Status of Cabezon (*Scorpaenichthys marmoratus*) in California Waters as Assessed in 2005

by

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Executive Summary

Stock

This is the second assessment of the population status of cabezon (*Scorpaenichthys marmoratus* [Ayres]) off the west coast of the United States. The first assessment was for a coastwide California cabezon stock in the year 2003 (Cope *et al.* 2004). Two substocks (the northern California substock (NCS) and the southern California substock (SCS)) are delineated for the purposes of this assessment at Point Conception, CA. This delineation is based on differences in how the fishery has operated spatially (the NCS has been the primary area from which removals have occurred), the ecology of nearshore groundfish species, and current management needs.

Catches

Cabezon removals were assigned to six fleets (two commercial and four recreational; Figures E-1–E-3; Table E-1) for each substock because each of these fleets targets a different component of the population. Recreational removals were reconstructed for each of the four fleets back to 1916, when the commercial fishery began. The recreational fishery for cabezon did not begin in earnest until the late 1920s when the California CPFV fleet started. Historically, the CPFV fleet has been the primary source of removals of cabezon. The commercial catch of California was reconstructed back to 1916 for each substock and has become a major source of removals in the last 10 years because of the developing live-fish fishery. The sensitivity of the assessment results to the magnitude of historical recreational catch is explored as part of the assessment. Discard mortality is assumed to be negligible because cabezon can generally survive catch and release in the commercial nearshore fishery and cabezon have not been commonly recorded in the West Coast Observer Program.

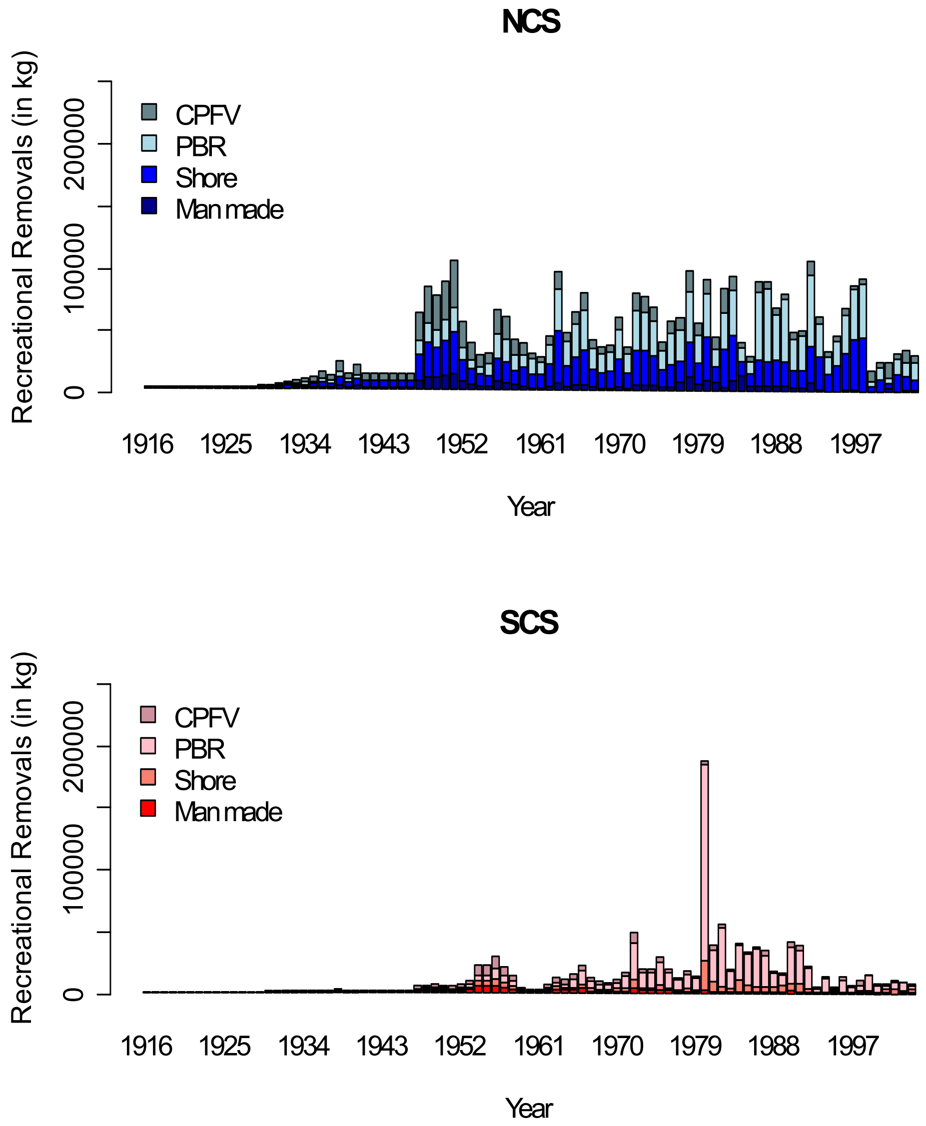


Figure E-1. Recreational fishery cabezon removals (in kg) by fleet and substock.

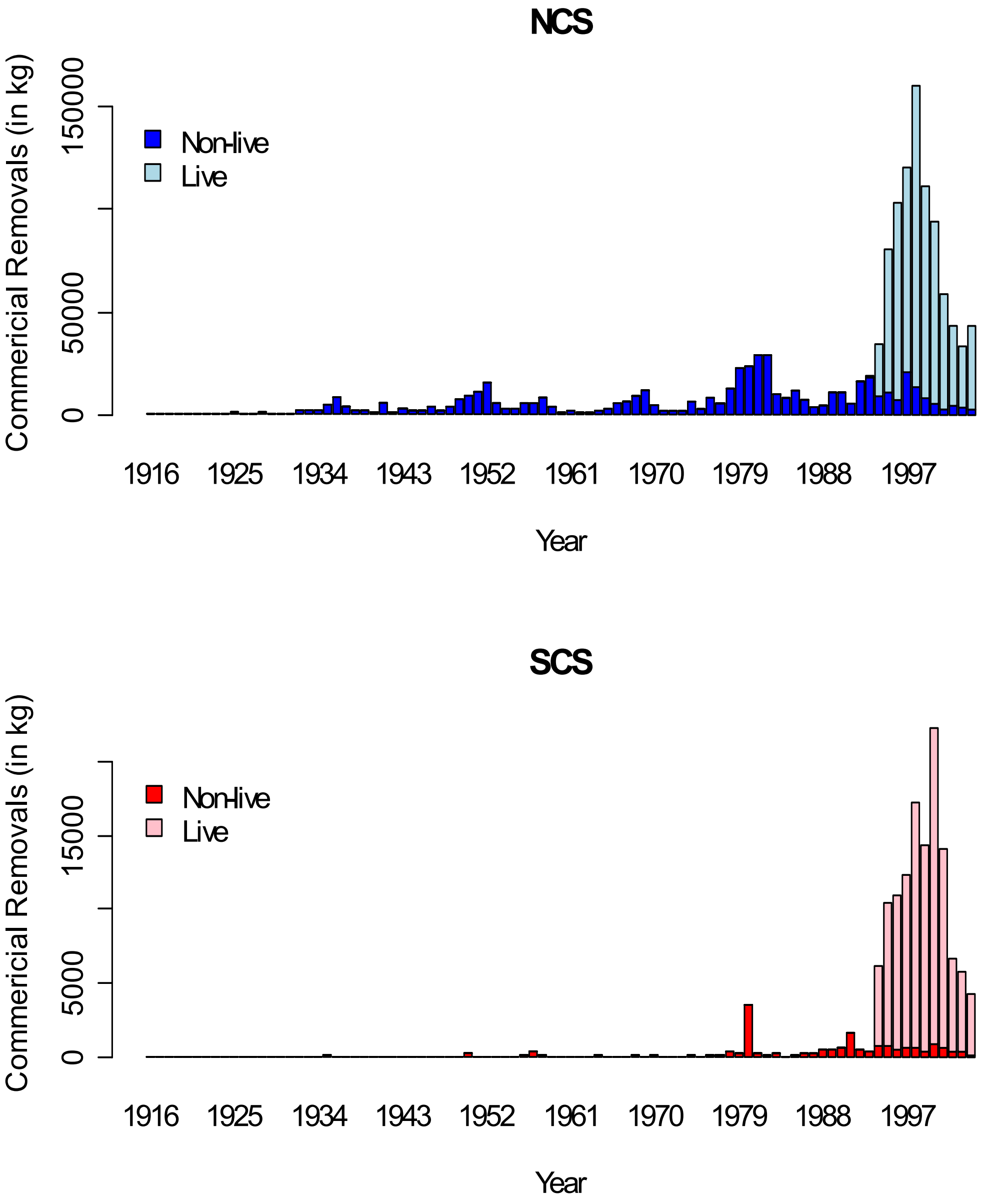


Figure E-2. Commercial fishery cabezon removals (in kg) by fleet and substock.

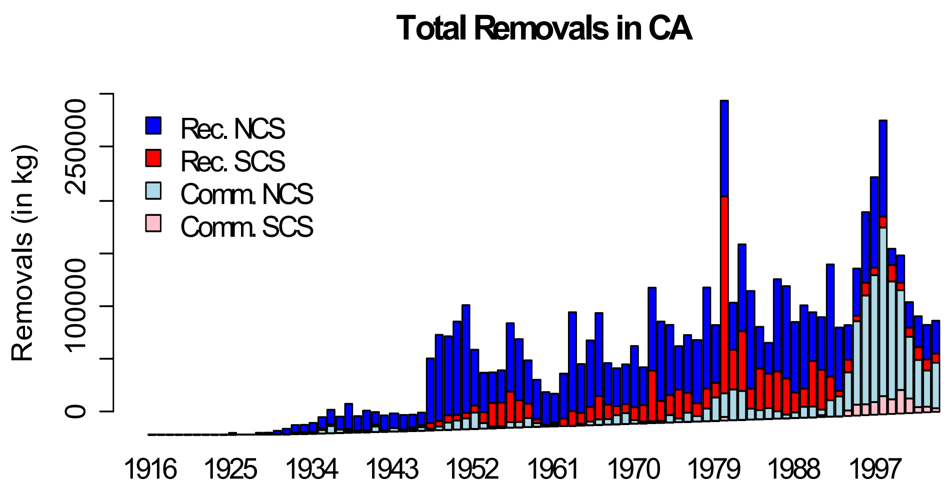


Figure E-3. Removals of cabezon (in kg) by sector and substock.

Table E-1. Removals (in kg) of cabezon by substock, sector, and fleet.

	NCS						SCS					
	Commercial		Recreational				Commercial		Recreational			
Year	Non-live	Live	Man-Made	Shore	PBR	CPFV	Non-live	Live	Man-Made	Shore	PBR	CPFV
1916	32	0	330	707	0	0	0	0	0	23	20	0
1917	151	0	330	707	0	0	0	0	0	23	20	0
1918	76	0	330	707	0	0	0	0	0	23	20	0
1919	0	0	330	707	0	0	0	0	0	23	20	0
1920	0	0	330	707	0	0	0	0	0	23	20	0
1921	0	0	330	707	0	0	0	0	0	23	20	0
1922	0	0	330	707	0	0	0	0	0	23	20	0
1923	0	0	330	707	0	0	0	0	0	23	20	0
1924	0	0	330	707	0	0	0	0	0	23	20	0
1925	1520	0	330	707	0	0	0	0	0	23	20	0
1926	0	0	330	707	0	0	0	0	0	23	20	0
1927	341	0	330	707	0	0	0	0	0	23	20	0
1928	1192	0	330	707	0	0	0	0	39	23	20	16
1929	542	0	330	707	490	980	0	0	78	45	41	31
1930	474	0	494	1059	734	1467	0	0	117	68	61	47
1931	505	0	658	1411	977	1955	0	0	157	91	82	63
1932	2121	0	822	1761	1220	2440	1	0	196	114	102	78
1933	1901	0	986	2113	1464	2928	33	0	235	136	122	94
1934	2370	0	1150	2465	1708	3416	0	0	274	159	143	110
1935	4712	0	1314	2817	1952	3903	67	0	314	182	163	126
1936	8334	0	1847	3958	2742	5484	6	0	441	256	229	176
1937	3713	0	1595	3420	2369	4738	1	0	292	169	152	117
1938	2460	0	3050	6538	4529	9058	0	0	825	479	429	330
1939	1823	0	1735	3719	2576	5153	1	0	309	179	161	124
1940	1512	0	2534	5432	3763	7525	27	0	291	169	151	116
1941	6018	0	1927	5165	0	5724	35	0	613	356	319	245
1942	1040	0	1927	5165	0	5724	4	0	613	356	319	245
1943	3411	0	1927	5165	0	5724	0	0	613	356	319	245
1944	1754	0	1927	5165	0	5724	15	0	613	356	319	245
1945	1952	0	1927	5165	0	5724	0	0	613	356	319	245
1946	3542	0	1927	5165	0	5724	0	0	613	356	319	245
1947	2047	0	7649	20498	11359	22718	6	0	1885	1094	980	754
1948	3714	0	10246	27456	15215	30429	6	0	2122	1232	1104	849
1949	7273	0	9376	25125	13923	27846	5	0	2763	1604	1437	1105
1950	9544	0	10769	28858	15991	31983	289	0	2153	1250	1120	861
1951	10802	0	12757	34184	18943	37886	19	0	1976	1147	1028	790
1952	15595	0	6649	17818	9874	19747	51	0	2659	1543	1383	1064
1953	6021	0	4679	12538	6948	13896	15	0	3954	2295	2057	1582
1954	2816	0	3483	9333	5172	10344	1	0	9036	5244	4700	3614
1955	3141	0	3096	8296	9194	9194	9	0	8713	5057	4532	3485
1956	5566	0	6780	18167	20135	20135	58	0	9882	5735	5140	8051
1957	5627	0	6064	16250	18010	18010	363	0	7220	4190	3755	5882
1958	8787	0	4178	11480	12408	12408	67	0	4868	2825	2532	3966
1959	4297	0	3325	14968	9875	9875	7	0	1246	723	648	1015
1960	1385	0	1559	11480	12235	4929	3	0	597	346	311	486
1961	2236	0	1527	11480	9928	4000	10	0	706	410	367	575
1962	1120	0	2393	18948	15553	6266	2	0	2171	1260	1129	1769
1963	1271	0	5290	41894	34387	13854	5	0	4368	2535	2272	3559
1964	2326	0	2978	16848	19361	7800	70	0	3475	2017	1807	2831
1965	3357	0	4005	22658	26037	10490	16	0	3602	2090	1874	7204
1966	5664	0	4942	27955	32124	12942	51	0	5507	3196	2864	11014
1967	6441	0	2580	14593	16769	6756	38	0	2849	1653	2422	5698
1968	9059	0	2219	12554	14426	5812	61	0	2029	1178	1725	4058
1969	11677	0	2347	13275	15255	6146	43	0	1939	1125	1648	3878
1970	4762	0	3752	21224	24389	9826	90	0	2473	1435	2102	4946
1971	2026	0	2231	12619	14501	5842	24	0	2558	1485	2174	10232
1972	2618	0	4935	27920	32084	12926	37	0	7459	4329	6340	29836
1973	2051	0	4784	27065	31101	12530	15	0	2986	1733	2538	11944
1974	6694	0	4231	23933	27502	11080	65	0	3044	1767	2587	12176
1975	3299	0	2517	14239	16362	6592	27	0	4521	2624	3843	18084
1976	8604	0	3745	17654	24345	9808	89	0	2995	1738	2546	11980
1977	5404	0	6761	17896	24677	9942	107	0	1936	1124	1646	7744
1978	12569	0	10956	29002	39992	16112	320	0	2858	1659	2429	11432
1979	22612	0	6221	16466	22706	9148	214	0	2138	1241	1817	8552
1980	23658	0	9349	34458	49007	11518	3572	0	3043	2287	24283	156824
1981	28946	0	7519	12970	58326	10055	260	0	3465	309	9316	25511
1982	28787	0	3167	30039	28423	19196	153	0	2062	400	4123	48486
1983	10517	0	8314	36160	31329	11569	186	0	1740	1004	3382	12738
1984	8420	0	12692	11610	47345	3560	53	0	631	1434	10017	27356
1985	11656	0	4342	10195	24277	3015	115	0	456	813	5595	25783
1986	7176	0	4494	20272	55278	7848	185	0	1697	1026	3722	30759
1987	3722	0	4317	19475	58646	5645	290	0	3478	1014	3678	25983
1988	5288	0	4709	21245	36011	5862	493	0	1404	1084	3930	11985
1989	10888	0	4331	19537	50886	3450	458	0	2322	1465	5311	7835
1990	11171	0	3014	13596	26050	4834	606	0	4421	1749	6344	29047
1991	5794	0	3147	14196	27200	5047	1596	0	4120	1630	5912	27067
1992	16211	0	6667	30075	57623	10692	461	0	2385	944	3422	15666
1993	18723	390	1941	26469	46026	5027	387	4	1495	68	373	3615
1994	9095	25873	942	13569	28263	3682	704	5482	1194	382	717	10589
1995	11322	68877	573	20109	43483	3564	787	9655	839	673	1314	1751
1996	7898	94700	1879	29744	35850	5606	455	10470	2724	1336	265	8610
1997	21149	99163	1854	40373	11355	3225	630	11719	1620	949	630	2939
1998	13988	145361	557	43044	19310	3800	668	16570	3185	651	1819	4730
1999	8554	102158	439	4456	22333	7264	320	14006	1041	818	2189	11594
2000	5343	88835	317	9608	17559	5182	851	21441	1818	140	435	5506
2001	3210	55305	3674	3901	27559	12766	606	13510	1094	1014	2399	3465
2002	5035	38652	943	13256	14365	2942	357	6360	1823	173	3455	5723
2003	3666	30303	1874	11280	64019	9538	361	5407	1317	506	1859	6364
2004	3058	40219	1522	8845	13955	5310	167	4084	2266	391	3592	2296

Data and assessment

Three potential indices of abundance are formally considered for the NCS: 1) California CPFV Logbook, 2) Monterey nearshore reef adult survey, and 3) TENERA nearshore reef benthic adult survey. There are also three potential indices of abundance for the SCS: 1) California CPFV Logbook index, 2) CalCOFI larval index, and 3) Southern California Power Plant impingement (recruitment) index. Each index is developed by fitting generalized linear models to the proportion of non-zero records and the catch-rate (or whatever quantity is being measured) given that the catch was non-zero, and taking the product of the resultant year effects. Only the CPFV index is used in the base model for the NCS because of its area-wide coverage and the potential bias in SCUBA surveys for cryptic species like cabezon. The results for the NCS assessment are sensitive to the inclusion (or otherwise) of the TENERA survey (Fig. E-4). The TENERA index was not included because SCUBA surveys may not be appropriate for cryptic species and the trend contradicted the CPUE trend for Morro Bay (the spatially closest port). The base model for the SCS uses all three indices. Fishery mean weight and catch length composition data are also used to fit the model. The assessment is based on the program Stock Synthesis 2, developed specifically to use age-and length-structured data.

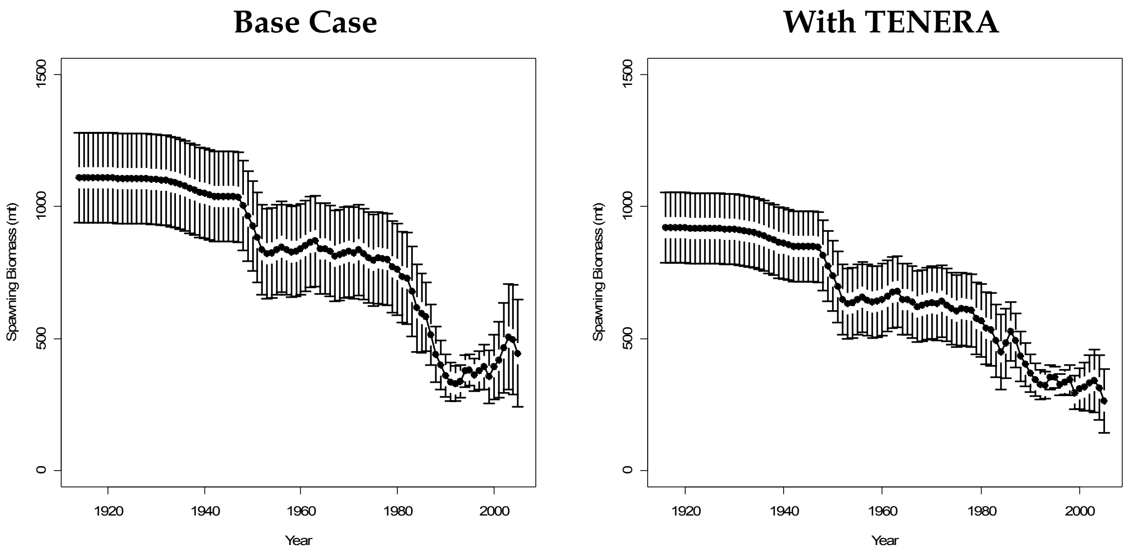


Figure E-4. Spawning biomass trajectories without and with the inclusion of the TENERA adult survey.

Unresolved problems and major uncertainties

Several sources of uncertainty were recognized and explored using sensitivity analyses. Inclusion and exclusion of data sources generally made little difference to the outputs for the NCS or the SCS, except in one major case. The exclusion of the mean weight value for the recreational man-made fleet for 2000 led to a major reduction in the status of the SCS (to 5.8% of virgin biomass in 2005; Fig. E-5). The use of this one data point is perhaps the most important uncertainty of the SCS assessment. Other major uncertainties relate to the values assumed for natural mortality (*M*) for each sex, the extent of variation in recruitment (σ_R), the values for stock-recruitment parameters such as steepness (*h*), the number of years for which recruitment residuals are estimated, the size of the historical recreational catch, the effective sample size assigned to the catch length composition data, and the length–at-age CVs. The catch by the PBR fleet in 1980 based on RecFIN is very large, but does not seem to influence the results for the SCS substantially.

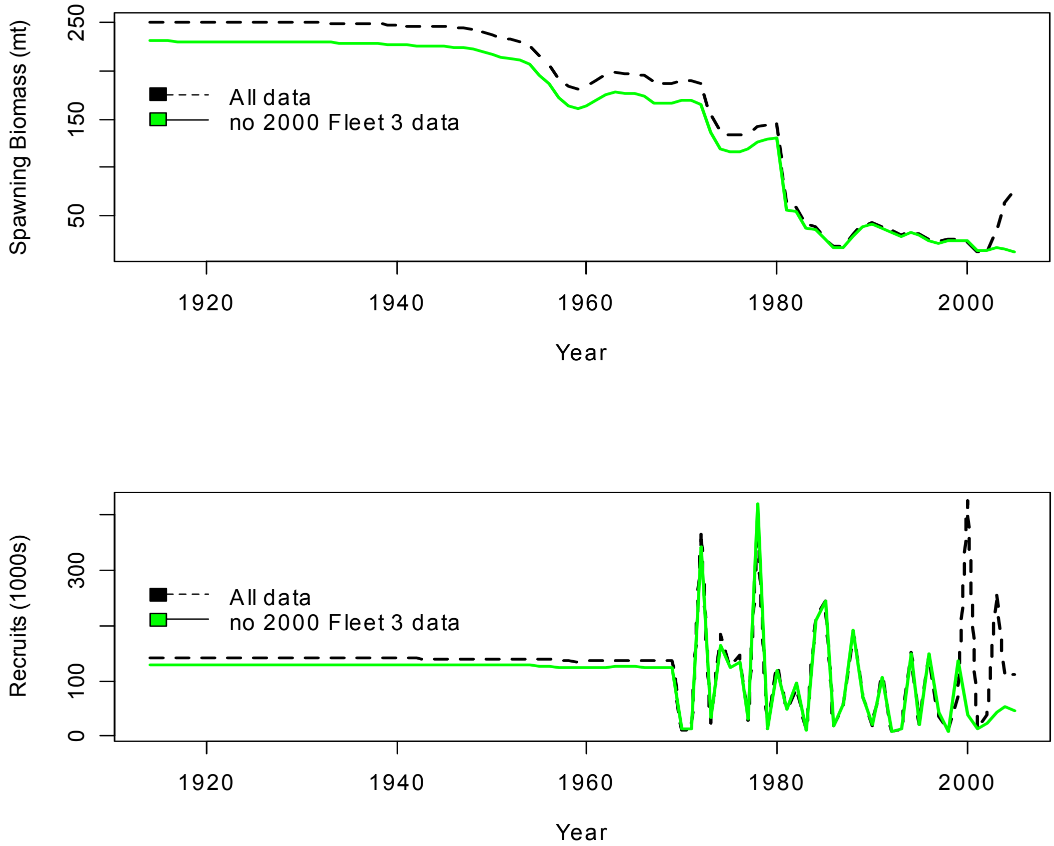


Figure E-5. MPD time-trajectories of reproductive output (upper panel) and recruitment (lower panel) for the SCS, including and excluding the mean weight datum for 2000 for the man-made fleet.

Reference points

Substock-specific reference points for each base case are provided in Table E-2. Figure E-6 includes reference points based on federal (the 40-10 control rule with a $F_{45\%}$ F_{MSY} proxy) and state (the 60-20 control rule with a $F_{50\%}$ F_{MSY} proxy) guidelines for each substock.

Table E-2. Reference points for each cabezon substock.

	Substock					
	NCS			SCS		
	Low *M*	Base Case	High *M*	Low SB_{2005}	Base Case	High SB_{2005}
Unfished Spawning Stock Biomass (SB_0)	1066	1110	1296	247	251	252
Unfished Summary (2+) Age Biomass (B_0)	1659	1858	2357	426	433	436
Unfished Recruitment (R_0)	366	627	1135	139	141	142
SPR_{msy} or F_{msy}	F_{MSY}	F_{MSY}	F_{MSY}	F_{MSY}	F_{MSY}	F_{MSY}
Basis for F_{msy}	$F_{45\%}$	$F_{45\%}$	$F_{45\%}$	$F_{45\%}$	$F_{45\%}$	$F_{45\%}$
Spawning Stock Biomass at MSY proxy ($F_{45\%}$)	409	426	498	95	96	97
MSY ($F_{45\%}$)	87	119	173	26	26	26
Exploitation Rate corresponding to $F_{45\%}$	0.11	0.13	0.15	0.13	0.13	0.13
Basis for F_{msy}	$F_{50\%}$	$F_{50\%}$	$F_{50\%}$	$F_{50\%}$	$F_{50\%}$	$F_{50\%}$
Spawning Stock Biomass at MSY proxy ($F_{50\%}$)	469	489	570	108	110	111
MSY ($F_{50\%}$)	83	112	164	24	25	25
Exploitation Rate corresponding to $F_{50\%}$	0.10	0.11	0.13	0.11	0.11	0.11

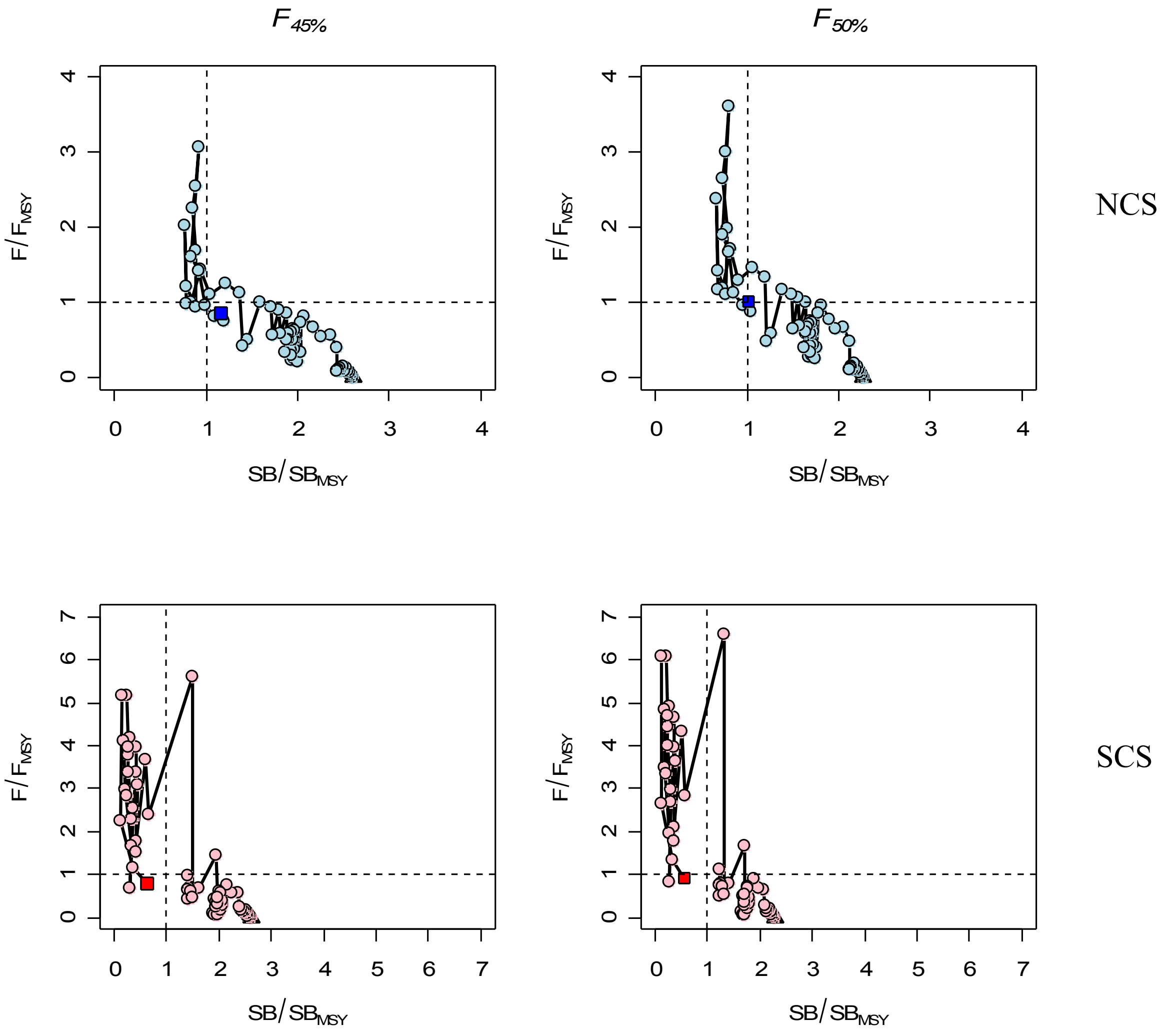
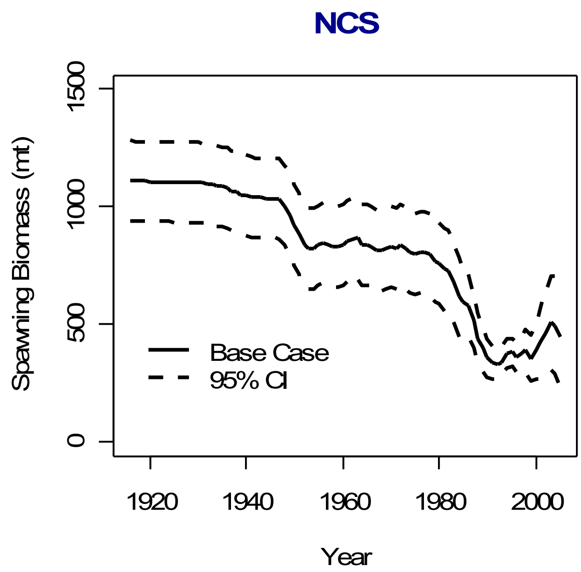


Figure E-6. Spawning biomass and exploitation rates relative to the target levels (at MSY) for each substock (NCS top row; SCS bottom row) for each F_{MSY} proxy (columns). Solid triangles represent the start of the time period; solid squares represent the end of the time period.

Stock biomass

The unfished reproductive outputs of the California cabezon substocks are estimated to be 1110 (NCS) and 251 (SCS) mt, respectively, with estimated reproductive outputs of 445 (NCS) and 71 (SCS) mt in 2005 (Figure E-7). This leads to an estimated depletion level of 40.1% and 28.3% for each substock. Total unfished cabezon reproductive output is estimated at 1316 mt compared to 1268 for a one stock model (Table E-3). Current total cabezon reproductive output for the two substock model is 516 mt, compared with 634 mt for the one stock model. The previous assessment estimated a depletion rate for 2003 intermediate between those for the one and two stock models for 2003 (Table E-3).



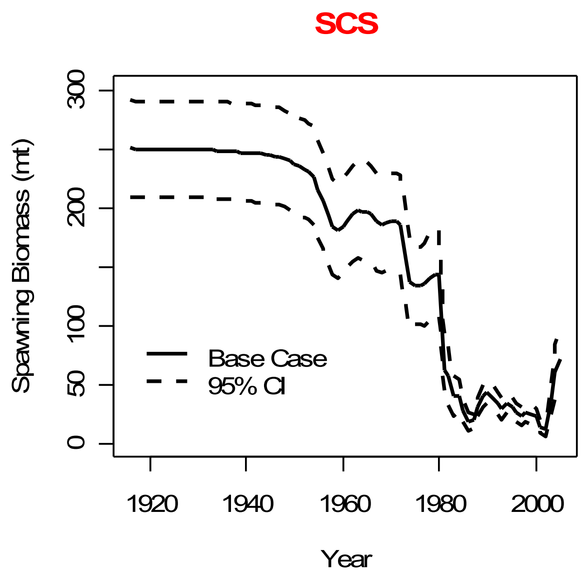


Figure E-7. Time-trajectories of reproductive output (measured in spawning biomass) for the NCS and the SCS.

Table E-3. Total cabezon reproductive output and depletion rates in California.

Model	Total California Cabezon Spawning Biomass (mt)					
	SB_{1916}	SB_{1930}	SB_{2003}	SB_{2005}	SB_{2003}/SB_{1930}	SB_{2005}/SB_{1916}
2005 Assessment						
two substock model	1361	1353	542	516	40.0%	37.9%
one stock model	1268	1260	353	634	28.0%	50.0%
2003 Assessment		902	313		34.7%	

Recruitment

A Beverton-Holt equation with lognormal process error is used to characterize the spawner-recruitment relationship of cabezon. The steepness parameter is set to 0.7 for the base model. Recruitment residuals are estimated for 1980–2003 (NCS) and 1970–2003 (SCS). There are several major recruitment events for the NCS after 1980, but only two for the SCS: one in 2000 and another in 2003, both about twice the historical average (Figure E-8). Actual recruitment patterns are unclear because of a lack of age-composition data.

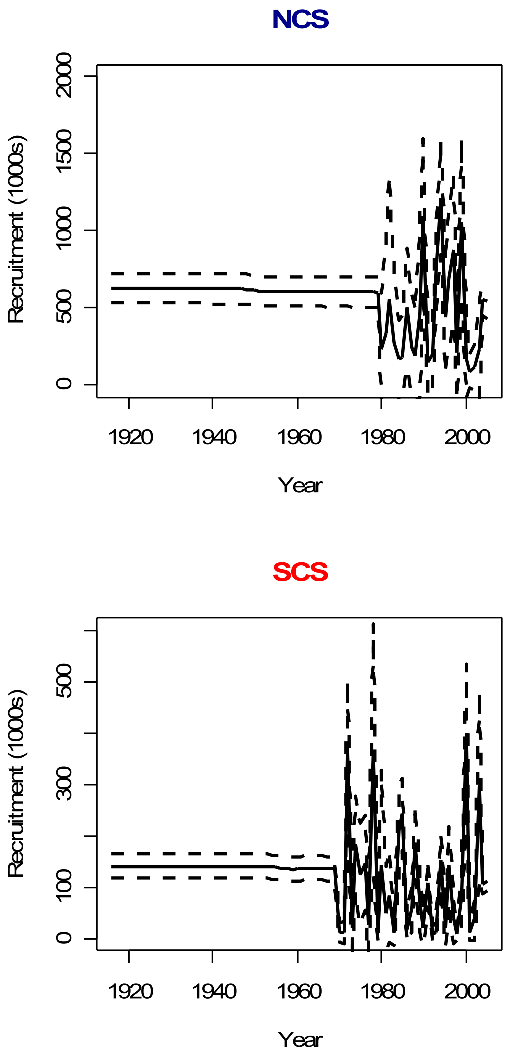


Figure E-8. Time-trajectories of recruitment (1000s) for the NCS and the SCS. Bold lines are point estimates; broken lines represent the approximate 95% confidence intervals.

Table E-4. Ten year summary of catches, biomass, recruitment and depletion levels for each of the cabezon substocks. Parenthetic values are asymptotic standard deviations.

NCS								
Year	Statewide OY ($F_{50\%}$)	Total Catch	Exploitation Rate	Spawning Potential Ratio (SPR)	Summary Age (2+) Biomass	Spawning Stock Biomass	Recruitment	Depletion level
1995	--	125	13%	40%	779	382 (30)	437 (185)	34%
1996	--	170	17%	33%	917	362 (32)	687 (226)	33%
1997	--	206	20%	29%	909	380 (37)	876 (245)	34%
1998	--	250	25%	25%	895	393 (44)	206 (154)	35%
1999	--	127	14%	41%	876	356 (51)	1059 (274)	32%
2000	72	119	12%	45%	849	393 (63)	171 (129)	35%
2001	72	83	8%	56%	963	420 (74)	86 (56)	38%
2002	81	74	8%	61%	959	466 (87)	118 (76)	42%
2003	88	68	7%	63%	900	507 (101)	232 (165)	46%
2004	69	73	9%	60%	815	496 (105)	554 (54)	45% (8%)
2005	69	--	--		731	445 (103)	541 (56)	40% (8%)

SCS								
Year	Statewide OY ($F_{50\%}$)	Total Catch	Exploitation Rate	Spawning Potential Ratio (SPR)	Summary Age (2+) Biomass	Spawning Stock Biomass	Recruitment	Depletion level
1995	--	15	19%	29%	57	31 (4)	21 (17)	12%
1996	--	24	29%	17%	75	26 (4)	144 (37)	10%
1997	--	18	22%	23%	64	23 (4)	38 (25)	9%
1998	--	28	32%	16%	82	26 (4)	8 (7)	10%
1999	--	30	39%	14%	74	25 (4)	80 (29)	10%
2000	72	30	39%	12%	52	23 (3)	398 (69)	9%
2001	72	22	24%	12%	43	14 (3)	10 (7)	5%
2002	81	18	15%	29%	116	12 (3)	38 (21)	5%
2003	88	16	11%	47%	130	35 (7)	298 (93)	14%
2004	69	13	7%	59%	135	60 (12)	105 (10)	24% (5%)
2005	69	--	--		191	71 (15)	111 (10)	28% (6%)

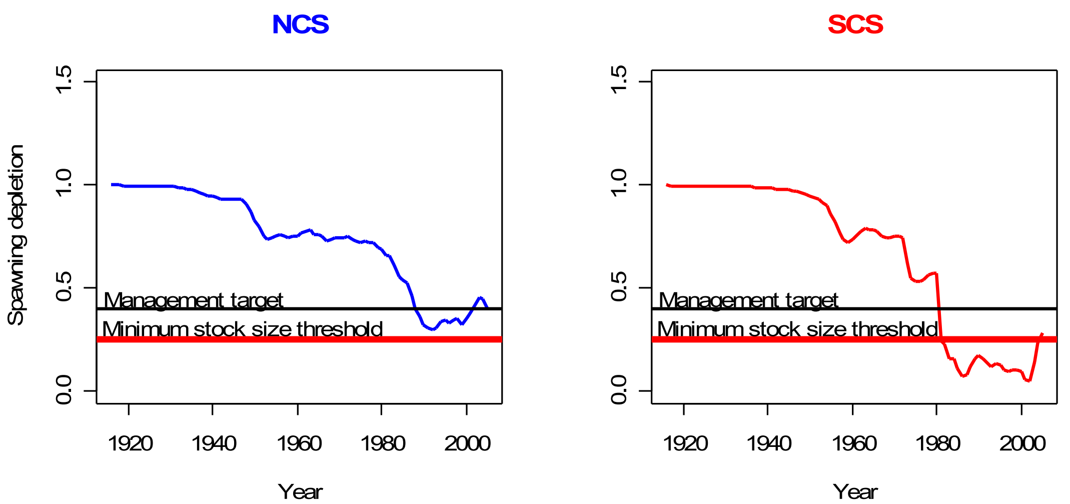


Figure E-9. Time-trajectory (1916-2005) of spawning depletion for each substock in relation to management targets.

Exploitation status
The current (2005) reproductive output of the cabezon resource off California is estimated to be about 40.1% and 28.3% of the unfished level based on the base models (Table E-4). The NCS, the major fished substock off California, seems healthy at this time, and is just above its target level (Fig. E-9). The status of the SCS is much more uncertain and sensitive to the exact specifications of the assessment, but its reproductive output is estimated to be more than 25% of the unfished level at present (Fig. E-9).

Management performance
No management regulations existed for cabezon before 1982 when a size limit (12-inches) was set for recreationally caught cabezon off California. This limit was raised to 14-inches in 2000, and extended to include commercially retained fish. It was increased further to 15-inches in 2001. Recreational bag limits have been 10fish/day in California since 2000. Cabezon are currently included in the California recreational regulatory complex Rockfish, Cabezon, and Greenlings (the RCG complex) and subject to seasonal closures for recreational fishers. Oregon imposed a 16-inch commercial size limit and a 15-inch recreational size limit for cabezon in 2001. Oregon has a 10fish/day bag limit for cabezon and greenling combined. California and Oregon are proposing slot limits for cabezon; cabezon must be between 15–22 inches in California and 15–19 inches in Oregon to be retained. There is no size limit in Washington and recreational fishers are limited to 15 bottom-type fishes daily.

Historically, commercial landings of cabezon were monitored as part of a mixed group called “Other Fish”. This group of species includes sharks, skates, rays, grenadiers and other groundfish. This group has been defined historically as groundfish species that do not have directed or economically important fisheries. The coastwise ABC for this entire group of species was 14,700mt during 1999–2002 (5,200mt for the Eureka, Monterey and Conception INPFC areas and 9,500mt for the Columbia and Vancouver INPFC areas). In California, the cabezon fishery is independently monitored and regulated by analyzing two-month cumulative trip limits. In 2004, the season closed on 4 September when the annual commercial allocation of 75,600 pounds was reached before ends year.

Regional Management
The cabezon has thus far been managed on a coastwide basis in California. The results of this two substock assessment provide the scientific basis for cabezon to be managed regionally using the California Department of Fish and Game northern/central and southern California management areas. More work and sampling effort is needed to evaluate whether cabezon in these two areas differ biologically (growth, maturity, etc.), but the results of this assessment indicate that the biomass of cabezon in the southern management area may be smaller than that of conspecifics north of Point Conception. Regional management is an important consideration in relatively sedentary nearshore reef species such as cabezon and future assessments should continue to provide scientific analyses on increasingly finer spatial scales.

Forecasts
Twelve-year yield forward projections are conducted for each substock under two alternative ABC control rules (based on F_{MSY} proxies of $F_{45\%}$ and $F_{50\%}$) and two OY

threshold control rules (40-10 or 60-20). The standard PFMC OY control rule for groundfish such as cabezon is based on $F_{45\%}$ with a 40-10 adjustment for stocks below the target level of 40% of the unfished reproductive output. The California Nearshore Fishery Management Plan proposes the use of a F_{MSY} proxy of $F_{50\%}$ and a 60-20 adjustment for stocks below 60% of the unfished reproductive output. The relative proportion of the six fleets in future harvests is assumed to be the same as the last year (2004) in the model. Results of the projections are given in Table E-5.

Table E-5. Summary of forecast outputs for the A) NCS and B) SCS.

A) NCS

	40-10/$F_{45\%}$					60-20/$F_{50\%}$				
Year	OY	ABC	SB_{2+}	SB	Depletion	OY	ABC	SB_{2+}	SB	Depletion
2005	59	107	727	440	40%	59	90	727	440	40%
2006	59	90	684	393	35%	59	78	684	393	35%
2007	84	81	655	360	32%	44	71	655	360	32%
2008	76	78	655	327	29%	43	70	691	351	32%
2009	77	81	684	321	29%	48	73	746	363	33%
2010	84	86	721	335	30%	58	78	805	390	35%
2011	91	92	755	354	32%	68	83	857	420	38%
2012	97	96	782	370	33%	77	88	900	445	40%
2013	102	100	803	383	34%	84	91	934	465	42%
2014	105	103	821	392	35%	89	95	960	481	43%
2015	108	105	834	400	36%	93	97	981	494	44%
2016	110	107	845	406	37%	96	100	997	503	45%

B) SCS

	40-10/$F_{45\%}$					60-20/$F_{50\%}$				
Year	OY	ABC	SB_{2+}	SB	Depletion	OY	ABC	SB	SB_{2+}	Depletion
2005	10	24	197	72	29%	10	21	197	72	29%
2006	10	27	217	90	36%	10	23	217	90	36%
2007	30	26	226	112	45%	22	23	226	112	45%
2008	29	25	219	111	45%	22	23	227	116	46%
2009	28	25	214	106	43%	21	23	228	115	46%
2010	27	25	211	103	41%	21	23	230	115	46%
2011	27	25	209	101	40%	22	23	232	116	46%
2012	27	25	207	100	40%	22	23	234	117	47%
2013	27	25	206	100	40%	22	24	235	118	47%
2014	26	26	205	99	40%	23	24	237	118	47%
2015	26	26	204	99	39%	23	24	237	119	48%
2016	26	26	204	98	39%	23	24	238	120	48%

Decision table

Projections based on alternative states of nature for each substock were explored to capture uncertainty in population conditions. For the NCS, the low and high *M* scenarios refer to different assumptions about sex-specific natural mortality and were selected to represent the 95% confidence intervals for terminal spawning biomass based on the Hessian approximation. The low scenario assumes M = 0.2yr^{-1} and 0.25 yr^{-1} for females and males respectively, while the high scenario assumes 0.3 yr^{-1} and 0.35 yr^{-1} respectively. For the SCS, the low and high scenarios are based on altering the CV on the mean weight avalue in the year 2000 for the man-made fleet. These states of nature attempt to capture the uncertainty in current depletion based on the uncertainty in the magnitude of the 2000 recruitment. Results from each of the states of nature are given in Table E-2.

Decision analysis population projections are provided in Table E6 for each state of nature and several state-dependent future catch series. The NCS will drop below the overfished threshhold if catch levels are based on the 40-10 rule and the high *M* scenario, but the true state of nature is either the base case or low *M* scenario. This also occurs if catches are based on the base case model but the low *M* state of nature is correct. All other scenarios lead to depletion levels above 25% in 2016. Under the 60-20 rule, only the high *M* catch with a low *M* true state of nature leads to a depletion level in 2016 below 25%. In the SCS, all combinations of catch and true state of nature under either control rule lead to a depletion level in 2016 larger than 25%.

Table E-6. Decision analysis of different states of nature under different catch histories and fishery control rules for each cabezon substock.

NCS 40-10/$F_{45\%}$

			State of Nature					
			Low M (F= 0.2/M=0.25) p = 0.18		Base Case M (F=0.25/M=0.3) p = 0.58		High M (F=0.3/M=0.35) p = 0.24	
	Year	OY	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low M model	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	40	256	24%	360	32%	523	40%
	2008	40	249	23%	353	32%	515	40%
	2009	43	255	24%	366	33%	536	41%
	2010	49	273	26%	396	36%	583	45%
	2011	55	293	28%	431	39%	637	49%
	2012	60	312	29%	464	42%	687	53%
	2013	65	328	31%	493	44%	731	56%
	2014	68	342	32%	518	47%	769	59%
	2015	72	354	33%	540	49%	802	62%
	2016	74	364	34%	559	50%	829	64%
Catch based on Base Case	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	84	256	24%	360	32%	523	40%
	2008	76	222	21%	327	29%	490	38%
	2009	77	207	19%	321	29%	493	38%
	2010	84	206	19%	335	30%	526	41%
	2011	91	208	20%	354	32%	567	44%
	2012	97	207	19%	370	33%	603	47%
	2013	102	202	19%	383	34%	634	49%
	2014	105	194	18%	392	35%	660	51%
	2015	108	184	17%	400	36%	683	53%
	2016	110	173	16%	406	37%	702	54%
Catch based on High M Catch	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	157	256	24%	360	32%	523	40%
	2008	136	176	17%	283	25%	447	35%
	2009	134	129	12%	246	22%	422	33%
	2010	142	101	9%	235	21%	433	33%
	2011	151	75	7%	229	21%	452	35%
	2012	157	42	4%	218	20%	466	36%
	2013	161	5	1%	202	18%	475	37%
	2014	164	8	1%	184	17%	481	37%
	2015	166	0	0%	164	15%	486	37%
	2016	168	0	0%	144	13%	490	38%

Table E-6. Continued.

NCS 60-20/$F_{50\%}$

		OY	State of Nature					
		Commerical	Low M (F= 0.2/M=0.25) p = 0.18		Base Case M (F=0.25/M=0.3) p = 0.58		High M (F=0.3/M=0.35) p = 0.24	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low M model	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	44	256	24%	360	32%	523	40%
	2008	44	247	23%	351	32%	513	40%
	2009	46	251	24%	362	33%	532	41%
	2010	50	267	25%	391	35%	578	45%
	2011	53	287	27%	425	38%	632	49%
	2012	57	306	29%	459	41%	684	53%
	2013	60	325	30%	490	44%	730	56%
	2014	63	341	32%	519	47%	770	59%
	2015	65	356	33%	544	49%	806	62%
	2016	67	370	35%	566	51%	836	65%
Catch based on Base Case	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	44	256	24%	360	32%	523	40%
	2008	43	247	23%	351	32%	513	40%
	2009	48	251	24%	363	33%	533	41%
	2010	58	266	25%	390	35%	578	45%
	2011	68	281	26%	420	38%	627	48%
	2012	77	292	27%	445	40%	670	52%
	2013	84	298	28%	465	42%	706	55%
	2014	89	301	28%	481	43%	736	57%
	2015	93	301	28%	494	44%	760	59%
	2016	96	299	28%	503	45%	780	60%
Catch based on High M Catch	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	101	256	24%	360	32%	523	40%
	2008	89	212	20%	317	29%	480	37%
	2009	92	190	18%	304	27%	478	37%
	2010	105	181	17%	311	28%	505	39%
	2011	119	172	16%	320	29%	536	41%
	2012	129	155	15%	322	29%	560	43%
	2013	136	132	12%	319	29%	577	45%
	2014	141	105	10%	313	28%	590	46%
	2015	144	75	7%	304	27%	599	46%
	2016	147	44	4%	294	26%	606	47%

SCS 40-10/$F_{45\%}$

		OY	State of Nature					
		Commerical	Low ($Depletion_{2005}$=0.2) p = 0.16		Base Case p = 0.58		High ($Depletion_{2005}$=0.35) p = 0.26	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low model	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	20	78	31%	112	45%	132	52%
	2008	20	80	32%	117	47%	137	54%
	2009	20	79	32%	117	47%	136	54%
	2010	21	81	33%	118	47%	136	54%
	2011	22	83	34%	119	47%	135	54%
	2012	23	86	35%	119	48%	135	54%
	2013	23	88	36%	120	48%	134	53%
	2014	24	89	36%	120	48%	134	53%
	2015	24	90	37%	120	48%	132	52%
	2016	24	92	37%	120	48%	131	52%
Catch based on Base Case	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	30	78	31%	112	45%	132	52%
	2008	29	74	30%	111	45%	131	52%
	2009	28	69	28%	106	43%	125	50%
	2010	27	67	27%	103	41%	121	48%
	2011	27	66	27%	101	40%	118	47%
	2012	27	66	27%	100	40%	116	46%
	2013	27	66	27%	100	40%	114	45%
	2014	26	67	27%	99	40%	113	45%
	2015	26	67	27%	99	39%	112	44%
	2016	26	67	27%	98	39%	111	44%
Catch based on High Catch	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	34	78	31%	112	45%	132	52%
	2008	32	73	29%	110	44%	129	51%
	2009	31	67	27%	104	42%	121	48%
	2010	30	64	26%	101	40%	115	46%
	2011	29	64	26%	99	40%	112	44%
	2012	28	64	26%	98	39%	109	43%
	2013	28	64	26%	97	39%	107	42%
	2014	28	64	26%	97	39%	105	42%
	2015	27	65	26%	97	39%	104	41%
	2016	27	65	26%	96	39%	103	41%

Table E-6. Continued.

SCS 60-20/$F_{50\%}$

		OY	State of Nature					
			Low ($Depletion_{2005}$=0.2)		Base Case (F=0.25/M=0.3)		High (Depletion2005=0.2)	
		Commerical	p = 0.16		p = 0.58		p = 0.26	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	10	78	31%	112	45%	132	52%
	2008	12	85	34%	123	49%	142	56%
	2009	14	89	36%	127	51%	146	58%
Catch based on	2010	15	93	38%	130	52%	148	59%
Low model	2011	17	98	40%	134	53%	151	60%
	2012	18	103	42%	136	55%	152	60%
	2013	19	106	43%	138	55%	153	60%
	2014	20	109	44%	139	56%	152	60%
	2015	21	112	45%	140	56%	152	60%
	2016	21	113	46%	140	56%	151	60%
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	22	78	31%	112	45%	132	52%
	2008	22	79	32%	116	46%	136	54%
	2009	21	77	31%	115	46%	134	53%
Catch based on	2010	21	78	32%	115	46%	133	53%
Base Case	2011	22	80	33%	116	46%	132	52%
	2012	22	83	34%	117	47%	132	52%
	2013	22	85	35%	118	47%	132	52%
	2014	23	87	35%	118	47%	132	52%
	2015	23	89	36%	119	48%	132	52%
	2016	23	91	37%	120	48%	131	52%
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	27	78	31%	112	45%	132	52%
	2008	26	76	31%	116	46%	133	53%
	2009	25	72	29%	115	46%	128	51%
Catch based on	2010	24	71	29%	115	46%	125	50%
High Catch	2011	24	72	29%	116	46%	124	49%
	2012	24	74	30%	117	47%	123	49%
	2013	24	75	31%	118	47%	123	49%
	2014	23	77	31%	118	47%	123	49%
	2015	23	79	32%	119	48%	123	49%
	2016	23	80	33%	120	48%	122	49%

Research Recommendations

1. Accurate accounting of removals, especially from the recreational and live-fish fisheries: Fisheries primarily exploited by recreational and live-fish commercial fisheries are traditionally hard to monitor. More effort to monitor these fishery sectors may be necessary to accurately monitor fishing mortality.

2. A fishery-independent survey of cabezon population abundance: The current fishery-independent survey being developed in the Morro Bay area will become an important input into future assessments of cabezon. Expansion of this survey will increase its usefulness as an index of abundance for central and northern California.

3. A study of the stock structure of cabezon: This assessment assumes two substocks of cabezon along the California coast. Current work on cabezon stock structure should be included in the next assessment.

4. Age validation/ age determination: Catch age-composition data were not available for this assessment. Accurate ageing is crucial to understand the population dynamics of a species, especially those for which there is limited survey information. Information on the age-structure of the catches for each fishery sector would substantially improve some aspects of the assessment.

5. A better understanding of the relationship between CPUE and population size: Changes in recreational CPUE indices are assumed to reflect changes in population size in a linearly proportional manner. The results of the assessment would be severely in error if this assumption were substantially violated. Therefore, if future assessments depend on CPUE data, it is vital that the relationship between CPUE and population size be quantified.

6. Alternative assessment procedures: The need for greater spatial resolution in the management of nearshore fisheries also increases the amount of data required to perform traditional stock assessments. Alternative assessment procedures that are less data-hungry, but still provide relevant management outputs should be developed to address this need. In addition, the nest-guarding behavior of males gives new values to males in the cabezon population. Another metric other than spawning biomass may be needed to help account for the male portion of the population in reference points.

7. Effect of climate on cabezon: Several of the data sources in this assessment (*e.g.* the power-plant impingement and CalCOFI indices, and some length-composition data) indicate that there was potentially good recruitment after 1999 (and before 1977 for the impingement data) whereas these same sources indicate that recruitment was very poor prior to 1999 in the SCS. Cabezon may be influenced by climatic/oceanic regimes. A better understanding of the relationship between cabezon population dynamics and climate would reduce the uncertainty of future assessments.

8. Sex-specific data: Given the strong correlation of color to gender in cabezon (O'Connell 1953; Lauth 1987; Grebel 2003), collection of sex-specific information (at least recording fish color) would greatly enhance future assessments.

Purpose

This is the second assessment of the population status of cabezon (*Scorpaenichthys marmoratus* [Ayres]) along the California coast (Figure 1). Although commercial removals of cabezon have increased off Oregon in recent years because of the live-fish fishery (ODF&W 2002), and substantial recreational catches of cabezon occur in both Oregon and Washington waters (Cope *et al*. 2004), the available data sources remain insufficient to form the basis for a reliable assessment of cabezon in those areas. The current assessment is intended to provide information that will be of use by managers at both the state and federal levels. This document follows, to the extent possible given the available information, the Terms of Reference for stock assessments established by the PFMC Scientific and Statistical Committee.

Two objectives are addressed in this document. First, the life history of cabezon is described and all the available data sources that were considered for use in the assessment are explained. This document only provides detailed information for those data sources that were considered for use in the population modeling. Many other sources of information were considered, but ultimately rejected, and are not included in this document for brevity. Second, the document describes the results of the use of a new stock assessment technique (Stock Synthesis 2 [SS2], Methot 2005), and summarizes how the results from SS2 relate to those based on the assessment technique used for the 2003 assessment (the OC model). Unlike the 2003 assessment, increased attention is given to the spatial structure of the data for cabezon off California, with the consequence that the analyses of this document are based on two putative populations ("substocks") separated at Point Conception, CA.

This assessment differs from those performed for most other west coast groundfish species because there is no fishery-independent index of abundance that covers the range of the stock. It consequently relies on indices of abundance based on recreational CPUE and spatially-restricted fishery-independent data, and information about larval and recruit abundance. Although no state- or federally-funded biomass indices are currently available for this species, these alternative data sources are considered to be adequate for estimating the values of the parameters of a population dynamics model. Much uncertainty remains in regard to the assumption that changes in recreational CPUE are linearly proportional to changes in population size. There is no information on the age-structure of the catches. Therefore, although the model is age-structured, it is fit to mean weights and length-composition data by converting the model-predicted catch age-compositions to catch size-compositions using growth curves and weight-length relationships.

Acronyms used in this document:

ABC – Allowable Biological Catch
AIC – Akaike Information Criterion
CalCOFI - California Cooperative Oceanic Fisheries Investigation
CalCOM - California Commercial Cooperative Groundfish Program
CDF&G – California Department of Fish and Game
CPFV – Commercial Passenger Fishing Vessel
CPUE – Catch per unit of effort
CRFS – California Recreational Fisheries Survey
CV – Coefficient of variation
EEZ – Economic Exclusive Zone
FMP – Groundfish Fishery Management Plan
GLM – Generalized Linear Model
IRI – Index of Relative Importance
MODE – Fishing Method (shore, private boat, charter boat)
MPD – Maximum of the posterior density function
MRFSS - Marine Recreational Fisheries Statistics Survey
NCS – Northern California Substock
NFMP – Nearshore Fishery Management Plan
NWFSC – Northwest Fisheries Science Center
OC – Original Cabezon model used in the 2004 assessment
PBR – Private Boat and Rental
PFEL – Pacific Fisheries Environmental Laboratory
PFMC – Pacific Fishery Management Council
PSFMC – Pacific States Marine Fisheries Commission
RecFIN – Recreational Fisheries Information Network
SCS – Southern California Substock
SS2 – Stock Synthesis 2
SWFSC – Southwest Fishery Science Center
WAVE – Bi-Monthly period of catches
OY- Optimum Yield

Introduction

The cabezon (*Scorpaenichthys marmoratus*) is the largest member of the family Cottidae (commonly referred to as sculpins) found in the waters along the Northeast Pacific. Cabezon are desired by both commercial and recreational fishers because of their great size, physical attractiveness, and tasty flesh. Current knowledge of cabezon life history is sparse, and is usually based on information collected from a limited extent of the range of the species. The population status of cabezon in California waters was assessed in 2003, and the spawning output was estimated to be less than 40% of the unfished spawning output, but there was considerable uncertainty (Cope *et al*. 2004). Cabezon are currently managed as part of a nearshore complex of fishes that include several species of rockfishes and greenlings.

This is the second quantitative assessment of the population status of cabezon. In an attempt to enhance the spatial resolution of the assessment, it is based on two putative populations ("substocks") of cabezon in California, delineated at Point Conception, CA (Figure 1). Available data for the Oregon and Washington remain insufficient to form the basis for a reliable stock assessment for cabezon in these areas.

Stock Structure

There is little direct information on the stock structure of cabezon off the U.S. west coast. The genetic structure of cabezon is being investigated at California Polytechnic State University at San Luis Obispo, but no results are presently available (Dr. Royden Nakamura, pers. comm.).

The need for more spatial resolution in the assessment of cabezon was identified by the STAR panel that reviewed the past assessment. Distinct fishing histories, the distribution of fishing effort north and south of Point Conception, and the ecology of nearshore fishes, also indicate the need for a more spatially-resolved cabezon assessment. Specifically, the live-fish fishery for cabezon is active primarily north from the Morro Bay while, historically, the recreational take of cabezon has been greatest in central California, with the removals off southern Californian being fairly low. Cabezon are a cooler-water species, and are more abundant in the central and northern Californian nearshore areas. Typical of nearshore reef fishes, cabezon subpopulations are often spatially discrete, and therefore susceptible to serial depletion, which suggests the need to examine population trends at small spatial scales. The extent to which assessments can be conducted at small spatial scales is, however, limited. Nevertheless, it is possible to treat the cabezon resource off California as two populations (or "substocks"; the Northern California Substock (NCS) and the Southern California Substock (SCS)) with a division at Point Conception (Figure 1). This assessment accordingly reflects California-specific management needs by separating the central and northern management areas from the southern management area (Figure 1). One could also argue for an additional division north of Punta Gorda (the CDF&G Northern California Region) because of its unique fishing history, but there are currently insufficient data to support such a division. This assessment also explores the implications of assessing the entire cabezon resource off California as a single homogeneous resource to determine some of the impacts of allowing for spatial resolution.

Life History

Distribution
Cabezon is distributed along the entire west coast of the continental United States. It ranges from central Baja California north to Sitka, Alaska (Quast 1968; Miller and Lea 1972; Love *et al*. 1996). Cabezon are primarily a nearshore species found intertidally and among jetty rocks, out to depths of greater than 100 m (Miller and Lea 1972; Love *et al*. 1996). The majority of the commercial and recreational catch is taken inside of 15–20fm (and approximately 99% within 30fm; Feder *et al.* 1974) and along the central California coast up through Oregon.

Species Associations
Cabezon is a member of a nearshore assemblage of fishes that includes several *Sebastes* species (*e.g. S. atrovirens, S. auriculatus, S. carnarus, S. caurinus, S. chrysomelas, S. dallii, S. maliger, S. melanops, S. mystinus, S. nebulosus*, *S. rastrelliger, S. serranoides,* and *S. serriceps*), kelp (*Hexagrammos decagrammus*) and rock greenling (*H. lagocephlaus*), monkeyface prickleback (*Cebidichthys violaceus)*), California scorpionfish (*Scorpaena guttata*), and California sheephead (*Semicossyphus pulcher*). These 19 fishes are included in California's Nearshore Fishery Management Plan (CDF&G 2002), an FMP required by mandate of the 1999 Marine Life Management Act. At present, only cabezon, California sheephead (Alonzo *et al*. 2004), and black rockfish (Ralston and Dick 2003) have been assessed, although gopher rockfish, kelp greenling, and California scorpionfish are scheduled to be assessed during 2005.

Spawning and Early Life History
Cabezon are known to spawn in recesses of natural and manmade objects, and males are reported to show nest-guarding behavior (Garrison and Miller 1982). Spawning is protracted, and there appears to be a seasonal progression of spawning that begins off California in winter and proceeds northward to Washington by spring. Spawning off California peaks in January and February (O'Connell 1953) while spawning in Puget Sound (Washington State) occurs for up to 10 months (November-August), peaking in March–April (Lauth 1987). Laid eggs are sticky and adhere to the surface where deposited. After hatching, the young of the year spend 3–4 months as pelagic larvae and juveniles. Settlement takes place after the young fish have attained 3–5 cm in length (O'Connell; 1953; Lauth 1987). It is apparent that females lay multiple batches in different nests, but whether these eggs are temporally distinct enough to qualify for separate spawning events is not understood (O'Connell 1953; Lauth 1987).

The number of eggs spawned appears to increase with fish size (weight or length) (O'Connell 1953; Lauth 1988). However, the actual relationship between age / size and number of eggs spawned is uncertain because of the possibility of multiple spawnings. Therefore, rather than attempting to determine this relationship, the reproductive output has, for the purposes of this assessment, been defined to be proportional to the product of maturity-at-age and body weight at the start of the year. Maturity ogives (Figure 2; Table 1) were estimated using the California Department of Fish and Game (CDF&G) visual inspection codes and the data used by Grebel (2003). Females with gonads with early yolk stage eggs were assumed to be mature, although it is possible that some of these fish were maturing, but not yet mature. This will lead to a more optimistic interpretation of the rate at which cabezon mature (younger and at smaller size).

Age and Size relationships

Cabezon are among the largest of the cottids, attaining a length of nearly 1m and a weight in excess of 11 kg (Feder *et al.* 1974). Female cabezon are larger than males of the same age (Figure 3A). O'Connell (1953) provided the first estimates of cabezon age and growth using whole otoliths from specimens from central and southern California. Lauth (1987) provided another estimate of cabezon growth from the Puget Sound (WA) using several ageing structures (whole otoliths, sectioned fin rays). Finally, Grebel (2003) conducted a comprehensive study (almost 700 individuals collected over 6 years) on age and growth of cabezon from California using several age structures (sectioned otoliths, pectoral fin rays, dorsal fin rays, dorsal spines, and vertebrae). Her results using a thin-section of the saggital otolith form the basis for a growth curve for cabezon in this assessment. Ages from Grebel (2003) were all standardized to a 1 January birthdate to avoid bias caused by rapid growth during the first years of life, and von Bertalanffy growth curves were fitted to the resulting age-length data (Table 1). Partial "validation" of this growth curve was achieved by estimating the values for L_∞ and k from tag-recapture data (K. Karpov, CDF&G, pers. comm.) and setting t_0 so as to minimize the sums of squares of size-at-age for the combined sexes and the tag-recapture estimates. The ageing- and tagging-based growth curves do not appear to be in conflict (Figure 3B). Because Grebel (2003) found no biologically significant differences between the age-at-length relationships among regions (northern, central, and southern) in California, her sex-specific results are used for both substocks in this assessment. The growth curves obtained by Grebel (2003) differed statistically from that of O'Connell's (1953), who had much larger individuals in his samples. Whether these differences in estimated age-length relationships derive from an ageing disparity between whole and sectioned otoliths, or they represent real differences caused by changes in the population structure (possibly due to fishing) is purely speculative at present, and is therefore not considered further in this assessment.

Weight-length relationships for cabezon are provided in O'Connell (1953; central California), Lauth (1987; Puget Sound, WA), and Lea *et al.* (1999; central California) for both sexes combined. Lea *et al.* (1999) also provide relationships for females and males separately, but for central California only. Raw length-weight data used in Grebel (2003) provide substock- and sex-specific length-weight information with larger sample sizes than the earlier studies, and these data are used for the present assessment (length in cm and weight in kg; Table 1). Sampling effort covered the years 1993–2002 for the NCS, and 2002 for the SCS.

Natural Mortality (*M*)

Little is known about the natural mortality rate of cabezon, so empirical methods using life history traits (growth rate (k), age-at-maturity (a_M), maximum age (ω)) were used to estimate natural mortality. The previous assessment used the method of Hoenig (1983) to estimate a common M for both sexes. The STAR panel that reviewed the 2003 assessment suggested that this assessment address sex-specific natural mortality rates because of differential growth between the sexes. Five methods for estimating M (Hoenig 1983; Chen and Watanabe 1989; Jensen 1996) were therefore applied to data for each sex, and the results averaged to obtain sex-specific natural mortality rates (Table 2). The mean of these approaches imply a natural mortality rate of approximately 0.25 yr^{-1} for females and 0.3 yr^{-1} for males, but these methods may produce highly uncertain values of *M* (Pascual and Iribarne 1993). Therefore, sensitivity to the assumed values of *M* is explored when applying the assessment model.

Fisheries History

Historically, the recreational sector has been the main source of cabezon removals. Cabezon have been a very minor component of the catch in commercial fisheries for more than a century (Jordan and Everman 1898). The earliest modern commercial fishery information (O'Connell 1953) indicates that a small amount of cabezon was being sold in fish markets in the San Francisco area by the 1930s with incidental take recorded back to 1916. However, it was not until the 1990s that a truly directed commercial fishery for cabezon was established in the waters of California and Oregon.

The most significant change in the fishery for cabezon has been the development of the live-fish/premium commercial fishery that, in addition to cabezon, targets several other nearshore fishes (CDF&G 2002). This fishery started in southern California in the late 1980s and spread northward during the late 1990s to Oregon (Starr *et al.* 2002). Fishermen routinely obtain much higher prices for fish brought back to markets alive. Cabezon are not subject to barotrauma because they lack a swim bladder and are usually found in shallow nearshore waters accessible to many fishers. These traits make cabezon an ideal target for both the live-fish and recreational fisheries. Gears that take cabezon include hook and line and pot/trap type gears, as they are successful at bringing up fish with relatively little damage. Cabezon continues to be an important component of the live-fish fishery, even with increased restrictions on the live-fish catch, especially as the allowable catches of other marketable groundfish species have been reduced.

Fisheries Management

The Pacific Fishery Management Council (PFMC) and NOAA Fisheries have management responsibility for the groundfish species included in the Groundfish Fishery Management Plan (FMP) out to the boundary of the 200-mile Exclusive Economic Zone (EEZ). Many nearshore species, such as cabezon, that fall primarily within the 3-mile limit of states' waters are also included in state-specific Nearshore Fishery Management Plans (NFMP). NFMPs are currently being developed and implemented in California and Oregon in response to the increased commercial take of the live-fish fishery (CDF&G 2002)

No management regulations existed for cabezon before 1982 when a size limit (12-inches) was set for recreationally caught cabezon off California (see Appendix A for a complete list of California regulations). This limit was raised to 14-inches in 2000, and extended to include commercially retained fish. It was increased further to 15-inches in 2001. Recreational bag limits have been 10fish/day in California since 2000. Cabezon are currently included in the California recreational regulatory complex Rockfish, Cabezon, and Greenlings (the RCG complex) and subject to seasonal closures for recreational fishers. Oregon imposed a 16-inch commercial size limit and a 15-inch recreational size limit for cabezon in 2001. Oregon has a 10fish/day bag limit for cabezon and greenling combined. California and Oregon are proposing slot limits for cabezon; cabezon must be between 15–22 inches in California and 15–19 inches in Oregon to be retained. There is no size limit in Washington and recreational fishers are limited to 15 bottom-type fishes daily.

Historically, commercial landings of cabezon were monitored as part of a mixed group called “Other Fish”. This group of species includes sharks, skates, rays, grenadiers and other groundfish. This group has been defined historically as groundfish species that do not have directed or economically important fisheries. The coastwise ABC for this entire group of species was 14,700mt during 1999–2002 (5,200mt for the Eureka, Monterey and Conception INPFC areas and 9,500mt for the Columbia and Vancouver INPFC areas). In California, the cabezon fishery is independently monitored and regulated by analyzing two-month cumulative trip limits. In 2004, the season closed on 4 September when the annual commercial allocation of 75,600 pounds was reached before ends year.

Assessment Data Sources

Data for species managed by NOAA Fisheries and the Pacific Fishery Management Council are collected by both federal (and/or quasi-federal) and state agencies. This can complicate analysis because several agencies may collect the same types of data. Where this occurs, the analyses below are based on those data that are most likely to be informative regarding changes in population size.

Removals
Whenever possible, removals are characterized as landed catch plus fish released and presumed dead. Historical catches (prior to 1980) are reconstructed from historical documents, and reported and inferred relationships among fishing sectors. This is a change from the approach of inferring historical catches from state reports or backward projections of more recent catches as was done for the 2003 assessment.

Recreational Fishing History in California
Recreational fishing in California became popular in the late 1890s, but was limited to mostly big game fishes (tuna, marlin, and swordfish) and wealthy participants (Holder 1914). There remained in California limited recreational fishing opportunities to most people before 1920. Private boat access to nearshore fishes increased after 1920 (Croaker 1939), but it was not until Commercial Passenger Fishing Vessels (CPFVs) began operating in earnest off southern California in 1928 that the general public gained extensive accessibility to many nearshore fishes (Scofield 1928; Young 1969). Both barges – large, flat, open-spaced ships – and more traditional CPFV boats comprised the fleet. There were 15 barges and 20–30 boats off southern California in 1928 (Scofield 1928). The period 1929–39 saw a rapid increase in the popularity of CPFVs (Fig. 4; Croaker 1939), which also spread northward to central and northern California. By 1932, sportfishing in Monterey was very popular, with cabezon a major target species (Classic 1932). Pier and shore fishing modes also provided major recreational fishing outlets during this time of increased CPFV activity (Scofield 1928; Croaker 1938; Baxter & Young 1953; Young 1969). In all modes, most fishing occurred during the summer and autumn months, with some fishing extending into spring (Fry 1932; Baxter & Young 1953). CPFV captains have been required to submit logbooks detailing catches since 1936 (Croaker 1939; Baxter & Young 1953;

Young 1969), although compliance rates were and are not 100%. In 1937, the sportfishing catch exceeded the commercial catch for many species (Conner 1937).

The popularity of CPFV fishing continued to increase until the war years of 1942–46 when CPFV activity was considerably reduced (Fig. 4; Calhoun 1950). The CPFV fleet underwent a period of rapid re-establishment, reinvention, and growth after 1946 (Young 1969). Fleets, boat size, and passenger interest all increased throughout California. This expansion continued into the 1970s with the fleet peaking in 1973 (Baxter & Young 1953; Young 1969; Hill & Schneider 1999). A concomitant increase in private boat, shorefishing, and pier/jetty modes also occurred during this time, particularly in central California (especially in Monterey and Morro Bay), where cabezon are well represented, during the 1950s (Baxter & Young 1953).

Reconstructing Recreational Removals

This assessment uses a reconstructed catch history back to 1916 for both cabezon substocks. This initial year was selected because of the availability of commercial catches back to 1916 (see *Reconstructing Commercial Removals* below). Four recreational fishing modes are distinguished: 1) Man-made (piers/jetties), 2) Shore (beach/bank), 3) Private Boat and Rental (PBR), and 4) CPFV. These modes were distinguished for analysis and modeling purposes because of differences in selectivities and the length-frequency of the catch: the man-made and shore modes generally catch smaller individuals than the PBR and CPFV modes. Most cabezon are taken from jetties in the man-made mode (Pinkas *et al.* 1967). There was almost certainly very little recreational catch before 1916 so the fishing mortalities before 1916 for the four recreational modes are set to zero when conducting the assessment.

Information on the activities of recreational fishermen is collected by both state (CDF&G) and federal (MRFSS) programs. Since 1980 (excluding the years 1990–92), the MRFSS program (available via the RecFIN database: **http://www.psmfc.org/recfin/**) provides effort information from a random-digit dialing protocol and catch/trip information from intercept interviews. These data can be used to calculate total catches by mode. In 2004, the CDF&G, in cooperation with the PSFMC, started the California Recreational Fisheries Survey (CRFS) program to replace the MRFSS sampling program in California for all modes. This program aims to increase sampling effort for better catch and effort estimation, to increase spatial resolution of catches, and to identify targeted species. Before the CRFS was implemented, CDF&G only collected logbook catches from the CPFV fishery. Very few estimates of the removals by the man-made, shore, and PBR modes are available for the years before 1980. The CPFV fleet therefore provides the longest time-series of measured catches (1936-present) and is used to reconstruct the removals by the other three modes for the years prior to 1980.

Total recreational removals for each cabezon substock for each recreational mode were reconstructed in three steps: 1) the historical CPFV removals (in numbers) were reconstructed, 2) the CPFV removals were used to estimate the removals (in numbers) by the other three modes, and 3) the average weights per mode were used to estimate total removals in kg.

<u>1. Historical CPFV removals</u>

The historical CPFV catch (1916–2004) was reconstructed as follows:

- **Year 2004**: CRFS database, extracted 17 February, 2005.
- **Years 1957–78; 1980–2003**: Hill and Schneider (1999) performed a data recovery exercise to extract catch, effort, block (CDF&G designated 10 x 10 nautical mile statistical areas), and month information from the California CPFV logbooks. This information provides area-specific catches (in numbers) for each cabezon substock for 1957–2003, excluding 1979 (the data for this year are lost). This data set was obtained on 24 January, 2005.
- **Year 1979:** Oliphant *et al.* (1990) report the total catch of cabezon by the CPFV fleet for 1979. This total is allocated to substock using the geometric mean of the ratio $Catch_{NCS}$:$Catch_{SCS}$ for 1976–78 and 1980–82.
- **Years 1936–40; 1947–56**: Hill and Schneider (1999) provide CPFV catches for the SCS only. The total California CPFV catches for these years are found in Best (1963). The difference between total California catches and the catches from the SCS give the catches from the NCS.
- **Years 1941–46:** O'Connell (1953) provides the catch by the CPFV fleet in 1946 for each substock. No data are available for 1941–45; the catches during these years have been assumed equal to that for 1946.
- **Years 1928(SCS)/1929(NCS)–1935:** No data on catches are available for these years. Scofield (1928) identified the major start of the CPFV fleet in southern California to be 1928, which then moved into central and northern California in 1929 (Young 1929). These start years reflect the beginning of the CPFV time-series for the SCS and NCS, respectively. A linear increase in catch from the start year through 1935 is assumed because the CPFV fleet is known to have increased rapidly during these years (Fry 1932; Young 1969),
- **Years 1916–27(SCS)/–1928(NCS):** The catches by the CPFV fleet were assumed to be zero for these years.

Heimann & Miller (1970) reported that cabezon are rarely discarded in the CPFV fishery because of their large size and trophy status. Furthermore, discarded cabezon have a higher probability of survival because they are not affected by barotraumas. Even though a size limit has been imposed in recent years (see Appendix A), the analyses of this document assume that there is no discard mortality by the recreational sector. The reconstructed raw CPFV catches are shown in Fig. 5.

It was recognized early in the CPFV reporting process (Croaker 1938; Baxter & Young 1953) that logbook records may be inaccurate for two main reasons: 1) mis-reporting of catches (either over- or under-reporting; Karpov *et al.* 1995), and 2) less than 100% reporting compliance rates (Hill & Barnes 1998). Baxter & Young (1953) investigated these inaccuracies in CPFV catch and concluded that cabezon catch rates reported by the CPFV fleet are accurate and reliable. Reported CPFV removals are therefore not adjusted for mis-reporting. Since 1936, compliance rates have always been less than 100% though, and necessitate the adjustment of raw CPFV removals. Compliance rates (as reported from several sources) are provided in Table 3 and were assumed to be the same for the NCS and the SCS fleets. The reported compliance rates were then used to interpolate compliance rates for the years for which rates were not available, and CPFV removals in numbers were expanded to correct for lack of reporting compliance (Fig. 6). There are no compliance rates for the period 1962–1980. Values used for these years were semi-arbitrarily set to account for the expanding fleet during the 1960s and 1970s.

2. Estimating removals for the man-made, shore, and PBR modes via CPFV ratios

Removals (in numbers) for the other three recreational modes (man-made, shore, and PBR) were determined in two ways: 1) based on surveys of the modes, and 2) based on an estimate of the ratio of the catch by the mode to the catch by the CPFV mode multiplied by the catch by the CPFV mode. Surveys are available for only a small numbers of years:

a) the RecFIN database contains estimates of removals for the years 1980–89 and 1993–2004 (2004 via CRFS). This data was extracted 17 February, 2005.
b) Miller & Gotshall (1965) provide estimates of NCS removals for the period 1957–61.

The ratios of the CPFV catches to the catches by the other modes from RecFin were used to estimate removals when data were missing for the years 1980–2004 (Tables 4 & 5). The work of Miller & Gotshall (1965) and Pinkas *et al.* (1968) provide ratios for the years of their study (Tables 4 & 5). These ratios were used to make inferences about the ratios for the years for which no data are available. The PBR fishery was assumed to start in the same year as the CPFV fishery. The man-made and shore modes began before the CPFV fishery, so the estimated catch in these modes for the years before the CPFV fishery began were projected back to 1916.

3. Calculating removals in kg

The average annual weight of the removals (in kg) for each mode are given in Tables 4 and 5 for the NCS and SCS respectively, with shaded values indicating reported weights. The reported weights for 1980–2004 are taken from RecFIN. The reported weights for the NCS for the years before 1980 are: 1) 1947–51: Baxter & Young (1953) and 2) 1957–61: Miller and Gotshall (1965), while the reported values for the SCS for 1964–66 taken from Pinkas *et al.* (1968). The weights for all remaining years are assumed values, based on these sources, averaged RecFIN weights, or a mid-point of the two (Table 4 & 5). The weights for the PBR mode for the years prior to 1980 are set to those for the CPFV mode because these fisheries catch similar sized fish. The removals in the NCS by mode are heaver on average than those in the SCS. Removals (in kg) were calculated by multiplying numbers by average weights. The total removals (in kg) by the recreational sector by mode are shown in Figure 7 and by sub-stock in Figure 8A. Figure 8B compares the total recreational removals (in kg) between the current and the 2003 assessment. Despite the complete reconstruction of the removals by the recreational sector, the two series of catches are not notably different. Removals in weight were converted to metric tons before being included in the assessment model.

Sensitivities to assumed pre-1980 removals

The removals are considered known without error in the assessment, but the above reconstruction is subject to considerable uncertainty. Two types of sensitivity tests are considered to examine the implications of this uncertainty: 1) using numbers instead of biomass for the recreational removals, and 2) doubling and halving the pre-1980 removals.

Recreational catch in 1980

The 2003 assessment and subsequent STAR panel identified the extraordinarily high recreational removal for 1980 as an area for further investigation. Figure 7 reveals that the high 1980 removal is attributed primarily to the catch by the PBR mode from the SCS. Further investigation reveals that RecFIN waves (*i.e.* bi-monthly totals) 1, 2, 3, and 5 have notably higher removals (in kg) in 1980 than during 1982–89 (Figure 9, upper panel), but that average wave weights are not markedly different among years (Figure 9, lower panel).

Commercial Catches

Several sources of California commercial landings are available to reconstruct commercial cabezon landings by substock back to 1916 (the first year of required reporting in the commercial fishery):

- **Years 1978–2004**: The CalCOM database provides annual landings (in pounds) by gear. Data was extracted on 19 April, 2005.
- **Years 1930–77**: The Pacific Fisheries Environmental Laboratory (PFEL) live access server (http://las.pfeg.noaa.gov:8080/las_fish1/servlets/dataset) and the California Explores the Ocean (http://ceo.ucsd.edu/fishcatchtables/fish-catch-download.html) website provide electronic summaries of CDF&G fish ticket receipts originally reported in the Fish Bulletin series (available electronically at: http://ceo.ucsd.edu/fishbull/). These sources were compared with landings in the Fish Bulletin publications and found not to be different for these years. All landings are reported in pounds. Data was obtained on 8 March, 2005.
- **Years 1916–29:** The publication *California Fish and Game* (vols 1–16) are the original source of landing reports before the Fish Bulletin series and are used for this time period. During 1916–29, cabezon was included in the category "sculpin" which included the California scorpionfish. Given the limited northern range of the scorpionfish (Love *et al.* 1987), 100% of the "sculpin" catch from Monterey north was assumed to be cabezon. Fish Bulletins 74 (CDF&G 1949) and 149 (Heimann and Carlisle 1970) provide summarized commercial cabezon landings for 1916–47 and 1916–69 respectively and were used to cross-compare cabezon catches from the *California Fish and Game* volumes. Both sources provided the same estimates of total cabezon landings.
- **Years 1916–77 adjusted**: The spatial resolution of landings from the CalCOM database is sufficient to separate landings into substocks. All other sources used the port complex "Santa Barbara" which included Morro Bay of the NCS and Santa Barbara of the SCS. Landings in the "Santa Barbara" port complex are therefore allocated to substock using the geometric mean of the ratio of the Morro Bay to Santa Barbara landings for the years 1978–82 from CalCOM (Figure 10).

Finally, total cabezon landings in pounds were converted into metric tons. Two fleets are distinguished for assessment purposes: 1) non-live, and 2) live. Cabezon commercial landings for each substock are given in Table 6. California landings of cabezon were low until the early- to mid-1990s when the live-fish/premium finfish fishery began targeting cabezon (Fig. 11). Commercial cabezon landings reached a peak of over 150mt in 1998 and averaged more than 80mt since the mid-1990's, most of which came from the NCS (Fig. 12A). There is no discernable difference between the commercial landings in the present assessment and those used in the 2003 assessment (Fig. 12B).

Cabezon are caught commercially using a variety of gears-types, but have been taken almost exclusively by hook-and-line and pots recently (Fig. 13). All catches are assumed to be taken using a single gear-type for the purposes of this assessment.

There have also been spatial and temporal patterns in cabezon commercial landings. Historically, much of the landings were reported in the late winter/early spring months, but much of the catch has been taken in the summer and fall months since the start of the live-fish fishery (Fig. 14). Currently, no commercial fishing for cabezon is allowed in March and April. All catch is assumed to be taken in the middle of the year for the purposes of the assessment. Figure 15 shows the port complexes affiliated with commercial cabezon landings. The "Santa Barbara" complex contains both Morro Bay and Santa Barbara, with Morro Bay contributing the most to the recent live-fish fishery catch. All NCS ports report higher commercial landings than either of the SCS ports.

Commercial Discards
Discard mortality is assumed to be negligible for the purposes of this assessment because of the shallow habitat of this fish, its physiology, and its hardiness. The lack of any appreciable cabezon discard in the West Coast Groundfish Observer Program (WCGOP 2005) supports this assumption. Further information regarding discards in the nearshore life-fish fishery is being collected by the West Coast Groundfish Observer Program, but this information was not available for this assessment (J. Cusick, pers. comm.)

Total Removals
Given the nearshore depth-distribution and latitudinal range of cabezon, it is not surprising that the bulk of the historical removals are by the recreational sector north of Point Conception (Fig. 16). Recently though, the landings by the live-fish fishery have surpassed those by the recreational fishery as the main source of cabezon removal. Total removals (kg) used in the current assessment are not noticeably different from those used in the 2003 assessment, particularly for recent years (Fig. 16).

Size Compositions
Cabezon otoliths and other ageing structures have not been collected routinely during port sampling. Therefore, the only information on the biological structure of the catch is from length and weight measurements. Sex is not recorded when sampling for length or weight, so all of the catch length-compositions considered in this assessment are sex-aggregated. Catch length-compositions (Table 7A) were developed for each substock, fishery sector, and fleet (Table 8; Figs. 17–19).

The catch length-compositions for each state and year for the recreational fisheries were obtained from the RecFIN website (extracted on 17 February, 2005). RecFIN expands the sampled length proportions by port, fishing fleet (mode), and wave (bi-monthly period) to estimate the proportions-at-length for the entire year. It was noticed that not all lengths retrieved from RecFIN were true lengths; many were weighed fish converted to lengths (Fig. 20). Instead of using these data as lengths (as was done during the 2003 assessment), these weighed fish were used to calculate mean body weights (in kg) for each year (Table 9). This reduced the number of length measurements substantially, especially during 1980–89 (Tables 7B & C; Fig. 20).

The commercial length-compositions for California were extracted on 19 April, 2005 from the CALCOM database. Commercial length samples are expanded using the standard routine at the port-gear-month level and then aggregated for the state. No body weights are available for either commercial fleet.

The sample sizes for each year and fleet used in the assessment were ultimately determined by an iterative re-weighting method that compared the inputted sample sizes to the model-calculated fleet-specific effective sample sizes. The model-calculated annual effective sample sizes replaced the initial sample sizes and the model was re-run until the inputted sample sizes matched the effective sample sizes. The initial sample sizes for the commercial fishery were based on the number of clusters from which the raw length samples were obtained. The initial recreational sample sizes were based on the number of unique sampling opportunities (as identified by the ID_CODE field in the RecFIN output). Sensitivity of the model results to the use of the initial sample sizes was investigated.

Several additional sources of length-composition and mean weight data were investigated for the SCS:

- CDF&G southern California commercial fishery sampling program (1993–present)
- Los Angeles County Sanitation Department trawl survey (1972–present)
- City of Los Angeles Sanitation Department trawl and rig surveys (1987–present)
- Orange County Sanitation Department trawl survey (1970–present)
- San Diego County Sanitation Department trawl survey (1991–present)
- Southern California Coastal Water Research Program (1994,1998)

Cabezon did not occur in any of these databases frequently enough to provide additional information for the assessment of the SCS and will not be discussed further.

Indices of Abundance

There is no standardized survey designed to provide biomass indices for cabezon along the U.S. west coast. All surveys presently used to provide biomass indices for groundfish populations are conducted at depths that are largely outside the depth preference of cabezon. Cabezon are caught so infrequently in the standardized trawl surveys that those data sources are not considered further in this assessment. A nearshore trap survey, designed to monitor cabezon abundance in the Morro Bay area, is in its first year of implementation and will be valuable for future cabezon assessments (and possibly those for other nearshore fishes). Therefore, in common with the assessments of yelloweye rockfish (Methot *et al*. 2002), cowcod (Butler *et al*. 1999), and bocaccio (McCall 2003), this assessment is based on recreational CPUE data, larval abundance indices from standardized egg/larvae surveys (as a possible index of reproductive output), impingement rates of young-of-the-year cabezon (considered as a possible index of recruitment), and the results of fishery-independent surveys of adult cabezon.

Three potential indices of abundance (in addition to several indices based on data from the CPFV fleet) are developed for each substock by fitting generalized linear models (GLMs) to the proportion of zero and non-zero records, and then to the non-zero catch rates (or whatever quantity was being measured, such as number of larvae impinged). This approach is known as the "delta method" and is described in detail elsewhere (Lo *et al.* 1992; Vignaux 1994; Maunder & Punt 2004). The product of the year effects from each GLM (which can conveniently be based on different error structures) yields the index of abundance. Table 10 lists the data sources considered in this assessment for each substock, the years for which data are available, the number of data points, the number of non-zero records for each data source, and the percentage of the data points for which the catch rate is non-zero.

The proportion of non-zero records was modeled as a binomial random variable; both gamma and lognormal error structures were explored for the positive records. Only main-factor models were considered and no interaction terms were explored, though year-area interactions, if present, can seriously compromise the development of abundance indices (Maunder & Punt 2004). A variety of alternative fixed-effects models were explored, and the final fixed-effects model for each choice of error model was selected using AIC (Burnham & Anderson 1998). Tables 11 and 12 list the fixed-effects models considered and the associated AIC values, and Tables 13 and 14 list the index values for each data source. The results of the analyses for the CPFV fleets are illustrated by plots of the results of the gamma and lognormal models along with non-GLM derived indices produced using the geometric mean of positive catch rates (Fig. 21). The CVs in Tables 13 and 14 and Fig. 21 were calculated by bootstrapping the best fitting model and should be viewed as under-estimates of the true variation of the index about the trend in the population. Index values for the CalCOFI and impingement series were taken from the 2003 assessment.

CPFV CPUE indices

The CPFV logbooks contain information on effort from 1947 for the southern California fleet and from 1957 for the central/northern California fleet (Hill & Schneider 1999). Effort was recorded as angler days prior to 1959 and as angler hours from 1962. Effort was recorded in angler hours and angler days in 1960 and 1961. Young (1969) estimated a conversion factor to relate the two measures of effort and estimated angler hours for 1947–59, the assumption being made that conditions in the CPFV fleet did not change over this period. Unfortunately, this was one of the most dynamic periods during the history of the CPFV fleet (Young 1969; see also *Recreational Fishing History in California*), so this assumption may not be valid. Considering this uncertainty, three sets of CPUE indices were developed for each substock: 1) separate indices for 1947/57–61 and 1962–present, 2) an index for the entire period based on angler hours, and 3) an index for the years for which effort was recorded in angler hours (1960–present). The last of these three indices was chosen for the base-case model and the others were used in the tests of sensitivity. Factors considered in the GLM were year, month, and location. Instead of using CDF&G blocks to define location, blocks were collapsed into groups based on major fishing ports or areas. The final fixed-effects model chosen for each substock included all factors (Tables 11 and 12). Both lognormal and gamma error structures were considered, but the lognormal model was ultimately selected for the base cases based on the work of Dick (2004) who found the lognormal error model appropriate for California CPFV indices. Sensitivity to the choice of error model when standardizing the catch and effort data was not explored because the lognormal and gamma indices were essentially indistinguishable (Fig. 21). Diagnostic plots for the base case CPFV index are provided in Figures 22 and 23.

The spatial nature of catch rates along the California coast was explored in two ways. First, the percent index of relative importance (%IRI; Pinkas *et al*. 1971; Cortez 1999) – using numbers of cabezon, weight of cabezon catch, and frequency of cabezon occurrence – was used to summarize the contribution of each location (Fig. 24) and blocks within location (Fig. 25) to the CPFV fishery. For the NCS, Halfmoon Bay and Morro Bay comprised over two-thirds of the total IRI (Fig. 24). In both of these complexes, multiple blocks contributed to the total location IRI (Fig. 25). In the south, most of the IRI is contributed by the northern-most locations (Fig. 24) and no one block dominated the catch. Second, CPUE indices were developed for each location to compare trends on smaller spatial scales (Figs. 26 and 27). Trends varied among locations within substocks indicating potentially different patterns in abundance through time. In general, the most distinctive declines were found in the southern locations of the NCS and in more recent years throughout the SCS.

An index from the central California CPFV observer program (1987–98), operated by CDF&G, was also considered during the 2003 assessment. The CPFV logbook and CPFV observer series exhibit similar trends (Cope *et al*. 2004). The index developed from the observer data was not used in this assessment because the observer program information is not independent from the information contained in the CPFV logbooks and the indices based on the logbook data represent the longer time series.

Adult Surveys

Two fishery-independent surveys were investigated for potential use in the NCS assessment (Table 10). The first is a visual count of adult fish among nearshore rocky reefs in the Monterey area during 1993–98 (the "Monterey adult survey"). Transects were either randomly assigned or repeated on permanent transects. Lengths of transects varied from a few minutes to over an hour. All cabezon were counted and assigned to different life history categories (YOY, juvenile, subadult, and adult). Adults were used to develop an abundance index using year, month, location (reef) and depth as factors (Table 11).

The second fishery-independent survey was a nearshore benthic survey of adult fishes, conducted from 1977–2002 by TENERA Environmental (an environmental consulting firm in San Luis Obispo, CA) at one site just south of Point Buchon (Figure 1). Transects were 50m in length in depths from 3–10 m along high to moderate relief rocky reefs and kelp forests. Abundance indices were developed using the factors year and month (Table 11).

These two indices were not included in the NCS base case model for two reasons: 1) SCUBA surveys may not provide reliable abundance indices for cryptic species such as cabezon; and 2) the spatial coverage of these surveys, which is limited, is such that abundance indices based on them may not be representative of coastwide trends. To explore the second issue, the standardized abundance estimate from the TENERA survey was compared to its nearest fishing location, Morro Bay (Fig. 26). The trends are quite different, supporting the conclusion that the TENERA data is not appropriate to include in the current assessment base case model. Despite not including either of these adult surveys in the base case, sensitivity of the results of the assessment to their inclusion is examined.

CalCOFI
The Southwest Fishery Science Center (SWFSC) has conducted larval tows off California since 1950. Tows are generally made at stations from the Mexican border to roughly 36°N, so these data relate primarily to southern California. Surface (manta) and subsurface (oblique) tows are taken, but the subsurface tows catch few cabezon (Table 10) and are therefore not considered further in this assessment. Surface tows made south of 31°N during June-September and west of 122°W are also excluded from the analyses due to few positive tows. Additionally, data for the years 1977, 1979, 1982 and 1983 are excluded because of changes in survey methodology. The factors considered in the analyses were: day and night (day: between 6AM and 6PM), latitude (north and south of 34°N), longitude (east and west of 121°W), and month. The resultant index is shown in Figure 28.

Power-plant Impingement
An index of recruitment was created using impingement data obtained from the Edison power plants in California (Figure 29). These data (catch in numbers per standardized flow volume) come from only the extreme southern California Bight (33-34°N) and are consequently used only for the assessment of the SCS. The factors considered when developing this index were: station (some stations had multiple intake areas), and season (Dec-Feb, Mar-May, Jun-Aug, and Sept-Nov). This index is considered to pertain to recruitment rather than to reproductive output because the lengths of the fish impinged were primarily those of fish aged 0 and 1 years (Figure 30).

Ichthyoplankton Indices
Cabezon larvae are initially neustonic and available (and readily identifiable) to planktonic sampling gears. The SWFSC has conducted ichthyoplankton surveys off the west coast and developed databases with information on the abundance of cabezon larvae. Generally the size of fish collected during these studies is <15mm (pre-settlement) and therefore not thought to correlate well with recruitment to age-1. However, the abundance of this size group may relate (in a linearly proportional way) to the amount of reproductive output the year before the year of sampling. The possibility of developing an index using the Santa Cruz mid-water juvenile rockfish survey was investigated. However, cabezon are only a very small component of the catch in this survey (Steve Ralston, SWFSC, pers. comm.) so no attempt was made to develop an index of pre-settlement cabezon using these data.

RecFIN
The 2003 assessment considered a recreational CPUE index based on data for the shore and PBR fleets combined. An index of abundance based on CPUE data would be required separately for each fleet for this assessment because it considers each of these modes separately. The catch and effort data for the PBR fleet was explored and it was found that there are few records with cabezon (Table 10). An abundance index based on RecFIN is therefore not considered further in this assessment.

Southern California Sanitation Districts Fish Surveys
The sanitation districts of Los Angeles, Orange, and San Diego Counties and the City of Los Angeles conduct fish surveys every year to monitor the effects of sewage outfall on nearshore communities. As was the case with the size composition data,

none of these data sources provided sufficient information to develop indices of abundance for cabezon.

Data Input Files
The SS2 input files for each substock are provided in Appendices B-1 (NCS) and C-1 (SCS).

Assessment

Assessment Model
This is the second assessment of the cabezon resource off the California coast. It differs in several key ways from the past assessment (Cope *et al.* 2004). The past assessment was based on an age- and sex-structured population dynamics model developed specifically for cabezon in AD Model Builder (Otter Research Ltd.). In contrast, the present assessment is based on Stock Synthesis 2 (SS2; Methot 2005), a flexible length- and age-based population dynamics modeling environment. The two models differ in terms of how the recruitment bias-correction is modeled, whether the impact of selectivity on weight-at-age is accounted for, and whether additional survey index variability is estimated. A formal comparison of the two models is provided in Appendix D.

Another major difference from the past assessment is that California is divided into two regions for the purposes of this assessment. The ecology of nearshore reef fishes leads to the expectation of low rates of movement among reefs. This, combined with the different fishing histories of central/northern California and southern California, imply different time-trajectories of population size in these two broad regions. Although even finer scale assessments would be desirable (e.g. by conducting assessments separately for northern and central California), the two-substock approach is the only one that can be supported by the currently available data. Results from a one-stock model with twelve fleets representing the area-specific fleet designations of the two-substock model are also presented for comparison. This model includes all of the indices used in the assessments of the NCS and the SCS.

The population dynamics model
The base case assessment for each substock is based on the following assumptions:

1. There are two fishery sectors (commercial and recreational). The commercial sector consists of two fleets and the recreational sector consists of four fleets.
    - Fleet 1: Commercial non-live-fish fishery
    - Fleet 2: Commercial live-fish fishery
    - Fleet 3: Recreational mode: Man-made
    - Fleet 4: Recreational mode: Shore
    - Fleet 5: Recreational mode: Private boat and rentals (PBR)
    - Fleet 6: Recreational mode: Commercial Passenger Fishing Vessel (CPFV).

    Fleet distinctions imply different length-specific selectivity patterns.
2. Selectivity is assumed to be dome-shaped for the commercial live-fish fishery and the man-made and shore fleets in the recreational fishery because each of these fleets tends not to land the larger sized fishes. Selectivity is assumed to be asymptotic and related to length by a logistic function for the remaining

fleets. All selectivities are assumed to be constant over time. The sensitivity of the results of the assessment to alternative specifications related to selectivity is examined in the tests of sensitivity. The selectivity patterns for the commercial fleets in the assessment of the SCS are set to those for the commercial fleets in the NCS owing to a lack of size composition data for the commercial fleets in the SCS.

3. There is one fishing season each year and the removals are taken instantaneously in the middle of the year after half of the natural mortality.
4. The estimates of removals-in-mass are known with negligible error.
5. Recruitment is related to reproductive output by means of a Beverton-Holt stock-recruitment relationship with log-normally distributed process error.
6. Length-at-age is normally distributed about its expected value.
7. There is no connection between the two substocks of cabezon, either through recruitment or migration.

Parameter estimation

The population dynamics model includes many parameters. The values for some of these parameters are based on auxiliary information, while others are estimated by fitting the model to the data (Table 15). The base-case value for steepness (*h*) is assumed to be 0.7 based on a recommendation from the past assessment. The implications of this choice of steepness is evaluated using a likelihood profile. Recruitment variation, σ_R, is set equal to 1.0 as was case for the past assessment. The base-case values for the instantaneous rate of natural mortality are set to 0.25yr^{-1} for females and 0.3yr^{-1} for males (Table 2). Given the considerable uncertainty associated with the (assumed) base-case values for σ_R and *M*, sensitivity tests examine the consequences of changing the values for these parameters.

Growth is not estimated within the model. Rather, the values for the parameters related to growth and fecundity are taken from Table 1. The values that determine the variability in length-at-age are computed by assuming that the coefficient of variation of the length at age 1 is 0.14 and that at age 17 is 0.09. There is an indication that the CV of length-at-age decreases linearly with age for many marine fishes (Erzini 1994). The only data on length-at-age for cabezon (Grebel 2003; Fig. 3A) indicates that the coefficient of variation for age-0 females is 0.11 and that for age-0 males is 0.14, while the coefficient of variation of length-at-age for age-10 is 0.01 for females and 0.09 for males. These values were based on small sample sizes (2 to 13 animals), therefore the upper limit for the CVs (0.14 and 0.09) are assumed for the base-case analyses and the value for age 10 is increased slightly and assumed to apply to age 17.

No attempt is made to estimate recruitment deviations for the first year of the assessment period (1916), nor those for some of the subsequent years, because the data are completely uninformative regarding the values for some of the early (and most recent) recruitment deviations. Running the NCS model while estimating all recruitments produces a recruitment event in 1960 almost three times larger than any another recruitment event, while doing the same in SCS, produces a relatively poor recruitment history (Fig. 31). The past assessment considered the availability of length-composition and impingement data to determine the years for which recruitment deviations should be estimated. For this assessment, the base-case models for each substock were run estimating recruitment deviations for all years to determine the first year for which recruitment deviations could be estimated with reasonable precision. The asymptotic standard deviations for the recruitment deviations are shown in Fig. 32. A decrease in these standard deviations may indicate when estimation of recruitment deviations should begin because the data provide some information about the recruitment deviations. There is a dramatic drop in the asymptotic standard deviation of the recruitment deviations for the SCS in 1970, but only a slow and steady decline in these asymptotic standard deviations for the NCS after 1960. Considering all of these factors, 1970 was chosen as the first year for which a recruitment deviation is estimated for the SCS and 1980 for the NCS (the latter based mostly on available length data). The base case models end recruitment estimation in 2003 because there is no information available to estimate a 2004 value, though the choice of the last year for which a recruitment deviation is estimated may impact the results of the assessment (Fig. 33). Therefore, sensitivity of the assessment results to the years for which recruitment deviations are estimated is considered in the tests of sensitivity.

Selectivity as a function of length was estimated for all fleets for which mean weight or length-composition data were available. Dome-shaped selectivity was modeled using an eight-parameter double-logistic curve for the commercial live-fish and recreational man-made and shore fleets. All parameters were estimated except for the minimum size selectivity (parameter 2) and the width of the dome (parameter 8) for the live-fish and shore fleets. For the man-made fleet, the initial slope (parameter 4) and the selectivity at the maximum size (parameter 5) were also pre-specified (Table 15). Length selectivities for the non-live commercial and recreational PBR and CPFV fleets were described using a logistic equation with both parameters estimated. There are no length-frequency data for the commercial fleets for the SCS, so the selectivity patterns for these fleets were set to those estimated for the NCS. The selectivity pattern for the CPFV fleet used when calculating the model-estimates for the indices of abundance derived using the catch and effort data for the CPFV fleet were set to those for the CPFV fleet. Age selectivities with full selectivity at age 0 and age 0 to 1 only were assumed when fitting to the CalCOFI larval tows and power plant impingement data, respectively. Sensitivity to alternative formulations of the CalCOFI larval survey selectivity was explored by parameterizing to fully select age 5 and older individuals and matching the selectivity to the maturity function.

Likelihood components

The following five components comprised the objective function that was minimized to estimate the free parameters of the model:

1. Abundance Index (assumed to be log-normally distributed).
2. Mean Weight (assumed to be normally distributed).
3. Length Composition (assumed to multinomially distributed).
4. Recruitment Deviations.
5. Parameter Priors (penalties on deviations from the prior distribution; generally very small for these model parameterizations)

Coefficients of variation about the abundance indices derived from bootstrapping or jackknifing techniques may greatly underestimate the true uncertainty regarding the relationship between these indices and biomass. A catchability scaling parameter was estimated during the 2003 assessment to inflate the coefficients of variation for the indices. That option is not currently available in SS2, so the pre-specified coefficients of variation for the abundance indices were adjusted iteratively until the model-calculated R.M.S.E. matched the pre-specified coefficient of variation for each index. The sensitivity of the results to setting the coefficients of variation to those obtained from the bootstrap procedure (Tables 13 and 14) is explored in the tests of sensitivity.

The mean weight data (Table 9) were assumed to be normally distributed with coefficients of variation based on the raw data when these data were included in the objective function. The coefficients of variation for the estimates of mean weight for the CPFV fleet for 1947–51 for the NCS were set to 0.5 (larger than observed for RecFIN – average CV = 0.41) to avoid over-weighting these early data.

The catch length-composition data were pooled into 44 length-classes, each of width 2cm (first length-class 0–7.9cm). Although the length compositions can be based on hundreds or thousands of measurements, fits to length-frequency data usually exhibit substantial overdispersion relative to a multinomial distribution where the sample sizes are set to the number of animals measured. Therefore, for the purposes of the present analyses, the sample sizes are compared to the "effective" number of animals measured each year using the approach developed by McAllister and Ianelli (1997). Sample sizes are then iteratively changed to the effective sample sizes until the mean inputted sample sizes are similar to the mean effective sample sizes. Alternatively, one could set an upper limit to the effective sample size (say 200) to avoid large differences in sample sizes across fleets. For instance, the fleet with the largest average sample size would receive a maximum value 200 for all sampled years. The average sample sizes for all other fleets could then be re-scaled in relation to 200 based on their relationship to the fleet with the highest average sample size. Finally, the iterative procedure would be followed to obtain the final effective sample sizes internally consistent with the model, with the maximum value possible being 200. Model sensitivity to the method used to assign effective sample sizes and to assuming the original sample sizes (Table 8) was explored in the tests of sensitivity.

Recruitment deviation and parameter priors were calculated assuming lognormal and normal error structures, respectively. The variances for all of the estimated parameters were set very high to minimize the influence of the prior on the results.

Parameter (Control) Input Files
The SS2 files for the assessments of each substock are provided in Appendices B-2 (NCS) and C-2 (SCS).

Model diagnostics (base models)
Abundance Surveys
Figures 34 and 35 show the fits to the base-case indices of abundance for the NCS and SCS respectively. As expected from the 2003 assessment, the model tracks the changes in the CPFV indices qualitatively, but there are considerable differences between the model-estimates and the data for some years. These differences are consistent with the very wide confidence intervals assumed for the data. The fit of the CPFV index for the SCS (Fig. 35) is particularly poor in the most recent years. This is because the length and weight data drive population dynamics rather than the abundance index information, with the result that the model predictions are substantially in excess of the observations. The NCS model also tends to overestimate the index values in more recent (post-1990) years (Fig. 34). The CalCOFI and Impingement indices are imprecise, and the fits to these data series are also not very good, particularly that to the CalCOFI index in recent years (Fig. 35).

Mean Weights
Figures 36 and 37 show the fits to the mean weight data by substock. The confidence intervals for the mean weights are wide (as expected given the CVs in Table 8), which implies that the model is not constrained to a substantial extent by these data, particularly for the NCS. The fit of the model to the data for the PBR mode (fleet 5) for the NCS is very poor with the model consistently over-estimating the mean weight of the catch. Given that the model is able to mimic the length-frequency data for this fleet, this suggests a conflict between the length and weight data, undersampling of the weight data, or error in the length-weight relationship (or both). There are no very poor fits to the mean weight data for the SCS (Figure 36), although there remain runs of residuals for some fleets. The 95% confidence intervals for some of the mean weights are quite narrow for the SCS and the model consequently attempts to mimic these mean weights quite closely. One reason for the increasing trend in abundance evident for the SCS is the low mean weight for the man-made fleet (fleet 3) in 2000. This weight is interpreted as a recruitment event, which translates into large increases in biomass during the final years of the assessment period. Sensitivity to the inclusion in the assessment of this data point is explored below.

Length-composition Data
The base-case fits to the length-composition data for the NCS are given in Figures 38–43 and the corresponding Pearson residuals are summarized in Figures 44 and 45. Note that fits for the shore and man-made fleets are not shown because the lengths for these fleets are derived from weights (Table 7). When interpreting these figures, it should be noted that the observed and model-predicted lengths are "plussed" at low and high sizes. This has little impact on the results at high size, but can give a misleading impression at low size (e.g. the fit to the data for 1999 and 2000 for the non-live-fish fleet (Figure 38)). The fits to the length frequency data for the commercial fleets (Figures 38 and 39) are better than those to the data for the recreational fleets (Figures 40–43) and consequently have the higher effective sample sizes. Of the recreational fleets, the fits to the observer data for the CPFV fleet (Figure 42) are better than those to the data for the remaining fleets. This result is hardly surprising given the actual sample sizes for the various recreational fleets (Table 8). The fits to the length-composition data for the SCS (Figures 46 and 47) and the corresponding Pearson residuals (Figure 48) are only shown for two of the six fleets as there are either no length data or the length data are all computed from measured weights for the remaining fleets. As before, the fits to the CPFV observer data are better than the fits to the recreational PBR data.

Results
Base-case results: NCS
Figure 49 shows the MPD estimates of the time-trajectories of reproductive output (in absolute terms) and recruitment, along with their asymptotic 95% confidence intervals. There is considerable inter-annual variation in recruitment. The estimates of recruitment are most precise before 1980 and recently, because no recruitment deviations are estimated for these years and the estimates of recruitment consequently reflect expectations based on the stock-recruitment relationship (Figure 49B). In contrast, the estimates of reproductive output are most precise during the late 1980s and early 1990s (Figure 49A). The NCS is estimated to have been at 40.1% of its virgin level at the start of 2005 (445 mt). Major recruitment events are seen in the

1990s. Figure 50A shows the estimated spawner-recruit relationship. Appendix E lists the MPD estimates of the numbers-at-age matrix for each gender.

Figures 51 and 52 show the length- and age-specific selectivity ogives for each fleet. The live-fish fishery (fleet 2) is dome-shaped with respect to length. Selectivity for the man-made and shore fleets (fleets 3 and 4) also decline with size. Males are less selected than females for a given age because females are larger at age. Selectivity based on age and length suggests that immature fish are not completely excluded from the current and historical catch, especially in the man-made and shore fisheries.

Harvest rates for each fleet are given in Figure 53. The onset of the live-fish fishery in the late 1990s is dramatic and the peak harvest rate by this fleet is greater than that for any other fleet. The PBR harvest rates during the 1980s also represent a major period of removals from NCS.

Base-case results: SCS
Figure 54 shows the MPD estimates of the time-trajectories of reproductive output (in absolute terms) and recruitment, along with their asymptotic standard errors. The time-trajectory of reproductive output drops dramatically after 1980, stays low until the early 2000s, and then increases substantially. The increase in reproductive output occurs because of the 2000 year-class, the largest in the time-series. The size of this year-class is inferred primarily from the mean weight data for 2000 for the man-made recreational fleet (fleet 3). The major recruitment events are consistently lagged 1 year compared to the NCS. The reproductive output is estimated very precisely during the 1990s. The SCS is estimated to have been at 28.3% of its virgin level at the start of 2005 (71 mt). The biomass of cabezon off southern California is smaller than that off central / northern California and the resource is estimated to be more depleted off southern California than off central/northern California. Figure 50B shows the estimated spawner-recruit relationship. Appendix F lists the MPD estimates of the numbers-at-age matrix.

Figures 55 and 56 show the length- and age-specific selectivity ogives for each fleet. The selectivity patterns for the non-live-fish and live-fish fleets are set to those for the NCS. The selectivity patterns for the man-made and shore fleets decline more rapidly with length for the SCS than is the case for the NCS. Males are less selected than females for a given age because females are larger at age and fish are generally caught smaller in the SCS relative to the NCS. Selectivity based on age and length suggests that immature fish are not completely excluded from the current and historical catch, especially in the man-made recreational fishery.

Harvest rates for each fleet are given in Figure 57. There are two significant periods of removals: 1) the 1980s when harvest rates increased dramatically because of the increase in recreational fishing, particularly by the PBR mode; and 2) the late 1980s when the live-fish fishery took large catches. The first of these periods of harvest, along with the lack of strong recruitment events, led to the large reduction in reproductive output during the early 80s (Fig. 54).

Base-case results: One California stock
Figures 58 and 59 show MPD estimates of the time-trajectories of reproductive output (in absolute terms) and recruitment, along with their asymptotic standard errors when the data for the NCS and SCS are combined, and cabezon off California are

consequently treated as a single homogenous population. Results are shown when all of the data are used and when the 2000 mean weight datum for the man-made fleet off southern California is ignored. The time-trajectory of reproductive output for the combined assessment is qualitatively similar to that for the SCS, although, as expected, biomass levels are higher. There is a large increase in reproductive output at the end of the time-series, which can be attributed to the 2000 mean weight datum for man-made fleet off southern California. The depletion of the combined resource is 50% at the start of 2005 (634 mt compared to an unfished spawning biomass of 1,268 mt).

Table 16 compares the estimates of the total California cabezon reproductive output from the two substock model, the one stock model, and the 2003 assessment model. Total reproductive output in 2003 is greater for both of the current models compared to the 2003 assessment. However, both 2003 depletion estimates from this assessment are within the uncertainty ranges presented in the 2003 assessment (Cope *et al.* 2004). The estimate of 2003 depletion from the one stock model is larger than that from the two substock model (Table 16). When the one stock model uses all of the length data reported in RecFIN (meaning all weights converted to lengths and true measured lengths), as was the case for the 2003 assessment, the estimate of the 2003 depletion is very similar to that obtained during the 2003 assessment (Table 16, "one stock/all lengths").

Sensitivity analyses

The sensitivity tests related to data set choices differed among substocks. The selectivity pattern for a fleet is fixed to that for the base-case analysis if removal of a data source causes selectivity for that fleet to be inestimable.

NCS

- Trial 1: Ignore the length composition data for the commercial non-live-fish fleet (fleet 1).
- Trial 2: Ignore the length composition data for the commercial live-fish fleet (fleet 2).
- Trial 3: Ignore the mean weight data for the recreational man-made fleet (fleet 3).
- Trial 4: Ignore the length composition and mean weight data for the recreational shore fleet (fleet 4).
- Trial 5: Ignore the length composition and mean weight data for the recreational PBR fleet (fleet 5).
- Trial 6: Ignore the length composition and mean weight data for the recreational CPFV fleet (fleet 6).
- Trial 7: Base the analysis on the CPFV index for 1957–2003 (Table 13).
- Trial 8: Base the analysis on the CPFV indices for 1957–61 and 1962–2003 (Table 13).
- Trial 9: Do not include the CPFV index
- Trial 10: Add the Monterey adult survey and the TENERA adult survey.
- Trial 11: Add the TENERA adult survey.
- Trial 12: Add the Monterey adult survey.
- Trial 13: Nonlinear relationship between CPUE and abundance ($\beta = 0.5$).

SCS

Trial 1:	Ignore the mean weight data for the recreational man-made fleet (fleet 3).
Trial 2:	Ignore the mean weight data for the recreational shore fleet (fleet 4).
Trial 3:	Ignore the all mean weight data for the recreational shore fleet except the data point for 2000.
Trial 4:	Ignore the length composition and mean weight data for the recreational PBR fleet (fleet 5).
Trial 5:	Ignore the length composition and mean weight data for the recreational CPFV fleet (fleet 6).
Trial 6:	Base the analysis on the CPFV index for 1947–2003 (Table 13).
Trial 7:	Base the analysis on the CPFV indices for 1947–61 and 1962–2003 (Table 13).
Trial 8:	Ignore all CPFV indices.
Trial 9:	Ignore the CalCOFI index.
Trial 10:	Ignore the Impingement index.
Trial 11:	Use the CPFV index only.
Trial 12:	Nonlinear relationship between CPUE and abundance ($\beta = 0.5$)

The results of these sensitivity analyses are provided in Table 17. Table 18 examines the sensitivity of the results to changing the values for M and σ_R, and Table 19 explores the sensitivity of the results to: a) the years for which recruitment residuals are estimated, b) the specifications for length-/age-specific selectivity, c) the specifications of the CalCOFI selectivity, d) the length data included in the analyses, e) the coefficients of variation assumed for the abundance indices, f) the effective sample sizes assumed for the length-composition data, g) the historical catches, and h) the coefficients of variation assumed for length-at-age.

Overall, the results in Tables 17 indicate that the NCS model is not greatly sensitive to adding or removing data sources. Ignoring the length-composition data for the live-fish commercial fleet (trial 2), ignoring the size information for the recreational man-made and shore fleets (trials 3 and 4), including the longest CPFV time-series (trial 7), and excluding all CPFV indices (trial 9) all lead to less optimistic estimates of depletion. Ignoring the size information for the CPFV fleet (trial 6) leads to more optimistic estimates of depletion. The results are most sensitive to including the TENERA adult survey (trials 10 and 11). The inclusion of this index leads to markedly lower estimates of current depletion, though the fits to the TENERA index are not good (Fig. 60). The potential to miss cryptic species using SCUBA surveys, and the inconsistency between the CPFV index for Morro Bay and the TENERA index (Fig. 26) suggests that the limited spatial coverage of the TENERA survey is such that this index does not provide an index of abundance for the entire NCS. This finding should not, however, rule out future use of other spatially-limited fishery-independent surveys.

The SCS model is also generally insensitive to the data sources included in the assessment (Table 17), except for one important case; the exclusion of the man-made mean weight data (trial 1). Exclusion of these data leads to the conclusion that stock is much more depleted than is suggested by the base-case analysis. Figure 61 compares the estimated time-trajectory of reproductive output (upper panel) and recruitment (lower panel) with and without the mean weight data for the man-made fleet for 2000. The estimates of recruitment are similar up to 2000, when the analysis that ignored the 2002 mean weight datum suggests complete recruitment failure. Figure 62 compares the fits to the length-composition data for PBR fleet when the mean weight datum in year 2000 for this fleet is (base case) or is not included in the analysis. The fit to the length-composition data for 2002 is slightly better when this data point is ignored, but the fit to the length-composition data for 2003 data is better when this data point is not ignored. There is also a noticeable cohort in the data for years 2002-2004 of correct length to support a recruitment event in year 2000. These results, along with evidence for strong year-classes in 1999 or 2000 for several others species off the California coast, suggests that there may have been a strong year-class in 2000 and consequently that the 2000 mean weight datum for the man-made fleet should not be ignored.

The results in Table 18 indicate that the assessments for both substocks are more sensitive to the values assumed for *M* than to that assumed for σ_R, and more sensitive to the value for female *M* than to that for male *M*. Decreasing female *M* from its base-case value leads to a more depleted resource and *vice versa*. Both substocks are estimated to be more depleted as σ_R is increased. The fit of the model to the data, as quantified by the value for the negative-log-likelihood, improves as *M* is increased.

The factors considered in Table 19 generally had less impact on the outcomes from the assessment than those examined in Tables 17 and 18. The factors that changed the depletion for the NCS the most were starting recruitment estimation before 1970 or in 1990, the use of RecFIN weights as lengths ("all lengths"), and the values assumed for variation in length-at-age. Specifically, the results for NCS are sensitive to the assumption that length-at-age CVs change linearly and decrease with age, although this assumption seems biologically realistic The results for the SCS were most sensitive to the years for which recruitment residuals are estimated (mainly pre-1970 and 2004), making the selectivity patterns for all fleets logistic, halving catches, and the assumed level of variation in length-at-age. These sensitivities lead to less optimistic appraisals of stock status, including that the stock may be depleted to below 25% of its unfished level at present. The estimates of absolute spawning biomass are more sensitive than those of depletion.

Figure 63 shows substock-specific likelihood profiles for steepness and Figure 64 provides the subsequent estimates of unfished spawning and current biomass and current depletion. The data argue for a steepness of 1 for the SCS, but this may be more indicative of the data being uninformative. Local minima are also apparent within these profiles, though they seem not to affect the results greatly.

Projection and decision analysis

Twelve-year yield forward projections are conducted for each substock under two alternative ABC control rules (based on F_{MSY} proxies of $F_{45\%}$ and $F_{50\%}$) and two OY threshold control rules (40-10 or 60-20). The standard PFMC OY control rule for groundfish such as cabezon is based on $F_{45\%}$ with a 40-10 adjustment for stocks below the target level of 40% of the unfished reproductive output. The California Nearshore Fishery Management Plan proposes the use of a F_{MSY} proxy of $F_{50\%}$ and a 60-20 adjustment for stocks below 60% of the unfished reproductive output. The relative proportion of the six fleets in future harvests is assumed to be the same as the last year (2004) in the model.

The results in Table 20 suggest that a reduction in population size will occur for the NCS under the two control rules based only on the F_{MSY} proxies. In contrast, the projections for the remaining control rules suggest that some increase in reproductive output will occur. The extent of this increase is greatest for the most conservative OY control rule ($F_{50\%}$ with a 60-20 adjustment) and least for the least conservative control rule ($F_{45\%}$ with a 40-10 adjustment). The projections for the SCS model beyond 2006–07 should be interpreted with considerable caution because they are influenced by the (strong, but uncertain) 2000 year-class.

Projections based on alternative states of nature for each substock were explored to capture uncertainty in population conditions. For the NCS, the low and high *M* scenarios refer to different assumptions about sex-specific natural mortality and were selected to represent the 95% confidence intervals for terminal spawning biomass based on the Hessian approximation. The low scenario assumes $M = 0.2\text{yr}^{-1}$ and 0.25 yr^{-1} for females and males respectively, while the high scenario assumes 0.3 yr^{-1} and 0.35 yr^{-1} respectively. For the SCS, the low and high depletion rates refer to depletion rates in 2005 of roughly 20% and 35%, respectively.This range of depletion for the SCS was determined by the STAR panel to adequately cover uncertainty in its value and was determined by modifying the year 2000 man-made fleet mean weight CV value (*e.g.* an increase in the CV lead to a less depleted resource in 2000). These states of nature attempt to capture the uncertainty in current depletion based on the uncertainty in the magnitude of the 2000 recruitment. Probabilities for each state of nature were calculated, as directed by the STAR panel, assuming a normal probability density function (pdf) parameterized by the expected base case depletion rate and its asymptotic standard deviation.These respective substock pdfs were used to estimate the cumulative densities at the low and high depletion rates of 0.3 and 0.49 for the NCS and 0.2 and 0.35 for the SCS. Each cumulative density, representing the mid-point of the total density of each state of nature, was then doubled to determine the associated probability for each state of nature. Results from each of the states of nature are given in Figure 65.

Decision analysis population projections are provided in Table 21 for each state of nature and several state-dependent future catch series. The NCS will drop below the overfished level if catch levels are based on the 40-10 rule and the high *M* scenario, but the true state of nature is either the base case or low *M* scenario. This also occurs if catches are based on the base case model but the low *M* state of nature is correct. All other scenarios lead to depletion levels above 25% in 2016. Under the 60-20 rule, only the high *M* catch with a low *M* true state of nature leads to a depletion level in 2016 below 25%. In the SCS, all combinations of catch and true state of nature under either control rule lead to a depletion level in 2016 larger than 25%.

Response To STAR Panel Review

The STAR panel, during its review of the assessment, made several recommendations for further model exploration. The following is a list of these recommendations and the subsequent STAT team responses:

1. SCS Fleet 3 year 2000 mean weight datum: The STAR panel recommended further exploration of the effects of the mean weight datum for the SCS for 2000. This request was met and lead to examination of model fits with and without the mean weight datum for 2000, specifically to the length-composition data for the PBR fleet (the only fleet with length fits post-1999). Fits with and without the mean weight datum for the PBR fleet in 2000 are included in Figure 62 and lead to greater confidence in the existence of a large 2000 year-class in the SCS.

2. TENERA adult survey: The NCS model was sensitive to the exclusion of the TENERA adult survey so the STAR panel requested to see the model fits when this survey was included. This request was met and model fits with and without the TENERA adult survey are shown in Figure 60. The STAR panel also suggested comparing the trend in abundance indicated by the TENERA survey to the CPFV CPUE trend for Morro Bay. This request was met (Figure 26).

3. Effective sample sizes: The STAR panel expressed concerns over the method used to determine the effective samples sizes for the length-composition data. Specifically, there were orders of magnitude differences in effective samples sizes among years within some fleets. An alternate method of calculating effective samples sizes was defined. This request was met by an additional sensitivity run for each substock (Table 19) that found no notable differences in model outputs between the two methods for calculating effective sample sizes.

4. Local minima in the steepness profiles: The STAR panel felt that the likelihood profiles for steepness needed additional work to address the lack of smoothness and suggested finer increments when calculating these profiles. This request was met, but the profiles remained clunky (Figs. 62 and 63), suggesting local minima.

5. One sex model: The STAR panel suggested the exploratory development of a one-sex model because the nest-guarding behavior of males should increase their contribution to future reproductive output and thus their value in the population dynamics. This request was met and a one-sex model was produced, but it ultimately just combined the male and female spawning biomasses. It did highlight, however, the issue of what population metric, instead of spawning biomass, should be used when males contribute more than just sperm to reproductive output.

6. Location-specific CPUE analysis: In addition to the IRI spatial catch analysis, the STAR panel suggested the STAT team produce CPUE trends for each location within a substock and compare trends among areas. This analysis was completed and its results are presented in Figs 26 and 27.

Research Recommendations

1. Accurate accounting of removals, especially from the recreational and live-fish fisheries: Fisheries primarily exploited by recreational and live-fish commercial fisheries are traditionally hard to monitor. More effort to monitor these fishery sectors may be necessary to accurately monitor fishing mortality.

2. A fishery-independent survey of cabezon population abundance: The current fishery-independent survey being developed in the Morro Bay area will become an important input into future assessments of cabezon. Expansion of this survey will increase its usefulness as an index of abundance for central and northern California.

3. A study of the stock structure of cabezon: This assessment assumes two substocks of cabezon along the California coast. Current work on cabezon stock structure should be included in the next assessment.

4. Age validation/ age determination: Catch age-composition data were not available for this assessment. Accurate ageing is crucial to understand the population dynamics of a species, especially those for which there is limited survey information. Information on the age-structure of the catches for each fishery sector would substantially improve some aspects of the assessment.

5. A better understanding of the relationship between CPUE and population size: Changes in recreational CPUE indices are assumed to reflect changes in population size in a linearly proportional manner. The results of the assessment would be severely in error if this assumption were substantially violated. Therefore, if future assessments depend on CPUE data, it is vital that the relationship between CPUE and population size be quantified.

6. Alternative assessment procedures: The need for greater spatial resolution in the management of nearshore fisheries also increases the amount of data required to perform traditional stock assessments. Alternative assessment procedures that are less data-hungry, but still provide relevant management outputs should be developed to address this need. In addition, the nest-guarding behavior of males gives new value to males in the cabezon population. A metric other than spawning biomass may be needed to account for the male portion of the population in reference points.

7. Effect of climate on cabezon: Several of the data sources in this assessment (*e.g.* the power-plant impingement and CalCOFI indices, and some length-composition data) indicate that there was potentially good recruitment after 1999 (and before 1977 for the impingement data) whereas these same sources indicate that recruitment was very poor prior to 1999 in the SCS. Cabezon may be influenced by climatic/oceanic regimes. A better understanding of the relationship between cabezon population dynamics and climate would reduce the uncertainty of future assessments.

8. Sex-specific data: Given the strong correlation of color to gender in cabezon (O'Connell 1953; Lauth 1987; Grebel 2003), collection of sex-specific information (at least recording fish color) would greatly enhance future assessments.

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Table 1. Biological parameters for cabezon. Values in parenthesis are the estimated standard errors.

A. Age and growth (VBGF) parameters. Length in cm.

	Parameter L_∞ (cm)	95% C.I.	k (yr^{-1})	95% C.I.	t_0 (yr)	95% C.I.
NCS						
Female	62.12 (3.53)	55.18 - 69.07	0.18 (0.03)	0.12 - 0.24	-1.06 (0.39)	-1.82 - -0.29
Male	46.85 (2.50)	41.93 - 51.77	0.28 (0.07)	0.14 - 0.43	-1.19 (0.74)	-2.53 - 0.26
Combined	56.78 (2.57)	51.73 - 61.83	0.20 (0.03)	0.14 - 0.26	-1.23 (0.38)	-1.98 - -0.49

B. Relationship between maturity and age / length (combined sex and area)

	a	b
age (years)	-1.575	4.097
length (cm)	-0.743	25.702

C. Weight (kg)-length (cm) relationship

	a	b	R^2	Sample Size
NCS				
Female	0.00000920	3.187	0.99	322
Male	0.00001163	3.118	0.96	227
SCS				
Female	0.00001236	3.113	0.95	55
Male	0.00001989	2.997	0.91	7

Table 2. Natural mortality calculations used to obtain sex-specific estimates of *M* used in the 2005 assessment.

Method	Equation	Input values (per sex)	Estimated *M*	
			Female	Male
Hoenig (1983)	$\ln(Z) = 1.46 - 1.01\ln(\omega)$	ω = 17 (both sexes)	-0.25	-0.25
Chen and Watanabe (1989)	$M(t)=\begin{cases}\frac{k}{1-e^{-k(t-t_0)}}, & t \le t_M \\ \frac{k}{a_0+a_1(t-t_M)+a_2(t-t_M)^2}, & t \ge t_M\end{cases}$ where $a_0 = 1-e^{-k(t_M-t_0)}$, $a_1 = ke^{-k(t_M-t_0)}$, $a_2 = -0.5k^2e^{-k(t_M-t_0)}$, $t_M = -\frac{1}{k}\ln(1-e^{kt_0})+t_0$	k = 0.18 (F);0.28 (M) t_0 = -1.06 (F); -1.18 (M)	-0.20	-0.16
Jensen (1996)	$M = 1.65/a_M$	a_M = 7 (both sexes)	-0.24	-0.24
Jensen (1996)	$M = 1.5k$	k = 0.18 (F);0.28 (M)	-0.27	-0.42
Jensen (1996)	$M = 1.6k$	k = 0.18 (F);0.28 (M)	-0.29	-0.45
			Average *M* estimate	
			-0.25	-0.30

Table 3. Reported and assumed CPFV compliance rates, and raw and subsequent expanded CPFV removals for each cabezon substock, 1916-1961. Reported rates for 1987–98 are for the NCS and are applied to the SCS.

		Catch (in numbers)				
		Northern California substock		Southern California substock		
Year	Compliance rates	Raw CPFV	expanded CPFV	Raw CPFV	Expanded CPFV	
1916		0	0	0	0	no expansion made (few CPFVs)
1917		0	0	0	0	
1918		0	0	0	0	
1919		0	0	0	0	
1920		0	0	0	0	
1921		0	0	0	0	
1922		0	0	0	0	
1923		0	0	0	0	
1924		0	0	0	0	
1925		0	0	0	0	
1926		0	0	0	0	
1927		0	0	0	0	
1928	1.00	0	0	39	39	
1929	1.00	432	432	78	78	
1930	1.00	647	647	117	117	
1931	1.00	862	862	157	157	
1932	1.00	1076	1076	196	196	
1933	1.00	1291	1291	235	235	
1934	1.00	1506	1506	274	274	
1935	1.00	1721	1721	314	314	
1936	0.80	1934	2418	353	441	Croaker 1938
1937	0.90	1880	2089	263	292	
1938	0.95	3794	3994	784	825	
1939	0.90	2045	2272	278	309	War years assumed to equal 1946 values (taken from O'Connell 1953)
1940	0.90	2986	3318	262	291	
1941	0.90	2272	2524	552	613	
1942	0.90	2272	2524	552	613	
1943	0.90	2272	2524	552	613	
1944	0.90	2272	2524	552	613	
1945	0.90	2272	2524	552	613	
1946	0.90	2272	2524	552	613	
1947	0.83	8304	10017	1563	1885	Baxter & Young 1953
1948	0.93	12531	13416	1982	2122	
1949	0.93	11406	12278	2567	2763	
1950	0.98	13749	14102	2099	2153	
1951	0.96	16053	16704	1899	1976	
1952	0.95	8272	8707	2526	2659	Assumed values from Miller and Gotshall (1965)
1953	0.95	5821	6127	3756	3954	
1954	0.95	4333	4561	8584	9036	
1955	0.95	3851	4054	8277	8713	
1956	0.95	8434	8878	9388	9882	
1957	0.95	7544	7941	6859	7220	
1958	0.95	5197	5471	4625	4868	
1959	0.95	4136	4354	1184	1246	
1960	0.95	1939	2041	567	597	Miller & Gotshall (1965)
1961	0.95	1900	2000	671	706	

Table 3 (continued). Reported and assumed CPFV compliance rates, and raw and subsequent expanded CPFV removals for each cabezon substock, 1962-2004. Reported rates for 1987–98 are for the NCS and are applied to the SCS.

		Catch (in numbers)				
		Northern California substock		Southern California substock		
Year	Compliance rates	Raw CPFV	expanded CPFV	Raw CPFV	Expanded CPFV	
1962	0.85	2663	3133	1845	2171	Assumed values discounted for increasing in CPFV fleet through 60s & 70s
1963	0.85	5888	6927	3713	4368	
1964	0.85	3315	3900	2954	3475	
1965	0.85	4458	5245	3062	3602	
1966	0.85	5500	6471	4681	5507	
1967	0.85	2871	3378	2422	2849	
1968	0.85	2470	2906	1725	2029	
1969	0.85	2612	3073	1648	1939	
1970	0.80	3930	4913	1978	2473	
1971	0.80	2337	2921	2046	2558	
1972	0.80	5170	6463	5967	7459	
1973	0.80	5012	6265	2389	2986	
1974	0.80	4432	5540	2435	3044	
1975	0.80	2637	3296	3617	4521	
1976	0.80	3923	4904	2396	2995	
1977	0.80	3977	4971	1549	1936	
1978	0.80	6445	8056	2286	2858	
1979	0.80	3659	4574	1710	2138	
1980	0.65	4132	6357	1986	3055	
1981	0.65	3533	5435	2255	3469	Karpov *et al.* 1995
1982	0.65	3670	5646	1476	2271	
1983	0.65	2360	3631	1367	2103	
1984	0.65	1322	2034	415	638	
1985	0.65	1165	1792	578	889	
1986	0.65	2546	3917	1813	2789	
1987	0.71	2676	3763	1960	2756	D. Wilson-Vandenberg (CDF&G; pers. comm.)
1988	0.76	3124	4105	2241	2945	
1989	0.80	3020	3775	3184	3980	
1990	0.91	2382	2627	4310	4754	
1991	0.63	1731	2743	2795	4430	
1992	0.62	3597	5811	1587	2564	
1993	0.68	1851	2732	955	1410	
1994	0.62	1241	2001	644	1038	
1995	0.56	1075	1937	1013	1825	
1996	0.54	1601	2981	2063	3841	
1997	0.65	1715	2628	1683	2579	
1998	0.48	1840	3837	849	1770	
1999	0.65	2271	3494	773	1189	Average from 1980-1998 values
2000	0.65	1712	2634	1651	2540	
2001	0.65	4680	7200	1305	2008	
2002	0.65	1177	1811	817	1257	
2003	0.65	3228	4966	435	669	
2004	0.65	1930	2969	747	1149	

Table 4. Numbers removed, averaged weights, removals in weight, CPFV ratios, and expanded removals (numbers) by year for each mode in the recreational fleet for the NCS. Shaded values indicate reported values; non-shaded are assumed.

	CPFV			Man-Made				Shore-based				PBR			
Year	Removals (#s)	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)
1916	0		0		485	0.68	330		1728	0.41	707		0		0
1917	0		0		485	0.68	330		1728	0.41	707		0		0
1918	0		0		485	0.68	330		1728	0.41	707		0		0
1919	0		0		485	0.68	330		1728	0.41	707		0		0
1920	0		0		485	0.68	330		1728	0.41	707		0		0
1921	0		0		485	0.68	330		1728	0.41	707		0		0
1922	0		0		485	0.68	330		1728	0.41	707		0		0
1923	0		0		485	0.68	330		1728	0.41	707		0		0
1924	0		0		485	0.68	330		1728	0.41	707		0		0
1925	0		0		485	0.68	330		1728	0.41	707		0		0
1926	0		0		485	0.68	330		1728	0.41	707		0		0
1927	0		0		485	0.68	330		1728	0.41	707		0		0
1928	0		0		485	0.68	330		1728	0.41	707		0		0
1929	432	2.27	980	1.12	485	0.68	330	4.00	1728	0.41	707	0.50	216	2.27	490
1930	647	2.27	1467	1.12	727	0.68	494	4.00	2588	0.41	1059	0.50	324	2.27	734
1931	862	2.27	1955	1.12	968	0.68	658	4.00	3448	0.41	1411	0.50	431	2.27	977
1932	1076	2.27	2440	1.12	1208	0.68	822	4.00	4304	0.41	1761	0.50	538	2.27	1220
1933	1291	2.27	2928	1.12	1450	0.68	986	4.00	5164	0.41	2113	0.50	646	2.27	1464
1934	1506	2.27	3416	1.12	1691	0.68	1150	4.00	6024	0.41	2465	0.50	753	2.27	1708
1935	1721	2.27	3903	1.12	1933	0.68	1314	4.00	6884	0.41	2817	0.50	861	2.27	1952
1936	2418	2.27	5484	1.12	2715	0.68	1847	4.00	9672	0.41	3958	0.50	1209	2.27	2742
1937	2089	2.27	4738	1.12	2346	0.68	1595	4.00	8356	0.41	3420	0.50	1045	2.27	2369
1938	3994	2.27	9058	1.12	4485	0.68	3050	4.00	15976	0.41	6538	0.50	1997	2.27	4529
1939	2272	2.27	5153	1.12	2551	0.68	1735	4.00	9088	0.41	3719	0.50	1136	2.27	2576
1940	3318	2.27	7525	1.12	3726	0.68	2534	4.00	13272	0.41	5432	0.50	1659	2.27	3763
1941	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1942	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1943	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1944	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1945	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1946	2524	2.27	5724	1.12	2834	0.68	1927	5.00	12620	0.41	5165	0.00	0	2.27	0
1947	10017	2.27	22718	1.12	11249	0.68	7649	5.00	50085	0.41	20498	0.50	5009	2.27	11359
1948	13417	2.27	30429	1.12	15067	0.68	10246	5.00	67085	0.41	27456	0.50	6709	2.27	15215
1949	12278	2.27	27846	1.12	13788	0.68	9376	5.00	61390	0.41	25125	0.50	6139	2.27	13923
1950	14102	2.27	31983	1.12	15837	0.68	10769	5.00	70510	0.41	28858	0.50	7051	2.27	15991
1951	16705	2.27	37886	1.12	18760	0.68	12757	5.00	83525	0.41	34184	0.50	8353	2.27	18943
1952	8707	2.27	19747	1.12	9778	0.68	6649	5.00	43535	0.41	17818	0.50	4354	2.27	9874
1953	6127	2.27	13896	1.12	6881	0.68	4679	5.00	30635	0.41	12538	0.50	3064	2.27	6948
1954	4561	2.27	10344	1.12	5122	0.68	3483	5.00	22805	0.41	9333	0.50	2281	2.27	5172
1955	4054	2.27	9194	1.12	4553	0.68	3096	5.00	20270	0.41	8296	1.00	4054	2.27	9194
1956	8878	2.27	20135	1.12	9970	0.68	6780	5.00	44390	0.41	18167	1.00	8878	2.27	20135
1957	7941	2.27	18010	1.12	8918	0.68	6064	5.00	39705	0.41	16250	1.00	7941	2.27	18010
1958	5471	2.27	12408	1.12	6144	0.68	4178	5.13	28051	0.41	11480	1.00	5471	2.27	12408
1959	4354	2.27	9875	1.12	4890	0.68	3325	8.40	36574	0.41	14968	1.00	4354	2.27	9875
1960	2041	2.42	4929	1.12	2292	0.68	1559	13.74	28051	0.41	11480	2.48	5066	2.42	12235
1961	2000	2.00	4000	1.12	2246	0.68	1527	8.40	28051	0.41	11480	2.48	4964	2.00	9928

Table 4 (continued).

	CPFV			Man-Made				Shore-based				PBR			
Year	Removals (#s)	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)
1962	3133	2.00	6266	1.12	3518	0.68	2393	8.40	26317	0.72	18948	2.48	7776	2.00	15553
1963	6927	2.00	13854	1.12	7779	0.68	5290	8.40	58187	0.72	41894	2.48	17194	2.00	34387
1964	3900	2.00	7800	1.12	4380	0.68	2978	6.00	23400	0.72	16848	2.48	9680	2.00	19361
1965	5245	2.00	10490	1.12	5890	0.68	4005	6.00	31470	0.72	22658	2.48	13019	2.00	26037
1966	6471	2.00	12942	1.12	7267	0.68	4942	6.00	38826	0.72	27955	2.48	16062	2.00	32124
1967	3378	2.00	6756	1.12	3794	0.68	2580	6.00	20268	0.72	14593	2.48	8385	2.00	16769
1968	2906	2.00	5812	1.12	3263	0.68	2219	6.00	17436	0.72	12554	2.48	7213	2.00	14426
1969	3073	2.00	6146	1.12	3451	0.68	2347	6.00	18438	0.72	13275	2.48	7628	2.00	15255
1970	4913	2.00	9826	1.12	5517	0.68	3752	6.00	29478	0.72	21224	2.48	12195	2.00	24389
1971	2921	2.00	5842	1.12	3280	0.68	2231	6.00	17526	0.72	12619	2.48	7250	2.00	14501
1972	6463	2.00	12926	1.12	7258	0.68	4935	6.00	38778	0.72	27920	2.48	16042	2.00	32084
1973	6265	2.00	12530	1.12	7036	0.68	4784	6.00	37590	0.72	27065	2.48	15550	2.00	31101
1974	5540	2.00	11080	1.12	6221	0.68	4231	6.00	33240	0.72	23933	2.48	13751	2.00	27502
1975	3296	2.00	6592	1.12	3701	0.68	2517	6.00	19776	0.72	14239	2.48	8181	2.00	16362
1976	4904	2.00	9808	1.12	5507	0.68	3745	5.00	24520	0.72	17654	2.48	12172	2.00	24345
1977	4971	2.00	9942	2.00	9942	0.68	6761	5.00	24855	0.72	17896	2.48	12339	2.00	24677
1978	8056	2.00	16112	2.00	16112	0.68	10956	5.00	40280	0.72	29002	2.48	19996	2.00	39992
1979	4574	2.00	9148	2.00	9148	0.68	6221	5.00	22870	0.72	16466	2.48	11353	2.00	22706
1980	6357	1.81	11518	2.07	13157	0.71	9349	4.97	31598	1.09	34458	4.04	25695	1.91	49007
1981	5435	1.85	10055	1.91	10365	0.73	7519	3.11	16893	0.77	12970	5.45	29635	1.97	58326
1982	5646	3.40	19196	0.83	4710	0.67	3167	4.88	27576	1.09	30039	2.89	16309	1.74	28423
1983	3631	3.19	11569	2.96	10762	0.77	8314	10.36	37627	0.96	36160	5.03	18254	1.72	31329
1984	2034	1.75	3560	4.71	9582	1.32	12692	5.24	10655	1.09	11610	14.62	29747	1.59	47345
1985	1792	1.68	3015	4.72	8466	0.51	4342	8.63	15465	0.66	10195	7.85	14066	1.73	24277
1986	3917	2.00	7848	1.69	6608	0.68	4494	5.02	19682	1.03	20272	9.72	38089	1.45	55278
1987	3763	1.50	5645	1.69	6349	0.68	4317	5.02	18908	1.03	19475	9.79	36834	1.59	58646
1988	4105	1.43	5862	1.69	6926	0.68	4709	5.02	20627	1.03	21245	6.39	26251	1.37	36011
1989	3775	0.91	3450	1.69	6369	0.68	4331	5.02	18968	1.03	19537	8.36	31567	1.61	50886
1990	2627	1.84	4834	1.69	4432	0.68	3014	5.02	13200	1.03	13596	6.20	16281	1.60	26050
1991	2743	1.84	5047	1.69	4628	0.68	3147	5.02	13783	1.03	14196	6.20	17000	1.60	27200
1992	5811	1.84	10692	1.69	9804	0.68	6667	5.02	29199	1.03	30075	6.20	36014	1.60	57623
1993	2732	1.84	5027	1.35	3685	0.53	1941	8.89	24290	1.09	26469	12.83	35061	1.31	46026
1994	2001	1.84	3682	0.64	1284	0.73	942	6.32	12648	1.07	13569	10.58	21164	1.34	28263
1995	1937	1.84	3564	1.31	2541	0.23	573	9.99	19345	1.04	20109	15.28	29591	1.47	43483
1996	2981	1.88	5606	1.21	3606	0.52	1879	10.28	30639	0.97	29744	7.96	23730	1.51	35850
1997	2628	1.23	3225	1.06	2777	0.67	1854	13.23	34765	1.16	40373	3.58	9399	1.21	11355
1998	3837	0.99	3800	0.25	961	0.58	557	10.64	40841	1.05	43044	3.54	13577	1.42	19310
1999	3494	2.08	7264	0.58	2035	0.22	439	1.71	5975	0.75	4456	4.25	14867	1.50	22333
2000	2634	1.97	5182	0.23	593	0.54	317	3.90	10272	0.94	9608	3.49	9180	1.91	17559
2001	7200	1.77	12766	0.73	5274	0.70	3674	0.45	3246	1.20	3901	2.11	15186	1.81	27559
2002	1811	1.62	2942	0.75	1351	0.70	943	5.48	9923	1.34	13256	4.95	8956	1.60	14365
2003	4966	1.92	9538	0.27	1349	1.39	1874	1.75	8712	1.29	11280	7.17	35607	1.80	64019
2004	2969	1.79	5310	0.49	1453	1.05	1522	1.57	4672	1.89	8845	2.37	7028	1.99	13955

Table 5. Numbers removed, averaged weights, removals in weight, CPFV ratios, and expanded removals (numbers) by year for each mode in the recreational fleet for the SCS. Shaded values indicate reported values; non-shaded are assumed.

	CPFV			Man-Made				Shore-based				PBR			
Year	Removals (#s)	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)
1916	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1917	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1918	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1919	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1920	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1921	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1922	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1923	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1924	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1925	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1926	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1927	0		0	1.16	45	0.50	23	0.61	24	0.85	20	0.00	0		0
1928	39	1.00	39	1.16	45	0.50	23	0.61	24	0.85	20	0.40	16	1.00	16
1929	78	1.00	78	1.16	91	0.50	45	0.61	48	0.85	41	0.40	31	1.00	31
1930	117	1.00	117	1.16	136	0.50	68	0.61	72	0.85	61	0.40	47	1.00	47
1931	157	1.00	157	1.16	182	0.50	91	0.61	96	0.85	82	0.40	63	1.00	63
1932	196	1.00	196	1.16	228	0.50	114	0.61	120	0.85	102	0.40	78	1.00	78
1933	235	1.00	235	1.16	273	0.50	136	0.61	144	0.85	122	0.40	94	1.00	94
1934	274	1.00	274	1.16	318	0.50	159	0.61	168	0.85	143	0.40	110	1.00	110
1935	314	1.00	314	1.16	364	0.50	182	0.61	192	0.85	163	0.40	126	1.00	126
1936	441	1.00	441	1.16	512	0.50	256	0.61	270	0.85	229	0.40	176	1.00	176
1937	292	1.00	292	1.16	339	0.50	169	0.61	179	0.85	152	0.40	117	1.00	117
1938	825	1.00	825	1.16	958	0.50	479	0.61	505	0.85	429	0.40	330	1.00	330
1939	309	1.00	309	1.16	359	0.50	179	0.61	189	0.85	161	0.40	124	1.00	124
1940	291	1.00	291	1.16	338	0.50	169	0.61	178	0.85	151	0.40	116	1.00	116
1941	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1942	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1943	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1944	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1945	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1946	613	1.00	613	1.16	712	0.50	356	0.61	375	0.85	319	0.40	245	1.00	245
1947	1885	1.00	1885	1.16	2188	0.50	1094	0.61	1153	0.85	980	0.40	754	1.00	754
1948	2122	1.00	2122	1.16	2463	0.50	1232	0.61	1298	0.85	1104	0.40	849	1.00	849
1949	2763	1.00	2763	1.16	3207	0.50	1604	0.61	1691	0.85	1437	0.40	1105	1.00	1105
1950	2153	1.00	2153	1.16	2499	0.50	1250	0.61	1317	0.85	1120	0.40	861	1.00	861
1951	1976	1.00	1976	1.16	2294	0.50	1147	0.61	1209	0.85	1028	0.40	790	1.00	790
1952	2659	1.00	2659	1.16	3086	0.50	1543	0.61	1627	0.85	1383	0.40	1064	1.00	1064
1953	3954	1.00	3954	1.16	4589	0.50	2295	0.61	2420	0.85	2057	0.40	1582	1.00	1582
1954	9036	1.00	9036	1.16	10488	0.50	5244	0.61	5529	0.85	4700	0.40	3614	1.00	3614
1955	8713	1.00	8713	1.16	10113	0.50	5057	0.61	5332	0.85	4532	0.40	3485	1.00	3485
1956	9882	1.00	9882	1.16	11470	0.50	5735	0.61	6047	0.85	5140	0.81	8051	1.00	8051
1957	7220	1.00	7220	1.16	8380	0.50	4190	0.61	4418	0.85	3755	0.81	5882	1.00	5882
1958	4868	1.00	4868	1.16	5650	0.50	2825	0.61	2979	0.85	2532	0.81	3966	1.00	3966
1959	1246	1.00	1246	1.16	1446	0.50	723	0.61	762	0.85	648	0.81	1015	1.00	1015

Table 5 (continued).

Year	CPFV			Man-Made				Shore-based				PBR			
	Removals (#s)	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)	CPFV ratio	#s Expanded	Avg. Wt (kg)	Removals (kg)
1960	597	1.00	597	1.16	693	0.50	346	0.61	365	0.85	311	0.81	486	1.00	486
1961	706	1.00	706	1.16	819	0.50	410	0.61	432	0.85	367	0.81	575	1.00	575
1962	2171	1.00	2171	1.16	2520	0.50	1260	0.61	1328	0.85	1129	0.81	1769	1.00	1769
1963	4368	1.00	4368	1.16	5070	0.50	2535	0.61	2673	0.85	2272	0.81	3559	1.00	3559
1964	3475	1.00	3475	1.16	4033	0.50	2017	0.61	2126	0.85	1807	0.81	2831	1.00	2831
1965	3602	1.00	3602	1.16	4181	0.50	2090	0.61	2204	0.85	1874	2.00	7204	1.00	7204
1966	5507	1.00	5507	1.16	6392	0.50	3196	0.61	3370	0.85	2864	2.00	11014	1.00	11014
1967	2849	1.00	2849	1.16	3307	0.50	1653	1.00	2849	0.85	2422	2.00	5698	1.00	5698
1968	2029	1.00	2029	1.16	2355	0.50	1178	1.00	2029	0.85	1725	2.00	4058	1.00	4058
1969	1939	1.00	1939	1.16	2251	0.50	1125	1.00	1939	0.85	1648	2.00	3878	1.00	3878
1970	2473	1.00	2473	1.16	2870	0.50	1435	1.00	2473	0.85	2102	2.00	4946	1.00	4946
1971	2558	1.00	2558	1.16	2969	0.50	1485	1.00	2558	0.85	2174	4.00	10232	1.00	10232
1972	7459	1.00	7459	1.16	8658	0.50	4329	1.00	7459	0.85	6340	4.00	29836	1.00	29836
1973	2986	1.00	2986	1.16	3466	0.50	1733	1.00	2986	0.85	2538	4.00	11944	1.00	11944
1974	3044	1.00	3044	1.16	3533	0.50	1767	1.00	3044	0.85	2587	4.00	12176	1.00	12176
1975	4521	1.00	4521	1.16	5248	0.50	2624	1.00	4521	0.85	3843	4.00	18084	1.00	18084
1976	2995	1.00	2995	1.16	3476	0.50	1738	1.00	2995	0.85	2546	4.00	11980	1.00	11980
1977	1936	1.00	1936	1.16	2247	0.50	1124	1.00	1936	0.85	1646	4.00	7744	1.00	7744
1978	2858	1.00	2858	1.16	3317	0.50	1659	1.00	2858	0.85	2429	4.00	11432	1.00	11432
1979	2138	1.00	2138	1.16	2482	0.50	1241	1.00	2138	0.85	1817	4.00	8552	1.00	8552
1980	3055	1.00	3043	2.07	6326	0.36	2287	5.76	17609	1.38	24283	36.53	111585	1.41	156824
1981	3469	1.00	3465	0.21	744	0.41	309	3.75	13023	0.72	9316	5.58	19359	1.32	25511
1982	2271	0.91	2062	0.35	790	0.51	400	1.93	4376	0.94	4123	22.64	51406	0.94	48486
1983	2103	0.83	1740	0.65	1373	0.73	1004	2.92	6141	0.55	3382	7.24	15220	0.84	12738
1984	638	0.99	631	5.31	3389	0.42	1434	16.84	10746	0.93	10017	40.28	25698	1.06	27356
1985	889	0.51	456	6.34	5634	0.14	813	9.25	8219	0.68	5595	23.03	20469	1.26	25783
1986	2789	0.61	1697	0.80	2231	0.46	1026	1.57	4379	0.85	3722	13.04	36371	0.85	30759
1987	2756	1.26	3478	0.80	2205	0.46	1014	1.57	4327	0.85	3678	10.63	29305	0.89	25983
1988	2945	0.48	1404	0.80	2356	0.46	1084	1.57	4624	0.85	3930	5.03	14799	0.81	11985
1989	3980	0.58	2322	0.80	3184	0.46	1465	1.57	6249	0.85	5311	2.75	10960	0.71	7835
1990	4754	0.93	4421	0.80	3803	0.46	1749	1.57	7464	0.85	6344	6.50	30901	0.94	29047
1991	4430	0.93	4120	0.80	3544	0.46	1630	1.57	6955	0.85	5912	6.50	28795	0.94	27067
1992	2564	0.93	2385	0.80	2051	0.46	944	1.57	4025	0.85	3422	6.50	16666	0.94	15666
1993	1410	1.06	1495	0.19	262	0.26	68	0.24	343	1.09	373	4.34	6120	0.59	3615
1994	1038	1.15	1194	0.80	830	0.46	382	0.81	843	0.85	717	9.07	9414	1.12	10589
1995	1825	0.46	839	0.53	972	0.69	673	1.49	2723	0.48	1314	1.58	2892	0.61	1751
1996	3841	0.71	2724	0.64	2453	0.54	1336	0.13	504	0.53	265	2.52	9681	0.89	8610
1997	2579	0.63	1620	0.80	2063	0.46	949	0.67	1725	0.37	630	1.15	2978	0.99	2939
1998	1770	1.80	3185	0.80	1416	0.46	651	1.22	2168	0.84	1819	3.65	6468	0.73	4730
1999	1189	0.88	1041	2.13	2534	0.32	818	2.82	3351	0.65	2189	9.38	11147	1.04	11594
2000	2540	0.72	1818	0.97	2476	0.06	140	0.23	578	0.75	435	1.77	4508	1.22	5506
2001	2008	0.54	1094	0.59	1192	0.85	1014	1.19	2395	1.00	2399	2.82	5653	0.61	3465
2002	1257	1.45	1823	0.18	229	0.76	173	1.72	2161	1.60	3455	6.20	7793	0.73	5723
2003	669	1.97	1317	0.88	586	0.87	506	2.64	1769	1.05	1859	9.28	6211	1.02	6364
2004	1149	1.97	2266	0.64	737	0.53	391	2.14	2460	1.46	3592	1.22	1397	1.64	2296

Table 6. Commerical landings (in kg) of cabezon by substock.

	NCS		SCS	
Year	Non-live	Live	Non-live	Live
1916	32	0	0	0
1917	151	0	0	0
1918	76	0	0	0
1919	0	0	0	0
1920	0	0	0	0
1921	0	0	0	0
1922	0	0	0	0
1923	0	0	0	0
1924	0	0	0	0
1925	1520	0	0	0
1926	0	0	0	0
1927	341	0	0	0
1928	1192	0	0	0
1929	542	0	0	0
1930	474	0	0	0
1931	505	0	0	0
1932	2121	0	1	0
1933	1901	0	33	0
1934	2370	0	0	0
1935	4712	0	67	0
1936	8334	0	6	0
1937	3713	0	1	0
1938	2460	0	0	0
1939	1823	0	1	0
1940	1512	0	27	0
1941	6018	0	35	0
1942	1040	0	4	0
1943	3411	0	0	0
1944	1754	0	15	0
1945	1952	0	0	0
1946	3542	0	0	0
1947	2047	0	6	0
1948	3714	0	6	0
1949	7273	0	5	0
1950	9544	0	289	0
1951	10802	0	19	0
1952	15595	0	51	0
1953	6021	0	15	0
1954	2816	0	1	0
1955	3141	0	9	0
1956	5566	0	58	0
1957	5627	0	363	0
1958	8787	0	67	0
1959	4297	0	7	0
1960	1385	0	3	0
1961	2236	0	10	0
1962	1120	0	2	0
1963	1271	0	5	0
1964	2326	0	70	0
1965	3357	0	16	0
1966	5664	0	51	0
1967	6441	0	38	0
1968	9059	0	61	0
1969	11677	0	43	0
1970	4762	0	90	0
1971	2026	0	24	0
1972	2618	0	37	0
1973	2051	0	15	0
1974	6694	0	65	0
1975	3299	0	27	0
1976	8604	0	89	0
1977	5404	0	107	0
1978	12569	0	320	0
1979	22612	0	214	0
1980	23658	0	3572	0
1981	28946	0	260	0
1982	28787	0	153	0
1983	10517	0	186	0
1984	8420	0	53	0
1985	11656	0	115	0
1986	7176	0	185	0
1987	3722	0	290	0
1988	5288	0	493	0
1989	10888	0	458	0
1990	11171	0	606	0
1991	5794	0	1596	0
1992	16211	0	461	0
1993	18723	390	387	4
1994	9095	25873	704	5482
1995	11322	68877	787	9655
1996	7898	94700	455	10470
1997	21149	99163	630	11719
1998	13988	145361	668	16570
1999	8554	102158	320	14006
2000	5343	88835	851	21441
2001	3210	55305	606	13510
2002	5035	38652	357	6360
2003	3666	30303	361	5407
2004	3058	40219	167	4084

Table 7. Summary of the length-composition data used in the base-case assessment (A), the years / fleets for which data on mean body weight are available (B), and the total length-frequency data set (including fish weighed rather than measured) (C).

A) Base Case Lengths

Area	Sector	Fleet	Years Used	Source
NCS	Commerical	Non-Live	1995-2000	CalCOM
		Live	1997-2004	CalCOM
	Recreational	Man-made		RecFIN
		PBR	1993-2004	RecFIN
		CPFV	1987-1998	CDF&G CPFV Observer Program
		CPFV	1996-1998, 2001, 2003-2004	RecFIN
SCS		PBR	1994, 1996, 1998-1999, 2002-2004	RecFIN
		CPFV	1975-1978, 1986-1989	CDF&G CPFV Observer Program

B) Mean Body Weights (kg)

Area	Sector	Fleet	Years Used	Source
NCS	Recreational	Man made	1980-1988	RecFIN
		Shore	1980-1987,1989,1993-2000,2002-2004	RecFIN
		PBR	1980-1989,1993-2004	RecFIN
		CPFV	1947-1951	Baxter & Young 1953
		CPFV	1985-1986,1988,1996-1998, 2000-2004	RecFIN
SCS		Man-made	1980-1985,1987,1989,1999,2000	RecFIN
		Shore	1980-1989, 1995-1996, 1998-1999, 2002-2004	RecFIN
		PBR	1980-1989, 1993-2004	RecFIN
		CPFV	1980-1989, 1994, 1996, 1998-2000, 2003, 2004	RecFIN

C) All lengths

Area	Sector	Fleet	Years Used	Source
NCS	Commerical	Non-Live	1995-2000	CalCOM
		Live	1997-2004	CalCOM
	Recreational	Man made	1980-1988	RecFIN
		Shore	1980-1987,1989,1993-2000,2002-2004	RecFIN
		PBR	1980-1989,1993-2004	RecFIN
		CPFV	1987-1998	CDF&G CPFV Observer Program
		CPFV	1985-1986,1988,1996-1998, 2000-2004	RecFIN
SCS		PBR	1980-1989, 1993-1994, 1996, 1998-1999, 2002-2004	RecFIN
		CPFV	1975-1978, 1986-1989	CDF&G CPFV Observer Program
		CPFV	1980-1981, 1983, 1986-1987, 1989, 1996, 2004	RecFIN

Table 8. Catch length-compositions by substock, fishery sector, and fleet. N = original length-composition sample sizes before iterative re-weighting. N_{eff} = base-case sample sizes after iterative re-weighting. Only measured lengths are included in this table.

A) NCS

				Length bin																																	
Sector	Year	N	Neff	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72+
Commercial																																					
Non-live	1995	206	95	0	0	0	0	0	0	0	0	0	0	0.07007	0.05798	0.10387	0.11267	0.09068	0.12036	0.08079	0.08272	0.04534	0.13877	0.01759	0.01127	0.02995	0.02006	0.00962	0.00055	0.00605	0.00082	0	0	0.00082	0	0	0
	1996	1696	1916	0	0	0	0	0	0	0	0.00053	0.00053	0.00749	0.023	0.06499	0.13613	0.15967	0.13533	0.11821	0.08264	0.05456	0.04547	0.04012	0.04172	0.03584	0.02059	0.01337	0.00856	0.00562	0.00508	0	0.00053	0	0	0	0	0
	1997	396	85	0	0	0	0	0	0	0	0	0	0.00069	0.00399	0.01474	0.07804	0.12244	0.10302	0.12244	0.0914	0.08498	0.10545	0.02601	0.06226	0.03156	0.03191	0.01786	0.01544	0.02549	0.02445	0.02445	0	0.01335	0	0	0	0
	1998	46	39	0	0	0	0	0	0	0	0	0	0	0.00686	0.00686	0.06293	0.09941	0.18438	0.14716	0.13418	0.21425	0.0524	0.01616	0.02449	0.04456	0	0.00637	0	0	0	0	0	0.00000	0	0	0	0
	1999	51	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05588	0.22602	0.19016	0.17181	0.17264	0.09591	0.03128	0	0.03336	0	0.02294	0	0	0	0	0	0	0	0	0
	2000	112	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13188	0.20211	0.09871	0.09871	0.12017	0.07647	0.09247	0.02146	0.05462	0.05462	0	0.02146	0	0	0	0.02731	0	0	0
Live	1997	514	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00725	0.1087	0.12319	0.18841	0.12319	0.15942	0.06522	0.07246	0.04348	0.04348	0.02174	0.01449	0.00725	0.01449	0	0.00725	0	0	0	0	0
	1998	1338	27	0	0	0	0	0	0	0	0	0	0	0.00386	0.0198	0.06022	0.08788	0.1658	0.18844	0.15045	0.10312	0.09671	0.03758	0.03118	0.01994	0.01169	0.0054	0.00773	0.00661	0.00253	0.00108	0	0	0	0	0	0
	1999	1450	123	0	0	0	0	0	0	0	0	0	0.00067	0	0.00091	0.00037	0.00395	0.0364	0.2263	0.21196	0.15428	0.11703	0.08334	0.04606	0.03948	0.0262	0.01865	0.01649	0.00644	0.00752	0.00291	0.00096	0.00008	0	0	0	0
	2000	2810	298	0	0	0	0	0	0	0	0	0	0	0.00024	0.00063	0.0013	0.00192	0.08805	0.20847	0.18594	0.15682	0.09852	0.08993	0.06075	0.03747	0.02311	0.02402	0.00972	0.00544	0.00382	0.00171	0.00181	0.00031	0	0	0	0
	2001	2101	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0003	0.02161	0.09625	0.23274	0.20812	0.15121	0.1169	0.07212	0.04096	0.0208	0.0205	0.00702	0.00606	0.00394	0.00118	0	0.0003	0	0	0	0
	2002	1288	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08137	0.21831	0.1316	0.11103	0.10026	0.11376	0.06239	0.05915	0.04763	0.0268	0.02137	0.01515	0.0085	0	0.00269	0	0	0	0
	2003	762	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03104	0.15447	0.16724	0.0727	0.07891	0.05646	0.00179	0.0764	0.06016	0.18049	0	0.06016	0.06016	0	0	0	0	0	0
	2004	1036	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00682	0.02163	0.25906	0.31331	0.23871	0.00418	0.00082	0.07678	0.00082	0.07615	0.00073	0.00036	0.00064	0	0	0	0	0	0
Recreational																																					
Shore	1993	27	43	0	0	0	0	0.02941	0	0	0	0.02941	0	0	0.02941	0.02941	0.08824	0.14706	0.14706	0.14706	0.08824	0.02941	0.05882	0.02941	0.02941	0.02941	0	0.02941	0.05882	0	0	0	0	0	0	0	0
	1994	15	11	0	0	0	0	0	0.09524	0.04762	0	0	0	0	0.04762	0.04762	0.04762	0.09524	0.2381	0.04762	0	0.19048	0.09524	0	0	0	0	0	0.04762	0	0	0	0	0	0	0	0
	1995	13	8	0	0	0	0	0	0	0.05882	0	0	0	0.05882	0	0	0.11765	0.17647	0.17647	0.05882	0.05882	0.17647	0.05882	0	0	0	0	0	0	0	0	0.05882	0	0	0	0	0
	1996	26	15	0	0	0	0	0	0	0	0	0	0.02703	0	0.02703	0.10811	0.10811	0.13514	0.18919	0.13514	0.10811	0	0.05405	0.05405	0	0.02703	0.02703	0	0	0	0	0	0	0	0	0	0
	1997	20	32	0	0	0	0	0	0	0	0	0.06897	0	0.03448	0.03448	0.03448	0.13793	0.13793	0.13793	0.17241	0.03448	0.10345	0.10345	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1998	20	12	0	0	0	0	0	0	0	0	0	0.02632	0.02632	0	0.02632	0.10526	0.13158	0.15789	0.21053	0.05263	0.13158	0.02632	0.02632	0	0.05263	0.02632	0	0	0	0	0	0	0	0	0	0
	1999	16	13	0	0	0	0	0	0	0	0	0	0.03448	0	0.10345	0.10345	0.31034	0.17241	0.06897	0.06897	0.10345	0.03448	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2000	5	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.625	0	0.25	0.125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2001	7	6	0	0	0	0	0	0	0	0	0	0.28571	0	0	0	0.14286	0	0	0	0.14286	0.42857	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2002	5	8	0	0	0	0	0	0	0	0.12500	0	0.12500	0	0	0	0.12500	0	0	0	0.12500	0.12500	0	0.12500	0.12500	0.12500	0	0	0	0	0	0	0	0	0	0	0
	2003	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0	0	0	0.4	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0
	2004	10	11	0	0	0	0	0	0	0	0	0	0	0	0	0.14286	0	0.07143	0	0.07143	0.21429	0	0.14286	0.07143	0	0.14286	0.07143	0	0.07143	0	0	0	0	0	0	0	0
PBR	1993	46	32	0	0	0	0	0	0	0	0.03226	0	0	0	0	0.01613	0.04839	0.08065	0.08065	0.24194	0.12903	0.16129	0.04839	0.01613	0.01613	0.03226	0.03226	0.01613	0.03226	0	0	0.01613	0	0	0	0	0
	1994	44	47	0	0	0	0	0	0	0	0	0	0.01724	0.03448	0.05172	0	0.06897	0.05172	0.10345	0.15517	0.15517	0.10345	0.05172	0.08621	0	0	0.01724	0.01724	0.03448	0.01724	0.01724	0.01724	0	0	0	0	0
	1995	32	24	0	0	0	0	0	0	0	0	0	0	0	0.02000	0.06000	0.10000	0.14000	0.10000	0.12000	0.08000	0.10000	0.04000	0.04000	0.02000	0.02000	0.04000	0.02000	0.04000	0.04000	0.02000	0	0	0	0	0	0
	1996	38	131	0	0	0	0	0	0	0	0	0.01695	0	0	0.01695	0.01695	0.08475	0.08475	0.0678	0.10169	0.0678	0.13559	0.0678	0.0678	0.0678	0.0339	0.05085	0.0339	0.0339	0.0339	0	0	0	0.01695	0	0	0
	1997	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25000	0.25000	0.37500	0	0.12500	0	0	0	0	0	0	0	0	0	0	0	0	0
	1998	24	32	0	0	0	0	0	0	0.03226	0	0	0.03226	0	0	0.06452	0.03226	0.06452	0.03226	0.19355	0.16129	0.16129	0.03226	0.03226	0.09677	0	0	0	0.06452	0	0	0	0	0	0	0	0
	1999	28	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13333	0.06667	0.03333	0.2	0.2	0.06667	0.13333	0.03333	0.06667	0	0.03333	0.03333	0	0	0	0	0	0	0	0	0
	2000	18	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04545	0	0.09091	0.09091	0.04545	0.22727	0.09091	0.18182	0.09091	0	0.04545	0.04545	0	0	0.04545	0	0	0	0	0
	2001	17	16	0	0	0	0	0	0	0	0	0	0	0.04167	0	0	0	0.08333	0	0.04167	0.04167	0.08333	0.125	0.29167	0.08333	0.08333	0.04167	0.04167	0	0.04167	0	0	0	0	0	0	0
	2002	12	20	0	0	0	0	0	0	0	0	0	0	0	0	0.05556	0	0	0.05556	0.16667	0.05556	0.11111	0.05556	0.11111	0	0.16667	0	0.05556	0	0.05556	0	0.05556	0	0.05556	0	0	0
	2003	37	49	0.02083	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.125	0.125	0.10417	0.0625	0.10417	0.14583	0.10417	0.0625	0.08333	0	0.04167	0	0.02083	0	0	0	0	0
	2004	153	113	0	0	0	0	0	0	0	0	0	0	0	0	0.00394	0.00394	0.01181	0.01969	0.04331	0.08268	0.09055	0.09843	0.15748	0.1378	0.12598	0.06299	0.05118	0.05118	0.02362	0.01969	0	0.00787	0.00394	0.00394	0	0
CPFV (Observer)	1987	32	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03125	0	0.09375	0.0625	0.09375	0.0625	0.15625	0.09375	0.09375	0.0625	0.0625	0.15625	0	0.03125	0	0	0	0	0
	1988	80	45	0	0	0	0	0	0	0	0	0	0	0.01250	0.02500	0.02500	0	0.01250	0.03750	0.05000	0.07500	0.07500	0.10000	0.20000	0.05000	0.06250	0.12500	0.02500	0.02500	0.05000	0	0.01250	0.02500	0.01250	0	0	0
	1989	74	82	0	0	0	0	0	0	0	0	0	0	0	0.01351	0.01351	0.02703	0.04054	0.10811	0.02703	0.10811	0.10811	0.04054	0.10811	0.09459	0.10811	0.05405	0.05405	0.05405	0.01351	0.01351	0	0.01351	0	0	0	0
	1990	11	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09091	0	0	0	0.27273	0.09091	0.09091	0.09091	0.09091	0.09091	0	0	0.09091	0	0.09091	0	0	0	0	0	0
	1991	18	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.05556	0.11111	0.16667	0.11111	0.05556	0.11111	0.05556	0	0.05556	0.05556	0.16667	0.05556	0	0	0	0	0	0	0
	1992	30	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0.03333	0.1	0.2	0.03333	0.16667	0.13333	0.06667	0.06667	0.06667	0.06667	0	0.03333	0	0	0.03333	0	0	0	0	0	0
	1993	32	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0625	0.09375	0.0625	0.125	0.1875	0.09375	0.09375	0.03125	0.09375	0.0625	0.0625	0	0.03125	0	0	0	0	0	0	0	0
	1994	41	28	0	0	0	0	0	0	0	0	0	0	0	0	0.04878	0	0.14634	0.17073	0.04878	0.09756	0.12195	0.09756	0.09756	0.02439	0	0.04878	0.04878	0	0	0.02439	0	0.02439	0	0	0	0
	1995	37	31	0	0	0	0	0	0	0	0	0	0	0	0.02703	0.02703	0.02703	0.02703	0.16216	0.08108	0.18919	0.08108	0.16216	0.02703	0.05405	0.08108	0	0.02703	0	0.02703	0	0	0	0	0	0	0
	1996	107	102	0	0	0	0	0	0	0	0	0.00935	0	0	0.00935	0.05607	0.13084	0.09346	0.1028	0.1215	0.09346	0.07477	0.06542	0.06542	0.06542	0.05607	0.02804	0	0.00935	0	0.00935	0.00935	0	0	0	0	0
	1997	59	21	0	0	0	0	0	0	0	0	0	0.01695	0	0	0	0.01695	0.08475	0.27119	0.10169	0.15254	0.10169	0.01695	0.15254	0.01695	0	0.03390	0	0.01695	0	0.01695	0	0	0	0	0	0
	1998	41	35	0	0	0	0	0	0	0	0	0	0	0.02439	0	0.02439	0.02439	0.07317	0.17073	0.14634	0.19512	0.04878	0.12195	0.09756	0.04878	0.02439	0	0	0	0	0	0	0	0	0	0	0
CPFV (RecFIN)	1996	13	20	0	0	0	0	0	0	0	0	0	0	0	0	0.06250	0	0.06250	0	0.06250	0.06250	0.12500	0.06250	0.12500	0.12500	0	0	0.06250	0.12500	0	0.06250	0	0	0	0	0.06250	0
	1997	15	18	0	0	0	0	0	0	0	0	0	0.04000	0	0	0	0	0.04000	0.16000	0.08000	0.20000	0.08000	0.04000	0.24000	0.04000	0	0.08000	0	0	0	0	0	0	0	0	0	0
	1998	17	17	0	0	0	0	0	0	0	0	0	0	0.03846	0	0.03846	0.03846	0.07692	0.19231	0.26923	0.15385	0.03846	0.11538	0	0	0	0.03846	0	0	0	0	0	0	0	0	0	0
	2001	20	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02632	0.02632	0.07895	0.10526	0.13158	0.02632	0.21053	0.18421	0.10526	0.02632	0.05263	0.02632	0	0	0	0	0	0	0	0
	2003	26	37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01786	0.10714	0.07143	0.10714	0.14286	0.17857	0.05357	0.08929	0.08929	0.03571	0.03571	0.01786	0.01786	0.01786	0	0	0	0	0.01786
	2004	16	36	0	0	0	0	0	0	0	0	0	0	0.04167	0.04167	0	0	0	0	0.04167	0.16667	0.125	0.08333	0.16667	0.16667	0.04167	0.08333	0	0	0	0	0	0	0.04167	0	0	0

Table 8 continued.

B) SCS

				Length bin																															
Sector	Year	N	N_{eff}	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68+
Recreational																																			
PBR	1994	7	17	0	0	0	0	0	0	0	0	0	0	0	0	0.06667	0.13333	0.2	0.06667	0.06667	0.06667	0	0.06667	0	0.06667	0	0	0.06667	0.06667	0	0.13333	0	0	0	0
	1996	10	42	0	0	0	0	0	0	0	0	0	0.03448	0.03448	0.13793	0.2069	0.2069	0.13793	0.03448	0.13793	0	0.03448	0	0	0	0	0	0	0	0	0	0.03448	0	0	0
	1998	7	12	0	0	0	0	0	0	0	0	0	0	0.09524	0.04762	0	0.28571	0.28571	0.14286	0	0.09524	0.04762	0	0	0	0	0	0	0	0	0	0	0	0	0
	1999	16	40	0	0	0	0	0	0	0.02500	0	0.02500	0.02500	0	0.07500	0.02500	0.12500	0.25000	0.17500	0.12500	0.05000	0.05000	0.02500	0	0	0	0.02500	0	0	0	0	0	0	0	0
	2002	11	17	0	0	0	0	0	0	0	0	0	0	0	0	0.27273	0.22727	0.22727	0.04545	0.04545	0	0.04545	0.09091	0	0	0	0.04545	0	0	0	0	0	0	0	0
	2003	12	45	0	0	0	0	0	0	0	0	0	0	0	0.03448	0.03448	0.17241	0.2069	0.17241	0.10345	0.13793	0	0.03448	0.03448	0	0.03448	0.03448	0	0	0	0	0	0	0	0
	2004	41	42	0	0	0	0	0	0	0	0	0	0.00862	0	0.01724	0.06034	0.07759	0.11207	0.08621	0.10345	0.16379	0.08621	0.07759	0.06034	0.0431	0.03448	0.02586	0.02586	0	0.00862	0	0	0	0	0.00862
CPFV	1975	76	66	0	0	0	0	0	0	0.01316	0	0.01316	0.02632	0.09211	0.07895	0.14474	0.17105	0.07895	0.11842	0.03947	0.07895	0.03947	0.02632	0.02632	0.02632	0	0.01316	0	0	0.01316	0	0	0	0	0
	1976	95	83	0	0	0	0.01053	0	0	0	0.01053	0.01053	0.05263	0.06316	0.10526	0.18947	0.09474	0.06316	0.08421	0.05263	0.08421	0.03158	0.04211	0.02105	0.02105	0.04211	0	0.01053	0.01053	0	0	0	0	0	0
	1977	76	83	0	0	0	0	0.01316	0	0	0	0	0.06579	0.11842	0.13158	0.14474	0.06579	0.09211	0.09211	0.05263	0.03947	0.05263	0.01316	0.03947	0.03947	0	0.01316	0.01316	0	0	0	0.01316	0	0	0
	1978	101	142	0	0	0	0.00990	0	0	0.0198	0.0099	0	0.0495	0.0495	0.06931	0.11881	0.07921	0.10891	0.07921	0.0495	0.08911	0.07921	0.02970	0.02970	0.03960	0	0.03960	0.03960	0	0.00990	0	0	0	0	0
	1986	82	124	0	0	0	0	0	0	0.0122	0.0122	0.07317	0.18293	0.15854	0.19512	0.17073	0.04878	0.03659	0.03659	0.03659	0	0.02439	0.0122	0	0	0	0	0	0	0	0	0	0	0	0
	1987	100	68	0	0	0	0	0	0	0	0	0.02000	0.01000	0.13000	0.12000	0.25000	0.13000	0.12000	0.09000	0.09000	0.03000	0.01000	0	0	0	0	0	0	0	0	0	0	0	0	0
	1988	65	63	0	0	0	0	0	0	0	0	0.01538	0.06154	0.04615	0.07692	0.12308	0.15385	0.12308	0.09231	0.10769	0.15385	0.01538	0.01538	0	0	0.01538	0	0	0	0	0	0	0	0	0
	1989	93	81	0	0	0	0	0	0.01075	0	0.02151	0.06452	0.16129	0.16129	0.08602	0.09677	0.08602	0.06452	0.08602	0.03226	0.01075	0.03226	0.01075	0.01075	0.04301	0.02151	0	0	0	0	0	0	0	0	0

Table 9. Annual mean body weights of cabezon by substock and fleet.
A)NCS

Fleet	Year	Mean weight (kg)	CV
Man made	1980	0.77	1.23
	1981	0.69	0.70
	1982	0.71	0.75
	1983	0.72	0.72
	1984	1.04	0.76
	1985	0.55	0.86
	1986	0.86	0.74
	1987	0.75	0.76
	1988	1.13	0.86
	1989	0.62	0.64
	1993	0.44	0.98
	1994	0.80	1.00
	1995	0.20	0.52
	1996	0.33	1.11
	1997	0.68	1.29
	1999	0.26	0.91
	2001	0.50	0.87
	2002	0.63	0.88
	2003	0.98	0.83
	2004	0.93	0.82
Shore	1958	0.41	0.20
	1960	0.41	0.20
	1961	0.41	0.20
	1980	1.07	0.73
	1981	0.78	0.47
	1982	1.03	0.69
	1983	0.93	0.49
	1984	0.97	0.58
	1985	0.70	0.56
	1986	0.98	0.51
	1987	0.60	0.79
	1988	0.72	0.68
	1989	0.89	1.04
	1993	0.92	0.62
	1994	0.88	0.90
	1995	0.87	0.51
	1996	0.91	0.39
	1997	1.16	0.45
	1998	1.15	0.42
	1999	0.95	0.54
	2000	0.95	0.70
	2001	0.88	0.01
	2002	1.16	0.44
	2003	1.27	0.36
	2004	1.60	0.36

Fleet	Year	Mean weight (kg)	CV
PBR	1980	1.56	0.45
	1981	2.02	0.83
	1982	1.57	0.40
	1983	1.62	0.44
	1984	1.40	0.40
	1985	1.56	0.39
	1986	1.37	0.43
	1987	1.38	0.44
	1988	1.44	0.46
	1989	1.33	0.54
	1993	1.29	0.39
	1994	1.43	0.52
	1995	1.28	0.53
	1996	1.27	0.51
	1997	0.80	0.46
	1998	1.23	0.40
	1999	1.48	0.38
	2000	1.46	0.36
	2001	1.57	0.33
	2002	1.33	0.46
	2003	1.61	0.29
	2004	1.83	0.44
CPFV	1947	2.27	0.50
	1948	2.27	0.50
	1949	2.27	0.50
	1950	2.27	0.50
	1951	2.27	0.50
	1960	2.42	0.50
	1980	1.64	0.32
	1981	1.67	0.29
	1983	2.33	0.45
	1985	1.54	0.41
	1986	1.79	0.80
	1988	1.64	0.63
	1989	1.07	0.29
	1994	1.22	0.34
	1995	2.44	0.42
	1996	1.28	0.48
	1997	1.13	0.50
	1998	1.32	0.30
	1999	1.59	0.29
	2000	1.59	0.44
	2001	1.58	0.33
	2002	1.63	0.44
	2003	1.55	0.30
	2004	1.56	0.40

Table 9 (continued).

B)SCS

Fleet	Year	Mean weight (kg)	CV
Man made	1980	0.49	0.52
	1981	0.42	0.65
	1982	0.49	0.29
	1983	0.58	0.66
	1984	0.45	0.56
	1985	0.26	0.50
	1987	0.81	0.54
	1989	0.84	0.82
	1999	0.31	0.70
	2000	0.05	0.39
Shore	1980	1.13	0.54
	1981	0.78	0.51
	1982	0.81	0.52
	1983	0.74	0.56
	1984	0.89	0.22
	1985	0.80	0.49
	1986	0.89	0.76
	1987	1.06	0.55
	1988	1.13	0.53
	1989	1.36	0.53
	1995	0.36	0.55
	1996	0.56	0.25
	1998	0.78	0.52
	1999	0.76	0.32
	2002	1.59	0.53
	2003	0.69	0.15
	2004	0.67	0.05

Fleet	Year	Mean weight (kg)	CV
PBR	1980	1.29	0.49
	1981	1.26	0.51
	1982	1.06	0.57
	1983	0.82	0.53
	1984	1.04	0.43
	1985	1.14	0.72
	1986	0.84	0.66
	1987	1.07	0.65
	1988	0.78	0.37
	1989	1.10	0.56
	1993	0.47	0.23
	1994	1.20	0.69
	1995	0.67	0.28
	1996	0.68	0.35
	1997	1.42	0.52
	1998	0.76	0.11
	1999	0.68	0.46
	2000	1.66	0.52
	2001	0.68	0.16
	2002	0.79	0.63
	2003	0.98	0.42
	2004	1.20	0.57
CPFV	1980	0.97	0.59
	1981	1.02	0.50
	1982	0.75	0.80
	1983	0.79	0.63
	1984	1.04	0.46
	1985	0.56	0.50
	1986	0.59	0.34
	1987	1.16	0.43
	1988	0.51	0.56
	1989	0.69	0.65
	1994	0.94	0.22
	1996	0.65	0.15
	1998	1.01	0.67
	1999	0.46	0.27
	2000	0.71	0.21
	2003	2.17	0.38
	2004	1.62	0.45

Table 10. Summary statistics for the data sources that could form the basis for abundance indices.

Area	Data Source	Years	# Observations	# Positives	% Positive
NCS	CPFV Logbook CPUE	1957-2003	23993	6440	26.84%
	CPFV Observer CPUE	1988-1997	4546	236	5.19%
	RecFIN PBR*	1980-1989;1993-2004	113980	2100	1.84%
	Monterey Adult Survey*	1993-1998	103	77	74.76%
	TENERA Adult Survey*	1977-2002	85	79	92.94%
	CalCOFI oblique (C1) tow*	1951-1975	3257	82	2.52%
	CalCOFI oblique (CB) tow*	1978-2004	1171	18	1.54%
SCS	CPFV Logbook CPUE	1947-2003	32388	10305	31.82%
	RecFIN PBR*	1980-1989;1993-2004	97183	777	0.80%
	CalCOFI oblique (C1) tow*	1951-1975	25252	112	0.44%
	CalCOFI oblique (CB) tow*	1977-2004	8115	30	0.37%
	CalCOFI manta tow	1978,1980,1981,1984-2002	2380	344	14.45%
	Power Plant	1972-2002	6834	962	14.08%

*Not used in the base case assessment

Table 11. AIC values for the different models considered when developing potential indices of abundance for the NCS.

Model	Binomial AIC	Lognormal AIC	Gamma AIC
NCS CPFV			
1957-1961			
Yr	2510	3088	-2342
Yr+Loc	2306	2932	-2480
Yr+Mo	2513	2993	-2527
Yr+Mo+Loc	*2303*	*2829*	*-2664*
1962-2003			
Yr	27512	27709	-46429
Yr+Loc	26913	27068	-47314
Yr+Mo	27027	27483	-46864
Yr+Mo+Loc	*26392*	*26786*	*-47708*
1960-2003			
Yr	28583	28954	-48693
Yr+Loc	27973	28285	-49595
Yr+Mo	28098	28700	-49189
Yr+Mo+Loc	*27449*	*27971*	*-50055*
1957-2003			
Yr	30022	30832	-51545
Yr+Loc	29373	30126	-52449
Yr+Mo	29556	30528	-52121
Yr+Mo+Loc	*28859*	*29758*	*-53005*
MONTEREY			
Yr	118	172	-35
Yr + Loc	120	190	-22
Yr + Mo	122	174	-33
Yr+Dep	*123*	*171*	*-42*
Yr+Loc+Dep	134	185	-32
Yr+Mo+Dep	129	176	-34
Yr+Mo+Loc	124	188	-23
Yr+Mo+Loc+Dep	141	187	-29
TENERA			
Yr	68	200	227
Yr + Mo	*76*	*181*	*214*

Yr- Year; Mo- Month; Loc- Location; Dep- Depth

Table 12. AIC values for the different models considered when developing potential indices of abundance for the SCS.

Model	Binomial AIC	Lognormal AIC	Gamma AIC
SCS CPFV			
1947-1961			
Yr	8248	10047	-14458
Yr+Loc	7869	9607	-14904
Yr+Mo	7777	9826	-14768
Yr+Mo+Loc	*7315*	*9363*	*-15373*
1962-2003			
Yr	36978	37553	-94978
Yr+Loc	34992	34739	-98741
Yr+Mo	36089	37169	-95471
Yr+Mo+Loc	*33944*	*34064*	*-99558*
1960-2003			
Yr	38174	38582	-97845
Yr+Loc	36111	35800	-101619
Yr+Mo	37269	38183	-98336
Yr+Mo+Loc	*35033*	*35101*	*-102442*
1947-2003			
Yr	45226	47653	-119326
Yr+Loc	43243	44680	-123315
Yr+Mo	43994	47079	-120049
Yr+Mo+Loc	*41766*	*43800*	*-124455*
CalCOFI			
Yr	1929.86	1078.24	
Yr+Day/Night	1838.51	1069.41	
Yr+Day/Night+Lat	*1769.81*	*1057.76*	
Yr+Lat	1868.8	1071.46	
Yr+Long	1931.07	1080.08	
Yr+Mo	1905.78	1077.1	
Impingement			
Yr	5494.07	2904.42	
Yr+Mo	5607.46	3016.11	
Yr+Season	4993.35	2682.41	
Yr+Season+Station	*4881.64*	*2620.23*	
Yr+Station	5380.96	2841.29	

Yr- Year; Mo- Month; Loc- Location; Lat- Latitude; Long- Longitude

Table 13. Fishery-dependent and -independent abundance indices considered in the 2005 cabezon stock assessment for the NCS. The CVs are derived from a bootstrap procedure.

	Fishery Dependent								Fishery Independent			
	Northern California CPFV								Monterey		TENERA	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1957	0.06	0.26					0.0332	0.09				
1958	0.04	0.22					0.0209	0.05				
1959	0.03	0.20					0.0156	0.05				
1960	0.02	0.22			0.01	0.08	0.0095	0.08				
1961	0.02	0.25			0.01	0.07	0.0088	0.07				
1962			0.01	0.11	0.01	0.11	0.0093	0.11				
1963			0.02	0.14	0.02	0.13	0.0150	0.13				
1964			0.02	0.15	0.02	0.15	0.0167	0.15				
1965			0.02	0.08	0.02	0.08	0.0196	0.08				
1966			0.02	0.10	0.02	0.11	0.0169	0.11				
1967			0.01	0.09	0.01	0.09	0.0104	0.10				
1968			0.01	0.09	0.01	0.10	0.0069	0.10				
1969			0.01	0.14	0.01	0.15	0.0058	0.16				
1970			0.01	0.17	0.01	0.18	0.0086	0.19				
1971			0.01	0.09	0.01	0.09	0.0069	0.09				
1972			0.01	0.10	0.01	0.10	0.0115	0.11				
1973			0.01	0.12	0.01	0.11	0.0105	0.12				
1974			0.01	0.08	0.01	0.09	0.0098	0.10				
1975			0.01	0.07	0.01	0.07	0.0058	0.07				
1976			0.01	0.19	0.01	0.19	0.0073	0.21				
1977			0.01	0.12	0.01	0.12	0.0065	0.12			1.47	0.49
1978			0.01	0.11	0.01	0.11	0.0129	0.10			2.28	0.68
1979											1.73	0.23
1980			0.01	0.09	0.01	0.09	0.0098	0.10			1.52	0.40
1981			0.01	0.08	0.01	0.09	0.0063	0.09			1.09	0.48
1982			0.01	0.11	0.01	0.10	0.0052	0.11			1.54	0.47
1983			0.01	0.23	0.01	0.20	0.0054	0.23			1.42	0.52
1984			0.00	0.12	0.00	0.12	0.0028	0.13			0.77	0.58
1985			0.00	0.15	0.00	0.15	0.0020	0.14			1.55	0.38
1986			0.00	0.27	0.00	0.26	0.0041	0.27			4.48	0.62
1987			0.01	0.11	0.01	0.11	0.0057	0.11			2.28	0.76
1988			0.01	0.09	0.01	0.10	0.0071	0.10			1.85	0.37
1989			0.01	0.17	0.01	0.18	0.0055	0.19			2.16	0.46
1990			0.00	0.11	0.00	0.11	0.0043	0.12			2.52	0.38
1991			0.00	0.16	0.00	0.17	0.0033	0.18			3.49	0.28
1992			0.00	0.20	0.00	0.21	0.0044	0.21			1.70	0.38
1993			0.00	0.16	0.00	0.17	0.0032	0.18	0.11	0.38	0.92	0.54
1994			0.00	0.18	0.00	0.18	0.0021	0.18	0.25	0.32	0.83	0.52
1995			0.00	0.17	0.00	0.17	0.0021	0.16	0.21	0.43	1.42	0.46
1996			0.00	0.13	0.00	0.14	0.0034	0.15	0.08	1.01	0.84	0.58
1997			0.00	0.10	0.00	0.10	0.0042	0.11	0.25	0.29	1.83	0.34
1998			0.00	0.13	0.00	0.14	0.0035	0.15	0.15	0.50	1.02	0.55
1999			0.00	0.15	0.00	0.14	0.0043	0.15				
2000			0.00	0.15	0.00	0.14	0.0033	0.14			0.78	0.28
2001			0.01	0.18	0.01	0.19	0.0060	0.19			0.88	0.36
2002			0.00	0.27	0.00	0.28	0.0023	0.29			0.57	0.47
2003			0.01	0.07	0.01	0.08	0.0091	0.08				

Table 14. Fishery dependent and independent abundance indices considered in the 2005 cabezon stock assessment for the SCS. The CVs are derived from a bootstrap procedure.

	Fishery Dependent								Fishery Independent			
	Southern California CPFV								CalCOFI		Impingement	
Year	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV	Index	CV
1947	0.000436	1.62					0.000817	1.77				
1948	0.000968	0.34					0.001498	0.38				
1949	0.000930	0.27					0.001438	0.21				
1950	0.001173	0.25					0.001696	0.28				
1951	0.001194	0.25					0.001601	0.25				
1952	0.001560	0.26					0.001936	0.25				
1953	0.002569	0.18					0.003053	0.14				
1954	0.006878	0.16					0.006356	0.11				
1955	0.008510	0.14					0.006688	0.11				
1956	0.010580	0.24					0.009009	0.25				
1957	0.005703	0.14					0.004561	0.10				
1958	0.003395	0.11					0.003050	0.07				
1959	0.000751	0.24					0.000888	0.19				
1960	0.000220	0.35			0.0004	0.26	0.000394	0.24				
1961	0.000487	0.42			0.0008	0.76	0.000733	0.60				
1962			0.001614	0.14	0.0016	0.14	0.001627	0.14				
1963			0.002329	0.23	0.0024	0.25	0.002318	0.23				
1964			0.002292	0.09	0.0023	0.09	0.002320	0.09				
1965			0.001840	0.08	0.0019	0.07	0.001865	0.08				
1966			0.002447	0.39	0.0025	0.40	0.002492	0.38				
1967			0.001742	0.11	0.0018	0.11	0.001781	0.11				
1968			0.001051	0.28	0.0011	0.28	0.001075	0.29				
1969			0.001110	0.24	0.0011	0.26	0.001128	0.27				
1970			0.001092	0.17	0.0011	0.17	0.001114	0.17				
1971			0.001328	0.20	0.0013	0.19	0.001371	0.20				
1972			0.002351	0.40	0.0024	0.45	0.002436	0.44			13.57	0.22
1973			0.001159	0.18	0.0012	0.18	0.001207	0.16			17.22	0.20
1974			0.001586	0.12	0.0016	0.12	0.001634	0.12			6.52	0.18
1975			0.002205	0.12	0.0022	0.12	0.002288	0.10			9.38	0.15
1976			0.001708	0.11	0.0017	0.11	0.001760	0.10			7.12	0.16
1977			0.001127	0.08	0.0011	0.08	0.001156	0.08			4.39	0.23
1978			0.001440	0.10	0.0015	0.11	0.001476	0.10	63.18	0.70	3.31	0.21
1979											1.48	0.22
1980			0.001220	0.14	0.0012	0.13	0.001257	0.13	100.16	0.48	1.70	0.20
1981			0.001214	0.10	0.0012	0.10	0.001256	0.10	43.57	0.30	2.76	0.24
1982			0.000844	0.11	0.0009	0.11	0.000865	0.11			2.30	0.26
1983			0.000783	0.12	0.0008	0.11	0.000813	0.12			2.36	0.24
1984			0.000228	0.19	0.0002	0.19	0.000235	0.17	39.44	0.28	2.46	0.22
1985			0.000461	0.72	0.0005	0.70	0.000473	0.90	74.52	0.31	2.36	0.21
1986			0.001314	0.10	0.0013	0.10	0.001355	0.10	29.46	0.34	1.58	0.24
1987			0.001658	0.09	0.0017	0.09	0.001708	0.09	32.96	0.46	2.65	0.20
1988			0.001426	0.11	0.0014	0.11	0.001463	0.11	31.43	0.30	1.04	0.34
1989			0.002456	0.10	0.0025	0.09	0.002551	0.09	87.16	0.21	2.59	0.24
1990			0.002987	0.09	0.003	0.09	0.003098	0.09	44.32	0.50	1.73	0.26
1991			0.002035	0.09	0.0021	0.09	0.002113	0.08	85.75	0.32	2.39	0.23
1992			0.001186	0.07	0.0012	0.07	0.001217	0.07	16.66	0.67	1.51	0.24
1993			0.000726	0.12	0.0007	0.13	0.000739	0.13	16.82	0.50	0.56	0.34
1994			0.000445	1.21	0.0005	1.23	0.000458	1.26	16.66	0.58	0.80	0.36
1995			0.000626	0.16	0.0006	0.16	0.000649	0.15	30.34	0.38	0.84	0.44
1996			0.001143	0.20	0.0012	0.18	0.001195	0.19	33.24	0.35	0.76	0.43
1997			0.000828	0.15	0.0008	0.15	0.000859	0.14	46.69	0.37	1.32	0.39
1998			0.000338	0.16	0.0003	0.15	0.000351	0.14	3.16	0.29	0.77	0.41
1999			0.000338	0.18	0.0003	0.19	0.000351	0.19	52.95	0.29	5.87	0.22
2000			0.000636	0.69	0.0006	0.68	0.000652	0.77	40.23	0.36	4.26	0.32
2001			0.000826	0.14	0.0008	0.13	0.000852	0.13	29.37	0.37	6.02	0.49
2002			0.000434	0.26	0.0004	0.28	0.000443	0.29	112.91	0.34	8.27	0.29
2003			0.000375	0.18	0.0004	0.17	0.000407	0.18				

Table 15. Input variables and parameters of the population dynamics model. The base-case values are given for those parameters that are pre-specified. An X indicates the parameter is estimated. Prior distributions for the parameters are listed in the SS2 control files (Appendices B-2 and C-2).

	Cabezon substock			
	NCS		SCS	
Parameter	Pre-specified in Base Case	Estimated in Base Case	Pre-specified in Base Case	Estimated in Base Case
Age at minimum length (L_{min})	0		0	
Age at maximum length (L_{max})	17		17	
Natural Mortality (*M*)	0.25(F)/0.3(M)		0.25(F)/0.3(M)	
Minimum Length (L_{min})	10.79(F)/16.93(M)		10.79(F)/16.93(M)	
Maximum Length (L_{max})	59.71(F)/46.56(M)		59.71(F)/46.56(M)	
Growth rate (k)	0.18(F)/0.28(M)		0.18(F)/0.28(M)	
Length at age 0 CV	0.14		0.14	
Length at age 17 CV	0.09		0.09	
$\ln R_O$		X		X
steepness (*h*)	0.7		0.7	
σ_R	1		1	
Recruitment (years)		(1980-2003)		(1970-2003)
Selectivities				
Commercial non-live				
parameter 1		X	NSC value	
parameter 2		X	NSC value	
Commericial live				
parameter 1		X	NSC value	
parameter 2	0		NSC value	
parameter 3		X	NSC value	
parameter 4		X	NSC value	
parameter 5		X	NSC value	
parameter 6		X	NSC value	
parameter 7		X	NSC value	
parameter 8	1		NSC value	
Recreational Man-made				
parameter 1		X	NSC value	
parameter 2	0		NSC value	
parameter 3		X	NSC value	
parameter 4	0.5			X
parameter 5	-0.5		NSC value	
parameter 6		X		X
parameter 7		X		X
parameter 8	4		NSC value	
Recreational Shore				
parameter 1		X	NSC value	
parameter 2	0		NSC value	
parameter 3		X	NSC value	
parameter 4		X		X
parameter 5		X	NSC value	
parameter 6		X		X
parameter 7		X		X
parameter 8	4		NSC value	
Recreational PBR				
parameter 1		X		X
parameter 2		X		X
Recreational CPFV				
parameter 1		X		X
parameter 2		X		X
CPFV survey	mirrors Recreational CPFV		mirrors Recreational CPFV	
CalCOFI survey				
parameter 1			0	
parameter 2			0	
Impingement survey				
parameter 1			0	
parameter 2			1	

Table 16. Comparison of total cabezon reproductive output (measured in spawning biomass (mt)) and depletion rates in California among the two current assessment models and previous assessment.

Model	Total California Cabezon Spawning Biomass (mt)					
	SB_{1916}	SB_{1930}	SB_{2003}	SB_{2005}	SB_{2003}/SB_{1930}	SB_{2005}/SB_{1916}
2005 Assessment						
two substock model	1361	1353	542	516	40.0%	37.9%
one stock model	1268	1260	353	634	28.0%	50.0%
one stock/all lengths	1245	1207	428	318	35.5%	25.5%
2003 Assessment		902	313		34.7%	

Table 17. Values for the likelihood components and summary statistics related to the current status of the resource for the sensitivity tests that involve changing the data sources included in the assessment (- data source is ignored)

NCS

		Trial												
Likelihood Components	Base Case	1	2	3	4	5	6	7	8	9	10	11	12	13
Abundance Index														
CPFV (1960-2003)	24.49	24.21	25.4	25.27	27.11	23.8	21.00	-	-	-	22.80	23.17	20.65	23.29
CPFV (1957-2003)	-	-	-	-	-	-	-	28.98	-	-	-	-	-	-
CPFV (1957-1961;1962-2003)	-	-	-	-	-	-	-	-	2.76/21.93	-	-	-	-	-
Monterey adult survey	-	-	-	-	-	-	-	-	-	-	2.40	-	2.11	-
TENERA adult survey	-	-	-	-	-	-	-	-	-	-	19.69	19.57	-	-
RecFIN PBR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean Body Weight	21.75	21.74	20.29	17.57	17.54	13.76	13.44	21.70	21.12	21.44	18.74	19.27	21.63	19.89
Lengt														
										51.28	53.5	53.68	52.71	51.78
Commerical (live)	51.98	46.7	-	48.55	43.61	52.85	50.11	54.37	52.32	51.69	50.86	49.76	50.29	51.18
Rec: Shore-based	88.38	80.74	77.64	80.08	-	85.73	77.66	77.34	77.56	91.84	77.55	78.88	78.69	90.15
Rec: PBR	112.52	109.05	110.68	110	105.04	-	115.56	112.56	111.08	111.46	113.26	112.45	111.81	110.90
Rec: CPFV	146	141.98	143.3	142.25	138.03	147.05	-	143.47	143.96	144.06	144.65	143.94	142.48	146.36
Recruitment penalty	6.91	6.25	7.59	6.74	6.71	5.29	11.12	6.47	7.04	7.76	8.96	8.85	7.19	8.25
Parameter priors	6.05	5.12	4.99	4.47	2.98	2.53	4.12	3.31	3.33	1.98	2.16	2.02	1.99	3.37
TOTAL LIKELIHOOD	509.7	435.78	380.72	487.57	395.25	381.24	343.2	500.04	490.69	481.50	514.56	511.58	489.55	505.19
1916 reproductive output	1110 (87)	1196 (118)	1104 (95)	1096 (89)	1133 (96)	1268 (105)	900 (106)	1091 (82)	1108 (88)	1057 (98)	917 (68)	921 (68)	1092 (87)	1063 (82)
2005 reproductive output	445 (103)	390 (67)	404 (73)	372 (56)	414 (71)	534 (54)	324 (54)	396 (44)	443.72 (103)	398 (65)	276 (23)	264 (32)	448 (51)	447 (88)
%Depletion	40.1 (7)%	41.4 (8)%	36.4 (8)%	38.1 (7)%	36.56 (7)%	42.1 (8)%	47.42 (11)%	36.3 (7)%	40.1 (7)%	37.6 (10)%	30.1 (6)%	28.7 (6)%	41.0 (8)%	42.0 (6)%

SCS

						Trial							
Likelihood Components	Base Case	1	2	3	4	5	6	7	8	9	10	11	12
Abundance Index													
CPFV (1960-2003)	49.24	40.65	49.39	46.41	30.94	53.29	-	-	-	46.71	43.97	41.55	45.23
CPFV (1947-2003)	-	-	-	-	-	-	82.45	-	-	-	-	-	
CPFV (1947-1961;1962-2003)	-	-	-	-	-	-	-	13.07/41.92	-	-	-	-	
CalCOFI larval tows	10.03	9.20	10.17	9.93	9.90	6.01	8.57	14.08	9.03	-	12.16	-	15.30
Impingement	14.01	15.28	14.19	13.95	14.11	11.79	12.56	13.02	9.26	16.64	-	-	20.59
RecFIN PBR													
Mean Body Weight	62.27	36.12	62.25	53.13	38.38	51.58	67.69	57.30	42.97	57.07	59.90	55.50	76.69
Length Comps.													
Rec: PBR	70.64	63.68	70.71	66.77	-	73.66	72.89	69.48	68.16	68.82	70.12	69.30	73.05
Rec: CPFV	86.99	85.28	86.87	85.96	87.20	-	87.29	91.09	95.78	84.95	87.18	85.21	87.79
Recruitment penalty	26.69	20.79	26.34	22.04	21.29	16.04	24.23	22.25	20.53	27.99	25.00	28.02	34.77
Parameter priors	4.45	4.25	4.23	4.29	4.20	5.85	4.31	4.73	4.32	4.64	5.22	5.13	4.53
TOTAL LIKELIHOOD	324.41	275.26	324.15	302.48	206.34	218.22	359.99	326.88	250.05	306.82	303.58	284.71	357.43
1916 reproductive output	251 (21)	230 (21)	250 (21)	248 (23)	264 (22)	318 (30)	261 (19)	314 (25)	381 (30)	230 (23)	237 (22)	210 (18)	216 (14)
2005 reproductive output	71 (15)	13 (7)	74 (16)	84 (18)	69 (15)	76 (17)	62 (13)	90 (19)	154 (42)	66 (15)	60 (14)	56 (14)	63 (12)
%Depletion	28.3 (6)%	5.8 (3)%	29.7 (6)%	34.1 (7)%	26.2 (6)%	23.9 (5)%	23.4 (5)%	28.5 (6)%	40.5 (11)%	28.7 (7)%	25.3 (6)%	26.5 (6)%	29.0 (5)%

Table 18. Results of the sensitivity tests in which the (pre-specified) values for M and σ_R are varied. The results in bold typeface pertain to the base case analyses.

NCS

M						Negative Log
Female	Male	σ_R	SB_{1916}	SB_{2005}	Depletion	Likelihood
0.2	0.25	0.5	1006	359	35.69%	519.04
		1	1065	326	30.61%	508.94
		1.5	1059	295	27.86%	510.93
0.25	0.25	0.5	892	499	55.94%	523.55
		1	1065	473	44.41%	510.41
		1.5	1151	402	34.93%	509.07
0.25	0.3	0.5	954	373	39.10%	520.12
		1	**1110**	**445**	**40.10%**	**509.70**
		1.5	1164	383	32.90%	508.15
0.3	0.35	0.5	1003	686	68.39%	526.69
		1	1265	619	48.93%	507.67
		1.5	1479	520	35.16%	505.17
0.2	0.35	0.5	1118	344	30.77%	518.51
		1	1135	304	26.78%	509.03
		1.5	1141	282	24.72%	513.53

SCS

M						Negative Log
Female	Male	σ_R	SB_{1916}	SB_{2005}	Depletion	Likelihood
0.2	0.25	0.5	327	59	18.00%	371.13
		1	261	67	25.50%	355.13
		1.5	242	71	29.29%	363.16
0.25	0.25	0.5	237	55	23.31%	335.96
		1	220	63	28.65%	329.70
		1.5	209	65	30.94%	340.86
0.25	0.3	0.5	263	56	21.47%	326.14
		1	**251**	**71**	**28.27%**	**324.42**
		1.5	239	68	28.56%	334.38
0.3	0.35	0.5	213	59	27.69%	307.26
		1	238	68	28.72%	302.32
		1.5	235	66	27.99%	315.82
0.2	0.35	0.5	379	62	16.40%	358.63
		1	306	69	22.67%	348.42
		1.5	290	76	26.20%	352.15

Table 19. Results of the sensitivity tests in which changes are made to: a) the years for which recruitment residuals are estimated, b) the specifications for length/age-specific selectivity, c) the length data included in the analyses, d) the historical catches, e) the coefficients of variation assumed for the abundance indices and the effective sample sizes assumed for the length-composition data, and f) the coefficients of variation assumed for length-at-age.

NCS

		SB_{1916}	SB_{2005}	Depletion	Negative Log Likelihood
Base Case		1110	445	40.09%	510.00
Recruitment Year					
	start:1916	1693	512	30.27%	500.29
	start:1947	1608	512	31.82%	499.97
	start:1970	1354	519	38.31%	502.26
	start:1990	753	223	29.53%	527.14
	end: 2002	1130	468	41.43%	507.56
	end: 2004	1107	428	38.67%	506.01
Logisitic Selectivity					
	all fleets	1014	454	44.74%	532.36
	fleet 3 & 4	1014	453	44.73%	531.88
All lengths		962	324	33.64%	708.75
Original CV/N_{eff}		1014	453	44.73%	531.88
Max N_{eff} = 200		1292	534	41.33%	627.82
Catch history					
	Halved	747	351	47.05%	512.29
	Double	1858	720	38.73%	503.84
	Numbers	1709	744	43.53%	507.01
Length at age CV (both sexes)					
	0.05	1456	618	42.47%	537.95
	0.2	664	157	23.70%	534.09
	0.2/0.05	1213	542	44.67%	524.47
	0.05/0.2	781	197	25.16%	521.70
	0.09/0.014	960	306	31.94%	507.29

SCS

		SB_{1916}	SB_{2005}	Depletion	Negative Log Likelihood
Base Case		251	71	28.27%	324.42
Recruitment Year					
	start:1916	432	76	17.55%	289.22
	start:1960	401	79	19.68%	301.46
	start:1980	259	69	26.74%	326.12
	end: 2002	243	69	28.59%	370.32
	end: 2004	246	73	29.65%	321.85
Logositic Selectivity					
	all fleets	231	50	21.61%	351.89
	fleet 3 & 4	236	73	31.04%	358.53
CalCOFI selectivity					
	selectivity= female maturity	231	68	29.32%	312.63
All lengths		283	59	20.97%	322.73
Original CV/N_{eff}		236	73	31.04%	358.53
Max N_{eff} = 200		257	72	28.02%	349.78
Catch history					
	Halved	136	29	21.50%	325.98
	Double	431	105	24.48%	334.81
	Numbers	266	84	31.56%	317.07
	1980 catch	226	66	29.12%	319.05
Length at age CV (both sexes)					
	0.05	317	86	27.19%	364.81
	0.2	189	26	13.98%	326.35
	0.2/0.05	248	70	28.08%	330.73
	0.05/0.2	254	58	23.03%	319.37
	0.09/0.014	257	62	24.09%	316.57

Table 20. Projections (2006–16) of harvest levels, age 2^+ biomass, spawning biomass and depletion for each substock under two different control rules/F_{MSY} proxies.

A) NCS

	40-10/$F_{45\%}$					60-20/$F_{50\%}$				
Year	OY	ABC	SB_{2+}	SB	Depletion	OY	ABC	SB_{2+}	SB	Depletion
2005	59	107	727	440	40%	59	90	727	440	40%
2006	59	90	684	393	35%	59	78	684	393	35%
2007	84	81	655	360	32%	44	71	655	360	32%
2008	76	78	655	327	29%	43	70	691	351	32%
2009	77	81	684	321	29%	48	73	746	363	33%
2010	84	86	721	335	30%	58	78	805	390	35%
2011	91	92	755	354	32%	68	83	857	420	38%
2012	97	96	782	370	33%	77	88	900	445	40%
2013	102	100	803	383	34%	84	91	934	465	42%
2014	105	103	821	392	35%	89	95	960	481	43%
2015	108	105	834	400	36%	93	97	981	494	44%
2016	110	107	845	406	37%	96	100	997	503	45%

B) SCS

	40-10/$F_{45\%}$					60-20/$F_{50\%}$				
Year	OY	ABC	SB_{2+}	SB	Depletion	OY	ABC	SB	SB_{2+}	Depletion
2005	10	24	197	72	29%	10	21	197	72	29%
2006	10	27	217	90	36%	10	23	217	90	36%
2007	30	26	226	112	45%	22	23	226	112	45%
2008	29	25	219	111	45%	22	23	227	116	46%
2009	28	25	214	106	43%	21	23	228	115	46%
2010	27	25	211	103	41%	21	23	230	115	46%
2011	27	25	209	101	40%	22	23	232	116	46%
2012	27	25	207	100	40%	22	23	234	117	47%
2013	27	25	206	100	40%	22	24	235	118	47%
2014	26	26	205	99	40%	23	24	237	118	47%
2015	26	26	204	99	39%	23	24	237	119	48%
2016	26	26	204	98	39%	23	24	238	120	48%

Table 21. Decision analyses of different states of nature under different catch histories and fishery control rules for each cabezon substock. The probability (p) of each state of nature is given in the text.

NCS 40-10/$F_{45\%}$

			State of Nature					
			Low M (F= 0.2/M=0.25) p = 0.18		Base Case M (F=0.25/M=0.3) p = 0.58		High M (F=0.3/M=0.35) p = 0.24	
	Year	OY	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low M model	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	40	256	24%	360	32%	523	40%
	2008	40	249	23%	353	32%	515	40%
	2009	43	255	24%	366	33%	536	41%
	2010	49	273	26%	396	36%	583	45%
	2011	55	293	28%	431	39%	637	49%
	2012	60	312	29%	464	42%	687	53%
	2013	65	328	31%	493	44%	731	56%
	2014	68	342	32%	518	47%	769	59%
	2015	72	354	33%	540	49%	802	62%
	2016	74	364	34%	559	50%	829	64%
Catch based on Base Case	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	44	256	24%	360	32%	523	40%
	2008	43	222	21%	351	32%	490	38%
	2009	48	207	19%	363	33%	493	38%
	2010	58	206	19%	390	35%	526	41%
	2011	68	208	20%	420	38%	567	44%
	2012	77	207	19%	445	40%	603	47%
	2013	84	202	19%	465	42%	634	49%
	2014	89	194	18%	481	43%	660	51%
	2015	93	184	17%	494	44%	683	53%
	2016	96	173	16%	503	45%	702	54%
Catch based on High M Catch	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	157	256	24%	360	32%	523	40%
	2008	136	176	17%	283	25%	447	35%
	2009	134	129	12%	246	22%	422	33%
	2010	142	101	9%	235	21%	433	33%
	2011	151	75	7%	229	21%	452	35%
	2012	157	42	4%	218	20%	466	36%
	2013	161	5	1%	202	18%	475	37%
	2014	164	8	1%	184	17%	481	37%
	2015	166	0	0%	164	15%	486	37%
	2016	168	0	0%	144	13%	490	38%

Table 21 continued.

NCS 60-20/$F_{50\%}$

		OY	State of Nature					
			Low M (F= 0.2/M=0.25)		Base Case M (F=0.25/M=0.3)		High M (F=0.3/M=0.35)	
		Commerical	p = 0.18		p = 0.58		p = 0.24	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low M model	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	44	256	24%	360	32%	523	40%
	2008	44	247	23%	351	32%	513	40%
	2009	46	251	24%	362	33%	532	41%
	2010	50	267	25%	391	35%	578	45%
	2011	53	287	27%	425	38%	632	49%
	2012	57	306	29%	459	41%	684	53%
	2013	60	325	30%	490	44%	730	56%
	2014	63	341	32%	519	47%	770	59%
	2015	65	356	33%	544	49%	806	62%
	2016	67	370	35%	566	51%	836	65%
Catch based on Base Case	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	44	256	24%	360	32%	523	40%
	2008	43	247	23%	351	32%	513	40%
	2009	48	251	24%	363	33%	533	41%
	2010	58	266	25%	390	35%	578	45%
	2011	68	281	26%	420	38%	627	48%
	2012	77	292	27%	445	40%	670	52%
	2013	84	298	28%	465	42%	706	55%
	2014	89	301	28%	481	43%	736	57%
	2015	93	301	28%	494	44%	760	59%
	2016	96	299	28%	503	45%	780	60%
Catch based on High M Catch	2005	59	323	30%	440	40%	637	49%
	2006	59	286	27%	393	35%	567	44%
	2007	101	256	24%	360	32%	523	40%
	2008	89	212	20%	317	29%	480	37%
	2009	92	190	18%	304	27%	478	37%
	2010	105	181	17%	311	28%	505	39%
	2011	119	172	16%	320	29%	536	41%
	2012	129	155	15%	322	29%	560	43%
	2013	136	132	12%	319	29%	577	45%
	2014	141	105	10%	313	28%	590	46%
	2015	144	75	7%	304	27%	599	46%
	2016	147	44	4%	294	26%	606	47%

SCS 40-10/$F_{45\%}$

		OY	State of Nature					
			Low ($Depletion_{2005}$=0.2)		Base Case		High ($Depletion_{2005}$=0.35)	
		Commerical	p = 0.16		p = 0.58		p = 0.26	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Catch based on Low model	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	20	78	31%	112	45%	132	52%
	2008	20	80	32%	117	47%	137	54%
	2009	20	79	32%	117	47%	136	54%
	2010	21	81	33%	118	47%	136	54%
	2011	22	83	34%	119	47%	135	54%
	2012	23	86	35%	119	48%	135	54%
	2013	23	88	36%	120	48%	134	53%
	2014	24	89	36%	120	48%	134	53%
	2015	24	90	37%	120	48%	132	52%
	2016	24	92	37%	120	48%	131	52%
Catch based on Base Case	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	30	78	31%	112	45%	132	52%
	2008	29	74	30%	111	45%	131	52%
	2009	28	69	28%	106	43%	125	50%
	2010	27	67	27%	103	41%	121	48%
	2011	27	66	27%	101	40%	118	47%
	2012	27	66	27%	100	40%	116	46%
	2013	27	66	27%	100	40%	114	45%
	2014	26	67	27%	99	40%	113	45%
	2015	26	67	27%	99	39%	112	44%
	2016	26	67	27%	98	39%	111	44%
Catch based on High Catch	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	34	78	31%	112	45%	132	52%
	2008	32	73	29%	110	44%	129	51%
	2009	31	67	27%	104	42%	121	48%
	2010	30	64	26%	101	40%	115	46%
	2011	29	64	26%	99	40%	112	44%
	2012	28	64	26%	98	39%	109	43%
	2013	28	64	26%	97	39%	107	42%
	2014	28	64	26%	97	39%	105	42%
	2015	27	65	26%	97	39%	104	41%
	2016	27	65	26%	96	39%	103	41%

Table 21 continued.

SCS 60-20/$F_{50\%}$

			State of Nature					
		OY	Low (Depletion$_{2005}$=0.2)		Base Case (F=0.25/M=0.3)		High (Depletion2005=0.2)	
		Commerical	p = 0.16		p = 0.58		p = 0.26	
	Year	Removals	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	10	78	31%	112	45%	132	52%
	2008	12	85	34%	123	49%	142	56%
	2009	14	89	36%	127	51%	146	58%
Catch based on Low model	2010	15	93	38%	130	52%	148	59%
	2011	17	98	40%	134	53%	151	60%
	2012	18	103	42%	136	55%	152	60%
	2013	19	106	43%	138	55%	153	60%
	2014	20	109	44%	139	56%	152	60%
	2015	21	112	45%	140	56%	152	60%
	2016	21	113	46%	140	56%	151	60%
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	22	78	31%	112	45%	132	52%
	2008	22	79	32%	116	46%	136	54%
	2009	21	77	31%	115	46%	134	53%
Catch based on Base Case	2010	21	78	32%	115	46%	133	53%
	2011	22	80	33%	116	46%	132	52%
	2012	22	83	34%	117	47%	132	52%
	2013	22	85	35%	118	47%	132	52%
	2014	23	87	35%	118	47%	132	52%
	2015	23	89	36%	119	48%	132	52%
	2016	23	91	37%	120	48%	131	52%
	2005	10	51	21%	72	29%	89	35%
	2006	10	63	26%	90	36%	110	43%
	2007	27	78	31%	112	45%	132	52%
	2008	26	76	31%	116	46%	133	53%
	2009	25	72	29%	115	46%	128	51%
Catch based on High Catch	2010	24	71	29%	115	46%	125	50%
	2011	24	72	29%	116	46%	124	49%
	2012	24	74	30%	117	47%	123	49%
	2013	24	75	31%	118	47%	123	49%
	2014	23	77	31%	118	47%	123	49%
	2015	23	79	32%	119	48%	123	49%
	2016	23	80	33%	120	48%	122	49%

Figure 1. Map of the assessment areas (divided between NCS and SCS at Pt. Conception) and California Fish and Game regions (solid lines). Major fishing ports, landmarks, cities, and islands are also distinguished. Map obtained from http://www.dfg.ca.gov/mrd/fishing_map.html. Red stars indicate where the adult fish surveys used as indices of abundance were conducted.

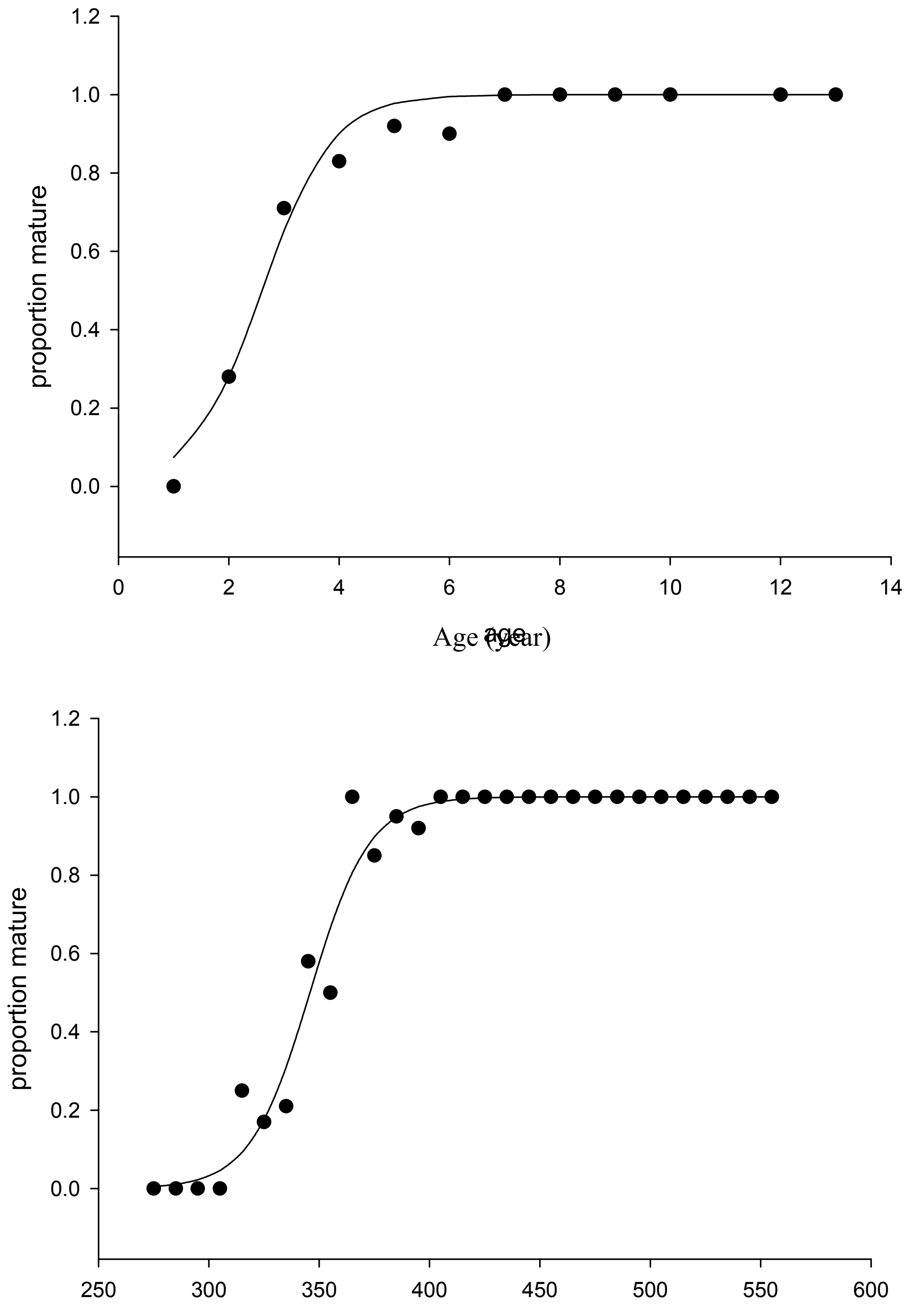
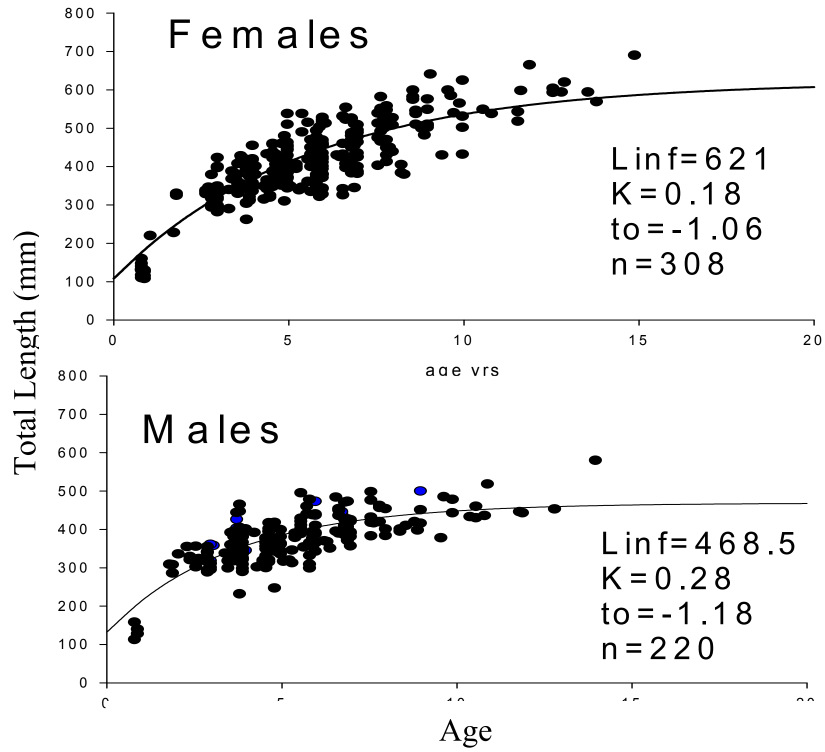


Figure 2. Maturity of female cabezon versus age and length.

A)



B)

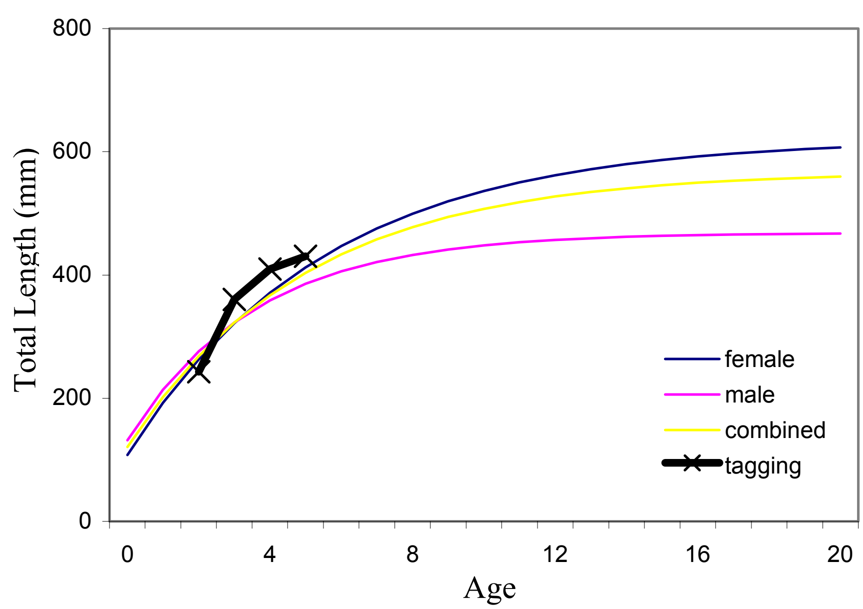


Figure 3. A) Von Bertalanffy growth curves for male and female cabezon from California (Grebel 2003). B) Von Bertalanffy growth curves for California cabezon and that estimated from tag recapture information. Results are only shown for the tag-recapture-based growth curve for lengths for which tag-recapture data are available.

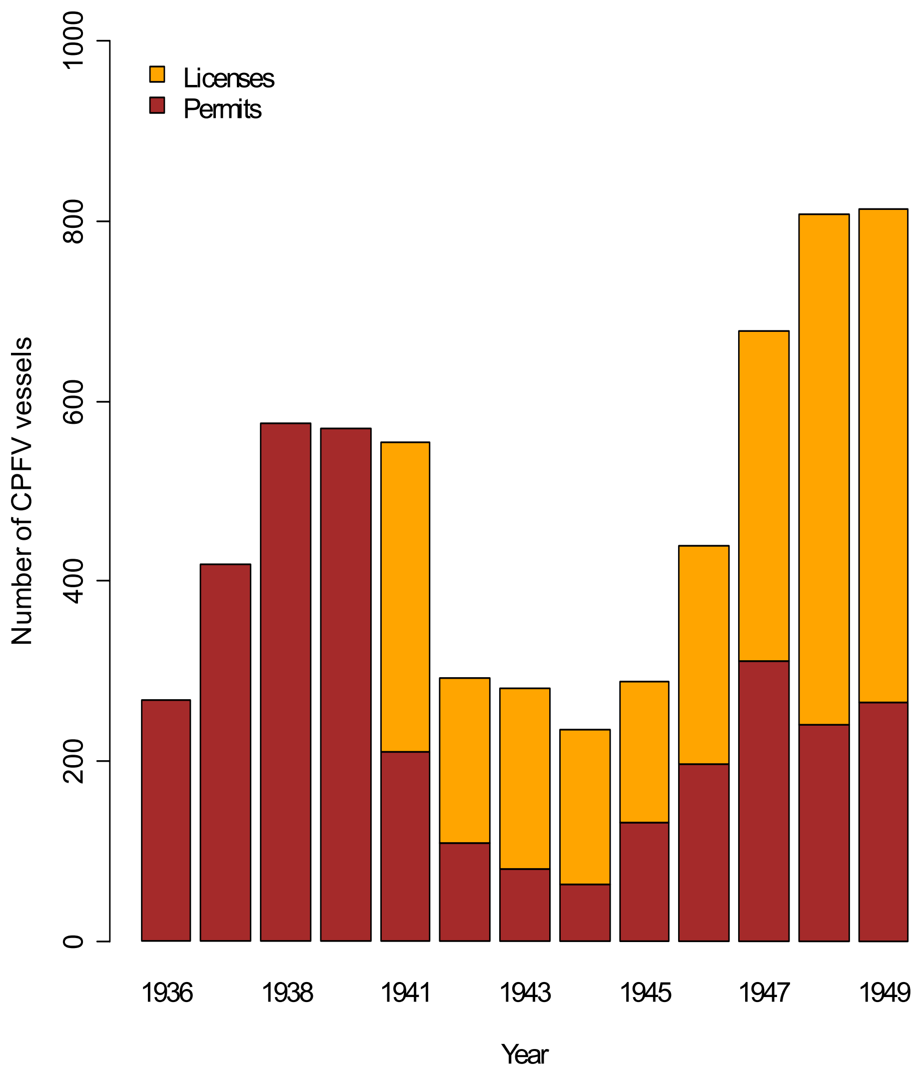


Figure 4. Registered Commercial Passenger Fishing Vessels (CPFVs) in California 1936–49 (*source*: Fishery Bulletins 57, 59, 63, 67, 74, 80).

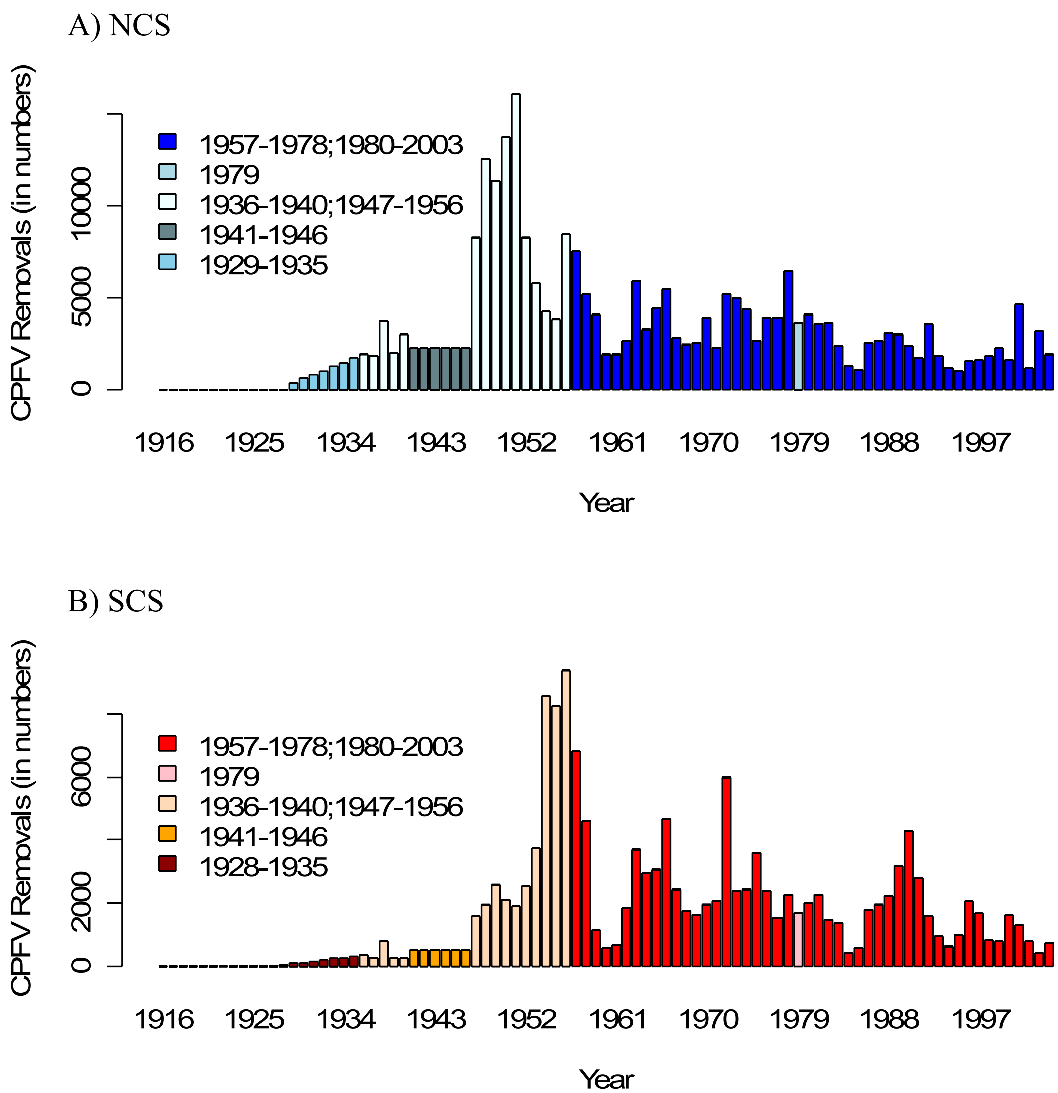


Figure 5. Raw recreational removals by the CPFV mode: 1916–2004. Each color represents a different data source used when quantifying removals (see text for details).

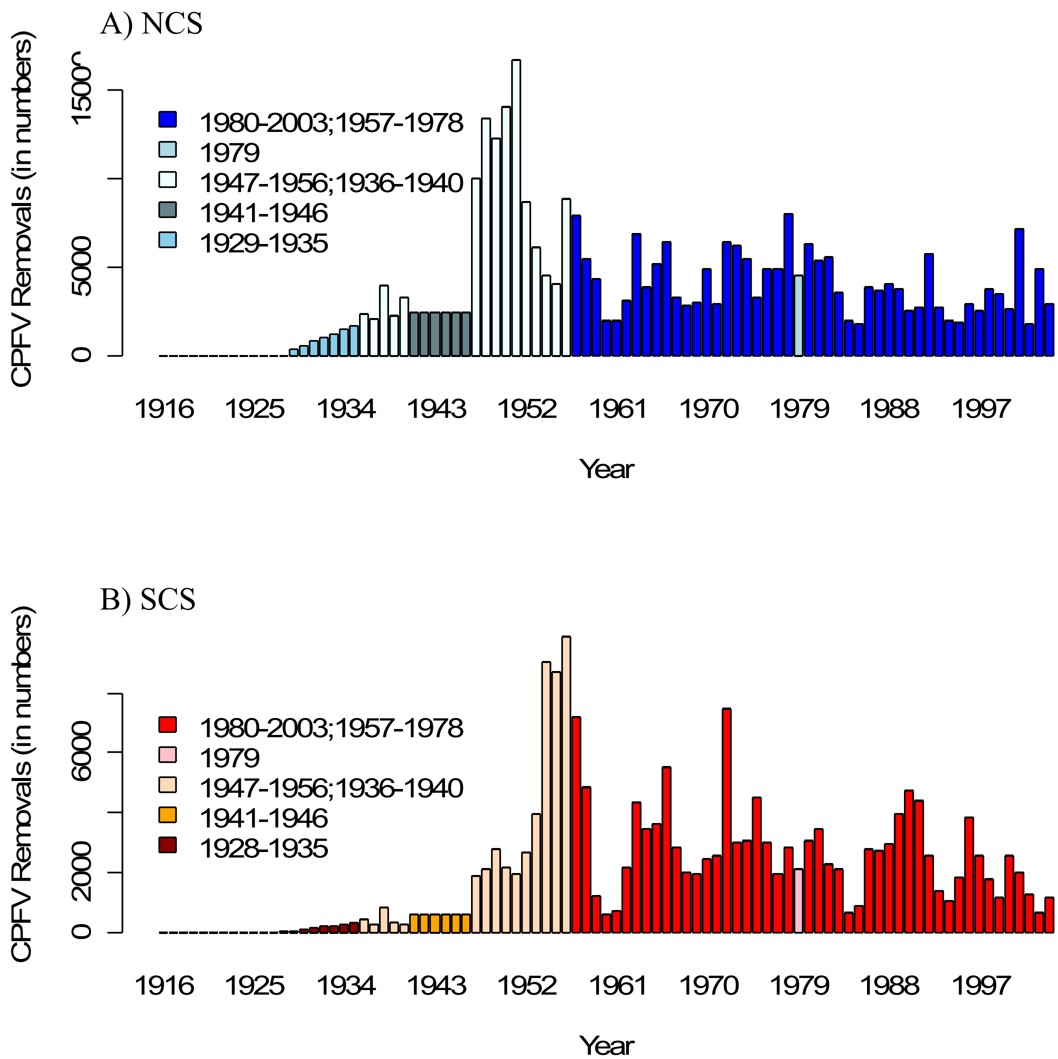
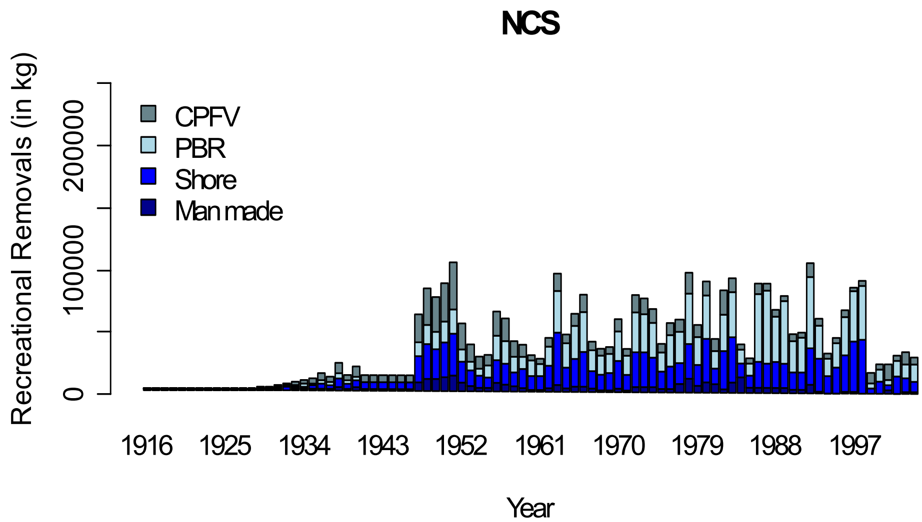


Figure 6. Expanded recreational removals by the CPFV mode: 1916–2004. Each color represents a different data source used when quantifying removals (see text for details).



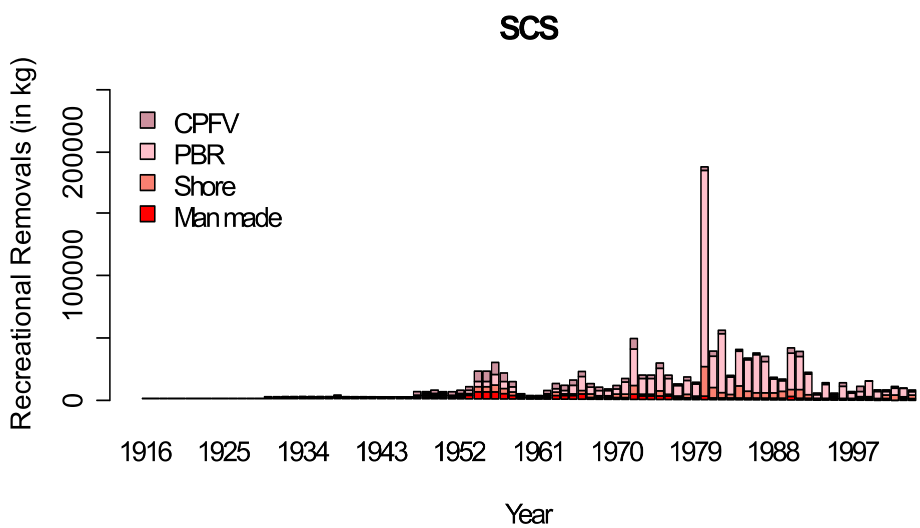


Figure 7. Removals (in kg) of cabezon by the recreational fishery by substock.

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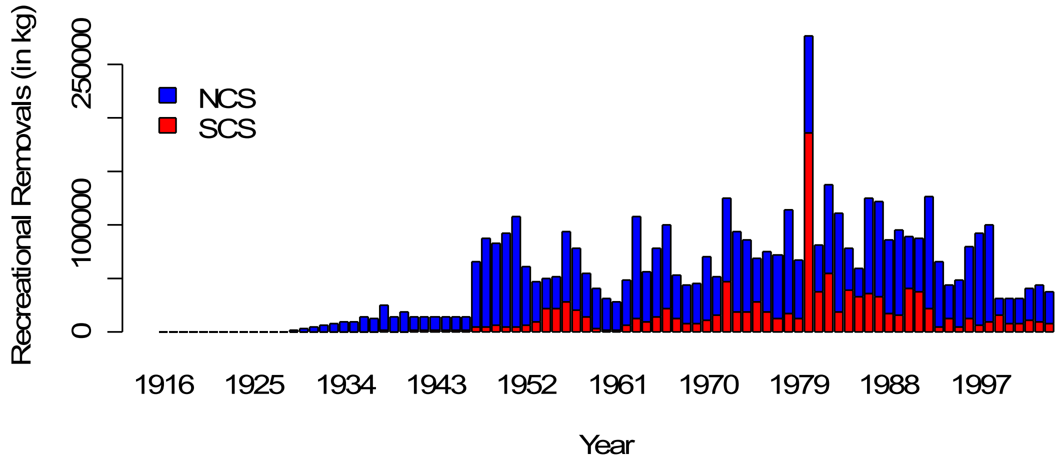
A) Total 2004 Assessment Recreational Removals



B) New vs Old Assessment Recreational Removals

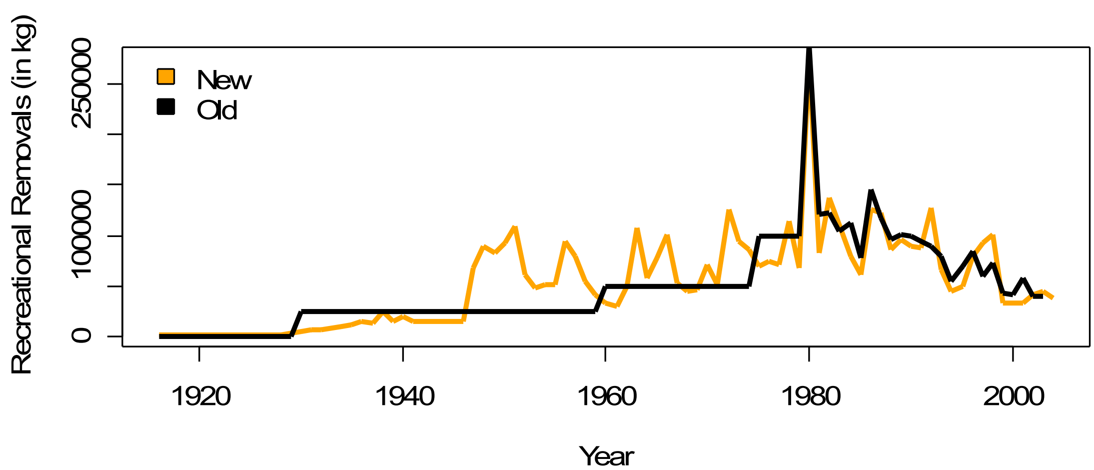


Figure 8. A) Total estimated recreational removals by substock, and B) estimated recreational removals for the present assessment ("New"), and those used in the past assessment ("Old").

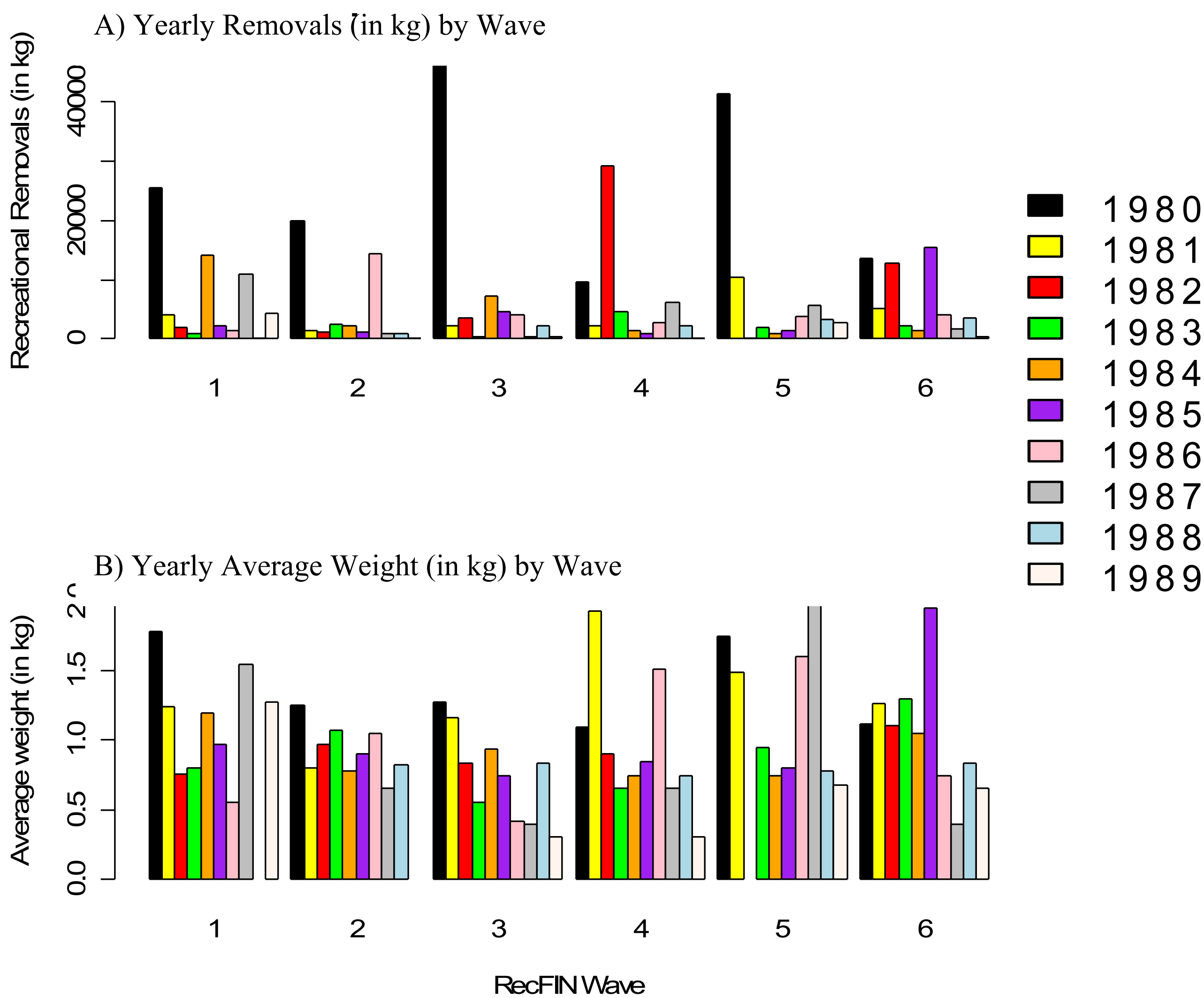


Figure 9. Annual recreational removals (kg) by wave (upper panel), and annual average weights (kg) of removed fish by wave (1980–89) (lower panel).

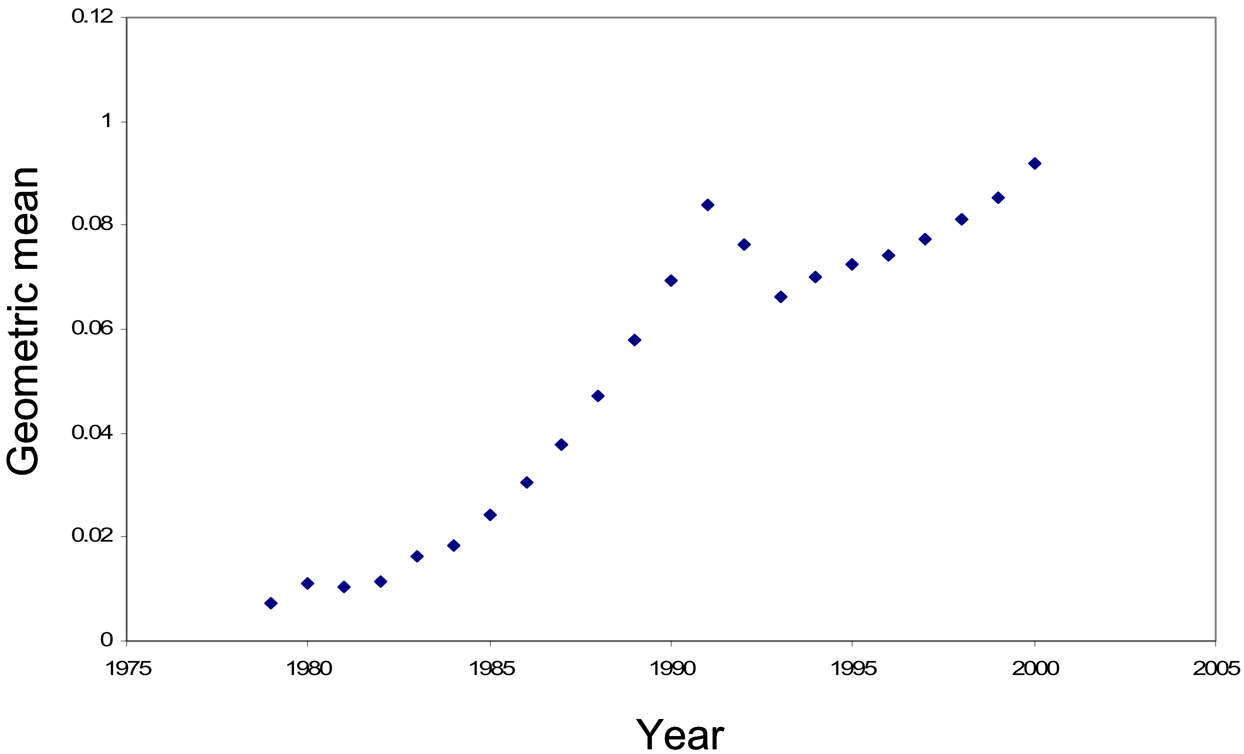


Figure 10. Cumulative geometric mean of landings reported in Santa Barbara (OSB) to those reported in Morro Bay (MRO). The geometric means of the circled years (1978–82) were used to allocate the 1916–77 "Santa Barbara" port complex landings to each substock. These years were chosen to represent the pre-1978 time period because they occur before the rapid increase in ratios that presume a change in the catch relationships between OSB and MRO.

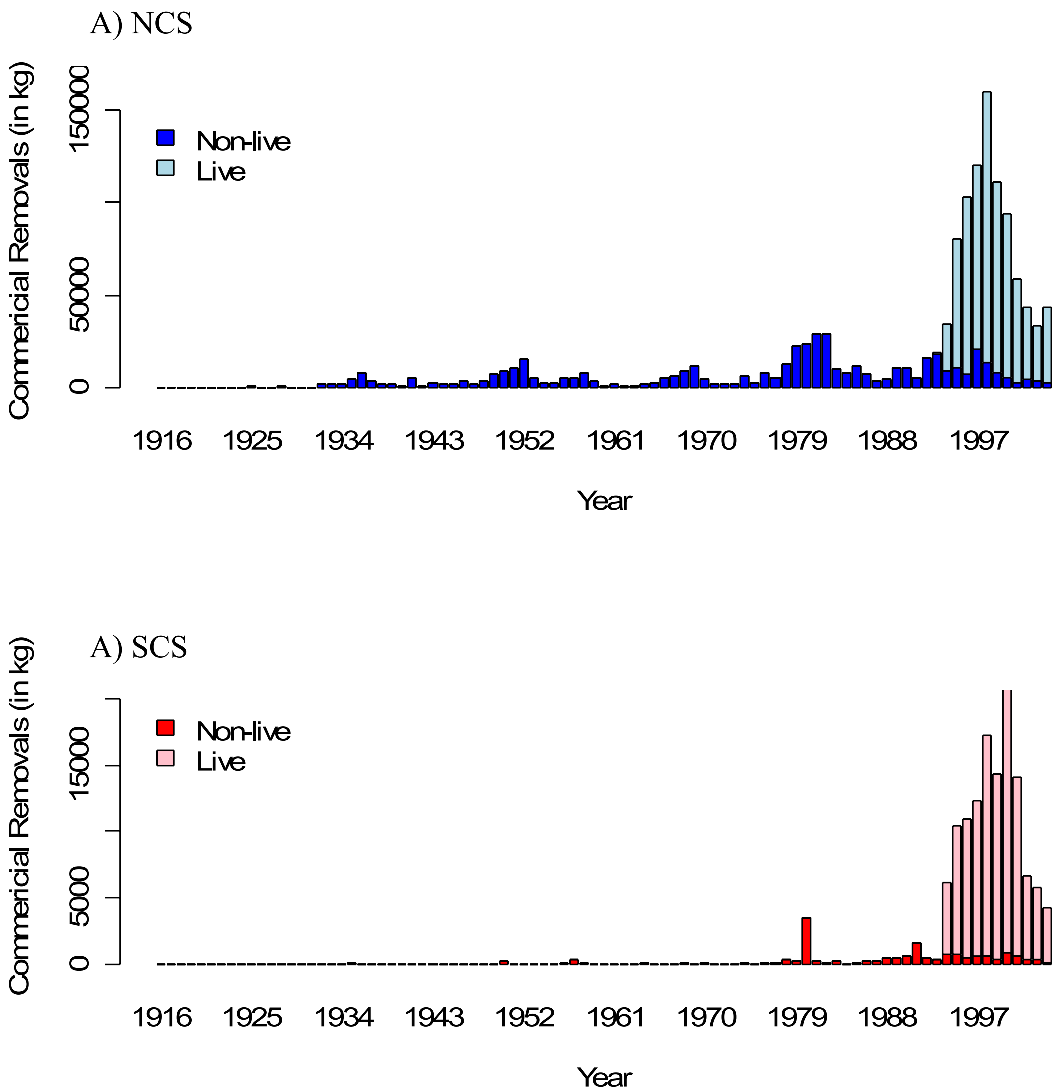


Figure 11. Commercial landings of cabezon by fleet and substock.

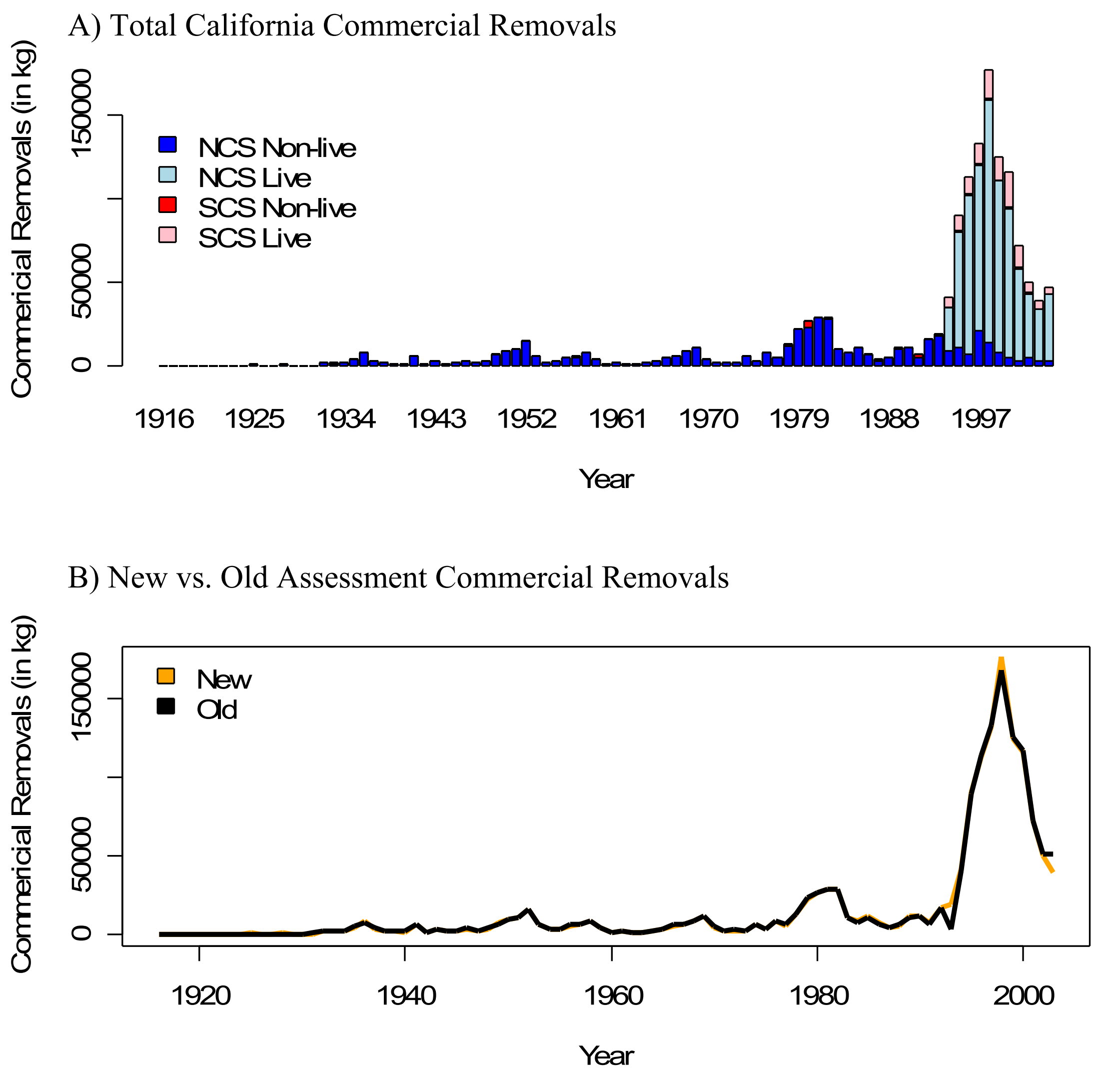


Figure 12. A) Commercial landings by fleet and substock, and B) commercial landings used in the present ("New") and past ("Old") assessments.

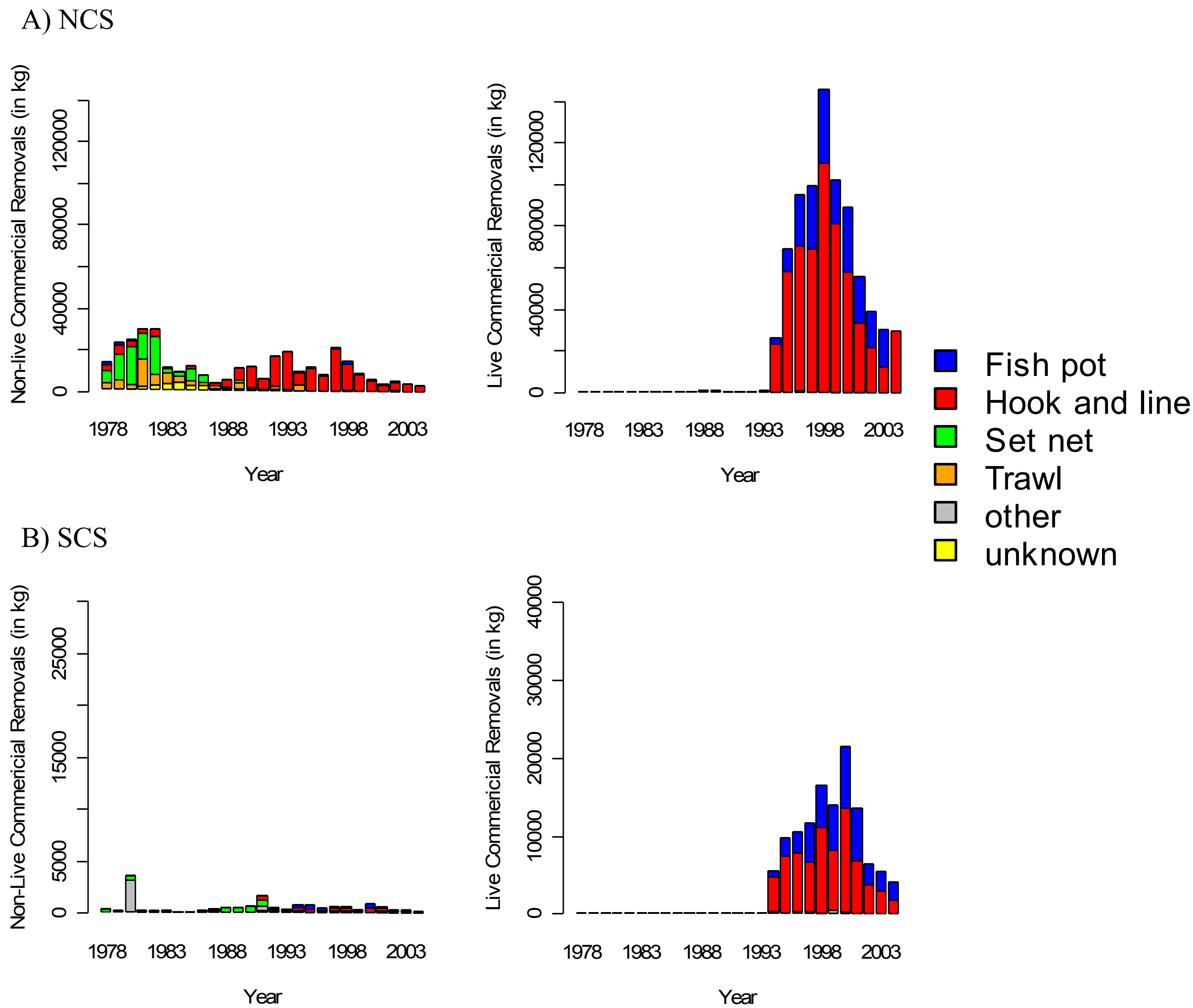


Figure 13. Commercial cabezon landings by fleet, substock and gear type.

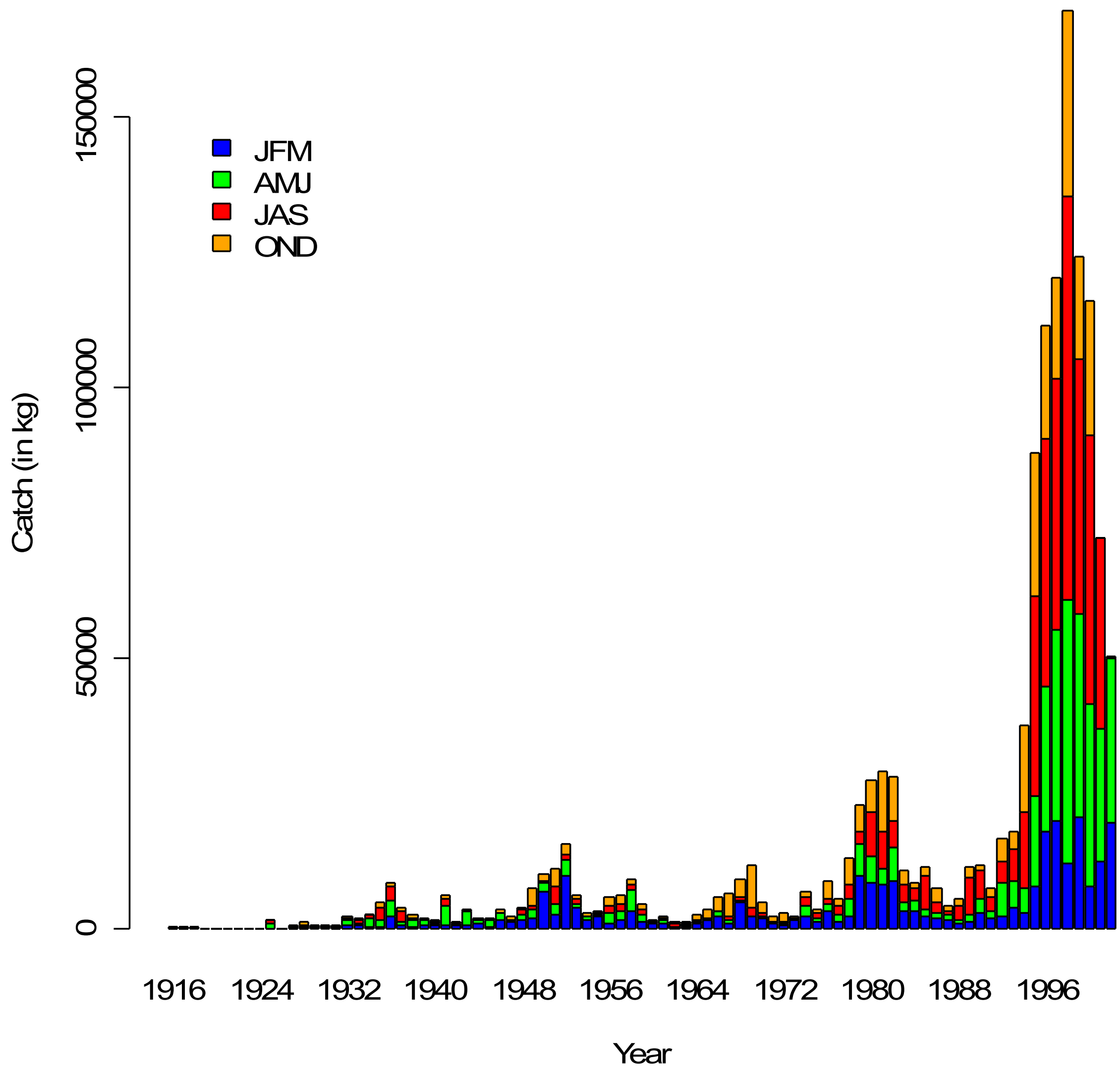


Figure 14. Commercial cabezon landings by three-month period: JFM: January, February, March; AMJ: April, May, June; JAS: July, August, September; OND: October, November, December.

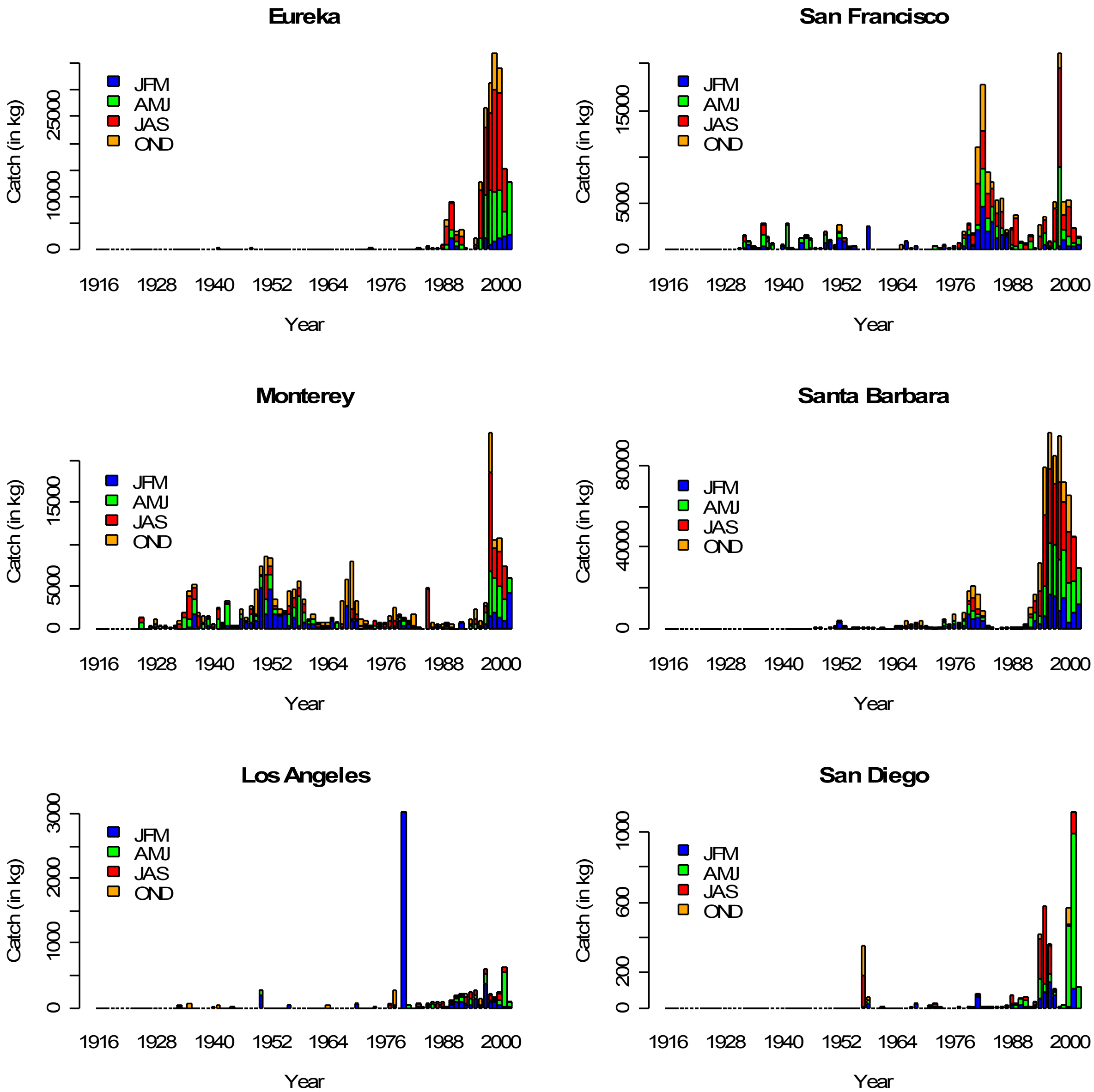


Figure 15. Commercial cabezon landings by three-month period and port complex. The Santa Barbara complex includes Morro Bay (NCS) and Santa Barbara (SCS).

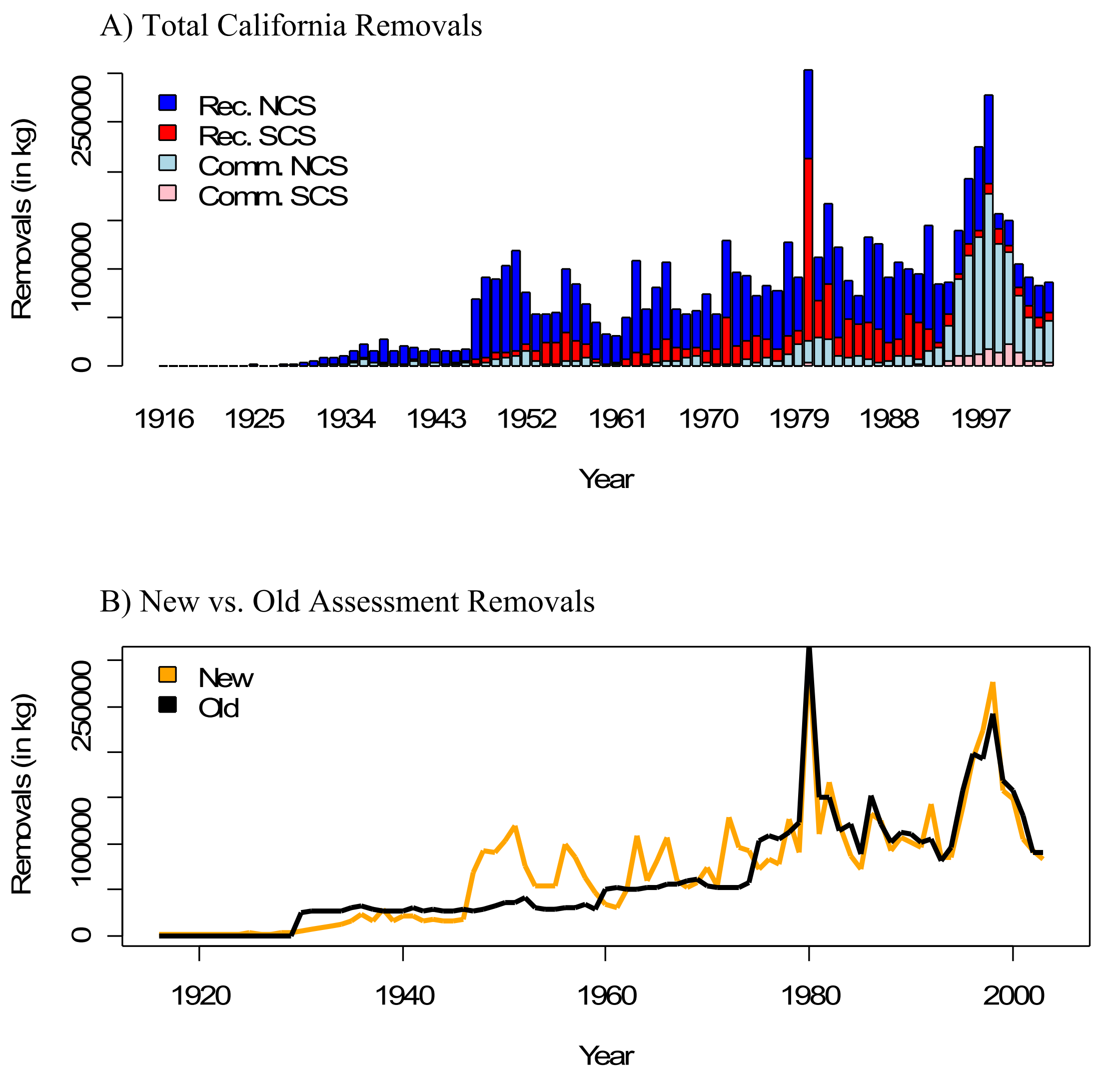
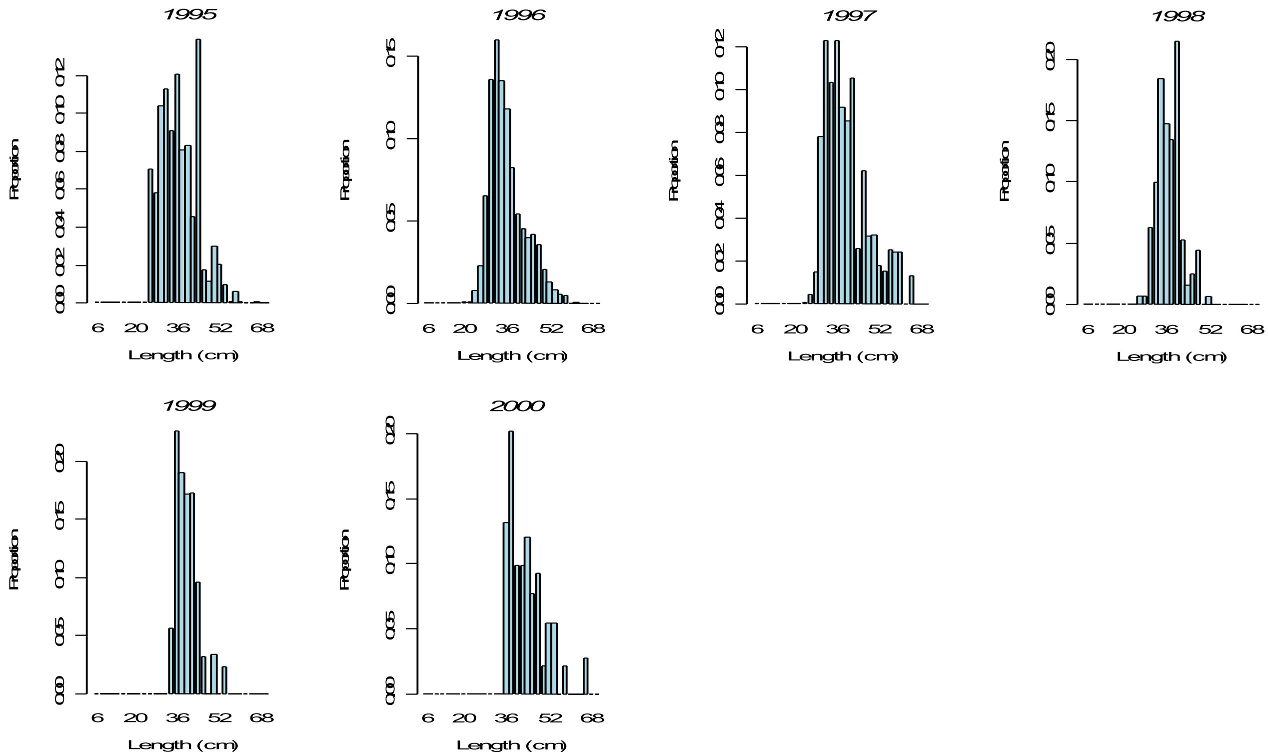


Figure 16. Total cabezon removals A) by fishery sector and substock, and B) used in the present ("New") and past ("Old") assessment.

A) Non-Live



B) Live

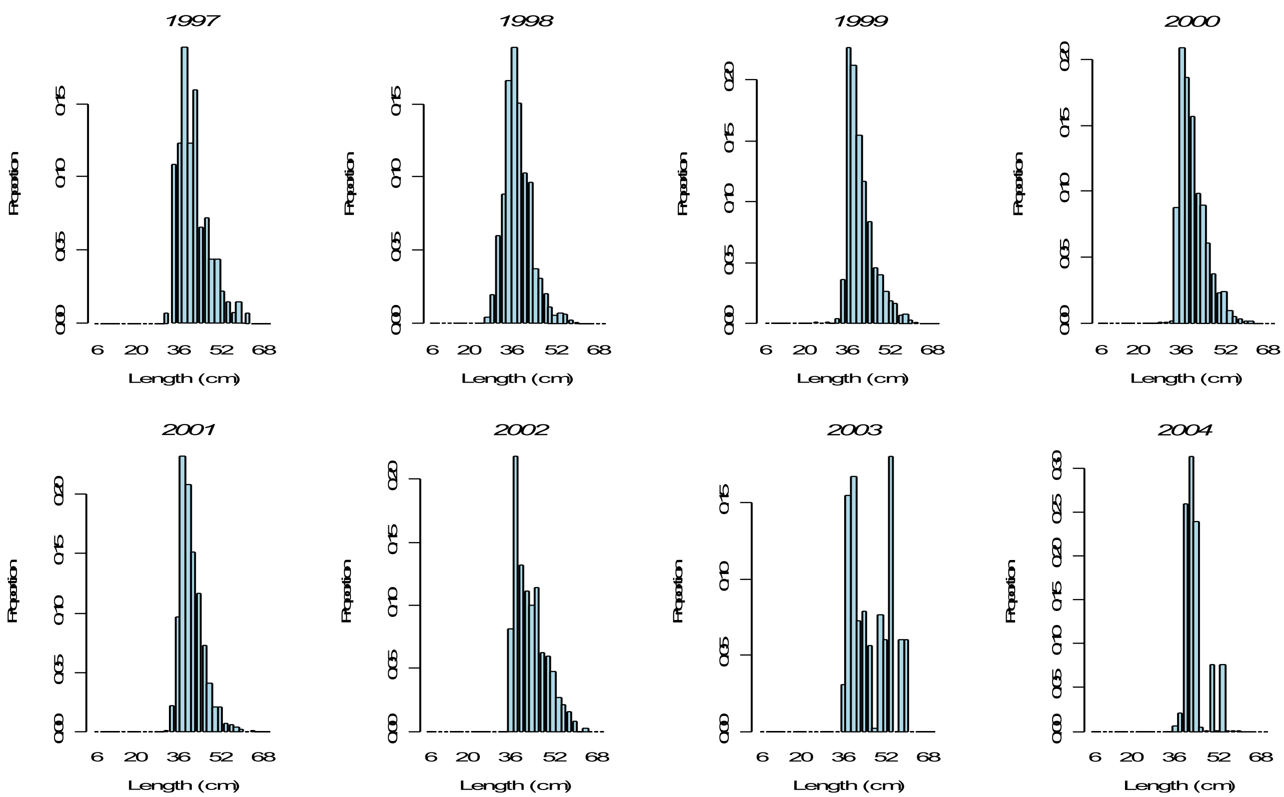
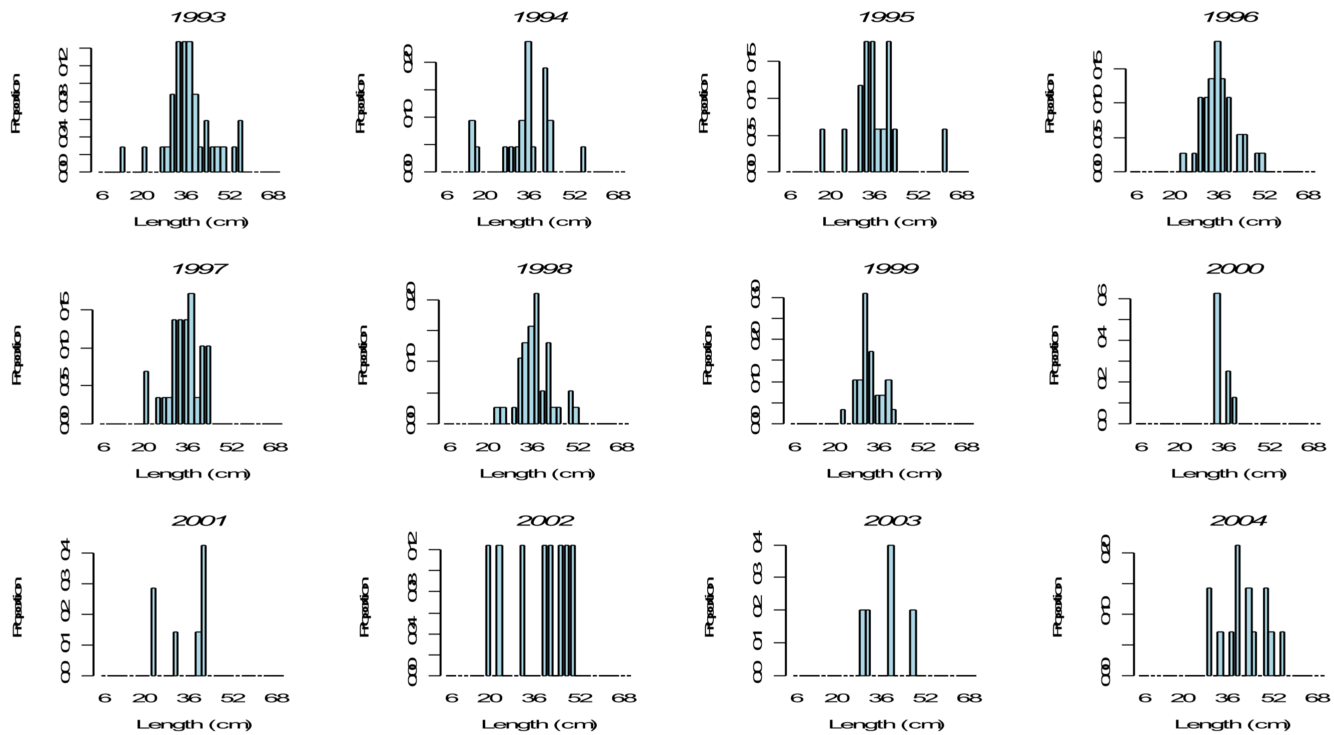


Figure 17. Commercial length compositions by fleet for the NCS.

A) Shore



B) PBR

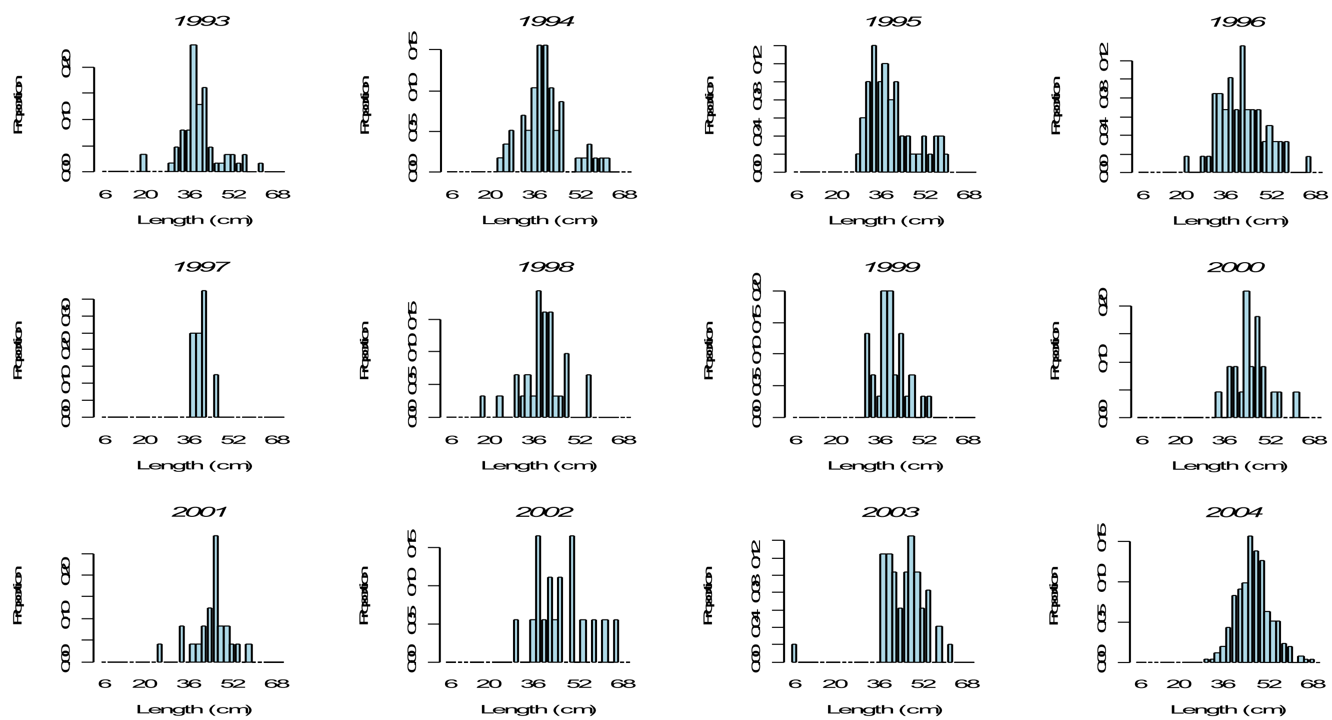
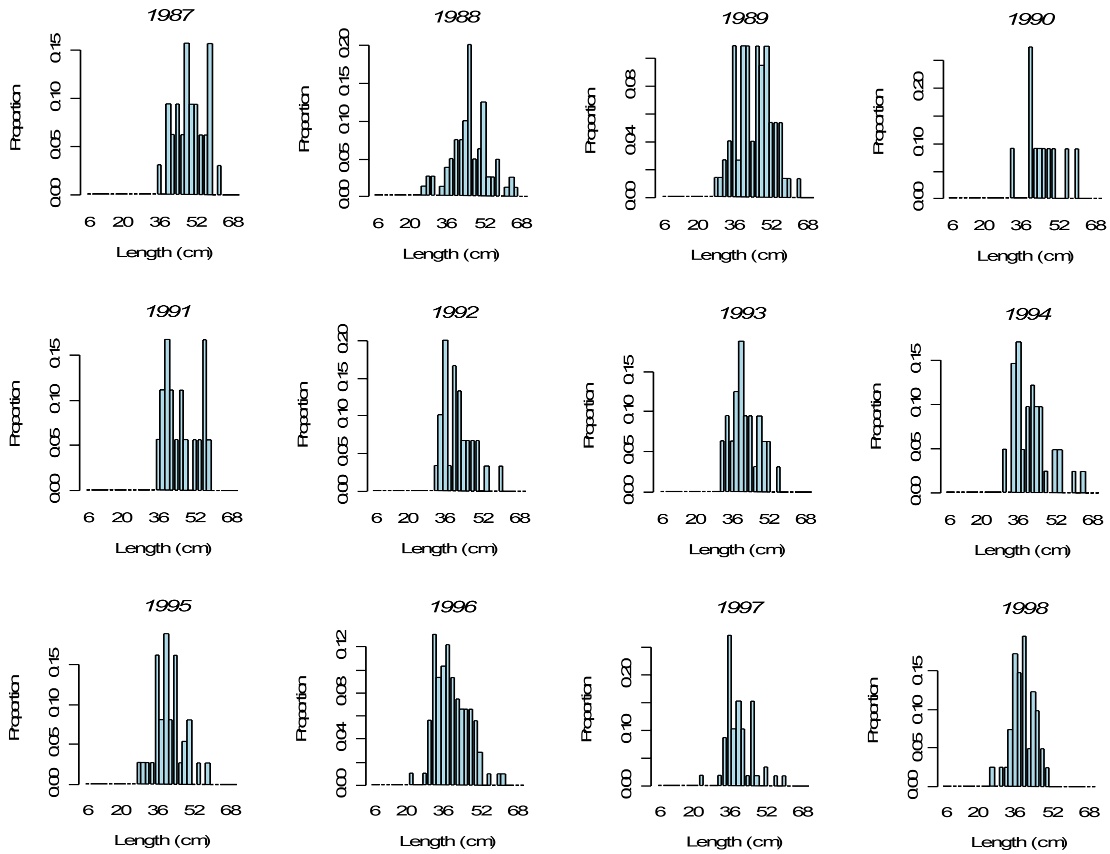


Figure 18. Recreational length compositions by fleet for the NCS.

C) CPFV Observer



D) CPFV RecFIN

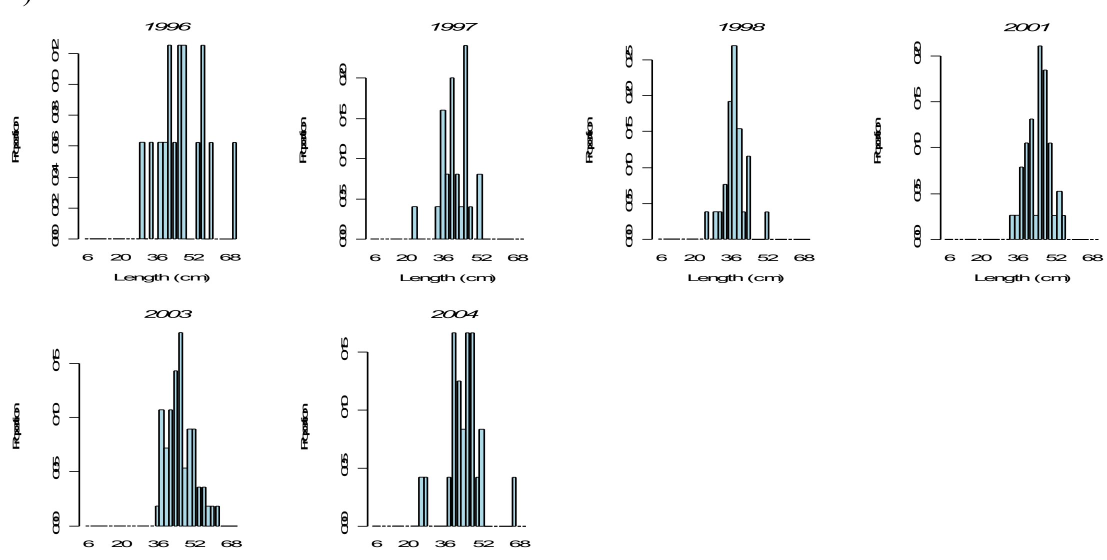
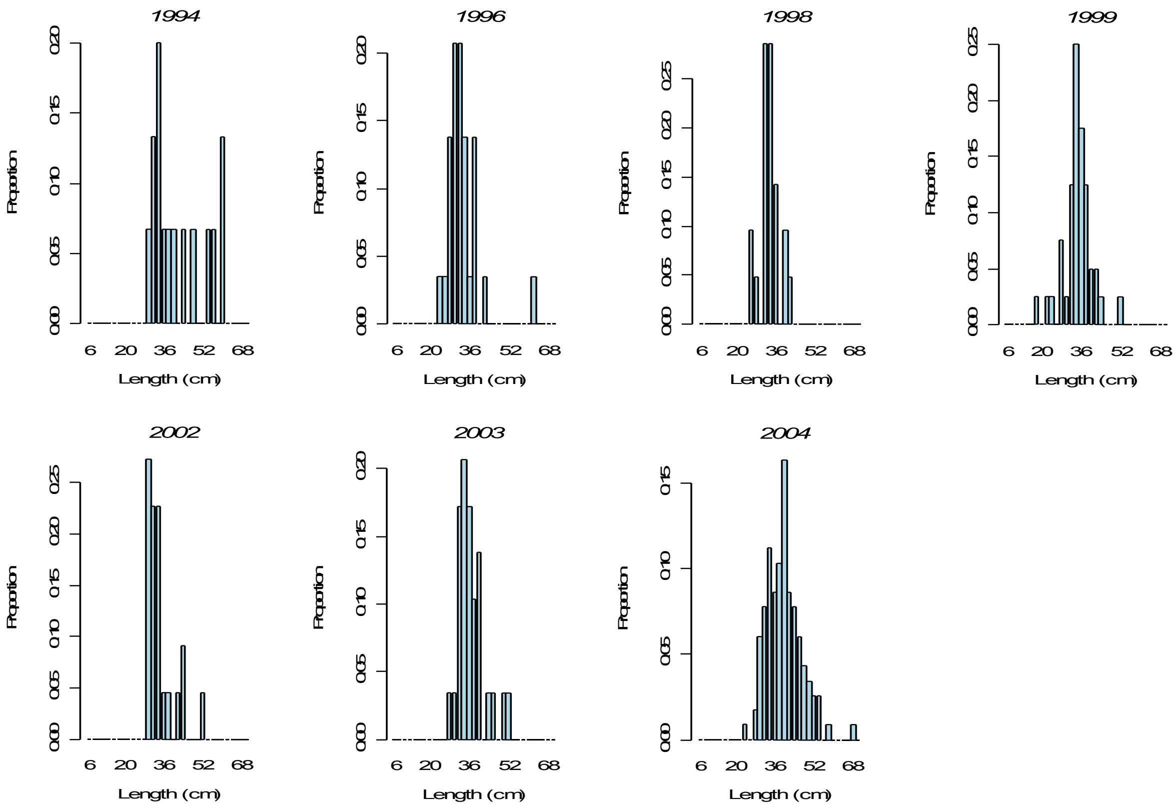


Figure 18 continued.

A) PBR



B) CPFV Observer

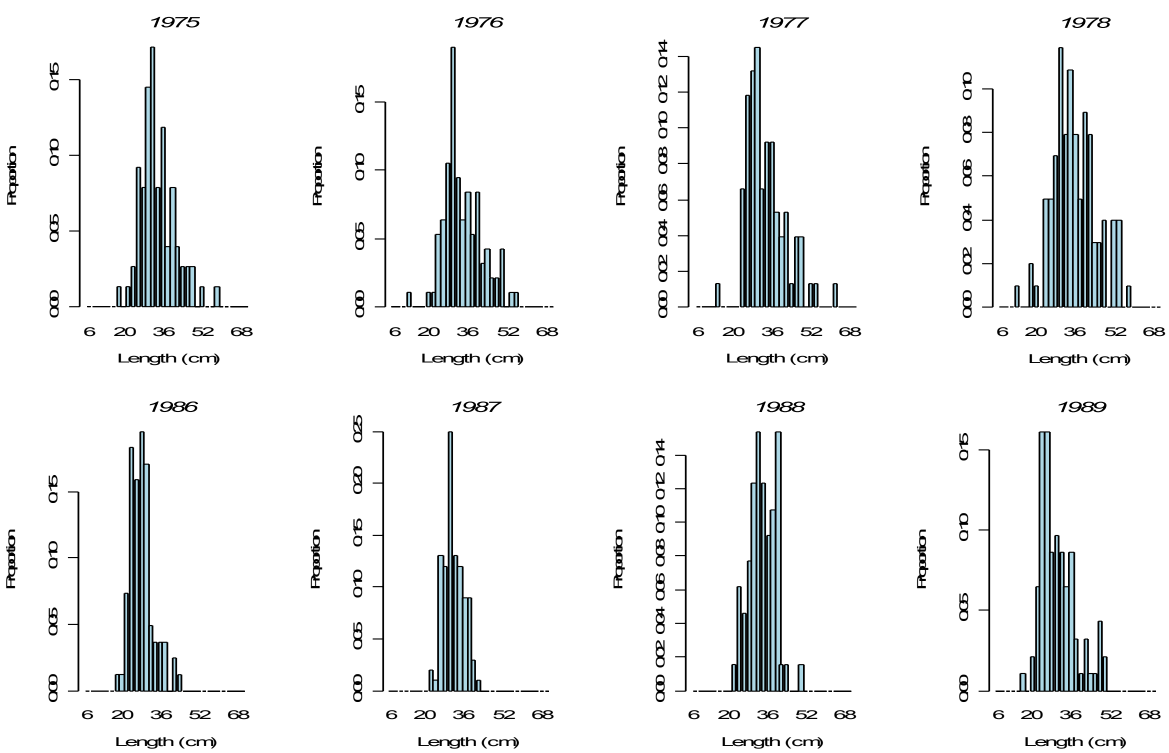


Figure 19. Recreational length compositions by fleet for the SCS.

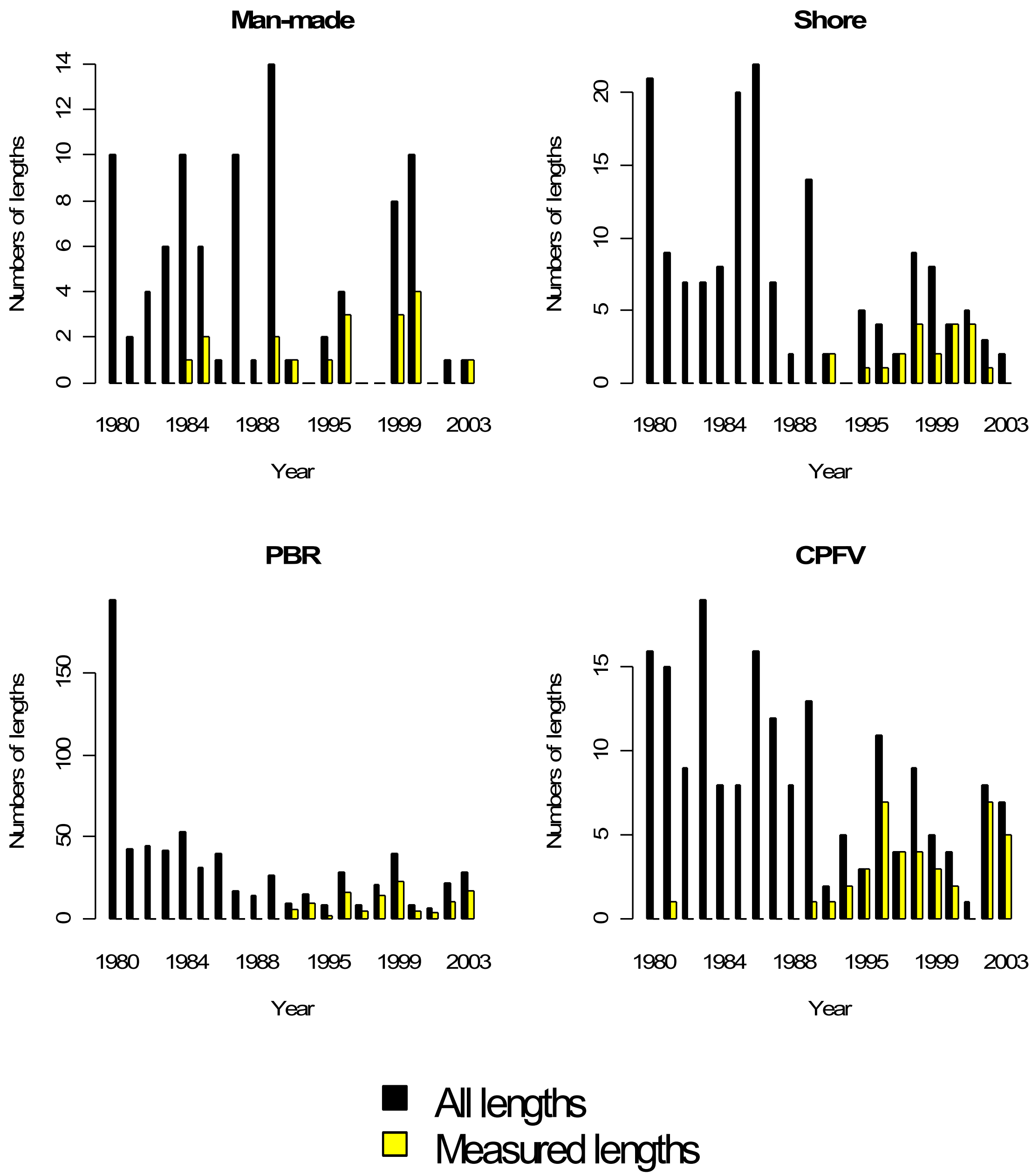


Figure 20. Numbers of cabezon length measurements provided by RecFIN per fleet. “All lengths” represents all lengths provided by RecFIN. “Measured lengths” are fish that were actually measured. The difference between the two is the number of fish that were weighed and subsequently converted to lengths.

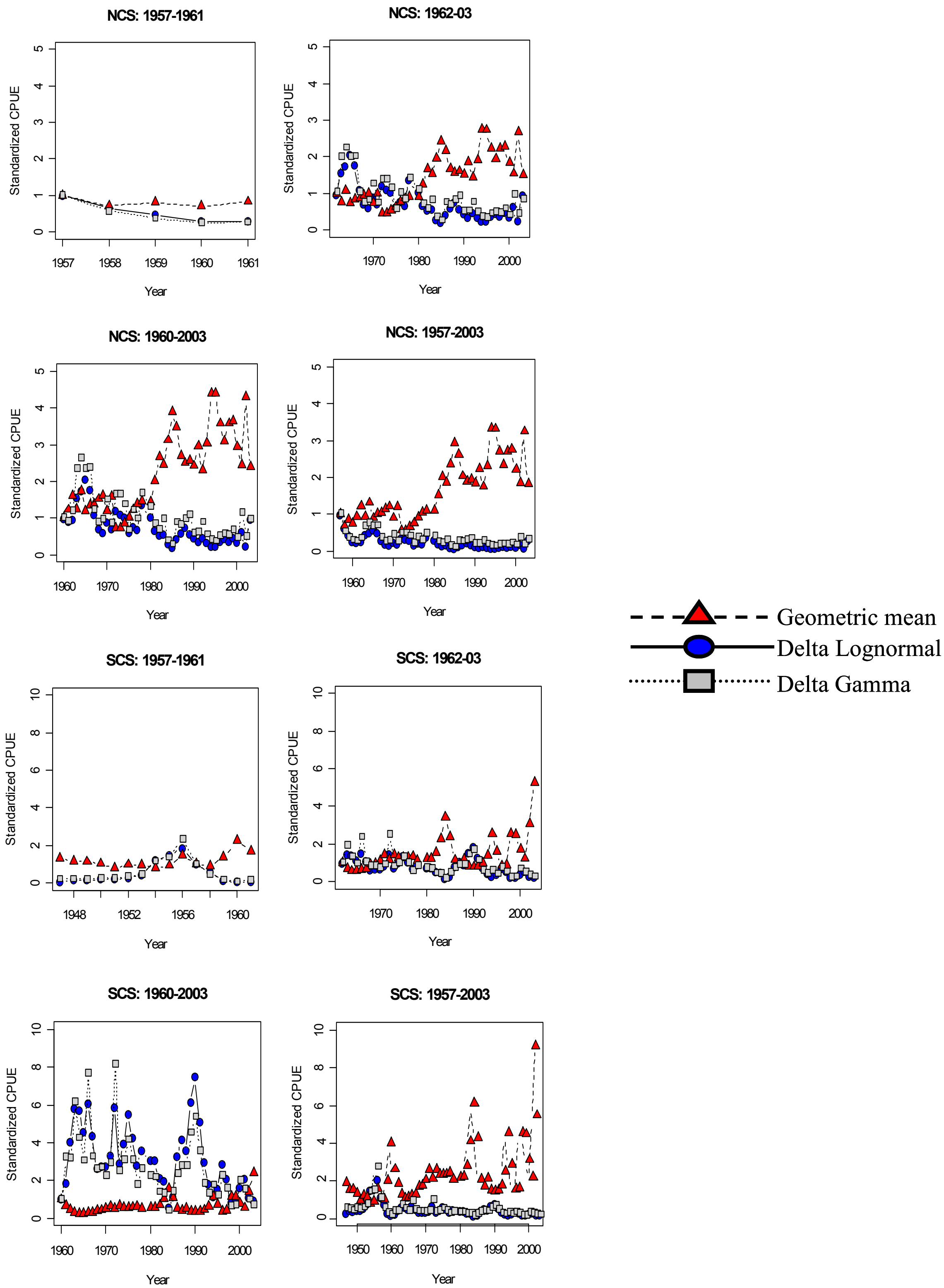


Figure 21. Geometric mean and GLM-based recreational CPUE abundance indices for the CPFV fleet for each time block.

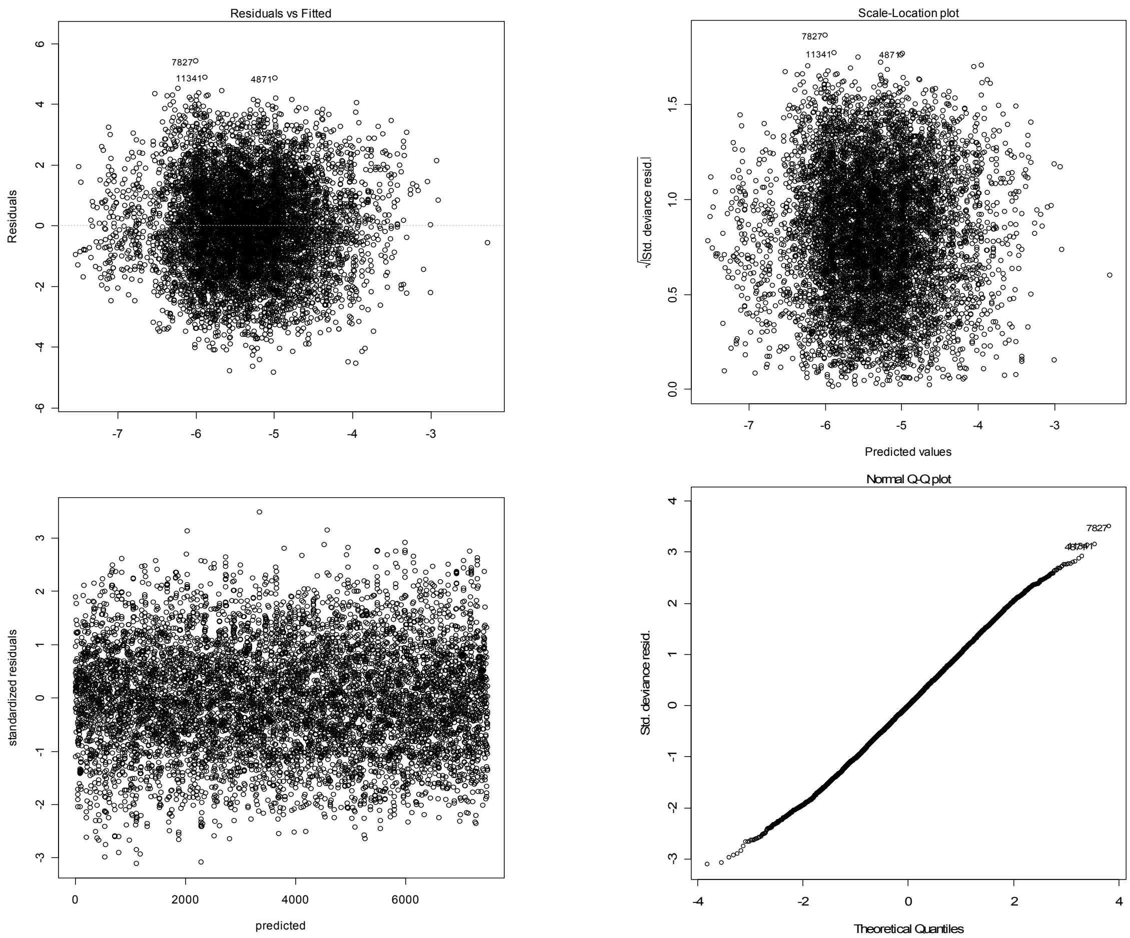


Figure 22. Diagnostic plots for the NCS CPFV CPUE index.

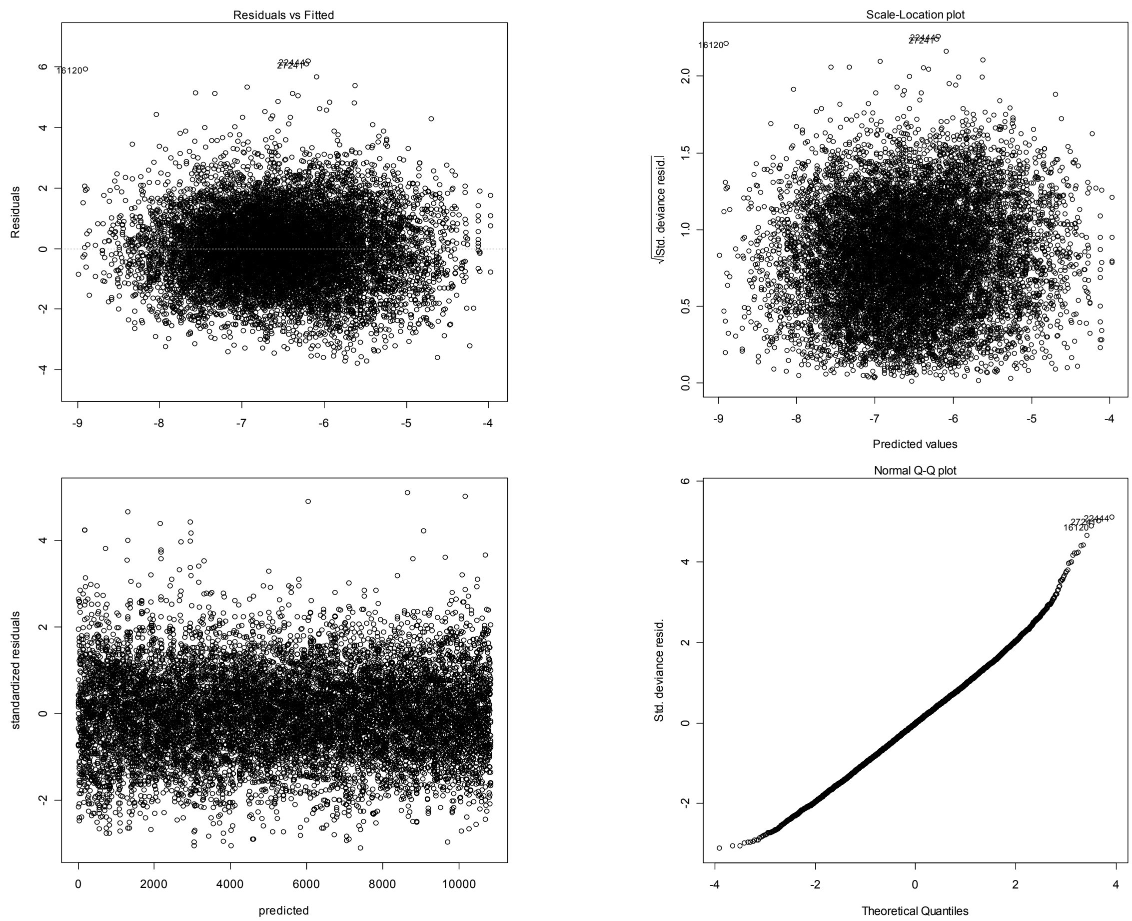


Figure 23. Diagnostic plots for the SCS CPFV CPUE index.

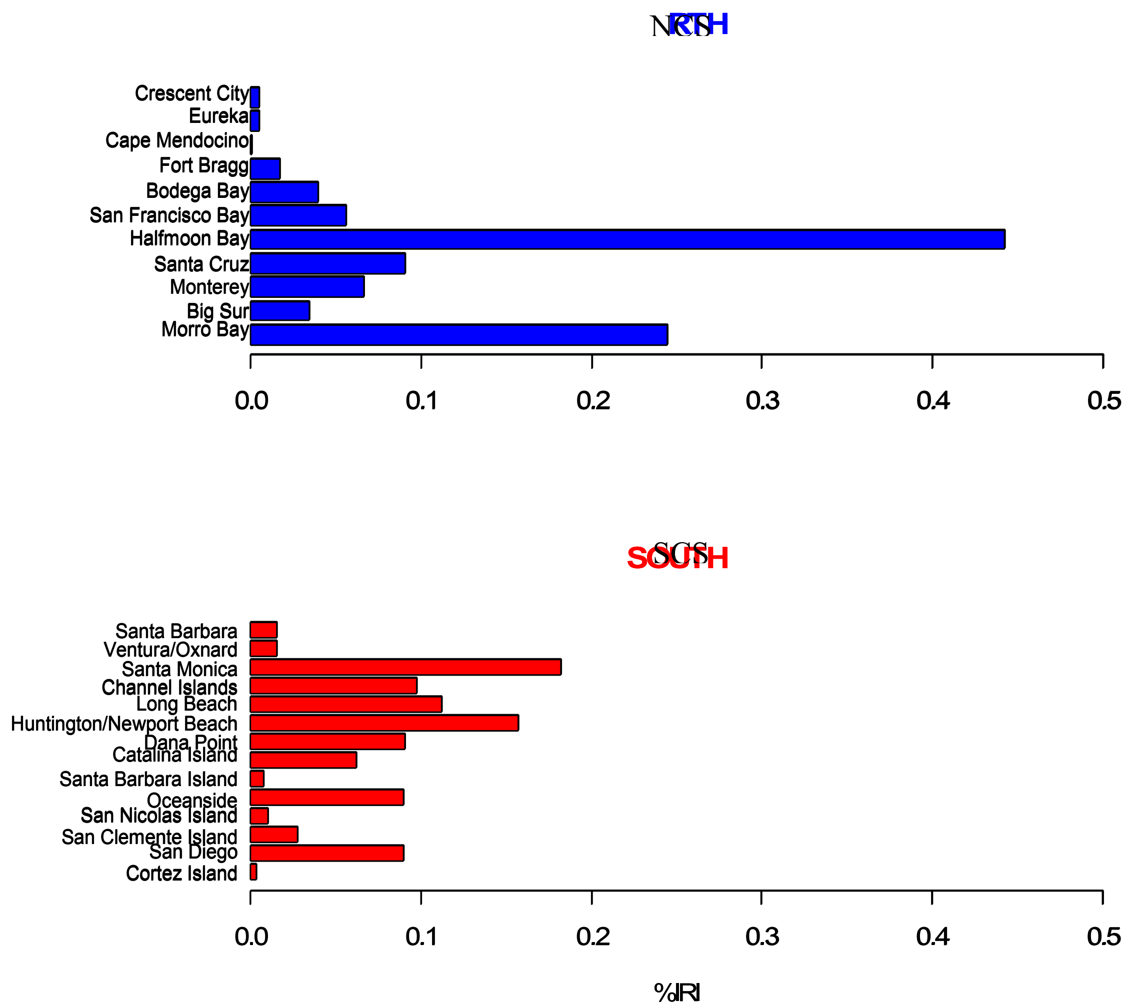


Figure 24. Percent Index of Relative Importance (%IRI) by location and substock for the CPFV fleet.

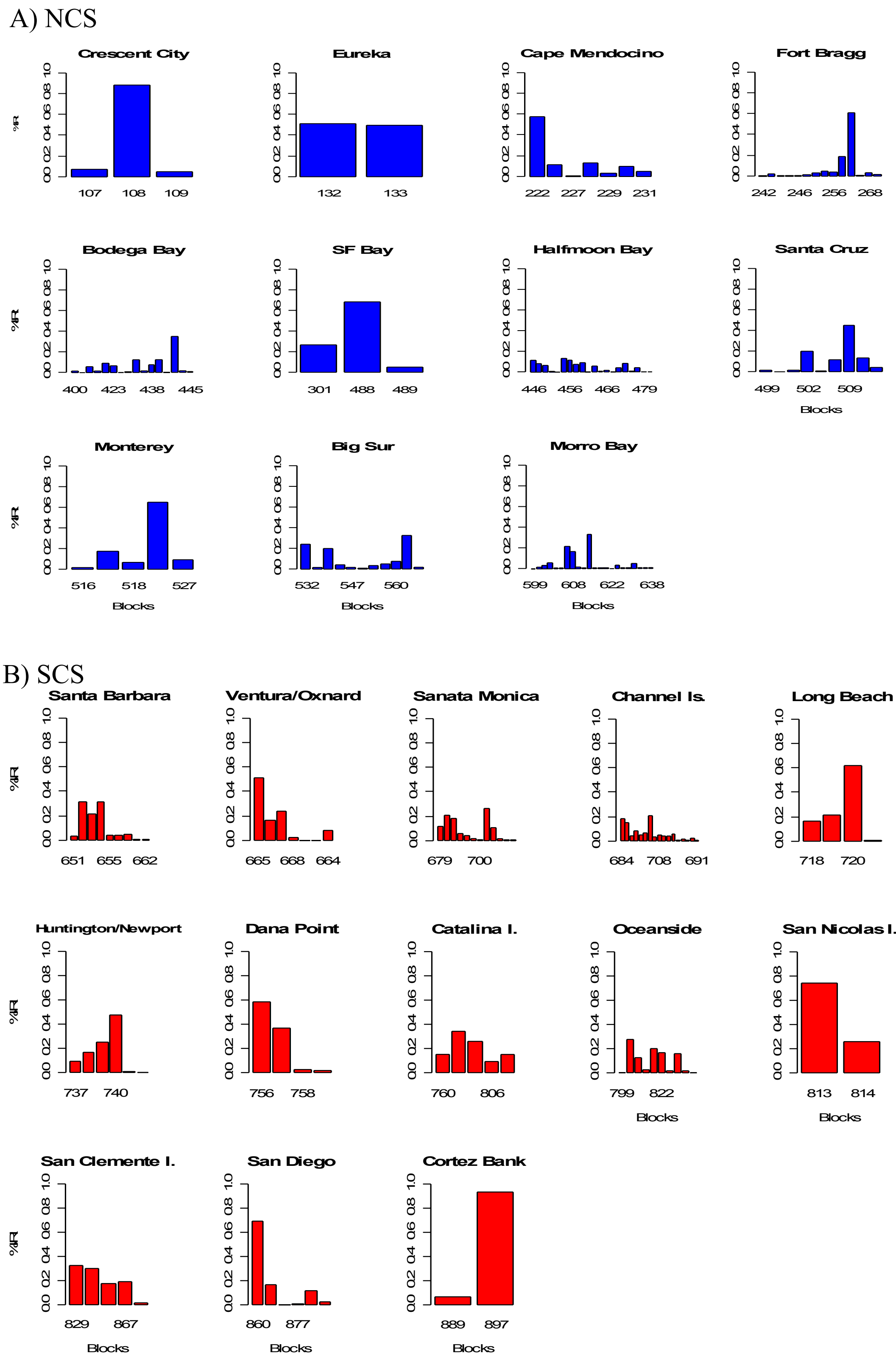


Figure 25. Percent Index of Relative Importance (%IRI) by location and CDF&G block for each substock for the CPFV fleet.

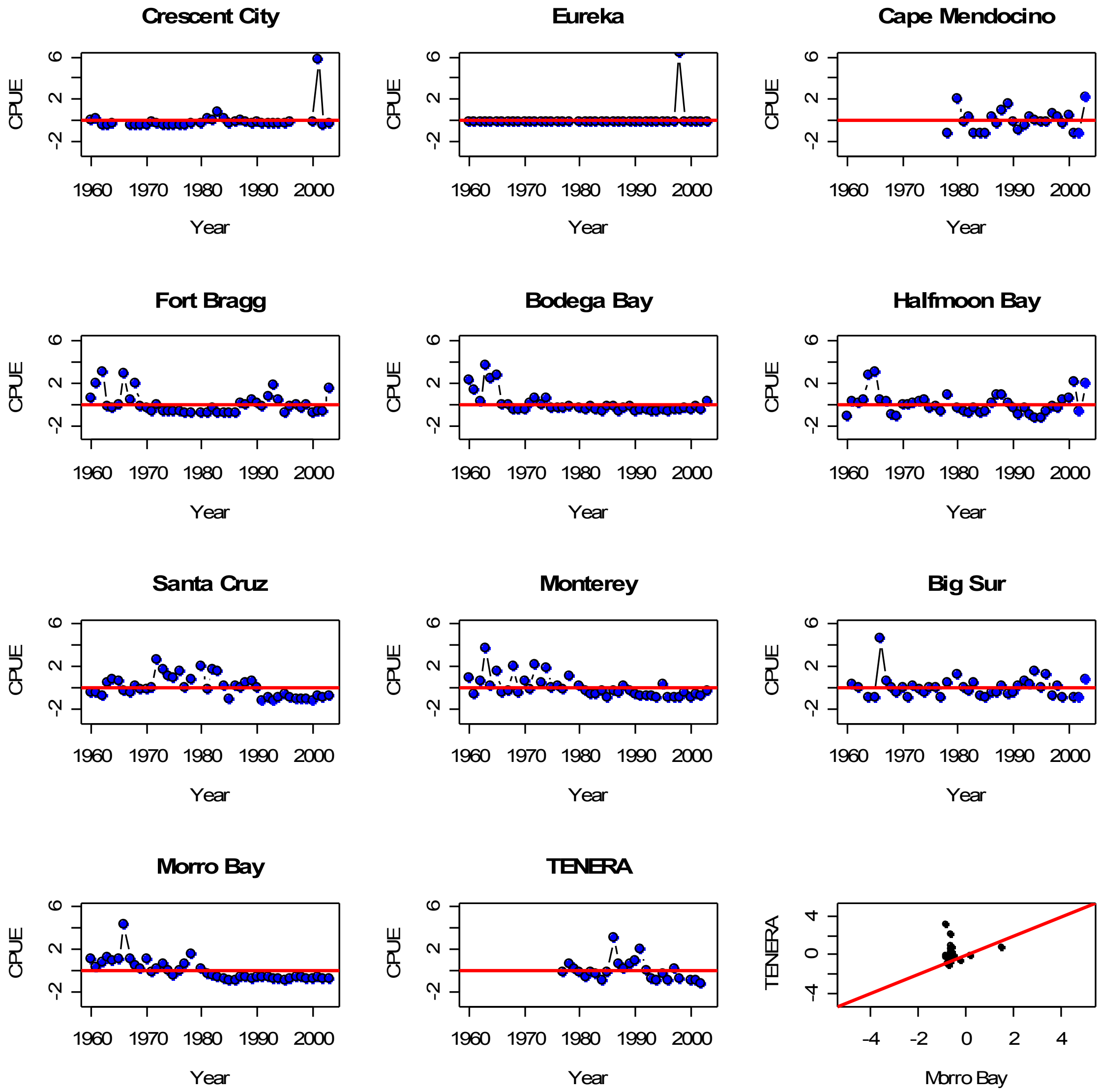


Figure 26. Port-specific trends in abundance based on standardized (Z-score) year effects from the delta GLM model for the NCS CPFV fleet and TENERA adult survey. The horizontal line references the points to mean zero.The lower right panel compares the TENERA adult survey index with the abundance index for the port closest to it, Morro Bay.

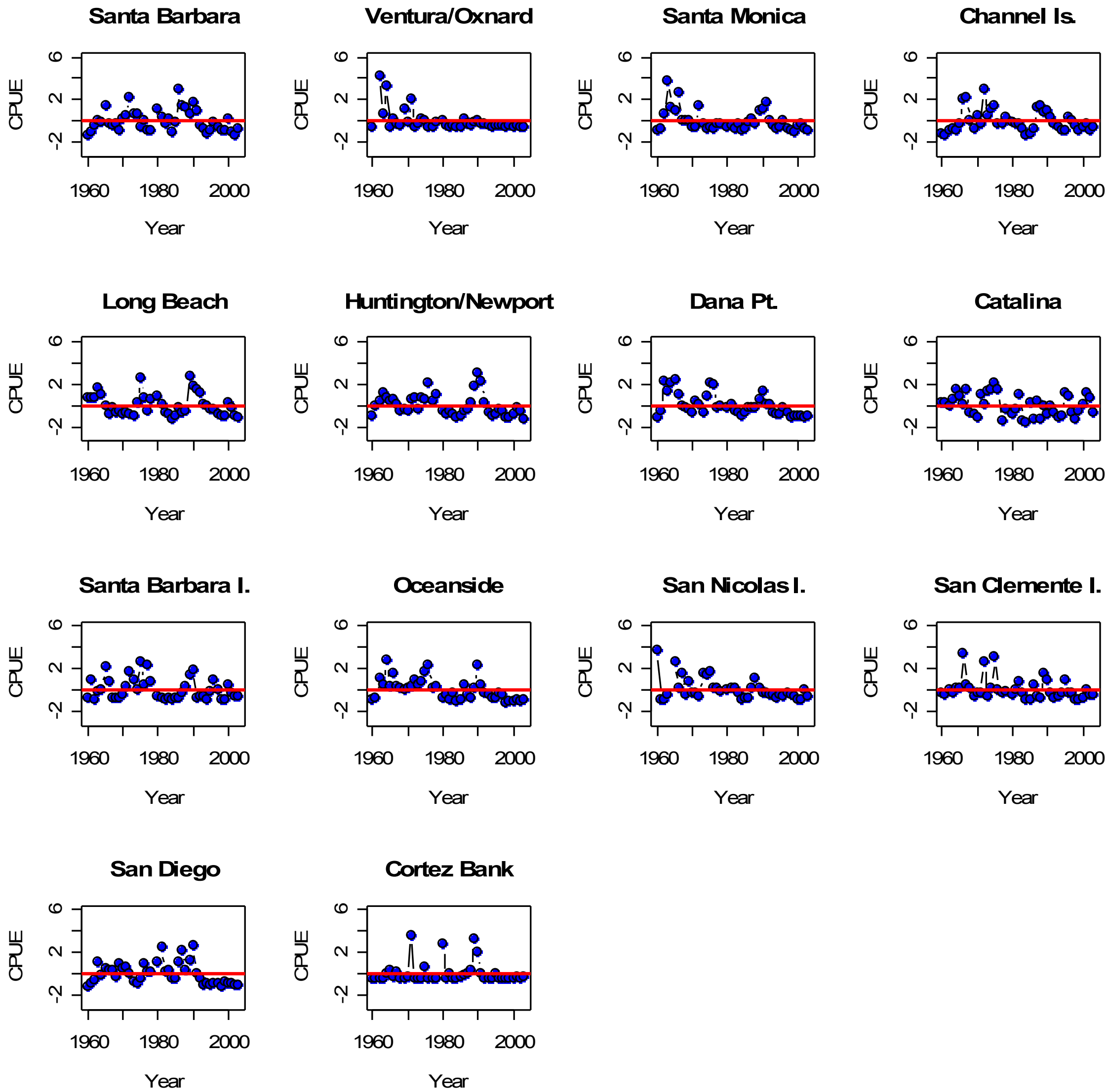


Figure 27. Port-specific trends in abundance based on standardized (Z-score) year effects from the delta GLM model for the SCS CPFV fleet. The horizontal line references the points to mean zero.

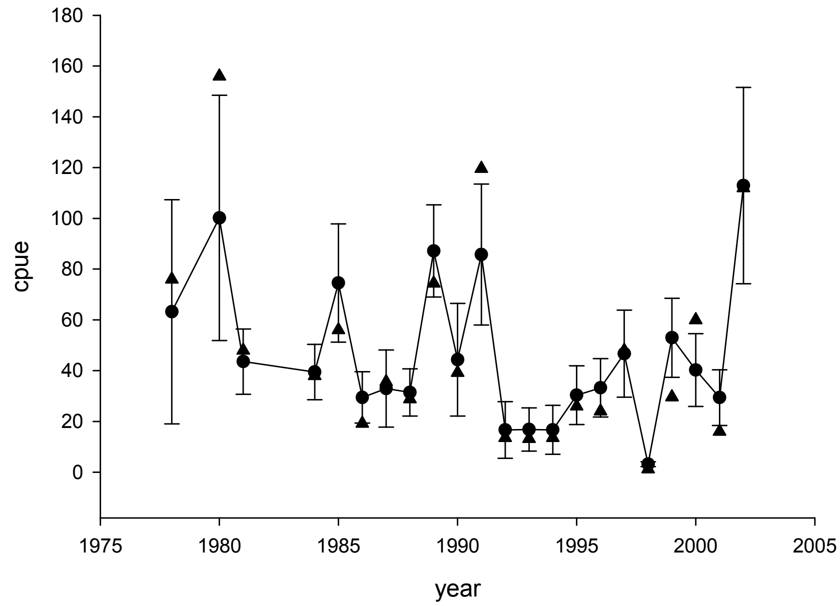


Figure 28. Index of reproductive output for southern California based on data from the CalCOFI larval surveys. The GLM-based indices are the connected circles and the raw averages are the unconnected triangles.

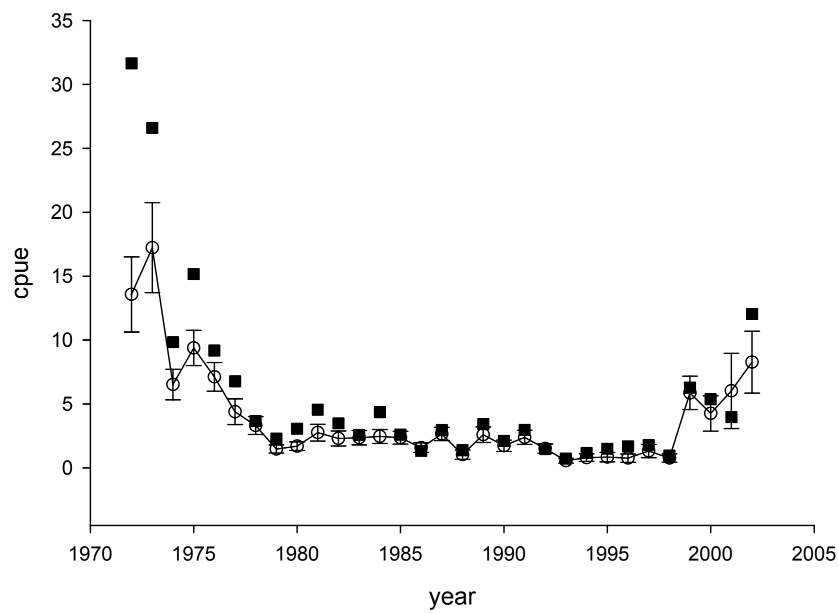


Figure 29. Index of recruitment from power-plant impingement data. The GLM-based indices are the connected circles and the raw averages are the unconnected squares.

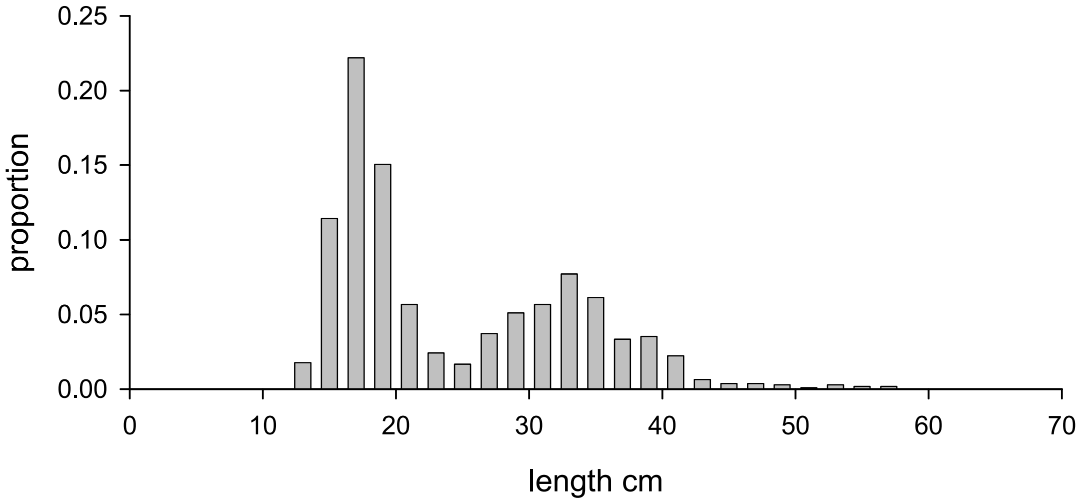


Figure 30. The raw length frequency of cabezon sampled in the power plants used to create the impingement time series.

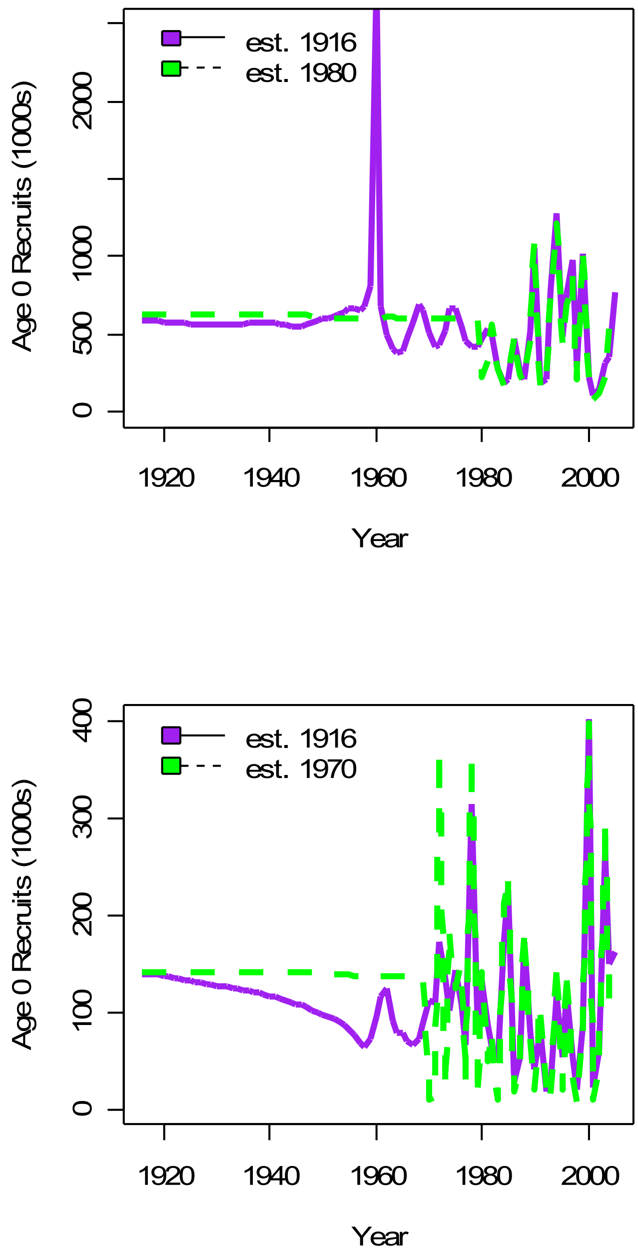


Figure 31. Comparison of recruitment trajectories when recruitment estimation begins at the start of the model (1916) or in the year used for the base case for each cabezon substock.

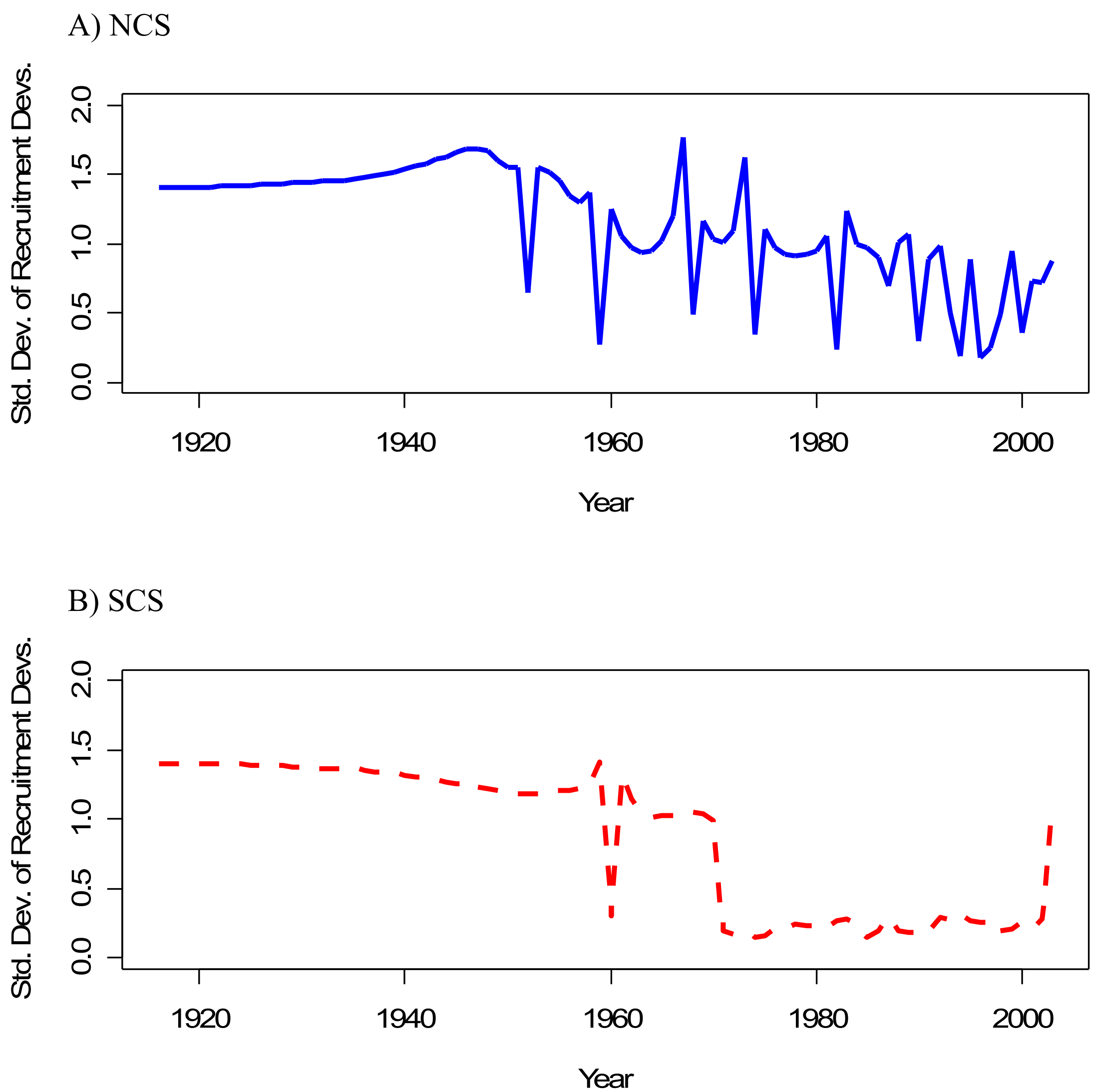


Figure 32. Asymptotic standard errors for the annual recruitment deviationss for the A) NCS and B) SCS.

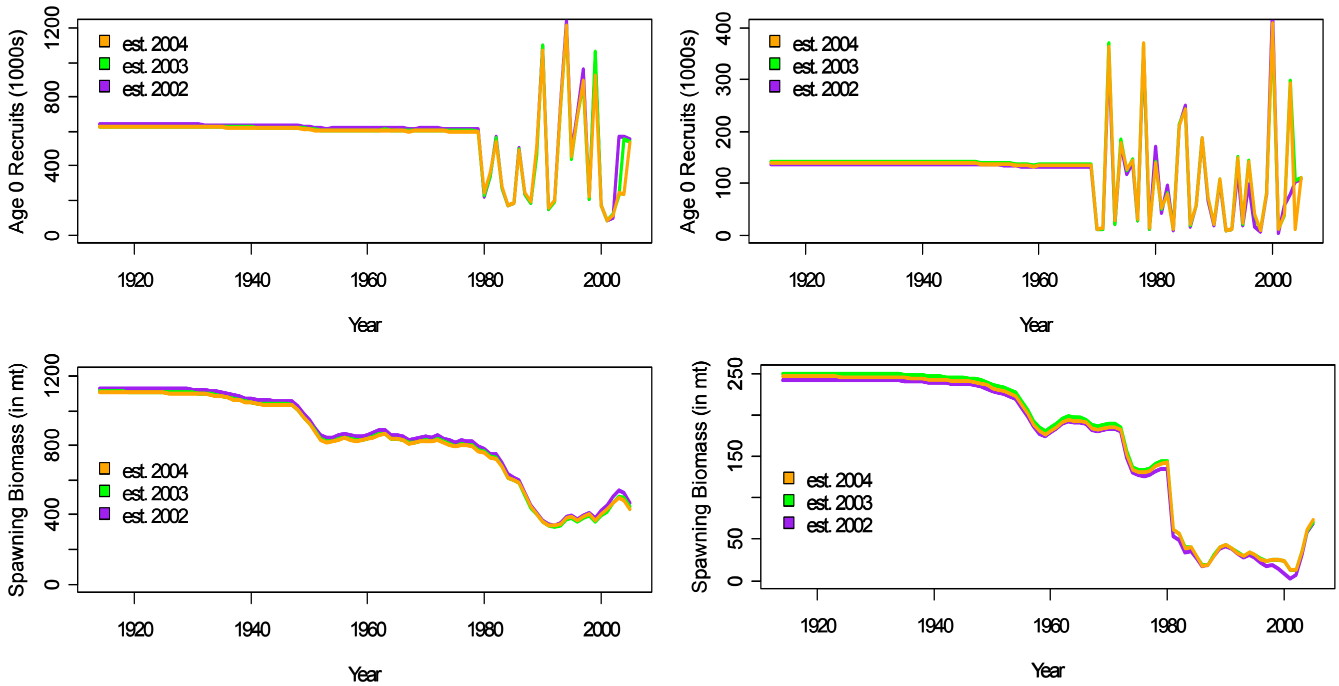


Figure 33. An example of the sensitivity of the time-trajectories of recruitment and spawning biomass to the last year for which recruitment deviations are estimated.

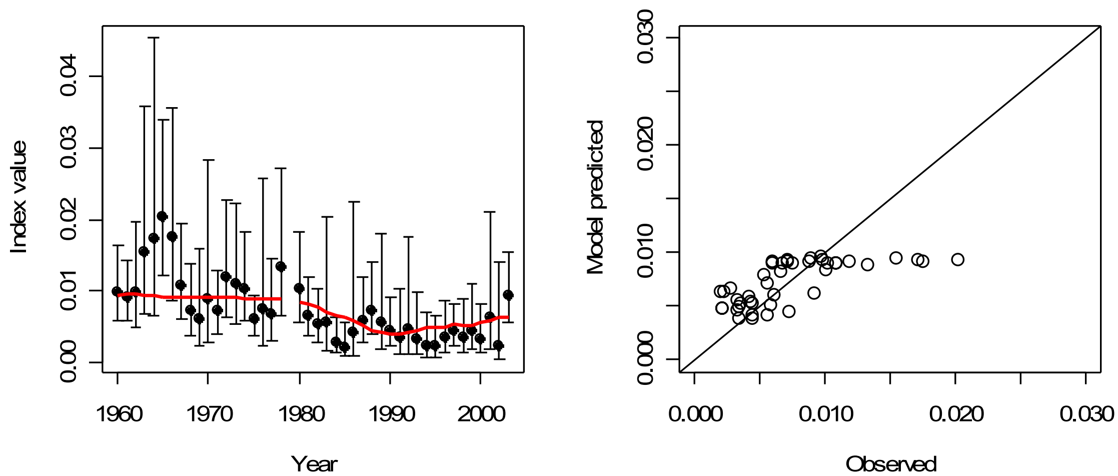


Figure 34. Fits to CPFV CPUE data for the NCS. The left panel shows the fit of the model (solid red line) to the observed CPUE data (solid black dots). The vertical lines in the left panel are the 95% confidence intervals for the data (based on the assumed coefficients of variation). The panel on the right compares the observed and model-predicted abundance indices, with the solid line indicating the 1:1 relationship.

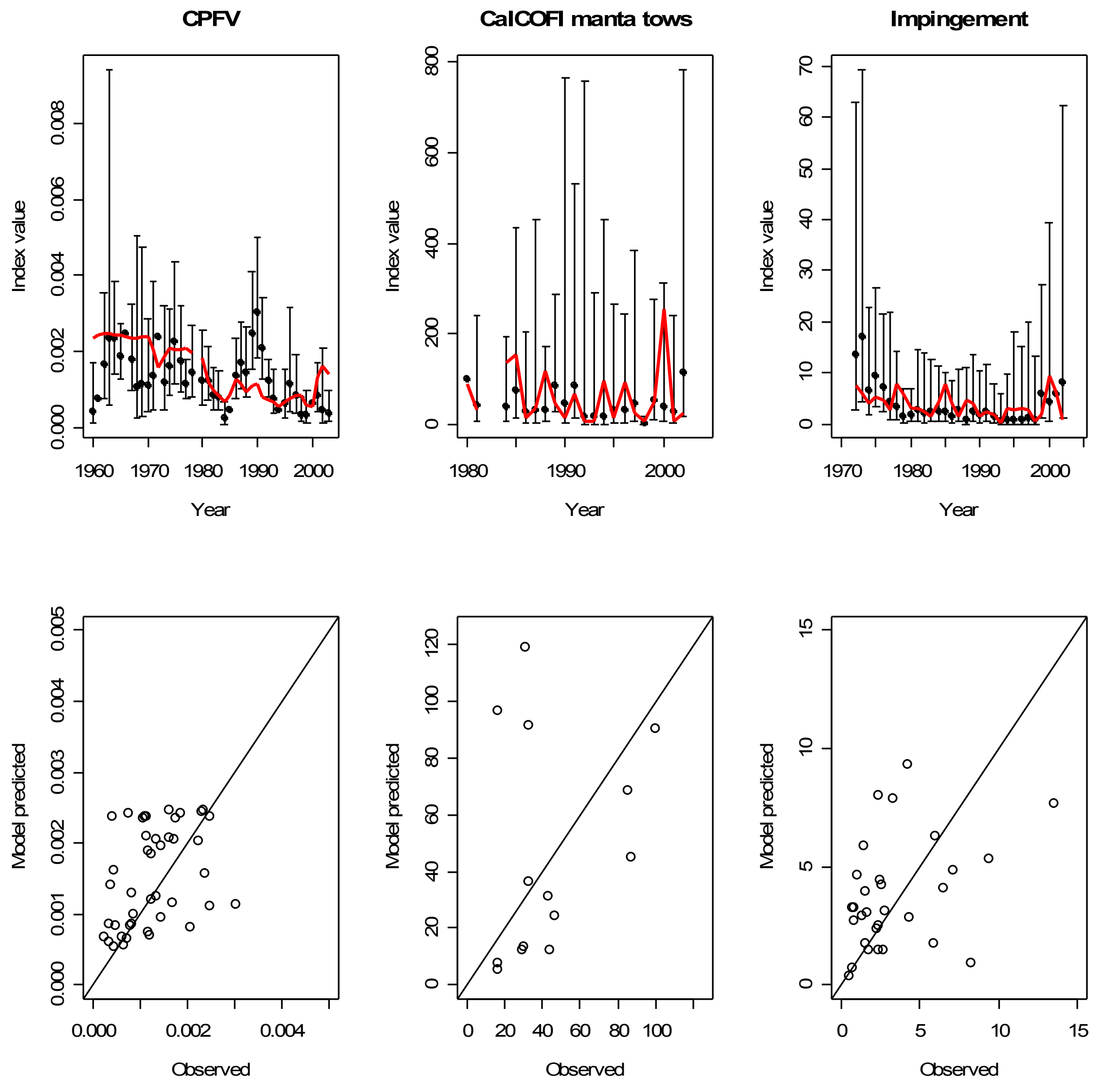


Figure 35. Fits to the abundance indices for the SCS. The upper panels show the fit of the model (solid red lines) to the observed indices (solid black dots). The vertical lines in the upper panels are the 95% confidence intervals for the data (based on the assumed coefficients of variation). The lower panels compare the observed and model-predicted abundance indices, with the solid lines indicating the 1:1 relationships.

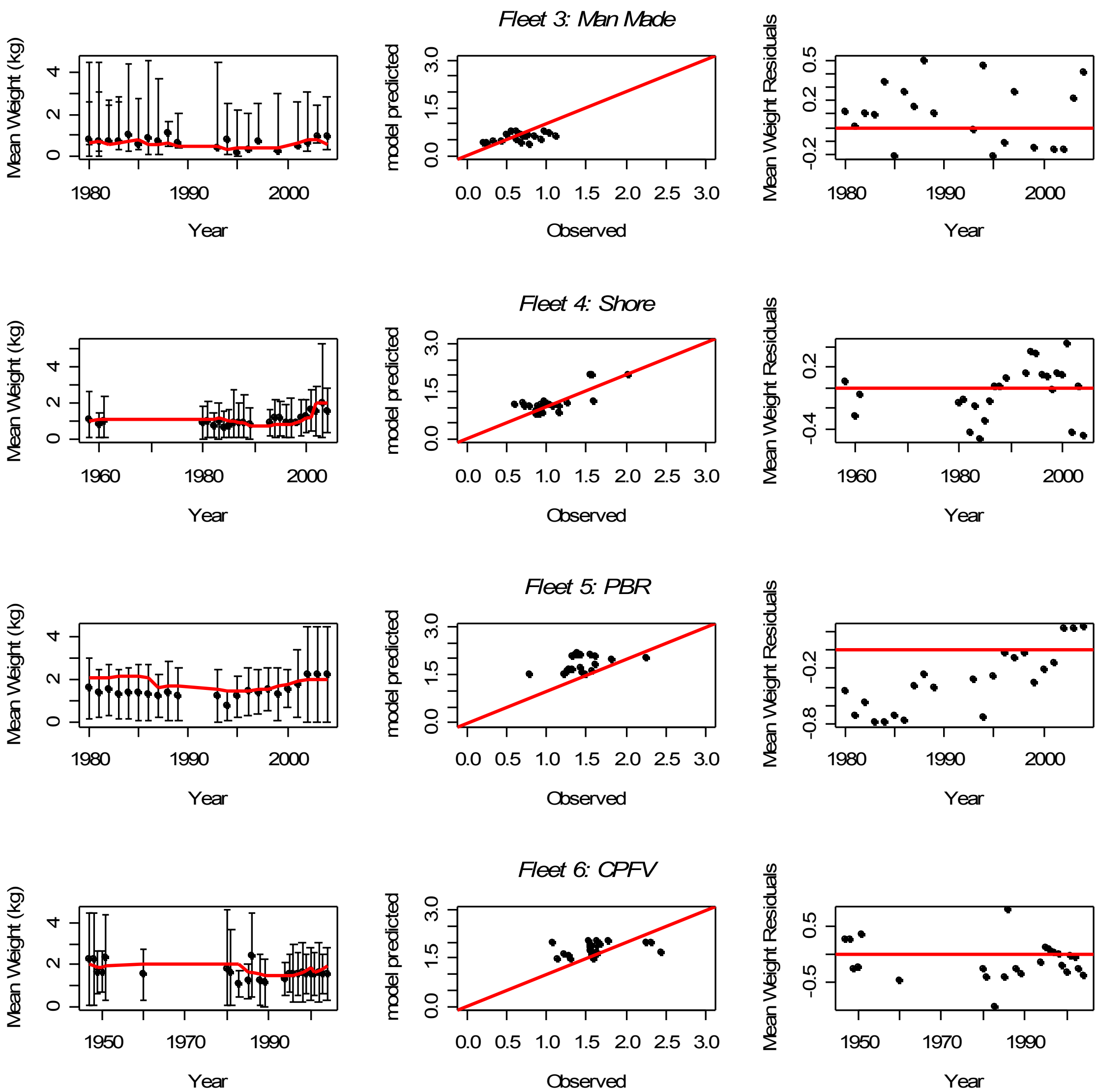


Figure 36. Base-case model fits to the mean weight data for the NCS. The left panels show the observed (solid dots with 95% confidence intervals) and model-predicted (solid red lines) mean weights. The center panels plot the observed *versus* model-predicted mean weights and the right panels show the time-sequence of residuals.

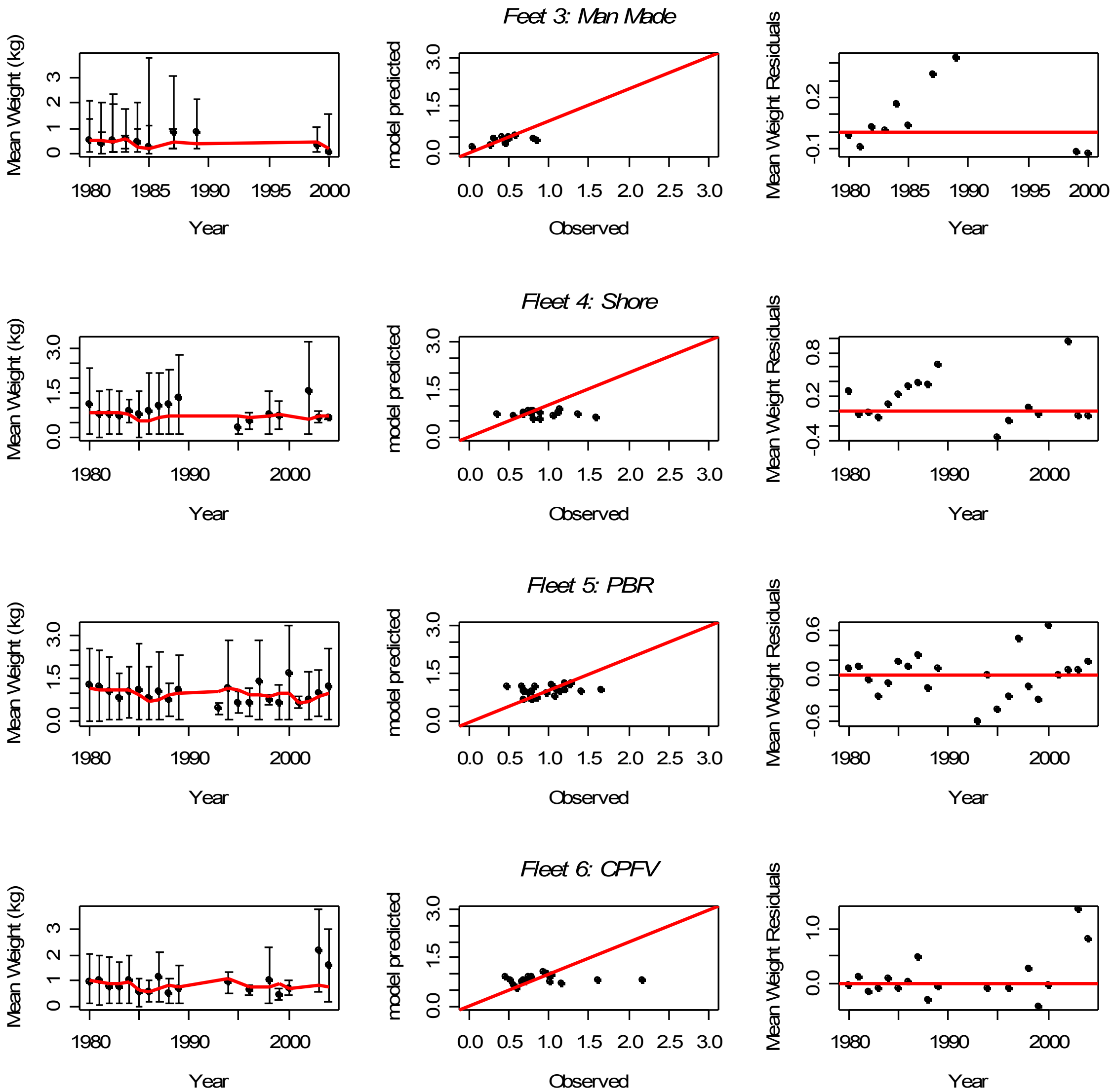


Figure 37. Base-case model fits to the mean weight data for the SCS. The left panels show the observed (solid dots with 95% confidence intervals) and model-predicted (solid red lines) mean weights. The center panels plot the observed *versus* model-predicted mean weights and the right panels show the time-sequence of residuals.

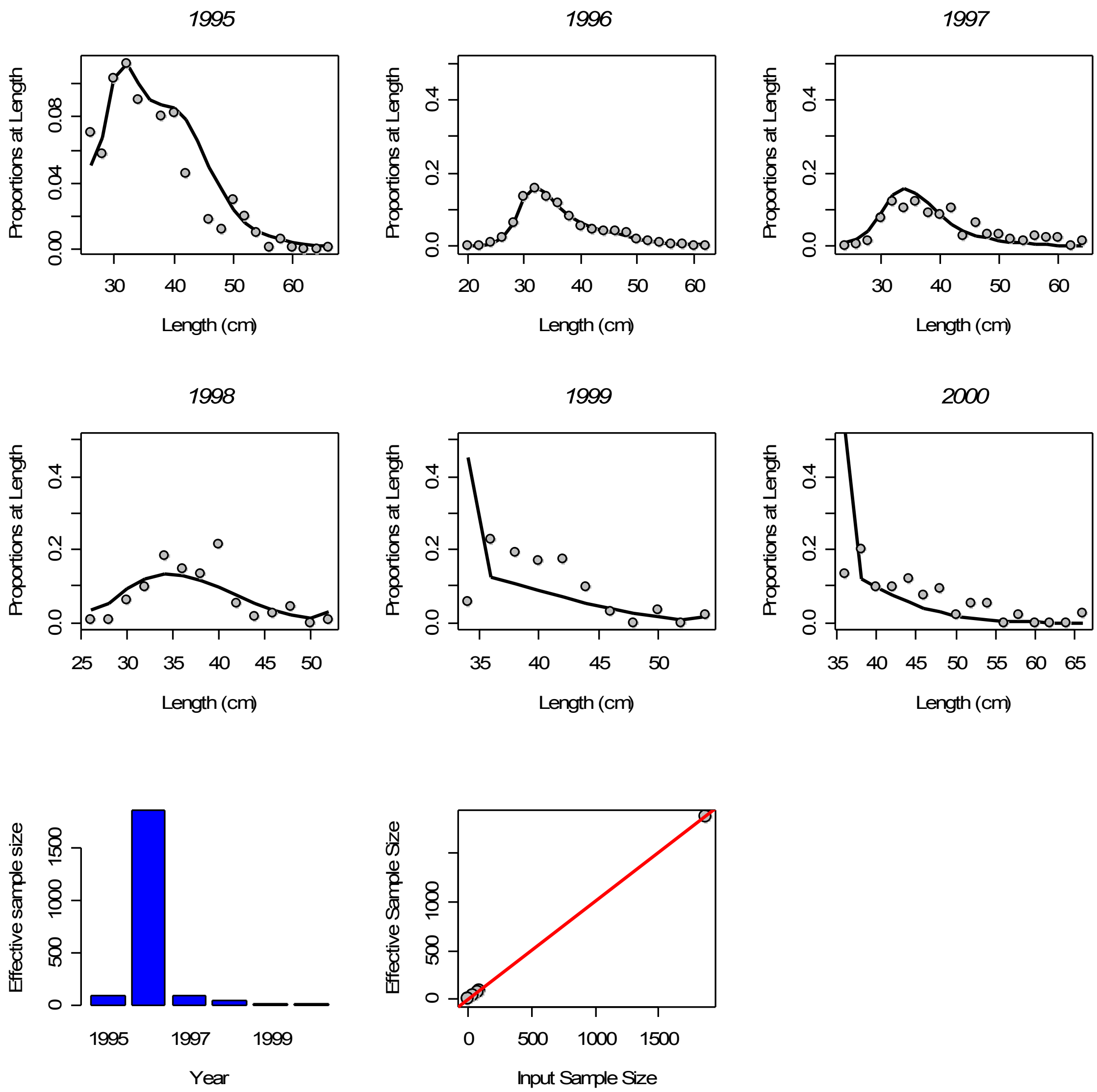


Figure 38. Observed (solid circles) and model-predicted (solid lines) length-composition data for the commercial non-live-fish fleet (fleet 1) in the NCS. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

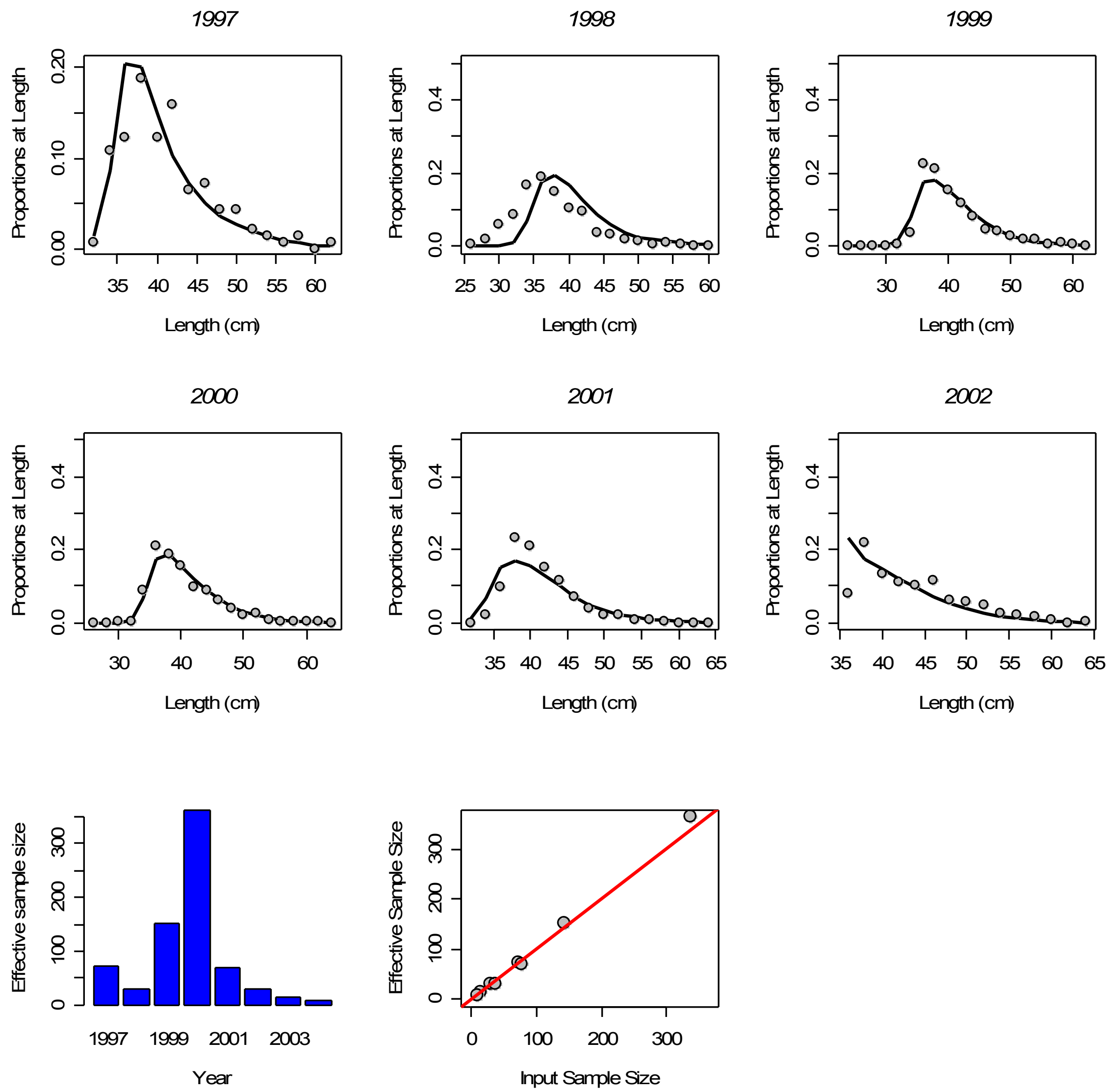


Figure 39. Observed (solid circles) and model-predicted (solid lines) length-composition data for the commercial live-fish fleet (fleet 2) in the NCS. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

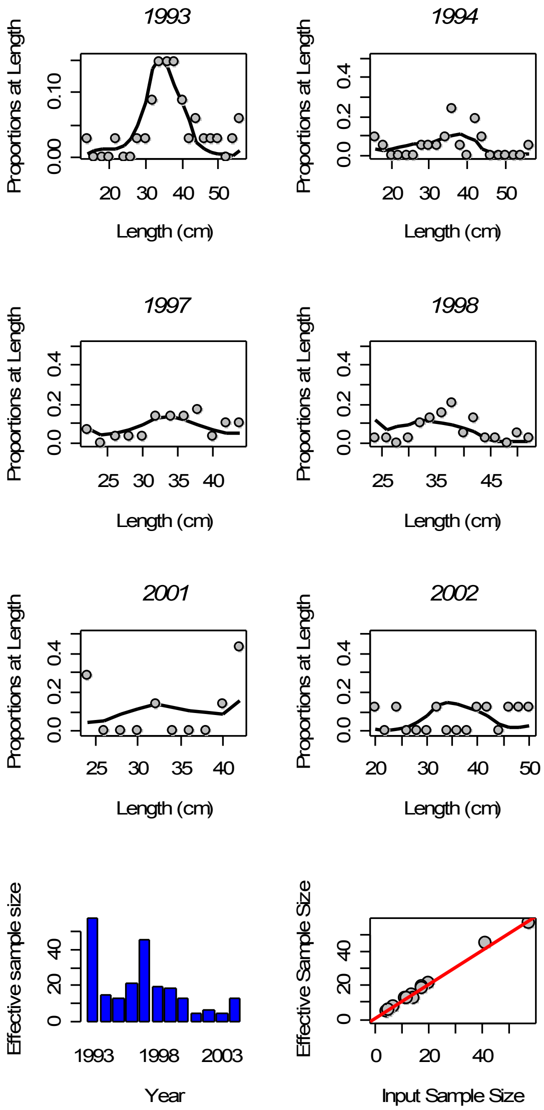


Figure 40. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational shore mode (fleet 4) in the NCS. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

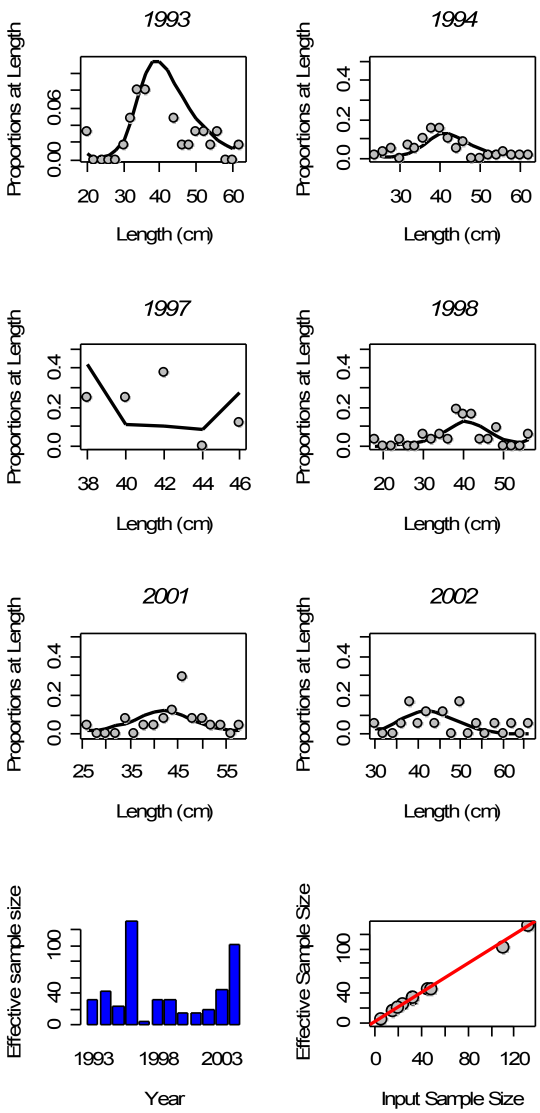


Figure 41. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational PBR mode (fleet 5) in the NCS. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

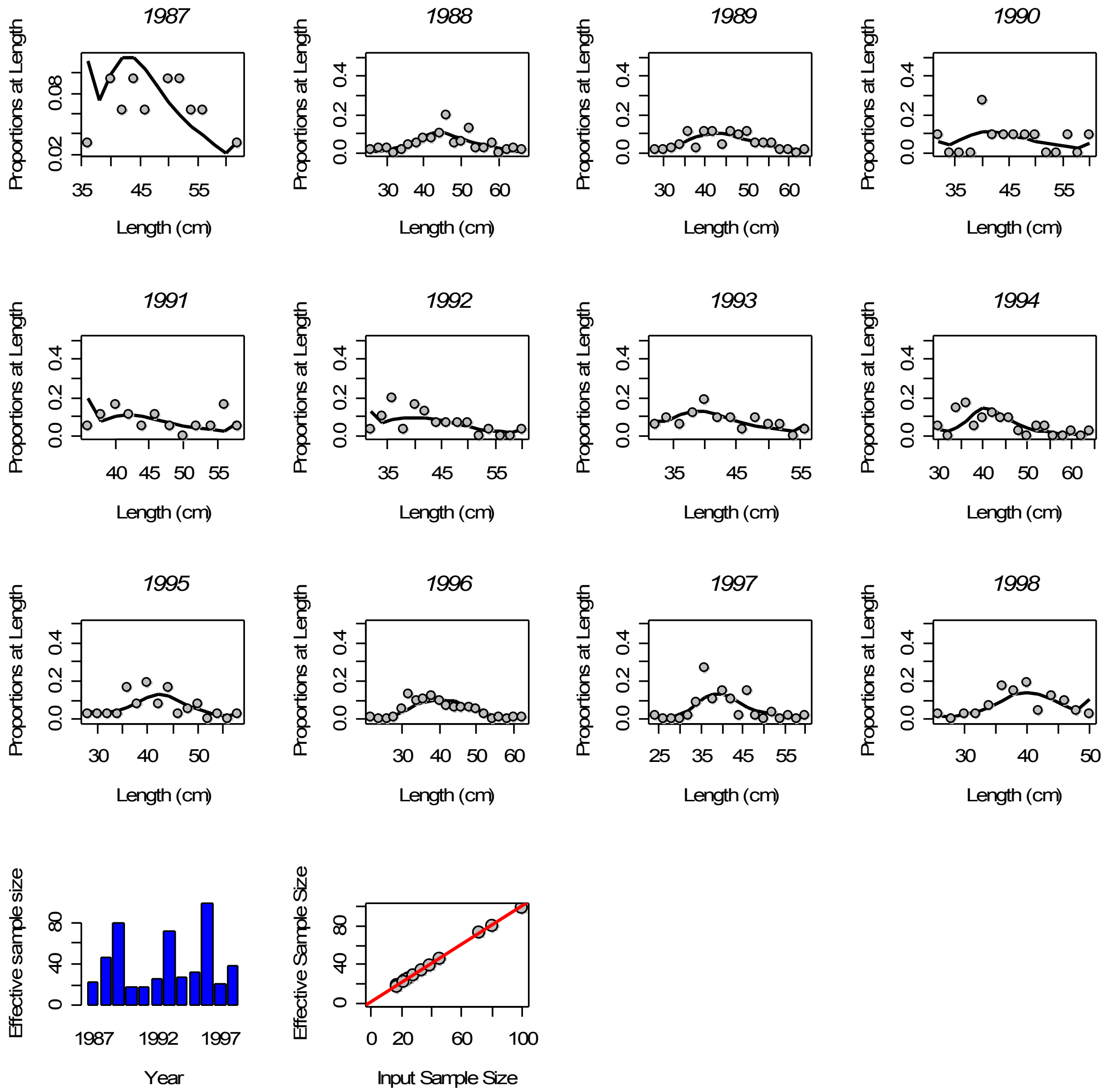


Figure 42. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational CPFV mode (fleet 6) in the NCS from CDF&G observer data. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

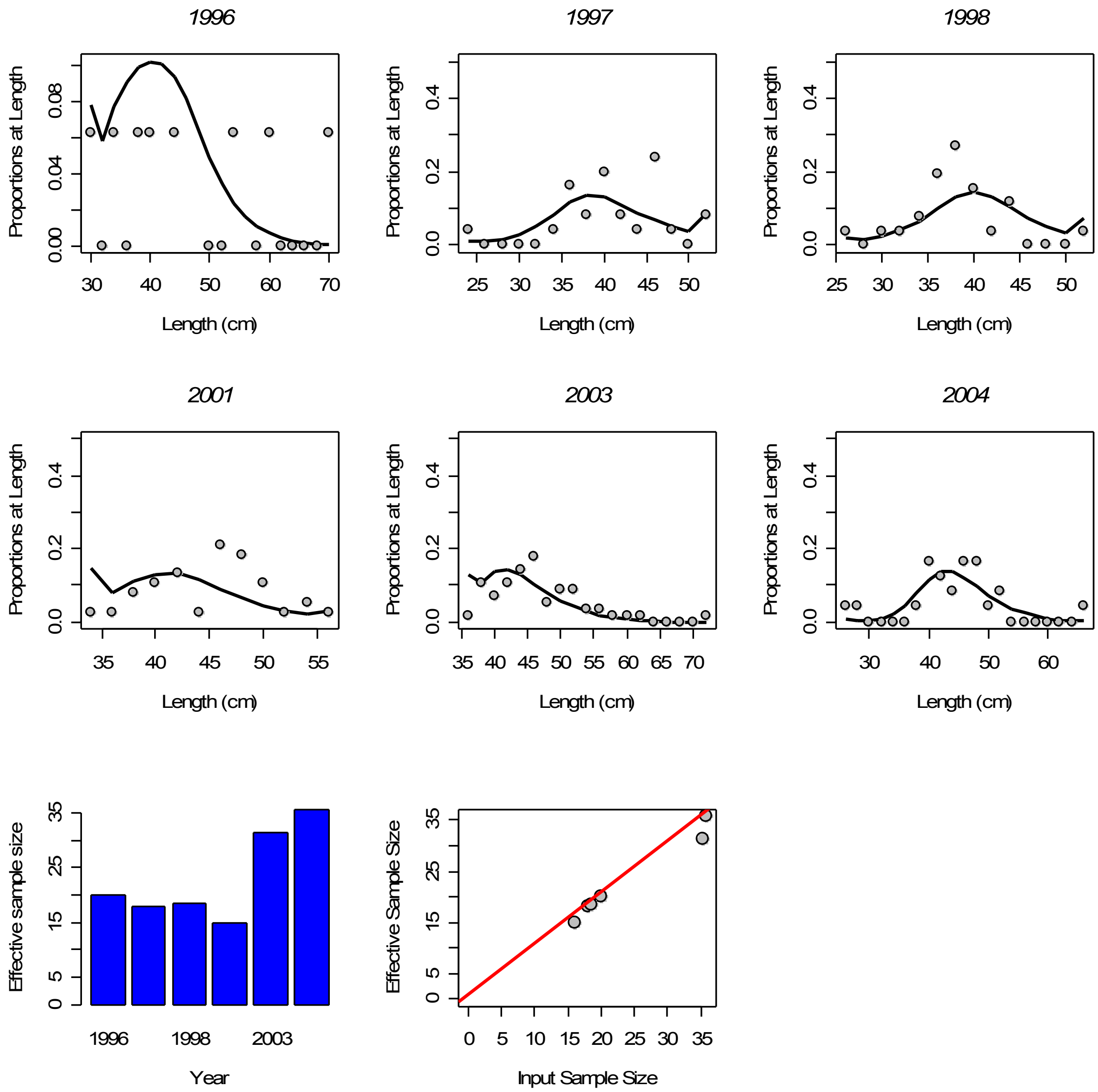


Figure 43. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational CPFV mode (fleet 6) in the NCS from RecFIN. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

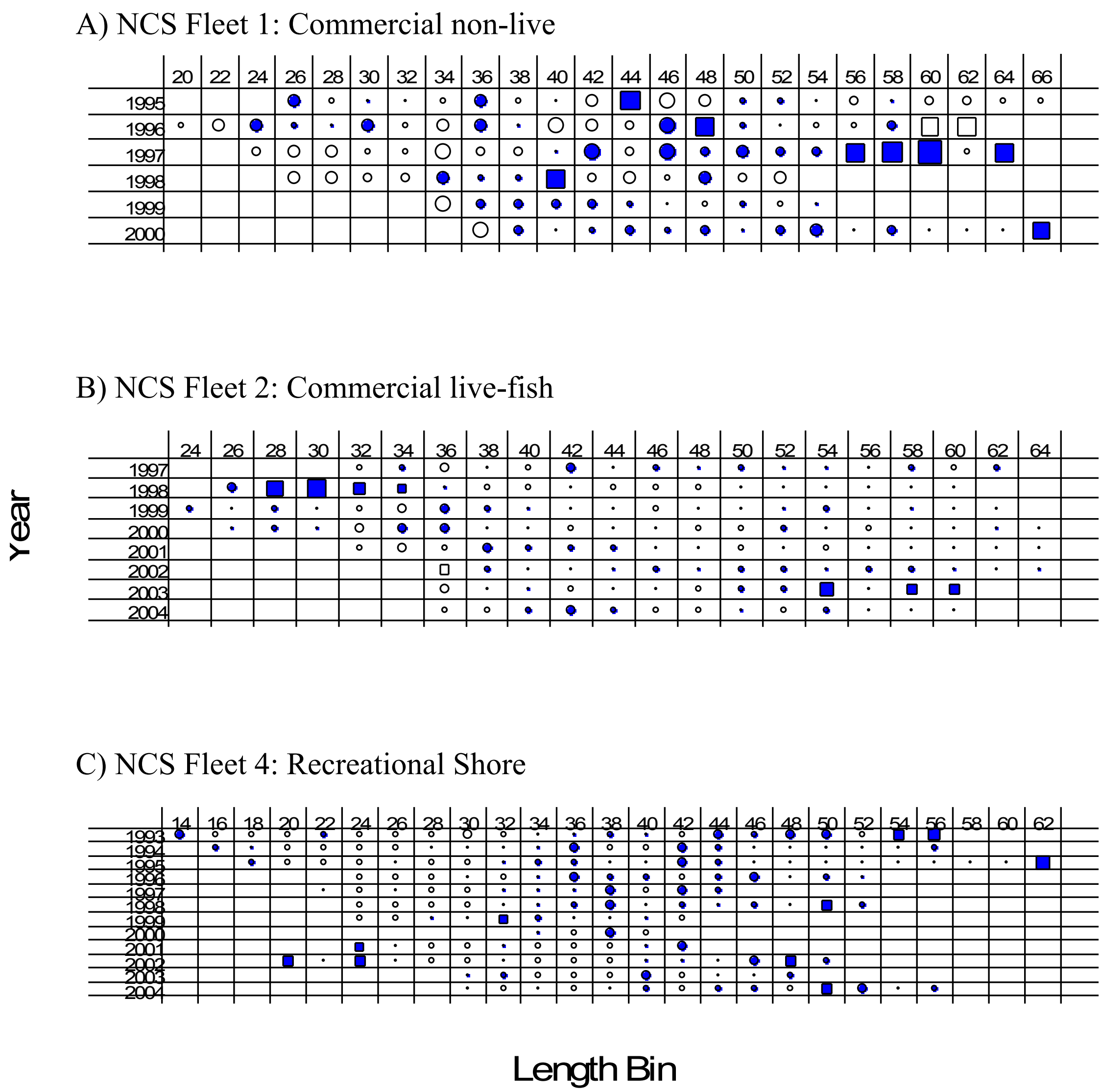


Figure 44. Pearson residual plots of fits to the length-composition data for the commercial fleets (A and B) and the recreational shore fleet in the NCS. Solid symbols represent negative values; open symbols positive values; squares represent residuals <-2 and >2.

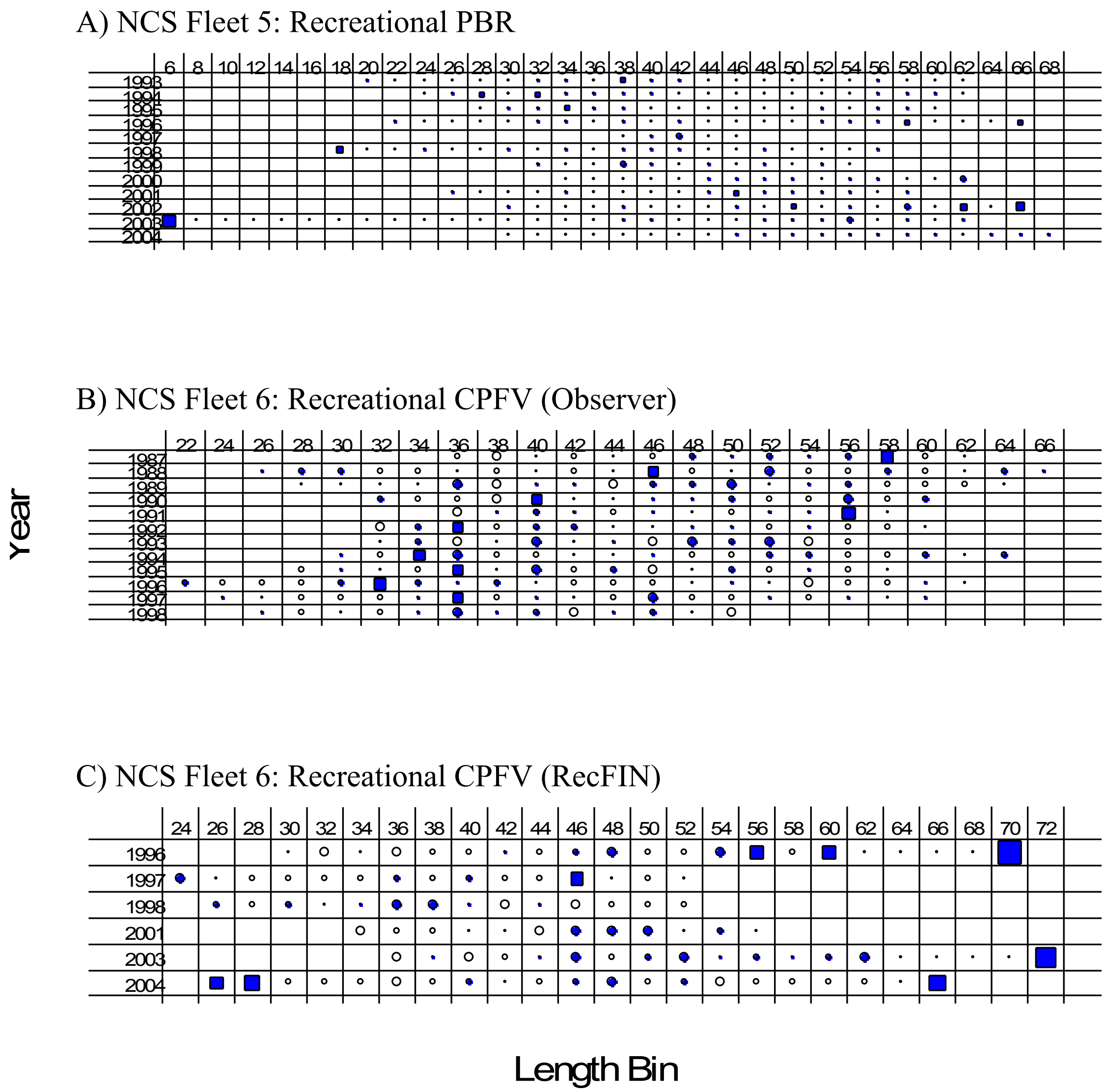


Figure 45. Pearson residual plots of fits to length composition data for the recreational fleets in the NCS. Solid symbols represent negative values; open symbols positive values; squares represent residuals <-2 and >2.

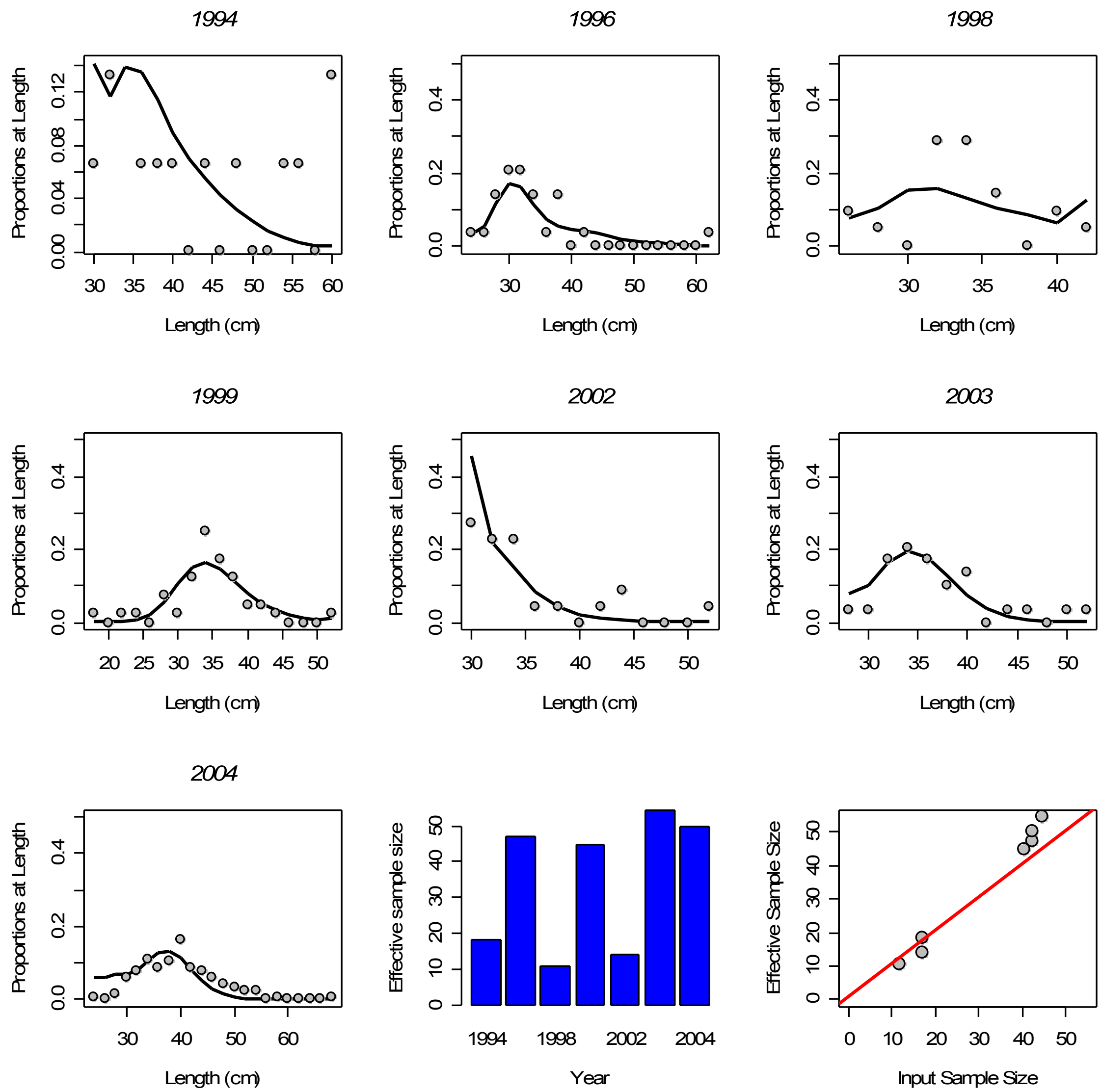


Figure 46. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational PBR mode (fleet 5) in the SCS. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

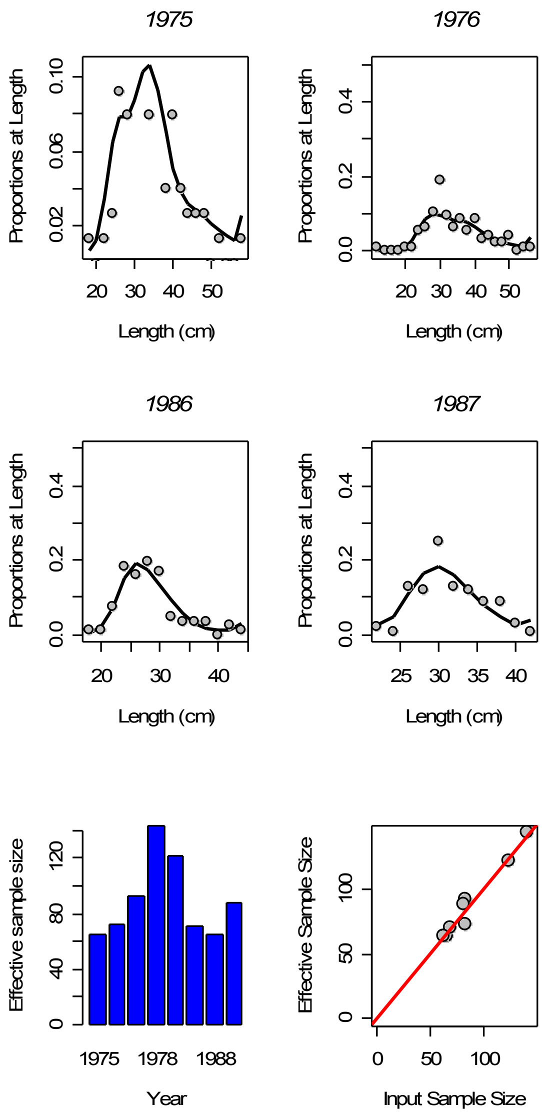


Figure 47. Observed (solid circles) and model-predicted (solid lines) length-composition data for the recreational CPFV mode (fleet 6) in the SCS from CDF&G observer data. The annual effective sample sizes are summarized by the histogram and a comparison of inputted to effective sample sizes is given in the lower center panel (the solid red line in this panel is the 1:1 line).

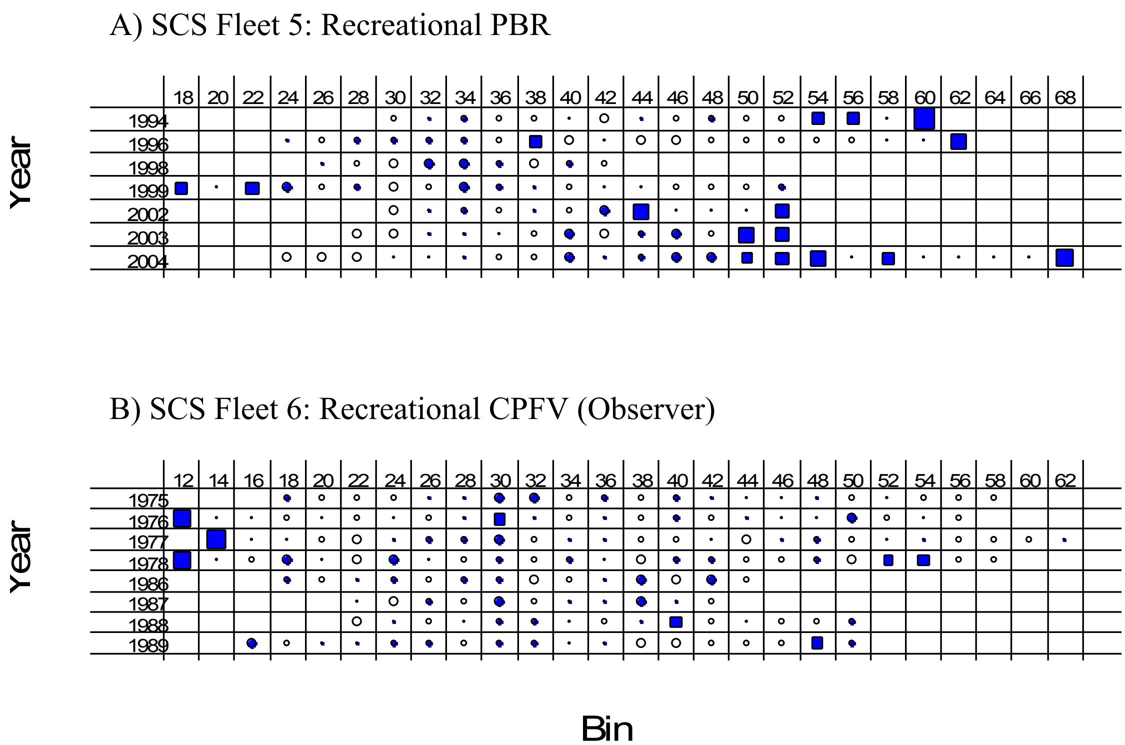
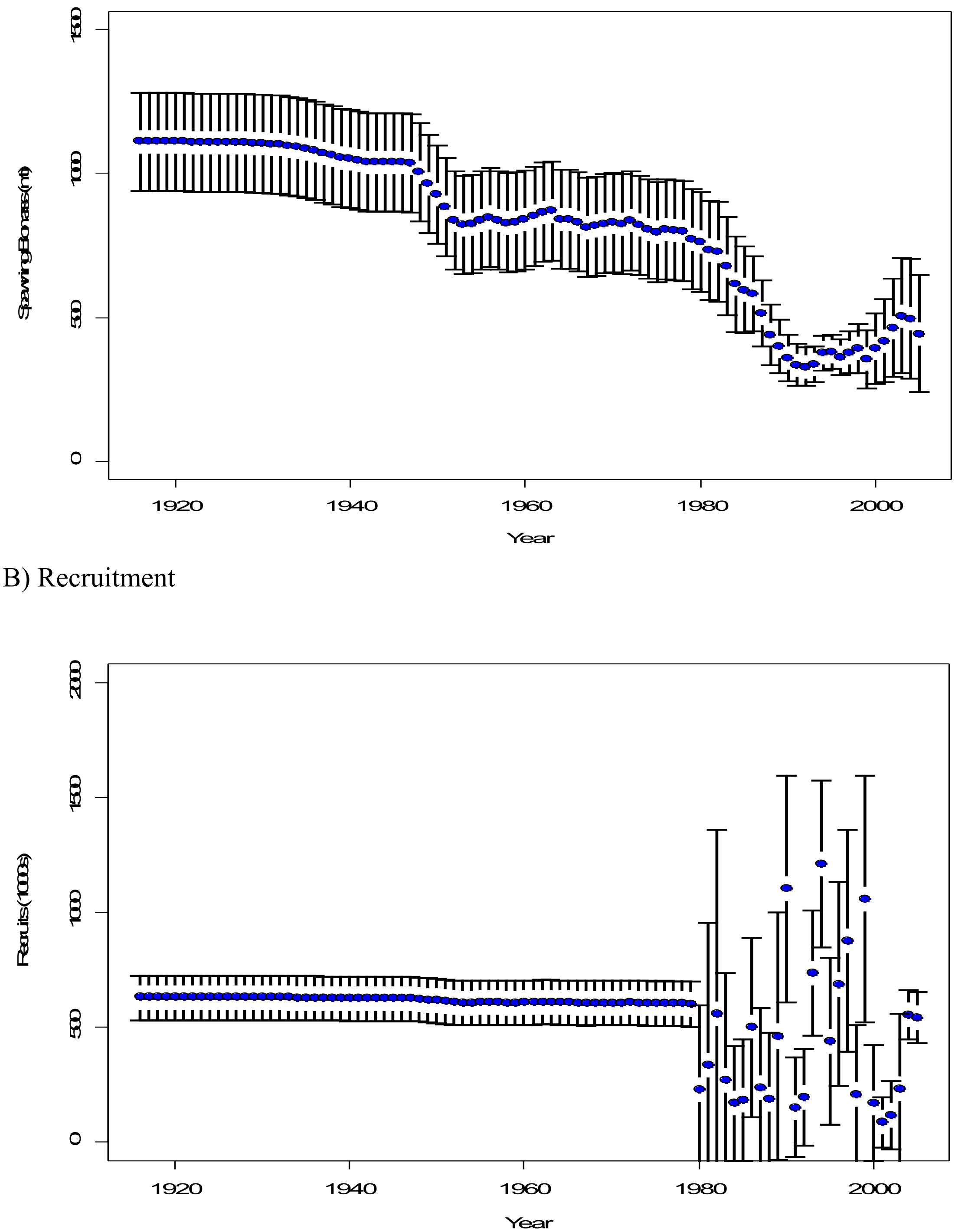


Figure 48. Pearson residual plots of fits to the length-composition data for the recreational fleets in the SCS. Solid symbols represent negative values; open symbols positive values; squares represent residuals <-2 and >2.

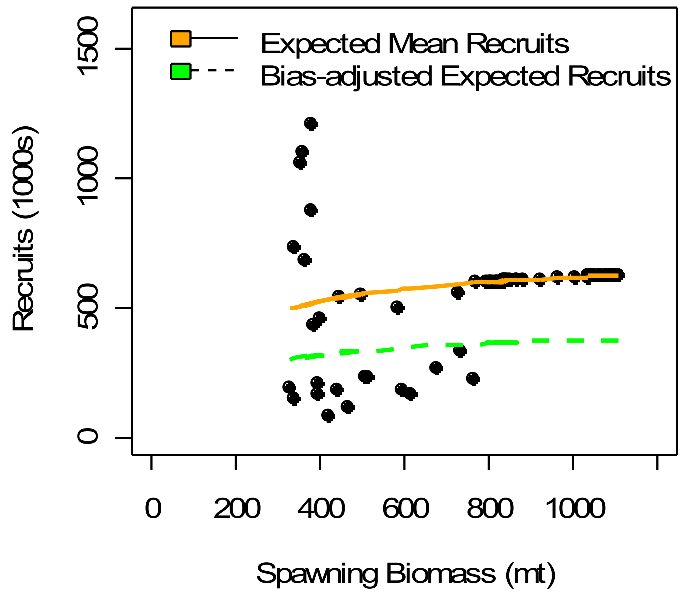
A) Reproductive Output



B) Recruitment

Figure 49. MPD time-trajectories of A) reproductive output (measured in spawning biomass) and B) recruitment for the NCS. The vertical bars represent asymptotic 95% confidence intervals.

A) NCS



B) SCS

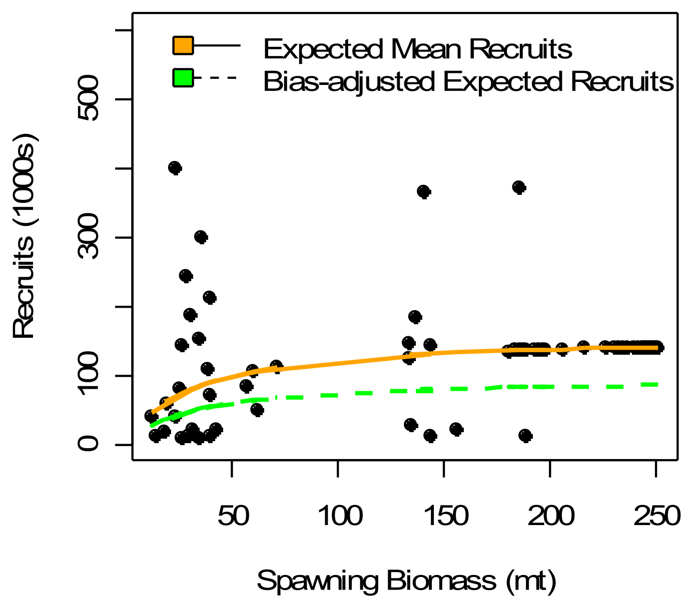


Figure 50. Relationship between spawners and recruits for A) the NCS and B) the SCS.

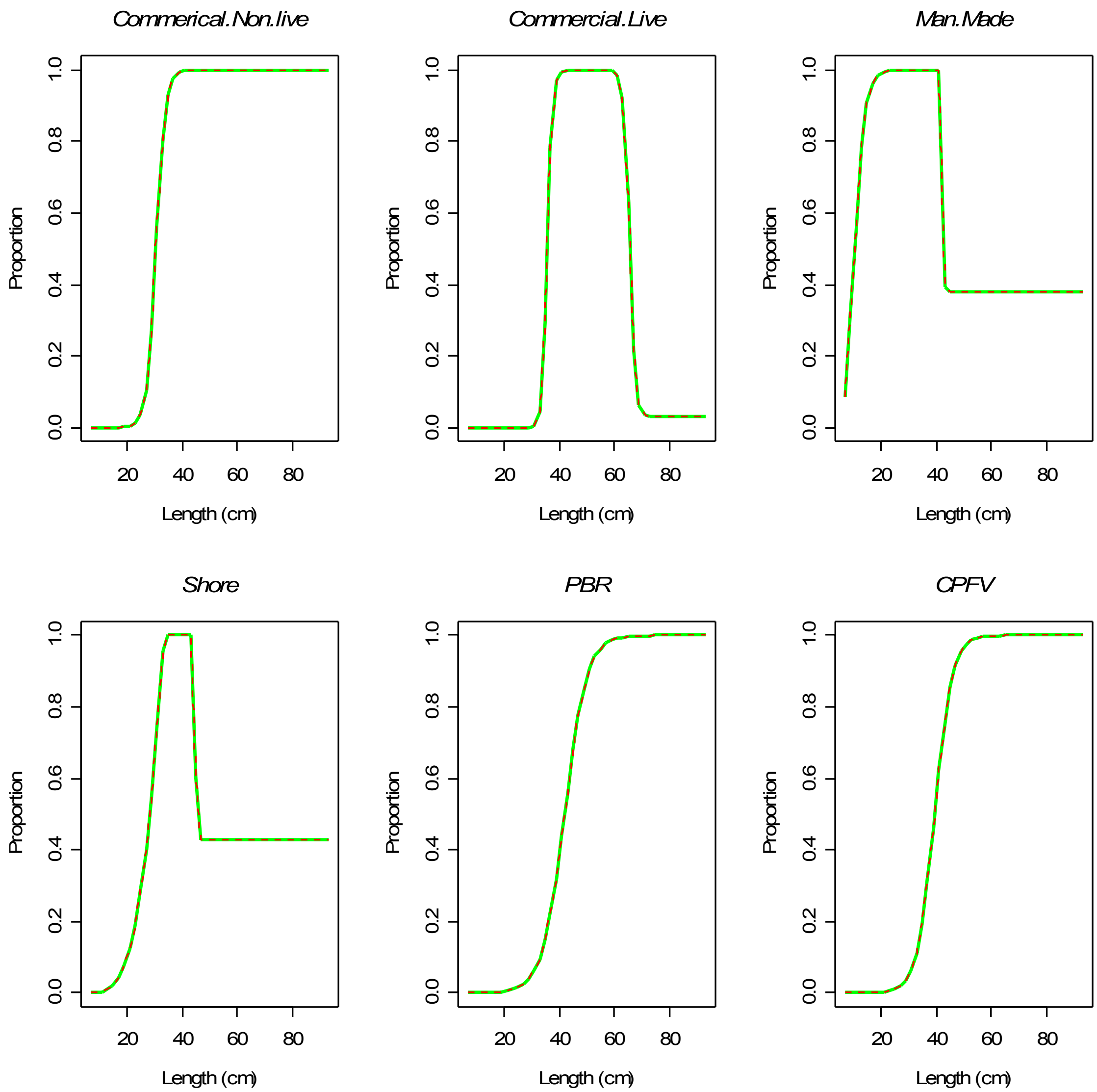


Figure 51. MPD estimates of selectivity as a function of length for the NCS.

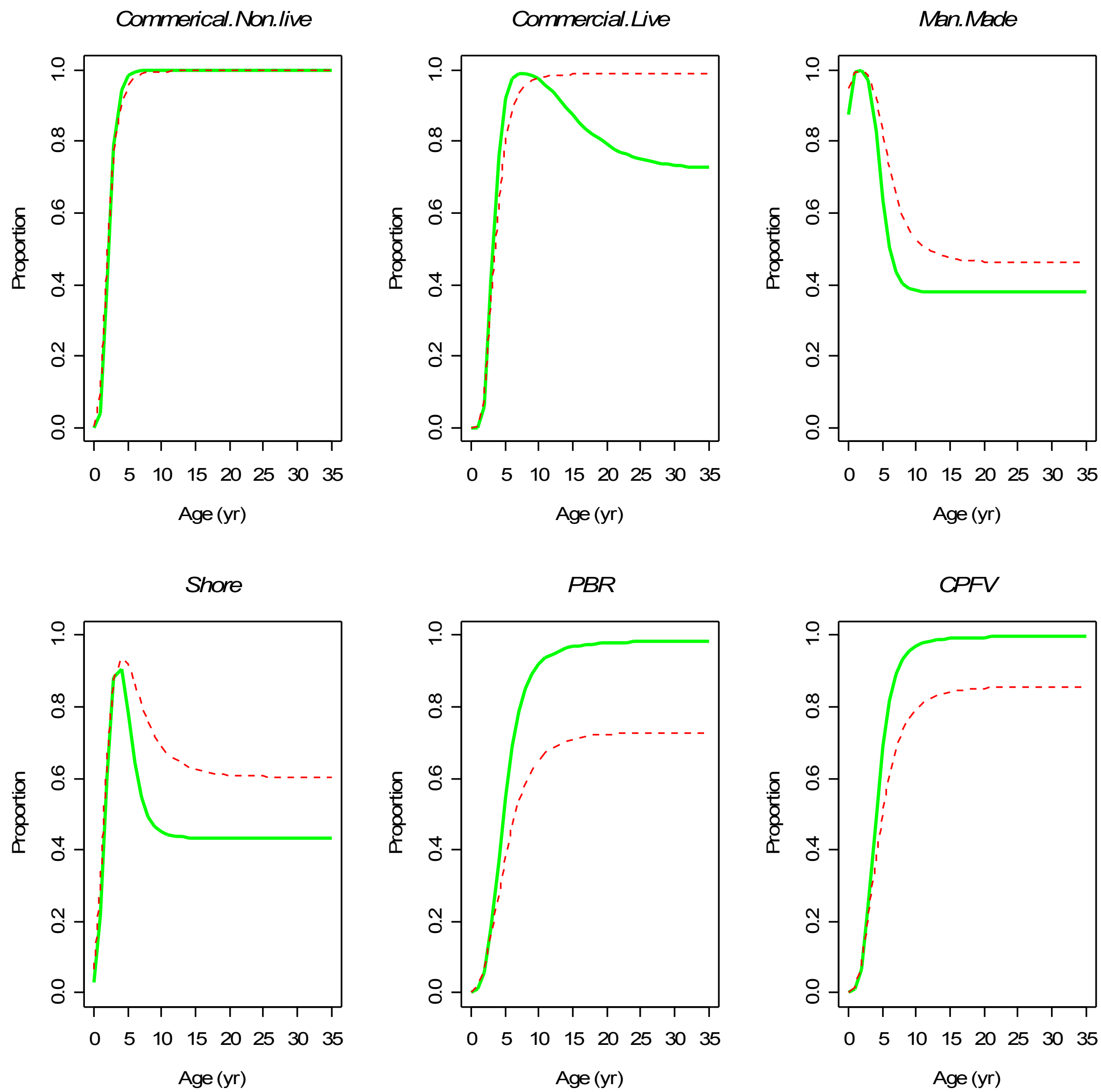


Figure 52. MPD estimates of selectivity as a function of age for the NCS (females: solid lines; males: dashed lines).

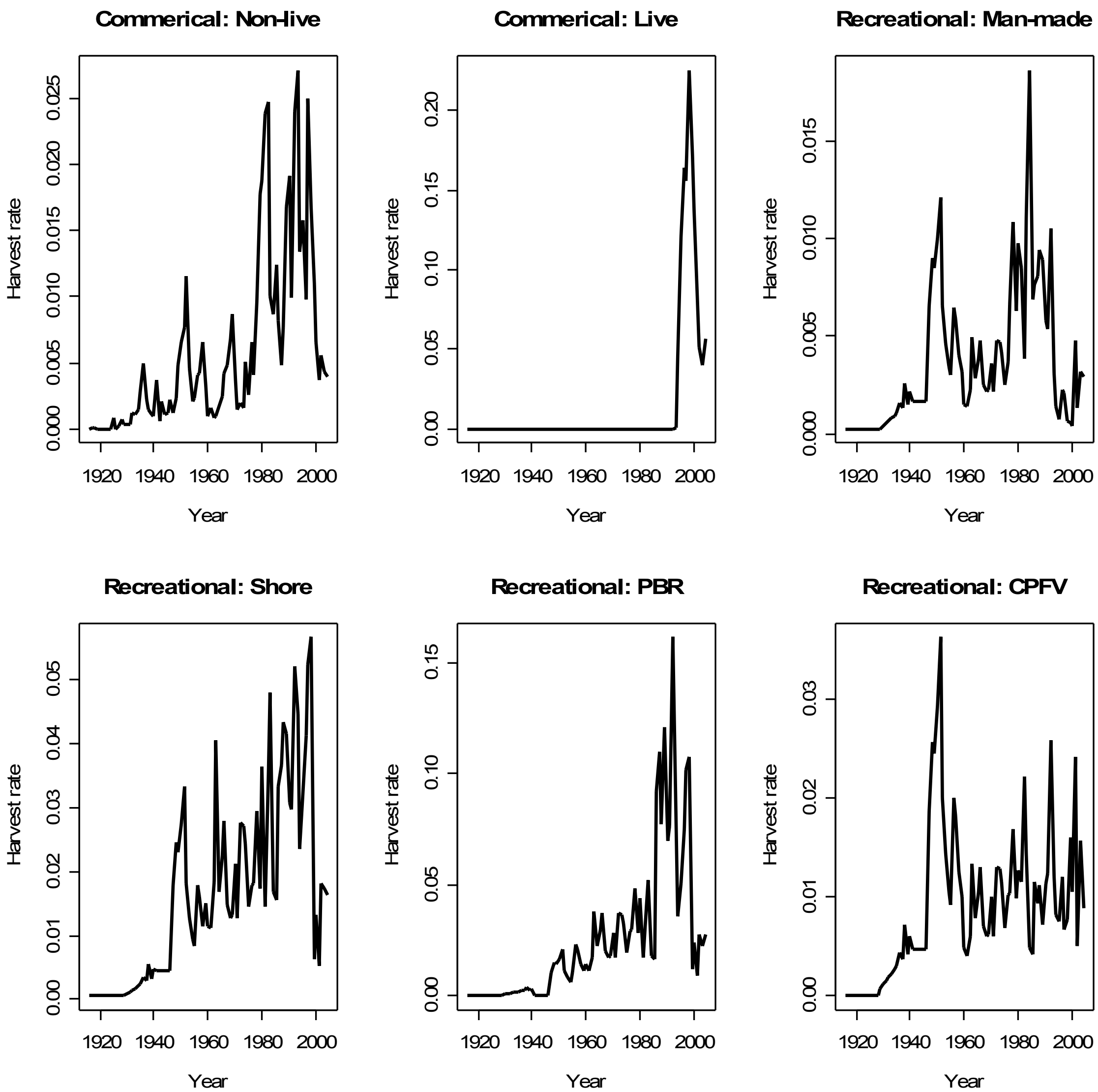
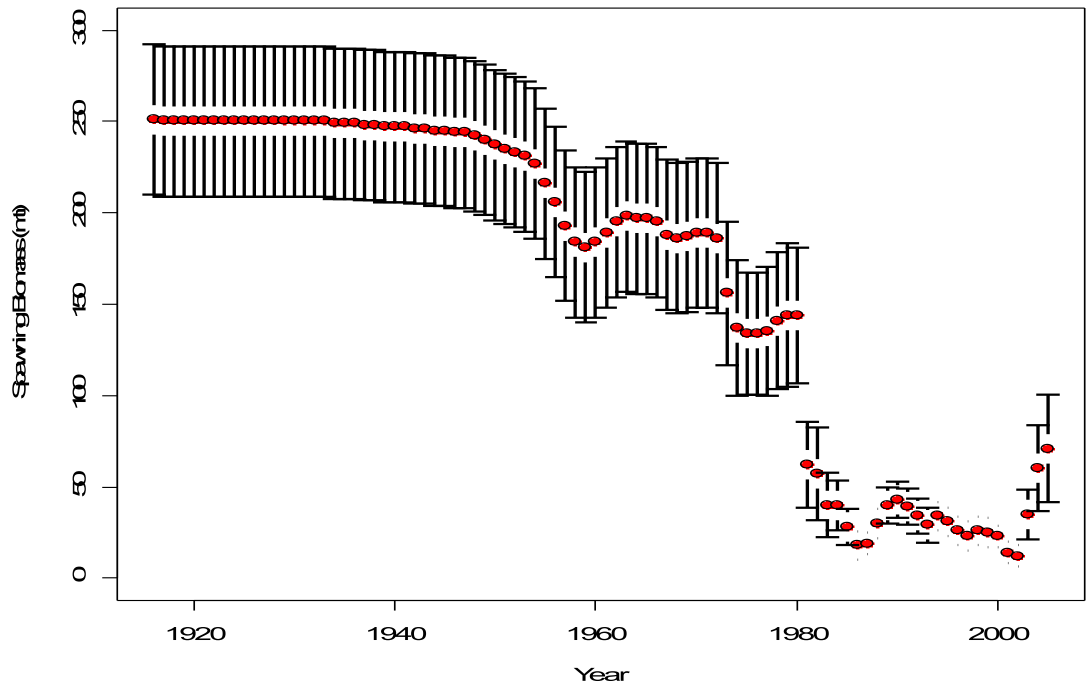


Figure 53. MPD estimates of harvest rate by fleet for the NCS.

A) Reproductive Output



B) Recruitment

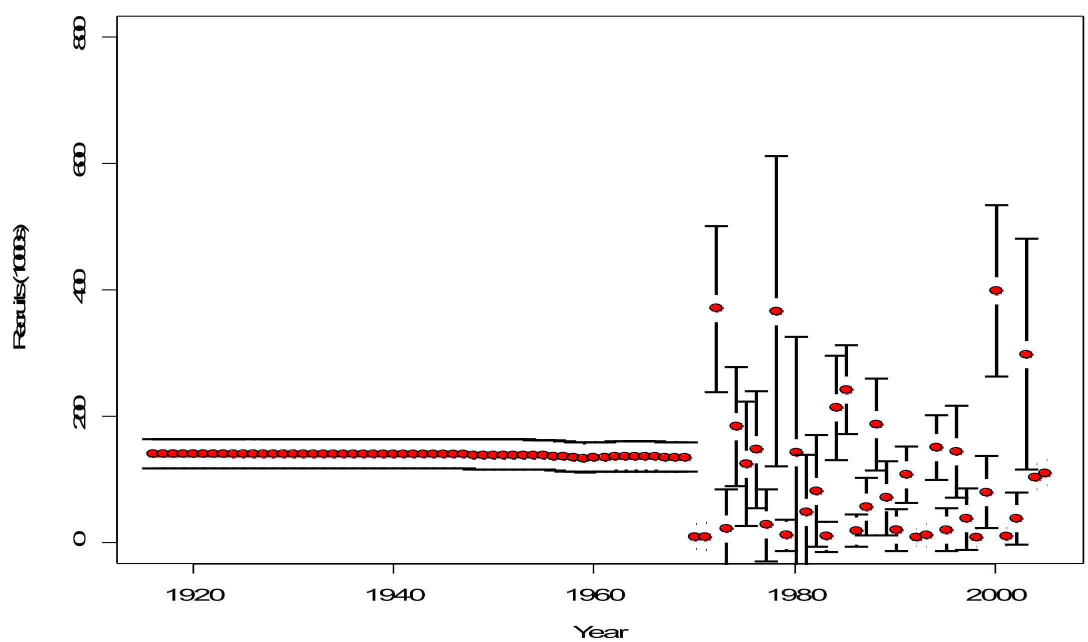


Figure 54. MPD time-trajectories of A) reproductive output (measured in spawning biomass (mt)) and B) recruitment (1000s) for the SCS. The vertical bars represent asymptotic 95% confidence intervals.

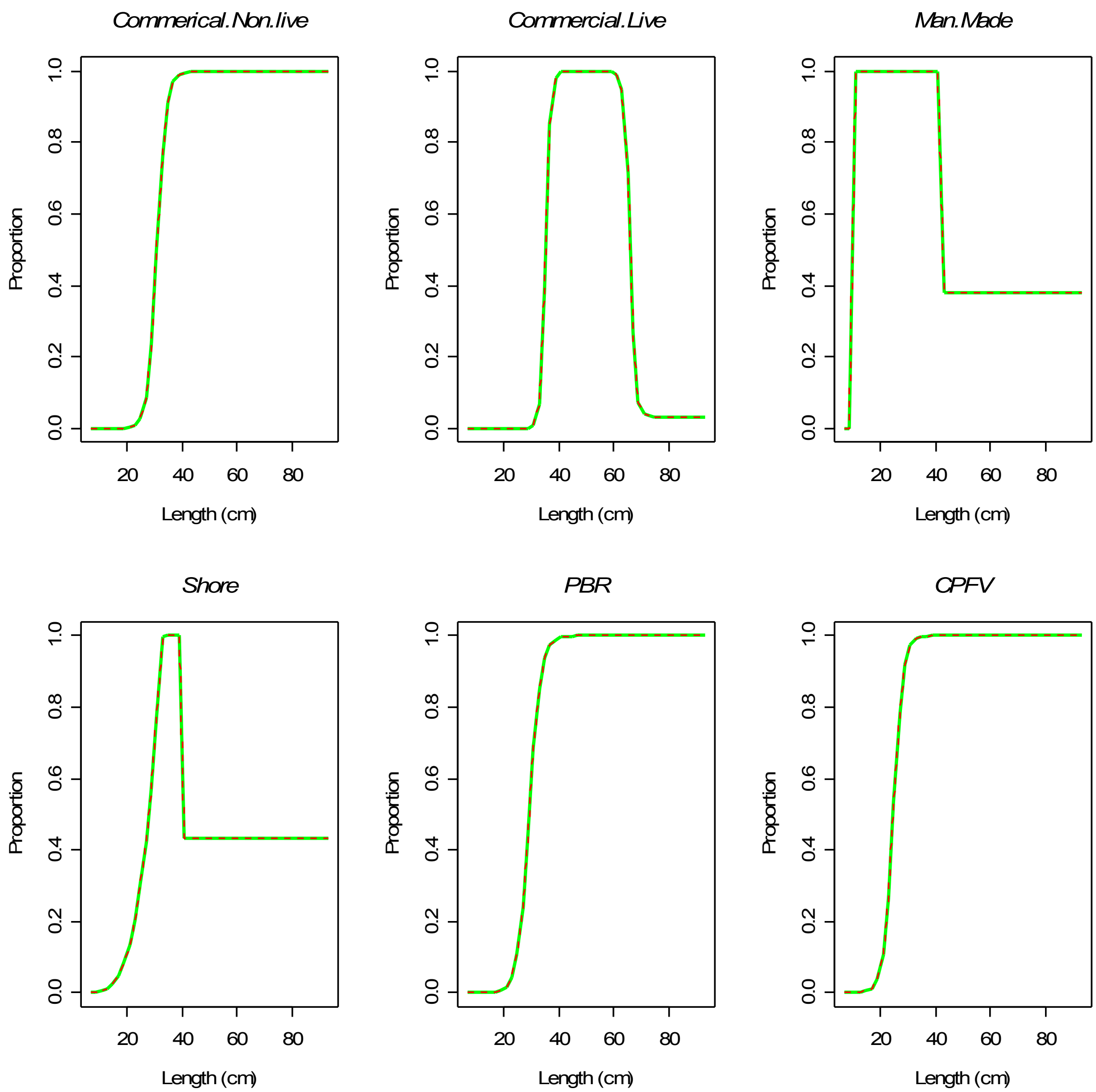


Figure 55. MPD estimates of selectivity as a function of length for the SCS.

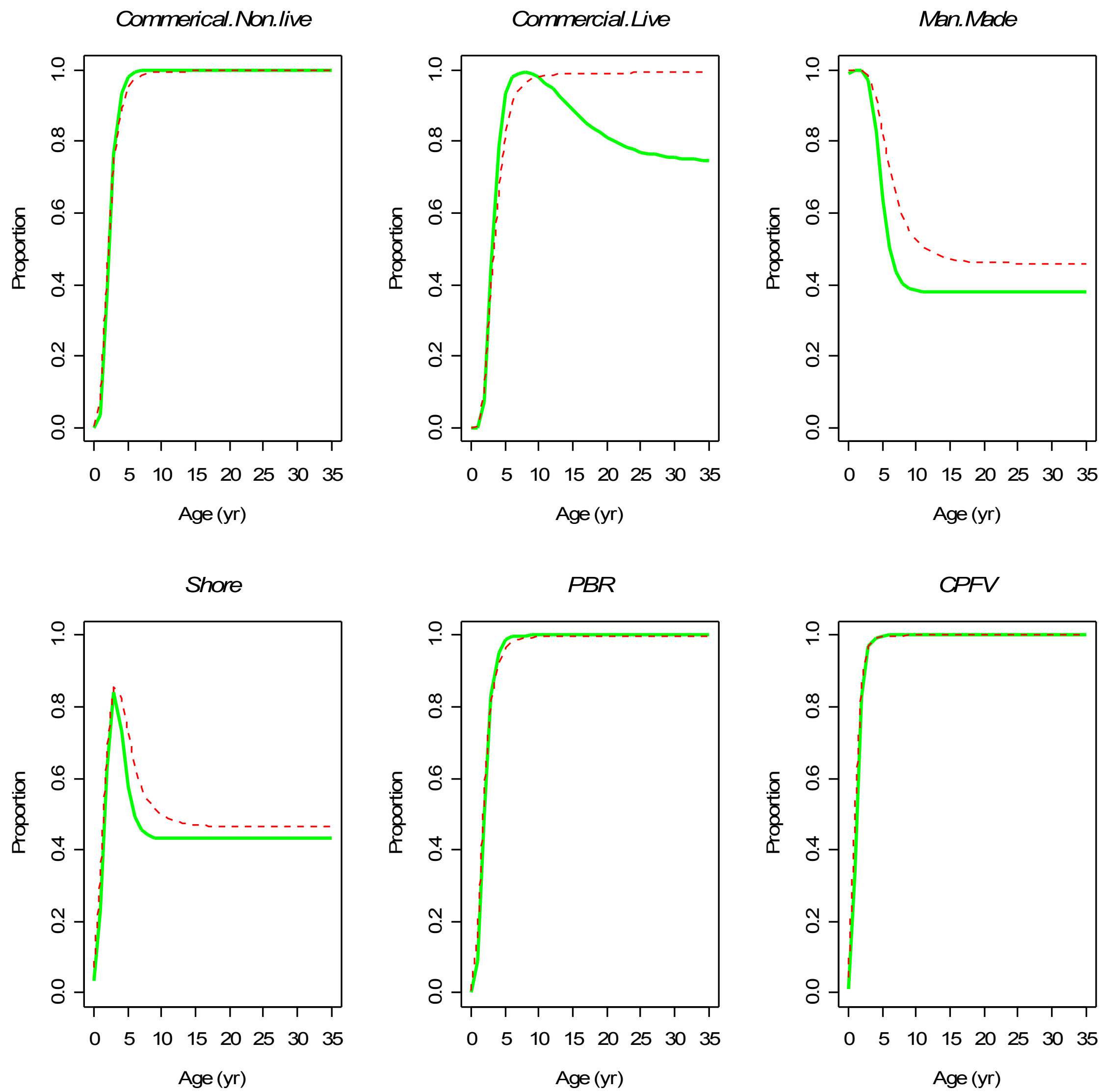


Figure 56. MPD estimates of selectivity as a function of age for the SCS (females: solid lines; males: dashed lines).

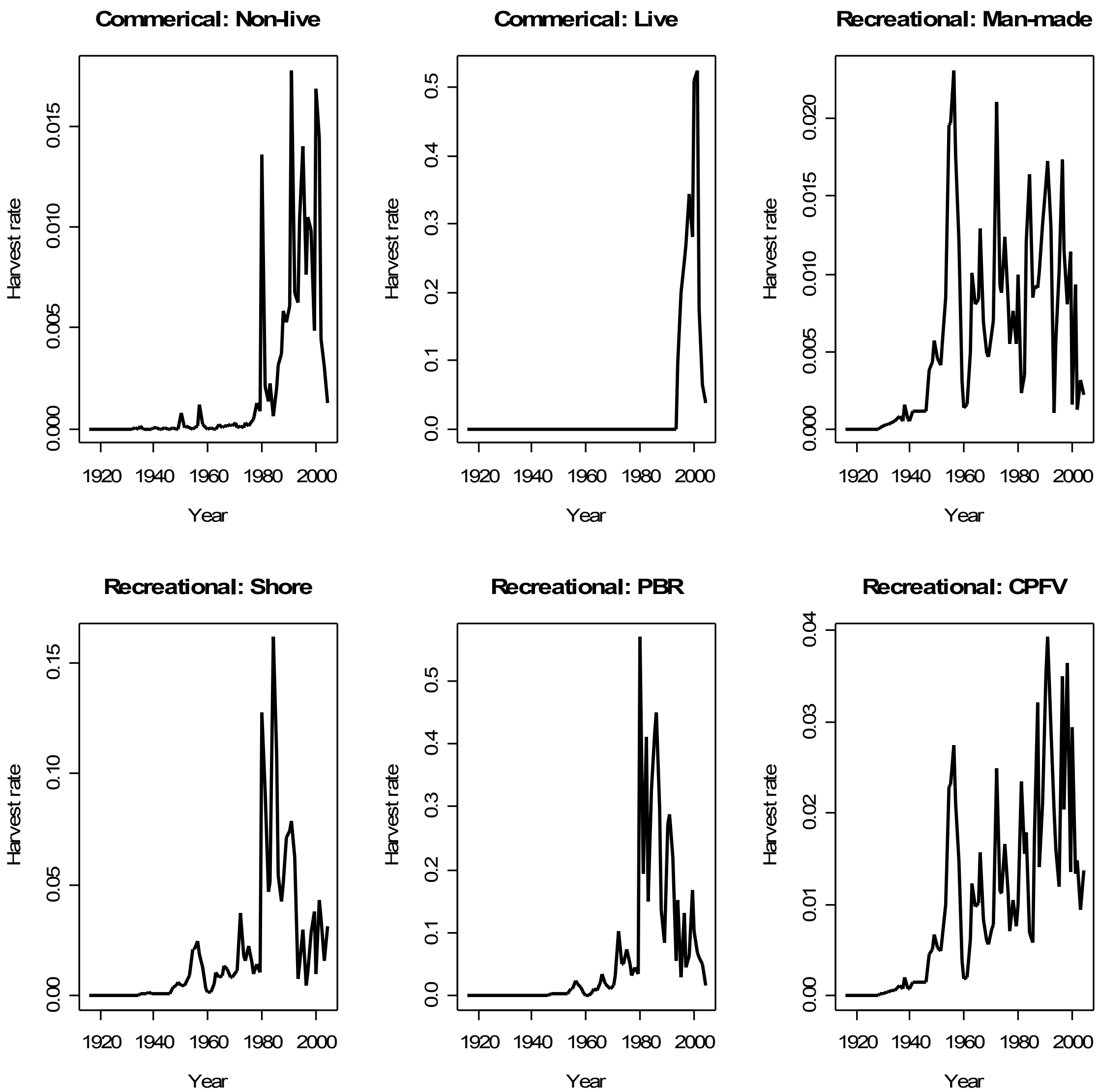
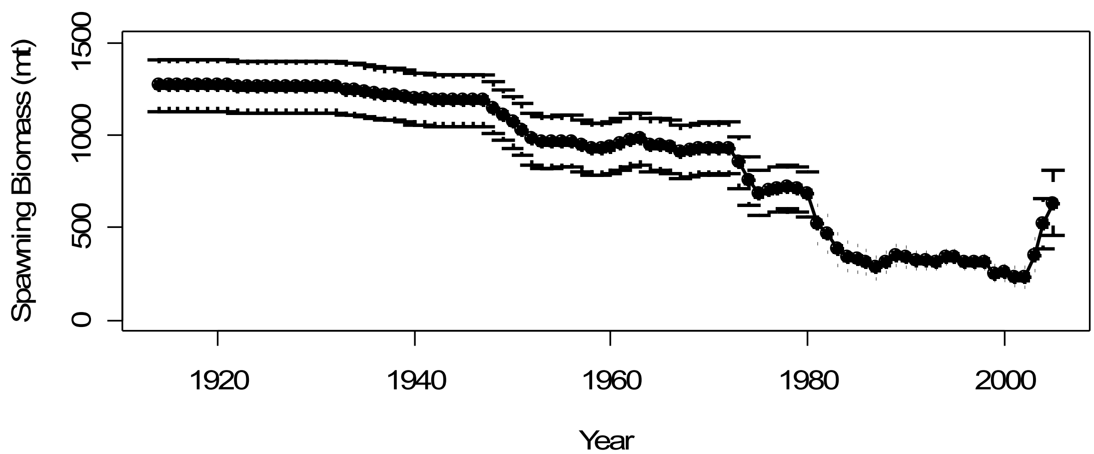


Figure 57. MPD estimates of harvest rate by fleet for the SCS.

A) All mean weight data



B) Year 2000, fleet 3 mean weight data excluded

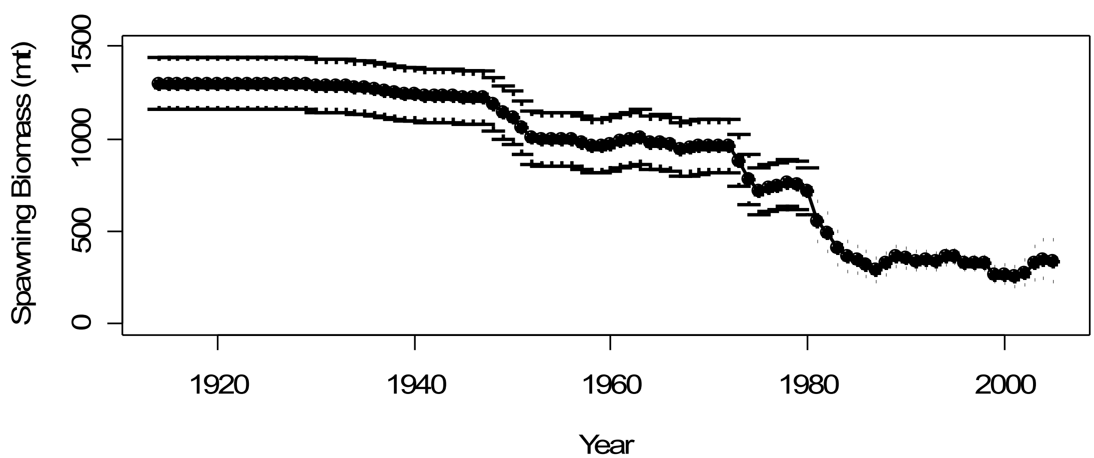
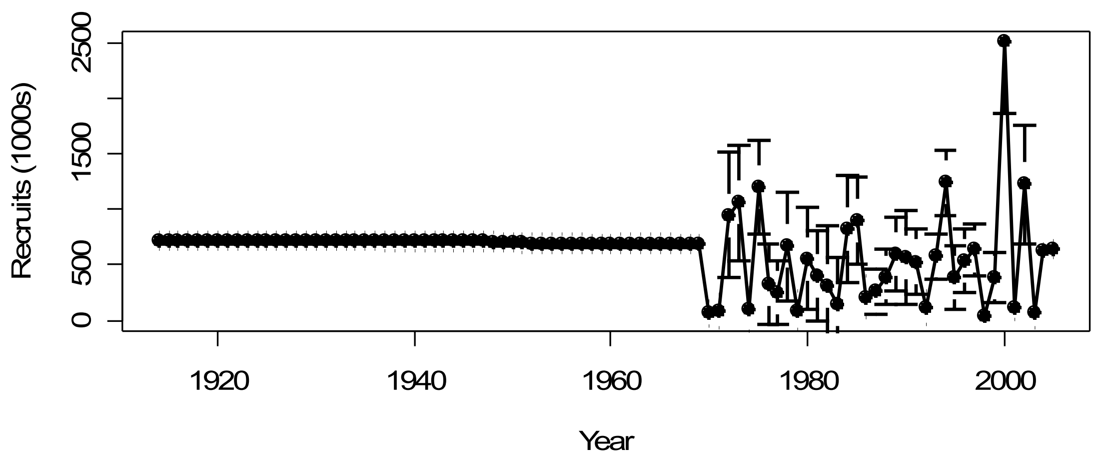


Figure 58. MPD time-trajectories of reproductive output (measured in spawning biomass) for the analyses which combine the data for the NCS and the SCS, and consequently treat California as a single homogeneous population. Results are shown when A) the entire data set is used and B) when the 2000 mean weight datum for the man-made fleet is ignored. The vertical bars represent asymptotic 95% confidence intervals.

A) All mean weight data



B) Year 2000, fleet 3 mean weight data excluded

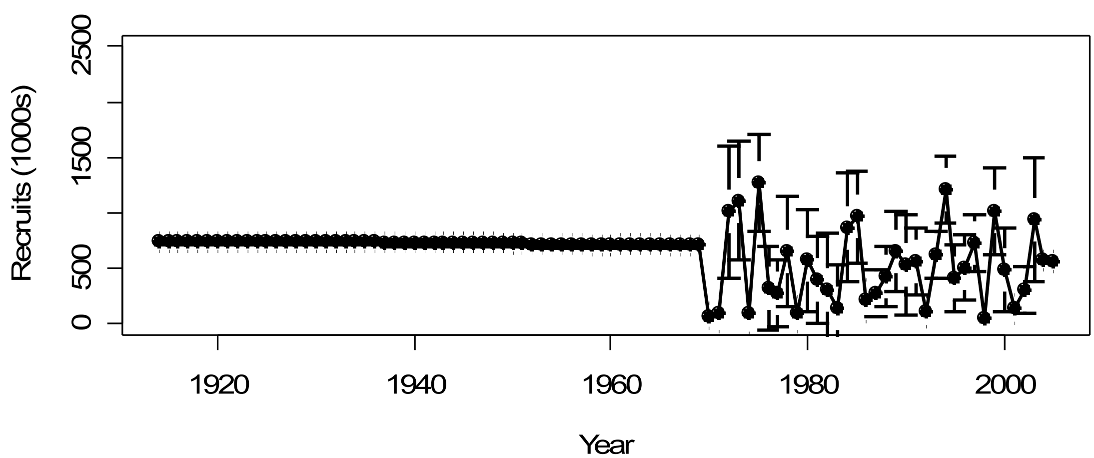


Figure 59. MPD time-trajectories of recruitment (000s) for the analyses which combine the data for the NCS and the SCS, and consequently treat California as a single homogeneous population. Results are shown when the entire data set is used (upper panel) and when the 2000 mean weight datum for the man-made fleet is ignored (lower panel). The vertical bars represent asymptotic 95% confidence intervals.

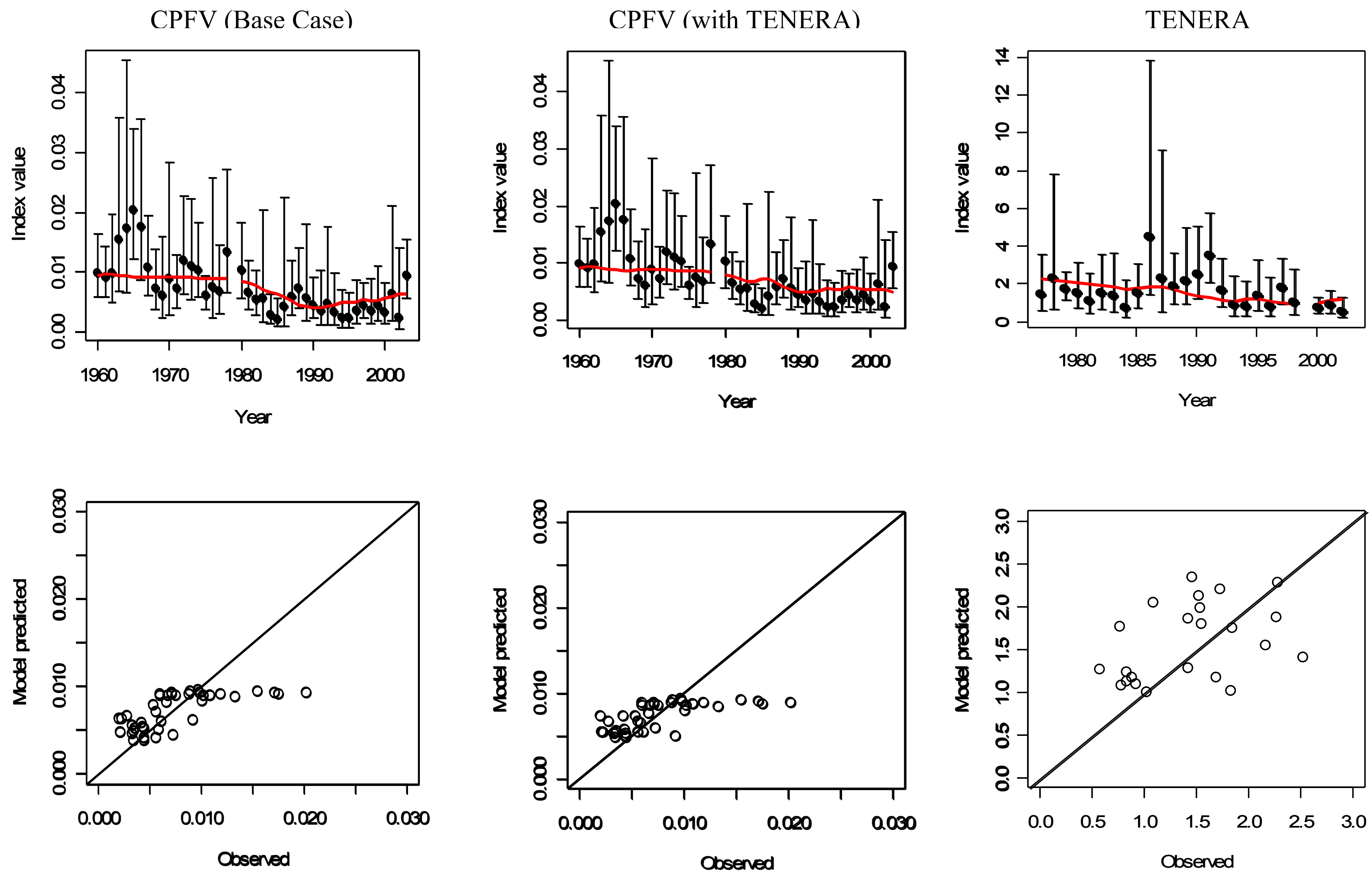


Figure 60. Comparison of model fits without (left panels) and with (middle and right panels) the TENERA adult survey.

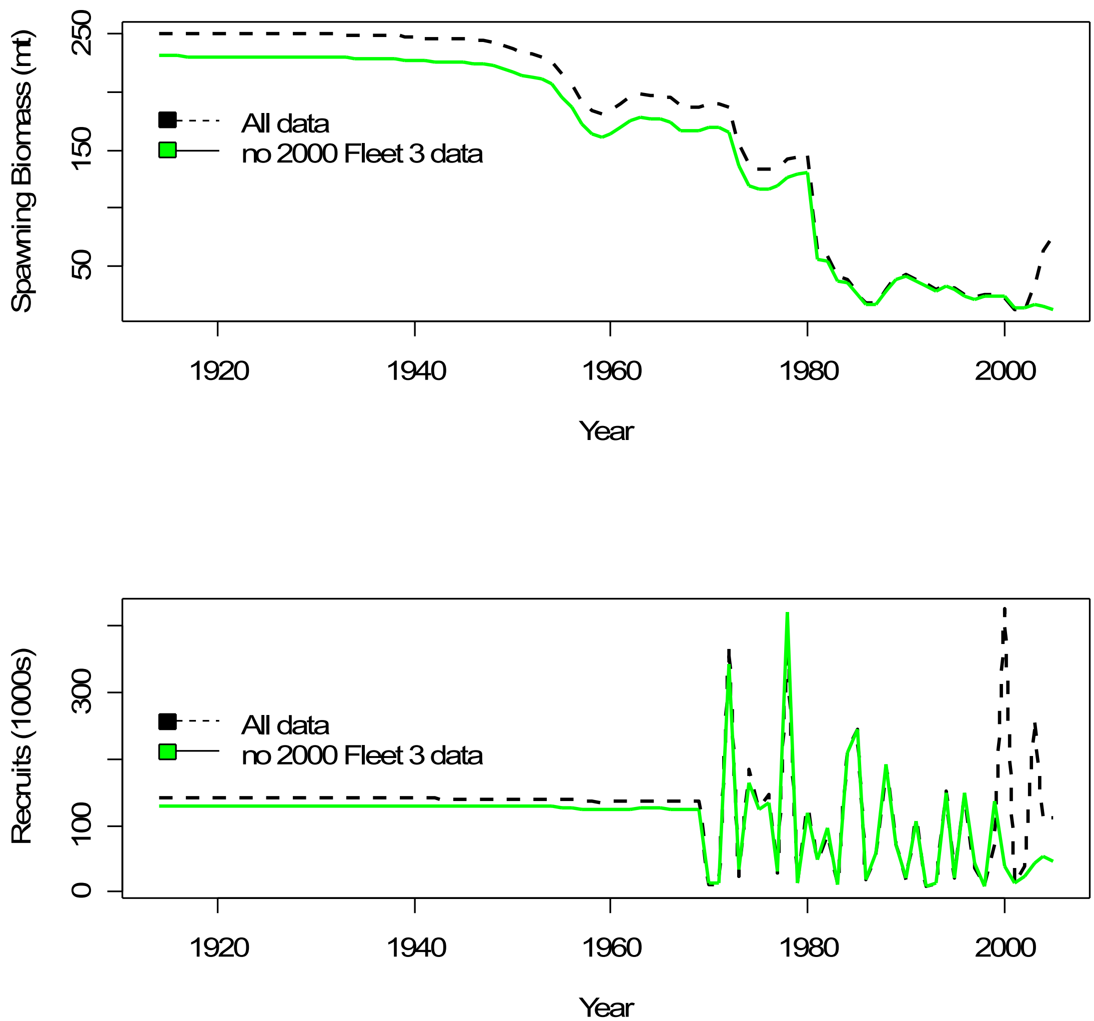
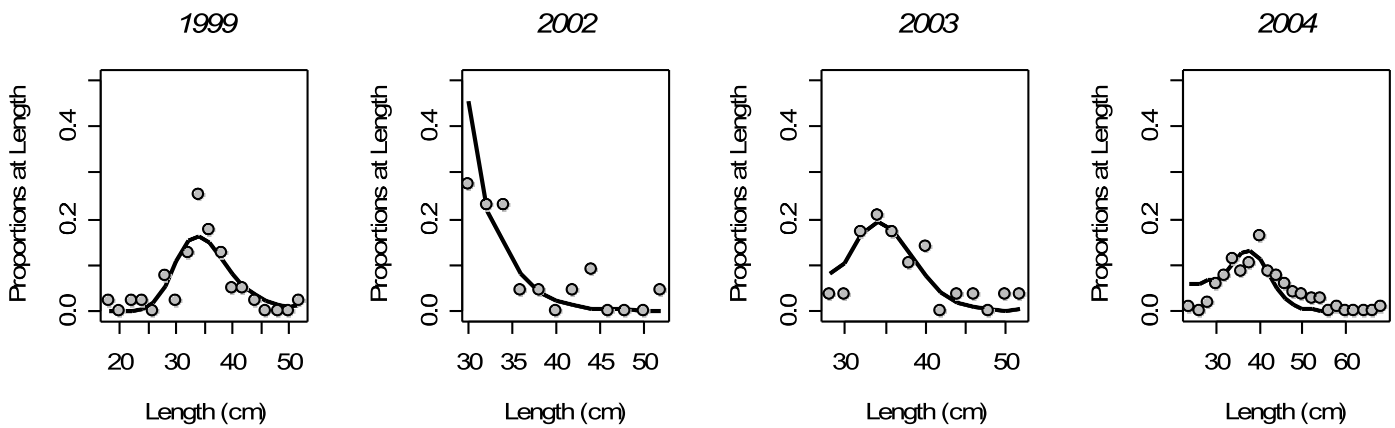


Figure 61. MPD time-trajectories of reproductive output (upper panel) and recruitment (lower panel) for the SCS. Results are shown when the entire data set is used ("all data") and when the 2000 mean weight datum for the man-made fleet is ignored ("no 2000 fleet 3 data"). Fleet 3 is the man-made fleet for the SCS.

A) Base Case



B) Less 2000 mean weight data for fleet 3 (man-made)

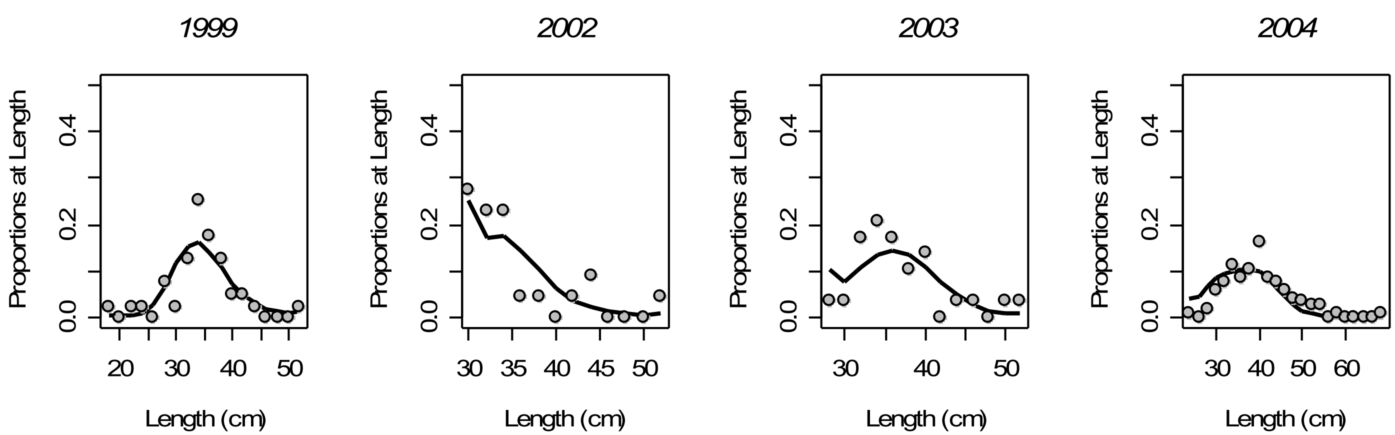


Figure 62. Comparison of fits to the recreational PBR length data when the year 2000 mean weight datum A) is included; B) is not included. A noticeable cohort (following the length modes) is apparent in years 2002-2004.

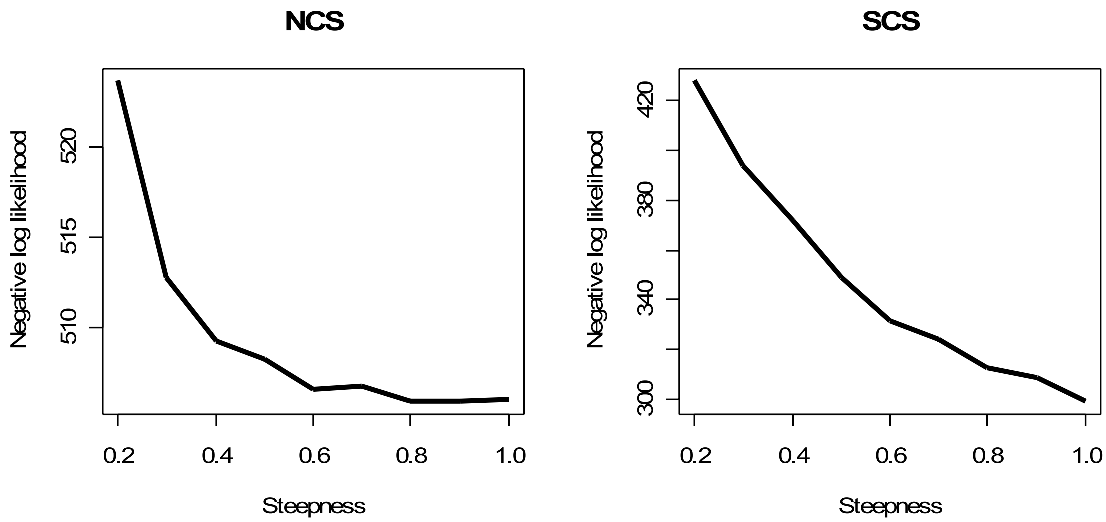


Figure 63. Likelihood profiles for steepness.

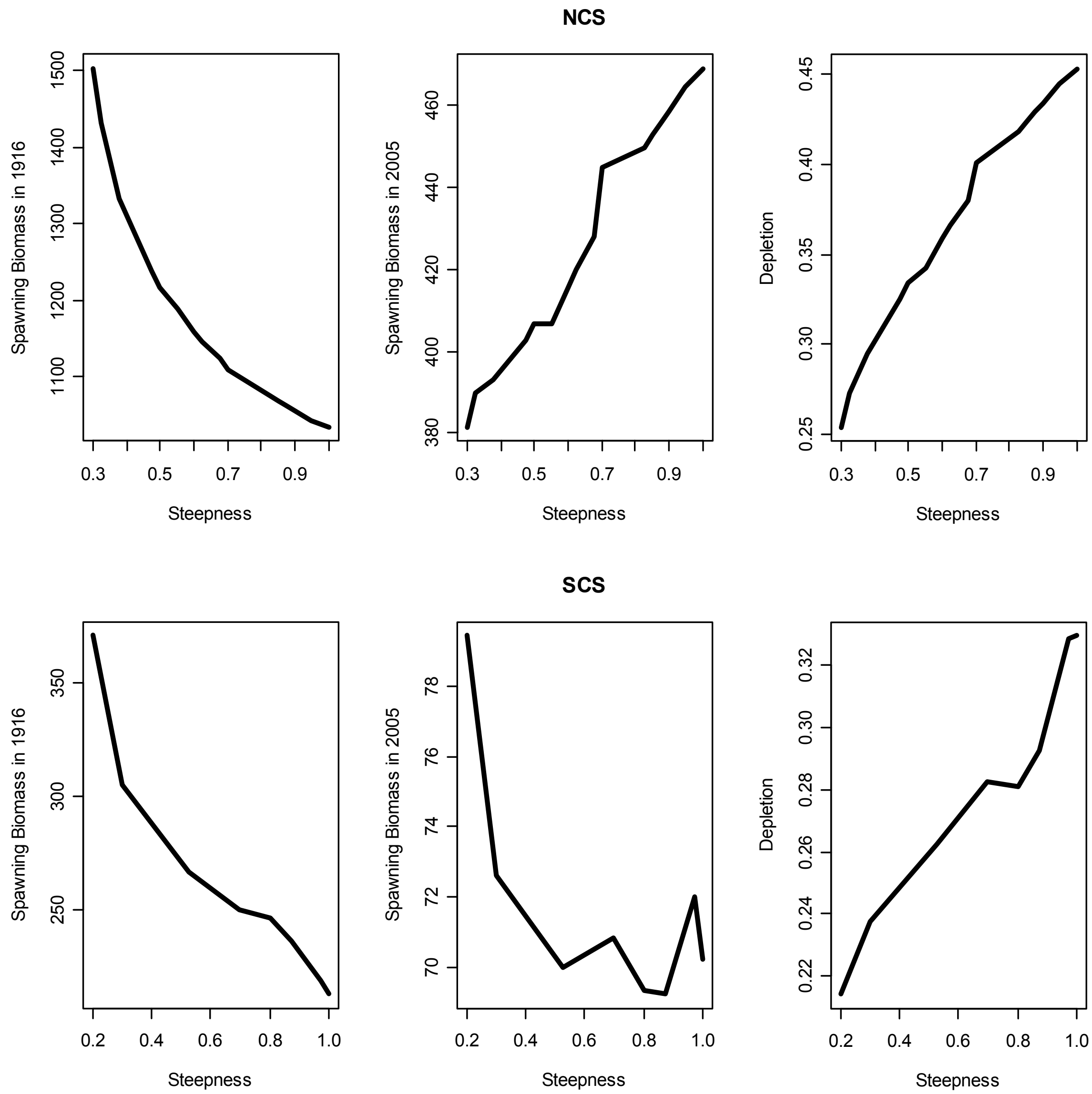


Figure 64. Beginning (1916) and ending (2005) spawning biomass and depletion for each steepness value in the likelihood profile. Base case value: steepness = 0.7. Note the limited range of the y-axes make the local minimums (kinks) distinct.

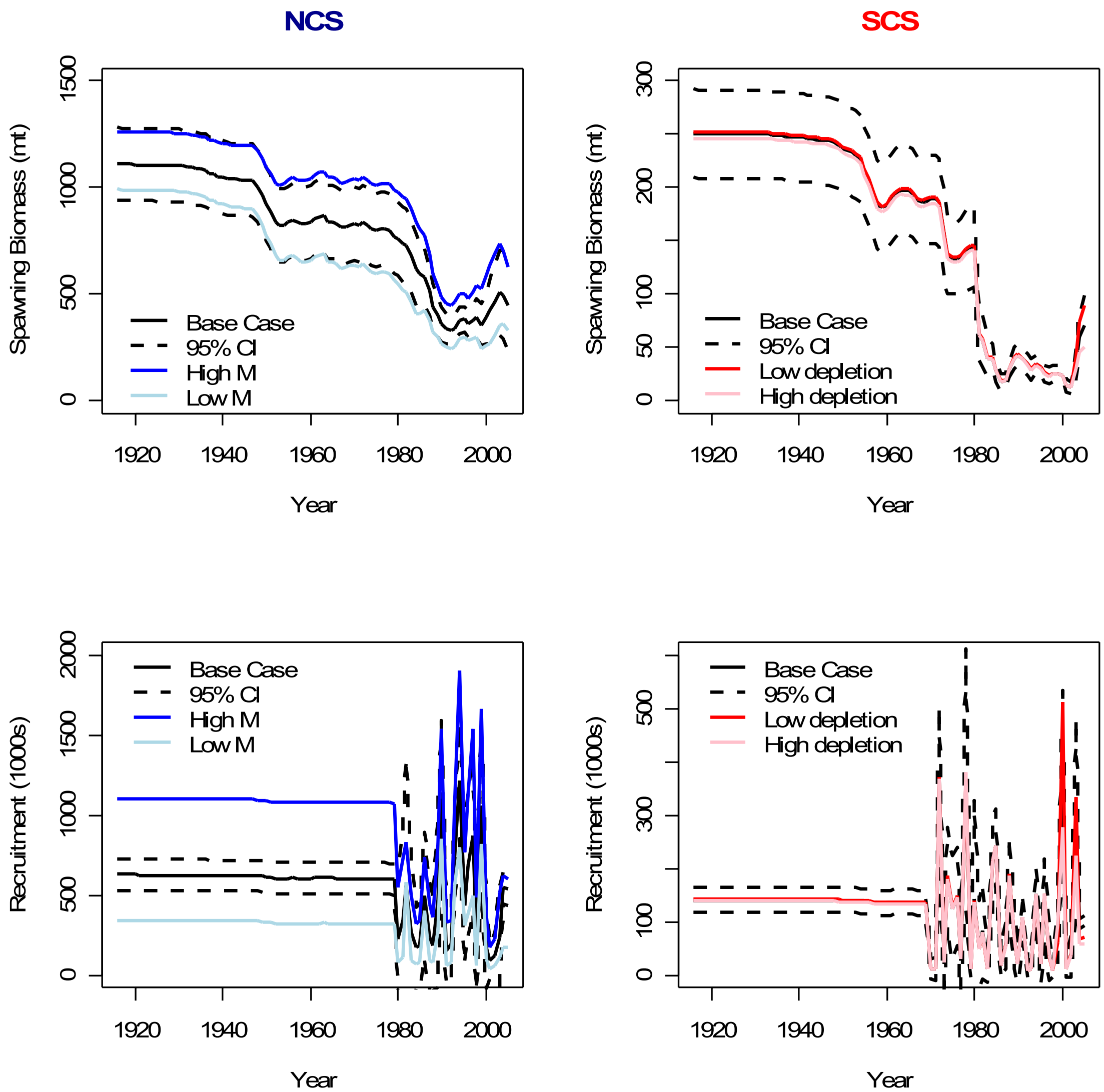


Figure 65. Spawning biomass (upper panels) and recruitement trajectories (lower panels) for the NCS (left panels) and SCS (right panels) under different states of nature. For the NSC, low and high *M* states refer to natural mortality values of 0.2/0.25 and 0.3/0.35 for females and males respectively. For the SCS, low depletion and high depletion states refer to depletions of 20% and 35% at the start of year 2000 respectivley.

Appendix A. Summary of California Management Measures Affecting Cabezon

Year	Description	Effective Date
1982	Recreational and commercial size limit 12" total length	1/1/1982
1999	Recreational and commercial size limit 14" total length	1/1/1999
Pre-2000	Recreational Bag Limit of 10 fish w/in 20 fish aggregate	3/1/1984
2000	FGC fixes cabezon OY at 67,132 pounds (37.6%) recreational; 111,596 pounds (62.4%) commercial; Total = 178,728 pounds	10/2000
2000	FGC changes cabezon OY to 63,608 pounds (40.3%) recreational; 94,398 pounds (59.7%) commercial; Total = 158,006 pounds	12/2000
2001	Weekday closures - Commercial take prohibited Thursday through Sunday	01/2001
2001	Central and Southern Management Areas; recreational bag limit 10 fish; Recreational Fishery open year round; no depth restrictions, except no take in Cowcod Closure area in southern management area	1/1/2001
2001	Size limit increased to 15" total length (recreational and commercial)	Mar-01
2001	FGC fixes cabezon OY at 63,608 pounds recreational; 94,398 pounds commercial; Total OY = 178,728 pounds in emergency regulations	Sep-01
2002	Finfish traps required to have rigid 5" rings in entrance	1/8/2002
2002	FGC fixes cabezon OY at 84,330 pounds (47.2%) recreational; 94,398 (52.8%) pounds commercial; Total OY = 178,728 pounds reaffirming emergency action	2/4/2002
2003	Northern Rockfish and Lingcod Management Area; recreational bag limit remains at 10 fish; Open year round; No depth Restriction	1/3/2003
2003	FGC fixes cabezon OY at 118,300 pounds (61%) recreational; 75,600 pounds (39%) commercial; Total OY = 193,900 pounds	1/1/2004
2004	FGC fixes cabezon OY at 92,793 pounds (61%) recreational; 59,326 pounds (39%) commercial; Total OY = 152119 pounds	1/1/2004
2004	Recreational rockfish, cabezon, and greenling (RCG) complex; 10 fish bag-limit regulation established; cabezon sub-limit 3 fish/bag limit	5/1/2004

Appendix B-1. SS2 .DAT File for the NCS

```
#_Number_of_datafiles: 1
#_start_nudata: 1
1916 #_styr
2004 #_endyr
1	#N_seasons_per_year
12	#vector_with_N_months_in_each_season
1	#spawning_season_-_spawning_will_occur_at_beginning_of_this_season
6	#N_fishing_fleets
1	#N_surveys;_data_type_numbers_below_must_be_sequential_with_the_N_fisheries
fleet1%fleet2%fleet3%fleet4%fleet5%fleet6%survey1
0.5	0.5	0.5	0.5	0.5	0.5	0.5	#_surveytiming_in_season
2	#number_of_genders(1 / 2)
35	#accumulator_age;_model_always_starts_with_age_0

#Catch (mt)
#Fleet 1 #Fleet 2 #Fleet 3 #Fleet 4 #Fleet 5 #Fleet 6
#Comm NCAL	#NCAL_live	#N_Man-made	#N_Shore	#N_PBR	#N_CPFV #Year
0	0	0	0	0	0	#	initial_equilibrium
0.031751462	0	0.329896077	0.707217857	0	0	#1916	1
0.151499831	0	0.329896077	0.707217857	0	0	#1917	1
0.075749916	0	0.329896077	0.707217857	0	0	#1918	1
0	0	0.329896077	0.707217857	0	0	#	1919	1
0	0	0.329896077	0.707217857	0	0	#	1920	1
0	0	0.329896077	0.707217857	0	0	#	1921	1
0	0	0.329896077	0.707217857	0	0	#	1922	1
0	0	0.329896077	0.707217857	0	0	#	1923	1
0	0	0.329896077	0.707217857	0	0	#	1924	1
1.520441422	0	0.329896077	0.707217857	0	0	#1925	1
0	0	0.329896077	0.707217857	0	0	#	1926	1
0.341101417	0	0.329896077	0.707217857	0	0	#1927	1
1.19204059	0	0.329896077	0.707217857	0	0	#1928	1
0.542496402	0	0.329896077	0.707217857	0.489879695	0.979759389	#1929
0.474457556	0	0.494080468	1.059189707	0.733685561	1.467371122	#1930
0.505301833	0	0.658264858	1.411161557	0.977491428	1.954982855	#1931
2.12099764	0	0.8216856	1.761496329	1.220163313	2.440326626	#1932
1.901458962	0	0.985869991	2.113468179	1.46396918	2.927938359	#1933
2.369566226	0	1.150054381	2.46544003	1.707775046	3.415550092	#1934
4.712370506	0	1.314238772	2.81741188	1.951580913	3.903161825	#1935
8.334305099	0	1.846501656	3.958455506	2.741965512	5.483931025	#1936
3.713106648	0	1.595261356	3.419856721	2.368885838	4.737771675	#1937
2.460284688	0	3.05001142	6.538491021	4.529119213	9.058238426	#1938
1.823441085	0	1.735009	3.719442063	2.576404319	5.152808639	#1939
1.511823168	0	2.533785151	5.431826041	3.762548209	7.525096419	#1940
6.018262766	0	1.927448379	5.164982267	0	5.724334949	#1941
1.039633574	0	1.927448379	5.164982267	0	5.724334949	#1942
3.410560577	0	1.927448379	5.164982267	0	5.724334949	#1943
1.754041462	0	1.927448379	5.164982267	0	5.724334949	#1944
1.951807709	0	1.927448379	5.164982267	0	5.724334949	#1945
3.542102347	0	1.927448379	5.164982267	0	5.724334949	#1946
2.046608502	0	7.649465297	20.49826758	11.35908542	22.71817083	#1947
3.714467425	0	10.24586961	27.45585066	15.21462005	30.4292401	#1948
7.273352687	0	9.376074166	25.12506033	13.92301595	27.8460319	#1949
9.544035789	0	10.76896872	28.85759902	15.99139688	31.98279376	#1950
```

10.80230086	0	12.75674531	34.18424277	18.94314884	37.88629767	#1951
15.59541079	0	6.649085988	17.81755174	9.873570602	19.7471412	#1952
6.02098432	0	4.678873303	12.53797399	6.947900205	13.89580041	#1953
2.816354651	0	3.483000022	9.333393074	5.172086312	10.34417262	#1954
3.141126745	0	3.09583032	8.295894655	9.194316119	9.194316119	#1955
5.565577641	0	6.779669852	18.16747724	20.13496263	20.13496263	#1956
5.626812602	0	6.064131369	16.2500492	18.00988266	18.00988266	#1957
8.787443817	0	4.17792	11.48042136	12.40801763	12.40801763	#1958 1
4.29687995	0	3.324924818	14.9684624	9.874704583	9.874704583	#1959
1.385270914	0	1.558606237	11.48042136	12.23468439	4.929133605	#1960
2.236210087	0	1.527296655	11.48042136	9.928466438	4	#1961
1.119919413	0	2.39251021	18.948384	15.55294268	6.266	#1962
1.27051206	0	5.289791965	41.894496	34.38724351	13.854	#1963
2.325567772	0	2.978228477	16.848	19.36050955	7.8	#19641
3.357490277	0	4.005335478	22.6584	26.03740323	10.49	#19651
5.664007172	0	4.941568328	27.95472	32.12355316	12.942	#1966
6.441464391	0	2.57960405	14.59296	16.76917981	6.756	#1967
9.05914561	0	2.21916204	12.55392	14.42606173	5.812	#1968
11.67682683	0	2.346691311	13.27536	15.25508868	6.146	#1969
4.76226566	0	3.751804233	21.22416	24.3892778	9.826	#1970
2.025743255	0	2.230616765	12.61872	14.50052523	5.842	#1971
2.61768122	0	4.935459141	27.92016	32.08383929	12.926	#1972
2.051144425	0	4.784256772	27.0648	31.10092112	12.53	#1973
6.694115307	0	4.230611735	23.9328	27.50185203	11.08	#1974
3.298523276	0	2.516984888	14.23872	16.36211269	6.592	#1975
8.604192524	0	3.744931398	17.6544	24.34459971	9.808	#1976
5.404098778	0	6.76056	17.8956	24.67720333	9.942	#1977
12.5694965	0	10.95616	29.0016	39.99186281	16.112	#1978
22.61203023	0	6.22064	16.4664	22.70640274	9.148	#1979
23.65846769	0	9.348727496	34.45772272	49.00671912	11.51783816	#1980
28.94644684	0	7.519062375	12.96975469	58.32562896	10.05475	#1981
28.78678235	0	3.167188615	30.03900967	28.42322284	19.1964	#1982
10.51744489	0	8.313580502	36.15990696	31.32871481	11.56890092	#1983
8.420034046	0	12.69212756	11.60985863	47.34526823	3.5595	#1984
11.65641518	0	4.341572875	10.19462608	24.27737884	3.0146744	#1985
7.176283933	0	4.493712327	20.27239613	55.2777959	7.848399482	#1986
3.721724901	0	4.317038419	19.4753706	58.64640511	5.6445	#1987
5.288432739	0	4.709392163	21.24538834	36.01139926	5.862389974	#1988
10.88757621	0	4.330805217	19.53747648	50.88564434	3.45017015	#1989
11.17061781	0	3.013781538	13.59601344	26.04981119	4.83368	#1990
5.794188165	0	3.146860586	14.19637033	27.20008835	5.04712	#1991
16.21093556	0	6.666571951	30.07477506	57.62293599	10.69224	#1992
18.72292977	0.390089386	1.940912305	26.4690734	46.0260903	5.02688	#1993
9.095432995	25.87290535	0.941871535	13.5690343	28.26348945	3.68184	#1994
11.32166405	68.87708505	0.572569873	20.10921565	43.48294435	3.56408	#19951
7.89840289	94.70009524	1.878782791	29.74437812	35.85003788	5.6062323	#1996
21.14919503	99.16344357	1.853932593	40.37323392	11.35458572	3.2253321	#1997
13.98833324	145.3609131	0.556707423	43.04413659	19.310319	3.7999302	#1998
8.553843777	102.1576064	0.439056108	4.456023757	22.33252289	7.2641450	#1999
5.343317409	88.83469309	0.317432275	9.607951898	17.55877454	5.1816955	#2000
3.209619184	55.30514955	3.674133608	3.901197937	27.5594693	12.766374	#2001
5.034874638	38.65196149	0.943410768	13.25642934	14.36498529	2.9424817	#2002
3.66638664	30.30314144	1.874122636	11.27955443	64.01934328	9.537619	#2003
3.058119352	40.21866933	1.522376578	8.845096081	13.95493414	5.310409	#2004

#Abundance_Indices

43
#_N_observations

#Year	Season	Type	Value	CV	
1960	1	7	0.009820805	0.263234495	#NCA
1961	1	7	0.009032642	0.230330184	
1962	1	7	0.009706386	0.361947431	
1963	1	7	0.015471678	0.427756055	
1964	1	7	0.017254287	0.493564679	
1965	1	7	0.020285735	0.263234495	
1966	1	7	0.017531746	0.361947431	
1967	1	7	0.010845353	0.296138807	
1968	1	7	0.007198182	0.329043119	
1969	1	7	0.006055343	0.493564679	
1970	1	7	0.00885327	0.592277615	
1971	1	7	0.007170684	0.296138807	
1972	1	7	0.011867154	0.329043119	
1973	1	7	0.010938157	0.361947431	
1974	1	7	0.01022829	0.296138807	
1975	1	7	0.005989792	0.230330184	
1976	1	7	0.007570519	0.625181927	
1977	1	7	0.006733635	0.394851743	
1978	1	7	0.013358657	0.361947431	
1980	1	7	0.010162064	0.296138807	
1981	1	7	0.006622695	0.296138807	
1982	1	7	0.00536096	0.329043119	
1983	1	7	0.005602485	0.658086239	
1984	1	7	0.002865117	0.394851743	
1985	1	7	0.002083621	0.493564679	
1986	1	7	0.004183166	0.85551211	
1987	1	7	0.005830044	0.361947431	
1988	1	7	0.007301597	0.329043119	
1989	1	7	0.005668581	0.592277615	
1990	1	7	0.004448853	0.361947431	
1991	1	7	0.00342189	0.559373303	
1992	1	7	0.004534689	0.690990551	
1993	1	7	0.003310258	0.559373303	
1994	1	7	0.002212236	0.592277615	
1995	1	7	0.002194948	0.559373303	
1996	1	7	0.003470371	0.460660367	
1997	1	7	0.004307096	0.329043119	
1998	1	7	0.00358199	0.460660367	
1999	1	7	0.004436086	0.460660367	
2000	1	7	0.003328478	0.460660367	
2001	1	7	0.00618101	0.625181927	
2002	1	7	0.002319527	0.921320734	
2003	1	7	0.009272311	0.263234495	

#_Discard_Biomass
1 #_(1=biomass;_2=fraction)
0 #_N_observations

#Year	Season	Type	Value	CV

#_Mean_BodyWt
87

# Year	Seas	Type	Partition	Value	CV
1980	1	3	2	0.771000727	1.231745476

1981	1	3	2	0.692048349	0.695174527
1982	1	3	2	0.709591991	0.745625242
1983	1	3	2	0.723568813	0.720831724
1984	1	3	2	1.040724967	0.761640555
1985	1	3	2	0.55289197	0.862025681
1986	1	3	2	0.858910045	0.742702955
1987	1	3	2	0.745115104	0.755085341
1988	1	3	2	1.12509373	0.856051788
1989	1	3	2	0.620900879	0.638174215
1993	1	3	2	0.442474976	0.980457698
1994	1	3	2	0.796495296	1.002666645
1995	1	3	2	0.204127272	0.515485448
1996	1	3	2	0.328879094	1.108242877
1997	1	3	2	0.684565464	1.292301261
1999	1	3	2	0.256929283	0.910473203
2001	1	3	2	0.502470821	0.866268073
2002	1	3	2	0.629893288	0.881498492
2003	1	3	2	0.979647375	0.830381248
2004	1	3	2	0.9335964	0.820661766
#1958	1	4	2	0.409269593	0.4
#1960	1	4	2	0.409269593	0.4
#1961	1	4	2	0.409269593	0.4
1980	1	4	2	1.072243537	0.733553352
1981	1	4	2	0.784292155	0.465149369
1982	1	4	2	1.026090013	0.688127327
1983	1	4	2	0.932228904	0.487914648
1984	1	4	2	0.965009272	0.579691203
1985	1	4	2	0.697274231	0.564415948
1986	1	4	2	0.984303992	0.510081224
1987	1	4	2	0.598035704	0.78662892
1988	1	4	2	0.719441691	0.684974943
1989	1	4	2	0.894365194	1.035706453
1993	1	4	2	0.918257238	0.62376452
1994	1	4	2	0.879155569	0.897535182
1995	1	4	2	0.868433525	0.505457933
1996	1	4	2	0.914216235	0.391978536
1997	1	4	2	1.158888006	0.448876121
1998	1	4	2	1.152203812	0.416023135
1999	1	4	2	0.945571684	0.543993355
2000	1	4	2	0.950219531	0.69721983
2001	1	4	2	0.880272212	0.010286167
2002	1	4	2	1.163330424	0.436460939
2003	1	4	2	1.274184981	0.355108032
2004	1	4	2	1.600616499	0.356725394
1980	1	5	2	1.563535742	0.453047459
1981	1	5	2	2.021080143	0.825346518
1982	1	5	2	1.569353711	0.40325483
1983	1	5	2	1.624775025	0.444615957
1984	1	5	2	1.402077638	0.400188283
1985	1	5	2	1.563644823	0.385746612
1986	1	5	2	1.368634448	0.429016869
1987	1	5	2	1.38339557	0.437022281
1988	1	5	2	1.438416929	0.458692051
1989	1	5	2	1.326550721	0.541913875
1993	1	5	2	1.293792074	0.393233477
1994	1	5	2	1.432145831	0.51622684

1995	1	5	2	1.275656844	0.532885972
1996	1	5	2	1.268414709	0.506097026
1997	1	5	2	0.797124126	0.457241472
1998	1	5	2	1.2319693	0.404810621
1999	1	5	2	1.483148295	0.38433551
2000	1	5	2	1.457350868	0.361141709
2001	1	5	2	1.569765793	0.334540822
2002	1	5	2	1.330579056	0.46248491
2003	1	5	2	1.606485337	0.291289558
2004	1	5	2	1.831998572	0.441353905
1947	1	6	2	2.267961549	0.5
1948	1	6	2	2.267961549	0.5
1949	1	6	2	2.267961549	0.5
1950	1	6	2	2.267961549	0.5
1951	1	6	2	2.267961549	0.5
#1960	1	6	2	2.415058111	0.5
1980	1	6	2	1.636278998	0.316600019
1981	1	6	2	1.668520493	0.293888142
1983	1	6	2	2.330229466	0.450310026
1985	1	6	2	1.537378076	0.409512107
1986	1	6	2	1.786012254	0.800116307
1988	1	6	2	1.640035311	0.626964254
1989	1	6	2	1.06781061	0.292881644
1994	1	6	2	1.221613026	0.337743412
1995	1	6	2	2.444107572	0.418985085
1996	1	6	2	1.283684283	0.477886763
1997	1	6	2	1.131992316	0.496963678
1998	1	6	2	1.315338896	0.297766273
1999	1	6	2	1.592032716	0.287283245
2000	1	6	2	1.593232273	0.439072715
2001	1	6	2	1.583673006	0.325171303
2002	1	6	2	1.634294865	0.443055144
2003	1	6	2	1.550760006	0.303641097
2004	1	6	2	1.560650564	0.40487784

0.0001	#min_proportion_for_compressing_tails_of_observed_composition										
0.0001	#_constant added to expected frequencies										
44	#_N_length_bins							#_lower_edge_of_length_bins			
						6	8	10	12	14	16
	18	20	22	24	26	28	30	32	34	36	38
	40	42	44	46	48	50	52	54	56	58	60
	62	64	66	68	70	72	74	76	78	80	82
	84	86	88	90	92						
56	#N_observations										#Year
	Seas	Fleet	sexes	Mkt	Nsamp	begin	data:	females	then	males	
1995	1	1	0	0	95.082	0	0	0	0	0	0
	0	0	0	0	0.070074196		0.057982962		0.103874691		
	0.112668315		0.090684254		0.120362737		0.080791426		0.082715032		
	0.045342127		0.138774389		0.017587249		0.011266832		0.029953284		
	0.020060456		0.009618027		0.000549602		0.006045617		0.000824402		0
	0	0.000824402	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1996 1 1 0 0 1865.47 0 0 0 0 0 0
0 0.000534902 0.000534902 0.007488633 0.023000802 0.064990639
0.136132656 0.159668361 0.135330302 0.118213426 0.082642418
0.054560043 0.045466702 0.040117679 0.041722386 0.035838459
0.020593742 0.01337256 0.008558438 0.005616475 0.005081573 0
0.000534902 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1997 1 1 0 0 82.6977 0 0 0 0 0 0
0 0 0 0.000693722 0.0039889 0.014741589 0.078043704
0.122441901 0.10301769 0.122441901 0.091397849 0.084980923
0.105445716 0.026014568 0.062261533 0.031564343 0.031911204
0.017863337 0.01543531 0.025494277 0.024453694 0.024453694 0
0.013354145 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1998 1 1 0 0 37.6852 0 0 0 0 0 0
0 0 0 0 0.006856024 0.006856024 0.062928501
0.099412341 0.184378061 0.147159647 0.134182174 0.214250735
0.052399608 0.016160627 0.024485798 0.044564153 0 0.006366308
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0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0
1999 1 1 0 0 3.94262 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.0558799
0.226021685 0.190158465 0.171809842 0.17264387 0.095913261
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	0	0	0	0.027027027	0	0.027027027	0.108108108				
	0.108108108	0.135135135	0.189189189	0.135135135	0.108108108	0					
	0.054054054	0.054054054	0	0.027027027	0.027027027	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0				
1997	1	4	0	0	41.1836	0	0	0	0	0	0
	0	0	0.068965517	0	0.034482759	0.034482759	0.034482759				
	0.137931034	0.137931034	0.137931034	0.172413793	0.034482759						
	0.103448276	0.103448276	0	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0					
1998	1	4	0	0	17.3372	0	0	0	0	0	0
	0	0	0	0.026315789	0.026315789	0	0.026315789				
	0.105263158	0.131578947	0.157894737	0.210526316	0.052631579						
	0.131578947	0.026315789	0.026315789	0	0.052631579	0.026315789					
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
1999	1	4	0	0	17.3993	0	0	0	0	0	0
	0	0	0	0.034482759	0	0.103448276	0.103448276				
	0.310344828	0.172413793	0.068965517	0.068965517	0.103448276						
	0.034482759	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2000	1	4	0	0	14.4385	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0.625	0	0.25
	0.125	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	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	4	0	0	4.38686	0	0	0	0	0	0
	0	0	0	0.285714286	0	0	0	0.142857143	0		
	0	0	0.142857143	0.428571429	0	0	0	0	0		
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
2002	1	4	0	0	6.74202	0	0	0	0	0	0
	0	0.125	0	0.125	0	0	0	0.125	0	0	0
	0.125	0.125	0	0.125	0.125	0.125	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2003	1	4	0	0	4.7017	0	0	0	0	0	0
	0	0	0	0	0	0	0.2	0.2	0	0	0
	0.4	0	0	0	0.2	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2004	1	4	0	0	11.8276	0	0	0	0	0	0
	0	0	0	0	0	0	0.142857143	0	0.071428571		
	0	0.071428571	0.214285714	0	0.142857143	0.071428571	0				
	0.142857143	0.071428571	0	0.071428571	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
1993	1	5	0	0	32.882	0	0	0	0	0	0
	0	0.032258065	0	0	0	0	0.016129032	0.048387097			
	0.080645161	0.080645161	0.241935484	0.129032258	0.161290323						
	0.048387097	0.016129032	0.016129032	0.032258065	0.032258065						
	0.016129032	0.032258065	0	0	0.016129032	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0										
1994	1	5	0	0	45.3439	0	0	0	0	0	0
	0	0	0	0.017241379	0.034482759	0.051724138	0				
	0.068965517	0.051724138	0.103448276	0.155172414	0.155172414						
	0.103448276	0.051724138	0.086206897	0	0	0.017241379					
	0.017241379	0.034482759	0.017241379	0.017241379	0.017241379	0					
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
1995	1	5	0	0	24.4959	0	0	0	0	0	0
	0	0	0	0	0	0.02	0.06	0.1	0.14	0.1	0.12
	0.08	0.1	0.04	0.04	0.02	0.02	0.04	0.02	0.04	0.04	0.02
	0	0	0	0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1996	1	5	0	0	132.302	0	0	0	0	0	0
	0	0	0.016949153		0	0	0.016949153		0.016949153		
	0.084745763		0.084745763		0.06779661		0.101694915		0.06779661		
	0.13559322		0.06779661		0.06779661		0.06779661		0.033898305		
	0.050847458		0.033898305		0.033898305		0.033898305		0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
1997	1	5	0	0	4.70691	0	0	0	0	0	0
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	0.25	0.375	0	0.125	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1998	1	5	0	0	32.9798	0	0	0	0	0	0
	0.032258065		0	0	0.032258065		0	0	0.064516129		
	0.032258065		0.064516129		0.032258065		0.193548387		0.161290323		
	0.161290323		0.032258065		0.032258065		0.096774194		0	0	0
	0.064516129		0	0	0	0	0	0	0	0	0
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1999	1	5	0	0	33.1079	0	0	0	0	0	0
	0	0	0	0	0	0	0	0.133333333		0.066666667	
	0.033333333		0.2	0.2	0.066666667		0.133333333		0.033333333		
	0.066666667		0	0.033333333		0.033333333		0	0	0	0
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	0	0	0	0							
2000	1	5	0	0	15.012	0	0	0	0	0	0
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	0.090909091		0.090909091		0.045454545		0.227272727		0.090909091		
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1988 1 6 0 0 45.7256 0 0 0 0 0 0
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0 0 0
1991 1 6 0 0 16.986 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.055555556
0.111111111 0.166666667 0.111111111 0.055555556 0.111111111
0.055555556 0 0.055555556 0.055555556 0.166666667 0.055555556
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0
1992 1 6 0 0 25.0254 0 0 0 0 0 0
0 0 0 0 0 0 0 0.033333333 0.1 0.2
0.033333333 0.166666667 0.133333333 0.066666667 0.066666667
0.066666667 0.066666667 0 0.033333333 0 0 0.033333333
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1993 1 6 0 0 71.1077 0 0 0 0 0 0
0 0 0 0 0 0 0 0.0625 0.09375 0.0625 0.125
0.1875 0.09375 0.09375 0.03125 0.09375 0.0625 0.0625 0 0.03125 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1994 1 6 0 0 28.0743 0 0 0 0 0 0
0 0 0 0 0 0 0.048780488 0 0.146341463
0.170731707 0.048780488 0.097560976 0.12195122 0.097560976

	0.097560976	0.024390244	0	0.048780488	0.048780488	0	0				
	0.024390244	0	0.024390244	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0			
1995	1	6	0	0	32.8691	0	0	0	0	0	0
	0	0	0	0	0	0.027027027	0.027027027	0.027027027			
	0.027027027	0.162162162	0.081081081	0.189189189	0.081081081						
	0.162162162	0.027027027	0.054054054	0.081081081	0	0.027027027					
	0	0.027027027	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
1996	1	6	0	0	99.7415	0	0	0	0	0	0
	0	0	0.009345794	0	0	0.009345794	0.056074766				
	0.130841121	0.093457944	0.102803738	0.121495327	0.093457944						
	0.074766355	0.065420561	0.065420561	0.065420561	0.056074766						
	0.028037383	0	0.009345794	0	0.009345794	0.009345794	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
1996	1	6	0	0	20.0009	0	0	0	0	0	0
	0	0	0	0	0	0	0.0625	0	0.0625	0	0.0625
	0.0625	0.125	0.0625	0.125	0.125	0	0	0.0625	0.125	0	0.0625
	0	0	0	0	0.0625	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
1997	1	6	0	0	21.2162	0	0	0	0	0	0
	0	0	0	0.016949153	0	0	0	0.016949153			
	0.084745763	0.271186441	0.101694915	0.152542373	0.101694915						
	0.016949153	0.152542373	0.016949153	0	0.033898305	0					
	0.016949153	0	0.016949153	0	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
1997	1	6	0	0	17.9703	0	0	0	0	0	0
	0	0	0	0.04	0	0	0	0	0.04	0.16	0.08
	0.2	0.08	0.04	0.24	0.04	0	0.08	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						

1998 1 6 0 0 38.7177 0 0 0 0 0 0
0 0 0 0 0.024390244 0 0.024390244 0.024390244
0.073170732 0.170731707 0.146341463 0.195121951 0.048780488
0.12195122 0.097560976 0.048780488 0.024390244 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0
1998 1 6 0 0 18.5415 0 0 0 0 0 0
0 0 0 0 0.038461538 0 0.038461538 0.038461538
0.076923077 0.192307692 0.269230769 0.153846154 0.038461538
0.115384615 0 0 0 0.038461538 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
2001 1 6 0 0 16.1135 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0.026315789
0.026315789 0.078947368 0.105263158 0.131578947 0.026315789
0.210526316 0.184210526 0.105263158 0.026315789 0.052631579
0.026315789 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
2003 1 6 0 0 35.2786 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0.017857143
0.107142857 0.071428571 0.107142857 0.142857143 0.178571429
0.053571429 0.089285714 0.089285714 0.035714286 0.035714286
0.017857143 0.017857143 0.017857143 0 0 0 0
0.017857143 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
2004 1 6 0 0 35.7447 0 0 0 0 0 0
0 0 0 0 0.041666667 0.041666667 0 0 0
0 0.041666667 0.166666667 0.125 0.083333333 0.166666667
0.166666667 0.041666667 0.083333333 0 0 0 0 0
0 0.041666667 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0

1 #_N_age'_bins
#_lower_age_of_age'_bins
1

0 #_number_of_ageerr_types
#_vector_with_stddev_of ageing_precision_for_each_AGE_and_type
0 #_N_age_observations
#Year Season Fleet Gender Mkt ageerr Lbin_lo Lbin_hi Nsamp
0 #_N_size-at-age_observations;_values_on_row1;_N_on_row2 #Year Season Fleet Gender Mkt ageerr Nsamp
#_environmental_data
1 # N_variables
0 # N_observations
#_Year Variable Value
999 #end of file

Appendix B-2. SS2 .CTL File for the NCS

```
#	stage-2a -	new	Format
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	#area_for_each_fleet/survey
0	#do_migration_(0/1)

0	#_N_Block_Designs
#0	#_N_Blocks_per_Design(Block_1_always_starts_in_styr)
#1975	1985	1986	1990	1995	2001	#_Block_Design_1
#_Block_Design_2
#1987	1990
#1995	2001

#Natural_mortality_and_growth_parameters_for_each_morph
0	#_Last_age_for_natmort_young
0	#_First_age_for_natmort_old
0	#_age_for_growth_Lmin
17	#_age_for_growth_Lmax
-4	#_MGparm_dev_phase
#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-variable	use_dev
	dev_minyr	dev_maxyr	dev_stddev
	0.02	0.5	0.25	0.26	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_natM_young
	0	0.5	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_natM_old_as_exponential_offset(rel_young)
	1	40	10.79	19.26	0	10	-2	0	0	0	0
	0.5	0	0	#M1_Lmin
	40	90	59.71	62.13	0	10	-2	0	0	0	0
	0.5	0	0	#M1_Lmax
	0.05	0.25	0.18	0.185	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_VBK
	0.14	0.14	0.14	0.139	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_CV-young
	-3	3	-0.4418	-0.049	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_CV-old_as_exponential_offset(rel_young)
	-3	3	0.1823	-0.1	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_natM_young_as_exponential_offset(rel_morph_1)
	-3	3	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_natM_old_as_exponential_offset(rel_young)
	-3	3	0.2076	0.4	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_Lmin_as_exponential_offset ln(16.93/10.79)
	-3	3	-0.2488	-0.2	0	0.8	-2	0	0	0	0
	0.5	0	0	#M2_Lmax_as_exponential_offset ln(46.75/58.65)=ln(M/F)
	-3	3	0.442	0.4	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_VBK_as_exponential_offset ln(0.28/0.18)
	-3	3	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_CV-young_as_exponential_offset(rel_CV-young_for_morph_1)
	-3	3	-0.4418	-0.049	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_CV-old_as_exponential_offset(rel_CV-young) ln(0.09/0.14)
```

```
# Add 2+2*gender lines to read the wt-Len and mat-Len parameters

        -3      3       0.000009204     0.000009204     0       0.8     -3      0       0
        0       0       0.5     0       0       #Female wt-len-1
        -3      3       3.187   3.187   0       0.8     -3      0       0       0       0
        0.5     0       0       #Female wt-len-2
        -3      3       34.6    35      0       0.8     -3      0       0       0       0
        0.5     0       0       #Female mat-len-1
        -3      3       -0.7    -0.7    0       0.8     -3      0       0       0       0
        0.5     0       0       #Female mat-len-2
        -3      3       1       1       0       0.8     -3      0       0       0       0
        0.5     0       0       #Female eggs/gm intercept
        -3      3       0       0       0       0.8     -3      0       0       0       0
        0.5     0       0       #Female eggs/gm slope
        -3      3       0.00001163      0.0000089088    0       0.8     -3      0       0
        0       0       0.5     0       0       #Male wt-len-1
        -3      3       3.118   3.190852        0       0.8     -3      0       0       0
        0       0.5     0       0       #Male wt-len-2

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

#_custom-env_read
0       #_ 0=read_one_setup_and_apply_to_all_env_fxns;
1=read_a_setup_line_for_each_MGparm_with_Env-var>0
         # except read NO setup lines If no MGparms have Env-var>0
#_custom-block_read
0       #_ 0=read_one_setup_and_apply_to_all_MG-blocks;  1=read_a_setup_line_for_each_block x
MGparm_with_block>0                                       # except read NO setup lines If no
MGparms have block>0

#_Spawner-Recruitment_parameters
1       # SR_fxn:  1=Beverton-Holt
#LO     HI      INIT    PRIOR   PRIOR TYPE      SD      PHASE
3       30      9       12      0       10      2       #Ln(R0)
0.2     1       0.7     0.71    0       0.8     -3      #steepness
0       1       1       1.1     0       1       -1      #SD_recruitments
0       5       0       0       0       1       -3      #Env_link
0       5       0       0       0       1       -3      #r1: offset that allows use of recruitment
diff. than initial recruitment for virgin recruitment
0       #env-var_for_link
#       recruitment_residuals
#       start_rec_year  end_rec_year    Lower_limit     Upper_limit     phase
        1980    2003    -15     15      1

#init_F_setup,  for     each    fleet
#       LO      HI      INIT    PRIOR   PRIOR TYPE      SD      PHASE
        0       1       0.000   0.0001  0       99      -1
```

0	1	0	0.1	0	99	-2
0	1	0	0.1	0	99	-2
0	1	0	0.1	0	99	-2
0	1	0.000	0.0001	0	99	-1
0	1	0.000	0.0001	0	99	-1

#_Qsetup
#_add_parm_row_for_each_positive_entry_below(row_then_column)

#-Float(0/1) #Do-power(0/1) #Do-env(0/1) #Do-dev(0/1-not implemented) #Env-Var #Biomass(1)/Numbers(2) for each fleet and survey

0	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
0	0	0	0	0	1
0	0	0	0	0	2

#LO	HI	INIT	PRIOR	PRIOR TYPE		SD	PHASE
#-30	30	0	0.1	20	2		
#-30	30	0	0.1	20	2		
#-30	30	0	0.1	20	2		
#-30	30	0	0.1	20	2		
#-30	30	-3	-2	10	1	#log(Q) (if float =1)	
#-30	30	0.01	-1	1	4	#Q-power	
#-30	30	0.01	-1	1	4	#Q-env	

#_SELEX_&_RETENTION_PARAMETERS

#Selex_type Do_retention(0/1) Do_male Mirrored_selex_number

1	0	0	0	#_fleet_1
2	0	0	0	#_fleet_2
2	0	0	0	#_fleet_3
2	0	0	0	#_fleet_4
1	0	0	0	#_fleet_5
1	0	0	0	#_fleet_6
5	0	0	6	#_survey_1
#_Age	selex			
10	0	0	0	#_fleet_1
10	0	0	0	#_fleet_2
10	0	0	0	#_fleet_3
10	0	0	0	#_fleet_4
10	0	0	0	#_fleet_5
10	0	0	0	#_fleet_6
10	0	0	0	#_survey_1

LO HI INIT PRIOR PR_type SD PHASE env-variable use_dev dev_minyr dev_maxyr dev_stddev Block_Pattern

19	70	45	45	0	10	2	0	0	0	0
0.5	0	0	#infl_for_logistic FLT 1							
0.001	30	5	5	0	5	3	0	0	0	0
0.5	0	0	#95%width_for_logistic							

10	60	40	50	0	10	3	0	0	0	0
0.5	0	0	#peak FLEET 2 LIVE FISH							
0.0001	0.1	0.000	0	0	99	-2	0	0	0	0
0.5	0	0	#init							
-10	5	0.0	0.0	0	3	2	0	0	0	0
0.5	0	0	#infl							
0.001	5	0.3	0.3	0	99	3	0	0	0	0
0.5	0	0	#slope							
-10	10	-5	9	0	99	3	0	0	0	0
0.5	0	0	#final							
-10	5	0.0	0.0	0	3	4	0	0	0	0
0.5	0	0	#infl2							
0.001	50	0.5	.3	0	99	5	0	0	0	0
0.5	0	0	#slope2							
0.1	10	1	4	0	99	-5	0	0	0	0
0.5	0	0	#width of top							

10	70	30	50	0	10	3	0	0	0	0
0.5	0	0	#peak FLEET 3 Man Made							
0.0001	0.1	0.00	0	0	99	-2	0	0	0	0
0.5	0	0	#init							
-10	5	0.5	0.0	0	3	3	0	0	0	0
0.5	0	0	#infl							
0.001	10	0.5	0.3	0	99	-3	0	0	0	0
0.5	0	0	#slope							
-5	20	-0.5	9	0	99	-3	0	0	0	0
0.5	0	0	#final							
-10	10	1	0.0	0	3	4	0	0	0	0
0.5	0	0	#infl2							
0.001	50	-1	0.3	0	99	5	0	0	0	0
0.5	0	0	#slope2							
0.1	50	4	20	0	99	-5	0	0	0	0
0.5	0	0	#width of top							

10	70	35	50	0	10	3	0	0	0	0
0.5	0	0	#peak FLEET 4 Shore							
0.0001	0.1	0.000	0	0	99	-2	0	0	0	0
0.5	0	0	#init							
-10	20	0.5	0.0	0	3	3	0	0	0	0
0.5	0	0	#infl							
0.001	10	0.5	0.3	0	99	3	0	0	0	0
0.5	0	0	#slope							
-5	10	0	9	0	99	3	0	0	0	0
0.5	0	0	#final							
-10	10	1	0.0	0	3	4	0	0	0	0
0.5	0	0	#infl2							
0.001	50	-1	0.3	0	99	5	0	0	0	0
0.5	0	0	#slope2							
0.1	50	4	20	0	99	-5	0	0	0	0
0.5	0	0	#width of top							

19	70	45	45	0	10	2	0	0	0	0
0.5	0	0	#infl_for_logistic FLT 5 PBR							
0.001	30	5	5	0	5	3	0	0	0	0
0.5	0	0	#95%width_for_logistic							

```
	19	70	45	45	0	10	2	0	0	0	0
	0.5	0	0	#infl_for_logistic FLT 6 CPFV
	0.001	30	5	5	0	5	3	0	0	0	0
	0.5	0	0	#95%width_for_logistic

	1	44	1	1	0	10	-3	0	0	0	0
	0.5	0	0	#min Len bin - fixed SURVEY 1
	0.001	100	44	50	0	5	-4	0	0	0	0
	0.5	0	0	#max Len bin fixed

#_custom-env_read
0
#_custom-block_read
0
-4	#_phase_for_selex_parm_devs
1#Max_lambda_phases:_
0	#sd_offset
#_survey_lambdas 0	0	0	0	0	0	1
#_discard_lambdas 0	0	0	0	0	0	0
#_meanwtlambda(one_for_all_sources) 1
#_lenfreq_lambdas 1	1	0	1	1	1	0
#_age_freq_lambdas 0	0	0	0	0	0	0
#_size@age_lambdas 0	0	0	0	0	0	0
#_initial_equil_catch	0
#_recruitment_lambda
1
#_parm_prior_lambda	1
#_parm_dev_timeseries_lambda 1
# crashpen lambda
100
#max F
0.9

999	#_end-of-file

#Q_setup:_add_parm_row_for_each_positive_entry_below(row_then_column)
```

Appendix C-1. SS2 .DAT File for the SCS

```
#_Number_of_datafiles: 1
#_start_nudata: 1
1916 #_styr
2004 #_endyr
1	#N_seasons_per_year
12	#vector_with_N_months_in_each_season
1	#spawning_season_-_spawning_will_occur_at_beginning_of_this_season
6	#N_fishing_fleets
3 #N_surveys;_data_type_numbers_below_must_be_sequential_with_the_N_fisheries
fleet1%fleet2%fleet3%fleet4%fleet5%fleet6%survey1%survey2%survey3
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5#_surveytiming_in_season
2	#number_of_genders(1 / 2)
 35	#accumulator_age;_model_always_starts_with_age_0

#Catch	(mt)
#Fleet	1	#Fleet	2	#Fleet	3	#Fleet	4	#Fleet	5	#Fleet	6
#Comm	SoCAL	#SoCAL_live	#S_Man-made	#S_Shore	#S_PBR	#S_CPFV	#
	Year	Season
0	0	0	0	0	0	#	initial_equilibrium
0	0	0.022633929	0.020285223	0	0	#	1916	1
0	0	0.022633929	0.020285223	0	0	#	1917	1
0	0	0.022633929	0.020285223	0	0	#	1918	1
0	0	0.022633929	0.020285223	0	0	#	1919	1
0	0	0.022633929	0.020285223	0	0	#	1920	1
0	0	0.022633929	0.020285223	0	0	#	1921	1
0	0	0.022633929	0.020285223	0	0	#	1922	1
0	0	0.022633929	0.020285223	0	0	#	1923	1
0	0	0.022633929	0.020285223	0	0	#	1924	1
0	0	0.022633929	0.020285223	0	0	#	1925	1
0	0	0.022633929	0.020285223	0	0	#	1926	1
0	0	0.022633929	0.020285223	0	0	#	1927	1
0	0	0.022633929	0.020285223	0.0156	0.039	#	1928	1
0	0	0.045267857	0.040570447	0.0312	0.078	#	1929	1
0	0	0.067901786	0.06085567	0.0468	0.117	#	1930	1
0.000453592	0	0.091116071	0.081661028	0.0628	0.157	#	1931	1
0.000907185	0	0.11375 0.101946251	0.0784	0.196	#	1932	1
0.033112239	0	0.136383929	0.122231474	0.094	0.235	#	1933	1
0.000453592	0	0.159017857	0.142516698	0.1096	0.274	#	1934	1
0.067131662	0	0.182232143	0.163322055	0.1256	0.314	#	1935	1
0.006350292	0	0.2559375	0.229379065	0.1764	0.441	#	1936	1
0.001360777	0	0.169464286	0.151879109	0.1168	0.292	#	1937	1
0.000453592	0	0.478794643	0.429110495	0.33	0.825	#	1938	1
0.001360777	0	0.179330357	0.160721385	0.1236	0.309	#	1939	1
0.026761946	0	0.168883929	0.151358975	0.1164	0.291	#	1940	1
0.0353802	0	0.355758929	0.318842101	0.2452	0.613	#	1941	1
0.003628738	0	0.355758929	0.318842101	0.2452	0.613	#	1942	1
0	0	0.355758929	0.318842101	0.2452	0.613	#	1943	1
0.014968546	0	0.355758929	0.318842101	0.2452	0.613	#	1944	1
0	0	0.355758929	0.318842101	0.2452	0.613	#	1945	1
0	0	0.355758929	0.318842101	0.2452	0.613	#	1946	1
0.006350292	0	1.093973214	0.980452465	0.754	1.885	#	1947	1
0.0058967	0	1.231517857	1.103724207	0.8488	2.122	#	1948	1
0.004989515	0	1.603526786	1.437130058	1.1052	2.763	#	1949	1
```

0.289391894	0	1.249508929	1.119848359	0.8612	2.153	#	1950	1
0.019050877	0	1.146785714	1.027784653	0.7904	1.976	#	1951	1
0.050802339	0	1.543169643	1.383036129	1.0636	2.659	#	1952	1
0.014514954	0	2.294732143	2.056609573	1.5816	3.954	#	1953	1
0.001360777	0	5.244107143	4.699930223	3.6144	9.036	#	1954	1
0.008618254	0	5.056651786	4.531926962	3.4852	8.713	#	1955	1
0.057606223	0	5.735089286	5.139963531	8.050630791	9.882	#1956	1	
0.36332744	0	4.190178571	3.755367	5.88196259	7.22	#1957	1	
0.06667807	0	2.825178571	2.532011988	3.965844029	4.868	#1958	1	
0.006803885	0	0.723125	0.648086881	1.015086619	1.246	#1959	1	
0.002721554	0	0.346473214	0.310519958	0.486361727	0.597	#1960	1	
0.009979031	0	0.409732143	0.367214557	0.575161439	0.706	#1961	1	
0.002267962	0	1.259955357	1.12921077	1.768662158	2.171	#1962	1	
0.004535923	0	2.535	2.271945021	3.558505899	4.368	#	1963	1
0.069853216	0	2.016741071	1.807465419	2.831	3.475	#	1964	1
0.016329323	0	2.090446429	1.873522428	7.204	3.602	#	1965	1
0.050802339	0	3.196026786	2.864377572	11.014	5.507	#	1966	1
0.037648162	0	1.6534375	2.42165	5.698	2.849	#	1967	1
0.06078137	0	1.177544643	1.72465	4.058	2.029	#	1968	1
0.042637677	0	1.1253125	1.64815	3.878	1.939	#	1969	1
0.09026487	0	1.435223214	2.10205	4.946	2.473	#	1970	1
0.0235868	0	1.484553571	2.1743	10.232	2.558	#	1971	1
0.037194569	0	4.328883929	6.34015	29.836	7.459	#	1972	1
0.014514954	0	1.732946429	2.5381	11.944	2.986	#	1973	1
0.0648637	0	1.766607143	2.5874	12.176	3.044	#	1974	1
0.027215539	0	2.623794643	3.84285	18.084	4.521	#	1975	1
0.089357685	0	1.738169643	2.54575	11.98	2.995	#	1976	1
0.107047785	0	1.123571429	1.6456	7.744	1.936	#	1977	1
0.319782578	0	1.658660714	2.4293	11.432	2.858	#	1978	1
0.21409557	0	1.240803571	1.8173	8.552	2.138	#	1979	1
3.572039439	0	2.287276949	24.28264818	156.824185	3.043394524	#1980 1		
0.259908393	0	0.308513612	9.316412523	25.51136875	3.465066157	#1981 1		
0.152860608	0	0.399851606	4.122956505	48.48580236	2.061955856	#1982 1		
0.185972847	0	1.004152196	3.381780524	12.73756525	1.739988905	#1983 1		
0.0530703	0	1.433987883	10.01679734	27.35597033	0.631265372	#1984 1		
0.114758854	0	0.813499478	5.594826462	25.78336369	0.456260341	#1985 1		
0.18461207	0	1.026352	3.7219205	30.75871882	1.697173958	#1986 1		
0.290299078	0	1.014208	3.677882	25.98283703	3.477591651	#1987 1		
0.493054841	0	1.08376	3.9301025	11.98452193	1.40365712	#1988 1		
0.458128233	0	1.46464	5.31131	7.834712066	2.321754077	#1989 1		
0.605999326	0	1.749472	6.344213	29.04694	4.42122	#1990 1		
1.596191338	0	1.63024	5.911835	27.0673	4.1199	#1991 1		
0.461303379	0	0.943552	3.421658	15.66604	2.38452	#1992 1		
0.387367833	0.004082331	0.068191985	0.372852753	3.615335	1.49455#1993 1			
0.703521672	5.482116656	0.381984	0.716557479	10.58852564	1.193553213#1994 1			
0.78743625	9.655165905	0.672649083	1.313871787	1.751247422	0.838858431			
0.454953087	10.47027129	1.336033481	0.264610598	8.609793004	2.723841859			
0.630493311	11.71946451	0.949072	0.629774821	2.939099936	1.620110787			
0.66768788	16.57018067	0.65136	1.818910405	4.72988573	3.185354609			
0.320236171	14.00647693	0.818339996	2.189281708	11.59394183	1.040713461			
0.850939173	21.44130848	0.140301836	0.435422308	5.506288144	1.818307695			
0.605545734	13.51024695	1.013583537	2.399197116	3.464955588	1.093646118			
0.35743074	6.359817775	0.173477764	3.454976208	5.723285614	1.823330904			
0.360605886	5.406820332	0.506464518	1.859074105	6.364332926	1.317286472			
0.167375562	4.083691565	0.390548387	3.592009512	2.295529853	2.265961028			

#Abundance_Indices
96
#_N_observations

#Year	Season	Type	Value	CV	
1960	1	7	0.0004068	0.73521986	#soCAL
1961	1	7	0.000752368	2.149104207	
1962	1	7	0.001638443	0.395887617	
1963	1	7	0.002358607	0.706942173	
1964	1	7	0.002327071	0.254499182	
1965	1	7	0.001863092	0.197943809	
1966	1	7	0.002484396	1.131107477	
1967	1	7	0.00176781	0.311054556	
1968	1	7	0.001068786	0.791775234	
1969	1	7	0.001125285	0.73521986	
1970	1	7	0.001109469	0.480720678	
1971	1	7	0.001348063	0.537276052	
1972	1	7	0.002392308	1.272495912	
1973	1	7	0.001179491	0.508998365	
1974	1	7	0.001610348	0.339332243	
1975	1	7	0.002238103	0.339332243	
1976	1	7	0.001736429	0.311054556	
1977	1	7	0.001145585	0.226221495	
1978	1	7	0.001462472	0.311054556	
1980	1	7	0.001237435	0.36760993	
1981	1	7	0.001234042	0.282776869	
1982	1	7	0.000856295	0.311054556	
1983	1	7	0.000796743	0.311054556	
1984	1	7	0.000232116	0.537276052	
1985	1	7	0.000468776	1.979438085	
1986	1	7	0.001336265	0.282776869	
1987	1	7	0.00168358	0.254499182	
1988	1	7	0.001447898	0.311054556	
1989	1	7	0.002488253	0.254499182	
1990	1	7	0.00303796	0.254499182	
1991	1	7	0.002070488	0.254499182	
1992	1	7	0.001206023	0.197943809	
1993	1	7	0.000736278	0.36760993	
1994	1	7	0.000450407	3.478155493	
1995	1	7	0.000632539	0.452442991	
1996	1	7	0.001158318	0.508998365	
1997	1	7	0.000840106	0.424165304	
1998	1	7	0.000342289	0.424165304	
1999	1	7	0.000341477	0.537276052	
2000	1	7	0.000642221	1.922882711	
2001	1	7	0.00083581	0.36760993	
2002	1	7	0.000440773	0.791775234	
2003	1	7	0.000381094	0.480720678	
1978	1	8	63.18	2.035633936	#CalCOFI:manta
1980	1	8	100.16	1.395863271	
1981	1	8	43.57	0.872414544	
1984	1	8	39.44	0.814253575	
1985	1	8	74.52	0.901495029	
1986	1	8	29.46	0.988736483	
1987	1	8	32.96	1.337702301	
1988	1	8	31.43	0.872414544	
1989	1	8	87.16	0.610690181	

1990	1	8	44.32	1.45402424	
1991	1	8	85.75	0.930575514	
1992	1	8	16.66	1.948392482	
1993	1	8	16.82	1.45402424	
1994	1	8	16.66	1.686668119	
1995	1	8	30.34	1.105058423	
1996	1	8	33.24	1.017816968	
1997	1	8	46.69	1.075977938	
1998	1	8	3.16	0.843334059	
1999	1	8	52.95	0.843334059	
2000	1	8	40.23	1.046897453	
2001	1	8	29.37	1.075977938	
2002	1	8	112.91	0.988736483	
1972	1	9	13.57	0.78128954	#Impingement
1973	1	9	17.22	0.710263218	
1974	1	9	6.52	0.639236896	
1975	1	9	9.38	0.532697413	
1976	1	9	7.12	0.568210574	
1977	1	9	4.39	0.816802701	
1978	1	9	3.31	0.745776379	
1979	1	9	1.48	0.78128954	
1980	1	9	1.7	0.710263218	
1981	1	9	2.76	0.852315861	
1982	1	9	2.3	0.923342183	
1983	1	9	2.36	0.852315861	
1984	1	9	2.46	0.78128954	
1985	1	9	2.36	0.745776379	
1986	1	9	1.58	0.852315861	
1987	1	9	2.65	0.710263218	
1988	1	9	1.04	1.20744747	
1989	1	9	2.59	0.852315861	
1990	1	9	1.73	0.923342183	
1991	1	9	2.39	0.816802701	
1992	1	9	1.51	0.852315861	
1993	1	9	0.56	1.20744747	
1994	1	9	0.8	1.278473792	
1995	1	9	0.84	1.562579079	
1996	1	9	0.76	1.527065918	
1997	1	9	1.32	1.385013275	
1998	1	9	0.77	1.456039597	
1999	1	9	5.87	0.78128954	
2000	1	9	4.26	1.136421149	
2001	1	9	6.02	1.740144884	
2002	1	9	8.27	1.029881666	

#_Discard_Biomass
1 #_(1=biomass;_2=fraction)
0 #_N_observations
#Year Season Type Value CV

#_Mean_BodyWt
66
#16

#Year	Seas	Type	Mkt	Value	CV
1980	1	3	0	0.492279553	0.516130363
1981	1	3	0	0.419000775	0.645246975

1982	1	3	0	0.493063014	0.285650358
1983	1	3	0	0.582606394	0.66005437
1984	1	3	0	0.447899911	0.562729878
1985	1	3	0	0.262511582	0.49685921
1987	1	3	0	0.813149287	0.542383153
1989	1	3	0	0.844692038	0.820356296
1999	1	3	0	0.31451741	0.701299103
2000	1	3	0	0.049254253	0.386734508
1980	1	4	0	1.133678516	0.537232412
1981	1	4	0	0.77994266	0.505115433
1982	1	4	0	0.805991794	0.517202794
1983	1	4	0	0.738672454	0.561826014
1984	1	4	0	0.886476707	0.224471437
1985	1	4	0	0.797895245	0.493145332
1986	1	4	0	0.88600727	0.756979078
1987	1	4	0	1.060353528	0.54552634
1988	1	4	0	1.126576808	0.534704585
1989	1	4	0	1.364180271	0.531733214
1995	1	4	0	0.362203113	0.547912403
1996	1	4	0	0.556445073	0.254711646
1998	1	4	0	0.783191181	0.517260685
1999	1	4	0	0.755204318	0.317734566
2002	1	4	0	1.592516625	0.532034869
2003	1	4	0	0.692474995	0.145785004
2004	1	4	0	0.674016928	0.045379857
1980	1	5	0	1.291815069	0.492771083
1981	1	5	0	1.256246743	0.507110937
1982	1	5	0	1.058760669	0.567428189
1983	1	5	0	0.820683443	0.526648444
1984	1	5	0	1.038178219	0.431150315
1985	1	5	0	1.138877816	0.716713535
1986	1	5	0	0.84469507	0.655202169
1987	1	5	0	1.067968135	0.646030012
1988	1	5	0	0.777949064	0.36920555
1989	1	5	0	1.101149157	0.555970093
1993	1	5	0	0.471922251	0.230985364
1994	1	5	0	1.197234596	0.688265236
1995	1	5	0	0.666247912	0.281595989
1996	1	5	0	0.682121989	0.348046861
1997	1	5	0	1.416831368	0.517812268
1998	1	5	0	0.756209444	0.108261896
1999	1	5	0	0.678771359	0.455564135
2000	1	5	0	1.661831759	0.51780411
2001	1	5	0	0.677864698	0.164581821
2002	1	5	0	0.790203587	0.629333135
2003	1	5	0	0.975778341	0.419300425
2004	1	5	0	1.201594209	0.570482102
1980	1	6	0	0.96903267	0.586526236
1981	1	6	0	1.024516638	0.495414495
1982	1	6	0	0.751158095	0.802613803
1983	1	6	0	0.789939908	0.630483077
1984	1	6	0	1.039984011	0.464684213
1985	1	6	0	0.557513617	0.496718316
1986	1	6	0	0.594435488	0.342576808
1987	1	6	0	1.160390128	0.426335328
1988	1	6	0	0.510470251	0.560136709

1989 1 6 0 0.694230707 0.649223058
1994 1 6 0 0.94064579 0.221898574
1996 1 6 0 0.653026338 0.150768289
1998 1 6 0 1.012405152 0.667733344
1999 1 6 0 0.462834641 0.271836437
2000 1 6 0 0.706180788 0.211111379
2003 1 6 0 2.174173135 0.378784743
2004 1 6 0 1.615799715 0.445630383

0.0001 #min_proportion_for_compressing_tails_of_observed_composition
0.0001 #_constant added to expected frequencies

44 #_N_length_bins
#_lower_edge_of_length_bins 6
8 10 12 14 16 18 20 22 24 26 28
30 32 34 36 38 40 42 44 46 48 50
52 54 56 58 60 62 64 66 68 70 72
74 76 78 80 82 84 86 88 90 92

15 #N_observations #Year
Seas Fleet sexes Mkt Nsamp begin data: females then males
1994 1 5
0 0 16.9004 0 0 0 0 0 0 0 0
0 0 0 0 0.066666667 0.133333333 0.2 0.066666667
0.066666667 0.066666667 0 0.066666667 0 0.066666667 0
0 0.066666667 0.066666667 0 0.133333333 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
1996 1 5 0 0 42.3879 0 0 0 0 0 0
0 0 0 0.034482759 0.034482759 0.137931034 0.206896552
0.206896552 0.137931034 0.034482759 0.137931034 0 0.034482759
0 0 0 0 0 0 0 0 0 0.034482759
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 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 11.7108 0 0 0 0 0 0
0 0 0 0 0.095238095 0.047619048 0 0.285714286
0.285714286 0.142857143 0 0.095238095 0.047619048 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
1999 1 5 0 0 40.3432 0 0 0 0 0 0
0.025 0 0.025 0.025 0 0.075 0.025 0.125 0.25 0.175 0.125
0.05 0.05 0.025 0 0 0 0.025 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2002	1	5	0	0	16.904	0	0	0	0	0	0
	0	0	0	0	0	0	0.272727273	0.227272727			
	0.227272727	0.045454545	0.045454545	0	0.045454545	0.090909091					
	0	0	0	0.045454545	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
2003	1	5	0	0	44.6519	0	0	0	0	0	0
	0	0	0	0	0	0.034482759	0.034482759	0.172413793			
	0.206896552	0.172413793	0.103448276	0.137931034	0	0.034482759					
	0.034482759	0	0.034482759	0.034482759	0	0	0	0			
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
2004	1	5	0	0	42.2045	0	0	0	0	0	0
	0	0	0	0.00862069	0	0.017241379	0.060344828				
	0.077586207	0.112068966	0.086206897	0.103448276	0.163793103						
	0.086206897	0.077586207	0.060344828	0.043103448	0.034482759						
	0.025862069	0.025862069	0	0.00862069	0	0	0	0			
	0.00862069	0	0	0	0	0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
1975	1	6	0	0	65.9217	0	0	0	0	0	0
	0.013157895	0	0.013157895	0.026315789	0.092105263	0.078947368					
	0.144736842	0.171052632	0.078947368	0.118421053	0.039473684						
	0.078947368	0.039473684	0.026315789	0.026315789	0.026315789	0					
	0.013157895	0	0	0.013157895	0	0	0	0	0		
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0										
1976	1	6	0	0	82.878	0	0	0	0.010526316	0	
	0	0	0.010526316	0.010526316	0.052631579	0.063157895					
	0.105263158	0.189473684	0.094736842	0.063157895	0.084210526						
	0.052631579	0.084210526	0.031578947	0.042105263	0.021052632						
	0.021052632	0.042105263	0	0.010526316	0.010526316	0	0				
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1977 1 6 0 0 82.9085 0 0 0 0 0.013157895
0 0 0 0 0.065789474 0.118421053 0.131578947
0.144736842 0.065789474 0.092105263 0.092105263 0.052631579
0.039473684 0.052631579 0.013157895 0.039473684 0.039473684 0
0.013157895 0.013157895 0 0 0 0.013157895 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
1978 1 6 0 0 141.586 0 0 0 0.00990099 0
0 0.01980198 0.00990099 0 0.04950495 0.04950495
0.069306931 0.118811881 0.079207921 0.108910891 0.079207921
0.04950495 0.089108911 0.079207921 0.02970297 0.02970297
0.03960396 0 0.03960396 0.03960396 0 0.00990099 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 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 6 0 0 123.608 0 0 0 0 0 0
0.012195122 0.012195122 0.073170732 0.182926829 0.158536585
0.195121951 0.170731707 0.048780488 0.036585366 0.036585366
0.036585366 0 0.024390244 0.012195122 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1987 1 6 0 0 68.4037 0 0 0 0 0 0
0 0 0.02 0.01 0.13 0.12 0.25 0.13 0.12 0.09 0.09
0.03 0.01 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
1988 1 6 0 0 62.8068 0 0 0 0 0 0
0 0 0.015384615 0.061538462 0.046153846 0.076923077
0.123076923 0.153846154 0.123076923 0.092307692 0.107692308
0.153846154 0.015384615 0.015384615 0 0 0.015384615 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
1989 1 6 0 0 81.3786 0 0 0 0 0
0.010752688 0 0.021505376 0.064516129 0.161290323 0.161290323
0.086021505 0.096774194 0.086021505 0.064516129 0.086021505

0.032258065 0.010752688 0.032258065 0.010752688 0.010752688
0.043010753 0.021505376 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0
#1975 1 9 0 0 24.3005 0.04 0 0.02 0 0 0.08
0.12 0.26 0.16 0.2 0.06 0.04 0.02 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0
#1976 1 9 0 0 12.993 0 0 0 0.036036036
0.072072072 0.063063063 0.135135135 0.153153153 0.216216216
0.09009009 0.09009009 0.099099099 0.027027027 0.009009009
0.009009009 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0
#1977 1 9 0 0 41.3601 0.016949153 0 0.050847458
0.016949153 0.016949153 0.033898305 0.06779661 0.084745763
0.13559322 0.101694915 0.152542373 0.152542373 0.101694915
0.033898305 0.016949153 0 0 0.016949153 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0
#1978 1 9 0 0 0.576864 0 0 0 0 0
0 0 0.142857143 0.238095238 0.285714286 0.095238095
0.142857143 0.095238095 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0
#1992 1 9 0 0 36.2166 0.041666667 0 0.020833333 0
0.020833333 0.083333333 0.104166667 0.0625 0.145833333 0.208333333
0.083333333 0.041666667 0.041666667 0.020833333 0.020833333
0.020833333 0 0 0.0625 0.020833333 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0

	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0		
#1993	1	9	0	0	10.6635	0.125	0	0.03125	0.0625	0.03125	0
	0.03125	0.125	0.125	0.15625	0	0	0.15625	0.0625	0	0	0.03125
	0	0.03125	0	0.03125	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
#1994	1	9	0	0	8.63632	0.096774194		0.032258065		0.129032258	
	0.064516129		0	0.032258065		0.096774194		0.064516129		0.129032258	
	0.064516129		0.032258065		0.096774194		0.032258065		0.032258065		0
	0.032258065		0	0.032258065		0	0	0.032258065		0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	
#1995	1	9	0	0	4.65097	0.117647059		0.235294118		0.235294118	
	0	0	0.058823529		0.117647059		0	0	0.058823529		
	0.117647059		0	0.058823529		0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0								
#1996	1	9	0	0	6.84423	0.136363636		0.045454545		0	0
	0	0	0.045454545		0.181818182		0.181818182		0.136363636		
	0.181818182		0.045454545		0.045454545		0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0							
#1997	1	9	0	0	23.9716	0.08	0.04	0	0	0.04	0
	0.04	0.08	0.16	0.2	0.04	0.12	0.04	0	0	0.04	0.04
	0.04	0	0	0.04	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0						
#1998	1	9	0	0	3.1703	0.44	0.16	0.04	0	0	0
	0.04	0	0.04	0.12	0.04	0.04	0.04	0	0	0	0.04
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0

```
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0
#1999   1       9       0       0       1.59954 0.615635179     0.218241042     0.068403909
        0.03257329      0.013029316     0.022801303     0.006514658     0.009771987
        0.003257329     0.003257329     0       0       0.003257329     0       0.003257329
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0
#2000   1       9       0       0       2.90412 0.375   0.291666667     0.041666667
        0.016666667     0.025   0.075   0.05    0.033333333     0.033333333     0.016666667
        0.008333333     0.008333333     0.025   0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       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       9       0       0       0.536391        0.25    0.472222222     0.111111111
        0.083333333     0       0       0       0.027777778     0.055555556     0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
#2002   1       9       0       0       1.65306 0.564935065     0.279220779     0.084415584
        0.025974026     0.019480519     0.006493506     0       0       0       0.019480519
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0       0       0       0       0       0       0       0       0       0       0
        0

1       #_N_age'_bins
1       #_lower_age_of_age'_bins
0       #_number_of_ageerr_types
        #_vector_with_stddev_of ageing_precision_for_each_AGE_and_type          0
        #_N_age_observations
#Year   Season  Fleet   Gender  Mkt     ageerr  Lbin_lo Lbin_hi Nsamp
0       #_N_size-at-age_observations;_values_on_row1;_N_on_row2         #Year   Season
        Fleet   Gender  Mkt     ageerr  Nsamp
#_environmental_data
1       #       N_variables
0       #       N_observations
999     #end    of      file
```

Appendix C-2. SS2 .CTL File for the SCS

```
#	stage-2a -	new	Format
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
	#area_for_each_fleet/survey
0	#do_migration_(0/1)

0	#_N_Block_Designs
#0	#_N_Blocks_per_Design(Block_1_always_starts_in_styr)
#1975	1985	1986	1990	1995	2001	#_Block_Design_1
#_Block_Design_2
#1987	1990
#1995	2001

#Natural_mortality_and_growth_parameters_for_each_morph
0	#_Last_age_for_natmort_young
0	#_First_age_for_natmort_old
0	#_age_for_growth_Lmin
17	#_age_for_growth_Lmax
-4	#_MGparm_dev_phase
#	LO	HI	INIT	PRIOR	PR_type	SD	PHASE	env-variable	use_dev
	dev_minyr	dev_maxyr	dev_stddev
	0.02	0.5	0.25	0.26	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_natM_young
	0	0.5	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_natM_old_as_exponential_offset(rel_young)
	1	40	10.79	19.26	0	10	-2	0	0	0	0
	0.5	0	0	#M1_Lmin
	40	90	59.71	62.13	0	10	-2	0	0	0	0
	0.5	0	0	#M1_Lmax
	0.05	0.25	0.18	0.185	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_VBK
	0.14	0.14	0.14	0.139	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_CV-young
	-3	3	-0.4418	-0.049	0	0.8	-3	0	0	0	0
	0.5	0	0	#M1_CV-old_as_exponential_offset(rel_young)
	-3	3	0.1823	-0.1	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_natM_young_as_exponential_offset(rel_morph_1)
	-3	3	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_natM_old_as_exponential_offset(rel_young)
	-3	3	0.2076	0.4	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_Lmin_as_exponential_offset ln(13.28/10.79)
	-3	3	-0.2488	-0.2	0	0.8	-2	0	0	0	0
	0.5	0	0	#M2_Lmax_as_exponential_offset ln(46.72/60.72)=ln(M/F)
	-3	3	0.442	0.4	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_VBK_as_exponential_offset ln(0.28/0.18)
	-3	3	0	0	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_CV-young_as_exponential_offset(rel_CV-young_for_morph_1)
	-3	3	-0.4418	-0.049	0	0.8	-3	0	0	0	0
	0.5	0	0	#M2_CV-old_as_exponential_offset(rel_CV-young) ln(0.09/0.14)
```

```
# Add 2+2*gender lines to read the wt-Len and mat-Len parameters

    -3    3    0.00001236    0.0000089088    0    0.8    -3    0    0
    0    0    0.5    0    0    #Female wt-len-1
    -3    3    3.113    3.190852    0    0.8    -3    0    0    0
    0    0.5    0    0    #Female wt-len-2
    -3    3    34.6    35    0    0.8    -3    0    0    0    0
    0.5    0    0    #Female mat-len-1
    -3    3    -0.7    -0.7    0    0.8    -3    0    0    0    0
    0.5    0    0    #Female mat-len-2
    -3    3    1    1    0    0.8    -3    0    0    0    0
    0.5    0    0    #Female eggs/gm intercept
    -3    3    0    0    0    0.8    -3    0    0    0    0
    0.5    0    0    #Female eggs/gm slope
    -3    3    0.00001989    0.0000089088    0    0.8    -3    0    0
    0    0    0.5    0    0    #Male wt-len-1
    -3    3    2.997    3.190852    0    0.8    -3    0    0    0
    0    0.5    0    0    #Male wt-len-2

# pop*gmorph lines For the proportion of each morph in each area

    0    1    0.5    0.2    0    9.8    -3    0    0    0    0
    0.5    0    0    #frac to morph 1 in area 1
    0    1    0.5    0.2    0    9.8    -3    0    0    0    0
    0.5    0    0    #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

#_custom-env_read

0    #_ 0=read_one_setup_and_apply_to_all_env_fxns;
1=read_a_setup_line_for_each_MGparm_with_Env-var>0
     # except read NO setup lines If no MGparms have Env-var>0


#_custom-block_read
0    #_ 0=read_one_setup_and_apply_to_all_MG-blocks;  1=read_a_setup_line_for_each_block x
MGparm_with_block>0
     # except read NO setup lines If no MGparms have block>0


#_Spawner-Recruitment_parameters
1    # SR_fxn:  1=Beverton-Holt
#LO    HI    INIT    PRIOR    PRIOR TYPE    SD    PHASE
3    30    6    12    0    10    2    #Ln(R0)
0.2    1    0.7    0.71    0    0.8    -3    #steepness
0    1    1    1.1    0    1    -1    #SD_recruitments
0    5    0    0    0    1    -3    #Env_link
0    5    0    0    0    1    -3    #r1: offset that allows use of recruitment
diff. than initial recruitment for virgin recruitment
0    #env-var_for_link
#    recruitment_residuals
```

```
#       start_rec_year  end_rec_year    Lower_limit     Upper_limit     phase
        1970    2003    -15     15      1

#init_F_setup,  for     each    fleet
#       LO      HI      INIT    PRIOR   PRIOR TYPE      SD      PHASE
        0       1       0.000   0.0001  0       99      -1
        0       1       0       0.1     0       99      -2
        0       1       0       0.1     0       99      -2
        0       1       0       0.1     0       99      -2
        0       1       0.000   0.0001  0       99      -1
        0       1       0.000   0.0001  0       99      -1

#_Qsetup
#_add_parm_row_for_each_positive_entry_below(row_then_column)

#-Float(0/1)    #Do-power(0/1)  #Do-env(0/1)    #Do-dev(0/1-not implemented)    #Env-Var
        for     each    fleet   and     survey
0       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
0       0       0       0       0       1
0       0       0       0       0       2
0       0       0       0       0       2
0       0       0       0       0       2

#LO     HI      INIT    PRIOR   PRIOR TYPE      SD      PHASE
#-30    30      0       0.1     20      2
#-30    30      0       0.1     20      2
#-30    30      0       0.1     20      2
#-30    30      0       0.1     20      2
#-30    30      -3      -2      10      1       #log(Q) (if     float   =       1)
#-30    30      0.01    -1      1       4       #Q-power
#-30    30      0.01    -1      1       4       #Q-env

#_SELEX_&_RETENTION_PARAMETERS

#Selex_type     Do_retention(0/1)       Do_male(0/1)    Mirrored_selex_number

1       0       0       0       #_fleet_1
2       0       0       0       #_fleet_2
2       0       0       0       #_fleet_3
2       0       0       0       #_fleet_4
1       0       0       0       #_fleet_5
1       0       0       0       #_fleet_6
5       0       0       6       #_survey_1
0       0       0       0       #_survey_2
0       0       0       0       #_survey_3

#_Age   selex
10      0       0       0       #_fleet_1
10      0       0       0       #_fleet_2
10      0       0       0       #_fleet_3
10      0       0       0       #_fleet_4
10      0       0       0       #_fleet_5
```

```
10      0       0       0       #_fleet_6
10      0       0       0       #_survey_1
11      0       0       0       #_survey_2
11      0       0       0       #_survey_3

#LO     HI      INIT    PRIOR   PR_type SD      PHASE   env-variable    use_dev dev_minyr
        dev_maxyr       dev_stddev      Block_Pattern
19      70      31      45      0       10      -2      0       0       0       0       0.5
        0       0       #infl_for_logistic FLT 1
0.001   30      5       5       0       5       -3      0       0       0       0       0.5
        0       0       #95%width_for_logistic

30      70      50      50      0       10      -3      0       0       0       0       0.5
        0       0       #peak FLEET 2 LIVE FISH
0.0001  0.1     0.000   0       0       99      -2      0       0       0       0       0.5
        0       0       #init
-10     5       0.7     0.0     0       3       -2      0       0       0       0       0.5
        0       0       #infl
0.001    5      1.1     0.3     0       99      -3      0       0       0       0       0.5
        0       0       #slope
-10     10      -3.4    9       0       99      -3      0       0       0       0       0.5
        0       0       #final
-10      5      -0.6    0.0     0       3       -4      0       0       0       0       0.5
        0       0       #infl2
0.001    20     1       .3      0       99      -5      0       0       0       0       0.5
        0       0       #slope2
0.1     10      1       4       0       99      -5      0       0       0       0       0.5
        0       0       #width of top

30      70      36      50      0       10      -3      0       0       0       0       0.5
        0       0       #peak FLEET 3 Man Made
0.0001  0.1     0.00    0       0       99      -2      0       0       0       0       0.5
        0       0       #init
-10     5       -1.74   0.5     0       3       -2      0       0       0       0       0.5
        0       0       #infl
0.001    20     0.5     0.3     0       99      2       0       0       0       0       0.5
        0       0       #slope
-5      20      -0.5    9       0       99      -3      0       0       0       0       0.5
        0       0       #final
-10      5      -3      0.0     0       3       3       0       0       0       0       0.5
        0       0       #infl2
0.001    50     17      0.3     0       99      4       0       0       0       0       0.5
        0       0       #slope2
0.1     10      4       4       0       99      -5      0       0       0       0       0.5
        0       0       #width of top

40      70      33      50      0       10      -3      0       0       0       0       0.5
        0       0       #peak FLEET 4 Shore
0.0001  0.1     0.00    0       0       99      -2      0       0       0       0       0.5
        0       0       #init
-10     5       1.5     0.5     0       3       -2      0       0       0       0       0.5
        0       0       #infl
0.001   20      0.001   0.3     0       99      2       0       0       0       0       0.5
        0       0       #slope
-5      -2.3    -0.28   9       0       99      -3      0       0       0       0       0.5
        0       0       #final
```

```
-10     5       -1.9    0.0     0       3       3       0       0       0       0       0.5
        0       0       #infl2
0.001   50      6.4     0.3     0       99      4       0       0       0       0       0.5
        0       0       #slope2
0.1     10      4       4       0       99      -5      0       0       0       0       0.5
        0       0       #width of top

19      70      35      45      0       10      3       0       0       0       0       0.5
        0       0       #infl_for_logistic FLT 5
0.001   30      2.5     5       0       5       4       0       0       0       0       0.5
        0       0       #95%width_for_logistic

19      70      30      45      0       10      3       0       0       0       0       0.5
        0       0       #infl_for_logistic FLT 6
0.001   30      2.5     5       0       5       4       0       0       0       0       0.5
        0       0       #95%width_for_logistic

1       44      1       1       0       10      -3      0       0       0       0       0.5
        0       0       #min Len bin - fixed SURVEY 1
0.001   100     44      45      0       5       -4      0       0       0       0       0.5
        0       0       #max Len bin fixed

0       20      0       1       0       99      -4      0       0       0       0       0.5
        0       0       #minage SURVEY 2
0       20      0       1       0       99      -4      0       0       0       0       0.5
        0       0       #maxage

0       20      0       2       0       99      -4      0       0       0       0       0.5
        0       0       #minage SURVEY 3
0       20      1       2       0       99      -4      0       0       0       0       0.5
        0       0       #maxage

#_custom-env_read       0
#_custom-block_read
0
-4      #_phase_for_selex_parm_devs
1       #_max_lambda_phases:_read_this_Number_of_values_for_each_componentxtype_below
0       #sd_offset
#_survey_lambdas
0       0       0       0       0       0       1       1       1
#_discard_lambdas
0       0       0       0       0       0       0       0       0
#_meanwtlambda(one_for_all_sources)
1
#_lenfreq_lambdas
0       0       0       0       1       1       0       0       1
#_age_freq_lambdas
0       0       0       0       0       0       0       0       0
#_size@age_lambdas
0       0       0       0       0       0       0       0       0
#_initial_equil_catch
0
#_recruitment_lambda
1
#_parm_prior_lambda
1
```

#_parm_dev_timeseries_lambda
1
crashpen lambda
100
#max F
0.9

999 #_end-of-file

#Q_setup:_add_parm_row_for_each_positive_entry_below(row_then_column)

Appendix D. Comparing Assessment Models

The 2005 cabezon assessment makes the transition from a population dynamics model written specifically for cabezon (original cabezon model (OC)) to the Stock Synthesis 2 (Methot 2005) package. Both assessment models are implemented in ADMB, but differ slightly in terms of model structure. There are three major differences between the two models:

1. Recruitment bias correction: The OC model applies the log bias-correction of recruitment deviations in the recruitment penalty function. SS2 applies the bias-correction factor when predicting recruitment.
2. Fleet weight-at-age: Weight-at-age information is used in the calculation of age-specific catch. The OC model assumes the same weight-at-age relationship for all fleets. SS2 calculates fleet-specific weight-at-age after accounting for the impact of selectvity on weight-at-age.
3. Estimation of additional survey variability: SS2 currently has no way of estimating additional variance about the survey indices and uses only the inputted CVs. The OC model estimates an extra variance component (the "catchability scaling parameter") internally when fitting to the survey indices.

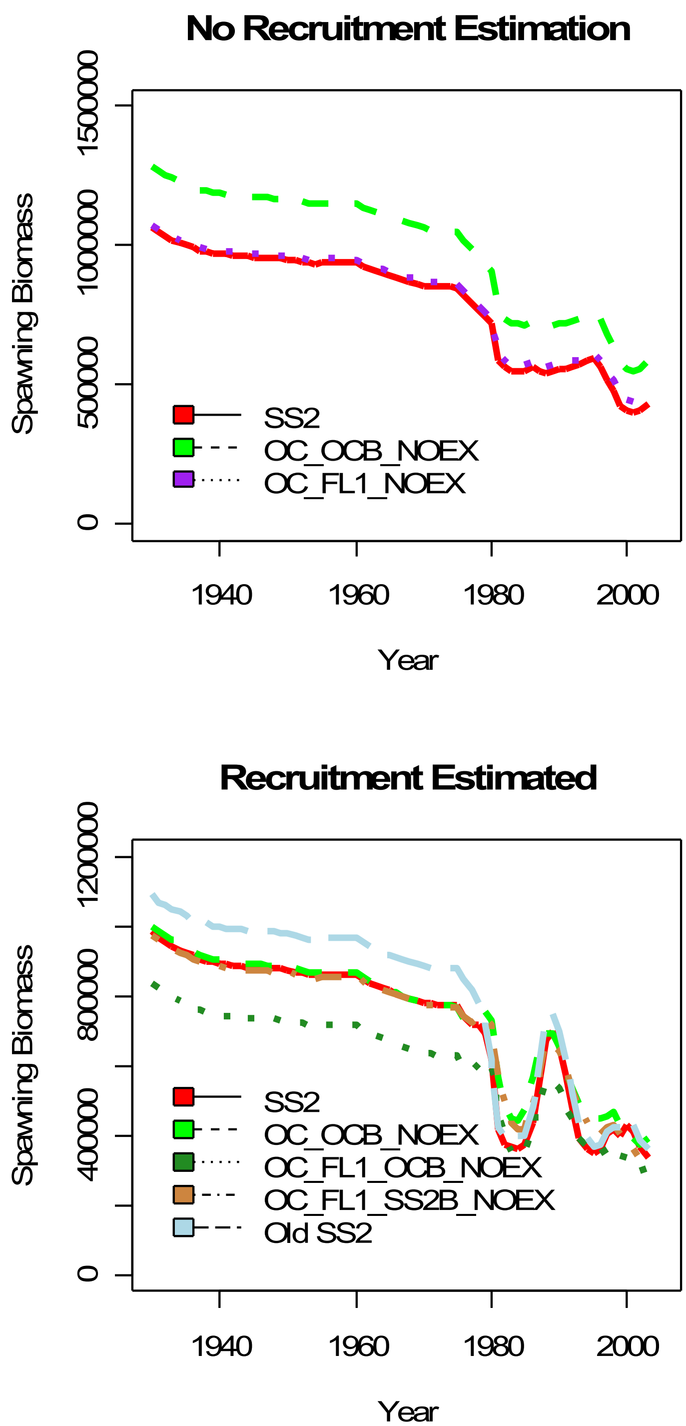
Several model runs based the OC assessment model were explored to examine the effects of these differences on estimates of reproductive output. Model runs are designated as follows:

- SS2: SS2 model
- Old SS2: SS2 v.1.09 (catch-at-age removed at the start of the year)
- OC: Original cabezon model
- SS2B: SS2 bias-correction
- OCB: OC bias-correction
- NOEX: Catchability scaling parameter not estimated
- FL1: SS2 Commerical fleet 1 weights-at-ages used for all OC fleets. This fleet was chosen because the weights-at-age for it from SS2 differed substantially from those calculated within the OC model so it was hypothesized to be influential. Other fleet weights-at-age were also examined and gave similar results.

A model with the designation OC_FL1_OCB_NOEX is the OC model using the fleet 1 SS2 weight-at-age values, the OC bias-correction method, and no estimation of the catchability scaling parameter.

Results of the comparisons are given in Figure 1 Appendix D. When recruitment deviations are not estimated, SS2 and OC give similar trends if the OC weights-at-age are replaced by the SS2 fleet 1 weights-at-age. When recruitments are estimated, this correction is not sufficient (and, in fact, not needed). Instead, it is necessary to apply the SS2 bias-correction approach for the OC model to produce similar results to SS2. Therefore, the first two differences between the OC and SS2 models are important when comparing assessment outputs. The third difference is important to consider when comparing SS2 model outputs to OC model outputs that estimated the catchability scaling parameter.

Figure 1 Appendix D. Model runs comparing the OC model to SS2. Descriptions of the model runs are found in the main Appendix D text.



Appendix E. Numbers (in 1000s)-at-age matrix for the NCS.

A) Females

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1916	314	244	190	148	115	90	70	55	42	33	26	20	16	12	9	7	6	4	3	3	10
1917	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1918	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1919	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1920	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1921	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1922	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1923	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1924	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1925	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1926	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1927	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1928	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	10
1929	314	244	190	148	115	90	70	54	42	33	26	20	16	12	9	7	6	4	3	3	9
1930	314	244	190	148	115	89	70	54	42	33	26	20	15	12	9	7	6	4	3	3	9
1931	313	244	190	148	115	89	70	54	42	33	25	20	15	12	9	7	6	4	3	3	9
1932	313	244	190	148	115	89	69	54	42	33	25	20	15	12	9	7	6	4	3	3	9
1933	313	244	190	148	115	89	69	54	42	33	25	20	15	12	9	7	6	4	3	3	9
1934	313	244	190	147	114	89	69	54	42	32	25	20	15	12	9	7	6	4	3	3	9
1935	313	244	190	147	114	89	69	53	41	32	25	19	15	12	9	7	6	4	3	3	9
1936	313	244	189	147	114	88	68	53	41	32	25	19	15	12	9	7	6	4	3	3	9
1937	312	243	189	147	113	88	68	53	41	32	25	19	15	12	9	7	5	4	3	3	9
1938	312	243	189	147	113	88	68	52	41	31	24	19	15	11	9	7	5	4	3	3	9
1939	312	243	189	146	113	87	67	52	40	31	24	19	15	11	9	7	5	4	3	3	9
1940	312	243	189	146	113	87	67	52	40	31	24	19	14	11	9	7	5	4	3	2	9
1941	312	242	188	146	113	87	67	52	40	31	24	18	14	11	9	7	5	4	3	2	9
1942	311	242	188	146	113	87	67	52	40	31	24	18	14	11	9	7	5	4	3	2	9
1943	311	242	188	146	113	87	67	52	40	31	24	18	14	11	9	7	5	4	3	2	8
1944	311	242	188	146	113	87	67	52	40	31	24	18	14	11	8	7	5	4	3	2	8
1945	311	242	188	146	113	87	67	52	40	31	24	18	14	11	8	7	5	4	3	2	8
1946	311	242	188	146	113	87	67	52	40	31	24	18	14	11	8	7	5	4	3	2	8
1947	311	242	188	146	113	87	67	52	40	31	24	18	14	11	8	7	5	4	3	2	8
1948	310	241	187	144	110	85	65	50	39	30	23	18	14	11	8	6	5	4	3	2	8
1949	309	240	185	141	107	81	62	48	37	29	22	17	13	10	8	6	5	4	3	2	7
1950	307	238	184	140	106	79	60	46	35	27	21	16	12	10	7	6	4	3	3	2	7
1951	305	237	183	139	104	77	58	44	33	26	20	15	12	9	7	5	4	3	2	2	7
1952	303	235	181	137	102	75	56	42	31	24	18	14	11	8	6	5	4	3	2	2	6
1953	302	235	181	137	102	75	55	41	31	23	18	14	10	8	6	5	4	3	2	2	6
1954	302	234	181	139	104	77	57	42	31	23	17	13	10	8	6	5	4	3	2	2	6
1955	303	235	182	140	106	80	59	43	32	24	18	13	10	8	6	5	4	3	2	2	6
1956	304	235	182	140	107	81	61	45	33	24	18	13	10	8	6	5	3	3	2	2	5
1957	303	235	181	139	105	80	60	45	33	24	18	13	10	7	6	4	3	3	2	2	5
1958	303	235	181	138	105	79	59	45	33	24	18	13	10	7	5	4	3	2	2	1	5
1959	303	235	182	139	105	79	59	45	33	25	18	13	10	7	5	4	3	2	2	1	5
1960	303	235	182	139	106	80	60	45	34	25	19	14	10	7	5	4	3	2	2	1	5
1961	304	236	182	140	107	81	61	45	34	26	19	14	10	8	6	4	3	2	2	1	5
1962	305	236	183	141	107	82	62	46	35	26	19	15	11	8	6	4	3	2	2	1	5
1963	305	237	183	140	107	81	62	46	35	26	20	15	11	8	6	4	3	2	2	1	4
1964	303	236	182	138	104	78	59	45	34	25	19	14	11	8	6	4	3	2	2	1	4
1965	303	236	183	139	105	78	59	44	34	25	19	14	11	8	6	4	3	2	2	1	4
1966	303	235	182	139	105	78	58	44	33	25	19	14	10	8	6	4	3	2	2	1	4
1967	302	235	181	138	104	77	57	42	32	24	18	14	10	8	6	4	3	2	2	1	4
1968	302	234	182	139	105	78	58	43	32	24	18	14	10	8	6	4	3	2	2	1	4
1969	303	235	182	139	106	79	59	44	32	24	18	14	10	8	6	4	3	2	2	1	4
1970	303	235	182	139	106	80	60	44	33	24	18	13	10	8	6	4	3	2	2	1	4
1971	303	235	181	139	105	79	59	44	33	24	18	13	10	7	6	4	3	2	2	1	4
1972	303	235	182	140	106	80	60	45	33	25	18	14	10	8	6	4	3	2	2	1	4
1973	302	235	181	138	104	78	59	44	33	24	18	13	10	7	5	4	3	2	2	1	4
1974	302	234	181	137	103	77	58	43	32	24	18	13	10	7	5	4	3	2	2	1	4
1975	301	234	181	138	103	77	57	42	32	24	18	13	10	7	5	4	3	2	2	1	4
1976	302	234	181	139	105	78	58	43	32	24	18	13	10	7	5	4	3	2	2	1	4
1977	301	234	181	138	105	78	58	43	32	24	18	13	10	7	5	4	3	2	2	1	4
1978	301	233	180	138	104	78	58	43	32	23	17	13	10	7	5	4	3	2	2	1	4
1979	300	232	178	135	101	75	56	42	31	23	17	12	9	7	5	4	3	2	2	1	3
1980	114	232	179	135	101	75	55	41	30	22	16	12	9	7	5	4	3	2	2	1	3
1981	169	88	177	133	98	72	53	39	29	22	16	12	9	6	5	4	3	2	1	1	3
1982	279	130	68	134	99	72	53	39	29	21	16	12	9	6	5	3	3	2	1	1	3
1983	135	217	100	51	97	71	51	37	27	20	15	11	8	6	4	3	2	2	1	1	3
1984	85	104	165	74	36	69	50	36	26	19	14	11	8	6	4	3	2	2	1	1	3
1985	91	65	79	124	55	27	51	37	27	20	14	11	8	6	4	3	2	2	1	1	3
1986	250	70	50	60	93	41	20	38	28	20	15	11	8	6	4	3	2	2	1	1	3
1987	119	193	54	38	44	67	29	14	27	19	14	10	7	5	4	3	2	2	1	1	2
1988	94	92	148	40	27	31	46	20	10	18	13	9	7	5	4	3	2	1	1	1	2
1989	231	73	70	110	29	19	22	32	14	7	12	9	6	5	3	2	2	1	1	1	2
1990	551	178	55	52	79	20	13	15	22	9	4	8	6	4	3	2	2	1	1	1	2
1991	76	426	137	42	38	56	14	9	10	15	6	3	6	4	3	2	2	1	1	1	2
1992	97	59	328	103	31	27	40	10	6	7	10	4	2	4	3	2	1	1	1	1	2
1993	367	75	45	239	71	20	17	25	6	4	4	6	3	1	2	2	1	1	1	0	1
1994	606	285	58	33	171	50	14	12	17	4	3	3	4	2	1	2	1	1	1	0	1
1995	219	471	220	44	24	122	35	10	8	12	3	2	2	3	1	1	1	1	1	0	1
1996	344	170	364	165	31	16	77	22	6	5	7	2	1	1	2	1	0	1	0	0	1
1997	438	267	131	270	112	19	9	45	13	3	3	4	1	1	1	1	0	0	0	0	1
1998	103	340	204	96	178	67	11	5	24	7	2	2	2	1	0	0	1	0	0	0	1
1999	530	80	261	149	61	100	35	5	3	12	3	1	1	1	0	0	0	0	0	0	0
2000	85	412	62	199	106	40	63	22	3	2	7	2	1	0	1	0	0	0	0	0	0
2001	43	66	320	47	142	71	26	40	14	2	1	5	1	0	0	0	0	0	0	0	0
2002	59	34	51	245	35	101	49	18	28	9	1	1	3	1	0	0	0	0	0	0	0
2003	116	46	26	39	181	25	72	35	13	20	7	1	0	2	1	0	0	0	0	0	0
2004	277	90	35	20	29	132	18	51	25	9	14	5	1	0	2	0	0	0	0	0	0

B) Males

	Age																				
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1916	314	232	172	128	95	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1917	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1918	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1919	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1920	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1921	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1922	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1923	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1924	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1925	314	232	172	127	94	70	52	38	28	21	16	12	9	6	5	3	3	2	1	1	3
1926	314	232	172	127	94	70	52	38	28	21	16	11	9	6	5	3	3	2	1	1	3
1927	314	232	172	127	94	70	52	38	28	21	16	11	9	6	5	3	3	2	1	1	3
1928	314	232	172	127	94	70	52	38	28	21	16	11	9	6	5	3	3	2	1	1	3
1929	314	232	172	127	94	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1930	314	232	172	127	94	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1931	313	232	172	127	94	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1932	313	232	172	127	94	70	51	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1933	313	232	172	127	94	69	51	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1934	313	232	172	127	94	69	51	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1935	313	232	171	127	94	69	51	38	28	21	15	11	8	6	5	3	3	2	1	1	3
1936	313	232	171	126	93	69	51	37	28	20	15	11	8	6	5	3	2	2	1	1	3
1937	312	231	171	126	93	68	50	37	27	20	15	11	8	6	4	3	2	2	1	1	3
1938	312	231	171	126	93	68	50	37	27	20	15	11	8	6	4	3	2	2	1	1	3
1939	312	231	170	126	92	68	50	37	27	20	15	11	8	6	4	3	2	2	1	1	3
1940	312	231	170	126	92	68	50	37	27	20	15	11	8	6	4	3	2	2	1	1	3
1941	312	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1942	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1943	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1944	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1945	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1946	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1947	311	230	170	125	92	68	50	36	27	20	14	11	8	6	4	3	2	2	1	1	3
1948	310	229	168	123	90	66	48	35	26	19	14	10	8	6	4	3	2	2	1	1	2
1949	309	228	167	121	88	64	46	34	25	18	13	10	7	5	4	3	2	2	1	1	2
1950	307	226	166	120	86	62	45	33	24	17	13	9	7	5	4	3	2	1	1	1	2
1951	305	225	164	119	85	60	43	31	23	16	12	9	6	5	3	3	2	1	1	1	2
1952	303	223	163	117	83	58	41	29	21	15	11	8	6	4	3	2	2	1	1	1	2
1953	302	223	163	117	83	59	41	29	21	15	11	8	6	4	3	2	2	1	1	1	2
1954	302	223	164	119	85	60	42	30	21	15	11	8	6	4	3	2	2	1	1	1	2
1955	303	223	164	120	87	62	43	30	21	15	11	8	6	4	3	2	2	1	1	1	2
1956	304	224	164	120	87	63	45	31	22	15	11	8	6	4	3	2	2	1	1	1	2
1957	303	223	164	119	86	62	45	32	22	16	11	8	5	4	3	2	2	1	1	1	2
1958	303	223	163	119	85	61	44	32	22	16	11	8	5	4	3	2	1	1	1	1	2
1959	303	223	164	119	86	61	44	32	23	16	11	8	5	4	3	2	1	1	1	1	2
1960	303	223	164	119	86	62	44	32	23	16	11	8	6	4	3	2	1	1	1	1	2
1961	304	224	165	120	87	63	45	32	23	16	12	8	6	4	3	2	1	1	1	1	1
1962	305	225	165	121	88	63	46	33	23	17	12	9	6	4	3	2	1	1	1	1	1
1963	305	225	165	120	87	63	46	33	23	17	12	9	6	4	3	2	1	1	1	1	1
1964	303	224	164	118	85	61	44	32	23	16	12	8	6	4	3	2	1	1	1	1	1
1965	303	224	165	119	85	61	44	31	23	16	12	8	6	4	3	2	2	1	1	1	1
1966	303	224	164	119	85	61	43	31	22	16	11	8	6	4	3	2	2	1	1	1	1
1967	302	223	163	118	85	60	43	30	22	15	11	8	6	4	3	2	1	1	1	1	1
1968	302	223	164	119	85	61	43	30	22	15	11	8	6	4	3	2	1	1	1	1	1
1969	303	223	164	120	86	61	44	31	22	15	11	8	6	4	3	2	1	1	1	1	1
1970	303	223	164	119	86	62	44	31	22	16	11	8	6	4	3	2	1	1	1	1	1
1971	303	223	164	119	86	62	44	31	22	16	11	8	6	4	3	2	1	1	1	1	1
1972	303	223	164	120	86	62	44	32	23	16	11	8	6	4	3	2	1	1	1	1	1
1973	302	223	163	118	85	61	44	31	22	16	11	8	6	4	3	2	1	1	1	1	1
1974	302	223	163	118	84	60	43	31	22	16	11	8	6	4	3	2	1	1	1	1	1
1975	301	222	163	118	84	60	42	30	21	15	11	8	5	4	3	2	1	1	1	1	1
1976	302	222	163	119	85	61	43	30	22	15	11	8	6	4	3	2	1	1	1	1	1
1977	301	222	163	118	85	61	43	30	22	15	11	8	5	4	3	2	1	1	1	0	1
1978	301	222	163	118	85	61	43	30	21	15	11	8	5	4	3	2	1	1	1	0	1
1979	300	220	161	116	83	59	42	30	21	15	10	7	5	4	3	2	1	1	1	0	1
1980	114	220	161	116	82	58	41	29	21	14	10	7	5	4	3	2	1	1	1	0	1
1981	169	83	159	114	80	56	39	28	20	14	10	7	5	3	2	2	1	1	1	0	1
1982	279	124	61	114	81	56	39	28	19	14	10	7	5	3	2	2	1	1	1	0	1
1983	135	206	90	43	79	55	38	26	19	13	9	7	5	3	2	2	1	1	1	0	1
1984	85	99	148	63	30	54	37	26	18	12	9	6	4	3	2	2	1	1	1	0	1
1985	91	62	71	106	45	21	38	26	18	13	9	6	4	3	2	2	1	1	1	0	1
1986	250	67	45	52	76	32	15	27	19	13	9	6	4	3	2	2	1	1	1	0	1
1987	119	183	49	32	36	52	22	10	18	12	9	6	4	3	2	1	1	1	1	0	1
1988	94	87	133	34	22	24	35	14	7	12	8	6	4	3	2	1	1	1	0	0	1
1989	231	69	63	94	24	15	17	23	10	4	8	5	4	3	2	1	1	1	0	0	1
1990	551	169	50	44	64	16	10	11	15	6	3	5	3	2	2	1	1	1	0	0	1
1991	76	405	123	35	31	44	11	7	7	10	4	2	3	2	2	1	1	1	0	0	1
1992	97	56	295	88	25	21	30	7	5	5	7	3	1	2	2	1	1	1	0	0	1
1993	367	71	40	203	58	16	13	18	4	3	3	4	2	1	1	1	1	0	0	0	1
1994	606	270	52	28	139	39	11	9	12	3	2	2	3	1	0	1	1	0	0	0	0
1995	219	448	198	37	20	95	26	7	6	8	2	1	1	2	1	0	1	0	0	0	0
1996	344	162	327	140	25	13	59	16	4	3	5	1	1	1	1	0	0	0	0	0	0
1997	438	253	118	229	92	15	7	33	9	2	2	3	1	0	0	1	0	0	0	0	0
1998	103	323	183	81	146	54	9	4	18	5	1	1	1	0	0	0	0	0	0	0	0
1999	530	76	234	126	50	82	28	4	2	9	2	1	0	1	0	0	0	0	0	0	0
2000	85	392	56	169	86	32	50	17	3	1	5	1	0	0	0	0	0	0	0	0	0
2001	43	63	289	41	116	56	20	31	11	2	1	3	1	0	0	0	0	0	0	0	0
2002	59	32	46	210	29	79	38	14	21	7	1	0	2	1	0	0	0	0	0	0	0
2003	116	44	23	34	148	20	54	26	9	14	5	1	0	1	0	0	0	0	0	0	0
2004	277	86	32	17	24	103	14	37	17	6	10	3	0	0	1	0	0	0	0	0	0

Appendix F. Numbers (in 1000s)-at-age matrix for the SCS.

A) Females

	Age																				
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1916	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1917	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1918	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1919	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1920	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1921	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1922	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1923	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1924	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1925	70	55	43	33	26	20	16	12	10	7	6	5	4	3	2	2	1	1	1	1	2
1926	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1927	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1928	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1929	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1930	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1931	70	55	43	33	26	20	16	12	10	7	6	4	4	3	2	2	1	1	1	1	2
1932	70	55	43	33	26	20	16	12	10	7	6	4	3	3	2	2	1	1	1	1	2
1933	70	55	43	33	26	20	16	12	10	7	6	4	3	3	2	2	1	1	1	1	2
1934	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1935	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1936	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1937	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1938	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1939	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1940	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1941	70	55	43	33	26	20	16	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1942	70	55	43	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1943	70	55	43	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1944	70	55	43	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1945	70	55	42	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1946	70	55	42	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1947	70	55	42	33	26	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1948	70	55	42	33	25	20	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1949	70	54	42	33	25	19	15	12	9	7	6	4	3	3	2	2	1	1	1	1	2
1950	70	54	42	32	25	19	15	12	9	7	5	4	3	3	2	2	1	1	1	1	2
1951	70	54	42	32	25	19	15	11	9	7	5	4	3	3	2	2	1	1	1	1	2
1952	70	54	42	32	25	19	15	11	9	7	5	4	3	3	2	2	1	1	1	1	2
1953	70	54	42	32	25	19	15	11	9	7	5	4	3	2	2	1	1	1	1	1	2
1954	70	54	42	32	24	19	14	11	9	7	5	4	3	2	2	1	1	1	1	1	2
1955	69	53	41	31	23	18	14	11	8	6	5	4	3	2	2	1	1	1	1	1	2
1956	69	53	40	30	22	17	13	10	8	6	5	4	3	2	2	1	1	1	1	0	2
1957	68	52	40	29	21	16	12	9	7	6	4	3	3	2	2	1	1	1	1	0	2
1958	68	52	40	29	21	15	12	9	7	5	4	3	2	2	2	1	1	1	1	0	2
1959	68	52	40	30	22	16	11	9	7	5	4	3	2	2	1	1	1	1	1	0	1
1960	68	53	40	31	23	17	12	9	7	5	4	3	2	2	1	1	1	1	1	0	1
1961	68	53	41	31	24	18	13	9	7	5	4	3	2	2	1	1	1	1	1	0	1
1962	68	53	41	32	24	18	14	10	7	5	4	3	2	2	1	1	1	1	1	0	1
1963	69	53	41	31	24	19	14	10	8	6	4	3	2	2	1	1	1	1	1	0	1
1964	68	53	41	31	23	18	14	11	8	6	4	3	2	2	1	1	1	1	1	0	1
1965	68	53	41	31	23	18	14	11	8	6	4	3	2	2	1	1	1	1	0	0	1
1966	68	53	41	31	23	17	13	10	8	6	4	3	2	2	1	1	1	1	0	0	1
1967	68	53	40	30	22	17	13	10	7	6	4	3	2	2	1	1	1	1	0	0	1
1968	68	53	40	30	22	17	12	9	7	6	4	3	2	2	1	1	1	1	0	0	1
1969	68	53	41	31	23	17	13	9	7	6	4	3	3	2	1	1	1	1	0	0	1
1970	5	53	41	31	23	17	13	10	7	5	4	3	3	2	1	1	1	1	0	0	1
1971	6	4	41	31	23	17	13	10	7	5	4	3	2	2	1	1	1	1	0	0	1
1972	185	4	3	30	23	17	13	10	7	5	4	3	2	2	1	1	1	1	0	0	1
1973	11	141	3	2	20	15	11	9	6	5	4	3	2	2	1	1	1	1	0	0	1
1974	92	8	107	2	2	14	11	8	6	5	3	3	2	1	1	1	1	1	0	0	1
1975	62	71	6	79	2	1	10	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1976	73	48	54	5	55	1	1	7	5	4	3	2	2	1	1	1	1	0	0	0	1
1977	14	57	37	40	3	40	1	1	5	4	3	2	2	1	1	1	1	0	0	0	1
1978	183	11	43	28	29	2	29	1	0	4	3	2	2	1	1	1	1	0	0	0	1
1979	6	141	8	32	20	21	2	21	0	0	3	2	2	1	1	1	1	0	0	0	1
1980	71	5	109	6	24	15	16	1	16	0	0	2	2	1	1	1	1	0	0	0	1
1981	25	54	3	52	2	6	4	4	0	4	0	0	1	0	0	0	0	0	0	0	0
1982	41	19	40	2	30	1	4	2	2	0	2	0	0	0	0	0	0	0	0	0	0
1983	5	32	14	23	1	13	0	2	1	1	0	1	0	0	0	0	0	0	0	0	0
1984	106	4	24	9	15	1	8	0	1	1	1	0	1	0	0	0	0	0	0	0	0
1985	121	81	3	13	4	6	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	9	93	59	2	6	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1987	28	7	68	33	1	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1988	93	22	5	41	17	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	35	72	16	4	26	11	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	10	27	54	11	2	17	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	54	7	20	32	6	1	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	4	41	5	12	16	3	1	4	2	0	0	0	0	0	0	0	0	0	0	0	0
1993	6	3	30	3	6	9	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0
1994	76	5	3	22	2	5	6	1	0	2	1	0	0	0	0	0	0	0	0	0	0
1995	10	59	3	2	14	1	3	3	1	0	1	0	0	0	0	0	0	0	0	0	0
1996	72	8	45	2	1	8	1	1	2	0	0	1	0	0	0	0	0	0	0	0	0
1997	19	55	6	30	1	1	4	0	1	1	0	0	0	0	0	0	0	0	0	0	0
1998	4	14	42	4	19	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	40	3	11	29	2	9	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2000	199	31	2	7	15	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	5	155	23	2	4	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	19	4	117	16	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2003	149	15	3	84	10	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	53	116	11	2	59	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

B) Males

	Age																				
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1916	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1917	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1918	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1919	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1920	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1921	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1922	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1923	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1924	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1925	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1926	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1927	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1928	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1929	70	52	39	29	21	16	12	9	6	5	4	3	2	1	1	1	1	0	0	0	1
1930	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1931	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1932	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1933	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1934	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1935	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1936	70	52	39	29	21	16	12	9	6	5	3	3	2	1	1	1	1	0	0	0	1
1937	70	52	38	28	21	16	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1938	70	52	39	28	21	16	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1939	70	52	39	28	21	16	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1940	70	52	38	28	21	16	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1941	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1942	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1943	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1944	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1945	70	52	38	28	21	15	11	8	6	5	3	3	2	1	1	1	1	0	0	0	1
1946	70	52	38	28	21	15	11	8	6	5	3	2	2	1	1	1	1	0	0	0	1
1947	70	52	38	28	21	15	11	8	6	5	3	2	2	1	1	1	1	0	0	0	1
1948	70	52	38	28	20	15	11	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1949	70	52	38	28	20	15	11	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1950	70	52	38	28	20	15	11	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1951	70	51	38	28	20	15	11	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1952	70	51	37	27	20	14	11	8	6	4	3	2	2	1	1	1	1	0	0	0	1
1953	69	50	36	26	19	14	10	7	5	4	3	2	2	1	1	1	0	0	0	0	1
1954	69	50	36	25	18	13	10	7	5	4	3	2	2	1	1	1	0	0	0	0	1
1955	68	50	35	25	17	12	9	6	5	4	3	2	1	1	1	1	0	0	0	0	0
1956	68	50	35	25	17	12	8	6	4	3	2	2	1	1	1	1	0	0	0	0	0
1957	68	50	36	25	17	12	8	6	4	3	2	2	1	1	1	1	0	0	0	0	0
1958	68	50	36	26	18	13	9	6	4	3	2	2	1	1	1	1	0	0	0	0	0
1959	68	50	37	27	19	14	9	6	4	3	2	2	1	1	1	1	0	0	0	0	0
1960	68	50	37	27	20	14	10	7	5	3	2	2	1	1	1	1	0	0	0	0	0
1961	69	50	37	27	20	14	10	7	5	3	2	2	1	1	1	1	0	0	0	0	0
1962	68	50	37	26	19	14	10	7	5	4	2	2	1	1	1	0	0	0	0	0	0
1963	68	50	37	26	19	14	10	7	5	4	3	2	1	1	1	0	0	0	0	0	0
1964	68	50	36	26	19	13	10	7	5	4	3	2	1	1	1	0	0	0	0	0	0
1965	68	50	36	26	18	13	9	7	5	4	3	2	1	1	1	0	0	0	0	0	0
1966	68	50	36	26	18	13	9	7	5	4	3	2	1	1	1	0	0	0	0	0	0
1967	68	50	37	26	19	13	9	7	5	3	3	2	1	1	1	0	0	0	0	0	0
1968	5	50	37	26	19	13	9	7	5	3	2	2	1	1	1	0	0	0	0	0	0
1969	6	4	37	26	19	14	10	7	5	3	2	2	1	1	1	0	0	0	0	0	0
1970	185	4	3	26	19	13	9	7	5	3	2	2	1	1	1	0	0	0	0	0	0
1971	11	133	3	2	16	11	8	6	4	3	2	1	1	1	1	0	0	0	0	0	0
1972	92	8	96	2	1	11	8	6	4	3	2	1	1	1	1	0	0	0	0	0	0
1973	62	67	6	67	1	1	8	5	4	3	2	1	1	1	1	0	0	0	0	0	0
1974	73	45	48	4	44	1	1	5	4	3	2	1	1	1	0	0	0	0	0	0	0
1975	14	54	33	33	3	30	1	0	3	2	2	1	1	1	0	0	0	0	0	0	0
1976	183	10	39	23	24	2	21	0	0	2	2	1	1	1	0	0	0	0	0	0	0
1977	6	134	8	27	16	16	1	15	0	0	2	1	1	1	0	0	0	0	0	0	0
1978	71	4	98	5	19	11	11	1	10	0	0	1	1	1	0	0	0	0	0	0	0
1979	25	51	3	41	2	5	3	3	0	3	0	0	0	0	0	0	0	0	0	0	0
1980	41	18	35	2	23	1	3	1	2	0	1	0	0	0	0	0	0	0	0	0	0
1981	5	30	12	19	1	9	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0
1982	106	4	21	8	11	0	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1983	121	76	2	11	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	9	88	50	1	4	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1985	28	7	58	25	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	93	21	5	33	13	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	35	68	14	3	20	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	10	26	47	9	2	12	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1989	54	7	17	26	5	1	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	4	39	5	9	12	2	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
1991	6	3	26	3	5	6	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0
1992	76	4	2	18	2	3	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1993	10	56	3	1	11	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	72	8	40	2	1	6	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1995	19	52	5	25	1	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1996	4	14	37	4	15	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	40	3	10	24	2	7	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
1998	199	29	2	6	12	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	5	147	21	1	3	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	19	4	104	13	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	149	14	3	70	8	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2002	53	110	10	2	47	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
2003	116	44	23	34	148	20	54	26	9	14	5	1	0	1	0	0	0	0	0	0	0
2004	277	86	32	17	24	103	14	37	17	6	10	3	0	0	1	0	0	0	0	0	0