    2.71    3       3       3       3       3       3       3       3       3       3       3
3       3       3       3       3                                                                                       69
#_N_age_observations                                                                                                    #Year   Season
        Fleet   Gender  Mkt     ageerr  Lbin_lo         Lbin_hi         Nsamp   1       2       3       4       5       6       7       8
        9       10      11      12      13      14      15-19   20-24   >25     1       2       3       4       5       6       7       8
        9       10      11      12      13      14      15-19   20-24   >25
#       HKL     Fishery         Ages                                                                                            1987
        1       1       3       0       1       1       17      -43     0       0.01181         0.02576         0.04347         0.02791
        0.04401         0.04669         0.05904         0.02791         0.0746  0.0059  0.04025         0       0.01932         0.03864
        0.0322  0.03972         0.00001         0.01377         0.00125         0.0331  0.01273         0.03834         0.02617         0.02969
        0.02609         0.05729         0.01886         0.03221         0.0055  0.02277         0.03586         0.04557         0.06354
1988    1       1       3       0       1       1       17      -33     0.00001         0.01519         0.06452         0.09842         0.04628
        0.07079         0.03126         0.0628  0.01735         0.04536         0.00558         0.05404         0.01095         0.00151
        0.02744         0.04064         0.01987         0.00001         0.00017         0.02198         0.03336         0.0391  0.03974
        0.01187         0.0423  0.02429         0.02866         0.0133  0.04062         0.00011         0.00608         0.01548         0.03643
        0.0345
1989    1       1       3       0       1       1       17      -16     0.00007         0.00215         0.11683         0.10393         0.00411
        0.10092         0.01369         0.07278         0.02575         0.07725         0.01419         0.09051         0.01291         0.0497
        0.01723         0.01677         0.05322         0.00016         0.00634         0.01544         0.05133         0.0086  0.00918
        0.00895         0.01392         0.00307         0.00803         0.00654         0.04523         0.00169         0.00211         0.01518
        0.00492         0.02732
1990    1       1       3       0       1       1       17      -22     0.00006         0.00931         0.0346  0.14009         0.06909
        0.1594  0.04041         0.05119         0.00836         0.02945         0.02162         0.04075         0.00901         0.02818
        0.04017         0.00881         0.03651         0.00004         0.00483         0.02703         0.02659         0.01474         0.02848
        0.05014         0.02352         0.01452         0.0021  0.00098         0.02317         0.01388         0.00196         0.00625
        0.00526         0.02951
1991    1       1       3       0       1       1       17      36      0       0.00485         0.00485         0.10343         0.12552
        0.12121         0.0571  0.03232         0.02316         0.00754         0.01455         0.0167  0.00215         0       0.01347
        0.00162         0.01077         0.00001         0.00403         0.0091  0.03359         0.01775         0.07752         0.04386
        0.03974         0.02829         0.00639         0.04038         0.01741         0.01386         0.01233         0.04853         0.04176
        0.02622
1993    1       1       3       0       1       1       17      -15     0.0003  0.00664         0.01422         0.06983         0.06563
        0.06558         0.08807         0.03639         0.04726         0.00855         0.00655         0.01787         0.01065         0.00373
        0.04531         0.02122         0.0542  0.00044         0.04529         0.00712         0.17696         0.02536         0.02626
        0.08077         0.01844         0.00312         0.00351         0.00238         0.00388         0.00227         0.00243         0.01221
        0.0088  0.01877
1994    1       1       3       0       1       1       17      -22     0.00001         0.00029         0.00467         0.05328         0.05567
        0.04445         0.02063         0.0468  0.01708         0.00174         0.02185         0.00778         0.00012         0.00031
        0.01924         0.00343         0.03965         0.00004         0.00185         0.08532         0.10507         0.12895         0.01996
        0.00138         0.01689         0.02598         0.00221         0.00162         0.05451         0.01984         0.00215         0.06008
        0.09107         0.04609
1995    1       1       3       0       1       1       17      29      0.00008         0.00243         0.06919         0.11579         0.11143
        0.10728         0.0415  0.02201         0.01727         0.01873         0.02331         0.01222         0.00589         0.01564
        0.02913         0.00075         0.00137         0.00006         0.0194  0.01513         0.04092         0.10054         0.08551
        0.0507  0.05614         0.0105  0.00826         0.00863         0.00035         0.00019         0.00027         0.00746         0.00067
        0.00128
1997    1       1       3       0       1       1       17      77      0.00005         0.0492  0.11904         0.06931         0.04513
        0.08368         0.07068         0.04398         0.0207  0.02312         0.0093  0.01332         0.00279         0.00011         0.01763
        0.00163         0.01332         0.00002         0.04579         0.06    0.04288         0.0291  0.03411         0.05627         0.03654
        0.00983         0.00684         0.01781         0.01338         0.00011         0.00929         0.03502         0.0113  0.00872
1998    1       1       3       0       1       1       17      38      0.00001         0.00013         0.06579         0.04889         0.01442
        0.01075         0.07319         0.03640         0.04787         0.08204         0.02382         0.00682         0.04543         0.00945
        0.05819         0.01850         0.08325         0.00001         0.00011         0.08328         0.06862         0.01183         0.00859
        0.03904         0.03094         0.02666         0.02989         0.01693         0.01036         0.02601         0.00451         0.00770
```

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     0.00154     0.00903
1999 1     1     3     0     1     1     17    62    0.00000     0.00250     0.01469     0.09154     0.04992
     0.10474     0.02389     0.06487     0.07249     0.00850     0.01787     0.03814     0.00505     0.00613
     0.02743     0.02371     0.04756     0.00013     0.00542     0.04036     0.14358     0.05183     0.02988
     0.01578     0.02866     0.02407     0.00365     0.01110     0.00816     0.00377     0.00435     0.00766
     0.01059     0.01196
2000 1     1     3     0     1     1     17    49    0.00099     0.00004     0.00286     0.02307     0.07492
     0.02310     0.01327     0.03619     0.04395     0.05622     0.05753     0.01094     0.02242     0.00287
     0.12035     0.05917     0.09043     0.00020     0.00464     0.00693     0.04321     0.07851     0.02443
     0.01043     0.01308     0.03057     0.03184     0.01868     0.00829     0.01062     0.00027     0.02407
     0.02803     0.02789
2001 1     1     3     0     1     1     17    55    0.00655     0.01440     0.00958     0.00858     0.03036
     0.04850     0.03837     0.05002     0.05563     0.02564     0.02076     0.06684     0.00683     0.00380
     0.08357     0.02102     0.13908     0.01296     0.04249     0.02861     0.01562     0.02948     0.05042
     0.01797     0.01744     0.01584     0.01667     0.01386     0.01328     0.00640     0.00308     0.02619
     0.01546     0.04470
2002 1     1     3     0     1     1     17    46    0.00000     0.00265     0.07199     0.03653     0.00823
     0.00282     0.02449     0.00935     0.00092     0.01646     0.01904     0.02734     0.01790     0.08201
     0.03653     0.01033     0.27331     0.00028     0.00536     0.05877     0.03606     0.00725     0.00404
     0.01891     0.01217     0.00022     0.00765     0.01307     0.01301     0.00999     0.02168     0.01785
     0.00819     0.12561
2003 1     1     3     0     1     1     17    37    0.00011     0.00226     0.06073     0.08146     0.05218
     0.00481     0.03538     0.06134     0.00916     0.02749     0.03989     0.00695     0.04767     0.03555
     0.08521     0.06043     0.07417     0.00001     0.00051     0.07918     0.08496     0.02675     0.01049
     0.01406     0.02465     0.00430     0.01100     0.00848     0.00414     0.01007     0.01021     0.01144
     0.00814     0.00683
#    Pot   Fishery     Ages                                                                        1987
     1     2     3     0     1     1     17    -28   0.00001     0.01246     0.04104     0.0267 0.01487
     0.0741 0.02912    0.07127     0.02712     0.04215     0.00909     0.01815     0.00476     0.02779
     0.07009     0.05307     0.0522 0     0.00438     0.02048     0.00554     0.01605     0.03627     0.0162
     0.05671     0.02997     0.05029     0.00744     0.01978     0.00989     0.02405     0.06454     0.03913
     0.02528
1988 1     2     3     0     1     1     17    -19   0.00012     0.00404     0.04267     0.01005     0.00568
     0.00637     0.00378     0.10176     0.00326     0.12772     0.00303     0.06988     0.02946     0.02121
     0.08625     0.03916     0.09657     0     0.0001 0.01112     0.01465     0.00041     0.01114     0.01461
     0.00061     0.00042     0.01107     0.01729     0.01126     0.00024     0.02523     0.01611     0.11705
     0.09769
1989 1     2     3     0     1     1     17    -34   0.00001     0.00083     0.00189     0.00288     0.00183
     0.01253     0.00329     0.01551     0.0168 0.06369     0.00169     0.0453 0.03477     0.02214     0.06225
     0.03037     0.18822     0.00022     0.00253     0.00124     0.00066     0.00034     0.00043     0.00028
     0.00343     0.0003 0.01885     0.00627     0.01097     0.00402     0.03954     0.06388     0.07158
     0.27144
1990 1     2     3     0     1     1     17    -20   0     0.00035     0.0011 0.00171     0.00129     0.02167
     0.00113     0.01071     0.001  0.03944     0.00308     0.04271     0.00306     0.02419     0.12046
     0.12015     0.13096     0.00001     0.00041     0.00125     0.00141     0.05207     0.00123     0.00096
     0.01565     0.00081     0.00102     0.00053     0.00095     0.00052     0.0249 0.06666     0.0967 0.21191
1991 1     2     3     0     1     1     17    -39   0     0.00004     0.00705     0.02641     0.01964
     0.02241     0.02081     0.02289     0.02278     0.0282 0.01558     0.02325     0.01446     0.02036
     0.06276     0.06611     0.14125     0     0.00005     0.00665     0.01009     0.00618     0.02246
     0.00328     0.01026     0.02049     0.01559     0.01283     0.01238     0.015  0.02933     0.06201
     0.07967     0.17974
1993 1     2     3     0     1     1     17    25    0.00031     0.01144     0.06086     0.13318     0.07923
     0.10535     0.04333     0.03733     0.01897     0.02551     0.00359     0.00904     0.00376     0.00395
     0.01042     0.02699     0.03777     0.00027     0.01325     0.02514     0.02726     0.06907     0.07414
     0.04162     0.00964     0.01774     0.01504     0.00724     0.01476     0.01389     0.00189     0.02858
     0.01557     0.0139
1994 1     2     3     0     1     1     17    -17   0.00004     0.00201     0.00293     0.12191     0.111
     0.11855     0.00083     0.06079     0.05048     0.03707     0.01293     0.02407     0.00049     0.00074
     0.05669     0.00875     0.00672     0.00009     0.00346     0.00596     0.02652     0.00547     0.0996
     0.03471     0.03695     0.03499     0.02238     0.02119     0.00398     0.00226     0.00275     0.02973
     0.02453     0.02944
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1995  1       2       3       0       1       1       17      27      0.00125         0.00021         0.02101         0.08477         0.15887
      0.14348         0.06793         0.05913         0.02989         0.03214         0.01013         0.02098         0.00019         0.01476
      0.01024         0.01088         0.01013         0.00011         0.00216         0.0095  0.04415         0.02459         0.10179
      0.05607         0.03064         0.01456         0.01923         0.00505         0.00086         0.00288         0.00072         0.00668
      0.00176         0.00326
1997  1       2       3       0       1       1       17      52      0.0002  0.00893         0.12293         0.05593         0.0701  0.10939
      0.11067         0.08515         0.07477         0.01968         0.01844         0.0178  0.01703         0.06363         0.02782
      0.00877         0.04945         0.00008         0.00273         0.00417         0.03733         0.00817         0.00648         0.02433
      0.02414         0.00132         0.00128         0.00083         0.00124         0.00062         0.001   0.01119         0.00234
      0.01208
1999  1       2       3       0       1       1       17      38      0.00014         0.00132         0.04943         0.21657         0.08375
      0.01932         0.04277         0.06265         0.04900         0.04544         0.01383         0.00617         0.00742         0.01981
      0.03430         0.00342         0.00436         0.00000         0.00357         0.02132         0.07987         0.03903         0.01077
      0.02620         0.01864         0.03846         0.00604         0.01387         0.01471         0.00453         0.00727         0.03167
      0.01194         0.01241
2000  1       2       3       0       1       1       17      39      0.00000         0.00003         0.00298         0.07823         0.16041
      0.08141         0.03032         0.02548         0.05795         0.06600         0.03350         0.00922         0.00648         0.00299
      0.01605         0.00661         0.00383         0.00000         0.00021         0.01851         0.04584         0.11200         0.02411
      0.00750         0.03185         0.06192         0.02767         0.01499         0.01912         0.01443         0.01519         0.00817
      0.00604         0.01097
2001  1       2       3       0       1       1       17      33      0.00001         0.01228         0.01303         0.00914         0.04595
      0.13437         0.05410         0.04214         0.03643         0.02302         0.04778         0.01497         0.01435         0.02477
      0.08740         0.03136         0.02046         0.00000         0.00008         0.01909         0.00035         0.05707         0.05219
      0.04373         0.02169         0.00609         0.02788         0.02308         0.00625         0.00954         0.01646         0.04442
      0.03656         0.02393
2002  1       2       3       0       1       1       17      29      0.00002         0.00116         0.00989         0.02543         0.04162
      0.02062         0.09929         0.05736         0.01779         0.01712         0.05268         0.04106         0.02822         0.01182
      0.09138         0.06148         0.07504         0.00000         0.00062         0.00252         0.00466         0.00973         0.02075
      0.04739         0.01659         0.01194         0.00348         0.04367         0.01073         0.01107         0.00275         0.06753
      0.01984         0.07476
2003  1       2       3       0       1       1       17      30      0.00006         0.00041         0.09481         0.24587         0.04966
      0.02564         0.05589         0.11681         0.03158         0.01358         0.04044         0.01408         0.01368         0.01120
      0.02397         0.03512         0.00673         0.00001         0.00024         0.04231         0.07646         0.00526         0.01165
      0.00032         0.02981         0.01408         0.01073         0.00020         0.00038         0.01121         0.00032         0.00654
      0.00980         0.00116
#     Trawl   Fishery         Ages Age-Length Key                                                                                   1987
      1       3       3       2       1       1       17      74      0.02581         0.14502         0.07748         0.04948         0.02129
      0.03447         0.00988         0.02503         0.01172         0.01647         0.00364         0.01392         0.00325         0.00961
      0.01394         0.01605         0.01995         0.01511         0.11358         0.05736         0.03849         0.01137         0.03124
      0.01406         0.02992         0.00515         0.01648         0.0052  0.01874         0.00905         0.01656         0.03118
      0.03135         0.05815
1988  1       3       3       2       1       1       17      85      0.00631         0.17122         0.11255         0.07967         0.01415
      0.02044         0.01175         0.01501         0.00543         0.01239         0.00823         0.00998         0.00326         0.00277
      0.0095  0.01014         0.0092  0.00066         0.10281         0.07044         0.04766         0.01842         0.02458         0.01058
      0.02973         0.01546         0.02438         0.00739         0.01541         0.00592         0.01143         0.03768         0.04534
      0.03012
1989  1       3       3       2       1       1       17      78      0.00885         0.09196         0.09879         0.07638         0.02252
      0.03821         0.01827         0.02217         0.00916         0.01421         0.0067  0.01234         0.00636         0.00672
      0.0143  0.01404         0.01702         0.00655         0.0545  0.05503         0.05241         0.02333         0.03601         0.01044
      0.02664         0.01191         0.02353         0.01299         0.03316         0.0074  0.01938         0.04929         0.03502
      0.06441
1990  1       3       3       2       1       1       17      75      0.00715         0.07564         0.07844         0.08158         0.02582
      0.04351         0.01831         0.01992         0.0044  0.01197         0.01171         0.01373         0.00799         0.00999
      0.01631         0.0157  0.02583         0.0018  0.04364         0.05868         0.0568  0.02977         0.04587         0.01684
      0.03286         0.014   0.02976         0.00479         0.01705         0.00776         0.02197         0.0436  0.04794         0.05886
1991  1       3       3       2       1       1       17      90      0.00577         0.07194         0.07807         0.07443         0.05676
      0.046   0.02964         0.02009         0.01075         0.01108         0.00651         0.0043  0.00357         0.00482         0.01431
      0.00476         0.0302  0.00469         0.06018         0.08763         0.05907         0.03643         0.02163         0.02426
      0.01943         0.01772         0.01517         0.0106  0.01118         0.0091  0.00994         0.03505         0.03301         0.0719
1993  1       3       3       2       1       1       17      64      0.00008         0.01263         0.0776  0.0921  0.05248         0.03594
      0.02462         0.01714         0.01693         0.006   0.00521         0.01194         0.00692         0.00805         0.03239
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     0.0353 0.03368 0.00005 0.02475 0.08753 0.08663 0.02583 0.03514 0.02859
     0.02692 0.02009 0.01911 0.0128 0.01284 0.00768 0.0138 0.05367 0.03009 0.04549
1994 1 3 3 2 1 1 17 57 0.00037 0.00282 0.05103 0.08647 0.0417
     0.02956 0.03335 0.01412 0.01187 0.02007 0.00506 0.00743 0.00929 0.00822
     0.03397 0.01785 0.04481 0.00015 0.00109 0.03246 0.07446 0.05458 0.03598
     0.02425 0.01775 0.01295 0.01502 0.01151 0.02058 0.01918 0.0158 0.05594
     0.04502 0.14529
1995 1 3 3 2 1 1 17 47 0.001 0.01219 0.04267 0.04762 0.06265
     0.02648 0.01469 0.0145 0.05576 0.02089 0.01238 0.00422 0.00629 0.01095
     0.02082 0.00844 0.03944 0.00055 0.01368 0.05472 0.03181 0.06974 0.05642
     0.03773 0.08611 0.0504 0.01426 0.01759 0.01041 0.01733 0.00043 0.05021
     0.00545 0.08216
1996 1 3 3 2 1 1 17 71 0.00155 0.00093 0.02152 0.01741 0.00901
     0.04224 0.01057 0.02549 0.00193 0.02621 0.00118 0.02004 0.01438 0.00229
     0.03265 0.04126 0.08135 0.00176 0.00368 0.00142 0.02343 0.03547 0.01015
     0.03736 0.02614 0.03427 0.02077 0.02269 0.02403 0.03341 0.01082 0.07054
     0.05837 0.23569
1997 1 3 3 2 1 1 17 100 0.00106 0.07218 0.05398 0.02766 0.02364
     0.02931 0.02565 0.02054 0.02083 0.01116 0.01546 0.01079 0.01196 0.00826
     0.02432 0.01677 0.0404 0.0013 0.0696 0.03221 0.03076 0.03847 0.03624 0.03509
     0.0276 0.02146 0.01769 0.01547 0.02988 0.01211 0.01042 0.06694 0.0419 0.09881998
     1 3 3 2 1 1 17 54 0.00268 0.00255 0.18607 0.08107 0.01736
     0.02109 0.02997 0.03952 0.02331 0.01825 0.01114 0.00926 0.00431 0.00249
     0.02994 0.01705 0.04501 0.00022 0.00178 0.10997 0.04862 0.00979 0.00942
     0.01699 0.01070 0.00608 0.00309 0.01045 0.01640 0.00507 0.00819 0.03482
     0.03143 0.13590
1999 1 3 3 2 1 1 17 61 0.00027 0.01534 0.02798 0.16525 0.05533
     0.01501 0.01321 0.02142 0.01751 0.00587 0.00611 0.01546 0.00721 0.00653
     0.03867 0.00862 0.02877 0.00001 0.01111 0.04417 0.12502 0.04689 0.00822
     0.01706 0.03411 0.02961 0.01679 0.01847 0.02569 0.00537 0.01031 0.05511
     0.03210 0.07140
2000 1 3 3 2 1 1 17 89 0.01370 0.01731 0.02372 0.04355 0.07848
     0.03465 0.02277 0.01489 0.01869 0.01128 0.01089 0.01074 0.01048 0.00556
     0.03315 0.01994 0.03118 0.00526 0.01815 0.03001 0.06513 0.10977 0.04431
     0.01778 0.02213 0.02319 0.02810 0.01717 0.02374 0.01957 0.01767 0.05636
     0.03192 0.06876
2001 1 3 3 2 1 1 17 87 0.08101 0.09009 0.04079 0.01443 0.02595
     0.03609 0.02509 0.00927 0.01802 0.01591 0.01107 0.00750 0.00812 0.00921
     0.03312 0.01787 0.03179 0.08992 0.08539 0.03012 0.02310 0.03551 0.03420
     0.02138 0.01240 0.01743 0.01619 0.01140 0.01464 0.01088 0.00953 0.03650
     0.02227 0.05382
2002 1 3 3 2 1 1 17 72 0.00007 0.17096 0.15073 0.05581 0.01142
     0.01680 0.02106 0.01370 0.00612 0.00400 0.00696 0.00692 0.00442 0.00351
     0.01957 0.01319 0.01596 0.00051 0.15622 0.08133 0.03119 0.00753 0.02183
     0.01374 0.00530 0.00821 0.01194 0.00702 0.01096 0.00882 0.00757 0.02794
     0.01869 0.06000
2003 1 3 3 2 1 1 17 57 0.00092 0.02061 0.17868 0.15137 0.03672
     0.00612 0.01348 0.00914 0.00911 0.00472 0.00257 0.00723 0.00687 0.00321
     0.02575 0.00997 0.01429 0.00203 0.03335 0.17829 0.10274 0.02262 0.00863
     0.01029 0.02241 0.01094 0.00551 0.00354 0.00803 0.00913 0.00676 0.03701
     0.01228 0.02568
#    Shelf Survey Ages                                                  1983
     1 5 0 0 1 1 17 100 0.38 0.3132 0.1597 0.1119 0.015 0.0128 0.0032 0 0.0006
     0.0012 0.0004 0.0005 0.0003 0 0.0011 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0
1989 1 5 0 0 1 1 17 100 0.3768 0.3969 0.1448 0.0427 0.0231 0.0103 0.0002 0.0012 0.0001
     0.0003 0.0017 0.0002 0.0015 0.0001 0.0002 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0
1992 1 5 0 0 1 1 17 100 0.1214 0.5364 0.257 0.0677 0.0131 0.0029 0.0009 0.0003 0
     0.0003 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
     0 0 0 0 0 0 0 0
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1995	1	5	0	0	1	1	17	100	0.3433	0.1292	0.0667	0.1364	0.1019	0.0905	0.046	0.0123	0.0238
	0.004	0.0018	0.0111	0.0012	0.0031	0.0201	0.0073	0.0014	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
1998	1	5	0	0	1	1	17	100	0.0068	0.0744	0.5378	0.1989	0.0318	0.0257	0.0391	0.0378	0.0131
	0.0034	0.0074	0.0055	0.0046	0.0014	0.0109	0.0007	0.0007	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
#	Northern		Pot	Survey	Ages									1983
	1	6	3	0	1	1	17	100	0.0013	0.04835		0.04274		0.14332		0.04317
	0.07144		0.02741		0.01791		0.01489		0.00971		0.01187		0.00324		0.00518		0.00281
	0.01511		0.02094		0.01489		0.0013	0.02202		0.09324		0.1131	0.04943		0.05439		0.02979
	0.02504		0.00626		0.00151		0.00496		0.00151		0.00108		0.00367		0.01986		0.02417
	0.05439		#!	N-POT	SURVEY	AGE	COMP
1989	1	6	3	0	1	1	17	100	0.00168		0.03694		0.10472		0.11522		0.03757
	0.01658		0.01364		0.00965		0.00525		0.00336		0.00818		0.01364		0.00483		0.0086
	0.01217		0.01406		0.01343		0.00168		0.02686		0.15089		0.13263		0.04134		0.02665
	0.02078		0.01112		0.02854		0.01196		0.01553		0.00756		0.00546		0.01049		0.01259
	0.01532		0.06107		#!	N-POT	SURVEY	AGE	COMP
#	AFSC	Slope	Survey	Ages					1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17
1991	1	8	3	0	1	1	17	59	0.0253	0.0510	0.0655	0.0401	0.0206	0.0081	0.0088	0.0074	0.0070
	0.0034	0.0100	0.0045	0.0114	0.0210	0.0212	0.0410	0.1025	0.0248	0.0395	0.0572	0.0471	0.0264	0.0151	0.0119	0.0149	0.0072
	0.0176	0.0102	0.0160	0.0180	0.0245	0.0479	0.0354	0.1374
1995	1	8	3	0	1	1	17	-100	0.0257	0.0574	0.0203	0.0106	0.0116	0.0121	0.0079	0.0074	0.0043
	0.0054	0.0036	0.0033	0.0050	0.0046	0.0155	0.0069	0.0208	0.0255	0.0388	0.0367	0.0473	0.0411	0.0329	0.0251	0.0203	0.0414
	0.0529	0.0157	0.0358	0.0306	0.0185	0.0870	0.1037	0.1242
1996	1	8	3	0	1	1	17	100	0.0477	0.0926	0.0168	0.0107	0.0137	0.0222	0.0198	0.0124	0.0095
	0.0117	0.0138	0.0101	0.0120	0.0072	0.0396	0.0289	0.0505	0.0671	0.0744	0.0233	0.0188	0.0402	0.0441	0.0178	0.0185	0.0194
	0.0212	0.0177	0.0158	0.0123	0.0057	0.0458	0.0471	0.0916
1997	1	8	3	0	1	1	17	100	0.0011	0.0286	0.0336	0.0484	0.0272	0.0183	0.0142	0.0177	0.0146
	0.0162	0.0139	0.0091	0.0112	0.0099	0.0510	0.0345	0.0826	0.0018	0.0282	0.0447	0.0419	0.0342	0.0269	0.0214	0.0201	0.0222
	0.0119	0.0140	0.0200	0.0144	0.0156	0.0618	0.0396	0.1493
1999	1	8	3	0	1	1	17	100	0.0073	0.0283	0.0128	0.0539	0.0218	0.0241	0.0141	0.0177	0.0156
	0.0189	0.0103	0.0119	0.0069	0.0114	0.0511	0.0367	0.0829	0.0164	0.0194	0.0199	0.0654	0.0379	0.0318	0.0203	0.0213	0.0141
	0.0118	0.0344	0.0154	0.0115	0.0082	0.0582	0.0527	0.1356
2000	1	8	3	0	1	1	17	100	0.0297	0.1005	0.0165	0.0125	0.0275	0.0150	0.0068	0.0109	0.0116
	0.0087	0.0151	0.0097	0.0110	0.0135	0.0367	0.0340	0.0766	0.0384	0.0964	0.0215	0.0195	0.0395	0.0203	0.0124	0.0124	0.0130
	0.0123	0.0125	0.0187	0.0098	0.0205	0.0515	0.0299	0.1353
2001	1	8	3	0	1	1	17	100	0.0216	0.0916	0.0490	0.0201	0.0055	0.0178	0.0240	0.0194	0.0009
	0.0164	0.0090	0.0072	0.0018	0.0013	0.0229	0.0315	0.0922	0.0197	0.1303	0.0279	0.0329	0.0030	0.0160	0.0189	0.0126	0.0185
	0.0020	0.0113	0.0090	0.0416	0.0057	0.0309	0.0474	0.1402
#	NWFSC	Slope	Survey	Ages										1998
	1	9	3	0	1	1	17	59	0.00263		0.00588		0.07867		0.04085		0.01992
	0.00972		0.01457		0.01427		0.01319		0.01948		0.01129		0.01638		0.01416		0.00818
	0.03826		0.02640		0.07789		0.01930		0.01448		0.06171		0.04450		0.01913		0.01706
	0.01350		0.02449		0.02003		0.01875		0.01530		0.01511		0.01990		0.01135		0.06814
	0.05552		0.15001
1999	1	9	3	0	1	1	17	-100	0.00037		0.00778		0.02513		0.03730		0.05311
	0.00964		0.01597		0.00966		0.01470		0.01294		0.01603		0.01341		0.01021		0.01651
	0.04188		0.03601		0.08327		0.01176		0.01910		0.02506		0.06333		0.05725		0.02062
	0.02885		0.01354		0.01467		0.00966		0.00988		0.01479		0.01772		0.00996		0.08524
	0.06111		0.13358
2001	1	9	3	0	1	1	17	100	0.01611		0.08930		0.03265		0.00849		0.00468
	0.03500		0.01772		0.00937		0.00175		0.00509		0.00894		0.00265		0.00749		0.01643
	0.05786		0.05220		0.06726		0.03883		0.12101		0.01846		0.00473		0.00943		0.03078
	0.02355		0.00269		0.01525		0.01213		0.00997		0.00915		0.01830		0.01585		0.06556
	0.02998		0.14135
2002	1	9	3	0	1	1	17	100	0.01930		0.02514		0.12611		0.03491		0.01701
	0.00841		0.01291		0.00589		0.00787		0.00837		0.00697		0.00976		0.00876		0.00902
	0.03599		0.02873		0.07111		0.02387		0.02532		0.13894		0.03771		0.01219		0.01548
	0.02335		0.01492		0.00946		0.00545		0.00889		0.00905		0.00863		0.01038		0.04012
```

```
        0.03365         0.14631
2003    1       9       3       0       1       1       17      100     0.01063         0.03034         0.06451         0.10257         0.02618
        0.01168         0.01326         0.01439         0.01093         0.01322         0.00588         0.00871         0.01568         0.00341
        0.02336         0.02334         0.05620         0.01301         0.02850         0.07655         0.12496         0.03603         0.02958
        0.01713         0.01534         0.01933         0.00326         0.00719         0.00712         0.00830         0.01316         0.02392
        0.03397         0.10836
2004    1       9       3       0       1       1       17      100     0.00413         0.00874         0.04918         0.08667         0.08603
        0.03944         0.01948         0.01116         0.00861         0.00631         0.00167         0.00182         0.00618         0.00687
        0.02541         0.02316         0.05177         0.00510         0.02517         0.06959         0.11733         0.07670         0.01824
        0.01409         0.01541         0.02162         0.00619         0.00397         0.00250         0.00901         0.00833         0.03163
        0.03570         0.10278
#       Southern        Pot     Survey  Ages                                                                                    1 9 8 6
        1       11      3       0       1       1       17      100     0.00677         0.06118         0.03983         0.02851         0.06691
        0.06144         0.08136         0.04179         0.03124         0.01276         0.00417         0.00677         0.0056 0 . 0 1 0 1 5
        0.02421         0.01966         0.02395         0.0069 0.08461          0.02512         0.0578 0.07641         0.06287         0.04712
        0.02538         0.02473         0.00612         0.00638         0.00234         0.00143         0.00208         0.01432         0.01458
        0.01549         #!      s-pot   agecomp         unbiased        new     ages
1991    1       11      3       0       1       1       17      100     0.00565         0.10539         0.09542         0.1315 0 . 0 6 4 5 8
        0.04488         0.01824         0.01003         0.00793         0.01172         0.01685         0.00729         0.0102 0 . 0 1 0 0 8
        0.01224         0.00495         0.01667         0.00216         0.06447         0.11186         0.09897         0.05234         0.02267
        0.01475         0.00938         0.00449         0.00309         0.00659         0.00571         0.00554         0.00385         0.01014
        0.00367         0.0067 #!       N-POT   SURVEY  AGE     COMP
#       Deep Pot Study                                                  1       2       3       4       5       6       7       8
          9       10      11      12      13      14      15      20      25      1       2       3       4       5       6       7       8
          9       10      11      12      13      14      15      20      25
2002    1       13      3       0       1       1       17      100     0.00000         0.00000         0.00483         0.00483         0.00725
        0.00725         0.01208         0.02415         0.02174         0.02899         0.02415         0.03865         0.02657         0.03140
        0.16908         0.09662         0.13285         0.00000         0.00000         0.00966         0.00242         0.00242         0.00725
        0.01932         0.01208         0.00966         0.01208         0.01691         0.02174         0.01208         0.02415         0.07246
        0.06280         0.09662
2003    1       13      3       0       1       1       17      100     0.00000         0.00000         0.01908         0.05724         0.01235
        0.00786         0.01347         0.01459         0.01010         0.01796         0.01908         0.01571         0.01684         0.01908
        0.10662         0.07183         0.08193         0.00000         0.00224         0.02806         0.04377         0.01908         0.00786
        0.01122         0.02357         0.01010         0.00673         0.00786         0.01235         0.02357         0.01122         0.10213
        0.09203         0.12907
65      #_N_size@age_observations;_values_on_row1;_N_on_row2                                                                    # Y e a r
        Season  Fleet   Gender  Mkt     ageerr  Nsamp                                                                           #
        HKL     Fishery         Size-at-Age                                                                                     1 9 8 7
        1       1       3       0       1       100     -43.4   49.2    56.6    56.5    58.3    59.9    64.4    62.3    62.8    64.3    - 5 7 . 7
        66.3    -62.3   59.8    68.2    62.3    65.1    -44.65  49.49   -46.16  52.46   54.57   55.7    56.11   55.32   58.15   56.94   5 5 . 6 7
        55.55   62.22   58.64   56.77   58.73   57.62
        1       10      11      16      8       14      14      18      9       23      2       12      0       6       14      10      1   4
        0       13      2       15      5       14      10      13      8       22      8       12      3       8       16      16      2 4 1 9 8 8
        1       1       3       0       1       100     -39.09  50.42   57.05   57.32   56.34   59.54   60.74   63.86   62.6    66.02   - 6 5 . 9 7
        63.96   -58.67  -81.19  66.81   66.03   66.49   -38.62  -49.04  52.03   53.51   55.79   53.84   -57     57.16   54.67   56.8    - 5 9 . 6 3
        59.26   -57.47  -67.33  58.62   60.95   60.88
        0       3       12      19      8       12      6       12      3       8       1       11      2       1       7       9       6
        0       0       6       9       8       7       2       8       3       5       2       6       0       2       5       8       7 1 9 8 9
        1       1       3       0       1       100     -50.62  -50.47  55.99   58.67   -52.25  58.01   -59.23  64.85   -61.22  62.34   - 6 2 . 4 1
        65.19   -64.52  71.76   -59.68  -62.99  59.03   -49.19  -49.03  -49.33  -53.07  -49.92  -50.14  -55.9   -52.55  -51.74  -56.65  - 5 7 . 8 7
        61.62   -51.43  -52.26  -61.78  -52.95  -60.37
        0       0       3       6       0       4       1       6       2       5       1       7       1       3       1       1       3
        0       0       0       2       0       0       1       1       0       1       1       3       0       0       1       0       1 1 9 9 0
        1       1       3       0       1       100     -44.42  -45.13  54.18   55.67   57.27   61.04   61.45   65.69   -59.24  -72.29  - 6 3 . 3 2
        62.5    -60.59  65.91   -69.66  -72.59  -66.12  -44.35  -44.35  51.38   52.54   -51.08  53.67   -59.28  -57     -55.56  -57.63  - 5 9 . 7 6
        -57.08  -55.38  -59.36  -60.01  -60.35  -64.28
        0       2       4       20      8       18      4       5       1       2       2       5       1       4       2       0       2
        0       1       4       3       2       4       2       1       1       0       0       1       1       0       0       0       1 1 9 9 1
        1       1       3       0       1       100     -45.1   53.3    -52.8   55.3    56.7    56.6    56.9    57.6    61.4    62.4    6 1 . 6
        60.5    -62.7   -57.7   64.3    -63     -61.4   -44.81  -57.86  48.77   49.29   51.28   51.85   52.1    53.71   52.92   -52.17  5 5 . 1 6
        53.93   56.75   -54.47  55.66   56.06   55.18
```

	0	3	1	16	24	25	20	10	9	4	4	6	1	0	9	1	2
	0	2	4	13	7	26	14	12	7	2	9	4	3	2	11	6	51993
	1	1	3	0	1	100	-43.16	-45.51	-51.29	50.77	-55.46	55.48	60.3	67.19	66.26	-62.21	-63.06
	-65.06	-66.53	-60.33	-59.49	-61.11	-62.56	-43.4	-46.55	-47.87	51.37	51.53	-53.17	55.65	-54.35	-59.81	-59.76	-59.72
	-60	-58.92	-60.79	-59.91	-59.98	-59.64											
	0	0	1	5	2	6	4	3	3	0	0	1	2	0	1	0	0
	0	1	0	10	3	2	3	1	0	0	0	0	0	0	0	0	01994
	1	1	3	0	1	100	-44.09	-46.74	-48.7	55.96	58.62	58.08	58.51	65.16	63.71	-71.73	63.48
	-60.15	-59.16	-63.27	64.62	-71.71	63.83	-45.34	-46.26	51.49	54.53	55.35	-55.29	-60.44	-62.93	-69.65	-66.21	-68.55
	-56.45	-57.81	-65.65	63.07	-66.26	-62.34											
	0	0	2	10	11	8	6	7	4	1	6	2	0	0	3	2	7
	0	0	5	6	6	1	0	1	1	0	0	2	1	0	3	1	11995
	1	1	3	0	1	100	-41.29	-45.51	58.54	55.51	61.14	61.04	59.54	66.45	66.44	60.98	66.3
	-60.16	-64.43	64.25	70.4	-58.83	-60.68	-42.34	-48.56	-52.19	53.12	51.78	54.52	54.76	55.9	-57.62	-57.36	62.52
	-57.63	-55.28	-56.87	-53.67	-57.92	-58.48											
	0	0	12	18	21	22	8	7	5	3	5	2	2	3	11	0	0
	0	1	2	6	13	11	8	7	2	2	3	0	0	0	1	0	0
1997	1	1	3	0	1	100	-43.12	49.59	56.91	56.46	61.93	64.14	65.55	66.83	64.96	67.41	66.36
	65.45	-65.93	-64.04	64.84	-75.5	-75.95	-43.82	48.81	51.6	52.08	57.08	53.65	56.31	58.41	55.21	-55.69	56.37
	59.42	-63.17	-60.51	58.08	59.39	-60.45											
	0	37	64	40	20	34	28	17	8	8	3	5	1	0	6	0	2
	0	18	22	15	9	11	17	11	3	2	6	4	0	2	10	3	21998
	1	1	3	0	1	100	-44.6	-46.9	52.9	54.1	60.9	59.8	64.7	60.7	62.9	65.3	63.2
	-57.4	63.5	-63.8	-70.6	-74.3	-74.7	-44.3	-47.0	53.4	54.2	57.9	59.0	60.6	59.3	59.9	61.2	60.2
	-55.9	60.2	-61.4	-65.1	-70.7	-66.7											
	0	0	35	22	4	3	10	8	7	7	4	2	6	1	2	0	2
	0	0	35	22	4	3	10	8	7	7	4	2	6	1	2	0	2
1999	1	1	3	0	1	100	-46.3	47.8	54.5	57.6	61.0	68.1	62.8	62.9	63.7	-68.7	63.9
	71.7	-66.7	-63.6	70.6	69.5	71.4	-39.1	47.9	52.6	54.3	56.5	57.2	58.3	60.1	61.4	-58.0	58.2
	60.0	-57.2	-56.9	58.9	56.8	57.3											
	0	4	19	68	24	13	7	15	12	2	6	5	2	2	4	5	5
	0	4	19	68	24	13	7	15	12	2	6	5	2	2	4	5	5
2000	1	1	3	0	1	100	-35.0	-49.4	51.6	54.1	57.3	57.1	59.5	64.4	60.9	62.6	65.4
	60.1	64.5	-72.2	69.4	65.5	71.0	-43.5	-44.6	49.0	52.2	55.8	56.0	57.1	61.6	59.5	60.4	61.8
	57.1	58.9	-65.4	64.9	59.5	58.4											
	0	0	4	20	44	14	5	6	12	13	10	5	5	0	7	11	1 5
	0	0	4	20	44	14	5	6	12	13	10	5	5	0	7	11	15
2001	1	1	3	0	1	100	-45.0	48.3	50.7	54.0	60.6	58.5	65.1	65.9	66.1	62.0	64.0
	70.6	60.8	-60.4	69.9	63.1	68.4	-45.0	47.6	49.8	52.5	57.8	56.9	59.0	60.4	60.8	59.5	57.4
	60.7	56.8	-59.0	60.7	57.4	59.2											
	1	11	10	7	16	29	11	11	10	8	8	8	3	2	12	9	3 0
	1	11	10	7	16	29	11	11	10	8	8	8	3	2	12	9	30
2002	1	1	3	0	1	100	-47.9	-49.4	50.5	54.8	55.4	-57.2	56.7	57.8	-68.2	-65.4	63.1
	63.9	61.5	68.5	66.2	-66.4	66.0	-39.8	-47.8	52.1	55.2	54.4	-55.2	55.4	56.5	-63.7	-60.9	57.1
	61.4	59.1	63.5	60.5	-55.9	60.1											
	0	2	32	12	3	1	6	3	0	2	4	3	3	4	4	2	3 3
	0	2	32	12	3	1	6	3	0	2	4	3	3	4	4	2	33
2003	1	1	3	0	1	100	-43.8	-45.1	52.7	56.3	61.6	-54.3	-61.0	63.1	-63.2	-62.7	-65.9
	-59.8	-69.0	-63.8	-68.4	-71.5	-79.4	-47.5	-47.8	53.4	55.7	59.2	-53.1	-60.9	59.5	-59.8	-60.2	-62.7
	-59.0	-65.9	-63.2	-66.6	-70.0	-76.5											
	0	0	12	14	4	1	2	4	1	2	2	1	2	1	2	1	0
	0	0	12	14	4	1	2	4	1	2	2	1	2	1	2	1	0
#	Pot	Fishery		Size-at-Age													1987
	1	2	3	0	1	100	-49.27	-50.93	54.37	56.13	-57.42	59.05	64.96	61.79	59.28	68.12	-65.82
	63.01	-69.25	58.65	68.43	62.54	66.67	-49.75	-52.96	53.05	-49.28	54.64	56.48	53.17	57.86	56.99	54.85	-57.06
	55.79	55.56	64.45	61.85	61.05	62.66											
	0	1	5	3	2	8	5	9	4	6	1	3	1	4	14	4	1 0
	0	1	4	1	3	6	3	9	5	9	1	3	3	3	12	7	61988
	1	2	3	0	1	100	-49.65	-49.45	-52.33	-50.63	-51.64	-52.05	-53.17	54.64	-54.74	60.14	-63.47
	69.15	-58.69	-57.03	59.02	-64.89	61.45	-51	-53.4	-53.04	-51.13	-56.01	-55.12	-51.24	-57.4	-58.02	-55.15	-60.97

	-53.22	-57.07	-51.97	-57.14	57.71	58.3											
	0	0	1	0	0	0	0	4	0	4	0	3	1	1	4	1	3
	0	0	1	1	0	1	1	0	0	1	1	1	0	2	1	9	91989
	1	2	3	0	1	100	-47.87	-49.44	-51.47	-52.37	-52.86	62.45	-63.63	65.03	55.62	60.48	-70.31
	62.34	57.28	67.5	60.26	63.45	64.12	-43.12	-43.72	-45.48	-48.17	-54.39	-55.63	-58.13	-65.26	-61.92	54.5	-59.09
	-55.78	-53.17	56.99	54.57	54.2	57											
	0	0	0	0	0	4	1	6	3	11	1	11	3	9	12	11	6 1
	0	0	0	0	0	0	0	1	0	3	1	2	1	7	14	14	531990
	1	2	3	0	1	100	-47.84	-51.33	-52.65	-53.37	-54.75	-62.48	-56.56	-67.79	-56.99	61.97	-70.95
	61.67	-70.4	-59.43	62.1	59.15	66.86	-48.94	-50.72	-51.62	-52.34	-55	-54.97	-56.51	-58.87	-58.59	-57.17	-57.47
	-57.72	-60.26	-58.73	55.65	60.31	57.82											
	0	0	0	0	0	1	0	2	0	4	1	4	1	2	9	9	2 0
	0	0	0	0	1	0	0	1	0	0	0	0	0	2	4	7	111991
	1	2	3	0	1	100	-50.29	-51.71	-54.18	55.27	54.68	55.68	56.79	61.21	62.98	62.84	66.22
	61.41	62.77	61.69	63.24	59.69	62.64	-49.52	-50.76	-53.37	51.91	-50.14	54.84	-53.22	54.56	55.9	56.52	53.25
	58.75	56.21	56.27	54.95	56.71	56.85											
	0	0	2	8	5	7	6	8	8	10	6	8	5	7	22	21	4 9
	0	0	2	3	2	6	1	3	5	5	4	4	4	9	18	21	501993
	1	2	3	0	1	100	-49.58	-48.8	53.09	53.01	54.8	58.34	57.75	57.13	55.91	57.1	-51.17
	-54.38	-51.16	-51.71	-51.97	55.72	58.15	-47.43	-47.17	-49.18	-51.16	52.41	52.29	53.12	-54.53	55.47	54.89	-56.22
	-54.13	-54.02	-53.16	57.11	56.46	56.58											
	0	0	6	11	9	14	7	8	3	3	0	1	0	0	0	4	5
	0	0	1	2	7	7	5	2	4	3	2	2	2	0	7	4	31994
	1	2	3	0	1	100	-46.9	-47.03	-48.2	56.31	58.45	62.06	-56.78	60.46	62.94	-60.56	-66.65
	-65.7	-58.38	-58.15	63.69	-65.87	-67.66	-49.75	-48.64	-50.8	-52.49	-54.58	55.64	-58.7	-55.29	-57.08	-53.87	-53.66
	-59.42	-55.89	-59.15	-55.3	-60.11	-58.06											
	0	0	0	6	9	10	0	4	4	2	2	2	0	0	6	1	0
	0	0	0	1	0	4	1	1	2	1	1	0	0	0	1	1	11995
	1	2	3	0	1	100	-41.02	-46.1	56.94	56.55	57.66	60.63	61.58	59.38	63.1	66.36	-66.69
	66.45	-61.71	-63.52	-73.28	-66.53	-63.31	-42.68	-45.01	-53.46	53.88	54.03	52.93	54.56	53.57	-54.44	56.52	-56.96
	-57.67	-58.51	-58.6	-57.85	-58.93	-59.28											
	1	0	3	12	23	20	10	9	4	4	1	3	0	2	1	2	1
	0	0	1	6	3	15	9	4	2	4	1	0	1	0	1	0	01996
	1	2	3	0	1	100	-51	-57.07	-57.31	-58.94	-62.43	-62.5	-62.33	-62.22	-64.1	-64.22	-65.15
	-63.56	-63.45	-65.57	-64.2	-64.82	-64.85	-50.8	-54.19	-55.2	-55.13	-56	-56.93	-57.18	-56.71	-57.57	-57.28	-57.85
	-57.43	-57.05	-57.95	-57.62	-57.55	-57.18											
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	01997
	1	2	3	0	1	100	-48.1	-47.56	57.12	-55.09	61.67	63.97	62.99	69.55	63.97	-68.56	-69.61
	-64.32	-64.78	-57.75	-66.35	-63.83	-69.09	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40	-40
	-40	-40	-40	-40	-40	-40											
	0	0	4	2	3	6	5	5	4	1	1	1	1	2	1	0	1
	0	0	0	4	1	1	5	3	0	0	0	0	0	0	1	0	11999
	1	2	3	0	1	100	-43.0	-43.3	55.7	59.4	62.2	64.4	68.3	70.1	66.3	67.2	68.0
	-63.6	-74.1	69.7	70.2	-63.2	-73.0	-48.4	-54.7	53.0	53.6	57.4	57.7	59.9	60.6	60.4	-66.9	58.6
	58.9	-62.9	-59.2	60.0	61.2	60.1											
	0	0	15	68	27	6	13	19	15	14	4	2	2	6	10	1	1
	0	1	5	19	10	3	7	5	10	2	4	4	1	2	8	3	3
2000	1	2	3	0	1	100	-50.0	-52.2	-51.3	58.2	60.8	63.0	68.2	64.8	69.3	71.0	69.8
	68.6	-61.9	-77.4	69.9	-67.7	-75.8	-46.7	-46.5	53.0	55.9	54.6	55.0	53.0	57.9	60.2	60.4	-57.0
	61.7	65.2	61.1	-57.4	-59.3	-67.8											
	0	0	2	28	56	25	10	8	19	22	11	4	2	1	5	2	1
	0	0	7	13	34	7	4	8	10	6	2	3	3	3	1	1	2
2001	1	2	3	0	1	100	-49.1	55.6	63.7	58.4	63.8	64.0	66.3	63.5	61.6	59.7	69.3
	67.1	61.8	67.1	61.5	69.9	69.0	-50.5	-51.6	53.0	-53.2	57.2	58.6	58.5	60.8	-65.9	59.1	58.9
	-59.8	-61.0	61.8	56.9	61.3	57.8											
	0	3	3	3	12	35	14	10	9	6	12	4	4	6	21	8	5
	0	0	3	0	10	10	8	4	1	5	4	1	2	3	7	7	4
2002	1	2	3	0	1	100	-47.0	-47.9	-57.0	58.5	64.3	63.2	66.9	72.7	72.1	69.2	71.7
	70.6	69.8	-65.8	70.1	72.1	67.6	-40.0	-53.6	-54.0	-53.8	-61.7	-58.2	60.2	-56.3	-59.8	-54.8	60.7
	-60.1	-60.1	-55.1	60.7	-61.2	64.6											

	0	0	2	4	8	4	17	10	3	3	9	7	5	2	16	10	1 3
	0	0	0	0	1	1	5	1	1	0	4	1	1	0	7	2	9
2003	1	2	3	0	1	100	-39.5	-42.6	57.1	59.8	64.9	69.0	67.3	67.0	64.5	-61.2	6 8 . 5
	74.9	72.5	-62.2	73.3	70.7	-66.4	-48.4	-48.9	50.3	55.4	-56.9	-53.1	-58.0	56.8	-54.0	-69.7	- 6 0 . 6
	-60.9	-59.0	-62.1	-48.8	-59.8	-59.4											
	0	0	16	43	9	5	10	22	6	2	8	3	3	2	5	7	1
	0	0	6	12	1	2	0	5	2	1	0	0	2	0	1	2	0
#	Trawl	Fishery		Size-at-Age													1 9 8 7
	1	3	3	2	1	100	41.76	45.41	48.78	51.75	54.72	54.42	59.39	57.45	57.82	60.26	6 1 . 5 6
	58.86	57.97	60.62	60.86	59.22	60.98	41.33	44.24	47.45	49.47	51.09	50.91	53.69	53.65	55	56.11	5 7 . 2
	55.73	53.97	53.31	54.97	56.13	55.71											
	26	139	73	48	25	36	13	33	16	28	6	20	5	16	27	23	3 8
	16	103	49	33	10	27	13	28	6	16	6	18	8	17	32	36	571988
	1	3	3	2	1	100	40.39	46.21	49.75	52.05	53.84	54.38	54.95	55.34	57.63	56.85	5 8 . 3 9
	57.01	61.7	55.64	57.74	59.74	61.81	-35.9	45.02	48.06	49.9	50.95	50.7	52.42	53.76	53.71	53.71	5 1 . 0 7
	54.03	54.43	54.92	56.42	54.72	55.28											
	6	198	127	97	19	27	16	23	9	21	14	17	8	4	16	18	1 8
	0	121	88	62	25	33	15	41	22	33	10	23	9	18	59	65	451989
	1	3	3	2	1	100	40.75	44.69	49.94	51.88	52.51	55.12	56.21	54.98	57.14	58.14	5 5 . 5 2
	57.52	57.17	57.4	57.56	56.81	61.85	41.83	43.82	48.35	50.22	51.13	51.94	53.22	52.56	51.28	53.07	5 2 . 7 1
	53.95	51.47	53.61	54.79	54.61	55.02											
	10	97	112	84	27	47	22	25	12	19	9	17	8	9	18	16	2 5
	7	64	60	56	26	40	13	29	13	26	14	38	8	23	56	41	751990
	1	3	3	2	1	100	-38.42	45.07	48.52	52.96	55.44	55.4	56.01	58.53	54.79	62.64	5 8 . 5 7
	57.92	57.68	60.05	58.37	58.84	60.58	-39.94	44.82	47.68	50.07	50.82	51.14	52.36	54.83	53.89	53.59	5 5 . 4 6
	53.71	55.13	53.1	54.47	55	55.81											
	2	56	70	81	28	47	22	24	5	16	13	17	10	12	19	20	3 3
	1	45	64	58	31	46	15	30	14	30	6	15	9	20	43	49	601991
	1	3	3	2	1	100	43.76	46.61	49.77	52.54	54.6	56.52	57.05	58.29	60.67	60.2	6 0 . 5 9
	62.9	57.94	62.27	61.49	61.92	59.74	44.18	46.05	48.82	50.49	51.63	52.77	54.15	53.64	53.58	55.4	5 4 . 8 1
	55.91	54.27	55.77	55.19	55.31	56.62											
	18	186	157	132	78	69	45	31	23	25	14	11	6	14	32	11	5 3
	12	124	138	78	44	27	29	24	22	19	17	15	11	13	47	41	941993
	1	3	3	2	1	100	-39.52	48.72	50.42	51.81	53.41	55.11	57.44	59.04	58.57	62.7	5 6 . 4 2
	58.07	62.19	62.17	58.95	59.12	59.1	-41.47	46.97	49.8	51.3	51.05	50.26	52.22	53.41	54.28	55.52	5 3 . 4
	54.31	54.15	53.66	56.15	55.48	56.15											
	0	11	70	83	47	33	22	17	19	7	7	12	9	9	35	35	3 5
	0	13	46	46	13	18	15	14	11	12	7	7	4	8	35	19	291994
	1	3	3	2	1	100	-41.09	-42.77	49.79	52.86	54.09	57.08	55.82	61.62	58.28	58.23	6 2 . 5 6
	61.9	57.63	57.57	59.9	59.43	60.36	-38.46	-41.83	46.6	49.88	51.71	49.93	53.44	51.78	54.75	54.1	5 6 . 9 5
	55.68	53.12	53.44	55.46	54.74	56.32											
	0	0	25	42	22	14	17	10	7	12	4	6	6	4	24	10	2 9
	0	0	19	40	31	22	13	10	7	9	6	11	11	10	32	26	761995
	1	3	3	2	1	100	-37.24	45.43	52.41	53.66	54.99	59.21	61.96	59.04	51.63	58.72	6 4 . 8 5
	63.18	58.62	63.44	61.36	61.91	62.8	-36.66	47.51	48.33	51.24	51.15	51.22	51.8	51.42	53.23	54.33	5 2 . 5
	53.12	54.13	-66.61	56.43	59.53	56.32											
	0	3	11	13	20	15	13	10	5	13	15	4	5	11	17	7	3 7
	0	3	13	7	14	13	8	17	15	6	4	3	5	1	24	4	351996
	1	3	3	2	1	100	-34.88	-42.84	49.69	44.47	47.51	57.2	49.32	-58.39	-66.89	-57.58	- 6 7 . 3 7
	-60.11	-51.96	-68.06	-61.41	-60.22	58.78	-35.66	-42.21	-52.16	48.86	48.18	-53.47	51.82	53.19	51.05	52.82	5 1 . 6 8
	55.39	54.26	-52.84	52.91	54.98	54.93											
	0	0	3	8	3	3	3	2	0	2	0	2	1	0	2	2	5
	0	0	0	6	7	2	9	5	8	4	5	3	5	2	15	9	371997
	1	3	3	2	1	100	-47.79	46.03	53.66	53.84	55.22	58.49	60.86	60.55	60.57	59.85	6 1 . 8 6
	61.73	59.24	60.79	61.27	60.07	61.44	-45.44	44.08	52.22	51.67	52.37	55.7	55.46	55.12	56.22	55.62	5 5 . 4 6
	54.86	54.88	57.93	55.64	55.62	55.23											
	1	102	66	36	31	46	49	37	35	19	29	21	19	15	45	29	7 4
	1	88	38	37	47	53	51	40	33	26	23	42	18	18	96	62	1411998
	1	3	3	2	1	100	-51.0	-47.9	53.3	56.2	63.1	60.8	64.3	64.7	65.7	63.3	6 2 . 4
	62.7	62.0	-63.9	61.6	57.6	59.1	-37.2	-44.7	49.5	54.9	52.0	60.2	58.7	61.4	55.2	-60.6	5 4 . 5
	55.5	55.3	57.0	56.4	54.8	55.7											

	2	2	104	53	13	17	26	33	20	13	9	8	4	2	24	12	3	0
	0	1	38	24	4	5	10	6	4	2	5	8	3	5	18	17	76	
1999	1	3	3	2	1	100	-39.8	50.1	57.0	56.7	59.6	60.9	60.2	63.2	64.3	67.0	6 5 . 1	
	61.1	59.5	62.2	61.1	62.1	62.3	-42.6	48.5	53.3	54.3	56.3	53.6	57.2	57.9	58.2	59.4	5 6 . 7	
	54.9	56.0	56.3	56.3	56.0	56.2												
	0	15	17	103	43	15	15	25	24	13	8	14	7	6	32	10	3	2
	0	17	31	81	31	5	12	23	20	14	12	16	4	6	34	20	44	
2000	1	3	3	2	1	100	42.8	49.4	53.6	57.0	59.2	59.7	60.4	62.4	62.0	62.4	6 0 . 4	
	60.3	61.4	60.6	62.0	60.9	61.8	42.5	48.4	51.5	53.5	54.2	54.7	55.3	56.5	57.9	56.3	5 5 . 8	
	55.8	55.8	55.8	56.7	56.8	57.6												
	6	25	35	70	140	64	45	34	44	26	21	21	22	13	73	39	7	0
	3	21	39	89	149	61	28	33	39	41	23	34	27	24	82	47	102	
2001	1	3	3	2	1	100	37.0	46.2	51.5	57.5	60.3	61.4	60.0	62.9	62.3	61.8	6 0 . 1	
	62.9	65.4	61.9	62.0	60.8	62.2	36.3	45.1	49.1	53.9	54.5	55.2	54.1	57.0	57.6	55.4	5 8 . 1	
	56.5	56.2	57.0	56.5	57.9	57.8												
	49	87	61	28	49	68	48	19	34	31	21	16	17	17	64	35	6	4
	63	66	40	41	65	60	37	23	31	27	21	27	20	17	67	42	98	
2002	1	3	3	2	1	100	-35.4	46.3	52.5	57.1	58.1	61.6	61.2	61.3	62.1	58.9	6 6 . 9	
	65.4	61.0	66.8	63.1	61.0	65.1	-33.4	44.5	50.8	53.4	53.5	55.6	57.9	57.7	57.1	57.8	5 6 . 8	
	56.7	55.9	55.2	56.2	57.2	56.8												
	0	252	128	47	10	17	21	15	7	3	9	9	4	5	22	13	2	1
	0	239	65	18	5	12	10	3	6	8	5	6	6	4	15	13	36	
2003	1	3	3	2	1	100	-41.5	46.1	53.1	53.5	57.5	62.1	61.7	65.4	65.1	59.5	5 9 . 9	
	62.3	66.4	63.1	63.0	61.7	63.9	-43.2	44.9	51.1	51.2	52.9	54.4	56.4	58.1	56.6	60.3	- 5 7 . 8	
	56.6	58.6	58.9	57.1	59.2	56.3												
	0	7	111	99	29	6	15	13	11	4	3	8	9	4	26	9	1	5
	1	18	95	55	13	6	7	19	8	5	2	5	7	5	24	9	18	
#	Northern		Pot	Survey	Size-at-Age		DEPTHS	225-450									1 9 8 3	
	1	6	3	0	1	100	-1	46.1	50.8	53.9	55.7	58.6	58.3	61	64.3	61.4	7 0 . 4	
	66.8	62.3	70.3	60.6	57.9	61.4	-1	45.8	50.5	51	52.5	50.4	54.8	52	56.1	59	5 5 . 1	
	55	61	54.8	56.1	55	53.4												
	0	10	18	65	27	46	18	12	8	7	5	3	5	3	11	17	1	5
	0	4	28	35	18	20	13	9	3	1	3	1	1	2	10	14	3 1 1 9 8 9	
	1	6	3	0	1	100	-1	47.2	51.1	56.3	59.8	56	61.8	60.6	55.5	65.5	7 1 . 6	
	62.5	57	58.2	56.8	64.8	59.1	-1	46.6	49.5	51.6	53.8	53.9	52.5	53.3	56.3	54.6	5 8 . 1	
	55.7	50	54.6	57.6	52.8	54.1												
	0	14	56	64	19	13	7	6	3	3	6	8	4	5	10	10	1	2
	0	9	62	54	19	12	8	8	13	5	7	7	5	5	9	13	4 1 #	
	AFSC	Slope	Survey	Size-at-Age			1	2	3	4	5	6	7	8	9	10	1	1
	12	13	14	15	16	17	1	2	3	4	5	6	7	8	9	10	1	1
	12	13	14	15	16	17												
1991	1	8	3	0	1	100	42.3	46.7	49.3	50.5	53.4	54.2	34.1	6.2	31.4	-58.0	6 1 . 1	
	57.8	40.5	58.4	59.2	51.1	61.7	41.5	44.0	42.9	49.9	50.3	50.4	51.4	52.8	51.8	52.8	5 4 . 3	
	52.1	54.5	54.1	55.5	55.7	57.3												
	19	24	30	18	10	6	5	5	4	2	5	3	6	12	14	23	5	5
	16	15	23	21	12	7	6	8	3	7	4	6	7	10	18	17	5 9 1 9 9 5	
	1	8	3	0	1	100	42.4	45.0	55.5	56.9	58.4	60.2	61.0	60.7	62.6	59.1	5 5 . 3	
	55.0	55.0	62.3	63.6	62.7	63.6	42.3	39.4	47.6	51.1	52.8	53.0	52.4	53.8	53.9	54.8	5 4 . 0	
	53.5	54.8	52.8	56.2	54.0	53.4												
	14	32	37	22	33	38	26	27	22	21	19	18	28	20	86	46	1 3 2	
	15	22	20	22	17	12	11	11	15	19	5	10	11	4	35	34	49	
1997	1	8	3	0	1	100	-42.0	48.4	51.0	57.6	58.1	59.2	58.9	61.1	61.5	64.1	6 3 . 4	
	52.0	65.8	57.8	64.4	63.2	63.9	39.53	44.26	50.04	52.74	53.62	53.73	53.08	53.56	53.77	56.29	5 5 . 8 1	
	56.45	57.63	59.37	55.89	56.40	56.49												
	0	105	21	24	29	61	47	31	26	39	34	25	32	19	112	70	1 3 5	
	49	70	25	21	38	47	21	20	18	26	19	16	18	8	52	50	100	
1998	1	8	3	0	1	100	-33.0	46.2	47.6	49.1	51.0	52.4	56.8	56.0	57.1	57.7	5 8 . 7	
	58.5	56.8	50.0	60.2	54.7	60.4	42.30	40.47	46.81	47.91	47.23	47.50	49.82	51.43	52.18	52.51	5 1 . 2 1	
	51.87	52.84	53.98	53.47	51.38	55.59												
	0	46	48	49	51	52	57	56	57	58	59	59	57	50	60	55	6	0
	1	37	57	54	43	33	26	26	24	13	18	23	16	17	70	57	207	

1999	1	8	3	0	1	100	-47.0	48.3	51.2	55.0	55.5	53.4	59.8	61.3	63.5	60.8	6 6 . 9
	60.3	34.4	55.8	61.0	50.0	63.3	-33.42	45.20	49.42	51.53	51.78	51.74	53.53	53.89	55.62	56.82	5 3 . 6 2
	53.95	55.49	57.40	55.00	49.93	52.63											
	0	19	5	29	16	13	8	13	14	12	6	7	5	5	27	21	5 6
	1	8	9	28	15	11	7	6	5	5	11	4	4	4	22	19	61
2000	1	8	3	0	1	100	41.1	39.86	45.66	55.24	56.93	58.64	56.48	59.71	60.89	61.74	6 0 . 6 8
	62.37	51.18	60.44	62.29	58.06	60.98	39.37	38.92	45.93	52.74	53.08	52.41	52.47	54.29	53.58	56.07	5 4 . 5 5
	54.33	55.00	53.91	55.05	56.47	56.62											
	35	118	36	30	66	38	17	25	28	22	33	27	17	26	84	70	1 7 6
	38	99	32	27	56	34	18	20	18	23	21	25	15	22	72	51	210
2001	1	8	3	0	1	100	40.7	48.9	52.6	54.5	57.1	51.8	61.5	61.2	-60.2	60.7	6 6 . 8
	65.8	62.5	64.4	64.0	61.3	63.1	38.7	47.6	51.8	52.7	-48.8	54.6	53.9	55.8	58.6	57.2	5 5 . 9
	59.0	48.2	57.2	55.1	55.4	56.9											
	12	46	24	10	3	7	10	9	2	11	6	9	5	4	30	17	4 6
	4	43	9	7	1	6	10	4	8	3	5	5	8	7	15	23	61
#	NWFSC	Slope	Survey	Size-at-Age													1 9 9 8
	1	9	3	0	1	100	-43.0	50.2	52.4	52.5	56.6	57.0	60.8	65.2	63.6	62.9	6 0 . 1
	60.6	60.5	60.2	62.7	65.1	63.1	-34.5	43.4	49.5	49.5	50.3	53.3	51.9	54.4	52.6	54.1	5 4 . 8
	54.3	53.8	57.2	54.8	56.2	56.4											
	1	5	50	30	12	7	10	12	11	15	8	11	10	4	26	19	5 3
	1	4	39	27	12	12	9	16	13	15	11	11	14	8	49	41	107
1999	1	9	3	0	1	100	-43.0	49.4	56.0	54.9	58.9	57.3	58.2	62.2	64.3	64.0	6 3 . 0
	58.5	64.4	62.8	62.1	62.7	64.2	-38.8	-45.2	50.0	52.1	51.7	52.0	53.9	55.7	57.1	55.5	5 3 . 5
	53.2	55.9	61.0	55.1	56.4	57.5											
	0	3	9	24	31	6	8	5	9	8	8	6	5	8	21	15	3 7
	1	2	10	28	28	8	13	5	7	4	5	8	8	4	40	30	65
2001	1	9	3	0	1	100	40.07	45.42	43.26	57.78	63.59	60.64	61.03	63.23	-55.23	65.15	6 4 . 0 5
	-53.39	-56.28	58.57	58.81	61.26	61.31	38.6	42.9	45.0	54.0	55.0	54.7	54.3	58.1	53.4	56.5	5 7 . 0
	56.1	56.4	54.5	55.4	56.0	56.2											
	6	88	20	7	4	19	11	5	1	2	4	1	2	6	18	18	2 3
	14	92	17	6	7	25	17	4	9	8	7	7	13	8	34	17	84
2002	1	9	3	0	1	100	40.52	47.20	50.12	51.14	52.13	58.24	63.85	49.30	60.11	61.12	6 3 . 1 0
	62.23	60.51	60.45	62.76	62.98	63.80	39.73	44.85	47.31	48.36	48.85	53.77	55.24	54.24	55.20	56.11	5 6 . 9 1
	57.90	45.77	38.62	56.44	56.53	56.65											
	33	45	219	74	39	19	28	15	11	15	12	12	12	12	51	40	9 3
	34	39	249	64	20	25	41	22	14	9	15	15	12	14	57	51	212
2003	1	9	3	0	1	100	40.0	38.3	51.6	54.2	55.5	55.7	59.6	59.3	62.4	64.3	6 7 . 5
	63.8	63.8	-58.8	65.8	60.0	63.9	38.0	43.5	48.0	50.2	51.3	51.8	54.7	57.9	56.8	-59.9	5 4 . 9
	38.6	35.3	57.4	42.3	45.3	57.0											
	13	26	66	79	19	14	10	10	8	8	4	5	10	2	15	10	3 3
	11	20	56	85	23	21	9	9	11	2	4	6	6	9	18	22	83
2004	1	9	3	0	1	100	42.4	46.1	52.3	55.6	56.0	55.8	51.1	60.5	64.7	63.6	- 6 2 . 6
	-55.2	65.8	59.4	62.9	63.0	62.3	40.5	40.2	47.7	51.2	51.8	51.3	49.8	52.9	57.6	56.9	- 1 9 . 9
	-53.5	57.5	56.2	56.8	56.0	57.1											
	4	4	29	69	53	25	7	7	6	5	1	1	5	4	16	14	2 9
	7	14	34	66	44	11	7	10	12	4	3	2	7	6	22	24	73
#	Southern		Pot	Survey	Ages												1 9 8 6
	1	11	3	0	1	100	-1	49.3	48.7	54.7	56.3	58.4	59.4	59.8	62.3	62.1	6 5 . 9
	62.8	67	63.3	60.8	65.3	66.6	-1	47.1	49.4	50.3	51.9	52.8	52.9	53.8	53.6	55.7	5 2 . 8
	59.7	55	63.1	54.1	56.2	55.9											
	0	30	18	18	55	59	82	43	39	14	6	11	7	12	32	27	3 3
	0	35	13	31	44	39	31	18	16	5	4	2	1	2	13	13	1 3 1 9 9 1
	1	11	3	0	1	100	-40.1	46.5	50.9	54	57	58.6	57.9	59.5	66.7	60.9	6 6 . 7
	61.9	63.7	63.4	60	-68.8	63.4	-38.6	45.1	48.1	50.7	50.8	51.7	52.8	53.1	53.2	55.5	5 7 . 1
	52.6	57.1	53.4	54.4	56	52.8											
	1	55	60	92	54	34	18	10	12	13	21	5	5	5	5	5	5
	1	28	47	53	34	16	8	8	6	4	5	5	5	5	5	5	5 #
	Deep Pot Study																
2002	1	13	3	0	1	100	-1.0	-1.0	53.0	52.5	63.3	63.3	61.0	62.5	64.0	67.6	6 2 . 5
	62.3	62.3	63.7	64.5	65.1	69.5	-1.0	-1.0	48.8	51.0	54.0	53.7	53.3	56.4	55.3	54.4	5 4 . 3
	55.4	56.6	55.6	55.6	56.4	58.7											

```
        0       0       2       2       3       3       5       10      9       12      10      16      11      13      70      40      5       5
        0       0       4       1       1       3       8       5       4       5       7       9       5       10      30      26      40
2003    1       13      3       0       1       100     -1.0    -1.0    52.4    52.5    54.4    57.6    59.7    62.9    66.7    65.3    63.9
        65.7    63.8    64.5    66.0    69.4    66.4    -1.0    44.5    50.1    50.6    50.4    54.6    54.5    55.4    55.9    58.7    59.9
        56.4    55.1    58.2    56.6    57.0    58.3
        0       0       17      51      11      7       12      13      9       16      17      14      15      17      95      64      7       3
        0       2       25      39      17      7       10      21      9       6       7       11      21      10      91      82      115
#_environmental_data                                                                                                                    1
        #       N_variables
81      #       N_observations
#_Year  Variable        Value
# This is the Q2CoastalSeaLvlNor z-score using all years
1925    1       1.4396398               1974    1       -0.4468948
1926    1       -0.0220060              1975    1       -1.6075926
1927    1       0.5015367               1976    1       -0.8251277
1928    1       1.7259856               1977    1       -1.5819497
1929    1       0.7861730               1978    1       -0.4550863
1930    1       0.4609354               1979    1       -1.3639849
1931    1       0.4481140               1980    1       -0.5829447
1932    1       1.3349312               1981    1       -0.5370011
1933    1       0.4348651               1982    1       -0.3681853
1934    1       1.4139969               1983    1       0.3391316
1935    1       0.3455423               1984    1       -0.1865480
1936    1       1.7388071               1985    1       -0.9985735
1937    1       1.2045798               1986    1       -0.6994062
1938    1       0.5976976               1987    1       -0.9344662
1939    1       -0.0818395              1988    1       -0.4622093
1940    1       0.1361252               1989    1       -0.6534627
1941    1       0.7088169               1990    1       -0.4771677
1942    1       1.2815085               1991    1       -1.0487909
1943    1       1.1592773               1992    1       -0.1940272
1944    1       -0.4878522              1993    1       1.3156991
1945    1       -0.3425424              1994    1       -0.5722601
1946    1       0.0000000               1995    1       -0.5124267
1947    1       0.6618049               1996    1       -0.0764972
1948    1       3.0295002               1997    1       0.6981323
1949    1       2.4055227               1998    1       -0.1769319
1950    1       -0.1741540              1999    1       -1.1962376
1951    1       0.7002692               2000    1       -0.4611409
1952    1       0.3976829               2001    1       -1.4857888
1953    1       0.5421380               2002    1       -1.4280922
1954    1       0.8579731               2003    1       -0.2292862
1955    1       -0.0818395              2004    1       -0.5754655
1956    1       0.9631091               2005    1        0.2874440
1957    1       0.6220584
1958    1       1.4524612               999     #end    of      file
1959    1       0.6190667
1960    1       0.4438401
1961    1       0.0976609
1962    1       -0.5583702
1963    1       0.5079474
1964    1       -1.1802108
1965    1       -0.4985368
1966    1       -1.3041515
1967    1       -0.6075191
1968    1       -1.8846785
1969    1       0.2757366
1970    1       -2.0221529
1971    1       -0.3582131
1972    1       -0.1772881
1973    1       -2.0168107
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