Status of Greenspotted Rockfish, *Sebastes chlorostictus*, in U.S. waters off California

Photo: Rick Starr

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Executive Summary

Stock

Greenspotted rockfish, *Sebastes chlorostictus* (Jordan and Gilbert 1880), also known as "chinafish," "bosco," "starry-eye" and "chucklehead," are found in waters off the west coast of North America, ranging from Copalis Head, Washington to Isla Cedros, Baja California (approximately 25° to 47° North latitude). Abundance of this species is greatest from northern Baja California to Mendocino County in California. Greenspotted rockfish associate with several benthic habitat types between depths of 30-363 meters (m), although adults are most common between 60 and 240 m (Love et al., 2002).

This is the first assessment of greenspotted rockfish prepared for the Pacific Fisheries Management Council (PFMC). Although no genetic information is available regarding stock structure for this species, we define two separate stocks based on evidence of differences in growth, exploitation history, and a well-established marine biogeographic boundary (Point Conception, 34° 27' North latitude), modeling each as an independent stock. For purposes of this assessment, we define northern California as U.S. waters between the California-Oregon border (42° North latitude) and Point Conception, and southern California as U.S. waters south of Point Conception and north of the U.S.-Mexico border.

Catches

Although not a primary target species, greenspotted rockfish are commonly taken by both commercial and recreational fisheries in California, with only 3% of coast wide catch landed north of the Oregon-California border (Figure ES1). Among rockfishes landed commercially in California, greenspotted rank 7th in total landings (1980-2009) south of Point Conception and rank 12th in northern California. Historical catch reconstruction efforts provided estimates of landings back to 1916. Annual commercial landings peaked at 162 mt in southern California in 1977, and 186 mt in 1981 in northern California. Recreational landings reached a peak of 74 mt in northern California and 117 mt in the Southern California Bight. Total catch peaked earlier in the southern part of the state relative to the north (Figure ES2), and annual statewide catch reached a maximum of 453 mt in 1982.

Implementation of coast wide Rockfish Conservation Areas (RCAs), Cowcod Conservation Areas (CCAs) in southern California, as well as recreational closures and depth restrictions has decreased catches of greenspotted rockfish in northern California to around 1 mt per year since 2003. In southern California, commercial catches have been less than 1 mt since 2003 and recreational catches have averaged 12 mt per year from 2000-2010 (Table ES1).

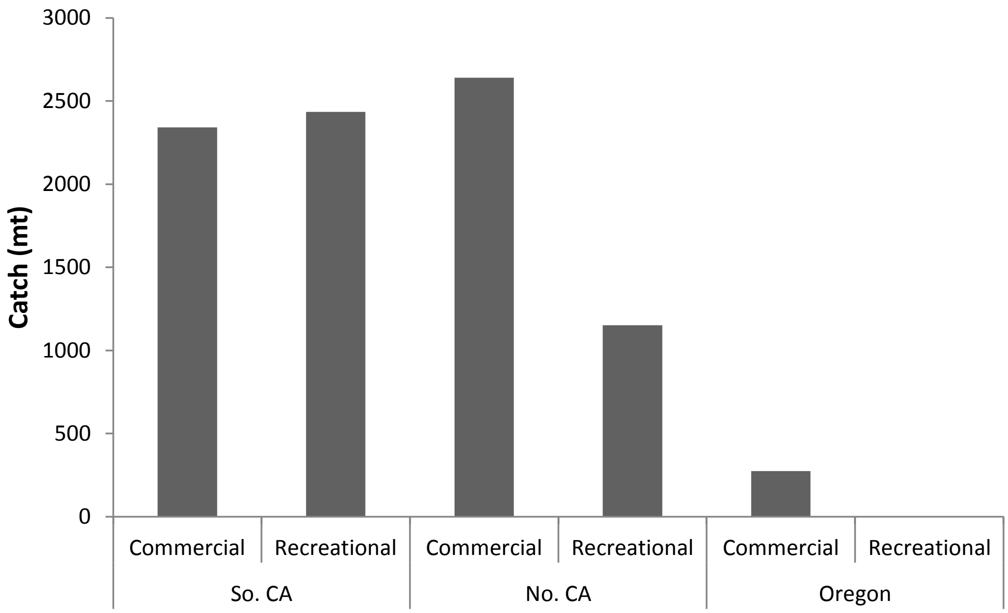

Figure ES1. Regional distribution of commercial and recreational greenspotted rockfish catch (total catch, 1969-2010). Regions within California are divided at Point Conception (34° 27′ N. latitude).

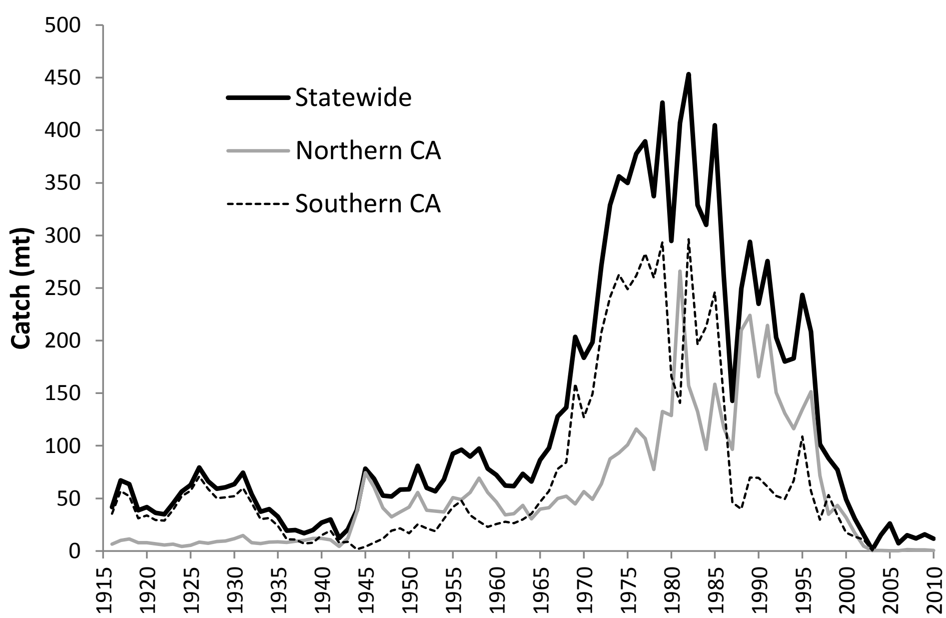

Figure ES2. Combined estimates of commercial and recreational catch of greenspotted rockfish in California, 1916-2010.

Table ES1. Recent catch (mt) of greenspotted rockfish by year, region, and fishery.

	Northern California		Southern California		
Year	Commercial	Recreational	Commercial	Recreational	Total
2000	4.0	27.8	3.5	13.9	49.2
2001	2.4	14.9	0.5	13.0	30.8
2002	3.5	1.1	1.0	9.7	15.5
2003	0.5	0.0	0.0	0.6	1.0
2004	0.4	0.2	0.1	14.5	15.2
2005	0.0	0.3	0.3	25.5	26.1
2006	0.1	0.1	0.5	6.7	7.4
2007	0.9	0.3	0.6	13.2	15.0
2008	0.5	0.4	0.7	10.2	11.9
2009	0.3	0.8	0.6	14.1	15.8
2010	0.1	0.3	0.8	10.5	11.7

Data and assessment

Data in the assessment include commercial catches by gear type (trawl, hook and line, and net) and recreational catches from commercial passenger fishing vessels (CPFV) and private/rental boats. Length composition data were obtained for all fleets. For this assessment, ages were estimated from otoliths of several thousand greenspotted rockfish caught by the northern California CPFV fleet and two fishery-independent surveys. Age compositions from these sources were included in the assessment, primarily for estimation of individual growth parameters. Fishery-independent, regional indices of abundance were included from NWFSC trawl and hook-and-line surveys. Fishery-dependent indices of relative abundance were developed using onboard sampling data from the recreational CPFV fleet in northern California and recreational dockside sampling data in both northern and southern California.

Parameters of an integrated, age-structured, catch at length model were estimated using Stock Synthesis. Base case models for northern California and southern California were developed with time-varying selectivity to account for regulatory changes likely to affect size composition of the catch. Alternative models assuming changes in growth or retention over time were considered, but rejected due to insufficient information in the available data sources.

Stock biomass

Trends in stock status for greenspotted rockfish are monitored using spawning output, a more reliable measure of reproductive potential than spawning biomass for species with size-dependent weight-specific fecundity. The assessment suggests that early declines in spawning output in southern California were followed by an increasing trend during the 1930s and 1940s, likely due to shifts in effort and reduced landings during WWII. Through the 1970s and most of the 1980s, estimated spawning output south of Point Conception declined rapidly, followed by a steady increase beginning in the late 1980s. In northern California, spawning output declined at a slower rate initially, but accelerated during the 1980s and 1990s. Model-estimated spawning output for the north has risen steadily since 1998 (Figure ES3, Table ES2). Trends in both regions are sensitive to values for parameters that influence stock productivity and are held fixed in the models (e.g. steepness of the stock-recruitment relationship and the natural mortality rate).

Base models for greenspotted rockfish suggest that spawning output relative to unfished levels ("depletion") was below the PFMC's minimum stock size threshold from 1984-2001 in southern California, and from 1990-2007 in northern California. Estimates of stock status in 2011 are 30.6% of unfished spawning output in the northern region and 37.4% in the south (Figure ES4, Table ES2). The sum of the regional estimates of spawning output in 2011 is 34.5% of the sum of unfished spawning outputs, which may be interpreted as an integrated estimate of current stock depletion for U.S. waters off California (Table ES3).

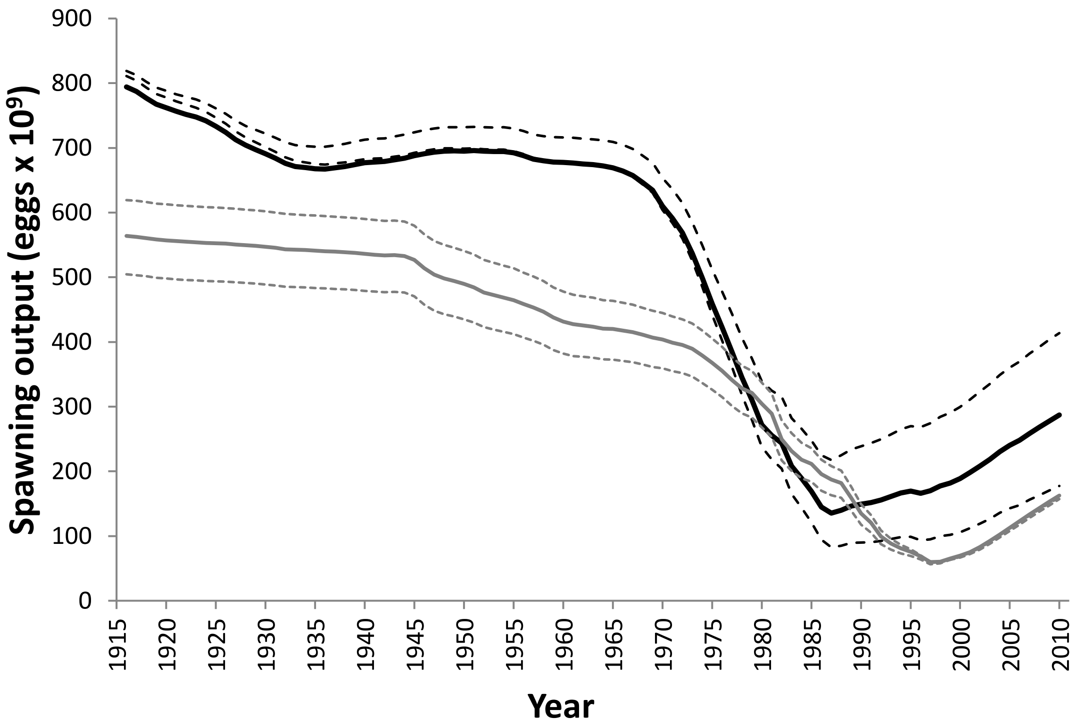

Figure ES3. Time series of estimated spawning output (1916-2010) for southern California (black lines) and northern California (grey lines). Solid lines = base case model; dashed lines = alternative states of nature.

Table ES2. Recent trends by region in spawning output (billions of larvae) and relative spawning output ("depletion", or percentage of unfished spawning output) for greenspotted rockfish, with alternative states of nature based on low and high values of the assumed natural mortality rate, M.

	Northern California				Southern California			
	Spawning Output		Depletion		Spawning Output		Depletion	
Year	**Base**	**(Low M, High M)**	**Base**	**(Low M, High M)**	**Base**	**(Low M, High M)**	**Base**	**(Low M, High M)**
2000	69.5	(66.9, 67.9)	12.3%	(10.8%, 13.5%)	189.0	(105.8, 299.6)	23.8%	(13%, 36.6%)
2001	75.3	(72, 73.9)	13.4%	(11.6%, 14.6%)	198.3	(112.3, 311.1)	25.0%	(13.8%, 38%)
2002	82.9	(79.1, 81.7)	14.7%	(12.8%, 16.2%)	208.2	(119.2, 323)	26.2%	(14.7%, 39.4%)
2003	92.3	(88, 91)	16.4%	(14.2%, 18%)	218.5	(126.7, 335.2)	27.5%	(15.6%, 40.9%)
2004	102.5	(97.8, 101.1)	18.2%	(15.8%, 20%)	230.4	(135.8, 349)	29.0%	(16.7%, 42.6%)
2005	112.7	(107.7, 111.2)	20.0%	(17.4%, 22%)	240.1	(142.8, 360.4)	30.2%	(17.6%, 44%)
2006	123.0	(117.7, 121.3)	21.8%	(19%, 24%)	247.9	(148, 369.7)	31.2%	(18.2%, 45.2%)
2007	133.3	(127.8, 131.4)	23.6%	(20.6%, 26%)	258.6	(156.1, 381.8)	32.6%	(19.2%, 46.6%)
2008	143.3	(137.6, 141.1)	25.4%	(22.2%, 28%)	268.1	(163.1, 392.6)	33.8%	(20.1%, 47.9%)
2009	153.2	(147.3, 150.6)	27.2%	(23.8%, 29.8%)	278.0	(170.6, 403.6)	35.0%	(21%, 49.3%)
2010	162.8	(156.9, 159.8)	28.9%	(25.3%, 31.7%)	287.1	(177.5, 413.8)	36.2%	(21.9%, 50.5%)

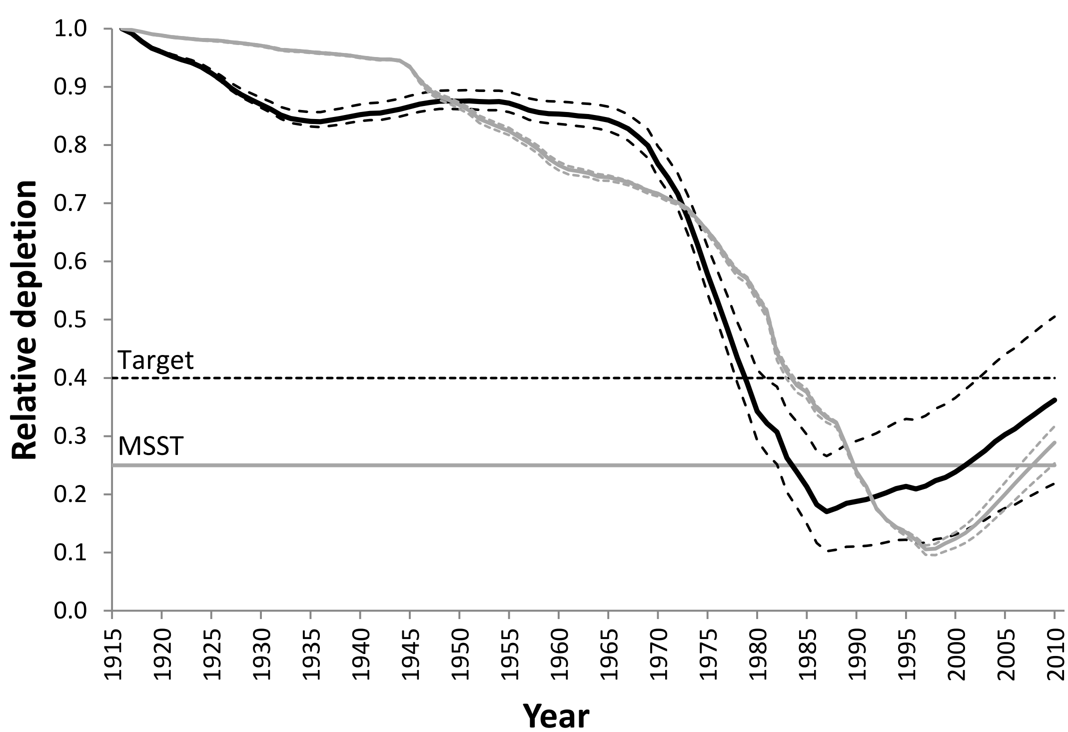

Figure ES4. Time series of estimated relative spawning output ("depletion") from 1916-2010. Grey lines represent base case model (solid line) and alternative states of nature (dashed lines) for northern California, and black lines represent southern California. The PFMC's minimum stock size threshold (MSST), 25% of unfished spawning output, and target level (40% of unfished) are shown for reference.

Table ES3. Integrated estimates of recent trends in spawning output (billions of larvae) and relative spawning output ("depletion", or percentage of unfished spawning output) for greenspotted rockfish, based on the sum of outputs from regional models.

	California (North + South)			
	Spawning Output		Depletion	
Year	**Base**	**(Low M, High M)**	**Base**	**(Low M, High M)**
2000	258.5	(172.7, 367.4)	19.0%	(12.1%, 27.8%)
2001	273.6	(184.3, 385)	20.2%	(12.9%, 29.1%)
2002	291.2	(198.4, 404.7)	21.4%	(13.9%, 30.6%)
2003	310.8	(214.7, 426.3)	22.9%	(15%, 32.2%)
2004	332.9	(233.6, 450.1)	24.5%	(16.3%, 34%)
2005	352.9	(250.5, 471.6)	26.0%	(17.5%, 35.6%)
2006	371.0	(265.7, 491)	27.3%	(18.6%, 37.1%)
2007	391.9	(283.8, 513.1)	28.9%	(19.8%, 38.8%)
2008	411.4	(300.7, 533.7)	30.3%	(21%, 40.3%)
2009	431.1	(317.9, 554.2)	31.8%	(22.2%, 41.9%)
2010	449.9	(334.4, 573.6)	33.1%	(23.4%, 43.3%)

Recruitment

Length and age composition data for greenspotted rockfish contain insufficient information to reliably resolve year-class strength. Both base models assume that recruitment follows a deterministic Beverton-Holt stock-recruitment relationship, so trends in recruitment reflect trends in estimated spawning output (Figure ES5, Table ES4).

Table ES4. Recent estimates of recruitment from the base models.

	Northern California		Southern California	
Year	**Base**	**(Low M, High M)**	**Base**	**(Low M, High M)**
2000	299.6	(223, 384.8)	619.3	(353.4, 999.9)
2001	309.3	(230.3, 397.3)	627.1	(361.6, 1007)
2002	320.8	(239.4, 411.7)	634.8	(369.9, 1013.9)
2003	333.3	(249.5, 427)	642.2	(378.1, 1020.6)
2004	345.0	(259.2, 441.1)	650.2	(387.3, 1027.6)
2005	355.3	(267.8, 453.4)	656.3	(393.8, 1033)
2006	364.5	(275.6, 464.3)	660.8	(398.4, 1037.3)
2007	372.6	(282.5, 473.8)	666.8	(405.1, 1042.5)
2008	379.7	(288.6, 482)	671.7	(410.6, 1047)
2009	385.9	(294, 489.2)	676.6	(416, 1051.4)
2010	391.4	(298.8, 495.6)	680.9	(420.7, 1055.2)

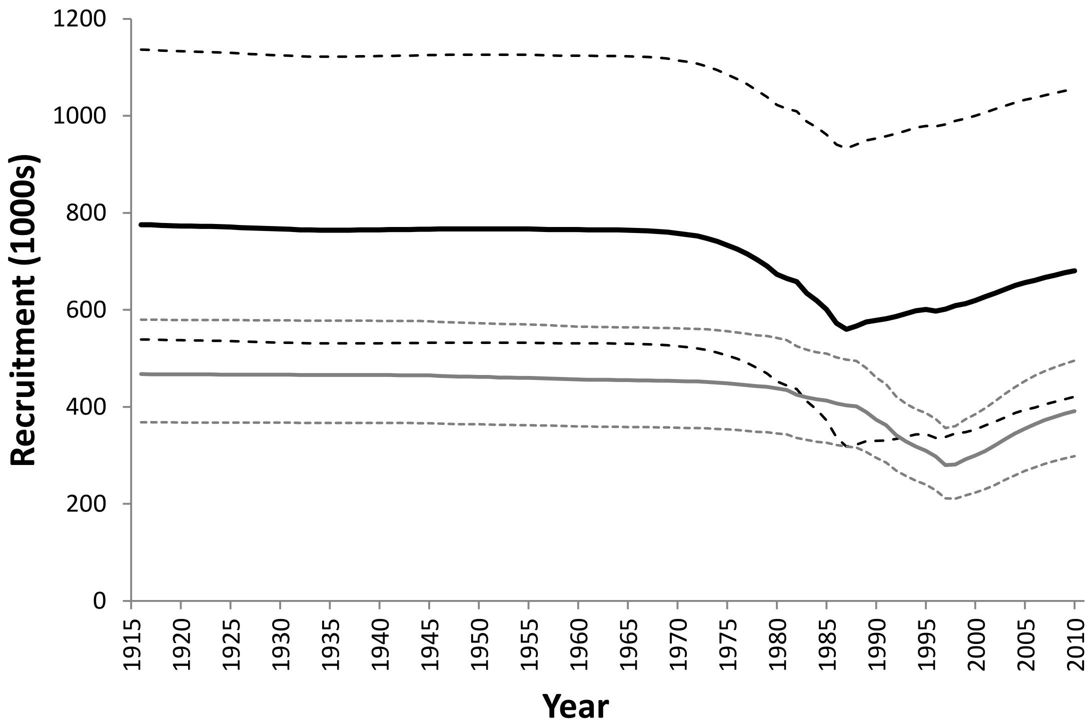

Figure ES5. Time series of recruitment from 1916-2010 for the base case models in northern and southern California. Black = southern California, grey = northern California.

Exploitation status

Historical harvest rates for greenspotted rockfish peaked in the mid-1980s in southern California, but continued to rise in northern California until about a decade later. SPR harvest rates exceeded the current proxy MSY value in northern California from 1973-2000, and from 1969-1998 in southern California (Figure ES6). Biomass in both regions is currently below target (<40% unfished spawning output), but above the MSST, and equilibrium SPR harvest rates have been below the proxy MSY level since 2001 in the north and since 1999 in the south. A summary of greenspotted rockfish exploitation histories for northern and southern California is provided as Figure ES7.

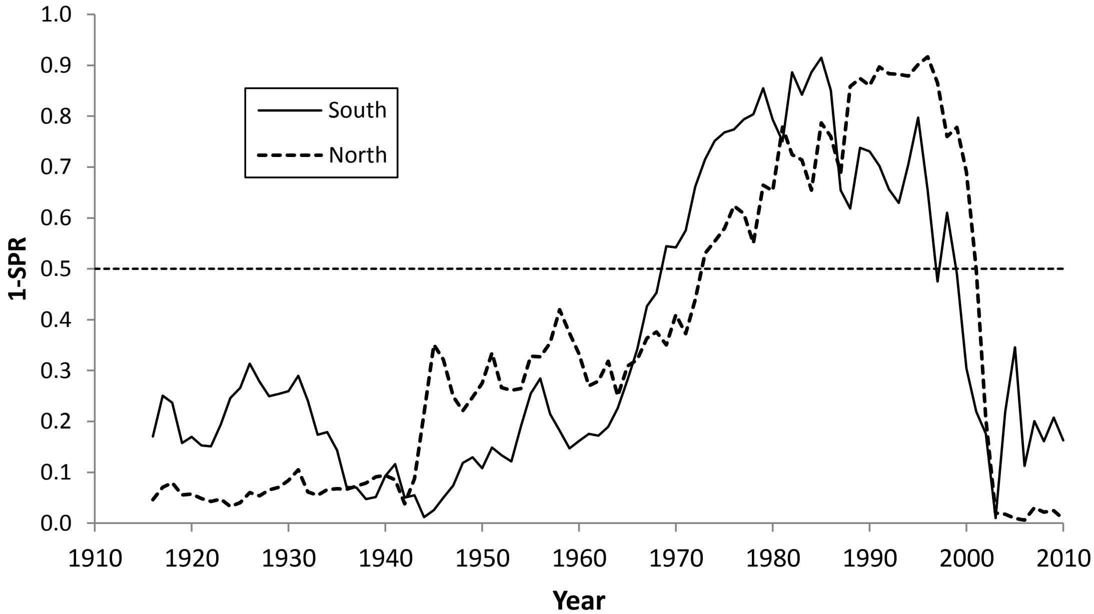

Figure ES6. Time series of estimated spawning potential ratios (SPR subtracted from 1 to emulate harvest rates) in northern and southern California. Values above 0.5 suggest harvest in excess of the current overfishing proxy.

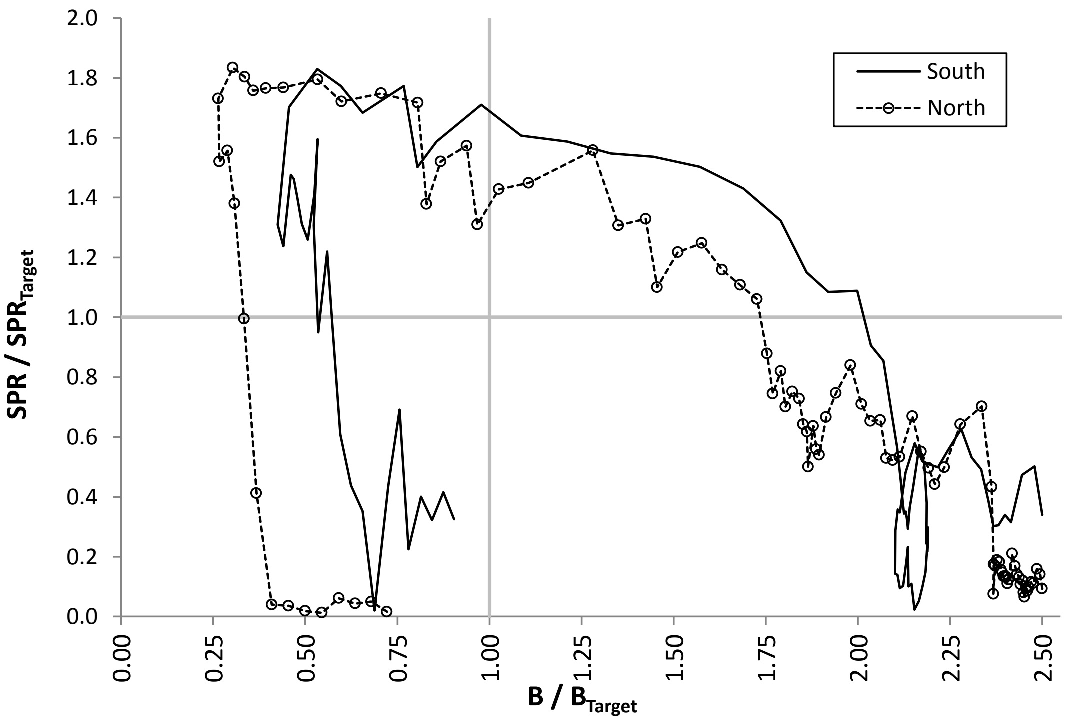

Figure ES7. Summary of greenspotted rockfish exploitation history in northern and southern California, relative to target harvest rate and biomass level.

Reference points

Estimated unfished spawning output south of Point Conception is about 40% larger than unfished spawning output in northern California. However, maximum sustainable yield based on the SPR proxy harvest rate for rockfish ($F_{SPR=50\%}$)is slightly larger in northern California (49 mt) than in the south (46 mt), in part due to faster individual growth rates in the north. Reference points for the northern and southern regions are presented in Tables ES5 and ES6, respectively. Integrated estimates (northern and southern regions combined) for biomass, spawning output, recruitment, depletion, and maximum sustainable yield are in Table ES7.

Table ES5. Reference points for the northern California base model and alternative states of nature.

Quantity	Northern Base Model	(Low M, High M)
Unfished total biomass (mt)	3160	(3383, 2920)
Unfished spawning output (SB_0, eggs x10^9)	564	(619, 505)
Unfished age 13+ biomass (mt)	2903	(3150, 2644)
Unfished recruitment (R_0, 1000s)	468	(368, 580)
Depletion (SB_{2011} / SB_0)	0.306	(0.269, 0.335)
Reference points based on SB$_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	226	(248, 202)
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.447	(0.447, 0.447)
Exploitation rate resulting in $SB_{40\%}$	0.040	(0.036, 0.046)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	53.1	(49.7, 55.5)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	258	(283, 231)
$SPR_{MSY\text{-}proxy}$	0.5	(0.5, 0.5)
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	0.034	(0.03, 0.038)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	49.4	(46.4, 51.6)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	134	(150, 117)
SPR_{MSY}	0.298	(0.302, 0.293)
Exploitation Rate corresponding to SPR_{MSY}	0.070	(0.061, 0.081)
MSY (mt)	58.8	(54.7, 61.9)

Table ES6. Reference points for the southern California base model and alternative states of nature.

Quantity	Southern Base Model	(Low M, High M)
Unfished total biomass (mt)	4331	(4190, 4705)
Unfished spawning output (SB_0, eggs x10^9)	794	(811, 819)
Unfished age 13+ biomass (mt)	3959	(3911, 4203)
Unfished recruitment (R_0, 1000s)	776	(539, 1137)
Depletion (SB_{2011} / SB_0)	0.374	(0.228, 0.518)
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	318	(324, 328)
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.447	(0.447, 0.447)
Exploitation rate resulting in $SB_{40\%}$	0.030	(0.024, 0.036)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	49.8	(40.3, 63.5)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	363	(371, 374)
$SPR_{MSY\text{-}proxy}$	0.5	(0.5, 0.5)
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	0.024	(0.02, 0.029)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	46.2	(37.4, 58.8)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	180	(187, 184)
SPR_{MSY}	0.288	(0.291, 0.286)
Exploitation Rate corresponding to SPR_{MSY}	0.057	(0.046, 0.071)
MSY (mt)	55.9	(45, 71.7)

Table ES7. Integrated reference points for California based on regional base models and alternative states of nature.

Quantity	Integrated Base Models	(Low M, High M)
Unfished total biomass (mt)	7491	(7574, 7625)
Unfished spawning output (SB_0, eggs x10^9)	1358	(1431, 1323)
Unfished age 13+ biomass (mt)	6862	(7061, 6847)
Unfished recruitment (R_0, 1000s)	1243	(908, 1717)
Depletion (SB_{2011} / SB_0)	0.345	(0.246, 0.448)
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	543	(572, 529)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	102.9	(90, 119.1)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	621	(654, 605)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	95.6	(83.8, 110.4)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	314	(337, 301)
MSY (mt)	114.7	(99.7, 133.6)

Management performance

It is difficult to evaluate management performance for greenspotted rockfish because landings are monitored in aggregate with other species in two shelf rockfish complexes, north and south of 40° 10′ N. lat. (species-specific catch limits are not assigned). Recent commercial landings have been at or below 1 mt in each region since implementation of RCAs in 2003, with recreational landings at similar levels in the north due to seasonal closures and depth restrictions. Recreational fisheries in the south account for the majority of recent landings, but total mortality appears to be sufficiently low as to pose little risk of overfishing. Trip limits for the southern shelf rockfish complex in waters south of 40° 10′ N. lat. are included in the main document.

Unresolved problems and major uncertainties

This assessment focuses on greenspotted rockfish found in U.S. waters off California, even though the range of the species extends into Mexican waters (to northern Baja California). The relationship between greenspotted found and harvested in the U.S. and in Mexico is unclear. It is not known what portion of greenspotted population resides in Mexican waters and what their biological and life history characteristics are.

As with most of the west coast rockfish species, catch history is one of the major sources of uncertainty, even with the California rockfish catch reconstruction by Ralston et al. (2010). An important component of uncertainty in historical landings is the fact that fishing effort exhibited a gradual shift towards deeper waters. Species composition sampling in Southern California began only in the late 1970s, and these compositions were applied to historical landings of multi-species market categories. Therefore, there is the potential to overestimate the historical contribution of slope species (e.g. blackgill) to landings in mixed-species market categories (e.g. unspecified rockfish) and to underestimate the contribution of nearshore and possibly shelf species such as greenspotted rockfish.

Reliable fishery-independent information is essential for any stock assessment. Surveys on the U.S. west coast commonly exclude the Cowcod Conservation Areas (CCAs) from the study area. This practice limits effective utilization of survey data and reduces the ability to accurately describe dynamics of the species.

This assessment treats the resource as two separate stocks, geographically stratified south and north of Point Conception with no linkage between the two areas. The break point between stocks was selected based on differences in regional exploitation history and general biogeographic considerations, as well as evidence of differences in growth and maturity. Further study is needed to validate regional differences in biological parameters for this species. Given the lack of information on greenspotted population genetics, uncertainty regarding stock structure of greenspotted rockfish remains, with the possibility that only one genetic stock exists with a gradual cline in life history parameters, as is observed in other rockfish species on the U.S. west coast. However, relatively small amounts of migration or dispersal are needed to maintain genetic homogeneity. Long-lived, slow growing, and sedentary species such as greenspotted rockfish are particularly susceptible to localized depletion. Regional differences in exploitation history and biological traits can result in demographic independence of local stocks, even in the absence of clear genetic differentiation, with important implications for management (Waples et al., 2008).

Decision tables

Decision tables describe the effect of different management actions on harvested populations given alternative states of nature. We examine the effect of three actions (low/medium/high catches) on spawning output and depletion, given three possible natural mortality rates for greenspotted rockfish (Tables ES8, ES9). During the STAR panel, the natural mortality rate (*M*) was identified as the major axis of uncertainty. The panel recommended a 'low' catch stream equal to average catch from 2009-2010, 'medium' catches based on application of the PFMC's default harvest control rule (the "40-10" rule) to base model predictions, and 'high' catches based on the constant, MSY proxy harvest rate (OFL catch stream from the base model). Since species-specific catch targets are not defined for greenspotted rockfish, catches by fleet in 2011 and 2012 were fixed at the average catch from 2009-2010. These years were chosen as representative of expected short-term fleet behavior given current commercial and recreational regulations (Appendix A). A decision table based on simple summation of regional catches and spawning outputs is provided as Table ES10.

Table ES8: Decision table for greenspotted rockfish in northern California (Point Conception to the California-Oregon border).

			State of nature					
			M = 0.056		Base Case: M = 0.065		M = 0.074	
Management decision	Year	Catch (mt)	Depletion	Spawning output	Depletion	Spawning output	Depletion	Spawning output
Constant catch based on 2009-2010 average catch	2011	0.7	27%	166	31%	172	33%	169
	2012	0.7	28%	176	32%	181	35%	178
	2013	0.7	30%	185	34%	190	37%	186
	2014	0.7	31%	193	35%	199	39%	194
	2015	0.7	33%	202	37%	208	40%	202
	2016	0.7	34%	211	38%	216	42%	210
	2017	0.7	35%	219	40%	224	43%	218
	2018	0.7	37%	227	41%	232	45%	226
	2019	0.7	38%	236	43%	241	46%	233
	2020	0.7	39%	244	44%	249	48%	241
	2021	0.7	41%	252	45%	256	49%	248
	2022	0.7	42%	260	47%	264	51%	255
40-10 adjusted catch with fleet allocations based on average 2009-2010 catch	2011	0.7	27%	166	31%	172	33%	169
	2012	0.7	28%	176	32%	181	35%	178
	2013	39.6	30%	185	34%	190	37%	186
	2014	39.8	30%	187	34%	193	37%	188
	2015	39.9	31%	189	35%	195	38%	190
	2016	39.9	31%	191	35%	196	38%	191
	2017	39.8	31%	192	35%	198	38%	193
	2018	39.7	31%	193	35%	199	38%	194
	2019	39.7	31%	195	36%	201	39%	195
	2020	39.6	32%	196	36%	202	39%	196
	2021	39.6	32%	197	36%	203	39%	197
	2022	39.7	32%	198	36%	205	39%	198
Constant harvest rate (OFL catch) with fleet allocations based on average 2009-2010 catch	2011	0.7	27%	166	31%	172	33%	169
	2012	0.7	28%	176	32%	181	35%	178
	2013	42.2	30%	185	34%	190	37%	186
	2014	42.1	30%	187	34%	192	37%	188
	2015	41.9	30%	188	34%	194	37%	189
	2016	41.7	31%	189	35%	195	38%	190
	2017	41.4	31%	191	35%	196	38%	191
	2018	41.2	31%	192	35%	198	38%	192
	2019	40.9	31%	193	35%	199	38%	193
	2020	40.8	31%	194	35%	200	38%	194
	2021	40.7	31%	195	36%	201	39%	195
	2022	40.6	32%	196	36%	202	39%	196

Table ES9: Decision table for greenspotted rockfish in southern California (Point Conception to the U.S.-Mexico border).

			State of nature					
			M = 0.056		Base Case: M = 0.065		M = 0.074	
Management decision	Year	Catch (mt)	Depletion	Spawning output	Depletion	Spawning output	Depletion	Spawning output
Constant catch based on 2009-2010 average catch	2011	13.0	23%	185	37%	297	52%	424
	2012	13.0	24%	192	39%	306	53%	434
	2013	13.0	25%	199	40%	315	54%	444
	2014	13.0	25%	206	41%	324	55%	454
	2015	13.0	26%	214	42%	333	57%	463
	2016	13.0	27%	221	43%	342	58%	472
	2017	13.0	28%	228	44%	351	59%	481
	2018	13.0	29%	235	45%	359	60%	490
	2019	13.0	30%	242	46%	368	61%	498
	2020	13.0	31%	250	47%	376	62%	506
	2021	13.0	32%	257	48%	384	63%	514
	2022	13.0	33%	264	49%	392	64%	522
40-10 adjusted catch with fleet allocations based on average 2009-2010 catch	2011	13.0	23%	185	37%	297	52%	424
	2012	13.0	24%	192	39%	306	53%	434
	2013	47.3	25%	199	40%	315	54%	444
	2014	46.9	25%	200	40%	318	55%	448
	2015	46.4	25%	201	40%	321	55%	451
	2016	46.0	25%	202	41%	324	55%	454
	2017	45.6	25%	203	41%	326	56%	457
	2018	45.3	25%	203	41%	328	56%	460
	2019	45.0	25%	203	42%	330	56%	462
	2020	44.8	25%	204	42%	332	57%	464
	2021	44.6	25%	204	42%	334	57%	466
	2022	44.5	25%	204	42%	335	57%	468
Constant harvest rate (OFL catch) with fleet allocations based on average 2009-2010 catch	2011	13.0	23%	185	37%	297	52%	424
	2012	13.0	24%	192	39%	306	53%	434
	2013	47.5	25%	199	40%	315	54%	444
	2014	46.9	25%	200	40%	318	55%	448
	2015	46.4	25%	201	40%	321	55%	451
	2016	46.0	25%	202	41%	324	55%	454
	2017	45.6	25%	203	41%	326	56%	457
	2018	45.3	25%	203	41%	328	56%	460
	2019	45.0	25%	203	42%	330	56%	462
	2020	44.8	25%	204	42%	332	57%	464
	2021	44.6	25%	204	42%	334	57%	466
	2022	44.5	25%	204	42%	335	57%	468

Table ES10: Statewide decision table for greenspotted rockfish based on summation of regional catches and spawning outputs. Depletion for each state of nature is estimated as the sum of regional spawning outputs in each year, divided by the sum of regional unfished spawning outputs.

			State of nature					
			M = 0.056		Base Case: M = 0.065		M = 0.074	
Management decision	Year	Catch (mt)	Depletion	Spawning output	Depletion	Spawning output	Depletion	Spawning output
Constant catch based on the sum of regional 2009-2010 average catches	2011	13.7	25%	351	35%	469	45%	593
	2012	13.7	26%	368	36%	487	46%	612
	2013	13.7	27%	384	37%	505	48%	630
	2014	13.7	28%	400	39%	523	49%	648
	2015	13.7	29%	416	40%	541	50%	665
	2016	13.7	30%	431	41%	558	52%	682
	2017	13.7	31%	447	42%	575	53%	699
	2018	13.7	32%	463	44%	592	54%	715
	2019	13.7	33%	478	45%	608	55%	731
	2020	13.7	34%	493	46%	624	56%	747
	2021	13.7	36%	509	47%	641	58%	762
	2022	13.7	37%	524	48%	657	59%	777
Sum of regional 40-10 adjusted catch with fleet allocations based on average 2009-2010 catch	2011	13.7	25%	351	35%	469	45%	593
	2012	13.7	26%	368	36%	487	46%	612
	2013	87.0	27%	384	37%	505	48%	630
	2014	86.8	27%	387	38%	511	48%	636
	2015	86.3	27%	390	38%	516	48%	641
	2016	85.9	27%	393	38%	520	49%	645
	2017	85.4	28%	395	39%	524	49%	649
	2018	85.0	28%	396	39%	527	49%	653
	2019	84.7	28%	398	39%	531	50%	657
	2020	84.4	28%	400	39%	534	50%	660
	2021	84.3	28%	401	40%	537	50%	663
	2022	84.3	28%	403	40%	540	50%	666
Constant harvest rate (sum of OFL catches) with fleet allocations based on average 2009-2010 catch	2011	13.7	25%	351	35%	469	45%	593
	2012	13.7	26%	368	36%	487	46%	612
	2013	89.6	27%	384	37%	505	48%	630
	2014	89.0	27%	387	38%	510	48%	636
	2015	88.3	27%	389	38%	515	48%	640
	2016	87.7	27%	391	38%	519	49%	644
	2017	87.0	27%	393	38%	522	49%	648
	2018	86.4	28%	395	39%	526	49%	652
	2019	86.0	28%	396	39%	529	49%	655
	2020	85.6	28%	397	39%	532	50%	658
	2021	85.3	28%	399	39%	535	50%	661
	2022	85.2	28%	400	40%	537	50%	664

Research and data needs

There is considerable uncertainty regarding the portion of greenspotted population residing in Mexico. It is possible that alternative sources of information (i.e. studies conducted at Universities in Mexico) could yield information on biology, life history and exploitation of greenspotted rockfish south of the U.S.-Mexico border.

Uncertainty in historical catch should be further evaluated through development of alternative historical catch streams reflecting differences in data quantity and quality available for different time periods. Existing reconstruction efforts focus entirely on historical landings, although discard has been a significant portion of removals for many species on the U.S. west coast. Coordinated reconstruction efforts for historical discard are also recommended.

Monitoring of relative or absolute abundance in the CCAs is a key research priority. Submersible or other non-invasive survey methods could potentially provide additional information on habitat and abundance for this species. Also, it is important to develop alternative methods to monitor length and age compositions of fish inside the CCAs.

The available data were limited (especially for the southern region) to reliably estimate growth, therefore, ageing the remaining available otoliths should be a priority. Careful consideration should be devoted to producing exactly the age data which would be of most direct benefit to the assessment, since expertise, time and funds are all limited. Further development of ageing criteria for greenspotted rockfish is recommended, along with estimation of among-reader ageing error.

Further exploration of stock structure and spatial variability of life history parameters of greenspotted rockfish is recommended. Alternative assumptions about stock structure should be explored for the next assessment.

1. Introduction

1.1 Distribution and Stock Structure

Greenspotted rockfish, *Sebastes chlorostictus* (Jordan and Gilbert 1880), also known as "chinafish," "bosco," "starry-eye" and "chucklehead," are found in waters off the west coast of North America, ranging from Copalis Head, Washington to Isla Cedros, Baja California (approximately 25° to 47° North latitude). Abundance of this species is greatest from northern Baja California to Mendocino County in California. Greenspotted rockfish associate with several benthic habitat types between depths of 30-363 meters (m), although adults are most common between 60 and 240 m (Love et al., 2002).

This is the first assessment of greenspotted rockfish prepared for the Pacific Fisheries Management Council (PFMC). Although no genetic information is available regarding stock structure for this species, we define two separate stocks based on evidence of differences in growth, exploitation history, and a well-established marine biogeographic boundary (Point Conception, 34° 27' North latitude), modeling each as an independent stock. For purposes of this assessment, we define northern California as U.S. waters between the California-Oregon border (42° North latitude) and Point Conception, and southern California as U.S. waters south of Point Conception and north of the U.S.-Mexico border (Figure 1).

1.2 Life History and Ecosystem Interactions

Greenspotted rockfish are a long-lived and slow growing species, with sedentary adults associating with a wide variety of benthic habitats. Maximum reported age is 51 years (Benet et al., 2009). Estimates of maximum length for greenspotted rockfish are in the vicinity of 50 cm. Benet et al. report maximum fork length as 48 cm for central California. Miller and Gotshall (1965) report 51 cm total length for the same area, but did not attempt to distinguish between greenspotted rockfish and pink rockfish (*Sebastes eos*) which grow to 56 cm (Love et al., 2002). Commercial port samplers in California have reported individuals larger than 50 cm fork length (up to 57 cm), although fish of this size appear to be rare (CALCOM, 2011). In southern California, Love et al. (1990) report maximum length as 50 cm total length. Sexual dimorphism is not apparent in greenspotted rockfish (Lenarz and Echeverria, 1991; Mason, 1998; Benet et al., 2009), although latitudinal differences in weight-at-length, length-at-age, and size-at-maturity have been observed (details in Data section).

Sebastes reproduction is characterized by internal fertilization, release of live larvae (parturition), and an extended pelagic juvenile stage (Love et al., 2002). The duration of the pelagic stage is unknown for greenspotted rockfish, and no information is available on temporal and spatial patterns in recruitment. This is due, in part, to challenges associated with identification of pelagic juveniles, particularly members of the subgenus *Sebastomus*, which includes greenspotted rockfish (Benet et al., 2009).

Seasonal maturation and size at maturity vary with latitude, a trend commonly seen in rockfishes (Love et al., 1990; Benet et al., 2009). In central and northern California, spawning months have been reported from March to September, with peak parturition from April to June (Wyllie Echeverria, 1987; Benet et al., 2009). In southern California spawning months begin in February and extend through July, with peak parturition in April (Love et al., 1990). Benet et al. estimate length at 50% maturity for female greenspotted as 26 cm, consistent with a previous estimate of 27 cm (Wyllie Echeverria, 1987) based on females from the same area. In southern California, Love et al. (1990) report length at 50% maturity as 22 cm (converted to fork length from total length). Love et al. detected evidence of multiple broods in females from southern California (ovaries containing eyed larvae and large numbers of fertilized or unfertilized eggs). No evidence of multiple broods was found in studies of greenspotted rockfish north of Point Conception (Wyllie Echeverria, 1987; Benet et al., 2009).

Several studies have reported on habitat associations for greenspotted rockfish. Yoklavich et al. (2000) quantified deep, rocky habitat in Monterey Bay. They observed smaller greenspotted rockfish in shallow depths (75-174 m), and reported strong associations with heterogeneous habitats (cobble-mud, mud-boulder, rock-mud, and rock-ridge). Laidig et al. (2009) studied habitat associations of demersal fishes from a manned submersible in central California, observing 809 greenspotted rockfish. They mainly encountered immature individuals (86% of greenspotted were <25 cm), identifying positive associations with all habitat types (boulder, brachiopod beds, cobble) other than mud. The predominance of juvenile rockfish in the study area suggests that the areas and depths surveyed may be nursery grounds for juvenile rockfish and/or transitional zones as individuals move toward adult habitats (Laidig et al., 2009). Juvenile greenspotted rockfish are commonly seen in traps targeting spot prawn in Monterey Bay, usually in low-relief habitats (pers. obs.).

Adult greenspotted rockfish are generally sedentary, and associate with a wide range of habitat types. Yoklavich et al. (2000) observed 426 greenspotted rockfish (fourth highest abundance of observed species) in Monterey Bay, noting that adults were common near rocky outcrops, ridges, caves, and overhangs. Anderson et al. (2009) described greenspotted rockfish as characteristic of transition zones between hard and soft sediments, based on *in situ* observations across Cordell Bank in central California. They classified habitat for greenspotted rockfish over a range of spatial scales. At the finest scale (1-10s of m), greenspotted were found to have weak associations with four of five possible categories: mud, boulders, cobbles, and rock (sand being the fifth category). At intermediate scales (10-100s of m) Anderson et al. characterized greenspotted habitat as depths between 100-300m and soft and mixed sediment types.

Movements of greenspotted rockfish have been monitored using acoustic tagging experiments. Starr et al. (2002) implanted acoustic tags in six adults in Monterey Bay, finding that adults exhibit limited horizontal movement and almost no vertical movement. They also identified two movement patterns. In the first pattern, 94% of time was spent within a 0.58 km^2 area. The second pattern involved larger movements, with excursions up to 3 km, but 60% of time was spent within the 1.6

km^2 study area. Lowe et al. (2009) monitored 4 adult greenspotted rockfish near oil platforms in southern California using acoustic tags. Probabilities of detection near the release sites dropped by 14% in one year of monitoring. Two individuals returned to their release sites after a 7-month absence.

Williams and Ralston (2002) studied the distribution and co-occurrence of rockfishes over continental shelf and slope habitats using fishery-independent trawl survey data. Greenspotted rockfish were consistently caught (>80% co-occurrence) with bocaccio (*S. paucispinis*), chilipepper (*S. goodei*), stripetail (*S. saxicola*), and shortbelly (*S. jordani*) rockfish. Williams and Ralston proposed species assemblages for management purposes, including greenspotted in a "southern shelf" assemblage along with bocaccio, chilipepper, shortbelly, stripetail, greenstriped, and cowcod. Since greenspotted rockfish is not a primary target of commercial fisheries, its association with other desirable shelf rockfish species (e.g. bocaccio and chilipepper) is likely a driving force behind historical exploitation of this species.

Molecular systematic studies (Hyde and Vetter, 2007) report that greenspotted rockfish are closely related to pink rockfish (*S. eos*) and greenblotched rockfish (*S. rosenblatti*). Greenspotted rockfish can be distinguished from pink and greenblotched rockfishes by a smooth lower jaw, lacking scales found on the lower mandibles of the other two species (Love et al., 2002).

1.3 Historical and Current Fisheries

Greenspotted rockfish have been caught by both commercial and recreational fisheries in northern and southern California. Recreational landings are negligible in Oregon, and commercial landings amount to less than 3% of the coast wide catch from 1969-2010 (PacFIN, 2011; V. Gertseva, pers. comm; Figure 2). Due to the small amount of catch from Oregon and a lack of reliable trend information from the area, we limit this assessment to U.S. waters off California.

Among rockfishes landed in California, greenspotted rockfish ranks 7th in commercial landings from 1980-2009 in southern California (Figure 3) and 12th in northern California (Figure 4). Among the rockfish species that are managed by the PFMC and that have not previously been assessed, greenspotted rockfish ranks first in commercial landings in both southern and northern California. Annual commercial landings peaked at 162 mt in southern California in 1977, and 186 mt in northern California for 1981 (CALCOM, 2011). Implementation of Rockfish Conservation Areas (RCAs) coast wide, and the Cowcod Conservation Areas (CCAs) in southern California, has reduced commercial landings of greenspotted rockfish in northern and southern California to less than 1 mt per region per year since 2003 (CALCOM, 2011).

Onboard surveys of Commercial Passenger Fishing Vessels (CPFVs) in southern California ranked greenspotted rockfish 7th among all rockfish species in terms of total catch (Collins and Crooke, unpublished manuscript). Ally et al. (1991) conducted a similar onboard CPFV study from 1985-1987, finding that greenspotted rockfish ranked 4th in total catch based on their estimates for southern California. Annual recreational landings peaked in the south in 1985 at 154 mt, and in the north in 1985 at 73 mt (RecFIN, 2011). Recreational depth restrictions in northern California since 2002 have reduced catch to less than 1 mt per year. Almost all recent landings of greenspotted rockfish are from the southern California recreational fishery, ranging from 7 to 25 mt per year from 2004-2010, with an average of 13 mt per year (RecFIN). Given the depth distribution of this species, greenspotted rockfish are almost never observed in recreational fisheries other than the CPFV and Private/Rental boat modes.

Total landings of greenspotted rockfish (commercial and recreational combined) peaked earlier in southern California relative to areas north of Point Conception (Figure 5).Southern California landings declined in the mid-1980s from approximately 200-250 mt per year to 50-100 mt per year. Landings in northern California rose after WWII, climbed steadily in the 1970s, peaked in the 1980s, then declined in the mid-1990s. Landings after 2003 have been minimal in northern California (typically <1 mt per year) due to management restrictions aimed at rebuilding overfished species.

Populations of several *Sebastes* species off the west coast of North America have experienced severe declines in abundance due to a combination of over-exploitation and poor reproductive success (Ralston 1998, Ralston 2002). Fisheries and survey data from both northern and southern California show evidence of declines in mean length over time for greenspotted rockfish (Figure 6, Figure 7) (Pearson and Ralston 1990, Ralston et al. 1990).

Previous publications have reported evidence of declining mean length (Mason, 1998; Benet et al., 2009) and catch-per-unit-effort (CPUE) (Love et al., 1998) for greenspotted rockfish in California. A reduction in mean length is consistent with the selective removal of large, older individuals that characterizes most fisheries (Beverton and Holt, 1956), although similar patterns may result from changes in recruitment, growth, or fishing practices.

1.4 Management History and Performance

Greenspotted rockfish are not usually a primary target of commercial or recreational fisheries. Regulations affecting this species are typically intended to alter fishing mortality of primary targets and/or overfished species. For example, implementation of RCAs statewide and CCAs in southern California has greatly reduced fishing mortality for greenspotted rockfish in the past decade.

Landings of greenspotted rockfish are currently aggregated into two minor shelf rockfish complexes, north and south of 40° 10′ N. latitude (Table 1; PFMC, 2010). Management performance for greenspotted rockfish is unknown, as total mortalities for species in complexes are not monitored on a species-specific basis. Landing limits of minor shelf rockfish for 2000-2010 in the limited entry (LE) trawl fishery, LE fixed-gear fishery, and open access (OA) fishery south of 40° 10′ N. lat. are provided as Table 2, Table 3, and Table 4, respectively.

Histories of commercial regulations (configurations of commercial trawl and non-trawl RCAs) likely to affect greenspotted rockfish are provided in Appendix A. A history of recreational groundfish regulations in California since 2000 is available online from CDFG ("recreghistory.pdf;" http://www.dfg.ca.gov/marine/groundfishcentral/index.asp), and was provided as a supplement to the assessment for review purposes.

1.5 Fisheries in Mexico

Abundance and catch of greenspotted rockfish ("Rocote Verde") in Mexico is unknown. Although adults are typically sedentary, the magnitude and consistency of larval transport across the U.S./Mexico border is unknown. This assessment assumes that fish in U.S. waters are an isolated population.

2. Data

2.1 Data from Commercial Fisheries

2.1.1 Recent Commercial Landings (1969-2010)

Commercial landings of greenspotted rockfish in California from 1969-2010 were downloaded from the CALCOM database (extraction date June 7, 2011). CALCOM contains landings estimates stratified by year, quarter, port complex, gear group, market category, and live/non-live status. The majority of commercially-caught greenspotted rockfish were taken by trawl, net, and hook-and-line gears (Table 5, Table 6). A small amount of landings, reported as caught by midwater trawl gear (<4 mt, all years combined), were combined with bottom trawl landings. Landings by other miscellaneous gear types (<1 mt) were combined with hook and line gear.

Estimated landings in northern California by hook and line gears in 1991 were large and inconsistent with adjacent years (Pearson et al., 2008). An analysis of the underlying sample data showed that high estimates of greenspotted rockfish landings in Crescent City, Eureka, and Fort Bragg in 1991 could be attributed to a single vessel that sorted its catch in an unusual way. In Fort Bragg, a hook and line fisherman sorted his landings by species, but used the same market category (250 - unspecified rockfish). As a result, port samples taken from this market category were not representative of the stratum as a whole. Since market category 250 is heavily used, the estimates of greenspotted rockfish landings were inflated by the catch estimation procedure. Further compounding this problem was the fact that corresponding strata in Eureka and Crescent City were not sampled, and these port complexes borrowed species compositions information from Fort Bragg. Revised estimates of hook and line species compositions for the Fort Bragg, Crescent City, and Eureka port complexes were produced based on samples from 1991 for market categories other than 250, and samples from 1992 for market category 250.

Trawl gears have dominated the commercial landings of greenspotted rockfish in northern California, except in the late 1980s and early 1990s when hook-and-line gear contributed a significant fraction to the total landings (Figure 8). Trawl landings in southern California increased suddenly in 1969 (Figure 9). Prior to 1968 it was illegal to process a trawl net south of Ventura county (Frey, 1971). Vessels using trawl gear made the majority of commercial landings during the 1970s, but were largely replaced by line gear until catch of greenspotted rockfish dropped with implementation of the CCAs and RCAs in 2001 and 2003, respectively. The spatial and temporal distribution of greenspotted landings differs by gear type (Figure 10, Figure 11, Figure 12). In southern California, the majority of the catch was landed within the Santa Barbara port complex, followed by Los Angeles, with a relatively small component of catch landed in San Diego, mostly by net gear. In northern California, the majority of trawl landings were north of San Francisco, whereas hook and line landings were spread among several ports complexes. Landings by net gear north of Point Conception were small relative to trawl and line gears in the area, and mostly limited to port complexes south of Bodega Bay.

Although a market category for greenspotted rockfish exists (market category number 255), the majority of greenspotted landings have been in group market categories such as “unspecified rockfish” (250) and “group reds” (959). However, a study of the reliability of California’s groundfish landings concluded that estimates for greenspotted rockfish are reliable since *S. chlorostictus* is a common species and is easily identifiable (Pearson et al., 2008). Possible misidentification with similar, but relatively rare, species (e.g. *S. rosenblatti*) was not considered to be an issue for landings estimates.

Due to the common name “chinafish,” greenspotted rockfish are sometimes landed in the market category for China rockfish (*S. nebulosus*). It is likely that large landings of China rockfish by trawl gears are actually greenspotted rockfish (Pearson et al., 2008). Although expansion of commercial landings based on rockfish species compositions accounts for the majority of this issue, an examination of species compositions from commercial port sampler data confirmed that some landings classified as china rockfish were, in fact, greenspotted rockfish. Nominal annual landings of trawl-caught china rockfish (141 mt in northern California, all years combined) were added to CALCOM estimates of greenspotted landings between the years 1969-2003.

2.1.2 Historical Commercial Catch Reconstruction

Ralston et al. (2010) reconstructed commercial rockfish landings for California from 1916-1968, and recreational landings from 1928-1980. We adopt these time series of reconstructed landings, with minor adjustments (redefining the boundary between northern and southern California for commercial landings at Point Conception, rather than the border of the Conception and Monterey INPFC areas). This data set extends the modeled time period back to 1916 for both the northern and southern stocks (Table 5, Table 6, Figure 5). We provide an electronic copy of Ralston et al. (2010) as supporting material to the assessment.

Miller and Hardwick (1973) report on unmarketable rockfish landed as animal food in California ports. For one port (Morro Bay), greenspotted rockfish is listed as one of three principle rockfish species in the animal food market category. However, Miller and Hardwick did not provide information on the overall species composition of the animal food market category (e.g. percent flatfish vs. rockfish). Heimann et al. (1968) provided data on species composition of the animal food market category in 1966 for all California ports combined, and rockfish were 15% of the landings by weight. Approximately 317,000 pounds of fish were landed as animal food in Morro Bay in 1966. If we assume that 15% of this was rockfish, and one third of the rockfish were greenspotted (a high estimate, but useful for illustration purposes), then approximately 18,500 pounds (8.4 mt) of greenspotted were landed as animal food in Morro Bay in 1966. If we also assume that 1966 is an average year, a decade of animal food landings would result in approximately 84 mt of greenspotted rockfish landed as animal food in Morro Bay. Since this estimate (which we believe is biased high) still amounts to only 3% of historical trawl landings in northern California, we did not account for landings of greenspotted rockfish as animal food in this assessment. We acknowledge that this assumption slightly underestimates total landings, and recommend further research on the extent of greenspotted landings in the animal food fishery.

2.1.3 Discards in Commercial Fisheries

Historical estimates of the amount of greenspotted rockfish caught and discarded by commercial fleets are infrequent and based on small sample sizes. A nine-month study of trawl catch composition in the Monterey Bay area reported retained and discarded catch of greenspotted rockfish by depth stratum (Heimann, 1963). A total of 16 trips (33 tows) were observed between March and November 1960, with 9 tows catching greenspotted rockfish (41 lbs. total). Catch- and effort-weighted estimates of discard ratios (retained/total catch) based on data from this study are 6% and 9%, respectively (Table 7). Heimann noted that greenspotted rockfish were most often grouped with species such as canary, blackgill, cowcod, vermilion, and yellowtail rockfish, but added that “a few small specimens were discarded.” Pikitch et al. (1988) estimated discard rates for the commercial trawl fleet in Oregon. In 1986 and 1987, onboard observers documented that 186 lbs. of greenspotted rockfish were caught in 8 hauls made during three trips targeting bottom rockfish with roller gear. All greenspotted rockfish were retained.

Recent information on discards (2002-2010) of greenspotted rockfish was provided by the West Coast Groundfish Observer Program (WCGOP). Data were stratified by year, gear, and two latitudinal regions: 1) south of Point Conception and 2) Point Conception to the California-Oregon border. Very few discarded greenspotted rockfish were measured for length (14 fish total from 2002-2009). Average weights of discarded fish based on sufficient sample sizes (>10 fish) were available for the Limited Entry (LE) trawl fleet north of Point Conception, as well as the hook and line fleet in some years (Table 8).

The WCGOP's estimated annual discard ratios for the LE trawl fleet were variable and often quite high, ranging from 37% to 100% (discard / total catch; Table 9). This information is not consistent with the historical estimates provided by either Heimann (1963) or Pikitch et al. (1988), although these studies were also based on small sample sizes. Closer examination of WCGOP's best estimates of target species for hauls encountering greenspotted rockfish suggests that over 95% of hauls used to estimate discard for this species were targeting species that typically occur on the fringes of greenspotted rockfish habitat (Dover sole, thornyheads, sablefish, "nearshore mix," petrale sole, and California halibut). Targeting information in the WCGOP data is often taken from logbooks and has not been validated, but it is the best available information. WCGOP discard ratios for the trawl fleet were not used in the assessment because 1) current fleet behavior does not appear to be representative of historical trawl activity due to spatial closures, and 2) trawl landings of greenspotted since 2003 have been negligible (<1 mt per year). Insufficient data are available to reliably estimate discard internally in assessment model. We assume a trawl discard ratio (discard/retained) equal to 0.06 for the base models, based on the data from Heimann (1963).

In the absence of other information about discard in hook and line fisheries, we apply discard ratios (sum of discard/sum of retained) based on 2002-2010 WCGOP data to recent and historical landings from line gears (0.16 for the north and 0.04 for the south). No discard ratios were available for net gears, so we assume net discard ratios are equal to the WCGOP ratios for hook and line gears. Given the depth distribution of greenspotted rockfish, we assume 100% discard mortality.

Total catch estimates (retained plus discarded catch) of greenspotted rockfish in northern and southern California are provided in Table 10 and Table 11.

2.1.4 Foreign Catch

Rogers (2003) estimated rockfish catch by foreign vessels off the West Coast of the United States from 1965-76. She estimated that 46 mt of greenspotted rockfish were caught between 1966 and 1973 (9, 26, 7, and 4 mt in 1966, 1967, 1968, and 1973, respectively).

2.1.5 Biological Sampling of Commercial Fisheries

Commercial length composition data for greenspotted rockfish show a truncation of population size structure in both northern and southern California, but contain little visual confirmation of strong year classes (Figure 13 through Figure 18). Estimates of recruitment deviations based on these data are unlikely to represent true year-class strength for this species. However, changes in length composition over time appear to provide adequate information to inform stock status (see base model results). Aggregated data (all years combined) for each fishery suggest differences in length composition of the catch among regions as well as among gear types (Figure 19, Figure 20) for greenspotted rockfish.

Commercial length composition data used in the assessment were downloaded from the CALCOM database (CALCOM, 2011). Numbers at length were expanded from port samples, weighted by landings in each stratum. Sample and fish counts by region and gear (Table 12) represent the number of sampled fish used in the expansions. The actual number of fish measured is higher since the expansion algorithm requires that a minimum of 10 fish be measured. The number of samples does not equal the number of trips, because greenspotted rockfish can be landed in multiple market categories from the same trip.

It is widely recognized that individual fish measured within a sample are not statistically independent of one another, i.e., fish of similar size tend to be caught together. Hence, it is unrealistic to use the number of fish as the sample size when computing variance estimates for length-frequency data that will be modeled using a multinomial distribution. Stewart (2007) provided guidance specific to west coast groundfish stock assessments on estimating the effective sample size (Neff) of a compositional vector that is based on some number of fish (Nfish) and samples (Nsamp) that produced the estimated frequency distribution. Stewart (2007) recommended that initial estimates of effective sample size (prior to iterative reweighting) be based on the following equations:

if $Nfish/Nsamp < 44$ then: $Neff = Nsamp + 0.138 \times Nfish$

if $Nfish/Nsamp \geq 44$ then: $Neff = 7.06 \times Nsamp$

For surveys, Stewart (pers. comm.) recommends estimating starting values using the following relationships:

if $Nfish/Nset < 55$ then: $Neff = Nset + 0.0707 \times Nfish$

if $Nfish/Nsamp \geq 55$ then: $Neff = 4.89 \times Nset$

The initial effective sample sizes for all length compositions in the greenspotted rockfish assessment were computed following this guidance (Table 13). These initial values were then adjusted after fitting the model. Specifically, initial estimates of Neff were reduced if the model's estimate of Neff was less than the input value. Initial estimates were not adjusted upward when model-estimated sample sizes exceeded the initial values.

2.2 Data from Recreational Fisheries

2.2.1 Recent Recreational Landings (1980 to present)

Recreational landings by CPFV and private/rental boats from 1980-2010 were downloaded from the RecFIN website (www.recfin.org). Estimates are not available for years 1990-1992 in all fishing modes, and estimates from 1993-1995 are not available for the CPFV boat mode in northern California. Missing data were interpolated using a linear trend based on either 1) adjacent years, or 2) the average of three adjacent years, when sufficient data were available, to account for interannual variability in catch estimates. RecFIN estimates are based on numbers of fish (Table 14), which are then converted to biomass based on calculated average weights for each stratum. The number of fish reported by anglers to have been discarded dead or that was otherwise unavailable to samplers (catch type B1) varies considerably from year to year (Table 14). A similar pattern is seen for catch type B2 (angler-reported estimates of fish discarded alive). See the section on recreational discards for further discussion of this topic. Recreational landings in this assessment are modeled in units of metric tons (Table 15, Figure 21, Figure 22).

Although RecFIN catch estimates prior to 2004 are not currently available by county district, Karpov et al. (1995) report recreational catch of greenspotted rockfish by coastal county district for the years 1981-1986. Landings were greatest in the Santa Cruz / Monterey area, and average weight per fish was found to decrease from north to south (Figure 23).

2.2.2 Historical Recreational Catch Reconstruction

Ralston et al. (2010) reconstructed recreational rockfish landings for California from 1928-1980. To retain the distinction between CPFV and private/rental fleets in years prior to 1980 (the first year in RecFIN), we partitioned the historical catch into CPFV and skiff modes. Miller and Gotshall (1965) report that skiff (private boat) fishermen landed less than 0.01% of greenspotted rockfish in the area from Oregon to Point Arguello between 1958 and 1961. By 1980-1982, private and rental boats made up 13% of the type A catch in northern California and 45% in southern California (by weight, based on RecFIN data). In each area, we interpolated a linear trend between these two percentages to estimate the fraction of historical recreational catch landed by private boats (Table 16, Table 17). For southern California, Pinkas et al. (1968) report on the percentage of total rockfish catch by boat mode, finding that less than 10% of rockfish were caught by private vessels. Given the tendency for private vessels to fish closer to shore relative to CPFVs of the time, we consider this to be an overestimate for greenspotted rockfish and adopt the proportions of private landings from northern California as the best available proxy.

Onboard observer studies in the 1970s (Collins and Crooke, unpublished manuscript) and Ally et al. (1991) provide an interesting peek into the distribution of catch rates in southern California

(Figure 24, Figure 25). These surveys focused on "open" party boats and had fewer opportunities to sample chartered boats targeting offshore banks. Nonetheless, high catch rates were observed in areas now closed to fishing (CCAs), suggesting that a non-trivial fraction of greenspotted rockfish in southern California may be inaccessible to current fisheries.

2.2.3 Discards in Recreational Fisheries

Estimates of catch type B1 (unavailable dead fish) for greenspotted rockfish vary considerably by year, area, and boat mode (Figure 26, Figure 27, Figure 28, Figure 29). We calculated ratios of B1/A catch types by decade (sum of B1 / sum of A), and applied the ratios to type A catch within the stratum, including years with interpolated catch estimates (Table 18). Since angler-reported discards are only one component of catch type B1, the ratio B1/A is used to better approximate total mortality, and is not intended to represent an actual discard ratio.

An estimate of historical discard (prior to 1980) is reported by Miller and Gotshall (1965), who found that approximately 5% of greenspotted rockfish in the 1960 central California ocean sport fishery were discarded (Table 19). Since no historical estimates of discard rates are available for southern California, we use rates calculated from the 1980s RecFIN data (7.2% for CPFV and 22.1% for private/rental) to estimate discard from 1928-1979. In northern California the CPFV and private fleets are modeled as a single fleet, and the estimate (5%) from Miller and Gotshall (1965) is applied to the combined recreational landings prior to 1961. We interpolated discard ratios from 5% in 1960 to the RecFIN estimate of 13% in 1980 using a linear trend.

Species-specific estimates of discarded fish in RecFIN (catch types B1 and B2) rely on anglers' abilities to correctly recall species that were discarded during a sampled trip. If an angler is unable to identify a discarded rockfish to species, it is classified as "rockfish genus" by the interviewer. Fish in this category are not currently accounted for in rockfish mortality estimates. From 2005-2009, 10%-15% of total rockfish catch (in numbers) in southern California was assigned to the rockfish genus category (RecFIN, 2011). This percentage drops to 5%-10% in northern California. A study of recreational anglers' ability to identify fish (Hartmann, 1980) found that although greenspotted rockfish were common in the deep water rockfish catch, only 5% of anglers were able to correctly identify them. The contribution of greenspotted rockfish landings to the rockfish genus category in RecFIN is unknown. We consider estimates of recreational discard in the assessment to be minimal estimates, and recommend further research aimed at estimating the species composition of the "rockfish genus" category, particularly for southern California.

2.2.4 Biological Sampling of Recreational Fisheries

Recreational length compositions were downloaded from RecFIN sample data and stratified by region, boat mode (CPFV or private/rental), and year. Annual composition data are available at county-level stratification, but the finest spatial resolution currently available for historical recreational catch in California is north and south of Point Conception. Ideally, composition data would be expanded using catch data at same level of stratification as the composition data. We combined samples within the northern and southern California regions, stratifying by boat mode (CPFV and private/rental) and year. Since 2004, finer stratification of landings is available from the California Recreational Fisheries Survey (CRFS) data.

Additional length composition data for the recreational CPFV (party boat) fleet were available from several sources: 1) California Department of Fish and Game (CDFG) onboard observer programs conducted in southern California from 1975-1978 (Collins and Crooke, unpublished data), 2) northern California length data from CDFG dockside observer programs conducted from 1978-84, and 3) northern California onboard observer data from 1987-1998. These data sets are documented by Ralston et al. (2010). Included in the assessment are data for 1975-1978 in southern California, and 1978-79 and 1990-96 in northern California. Not all years from these additional sources of length composition data were used in the assessment due to the possibility of duplicate data sets existing in RecFIN. The complete time series for recreational length composition data extends from 1975-2010 in southern CA and from 1978-2010 in northern CA (Figure 30, Figure 31, Figure 32, Figure 33). Actual sample sizes (number of samples and fish) and estimated effective sample sizes for recreational length compositions by year, region, and mode are provided in Table 20, Table 21 and Table 22. Compositions in a given year/mode/region that were based on fewer than 20 fish were not included in the model.

In northern California, recreational length composition data for the CPFV and private/rental fleets are similar (Figure 34). We combine the CPFV and private modes in northern California (Figure 35), but model them as separate fleets in southern California. Proportions at length differ among boat modes in southern California, with CPFV landings having a more focused distribution of lengths (Figure 36). Southern California recreational modes (both CPFV and private/rental) land a larger proportion of smaller fish compared to the northern CPFV fleet (Figure 37, Figure 38). These differences may be attributed to several factors, e.g. differences in selectivity, retention, growth, or recruitment.

Otoliths from recreational sampling programs in northern California (1977-1982) were aged by SWFSC staff (D. Pearson) for this assessment. A total of 1018 age estimates (Table 23) were generated from this data source, although only 460 had corresponding length information and adequate sample size per year (1978-1982). These data were modeled as conditional ages-at-length in the northern California model. Length information was missing for almost all otoliths collected in 1977 and a fraction of the samples from 1978-82. These data were modeled as unconditional age compositions for the years 1977-1979 (Table 23).

Length compositions of discarded greenspotted rockfish are available from onboard sampling of Recreational CPFVs in southern California (RecFIN, type 3d data). Insufficient data are available for the northern region. The available data include 197 fish from 84 trips on 40 vessels (117 drifts) between 2004-2010 (Figure 39, Figure 40). These data are representative of the time period, but due to regulatory changes that began around 2003 they may not represent the length composition of discarded fish in the historical fishery.

2.2.5 CDFG Onboard Observer Index for Northern California, 1987-1998

California Department of Fish and Game's (CDFG) onboard observer program in central/northern California recorded catch per angler hour (CPAH) information on CPFV trips from 1987-1998. Detailed location and depth information were also recorded. We identified 54 locations (out of 135 total) that caught at least 20 greenspotted rockfish, limiting our analyses to this subset of the data. These records accounted for over 92% of the total catch of greenspotted rockfish. Locations were assigned to CDFG blocks (18 total), reducing the number of parameters in the model and having little effect on the index. We fit catch per angler hour (CPAH) as the response variable in a delta-GLM model (Stefánsson, 1996) with a lognormal distribution for positive observations.

The final index was derived from year coefficients of the main effects model (Table 24, Figure 41). Categorical variables for year, month, and depth were significant (Figure 42), and no interactions between year and other explanatory variables were significant (Table 25). Variance estimates were derived using a jackknife routine. Length compositions from this data source are used in place of RecFIN estimates for the CPFV fleet from 1990-1996. To avoid the possibility of double-counting recreation length data we did not link composition data to this index, instead mirroring the selectivity pattern for this index to the northern California recreational fishery that was being sampled.

2.2.6 RecFIN CPUE Indices for Northern and Southern California

Catch and effort data from northern California dockside sampling (RecFIN sample data) were formatted into a trip-specific database by Maria De Yoreo (UCSC, NMFS SWFSC) and developed into an index of relative abundance. Details of the procedures used to develop the trip-specific database are attached as Appendix B. The method of Stephens and MacCall (2004) was used to subset the data into 623 trips that were effective effort for greenspotted rockfish, and a delta-GLM model was fit to the data to derive the annual index (Table 26, Figure 43, Figure 44). A complementary log-log link function was found to minimize the Akaike Information Criterion (AIC). Years after 2001 were excluded from the index due to seasonal closures and changes in depth restrictions for recreational fisheries (see section 1.4 for information on relevant recreational regulations). The index estimate for 1982 was inconsistent with adjacent years, identified as an outlier, and not included in the assessment.

A similarly-derived index was developed from RecFIN sample data by Dr. Alec MacCall (NMFS, SWFSC) for southern California. A "boat-level" dataset, similar but not identical to the one described in Appendix B, was provided by Wade Van Buskirk (PSMFC, pers. comm.). Details regarding development of this index were provided by Dr. MacCall (Appendix C).

2.3 Fishery Independent Data

2.3.1 Northwest Fisheries Science Center (NWFSC) combined trawl survey

Since 2003 NWFSC has conducted an annual shelf and slope trawl survey. The survey is based on a stratified random-grid design, covering the coastal waters from a depth of 55 m to 1,280 m from Washington to California (Figure 45, Figure 46, Figure 47). Detailed survey information can be found in Keller et al. (2007).

Survey data were stratified north and south of 34° 30′ N. latitude, and also by depth (75-125m and 125-400m in northern Calif., 55-125m and 125-400m in southern Calif.). Depth stratifications were determined by visual inspection of length compositions stratified by depth in the survey. Survey length composition data suggest that a greater proportion of small greenspotted rockfish inhabit shallower depths (Figure 48).

Trends in trawl survey catch rates vary by depth, but are not correlated among the northern and southern regions (Figure 49, Figure 50). We estimate a two-way interaction model for each region with depth-specific trends, weight each depth stratum by area, and combine the trends into a single index of abundance for each region (Table 28, Table 29, Figure 51, Figure 52). Trawl survey indices, area-based weights, and annual variance estimates for both regions were produced with R code developed by NWFSC staff (J. Wallace, pers. comm.).

Age and length composition data from the survey were also used in this assessment. Otoliths provided by the NWFSC were read by SWFSC staff (D. Pearson). Age reads for 2005, 2007, and 2009 (alternating due to workload constraints) were expanded by survey biomass estimates to develop age compositions following the previously mentioned stratification (Beth Horness, NWFSC; pers. comm.). Biomass-expanded length compositions were developed for all survey years (Figure 53, Figure 54). Numbers of survey trawls and numbers of fish for age and length compositions are in Table 30.

2.3.2 Southern California Hook-and-Line Survey

A fishery-independent survey of shelf rockfish distribution and abundance in the Southern California Bight has been conducted by the Northwest Fisheries Science Center (NWFSC) since 2004 (Harms et al., 2008). Sampling is based on rod-and-reel fishing aboard chartered commercial passenger fishing vessels under the direction and supervision of a team of scientists. Fishing effort during the survey is highly standardized and focused tightly on a series of standard stations that have been occupied during the late summer/early fall (Figure 55). The survey produces estimates of length-composition, depth-distribution, and catch-per-unit-effort (CPUE) for a variety of rockfishes for use in groundfish stock assessments. Greenspotted rockfish is one of three primary target species (along with bocaccio and vermillion rockfish). CPUE estimates from the survey are based on a Bayesian GLM that accounts for site, fishing time, survey vessel, angler, and other statistically significant effects (Harms et al., 2010). NWFSC staff (J. Wallace, pers. comm.) provided a time series of relative abundance (Table 31 and Figure 56) that was incorporated in the southern area model. Length compositions from the survey are illustrated in Figure 57,with associated sample sizes in Table 32.

Greenspotted rockfish ages (n=901 otoliths) from the hook and line survey were estimated by NMFS SWFSC staff (D. Pearson). Due to workload constraints, alternating years were aged (2004, 2006, 2008, and 2010). Sample sizes by age and 2-cm length bin are shown in Table 33. Sample sizes for conditional age-at-length compositions in this assessment are in numbers of fish, i.e. initial effective sample sizes are equal to actual sample sizes. Methods for data weighting in integrated stock assessment models is an area of active research, and further consideration of methods explicitly addressing correlations in composition data is recommended for the next assessment (Francis, 2011).

Harms et al. (2008) note that greenspotted rockfish are uncommon in depths shallower than 73 meters (40 fathoms), with larger fish in depths greater than 110 meters (60 fathoms). The tendency for smaller fish to be caught in shallower depths is consistent with length composition data from the NWFSC trawl survey. Catch rates were generally constant from 2004-2007 in the survey, although large, infrequent catches were encountered at depths greater than 146 meters, or 80 fathoms (Harms et al., 2008).

2.3.3 Fishery-independent data considered but not used

The AFSC/NWFSC triennial survey was conducted between 1977 and 2004. The data from the survey were not used in this assessment because greenspotted rockfish were rarely caught in the survey. Only 455 kg of greenspotted rockfish were caught from all trawls in the nine survey years that extended from 1977-2004.

Pelagic juvenile greenspotted rockfish are not easily identified. CalCOFI data are therefore not informative (A. MacCall, SWFSC, pers. comm.). The spawning season for this species is not well synchronized with the SWFSC juvenile survey in northern California, and very few species of the subgenus *Sebastomus* are caught north of Point Conception (K. Sakuma, SWFSC, pers. comm.). Large numbers of pelagic *Sebastomus* juveniles are caught by the juvenile survey in southern California, but determination of species compositions will require genetic analysis.

2.4 Biological Data

Many biological parameters used in the northern California assessment are based on a life history study of greenspotted rockfish completed by Benet et al. (2009). We provide an electronic copy of this study as supporting material to the assessment. Estimates of biological parameters for the southern California assessment are taken from region-specific, published sources whenever possible.

2.4.1 Length at Age

Benet et al. (2009) estimate parameters of the von Bertalanffy growth equation for greenspotted rockfish in central/northern California. Their study was the first to apply break-and-burn ageing techniques to this species. Previous studies of age and growth used readings from whole otoliths (Chen, 1971; Lea et al., 1999). Results from these studies were not considered for this assessment due to known biases in rockfish age estimates based on whole otoliths, particularly for older individuals (Chilton and Beamish, 1982).

Since length composition data play a critical role in this assessment, we investigated several factors that affect growth. Time-varying growth was considered in sensitivity runs. No evidence of sex-specific differences in growth (Lenarz and Wyllie Echeverria, 1991; Mason, 1998; Benet et al., 2009) or length-at-maturity (Wyllie Echeverria, 1987; Love et al., 1990) has been found in previous studies in greenspotted rockfish. Our assessment combines length composition data for both sexes.

Parameters of the von Bertalanffy growth equation are estimated within the model for northern California, but external to the southern California model. See the section on base model results for regional parameter estimates and comparisons of growth trajectories to available length-at-age data.

Evidence of regional differences in growth suggests that a statewide model for greenspotted rockfish may be inappropriate, especially when length composition data are a primary source of information in the model. Ideally, length-at-age data across a latitudinal gradient should be examined to help determine appropriate spatial structure. Sample sizes are currently insufficient to reliably estimate fine-scale latitudinal trends in growth. Ageing of remaining otoliths from surveys and further investigation of regional growth patterns is recommended for the next assessment.

2.4.2 Validation of Age Estimates

Benet et al. (2009) attempted to validate greenspotted ages using marginal increment analysis. Their attempt was inconclusive due to difficulties in identifying edge type, a common result for slow-growing *Sebastes* species.

Preliminary results from a study using bomb radiocarbon techniques (Kalish, 1995) show that patterns observed for greenspotted rockfish are consistent with previous studies for an eastern Pacific rockfish and flatfish species (Figure 58). Age estimates for the bomb carbon study were provided by the same SWFSC staff member who aged otoliths for the assessment (D. Pearson). We interpret the results of the bomb radiocarbon study as tentative validation of greenspotted ages, but concede that further research is needed.

2.4.3 Ageing Precision and Bias

Within-reader agreement for greenspotted ages was evaluated using 300 double reads, 100 each from the NWFSC trawl survey, NWFSC hook and line survey, and Recreational CPFV fishery (Figure 59, Figure 60). Estimates of ageing precision for the assessment were generated with software provided by A. Punt (Univ. of Washington) using multiple reads performed by the primary age reader (Figure 61). Future research related to estimation of among-reader error is recommended.

2.4.4 Weight-Length Relationship

Benet et al. (2009) reported the weight-length relationship for fish collected in Central California. Converted to fork length in cm and weight in kg, their relationship is

$$W = 0.00001323L^{3.108}$$

No previous studies have found evidence of sex-specific differences in the weight-length relationship. Data from the NWFSC hook and line survey (J. Harms, pers. comm.) were used to estimate a weight-length relationship for Southern California (Figure 62).

$$W = 0.00001055L^{3.137}$$

These data suggest that greenspotted rockfish in southern California weigh less at a given length compared to greenspotted rockfish in northern California, a result that is consistent with previous comparative studies (Love et al., 1990; Benet et al. 2009). Lea et al. (1999) reported a weight-length relationship based on 34 fish, but this information was not used given the small sample size relative to other available data sources.

2.4.5 Natural Mortality

Benet et al. (2009) estimated natural mortality rates (M) for greenspotted rockfish using the methods of Gunderson (1997), Beverton (1992), and Hoenig (1983). Estimates ranged from approximately 0.05 to 0.08. Our base model assumes a value of 0.065 for both the northern and southern California areas, but sensitivities to alternative values of natural mortality are presented. The STAR panel identified natural mortality as the major axis of uncertainty, and defined alternative states of nature based on a low M value of 0.056 and a high M value of 0.074 (see responses to STAR panel requests).

2.4.6 Maturity and Fecundity

Timing of seasonal maturity in greenspotted rockfishes varies with latitude (Benet et al., 2009), with spawning in southern California occurring earlier (February-July) than in central and northern California (March-September).

Length at maturity may also vary with latitude. Benet et al. (2009) and Wyllie Echeverria (1987) estimated female length at 50% maturity at 26 and 27 cm, respectively, in the northern part of California. Love et al. (1990) report 22 cm (converted to fork length) for females in the Southern California Bight. We assume the proportion of mature females is a logistic function of length, with inflection points equal to approximately 26 cm (Benet et al., 2009) in northern California and 22 cm in southern California (Love et al., 1990). Love et al. did not report a slope at the inflection point, so we set the slope at the inflection point for the southern model equal to the estimated slope for the northern region (Figure 63).

Dick (2009) developed a meta-analysis of rockfish fecundity, estimating parameters for greenspotted rockfish using a hierarchical linear model for weight-specific fecundity:

$$\frac{E}{kg} = 0.234 + 0.1328(kg)$$

where E is millions of eggs and kg is weight in kilograms. The slope of Dick's relationship is slightly less than the slope estimated by simple linear regression (Figure 64), due to the "shrinkage" effect in the hierarchical (random-slopes) regression model. We adopt the relationship from Dick (2009) for both regions of the assessment.

2.4.7 Sex Ratios

Little information on sex ratios exists for greenspotted rockfish. Estimates of sex ratio at length from the NWFSC trawl survey, although variable, do not show evidence of deviations from a 1:1 ratio in either region (Figure 65, Figure 66).

3. Model Description

3.1 History of Modeling Approaches

This is the first assessment of greenspotted rockfish for the PFMC. In 2009, the NMFS SWFSC conducted a review of an age-structured assessment of greenspotted rockfish, developed for purposes of evaluating data-poor, length-based assessment models. No status determination or other management reference points were recommended as a result of that review panel.

Dick and MacCall (2010) estimated a coast wide OFL for greenspotted rockfish using Depletion-Based Stock Reduction Analysis (DB-SRA). Their median estimate was 216 mt, with a 95% probability interval of (43, 1096). Catch-based allocation of the coast wide OFL into management regions north and south of approximately Cape Mendocino resulted in an estimate of 195 mt for U.S. waters south of 40° 10′ N. latitude. The 2011-2012 contributions of greenspotted rockfish to the PFMC's northern and southern shelf rockfish complexes are based on the median estimate from DB-SRA.

Although no data workshop was organized for this assessment, members of the assessment team, Groundfish Management Team, Groundfish Advisory Subpanel, and PFMC staff met for an informal discussion during the review of data-poor methodologies in April, 2011, in Santa Cruz, CA. Topics discussed included the use of time-varying selectivity to account for implementation of RCAs, CCAs, and other regulatory actions. Other discussion topics included fleet definitions, concerns over discard information, available data sources, and stock area definitions.

3.2 Assessment Program

An integrated, age-structured, catch at length stock assessment program (Stock Synthesis, version 3.21f; R. Methot, 2011) was used to define model structure and estimate parameters. Summary information from model runs was obtained using R4SS (http://code.google.com/p/r4ss/), a package available for the R language/environment (R Development Core Team, 2010; www.r-project.org).

3.3 Areas and Fleets

We model greenspotted rockfish in California waters as two independent stocks separated at Point Conception (34° 27′ N. lat.) for several reasons: 1) regional differences in exploitation history suggest stock status differs between regions over time, 2) regional differences in growth affect productivity of the stock, and accurate descriptions of growth are essential to models relying heavily on length composition data, 3) greenspotted rockfish are a benthic, sedentary species, and therefore susceptible to localized depletion, 4) Point Conception a well-documented biogeographic boundary (Horn et al., 2006), and 5) preliminary evidence of genetic stock structure around Point Conception has been observed in other southern, sedentary, demersal shelf rockfish species (*S. levis*; J. Hess, pers. comm.).

Major commercial fleets in the assessment include trawl, hook and line, and net gears in both regions. The relative importance of these fleets varies by region, as described above. Recreational catch is almost entirely by boat modes (CPFV and private/rental) due to the depth distribution of this species. These fleets are modeled separately in the southern region, but are combined in the north based on similarity of length composition data (see section on recreational landings). Timelines of data sources for the northern and southern models, by data type and year, are provided as Figure 67 and Figure 68.

3.4 Model specification and parameters

General model characteristics are summarized in Table 34 and Table 35. Units are metric tons (mt) for catch, centimeters (cm) for length, kilograms (kg) for individual weight. The fecundity relationship is in millions of eggs per kilogram, resulting in spawning biomass units of billions of eggs. Base models for both regions are similar in structure, with the exception of pooled recreational boat modes (CPFV and private/rental) in the northern model, and a greater number of time-varying selectivity parameters in the southern model. Recent landings (since 2003) by recreational fleets in northern California are minor (typically <1 mt), such that reliable data to inform changes in selectivity since 2003 are lacking. In southern California, recreational fleets continue to land amounts sufficient to inform changes in selectivity. Time blocks for selectivity parameters (Table 36) are based on management actions such as establishment of the CCAs in 2001, RCAs in 2003, and significant seasonal closures and depth restrictions for recreational fleets since 2003.

Selectivities for most fisheries and surveys are parameterized with double-normal selectivity curves. Functional forms for some fleets were constrained to asymptotic forms (either logistic curves or double normal functions with constrained parameters). Final selectivity curves for the northern and southern models are illustrated in Appendix D.

The model-estimated growth trajectory for northern California fits the observed age data, reasonably well (Figure 69). If the lower age (Amin) of the von Bertalanffy growth model in Stock Synthesis is greater than zero, the growth curve uses a linear interpolation between the lower edge of the smallest population length bin (assumed size at age 0), and length at the lower age, L(Amin). This can result in an interaction between estimates of the von Bertalanffy growth coefficient, k, and estimates of size at Amin, as noted in the pre-STAR assessment draft document. It was decided during the review panel to change the lower age parameter (Amin) to 0 and the upper age (Amax) to 999 (approximate asymptotic size), as this removed the constraint on size at age zero and made interpretation of the growth coefficient (k) more intuitive. In Stock Synthesis, distributions of size at age are accumulated up to the lower edge of the smallest population length bin (R. Methot, pers. comm.). The effect of this will be negligible for greenspotted rockfish, as fish of this size and age are not selected by any surveys or fisheries.

Growth parameters were not estimable in the model for southern California, and were fixed at values from an external fit to the data (Figure 70), with internally-estimated coefficients of variation (CVs). Growth may differ between the regions, but further study is needed to confirm the estimated trends (Figure 71). Attempts to estimate growth in the southern model often resulted in the von Bertalanffy growth parameter hitting its lower bound (0.03). The external estimate for this parameter (0.042) is still low relative to other rockfish, but given the results of the age validation study we retain the externally-estimated curve as the best available information.

The two parameters that largely determine productivity of the stock, steepness and the natural mortality rate, are fixed at externally estimated values. Steepness is fixed at 0.76 in both regions, the expectation of a prior distribution based on a meta-analysis of rockfish assessments from the U.S. west coast (M. Dorn, NWFSC; pers. comm.). Natural mortality is fixed at 0.65 in both regions, approximately the mid-point of the highest and lowest values reported in Benet et al. (2009). See the STAR panel requests for recommended future research on development of regional prior distributions for the natural mortality rate.

3.5 Stock and recruitment

Length frequency data for greenspotted rockfish do not show strong progressions of cohorts, and as a result, do not reliably estimate year-class strength or interannual variability in recruitment. We assume that recruitment is deterministic, and follows a Beverton-Holt stock recruitment relationship (SRR). Parameters of the SRR are R_0 (virgin recruitment, estimated) and steepness (h), the latter of which is fixed in our base models at the expectation (0.76) of a prior distribution for steepness developed by M. Dorn (NMFS AFSC, pers. comm.).

Preliminary attempts to estimate recruitment deviations were not considered at length, due to an obvious lack of information regarding cohort strength in the composition data.

4. Model selection and evaluation

4.1 Alternative models, structural choices, and key assumptions

4.1.1 Alternative hypotheses for changes in length frequency data

Length composition data for greenspotted rockfish show two distinct patterns, each of which can be attributed to a number of causes. The first pattern is change over time in the descending limb of the length frequency data, for example as seen in the northern California trawl data (Figure 13), southern California commercial hook and line (Figure 17), or southern CPFV data (Figure 30). These changes could be attributed to several factors, including 1) selective removal of large individuals (truncation of length structure due to exploitation), 2) changes in individual growth over time, 3) changes in spatial patterns of fishing (e.g. regulatory effects on selectivity), or 4) trends in recruitment.

We evaluated the possibility of changes in growth over time by blocking selectivity for the von Bertalanffy growth parameter (k). Specifically, we followed the general approach of Field (2007), who defined time-varying growth based on major shifts in the Pacific Decadal Oscillation index. Our blocks were defined as 1916-1991, 1992-1998, and 1999-2010. Age-at-length data were available in the northern model from the late 1970s/early 1980s and 2000s, so we applied the blocking only to this model. Age data in the southern model was limited to the 2000s, so no attempt at estimating time-varying growth for that region. The estimation of time-varying k (2 additional parameters) reduced the likelihood in the northern base model by only 2 points relative to the pre-STAR base model (Table 37), and the direction of change in k was not consistent with observations of lower oceanographic productivity from 1992-1998. Instead, the estimate for the period 1992-1998 was about the same as the baseline parameter value, and the value of k decreased during what is generally accepted as a more productive, recent period (1999-2010). The available data do not appear to contain sufficient information to estimate time-varying growth, but changes in growth may still contribute to the observed patterns in length composition data over time. Other constraints in the model structure (e.g. deterministic recruitment) also have the potential to confound interpretation of time varying growth parameters.

The absence of small fish in early years' length compositions for the northern trawl fishery and hook-and-line fisheries from both regions could be attributed to changes in growth, selectivity, retention, or recruitment. The base models agreed upon during the STAR panel assume time-varying selectivity, which may not be the reason for changes in the proportion of small fish landed. We explored models with fixed selectivity (based on the most recent, "left-most" ascending limb) and time-varying retention as an alternative hypothesis to time-varying selectivity. Since observed compositions are the product of retention and selectivity curves, we fixed selectivity using an asymptotic form and attempted to estimate time-varying retention curves, allowing the model to estimate the magnitude of discarded catch. We applied this approach to the trawl fishery composition data, identifying 1988 as the year that best explained variability over time in the ascending limb (Figure 72). Ultimately, we were not successful using a time-blocked approach to estimating time-varying retention. It is possible that further exploration of time-varying parameters using smooth trends in parameter values, rather than blocks, may provide an alternative to the current base models. Table 37 shows the degradation of fit in the pre-STAR panel base model when selectivity is assumed to be constant over time in the northern California model.

4.1.2 Requests by the STAR Panel and responses by the Stock Assessment Team (STAT)

At the STAR Panel meeting, the Panel decided on a number of model runs for the STAT to undertake. These runs were designed to explore model behavior and identify the major axes of uncertainty to formulate alternative states of nature. The runs requested, the rationales and the responses are listed below. In the end of the meeting, STAT and STAR Panel agreed upon "new" base models.

Parameter estimates, likelihood components, and derived quantities for each STAR panel request are in Table 38 and Table 39 for northern California, and Table 40 and Table 41 for southern California.

Estimates of spawning output in the pre-STAR panel report were inadvertently scaled by a factor of two (as reported by SS3 for single-gender models).The scaling error had no effect on other model outputs including stock status and estimated yield, and the error is corrected in this revised draft.

Request № 1: Add 6% discard to the northern trawl removals.
Rationale: This catch was accidentally omitted in the pre-STAR base model.
STAT Response: Addition of the omitted catch had a minor effect. Estimated stock status changed from 32.7% of unfished spawning output to 32.6%.

Request № 2: If possible, get Dr. Owen Hamel's (NMFS, NWFSC) prior on natural mortality and compare with values of M from alternative methods for estimating natural mortality considered in the assessment.
Rationale: In both models *M* is fixed and the results are likely sensitive to this parameter. Hamel's prior on *M* would provide additional external information on parameter that is not possible to estimate within the assessment (dues to limited amount of data available)
STAT Response: STAT made a number of attempts to obtain the prior during the STAR Panel week, but it was not possible (Dr. Hamel was not available at that time).

Request № 3: Add length composition to fleets and surveys (in both models) where conditional age-at-length compositions are used.
Rationale: With age data input as conditional age-at-length compositions, length composition data can be fully used (fish are not being double counted).
STAT Response:
<u>Northern model:</u> Length compositions associated with conditional age-at-length data for the NWFSC trawl survey and recreational CPFV fleet were added. The estimated growth curve was more consistent with the data (length at Amin increased and von Bertalanffy *k* decreased). Notable changes were observed in selectivity parameters which included a shift in the peak of the NWFSC trawl survey toward maximum length, and a decrease in the descending width of the dome-normal curve for the recreational fishery. Maximum annual F for the hook-and-line fishery increased from 0.32 to 0.49. Depletion dropped from 32.6% to 29.9%.
<u>Southern model:</u> Length compositions associated with conditional age-at-length data for the NWFSC trawl survey and NWFSC hook-and-line survey were added. Growth parameters remained fixed for this run (as in the pre-STAR base). No major changes were observed, apart from a decrease in the descending width of the selectivity curve for the CPFV fleet.

Request № 4: Estimate all growth parameters for the <u>southern model</u>.
Rationale: In pre-STAR configuration of the southern model all growth parameters (except for CVs of lengths at Amin and Amax) are fixed at the externally estimated values; however, the addition of length composition data may make growth estimable.
STAT Response: Estimated growth parameters suggest slower growth than external fits to the length and age data. The change produced a large effect on estimated stock status, with depletion

now estimated at 26.8% compared to the base model estimate of 34.5%. Selectivity parameters also changed, but the results did not appear to be inconsistent with expected patterns.

Request № 5: Conduct a run with NWFSC survey selectivity in the southern model to be asymptotic while still estimating growth.
Rationale: To explore how the selectivity pattern affects growth parameter estimation.
STAT Response: Fixing NWFSC trawl survey selectivity asymptotic resulted in slightly slower growth (k=0.036) relative to results from request 4 (k=0.04). It also resulted in reduced estimates of current stock depletion from 26.8% to 23.2%. The descending limbs of both recreational fleets' selectivity curves were slightly shifted to the right, as was the curve for the NWFSC hook-and-line survey. The width of the descending limb of selectivity curve for the trawl fleet (for the time block starting at 2001) also increased. Maximum estimated fishing mortality rate for the recreational CPFV fleet increased from 0.20 to 0.25.

Request № 6: Conduct a run with M fixed at: (a) 0.05 and then (b) 0.08 in the northern model while allowing the asymptotic trawl selectivity pattern to change (change the ascending limb of the selectivity curve first and then explore dome-shaped selectivity).
Rationale: To better understand the pattern exhibited by the length composition data.
STAT Response: Selectivity curves for the northern model were significantly affected by changing the natural mortality rate from the base model value (0.065). Fixing M at 0.08 resulted in a gradual shift toward selection of smaller fish in the northern trawl fishery, which is consistent with visual patterns in the data. However, selectivity for the hook-and-line fleet after 1988 shifted far to the right under the higher natural mortality rate, so much so that peak annual F for the fleet rose to 1.45. This fishery is a minor component relative to the trawl, so alternative configurations for selectivity should be considered in subsequent runs. Peak selectivity for the recreational fishery also shifted toward larger fish, with an abrupt decline near 40 cm length. Individual growth rates are negatively correlated with M. Fixing M at 0.05 results in better fits to the recreational CPFV length composition data, but estimated trawl selectivity patterns no longer reflect the increasing selection of smaller fish over time. Estimated length at A min (age 7) is more consistent with the observed length-at-age data when M=0.08. When shape of the trawl selectivity is allowed full flexibility with M=0.05, the data still support essentially asymptotic curves. With M=0.08, trawl selectivity shifts to a dome-shape for all time blocks. The ascending limb of each time block follows observed patterns in the data as well. Fishing mortality rates for the hook and line fishery still exceed 1, and the fit to recreational data again degrades with higher M. Individual growth is well-estimated (reasonable size at age 7), similar to the models with asymptotic trawl selectivity and M=0.08.
In general, it appears that the recreational composition data prefer a lower M, while the trawl data are more consistent with a higher M. Since the recreational fishery appears to select smaller fish, an increase in M with size or age could possibly explain the conflict between these two data sources under a constant M assumption.

Request № 7: Provide profiles on M for both models by data source.
Rationale: To better understand consistency of data from different sources.
STAT Response: Profiles were created for models containing all length composition data (request 3), catch data (request 1), internally estimated growth parameters (request 4), and asymptotic selectivity for the NWFSC trawl survey (request 5). Results for the northern model are presented in Figure 73 and Figure 74 Southern model profiles are shown in Figure 75 and Figure 76.

Request № 8: Provide sensitivities to historical catch estimates by varying catch back to 1969 ±25% and ±50%.

Rationale: To explore model sensitivity to uncertainty in catch history.
STAT Response: Sensitivities were produced based on a revised request. The Panel suggested varying catch by an increasing amount for catches further back in time. A linear ramp between 0% change in 1978 (the first year with port sampler data in California) and 25% change in 1916 was applied to historical landings (either increasing or decreasing historical catch). Trajectories of spawning output and spawning depletion for northern California (Figure 77) or southern California (Figure 78) were not sensitive to this amount of perturbation of historical catch streams.

Request № 9a: Southern model: Conduct a run with A_{min} = 0, and A_{max} = 999.
Request № 9b: Southern model: Conduct a run with A_{min} = 4, and A_{max} = 999.
Rationale: To examine effects of change in input parameters on growth estimation.
STAT Response: Results from request 4 were the starting point for this request. 9a: Estimated von Bertalanffy growth parameters were 2.3 cm at age 0, asymptotic size of 60 cm, and growth coefficient (*k*) of 0.034. In SS, distributions of size at age accumulated up to the lower edge of the smallest population length bin (R. Methot, pers. comm.). The effect of this will be negligible for greenspotted rockfish, as fish of this size and age are not selected by any surveys or fisheries. The revised growth curve appears to fit the NWFSC trawl survey data better. The age composition data are better fit in the results for request 9a, but there is a larger degradation of fit to the length compositions, resulting in a lower total likelihood. 9b: The estimated growth curve from request 9b is almost identical to 9a, with the exception that length at age zero is now constrained to equal 4cm (the lower edge of the smallest population length bin). With this parameterization of the growth curve, the descending width parameterization of the selectivity curves for the NWFSC trawl survey decreases, but there is little actual change in the curve, and almost no change in likelihood relative to request 9a.

Request № 10a: Southern model: Fix all growth parameters from request 4 except CVs, and set growth CVs to those estimated in request 3.
Request № 10b: Southern model: Fix growth CVs to those from request 3, and estimate the rest of the growth parameters.
Rationale: To examine effects of growth parameters on model output (i.e. depletion).
STAT Response: 10a: Fixing L(Amin), L(Amax), and *k* at values from request 4, and fixing CVs at values from request 3, resulted in a significantly degraded fits to the age and length composition data. Relative spawning output (depletion) was reduced from 26.8% (see Request 4) to 23.1%, illustrating the sensitivity of models driven by composition data to variability in population growth. Maximum F increased by 34%, with annual F for the recreational CPFV fleet peaking at 0.29, compared to 0.22 in the model from request 4.
10b: STAT fixed the growth CVs at the values from request 3, but allowed the model to estimate the other 3 growth parameters. Fixing the CVs resulted in a visually improved fit to younger/smaller fish caught by the NWFSC trawl survey, relative to the estimated growth curve from request 4. The likelihood component for the age composition data is smaller (317.4) with CVs fixed from request 3 than it is when CVs are estimated (320.9; request 4). Of course, fixing the two parameters results in a higher total likelihood which is driven by an approximately 10-point increase in the negative log likelihood for the length composition data. Spawning output is estimated at 22.9% of the unfished level.

Request № 11: Northern model: Run the model with no blocks on hook-and-line fishery selectivity (with all length data in, *M* fixed at 0.065).
Rationale: To explore effect of blocks in selectivity on model output; evaluate the need for blocks in hook-and-line fishery (given the limited amount of length composition data).

STAT Response: The fits to the hook-and-line data do not seem to be strongly affected by the assumption of constant selectivity, even though the peak of the selectivity curve shifts more than 4 cm to the right of the estimated peak from request 3. Stock depletion is essentially unchanged from request 3. Maximum F decreases slightly, from 4.9 to 4.7 in the hook and line fishery. The change (no time blocks in hook-and-line gear) is retained for the "new" base model.

Request № 12: Northern model: Conduct a model run (above) with NWFSC selectivity peak fixed at the level estimated from the model with lower *M* (0.05).
Rationale: To better understand pattern (peak parameter hitting the upper bound) observed in NWFSC survey selectivity.
STAT Response: Patterns in the length residuals for the trawl survey are largely unchanged. A minor decrease in the quality of fit to the age composition data occurs, relative to request 3. Maximum F decreases to 0.41 in this model.

Request № 13: Northern model: Conduct a model run with NWFSC selectivity freely estimated (keeping selectivity at smallest size fixed at 0).
Rationale: To better understand pattern (peak parameter hitting the upper bound) observed in NWFSC survey selectivity.
STAT Response: Residuals are unchanged relative to request 3 and the peak of the freely estimated curve hits the upper bound.

Request № 14: Southern model: Fix three growth parameters at base case from request 3, and profile over CVs from 0.1 to 0.2 with old and young equal, all for *M* from 0.05 to 0.1. Display contours of likelihood and depletion, for three values of steepness.
Rationale: To explore effect of different growth parameters on model derived quantities, help determine major axis of uncertainty for the decision table.
STAT Response: There is a clear minimum in negative log likelihood (NLL) at CV of length at age = 0.15 (Figure 79, Figure 80, Figure 81). NLL declines as *M* declines to .05. NLL declines as values of *h* go from 0.59 to 0.76 then 0.93.

Request № 15: Northern model: Use a logistic curve for the selectivity of the NWFSC survey.
Rationale: To explore whether logistic selectivity parameters will be more (than double-normal) consistent with length composition data.
STAT Response: With the logistic curve, the peak of the selectivity was more consistent with the composition data from the trawl survey. The logistic selectivity curve was retained for the "new" base model.

Request № 16a: Northern model: Conduct a model run with A_{min} set to 4 years (instead of 7 years in pre-STAR base case), growth parameters estimated.
Rationale: To explore the effect of different Amin values on growth estimation.
STAT Response: This removes the "dog leg" from the fitted curve.

Request № 16b: Northern model: Conduct a model run with A_{min} t= 0 and then to A_{max} set to 999, growth parameters estimated.
Rationale: To explore the effect of changes in growth settings on growth parameter estimation.
STAT Response: Length at A_{min} hits the lower bound of 0.01.

Request № 17: Northern model: Repeat a run from 16b, while fixing length at A_{min} at 0.01.
Rationale: To confirm no differences between 16b and 17.

STAT Response: As expected, the run caused no differences from 16b. These settings of growth parameters were retained for the "new" base case.

Request № 18: Northern model: Produce a contour plot of likelihood and depletion vs. *M* and *h*.
Rationale: To determine major axes of uncertainty.
STAT Response: There is a lower NLL as *M* declines to 0.05, and lower NLL as *h* goes to 1.0 (Figure 82). NLL declines toward high steepness and low *M*, but is not sensitive to steepness for *M* near 0.1. These results present no compelling reason to depart from the base case of *M*=.065 and *h*=0.76. They suggest that *M* be the major axis of uncertainty in defining states of nature.

4.2 Base case model results

Base models for both regions show a general pattern of declining spawning output through the 1980s (and 1990s in the north), followed by consistently increasing trends. Estimates of recent increases in spawning output for both models are largely driven by the combination of low catches in recent years, and the assumed parameter values for steepness and natural mortality. Unfortunately, no clear evidence of stock recovery is apparent in the data, e.g. consistently increasing abundance indices or higher proportions of large fish in the length compositions. Rates of increase in spawning output should therefore be viewed with caution. However, existing management measures appear to be effective at maintaining fishing mortality rates below estimated overfishing thresholds, and expansion of previously truncated size structure may be difficult to detect from fishery-dependent sources given current area and depth restrictions. Continuation of fishery-independent surveys and monitoring of abundance trends inside and outside the CCAs is critical for verification of estimated trends in stock biomass.

Region-specific exploitation histories have produced considerably different trajectories of relative depletion in the northern and southern regions. Stock status differed by up to twenty percentage points in the early 1980s (Figure 83). Specifically, the northern stock was around 54% of unfished biomass in 1980 when the southern stock was near 34%. Similarly, estimated spawning output in the south fell below the PFMC's minimum stock size threshold (25% of unfished spawning output) when the northern stock was just below the B_{MSY} proxy for rockfish.

A search for the global minimum of the negative log likelihoods identified a better solution for the southern region than the model specified in STAR panel request #3. Model outputs based on the improved solution are very similar to the results reviewed by the panel (Figure 84, Figure 85). The improved base model fit results in a slightly less depleted stock, with higher estimates of spawning output over the length of the time series. Subsequent evaluation of 50 runs for each of the base models, starting at different initial parameter values, did not identify any solutions with a smaller negative log likelihood than the current base models (Figure 86, Figure 87).

4.2.1 Northern California base model

A revised base model for northern California was identified during the STAR panel review (see STAR panel request #17). The trajectory of spawning output in the base model is very similar to the pre-STAR model (Figure 88). The revised northern base model suggests that spawning output in 2011 is 31% of the unfished level, with an asymptotic 95% confidence interval of (27%, 34%) (Figure 89). The asymptotic CV for spawning output in 2011 is 8%, but this underestimates uncertainty for several reasons including, but not limited to, the lack of information regarding annual recruitment deviations (Figure 90, Figure 91) and the use of fixed parameters defining stock productivity. The model suggests the northern stock was below the MSST from roughly 1990-2007, and harvest rates exceeded proxy MSY levels from the early 1970s to the late 1990s (Figure 92).

Table 42 lists all estimated and fixed parameter values in the northern base model, with asymptotic 95% confidence intervals for estimated parameters. Likelihood components, adjustments to input variances and effective sample sizes, time series of population estimates, and management reference points are in Table 43 through Table 46.

Patterns in time-varying selectivity are generally consistent with expected patterns given the changes in recent regulations. Ascending limbs for the northern trawl fishery shift toward smaller individuals in the time block representing 2003-2010, and the data support dome-shaped selectivity after 2002. Since greenspotted rockfish associate with such a diverse group of habitat types, we do not consider the assumption of asymptotic selectivity for pre-2003 trawl gear to be an unrealistic assumption. When selectivity for the northern trawl fleet was allowed to be dome-shaped prior to 2003, estimates of annual fishing mortality rates exceeded 0.8, compared to a maximum rate of less than 0.4 with asymptotic selectivity. The switch to dome-shaped selectivity in 2003 is consistent with limited access to shelf rockfish species (RCAs) and a tendency for larger greenspotted rockfish to occupy deeper depths. Although similar patterns probably exist for recreational fisheries in the north, we do not model time-varying selectivity for this fishery. Recreational landings are so small that available length composition data cannot accurately estimate changes in selectivity over time, and a change in selectivity would have a trivial effect on model results. This assumption may need further consideration when forecasting catch. See Appendix D for illustrations of selectivity curves estimated in the northern base model.

Fits to length composition data in the northern model (Appendix E) are generally quite good, especially since the model does not estimate annual recruitment deviations. The strength of correlations between initial estimates of effective sample size and the model-estimated values varies among data sets. There is little relationship between the two quantities in the commercial fleets, but a stronger correlation is apparent for the combined recreational fleet.

Model fits to unconditional age data from the recreational fishery tend to overestimate the expected proportion of both young and old fish, compared to data that are relatively concentrated around intermediate ages. These fits are based on length-based selectivity, but we saw no clear argument for asserting age-based selectivity (which would improve the fit to these data substantially).

Growth is estimated internally in the northern model, and fits to the conditional age-at-length data are quite reasonable (Appendix E).

Abundance indices for the northern region are quite variable, and make up a small fraction of the overall likelihood. The NWFSC trawl survey index (Figure 93) is generally flat, with the exception of a single low value in 2005. The model predicts a slightly increasing trend over the survey years (2003-2010). The RecFIN dockside index (Figure 94) is perhaps most consistent with base model biomass predictions, with high values in the 1980s, lower values in the 1990s, and an increase in the early 2000s. The 1982 data point from the northern dockside index was excluded from the final base model, as its mean and variance were both well below any other points in the 1980s. The onboard CPFV index shows no clear trend over time, with the exception that 1987 is lower than the other points. The model prediction declines over the majority of the time series, leveling out around 1996, and is within the ~95% confidence intervals for all observations (Figure 95).

4.2.2 Southern California base model

A revised base model for southern California was identified during the STAR panel review (see STAR panel request #3). The trajectory of spawning output in the base model is qualitatively very similar to the pre-STAR model (Figure 96). As mentioned above, exploration of alternative initial parameter values led to discovery of a parameter vector with lower negative log likelihood. The STAR panel chairperson was notified, and since outputs from the new model differed very little from request #3, it was adopted as the new base case for the southern region. The base model for southern California suggests that greenspotted rockfish south of Point Conception is at approximately 37% of unfished spawning output in 2011 (Figure 97). The asymptotic CV for spawning output in 2011 is 13%, but this underestimates uncertainty for several reasons including, but not limited to, the assumption of deterministic recruitment (Figure 98, Figure 99) and the use of fixed parameters defining stock productivity. The model suggests the southern stock was below the MSST from roughly 1984-2001, and harvest rates exceeded proxy MSY levels from the late 1960s to the late 1990s (Figure 100).

Table 47 lists all estimated and fixed parameter values in the northern base model, with asymptotic 95% confidence intervals for estimated parameters. Likelihood components, adjustments to input variances and effective sample sizes, time series of population estimates, and management reference points are in Table 48 through Table 51.

Selectivity is time-varying for the trawl, hook-and-line, CPFV, and private/rental fleets in the southern model. The ‘peak’ of the asymptotic selectivity curve in the pre-2001 trawl fishery consistently hit the upper bound (largest length bin), and was therefore fixed with an ascending limb consistent with observed length composition data. Trawl selectivity after 2001 was allowed to be dome-shaped, and parameter estimates were stable. As in the north, changes in selectivity for all fisheries are consistent with expected patterns given the combined set of regulatory actions since

2001 (CCAs, RCAs, seasonal closures and depth restrictions). See Appendix D for illustrations of selectivity curves estimated in the southern base model.

Fits to annual length composition data in the southern model are reasonable for the commercial fleets (see Appendix F for fits to southern length and age composition data). Between the two recreational fleets, the private/rental length composition data are more consistent with model predictions than the CPFV data, with the model underestimating the proportion of large fish in the mid-1980s, then underestimating proportions of small fish in the late 1990s. In general, fits to the southern data are less precise than in the northern model. Correlations between initial estimates of effective sample size and the model-estimated values are variable among data sets, but most consistent in the recreational fleets. Length compositions for the southern portion of the NWFSC trawl survey show a dominance of small fish. This may be due to the spatial coverage of the trawl survey, which does not include sampling within the CCAs. Fits to conditional age-at-length data are not as good as the northern model, which is expected for a model with an externally-estimated length-at-age relationship.

Fit to NWFSC trawl survey is difficult to interpret due to an abrupt change in the trend between 2007 and 2008 (Figure 101). The NWFSC hook and line survey is without strong trend, but possibly declining, which is inconsistent with predictions from the current base model (Figure 102). Given that fishery-dependent information about stock recovery is lacking, fishery independent surveys will be essential for evaluation of increasing trends in abundance which are currently driven by model assumptions about stock productivity. The RecFIN dockside index is highly variable with no apparent trend (Figure 103).

4.3 Uncertainty and sensitivity analyses

The alternative states of nature recommended by the STAR panel are based values of the natural mortality rate above and below the base model assumption of 0.065 yr^{-1}. In the southern model, a strong correlation between M and unfished equilibrium recruitment (R_0) interacts with increasing weight-specific fecundity to produce what were initially counter-intuitive patterns in unfished spawning output, SB_0. As seen in Figure ES3, estimates of spawning output for both the low and high M alternative states exceed the intermediate base case estimate. Given a sufficiently strong positive correlation between R_0 and M, low M is associated with smaller populations but will predict high SB_0 due to a large accumulation of older, larger fish with disproportionately high fecundity. When M is high, few old fish accumulate, but higher R0 results in a larger number of smaller mature fish. Both the low and the high M alternatives then exceed the intermediate base model in terms of SB_0. This pattern is not apparent when the correlation between R0 and M is not as strong, as in the northern model, as seen by examination of lifetime egg production curves for both models (Figure 104).

4.3.1 Likelihood profiles

Fleet-specific likelihood profiles over a range of natural mortality rate values were completed for STAR panel request #7, illustrating tension between data sources in the models. For northern California, total likelihood is minimized around M=0.06, similar to the base case assumption. However, the minimum arises from a summation of likelihoods for length composition data that are better fit by lower M values (e.g. the commercial trawl and hook and line length comps and the recreational comps), and likelihood components for indices and recreational age data that are better fit by higher M values (Figure 73 and Figure 74).

Negative log likelihood for the southern California model (Figure 75) is minimized at M=0.04 (the lowest value considered in the profile), but such a low natural mortality rate is inconsistent with the observed maximum age for this species (around 51 years). Results from the bomb radiocarbon study (Figure 58) suggest that age estimates are reasonably accurate, and one would expect to encounter older fish in the available samples, particularly those from the early 1970s and 1980s, if M were as low as 0.04 or 0.05. Similar to the northern model, length composition data are better fit by low M values in the southern base model, with the exception of the two NWFSC surveys, which are better fit by M values in the vicinity of the base case assumption (0.6 – 0.7). M near 0.065 is also consistent with the hook and line survey's age data, but ages from the trawl survey appear to 'prefer' lower M.

A dual profile over steepness and M for the northern model shows that the likelihood surface is relatively flat over a wide range of steepness values (Figure 82; STAR panel request #18). Consideration of uncertainty in steepness may improve estimates of uncertainty for the northern model, relative to the current use of M alone as a single axis of uncertainty. This approach would still not account for uncertainty in other structural assumptions of the model such as deterministic recruitment and a single functional form for the stock-recruitment relationship.

Since growth is an important factor in both regional models, and is estimated outside the southern model, profiles for the south were 3-dimensional (considering M, h, and the CV of length at age). In the southern model, total log likelihood improves with lower M and CVs of length at age around 0.15. Again, there was little contrast in likelihood among the three steepness values considered in the analysis (0.59, 0.76, and 0.93). The estimate of current stock status is sensitive to the assumed value of steepness, although it is more sensitive to alternative assumptions about M (Table 52).

4.3.2 Retrospective analyses

Removing the most recent 2 and 5 years of data from each base model revealed that the northern model is less sensitive to recent information than the southern model. With end years of 2005 and 2008, trajectories of spawning output and depletion remain similar for the northern model (Figure 105, Figure 106). The southern model is stable with 2 years' worth of data removed, but removing 5 years of data significantly changes the predicted trajectories (Figure 107, Figure 108). Differences in retrospective patterns between the models are in part due to the fact that all conditional age-at-length data in the southern model is from recent years, whereas the northern model contains age/length information from the 2000s and the late 1970s / early 1980s as well. Also, two of the three indices in the southern model begin in the early 2000s, and are significantly truncated by removing recent years' data. In terms of retrospective stability, the northern model also benefits from two long-term indices of abundance that end well before the recent time period: the onboard recreational survey from the 1980s and 1990s, and the dockside CPUE index that begins in 1980.

5. Reference points

Estimated unfished spawning output south of Point Conception is about 40% larger than unfished spawning output in northern California. However, maximum sustainable yield based on the SPR proxy harvest rate for rockfish ($F_{SPR=50\%}$)is slightly larger in northern California (49 mt) than in the south (46 mt), in part due to differences in individual growth rates. Reference points for the northern and southern regions are presented in Table 46 and Table 51, respectively. Integrated estimates (northern and southern regions combined) for biomass, spawning output, recruitment, depletion, and maximum sustainable yield are in Table 53.

6. Harvest projections and decision tables

Decision tables and 10-year harvest projections are included in the Executive Summary (Tables ES8, ES9, and ES10). Projections of yield based on the default (40-10) control rule and MSY proxy harvest rates (OFL catch) are almost identical given stock status. Although long-term projections (>10 years) converge to the MSY proxy yield in both regions, short-term OFL catch streams actually decline or remain roughly constant, most likely due to changes in predicted population age structure.

7. Regional management considerations

Greenspotted rockfish is currently managed as part of two minor shelf rockfish complexes, north and south of 40° 10′ N. latitude. Continued management under this system would require partitioning of yield estimates from the northern California model and estimation of sustainable yield for U.S. waters north of 42° N. latitude. Approaches to allocating yield could incorporate a number of data types, including survey data, habitat information, or historical catch. An apportionment of yield based on historical catch data and estimates of yield for U.S. waters off Oregon and Washington is described in Appendix L.

8. Research needs

There is considerable uncertainty regarding the portion of greenspotted population residing in Mexico. It is possible that alternative sources of information (i.e. studies conducted at Universities in Mexico) could yield information on biology, life history and exploitation of greenspotted rockfish south of the U.S.-Mexico border.

Uncertainty in historical catch should be further evaluated through development of alternative historical catch streams reflecting differences in data quantity and quality available for different time periods. Existing reconstruction efforts focus entirely on historical landings, although discard has been a significant portion of removals for many species on the U.S. west coast. Coordinated reconstruction efforts for historical discard are also recommended.

Monitoring of relative or absolute abundance in the CCAs is a key research priority. Submersible or other non-invasive survey methods could potentially provide additional information on habitat and abundance for this species. Also, it is important to develop alternative methods to monitor length and age compositions of fish inside the CCAs.

The available data were limited (especially for the southern region) to reliably estimate growth, therefore, ageing the remaining available otoliths should be a priority. Careful consideration should be devoted to producing exactly the age data which would be of most direct benefit to the assessment, since expertise, time and funds are all limited. Further development of ageing criteria for greenspotted rockfish is recommended, along with estimation of among-reader ageing error.

Further exploration of stock structure and spatial variability of life history parameters of greenspotted rockfish is recommended. Alternative assumptions about stock structure should be explored for the next assessment.

9. Acknowledgements

The authors thank members of the STAR panel (V. Gertseva (chairperson), M. Armstrong, L. Botsford, J. DeVore, S. Matson, G. Richter and K. Stokes) for excellent advice and lively discussion. We also thank Xi He for general advice and for sharing preliminary versions of the Stock Synthesis files, Beth Horness for generous assistance with NWFSC trawl survey data, Maria De Yoreo and Alec MacCall for development of RecFIN-based indices of abundance, John Wallace for generating NWFSC hook and line survey indices, and Becky Miller for maps of recreational CPUE. John Richards and Paul Gregory provided useful information regarding catch of greenspotted rockfish in animal food fisheries.

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11. Tables

Table 1. Species of rockfish managed as regional aggregations ("minor shelf rockfish complexes"), north and south of 40° 10′ N. latitude (PFMC, 2011). U.S. waters off California (the assessed area) contain the entire southern management area and a portion of the northern management area.

Southern Shelf Rockfish	Northern Shelf Rockfish
bronzespotted	bronzespotted
chameleon	bocaccio
dusky	chameleon
dwarf-red	chilipepper
flag	cowcod
freckled	dusky
greenblotched	dwarf-red
greenspotted	flag
greenstriped	freckled
halfbanded	greenblotched
harlequin	greenspotted
honeycomb	greenstriped
Mexican	halfbanded
pink	harlequin
pinkrose	honeycomb
pygmy	Mexican
redstripe	pink
rosethorn	pinkrose
rosy	pygmy
silvergray	redstripe
speckled	rosethorn
squarespot	rosy
starry	silvergray
stripetail	speckled
swordspine	squarespot
tiger	starry
vermillion	stripetail
yellowtail	swordspine
	tiger
	vermillion

Table 2. Cumulative landing limits of minor shelf rockfish in the limited entry trawl fishery south of 40°10' N. latitude, 2000-2010.

Year	Gear Requirements a/	Bimonthly Limits (lbs)					
		Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
2000	S	3,000/month		5,000/month			1,500/month
2001	S or MW	500/month		1,000/month		1,000/month (Sep) 500/month (Oct)	500/month
2002	S or MW	500/month		1,000/month b/	Closed		
2003 c/	S or MW	300 lb/month					
2004	L or MW	300 lb/month					
	S	300/month			200/month d/	200/month d/ (Sep) 300/month (Oct)	300/month
2005	L or MW	300/month e/					
	S	300/month f/					
2006	L or MW	300/month e/					
	S	300/month f/					
2007	L or MW	300/month e/					
	S	300/month f/					
2008	L or MW	300/month e/					
	S	300/month f/					
2009	L or MW	300/month e/					
	S	300/month f/					
2010	L or MW	300/month e/					
	S	300/month f/					

a/ S = small footrope trawls, which are bottom trawls with a footrope diameter ≤ 8 inches in diameter; MW = midwater trawls, which require bare footropes; L = large footrope trawls.
b/ No more than 300 lb of yelloweye allowed in monthly limit.
c/ Combined limit for minor shelf rockfish, chilipepper, and widow rockfish.
d/ Combined limit for minor shelf rockfish and widow rockfish.
e/ Combined limit for minor shelf rockfish and shortbelly rockfish.
f/ Combined limit for minor shelf rockfish, widow, yelloweye, and shortbelly rockfish.

Table 3. Cumulative landing limits of minor shelf rockfish in the limited entry fixed gear fishery south of 40°10’ N. latitude, 2000-2010.

Year	Area	Bimonthly Limits (lbs)					
		Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
2000	36° - 40°10’ N. lat.	100/month	Closed	300/month			100/month
	S of 36° N. lat.	Closed	100/month	300/month			100/month
2001	34°27' - 40°10' N. lat.	500/month	Closed		1,000/month	1,000/month (Sep) Closed (Oct)	Closed
	S of 34°27' N. lat.	Closed	500/month		1,000/month	1,000/month (Sep) Closed (Oct)	Closed
2002 a/	34°27' - 40°10' N. lat.	200/month	Closed	200/month b/	Closed		
	S of 34°27' N. lat.	Closed	1,000/month		Closed		
2003 a/	S of 40°10’ N. lat.	100	Closed	200	250	200	100
2004 a/	34°27' - 40°10' N. lat.	300	Closed	200		300	
	S of 34°27' N. lat.	Closed	2,000				
2004 c/	34°27' - 40°10' N. lat.	300	Closed	200		300	
	S of 34°27' N. lat.	Closed	2,000				
2005 c/	34°27' - 40°10' N. lat.	300	Closed	200		300	
	S of 34°27' N. lat.	2,000	Closed	2,000	3,000		
2006 c/	34°27' - 40°10' N. lat.	300	Closed	200		300	
	S of 34°27' N. lat.	3,000					
2007 c/	34°27' - 40°10' N. lat.	300	Closed	200		500 d/	
	S of 34°27' N. lat.	3,000	Closed	3,000			
2007 d/	34°27' - 40°10' N. lat.	300	Closed	200		500 d/	
	S of 34°27' N. lat.	3,000	Closed	3,000			
2008 d/	34°27' - 40°10' N. lat.	500 e/					
	S of 34°27' N. lat.	3,000	Closed	3,000			
2009 d/	34°27' - 40°10' N. lat.	500 e/					
	S of 34°27' N. lat.	3,000	Closed	3,000			
2010 d/	34°27' - 40°10' N. lat.	500 e/					
	S of 34°27' N. lat.	3,000	Closed	3,000			

a/ Combined limit for minor shelf rockfish and widow rockfish.

b/ Closed deeper than 20 fm.

c/ Combined limit for minor shelf rockfish, widow, and shortbelly rockfish.

d/ Combined limit for minor shelf rockfish, widow, bocaccio, and shortbelly rockfish.

e/ Combined limit of 2,500 lb/2 months for minor shelf rockfish, widow, bocaccio, shortbelly, and chilipepper rockfish, of which no more than 500 lb/2 months may be species other than chilipepper rockfish.

Table 4. Cumulative landing limits of minor shelf rockfish in the open access fishery south of 40°10' N. latitude, 2000-2010.

<table>
<tr><th rowspan="2">Year</th><th rowspan="2">Area</th><th colspan="6">Bimonthly Limits (lbs)</th></tr>
<tr><th>Jan-Feb</th><th>Mar-Apr</th><th>May-Jun</th><th>Jul-Aug</th><th>Sep-Oct</th><th>Nov-Dec</th></tr>
<tr><td rowspan="2">2000</td><td>36° - 40°10' N. lat.</td><td>200/month</td><td>Closed</td><td colspan="4">200/month</td></tr>
<tr><td>S of 36° N. lat.</td><td>Closed</td><td colspan="5">200/month</td></tr>
<tr><td rowspan="2">2001</td><td>34°27' - 40°10' N. lat.</td><td>200/month</td><td colspan="2">Closed</td><td>200/month</td><td>200/month (Sep)
Closed (Oct)</td><td>Closed</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>Closed</td><td colspan="3">200/month</td><td>200/month (Sep)
Closed (Oct)</td><td>Closed</td></tr>
<tr><td rowspan="2">2002 a/</td><td>34°27' - 40°10' N. lat.</td><td>200/month</td><td>Closed</td><td>200/month b/</td><td colspan="3">Closed</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>Closed</td><td colspan="2">500/month</td><td colspan="3">Closed</td></tr>
<tr><td>2003 c/</td><td>S of 40°10' N. lat.</td><td>100</td><td>Closed</td><td>200</td><td>250</td><td>200</td><td>100</td></tr>
<tr><td rowspan="2">2004 c/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>Closed</td><td colspan="5">500</td></tr>
<tr><td rowspan="2">2005 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>500</td><td>Closed</td><td>500</td><td colspan="3">750</td></tr>
<tr><td rowspan="2">2006 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td colspan="6">750</td></tr>
<tr><td rowspan="2">2007 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>750</td><td>Closed</td><td colspan="4">750</td></tr>
<tr><td rowspan="2">2008 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>750</td><td>Closed</td><td colspan="3">750</td><td>1,000</td></tr>
<tr><td rowspan="2">2009 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>750</td><td>Closed</td><td colspan="4">750</td></tr>
<tr><td rowspan="2">2010 d/</td><td>34°27' - 40°10' N. lat.</td><td>300</td><td>Closed</td><td colspan="2">200</td><td colspan="2">300</td></tr>
<tr><td>S of 34°27' N. lat.</td><td>750</td><td>Closed</td><td colspan="4">750</td></tr>
</table>

a/ Combined limit for minor shelf rockfish and widow rockfish.
b/ Closed deeper than 20 fm.
c/ Combined limit for minor shelf rockfish, chilipepper, and widow rockfish.
d/ Combined limit for minor shelf rockfish, chilipepper, widow, and shortbelly rockfish.

Table 5. Northern California landings of greenspotted rockfish by fishery and year.

Year	Trawl	Hook & Line	Net	CPFV	Private	Total
1916	0.3	5.3	0	0	0	5.60
1917	0.4	8.3	0	0	0	8.70
1918	0.5	9.4	0	0	0	9.90
1919	0.3	6.4	0	0	0	6.70
1920	0.3	6.6	0	0	0	6.90
1921	0.3	5.5	0	0	0	5.80
1922	0.2	4.8	0	0	0	5.00
1923	0.3	5.3	0	0	0	5.60
1924	0.1	3.7	0	0	0	3.80
1925	0.1	4.6	0	0	0	4.70
1926	0.4	6.8	0	0	0	7.20
1927	0.6	5.8	0	0	0	6.40
1928	0.8	6.5	0	0.54	0	7.84
1929	2	5.5	0	1.09	0	8.59
1930	1.6	7.4	0	1.25	0	10.25
1931	2.2	9.2	0	1.66	0	13.06
1932	2.3	2.9	0	2.08	0	7.28
1933	3.4	0.7	0	2.50	0	6.60
1934	2.8	2.1	0	2.91	0	7.81
1935	2.7	1.9	0	3.33	0	7.93
1936	1.8	2.1	0	3.75	0	7.65
1937	3	1.1	0	4.44	0	8.54
1938	3.4	1.5	0	4.37	0	9.27
1939	4.7	2.6	0	3.82	0	11.12
1940	3.6	2	0	5.50	0	11.10
1941	2.9	1.9	0	5.08	0	9.88
1942	0.9	0.5	0	2.70	0	4.10
1943	8.1	0.5	0	2.58	0	11.18
1944	31.5	1.1	0	2.12	0	34.72
1945	64.5	2.7	0	2.83	0	70.03
1946	48.6	3.7	0	4.86	0	57.16
1947	32.3	2.3	0	3.85	0	38.45
1948	20.6	2.2	0	7.68	0	30.48
1949	23.1	1.8	0	9.95	0	34.85
1950	24.1	3	0	12.13	0	39.23
1951	35.6	3	0	13.86	0	52.46
1952	22	2.3	0	12.06	0	36.36
1953	23.7	1.7	0	10.27	0	35.67
1954	19.9	2.3	0	12.77	0	34.97
1955	30	2.6	0	15.22	0	47.82
1956	26.1	2.8	0	16.99	0	45.89
1957	32.6	3.3	0	16.48	0	52.38
1958	35.7	3.4	0	26.23	0	65.33
1959	27.8	2	0	22.73	0	52.53
1960	24.1	2.3	0	17.64	0	44.04
1961	17	1.9	0	13.48	0.03	32.41
1962	15.3	2.6	0	15.26	0.15	33.30
1963	22	4	0	14.58	0.24	40.82

Table 5 (Continued) Northern California landings of greenspotted rockfish by fishery and year.

Year	Trawl	Hook & Line	Net	CPFV	Private	Total
1964	12.4	4.1	0	11.76	0.28	28.55
1965	16.4	2.7	0	17.92	0.57	37.59
1966	14.2	3.5	0	20.38	0.80	38.88
1967	21.4	2.9	0	22.08	1.04	47.41
1968	23.5	1.6	0	23.16	1.27	49.53
1969	14.98	0.89	0	25.18	1.58	39.13
1970	19.18	1.61	0	30.89	2.19	48.94
1971	19.62	2.02	0	23.39	1.85	43.30
1972	26.38	2.46	0	29.44	2.57	55.30
1973	34.62	3.01	0	42.18	4.04	72.35
1974	35.14	5.03	0	44.35	4.63	81.72
1975	41.50	3.56	0.01	46.34	5.24	89.68
1976	46.28	5.22	0.01	53.08	6.48	104.14
1977	46.38	4.52	0.01	45.49	5.96	95.06
1978	19.61	8.39	0	40.47	5.67	71.89
1979	59.04	14.24	0	45.73	6.83	123.41
1980	78.16	4.49	0.04	29.53	10.65	100.43
1981	172.46	34.68	0.07	42.13	0.31	228.58
1982	82.89	34.78	0.64	24.95	2.92	132.03
1983	69.58	22.64	0.68	27.39	3.91	121.95
1984	68.61	0.38	3.51	18.26	0.93	85.39
1985	70.03	1.8	7.42	66.85	5.83	150.41
1986	30.28	12.02	0.77	57.94	11.66	111.27
1987	67.43	3.58	1.09	10.24	9.26	88.96
1988	121.69	8.5	13.5	42.98	11.55	193.66
1989	141.52	29.25	9.45	14.93	13.84	208.81
1990	75.30	43.38	4.69	19.35	10.25	152.91
1991	33.18	125.86	4.98	17.66	9.60	191.28
1992	28.14	79.21	3.07	15.98	8.95	135.35
1993	49.16	46.76	0.87	14.29	8.84	119.91
1994	33.31	57.23	0.88	12.61	0.78	102.92
1995	39.89	56.62	1.7	10.93	13.32	122.45
1996	81.74	45.47	1.38	4.41	5.94	138.91
1997	24.45	25.76	0.24	14.65	0.82	65.87
1998	8.71	15.24	3.12	3.62	0.78	31.28
1999	6.63	3.71	0.07	21.79	9.75	41.91
2000	1.84	1.76	0.01	18.28	9.31	31.18
2001	1.73	0.46	0	11.38	3.45	16.92
2002	3.17	0.13	0.02	0.87	0.26	4.44
2003	0.29	0.14	0	0.00	0.00	0.43
2004	0.37	0	0	0.13	0.07	0.57
2005	0.01	0	0	0.23	0.08	0.31
2006	0.07	0.05	0	0.01	0.06	0.19
2007	0.76	0.09	0	0.16	0.18	1.19
2008	0.48	0.03	0	0.22	0.20	0.93
2009	0.19	0.05	0	0.61	0.23	1.08
2010	0.04	0.03	0	0.15	0.15	0.37

Table 6. Southern California landings of greenspotted rockfish by fishery and year.

Year	Trawl	Hook & Line	Net	CPFV	Private	Total
1916	0	34.0	0	0	0	34.0
1917	0	54.8	0	0	0	54.8
1918	0	50.0	0	0	0	50.0
1919	0	29.9	0	0	0	29.9
1920	0	32.5	0	0	0	32.5
1921	0	28.4	0	0	0	28.4
1922	0	27.9	0	0	0	27.9
1923	0	37.4	0	0	0	37.4
1924	0	50.1	0	0	0	50.1
1925	0	55.0	0	0	0	55.0
1926	0	68.3	0	0	0	68.3
1927	0	56.7	0	0	0	56.7
1928	0	48.3	0	0.1	0	48.4
1929	0	48.9	0	0.1	0	49.0
1930	0	49.8	0	0.2	0	50.0
1931	0	57.2	0	0.2	0	57.4
1932	0	43.9	0	0.3	0	44.2
1933	0	28.9	0	0.3	0	29.2
1934	0	29.8	0	0.4	0	30.2
1935	0	22.7	0	0.4	0	23.1
1936	0	10.2	0	0.4	0	10.6
1937	0	9.7	0	0.6	0	10.3
1938	0	6.2	0	0.6	0	6.8
1939	0	7.0	0	0.5	0	7.5
1940	0	14.0	0	0.4	0	14.4
1941	0	18.2	0	0.4	0	18.6
1942	0	7.3	0	0.2	0	7.5
1943	0	8.1	0	0.2	0	8.3
1944	0	1.5	0	0.1	0	1.6
1945	0	3.6	0	0.2	0	3.8
1946	0	7.3	0	0.3	0	7.6
1947	0	9.9	0	1.3	0	11.2
1948	0	15.2	0	3.4	0	18.6
1949	0	16.5	0	4.0	0	20.5
1950	0	10.8	0	5.3	0	16.1
1951	0.1	19.8	0	4.2	0	24.1
1952	0.1	14.0	0	6.3	0	20.4
1953	0.0	10.4	0	7.4	0	17.8
1954	0.4	13.9	0	14.7	0	29.0
1955	0.1	12.6	0	26.6	0	39.3
1956	0.4	13.9	0	30.6	0	44.9
1957	0.9	11.8	0	19.3	0	32.0
1958	1.7	9.6	0	15.3	0	26.6
1959	0.9	11.9	0	8.8	0	21.6
1960	2.3	12.3	0	9.7	0	24.3
1961	2.4	11.4	0	12.3	0.0	26.2
1962	1.4	10.0	0	13.1	0.4	24.8
1963	1.5	13.7	0	12.4	0.7	28.3

Table 6 (Continued) Southern California landings of greenspotted rockfish by fishery and year.

Year	Trawl	Hook & Line	Net	CPFV	Private	Total
1964	0.7	11.9	0	19.0	1.6	33.2
1965	1.3	16.1	0	23.6	2.7	43.7
1966	1.0	11.1	0	35.5	5.1	52.7
1967	2.3	14.0	0	47.3	8.4	72.0
1968	3.2	14.7	0	49.2	10.5	77.6
1969	87.6	16.1	0.2	35.6	9.0	148.5
1970	44.1	11.0	0.1	48.2	14.1	117.5
1971	65.1	12.6	0.1	45.3	15.2	138.3
1972	94.5	18.7	0.1	57.3	21.8	192.5
1973	104.9	17.7	0.3	69.6	29.9	222.5
1974	111.7	15.4	1.2	76.6	37.0	241.8
1975	82.7	27.6	1.0	76.0	41.0	228.3
1976	106.6	34.0	1.1	62.1	37.3	241.1
1977	132.0	28.8	1.5	58.9	39.3	260.6
1978	101.9	39.4	3.7	54.1	40.0	239.1
1979	65.9	64.4	10.1	70.7	57.8	268.9
1980	11.8	59.6	7.9	35.9	36.5	151.7
1981	18.5	65.0	9.3	23.0	15.8	131.6
1982	42.5	89.1	5.3	76.9	57.8	271.6
1983	67.8	21.8	2.6	70.6	19.2	182.0
1984	13.0	51.3	5.5	97.1	29.8	196.7
1985	6.1	41.3	23.5	104.1	49.8	224.8
1986	25.6	46.4	6.4	25.7	28.5	132.6
1987	13.2	13.9	8.4	0.1	7.2	42.8
1988	7.1	12.9	1.6	1.9	12.4	35.9
1989	4.4	20.0	8.3	8.0	22.2	62.9
1990	2.5	31.2	1.8	6.7	21.9	64.1
1991	3.7	15.6	2.0	8.4	25.9	55.6
1992	0.0	5.0	1.8	10.1	29.8	46.8
1993	0.0	4.1	1.2	6.8	31.5	43.6
1994	0.0	0.3	1.0	27.4	32.1	60.8
1995	0.0	41.8	0.6	6.4	49.8	98.6
1996	0.0	28.8	0.6	7.1	16.3	52.8
1997	0.1	16.5	0.3	3.2	7.5	27.6
1998	4.5	36.6	0.2	5.2	4.2	50.7
1999	2.2	4.3	0.0	10.8	13.6	31.0
2000	0.6	2.8	0.0	5.4	7.9	16.7
2001	0.2	0.2	0.1	2.5	9.8	12.8
2002	0.4	0.6	0	5.0	4.4	10.4
2003	0	0.0	0	0.0	0.5	0.5
2004	0	0.1	0	10.7	3.4	14.2
2005	0	0.3	0	22.8	2.3	25.3
2006	0	0.5	0	4.6	1.9	7.0
2007	0	0.6	0	10.5	2.4	13.5
2008	0	0.7	0	7.4	2.6	10.6
2009	0	0.6	0	10.8	3.0	14.4
2010	0	0.8	0	8.3	1.9	11.1

Table 7. Depth-based estimates of discard (% of total catch) by depth stratum in Monterey trawl fishery in 1960. Source: Heimann, 1963.

Depth	Total lbs	Discard %	Discard lbs	Effort (% tows)	Tows w/ Greenspotted	Total tows
Shallow (55-110 m)	17	1.5%	0.3	30%	2	10
Intermediate (110-238 m)	14	14.9%	2.1	58%	5	19
Deep (238-366 m)	10	0.0%	0	12%	2	4

Table 8. Average weights of discarded greenspotted rockfish by year, gear, and area. Source: WCGOP, 2011.

Year	Gear	Area	Number of Fish	Avg. Weight (kg)	Std. Dev. of Avg. Weight
2003	H&L	N of 3427	23	0.37	0.053
2008	H&L	N of 3427	25	0.95	0.089
2002	TRAWL	N of 3427	1028	0.36	0.016
2003	TRAWL	N of 3427	164	0.37	0.050
2004	TRAWL	N of 3427	115	0.49	0.043
2005	TRAWL	N of 3427	289	0.57	0.031
2006	TRAWL	N of 3427	331	0.37	0.027
2007	TRAWL	N of 3427	98	0.31	0.031
2008	TRAWL	N of 3427	40	0.53	0.163
2009	TRAWL	N of 3427	86	0.33	0.037
2010	TRAWL	N of 3427	30	0.34	0.051
2004	H&L	S of 3427	129	0.36	0.027
2005	H&L	S of 3427	53	0.40	0.016
2006	H&L	S of 3427	15	0.55	0.130
2007	H&L	S of 3427	13	0.39	0.032
2008	H&L	S of 3427	21	0.38	0.051

Table 9. WCGOP annual estimates of discard ratios for the California trawl and hook and line fleets by area and year.

Year	Gear	Area	Number of Trips	Number of Hauls	Discard (lbs.)	Retained (lbs.)	Discard Ratio Discard / Total lbs.	SD
2002	TRAWL	N of 3427	588	3212	749.92	102.8	0.879	0.438
2003	TRAWL	N of 3427	524	2511	132.29	60.5	0.686	0.387
2004	TRAWL	N of 3427	702	3854	122.52	7.9	0.939	0.452
2005	TRAWL	N of 3427	634	4029	364.1	3.9	0.989	0.447
2006	TRAWL	N of 3427	537	3200	272.78	0	1	0
2007	TRAWL	N of 3427	407	2604	67.08	115	0.368	0.267
2008	TRAWL	N of 3427	484	3341	46.62	0	1	0
2009	TRAWL	N of 3427	600	4422	62.39	0	1	0
2010	TRAWL	N of 3427	116	813	9.56	13.1	0.423	0.577
2007	TRAWL	S of 3427	42	217	0.1	0	1	0
2008	TRAWL	S of 3427	38	157	0	0	--	--
2002	H&L	N of 3427	69	392	0	1.2	0	0
2003	H&L	N of 3427	166	553	3.09	16.2	0.160	0.548
2004	H&L	N of 3427	381	829	5.6	3.9	0.589	0.577
2005	H&L	N of 3427	399	1035	0.9	12.35	0	0
2006	H&L	N of 3427	425	1010	0	0	--	--
2007	H&L	N of 3427	437	1038	0	19.9	0	0
2008	H&L	N of 3427	370	894	0	52.84	0	0
2009	H&L	N of 3427	367	702	7.2	0	1	0
2010	H&L	N of 3427	63	184	0	0	--	--
2002	H&L	S of 3427	10	21	0	0	--	--
2003	H&L	S of 3427	151	238	0	0	--	--
2004	H&L	S of 3427	92	174	7.3	96.6	0.070	0.095
2005	H&L	S of 3427	58	83	0	47.1	0	0
2006	H&L	S of 3427	110	170	0	18.26	0	0
2007	H&L	S of 3427	143	283	0	11.05	0	0
2008	H&L	S of 3427	105	192	0	17.7	0	0
2009	H&L	S of 3427	125	271	0	5.85	0	0
2010	H&L	S of 3427	60	134	0	0	--	--

Table 10. Estimated total catch of greenspotted rockfish in northern California (retained plus discarded catch) by year and fishery.

Year	Trawl	Hook and Line	Net	Recreational (CPFV + Private/Rental)
1916	0.32	6.15	0	0
1917	0.42	9.63	0	0
1918	0.53	10.90	0	0
1919	0.32	7.42	0	0
1920	0.32	7.66	0	0
1921	0.32	6.38	0	0
1922	0.21	5.57	0	0
1923	0.32	6.15	0	0
1924	0.11	4.29	0	0
1925	0.11	5.34	0	0
1926	0.42	7.89	0	0
1927	0.64	6.73	0	0
1928	0.85	7.54	0	0.57
1929	2.12	6.38	0	1.14
1930	1.70	8.58	0	1.31
1931	2.33	10.67	0	1.74
1932	2.44	3.36	0	2.18
1933	3.60	0.81	0	2.63
1934	2.97	2.44	0	3.06
1935	2.86	2.20	0	3.50
1936	1.91	2.44	0	3.94
1937	3.18	1.28	0	4.66
1938	3.60	1.74	0	4.59
1939	4.98	3.02	0	4.01
1940	3.82	2.32	0	5.78
1941	3.07	2.20	0	5.33
1942	0.95	0.58	0	2.84
1943	8.59	0.58	0	2.71
1944	33.39	1.28	0	2.23
1945	68.37	3.13	0	2.97
1946	51.52	4.29	0	5.10
1947	34.24	2.67	0	4.04
1948	21.84	2.55	0	8.06
1949	24.49	2.09	0	10.45
1950	25.55	3.48	0	12.74
1951	37.74	3.48	0	14.55
1952	23.32	2.67	0	12.66
1953	25.12	1.97	0	10.78
1954	21.09	2.67	0	13.41
1955	31.80	3.02	0	15.98
1956	27.67	3.25	0	17.84
1957	34.56	3.83	0	17.30
1958	37.84	3.94	0	27.54
1959	29.47	2.32	0	23.87
1960	25.55	2.67	0	18.53
1961	18.02	2.20	0	14.17
1962	16.22	3.02	0	16.12
1963	23.32	4.64	0	15.49

Table 10 (continued) Estimated total catch of greenspotted rockfish in northern California (retained plus discarded catch) by year and fishery.

Year	Trawl	Hook and Line	Net	Recreational (CPFV + Private/Rental)
1964	13.14	4.76	0	12.57
1965	17.38	3.13	0	19.26
1966	15.05	4.06	0	22.02
1967	22.68	3.36	0	23.99
1968	24.91	1.86	0	25.32
1969	15.88	1.03	0	27.69
1970	20.33	1.87	0	34.17
1971	20.79	2.34	0	26.03
1972	27.96	2.85	0	32.96
1973	36.70	3.49	0	47.50
1974	37.25	5.83	0	50.25
1975	43.99	4.13	0.01	52.83
1976	49.05	6.06	0.01	60.90
1977	49.17	5.24	0.01	52.51
1978	20.78	9.73	0.00	47.01
1979	62.58	16.52	0.00	53.46
1980	82.85	5.21	0.05	40.81
1981	182.81	40.23	0.08	42.99
1982	87.87	40.34	0.74	28.23
1983	73.75	26.26	0.79	31.71
1984	72.73	0.44	4.07	19.43
1985	74.23	2.09	8.61	73.62
1986	32.10	13.94	0.89	70.50
1987	71.47	4.15	1.26	19.75
1988	129.00	9.86	15.66	55.24
1989	150.01	33.93	10.96	29.14
1990	79.82	50.32	5.44	30.04
1991	35.17	146.00	5.78	27.67
1992	29.83	91.88	3.56	25.30
1993	52.11	54.24	1.01	23.49
1994	35.31	66.39	1.02	13.58
1995	42.28	65.68	1.97	24.61
1996	86.65	52.75	1.60	10.51
1997	25.91	29.88	0.28	15.70
1998	9.23	17.68	3.62	4.46
1999	7.03	4.30	0.08	32.01
2000	1.95	2.04	0.01	27.78
2001	1.83	0.53	0.00	14.92
2002	3.36	0.15	0.02	1.15
2003	0.31	0.16	0	0.00
2004	0.39	0.00	0	0.20
2005	0.01	0.00	0	0.30
2006	0.07	0.06	0	0.07
2007	0.81	0.10	0	0.34
2008	0.51	0.03	0	0.42
2009	0.20	0.06	0	0.85
2010	0.04	0.03	0	0.30

Table 11. Estimated total catch of greenspotted rockfish in southern California (retained plus discarded catch) by year and fishery.

Year	Trawl	Hook and Line	Net	CPFV	Private/Rental
1916	0.00	35.36	0	0	0
1917	0.00	56.99	0	0	0
1918	0.00	52.00	0	0	0
1919	0.00	31.10	0	0	0
1920	0.00	33.80	0	0	0
1921	0.00	29.54	0	0	0
1922	0.00	29.02	0	0	0
1923	0.00	38.90	0	0	0
1924	0.00	52.10	0	0	0
1925	0.00	57.20	0	0	0
1926	0.00	71.03	0	0	0
1927	0.00	58.97	0	0	0
1928	0.00	50.23	0	0.06	0
1929	0.00	50.86	0	0.11	0
1930	0.00	51.79	0	0.17	0
1931	0.00	59.49	0	0.22	0
1932	0.00	45.66	0	0.28	0
1933	0.00	30.06	0	0.33	0
1934	0.00	30.99	0	0.39	0
1935	0.00	23.61	0	0.44	0
1936	0.00	10.61	0	0.44	0
1937	0.00	10.09	0	0.66	0
1938	0.00	6.45	0	0.63	0
1939	0.00	7.28	0	0.52	0
1940	0.00	14.56	0	0.41	0
1941	0.00	18.93	0	0.38	0
1942	0.00	7.59	0	0.20	0
1943	0.00	8.42	0	0.19	0
1944	0.00	1.56	0	0.16	0
1945	0.00	3.74	0	0.21	0
1946	0.00	7.59	0	0.37	0
1947	0.00	10.30	0	1.44	0
1948	0.00	15.81	0	3.62	0
1949	0.00	17.16	0	4.24	0
1950	0.00	11.23	0	5.64	0
1951	0.11	20.59	0	4.52	0
1952	0.11	14.56	0	6.79	0
1953	0.00	10.82	0	7.96	0
1954	0.42	14.46	0	15.78	0
1955	0.11	13.10	0	28.49	0
1956	0.42	14.46	0	32.77	0
1957	0.95	12.27	0	20.74	0
1958	1.80	9.98	0	16.39	0
1959	0.95	12.38	0	9.45	0
1960	2.44	12.79	0	10.37	0
1961	2.54	11.86	0	13.23	0.03
1962	1.48	10.40	0	14.00	0.45
1963	1.59	14.25	0	13.32	0.83

Table 11. (continued) Estimated total catch of greenspotted rockfish in southern California (retained plus discarded catch) by year and fishery.

Year	Trawl	Hook and Line	Net	CPFV	Private/Rental
1964	0.74	12.38	0	20.36	1.93
1965	1.38	16.74	0	25.32	3.27
1966	1.06	11.54	0	38.02	6.28
1967	2.44	14.56	0	50.67	10.31
1968	3.39	15.29	0	52.71	12.86
1969	92.86	16.74	0.21	38.22	10.97
1970	46.75	11.44	0.10	51.70	17.21
1971	69.01	13.10	0.10	48.57	18.54
1972	100.17	19.45	0.10	61.47	26.68
1973	111.19	18.41	0.31	74.65	36.57
1974	118.40	16.02	1.25	82.10	45.16
1975	87.66	28.70	1.04	81.49	50.09
1976	113.00	35.36	1.14	66.59	45.59
1977	139.92	29.95	1.56	63.20	48.04
1978	108.01	40.98	3.85	58.02	48.87
1979	69.85	66.98	10.50	75.81	70.65
1980	12.51	61.98	8.22	38.51	44.59
1981	19.61	67.60	9.67	24.70	19.31
1982	45.05	92.66	5.51	82.41	70.64
1983	71.87	22.67	2.70	75.68	23.44
1984	13.78	53.35	5.72	104.15	36.39
1985	6.47	42.95	24.44	111.62	60.77
1986	27.14	48.26	6.66	27.52	34.80
1987	13.99	14.46	8.74	0.08	8.82
1988	7.53	13.42	1.66	2.00	15.13
1989	4.66	20.80	8.63	8.62	27.06
1990	2.65	32.45	1.87	6.88	25.61
1991	3.92	16.22	2.08	8.62	30.26
1992	0.00	5.20	1.87	10.36	34.92
1993	0.00	4.26	1.25	6.99	36.85
1994	0.00	0.31	1.04	28.01	37.56
1995	0.00	43.47	0.62	6.51	58.28
1996	0.00	29.95	0.62	7.28	19.04
1997	0.11	17.16	0.31	3.27	8.78
1998	4.77	38.06	0.21	5.31	4.92
1999	2.33	4.47	0.00	11.09	15.96
2000	0.64	2.91	0.00	5.47	8.42
2001	0.21	0.21	0.10	2.53	10.45
2002	0.42	0.62	0	5.06	4.68
2003	0	0.00	0	0.03	0.54
2004	0	0.10	0	10.86	3.60
2005	0	0.31	0	23.04	2.42
2006	0	0.52	0	4.66	1.99
2007	0	0.62	0	10.60	2.55
2008	0	0.73	0	7.46	2.75
2009	0	0.62	0	10.93	3.17
2010	0	0.83	0	8.45	2.05

Table 12. Sample sizes for commercial length composition data (number of samples and number of fish) by region, gear, and year. Compositions were not estimated for strata with fewer than 10 fish (not shown).

	Southern California						Northern California					
	Trawl		Hook and Line		Net		Trawl		Hook and Line		Net	
year	**# samp**	**# fish**	**# samp**	**# fish**	**# samp**	**# fish**	**# samp**	**# fish**	**# samp**	**# fish**	**# samp**	**# fish**
1978							19	36				
1979							13	27	13	102		
1980							30	63	1	31		
1981							21	68	19	122		
1982							11	20	9	43		
1983	3	95	1	16	9	29	31	94	2	39		
1984	3	46	9	70	8	37	44	97				
1985	2	21	7	56	17	131	74	256				
1986			25	334	10	88	39	91				
1987	1	22	12	172	6	29	28	96				
1988	1	12	6	81	10	34	28	106			2	11
1989			12	98	1	12	25	86			10	55
1990			2	12			42	145	3	12	5	12
1991							19	73	7	145		
1992			2	11	3	14	7	101	49	744		
1993							34	324	71	568		
1994							13	114	45	624	5	15
1995			20	264			11	78	16	261	3	13
1996			23	285	4	26	4	55	32	377		
1997			36	369			19	282	20	141		
1998			66	1201			4	87	3	66		
1999			5	92			2	35				
2000							7	107	3	19		
2001	1	42					8	165	11	70		
2002			4	15			5	78				
2003							1	67				
2004							6	61				
2005												
2006			2	18								
2007							2	12				
2008			5	107			4	26				
2009			9	186								
2010			12	260			1	31				
Total	11	238	258	3647	68	400	552	2881	304	3364	25	106

Table 13. Initial values for effective sample sizes for commercial fishery length composition data based on Stewart (2007).

	Southern California			Northern California		
year	**Trawl**	**Hook and Line**	**Net**	**Trawl**	**Hook and Line**	**Net**
1978				24.0		
1979				16.7	27.1	
1980				38.7	5.3	
1981				30.4	35.8	
1982				13.8	14.9	
1983	16.1	3.2	13.0	44.0	7.4	
1984	9.3	18.7	13.1	57.4		
1985	4.9	14.7	35.1	109.3		
1986		71.1	22.1	51.6		
1987	4.0	35.7	10.0	41.2		
1988	2.7	17.2	14.7	42.6		3.518
1989		25.5	2.7	36.9		17.59
1990		3.7		62.0	4.7	6.656
1991				29.1	27.0	
1992		3.5	4.9	20.9	151.7	
1993				78.7	149.4	
1994				28.7	131.1	7.07
1995		56.4		21.8	52.0	4.794
1996		62.3	7.6	11.6	84.0	
1997		86.9		57.9	39.5	
1998		231.7		16.0	12.1	
1999		17.7		6.8		
2000				21.8	5.6	
2001	6.8			30.8	20.7	
2002		6.1		15.8		
2003				7.1		
2004				14.4		
2005						
2006		4.5				
2007				3.7		
2008		19.8		7.6		
2009		34.7				
2010		47.9		5.3		

Table 14. Recreational catch of greenspotted rockfish in 1000s of fish from the RecFIN website (www.recfin.org) by subregion, catch type, boat mode, and year. Catch types: A= sampler examined, B1=unavailable landings and dead discard, B2=released alive. Catch types B1 and B2 are based on angler recollection of species-specific catch. See text for details regarding interpolated values (in bold italics).

	No. CA							SoCA							
	Type A		Type B1		Type B2			Type A		Type B1		Type B2			
Year	**CPFV**	**Private**	**CPFV**	**Private**	**CPFV**	**Private**	**No. CA Total**	**CPFV**	**Private**	**CPFV**	**Private**	**CPFV**	**Private**	**So. CA Total**	**Grand Total**
1980	37.8	17.9	3.2	0.2			59.1	117.6	77.8	0.8	9.1			205.2	264.4
1981	48.6	0.6	1.3				50.6	41.8	28.6				2.8	73.1	123.7
1982	32.9	5.0					37.8	112.9	101.0		0.4	0.6		214.9	252.8
1983	46.4	6.3					52.7	103.3	36.1	10.7	18.5			168.5	221.2
1984	27.5	2.4	0.7				30.7	192.3	64.0	14.0	26.7			297.0	327.7
1985	101.3	11.2					112.5	169.7	113.1	18.7	26.4		0.4	328.3	440.8
1986	85.9	15.7					101.6	78.6	71.5	15.7	56.8	0.2		222.9	324.5
1987	15.5	13.3	0.6				29.4	0.7	24.9					25.6	55.0
1988	63.6	***16.6***	2.9				83.1	3.8	32.0		3.3			39.1	122.2
1989	23.5	19.9					43.4	15.7	59.8		1.6			77.1	120.5
1990	***29.9***	***14.9***					44.8	***14.5***	***52.1***					66.6	111.4
1991	***27.8***	***14.0***					41.8	***18.4***	***58.7***					77.0	118.9
1992	***25.7***	***13.1***					38.8	***22.2***	***65.3***					87.5	126.3
1993	***23.6***	10.8		0.8			35.1	13.3	57.0		1.2		3.0	74.6	109.7
1994	***21.4***	1.3					22.7	56.7	67.5		25.0			149.3	172.0
1995	***19.3***	22.2					41.5	19.8	110.8	0.7	22.4		3.0	156.7	198.1
1996	9.5	13.4	0.1				22.9	25.0	35.2		7.8	0.7		68.7	91.6
1997	28.4	1.2	1.4		0.1		31.0	13.2	20.1		0.6		1.4	35.2	66.2
1998	7.2	0.9			0.2		8.2	17.5	10.0	2.3				29.8	38.0
1999	45.2	16.7	0.1				62.0	39.0	40.3	3.0		1.7		84.0	146.0
2000	40.0	16.6	0.6				57.3	19.1	19.0	1.2		1.5		40.8	98.1
2001	22.8	5.0					27.8	10.7	21.3	0.3				32.4	60.2
2002	2.2	0.5					2.7	17.0	14.0					31.0	33.6
2003	***0.0***	***0.0***					0.0	0.1	1.4					1.5	1.5
2004	0.2	0.1				0.0	0.3	28.7	9.3	0.3	0.2	0.1	0.3	39.0	39.3
2005	0.4	0.1				0.0	0.5	53.7	5.9	0.5	1.7	0.4	0.2	62.5	63.0
2006	0.0	0.1			0.0		0.1	12.2	5.1	0.1	0.4	0.2	0.1	18.1	18.3
2007	0.3	0.3			0.3	0.0	1.0	25.7	6.0	0.3	1.1	0.3	1.0	34.5	35.5
2008	0.7	0.3	0.1	0.0	0.1	0.1	1.3	19.2	6.3	0.2	0.6	0.3	0.4	26.9	28.2
2009	1.0	0.3			0.0		1.4	25.3	6.5	0.2	1.5	1.0	0.2	34.5	35.9
2010	0.4	0.2	0.0	0.0			0.7	24.6	4.8	0.2	1.6	0.4	0.7	32.5	33.1
Grand Total	**789.1**	**240.9**	**11.0**	**1.0**	**0.7**	**0.2**	**1042.9**	**1312.1**	**1225.3**	**69.3**	**206.9**	**7.4**	**13.6**	**2834.7**	**3877.5**

Table 15. Recreational catch (Type A, sampler-examined) in weight (mt) and numbers (1000s) for greenspotted rockfish in California. Waters south of 34° 27′ N. latitude are considered Southern California. Interpolated values (grey shading) are described in the main text.

	Northern and Central California				Southern California				Statewide			
	CPFV		Private		CPFV		Private		CPFV		Private	
Year	Catch (mt)	Catch (1000s)	Catch (mt)	Catch (1000s)	Catch (mt)	Catch (1000s)	Catch (mt)	Catch (1000s)	Catch (mt)	Catch (1000s)	Catch (mt)	Catch (1000s)
1980	29.53	37.84	10.65	17.94	35.91	117.56	36.51	77.77	65.45	155.39	47.16	95.71
1981	42.13	48.63	0.31	0.62	23.03	41.76	15.81	28.58	65.16	90.39	16.12	29.20
1982	24.95	32.85	2.92	4.98	76.85	112.89	57.84	101.03	101.80	145.74	60.76	106.01
1983	27.39	46.42	3.91	6.27	70.58	103.29	19.20	36.06	97.97	149.70	23.10	42.33
1984	18.26	27.55	0.93	2.43	97.13	192.29	29.79	63.98	115.39	219.84	30.72	66.41
1985	66.85	101.25	5.83	11.24	104.10	169.69	49.76	113.13	170.95	270.95	55.59	124.37
1986	57.94	85.91	11.66	15.72	25.67	78.63	28.49	71.52	83.61	164.54	40.15	87.24
1987	10.24	15.49	9.26	13.30	0.07	0.71	7.22	24.89	10.31	16.20	16.48	38.18
1988	42.98	63.63	11.55	16.60	1.87	3.81	12.39	32.00	44.85	67.43	23.94	48.60
1989	14.93	23.51	13.84	19.90	8.03	15.74	22.15	59.82	22.96	39.25	36.00	79.73
1990	19.35	29.95	10.25	14.87	6.72	14.49	21.88	52.08	26.07	44.44	32.13	66.95
1991	17.66	27.82	9.60	14.00	8.42	18.35	25.86	58.67	26.09	46.17	35.46	72.68
1992	15.98	25.69	8.95	13.14	10.12	22.22	29.84	65.26	26.10	47.91	38.78	78.40
1993	14.29	23.56	8.84	10.79	6.83	13.32	31.49	57.03	21.12	36.88	40.33	67.82
1994	12.61	21.43	0.78	1.27	27.38	56.75	32.10	67.51	39.99	78.17	32.87	68.78
1995	10.93	19.30	13.32	22.16	6.36	19.80	49.80	110.80	17.29	39.10	63.12	132.96
1996	4.41	9.53	5.94	13.36	7.12	24.99	16.27	35.17	11.53	34.52	22.21	48.53
1997	14.65	28.42	0.82	1.17	3.19	13.19	7.50	20.06	17.84	41.60	8.32	21.23
1998	3.62	7.16	0.78	0.87	5.19	17.51	4.20	10.00	8.81	24.67	4.98	10.87
1999	21.79	45.20	9.75	16.68	10.84	38.98	13.64	40.35	32.63	84.17	23.39	57.03
2000	18.28	40.03	9.31	16.59	5.41	19.06	7.86	19.00	23.69	59.10	17.17	35.59
2001	11.38	22.81	3.45	5.00	2.50	10.69	9.76	21.33	13.88	33.50	13.21	26.33
2002	0.87	2.18	0.26	0.48	5.00	16.96	4.37	13.99	5.88	19.14	4.63	14.47
2003	0.00	0.00	0.00	0.00	0.03	0.12	0.51	1.37	0.03	0.12	0.51	1.37
2004	0.13	0.15	0.07	0.10	10.73	28.71	3.37	9.29	10.86	28.87	3.43	9.39
2005	0.23	0.37	0.08	0.12	22.77	53.69	2.26	5.91	23.00	54.06	2.34	6.03
2006	0.01	0.03	0.06	0.08	4.61	12.16	1.86	5.15	4.62	12.19	1.92	5.22
2007	0.16	0.31	0.18	0.34	10.48	25.72	2.38	5.98	10.63	26.02	2.57	6.32
2008	0.22	0.69	0.20	0.29	7.37	19.16	2.57	6.27	7.59	19.85	2.77	6.56
2009	0.61	1.02	0.23	0.34	10.81	25.27	2.96	6.45	11.42	26.29	3.19	6.79
2010	0.15	0.43	0.15	0.21	8.35	24.65	1.92	4.84	8.50	25.07	2.07	5.06
Total	**502.5**	**789.1**	**153.9**	**240.9**	**623.5**	**1312.1**	**551.5**	**1225.3**	**1126.0**	**2101.3**	**705.4**	**1466.2**

Table 16. Partitioning of historical recreational catch (No. CA) into CPFV and private/party boat modes.

Year	Area	Pounds	Proportion Private	Private (mt)	CPFV (mt)
1928	NORTH	1197.8	0%	0	0.54
1929	NORTH	2395.1	0%	0	1.09
1930	NORTH	2752.6	0%	0	1.25
1931	NORTH	3670	0%	0	1.66
1932	NORTH	4587.4	0%	0	2.08
1933	NORTH	5504.7	0%	0	2.50
1934	NORTH	6422.1	0%	0	2.91
1935	NORTH	7339.5	0%	0	3.33
1936	NORTH	8256.9	0%	0	3.75
1937	NORTH	9787.3	0%	0	4.44
1938	NORTH	9626.2	0%	0	4.37
1939	NORTH	8418	0%	0	3.82
1940	NORTH	12123.3	0%	0	5.50
1941	NORTH	11204.6	0%	0	5.08
1942	NORTH	5952	0%	0	2.70
1943	NORTH	5692.4	0%	0	2.58
1944	NORTH	4673.8	0%	0	2.12
1945	NORTH	6231.6	0%	0	2.83
1946	NORTH	10725.3	0%	0	4.86
1947	NORTH	8485.2	0%	0	3.85
1948	NORTH	16933.8	0%	0	7.68
1949	NORTH	21946.1	0%	0	9.95
1950	NORTH	26744.5	0%	0	12.13
1951	NORTH	30554.9	0%	0	13.86
1952	NORTH	26586.5	0%	0	12.06
1953	NORTH	22641	0%	0	10.27
1954	NORTH	28146.3	0%	0	12.77
1955	NORTH	33554.1	0%	0	15.22
1956	NORTH	37465.2	0%	0	16.99
1957	NORTH	36329.2	0%	0	16.48
1958	NORTH	57819.6	0%	0	26.23
1959	NORTH	50115	0%	0	22.73
1960	NORTH	38880.9	0%	0	17.64
1961	NORTH	29785.1	0.2%	0.03	13.48
1962	NORTH	33951.9	0.9%	0.15	15.26
1963	NORTH	32678.1	1.7%	0.24	14.58
1964	NORTH	26557.5	2.4%	0.28	11.76
1965	NORTH	40763.7	3.1%	0.57	17.92
1966	NORTH	46685	3.8%	0.80	20.38
1967	NORTH	50957.8	4.5%	1.04	22.08
1968	NORTH	53868.4	5.2%	1.27	23.16
1969	NORTH	58987.2	5.9%	1.58	25.18
1970	NORTH	72921.9	6.6%	2.19	30.89
1971	NORTH	55641.9	7.3%	1.85	23.39
1972	NORTH	70581.1	8.0%	2.57	29.44
1973	NORTH	101895.3	8.7%	4.04	42.18
1974	NORTH	107979.9	9.5%	4.63	44.35
1975	NORTH	113719.4	10.2%	5.24	46.34
1976	NORTH	131305.1	10.9%	6.48	53.08
1977	NORTH	113433.5	11.6%	5.96	45.49
1978	NORTH	101717.6	12.3%	5.67	40.47
1979	NORTH	115883.6	13.0%	6.83	45.73

Table 17. Partitioning of historical recreational catch (So. CA) into CPFV and private/party boat modes.

Year	Area	Pounds	Proportion Private	Private (mt)	CPFV (mt)
1928	SOUTH	114.1	0%	0	0.05
1929	SOUTH	228.3	0%	0	0.10
1930	SOUTH	342.5	0%	0	0.16
1931	SOUTH	456.7	0%	0	0.21
1932	SOUTH	570.9	0%	0	0.26
1933	SOUTH	685	0%	0	0.31
1934	SOUTH	799.2	0%	0	0.36
1935	SOUTH	913.4	0%	0	0.41
1936	SOUTH	913.4	0%	0	0.41
1937	SOUTH	1360.9	0%	0	0.62
1938	SOUTH	1304.6	0%	0	0.59
1939	SOUTH	1073	0%	0	0.49
1940	SOUTH	849.9	0%	0	0.39
1941	SOUTH	785.5	0%	0	0.36
1942	SOUTH	417.2	0%	0	0.19
1943	SOUTH	399	0%	0	0.18
1944	SOUTH	327.6	0%	0	0.15
1945	SOUTH	436.9	0%	0	0.20
1946	SOUTH	751.9	0%	0	0.34
1947	SOUTH	2960.6	0%	0	1.34
1948	SOUTH	7452.1	0%	0	3.38
1949	SOUTH	8714.4	0%	0	3.95
1950	SOUTH	11597.5	0%	0	5.26
1951	SOUTH	9298.6	0%	0	4.22
1952	SOUTH	13968	0%	0	6.34
1953	SOUTH	16368.8	0%	0	7.42
1954	SOUTH	32445.8	0%	0	14.72
1955	SOUTH	58579.2	0%	0	26.57
1956	SOUTH	67368.1	0%	0	30.56
1957	SOUTH	42647.8	0%	0	19.34
1958	SOUTH	33693.1	0%	0	15.28
1959	SOUTH	19422.3	0%	0	8.81
1960	SOUTH	21321.8	0%	0	9.67
1961	SOUTH	27275	0.2%	0.03	12.34
1962	SOUTH	29595.8	2.7%	0.37	13.06
1963	SOUTH	28896.8	5.2%	0.68	12.43
1964	SOUTH	45357.4	7.7%	1.58	18.99
1965	SOUTH	57954.3	10.2%	2.68	23.61
1966	SOUTH	89503.5	12.7%	5.14	35.46
1967	SOUTH	122783.2	15.2%	8.44	47.25
1968	SOUTH	131582	17.6%	10.53	49.16
1969	SOUTH	98397.2	20.1%	8.98	35.65
1970	SOUTH	137367.6	22.6%	14.09	48.22
1971	SOUTH	133325.3	25.1%	15.18	45.29
1972	SOUTH	174540.9	27.6%	21.84	57.33
1973	SOUTH	219501.9	30.1%	29.95	69.62
1974	SOUTH	250307.7	32.6%	36.97	76.57
1975	SOUTH	257964	35.1%	41.01	76.00
1976	SOUTH	219213	37.5%	37.33	62.11
1977	SOUTH	216662.4	40.0%	39.34	58.94
1978	SOUTH	207499.9	42.5%	40.01	54.11
1979	SOUTH	283391.7	45.0%	57.84	70.70

Table 18. Estimates of discard ratios (discard/retained) based on catch types A and B1 from RecFIN, by area, boat mode, and decade.

	Northern California	Southern California	
Time period	**CPFV & Private modes**	**CPFV**	**Private**
1980-1989	0.016	0.072	0.221
1990-1999	0.015	0.023	0.170
2000-2010	0.007	0.012	0.070

Table 19. Percent discard (numbers of fish) in the 1960 central California ocean sport fishery. Source: Miller and Gotshall (1965).

Discard at Six Ports From Bodega Bay to Avila. Data Collected at Sea During 1960

	*Total fish caught	Number discarded	Percent discarded
ROCKFISH	**17,661**	**1,042**	**5.9**
Blue	7,070	483	6.8
Black	496	15	3.0
Olive	671	3	0.4
Yellowtail	4,771	61	1.3
Copper	309	1	0.3
Brown	226	1	0.2
Bocaccio	244	4	0.2
Rosy	892	333	37.3
Widow	847	17	2.0
Canary	980	21	2.1
Starry	429	17	4.0
Greenspotted	410	19	4.6
Greenstriped	91	22	24.2
Stripetail	13	5	38.5
Squarespot	90	24	26.7
Speckled	111	8	7.2
Calico	11	8	72.7
FLATFISH	**96**	**6**	**6.3**
Pacific sanddab	96	6	6.3
MISCELLANEOUS	**284**	**86**	**30.3**
Red Irish lord	2	2	100.0
Buffalo sculpin	2	2	100.0
Wolf-eel	2	1	50.0
Cabezon	18	1	5.6
Sablefish	18	8	44.4
Kelp greenling	16	1	6.3
Pacfic hake	26	24	92.3
Jacksmelt	15	4	26.7
Pacific mackerel	91	24	26.4
Blue shark	12	12	100.0
Spiny dogfish	1	1	100.0
Skates	1	1	100.0
Pacific hagfish	1	1	100.0
White croaker	79	4	5.1
TOTAL	**18,041**	**1,134**	**6.3**

Percent discarded of all fish caught on sampling days was 5.2.
* Includes only those species for which there were discards.

Table 20. Sample sizes for recreational length composition data from RecFIN.

	So. CA				No. CA			
	CPFV		Private		CPFV		Private	
Year	samples	fish	samples	fish	samples	fish	samples	fish
1980	52	96	34	114	53	121	5	23
1981	62	116	19	64	40	91	2	3
1982	92	244	68	209	37	51	11	29
1983	147	416	23	101	44	120	11	27
1984	223	687	22	93	90	221	4	5
1985	178	530	34	132	247	839	20	57
1986	80	124	12	54	206	595	8	43
1987	1	1	5	23	35	70	8	17
1988			10	27	37	98		
1989	3	3	17	69	45	71	7	43
1990								
1991								
1992								
1993	17	33	40	115	1	2	11	39
1994	54	148	45	128	9	12	4	6
1995	13	30	41	99	20	36	16	63
1996	44	62	29	76	60	125	2	12
1997	12	16	9	23	50	524	1	2
1998	52	147	18	34	38	187	4	4
1999	153	321	53	166	201	577	6	18
2000	145	318	22	62	66	146	5	16
2001	66	110	12	29	69	191	3	11
2002	90	158	11	40	32	56		
2003	7	7	9	13				
2004	238	521	98	237	3	5	5	11
2005	239	585	89	231	4	5	7	14
2006	325	884	113	386	2	2	8	10
2007	378	851	119	366	8	12	9	31
2008	343	800	107	483	18	34	16	24
2009	429	1008	130	369	15	31	14	36
2010	464	892	100	342	9	14	9	19

Table 21. Initial values for effective sample sizes of recreational length composition data by region, boat mode, and year, following Stewart (2007). CPFV and private modes were combined in the northern model (last column).

	So. CA		No. CA		No. CA
Year	**CPFV**	**Private**	**CPFV**	**Private**	**CPFV+Private**
1980	65.2	49.7	69.7	8.2	77.9
1981	78.0	27.8	52.6		55.0
1982	125.7	96.8	44.0	15.0	59.0
1983	204.4	36.9	60.6	14.7	75.3
1984	317.8	34.8	120.5		125.2
1985	251.1	52.2	362.8	27.9	390.6
1986	97.1	19.5	288.1	13.9	302.0
1987	-1.1	8.2	44.7		55.0
1988		13.7	50.5		50.5
1989	-3.4	26.5	54.8	12.9	67.7
1990					
1991					
1992					
1993	21.6	55.9		16.4	279.4
1994	74.4	62.7			205.0
1995	17.1	54.7	25.0	24.7	174.4
1996	52.6	39.5	77.3		135.7
1997	-14.2	12.2	122.3		123.6
1998	72.3	22.7	63.8		68.4
1999	197.3	75.9	280.6		289.1
2000	188.9	30.6	86.1		93.4
2001	81.2	16.0	95.4		99.9
2002	111.8	16.5	39.7		39.7
2003	-8.0	-10.8			
2004	309.9	130.7			10.2
2005	319.7	120.9			13.6
2006	447.0	166.3			11.7
2007	495.4	169.5		13.3	22.9
2008	453.4	173.7	22.7	19.3	42.0
2009	568.1	180.9	19.3	19.0	38.2
2010	587.1	147.2			22.6

Table 22. Actual and estimated initial effective samples sizes (EffN) for length composition data from recreational fisheries.

Northern CA onboard CPFV observer data (years 1990-1996 used in assessment)

YEAR	# fish	# trips	EffN
1987	122	24	40.8
1988	736	66	167.6
1989	1311	91	271.9
1990	249	39	73.4
1991	471	37	102.0
1992	821	103	216.3
1993	1290	85	263.0
1994	914	74	200.1
1995	643	61	149.7
1996	587	51	132.0
1997	708	71	168.7
1998	315	33	76.5

Northern CA dockside sampling program (1978, 1979 used in assessment)

year	# fish	# samples	EffN
1978	339	75	121.8
1979	596	100	182.2
1980	211	79	108.1
1981	149	49	69.6
1982	120	70	86.6
1983	64	32	40.8
1984	82	29	40.3

Southern CA onboard observer program

year	Trips	Fish	EffN
1975	118	914	244.1
1976	154	1424	350.5
1977	108	1572	324.9
1978	112	1595	332.1

Table 23. Sample sizes (number of fish) for age composition data from northern California recreational sampling by year and age. Ages with accompanying length information ("Age&Length") were modeled as conditional age-at-length. Only years with greater than 50 fish were included in the assessment.

	Age:	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44	46	48	Grand Total
Age&Length	1975																							1																1
	1977														1					1																				2
	1978							1		1		1	1	4	1	5	6	7	2	5	5	2	1		1	2	1		1	3	1	1	1							53
	1979			1					1	2	1	5	4	10	5	7	11	18	11	5	7	8	4	7	11	4	8	1	3	3	2	1	5		2		2	1		150
	1980	2			1		3	2	3	5	9	3	12	4	7	4	13	9	18	7	1	6	4	2	4	1	4		2	3		3	1		3		1			137
	1981		1		1	2	1	2	2	2	4	4		2	3	3	3	2	5	5	3	4	3	2		1	1	1	2		2	1	1		1	1				65
	1982			2		1	2	5	3	1	3		2			1		5	2	3	4	3	2	3	1	1	2	2	1	1		1		1		2	1			55
	1983										1		3	1	2		3	2	4	2		1	1							1			1							22
	Total	2	1	3	2	3	6	10	9	11	18	13	22	21	19	20	36	43	42	28	20	24	15	15	17	9	16	4	9	11	5	7	9	1	6	3	4	1		485
Age Only	1977			1	1	1		1	2	4	10	21	11	22	32	24	24	19	14	14	12	8	5	2	2	1	4	3		1	1	2								242
	1978		1					1	1	6	11	12	18	13	17	18	19	18	8	10	5	5	6	4	3	3	3	1	4	2	3		1		1	1		1	1	197
	1979					1		1	1	4	3	6	3	4	5	7	6	6	2	3	3	1	1		1		1	1	2			1								63
	1980							1	1		1	1		2		2	2			2	2						1													15
	1981			1					1		2	2		1	1																									8
	1982		1					1					3		1	1	1																							8
	Total		2	2	1	2		5	6	14	27	42	35	42	56	52	52	43	24	29	22	14	12	6	6	4	9	5	6	3	4	3	1		1	1		1	1	533
Grand Total		2	3	5	3	5	6	15	15	25	45	55	57	63	75	72	88	86	66	57	42	38	27	21	23	13	25	9	15	14	9	10	10	1	7	4	4	2	1	1018

Table 24. CDFG onboard sampling index, 1987-1998, with jackknife standard errors.

Year	Index	SE
1987	0.091	0.378
1988	0.169	0.236
1989	0.234	0.193
1990	0.294	0.253
1991	0.152	0.273
1992	0.143	0.195
1993	0.173	0.209
1994	0.258	0.194
1995	0.193	0.236
1996	0.139	0.295
1997	0.191	0.224
1998	0.283	0.306

Table 25. Evaluation of interaction terms with year effect in CDFG onboard sampling index, 1987-1998.

	AIC values	
Interaction term	**Binomial GLM**	**Gaussian GLM**
[none]	1203	1952
year:month	1279	2017
year:block	1269	1987
year:avg_depth	1219	1971

Table 26. RecFIN-based CPUE index for northern California, 1980-2001.

Year	Index	SE	Bin	Pos	# Samples	# Waves	# Counties
1980	0.599	0.211	0.92	0.651	39	6	5
1981	0.534	0.24	0.881	0.607	10	4	6
1982	0.122	0.077	0.31	0.395	23	5	6
1983	0.501	0.155	0.931	0.539	23	4	4
1984	0.756	0.209	0.882	0.857	47	6	7
1985	0.947	0.186	0.925	1.023	117	6	9
1986	0.717	0.155	0.929	0.772	89	5	8
1987	0.751	0.223	0.76	0.989	31	6	6
1988	0.803	0.282	0.824	0.974	30	5	5
1989	0.244	0.111	0.711	0.343	21	3	5
1993	--	--	--	--	4	2	1
1994	0.327	0.172	0.963	0.339	3	3	1
1995	0.295	0.192	0.804	0.367	10	2	4
1996	0.307	0.084	0.667	0.46	56	6	6
1999	0.77	0.164	0.897	0.858	83	6	6
2000	0.452	0.107	0.942	0.48	17	5	4
2001	0.674	0.199	0.927	0.723	20	4	3

Table 27. Evaluation of interactions between year effect and other explanatory variables for the Rec-based CPUE index in northern California.

Interaction Terms	BIC (Binomial)	BIC (Positive)
none	893.5	1321.5
YEAR:CNTY	1186	1534.2
YEAR:AREA	962.2	1373.4
YEAR:WAVE	1171.2	1544.5
WAVE:CNTY	1057.8	1474.9
AREA:CNTY	924.9	1345.5
AREA:WAVE	916.6	1339.7

Table 28. NWFSC trawl survey GLM index for northern California.

YEAR	Raw.MT	Mean.MT	Median.MT	CV.Median.MT	SD.of.log.MT
2003	951.66	1591.52	959.35	2.08	0.85
2004	1408.73	1875.28	1473.46	0.94	0.58
2005	77.77	103.07	88.06	0.73	0.53
2006	502.38	566.49	528.44	0.41	0.37
2007	504.85	591.38	515.74	0.65	0.53
2008	869.89	970.85	897.60	0.53	0.48
2009	2022.46	2335.70	2112.73	0.51	0.43
2010	553.63	656.78	583.97	0.55	0.44

Table 29. NWFSC trawl survey GLM index for southern California.

YEAR	Raw.MT	Mean.MT	Median.MT	CV.Median.MT	SD.of.log.MT
2003	535.34	659.41	587.10	0.57	0.39
2004	802.60	1331.77	897.72	2.69	0.70
2005	1128.86	1310.73	1184.09	0.51	0.42
2006	1410.33	1671.84	1516.07	0.48	0.41
2007	2388.25	2607.21	2480.96	0.38	0.35
2008	592.77	660.74	610.86	0.40	0.35
2009	818.73	883.25	849.95	0.28	0.25
2010	1388.06	1591.91	1399.63	0.60	0.49

Table 30. Samples sizes (number of tows and fish) for NWFSC trawl survey length composition data, with initial estimates of effective sample size (EffN_init), by area and year.

Area	year	NumFish	NumTows	EffN_init
No. CA	2003	165	10	21.67
	2004	313	11	33.13
	2005	26	8	9.84
	2006	125	16	24.84
	2007	120	10	18.48
	2008	235	14	30.61
	2009	383	15	42.08
	2010	283	14	34.01
So. CA	2003	145	15	25.25
	2004	115	7	15.13
	2005	174	15	27.30
	2006	252	14	31.82
	2007	478	24	57.79
	2008	285	21	41.15
	2009	270	26	45.09
	2010	299	13	34.14

Table 31. NWFSC hook-and-line survey index (J. Wallace, NMFS NWFSC, pers. comm.)

Year	Median_index	log-SD
2004	0.0375	0. 4860
2005	0.0178	0.5024
2006	0.0215	0. 5170
2007	0.0147	0. 5077
2008	0.0161	0. 5034
2009	0.0185	0. 5201
2010	0.0115	0. 5213

Table 32. Number of effective sets (# sites × proportion of sites catching greenspotted rockfish) and number of fish measured for length compositions from the southern CA hook and line survey.

Year	# sites sampled	Prop. Positive Sites	# fish	Eff. # of sets
2004	75	0.507	223	38.025
2005	90	0.5	129	45
2006	92	0.554	212	50.968
2007	99	0.455	190	45.045
2008	119	0.487	235	57.953

Table 33. Sample sizes (number of fish) for NWFSC hook-and-line survey age data.

	Length	AGES																													
Year	(cm)	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	39	47	Total
2004	16																															
	18								1																							1
	20									1	2		1																			4
	22									1	5	2	2		1	2	1															14
	24									1	1	2	3	1	3		2	1														14
	26										3	3	4	2	1	5	1	2	2	1												24
	28								2		1	1	1	7	3	5	2	2	5	6	3	1										39
	30									1	2	1	2	4	3	8	9	6	3	2	2	2										45
	32													1	3	3	6	5	8	3	4	2	2	1		2		1		1		42
	34													1		2	6	3	5	3	5	5	1	1								32
	36												1		2		2	2	2	5	5	2	4	2	1		1					29
	38															1								3	1					1	1	7
	40																								1							1
	42																				1											1
	44																															
2006	16																															
	18							1	1	1	1																					4
	20		1			1	1	1	3	1	1																					9
	22						1			1	6	1																				9
	24							1	4	1	3	5	2																			16
	26						1		2	2	7	5	2	4	1	2																26
	28										2	3	7	7	2		3															24
	30								1			1	6		5	2	3	1	1													20
	32										2		3	8	2	3	5	4	3	2	1											33
	34									1		2	4	4	4	3	3	3	3	2	1											30
	36											2		3	5	3	2	1	1		1											18
	38											1	1	1	2	2	2	2	1		1				1							14
	40																		2					2								4
	42																															
	44																															
2008	16		1					1			1																					3
	18				1	1	1	1																								4
	20			1		1		3	1	3	2																					11
	22						3	1	2	4	2	1																				13
	24								5	1	2	6		3	1																	18
	26								2	1	1	6	3	1	1	2	2															19
	28								1	2	4	4	11	4	3	1	1	2														33
	30							2	2	1	3	8	7	4	8	3	2	1			1											42
	32							1			2	2	3	3	2	6	5	1	1	1	1											28
	34									1	2	3	1	3	8	2	6	1	2	1	1		1									32
	36											2	2	2			1	1	1	5												14
	38												1			2	1	1	2		1	1										9
	40													1			1					2		1		1						6
	42																											1				1
	44																										1					1
2010	16					1																										1
	18			1	1	1		1																								4
	20	1	1		2	1	1	3		2	1																					12
	22				1	4	1	2		2		1				1																12
	24				2		1	3		1	2	2				1		1														13
	26					1	1	3	3	1	3					1				1												14
	28						3	2	4	3	1	1		3	1	2	1		2													23
	30						1	1	3	3	1	7	1		1	3	1	2	1	1	1											27
	32								1	1	1	6	1		2	2	6	1	1	1												23
	34								1	1	8	2	3	4	2	3	4	2	4	3	2	2										41
	36									1				3	4		3	1	4		1	2	1	1		1						22
	38												2		1	2			1	1				1	1	1						10
	40																						1									1
	42													2		1													1			4
	44																															

Table 34. General base model characteristics for the northern and southern California regions. Differences are highlighted in gray, and time-varying quantities are noted with an asterisk.

Characteristic	Northern California	Southern California
Starting year	1916	1916
Ending year	2010	2010
Number of areas	1	1
Number of seasons	1	1
Number of fishing fleets	4	5
Number of surveys	3	3
Individual growth	Estimated internally	Estimated externally
Number of estimated parameters	24	39
Population characteristics		
Maximum age	60	60
Genders	1	1
Population length bins	4 to 58, 2 cm bins	4 to 58, 2 cm bins
Ages for summary biomass	13	13
Data characteristics		
Data length bins	8 to 58, 2 cm bins	8 to 58, 2 cm bins
Data age bins	0-50, 55, 60	0-50, 55, 60
Minimum age for growth model (Amin)	0	7
Maximum age for growth model (Amax)	999 (L_∞)	30
First mature age	1	1
Fishery characteristics		
Fishery timing	0.5	0.5
Fishing mortality method	hybrid F	hybrid F
Maximum F	2.9	2.9
Trawl selectivity	asymptotic and domed*	asymptotic and domed*
Hook and line selectivity	asymptotic	asymptotic and domed*
Net selectivity	dome-shaped	dome-shaped
CPFV selectivity	dome-shaped (CPFV+Priv)	dome-shaped*
Private/rental selectivity		dome-shaped*
Survey characteristics		
Survey timing	0.5	0.5
NWFSC trawl survey selectivity	asymptotic	dome-shaped
RecFIN CPUE selectivity	identical to CPFV	identical to CPFV
CDFG Onboard selectivity	identical to CPFV	n/a
NWFSC hook and line survey selectivity	n/a	dome-shaped

* *time-varying quantity*

Table 35. Description of model parameters in the base-case models.

	Northern California		Southern California	
Parameter	**Number Estimated**	**Bounds**	**Number Estimated**	**Bounds**
Natural mortality (M)	--	NA	--	NA
Log(R0)	1	(3, 20)	1	(4, 10)
Steepness (h)	--	NA	--	NA
Length at Amin	--	NA	--	NA
Length at Amax	1	(30, 70)	--	NA
von Bertalanffy k	1	(0.01, 0.2)	--	NA
CV of Length at Amin	1	(0.01, 0.3)	1	(0.01, 0.3)
CV of Length at Amax	1	(0.01, 0.3)	1	(0.01, 0.3)
Catchability	Analytical solutions	NA	Analytical solutions	NA
Fishery Selectivities	17	Variable	28	Variable
Survey Selectivities	2	Variable	8	Variable

Table 36. Time blocks used to model time-varying selectivity in base models. Time-varying parameters for the double-normal selectivity curves are coded as 1 = length at peak, 2 = width of peak, 3 = ascending width, 4 = descending width, 5 = selectivity at smallest length, 6 = selectivity at largest length.

Area	**Fishery**	**Time Blocks**	**Time-varying param.**
Northern California	Trawl	1916 – 1987 (baseline) 1988 – 2002 2003 – 2011	1, 3, 4, 6
Southern California	Trawl	1916 – 2000 (baseline) 2001 – 2011	1, 3, 4, 6
	Hook and line	1916 – 2000 (baseline) 2001 – 2011	1, 3, 4, 6
	CPFV	1916 – 2000 (baseline) 2001 – 2011	1, 3, 4, 6
	Private/Rental	1916 – 2000 (baseline) 2001 – 2011	1, 3, 4, 6

Table 37. Pre-STAR panel comparisons of alternative models considering changes in length frequency data over time. An updated base model was selected during the STAR panel review.

Likelihood Component	No. CA Base Model	Time-varying Growth	Constant Selectivity
TOTAL	620.10	618.11	641.42
Catch	0.00	0.00	0.00
Equil_catch	0.00	0.00	0.00
Survey	-7.87	-8.33	-5.83
Length_comp	326.64	326.61	351.38
Age_comp	301.33	299.82	295.86
Recruitment	0.00	0.00	0.00
Forecast_Recruitment	0.00	0.00	0.00
Parm_priors	0.00	0.00	0.00
Parm_softbounds	0.00	0.00	0.01
Parm_devs	0.00	0.00	0.00
Crash_Pen	0.00	0.00	0.00
Reference point			
MSY	49.59	50.63	48.57
SB_0	562.38	553.62	529.16
Depletion 2011	0.33	0.36	0.29

Table 38. Northern California model parameter estimates, derived quantities, and likelihood components from STAR panel requests. Parameters with missing values were not estimated.

Parameter	Request 1	Request 3	Request 6 M=0.05	Request 6 M=0.08	Request 6, M=0.05 dome-shape trawl	Request 6, M=0.08 dome-shape trawl
L_at_Amin_Fem_GP_1	12.170	13.573	12.534	14.474	12.488	14.643
L_at_Amax_Fem_GP_1	38.771	38.470	38.626	38.032	38.650	38.259
VonBert_K_Fem_GP_1	0.071	0.064	0.076	0.053	0.076	0.047
CV_young_Fem_GP_1	0.255	0.208	0.245	0.180	0.246	0.177
CV_old_Fem_GP_1	0.073	0.090	0.073	0.111	0.072	0.114
SR_LN(R0)	6.167	6.135	5.724	6.501	5.726	6.516
SizeSel_1P_1_ComTrawl_N	46.520	45.666	44.806	46.263	44.729	45.406
SizeSel_1P_3_ComTrawl_N	4.560	4.415	4.563	4.285	4.561	4.207
SizeSel_1P_4_ComTrawl_N					4.288	2.107
SizeSel_1P_6_ComTrawl_N					5.470	-8.634
SizeSel_2P_1_ComHook_N	40.242	40.446	39.204	41.308	39.164	40.891
SizeSel_2P_3_ComHook_N	4.031	3.980	4.036	3.900	4.037	3.857
SizeSel_3P_1_ComNet_N	36.671	37.293	36.290	37.968	36.263	37.920
SizeSel_3P_3_ComNet_N	3.292	3.353	3.263	3.343	3.259	3.335
SizeSel_3P_4_ComNet_N	1.431	0.833	1.579	-0.210	1.584	-0.108
SizeSel_3P_6_ComNet_N	-1.913	-1.927	-2.344	-1.473	-2.387	-1.701
SizeSel_4P_1_Rec_N	34.605	37.168	34.260	40.222	34.226	39.257
SizeSel_4P_3_Rec_N	4.381	4.583	4.361	4.711	4.356	4.617
SizeSel_4P_4_Rec_N	3.877	2.409	3.248	-9.659	3.241	1.407
SizeSel_4P_6_Rec_N	-5.104	-1.809	-2.386	-1.101	-2.423	-1.716
SizeSel_6P_1_NWFSC_Trawl_Survey_N	24.203	56.687	20.964	56.887	20.954	53.632
SizeSel_6P_2_NWFSC_Trawl_Survey_N						
SizeSel_6P_3_NWFSC_Trawl_Survey_N	4.325	7.684	3.625	6.859	3.624	6.720
SizeSel_6P_4_NWFSC_Trawl_Survey_N						
SizeSel_6P_6_NWFSC_Trawl_Survey_N						
SizeSel_1P_1_ComTrawl_N_BLK1repl_1988	34.995	36.526	34.497	40.897	34.605	40.222
SizeSel_1P_1_ComTrawl_N_BLK1repl_2003	35.022	35.601	35.185	35.941	38.144	35.894
SizeSel_1P_3_ComTrawl_N_BLK1repl_1988	3.497	3.694	3.441	4.157	3.457	4.080
SizeSel_1P_3_ComTrawl_N_BLK1repl_2003	3.539	3.585	3.594	3.538	4.186	3.528
SizeSel_1P_4_ComTrawl_N_BLK1repl_1988					1.576	4.668
SizeSel_1P_4_ComTrawl_N_BLK1repl_2003	2.683	2.374	2.634	2.135	-9.094	2.097
SizeSel_1P_6_ComTrawl_N_BLK1repl_1988					1.995	-6.696
SizeSel_1P_6_ComTrawl_N_BLK1repl_2003					-7.983	-7.831
SizeSel_2P_1_ComHook_N_BLK2repl_1988	42.486	45.690	38.279	51.790	37.877	49.847
SizeSel_2P_3_ComHook_N_BLK2repl_1988	4.911	5.031	4.571	5.175	4.529	5.084
Max F	0.324	0.493	0.315	1.417	0.323	1.106
Current Depletion	0.326	0.299	0.238	0.349	0.238	0.330
Total Likelihood	619.609 #	660.997	660.787	665.773	661.002	659.727
Survey Likelihood	-7.879	-6.456	-5.366	-7.160	-5.391	-7.484
Length_comp Likelihood	326.701	371.611	360.988	380.642	361.269	374.933
Age_comp Likelihood	300.784	295.834	305.162	292.280	305.119	292.271

 # some length composition data were omitted from pre-STAR base model; likelihood not comparable

Table 39. Northern California model parameter estimates, derived quantities, and likelihood components from STAR panel requests. Parameters with missing values were not estimated.

Parameter	Request 11	Request 12	Request 13
L_at_Amin_Fem_GP_1	13.400	12.177	13.480
L_at_Amax_Fem_GP_1	38.505	38.870	38.502
VonBert_K_Fem_GP_1	0.065	0.071	0.065
CV_young_Fem_GP_1	0.214	0.243	0.211
CV_old_Fem_GP_1	0.088	0.082	0.089
SR_LN(R0)	6.136	6.128	6.136
SizeSel_1P_1_ComTrawl_N	45.772	45.738	45.671
SizeSel_1P_3_ComTrawl_N	4.432	4.483	4.423
SizeSel_1P_4_ComTrawl_N			
SizeSel_1P_6_ComTrawl_N			
SizeSel_2P_1_ComHook_N	44.817	43.705	44.779
SizeSel_2P_3_ComHook_N	4.957	4.923	4.951
SizeSel_3P_1_ComNet_N	35.986	36.891	37.248
SizeSel_3P_3_ComNet_N	3.014	3.308	3.347
SizeSel_3P_4_ComNet_N	-7.994	1.240	0.883
SizeSel_3P_6_ComNet_N	0.138	-1.980	-1.942
SizeSel_4P_1_Rec_N	37.037	36.203	37.087
SizeSel_4P_3_Rec_N	4.575	4.523	4.577
SizeSel_4P_4_Rec_N	2.465	2.797	2.440
SizeSel_4P_6_Rec_N	-1.792	-1.871	-1.820
SizeSel_6P_1_NWFSC_Trawl_Survey_N	56.613		56.631
SizeSel_6P_2_NWFSC_Trawl_Survey_N			-2.500
SizeSel_6P_3_NWFSC_Trawl_Survey_N	7.740	3.456	7.719
SizeSel_6P_4_NWFSC_Trawl_Survey_N			0.000
SizeSel_6P_6_NWFSC_Trawl_Survey_N			-0.257
SizeSel_1P_1_ComTrawl_N_BLK1repl_1988	36.383	35.638	36.422
SizeSel_1P_1_ComTrawl_N_BLK1repl_2003	35.560	35.248	35.578
SizeSel_1P_3_ComTrawl_N_BLK1repl_1988	3.677	3.580	3.680
SizeSel_1P_3_ComTrawl_N_BLK1repl_2003	3.584	3.566	3.585
SizeSel_1P_4_ComTrawl_N_BLK1repl_1988			
SizeSel_1P_4_ComTrawl_N_BLK1repl_2003	2.404	2.540	2.390
SizeSel_1P_6_ComTrawl_N_BLK1repl_1988			
SizeSel_1P_6_ComTrawl_N_BLK1repl_2003			
SizeSel_2P_1_ComHook_N_BLK2repl_1988			
SizeSel_2P_3_ComHook_N_BLK2repl_1988			
Max F	0.467	0.408	0.467
Current Depletion	0.300	0.304	0.299
Total Likelihood	663.708	666.312	662.749
Survey Likelihood	-6.520	-6.837	-6.519
Length_comp Likelihood	374.231	374.184	373.402
Age_comp Likelihood	295.989	298.963	295.860

Table 40. Southern California model parameter estimates, derived quantities, and likelihood components from STAR panel requests.

Parameter (* = fixed)	BASE	Request 3	Request 4	Request 5
L_at_Amin_Fem_GP_1	15.91*	15.91*	12.652	13.077
L_at_Amax_Fem_GP_1	36.38*	36.38*	37.838	37.838
VonBert_K_Fem_GP_1	0.042*	0.042*	0.040	0.036
CV_young_Fem_GP_1	0.142	0.152	0.250	0.230
CV_old_Fem_GP_1	0.157	0.144	0.104	0.113
SR_LN(R0)	6.612	6.641	6.564	6.528
SizeSel_2P_1_ComHook_S	37.300	37.278	37.242	37.771
SizeSel_2P_3_ComHook_S	3.821	3.836	3.878	3.905
SizeSel_3P_1_ComNet_S	38.226	38.226	38.189	38.385
SizeSel_3P_3_ComNet_S	3.221	3.236	3.257	3.255
SizeSel_3P_4_ComNet_S	3.269	3.296	3.209	3.192
SizeSel_3P_6_ComNet_S	-4.608	-4.475	-5.085	-5.256
SizeSel_4P_1_RecCPFV_S	37.711	38.687	34.071	35.178
SizeSel_4P_3_RecCPFV_S	5.103	5.226	4.800	4.885
SizeSel_4P_4_RecCPFV_S	2.519	-8.804	4.402	4.132
SizeSel_4P_6_RecCPFV_S	-1.081	-0.443	-2.397	-2.316
SizeSel_5P_1_RecPriv_S	30.380	30.003	28.738	29.298
SizeSel_5P_3_RecPriv_S	4.054	4.015	3.826	3.896
SizeSel_5P_4_RecPriv_S	5.782	5.907	5.853	6.145
SizeSel_7P_1_NWFSC_Trawl_Survey_S	15.466	16.052	16.237	15.443
SizeSel_7P_3_NWFSC_Trawl_Survey_S	2.148	2.640	2.524	2.354
SizeSel_7P_4_NWFSC_Trawl_Survey_S	-0.660	-4.181	-8.104	4*
SizeSel_7P_6_NWFSC_Trawl_Survey_S	0.544	0.772	0.662	9*
SizeSel_8P_1_NWFSC_HKL_Survey_S	36.833	35.113	33.523	33.856
SizeSel_8P_3_NWFSC_HKL_Survey_S	4.627	4.463	4.344	4.357
SizeSel_8P_4_NWFSC_HKL_Survey_S	1.527	2.530	3.015	2.924
SizeSel_8P_6_NWFSC_HKL_Survey_S	-3.529	-3.565	-3.733	-3.782
SizeSel_1P_1_ComTrawl_S_BLK1repl_2001	41.924	42.009	42.361	42.344
SizeSel_1P_3_ComTrawl_S_BLK1repl_2001	3.678	3.695	3.786	3.752
SizeSel_1P_4_ComTrawl_S_BLK1repl_2001	0.566	0.470	0.024	0.039
SizeSel_2P_1_ComHook_S_BLK1repl_2001	28.626	28.536	28.105	28.220
SizeSel_2P_3_ComHook_S_BLK1repl_2001	2.958	2.946	2.847	2.865
SizeSel_2P_4_ComHook_S_BLK1repl_2001	2.810	2.827	2.852	2.839
SizeSel_2P_6_ComHook_S_BLK1repl_2001	-5.005	-4.999	-5.341	-5.301
SizeSel_4P_1_RecCPFV_S_BLK1repl_2001	28.513	28.366	27.690	27.855
SizeSel_4P_3_RecCPFV_S_BLK1repl_2001	3.805	3.794	3.676	3.688
SizeSel_4P_4_RecCPFV_S_BLK1repl_2001	3.091	3.107	3.142	3.134
SizeSel_4P_6_RecCPFV_S_BLK1repl_2001	-3.351	-3.316	-3.586	-3.557
SizeSel_5P_1_RecPriv_S_BLK1repl_2001	29.421	29.298	28.659	28.804
SizeSel_5P_3_RecPriv_S_BLK1repl_2001	3.874	3.870	3.778	3.783
SizeSel_5P_4_RecPriv_S_BLK1repl_2001	2.730	2.720	2.743	2.743
SizeSel_5P_6_RecPriv_S_BLK1repl_2001	-2.286	-2.244	-2.504	-2.472
Max F	0.212	0.197	0.217	0.255
Current Depletion	0.345	0.368	0.268	0.232
Total Likelihood	736.26 #	776.01	751.17	754.04
Survey Likelihood	-0.39	-0.46	-0.44	-0.40
Length_comp Likelihood	396.75	434.50	430.72	436.71
Age_comp Likelihood	339.91	341.96	320.88	317.72

Table 41. Southern California model parameter estimates, derived quantities, and likelihood components from STAR panel requests.

Parameter (* = fixed)	Amin=0 Amax=999 Request 9a	Amin=4 Amax=999 Request 9b	Request 10a	Request 10b
L_at_Amin_Fem_GP_1	2.328	9.176	12.6517*	14.312
L_at_Amax_Fem_GP_1	56.986	56.535	37.8381*	37.503
VonBert_K_Fem_GP_1	0.034	0.035	0.04028*	0.033
CV_young_Fem_GP_1	0.237	0.217	0.15171*	0.15171*
CV_old_Fem_GP_1	0.063	0.062	0.14374*	0.14374*
SR_LN(R0)	6.551	6.553	6.531	6.525
SizeSel_2P_1_ComHook_S	37.715	37.664	37.681	37.907
SizeSel_2P_3_ComHook_S	3.880	3.878	3.859	3.865
SizeSel_3P_1_ComNet_S	38.396	38.376	38.260	38.390
SizeSel_3P_3_ComNet_S	3.243	3.243	3.208	3.214
SizeSel_3P_4_ComNet_S	3.133	3.131	3.167	3.165
SizeSel_3P_6_ComNet_S	-5.095	-5.070	-5.181	-5.251
SizeSel_4P_1_RecCPFV_S	36.603	36.535	36.393	37.185
SizeSel_4P_3_RecCPFV_S	5.003	5.003	4.982	5.014
SizeSel_4P_4_RecCPFV_S	3.318	3.324	3.431	3.145
SizeSel_4P_6_RecCPFV_S	-1.728	-1.723	-1.832	-1.745
SizeSel_5P_1_RecPriv_S	29.914	29.834	30.100	30.686
SizeSel_5P_3_RecPriv_S	3.980	3.971	4.009	4.069
SizeSel_5P_4_RecPriv_S	5.954	5.926	5.890	5.983
SizeSel_7P_1_NWFSC_Trawl_Survey_S	16.167	16.292	16.202	16.116
SizeSel_7P_3_NWFSC_Trawl_Survey_S	2.620	2.693	2.485	2.563
SizeSel_7P_4_NWFSC_Trawl_Survey_S	-6.436	-9.972	-7.114	-5.881
SizeSel_7P_6_NWFSC_Trawl_Survey_S	0.994	1.012	0.847	1.217
SizeSel_8P_1_NWFSC_HKL_Survey_S	34.340	34.296	34.260	34.677
SizeSel_8P_3_NWFSC_HKL_Survey_S	4.388	4.387	4.387	4.396
SizeSel_8P_4_NWFSC_HKL_Survey_S	2.744	2.758	2.783	2.648
SizeSel_8P_6_NWFSC_HKL_Survey_S	-3.675	-3.676	-4.093	-3.925
SizeSel_1P_1_ComTrawl_S_BLK1repl_2001	42.189	42.772	42.021	42.065
SizeSel_1P_3_ComTrawl_S_BLK1repl_2001	3.722	3.821	3.699	3.682
SizeSel_1P_4_ComTrawl_S_BLK1repl_2001	0.258	-7.489	0.450	0.390
SizeSel_2P_1_ComHook_S_BLK1repl_2001	28.387	28.369	28.371	28.532
SizeSel_2P_3_ComHook_S_BLK1repl_2001	2.900	2.897	2.903	2.925
SizeSel_2P_4_ComHook_S_BLK1repl_2001	2.816	2.819	2.823	2.795
SizeSel_2P_6_ComHook_S_BLK1repl_2001	-5.226	-5.234	-5.316	-5.210
SizeSel_4P_1_RecCPFV_S_BLK1repl_2001	28.107	28.080	27.998	28.284
SizeSel_4P_3_RecCPFV_S_BLK1repl_2001	3.724	3.723	3.714	3.737
SizeSel_4P_4_RecCPFV_S_BLK1repl_2001	3.109	3.113	3.162	3.113
SizeSel_4P_6_RecCPFV_S_BLK1repl_2001	-3.504	-3.513	-3.693	-3.550
SizeSel_5P_1_RecPriv_S_BLK1repl_2001	29.031	29.009	28.923	29.177
SizeSel_5P_3_RecPriv_S_BLK1repl_2001	3.808	3.807	3.800	3.812
SizeSel_5P_4_RecPriv_S_BLK1repl_2001	2.731	2.734	2.827	2.775
SizeSel_5P_6_RecPriv_S_BLK1repl_2001	-2.428	-2.435	-2.599	-2.476
Max F	0.251	0.249	0.290	0.285
Current Depletion	0.256	0.259	0.231	0.229
Total Likelihood	753.14	753.37	773.73	757.18
Survey Likelihood	-0.40	-0.40	-0.36	-0.37
Length_comp Likelihood	434.42	434.32	439.52	440.18
Age_comp Likelihood	319.11	319.43	334.57	317.36

Table 42. Parameters for the northern California base model, with asymptotic 95% intervals.

Parameter	Estimate	Fixed	Lower 95%	Upper 95%
Natural mortality, M	0.065	*	--	--
Length at Amin	0.01	*	--	--
Length at Amax	46.64		45.2	48.1
von Bertalanffy growth coefficient	0.0567		0.052	0.061
CV of length at Amin	0.228		0.172	0.283
CV of length at Amax	0.072		0.051	0.092
Weight-length coefficient	1.32E-05	*	--	--
Weight-length exponent	3.108	*	--	--
Proportion mature at length, inflection point	26.2	*	--	--
Proportion mature at length, slope	-0.4	*	--	--
Relative fecundity intercept	0.234	*	--	--
Relative fecundity slope	0.1328	*	--	--
Logarithm of unfished recruitment, R_0	6.147		6.09	6.21
Beverton-Holt steepness, h	0.76	*	--	--
Selectivity Parameters:				
SizeSel_1P_1_ComTrawl_N	45.32		42.66	47.98
SizeSel_1P_2_ComTrawl_N	-3	*	--	--
SizeSel_1P_3_ComTrawl_N	4.353		4.02	4.68
SizeSel_1P_4_ComTrawl_N	4	*	--	--
SizeSel_1P_5_ComTrawl_N	-9	*	--	--
SizeSel_1P_6_ComTrawl_N	9	*	--	--
SizeSel_1P_1_ComTrawl_N_BLK1repl_1988	36.99		34.15	39.84
SizeSel_1P_1_ComTrawl_N_BLK1repl_2003	35.80		30.73	40.86
SizeSel_1P_3_ComTrawl_N_BLK1repl_1988	3.730		3.23	4.23
SizeSel_1P_3_ComTrawl_N_BLK1repl_2003	3.578		2.32	4.84
SizeSel_1P_4_ComTrawl_N_BLK1repl_1988	4	*	--	--
SizeSel_1P_4_ComTrawl_N_BLK1repl_2003	2.216		-2.75	7.18
SizeSel_1P_6_ComTrawl_N_BLK1repl_1988	9	*	--	--
SizeSel_1P_6_ComTrawl_N_BLK1repl_2003	-7.5	*	--	--
SizeSel_2P_1_ComHook_N	45.30		40.22	50.38
SizeSel_2P_2_ComHook_N	-3	*	--	--
SizeSel_2P_3_ComHook_N	4.936		4.57	5.30
SizeSel_2P_4_ComHook_N	4	*	--	--
SizeSel_2P_5_ComHook_N	-9	*	--	--
SizeSel_2P_6_ComHook_N	9	*	--	--
SizeSel_3P_1_ComNet_N	37.44		34.41	40.48
SizeSel_3P_2_ComNet_N	-3	*	--	--
SizeSel_3P_3_ComNet_N	3.344		2.52	4.17
SizeSel_3P_4_ComNet_N	0.6169		-4.81	6.04
SizeSel_3P_5_ComNet_N	-9	*	--	--
SizeSel_3P_6_ComNet_N	-1.990		-5.14	1.16
SizeSel_4P_1_Rec_N	37.82		36.45	39.19
SizeSel_4P_2_Rec_N	-3	*	--	--
SizeSel_4P_3_Rec_N	4.609		4.46	4.76
SizeSel_4P_4_Rec_N	1.896		0.51	3.28
SizeSel_4P_5_Rec_N	-9	*	--	--
SizeSel_4P_6_Rec_N	-1.729		-2.93	-0.53
SizeSel_6P_1_NWFSC_Trawl_Survey_N	21.31		16.02	26.60
SizeSel_6P_2_NWFSC_Trawl_Survey_N	11.14		4.87	17.40

Table 43. Likelihood components for the northern California base model, by general category and fleet/survey.

Likelihood summary	Neg. log likelihood
TOTAL	669.528
Catch	1.14E-05
Survey	-6.842
Length_comp	379.030
Age_comp	297.338
Parm_softbounds	0.002

Fleet/Survey	Survey Likelihood	Length comp. likelihood	Age comp. likelihood
Trawl		139.20	
Hook and line		70.15	
Net		15.58	
Recreational		120.79	195.41
Rec. Dockside Index	-5.58		
NWFSC Trawl Survey	2.97	33.32	101.93
Rec. Onboard Index	-4.24		

Table 44. Adjustments to abundance index variance estimates and effective sample sizes for composition data in the northern California model.

Index Variance Tuning

Fleet	Q	N	r.m.s.e.	Input+VarAdj+extra	New_VarAdj
Rec. Dockside Index	6.33E-04	16	0.399	0.409	0.219
NWFSC Trawl Survey	7.40E-01	8	0.889	0.895	0.364
Rec. Onboard Index	2.86E-04	12	0.471	0.479	0.221

Length composition effective N tuning check

Fleet	mean(inputN*Adj)	HarMean(effN)	Var_Adj	HarEffN/MeanInputN
ComTrawl_N	16.41	15.69	0.52	0.96
ComHook_N	16.28	15.32	0.32	0.94
ComNet_N	7.94	10.07	1	1.27
Rec_N	55.68	61.33	0.45	1.10
NWFSC Trawl Survey	26.83	56.72	1	2.11

Age composition effective N tuning check

Fleet	mean(inputN*Adj)	HarMean(effN)	Var_Adj	HarEffN/MeanInputN
Rec_N	3.36	3.14	0.26	0.94
NWFSC Trawl Survey	2.26	2.04	0.36	0.91

Table 45. Time series of population estimates from the northern California base case model.

Year	Total Biomass	Age 13+ Biomass	Spawning Output	Recruits	Depletion	Catch	SPR	Exploitation
1916	3160.0	2903.0	563.8	467.5	1	6.5	0.954	0.002
1917	3154.1	2897.2	562.5	467.5	0.998	10.1	0.930	0.003
1918	3145.2	2888.3	560.6	467.3	0.994	11.4	0.920	0.004
1919	3135.4	2878.4	558.5	467.2	0.991	7.7	0.944	0.003
1920	3129.3	2872.3	557.1	467.1	0.988	8.0	0.943	0.003
1921	3123.2	2866.2	555.8	467.0	0.986	6.7	0.951	0.002
1922	3118.5	2861.6	554.7	466.9	0.984	5.8	0.958	0.002
1923	3114.9	2858.0	553.9	466.9	0.983	6.5	0.953	0.002
1924	3110.9	2853.9	553.0	466.8	0.981	4.4	0.967	0.002
1925	3108.9	2852.0	552.5	466.8	0.980	5.5	0.960	0.002
1926	3106.0	2849.1	551.8	466.7	0.979	8.3	0.940	0.003
1927	3100.7	2843.9	550.7	466.7	0.977	7.4	0.946	0.003
1928	3096.5	2839.7	549.7	466.6	0.975	9.0	0.934	0.003
1929	3091.0	2834.2	548.5	466.5	0.973	9.6	0.929	0.003
1930	3085.0	2828.4	547.2	466.4	0.971	11.6	0.916	0.004
1931	3077.6	2820.9	545.5	466.3	0.968	14.7	0.895	0.005
1932	3067.5	2810.9	543.3	466.2	0.964	8.0	0.939	0.003
1933	3063.9	2807.4	542.5	466.1	0.962	7.0	0.945	0.003
1934	3061.3	2804.8	541.9	466.1	0.961	8.5	0.934	0.003
1935	3057.5	2801.1	541.1	466.0	0.960	8.6	0.932	0.003
1936	3053.7	2797.3	540.3	465.9	0.958	8.3	0.933	0.003
1937	3050.3	2793.9	539.5	465.9	0.957	9.1	0.927	0.003
1938	3046.2	2789.8	538.6	465.8	0.955	9.9	0.921	0.004
1939	3041.5	2785.2	537.6	465.8	0.954	12.0	0.909	0.004
1940	3035.2	2778.9	536.2	465.7	0.951	11.9	0.906	0.004
1941	3029.0	2772.8	534.9	465.6	0.949	10.6	0.915	0.004
1942	3024.2	2768.1	533.9	465.5	0.947	4.4	0.962	0.002
1943	3025.5	2769.4	534.1	465.5	0.947	11.9	0.913	0.004
1944	3020.1	2764.0	532.9	465.4	0.945	36.9	0.783	0.013
1945	2992.9	2736.8	526.9	465.0	0.935	74.5	0.649	0.027
1946	2933.4	2677.4	513.8	464.0	0.911	60.9	0.679	0.023
1947	2888.2	2632.3	503.8	463.2	0.894	41.0	0.751	0.016
1948	2862.7	2606.8	498.1	462.7	0.884	32.5	0.779	0.012
1949	2845.4	2589.6	494.2	462.4	0.877	37.0	0.752	0.014
1950	2824.6	2568.9	489.7	462.0	0.869	41.8	0.725	0.016
1951	2800.1	2544.6	484.4	461.6	0.859	55.8	0.665	0.022
1952	2764.1	2508.7	476.6	460.9	0.845	38.7	0.733	0.015
1953	2744.8	2489.5	472.3	460.5	0.838	37.9	0.739	0.015
1954	2727.2	2472.1	468.4	460.1	0.831	37.2	0.735	0.015
1955	2710.6	2455.8	464.7	459.8	0.824	50.8	0.672	0.021
1956	2682.4	2427.9	458.6	459.2	0.814	48.8	0.673	0.020
1957	2656.9	2402.8	453.1	458.7	0.804	55.7	0.645	0.023
1958	2626.3	2372.5	446.5	458.0	0.792	69.3	0.580	0.029
1959	2583.8	2330.4	437.6	457.1	0.776	55.7	0.627	0.024
1960	2555.2	2302.0	431.5	456.5	0.765	46.8	0.667	0.020
1961	2535.9	2283.0	427.3	456.0	0.758	34.4	0.730	0.015
1962	2528.9	2276.1	425.5	455.9	0.755	35.4	0.720	0.016

Table 45 (continued). Time series from the northern California base case model.

Year	Total Biomass	Age 13+ Biomass	Spawning Output	Recruits	Depletion	Catch	SPR	Exploitation
1963	2521.1	2268.6	423.7	455.7	0.752	43.5	0.682	0.019
1964	2506.6	2254.4	420.5	455.3	0.746	30.5	0.750	0.014
1965	2504.5	2252.4	419.8	455.2	0.745	39.8	0.691	0.018
1966	2493.6	2241.9	417.5	455.0	0.741	41.1	0.679	0.018
1967	2481.7	2230.3	415.0	454.7	0.736	50.0	0.636	0.022
1968	2462.1	2211.1	411.0	454.2	0.729	52.1	0.624	0.024
1969	2441.2	2190.5	406.6	453.7	0.721	44.6	0.650	0.020
1970	2427.2	2176.9	403.8	453.4	0.716	56.4	0.590	0.026
1971	2402.7	2152.7	398.9	452.8	0.708	49.2	0.628	0.023
1972	2385.9	2136.2	395.4	452.3	0.701	63.8	0.561	0.030
1973	2356.2	2106.7	389.3	451.6	0.691	87.7	0.470	0.042
1974	2304.9	2055.8	379.0	450.2	0.672	93.3	0.446	0.045
1975	2249.9	2001.0	367.8	448.7	0.652	101.0	0.421	0.050
1976	2189.6	1941.1	355.5	446.9	0.631	116.0	0.376	0.060
1977	2117.2	1869.1	340.8	444.6	0.605	106.9	0.391	0.057
1978	2055.9	1808.1	328.1	442.5	0.582	77.5	0.450	0.043
1979	2022.7	1775.1	321.2	441.2	0.570	132.6	0.336	0.075
1980	1942.1	1695.0	304.5	438.1	0.540	128.9	0.347	0.076
1981	1869.1	1622.4	288.9	434.9	0.512	266.1	0.221	0.164
1982	1680.4	1434.3	249.6	425.3	0.443	157.2	0.276	0.110
1983	1593.8	1348.3	231.2	419.9	0.410	132.5	0.286	0.098
1984	1531.9	1287.2	218.1	415.6	0.387	96.7	0.345	0.075
1985	1504.8	1260.7	211.6	413.3	0.375	158.6	0.213	0.126
1986	1421.7	1179.5	195.7	407.1	0.347	117.4	0.240	0.100
1987	1375.4	1135.1	187.1	403.4	0.332	96.6	0.311	0.085
1988	1352.8	1113.3	181.7	401.0	0.322	209.8	0.141	0.188
1989	1226.6	989.7	159.2	389.5	0.282	224.0	0.126	0.226
1990	1092.1	857.6	135.0	373.8	0.239	165.6	0.140	0.193
1991	1011.5	779.4	120.4	362.3	0.214	214.6	0.103	0.275
1992	892.2	664.1	99.5	341.7	0.176	150.6	0.116	0.227
1993	829.4	604.6	88.6	328.5	0.157	130.9	0.117	0.216
1994	784.1	562.6	81.0	318.0	0.144	116.3	0.121	0.207
1995	751.8	533.2	75.7	309.9	0.134	134.5	0.098	0.252
1996	704.4	489.6	68.5	297.7	0.121	151.5	0.083	0.309
1997	644.0	433.3	59.5	280.3	0.106	71.8	0.135	0.166
1998	646.6	439.8	60.2	281.6	0.107	35.0	0.240	0.080
1999	678.6	475.5	65.2	291.6	0.116	43.4	0.222	0.091
2000	701.5	504.4	69.5	299.6	0.123	31.8	0.310	0.063
2001	732.7	542.5	75.3	309.3	0.134	17.3	0.502	0.032
2002	775.3	591.5	82.9	320.8	0.147	4.7	0.794	0.008
2003	827.9	649.8	92.3	333.3	0.164	0.5	0.980	0.001
2004	883.1	710.6	102.5	345.0	0.182	0.6	0.982	0.001
2005	937.2	768.6	112.7	355.3	0.200	0.3	0.991	0.000
2006	990.4	824.7	123.0	364.5	0.218	0.2	0.994	0.000
2007	1042.5	878.5	133.3	372.6	0.236	1.3	0.969	0.001
2008	1092.6	929.0	143.3	379.7	0.254	1.0	0.978	0.001
2009	1141.8	976.6	153.2	385.9	0.272	1.1	0.975	0.001
2010	1189.9	1020.2	162.8	391.4	0.289	0.4	0.992	0.000

Table 46. Reference points and intervals based on alternative states of nature for the northern California model.

Quantity	Northern Base Model	(Low M, High M)
Unfished total biomass (mt)	3160	(3383, 2920)
Unfished spawning output (SB_0, eggs x10^9)	564	(619, 505)
Unfished age 13+ biomass (mt)	2903	(3150, 2644)
Unfished recruitment (R_0, 1000s)	468	(368, 580)
Depletion (SB_{2011} / SB_0)	0.306	(0.269, 0.335)
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	226	(248, 202)
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.447	(0.447, 0.447)
Exploitation rate resulting in $SB_{40\%}$	0.040	(0.036, 0.046)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	53.1	(49.7, 55.5)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	258	(283, 231)
$SPR_{MSY\text{-}proxy}$	0.5	(0.5, 0.5)
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	0.034	(0.03, 0.038)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	49.4	(46.4, 51.6)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	134	(150, 117)
SPR_{MSY}	0.298	(0.302, 0.293)
Exploitation Rate corresponding to SPR_{MSY}	0.070	(0.061, 0.081)
MSY (mt)	58.8	(54.7, 61.9)

Table 47. Parameters for the southern California base model, with asymptotic 95% intervals.

Parameter	**Estimate**	**Fixed**	**Lower 95%**	**Upper 95%**
Natural mortality, M	0.065	*	--	--
Length at Amin	15.91	*	--	--
Length at Amax	36.38	*	--	--
von Bertalanffy growth coefficient	0.042	*	--	--
CV of length at Amin	0.152		0.123	0.180
CV of length at Amax	0.144		0.121	0.168
Weight-length coefficient	1.05E-05	*	--	--
Weight-length exponent	3.1367	*	--	--
Proportion mature at length, inflection point	21.5	*	--	--
Proportion mature at length, slope	-0.4	*	--	--
Relative fecundity intercept	0.234	*	--	--
Relative fecundity slope	0.1328	*	--	--
Logarithm of unfished recruitment, R_0	6.654		6.554	6.753
Beverton-Holt steepness, h	0.76	*	--	--
Selectivity Parameters:				
SizeSel_1P_1_ComTrawl_N	43	*	--	--
SizeSel_1P_2_ComTrawl_N	-4	*	--	--
SizeSel_1P_3_ComTrawl_N	3.8	*	--	--
SizeSel_1P_4_ComTrawl_N	4	*	--	--
SizeSel_1P_5_ComTrawl_N	-9	*	--	--
SizeSel_1P_6_ComTrawl_N	9	*	--	--
SizeSel_1P_1_ComTrawl_S_BLK1repl_2001	41.96		34.974	48.956
SizeSel_1P_3_ComTrawl_S_BLK1repl_2001	3.695		2.229	5.162
SizeSel_1P_4_ComTrawl_S_BLK1repl_2001	0.522		-13.741	14.784
SizeSel_1P_6_ComTrawl_S_BLK1repl_2001	-9	*	--	--
SizeSel_2P_1_ComHook_S	37.1458		35.102	39.190
SizeSel_2P_2_ComHook_S	-4	*	--	--
SizeSel_2P_3_ComHook_S	3.824		3.472	4.176
SizeSel_2P_4_ComHook_S	4	*	--	--
SizeSel_2P_5_ComHook_S	-9	*	--	--
SizeSel_2P_6_ComHook_S	9	*	--	--
SizeSel_2P_1_ComHook_S_BLK1repl_2001	28.532		25.560	31.505
SizeSel_2P_3_ComHook_S_BLK1repl_2001	2.946		1.857	4.036
SizeSel_2P_4_ComHook_S_BLK1repl_2001	2.827		1.260	4.394
SizeSel_2P_6_ComHook_S_BLK1repl_2001	-5.014		-12.562	2.534
SizeSel_3P_1_ComNet_S	38.155		36.333	39.977
SizeSel_3P_2_ComNet_S	-4	*	--	--
SizeSel_3P_3_ComNet_S	3.229		2.771	3.687
SizeSel_3P_4_ComNet_S	3.283		2.016	4.550
SizeSel_3P_5_ComNet_S	-9	*	--	--
SizeSel_3P_6_ComNet_S	-4.542		-15.025	5.941

Table 47 (continued). Parameters for the southern California base model, with asymptotic 95% intervals.

Parameter	Estimate	Fixed	Lower 95%	Upper 95%
Selectivity Parameters (continued)				
SizeSel_4P_1_RecCPFV_S	37.365		34.147	40.583
SizeSel_4P_2_RecCPFV_S	-4	*	--	--
SizeSel_4P_3_RecCPFV_S	5.103		4.765	5.441
SizeSel_4P_4_RecCPFV_S	2.691		-0.073	5.455
SizeSel_4P_5_RecCPFV_S	-9	*	--	--
SizeSel_4P_6_RecCPFV_S	-1.056		-2.480	0.367
SizeSel_4P_1_RecCPFV_S_BLK1repl_2001	28.356		27.254	29.459
SizeSel_4P_3_RecCPFV_S_BLK1repl_2001	3.793		3.540	4.047
SizeSel_4P_4_RecCPFV_S_BLK1repl_2001	3.110		2.513	3.707
SizeSel_4P_6_RecCPFV_S_BLK1repl_2001	-3.343		-4.950	-1.735
SizeSel_5P_1_RecPriv_S	29.949		27.562	32.337
SizeSel_5P_2_RecPriv_S	-4	*	--	--
SizeSel_5P_3_RecPriv_S	4.007		3.585	4.429
SizeSel_5P_4_RecPriv_S	5.778		4.057	7.499
SizeSel_5P_5_RecPriv_S	-9	*	--	--
SizeSel_5P_6_RecPriv_S	-9	*	--	--
SizeSel_5P_1_RecPriv_S_BLK1repl_2001	29.285		28.301	30.269
SizeSel_5P_3_RecPriv_S_BLK1repl_2001	3.869		3.651	4.087
SizeSel_5P_4_RecPriv_S_BLK1repl_2001	2.730		1.973	3.486
SizeSel_5P_6_RecPriv_S_BLK1repl_2001	-2.270		-3.185	-1.355
SizeSel_7P_1_NWFSC_Trawl_Survey_S	16.051		13.809	18.292
SizeSel_7P_2_NWFSC_Trawl_Survey_S	-4	*	--	--
SizeSel_7P_3_NWFSC_Trawl_Survey_S	2.640		1.464	3.816
SizeSel_7P_4_NWFSC_Trawl_Survey_S	-4.104		-29.677	21.469
SizeSel_7P_5_NWFSC_Trawl_Survey_S	-9	*	--	--
SizeSel_7P_6_NWFSC_Trawl_Survey_S	0.757		-0.278	1.792
SizeSel_8P_1_NWFSC_HKL_Survey_S	35.089		33.747	36.431
SizeSel_8P_2_NWFSC_HKL_Survey_S	-4	*	--	--
SizeSel_8P_3_NWFSC_HKL_Survey_S	4.462		4.245	4.679
SizeSel_8P_4_NWFSC_HKL_Survey_S	2.534		1.572	3.497
SizeSel_8P_5_NWFSC_HKL_Survey_S	-9	*	--	--
SizeSel_8P_6_NWFSC_HKL_Survey_S	-3.604		-7.016	-0.192

Table 48. Likelihood components for the southern California base model, by general category and fleet/survey.

Likelihood summary	Neg. log likelihood
TOTAL	774.794
Catch	7.85E-07
Survey	-0.472
Length_comp	433.081
Age_comp	342.178
Parm_softbounds	0.006

Fleet/Survey	Survey Likelihood	Length comp. likelihood	Age comp. likelihood
Trawl		18.16	
Hook and line		52.56	
Net		26.32	
Recreational CPFV		137.74	
Recreational Private		118.37	
Rec. Dockside Index	3.34		
NWFSC Trawl Survey	-1.00	53.70	148.281
NWFSC Hook & Line Survey	-2.81	26.23	193.898

Table 49. Adjustments to abundance index variance estimates and effective sample sizes for composition data in the southern California model.

Index Variance Tuning

Fleet	Q	N	r.m.s.e.	Input+VarAdj+extra	New_VarAdj
Rec. Dockside Index	2.76E-05	12	0.925	0.943	0.321
NWFSC Trawl Survey	8.43E-01	8	0.447	0.420	0.027
NWFSC Hook & Line Survey	1.08E-05	7	0.370	0.508	-0.139

Length composition effective N tuning check

Fleet	mean(inputN*Adj)	HarMean(effN)	Var_Adj	HarEffN/MeanInputN
Trawl	8.22	14.37	1	1.75
Hook and line	16.03	16.11	0.4	1.01
Net	14.79	15.42	1	1.04
Recreational CPFV	42.59	41.10	0.18	0.96
Recreational Private	40.93	40.55	0.6	0.99
NWFSC Trawl Survey	34.70	38.44	1	1.11
NWFSC Hook & Line Survey	64.93	139.10	1	2.14

Age composition effective N tuning check

Fleet	mean(inputN*Adj)	HarMean(effN)	Var_Adj	HarEffN/MeanInputN
NWFSC Trawl Survey	3.35	3.49	0.35	1.04
NWFSC Hook & Line Survey	3.47	3.48	0.2	1.00

Table 50. Time series of population estimates from the southern California base case model.

Year	Total Biomass	Age 13+ Biomass	Spawning Output	Recruits	Depletion	Catch	SPR	Exploitation
1916	4330.5	3959.1	794.0	775.7	1	35.4	0.830	0.009
1917	4298.9	3927.6	787.3	775.2	0.992	57.0	0.749	0.015
1918	4249.1	3877.7	776.7	774.4	0.978	52.0	0.763	0.013
1919	4205.3	3834.0	767.3	773.6	0.966	31.1	0.843	0.008
1920	4181.6	3810.3	762.0	773.2	0.960	33.8	0.830	0.009
1921	4156.5	3785.2	756.5	772.7	0.953	29.5	0.847	0.008
1922	4136.1	3764.9	751.9	772.3	0.947	29.0	0.849	0.008
1923	4117.0	3745.8	747.6	772.0	0.941	38.9	0.806	0.010
1924	4089.9	3718.8	741.5	771.4	0.934	52.1	0.754	0.014
1925	4052.0	3681.0	733.2	770.7	0.923	57.2	0.734	0.016
1926	4011.0	3640.2	724.2	769.9	0.912	71.0	0.686	0.020
1927	3959.2	3588.6	712.9	768.8	0.898	59.0	0.722	0.016
1928	3920.0	3549.7	704.2	768.0	0.887	50.3	0.751	0.014
1929	3890.1	3520.0	697.4	767.3	0.878	51.0	0.746	0.014
1930	3860.7	3490.9	690.7	766.7	0.870	52.0	0.740	0.015
1931	3831.7	3462.2	684.1	766.0	0.862	59.7	0.710	0.017
1932	3797.0	3427.7	676.3	765.2	0.852	45.9	0.759	0.013
1933	3775.8	3406.8	671.3	764.7	0.845	30.4	0.826	0.009
1934	3769.4	3400.7	669.5	764.5	0.843	31.4	0.821	0.009
1935	3762.6	3394.2	667.6	764.3	0.841	24.1	0.856	0.007
1936	3762.7	3394.6	667.1	764.3	0.840	11.1	0.928	0.003
1937	3774.6	3406.8	669.2	764.5	0.843	10.8	0.930	0.003
1938	3786.5	3419.1	671.4	764.7	0.845	7.1	0.953	0.002
1939	3801.5	3434.4	674.2	765.0	0.849	7.8	0.949	0.002
1940	3815.5	3448.7	676.9	765.3	0.852	15.0	0.907	0.004
1941	3822.8	3456.2	678.2	765.4	0.854	19.3	0.884	0.006
1942	3826.1	3459.7	678.8	765.5	0.855	7.8	0.950	0.002
1943	3839.5	3473.3	681.5	765.8	0.858	8.6	0.945	0.002
1944	3851.8	3485.8	684.0	766.0	0.861	1.7	0.988	0.000
1945	3869.9	3503.8	687.7	766.4	0.866	4.0	0.974	0.001
1946	3885.4	3519.3	691.0	766.7	0.870	8.0	0.949	0.002
1947	3896.8	3530.7	693.4	767.0	0.873	11.7	0.926	0.003
1948	3904.3	3538.1	695.1	767.1	0.875	19.4	0.881	0.005
1949	3904.4	3538.2	695.3	767.1	0.876	21.4	0.870	0.006
1950	3902.6	3536.3	695.0	767.1	0.875	16.9	0.892	0.005
1951	3904.4	3538.1	695.6	767.2	0.876	25.2	0.851	0.007
1952	3898.9	3532.5	694.6	767.1	0.875	21.5	0.866	0.006
1953	3896.4	3530.0	694.3	767.0	0.874	18.8	0.878	0.005
1954	3896.1	3529.7	694.5	767.1	0.875	30.7	0.810	0.009
1955	3884.2	3517.8	692.3	766.8	0.872	41.7	0.745	0.012
1956	3861.0	3494.9	688.0	766.4	0.866	47.7	0.716	0.014
1957	3832.3	3466.5	682.6	765.9	0.860	34.0	0.786	0.010
1958	3817.7	3451.9	679.8	765.6	0.856	28.2	0.818	0.008
1959	3809.2	3443.3	678.2	765.4	0.854	22.8	0.853	0.007
1960	3806.5	3440.4	677.6	765.4	0.853	25.6	0.839	0.007
1961	3801.4	3435.2	676.5	765.2	0.852	27.7	0.824	0.008
1962	3794.4	3428.1	675.1	765.1	0.850	26.3	0.828	0.008

Table 50 (continued). Time series from the southern California base case model.

Year	Total Biomass	Age 13+ Biomass	Spawning Output	Recruits	Depletion	Catch	SPR	Exploitation
1963	3788.5	3422.3	673.9	765.0	0.849	30.0	0.810	0.009
1964	3779.6	3413.5	672.0	764.8	0.846	35.4	0.773	0.010
1965	3765.1	3399.2	669.2	764.5	0.843	46.7	0.718	0.014
1966	3740.0	3374.6	664.2	764.0	0.836	56.9	0.659	0.017
1967	3704.5	3339.7	657.3	763.2	0.828	78.0	0.573	0.023
1968	3648.9	3284.9	646.5	762.0	0.814	84.3	0.547	0.026
1969	3588.2	3225.0	634.6	760.7	0.799	159.0	0.455	0.049
1970	3471.5	3108.5	609.6	757.7	0.768	127.2	0.458	0.041
1971	3380.9	3018.5	590.9	755.2	0.744	149.3	0.425	0.049
1972	3275.2	2913.4	568.7	752.2	0.716	207.9	0.338	0.071
1973	3121.0	2760.2	536.5	747.4	0.676	241.1	0.285	0.087
1974	2940.3	2581.1	499.1	741.2	0.629	262.9	0.249	0.102
1975	2744.5	2387.2	458.9	733.5	0.578	249.0	0.232	0.104
1976	2564.0	2208.7	422.3	725.3	0.532	261.7	0.226	0.118
1977	2381.9	2028.0	384.6	715.6	0.484	282.7	0.206	0.139
1978	2189.9	1837.5	344.8	703.4	0.434	259.7	0.197	0.141
1979	2022.5	1672.0	310.5	690.8	0.391	293.8	0.145	0.176
1980	1824.1	1477.6	271.9	673.6	0.342	165.8	0.207	0.112
1981	1742.8	1397.6	255.5	665.1	0.322	140.9	0.249	0.101
1982	1690.2	1345.3	243.7	658.4	0.307	296.3	0.114	0.220
1983	1499.2	1161.2	208.2	634.8	0.262	196.4	0.158	0.169
1984	1403.9	1069.9	189.4	619.6	0.239	213.4	0.114	0.199
1985	1288.8	962.1	169.2	600.7	0.213	246.3	0.085	0.256
1986	1143.6	826.8	144.7	572.9	0.182	144.4	0.149	0.175
1987	1095.5	781.0	135.1	560.2	0.170	46.1	0.345	0.059
1988	1133.4	818.4	140.0	566.8	0.176	39.7	0.381	0.049
1989	1175.9	862.9	146.4	575.0	0.184	69.8	0.262	0.081
1990	1192.2	883.9	149.0	578.2	0.188	69.5	0.269	0.079
1991	1208.4	905.4	151.8	581.6	0.191	61.1	0.298	0.067
1992	1230.0	933.0	155.9	586.3	0.196	52.4	0.344	0.056
1993	1256.4	965.4	161.1	592.1	0.203	49.4	0.370	0.051
1994	1284.2	999.1	166.6	598.0	0.210	66.9	0.295	0.067
1995	1294.3	1016.1	169.5	600.9	0.213	108.9	0.203	0.107
1996	1268.7	995.7	166.2	597.6	0.209	56.9	0.346	0.057
1997	1289.1	1018.0	170.0	601.5	0.214	29.6	0.525	0.029
1998	1333.0	1061.8	177.6	608.9	0.224	53.3	0.390	0.050
1999	1358.3	1084.9	182.0	613.0	0.229	33.9	0.510	0.031
2000	1396.7	1120.8	189.0	619.3	0.238	17.4	0.695	0.016
2001	1449.4	1170.7	198.3	627.1	0.250	13.5	0.781	0.012
2002	1503.6	1222.9	208.2	634.8	0.262	10.8	0.824	0.009
2003	1560.0	1277.2	218.5	642.2	0.275	0.6	0.990	0.000
2004	1626.5	1340.9	230.4	650.2	0.290	14.6	0.782	0.011
2005	1677.5	1390.3	240.1	656.3	0.302	25.8	0.654	0.019
2006	1715.4	1427.2	247.9	660.8	0.312	7.2	0.888	0.005
2007	1772.5	1481.9	258.6	666.8	0.326	13.8	0.800	0.009
2008	1821.7	1529.1	268.1	671.7	0.338	10.9	0.839	0.007
2009	1873.3	1577.6	278.0	676.6	0.350	14.7	0.792	0.009
2010	1920.1	1621.3	287.1	680.9	0.362	11.3	0.837	0.007

Table 51. Reference points and intervals based on alternative states of nature for the southern California model.

Quantity	**Southern Base Model**	**(Low M, High M)**
Unfished total biomass (mt)	4331	(4190, 4705)
Unfished spawning output (SB_0, eggs x10^9)	794	(811, 819)
Unfished age 13+ biomass (mt)	3959	(3911, 4203)
Unfished recruitment (R_0, 1000s)	776	(539, 1137)
Depletion (SB_{2011} / SB_0)	0.374	(0.228, 0.518)
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	318	(324, 328)
SPR resulting in $SB_{40\%}$ ($SPR_{SB40\%}$)	0.447	(0.447, 0.447)
Exploitation rate resulting in $SB_{40\%}$	0.030	(0.024, 0.036)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	49.8	(40.3, 63.5)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	363	(371, 374)
$SPR_{MSY\text{-}proxy}$	0.5	(0.5, 0.5)
Exploitation rate corresponding to $SPR_{MSY\text{-}proxy}$	0.024	(0.02, 0.029)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	46.2	(37.4, 58.8)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	180	(187, 184)
SPR_{MSY}	0.288	(0.291, 0.286)
Exploitation Rate corresponding to SPR_{MSY}	0.057	(0.046, 0.071)
MSY (mt)	55.9	(45, 71.7)

Table 52. Likelihoods and depletion estimates associated for alternative values of natural mortality (M) and Beverton-Holt steepness (h) in the southern California model. The CV of length at age is fixed at 0.15 for both ages in the growth model. Results represent qualitative trends, but will not exactly match base model results.

	h = 0.59		h = 0.76		h = 0.93	
M	**NLL**	**Depletion**	**NLL**	**Depletion**	**NLL**	**Depletion**
0.050	746.79	0.06	749.18	0.14	747.68	0.23
0.055	760.34	0.10	759.57	0.20	755.07	0.29
0.060	773.00	0.16	768.19	0.27	762.15	0.36
0.065	782.01	0.25	774.91	0.35	768.53	0.42
0.070	787.54	0.35	780.15	0.43	774.11	0.48
0.075	791.05	0.45	784.27	0.51	778.92	0.55
0.080	793.43	0.54	787.61	0.58	783.06	0.61
0.085	795.15	0.62	790.41	0.64	786.64	0.67
0.090	796.60	0.70	792.82	0.71	789.79	0.72
0.095	797.87	0.77	794.96	0.77	792.65	0.77
0.100	799.06	0.83	797.01	0.82	795.16	0.82

Table 53. Integrated reference points for California based on regional base models and alternative states of nature.

Quantity	Integrated Base Models	(Low M, High M)
Unfished total biomass (mt)	7491	(7574, 7625)
Unfished spawning output (SB_0, eggs x10^9)	1358	(1431, 1323)
Unfished age 13+ biomass (mt)	6862	(7061, 6847)
Unfished recruitment (R_0, 1000s)	1243	(908, 1717)
Depletion (SB_{2011} / SB_0)	0.345	(0.246, 0.448)
Reference points based on $SB_{40\%}$		
MSY Proxy Spawning Output ($SB_{40\%}$)	543	(572, 529)
Yield with $SPR_{SB40\%}$ at $SB_{40\%}$ (mt)	102.9	(90, 119.1)
Reference points based on SPR proxy for MSY		
Spawning Stock Output at SPR proxy for MSY (SB_{SPR})	621	(654, 605)
Yield with $SPR_{MSY\text{-}proxy}$ at SB_{SPR} (mt)	95.6	(83.8, 110.4)
Reference points based on estimated MSY values		
Spawning Stock Output at MSY (SB_{MSY})	314	(337, 301)
MSY (mt)	114.7	(99.7, 133.6)

12. Figures

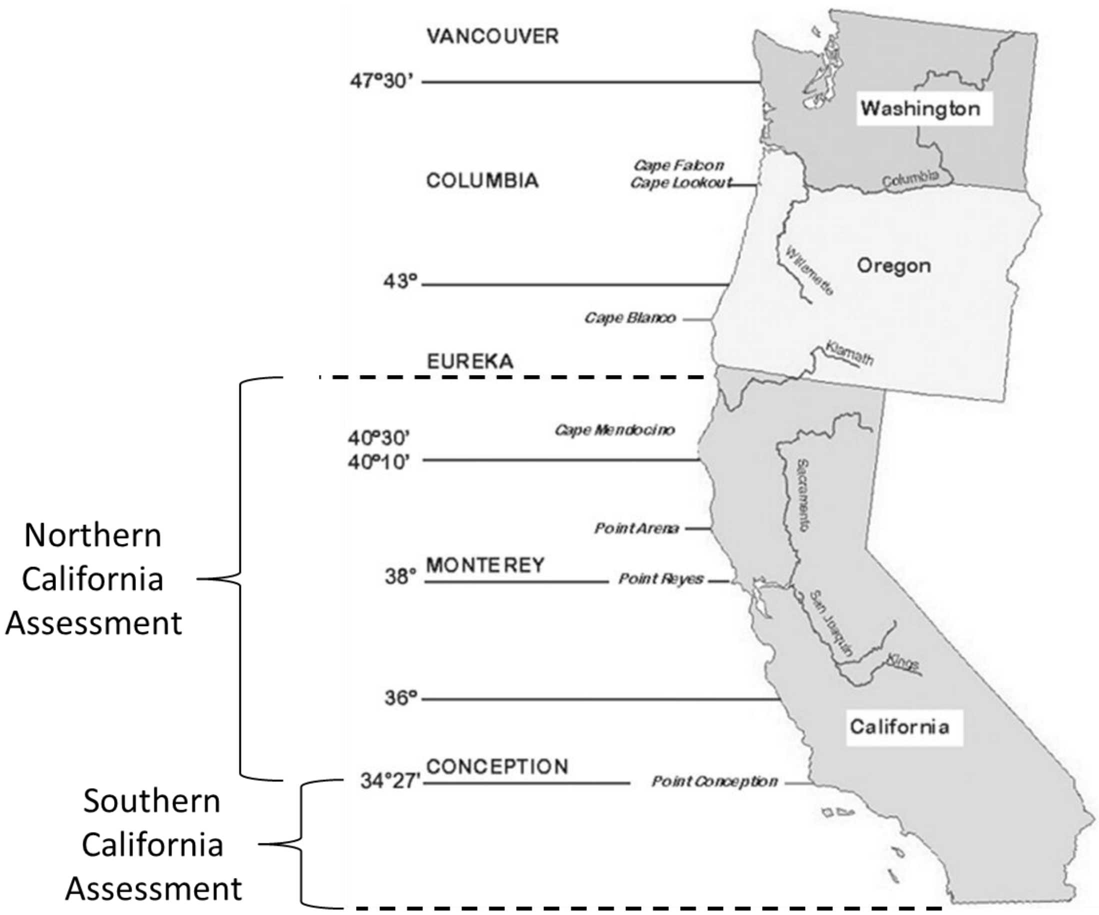


Figure 1. Stock boundary definitions for the assessment of greenspotted rockfish (*Sebastes chlorostictus*), relative to historical INPFC areas. The northern stock is defined as U.S. waters between the Oregon/California border and Point Conception. The southern stock includes U.S. waters between Point Conception and the U.S./Mexico border.

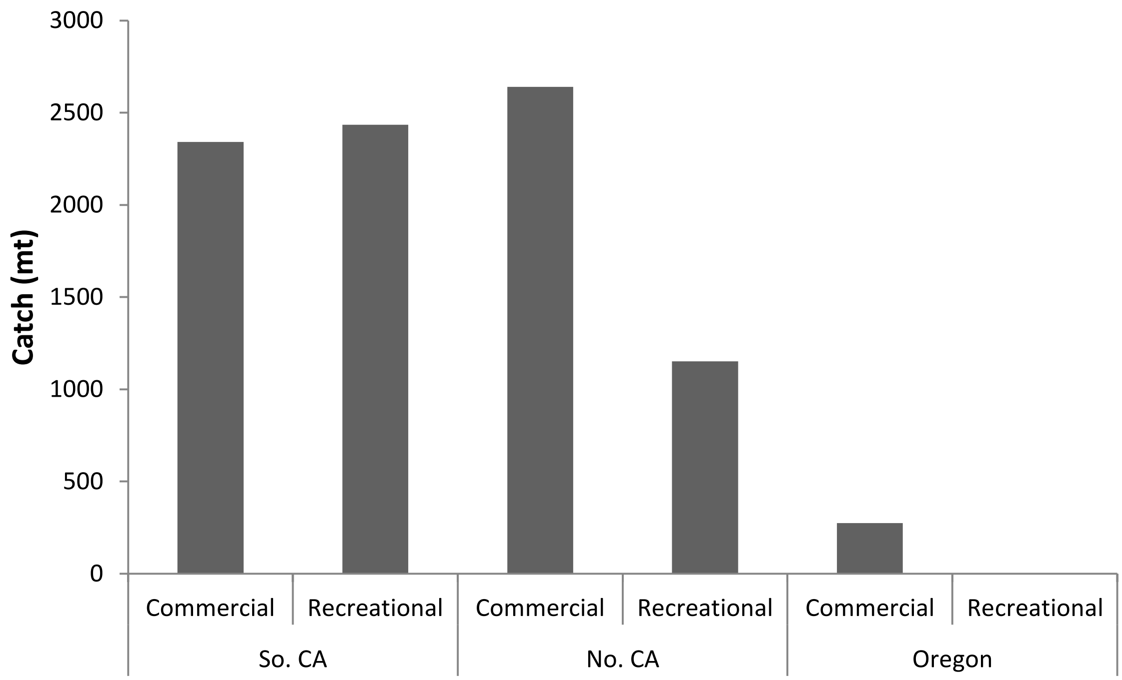


Figure 2. Total estimated catch (mt) of greenspotted rockfish by region and fishery, 1969-2010. Oregon landings combine all ports. Sources: CALCOM, RecFIN, PACFIN, Ralston et al. (2010) and V. Gertseva (NMFS NWFSC, pers. comm.).

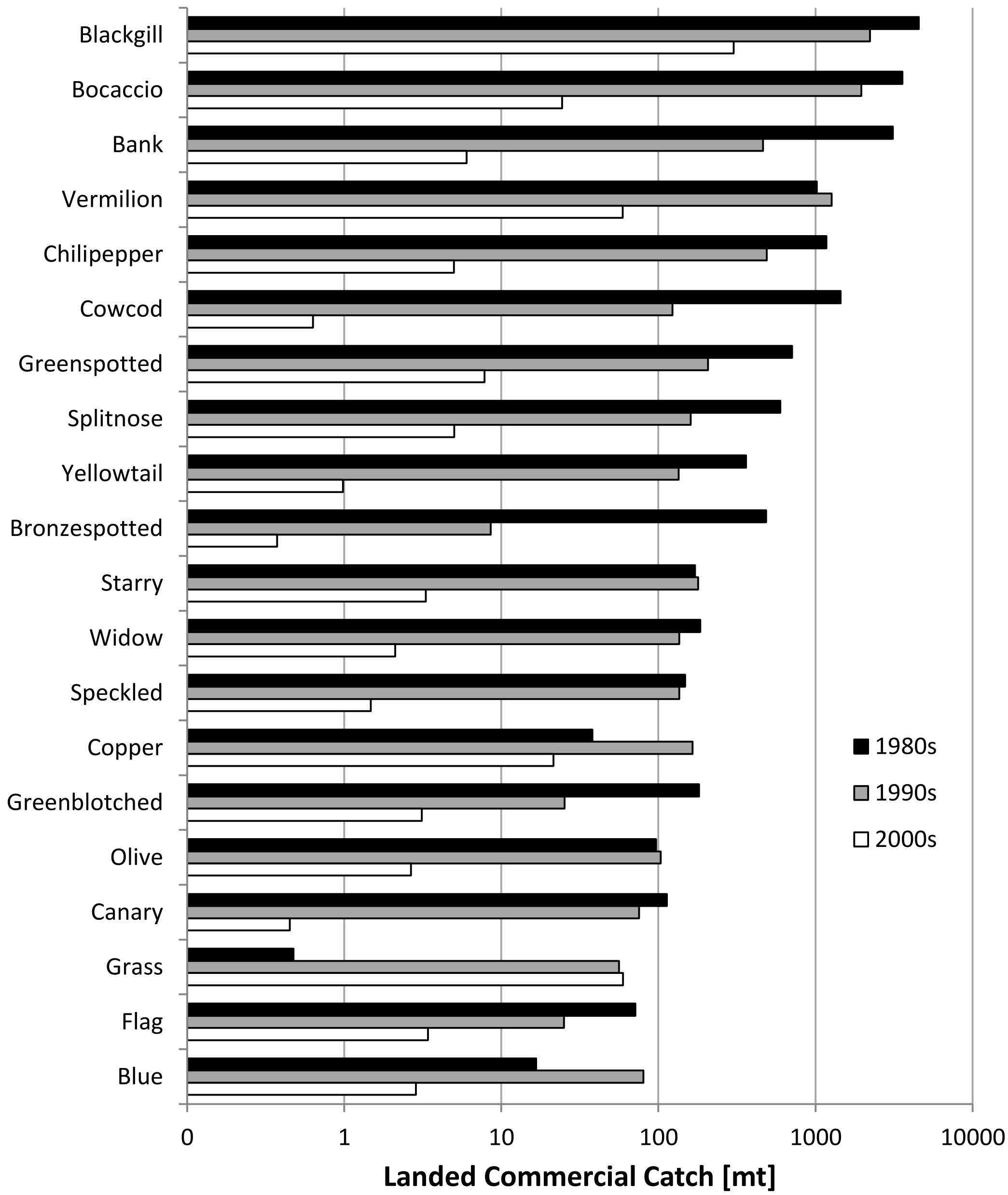


Figure 3. Commercial landings [mt] of rockfish species in southern California by species (top 20 shown) and decade (1980-1989, 1990-1999, and 2000-2009). Species are ranked by total landings. Source: CALCOM, 2011.

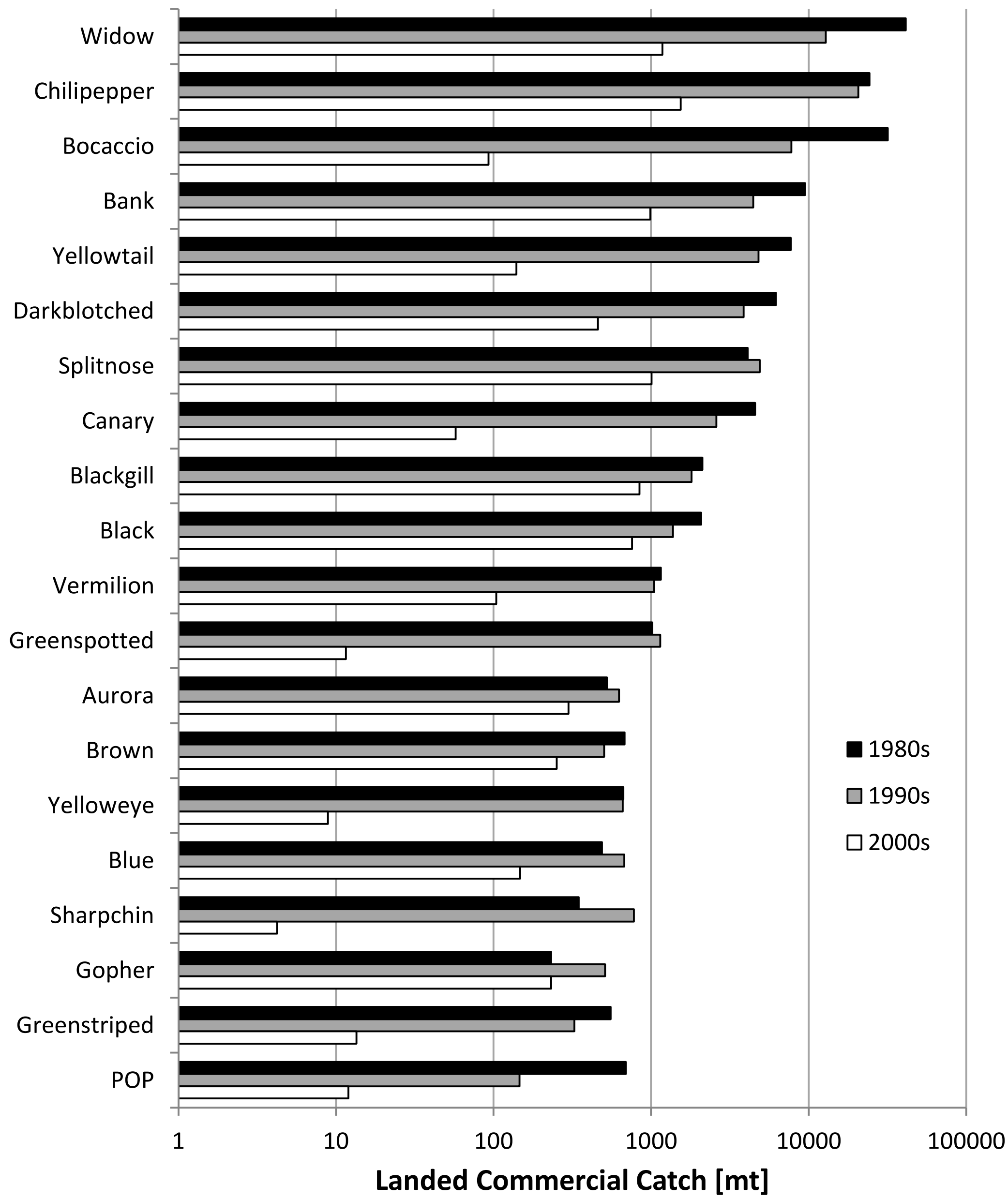


Figure 4. Commercial landings [mt] of rockfish species in northern California by species (top 20 shown) and decade (1980-1989, 1990-1999, and 2000-2009). Species are ranked by total landings. Source: CALCOM, 2011.

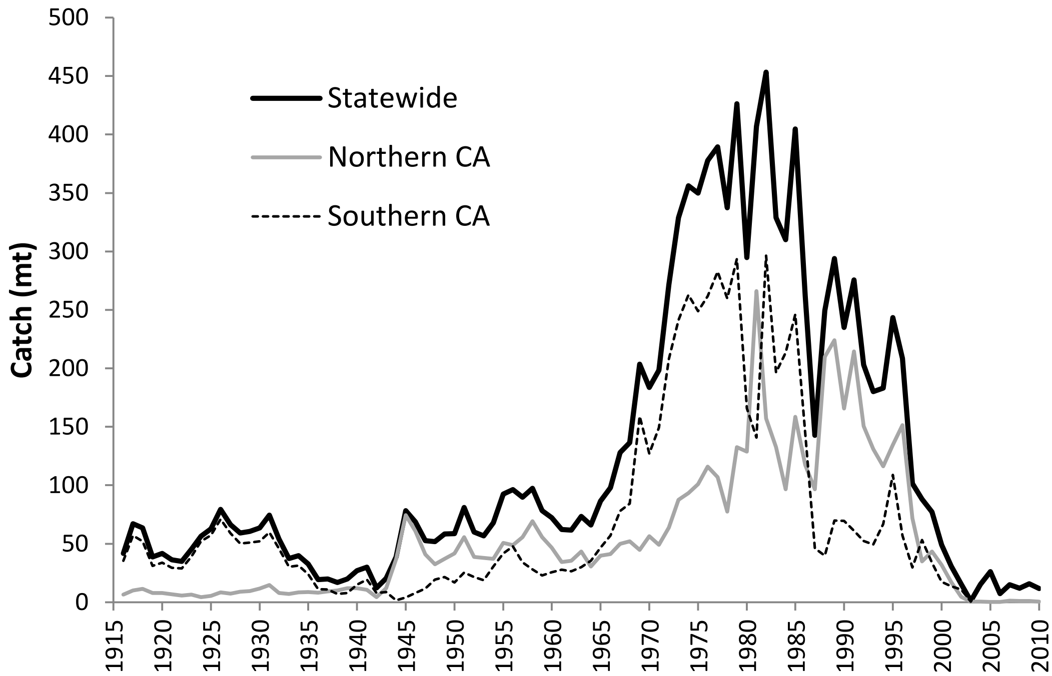


Figure 5. Total California landings (commercial and recreational combined) of greenspotted rockfish.

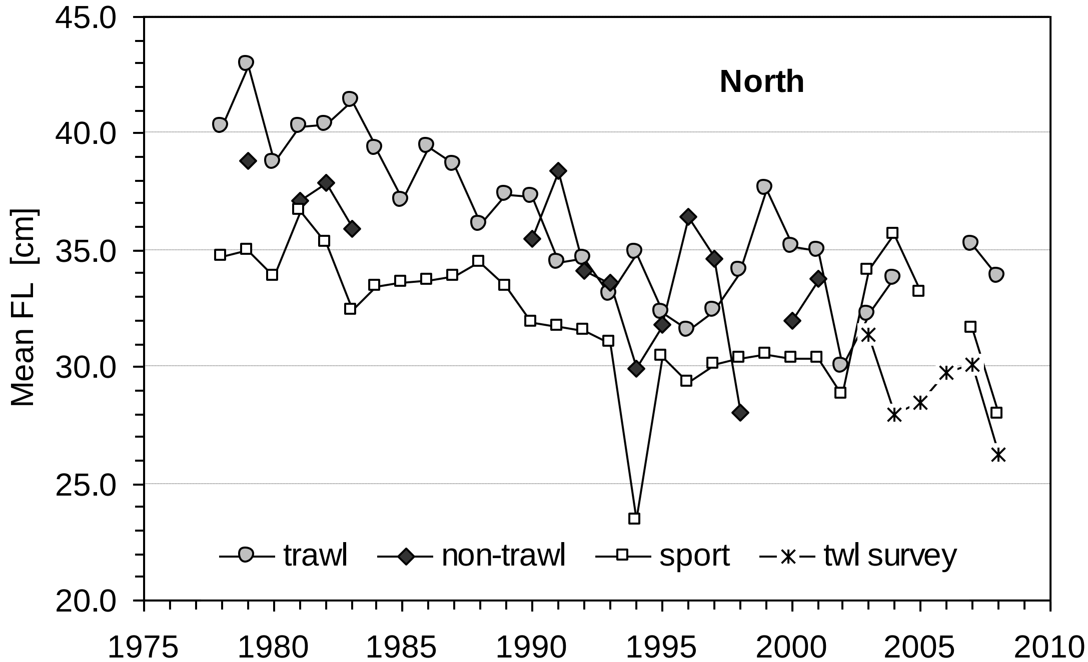


Figure 6. Time series of mean length of greenspotted rockfish from all fisheries and surveys north of Pt. Conception.

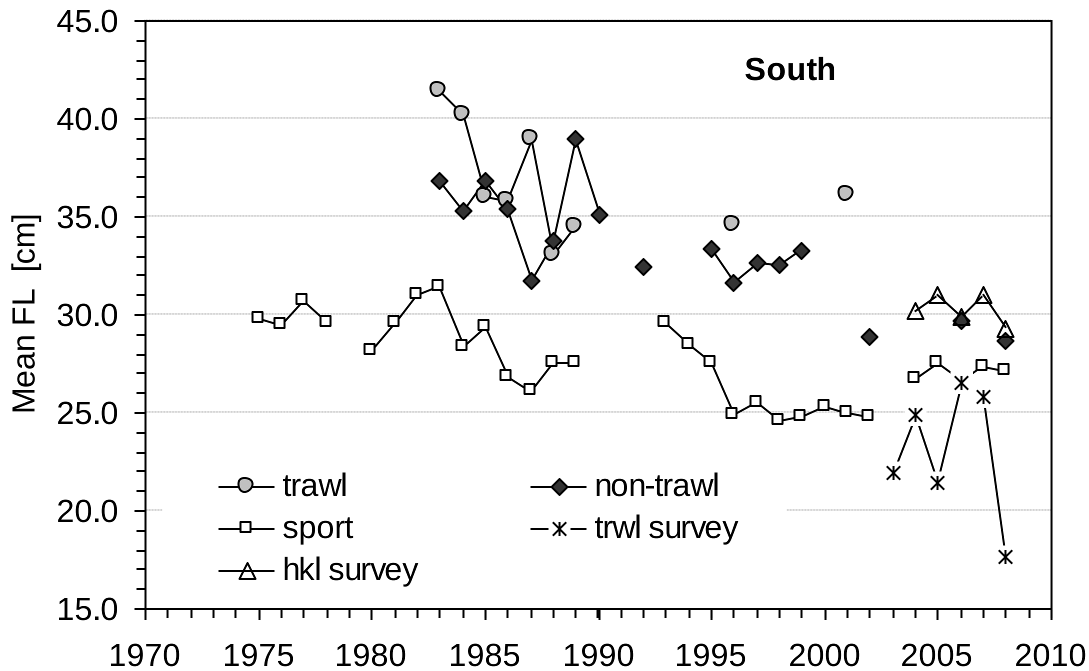


Figure 7. Time series of mean length of greenspotted rockfish from all fisheries and surveys south of Pt. Conception.

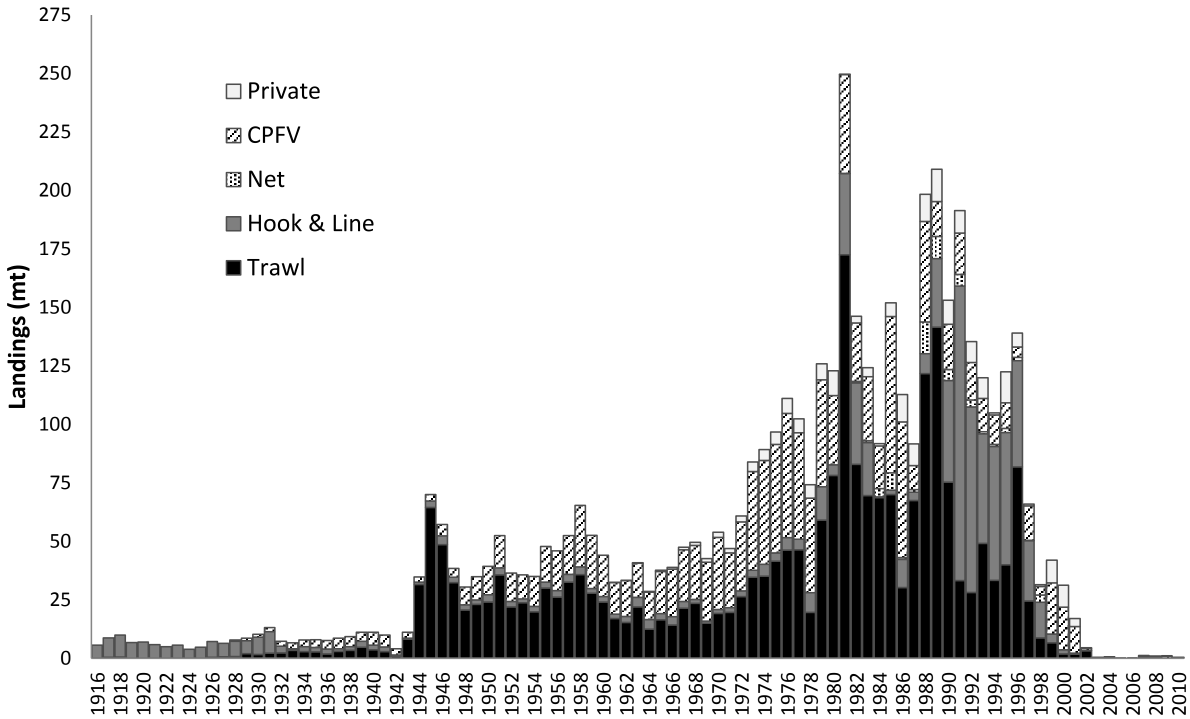


Figure 8. California landings (metric tons) of greenspotted rockfish north of Point Conception, by year and fishery.

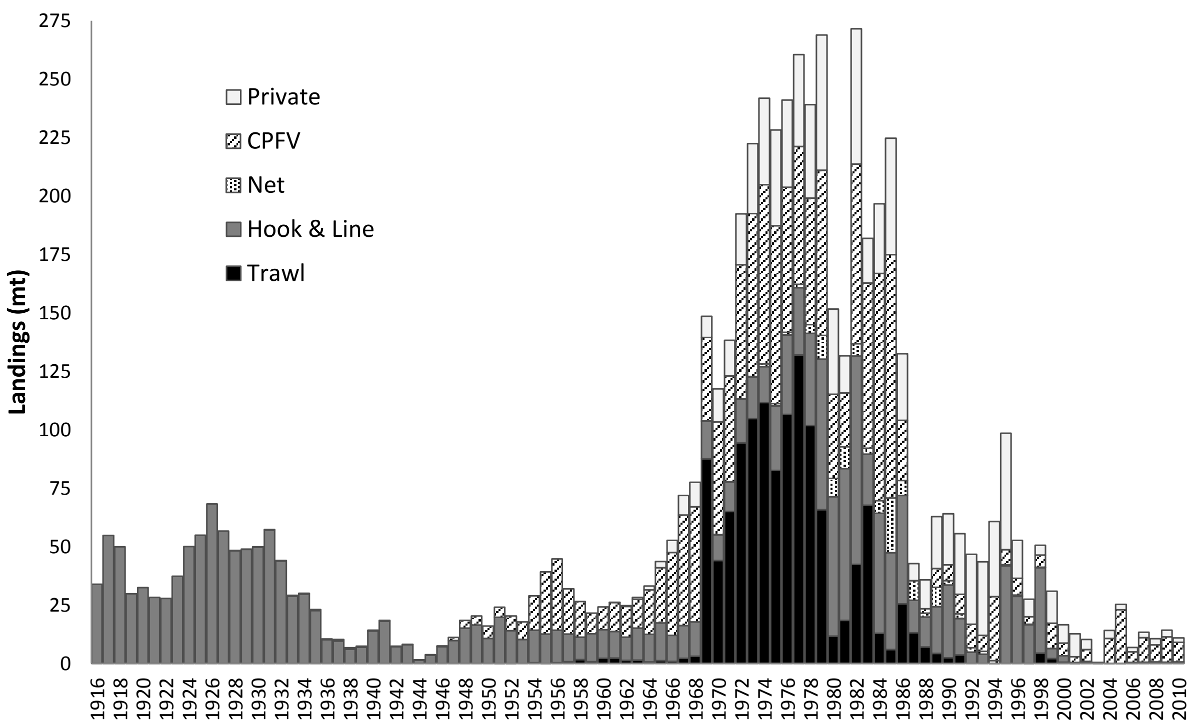


Figure 9. California landings (metric tons) of greenspotted rockfish south of Point Conception, by year and fishery.

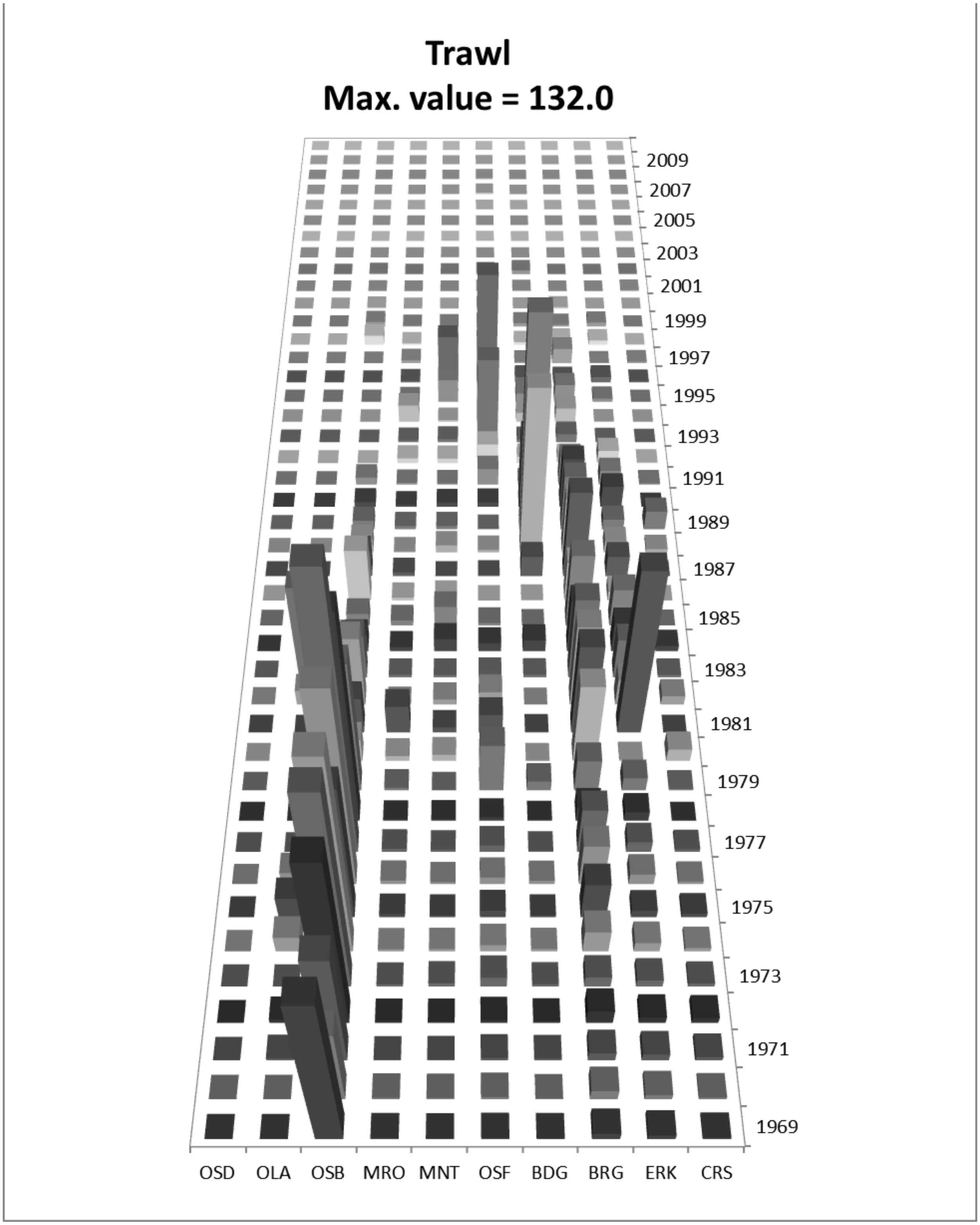


Figure 10. Distribution of commercial trawl landings [mt] by year and port complex. Port complexes south of Point Conception include OSD = San Diego, OLA = Los Angeles, and OSB = Santa Barbara.

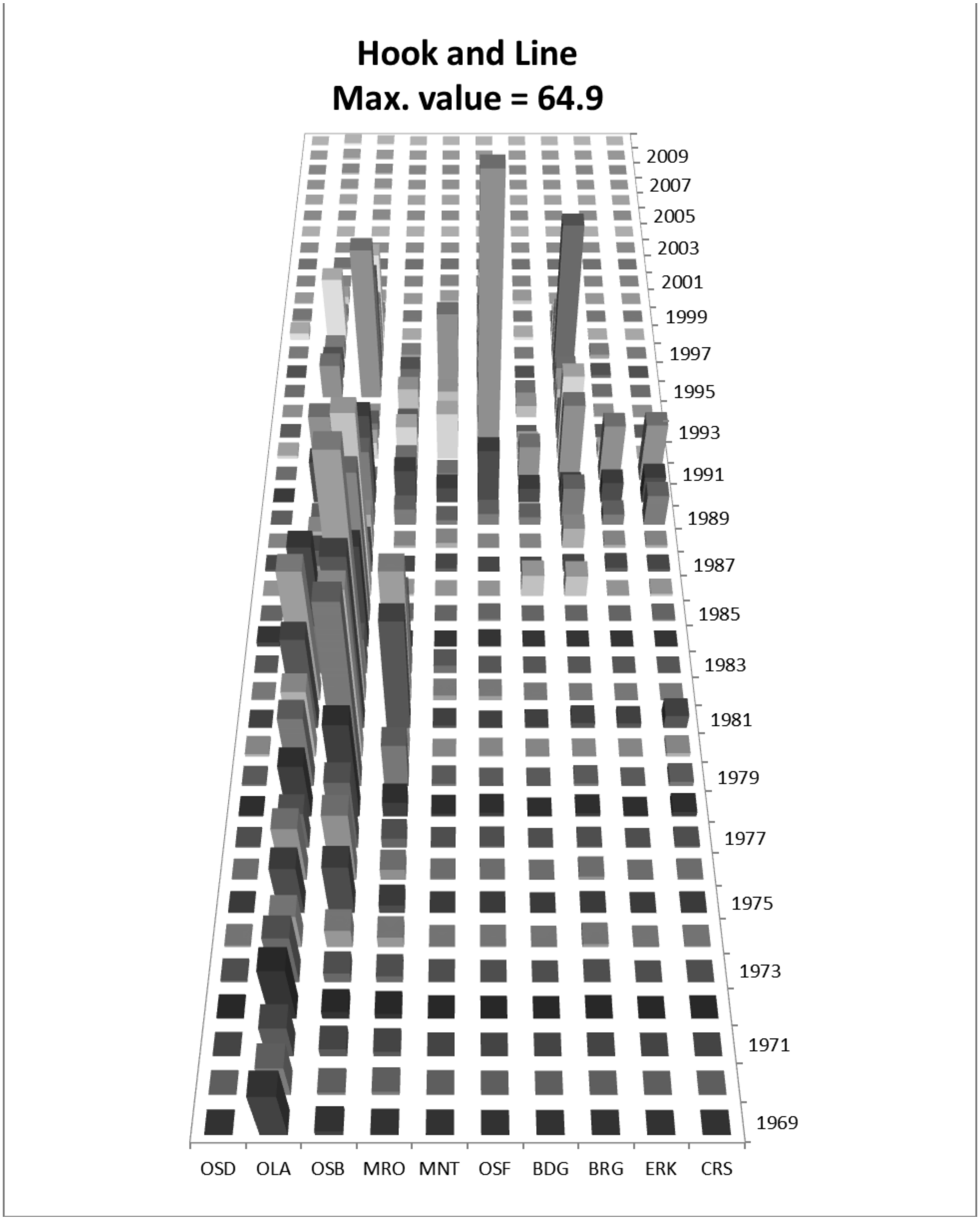


Figure 11. Distribution of commercial hook and line landings [mt] by year and port complex. Port complexes south of Point Conception include OSD = San Diego, OLA = Los Angeles, and OSB = Santa Barbara.

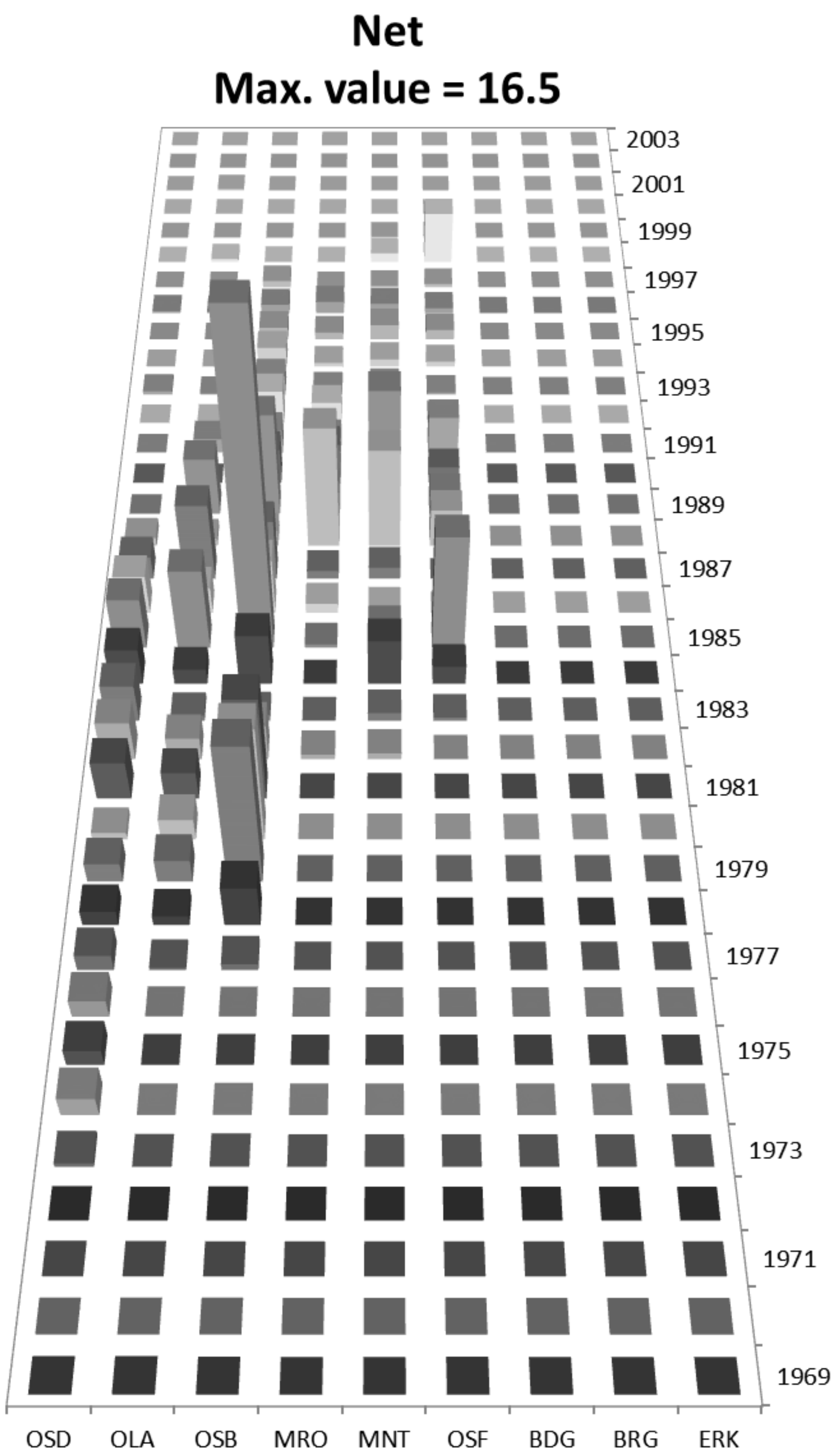


Figure 12. Distribution of commercial net gear landings [mt] by year and port complex. Port complexes south of Point Conception include OSD = San Diego, OLA = Los Angeles, and OSB = Santa Barbara.

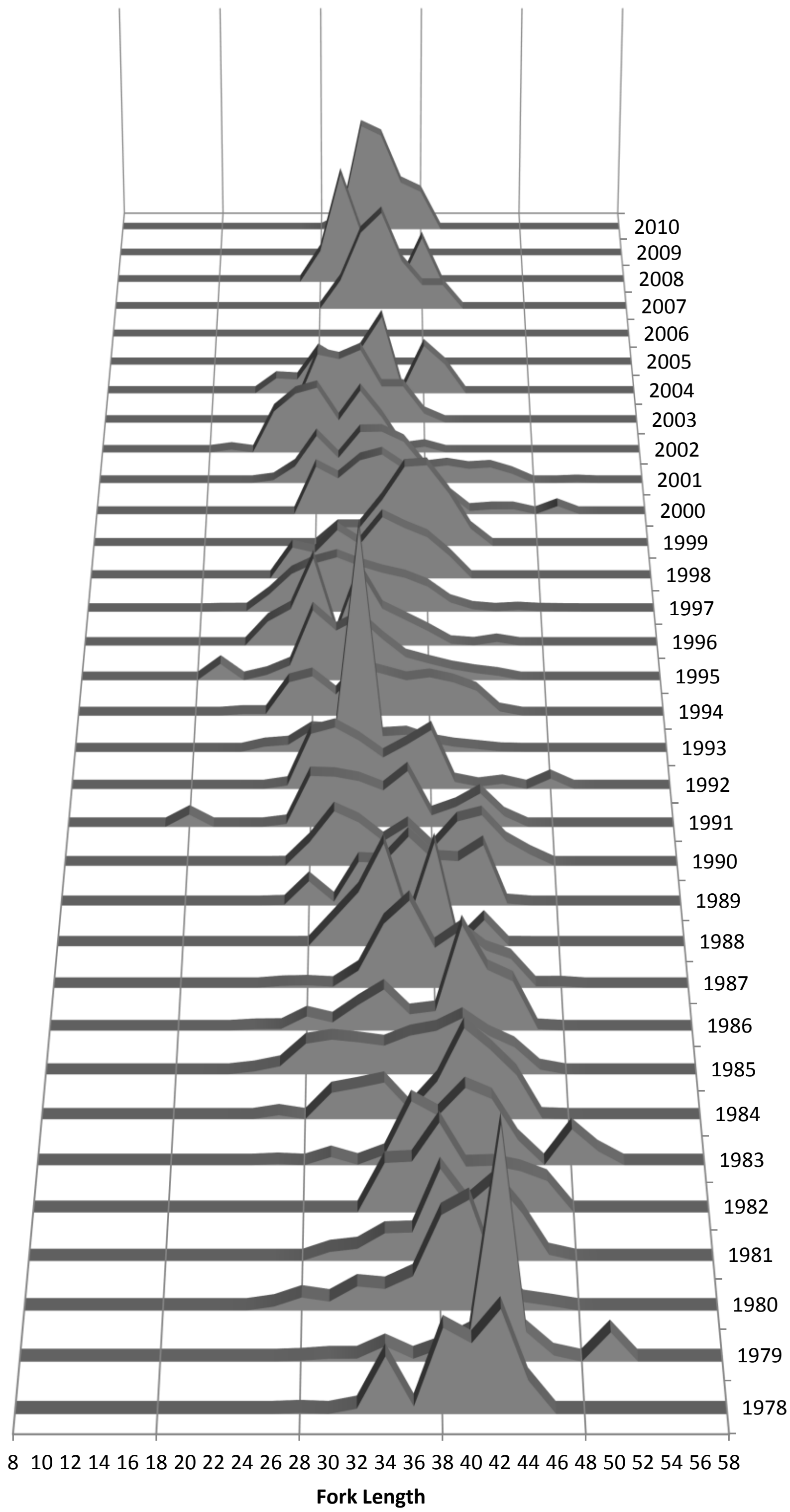


Figure 13. Length compositions for commercial trawl landings in California, north of Point Conception. Source: CALCOM.

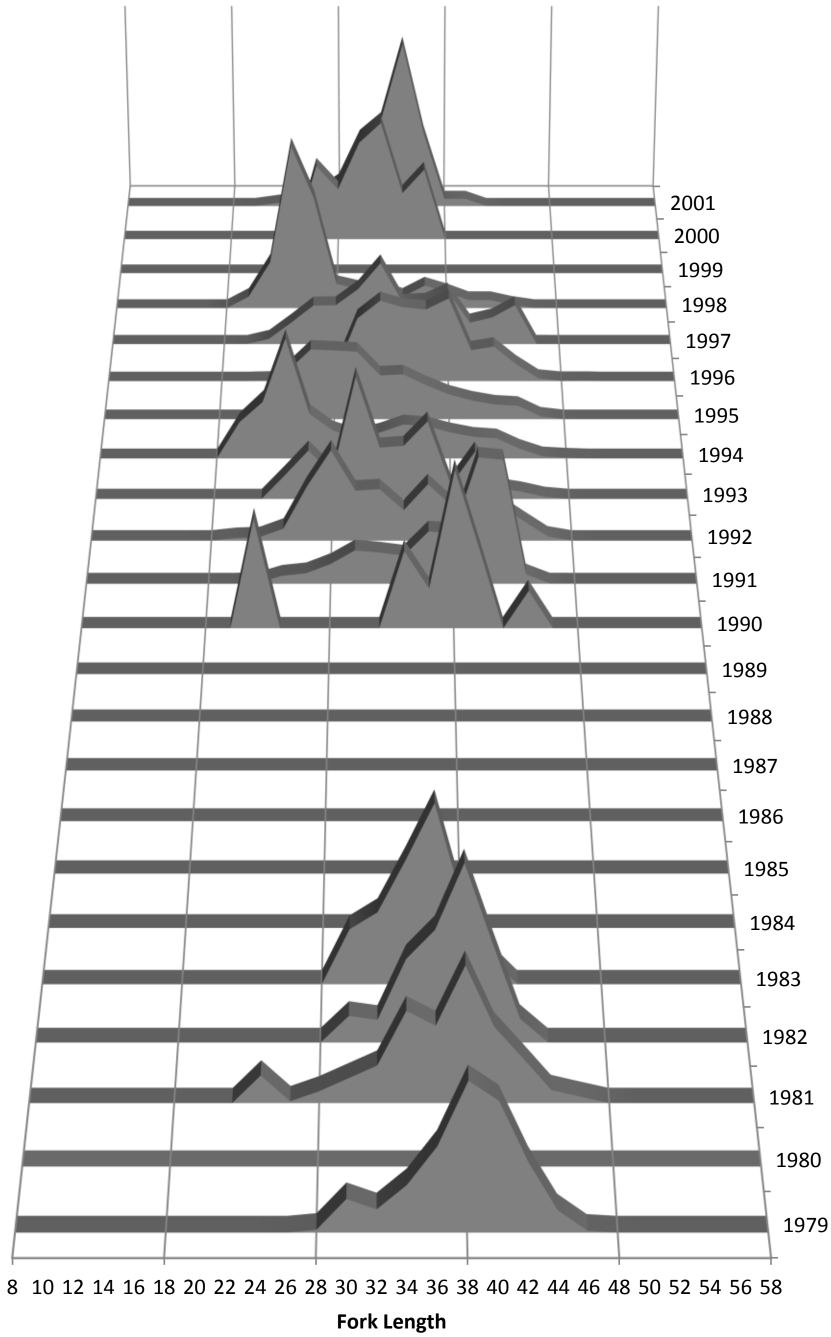


Figure 14. Length compositions for commercial hook and line landings in California, north of Point Conception. Source: CALCOM.

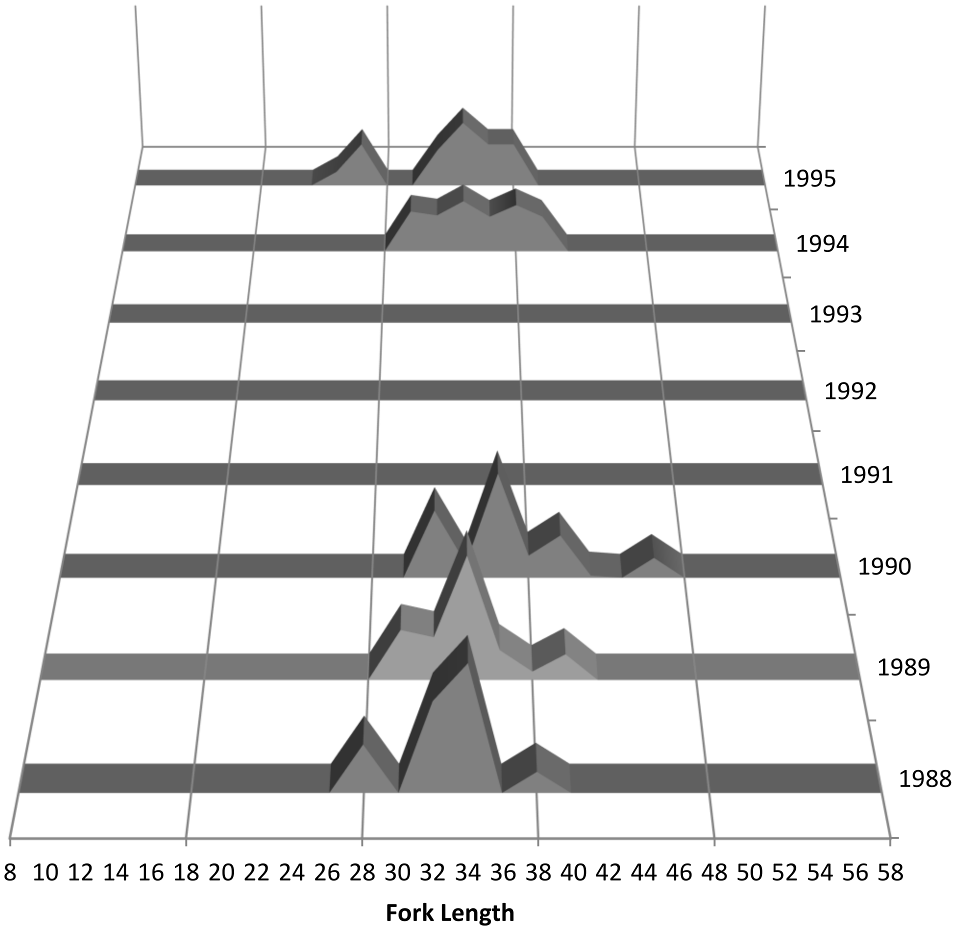


Figure 15. Length compositions for commercial landings by net gears in California, north of Point Conception. Source: CALCOM. Source: CALCOM.

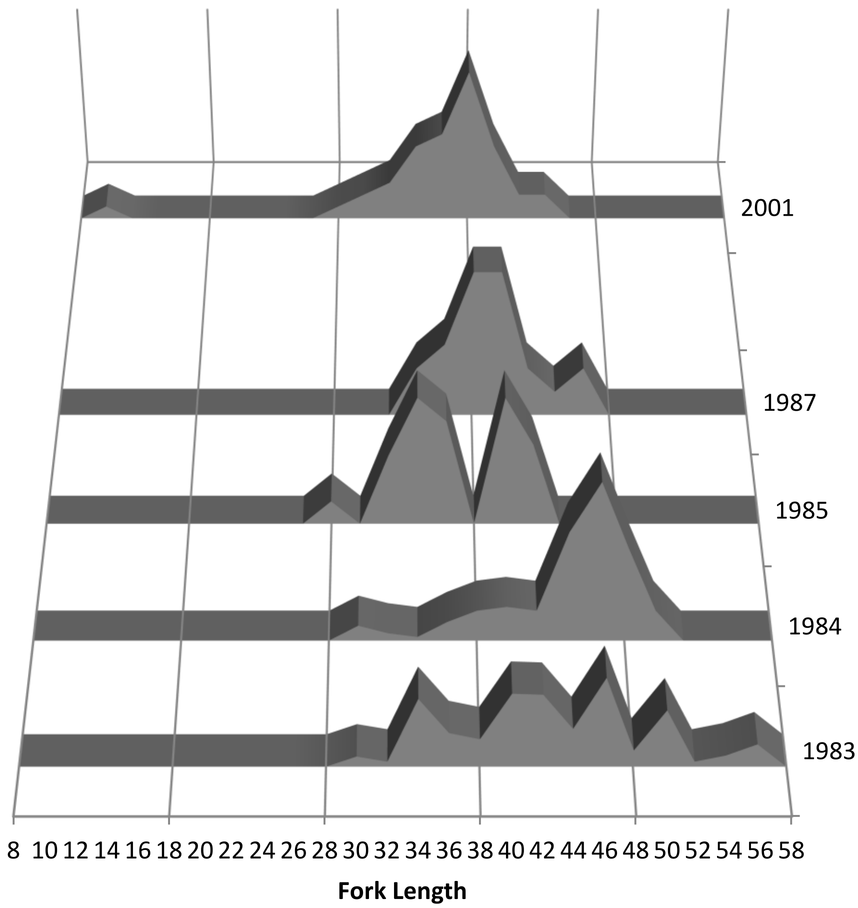


Figure 16. Length compositions for commercial trawl landings south of Point Conception. Source: CALCOM.

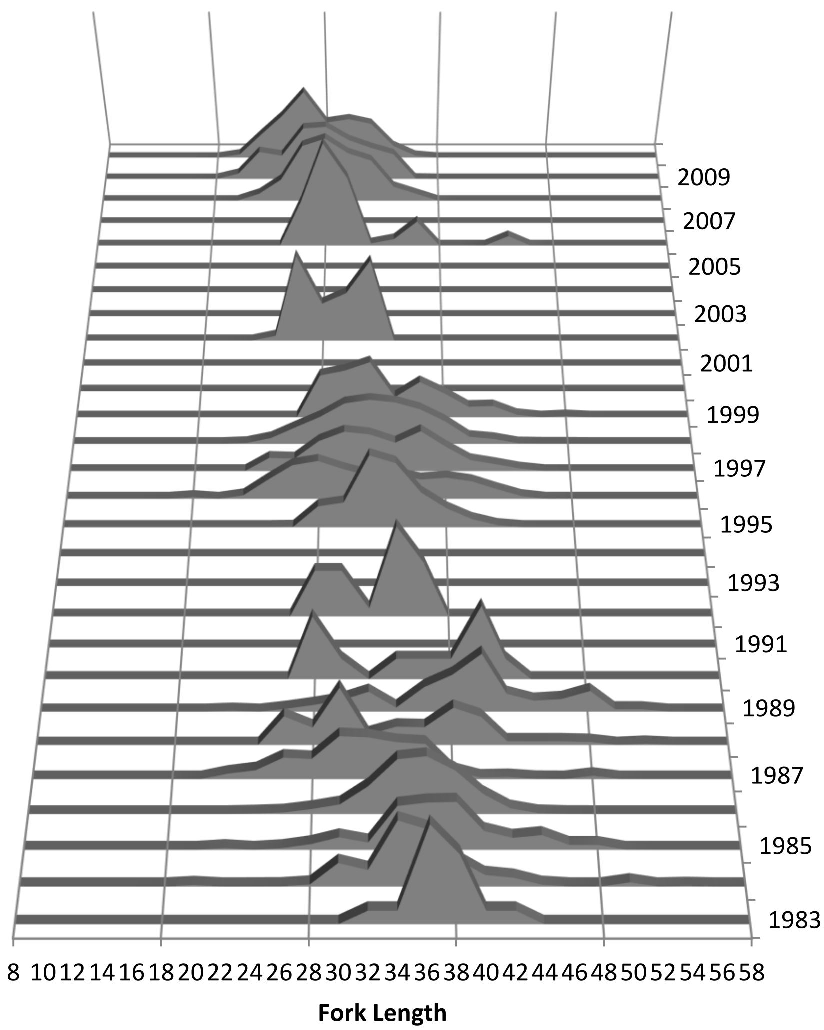


Figure 17. Length compositions for commercial hook and line landings south of Point Conception. Source: CALCOM.

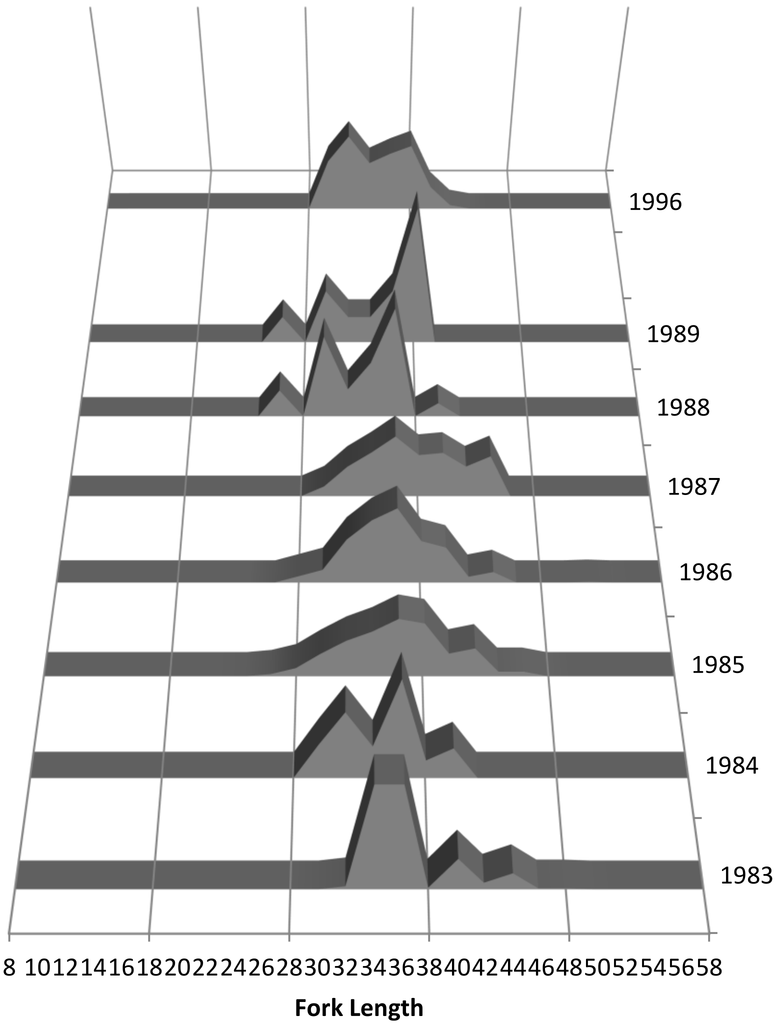


Figure 18. Length compositions for commercial net gear landings south of Point Conception. Source: CALCOM.

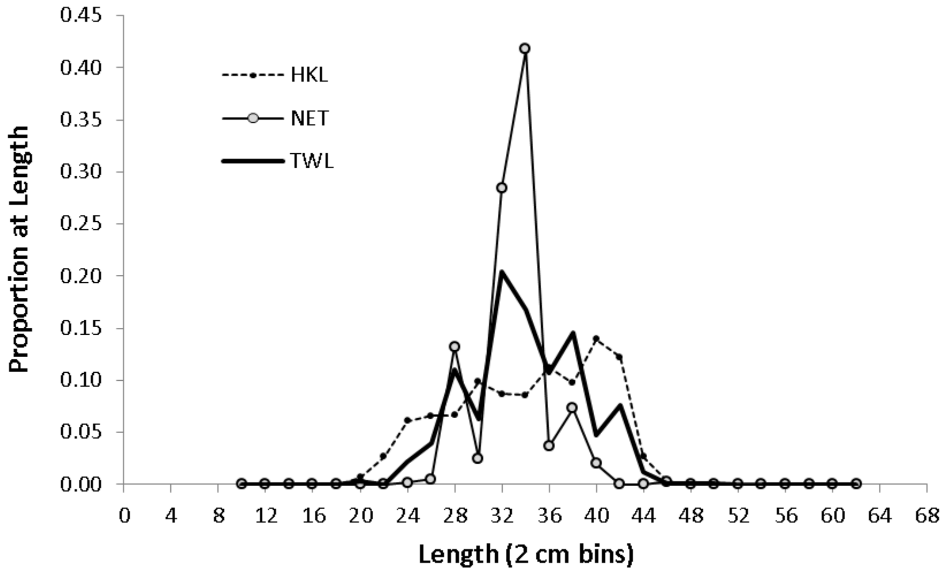


Figure 19. Length composition of greenspotted rockfish in northern California commercial fisheries, all years combined. TWL = trawl gears, HKL = hook and line gears, NET = net gears.

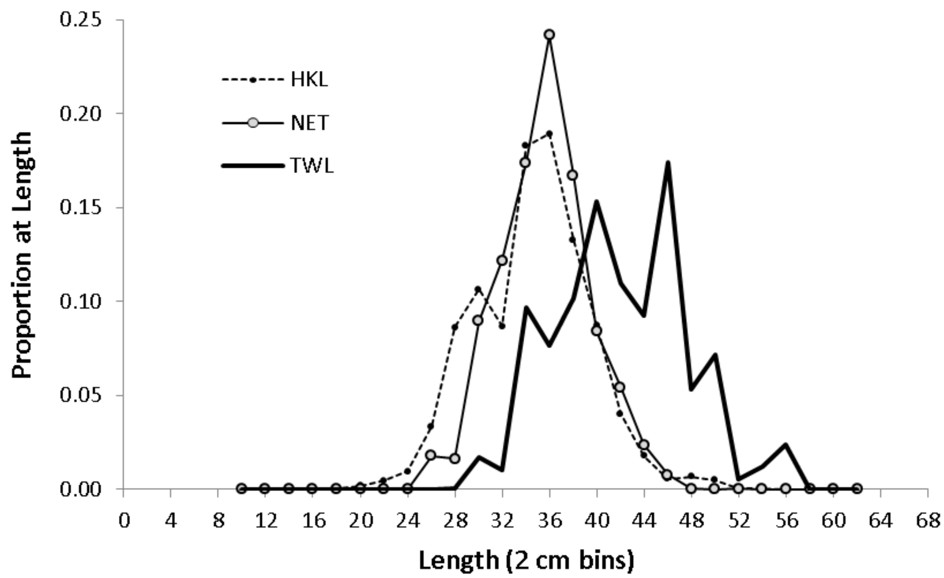


Figure 20. Length composition of greenspotted rockfish in southern California commercial fisheries, all years combined. TWL = trawl gears, HKL = hook and line gears, NET = net gears.

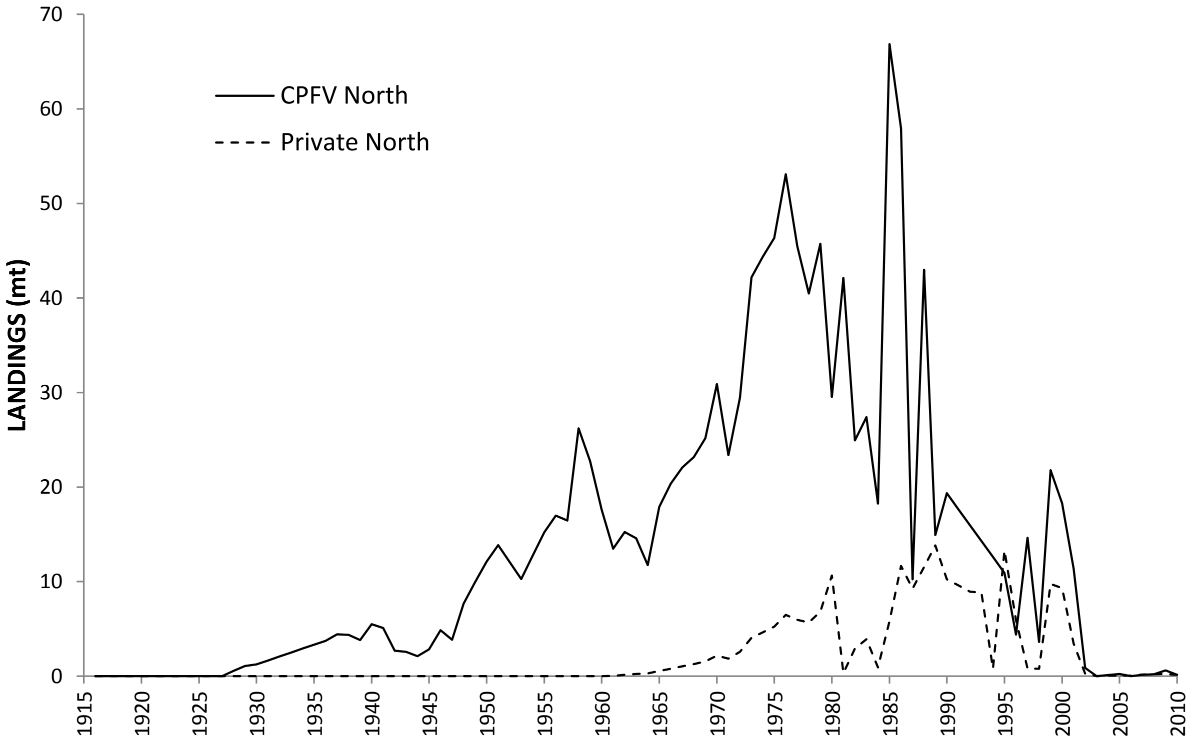


Figure 21. Recreational landings of *S. chlorostictus* in northern California by boat mode and year (RecFIN, type A catch).

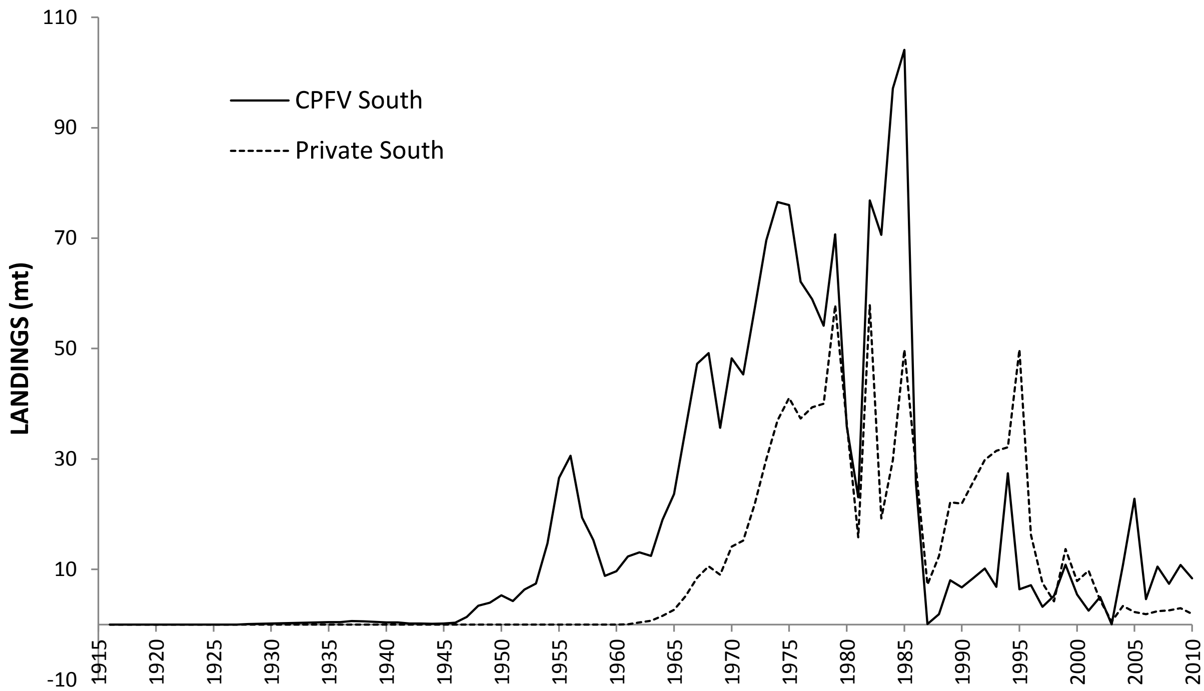


Figure 22. Recreational landings of *S. chlorostictus* in southern California by boat mode and year. (RecFIN, type A catch).

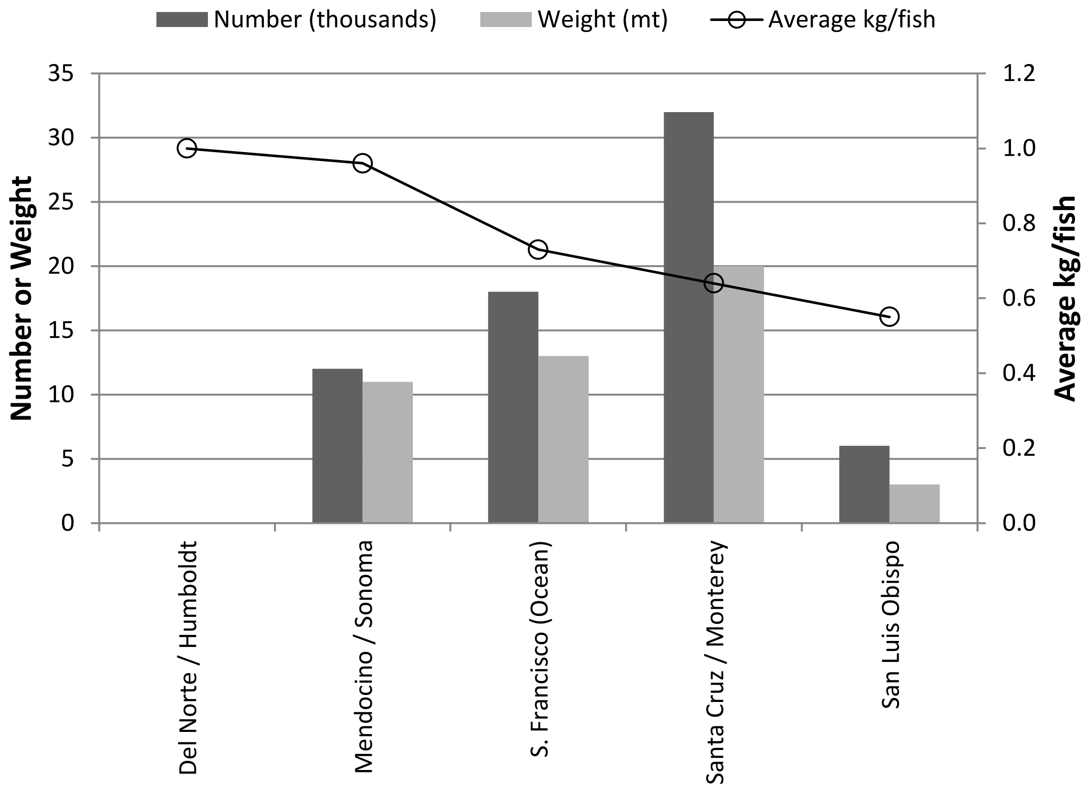


Figure 23. Recreational catch of greenspotted rockfish by coastal county district, 1981-1986. Source: Karpov et al. (1995).

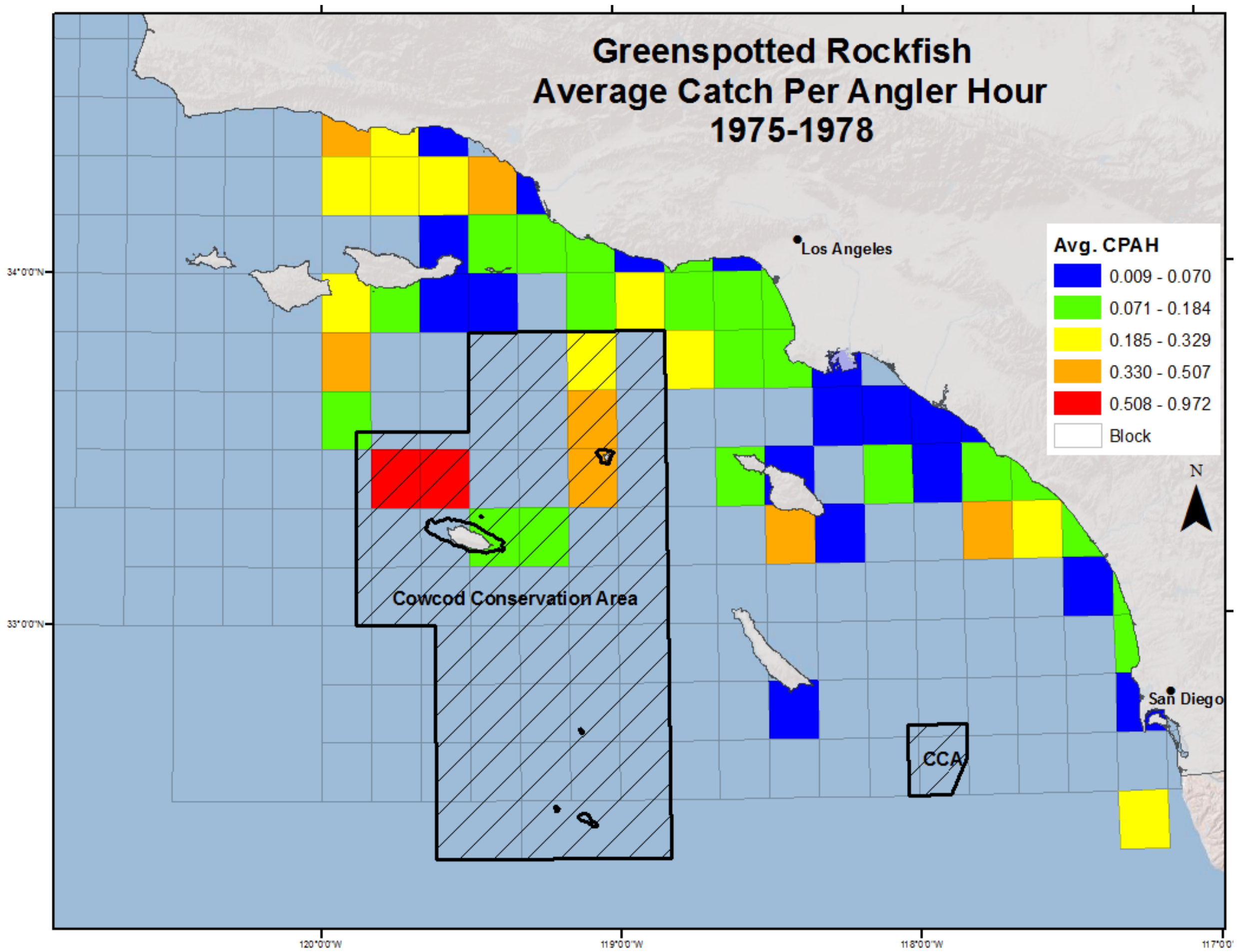


Figure 24. Catch per angler hour of greenspotted rockfish from onboard surveys of the southern California CPFVs, 1975-1978. Boundaries of Cowcod Conservation Areas (not established until 2001) shown for reference. Source: Collins and Crooke (CDFG; unpublished database).

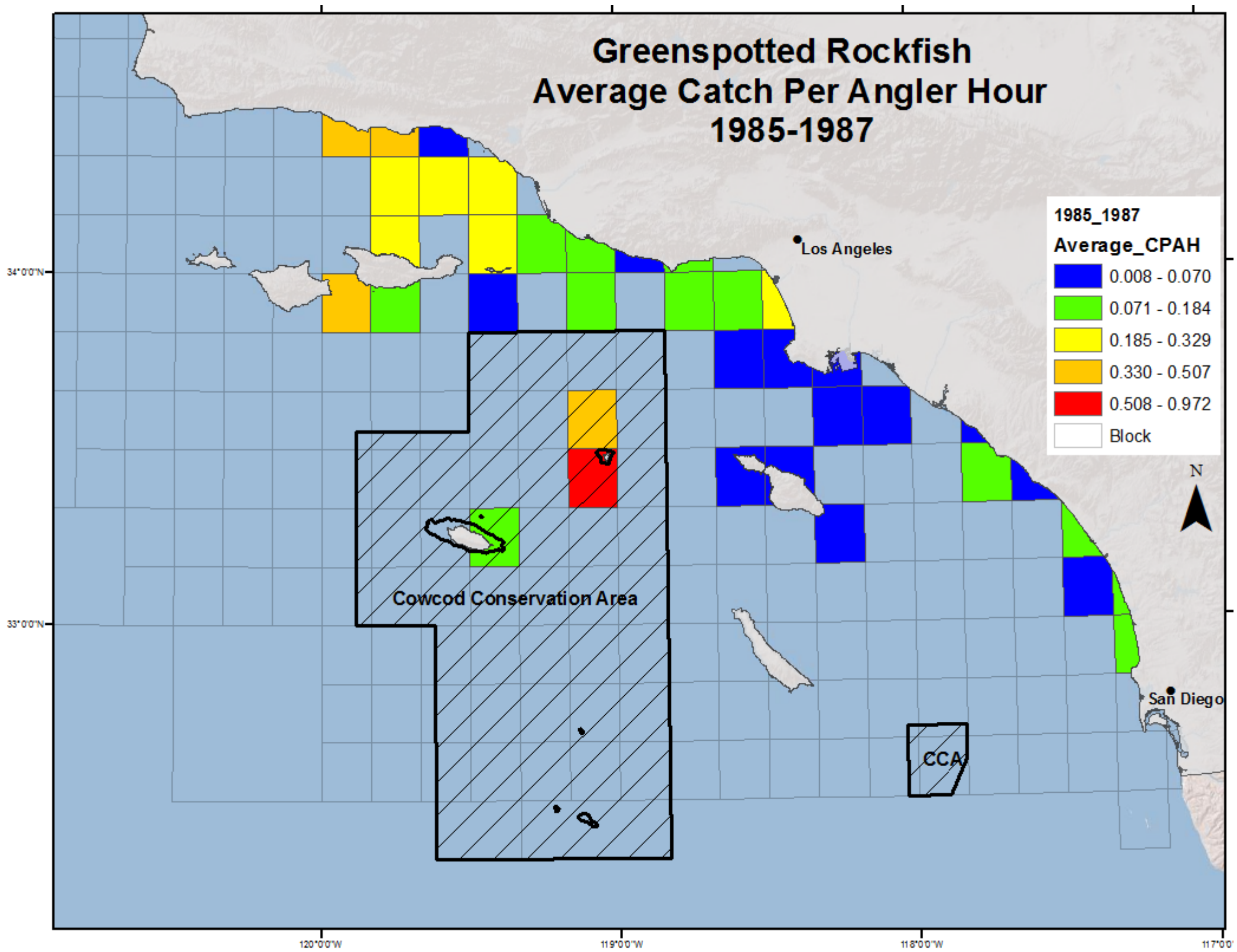


Figure 25. Catch per angler hour of greenspotted rockfish from onboard surveys of the southern California CPFVs, 1985-1987. Boundaries of Cowcod Conservation Areas (not established until 2001) shown for reference. Source: Data from Ally et al. (1991).

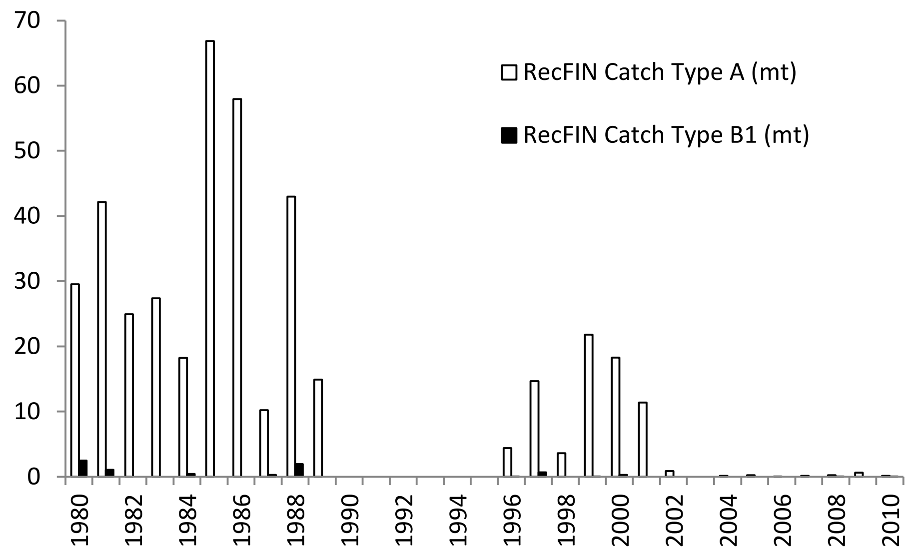


Figure 26. Recreational catch (mt) of greenspotted rockfish by year and catch type (A=sampler examined, B1=unavailable dead) for the northern California CPFV fleet.

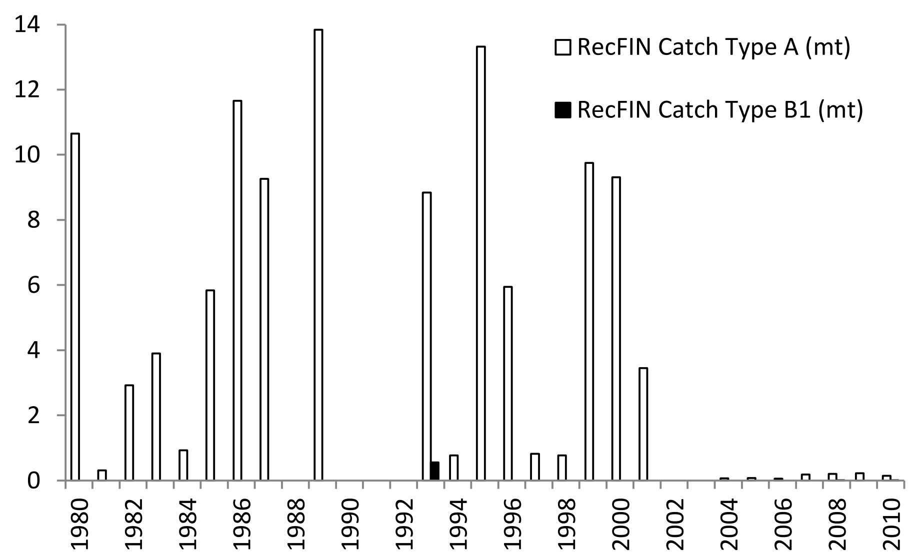


Figure 27. Recreational catch (mt) of greenspotted rockfish by year and catch type (A=sampler examined, B1=unavailable dead) for the northern California private/rental fleet.

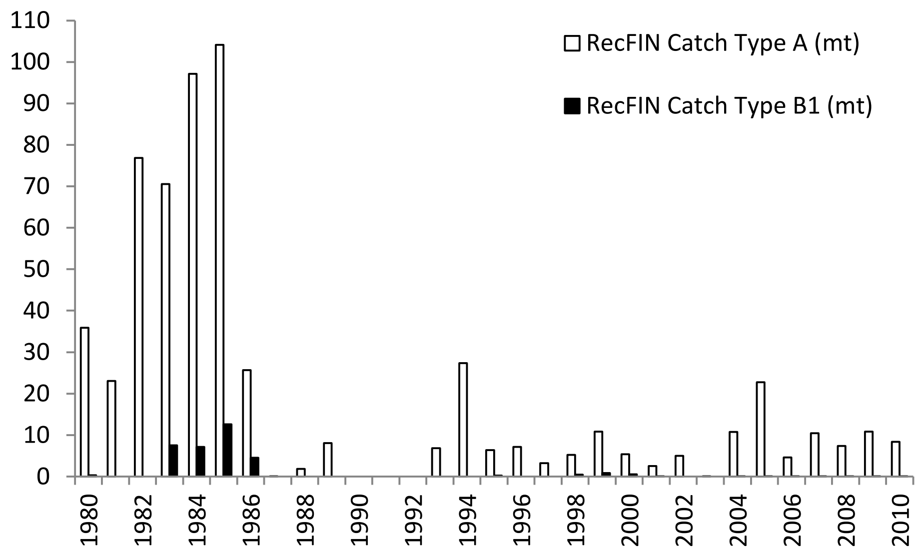


Figure 28. Recreational catch (mt) of greenspotted rockfish by year and catch type (A=sampler examined, B1=unavailable dead) for the southern California CPFV fleet.

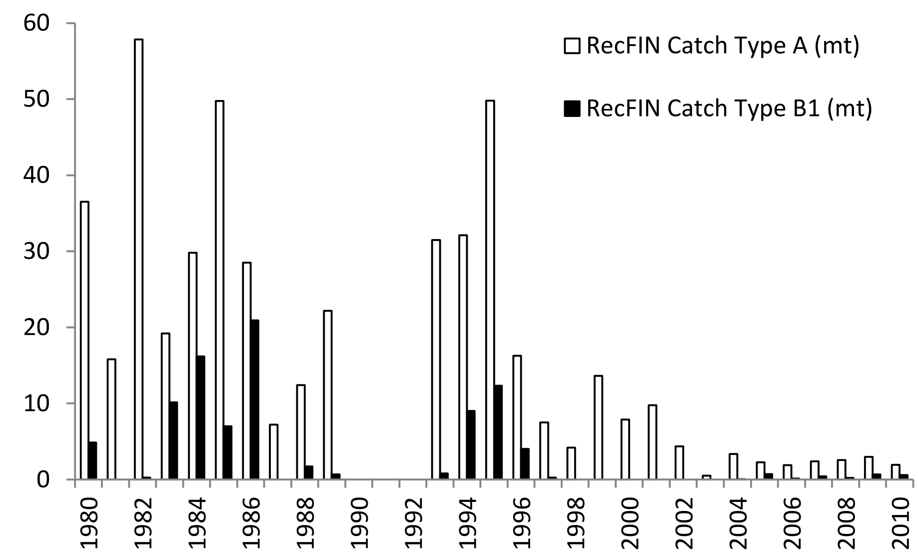


Figure 29. Recreational catch (mt) of greenspotted rockfish by year and catch type (A=sampler examined, B1=unavailable dead) for the southern California private/rental fleet.

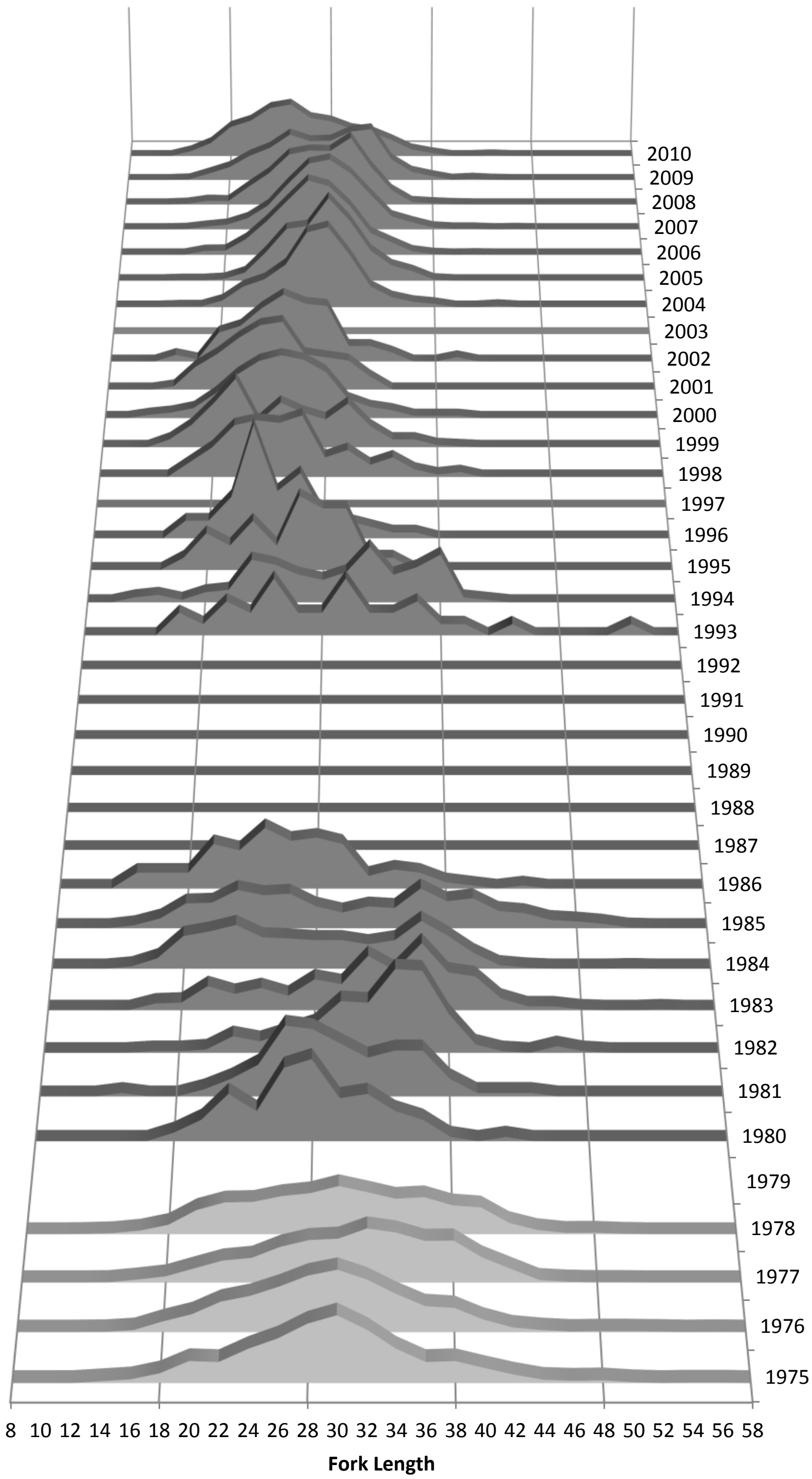


Figure 30. Length compositions for CPFV catch south of Point Conception. Compositions for 1975-1978 are based on whole catch (retained + discard). Years after 1978 are retained catch. Sources: Collins and Crooke (unpub. manuscript) and RecFIN.

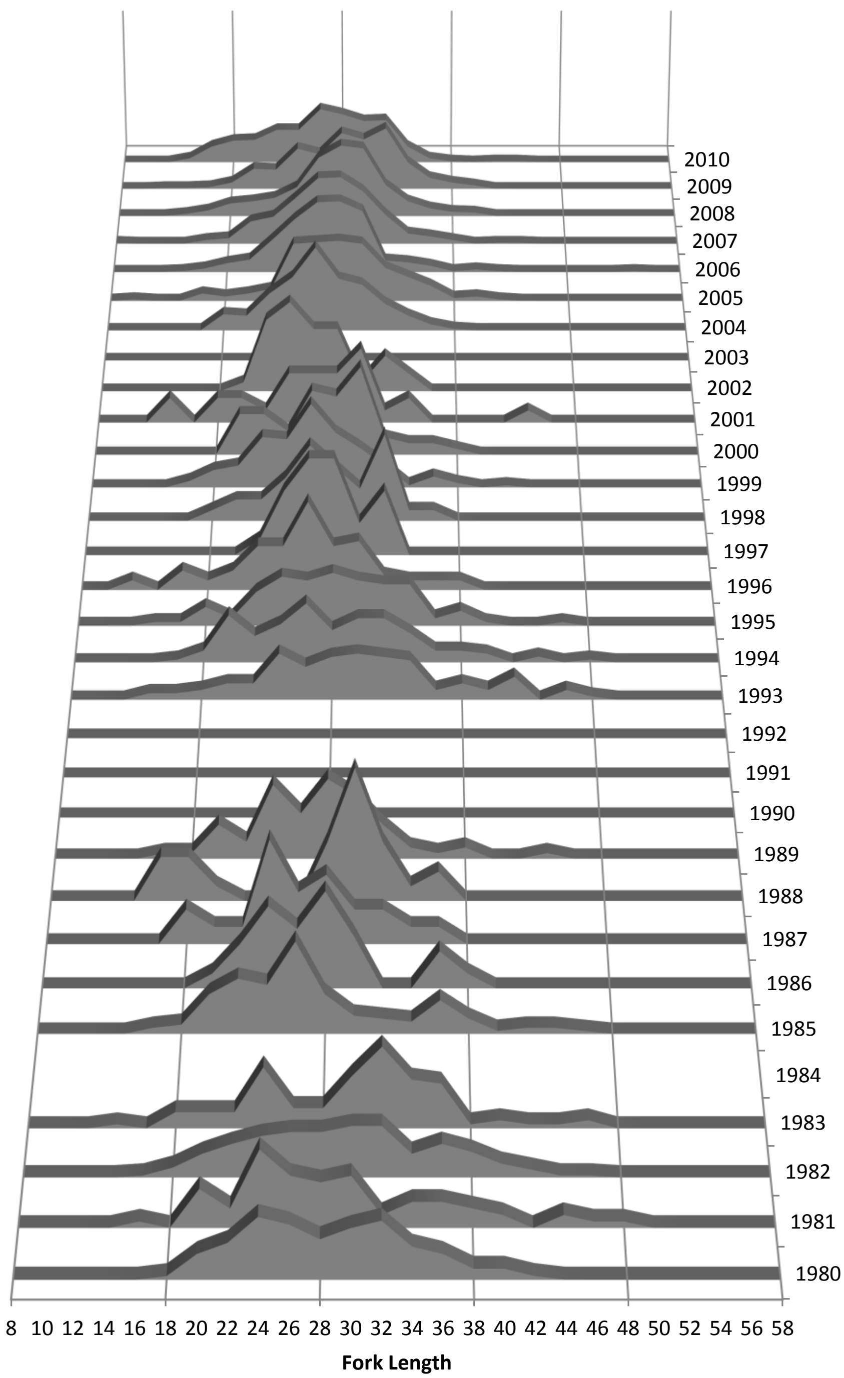


Figure 31. Length compositions for recreational private/rental boat landings south of Point Conception. Source: RecFIN.

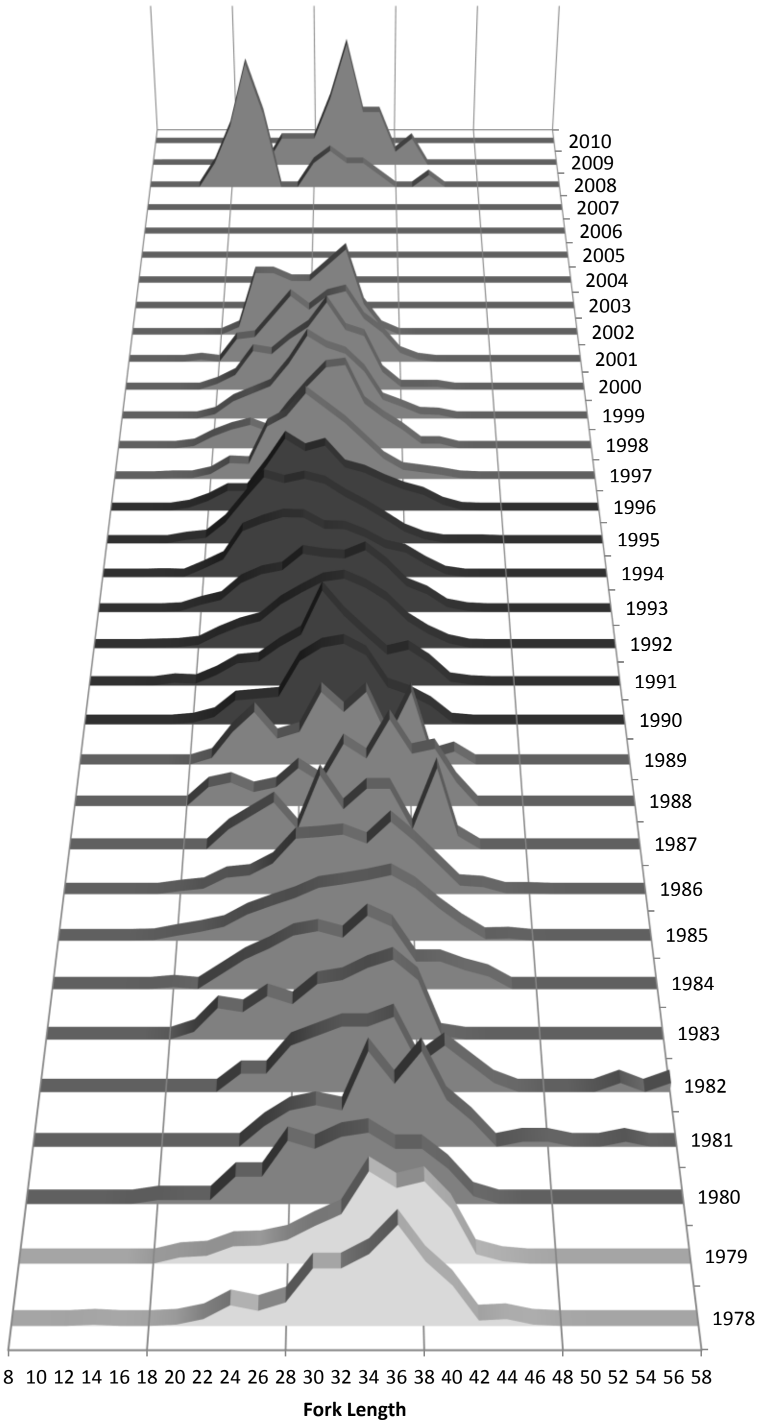


Figure 32. Length compositions for CPFV landings in California, north of Point Conception. Sources: California Cooperative Rockfish Survey (1978-79), RecFIN (1980-89, 1997-2010), CDFG Onboard CPFV Survey (1990-1996).

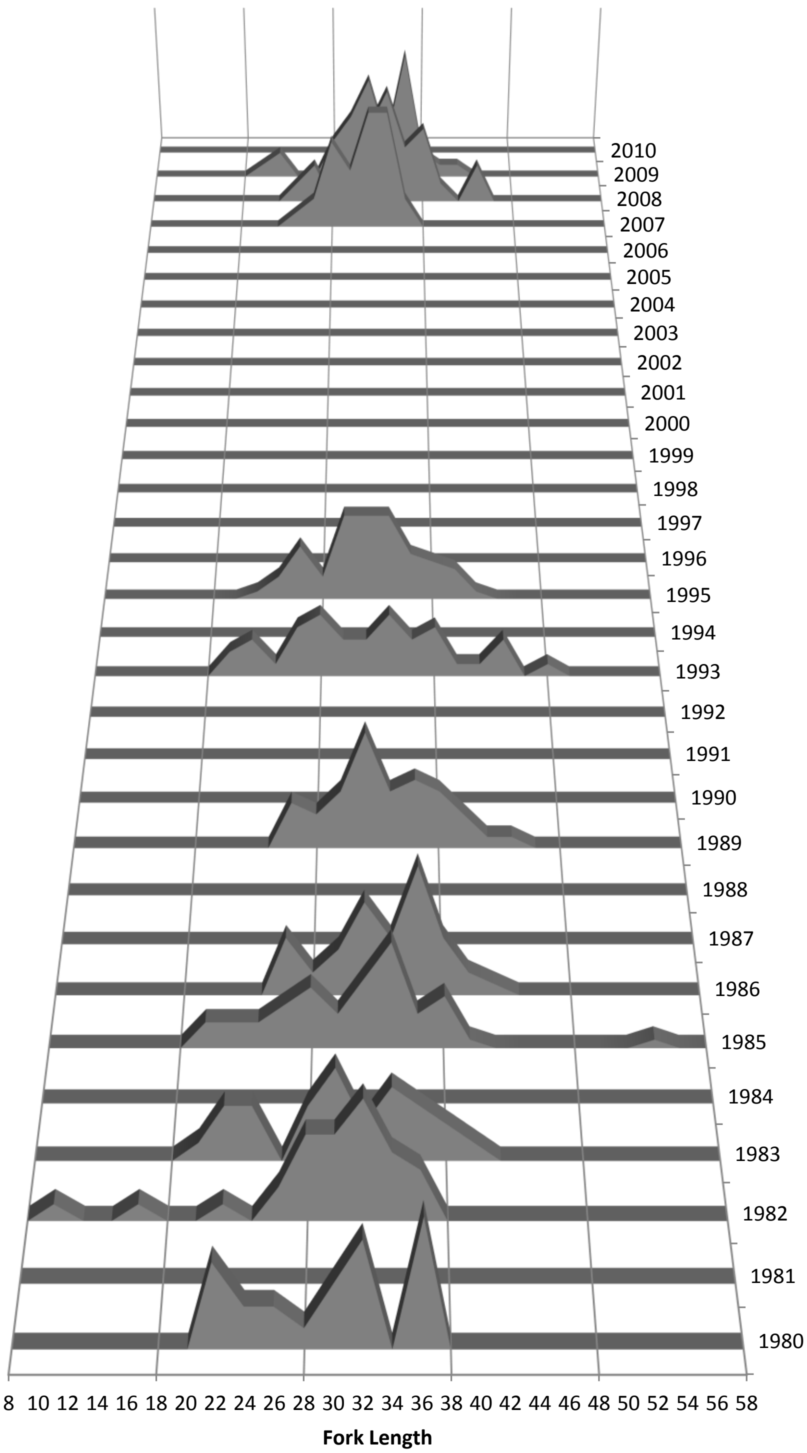


Figure 33. Length compositions for private/rental boat landings in California, north of Point Conception. Source: RecFIN.

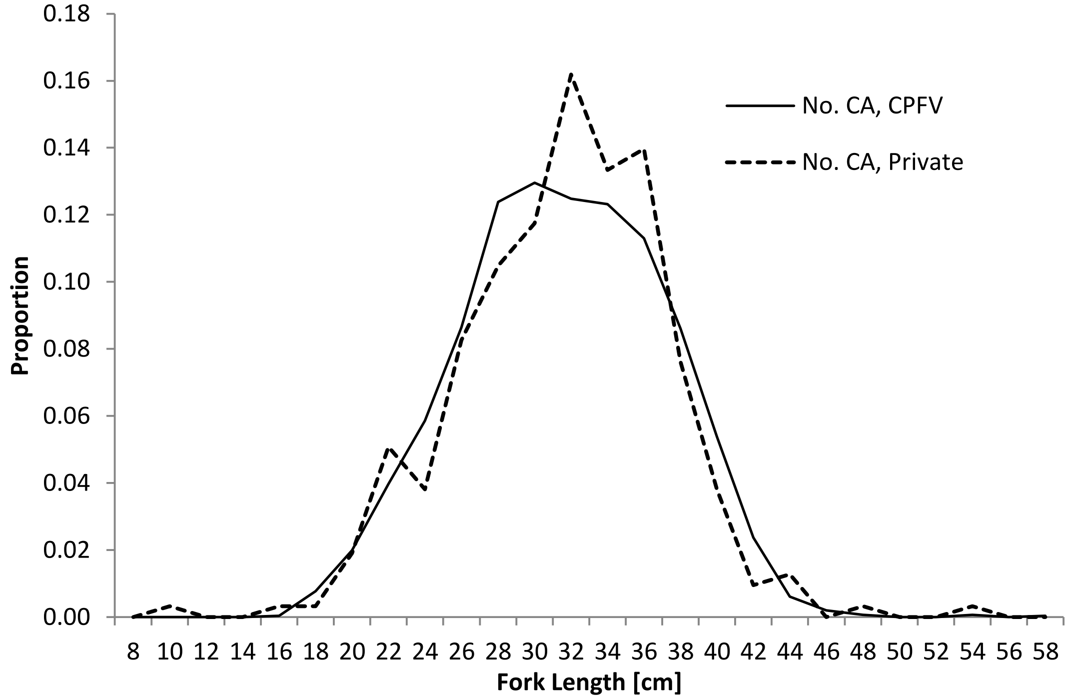


Figure 34. Comparison of length compositions from CPFV and Private boats in Northern California (1980-1989, 1996, 1999-2000 combined). Unexpanded samples sizes are 3125 (CPFV) and 315 (Private).

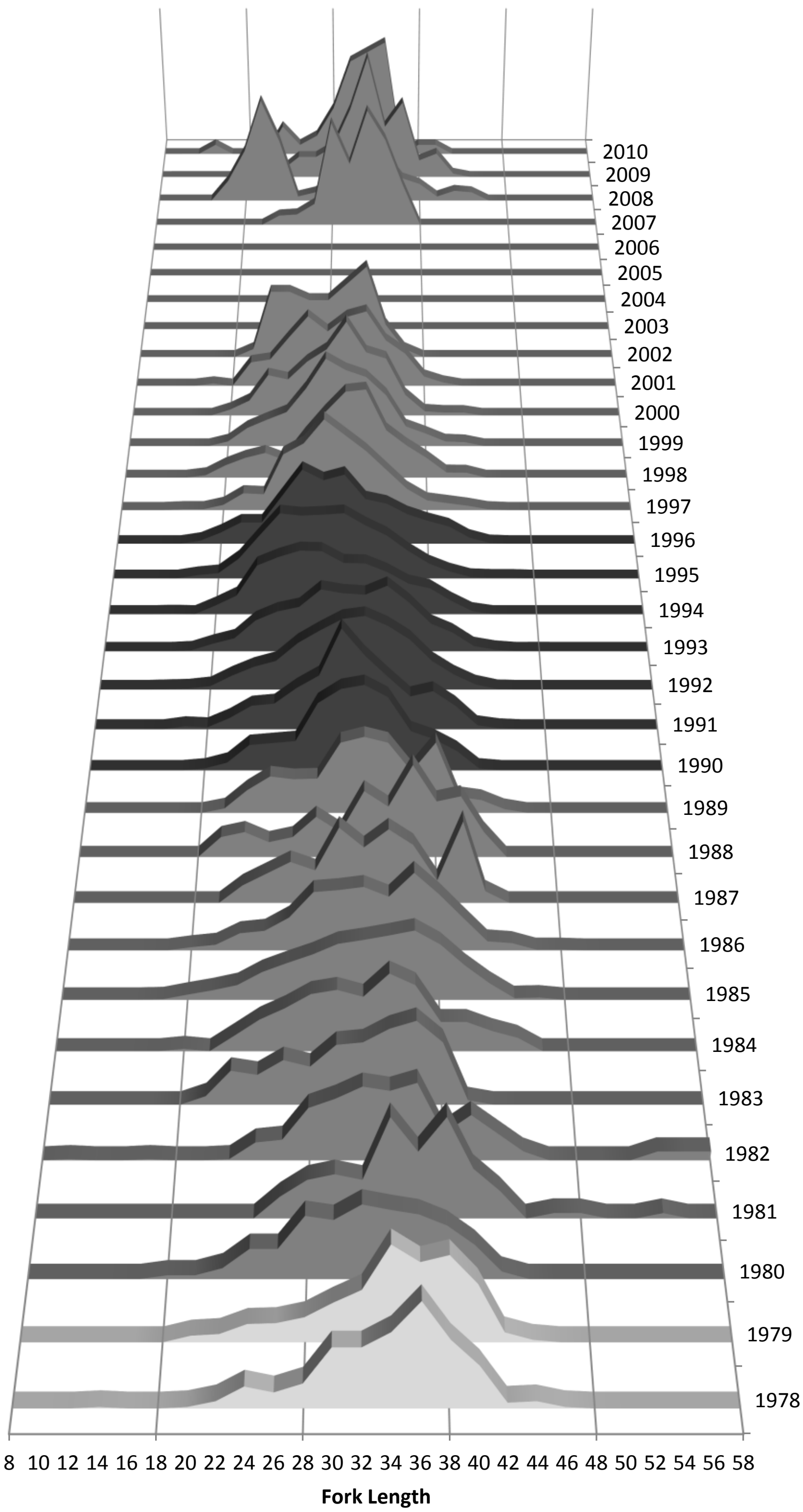


Figure 35. Length compositions for combined CPFV and private/rental boat landings in California, north of Point Conception. Source: RecFIN.

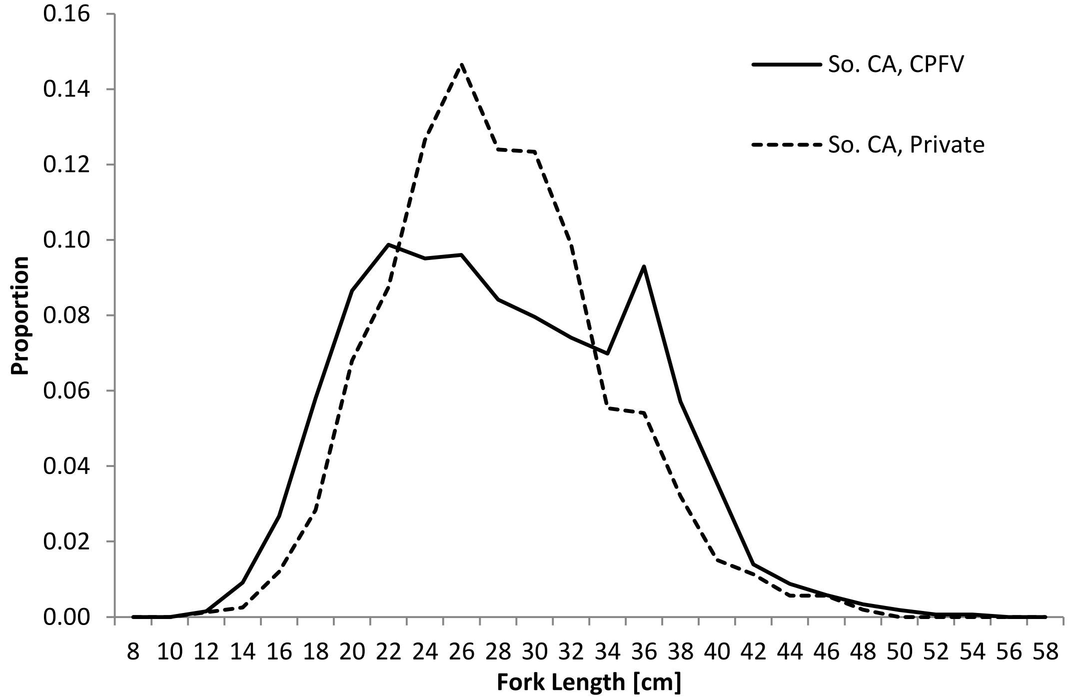


Figure 36. Comparison of length compositions from CPFV and Private boats in Southern California (1980-2000 combined). Samples sizes are 3292 (CPFV) and 1589 (Private).

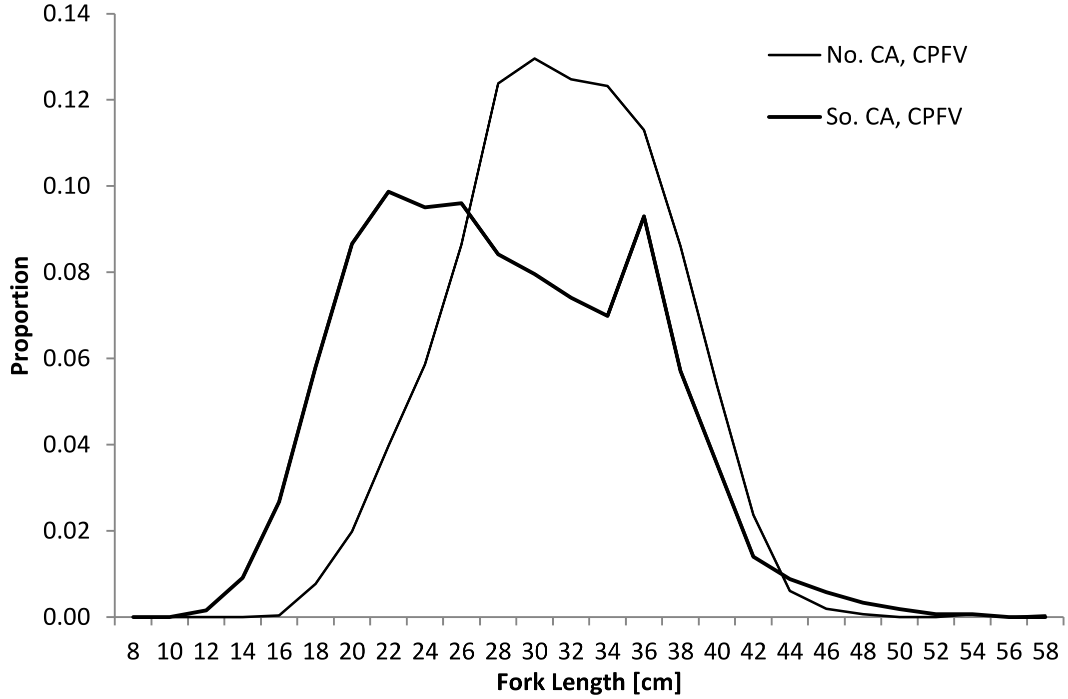


Figure 37. Comparison of CPFV length composition in northern and southern California, 1980-2000. Years after 2001 were excluded due to regulatory changes.

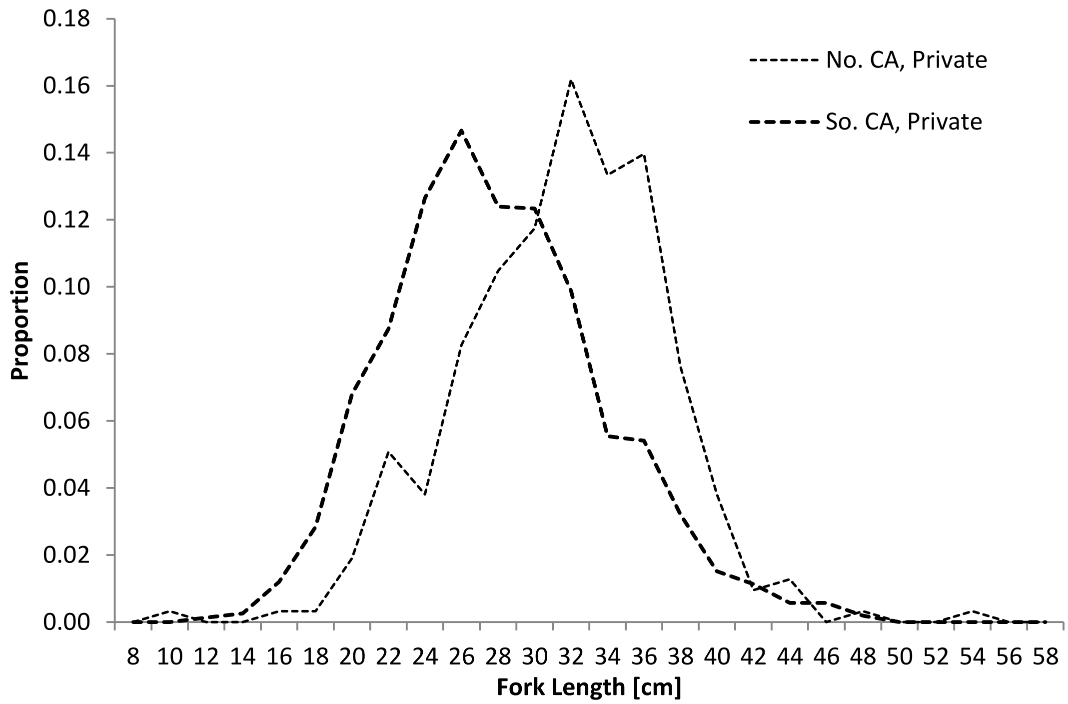


Figure 38. Comparison of private/rental mode length compositions in northern and southern California, 1980-2000. Years after 2001 were excluded due to regulatory changes.

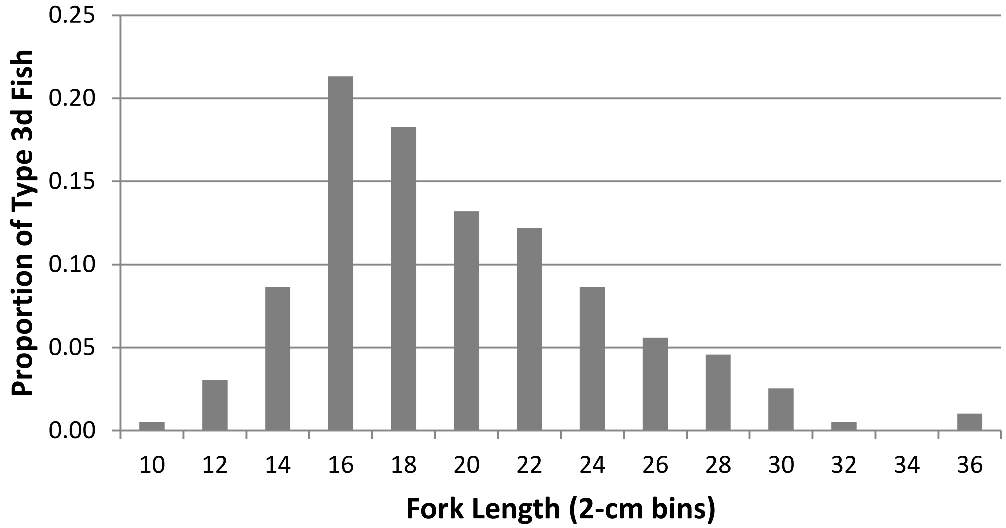


Figure 39. Length compositions from onboard sampling of discarded greenspotted rockfish from Recreational CPFVs in southern California. Data include 197 fish from 84 trips on 40 vessels (117 drifts) observed between 2004-2010. Source: RecFIN.

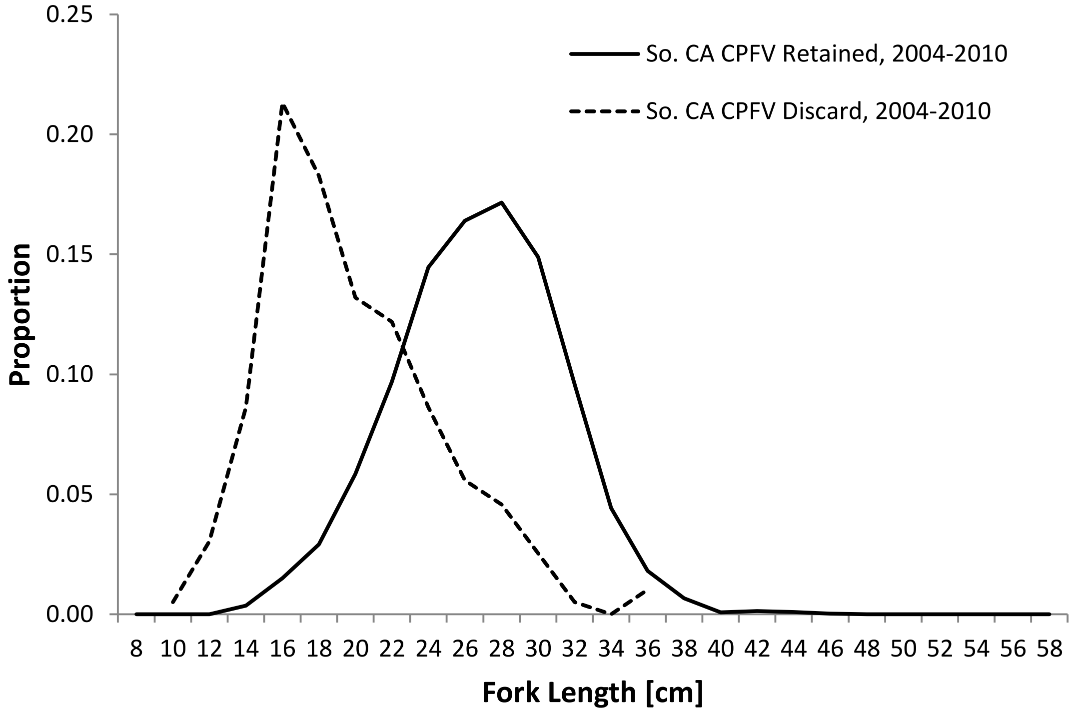
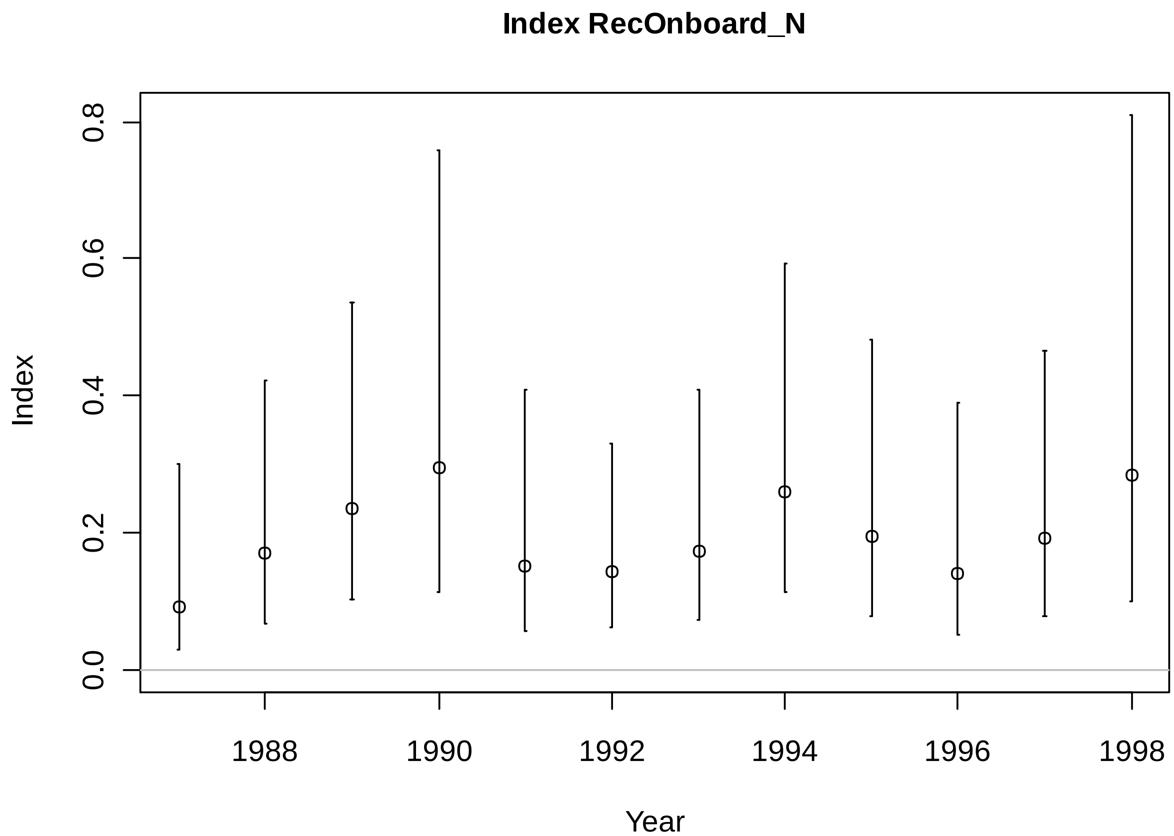


Figure 40. Comparison of length compositions for retained and discarded fish in the southern California CPFV fishery, 2004-2010.



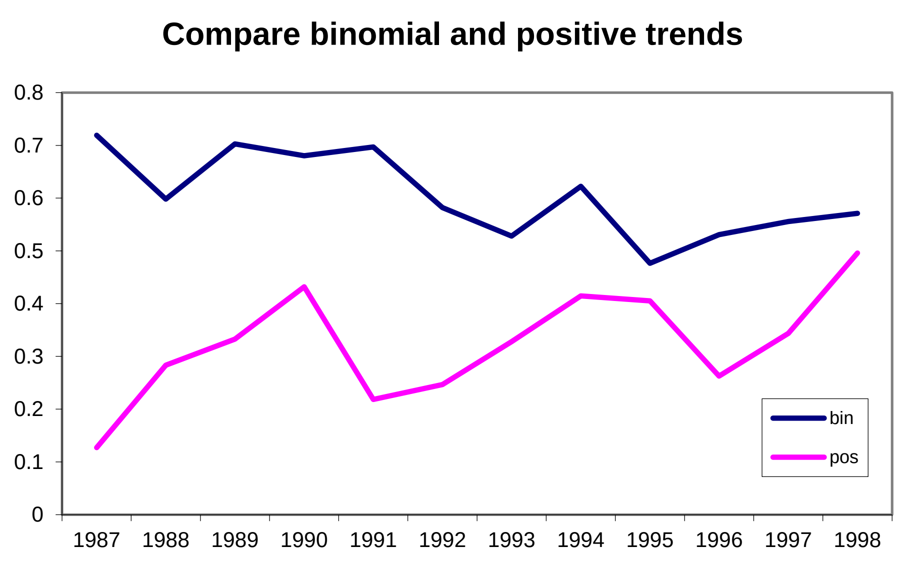
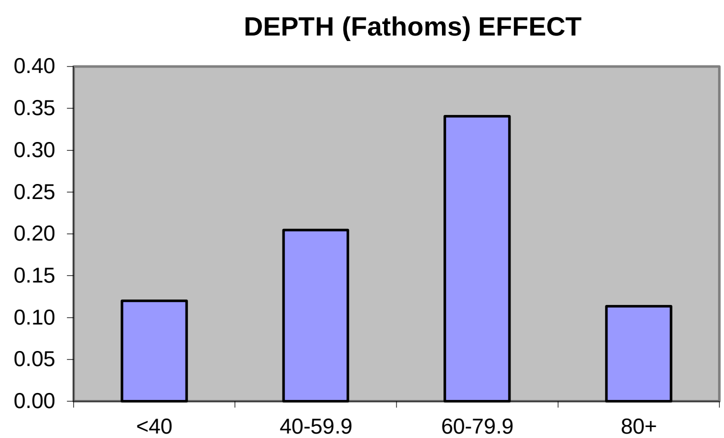


Figure 41. CDFG Onboard Sampling Index for northern California, 1987-1998. Upper panel: year effects from delta-GLM model. Lower panel: binomial and lognormal model components.



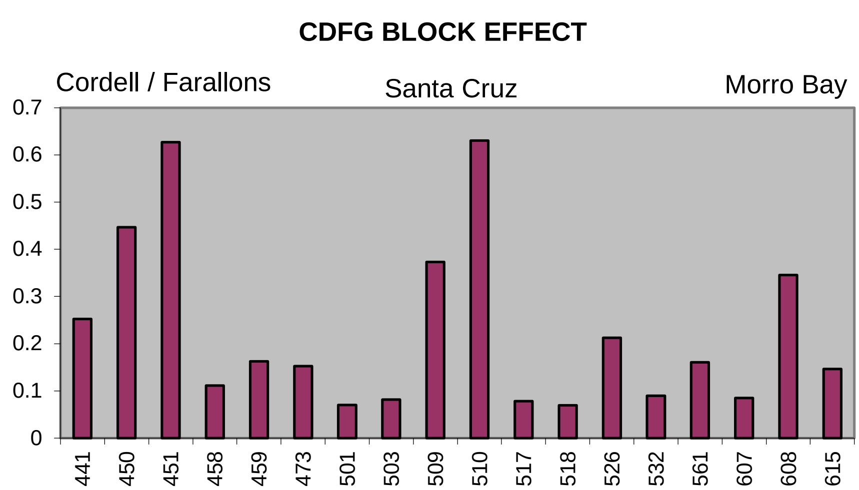


Figure 42. Month, depth, and block effects for the CDFG onboard sampling index.

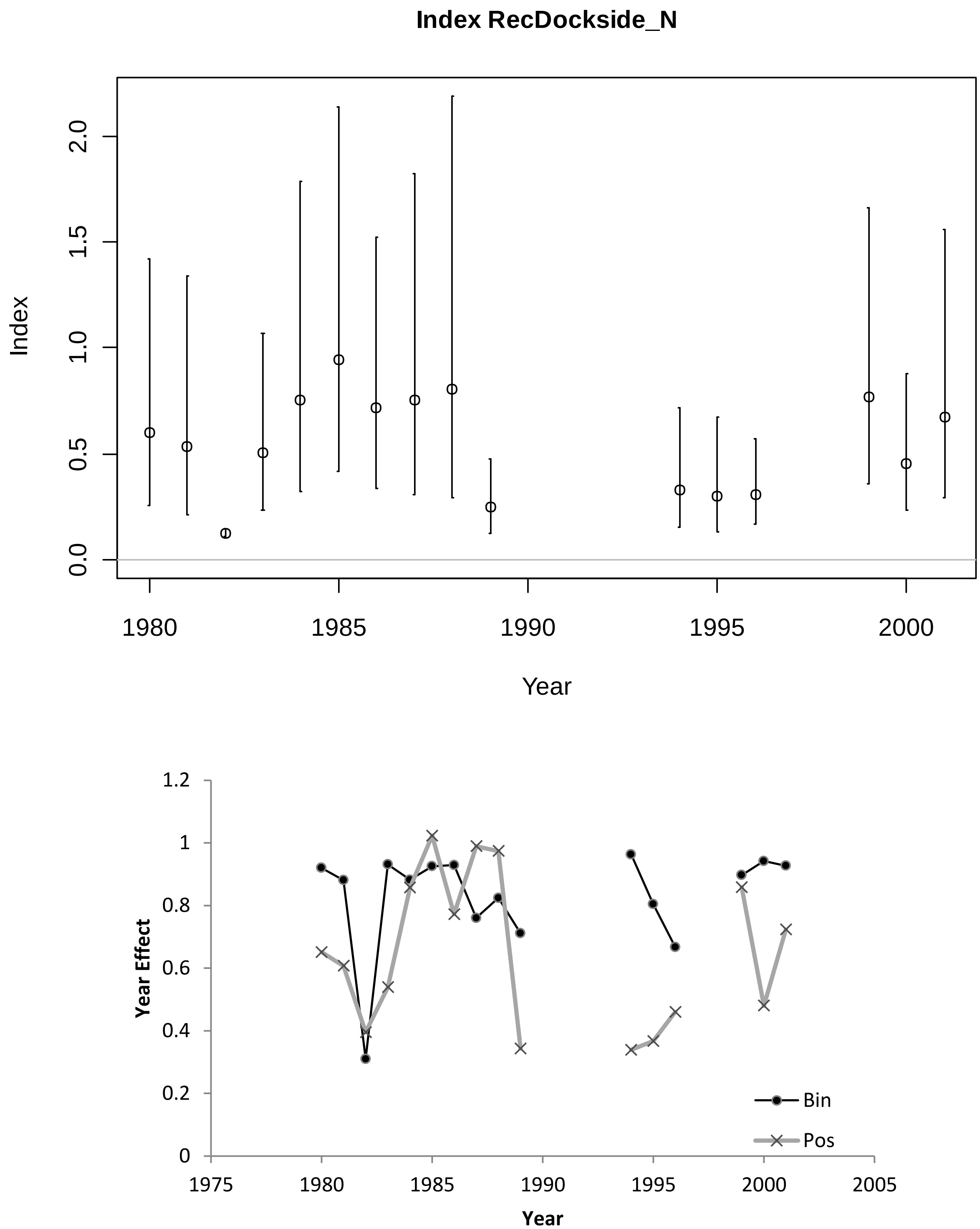


Figure 43. RecFIN CPUE index for northern California. Upper panel: year effect from delta-GLM; Lower panel: year effects from binomial (bin) and lognormal (pos) models

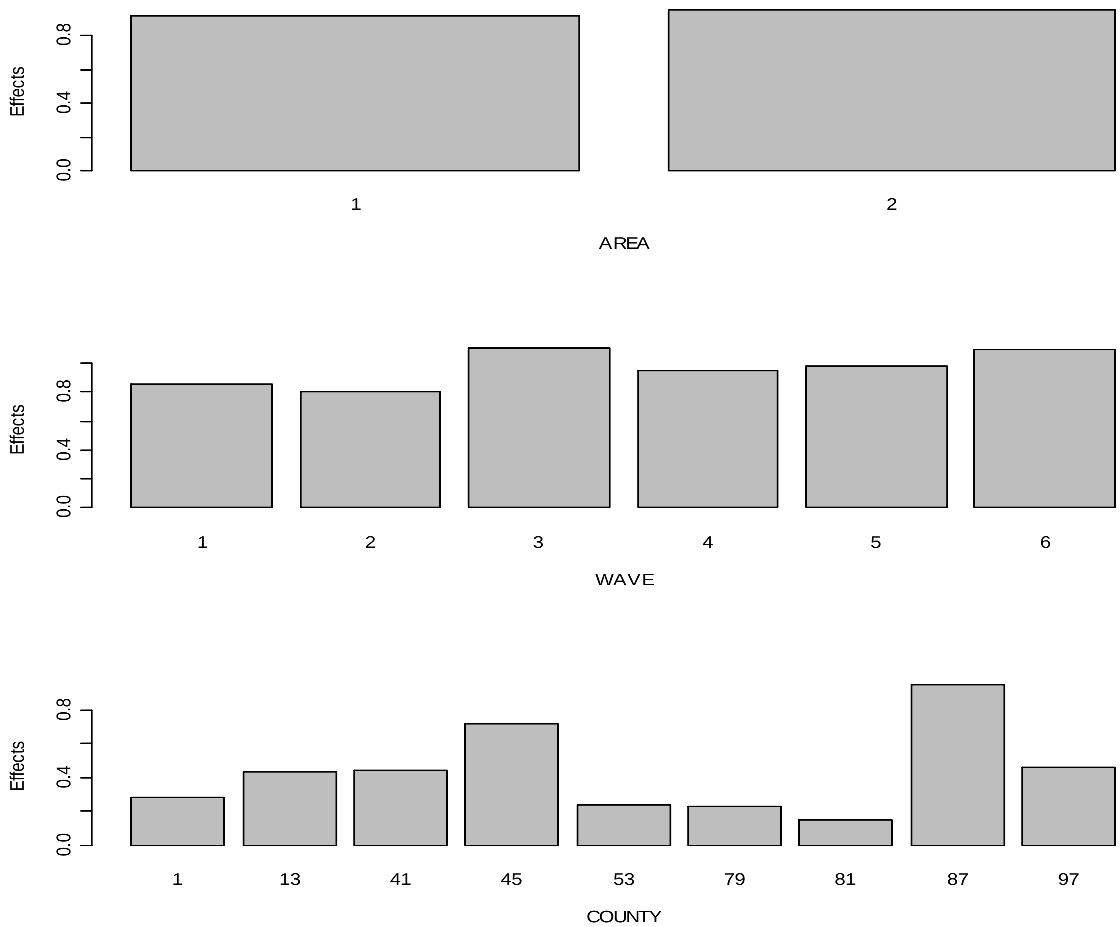


Figure 44. Explanatory variables (other than year effect) that were found to be significant for the northern California RecFIN CPUE index

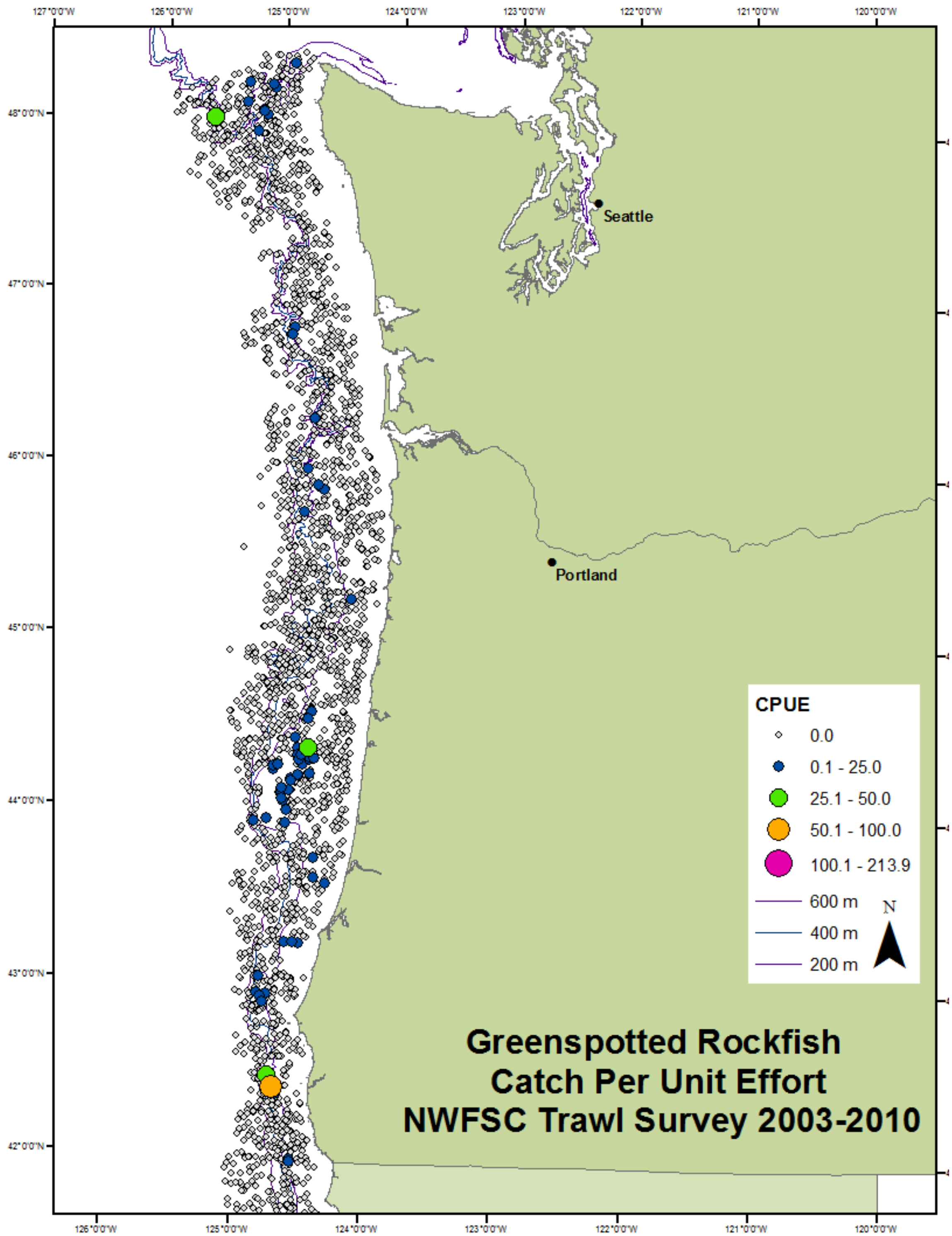


Figure 45. NWFSC trawl survey CPUE (kg per 2 hectares) in Washington and Oregon.

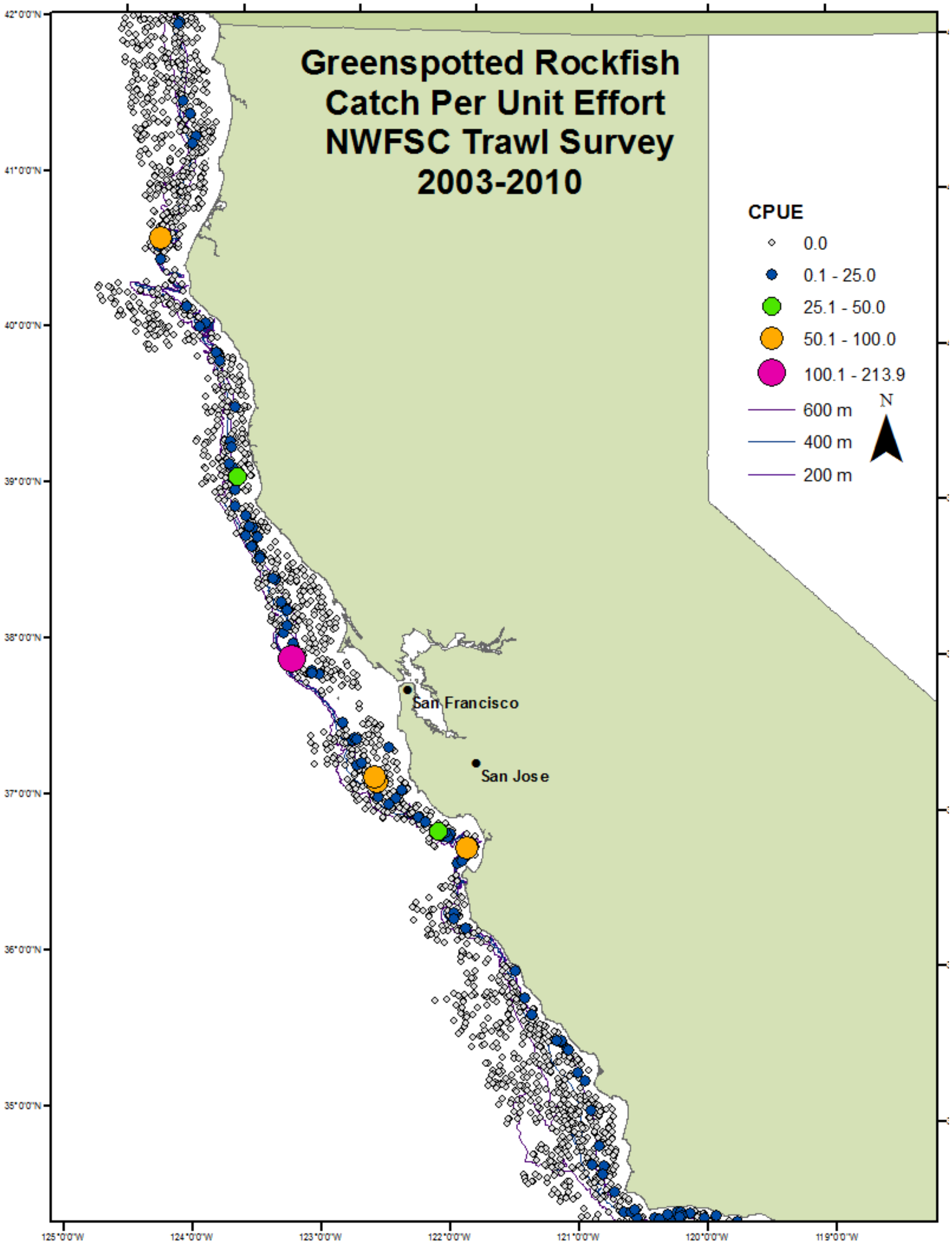


Figure 46. NWFSC trawl survey CPUE (kg per 2 hectares) in central and northern California

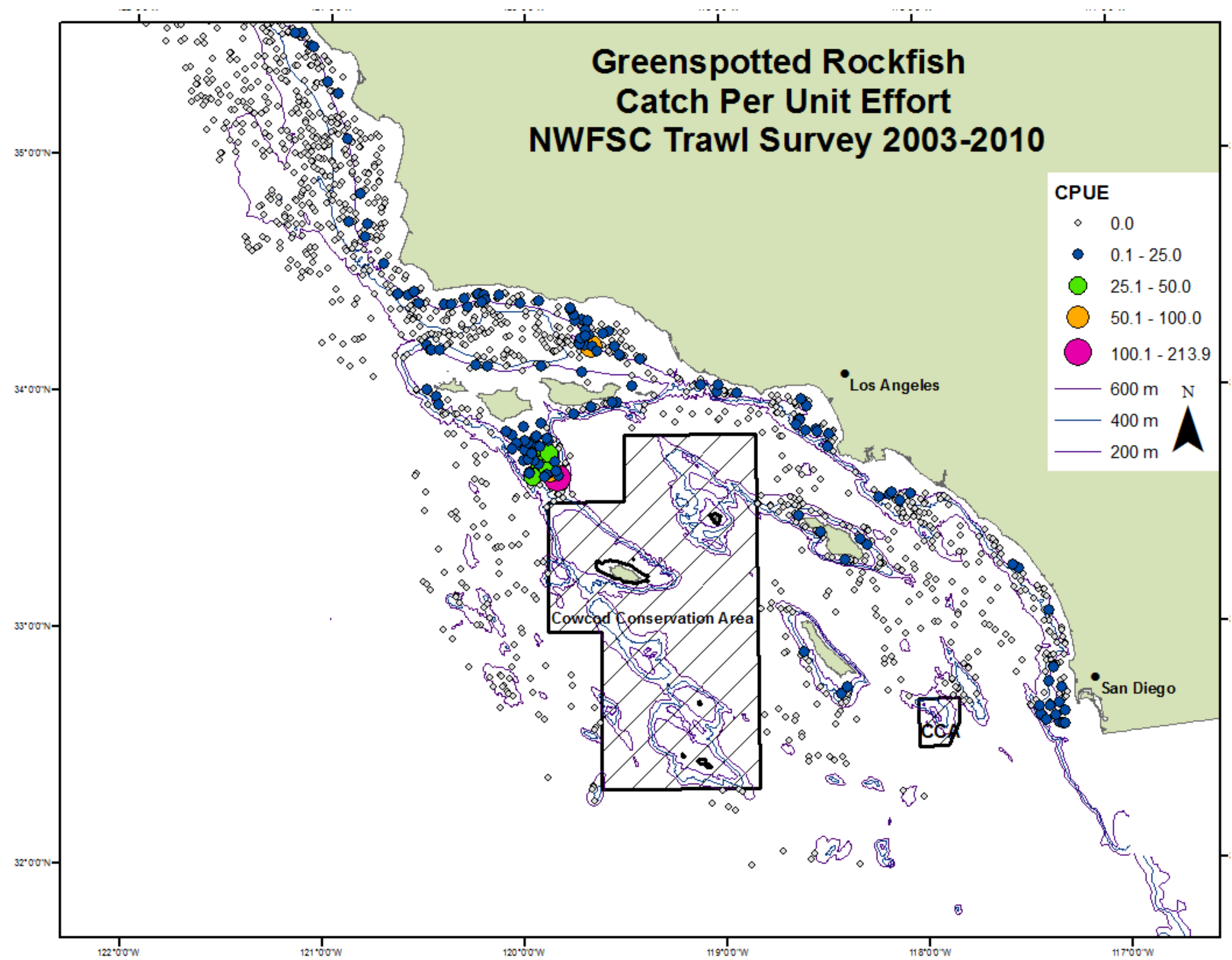


Figure 47. NWFSC trawl survey CPUE (kg per 2 hectares) in southern California.

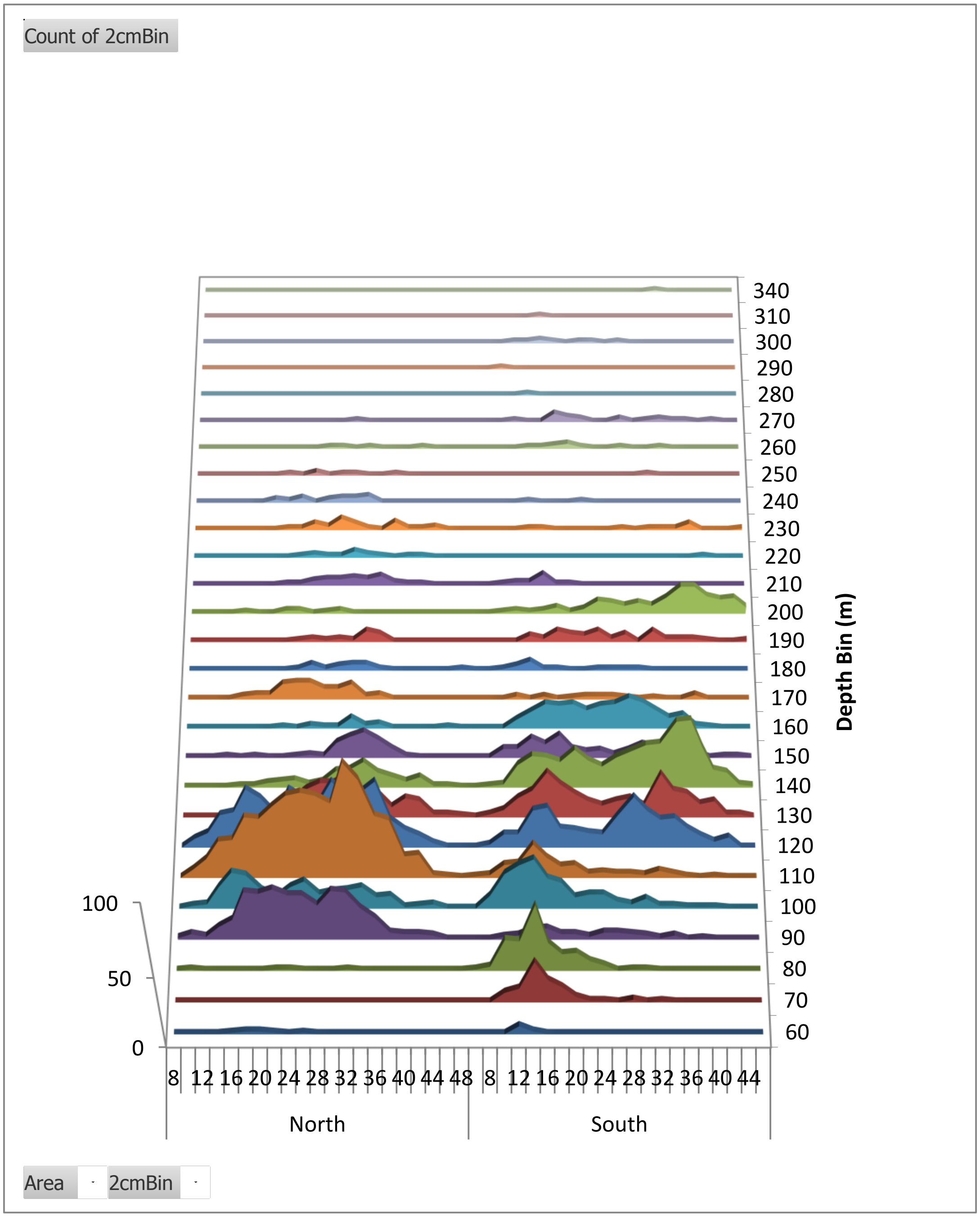


Figure 48. NWFSC trawl survey length composition data for greenspotted rockfish, by area and 10-m depth bin.

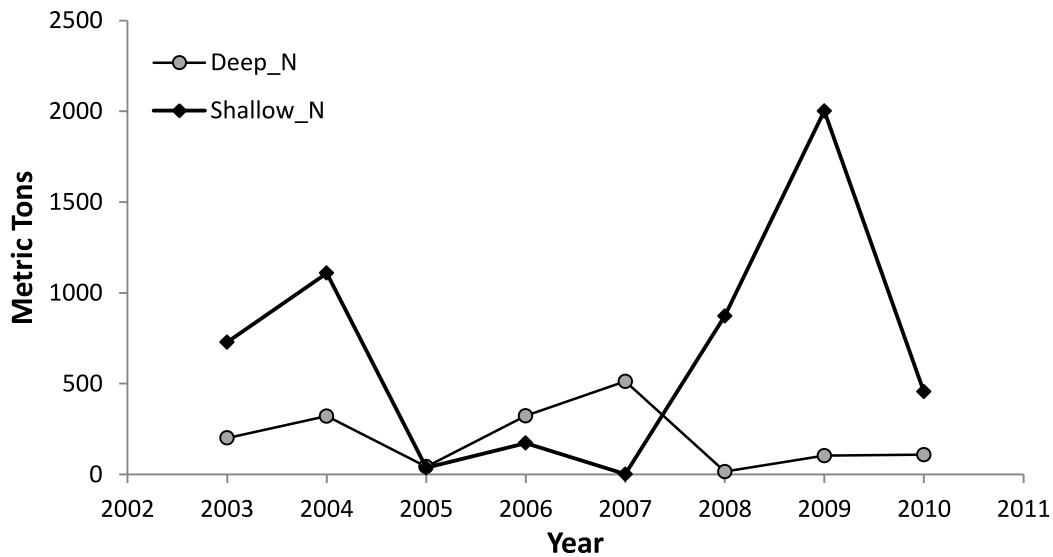


Figure 49. NWFSC GLM estimates of median greenspotted rockfish biomass in northern California, by depth stratum

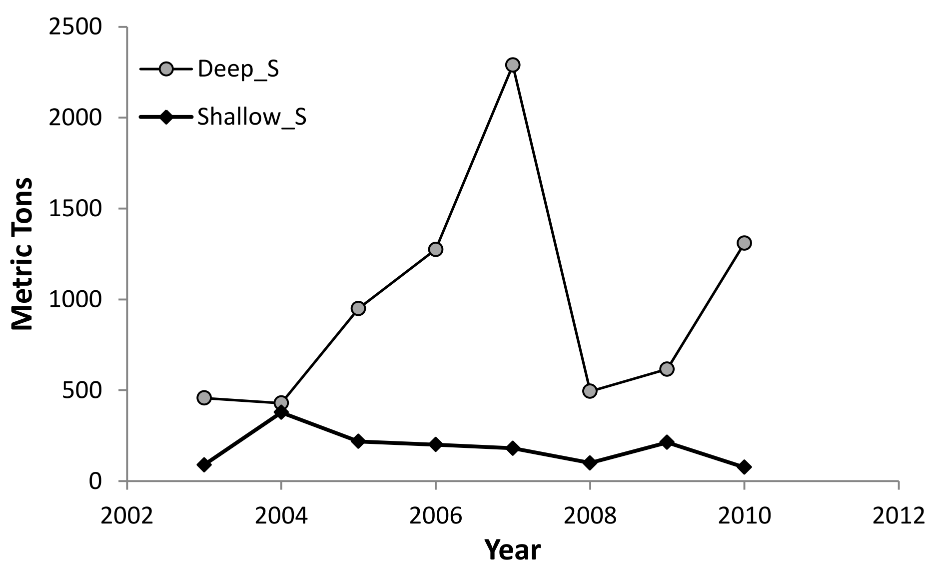


Figure 50. NWFSC GLM estimates of median greenspotted rockfish biomass south of Point Conception, by depth stratum

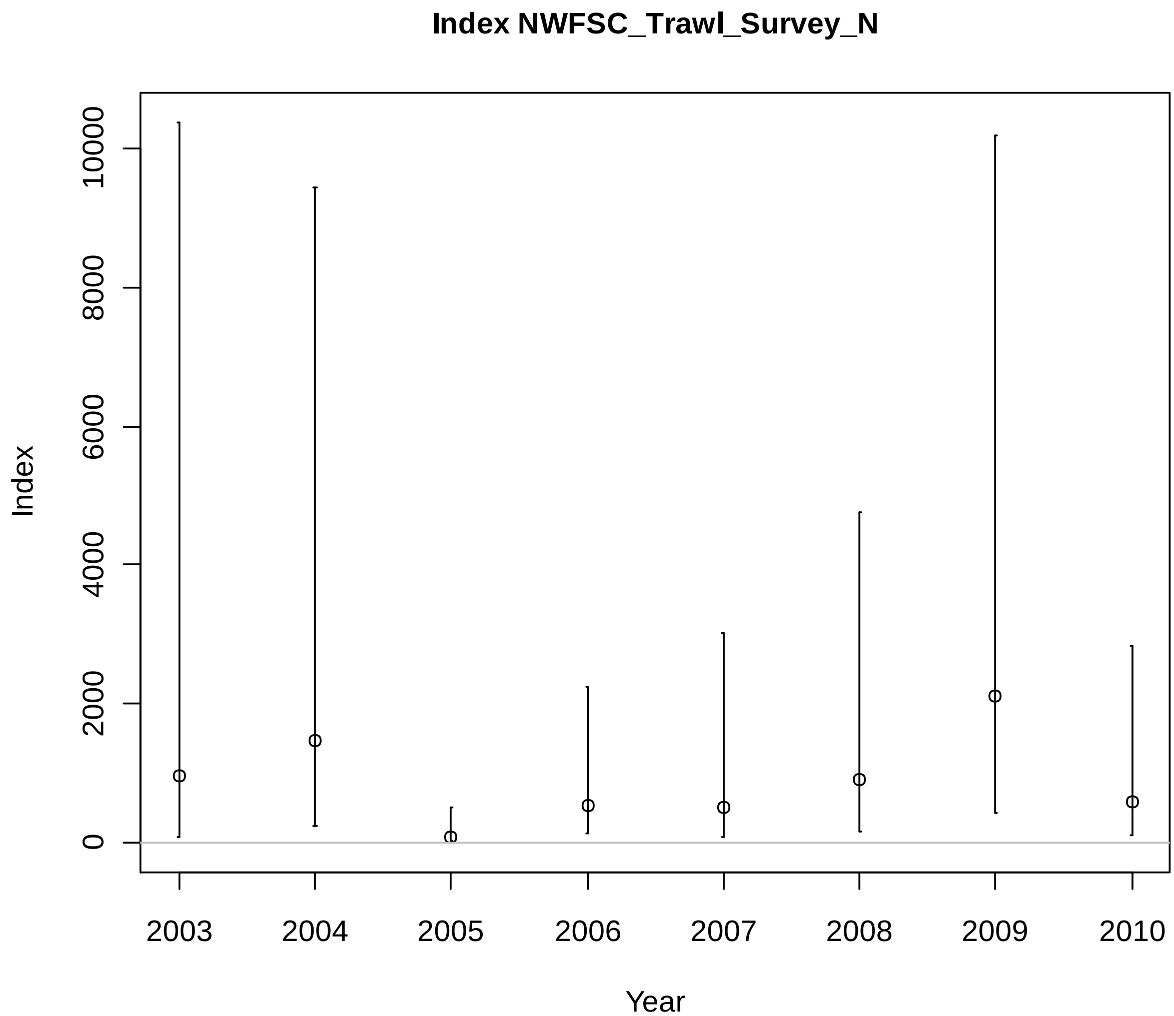


Figure 51. Area-weighted GLM index for greenspotted rockfish biomass in northern California

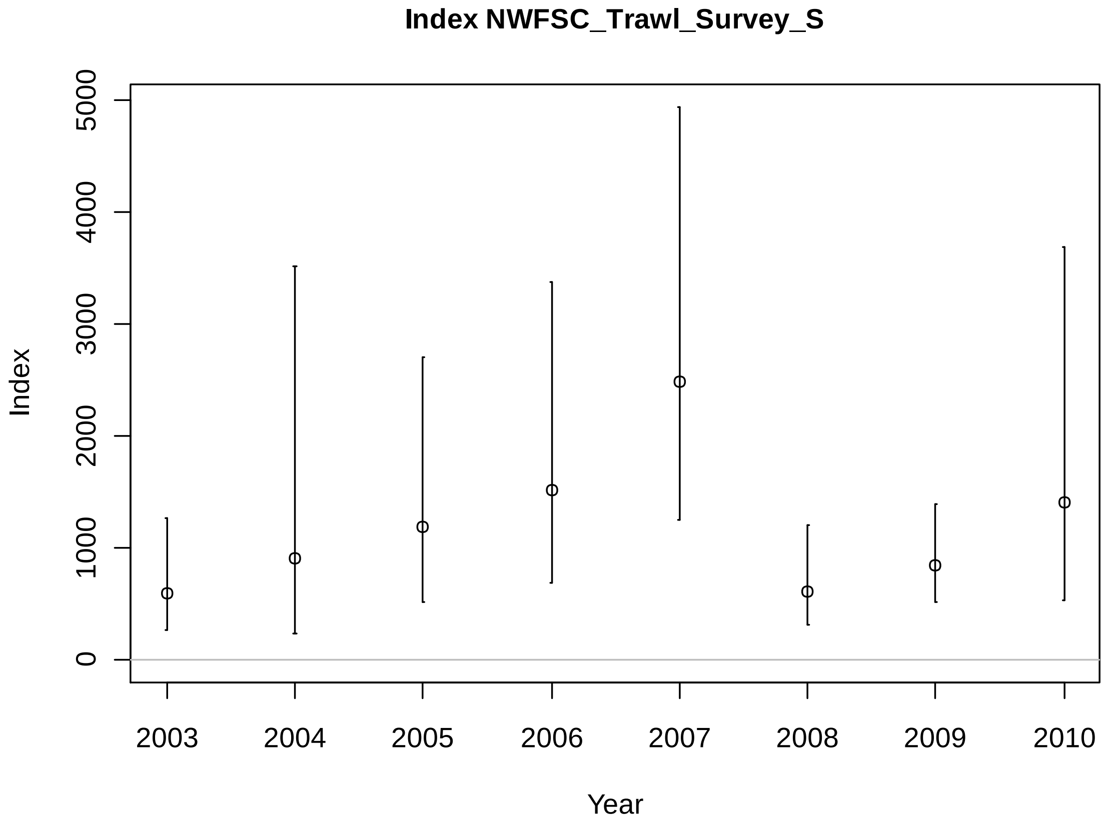


Figure 52. Area-weighted GLM index for greenspotted rockfish biomass south of Point Conception

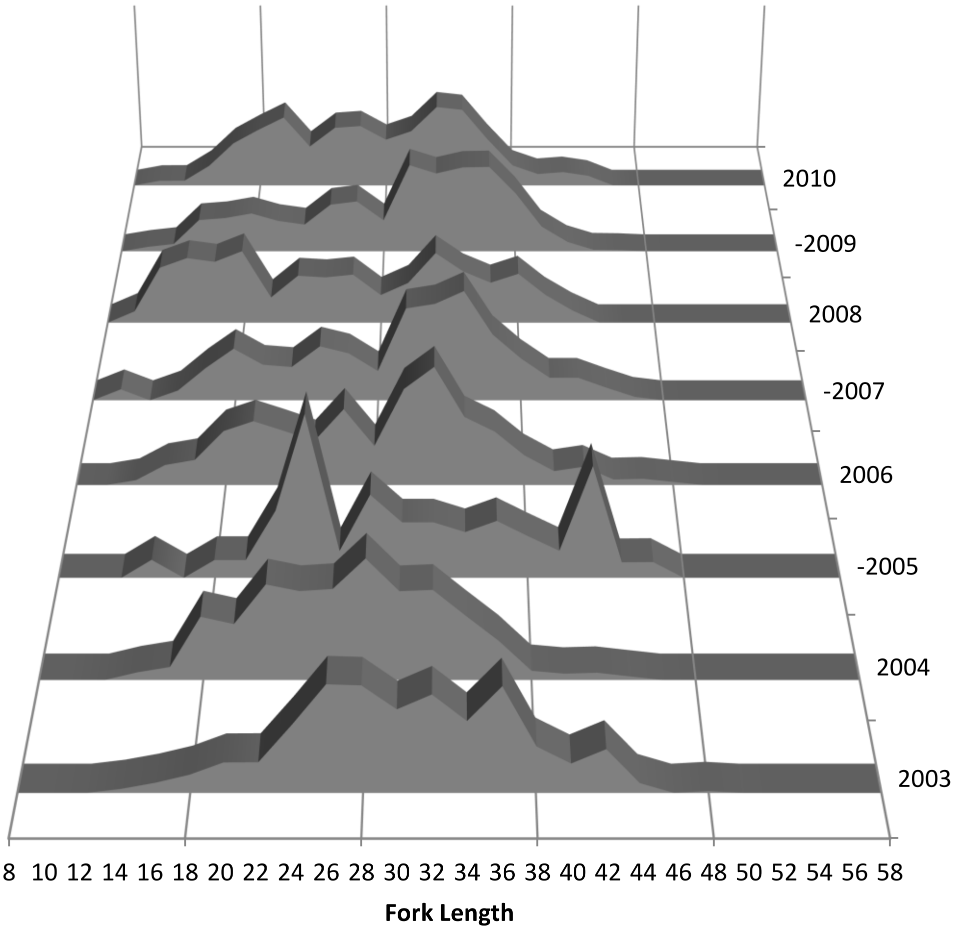


Figure 53. Length compositions for the NWFSC trawl survey hauls between 34° 30′ N. latitude and 42° N. latitude.

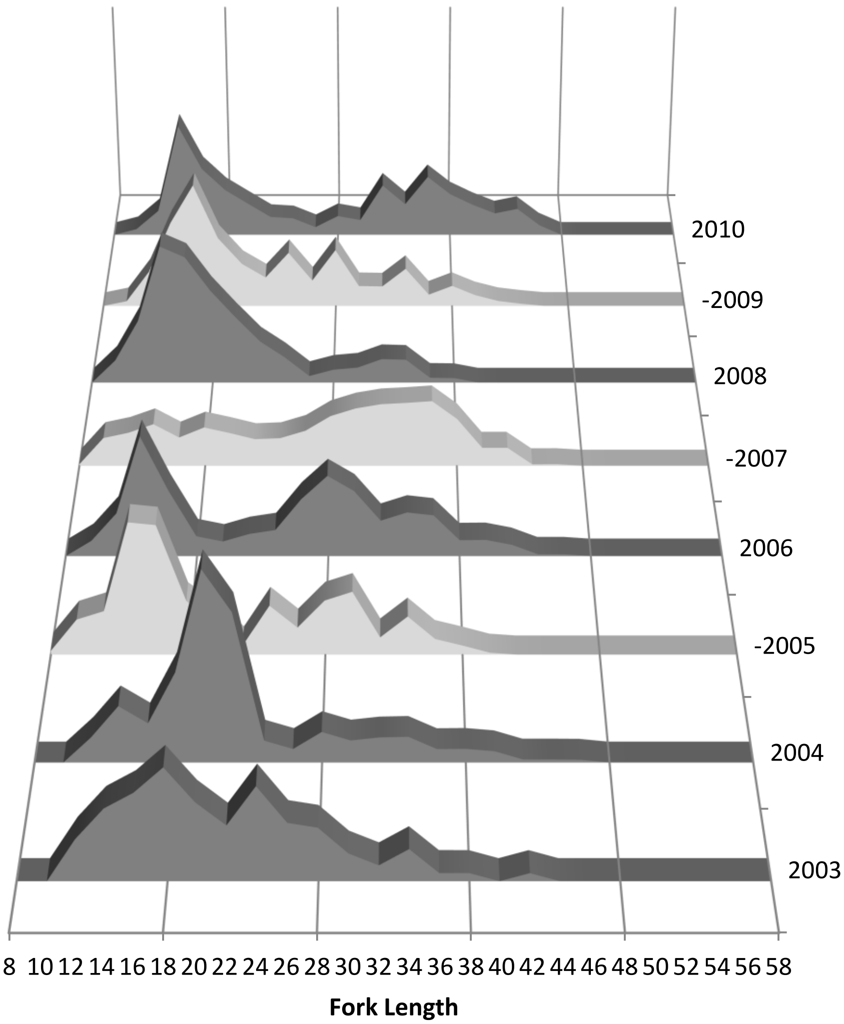


Figure 54. Length compositions for the NWFSC trawl survey, hauls south of 34° 30′ N. latitude.

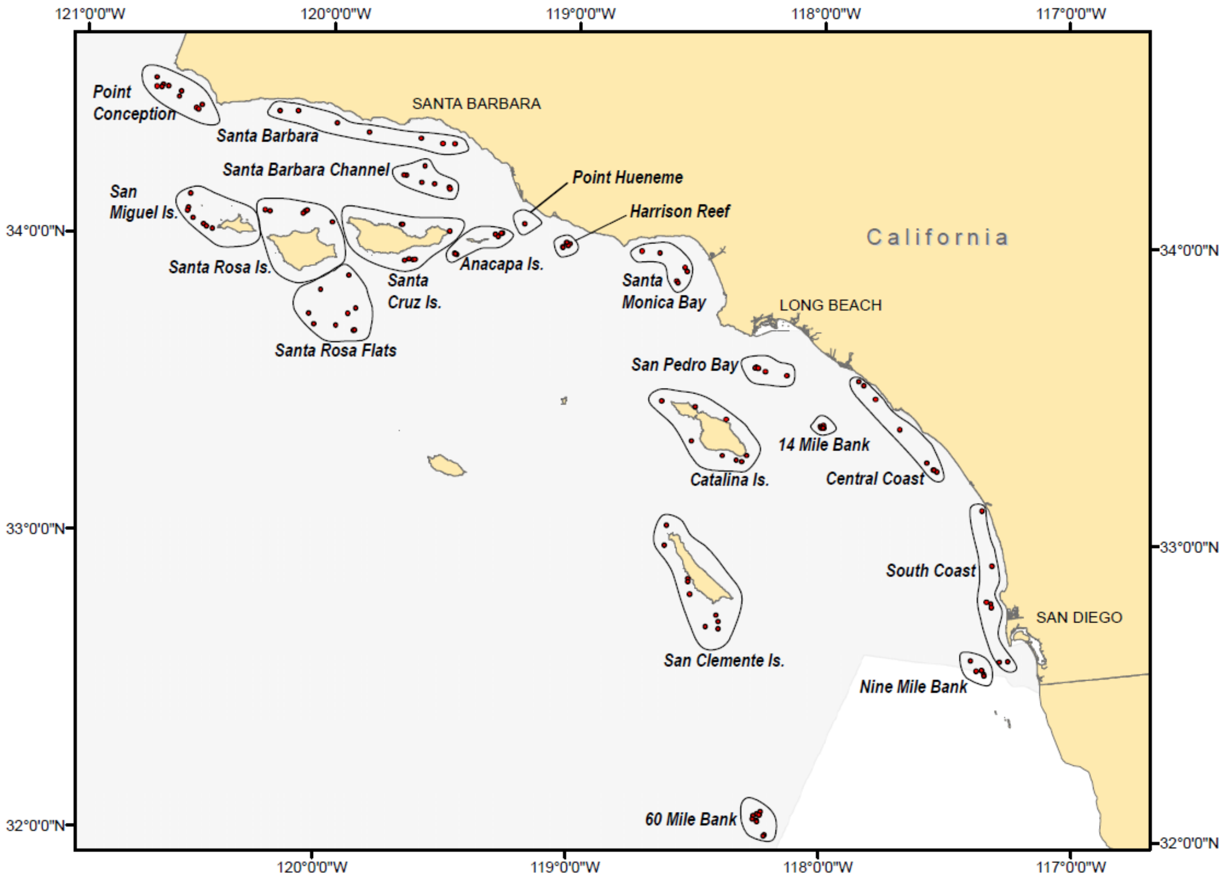


Figure 55. Fixed station locations for NWFSC hook-and-line survey. Source: Harms et al., 2008.

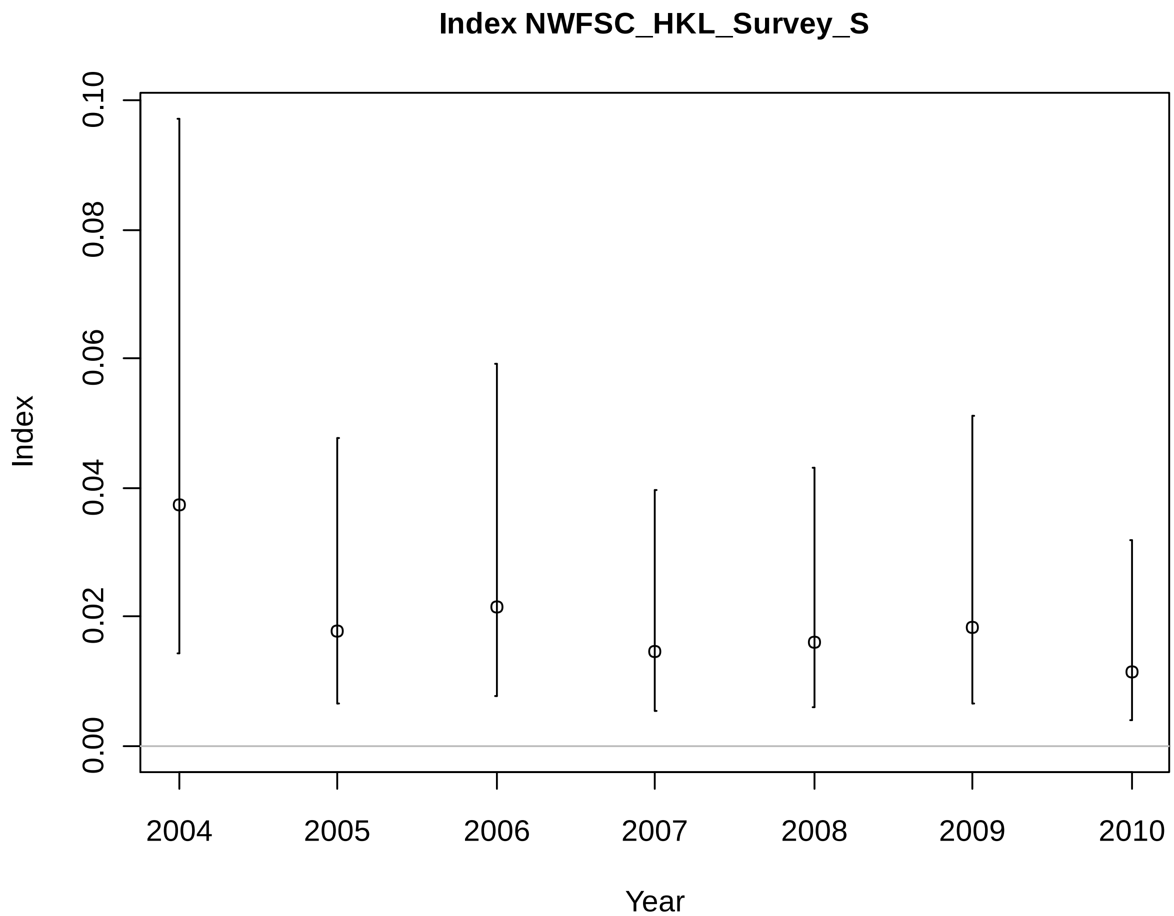


Figure 56. NWFSC hook and line survey for southern California.

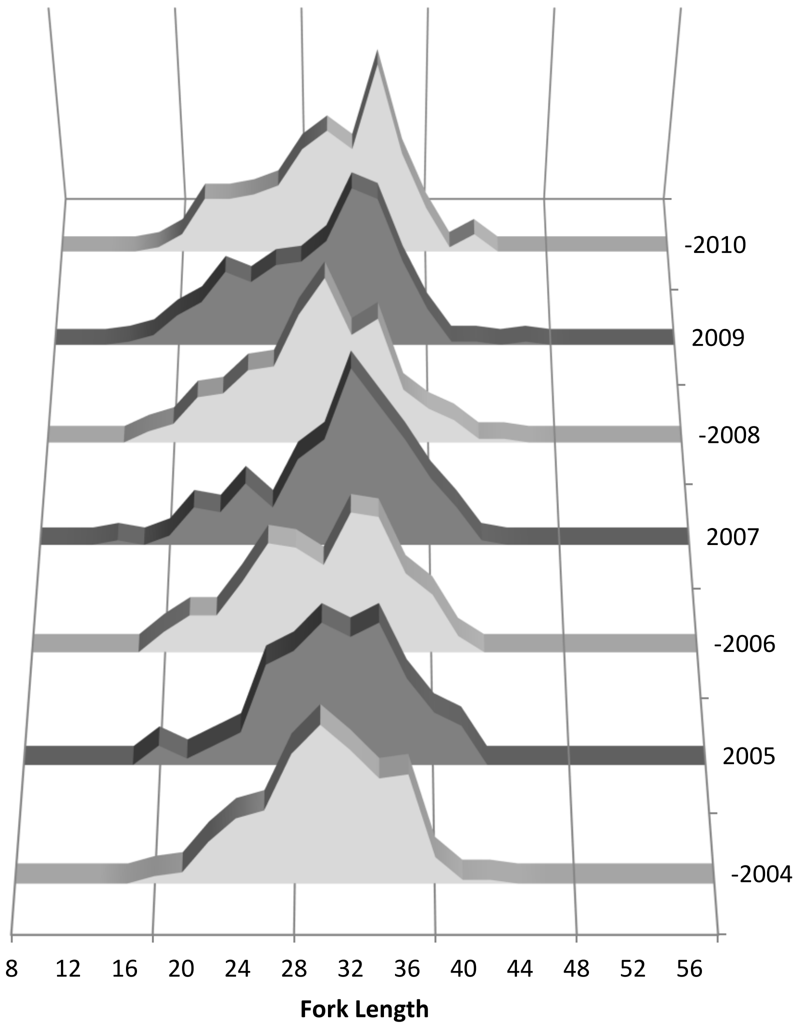


Figure 57. Length compositions for the NWFSC hook and line survey south of 34° 27’ N. latitude. Source: NWFSC.

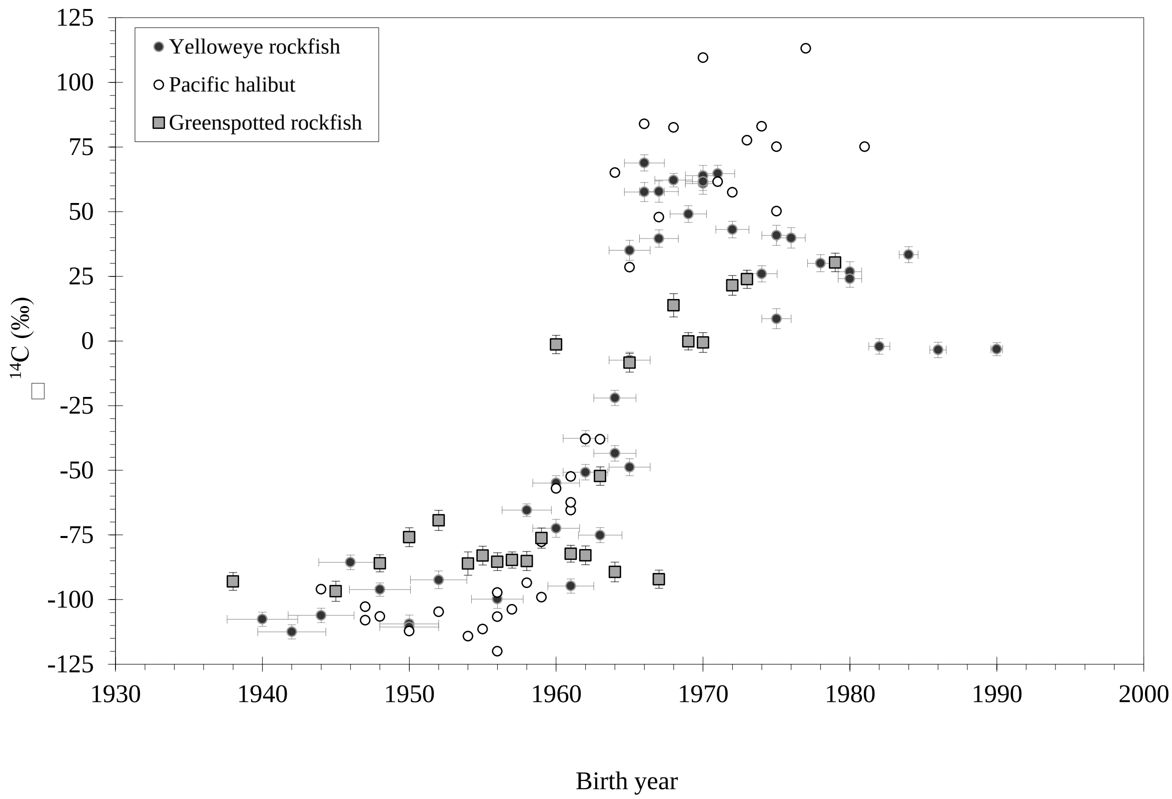


Figure 58. Preliminary results of greenspotted rockfish age validation study based on bomb radiocarbon method (J. Field, NMFS SWFSC, pers. comm.)

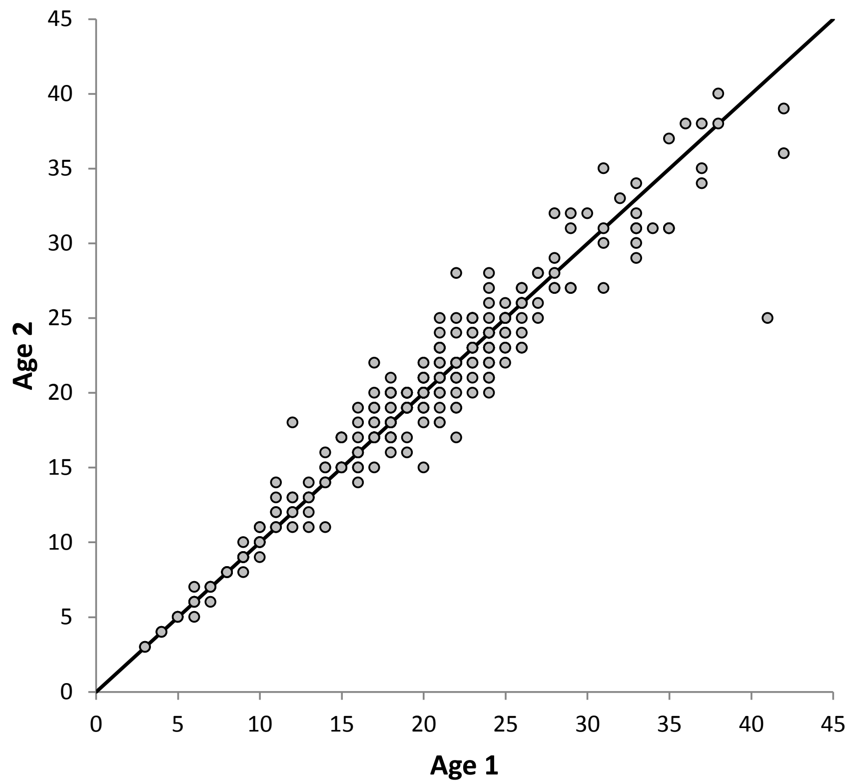


Figure 59. Scatterplot of 1st and 2nd reads (within-reader error only).

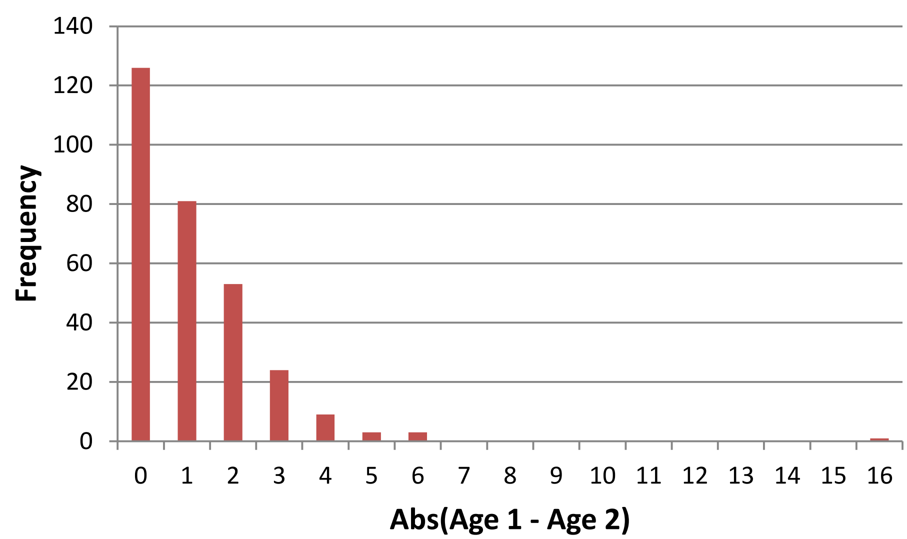


Figure 60. Frequency of absolute differences between age reads (within-reader differences).

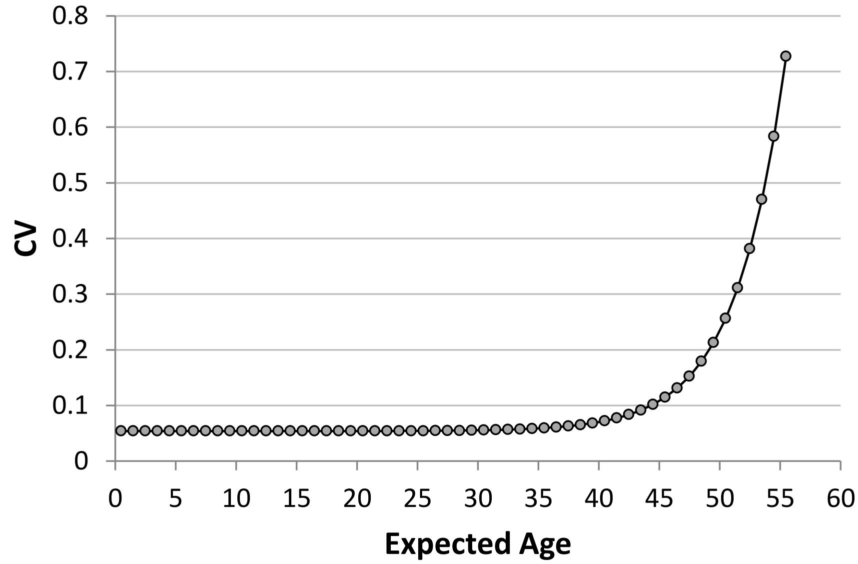


Figure 61. Estimated relationship between within-reader CV{age} and expected age based on Age-Reading Error Matrix Estimator (Punt et al., 2008) method. CVs above 42 years are extrapolated.

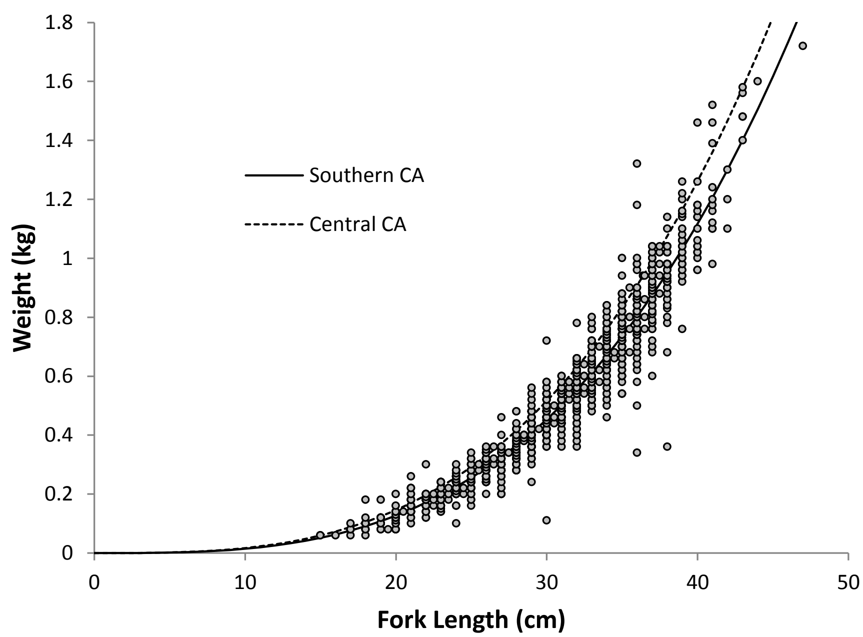


Figure 62. Weight-Length relationship for southern California estimated using data from the NWFSC hook and line survey (J. Harms, pers. comm.). The relationship for central California (dashed line; Benet et al., 2009) is shown for comparison.

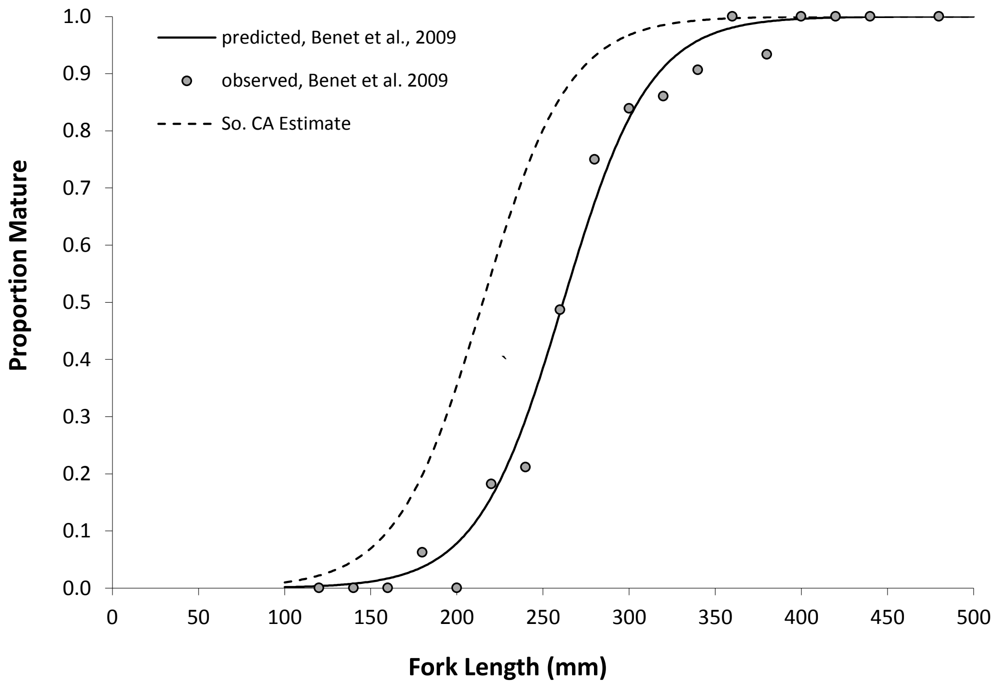


Figure 63. Proportion of mature females at length. The relationship for northern California is from Benet et al. (2009). The relationship for southern California is based on the reported value of 50% maturity in Love et al. (1990), with slope equal to the model for northern California.

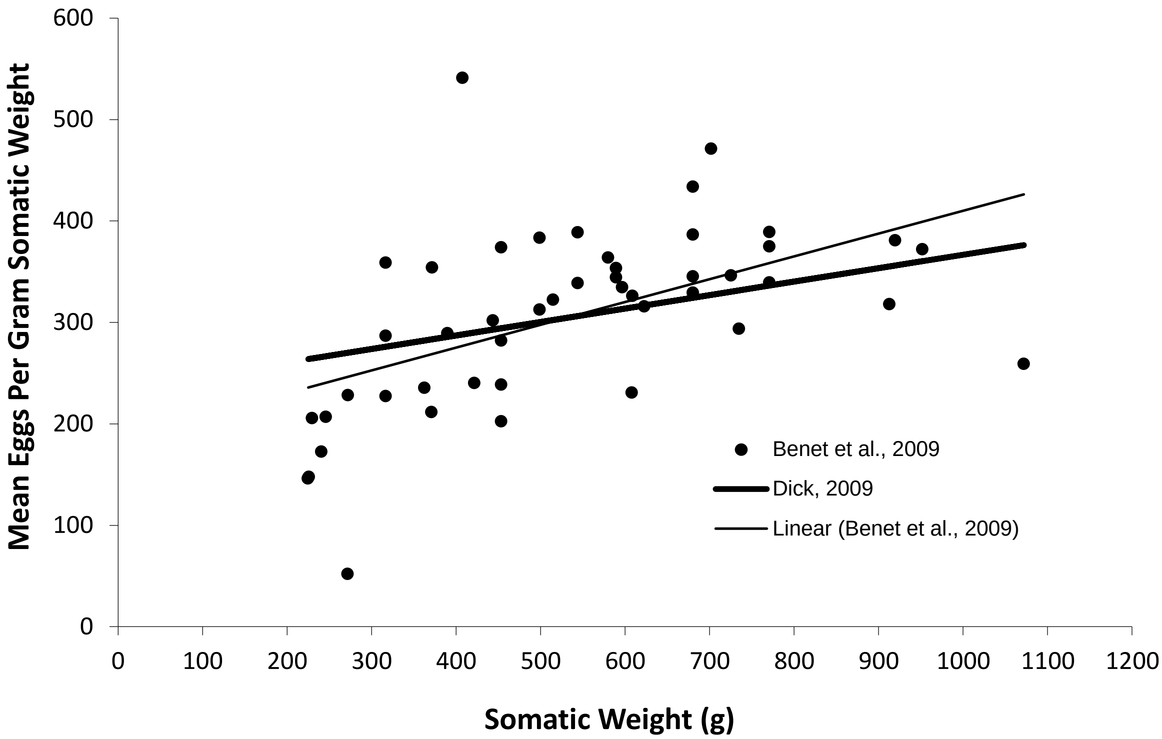


Figure 64. Relative fecundity (eggs per gram) of greenspotted rockfish as a function of body weight. The relationship based on a meta-analysis of rockfish fecundity (thick line; Dick, 2009) is compared to a simple linear regression of the data. The relationship assumed for both northern and southern models is that of Dick (2009).

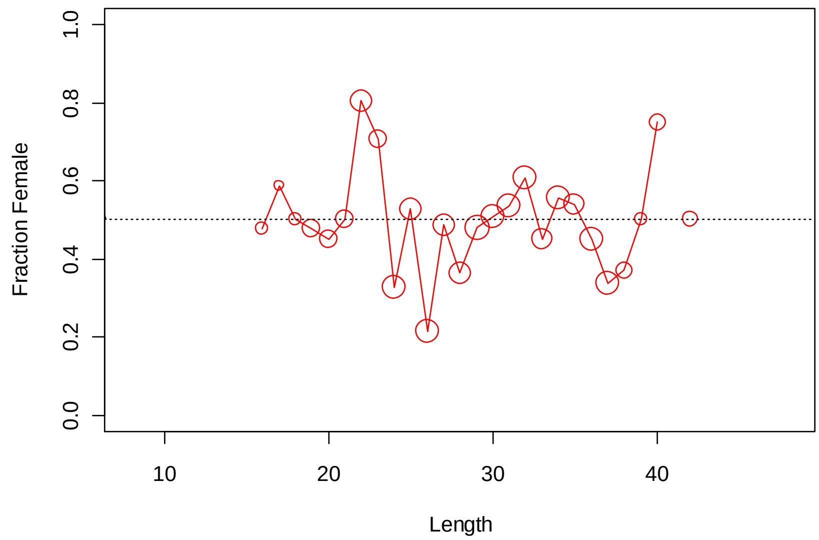


Figure 65. NWFSC survey sex ratios as a function of length for northern California.

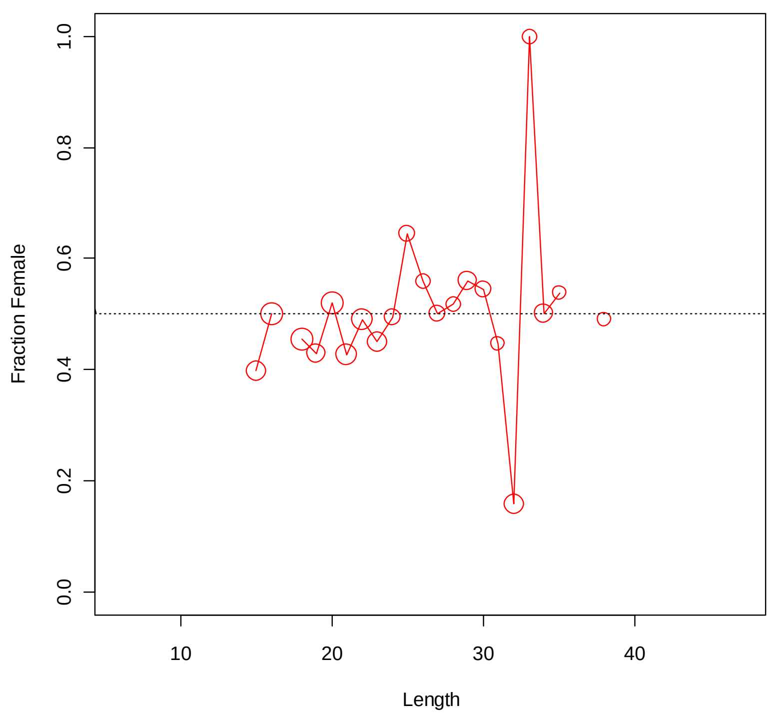


Figure 66. NWFSC survey sex ratios as a function of length for southern California.

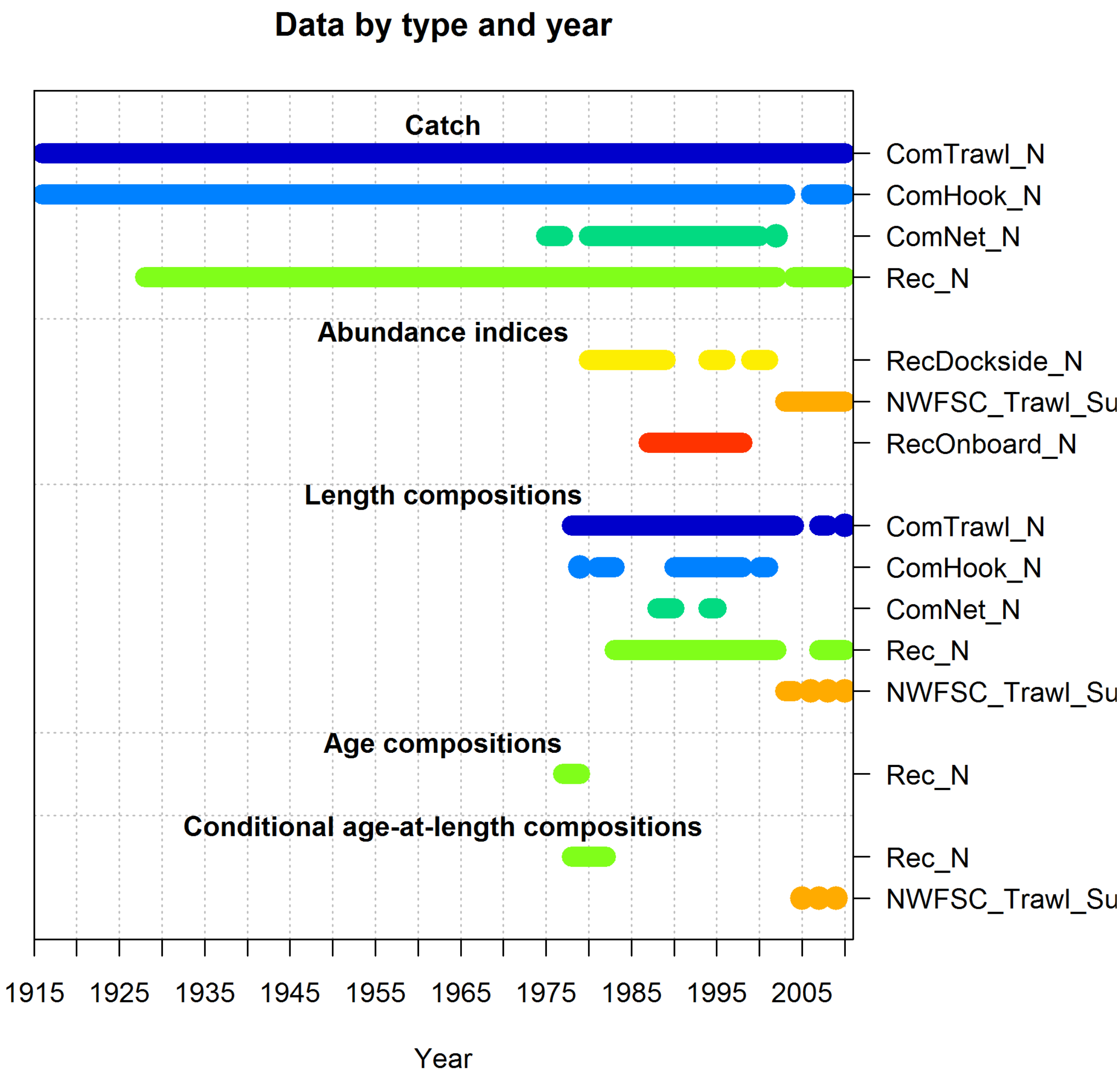


Figure 67. Data sources in the assessment of greenspotted rockfish in northern California.

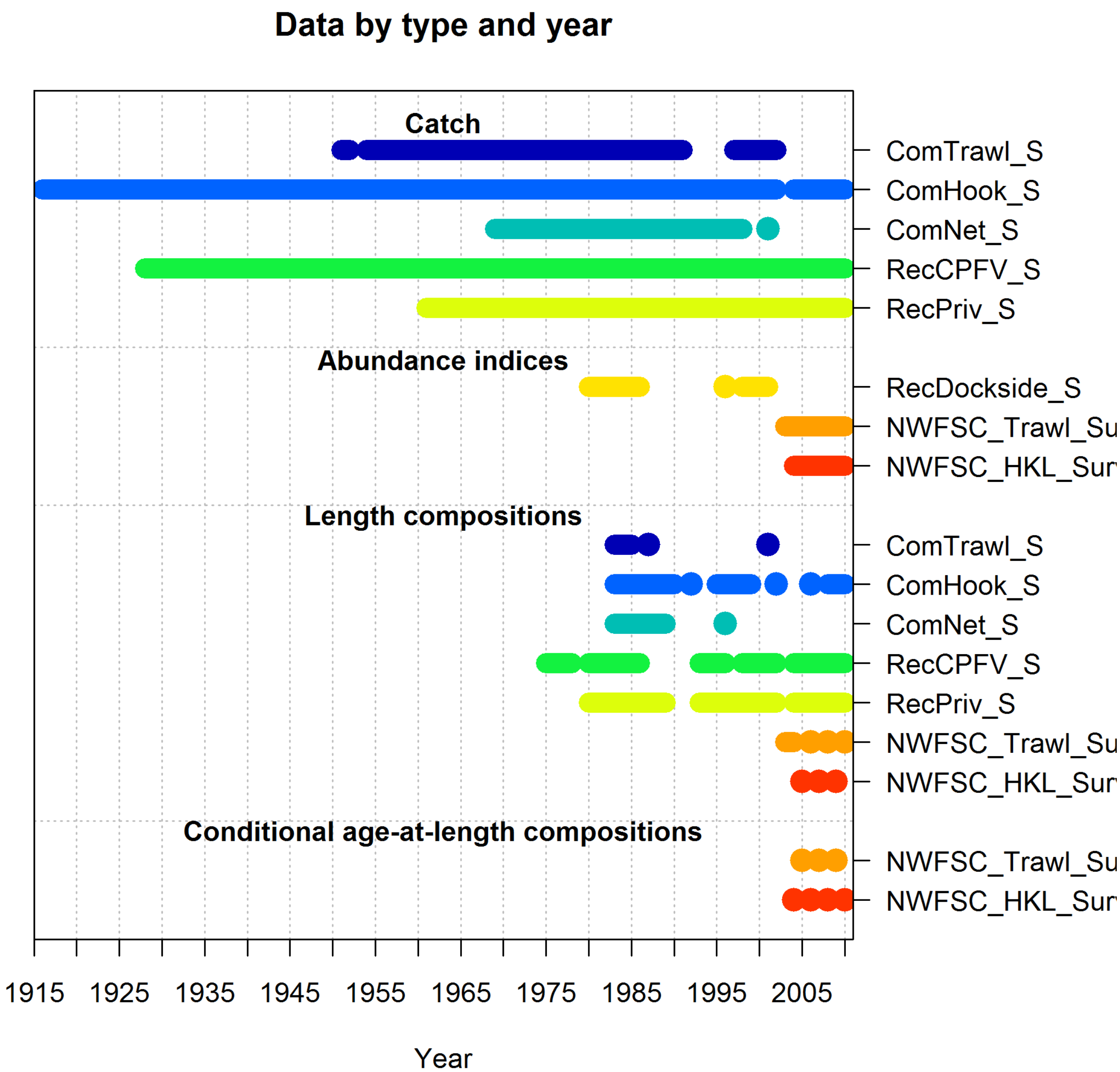


Figure 68. Data sources in the assessment of greenspotted rockfish in southern California

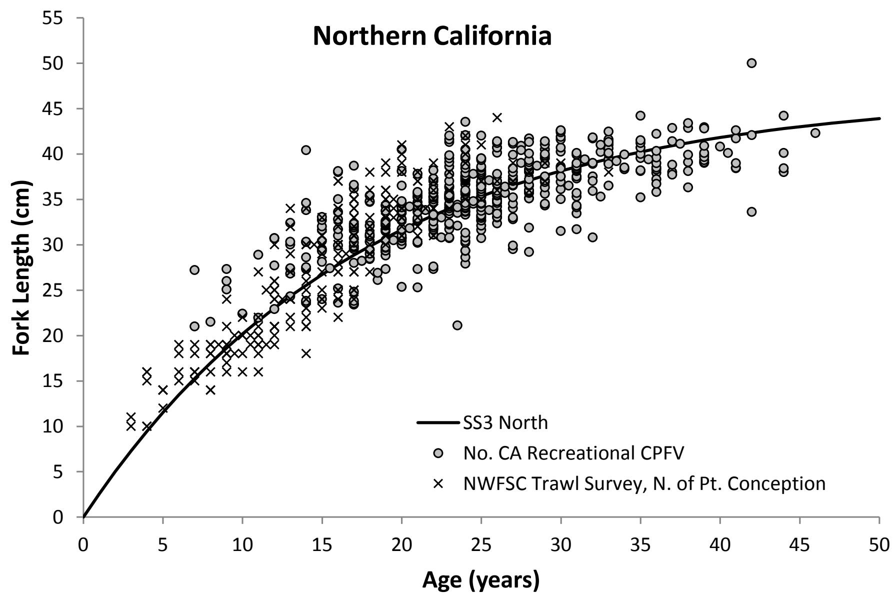


Figure 69. Internally-estimated growth trajectory for northern California ("SS3 North") and observed lengths at age from the recreational fleet and NWFSC trawl survey.

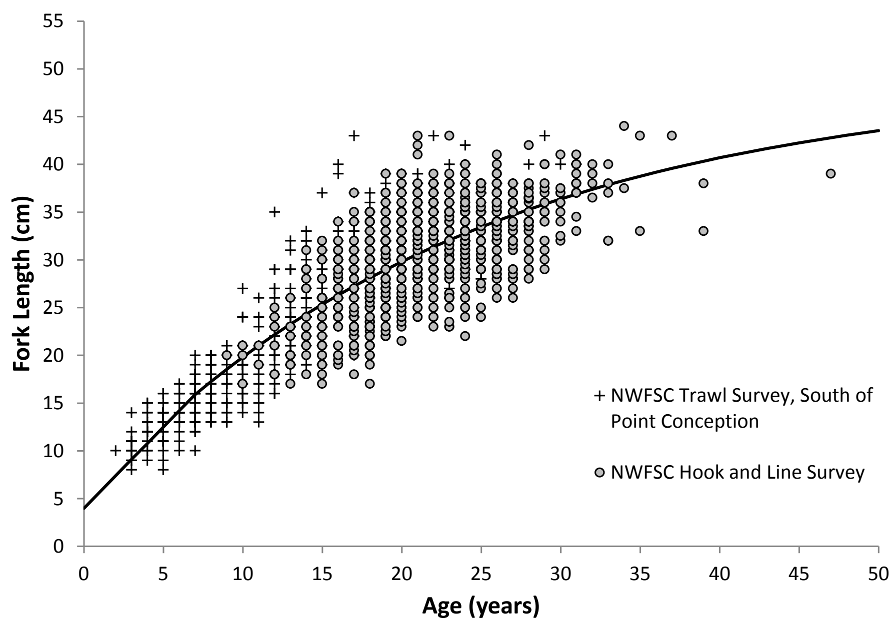


Figure 70. Externally-estimated growth trajectory for southern California (solid line) and observed lengths at age from the NWFSC trawl survey in the southern region and the NWFSC hook and line survey.

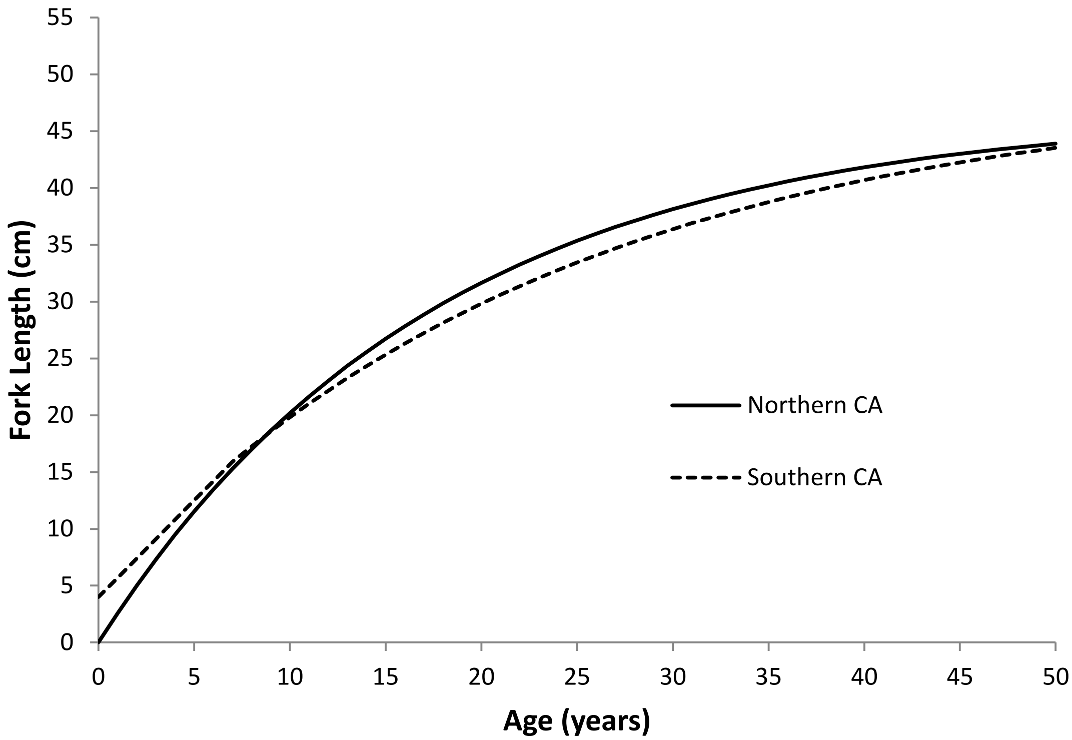


Figure 71. Comparison of internally-estimated growth curve for northern California and externally estimated growth curve for southern California.

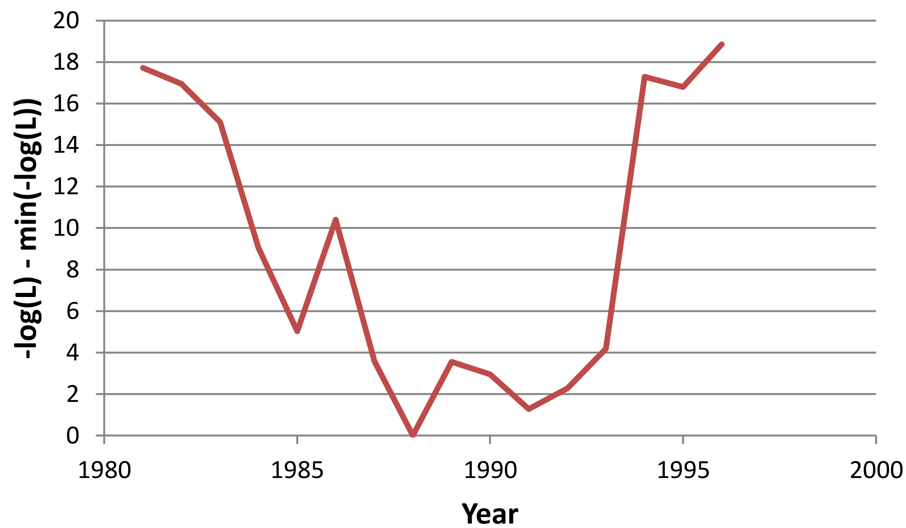


Figure 72. Likelihood profile to determine optimal year for division of time blocks in selectivity for the northern California trawl fleet. A single block was held constant (2003-2010) based on implementation of RCAs. The profile year divides two blocks for the time period 1916-2002, based on data beginning in 1978.

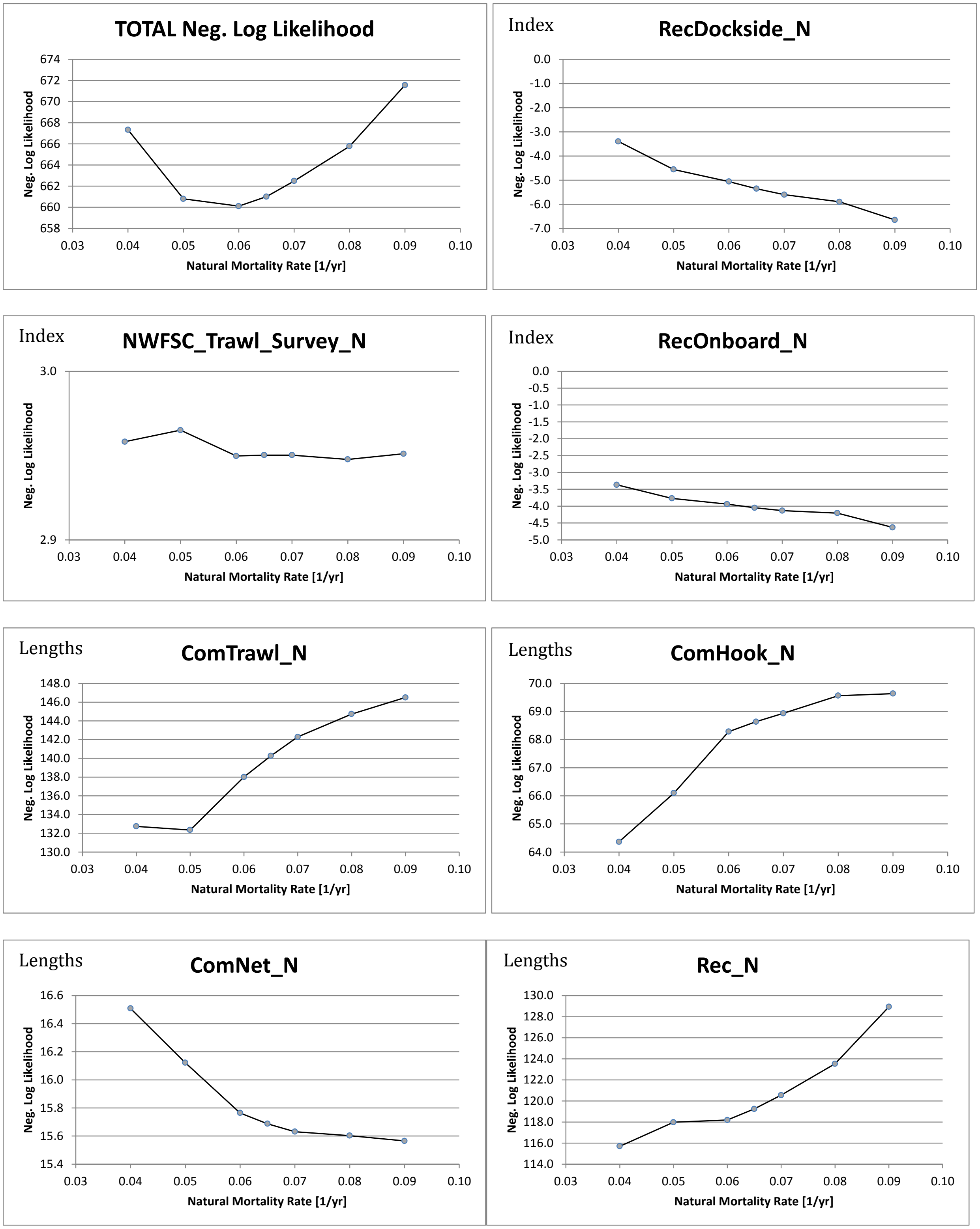


Figure 73. Response to STAR panel request # 7 for northern California: Fleet-specific likelihood components as a function of the natural mortality rate, M.

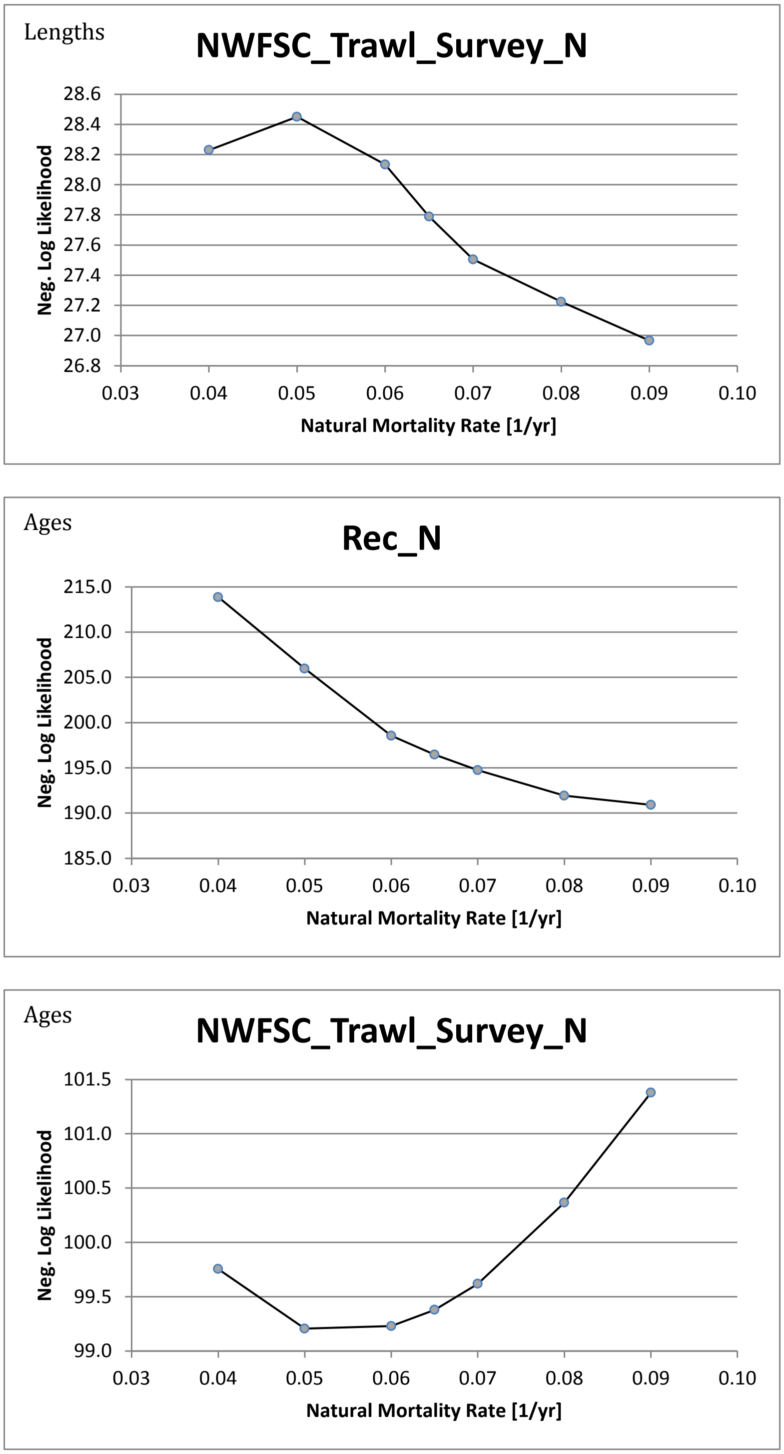


Figure 74. Continuation of Response to STAR panel request # 7 for northern California: Fleet-specific likelihood components as a function of the natural mortality rate, M.

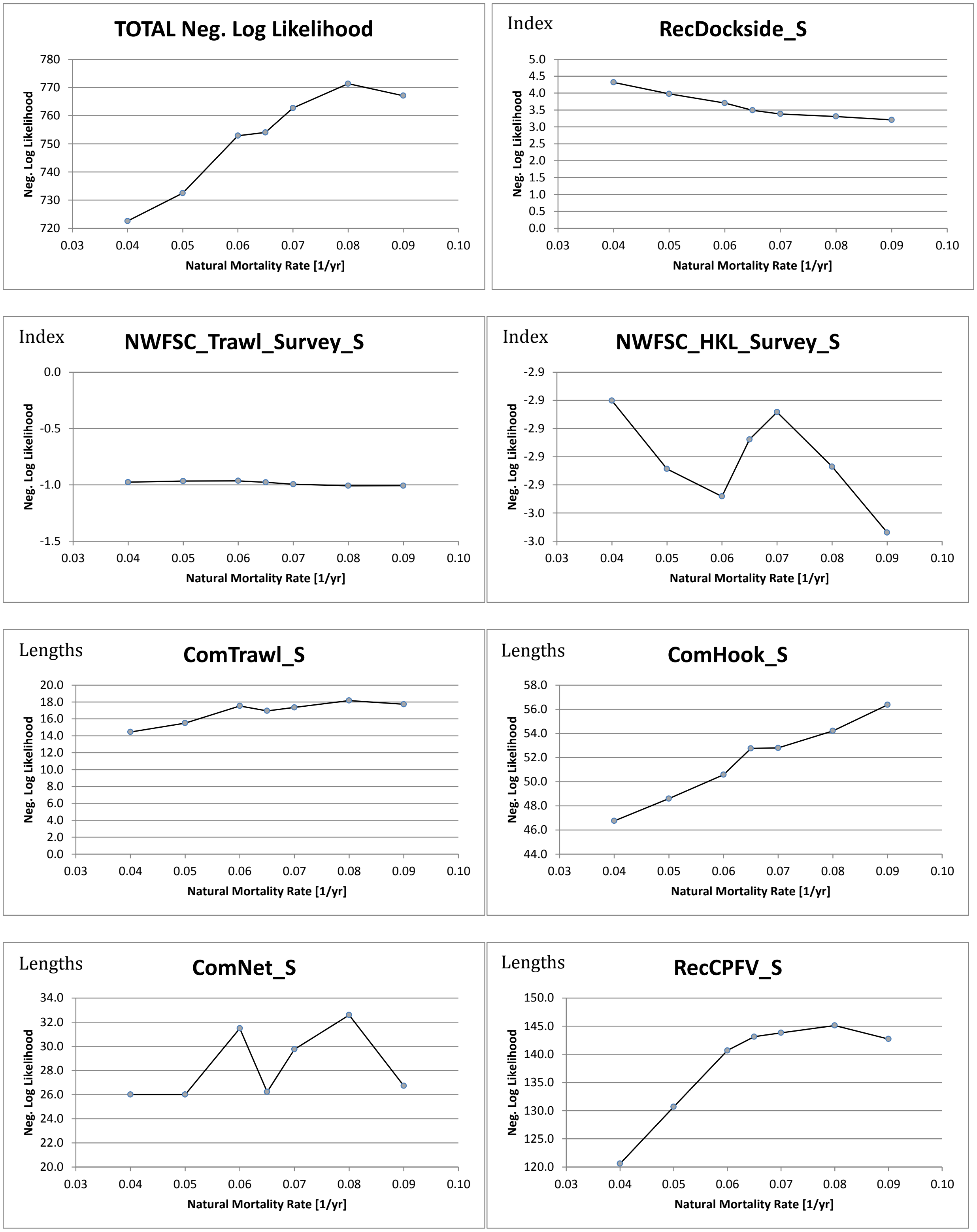


Figure 75. Response to STAR panel request # 7 for southern California: Fleet-specific likelihood components as a function of the natural mortality rate, M.

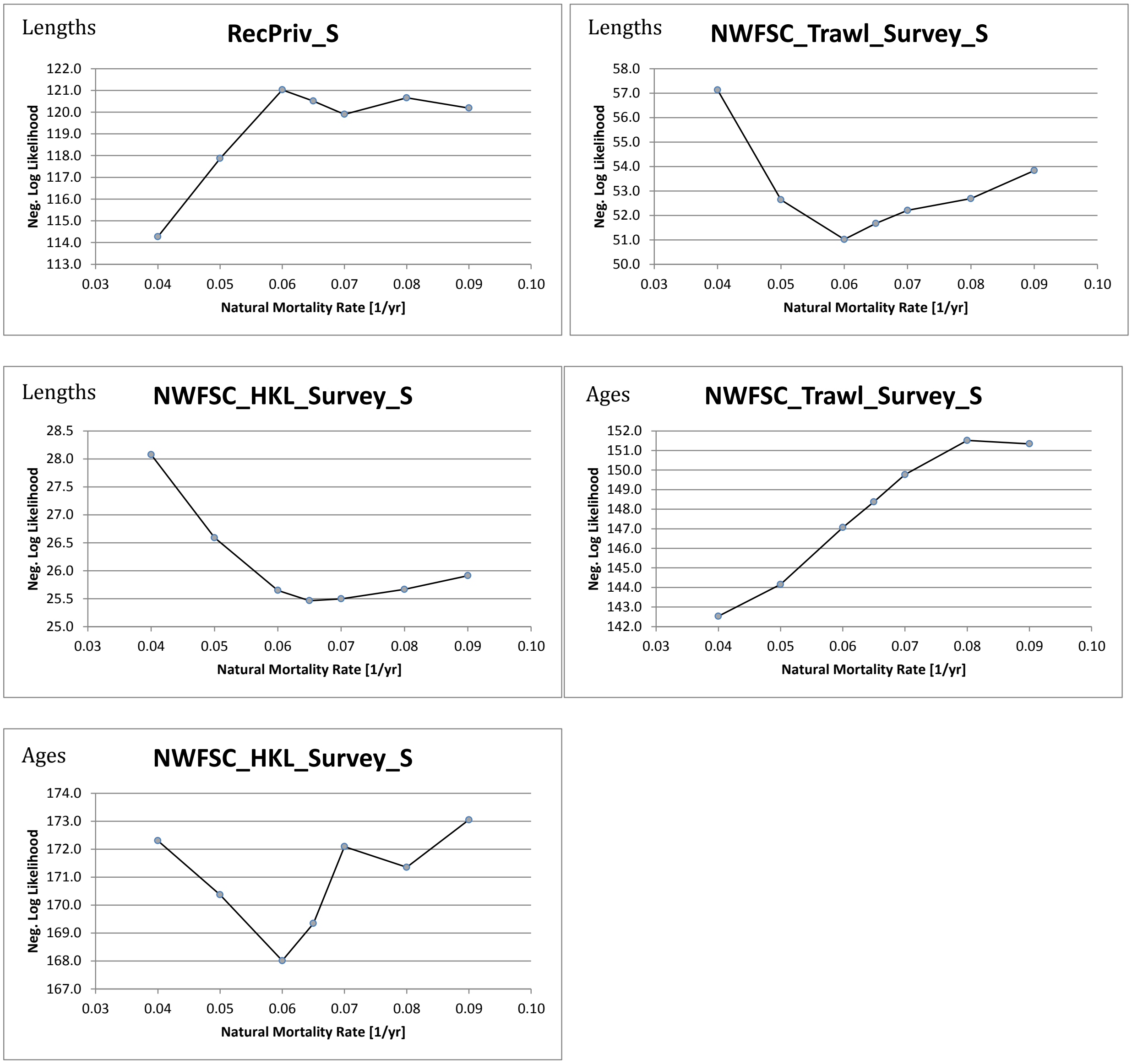
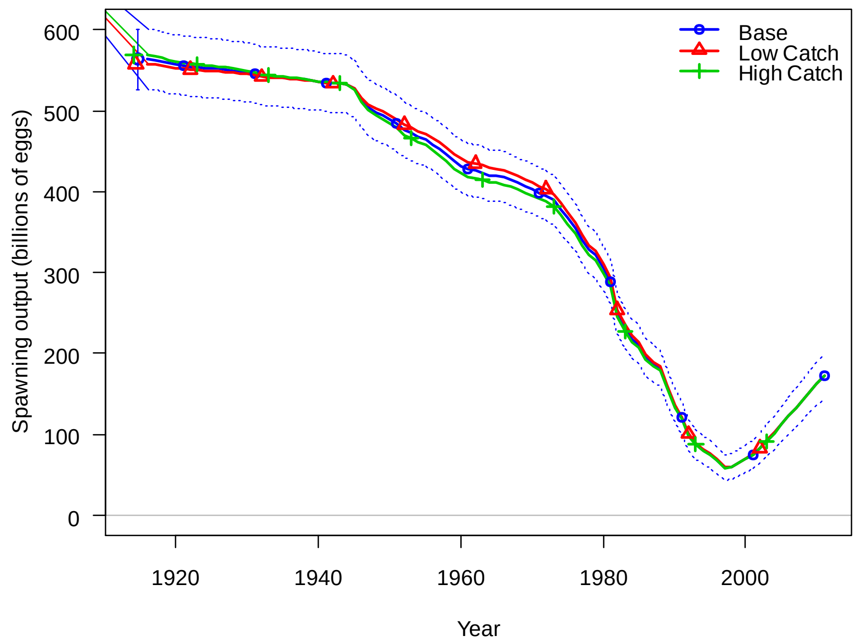


Figure 76. Continued response to STAR panel request # 7 for southern California: Fleet-specific likelihood components as a function of the natural mortality rate, M.



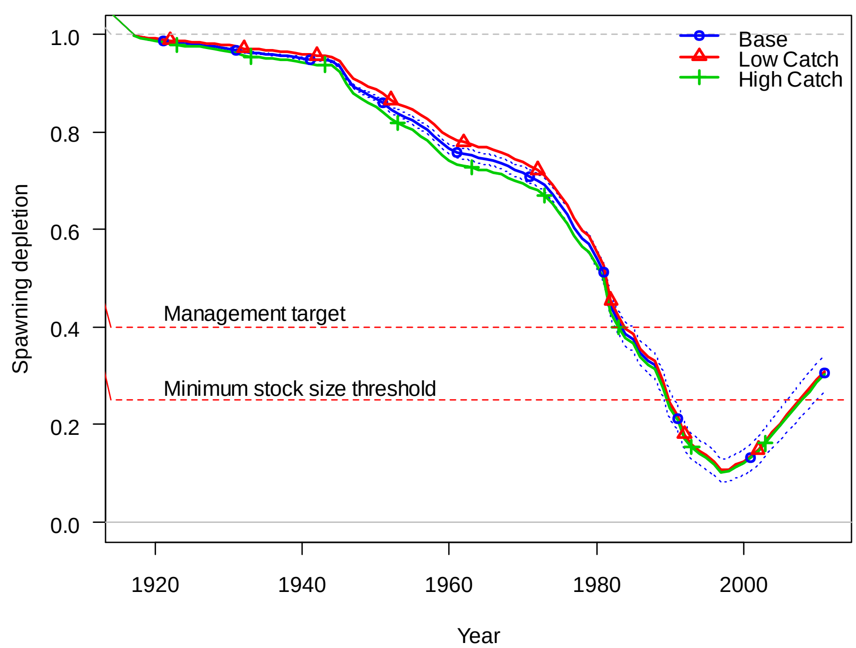


Figure 77. Response to STAR panel request #8: sensitivity of spawning output (upper panel) and spawning depletion (lower panel) to low and high estimates of historical catch reconstructions for northern California.

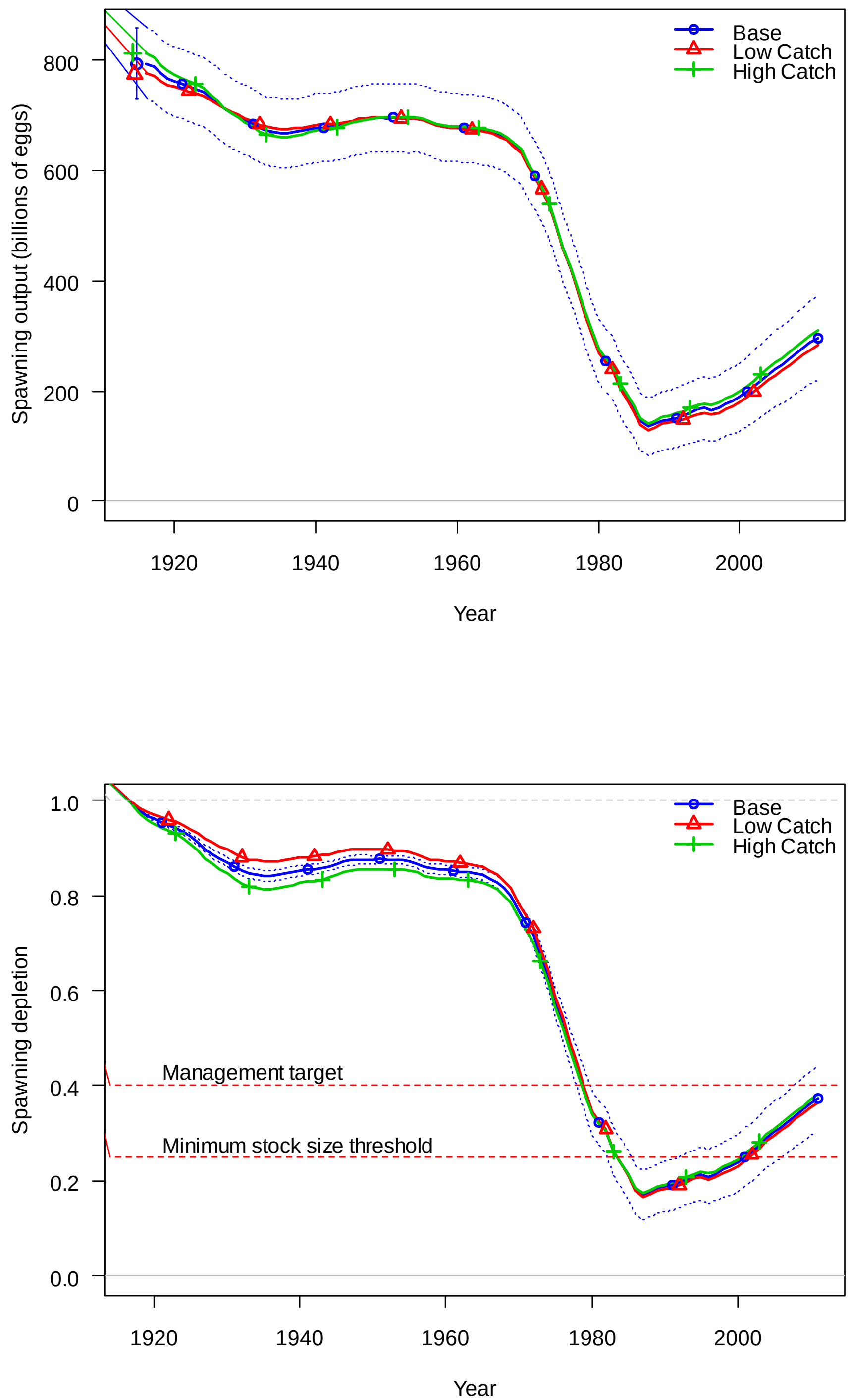


Figure 78. Response to STAR panel request #8: sensitivity of spawning output (upper panel) and spawning depletion (lower panel) to low and high estimates of historical catch reconstructions for southern California.

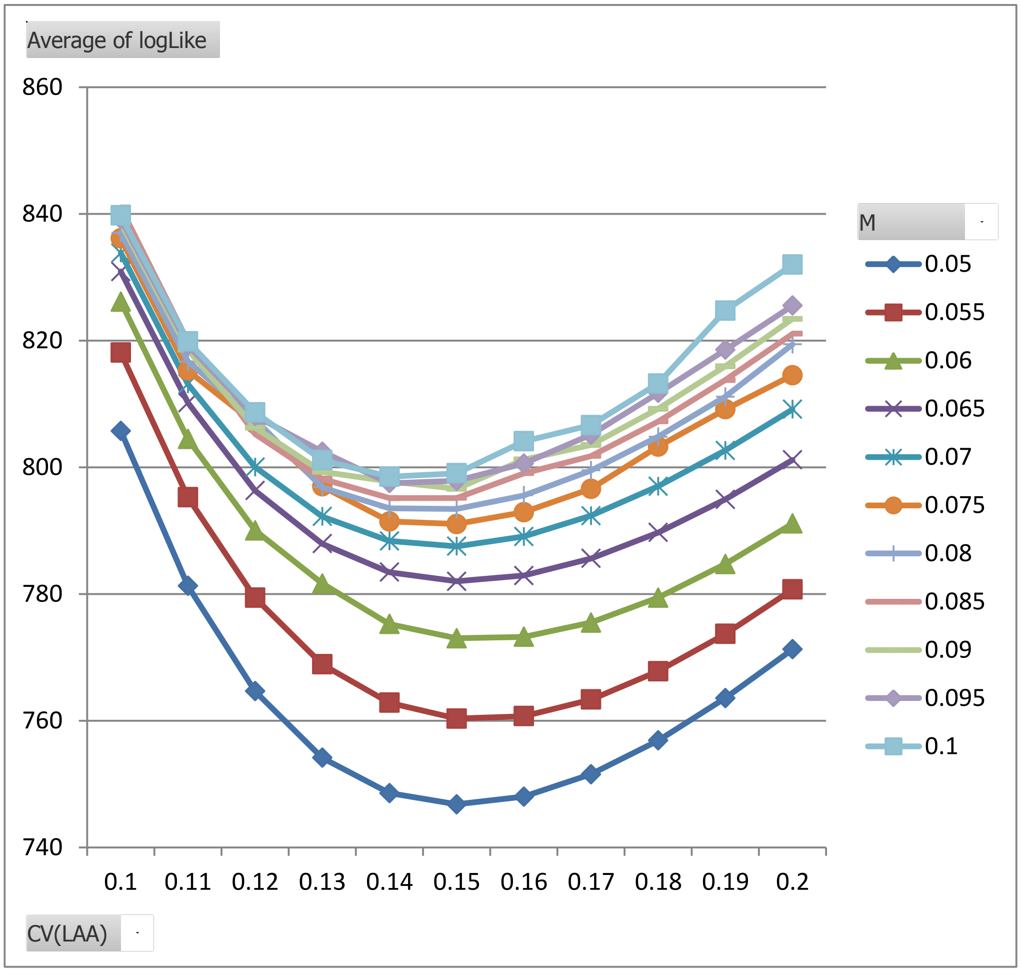


Figure 79. Response to STAR Panel request #14: Profile likelihood over CVs from 0.1 to 0.2 with old and young ages equal, all for M from 0.05 to 0.1, steepness (h=0.59). Deviations from smooth likelihood contours are due to lack of convergence during automated model runs.

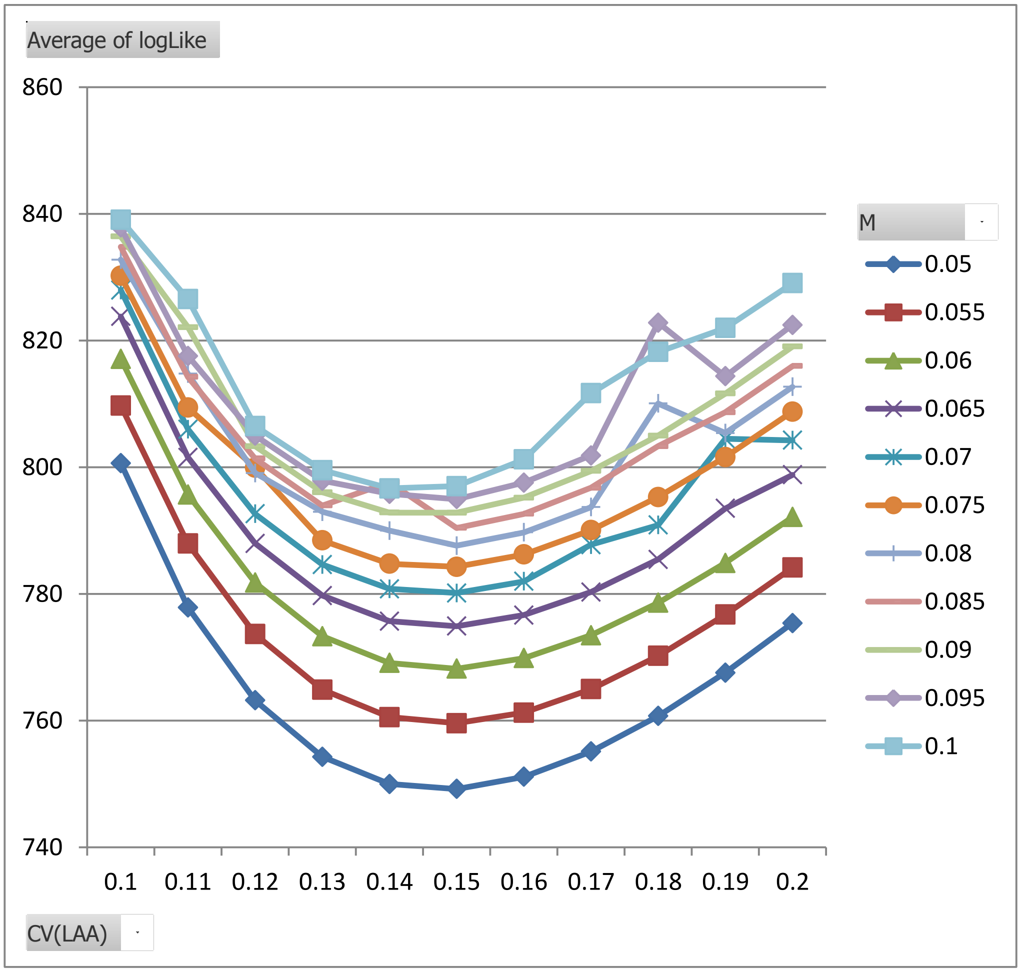


Figure 80. Response to STAR Panel request #14: Profile likelihood over CVs from 0.1 to 0.2 with old and young ages equal, all for M from 0.05 to 0.1, steepness (h=0.76). Deviations from smooth likelihood contours are due to lack of convergence during automated model runs.

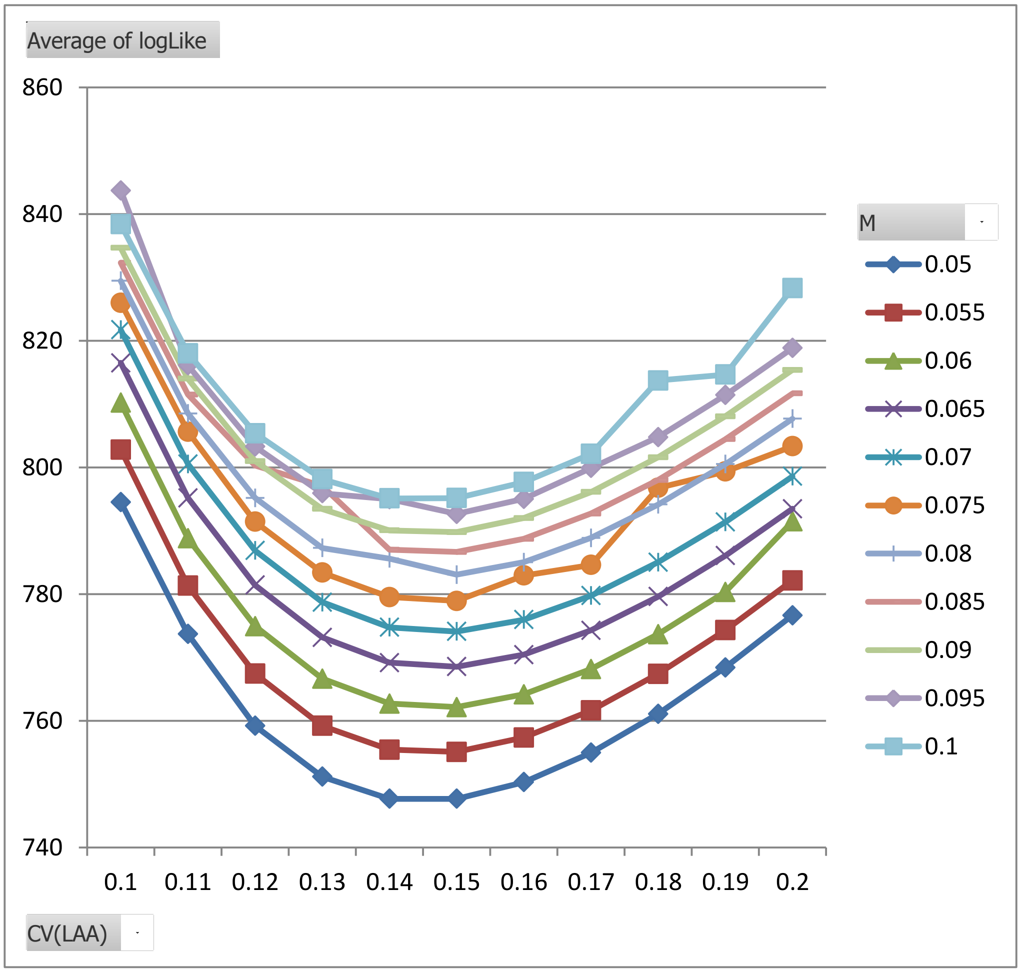


Figure 81. Response to STAR Panel request #14: Profile likelihood over CVs from 0.1 to 0.2 with old and young ages equal, all for M from 0.05 to 0.1, steepness (h=0.93). Deviations from smooth likelihood contours are due to lack of convergence during automated model runs.

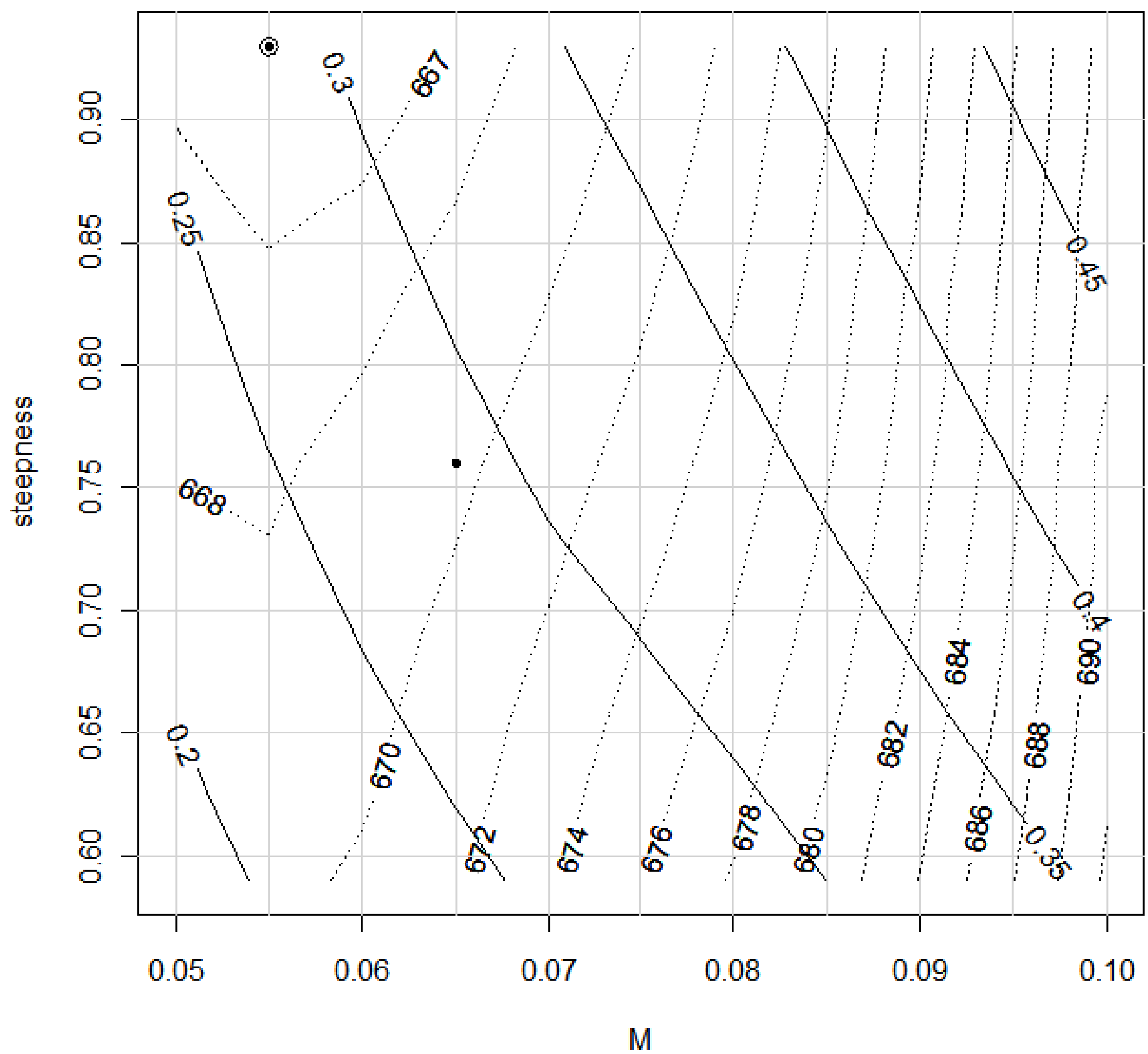


Figure 82. Response to STAR panel request #18: contours of likelihood (dotted lines) and depletion (solid lines) from the northern California model as a function of steepness (*h*) and the natural mortality rate (*M*). The solid circle at *h*=0.76 and *M*=0.065 represents the base model. The minimum negative log likelihood for the range of values in the grid occurs at *M*=0.055 and *h*=0.93 (the upper bound for steepness in the grid).

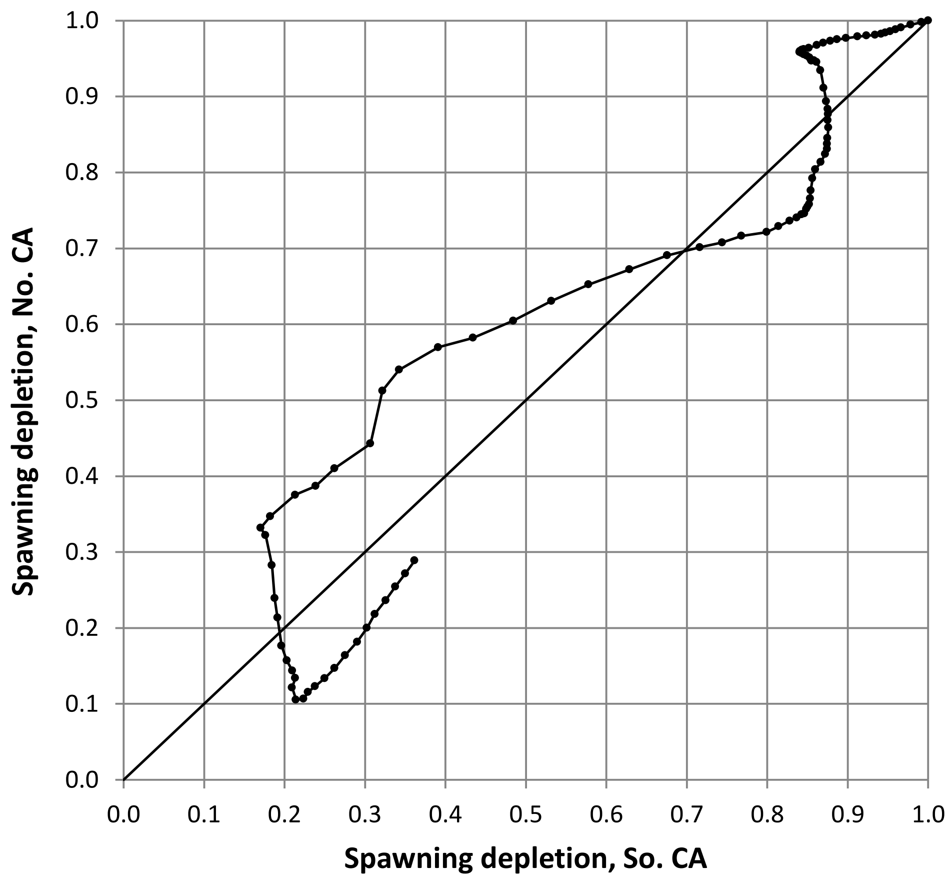


Figure 83. Comparison of depletion trajectories for northern and southern CA.

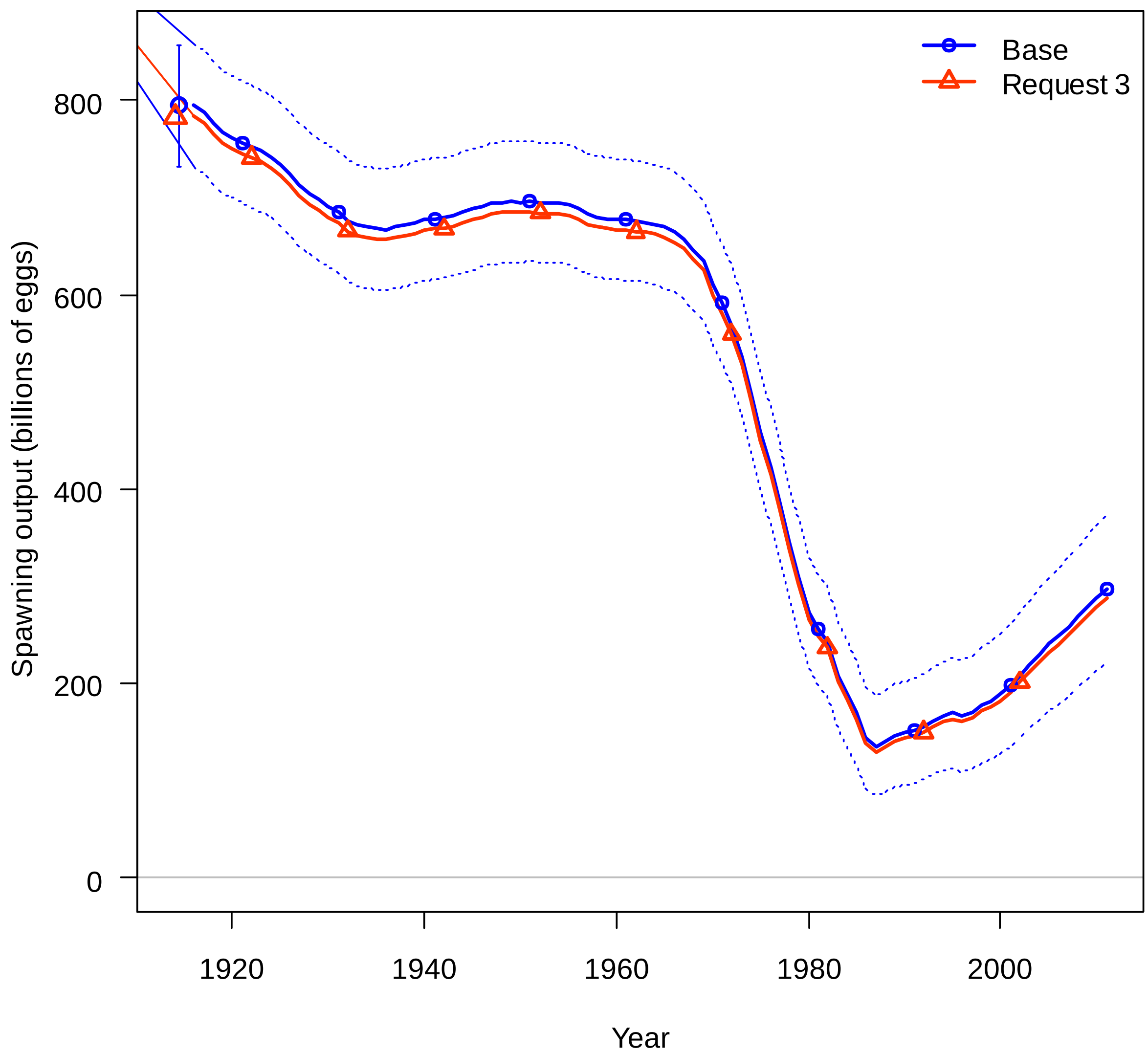


Figure 84. Comparison of spawning output from STAR panel request #3 and the final base model for southern California (see section 4.2 for details).

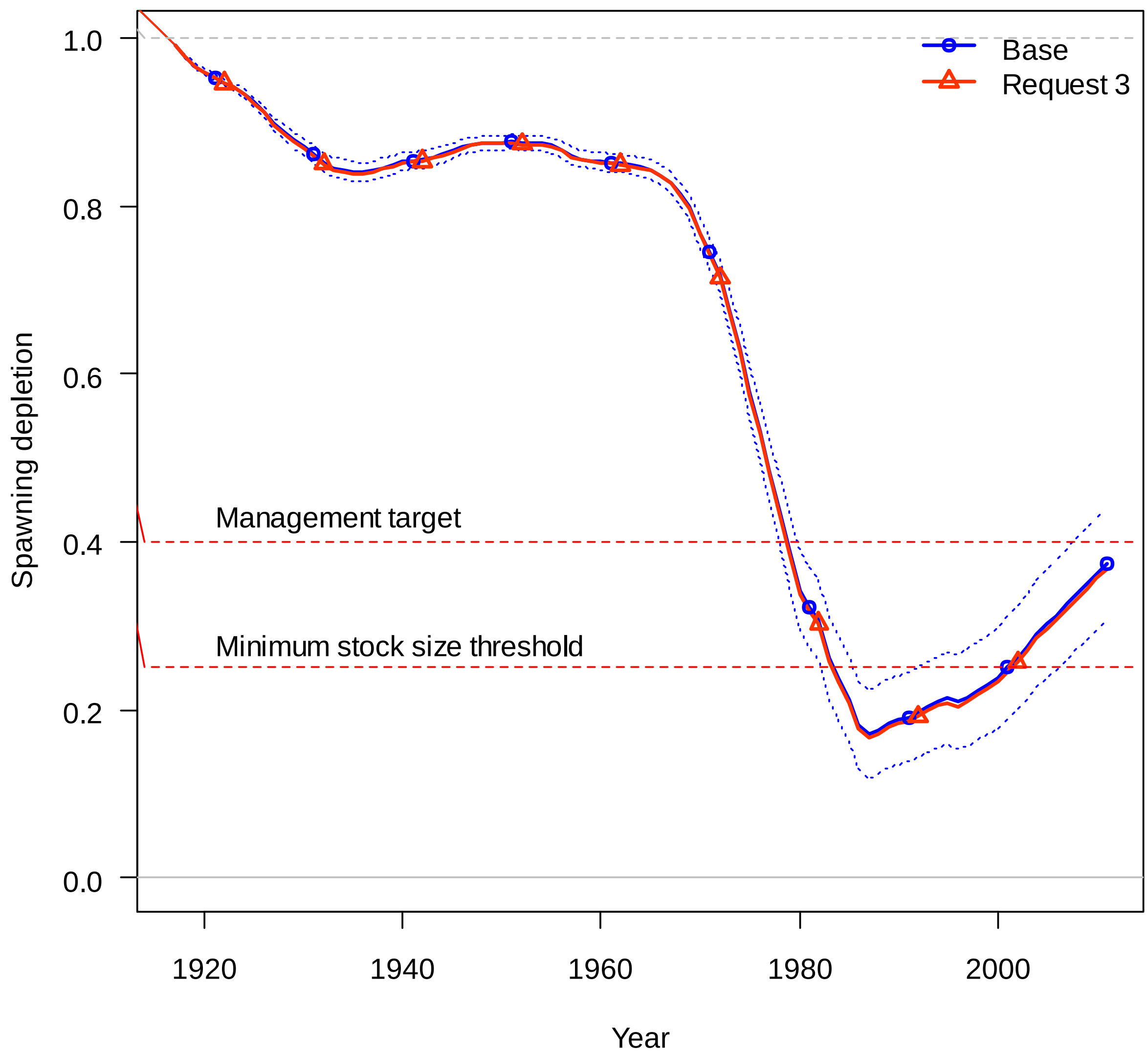


Figure 85. Comparison of spawning depletion from STAR panel request #3 and the final base model for southern California (see section 4.2 for details).

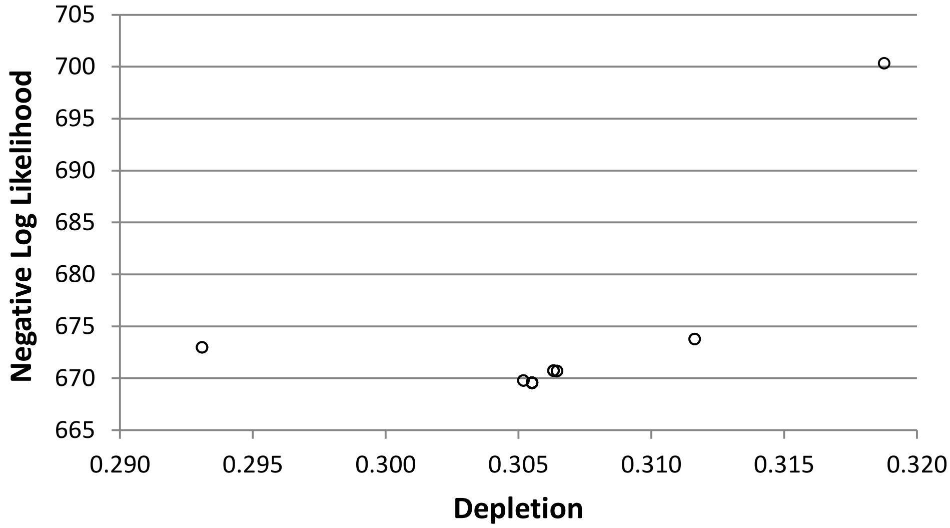


Figure 86. Negative log likelihoods (NLL) and estimated depletions based on 50 northern model runs starting from different initial parameter values; the northern California base model is at the minimum value of NLL for the set of 50 runs.

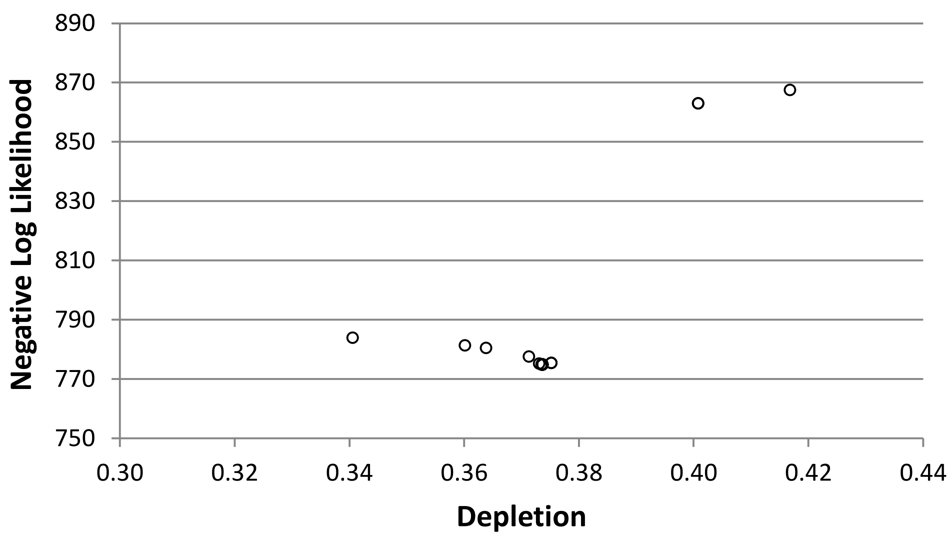


Figure 87. Negative log likelihoods (NLL) and estimated depletions based on 50 southern model runs starting from different initial parameter values; the southern California base model is at the minimum value of NLL for the set of 50 runs.

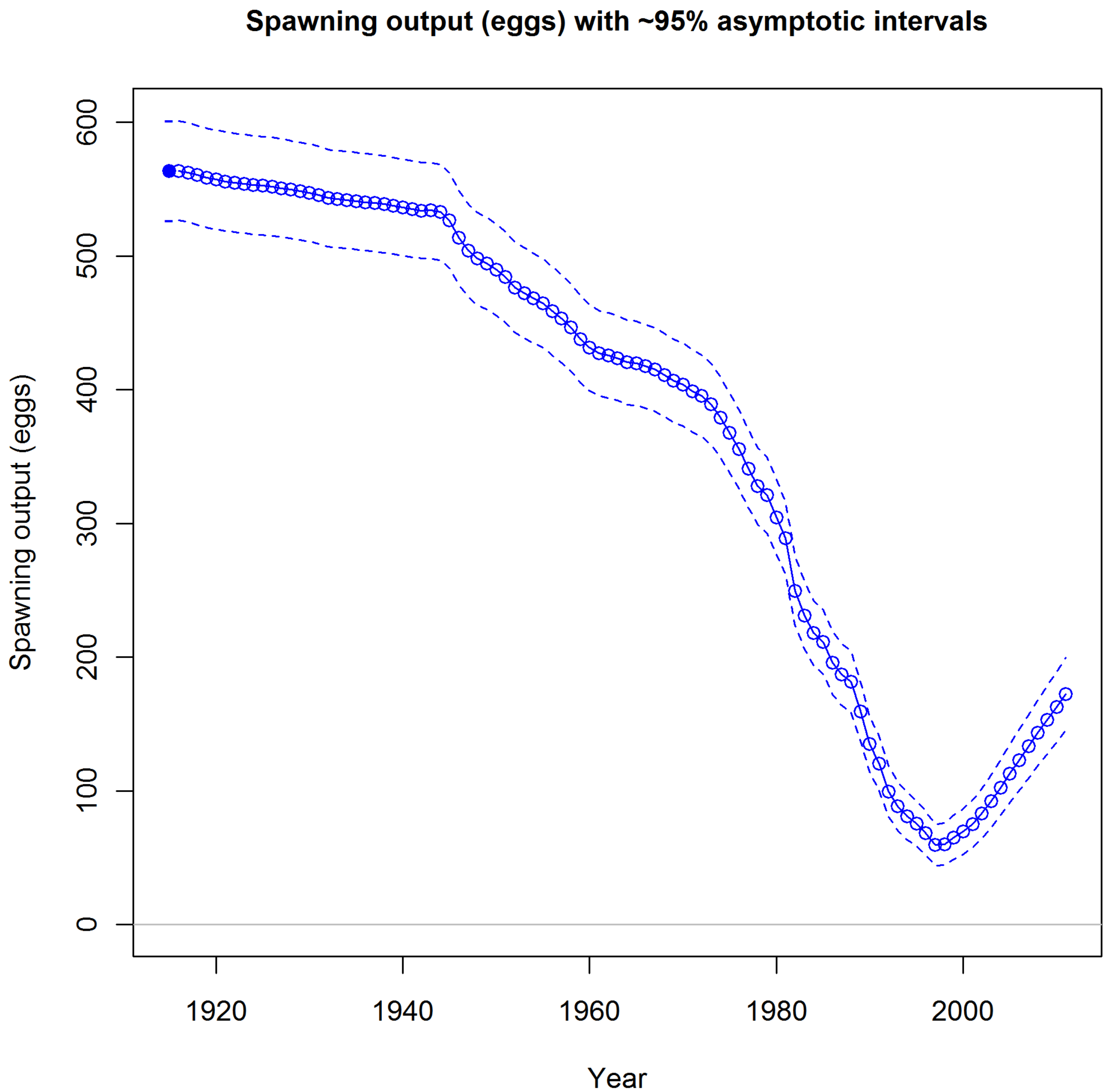


Figure 88. Time series of spawning output (billions of eggs) for greenspotted rockfish in northern California, with approximate 95% asymptotic confidence intervals (dashed lines).

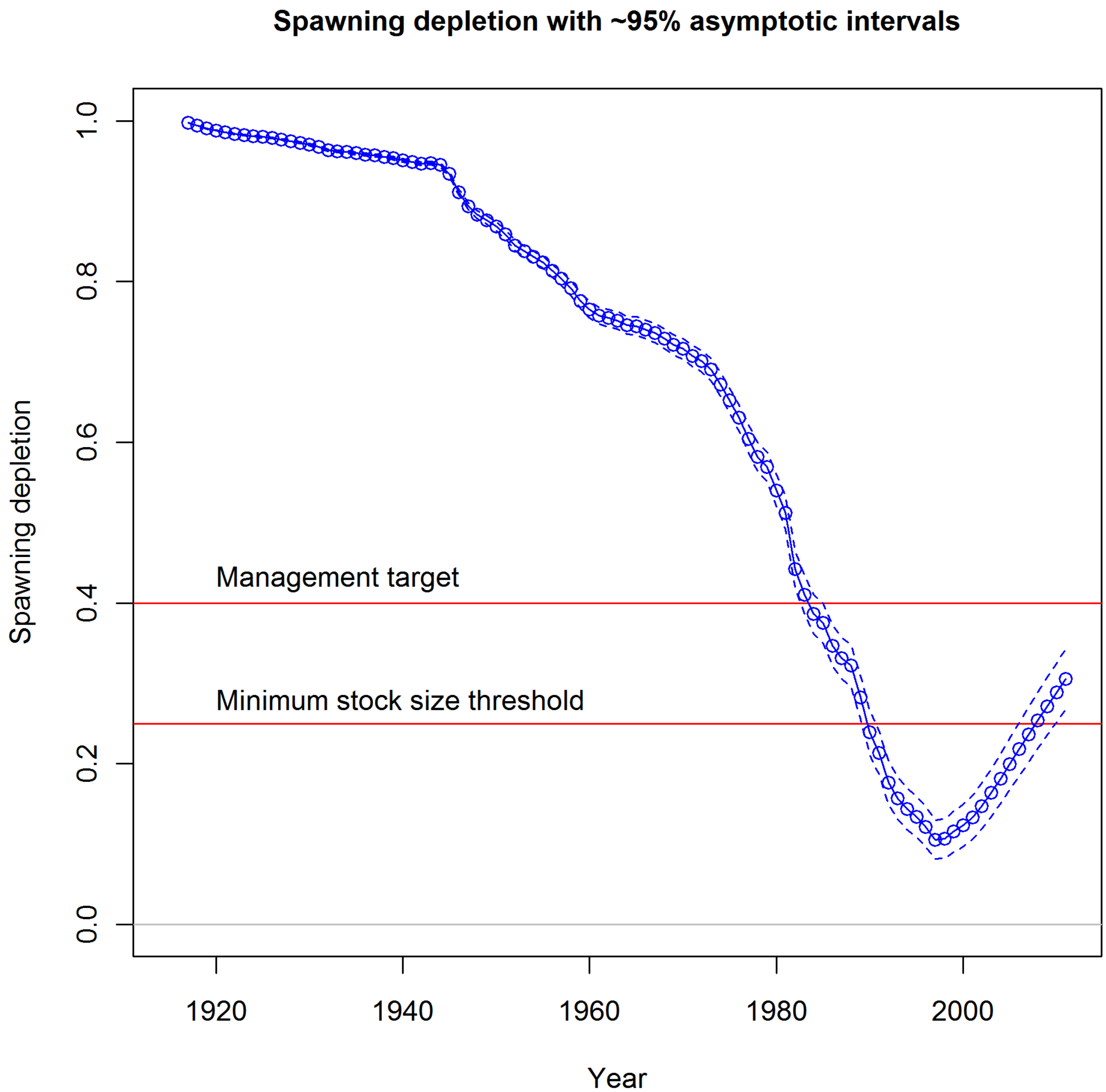


Figure 89. Time series of spawning depletion (spawning output as a fraction of unfished spawning output) for greenspotted rockfish in northern California, with approximate 95% asymptotic confidence intervals (dashed lines).

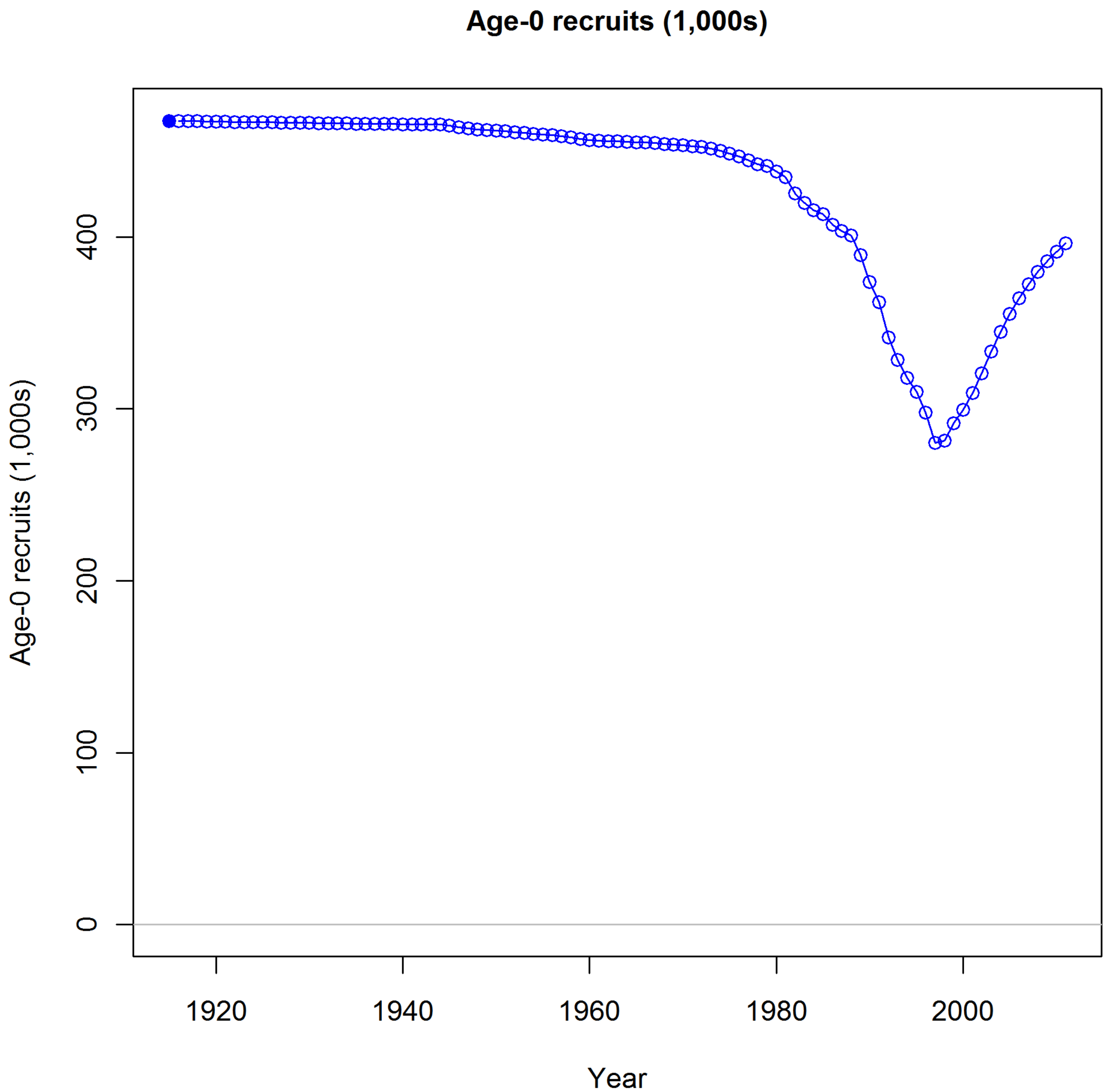


Figure 90. Deterministic recruitment for greenspotted rockfish in northern California

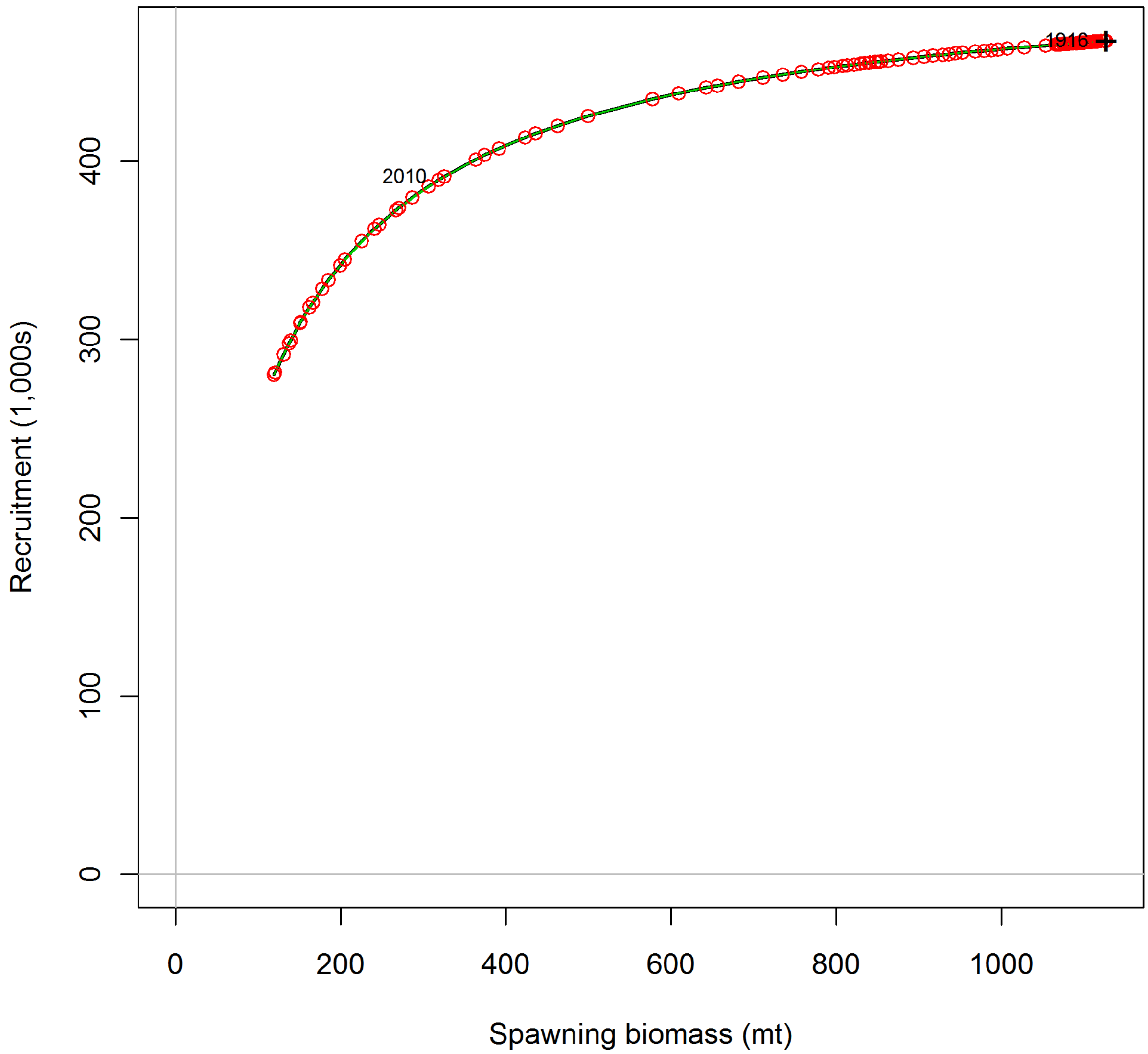


Figure 91. Stock-recruitment relationship for northern California base model.

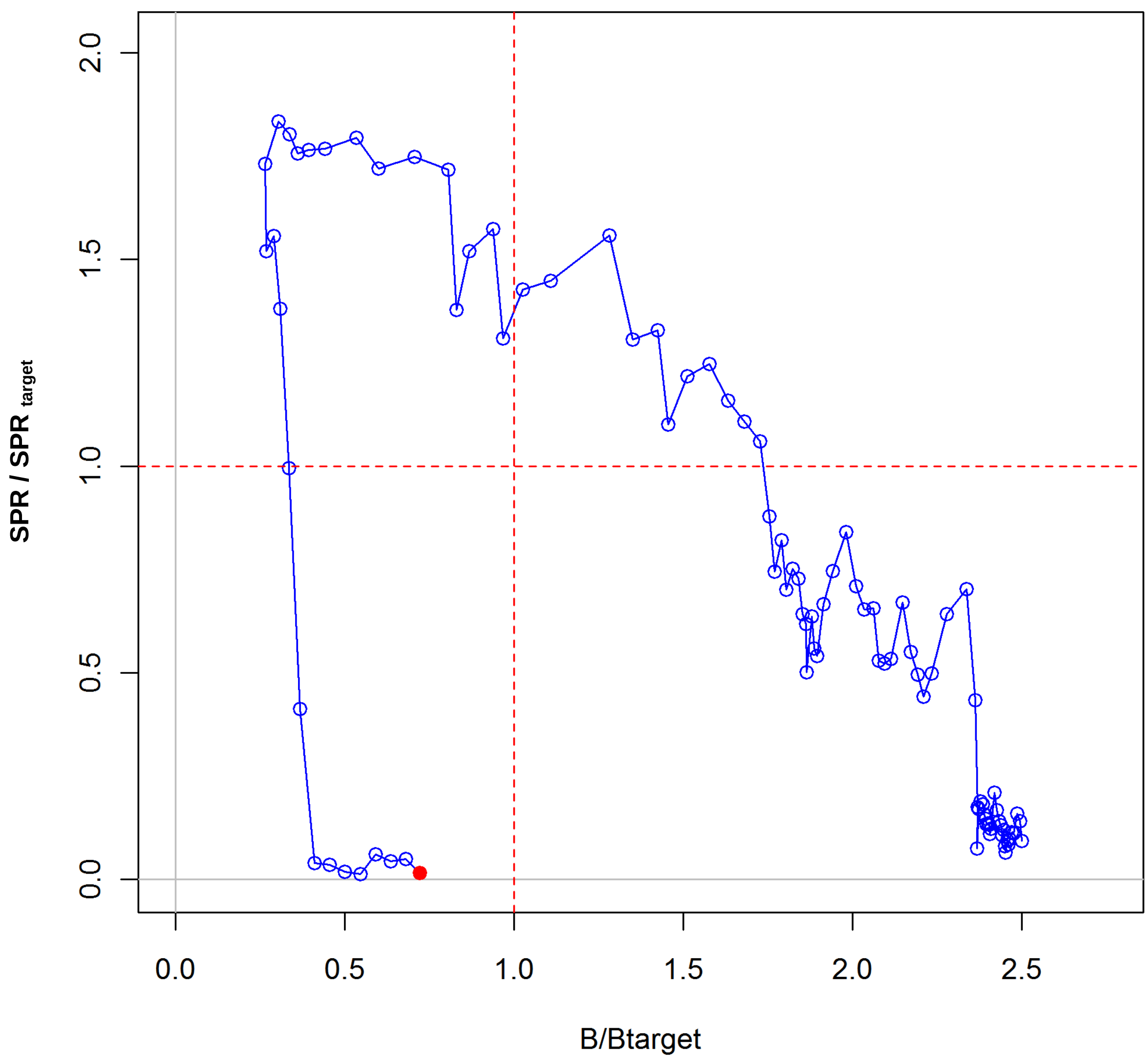


Figure 92. Exploitation history of greenspotted rockfish in northern California relative to biomass and harvest rate targets.

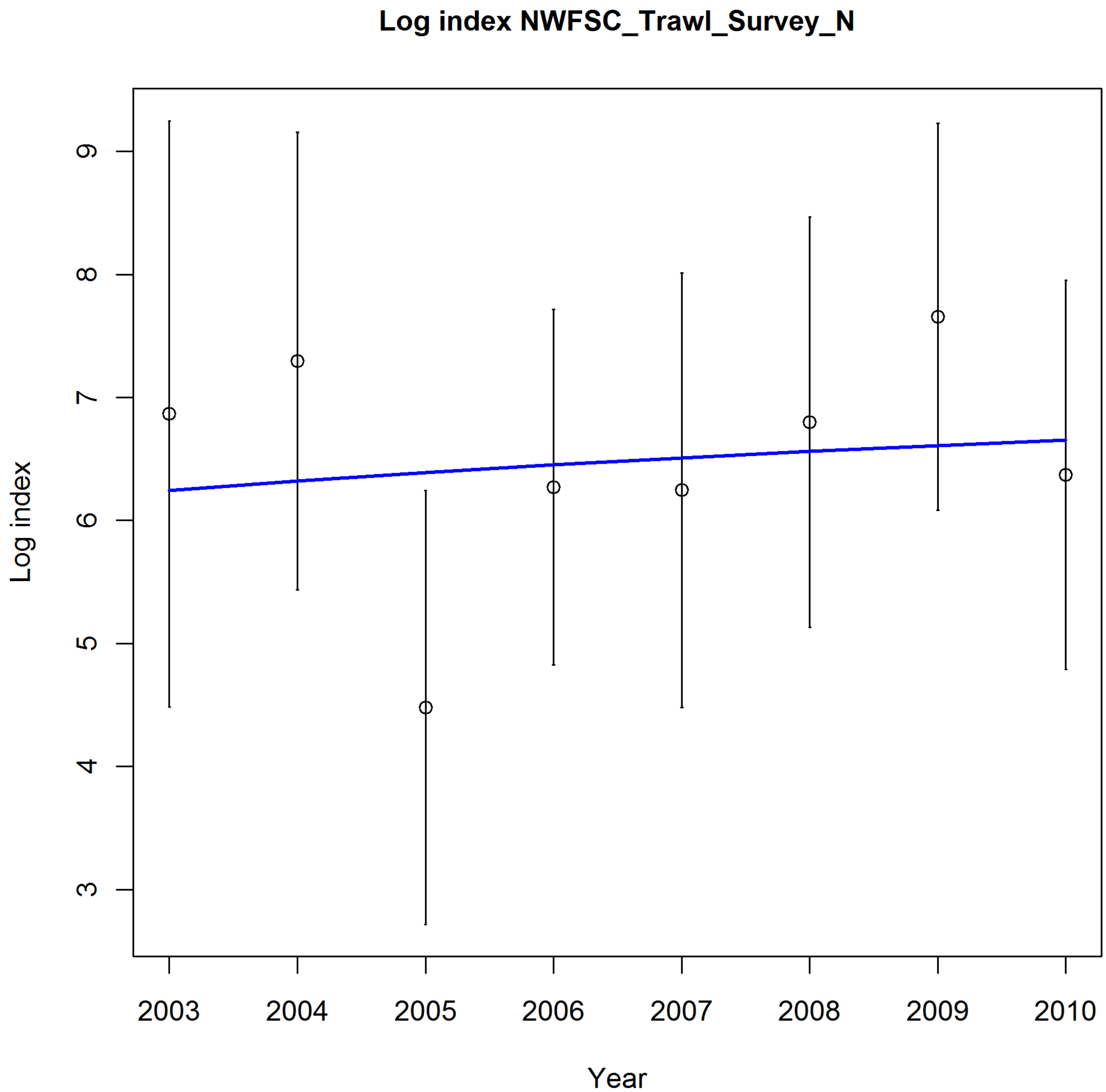


Figure 93. Fit to NWFSC trawl survey index in northern California (log space).

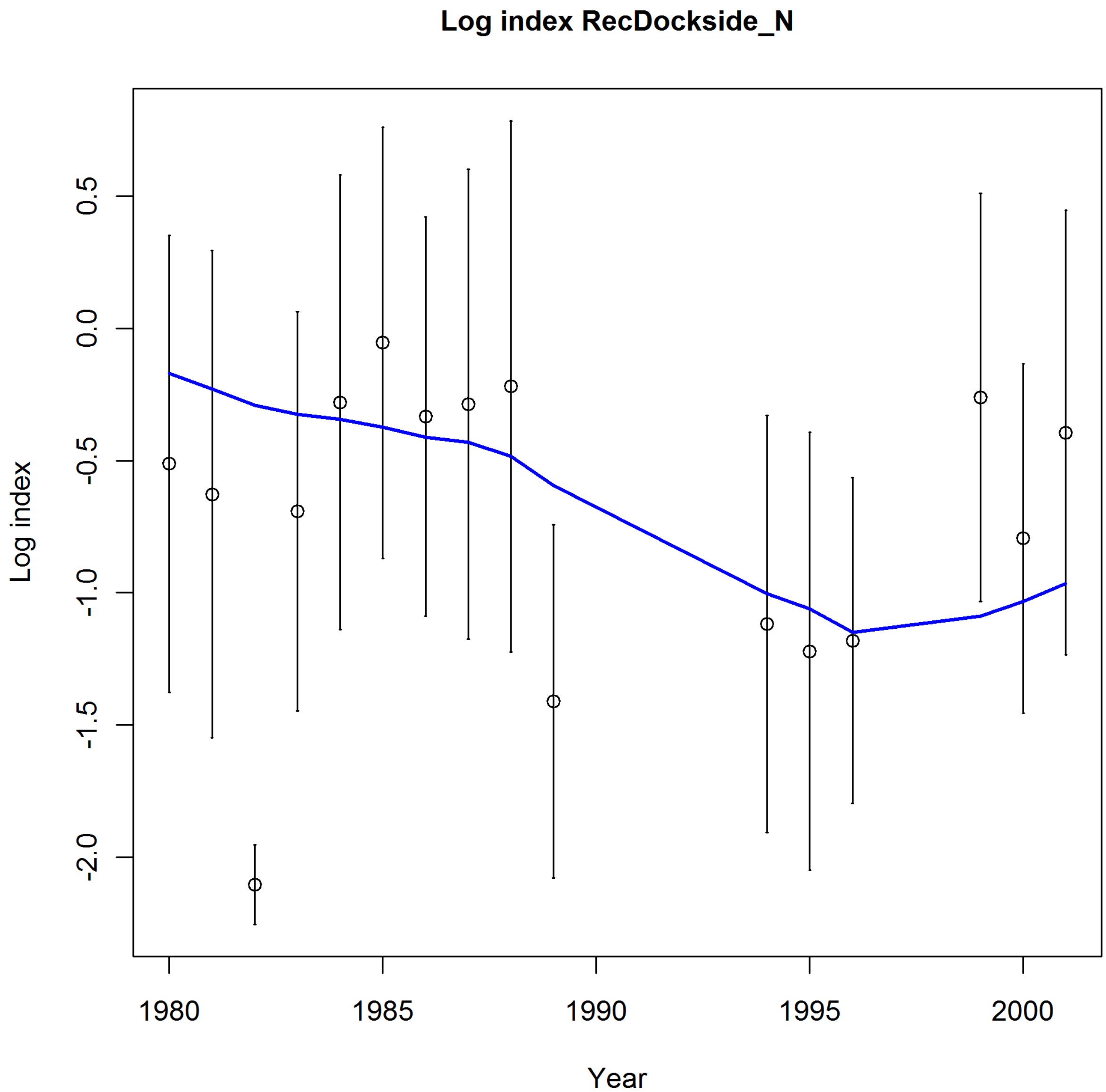


Figure 94. Fit to RecFIN dockside CPUE index for northern California. Estimate for 1982 is excluded from the likelihood.

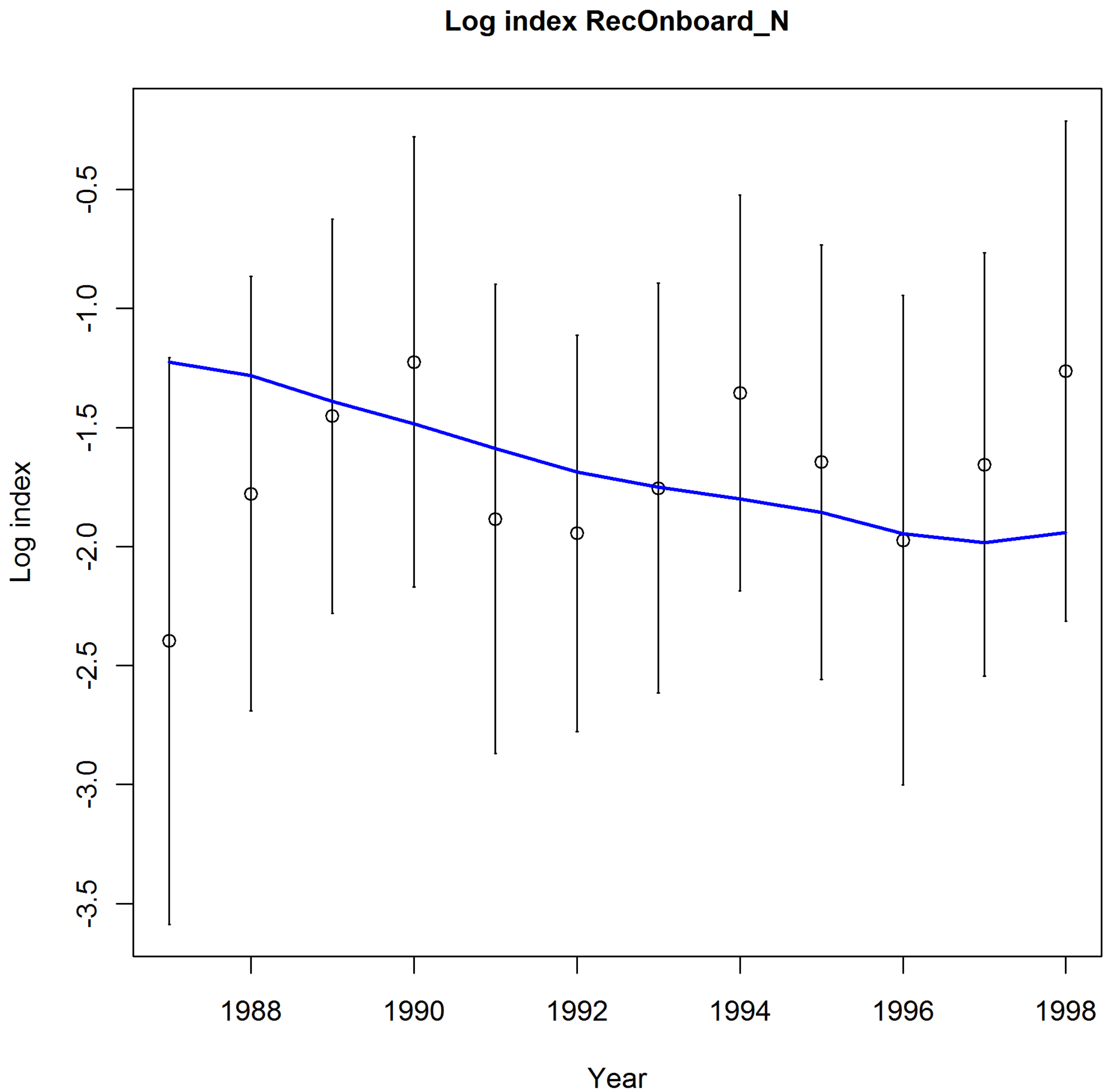


Figure 95. Fit to onboard CPFV CPUE index in northern California (log space).

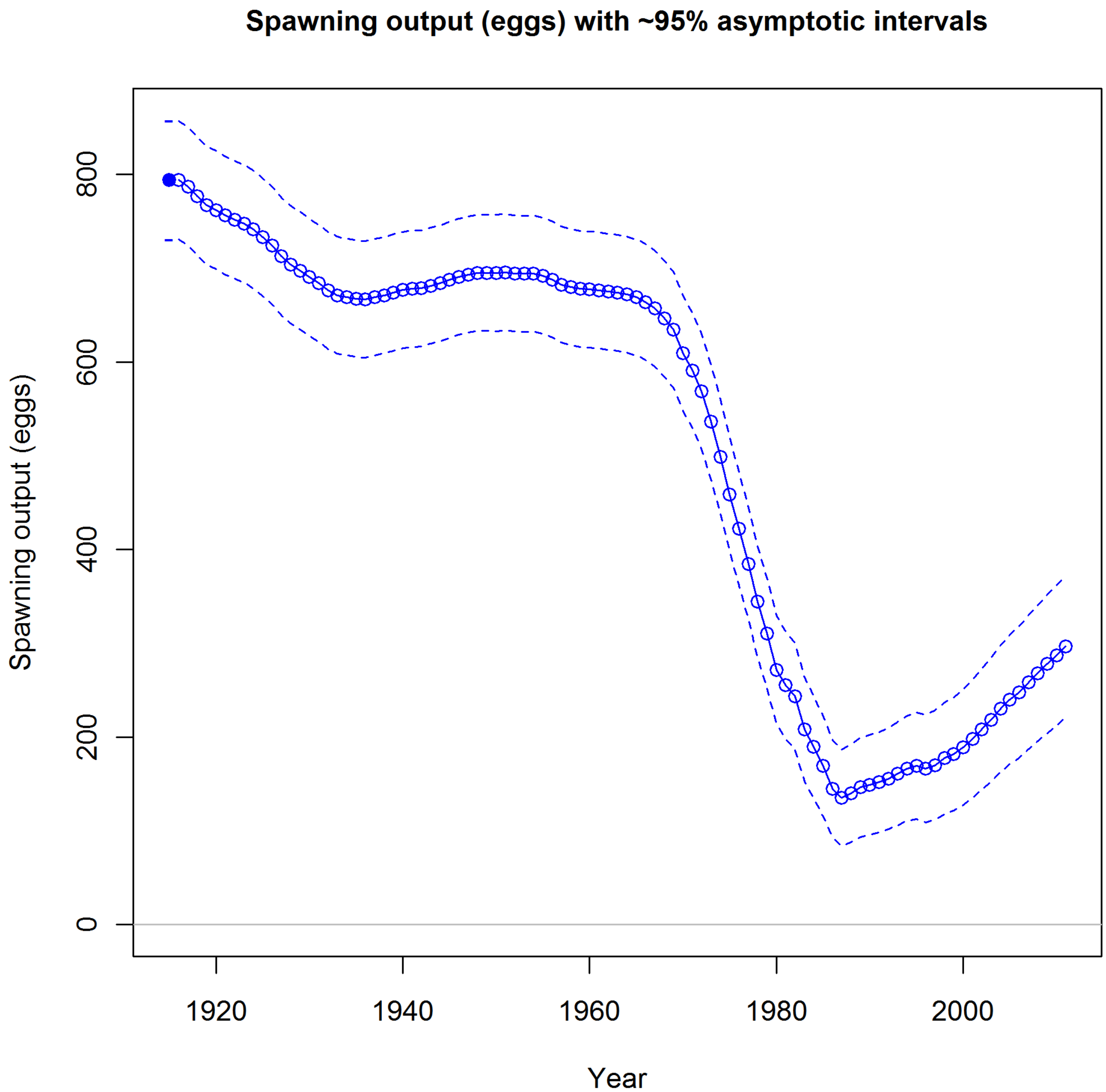


Figure 96. Spawning output for greenspotted rockfish in southern California.

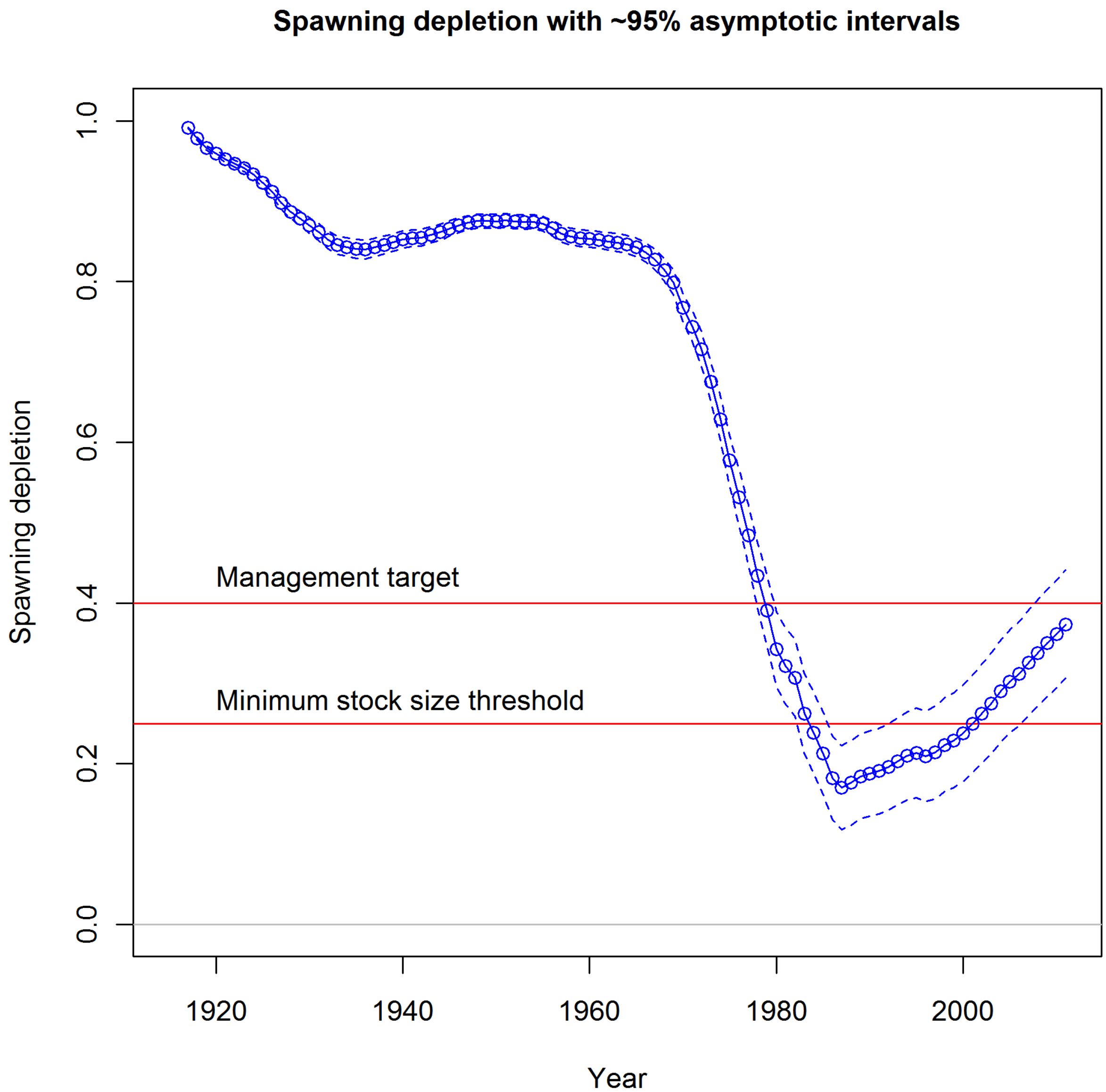


Figure 97. Spawning depletion for greenspotted rockfish in southern California.

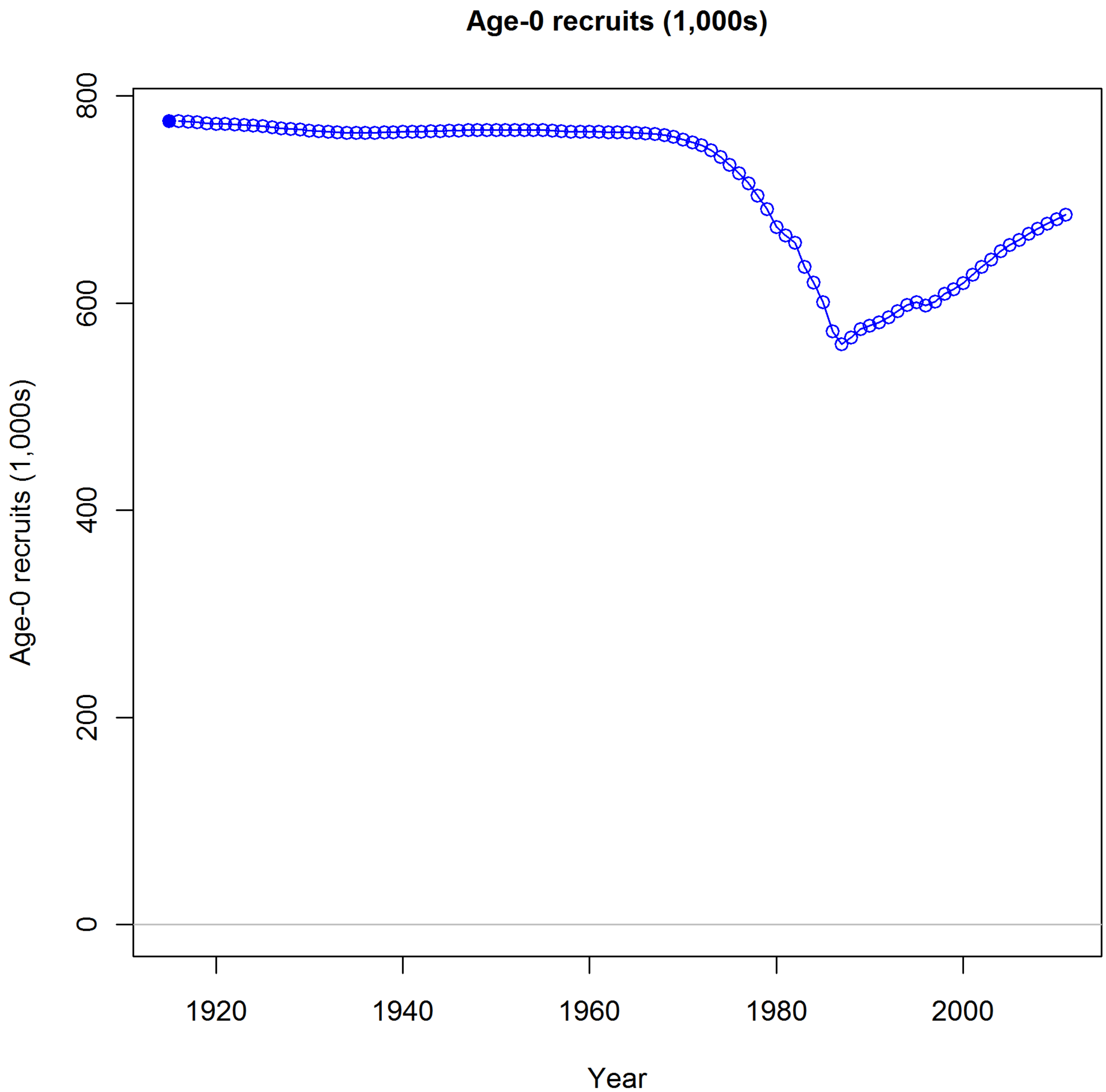


Figure 98. Deterministic recruitment trend for greenspotted rockfish in southern California.

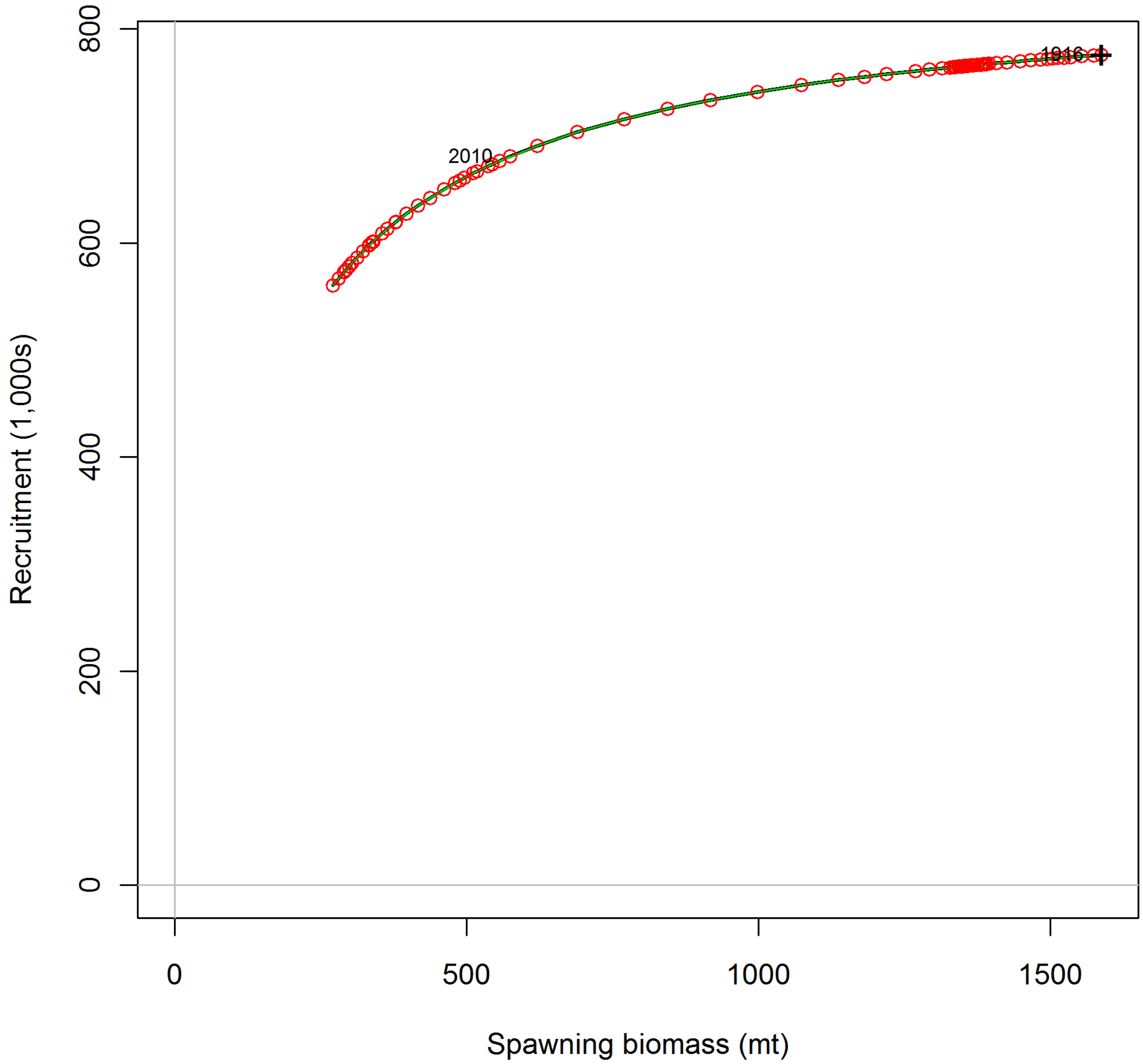


Figure 99. Stock-recruitment relationship for southern California base model.

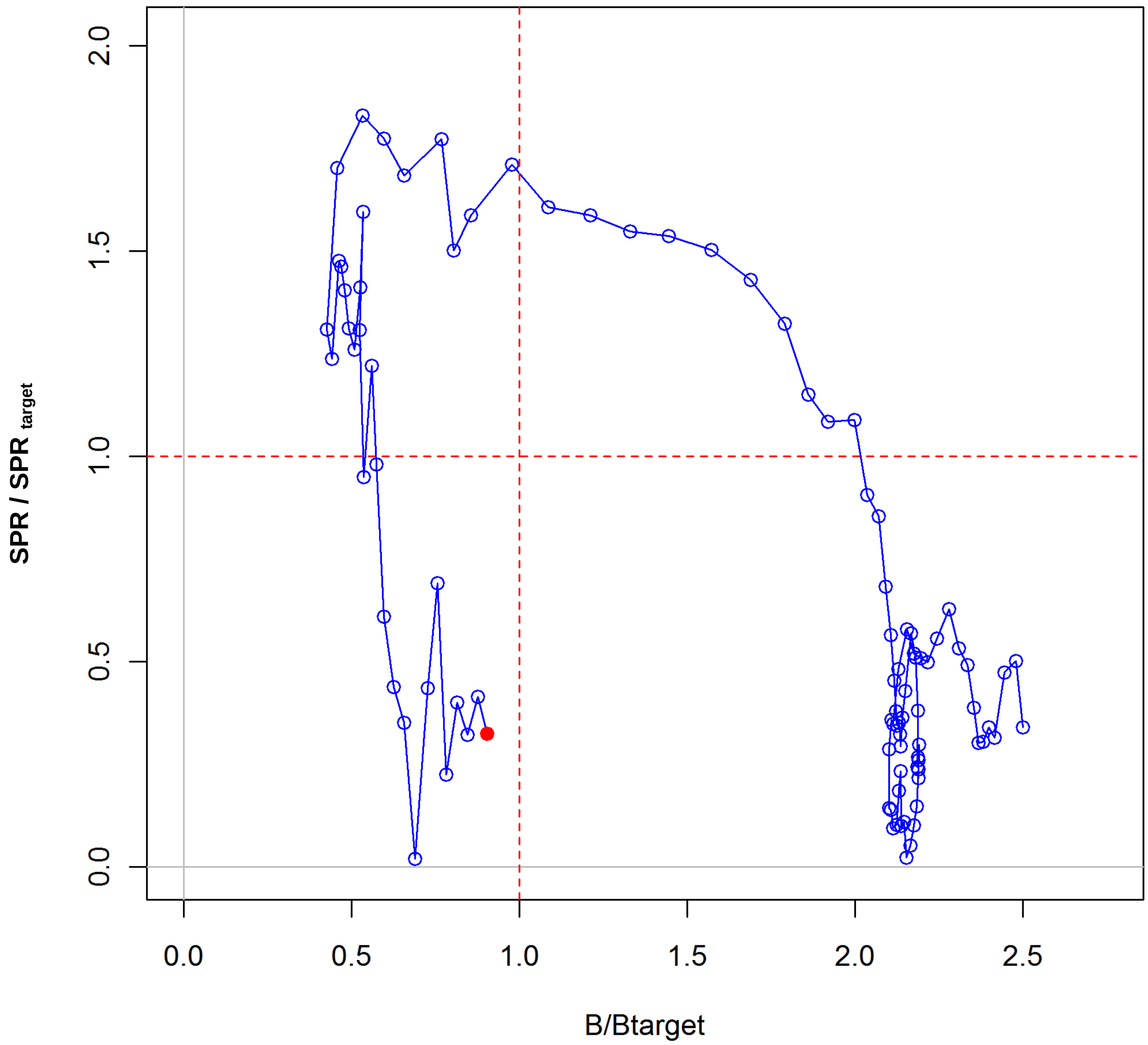


Figure 100. Exploitation history of greenspotted rockfish in southern California relative to biomass and harvest rate targets.

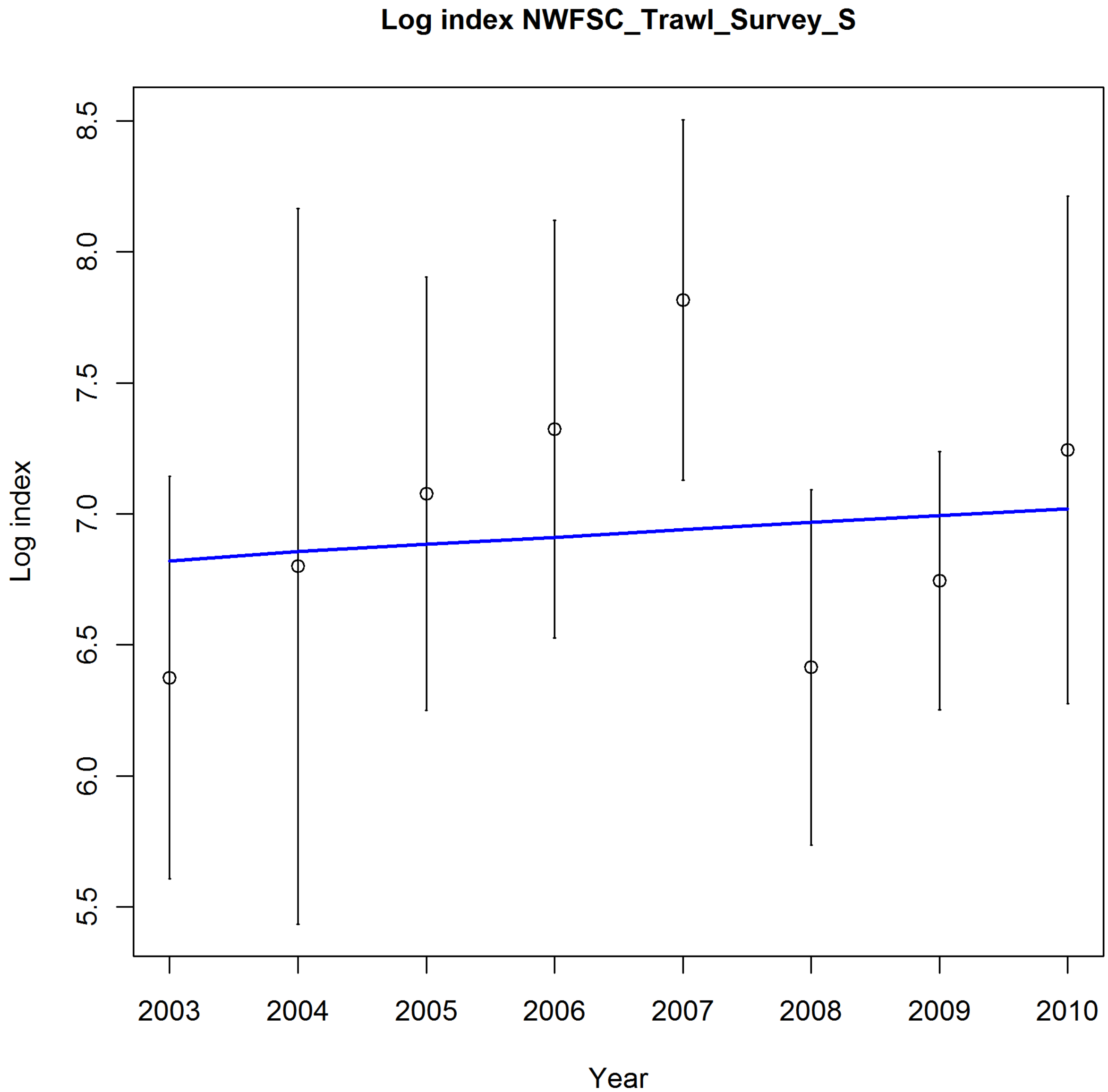


Figure 101. Fit to NWFSC trawl survey index in southern California (log space).

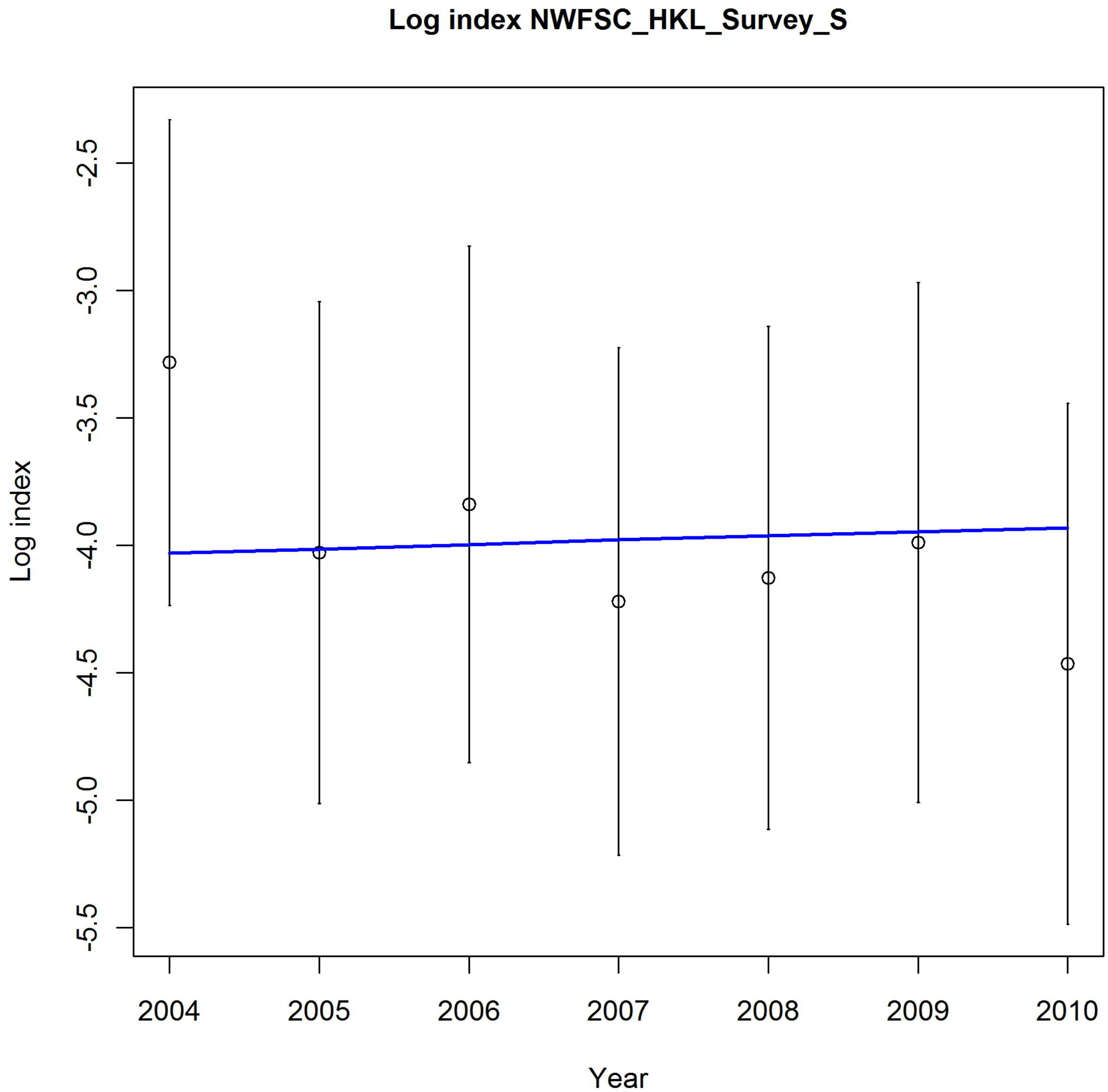


Figure 102. Fit to NWFSC hook and line survey index in southern California (log space).

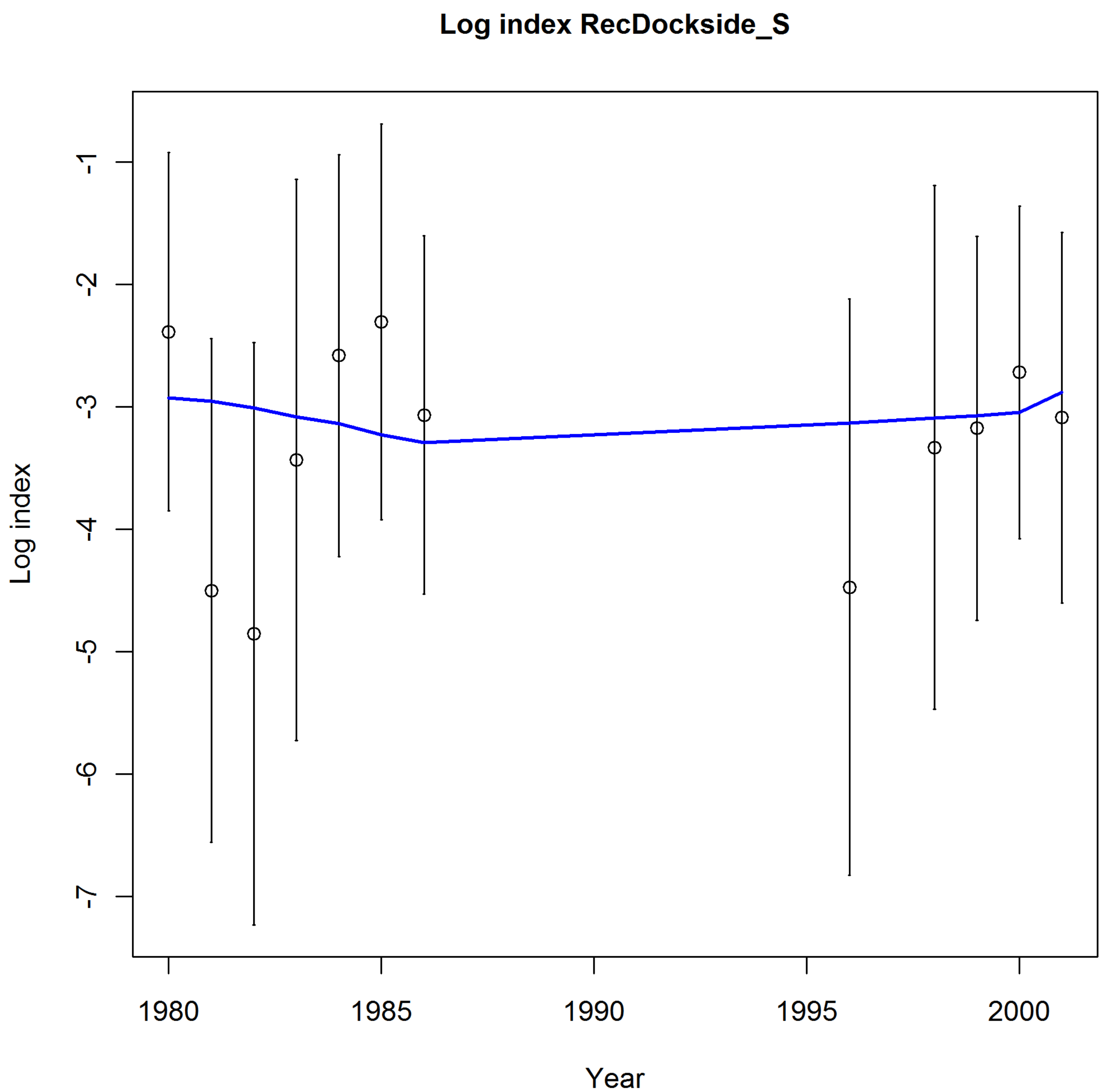


Figure 103. Fit to RecFIN dockside CPUE index for northern California (log space).

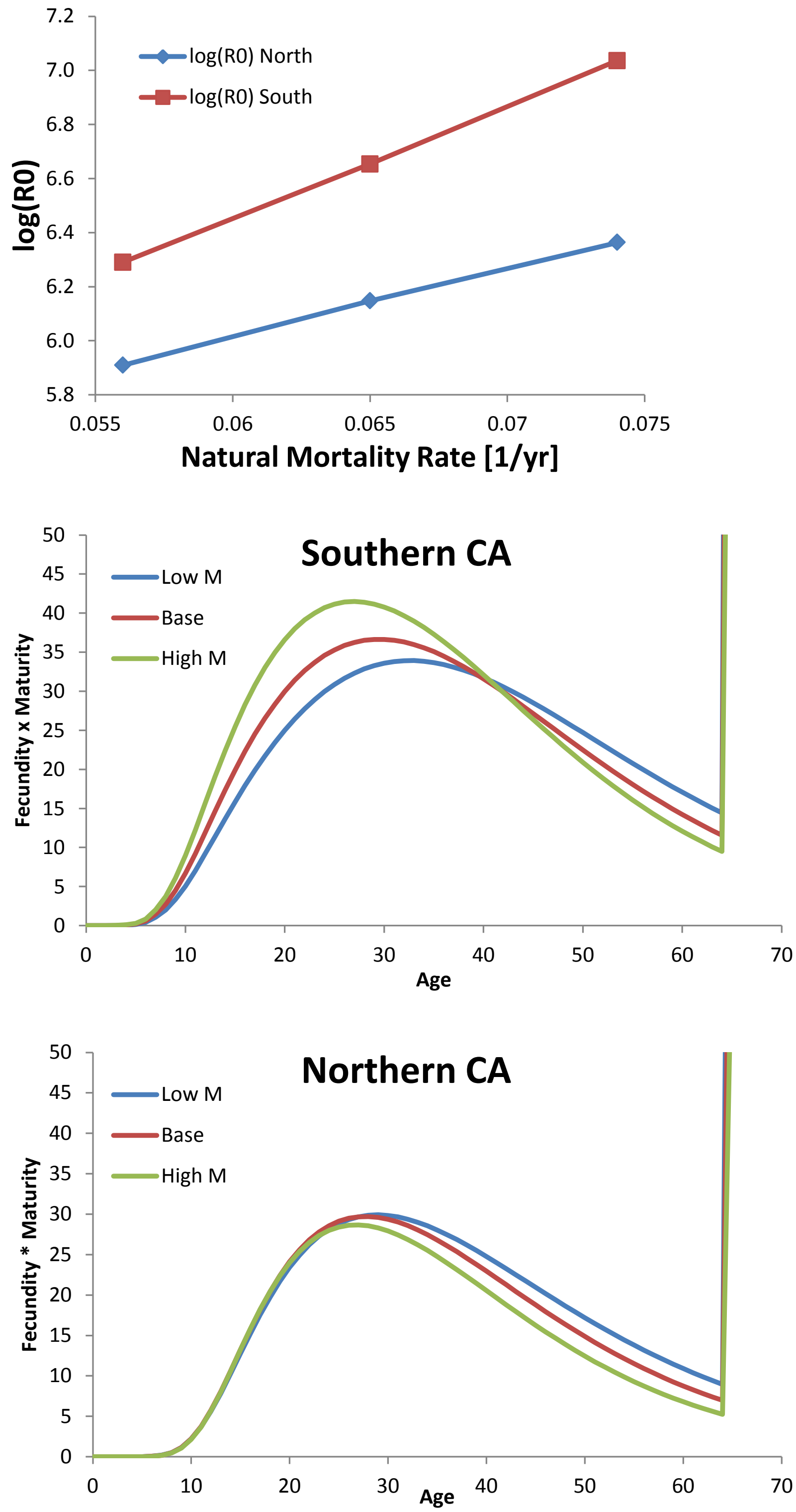


Figure 104. Correlation between R0 and M (upper panel) and lifetime egg production curves for unfished populations in northern and southern California (middle and lower panels).

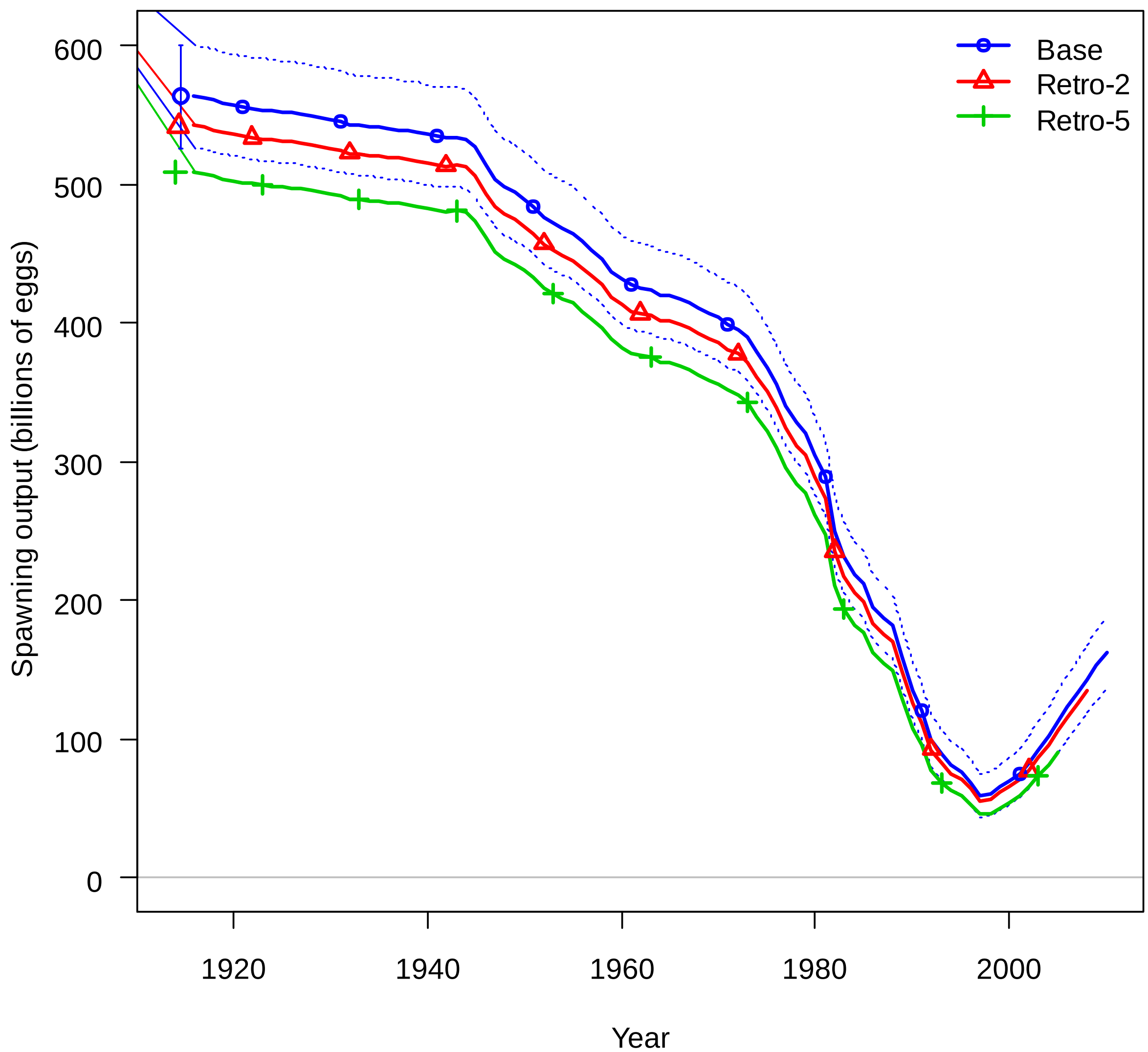


Figure 105. Retrospective analysis of northern California base model. Comparison of spawning output in base model to models removing 2 and 5 years of data. Dotted lines are asymptotic 95% confidence intervals from the base model.

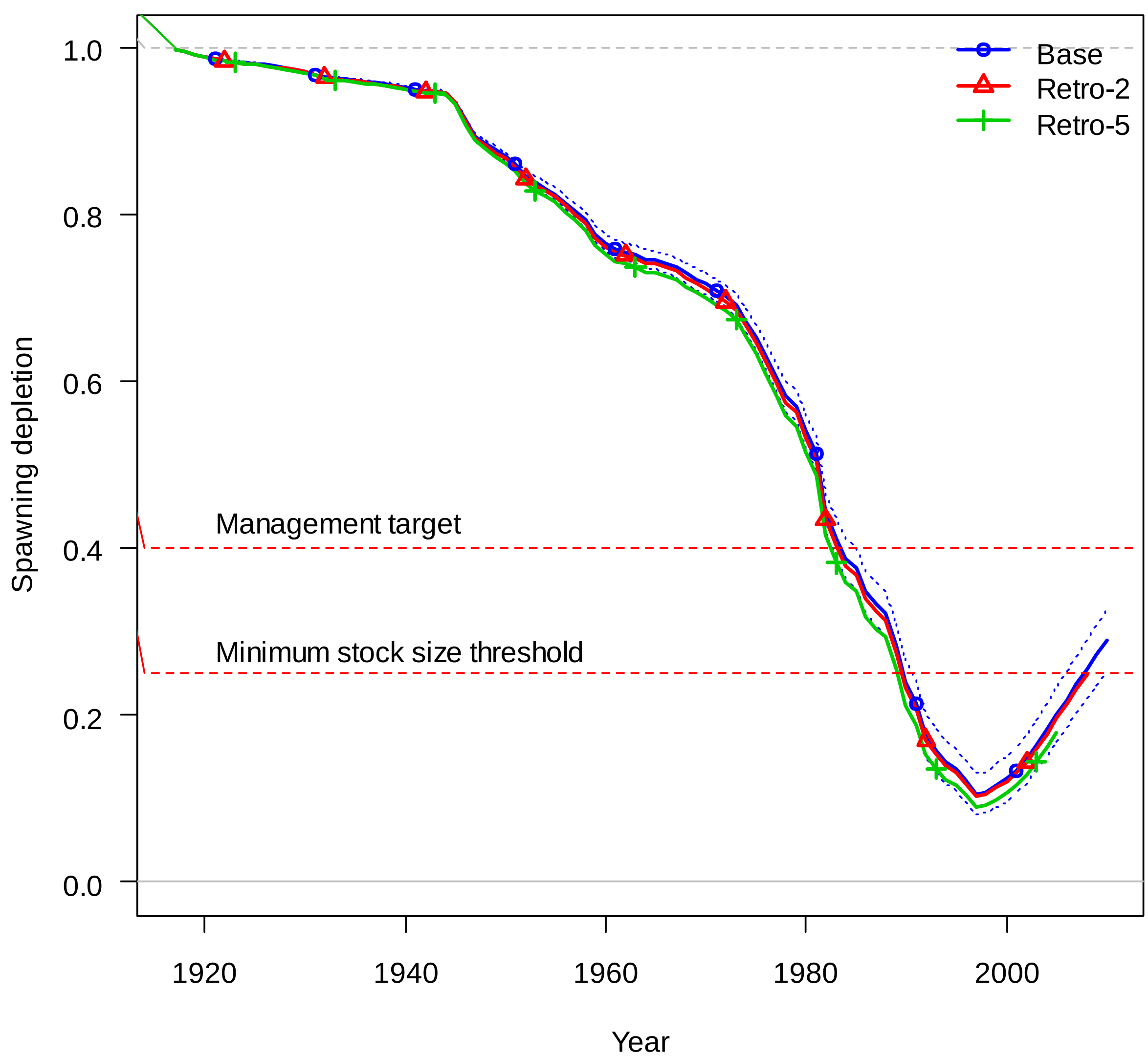


Figure 106. Retrospective analysis of northern California base model. Comparison of base model depletion to models removing 2 and 5 years of data. Dotted lines are asymptotic 95% confidence intervals from the base model.

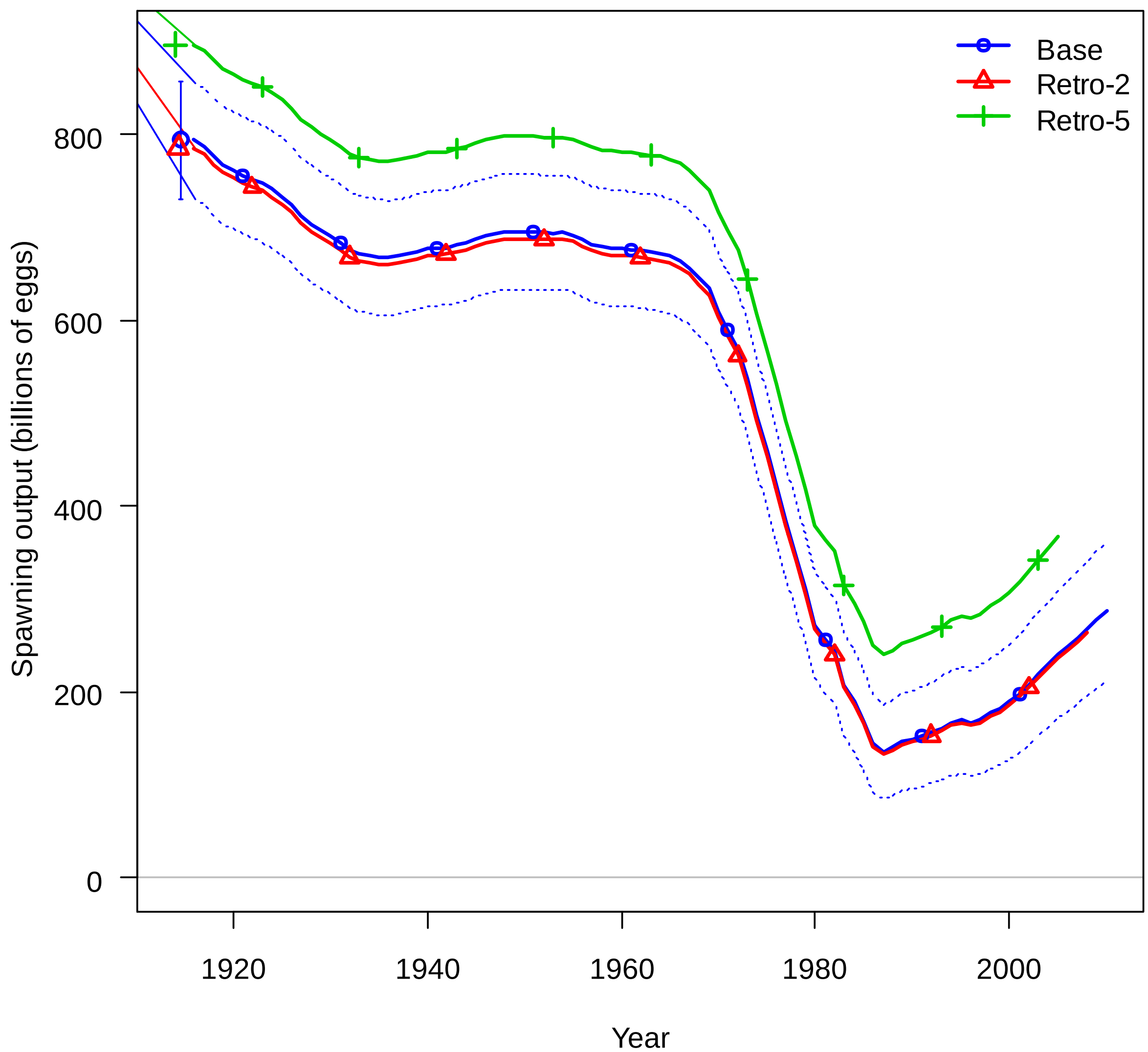


Figure 107. Retrospective analysis of southern California base model. Comparison of base model spawning biomass to models removing 2 and 5 years of data. Dotted lines are asymptotic 95% confidence intervals from the base model.

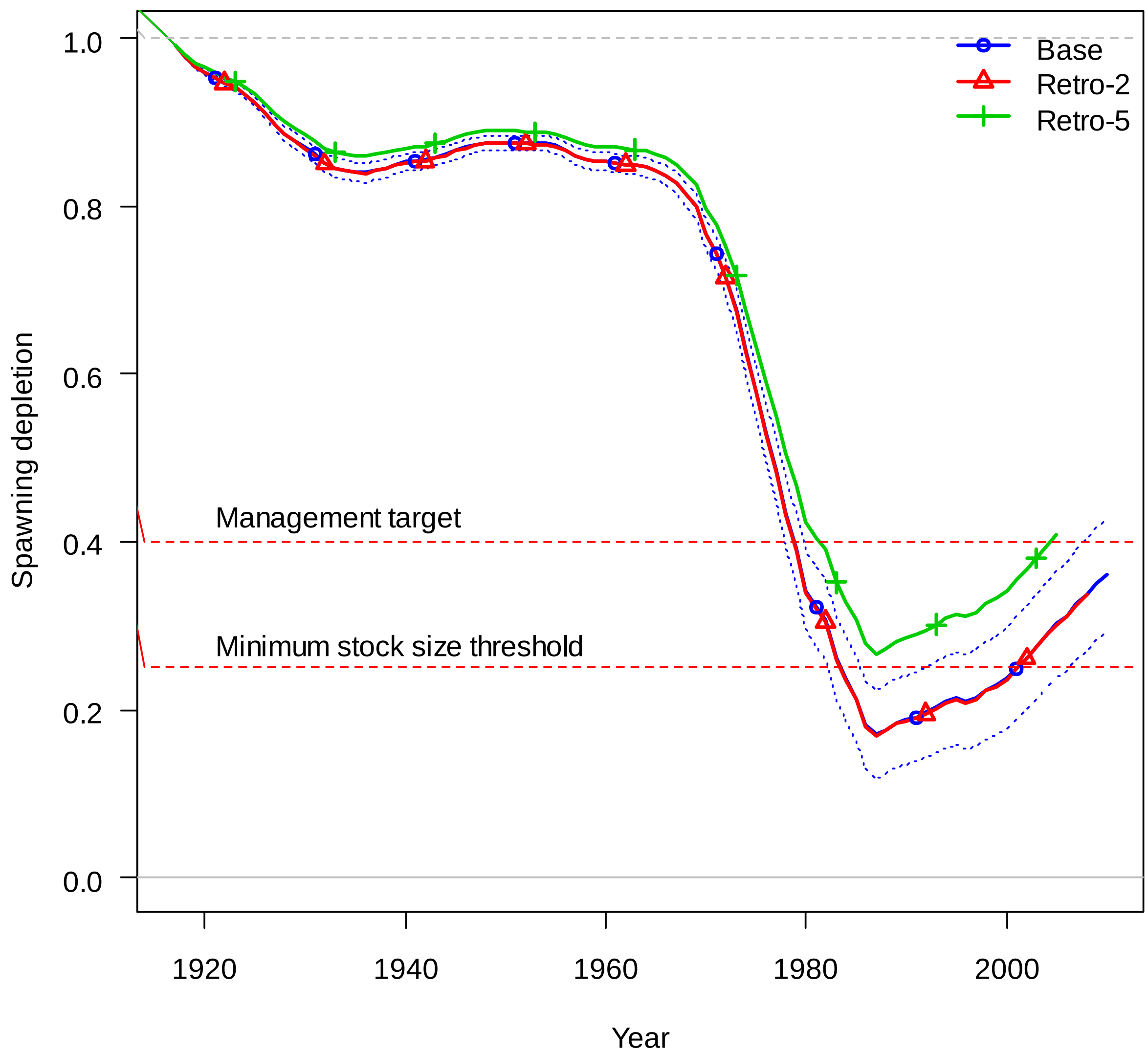


Figure 108. Retrospective analysis of southern California base model. Comparison of base model depletion to models removing 2 and 5 years of data. Dotted lines are asymptotic 95% confidence intervals from the base model.

Appendix A: Relevant Commercial Regulations

Table A1: Fixed gear RCA depth boundaries by year and month, 2002-2011, including inseason changes. Limits for areas north of 42° N. latitude not shown.

<table>
<tr><th>Year</th><th>Location</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="3">2011</td><td>40 10 - 42 00</td><td colspan="12">20 fm depth contour - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="12">30 fm - 150 fm line</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm line</td></tr>
<tr><td rowspan="3">2010</td><td>40 10 - 42 00</td><td colspan="12">20 fm depth contour - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="12">30 fm - 150 fm line</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm line</td></tr>
<tr><td rowspan="3">2009</td><td>40 10 - 42 00</td><td colspan="12">20 fm depth contour - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="12">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2008</td><td>40 10 - 46 16</td><td colspan="12">30 - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="12">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2007</td><td>40 10 - 46 16</td><td colspan="12">30 - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="12">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2006</td><td>40 10 - 46 16</td><td colspan="12">30 - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="4">30 - 150 fm</td><td colspan="4">20 - 150 fm</td><td colspan="4">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2005</td><td>40 10 - 46 16</td><td colspan="12">30 - 100 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="4">30 - 150 fm</td><td colspan="4">20 - 150 fm</td><td colspan="4">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2004</td><td>40 10 - 46 16</td><td colspan="12">30 - 100 fm</td></tr>
<tr><td>34 27 - 40 10 (+ islands)</td><td colspan="4">30 - 150 fm</td><td colspan="4">20 - 150 fm</td><td colspan="4">30 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)</td><td colspan="12">60 fm - 150 fm</td></tr>
<tr><td rowspan="3">2003</td><td>40 10 - 46 16</td><td colspan="10">27 - 100 fm</td><td colspan="2" rowspan="3">shore - 150 fm</td></tr>
<tr><td>34 27 - 40 10</td><td colspan="10">20 - 150 fm</td></tr>
<tr><td>South 34 27 (+ islands)20 -</td><td colspan="8">20 - 150 fm</td><td colspan="2">30 - 150 fm</td></tr>
<tr><td>2002</td><td>South 40 10</td><td colspan="6"></td><td colspan="6">CLOSED > 20fm (exceptions: sablefish, S Thorny and slope RF)</td></tr>
</table>

*****The Rockfish Conservation Area is an area closed to fishing by particular gear types, bounded by lines specifically defined by latitude and longitude coordinates set at 660.391-660.394. This RCA is not defined by depth contours, and the boundary lines that define the RCA may close areas that are deeper or shallower than the depth contour. Vessels that are subject to the RCA restrictions may not fish in the RCA, or operate in the RCA for any purpose other than transiting.**

Table A2: Limited entry trawl RCA depth boundaries by year and month, 2002 - 2011, including inseason changes. Limits for areas north of 42° N. latitude not shown.

<table>
<tr><th>Year</th><th>Area</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="4">2011[a]</td><td>45°46' - 40°10'</td><td colspan="2"></td><td colspan="2"></td><td colspan="2">75 - 200</td><td colspan="2">100 - 200</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>40°10' - 34°27'</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34°27' (mainland)</td></tr>
<tr><td>South 34°27' (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="4">2010[a]</td><td>45°46' - 40°10'</td><td colspan="2"></td><td colspan="2"></td><td colspan="2">75 - 200</td><td colspan="2">100 - 200</td><td colspan="2"></td><td></td><td></td></tr>
<tr><td>40°10' - 34°27'</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34°27' (mainland)</td></tr>
<tr><td>South 34°27' (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="4">2009[a]</td><td>45°46' - 40°10'</td><td colspan="3"></td><td></td><td colspan="2">75 - 200</td><td colspan="2">100 - 200</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>40°10' - 34°27'</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34°27' (mainland)</td></tr>
<tr><td>South 34°27' (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="4">2008[a]</td><td>42 40.5 - 40 10</td><td colspan="2">75 - [m]200</td><td colspan="2">75 - 200</td><td colspan="5">60 - 200</td><td>75 - 200</td><td colspan="2">75 - [m]200</td></tr>
<tr><td>40 10 - 34 27</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34 27 (mainland)</td></tr>
<tr><td>South 34 27 (islands)</td><td colspan="12">0 - 150</td></tr>
<tr><td rowspan="6">2007[a]</td><td>43°20' - 42°40'</td><td colspan="2" rowspan="2"></td><td rowspan="2"></td><td colspan="6">0 - 200</td><td>75 - 200</td><td colspan="2" rowspan="2"></td></tr>
<tr><td>42°40' -40°10'</td><td colspan="7">75 - 200</td></tr>
<tr><td>40°10' - 38'</td><td colspan="2">100 - [m]200</td><td colspan="8">100 - 150</td><td colspan="2">100 - [m]200</td></tr>
<tr><td>38° - 34°27'</td><td colspan="12" rowspan="2">100 - 150</td></tr>
<tr><td>South 34°27' (mainland)</td></tr>
<tr><td>South 34°27' (islands)</td><td colspan="12">0 - 150</td></tr>
</table>

Table A2 (continued): Limited entry trawl RCA depth boundaries by year and month, 2002 - 2011, including inseason changes. Limits for areas north of 42° N. latitude not shown.

Year	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006[a]	North 40 10	75 - [m]200		75 - 200				100 - 250		75 - 250		75 - [m]250	
	40 10 - 38	75 - 150		100 - 150				100 - 200		100 - 250			
	38 - 34 27							100 - 150				75 - 150	
	South 34 27 (mainland)												
	South 34 27 (islands)	0 - 150											
2005[a]	North 40 10	75 - [m]200		100 - 200							0 - 250		
	40 10 - 38	75 - 150		100 - 200		100 - 150							
	38 - 36			100 - 150							0 - 200		
	36 - 34 27										50 - 200		
	South 34 27 (mainland)												
	South 34 27 (islands)	0 - 150									0 - 200		
2004	North 40 10	75 - [m]200		60 - 200		60 - 150		75 - 150			0 - 250		
	40 10 - 38	75 - 150[z]				100 - 150[z]				75 - 150[z]			
	38 - 36										0 - 200[z]		
	36 - 34 27										0 - 150		
	South 34 27 (mainland)												
	South 34 27 (islands)	0 - 150											
2003	North 40 10	100 - [m]250		100 - 250		50 - 200		75 - 200		50 - 200		0 - [m]200	
	40 10 - 38	50 - [m]250		60 - 250		60 - 200							
	38 - 34 27	50 - 150		60 - 150									
	South 34 27 (mainland)	100 - 150				100 - 200							
	South 34 27 (islands)	0 - 150				0 - 200							
2002	North 40 10	Within DBCA - CLOSED TO TRAWLING, September - December, special footrope requirements outside DBCA											

[m]The "modified" depth" line is modified to exclude certain petrale sole areas from the RCA.

[a]Selective flatfish trawl required shoreward of the RCA north of 40 10

[z]Additional closure 0-10fm around Farallon Islands

*****The Rockfish Conservation Area is an area closeed to fishing by particular gear types, bounded by lines specifically defined by latitude and longitude coordinates set at 660.391-660.394. This RCA is not defined by depth contours, and the boundary lines that define the RCA may close areas that are deeper or shallower than the depth contour. Vessels that are subject to the RCA restrictions may not fish in the RCA, or operate in the RCA for any purpose other than transiting.**

Appendix B: Obtaining Catch and Effort Data Directly from RecFIN Sample Data

[Available in electronic format from the corresponding author]

Appendix C: RecFIN-based CPUE indexes for greenspotted rockfish

Alec MacCall 6/7/11

I develop two recreational CPUE series for greenspotted rockfish, based on a "boat-level" extract of RecFIN data performed by Wade Van Buskirk ca. 2005. The Northern California (north of Pt. Conception) index can be compared with a similar index developed by Maria De Yoreo from a newer and better-documented extract of RecFIN intercept data. My Southern California index does not yet have a corresponding data set such as that developed by De Yoreo for Northern California. Note that for Northern California, the Van Buskirk extract indicates a much smaller number of trips than the De Yoreo extract.

Northern California

The Van Buskirk extract for 1980-2006 data north of Pt. Conception consists of 4586 sampled trips. Data for 1993 were deleted due to poor coverage, 1997 and 1998 were deleted due to an inconsistent sampling frame (Deb Wilson-Vandenberg, CDFG, Pers. Comm.), and 2002-2006 were deleted due to regulatory changes that impact CPUE. Several poorly-sampled counties were also deleted, leaving 2373 trip records. Trips were pre-filtered by removing any trip containing salmon, albacore or striped bass, leaving 2109 records. Using the logistic regression method of Stephens and MacCall (2004), presence and absence of 35 other species was used to assign each trip a probability that greenspotted rockfish would be present. A threshold probability of 0.32 results in a minimum number of false predictions (both presence and absence), giving 195 trips that were considered appropriate for greenspotted rockfish CPUE (Table C1,C2).

A delta-GLM was run, using a logit link for the binomial portion and a lognormal distribution (MINPOS=2). Rather than going through the usual model development process, the model was chosen to agree with that of De Yoreo. Explanatory variables were Year (14), Area (2), Wave (6), and County (8). Year effects were jackknifed, giving CVs that were substantially larger than those of De Yoreo (Figure C1, Table C3).

Southern California

The Van Buskirk extract for 1980-2003 data south of Pt. Conception consists of 8637 sampled trips. Data for 2002-2003 were deleted due to regulatory changes that impact CPUE, and trips containing skipjack or albacore tuna were excluded, giving 7323 sampled trips. Using the logistic regression method of Stephens and MacCall (2004), presence and absence of 47 other species was used to assign each trip a probability that greenspotted rockfish would be present. A threshold probability of 0.23 results in a minimum number of false predictions (both presence and absence), giving 207 trips that were considered appropriate for calculation of greenspotted rockfish CPUE (Table C1,C2). Some strata were too sparse to be included in the GLM under the MINPOS=2 criterion, so Wave 4, Santa Barbara County, and years 1987-89, 1994-95, and 1997 were dropped, though some of these could potentially be combined into year "blocks" if needed for the assessment. The final dataset use in the analysis consisted of 183 trips, of which 111 were positive for greenspotted rockfish.

Tables

Table C1. Coverage of Northern California, by Wave.

N trips	WAVE							
YEAR	1	2	3	4	5	6	Total	
1980	3	4	3	4		2	16	
1981		1	1		1	1	4	(dropped)
1982	1		2	1	1	1	6	
1983			6	4	2		12	
1984	1	2	6	4	1	1	15	
1985	2	4	7	7	6	2	28	
1986		6	6	6	5	5	28	
1987	2	2	2	4	3	1	14	
1988	3	5		4	4		16	
1989			3	1	1		5	
1995			4	1			5	
1996	2	1	3	5	2	3	16	
1999	4	7	1	1	2	1	16	
2000	4			1		3	8	
2001	2			2	2		6	
Total	24	32	44	45	30	20	195	

Table C2. Coverage of Northern California by County

N trips	CNTY									
YEAR	1	13	41	45	53	79	81	87	97	Total
1980			1	1	8	3			3	16
1981					2	2				4
1982				3	1	1		1		6
1983			1		8			3		12
1984			1	1	2	6		4	1	15
1985	1	3	2	1	5	8		2	6	28
1986			2	1	9	5	1	6	4	28
1987		2	1		4				7	14
1988			3		3	1			9	16
1989		1	1		1		2			5
1995					2			3		5
1996	1				5	2	1	4	3	16
1999	1				2		1	2	10	16
2000								2	6	8
2001					1			3	2	6
Total	3	6	12	7	53	28	5	30	51	195
	(dropped)									

County codes: 1=Alameda; 13=Contra Costa; 41=Marin; 45=Mendocino; 53=Monterey; 79=San Luis Obispo; 81=San Mateo; 87=Santa Cruz; 97=Sonoma.

Table C3. GLM results for Northern California greenspotted rockfish.

year	index	jack.se	jack.cv
1980	0.0629	0.0600	0.9546
1982	0.0095	0.0220	2.3211
1983	0.0520	0.0433	0.8313
1984	0.0592	0.0656	1.1081
1985	0.0778	0.0610	0.7841
1986	0.0726	0.0891	1.2275
1987	0.0331	0.0642	1.9398
1988	0.0582	0.0650	1.1166
1989	0.1095	0.0750	0.6850
1995	0.0158	0.0268	1.7025
1996	0.0205	0.0332	1.6183
1999	0.0700	0.0295	0.4220
2000	0.0234	0.0329	1.4063
2001	0.0921	0.0539	0.5852

Table C4. Coverage of Southern California, by Wave.

N trips	WAVE							
YEAR	1	2	3	4	5	6	Total	
1980	5	6		2	1	1	15	
1981	4	3	2		1	2	12	
1982	2	2	2		1	3	10	
1983	4	4	1		1	6	16	
1984	9	4	1		1	2	17	
1985	3	4		1	2	7	17	
1986	4	8	3		2	2	19	
1987	1						1	(dropped)
1988	1	1				2	4	(dropped)
1989						1	1	(dropped)
1994	1				2		3	(dropped)
1995			1		1	1	3	(dropped)
1996	4		1		1	2	8	
1997	2				2		4	(dropped)
1998		1	1		3	6	11	
1999	1	10			7	7	25	
2000	1	16	1		3	11	32	
2001		5	2		1	1	9	
Total	42	64	15	3	29	54	207	

(dropped)

Table C5. Coverage of Southern California by County.

N trips	CNTY						
YEAR	37	59	73	83	111	Total	
1980	5		2		8	15	
1981	4	5	1		2	12	
1982	5	5				10	
1983	7	2	2		5	16	
1984	5	4	2	1	5	17	
1985	5	3	4	1	4	17	
1986	6	3	4	1	5	19	
1987	1					1	(dropped)
1988		1	2	1		4	(dropped)
1989			1			1	(dropped)
1994	1		1		1	3	(dropped)
1995	1		2			3	(dropped)
1996	2		3		3	8	
1997	2	1			1	4	(dropped)
1998	4	2	2	1	2	11	
1999	10	1	7	1	6	25	
2000	16		9		7	32	
2001	4		1		4	9	
Total	78	27	43	6	53	207	
				(dropped)			

County codes: 37=Los Angeles; 59=Orange; 73-San Diego; 83=Santa Barbara; 111=Ventura.

Table C6. GLM results for Southern California greenspotted rockfish.

year	index	jack.se	jack.cv
1980	0.0919	0.0374	0.4070
1981	0.0111	0.0079	0.7094
1982	0.0078	0.0068	0.8748
1983	0.0323	0.0268	0.8292
1984	0.0757	0.0376	0.4971
1985	0.0998	0.0484	0.4852
1986	0.0466	0.0190	0.4078
1996	0.0114	0.0098	0.8617
1998	0.0357	0.0268	0.7519
1999	0.0418	0.0192	0.4605
2000	0.0660	0.0233	0.3533
2001	0.0456	0.0352	0.7720

Figures

Figure C1: Comparison of Northern California CPUE indexes based on old and new RecFIN extracts

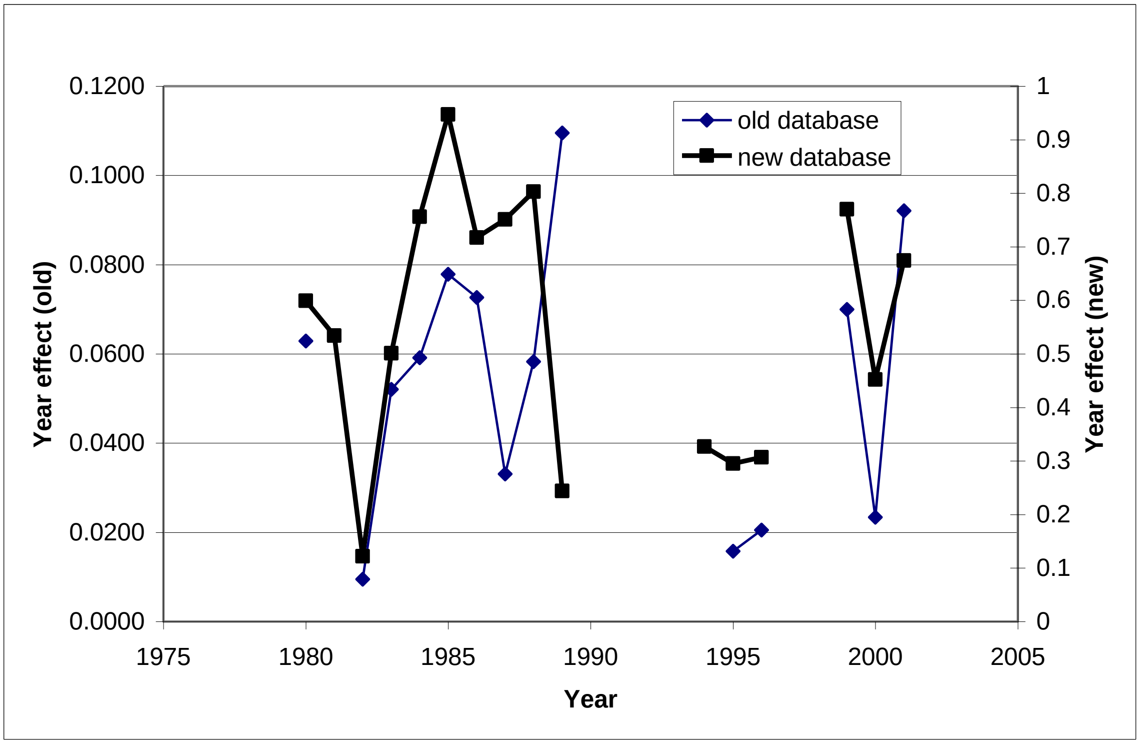
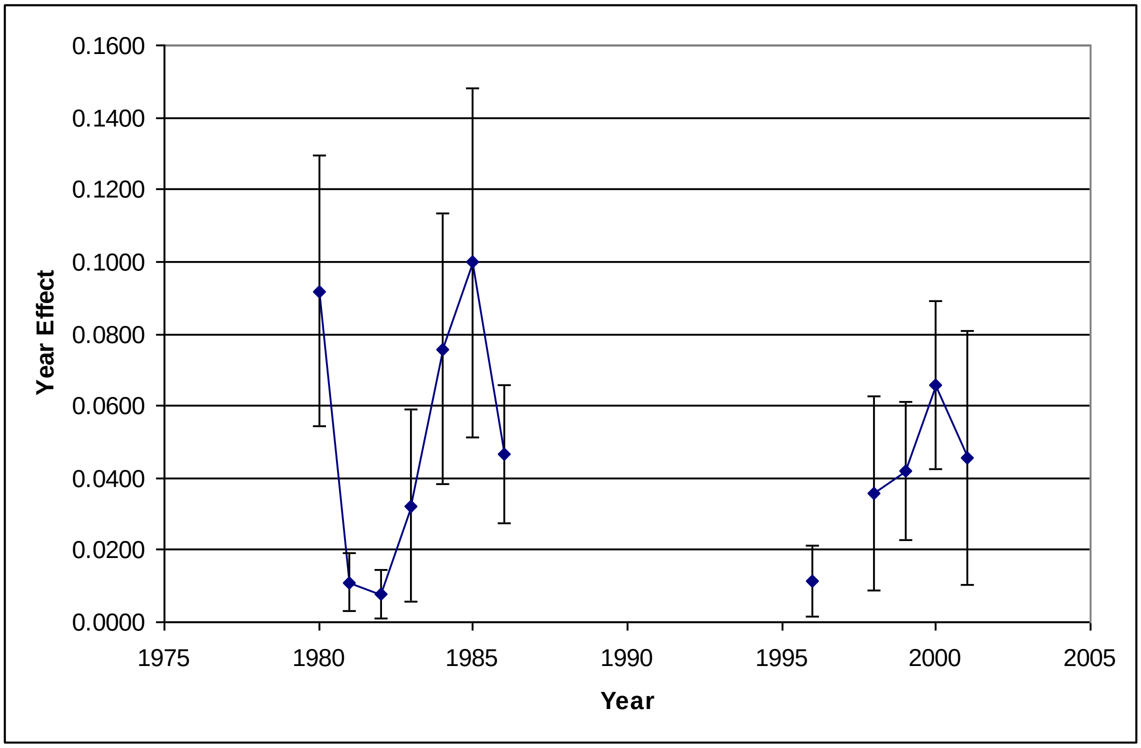
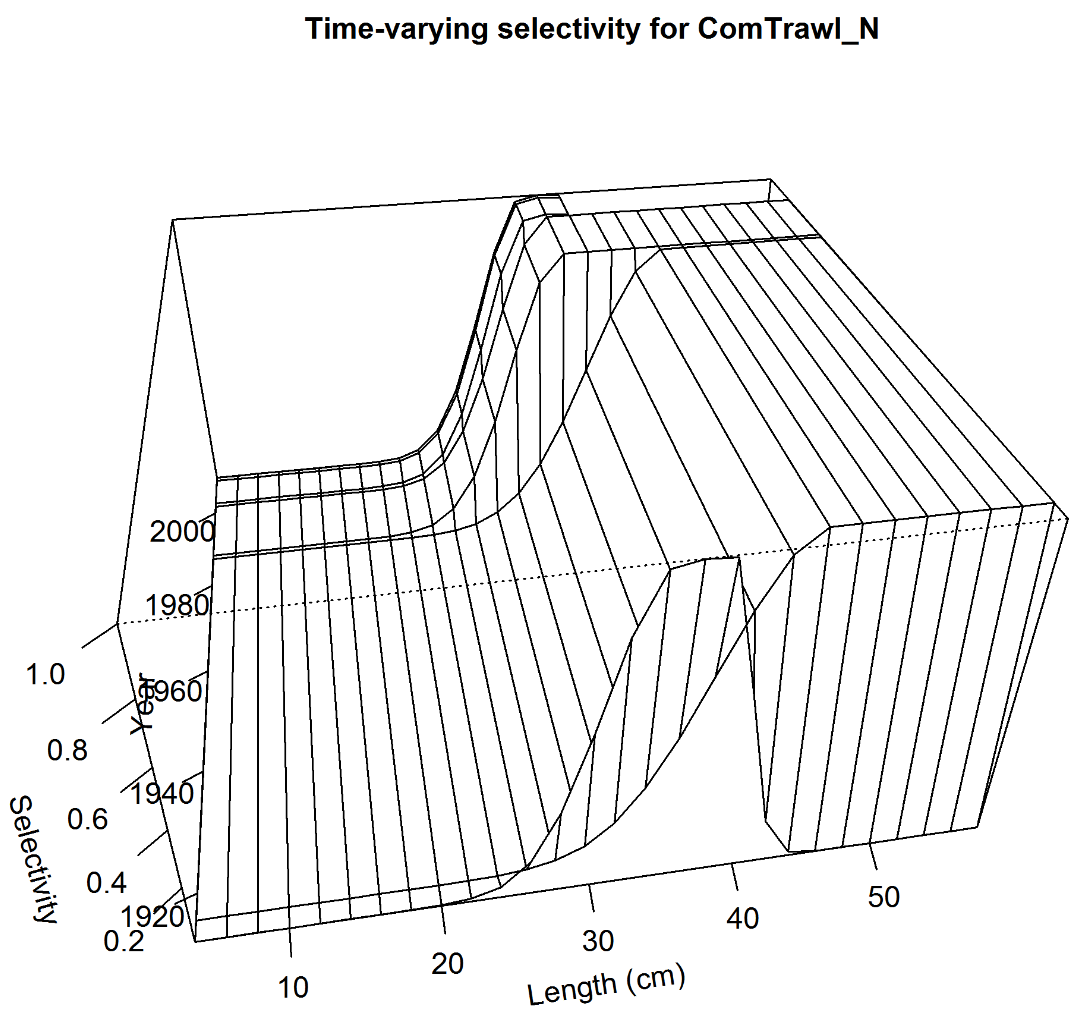


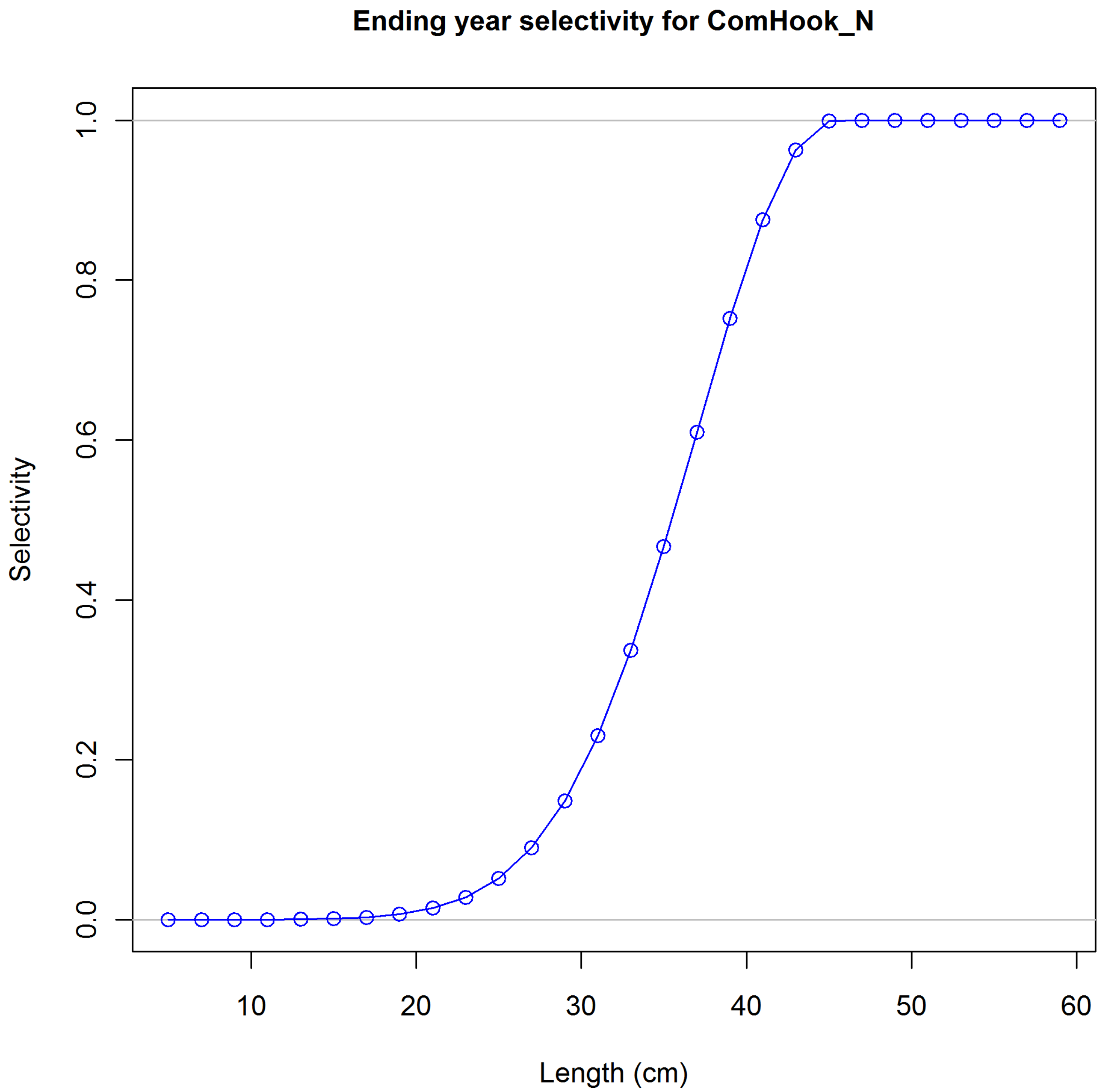
Figure C2: RecFIN CPUE index for Southern California. Error bars are 1 SE.



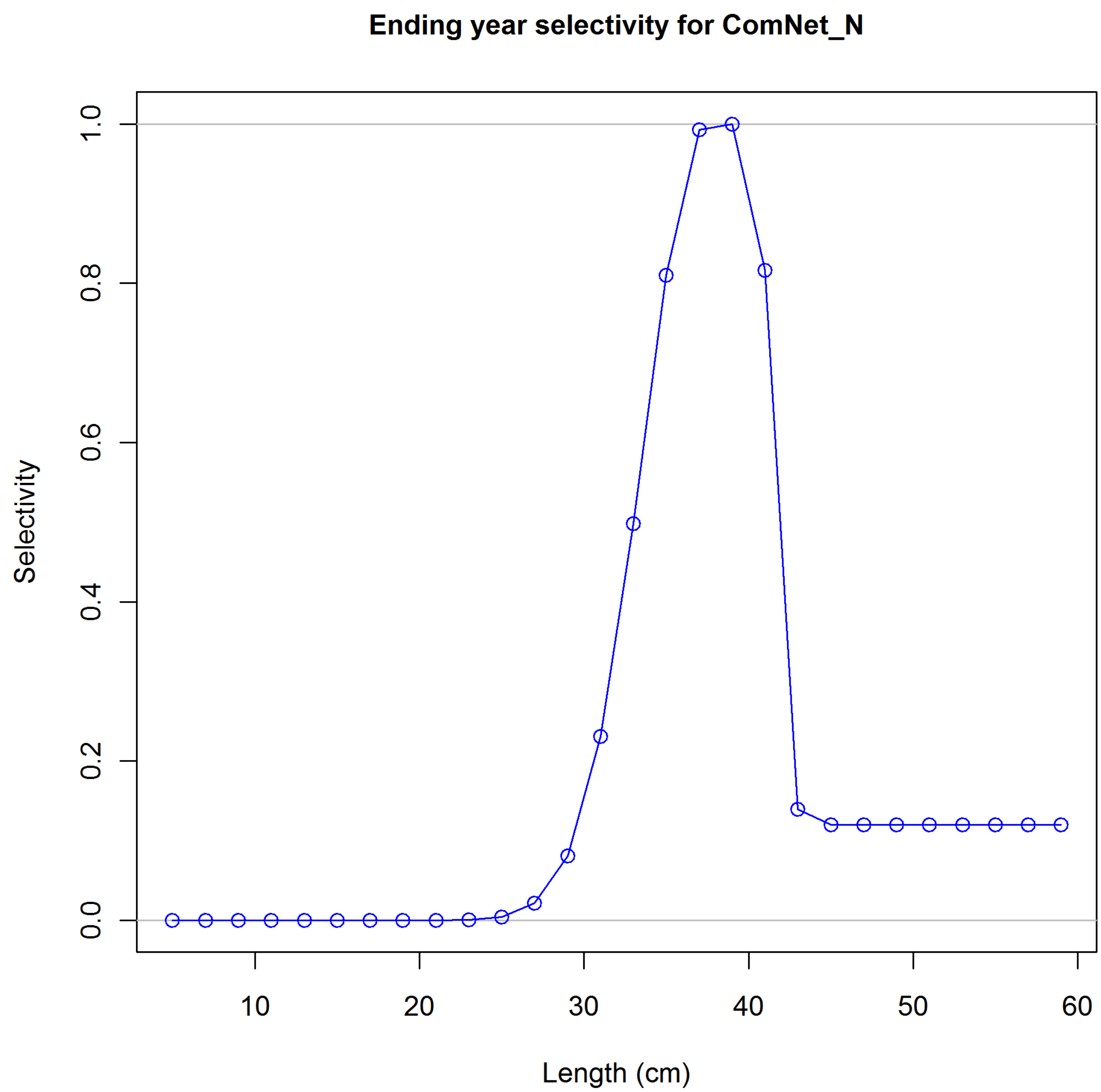
Appendix D: Selectivity curves



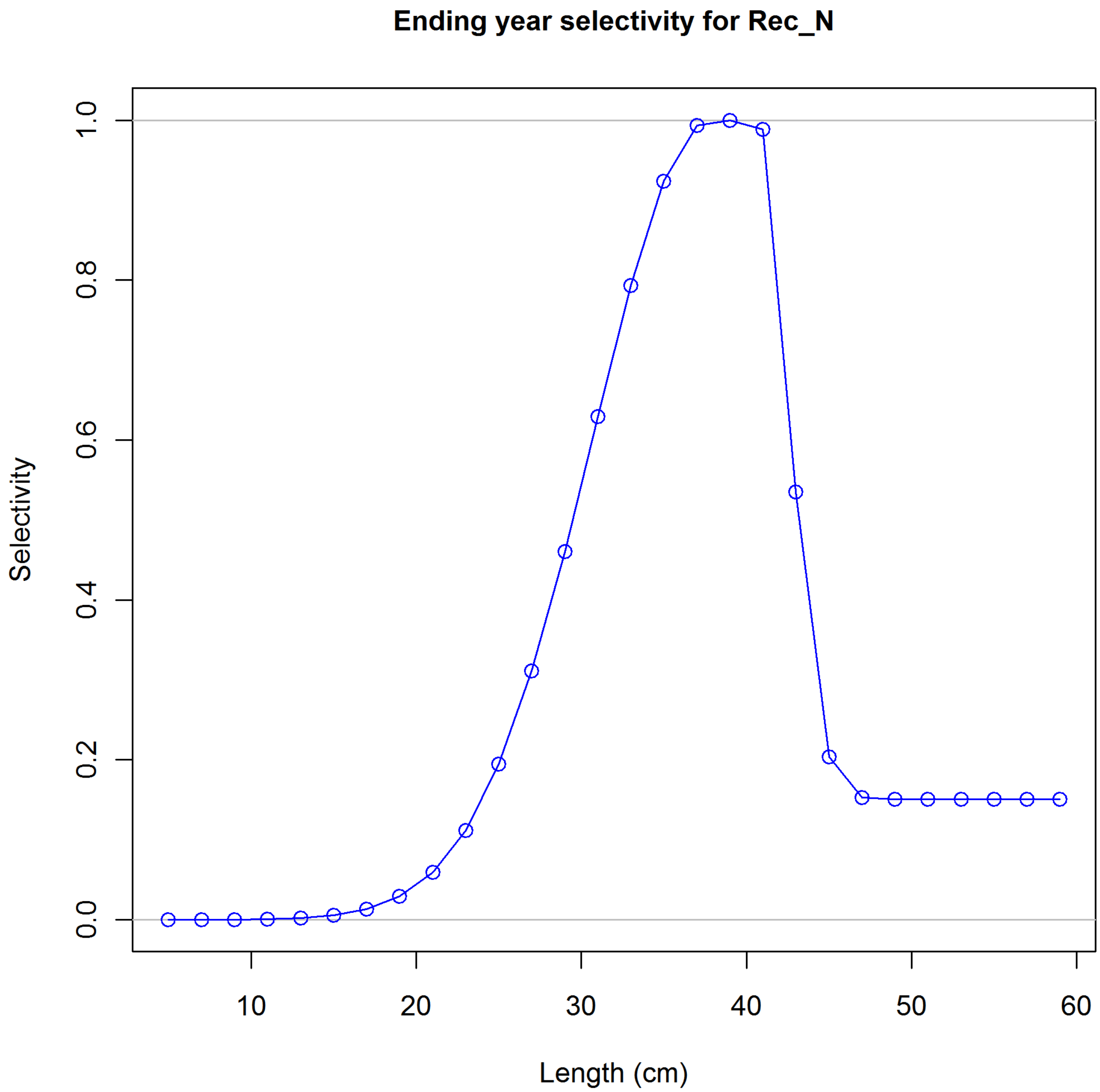
Time-varying selectivity in the northern trawl fishery



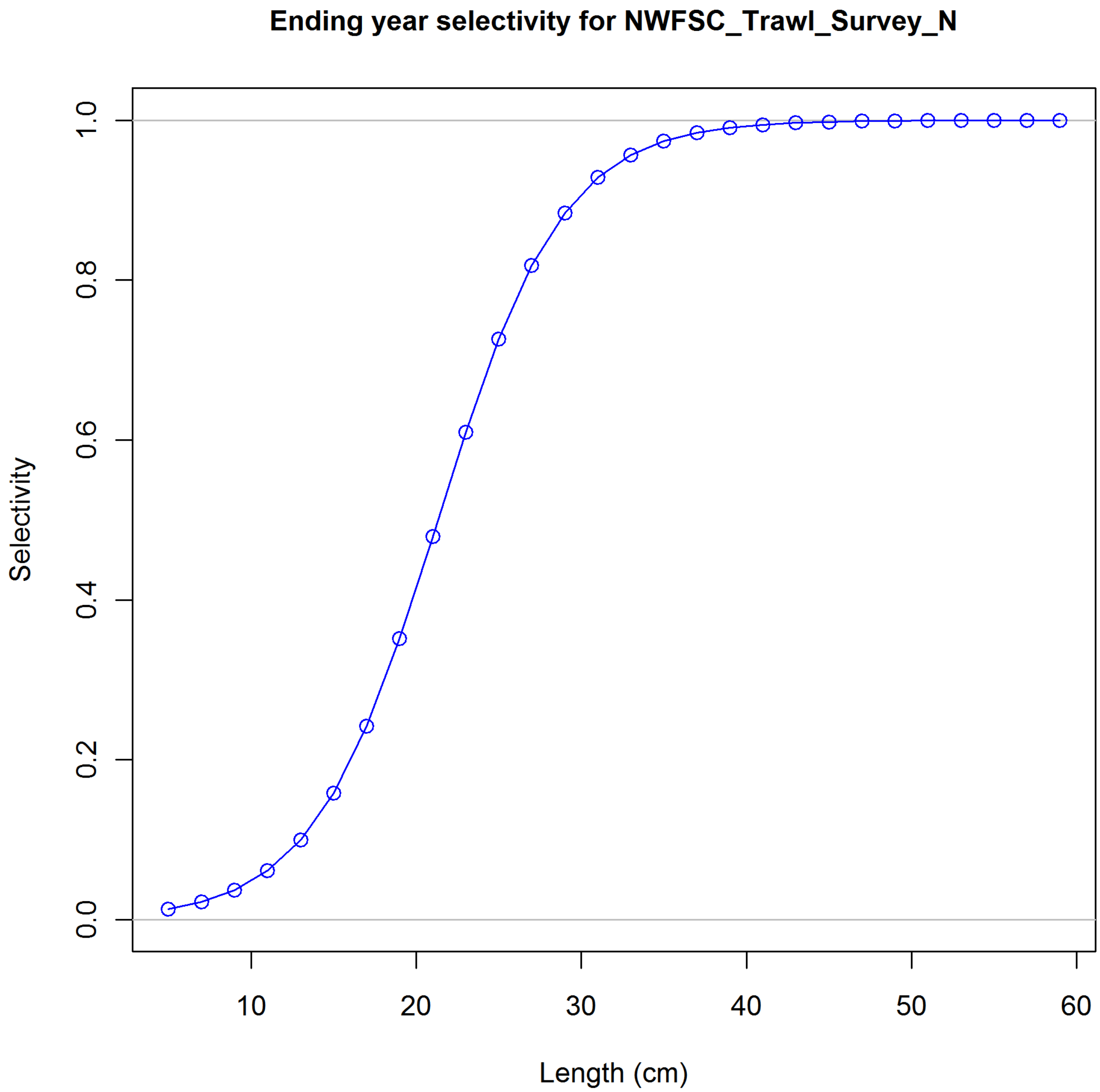
Northern California Hook and Line Selectivity



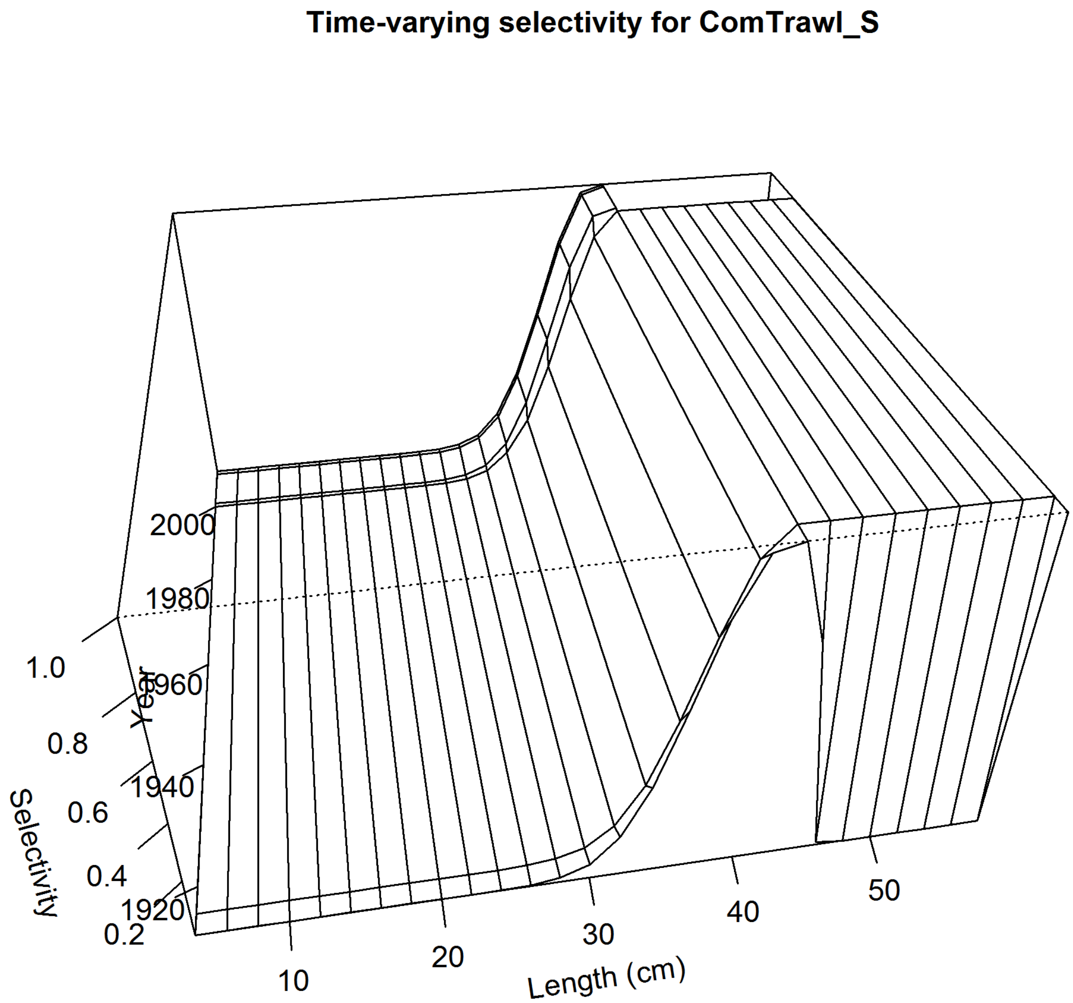
Northern California Commericial Net Gear Selectivity



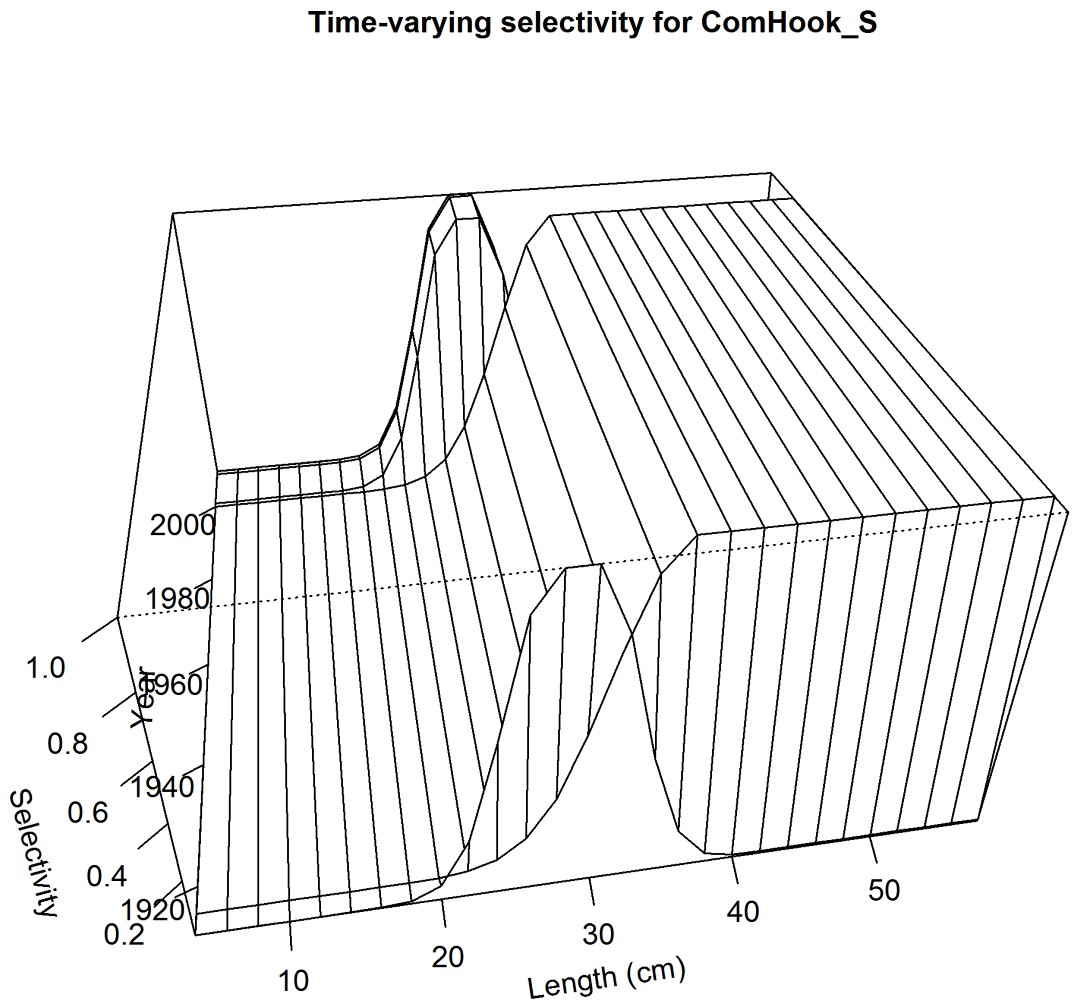
Northern California Recreational Selectivity (CPFV + Private/Rental)



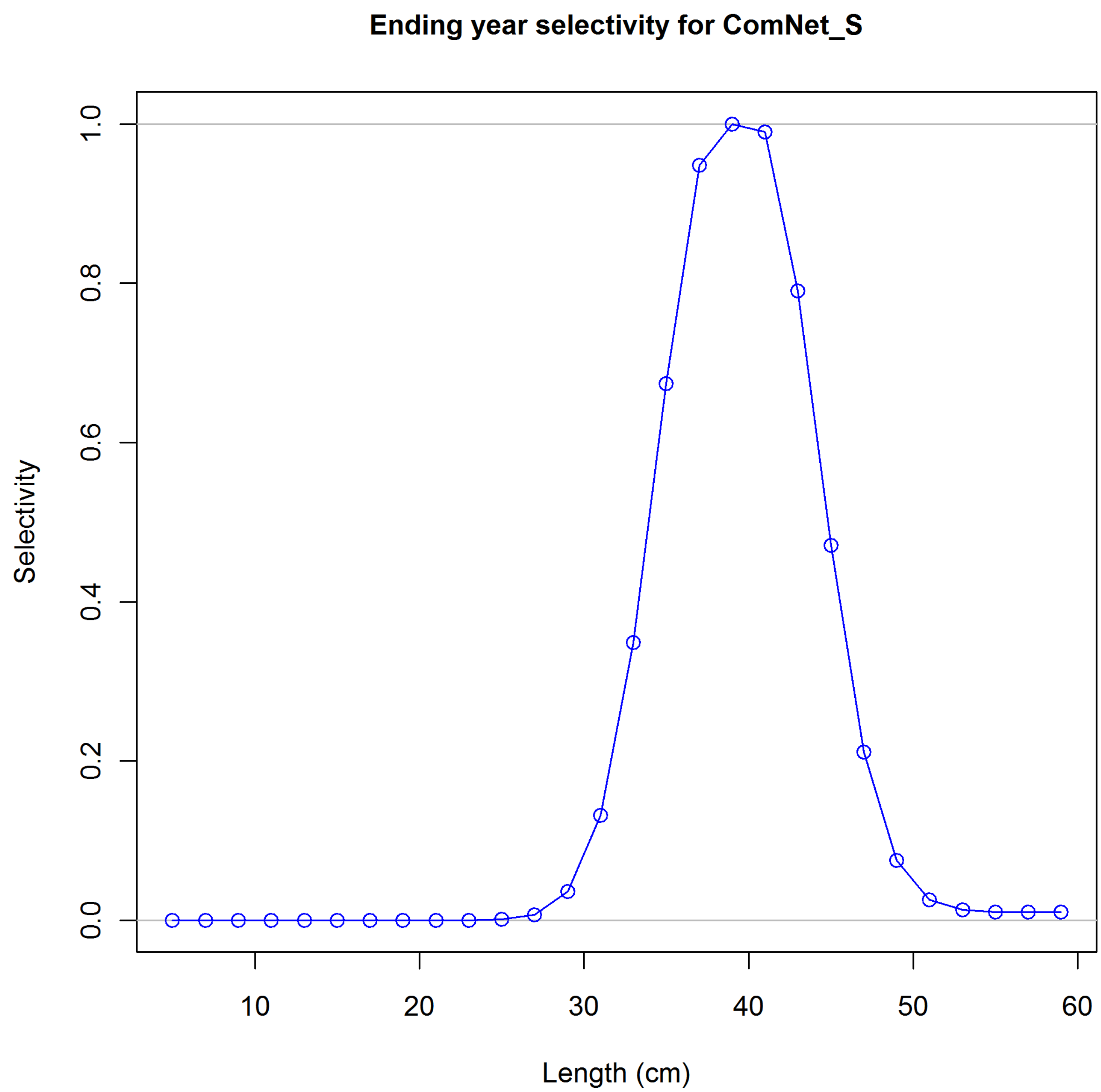
NWFSC Trawl Survey selectivity in northern California



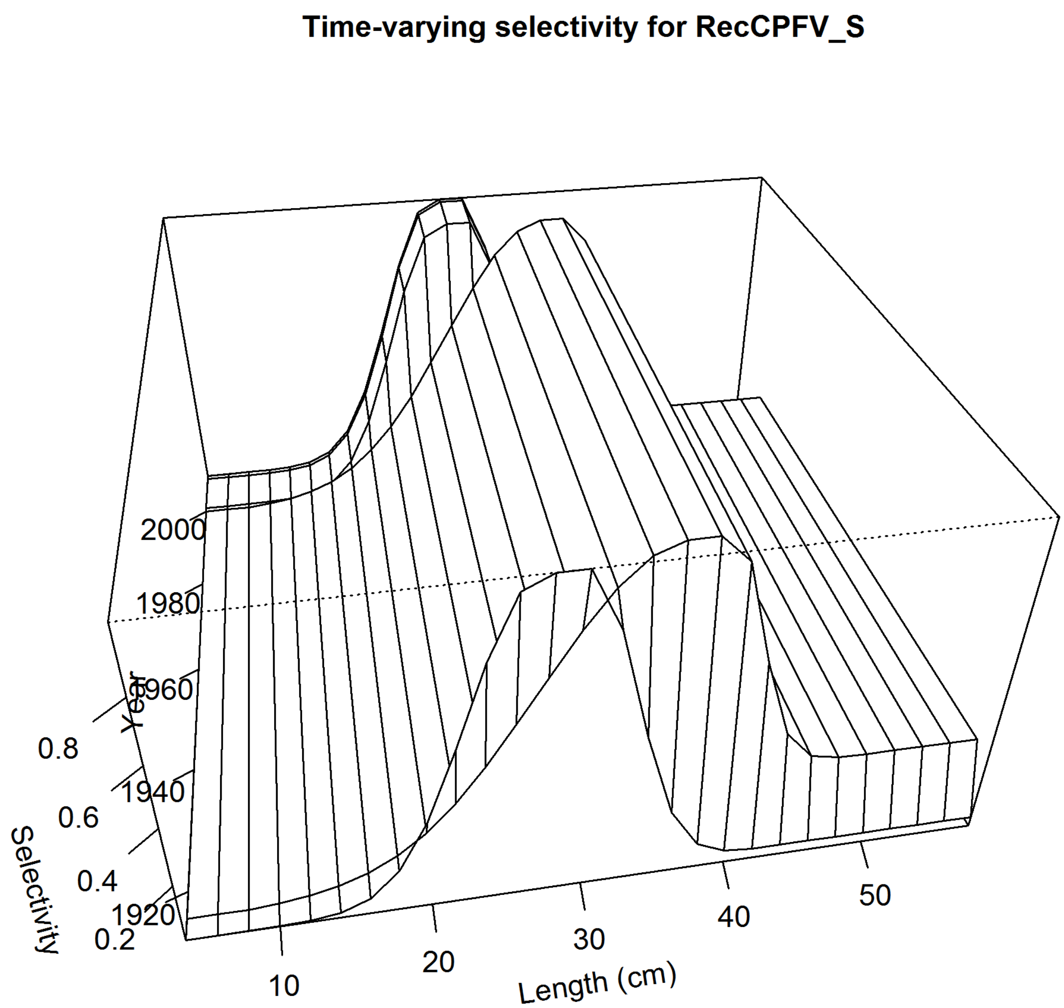
Time-varying selectivity for the southern California trawl fishery



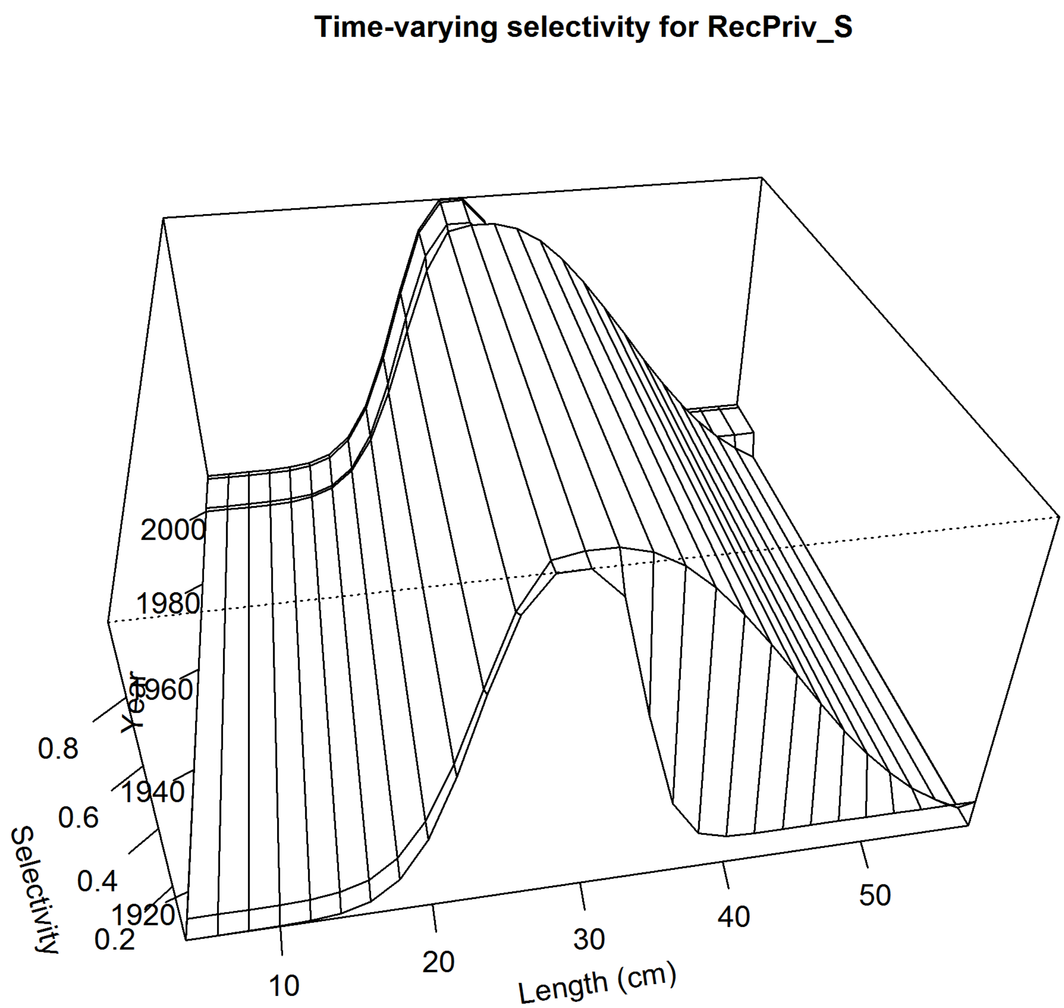
Time-varying selectivity for the southern California hook and line fishery.



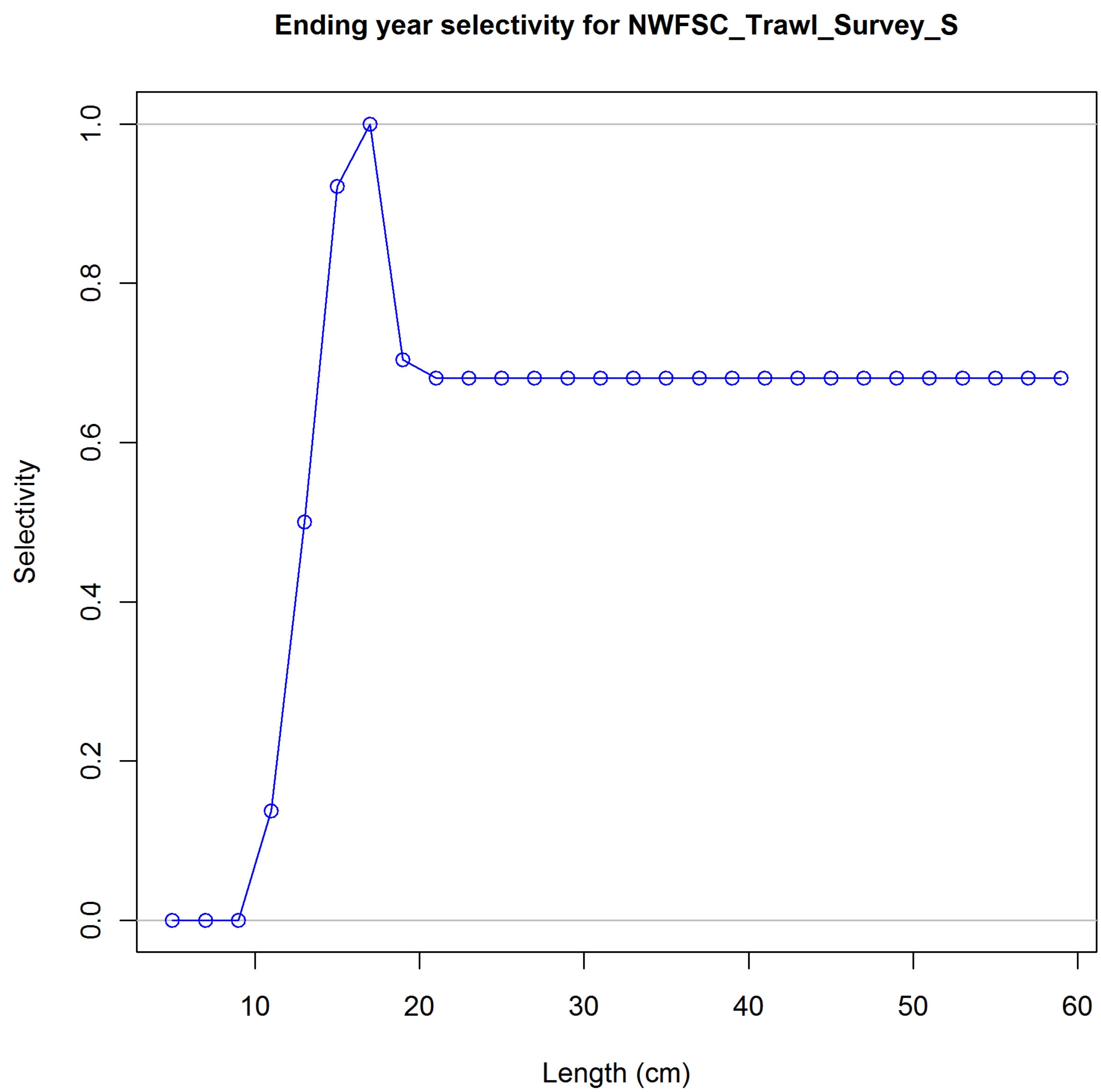
Selectivity for the southern California commercial net fishery.



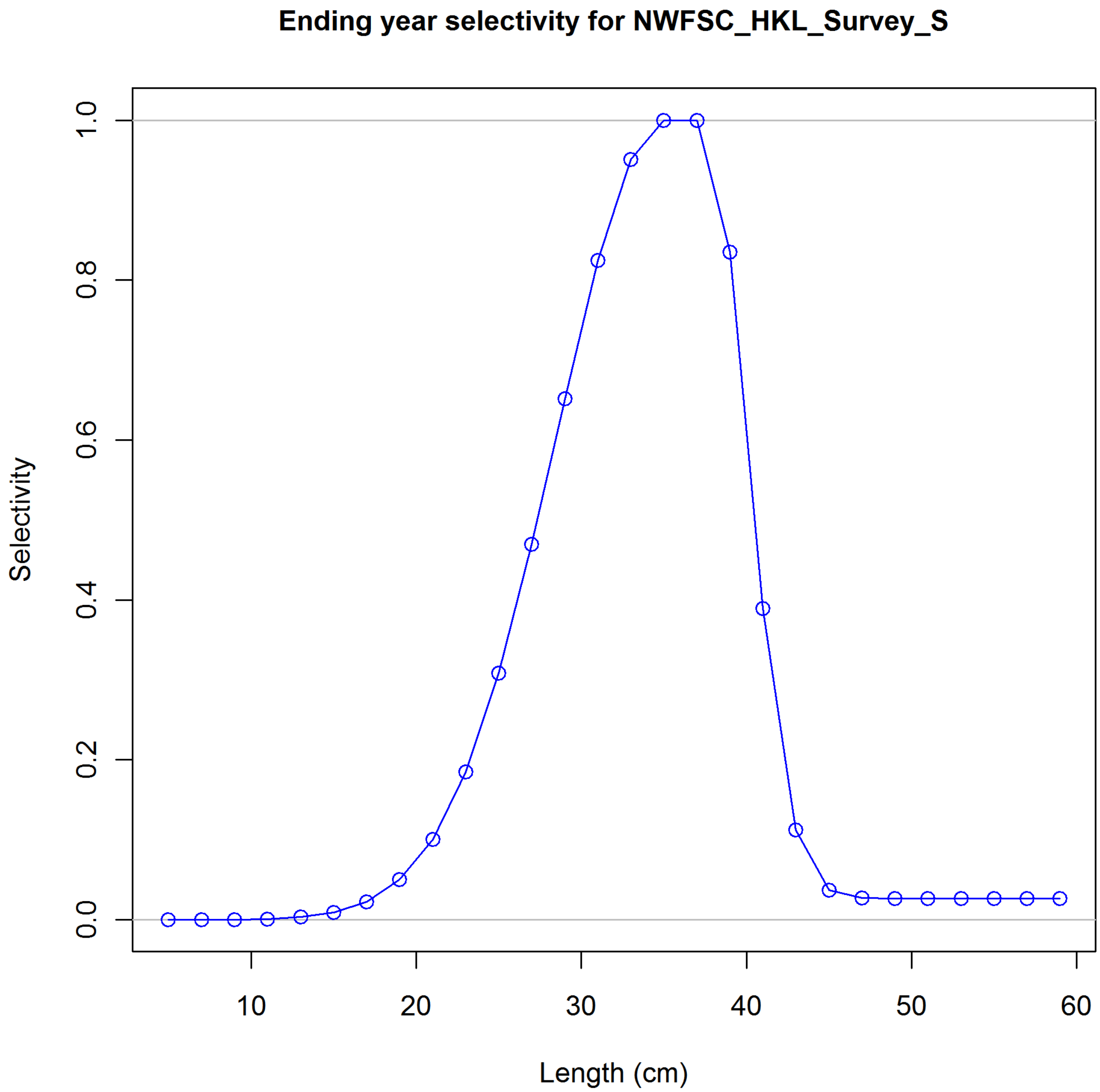
Time-varying selectivity for the southern California recreational CPFV fleet.



Time-varying selectivity for the southern California recreational private/rental boat fleet.

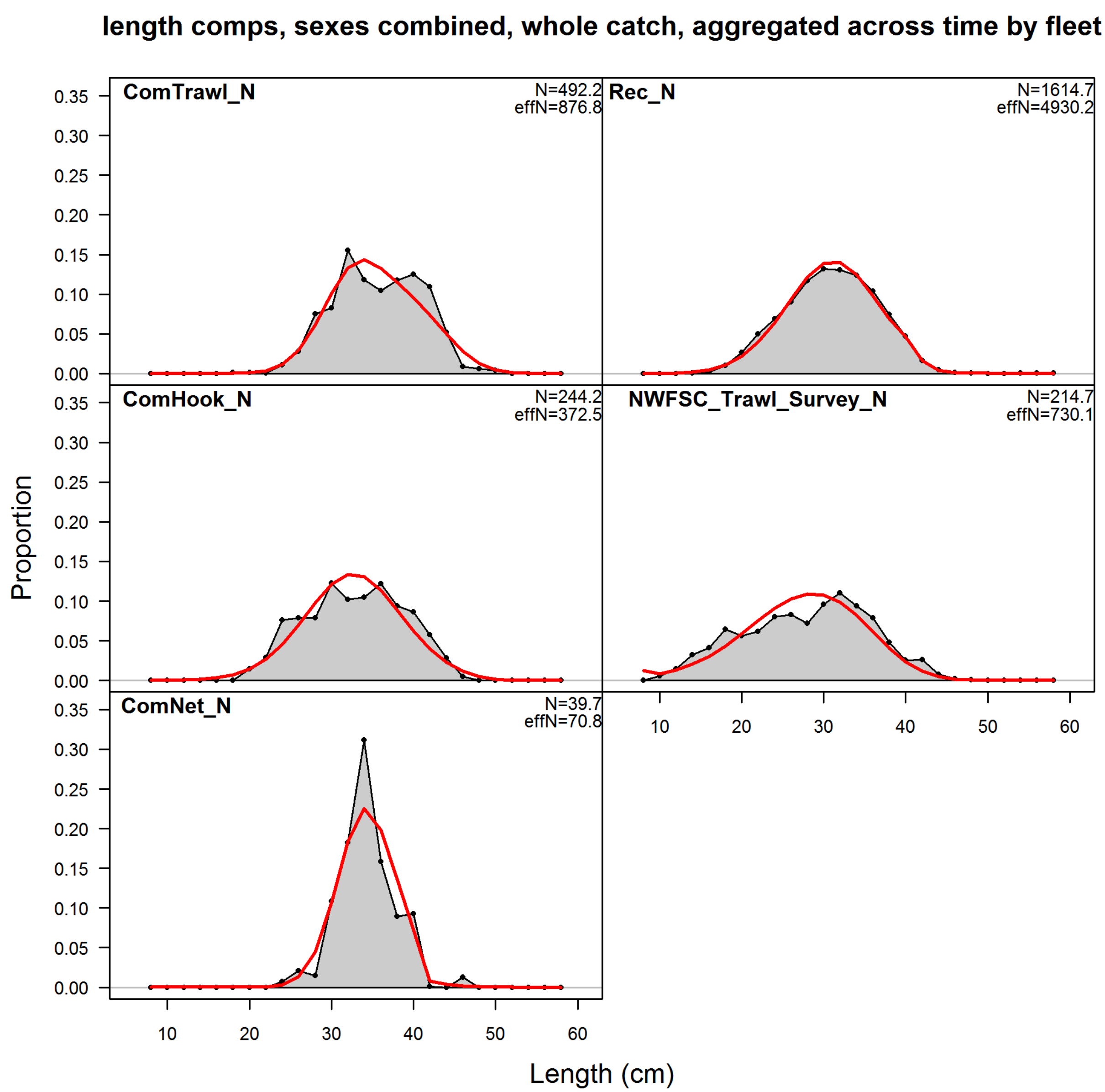


Selectivity for the NWFSC trawl survey in southern California

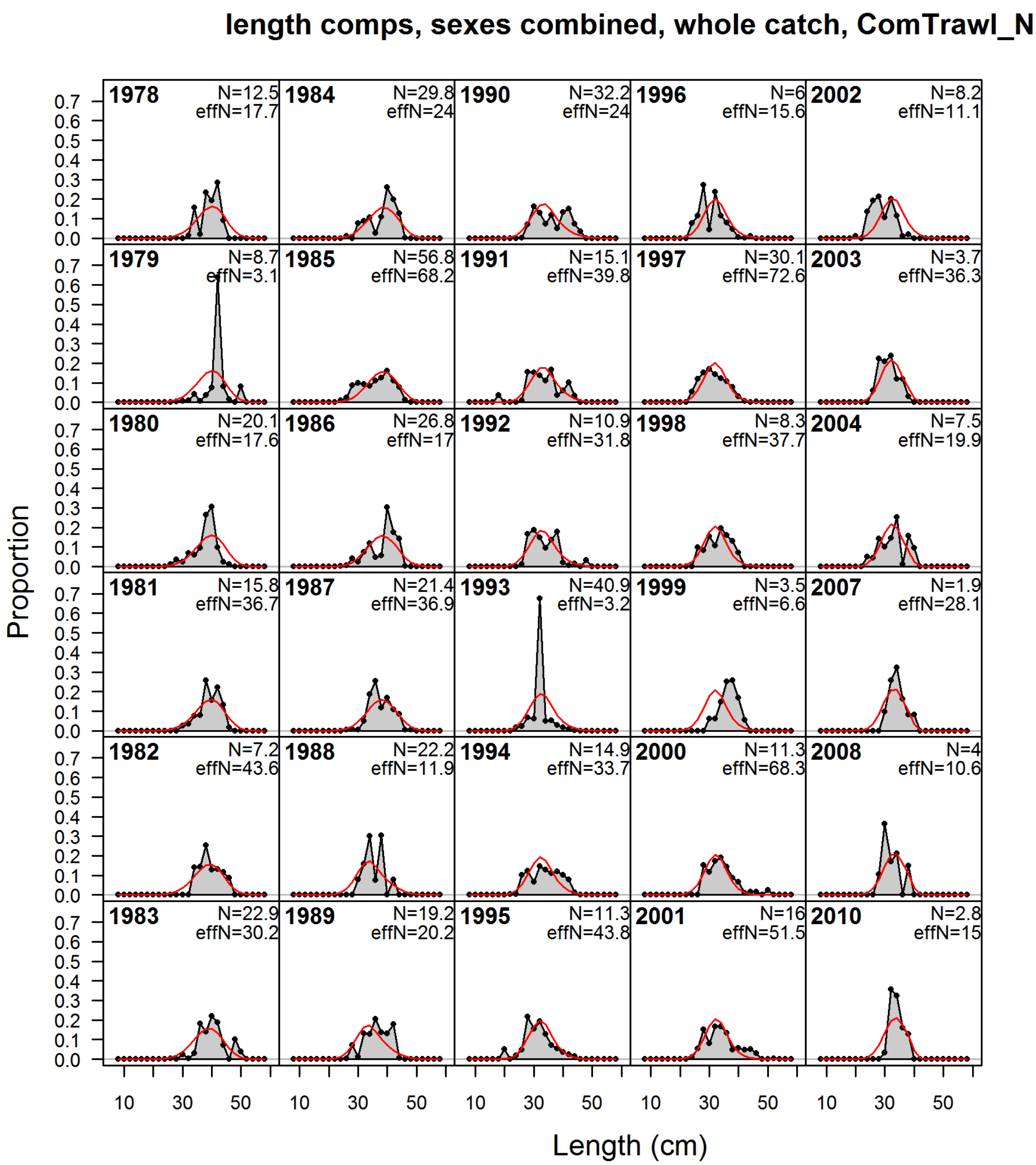


Selectivity for the NWFSC hook and line survey in southern California

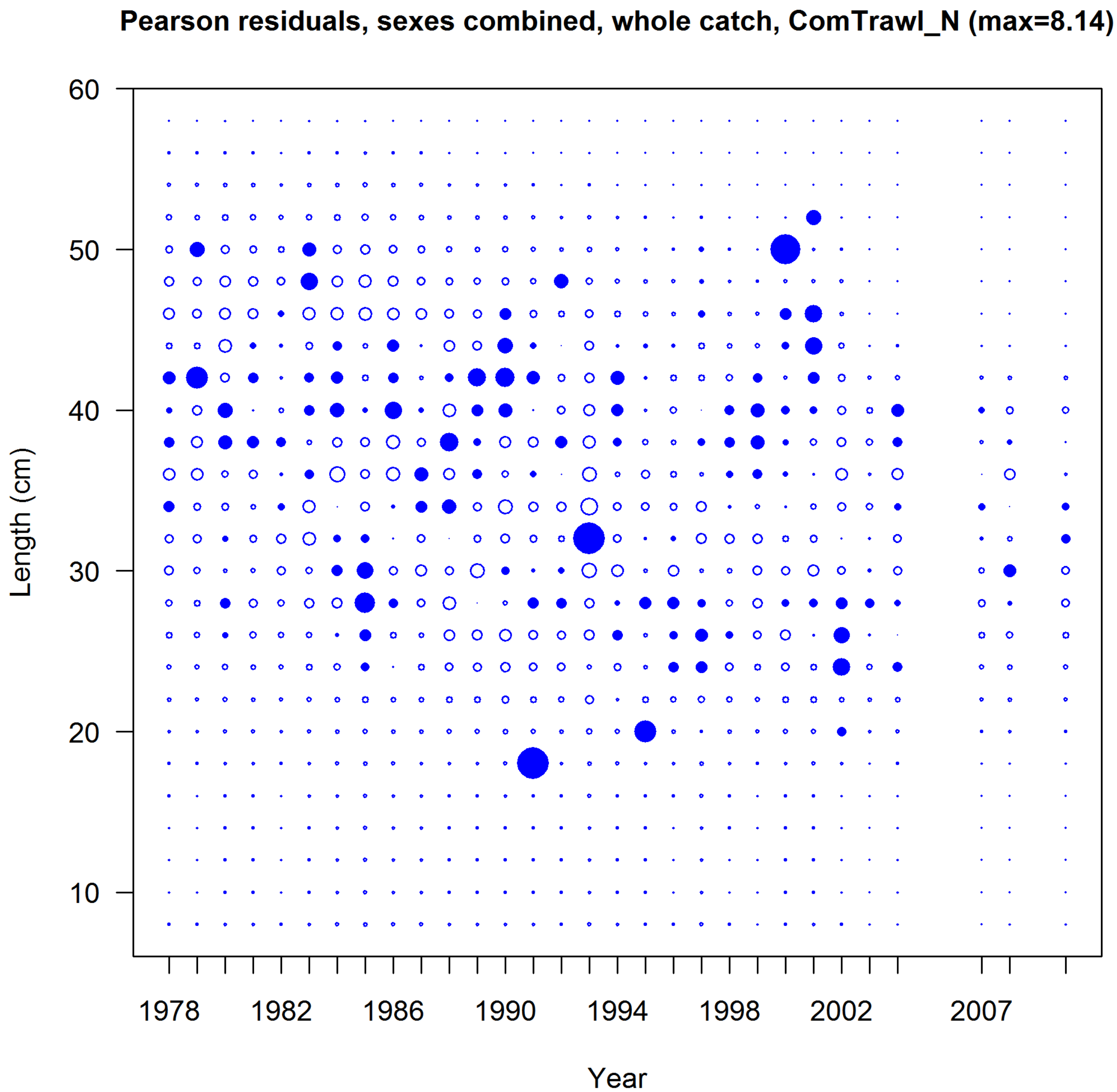
Appendix E: Base model fits to northern California fishery length and age data with diagnostics



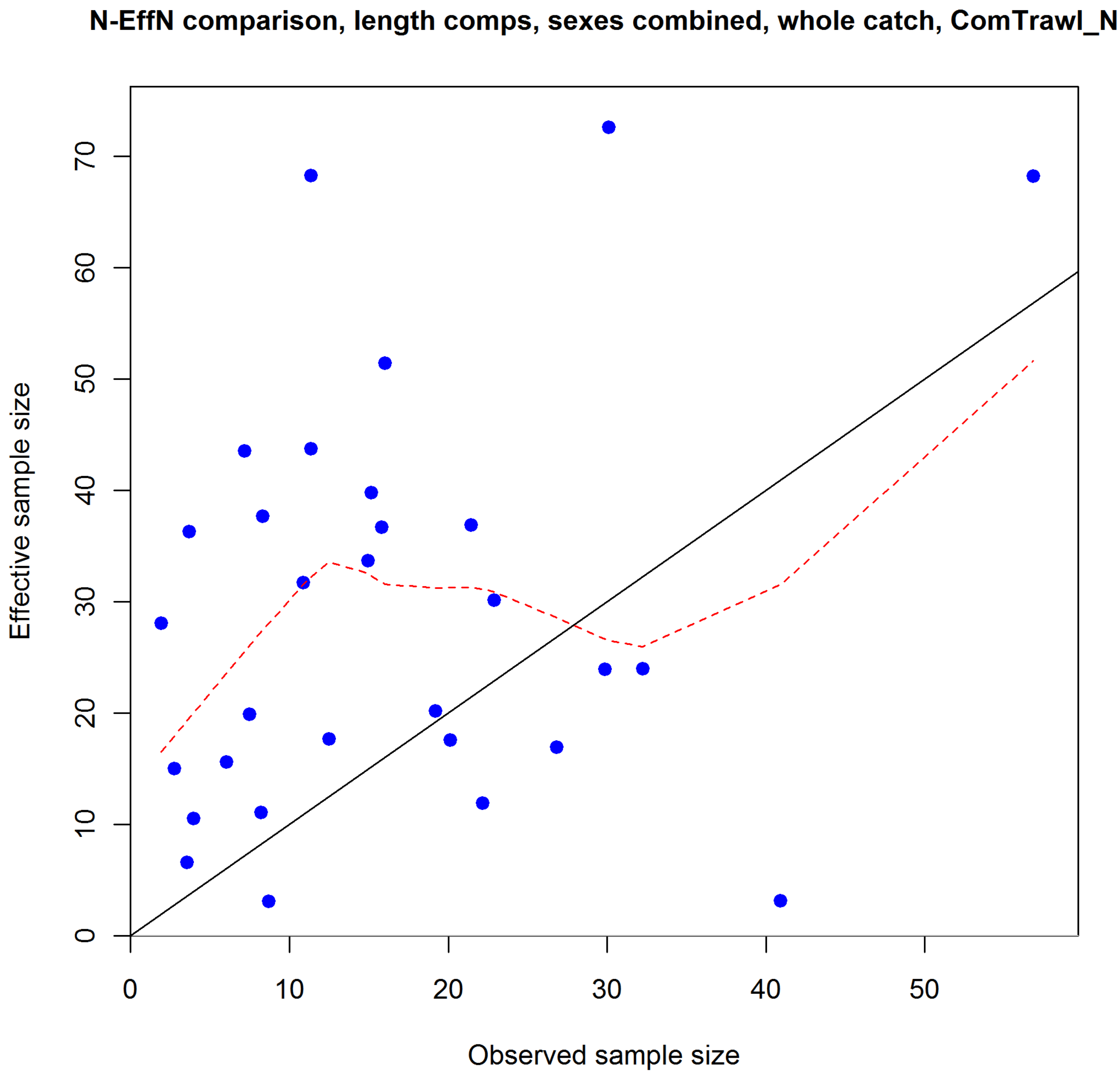
Fits to northern California length composition data, all years combined.



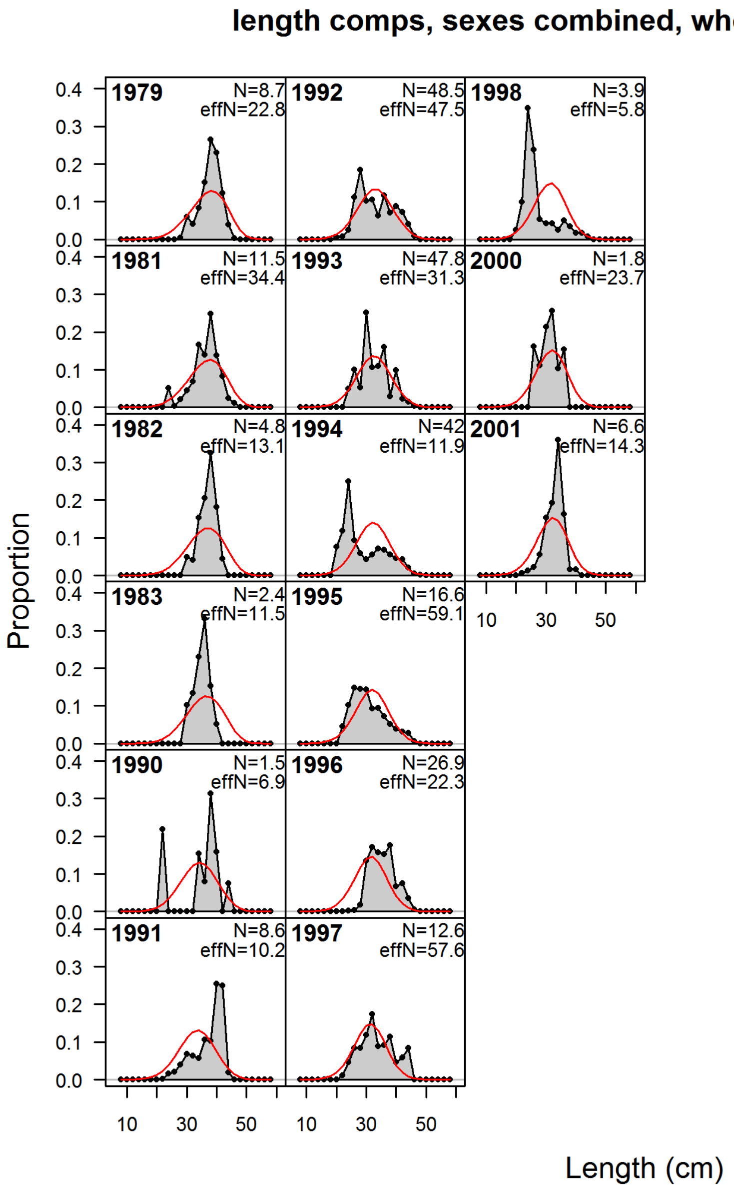
Length composition fits to northern California trawl fleet.



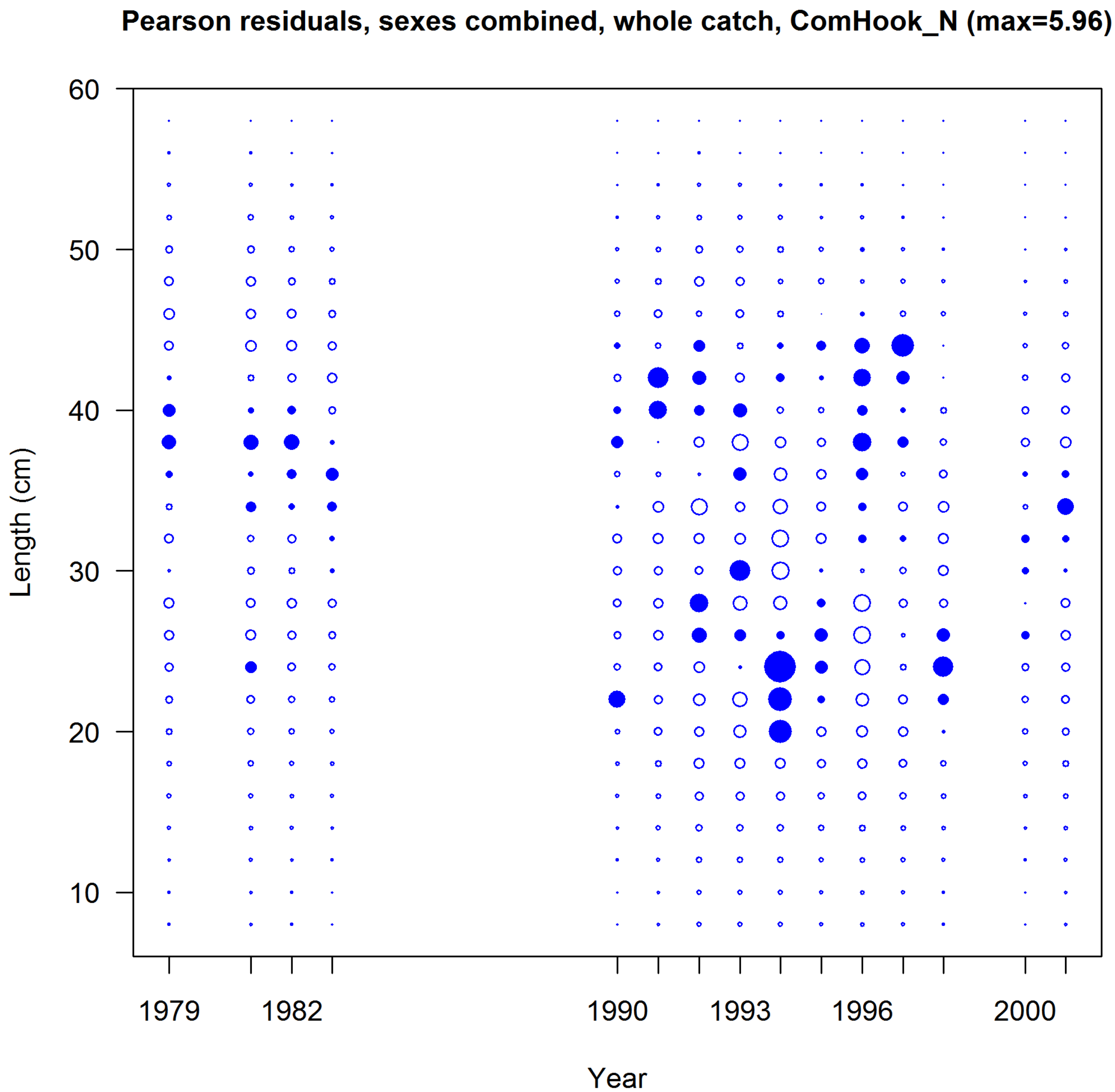
Length composition residuals for northern California trawl fleet.



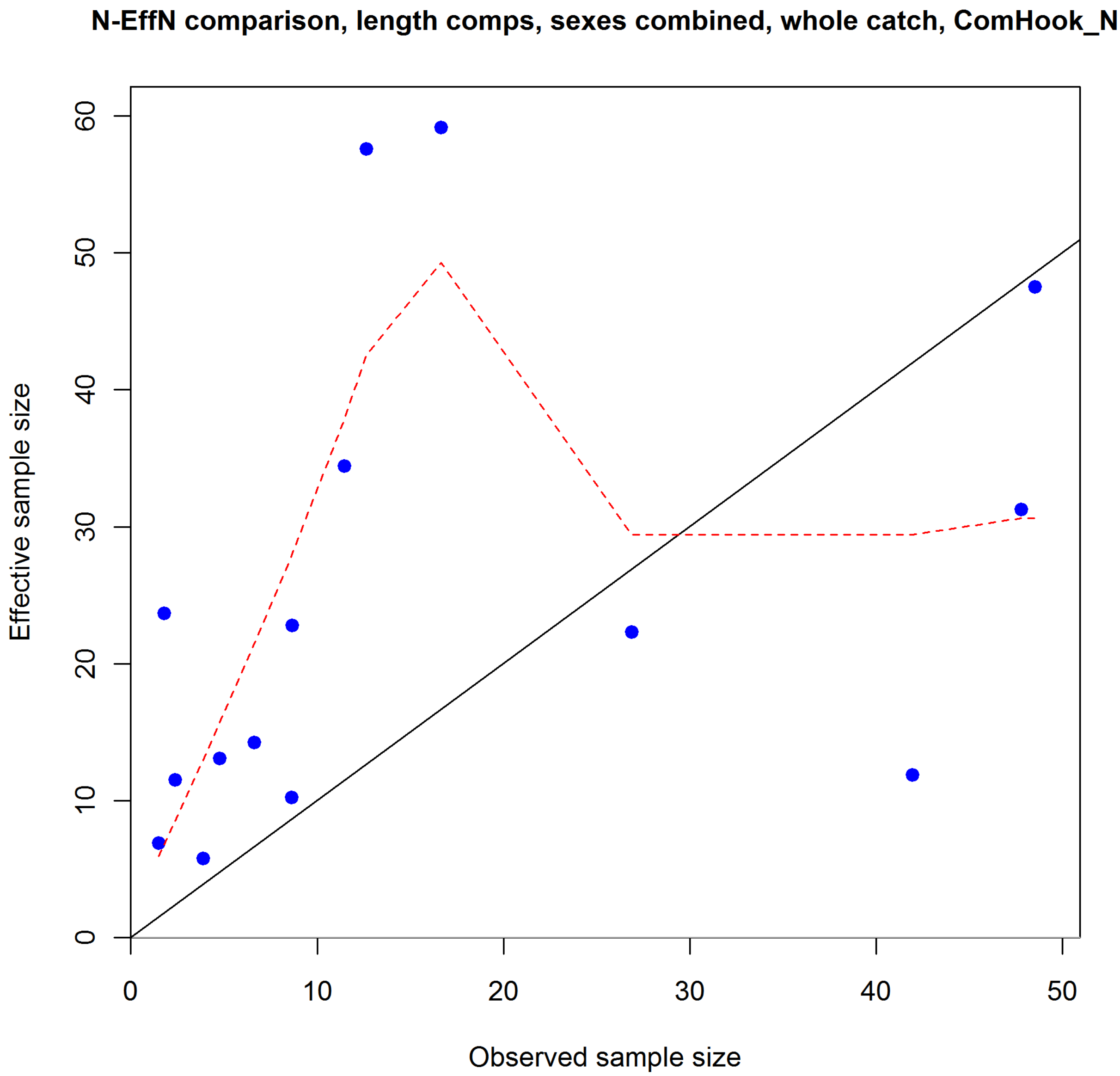
Effective sample size plot for northern California trawl fleet



Length composition fits to northern California hook and line fleet.

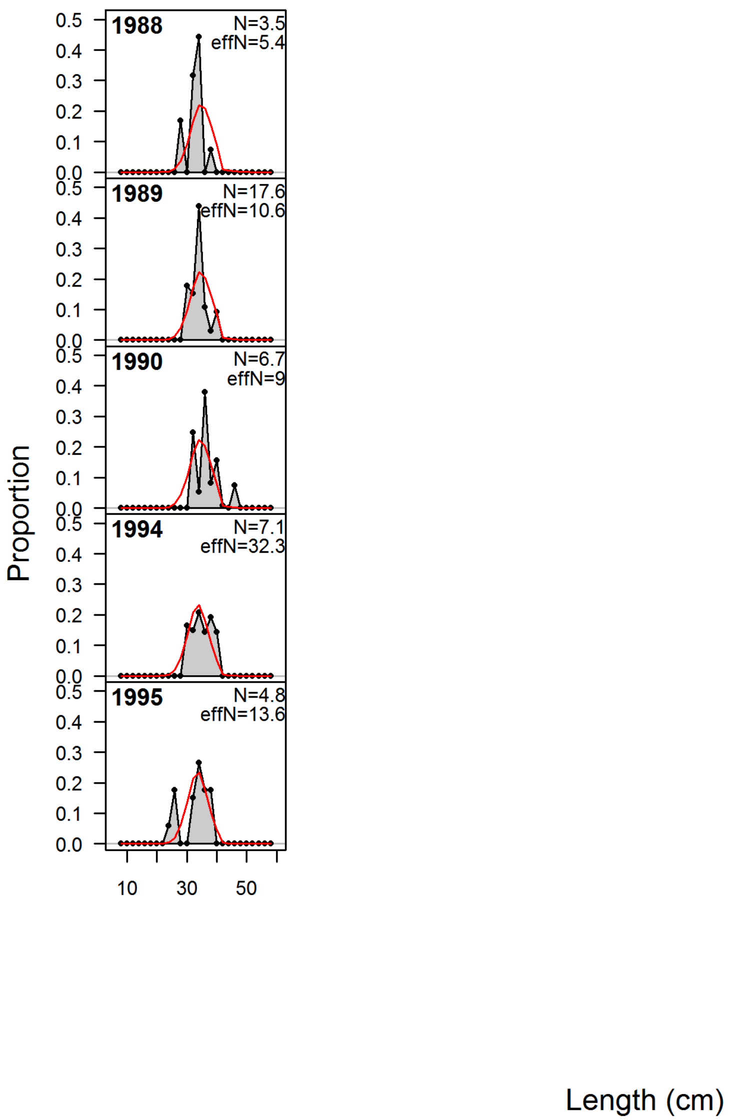


Length composition residuals for northern California hook and line fleet.

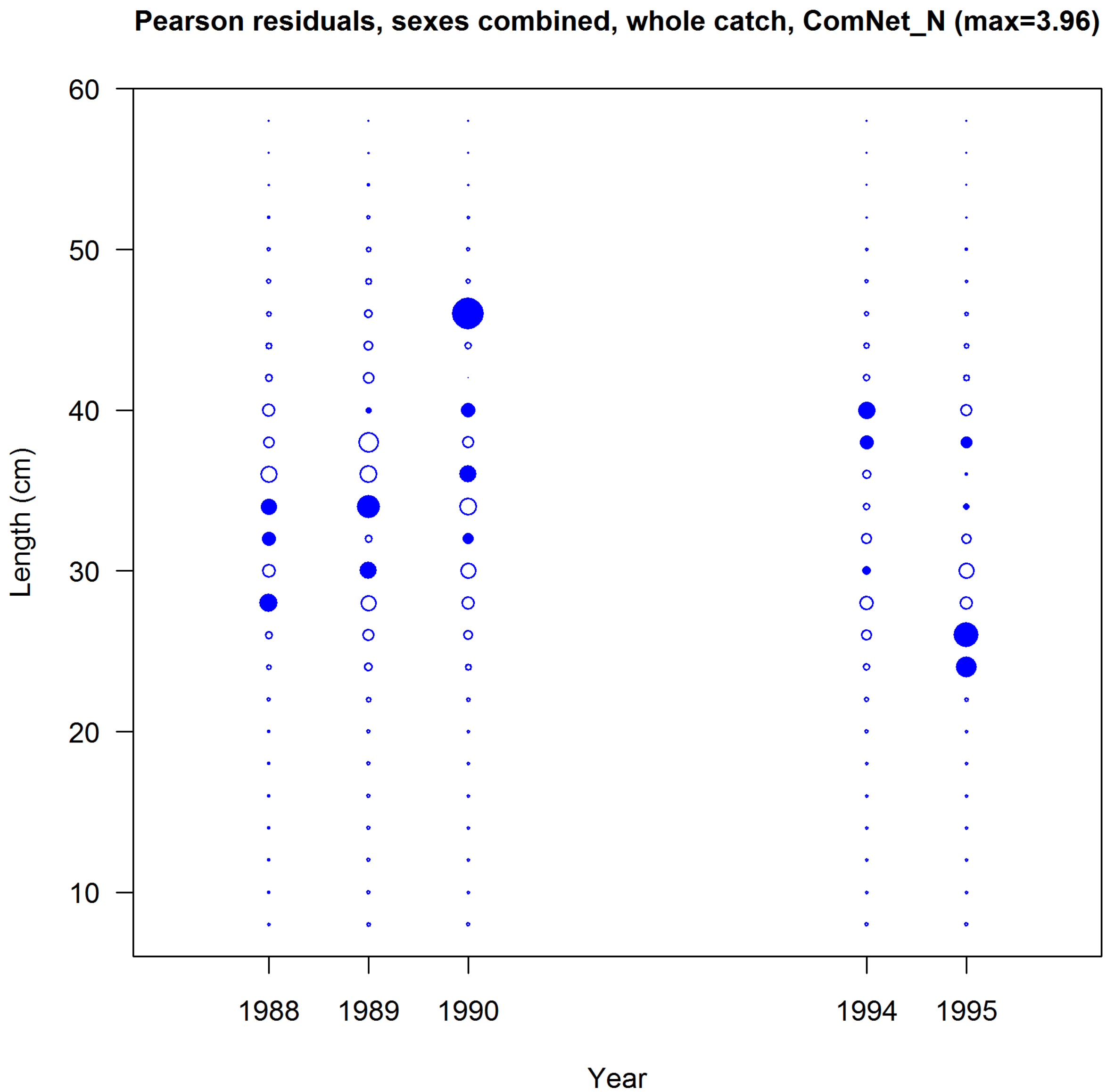


Effective sample size plot for northern California hook and line fleet

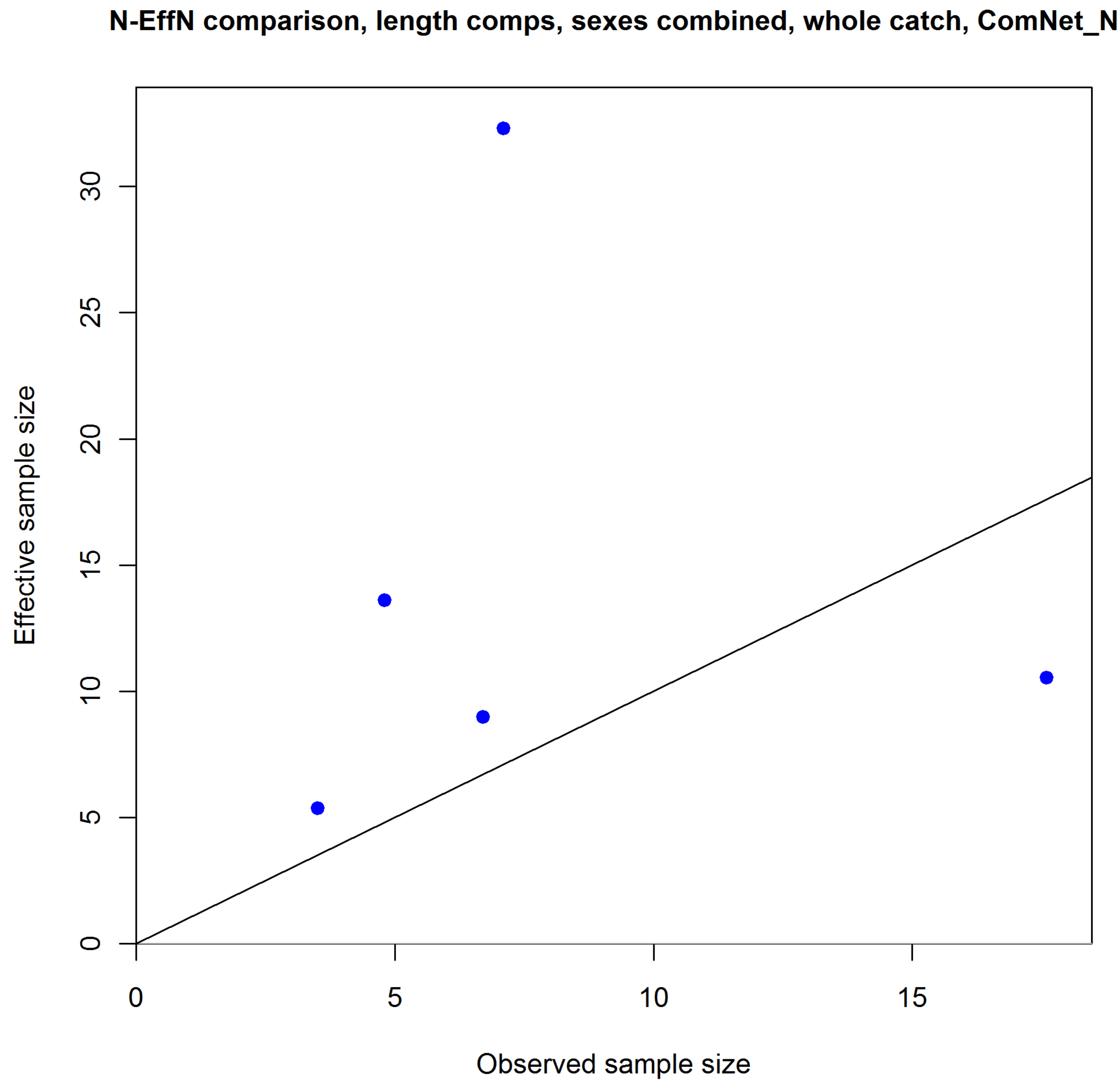
length comps, sexes combined, whole catch, ComNet_N



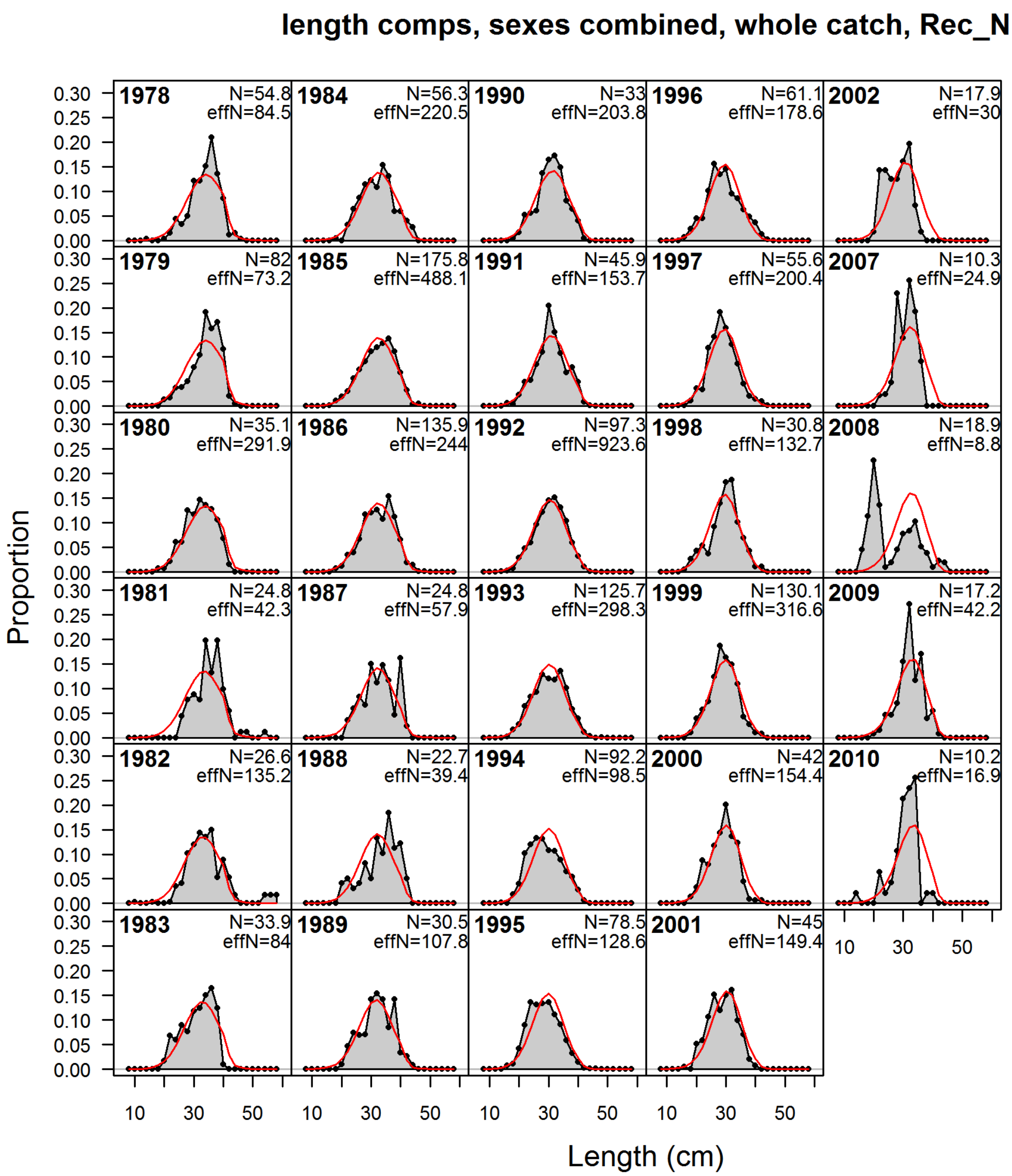
Length composition fits to northern California net fleet.



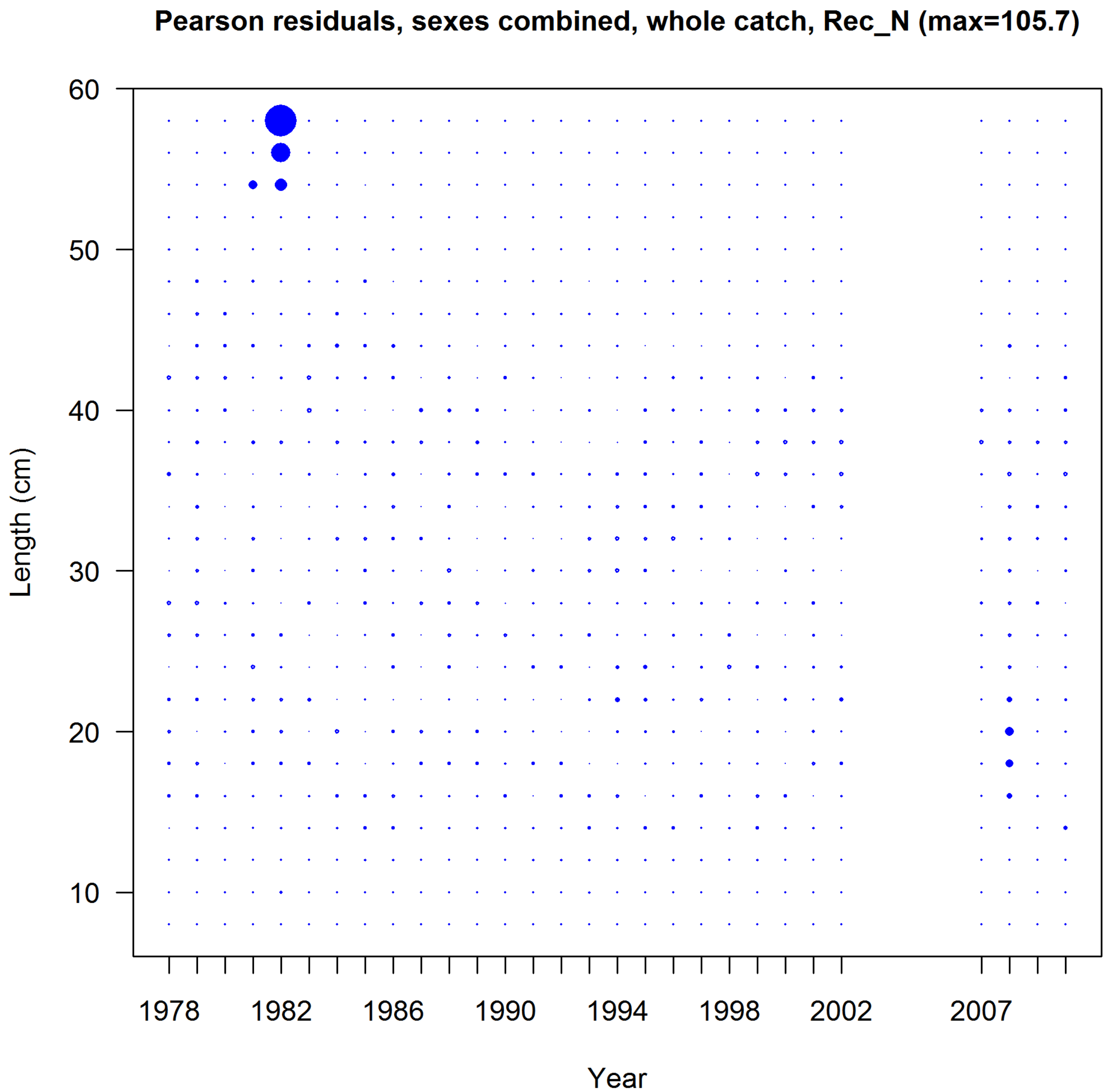
Length composition residuals for northern California net fleet.



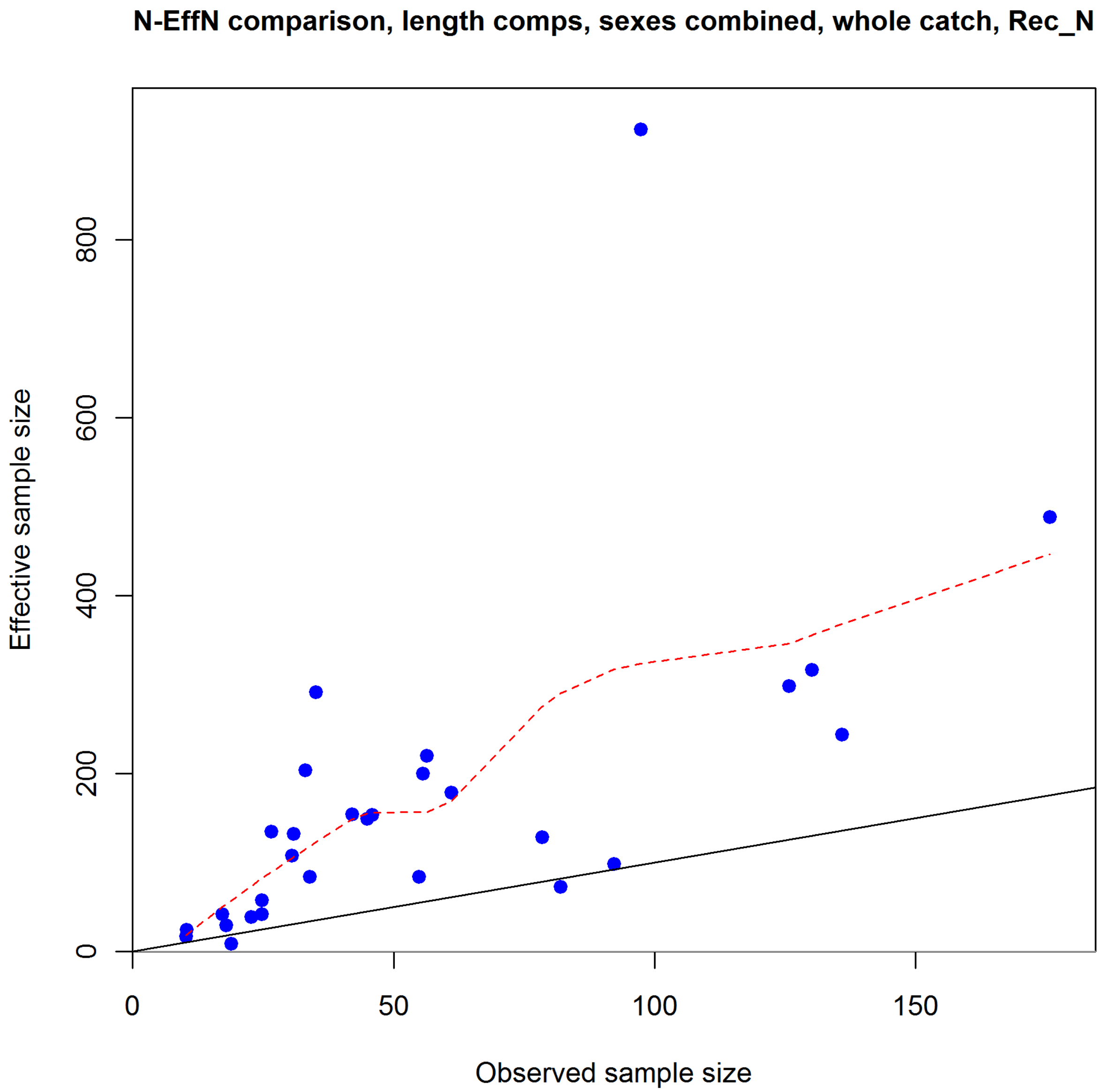
Effective sample size plot for northern California hook and line fleet



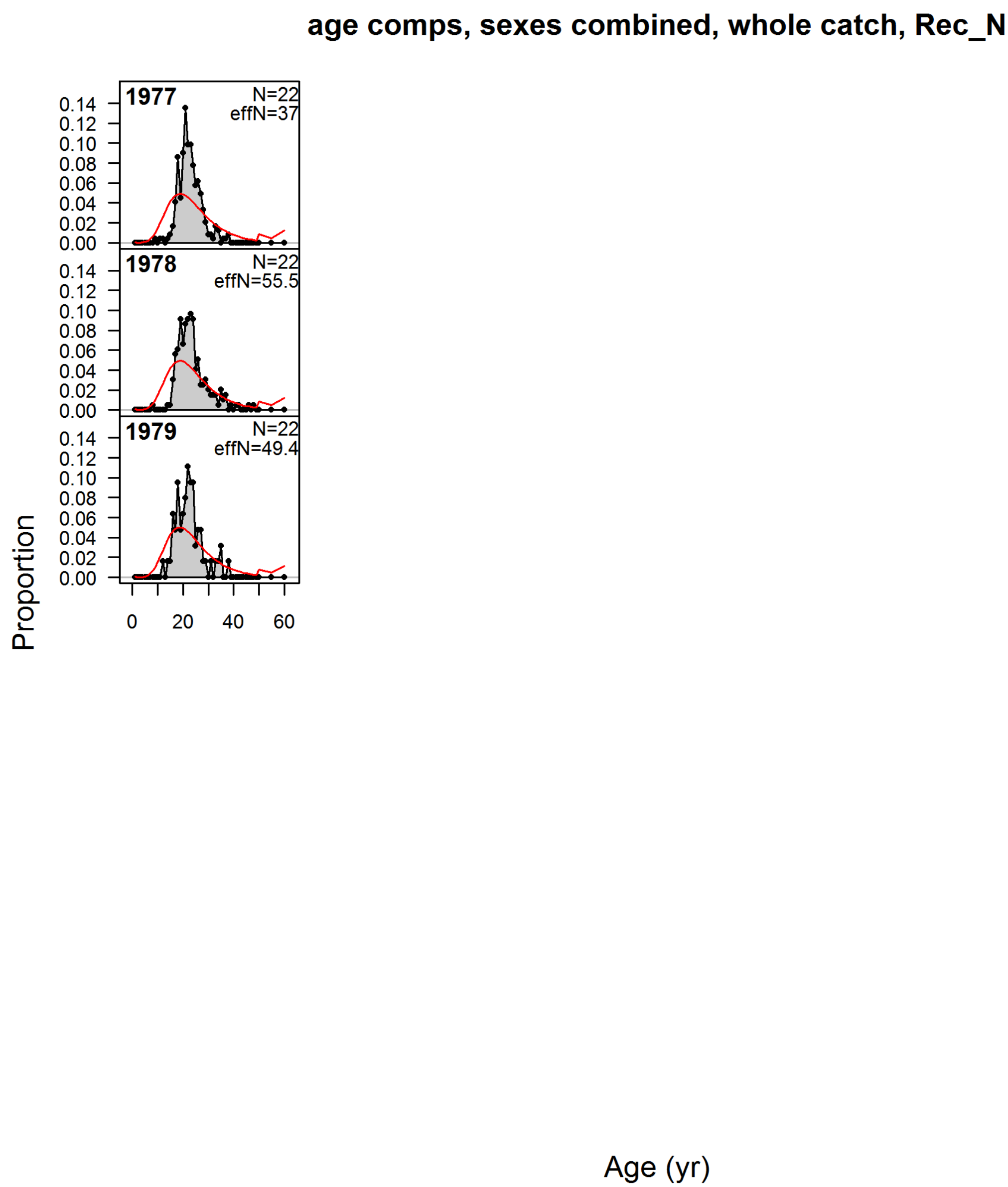
Length composition fits to northern California recreational fleet.



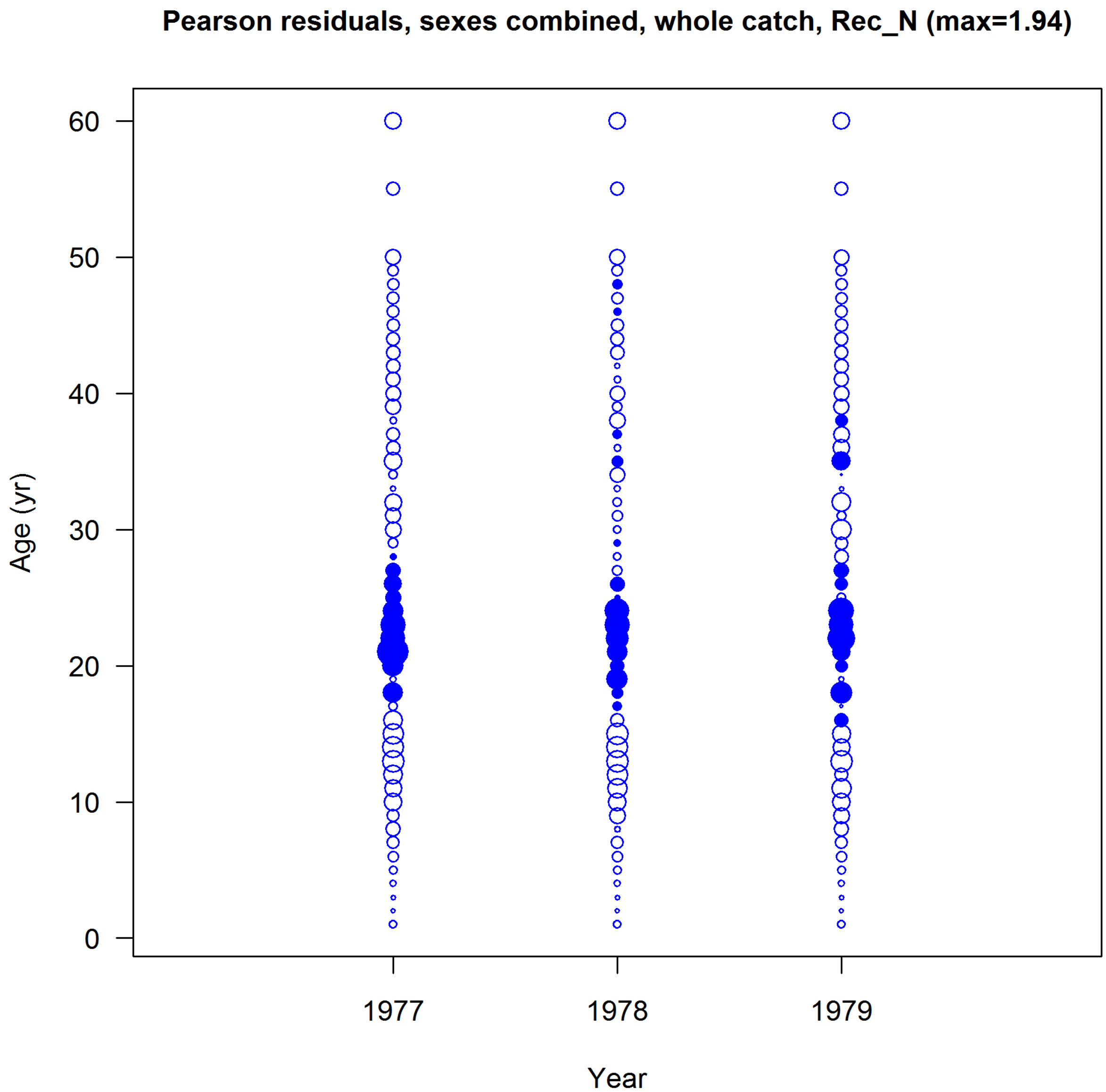
Length composition residuals for northern California recreational fleet.



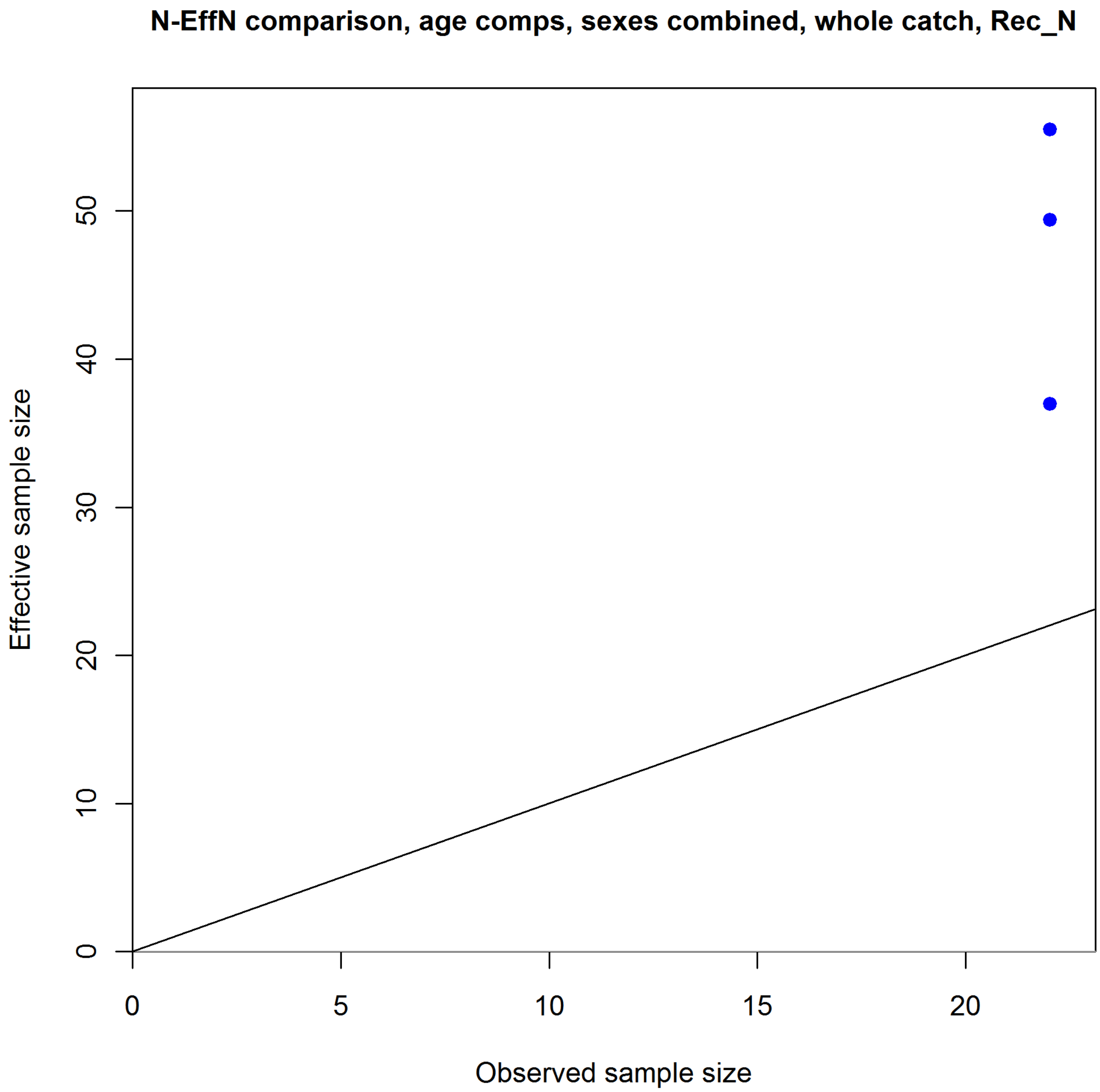
Effective sample size plot for northern California recreational fleet



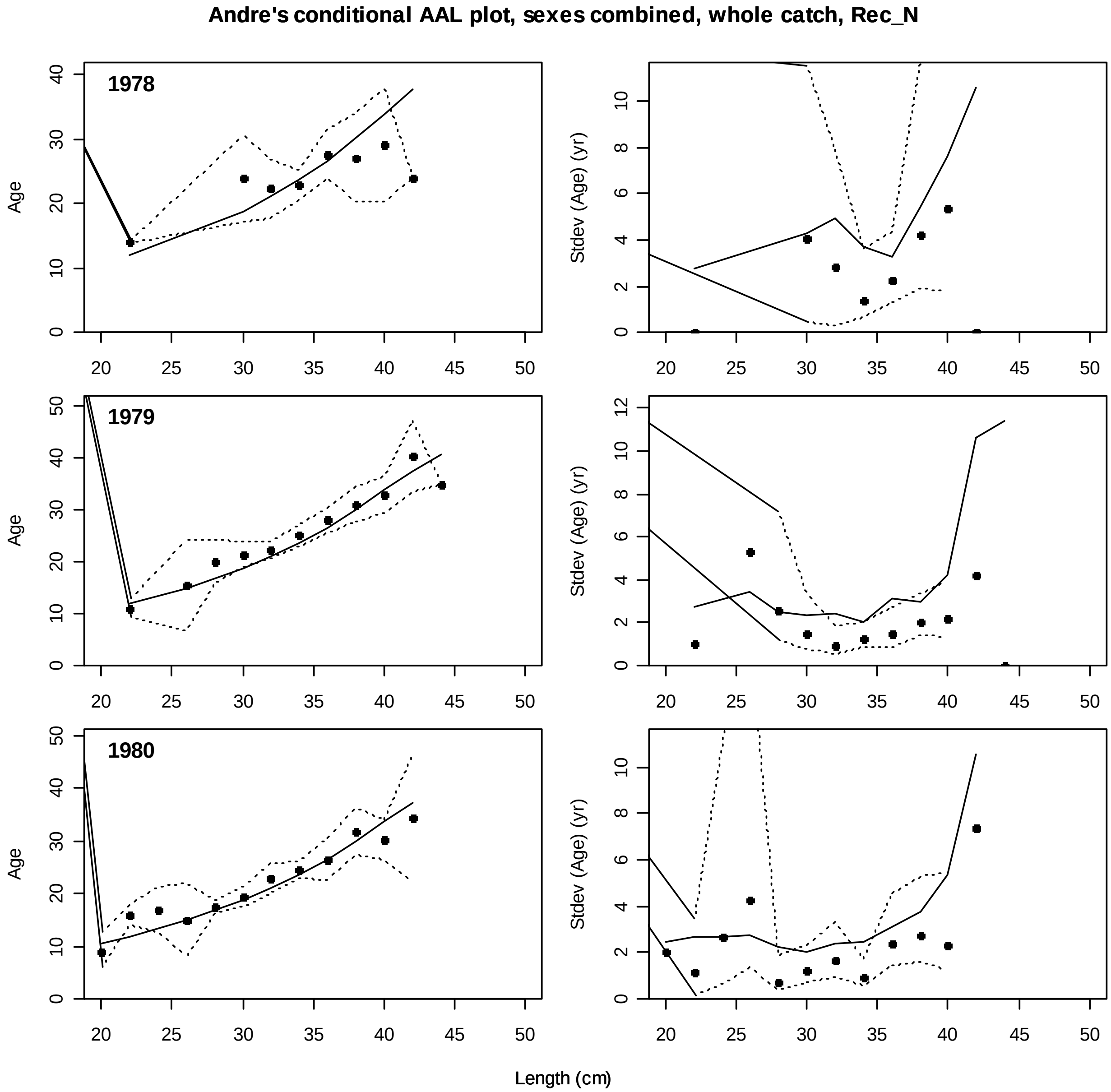
Unconditional age composition fits to northern California recreational fleet.



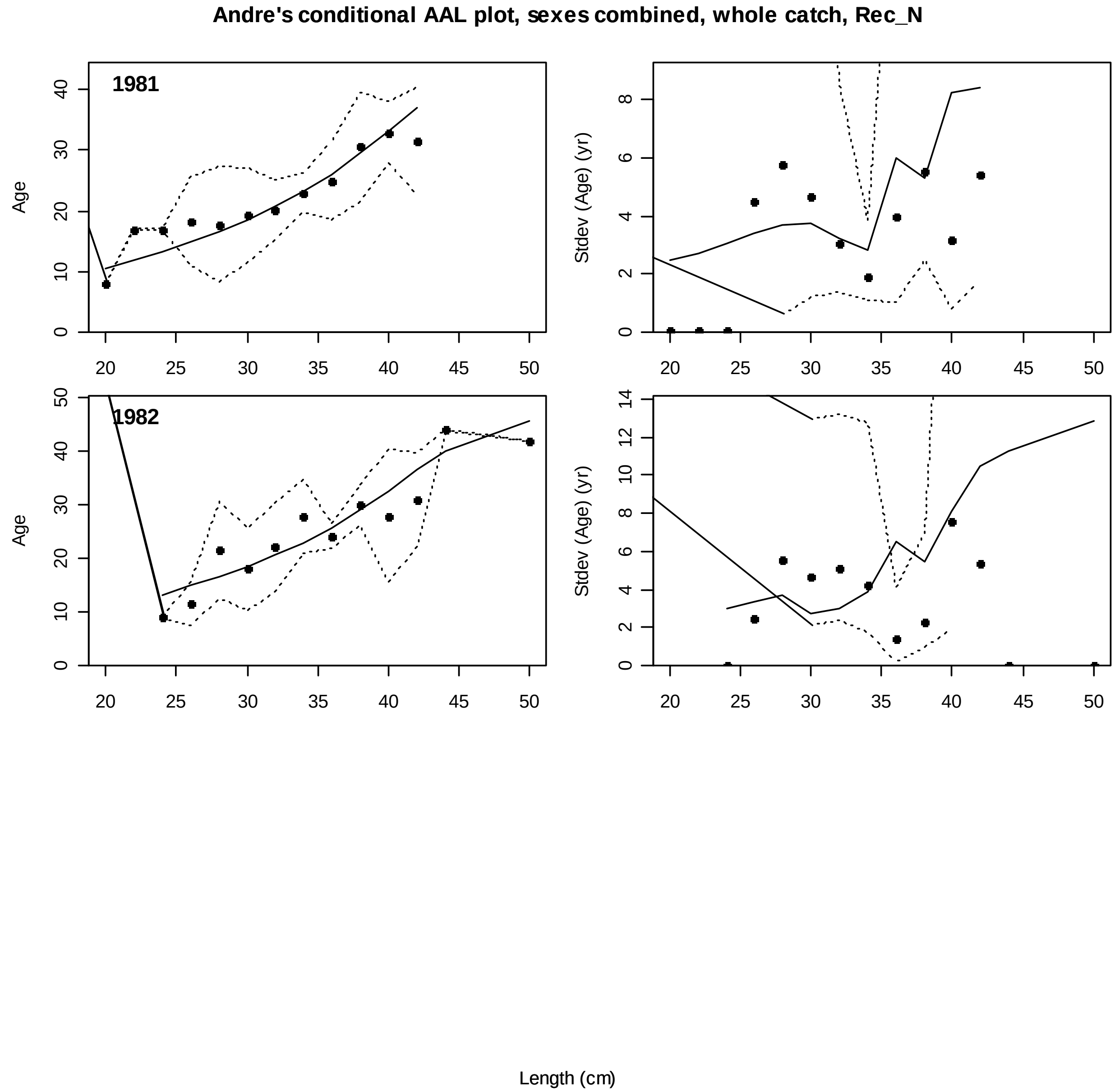
Unconditional age composition residuals for northern California recreational fleet.



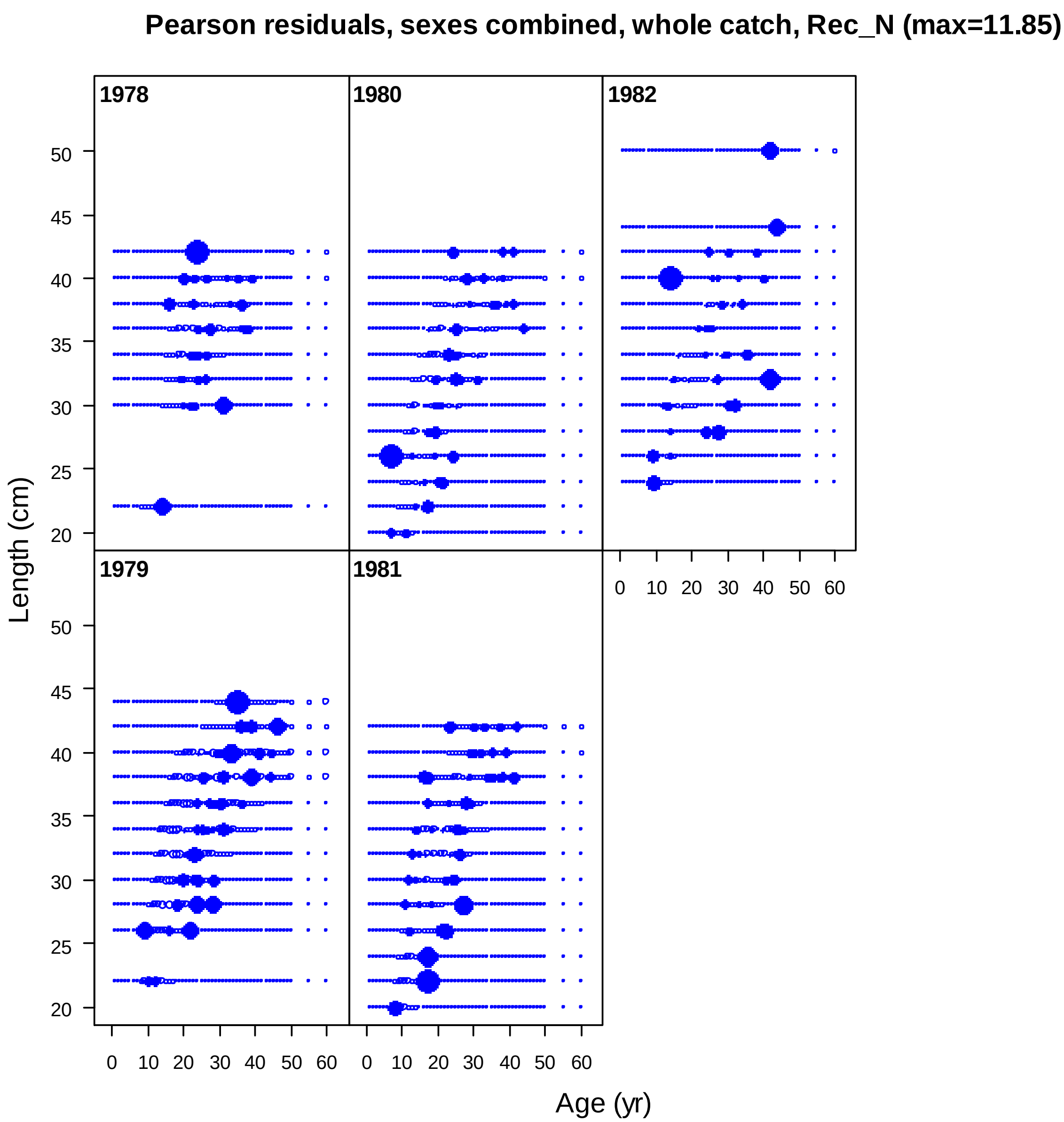
Effective sample size plot for northern California recreational age compositions



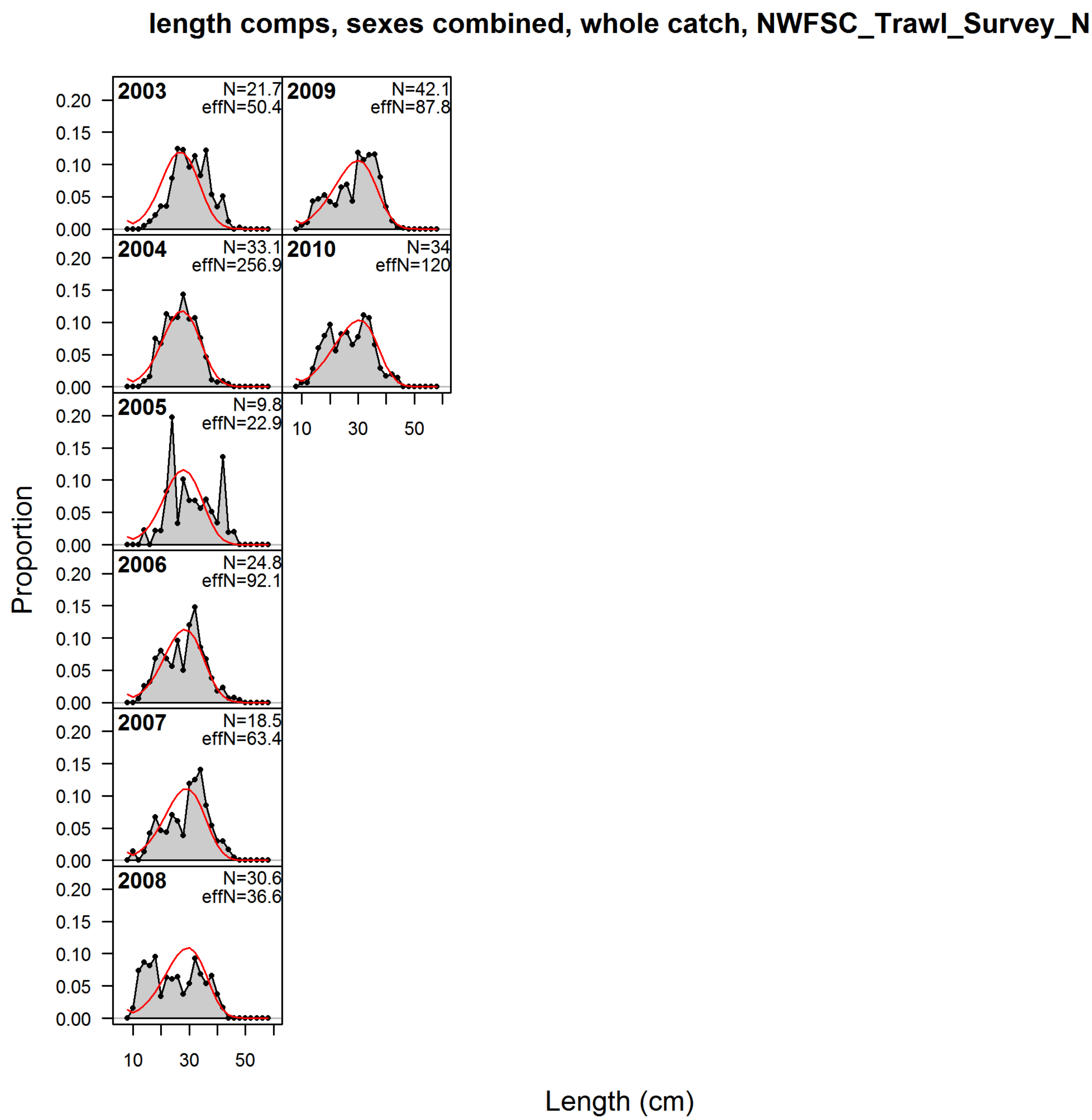
Conditional age-at-length fits to northern California recreational data



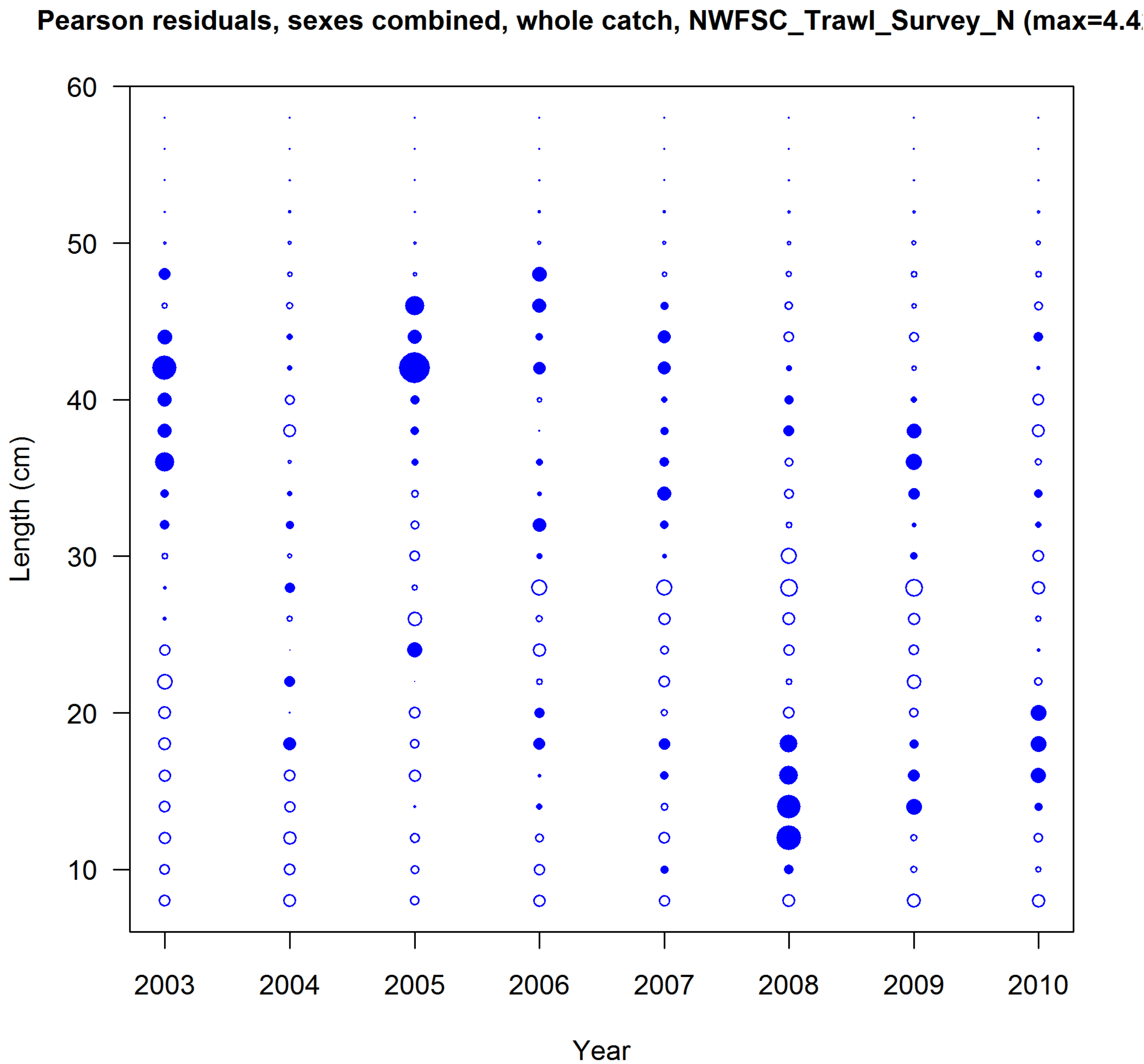
Conditional age-at-length fits to northern California recreational data (continued)



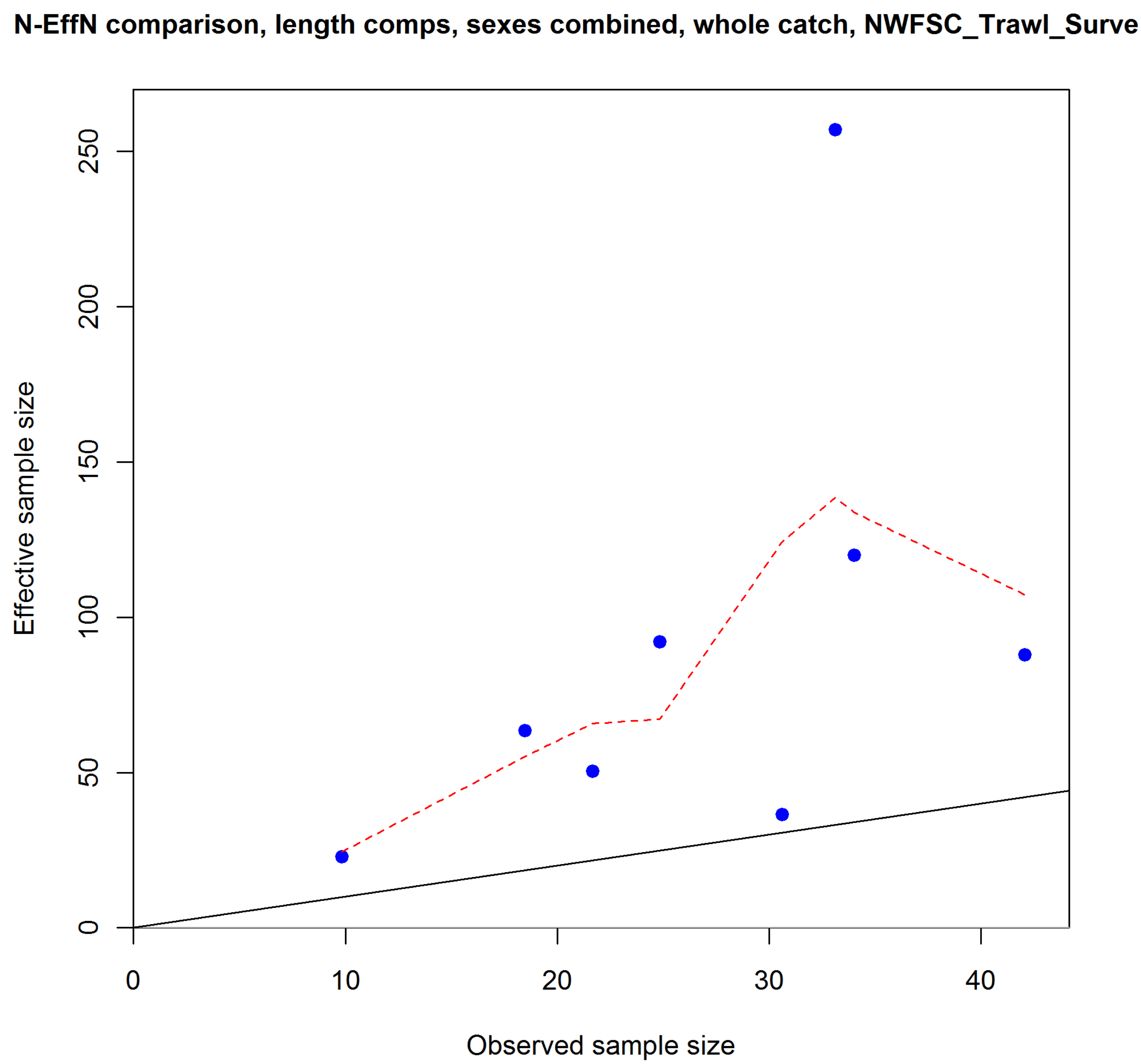
Residuals for conditional age-at-length data from the northern California recreational fishery



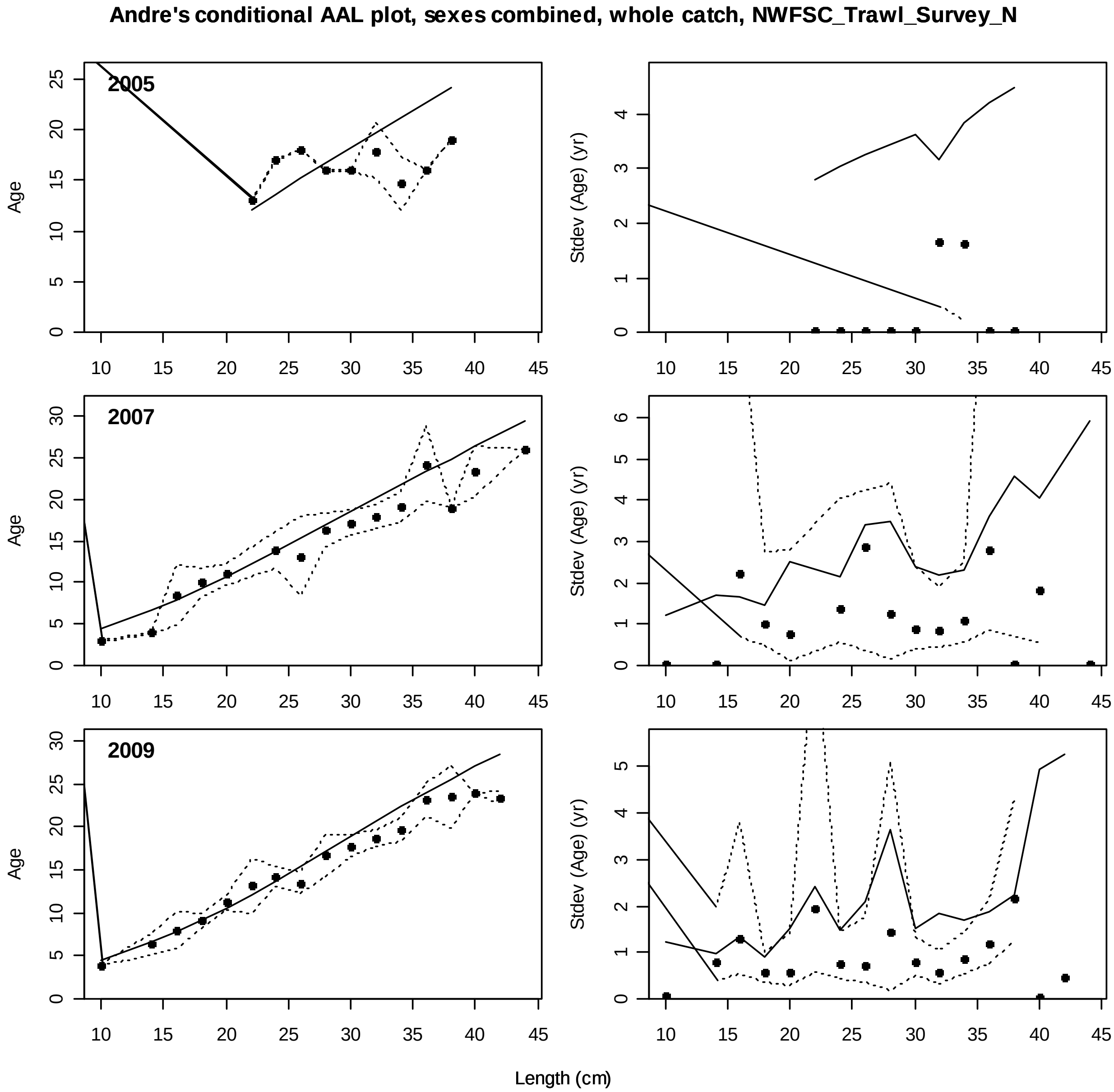
Length composition fits to NWFSC trawl survey in northern California.



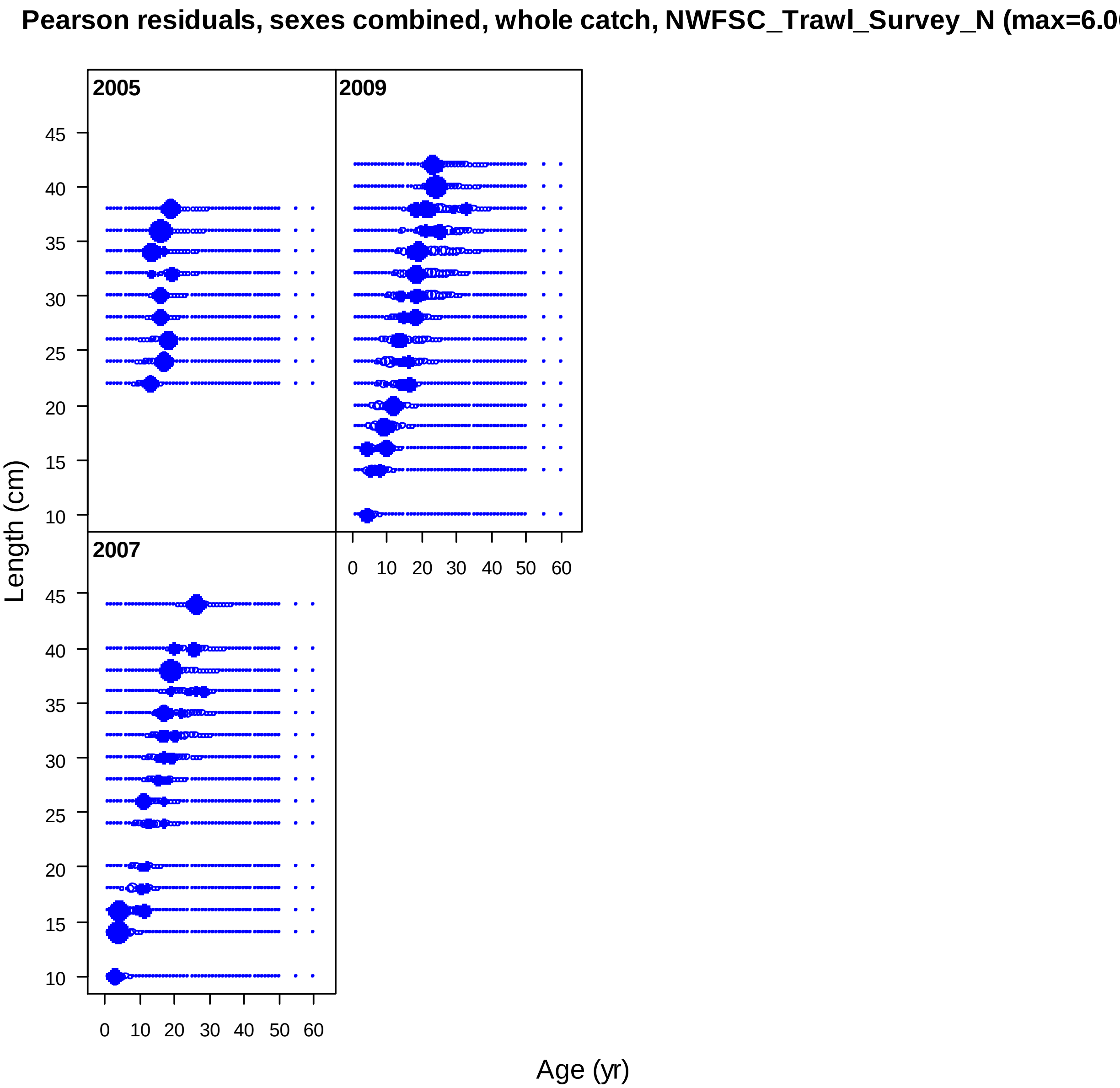
Length composition residuals for NWFSC trawl survey in northern California.



Effective sample size plot for NWFSC trawl survey in northern California.

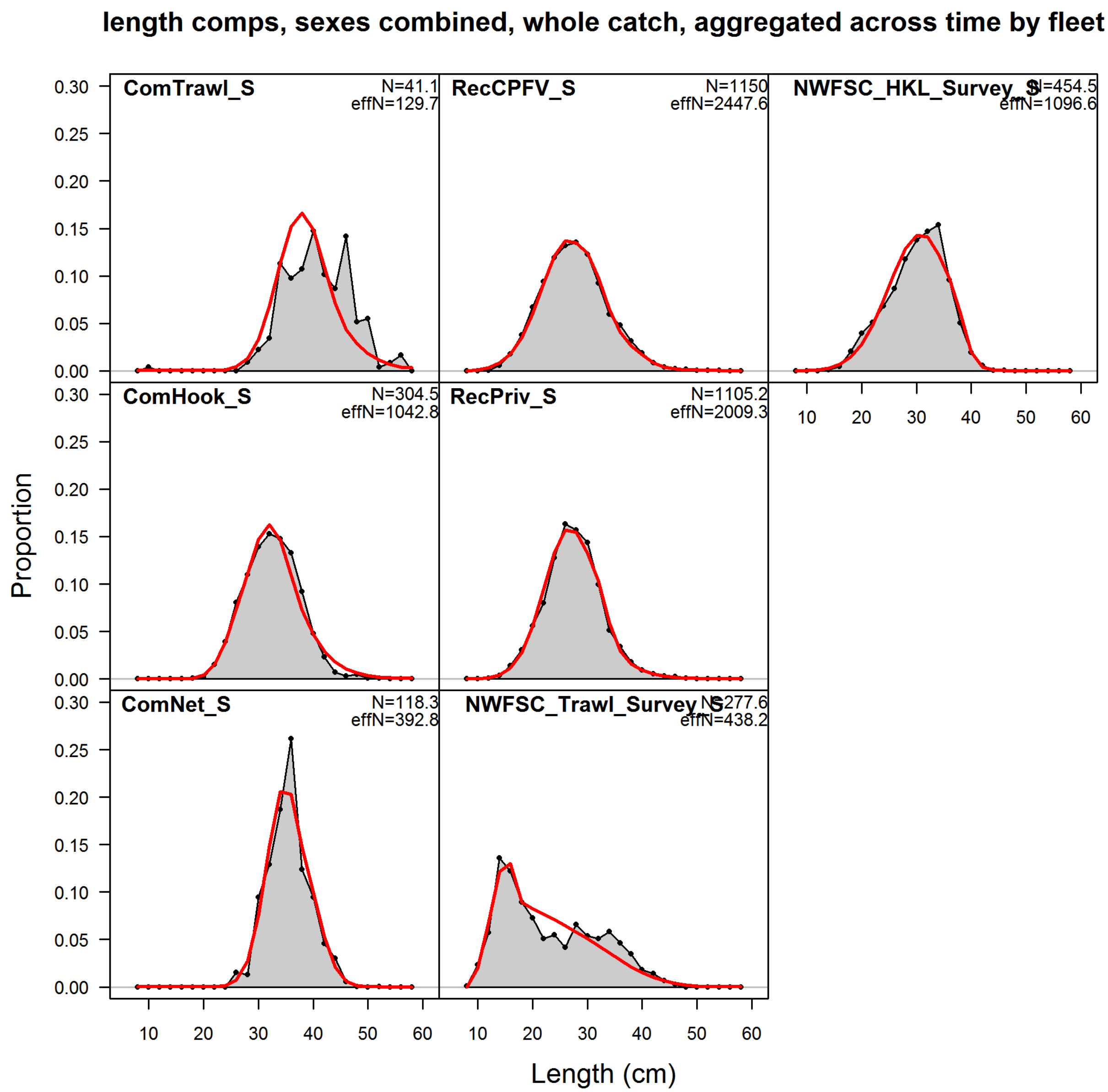


Conditional age-at-length fits to NWFSC trawl survey in northern California

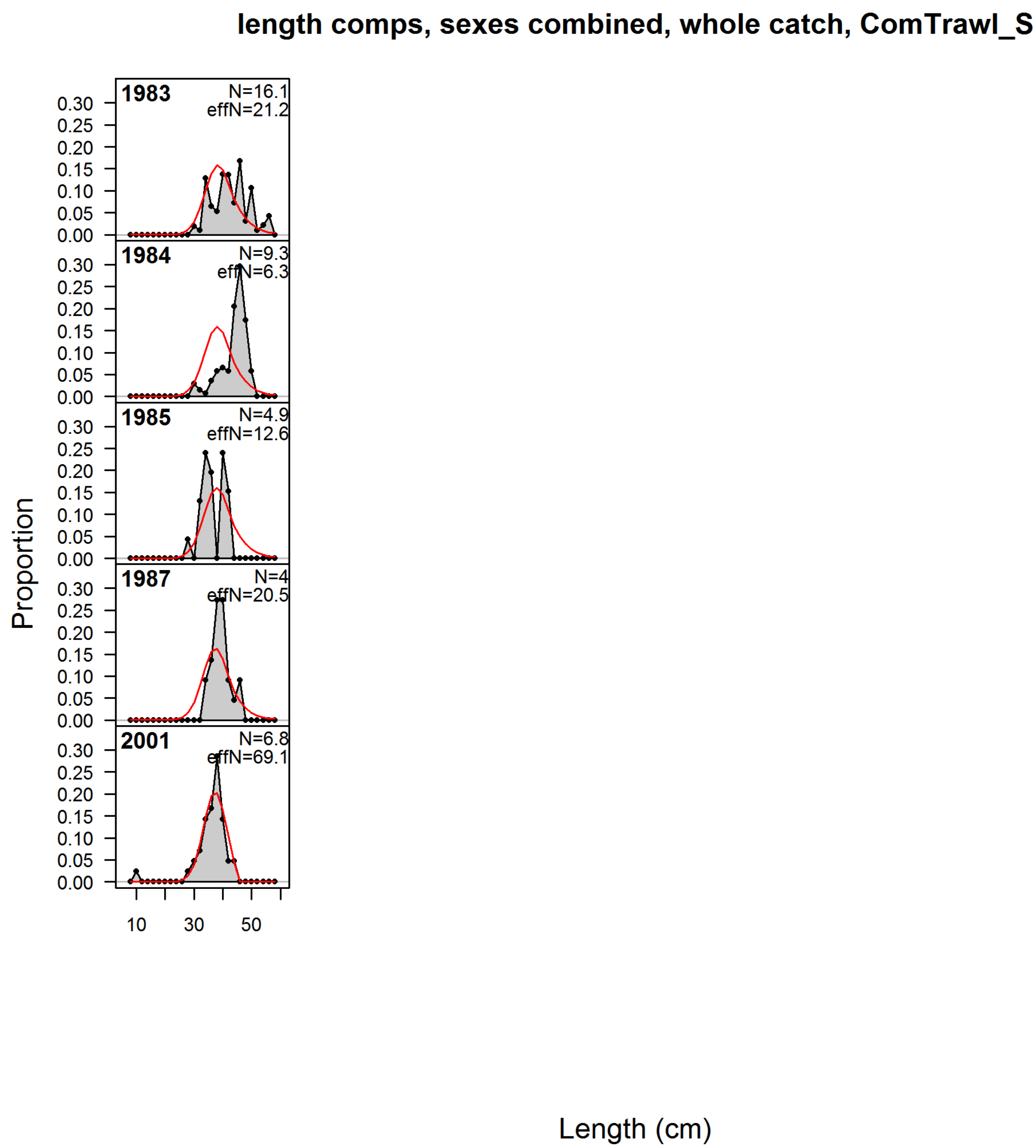


Conditional age-at-length residuals for NWFSC trawl survey in northern California

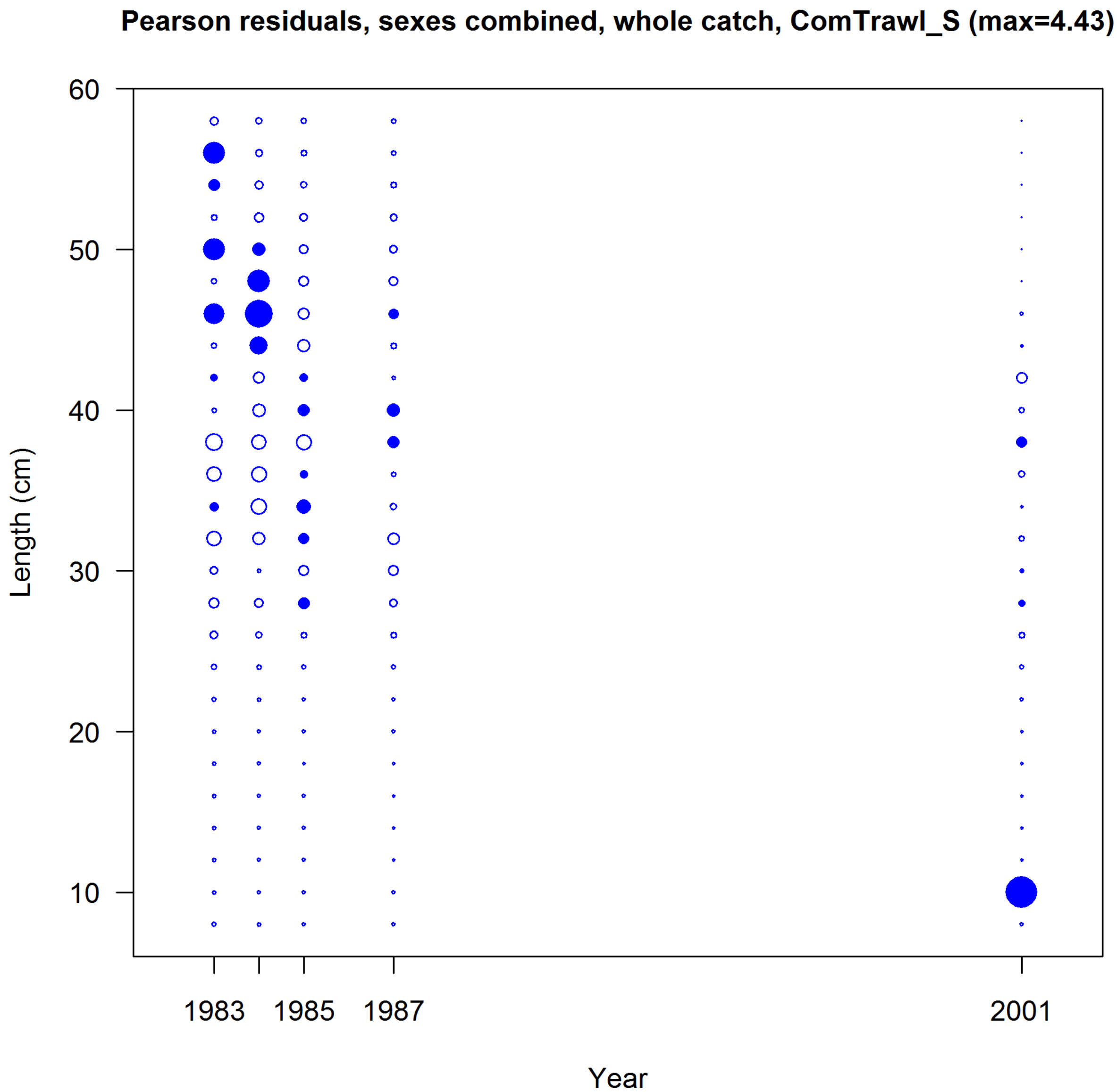
Appendix F: Base model fits to southern California fishery length and age data with diagnostics



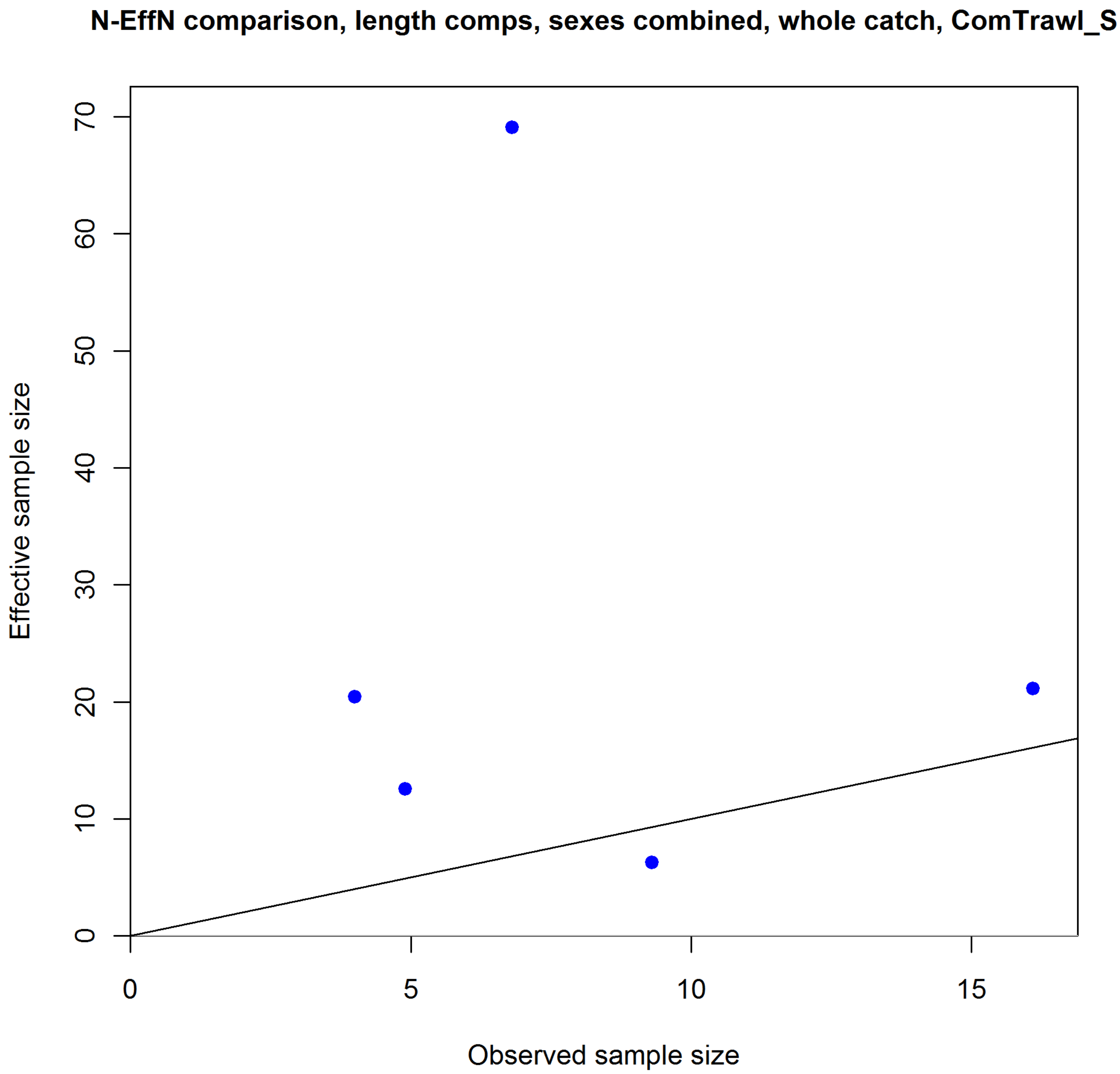
Fits to southern California length composition data, all years combined.



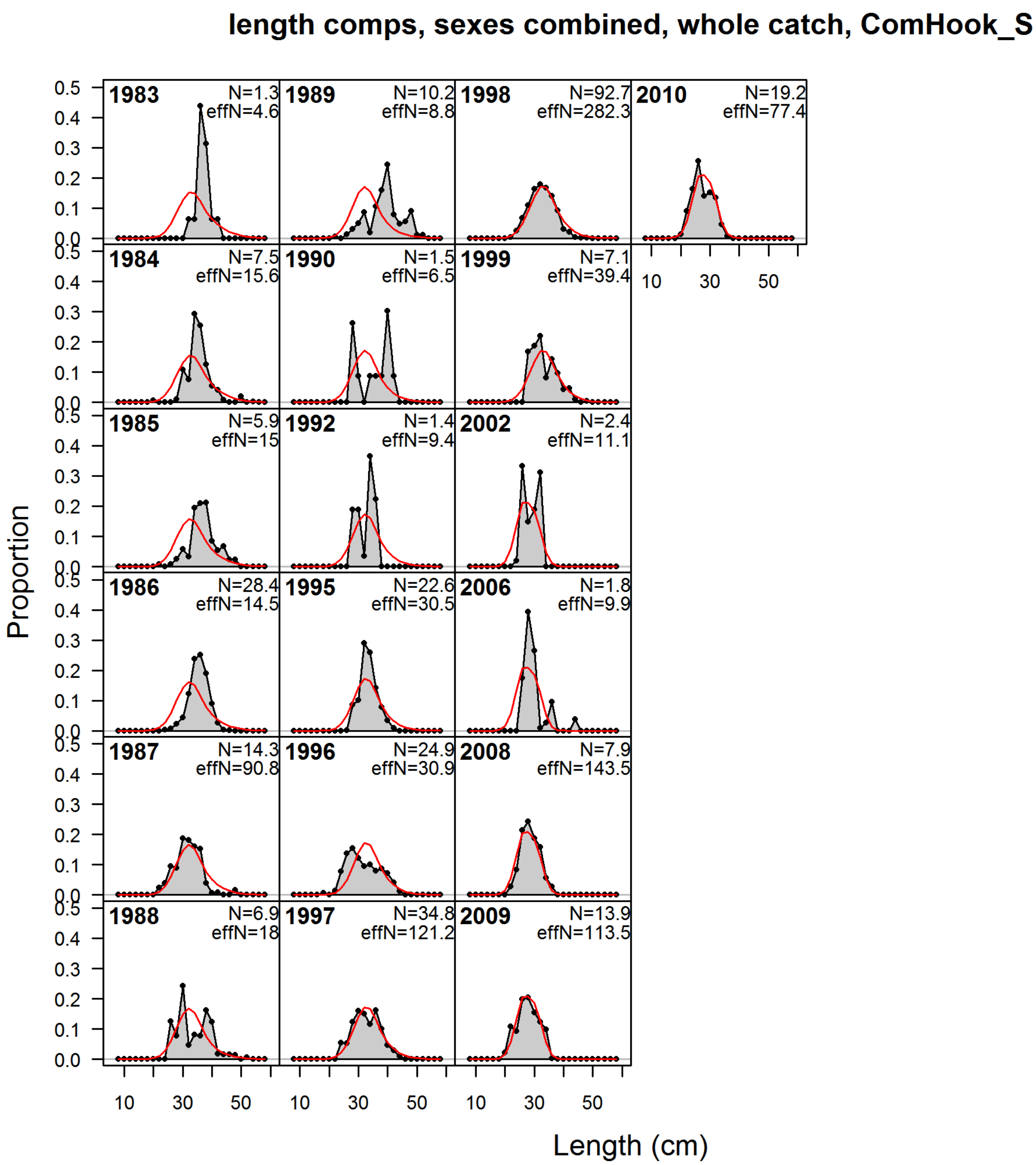
Length composition fits to southern California trawl fleet.



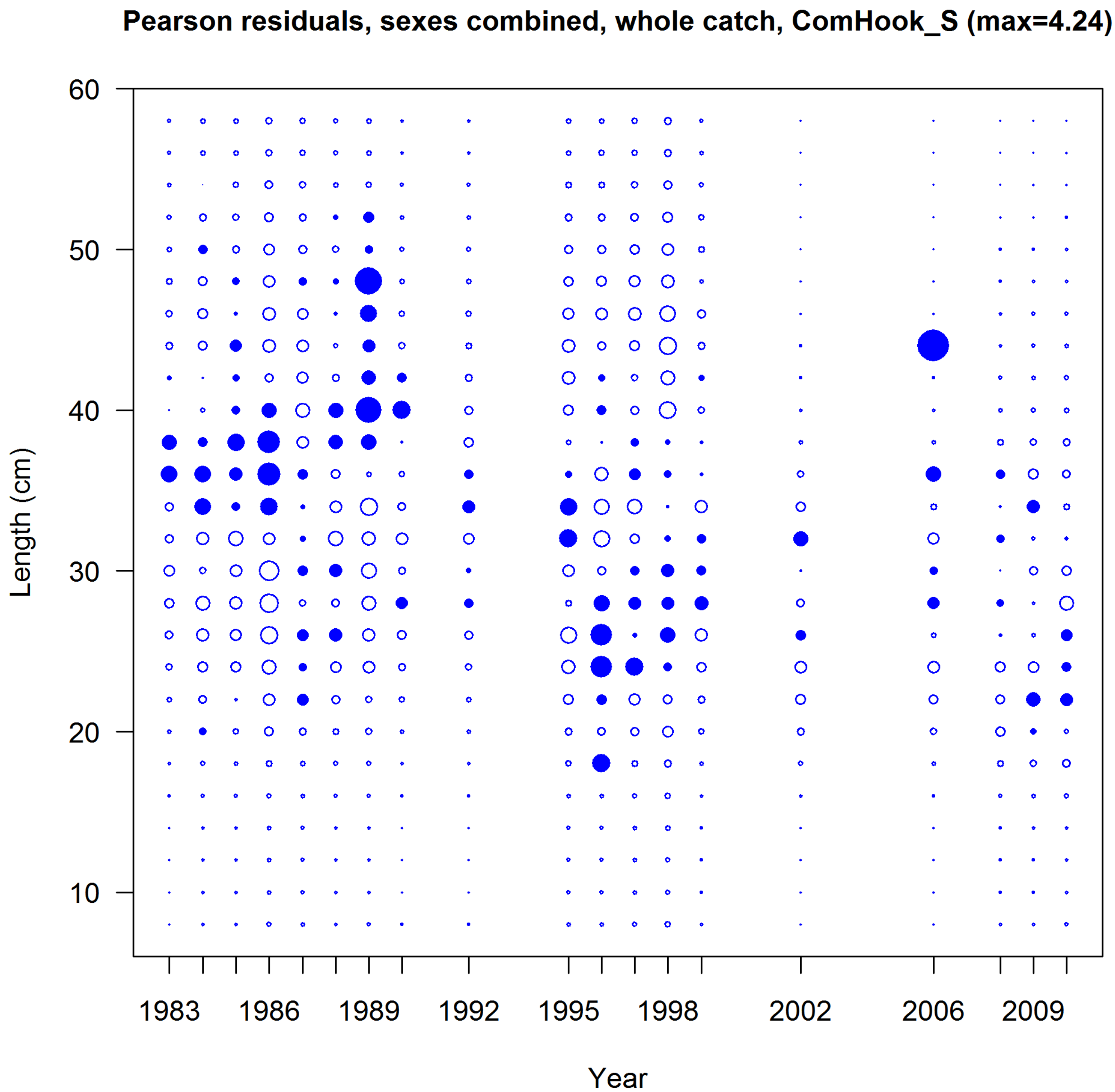
Length composition residuals for southern California trawl fleet.



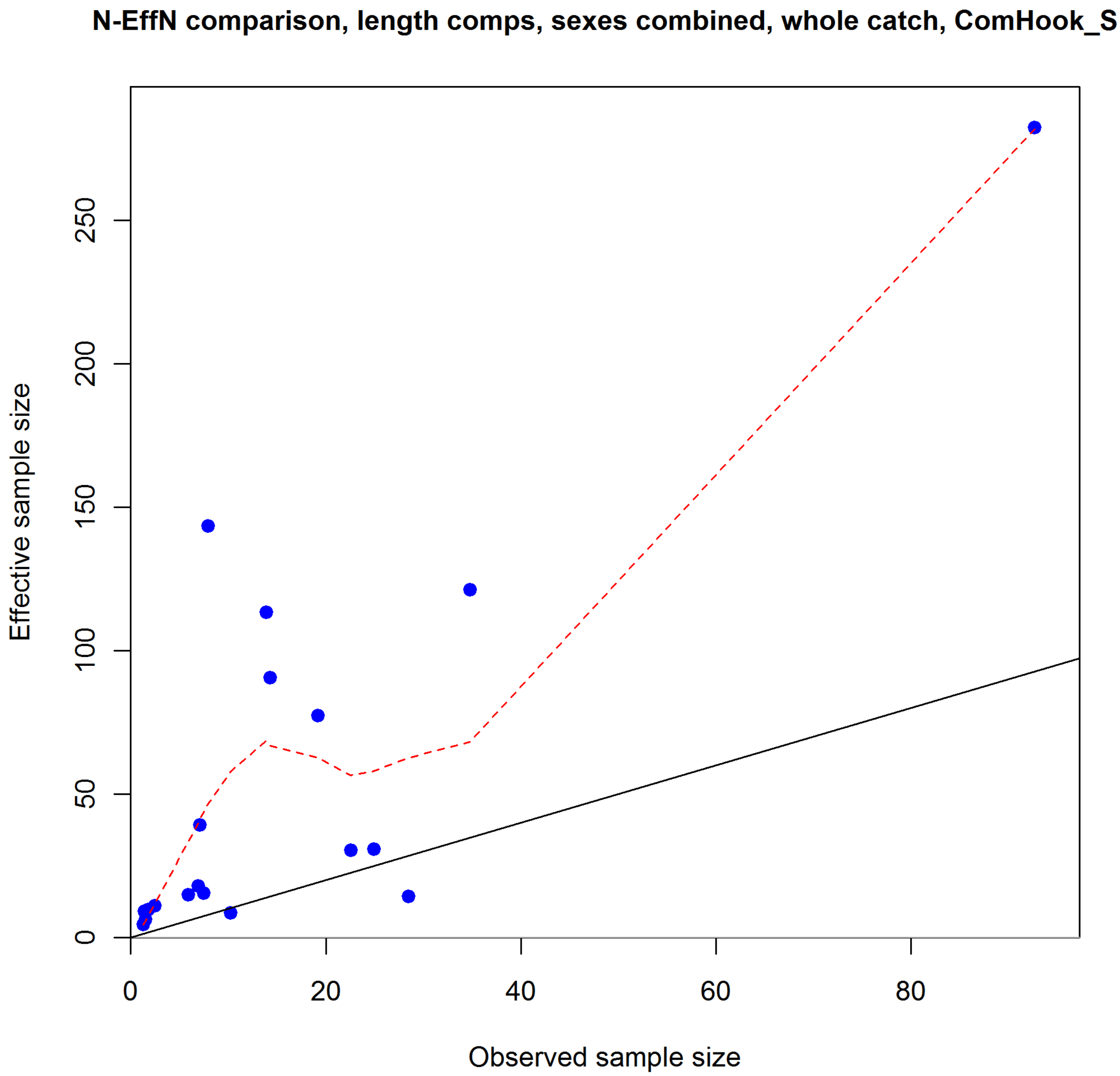
Effective sample size plot for southern California trawl fleet



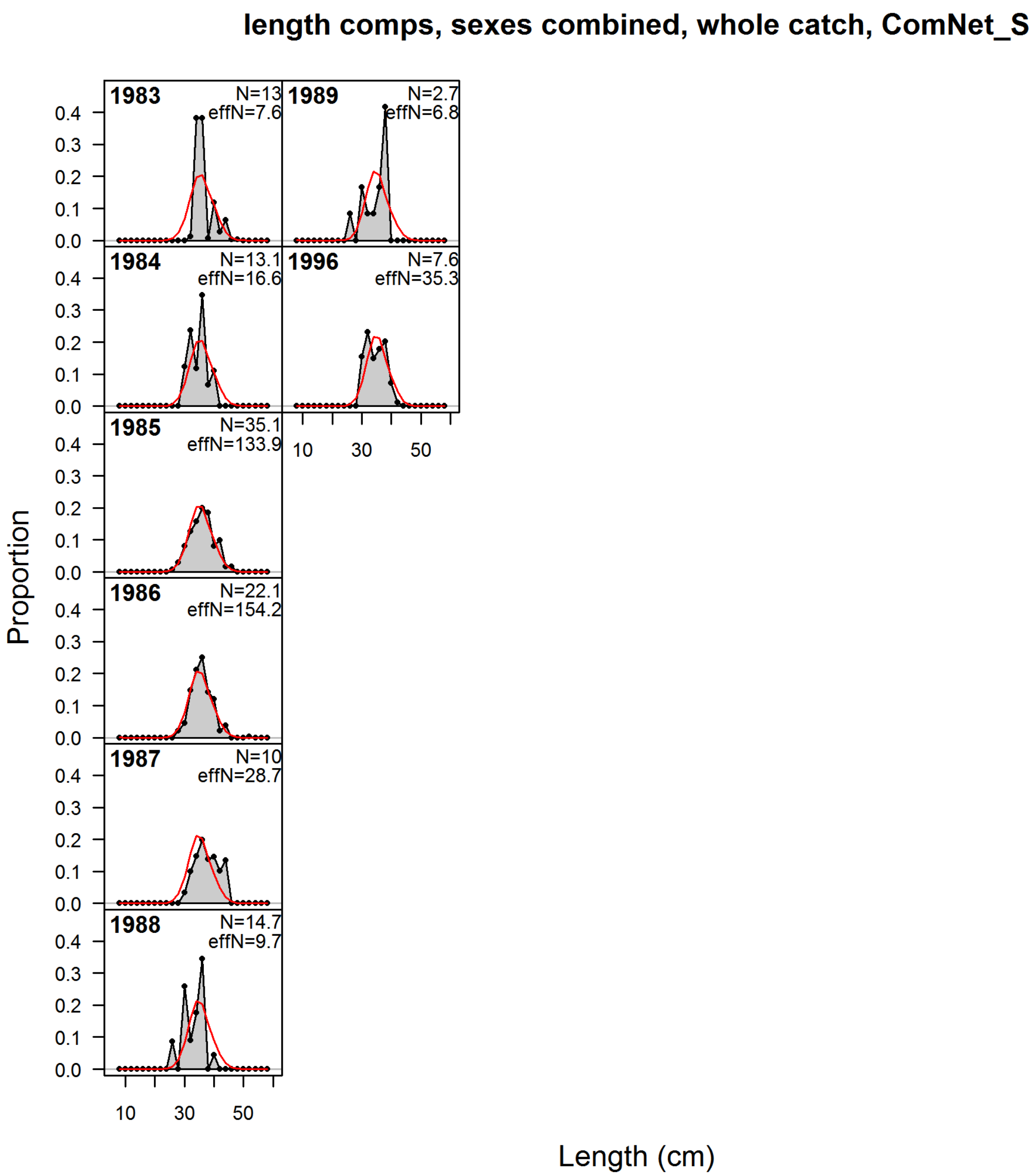
Length composition fits to southern California hook and line fleet.



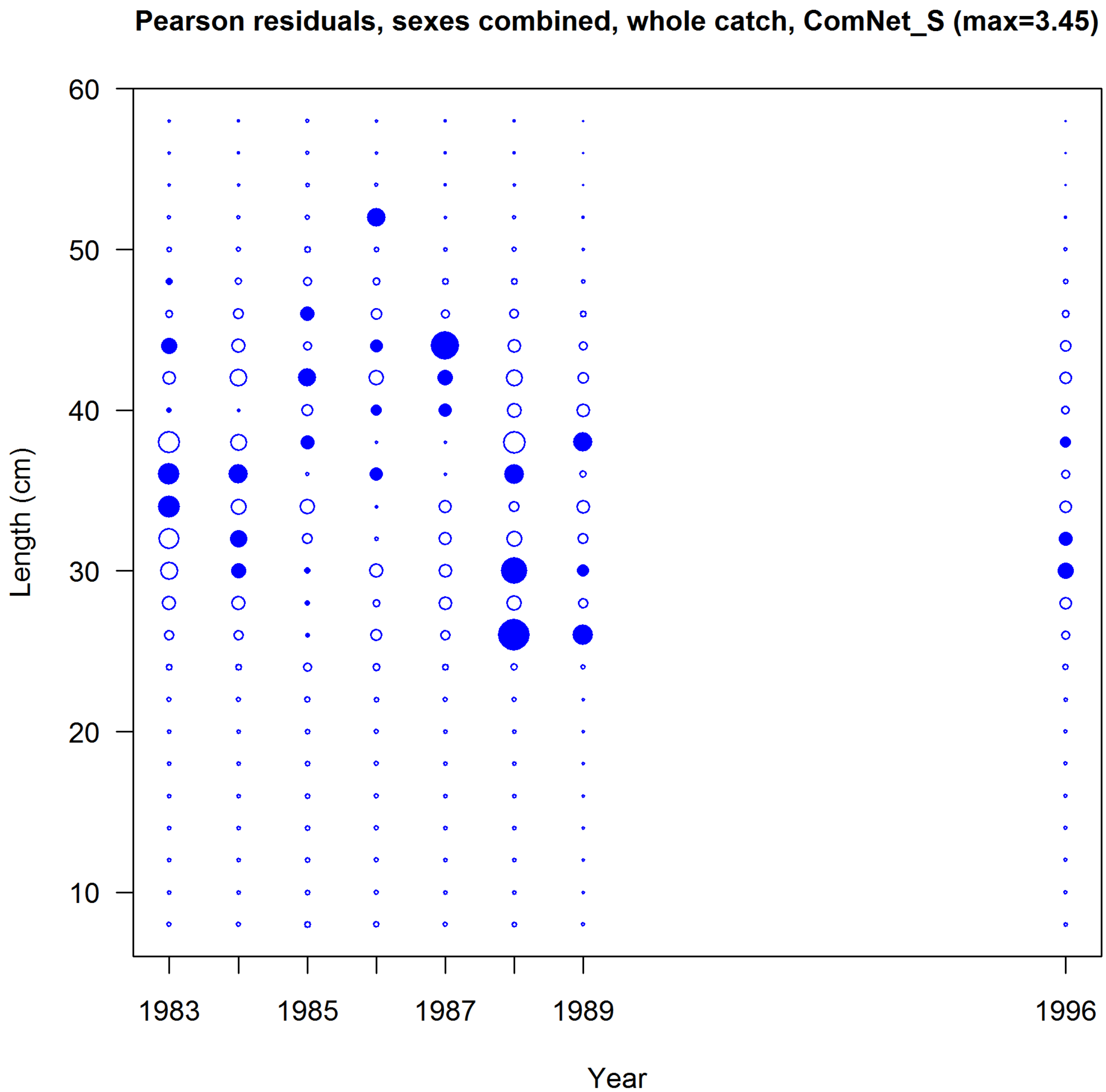
Length composition residuals for southern California hook and line fleet.



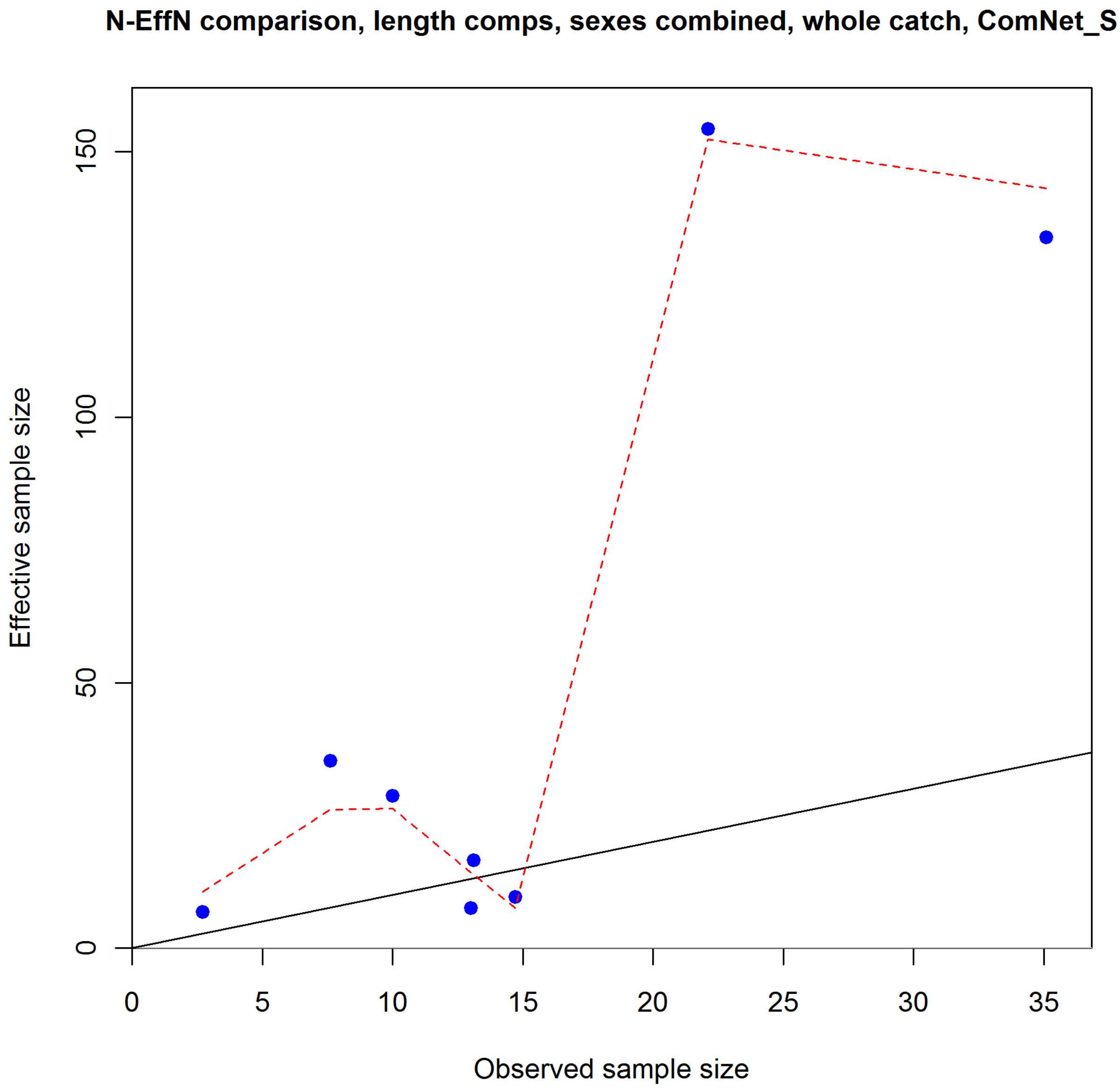
Effective sample size plot for southern California hook and line fleet



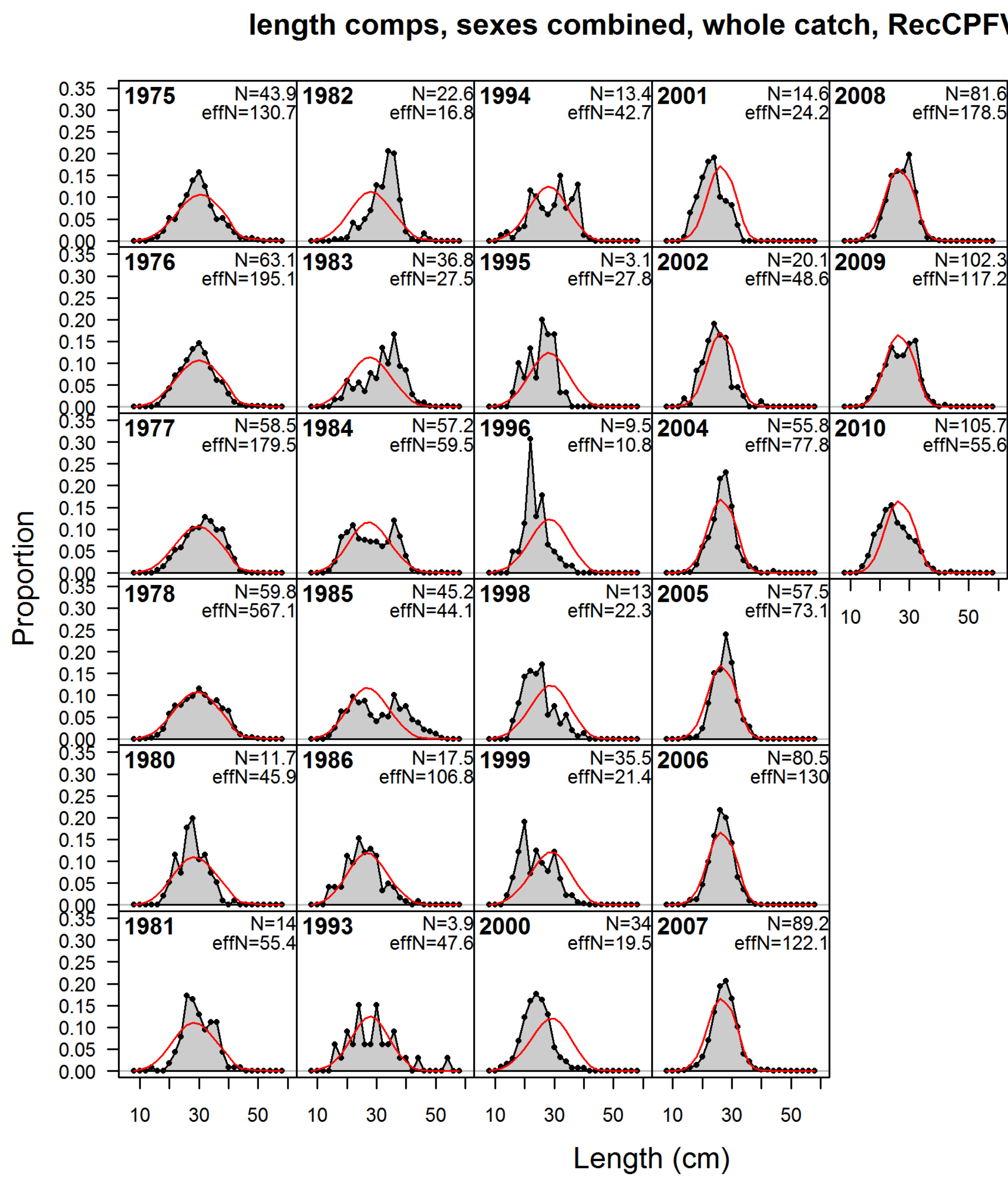
Length composition fits to southern California net fleet.



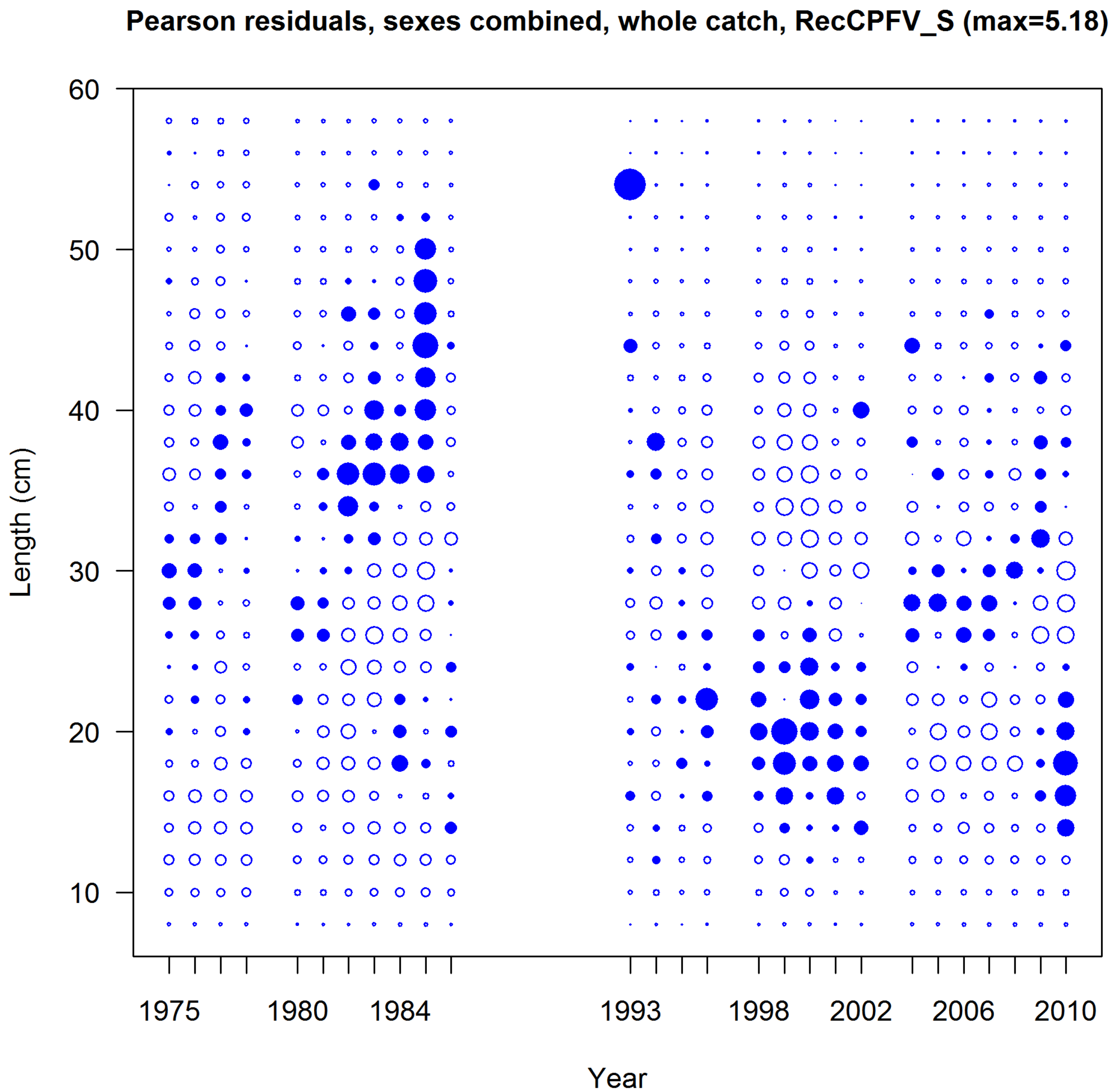
Length composition residuals for southern California net fleet.



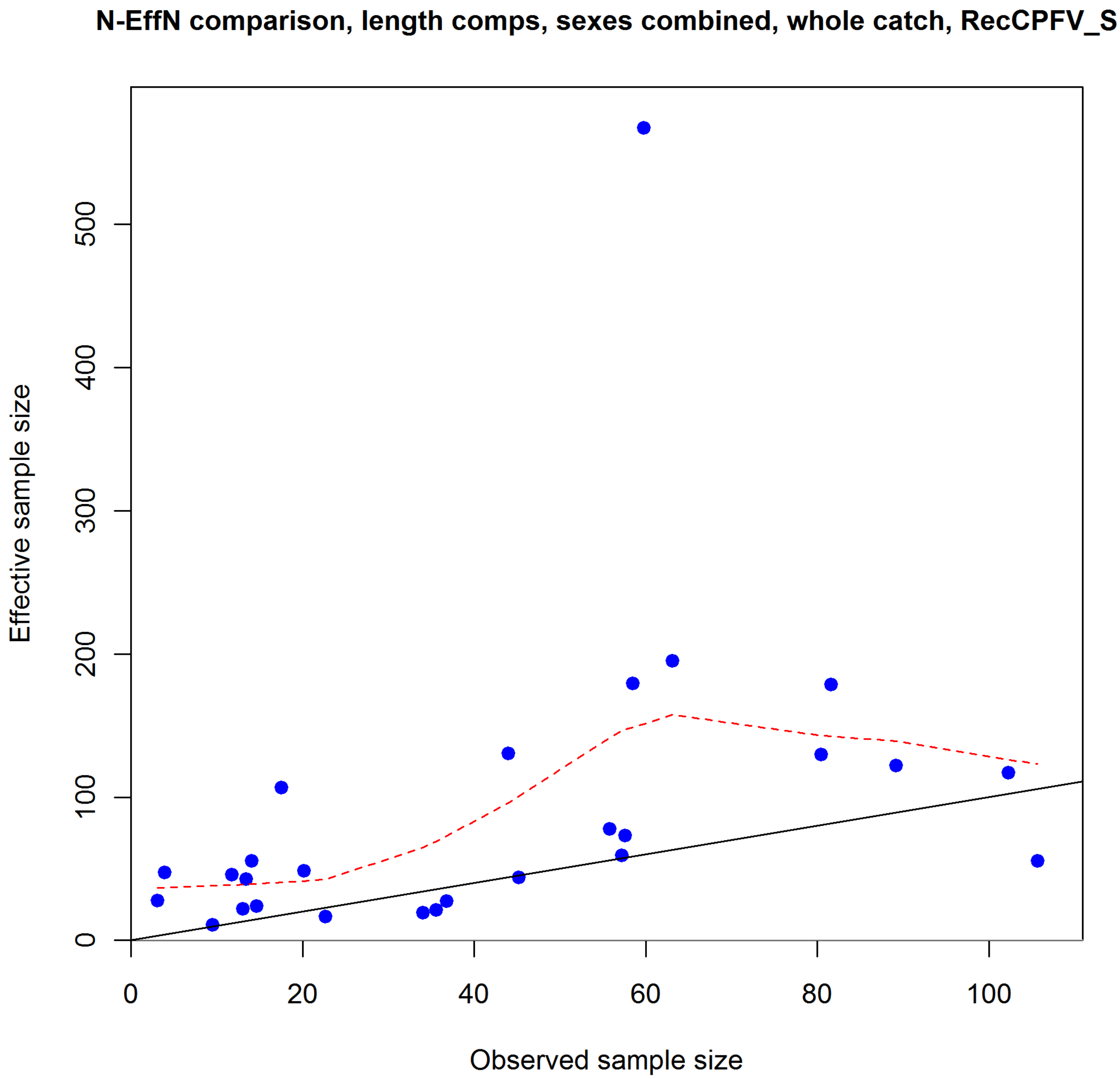
Effective sample size plot for southern California net fleet



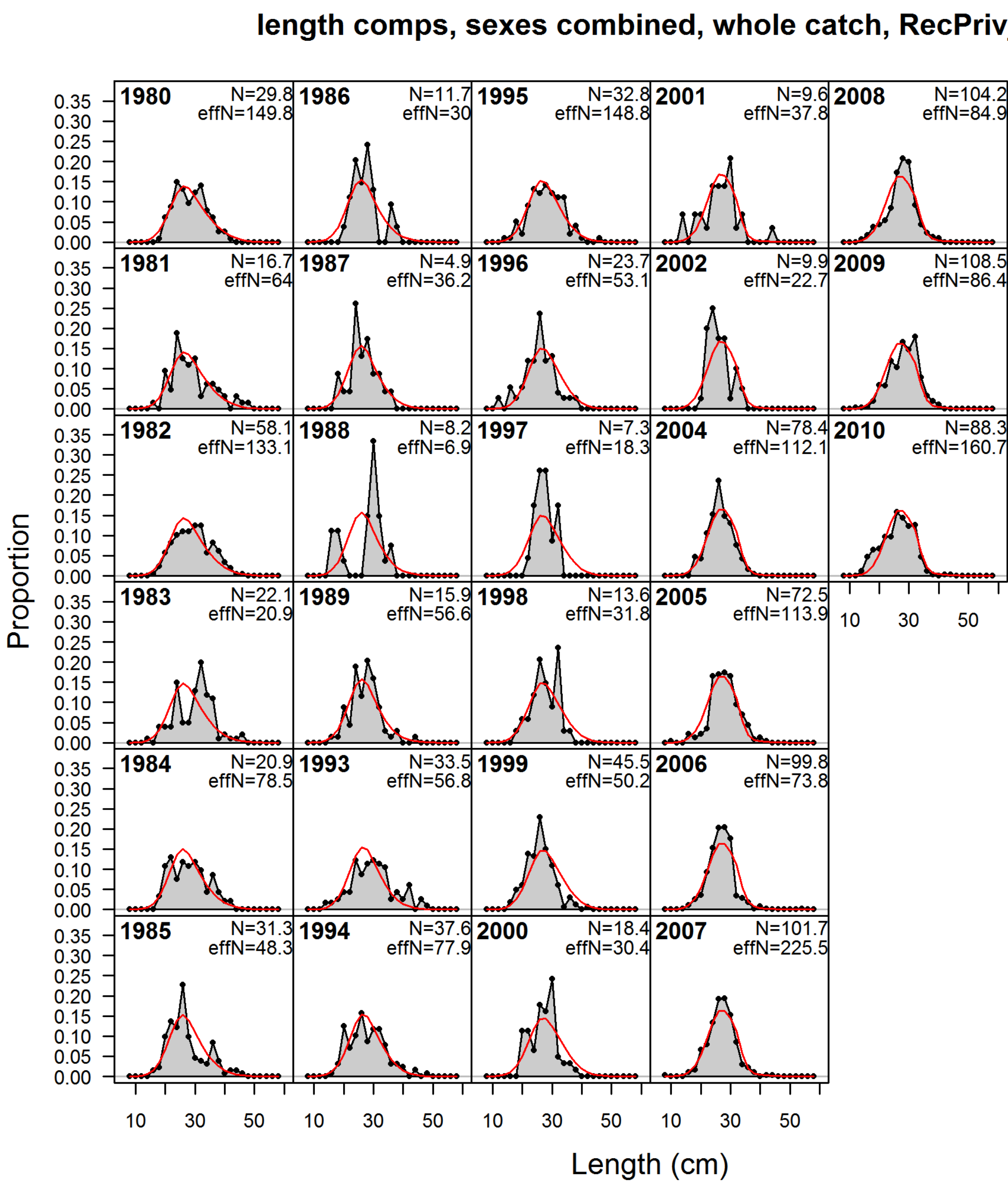
Length composition fits to southern California CPFV fleet.



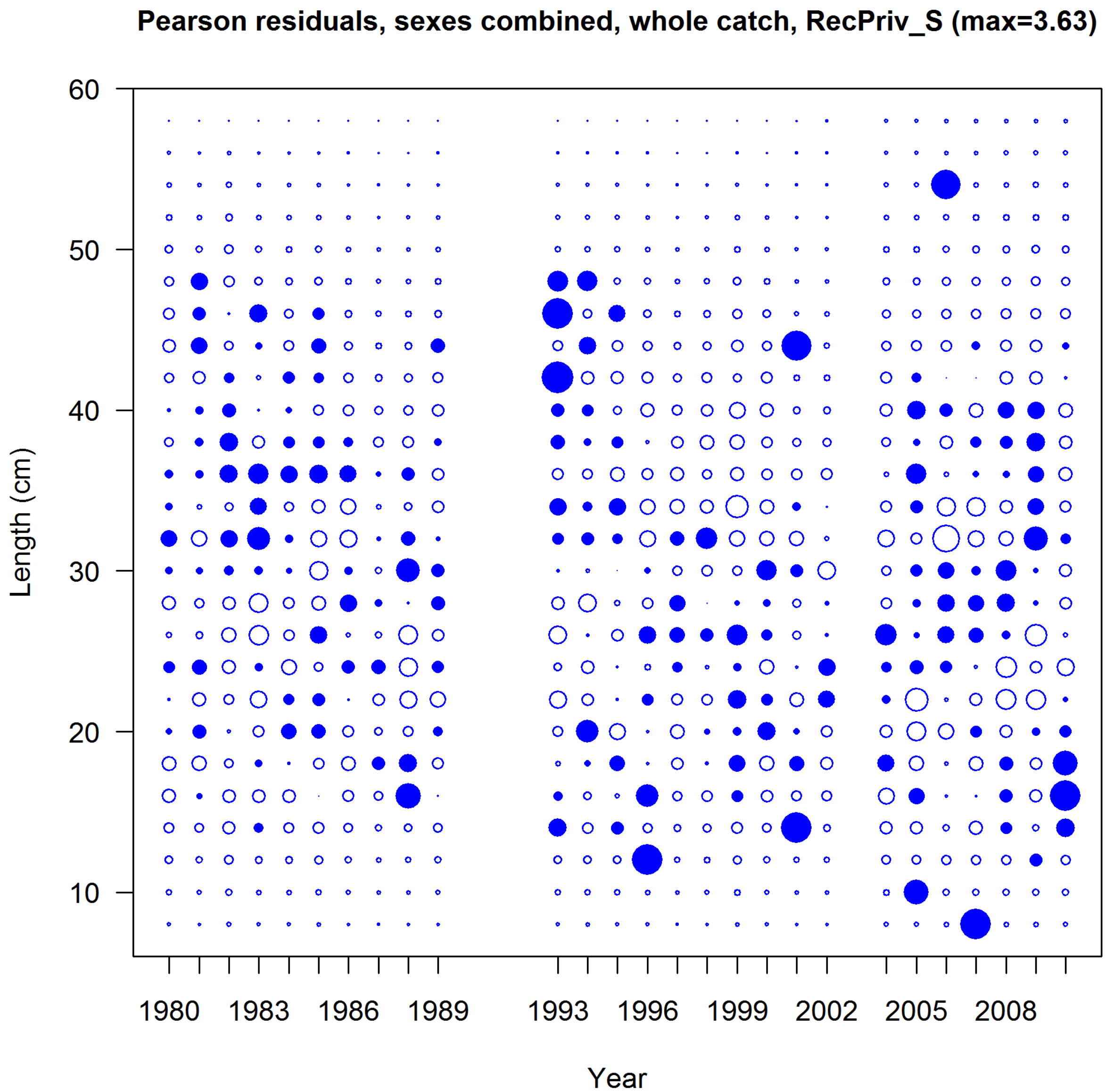
Length composition residuals for southern California CPFV fleet.



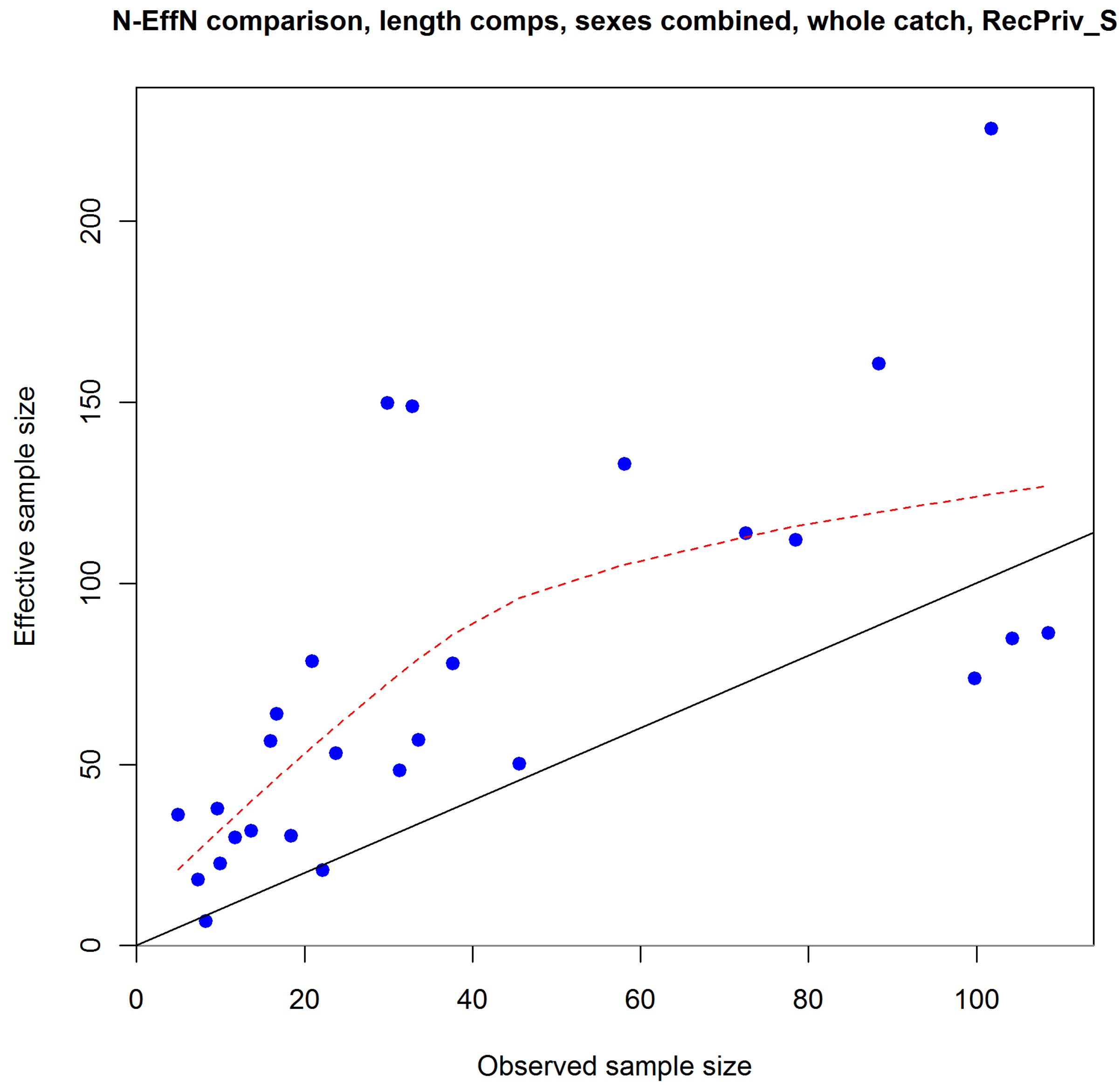
Effective sample size plot for southern California CPFV fleet



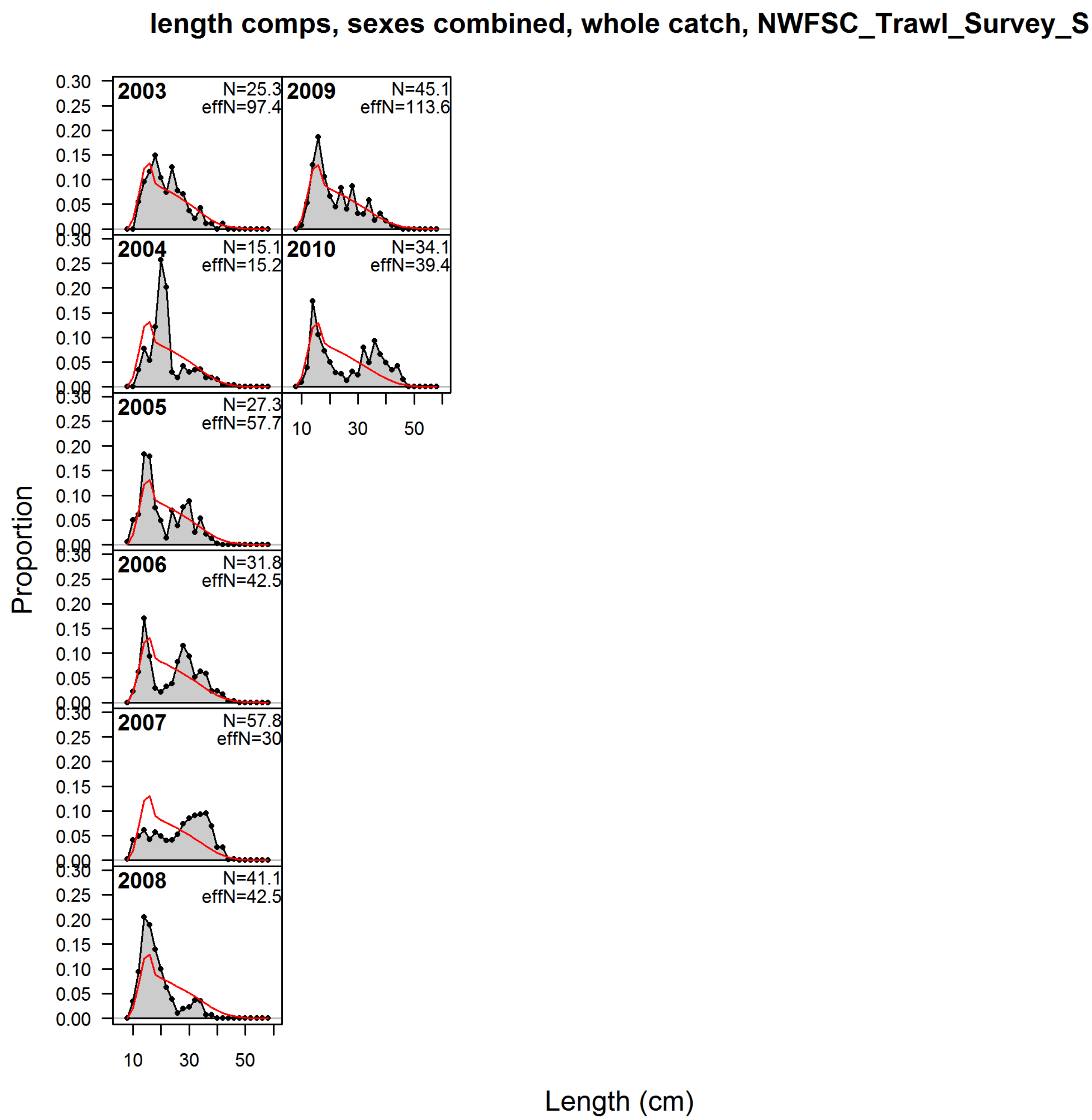
Length composition fits to southern California private/rental fleet.



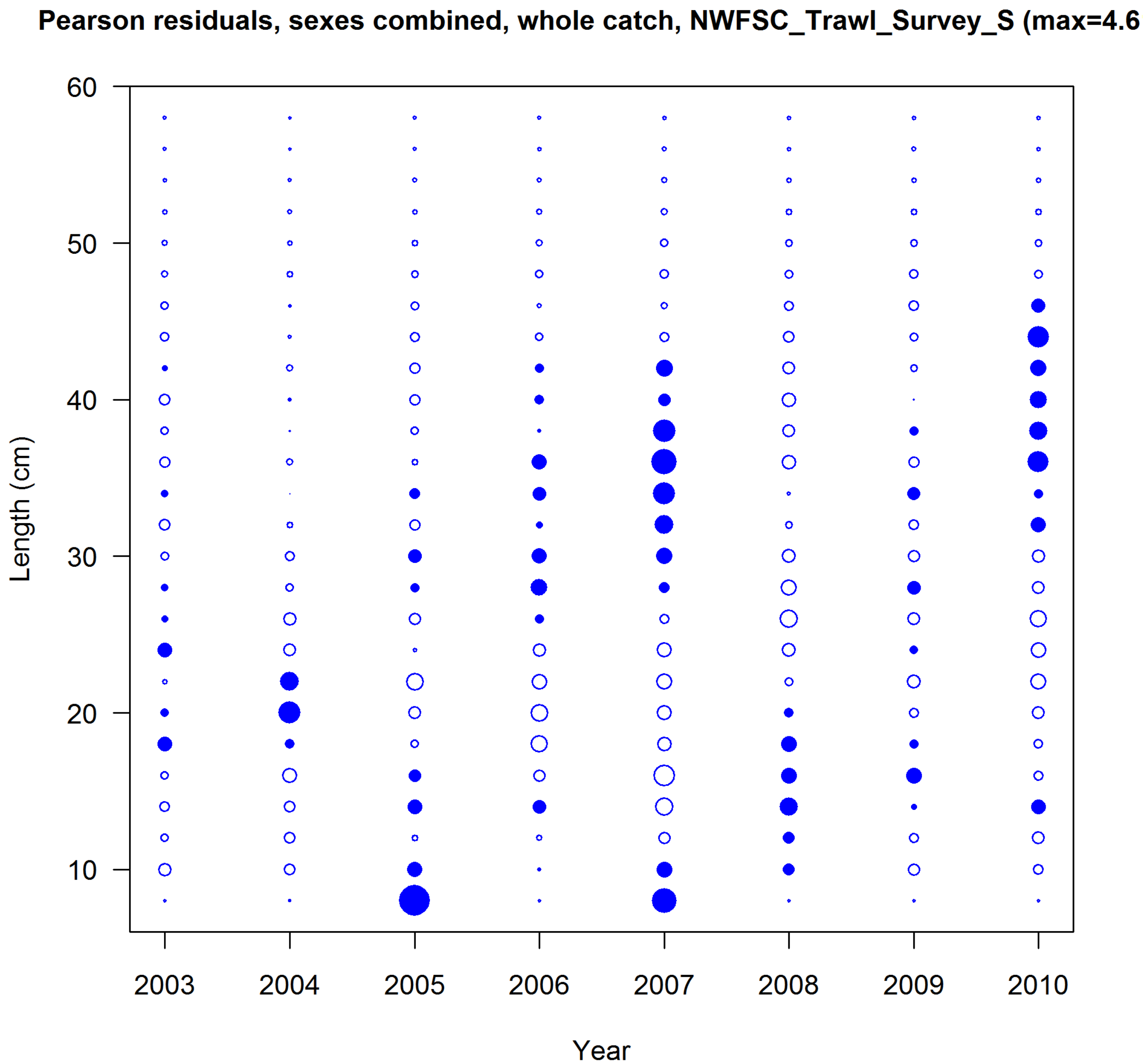
Length composition residuals for southern California private/rental fleet.



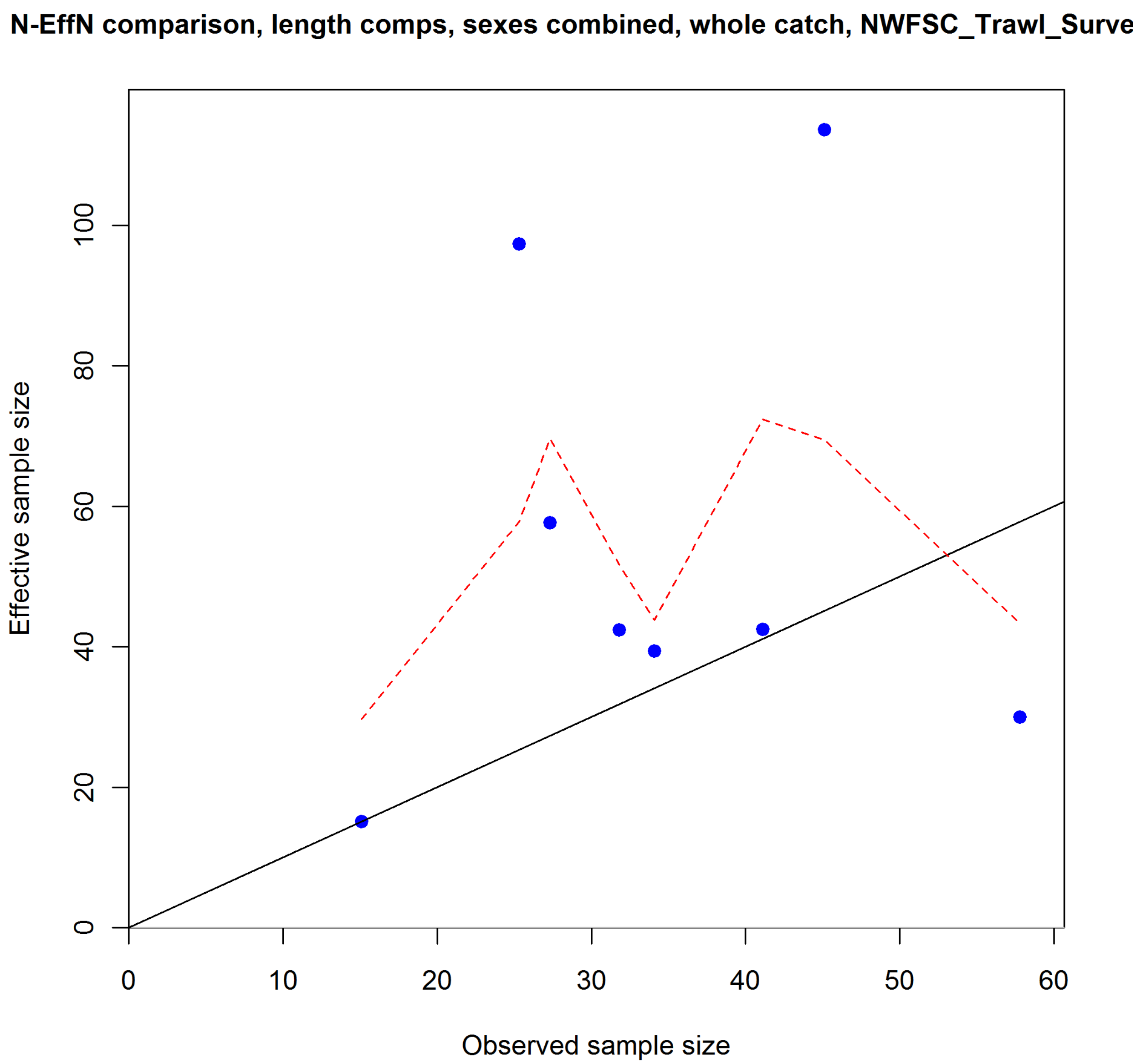
Effective sample size plot for southern California private/rental fleet



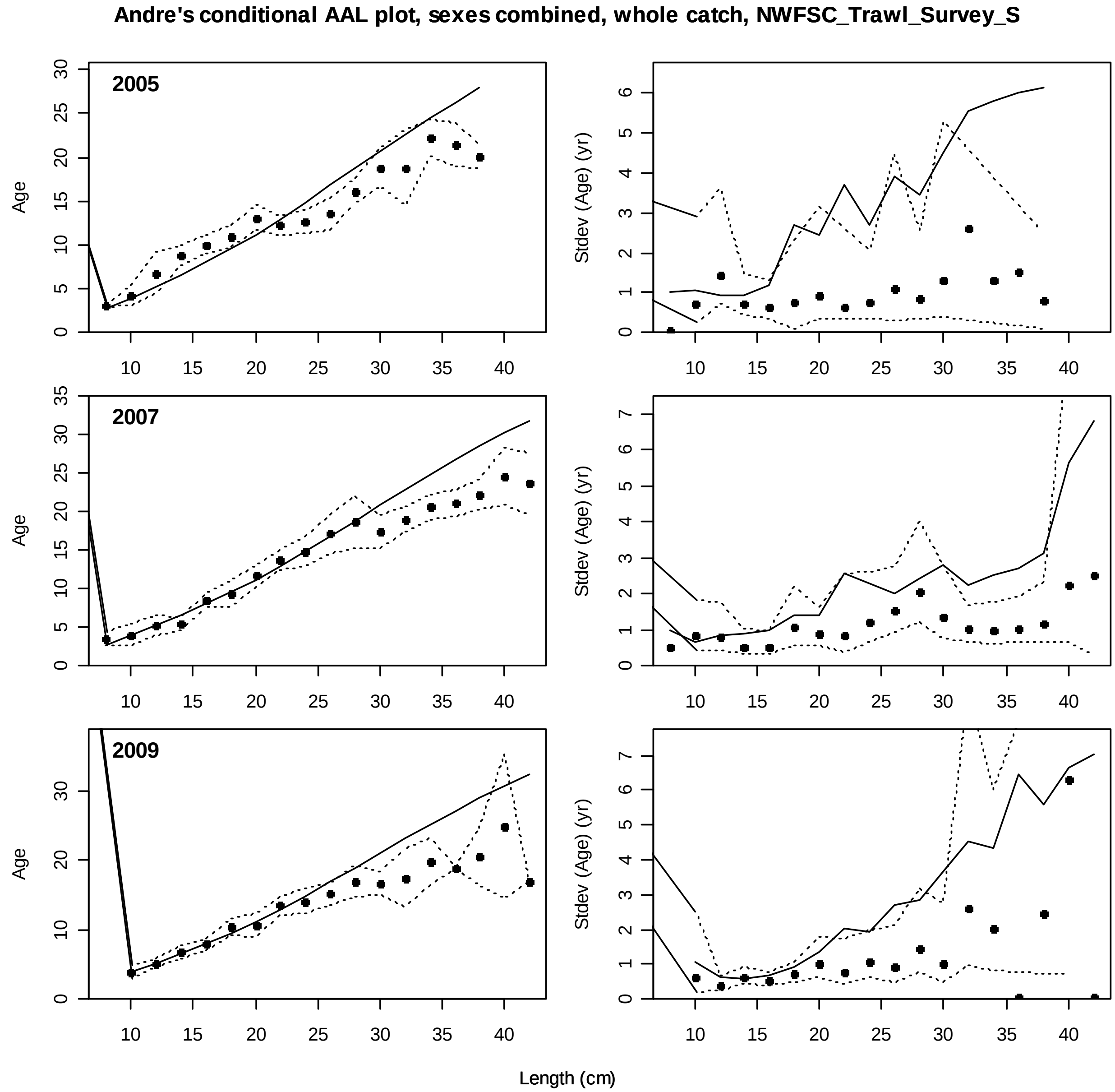
Length composition fits to southern California NWFSC trawl survey data



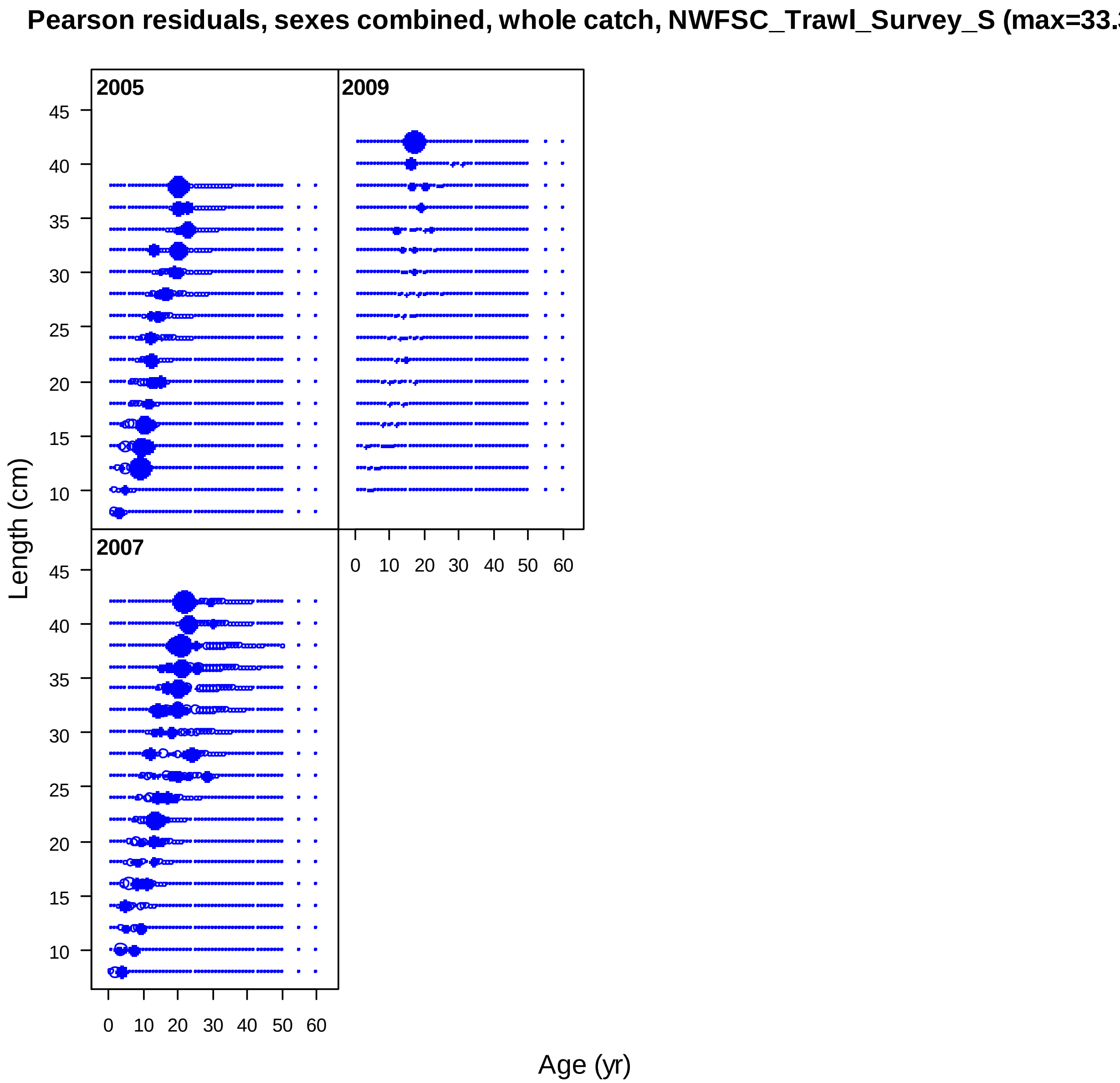
Length composition residuals for southern California NWFSC trawl survey data.



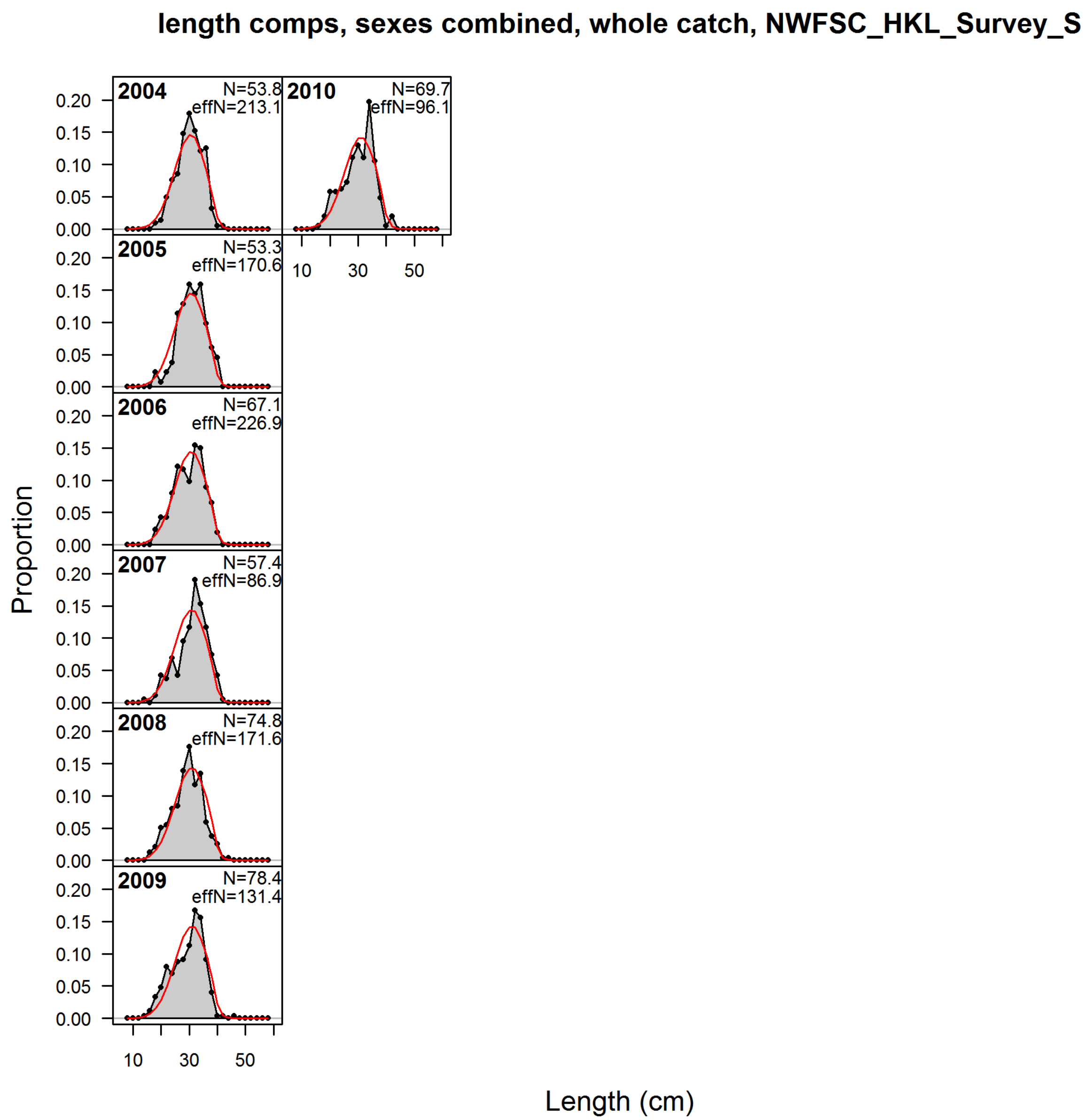
Effective sample size plot for southern California NWFSC trawl survey data



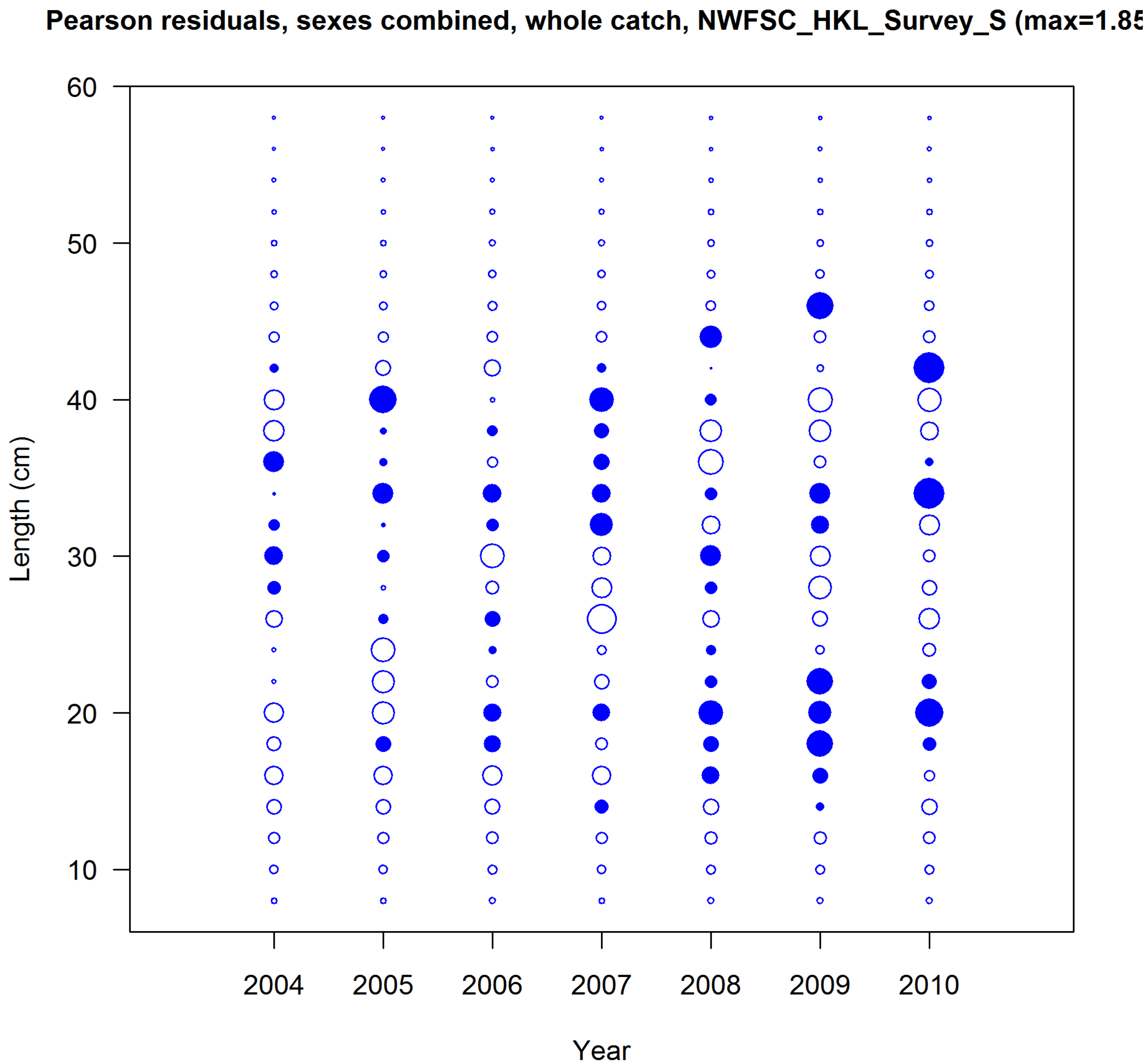
Conditional age-at-length fits to southern California NWFSC trawl survey data



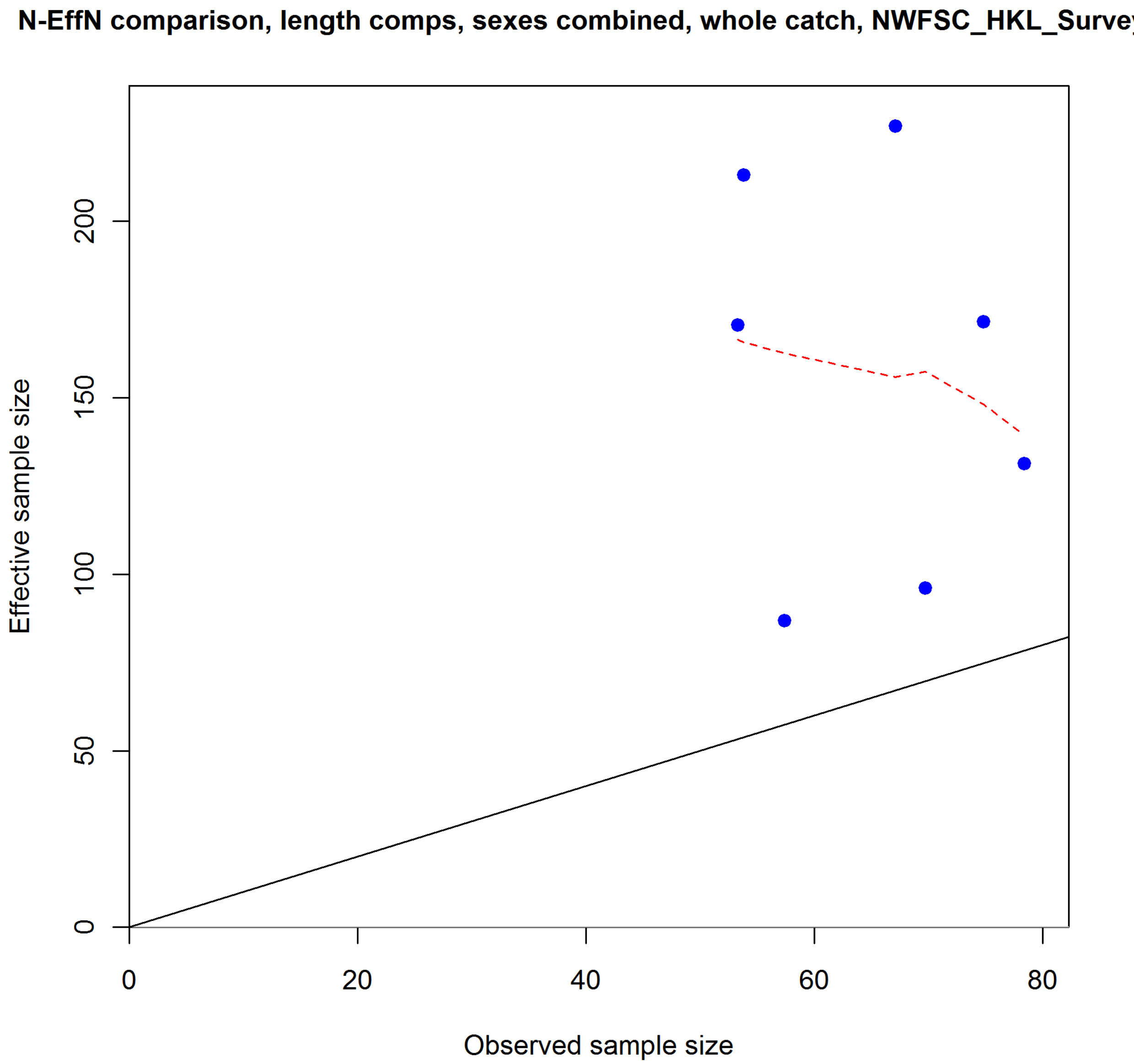
Conditional age-at-length residuals for southern California NWFSC trawl survey data



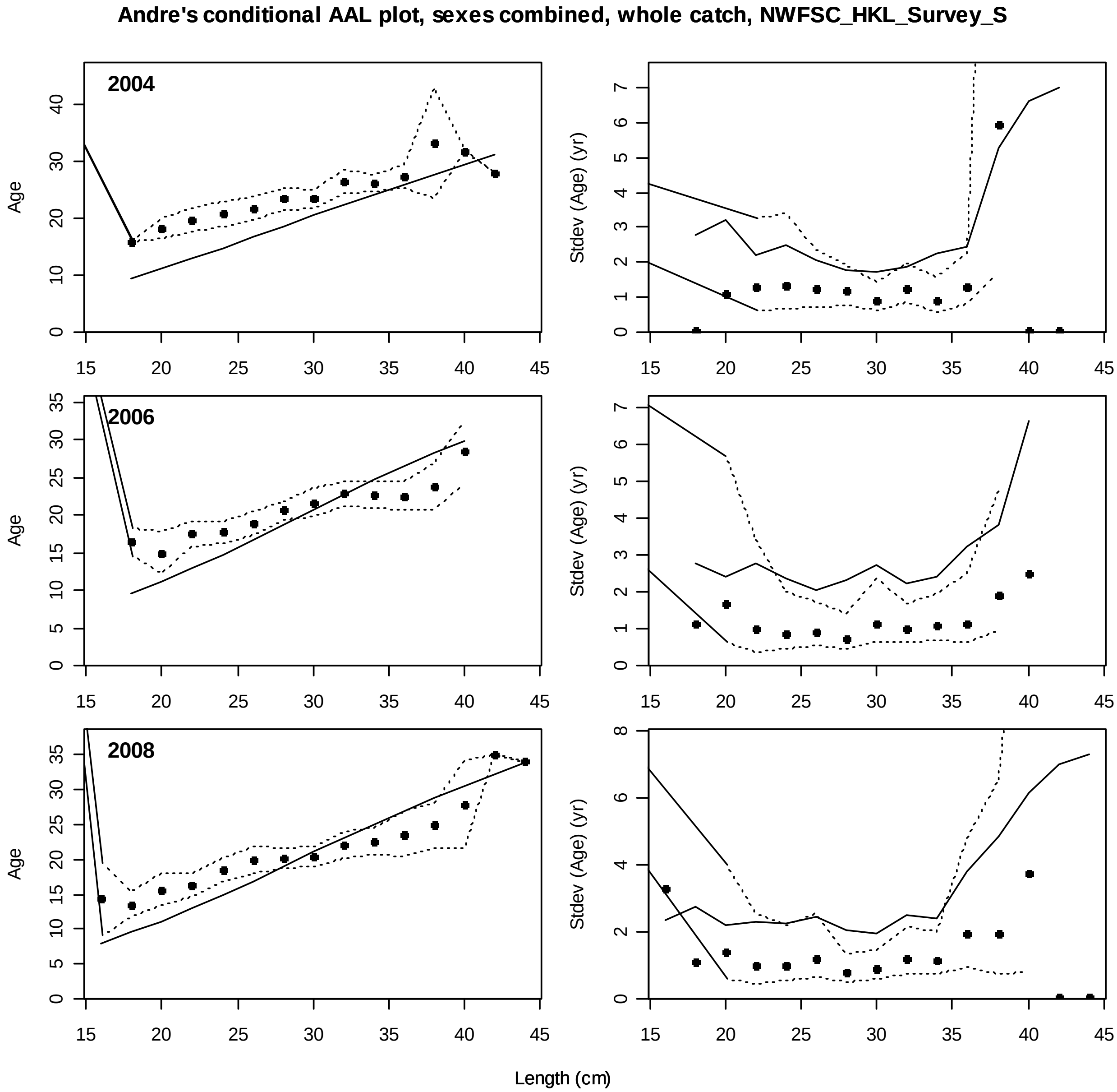
Length composition fits to southern California NWFSC hook and line survey data.



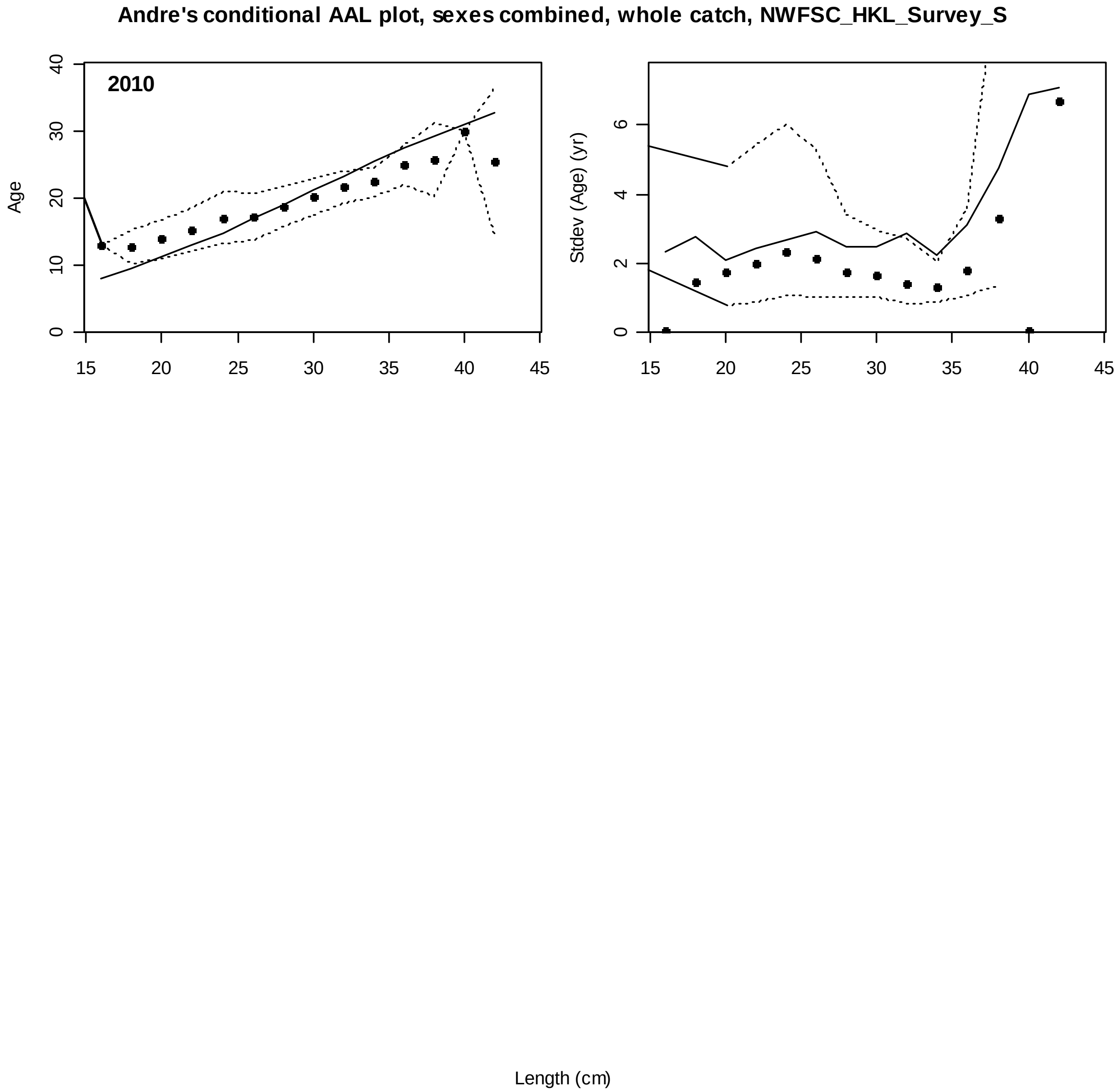
Length composition residuals for southern California NWFSC hook and line survey data.



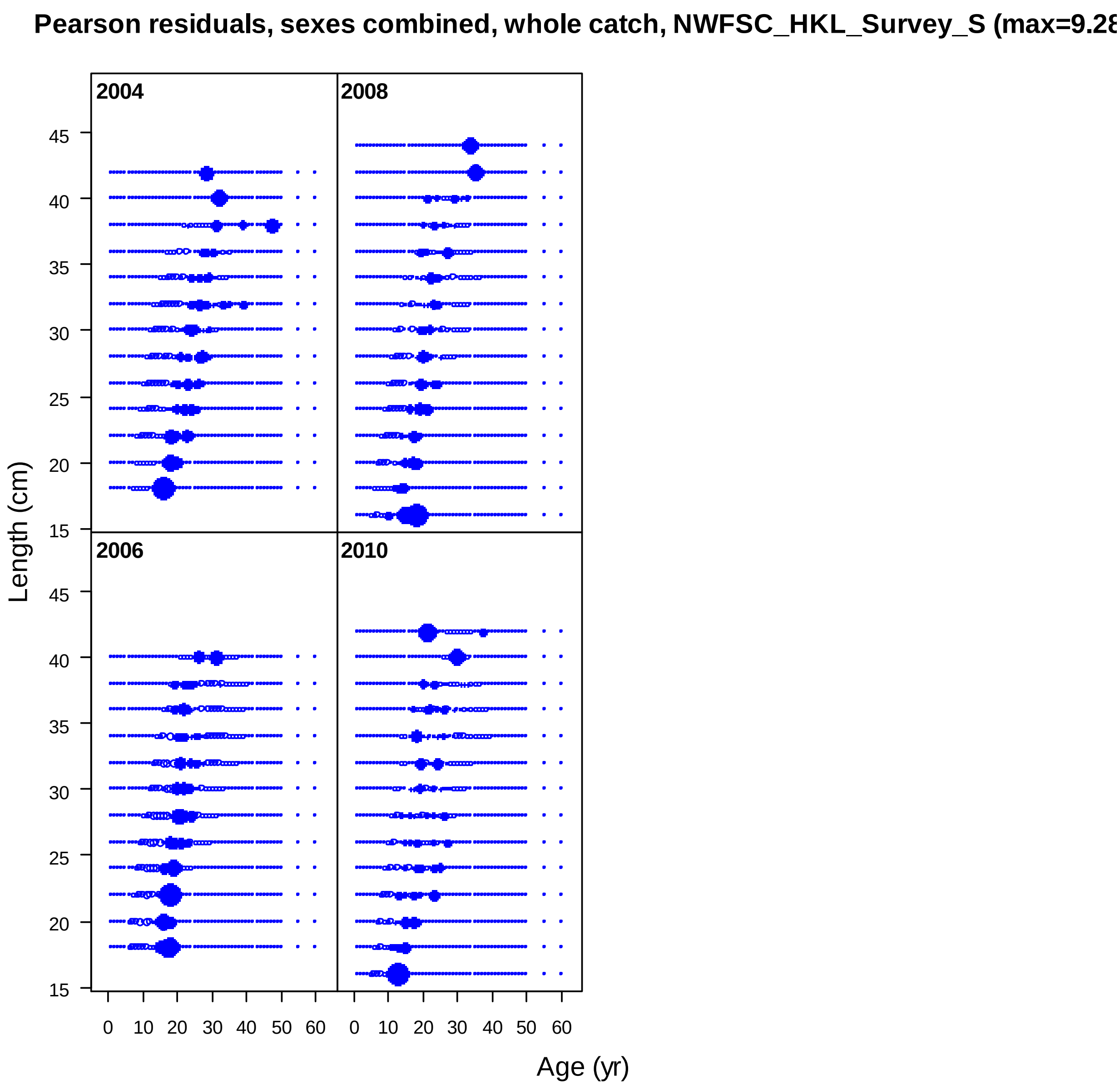
Effective sample size plot for southern California NWFSC hook and line survey data



Conditional age-at-length fits to southern California NWFSC hook and line survey data



Conditional age-at-length fits to southern California NWFSC hook and line survey data (Cont.)



Conditional age-at-length residuals for southern California NWFSC hook and line survey data

Appendix G: Stock Synthesis data files

Data file for northern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters off California, north of Point Conception

# MODEL DIMENSIONS
# ----------------
1916   #_styr
2010   #_endyr
1      #_nseas
12     #_months/season
1      #_spawn_seas
4      #_Nfleet
3      #_Nsurveys
1      #_N_areas

# FLEET/SURVEY NAMES, TIMING, ETC.
# --------------------------------
# Fishery & survey names separated by "%"
ComTrawl_N%ComHook_N%ComNet_N%Rec_N%RecDockside_N%NWFSC_Trawl_Survey_N%RecOnboard_N
0.5    0.5    0.5    0.5    0.5    0.5    0.5    #_surveytiming_in_season
1      1      1      1      1      1      1
       #_area_assignments_for_each_fishery_and_survey
1      1      1      1                           #_units of catch: 1=bio; 2=num
0.05   0.05   0.05   0.05                        #_se of log(catch) only used for
init_eq_catch and for Fmethod 2 and 3

1      #_Ngenders
65     #_Nages

0      0      0      0      #_init_equil_catch_for_each_fishery

95     #_N_lines_of_catch_to_read

# Catch in biomass (mt)
# ------------------------------------------------
#ComTrawl_N  ComHook_N    ComNet_N     Rec_N  Year   Season
0.32   6.15   0      0      1916   1
0.42   9.63   0      0      1917   1
0.53   10.90  0      0      1918   1
0.32   7.42   0      0      1919   1
0.32   7.66   0      0      1920   1
0.32   6.38   0      0      1921   1
0.21   5.57   0      0      1922   1
0.32   6.15   0      0      1923   1
0.11   4.29   0      0      1924   1
0.11   5.34   0      0      1925   1
0.42   7.89   0      0      1926   1
0.64   6.73   0      0      1927   1
0.85   7.54   0      0.57   1928   1
2.12   6.38   0      1.14   1929   1
1.70   8.58   0      1.31   1930   1
2.33   10.67  0      1.74   1931   1
2.44   3.36   0      2.18   1932   1
3.60   0.81   0      2.63   1933   1
2.97   2.44   0      3.06   1934   1
2.86   2.20   0      3.50   1935   1
```

1.91	2.44	0	3.94	1936	1
3.18	1.28	0	4.66	1937	1
3.60	1.74	0	4.59	1938	1
4.98	3.02	0	4.01	1939	1
3.82	2.32	0	5.78	1940	1
3.07	2.20	0	5.33	1941	1
0.95	0.58	0	2.84	1942	1
8.59	0.58	0	2.71	1943	1
33.39	1.28	0	2.23	1944	1
68.37	3.13	0	2.97	1945	1
51.52	4.29	0	5.10	1946	1
34.24	2.67	0	4.04	1947	1
21.84	2.55	0	8.06	1948	1
24.49	2.09	0	10.45	1949	1
25.55	3.48	0	12.74	1950	1
37.74	3.48	0	14.55	1951	1
23.32	2.67	0	12.66	1952	1
25.12	1.97	0	10.78	1953	1
21.09	2.67	0	13.41	1954	1
31.80	3.02	0	15.98	1955	1
27.67	3.25	0	17.84	1956	1
34.56	3.83	0	17.30	1957	1
37.84	3.94	0	27.54	1958	1
29.47	2.32	0	23.87	1959	1
25.55	2.67	0	18.53	1960	1
18.02	2.20	0	14.17	1961	1
16.22	3.02	0	16.12	1962	1
23.32	4.64	0	15.49	1963	1
13.14	4.76	0	12.57	1964	1
17.38	3.13	0	19.26	1965	1
15.05	4.06	0	22.02	1966	1
22.68	3.36	0	23.99	1967	1
24.91	1.86	0	25.32	1968	1
15.88	1.03	0	27.69	1969	1
20.33	1.87	0	34.17	1970	1
20.79	2.34	0	26.03	1971	1
27.96	2.85	0	32.96	1972	1
36.70	3.49	0	47.50	1973	1
37.25	5.83	0	50.25	1974	1
43.99	4.13	0.01	52.83	1975	1
49.05	6.06	0.01	60.90	1976	1
49.17	5.24	0.01	52.51	1977	1
20.78	9.73	0.00	47.01	1978	1
62.58	16.52	0.00	53.46	1979	1
82.85	5.21	0.05	40.81	1980	1
182.81	40.23	0.08	42.99	1981	1
87.87	40.34	0.74	28.23	1982	1
73.75	26.26	0.79	31.71	1983	1
72.73	0.44	4.07	19.43	1984	1
74.23	2.09	8.61	73.62	1985	1
32.10	13.94	0.89	70.50	1986	1
71.47	4.15	1.26	19.75	1987	1
129.00	9.86	15.66	55.24	1988	1
150.01	33.93	10.96	29.14	1989	1
79.82	50.32	5.44	30.04	1990	1
35.17	146.00	5.78	27.67	1991	1
29.83	91.88	3.56	25.30	1992	1
52.11	54.24	1.01	23.49	1993	1
35.31	66.39	1.02	13.58	1994	1
42.28	65.68	1.97	24.61	1995	1
86.65	52.75	1.60	10.51	1996	1
25.91	29.88	0.28	15.70	1997	1
9.23	17.68	3.62	4.46	1998	1

```
7.03   4.30   0.08   32.01  1999   1
1.95   2.04   0.01   27.78  2000   1
1.83   0.53   0.00   14.92  2001   1
3.36   0.15   0.02   1.15   2002   1
0.31   0.16   0      0.00   2003   1
0.39   0.00   0      0.20   2004   1
0.01   0.00   0      0.30   2005   1
0.07   0.06   0      0.07   2006   1
0.81   0.10   0      0.34   2007   1
0.51   0.03   0      0.42   2008   1
0.20   0.06   0      0.85   2009   1
0.04   0.03   0      0.30   2010   1

# ABUNDANCE INDICES
# -----------------
36     #_N_cpue_and_surveyabundance_observations

#_Units:  0=numbers; 1=biomass; 2=F
#_Errtype:  -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0  # 1 ComTrawl_N
2 1 0  # 2 ComHook_N
3 1 0  # 3 ComNet_N
4 1 0  # 4 Rec_N
5 0 0  # 5 RecDockside_N
6 1 0  # 6 NWFSC_Trawl_Survey_N
7 0 0  # 7 RecOnboard_N

# RecFIN Dockside Index (exclude 1982 outlier)
#year  seas   fleet  Index  SE
1980   1      5      0.599  0.211
1981   1      5      0.534  0.240
1982   1      -5     0.122  0.077
1983   1      5      0.501  0.155
1984   1      5      0.756  0.209
1985   1      5      0.947  0.186
1986   1      5      0.717  0.155
1987   1      5      0.751  0.223
1988   1      5      0.803  0.282
1989   1      5      0.244  0.111
1994   1      5      0.327  0.172
1995   1      5      0.295  0.192
1996   1      5      0.307  0.084
1999   1      5      0.770  0.164
2000   1      5      0.452  0.107
2001   1      5      0.674  0.199

# NWFSC trawl survey (metric tons)
#Year  Season Fleet  Value  seLogB
2003   1      6      959.3  0.845
2004   1      6      1473.5 0.578
2005   1      6      88.1   0.530
2006   1      6      528.4  0.367
2007   1      6      515.7  0.531
2008   1      6      897.6  0.482
2009   1      6      2112.7 0.433
2010   1      6      584.0  0.437

# Rec Onboard Index
#year  seas   fleet  Index  SE
1987   1      7      0.091  0.378
1988   1      7      0.169  0.236
1989   1      7      0.234  0.193
```

```
1990   1      7      0.294  0.253
1991   1      7      0.152  0.273
1992   1      7      0.143  0.195
1993   1      7      0.173  0.209
1994   1      7      0.258  0.194
1995   1      7      0.193  0.236
1996   1      7      0.139  0.295
1997   1      7      0.191  0.224
1998   1      7      0.283  0.306

# DISCARDED CATCH
# ---------------
0      # N fleets with discard

0      # N discard observations

# MEAN BODY WEIGHT
# ----------------

0      # N meanbodywt obs
30     # (NOT COND, but ignored if Nobs=0); deg of freedom for t dist of bodyweight
deviations

# LENGTH COMPOSITION SET-UP
# -------------------------
# population length bins (not necessarily same as data bins, below)
2      # length bin method: 1=use databins; 2=generate from binwidth,min,max below;
3=read vector
2      # binwidth for population size comp (must be factor or min size and max size
4      # minimum size in the population (lower edge of first bin and size at age 0.00)
58     # maximum size in the population (lower edge of last bin)

-0.0001      #_comp_tail_compression; neg. value disables (disable for sparse data,
e.g. cond'l age-at-length)
1e-007 #_add_to_comp
0      #_combine males into females at or below this bin number

# LENGTH COMPOSITION DATA
# -----------------------
26     #_N_LengthBins
# vector of length N_LengthBins with lower edges of each bin
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

90     #_N_Length_obs

# ComTrawl_N
#Year  Seas   Flt    Gender Part   Nsamp  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
1978   1      1      0      0      24.0   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00297       0.00000       0.01484       0.15727       0.02077
       0.23442       0.19288       0.28487       0.09199       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1979   1      1      0      0      16.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00273       0.00819       0.00846       0.04259       0.00819
       0.03576       0.07535       0.63937       0.08163       0.01693       0.00000
       0.08081       0.00000       0.00000       0.00000       0.00000
1980   1      1      0      0      38.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.01120       0.03641       0.02521       0.06723       0.06022       0.09524
```

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      0.26331     0.30532     0.09944     0.02381     0.01261     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1981  1     1     0     0     30.4  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.02524     0.03381     0.07714     0.07952
      0.25619     0.15667     0.22190     0.13238     0.01714     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1982  1     1     0     0     13.8  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.13924     0.14304
      0.25190     0.12911     0.13165     0.11646     0.08861     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1983  1     1     0     0     44.0  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00347     0.00000     0.02342     0.00173     0.02949     0.18127
      0.14050     0.21856     0.18734     0.07112     0.00087     0.10234
      0.03990     0.00000     0.00000     0.00000     0.00000
1984  1     1     0     0     57.4  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.01173     0.00000     0.07554     0.08945     0.10499     0.02454
      0.10826     0.25879     0.19798     0.12599     0.00273     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1985  1     1     0     0     109.3 0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00846
      0.02339     0.08850     0.10006     0.09273     0.08286     0.11189
      0.12570     0.16206     0.11189     0.07835     0.01381     0.00028
      0.00000     0.00000     0.00000     0.00000     0.00000
1986  1     1     0     0     51.6  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00438
      0.00487     0.04136     0.02384     0.07445     0.11922     0.04769
      0.05693     0.30414     0.17616     0.14258     0.00438     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1987  1     1     0     0     41.2  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00603     0.00754     0.00369     0.05075     0.18744     0.25461
      0.11742     0.16801     0.11005     0.08476     0.00469     0.00503
      0.00000     0.00000     0.00000     0.00000     0.00000
1988  1     1     0     0     42.6  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00027
      0.00012     0.00043     0.07959     0.15917     0.30126     0.07562
      0.30354     0.00234     0.07702     0.00059     0.00004     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1989  1     1     0     0     36.9  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00231     0.07239     0.01141     0.12971     0.12663     0.20410
      0.13638     0.13214     0.17893     0.00601     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1990  1     1     0     0     62.0  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00089     0.07113     0.16299     0.12999     0.07358     0.11906
      0.05084     0.13266     0.15117     0.07425     0.03344     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1991  1     1     0     0     29.1  0.00000     0.00000     0.00000
      0.00000     0.00000     0.03763     0.00000     0.00000     0.00000
      0.00912     0.15393     0.15165     0.13854     0.11060     0.16819
      0.03535     0.06100     0.10148     0.03250     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1992  1     1     0     0     20.9  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.01082     0.16745     0.18672     0.14744     0.09610     0.13513
      0.17914     0.02176     0.00733     0.01629     0.00000     0.03182
      0.00000     0.00000     0.00000     0.00000     0.00000
```

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1993  1     1     0     0     78.7  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.01640
      0.02211     0.06676     0.06162     0.67532     0.04868     0.05295
      0.02893     0.01646     0.00910     0.00168     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1994  1     1     0     0     28.7  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00532     0.00532
      0.10317     0.12167     0.06565     0.14778     0.12928     0.10951
      0.11863     0.10317     0.07706     0.01343     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1995  1     1     0     0     21.8  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.05119     0.00000     0.01685
      0.04630     0.21694     0.15449     0.19161     0.12751     0.07168
      0.05232     0.03461     0.02261     0.01390     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1996  1     1     0     0     11.6  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.07551
      0.11438     0.27231     0.04219     0.23624     0.11552     0.08056
      0.04528     0.00581     0.00057     0.01161     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1997  1     1     0     0     57.9  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00181     0.00214     0.05410
      0.11908     0.15207     0.17137     0.14415     0.12288     0.10671
      0.07917     0.02936     0.00759     0.00165     0.00544     0.00165
      0.00082     0.00000     0.00000     0.00000     0.00000
1998  1     1     0     0     16.0  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.09844     0.08203     0.15376     0.10836     0.19458     0.15986
      0.13125     0.07173     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1999  1     1     0     0     6.8   0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.06000     0.06000     0.14750     0.25250
      0.25750     0.16750     0.05500     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2000  1     1     0     0     21.8  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.15263     0.11579     0.17368     0.19211     0.14474
      0.08684     0.06579     0.01053     0.01579     0.01579     0.00000
      0.02632     0.00000     0.00000     0.00000     0.00000
2001  1     1     0     0     30.8  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00944
      0.05408     0.15279     0.08155     0.16567     0.16652     0.13391
      0.04893     0.05751     0.04635     0.05064     0.03004     0.00000
      0.00000     0.00258     0.00000     0.00000     0.00000
2002  1     1     0     0     15.8  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00962     0.00000     0.13462
      0.19231     0.21154     0.10577     0.20192     0.11538     0.00962
      0.01923     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2003  1     1     0     0     7.1   0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.05970     0.22388     0.20896     0.23881     0.11940     0.11940
      0.02985     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2004  1     1     0     0     14.4  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.04981
      0.04598     0.14176     0.09962     0.14559     0.25287     0.01149
      0.15709     0.09579     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2007  1     1     0     0     3.7   0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.09581     0.25749     0.32335     0.16168
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      0.08084      0.08084      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2008  1     1      0     0      7.6   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.10496      0.36443      0.16910      0.21283      0.00000
      0.14869      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2010  1     1      0     0      5.3   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.03226      0.35484      0.32258      0.16129
      0.12903      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# ComHook_N
#Year Seas  Flt    Gender Part  Nsamp 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
1979  1     2      0     0      27.1  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00493      0.05911      0.04105      0.08374      0.15107
      0.26437      0.22989      0.12315      0.03941      0.00328      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1981  1     2      0     0      35.8  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.05038
      0.00338      0.02167      0.04503      0.06839      0.16690      0.14016
      0.24796      0.13847      0.08190      0.02392      0.01182      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1982  1     2      0     0      14.9  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.04917      0.04187      0.15290      0.20553
      0.32501      0.18171      0.04380      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1983  1     2      0     0      7.4   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.10195      0.13342      0.22939      0.33134
      0.15293      0.05098      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1990  1     2      0     0      4.7   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.21855      0.00000
      0.00000      0.00000      0.00000      0.00000      0.15454      0.07946
      0.31346      0.15892      0.00000      0.07508      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1991  1     2      0     0      27.0  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00152      0.01617
      0.02142      0.04017      0.06777      0.06346      0.05723      0.10594
      0.10334      0.25409      0.24932      0.01907      0.00033      0.00017
      0.00000      0.00000      0.00000      0.00000      0.00000
1992  1     2      0     0      151.7 0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00545      0.00723      0.02487
      0.11147      0.18450      0.10269      0.10568      0.06274      0.11576
      0.07111      0.08791      0.07205      0.03988      0.00865      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1993  1     2      0     0      149.4 0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.04935
      0.10029      0.05254      0.25152      0.10641      0.11006      0.16001
      0.02935      0.09799      0.02305      0.01515      0.00427      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1994  1     2      0     0      131.1 0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.07607      0.11818      0.24893
      0.09302      0.05842      0.04284      0.05457      0.07141      0.06780
      0.05504      0.04552      0.04214      0.02016      0.00427      0.00162
      0.00000      0.00000      0.00000      0.00000      0.00000
```

```
1995  1     2     0     0     52.0  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.04512      0.10219
      0.14723      0.14523      0.14268      0.09291      0.09499      0.07198
      0.05245      0.03972      0.03123      0.02852      0.00573      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1996  1     2     0     0     84.0  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00124      0.00165
      0.00367      0.01830      0.13412      0.17131      0.15741      0.15280
      0.17597      0.06638      0.07407      0.03587      0.00549      0.00073
      0.00099      0.00000      0.00000      0.00000      0.00000
1997  1     2     0     0     39.5  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.01126      0.04615
      0.08323      0.08396      0.11859      0.17404      0.08914      0.09149
      0.11329      0.04650      0.05784      0.08426      0.00026      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1998  1     2     0     0     12.1  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.02494      0.09975      0.34913
      0.23840      0.05286      0.04188      0.04188      0.02475      0.04932
      0.03500      0.01750      0.01750      0.00707      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2000  1     2     0     0     5.6   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.16239      0.11111      0.21368      0.25641      0.10256      0.15385
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2001  1     2     0     0     20.7  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00654      0.01307
      0.02288      0.05556      0.15359      0.19281      0.35948      0.16340
      0.01634      0.01634      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# ComNet_N
#Year Seas  Flt   Gender Part  Nsamp 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
1988  1     3     0     0     3.5   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.16800      0.00000      0.31555      0.44267      0.00000
      0.07378      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1989  1     3     0     0     17.6  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.17862      0.15304      0.43810      0.10735
      0.03061      0.09228      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1990  1     3     0     0     6.7   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.24681      0.05248      0.38014
      0.08227      0.15603      0.00851      0.00000      0.07376      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1994  1     3     0     0     7.1   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.16489      0.14894      0.20745      0.14362
      0.19149      0.14362      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1995  1     3     0     0     4.8   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.05835
      0.17505      0.00000      0.00000      0.15091      0.26559      0.17505
      0.17505      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# Rec_N
```

```
#Year  Seas   Flt    Gender Part   Nsamp  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
1978   1      4      0      0      121.8  0.00000       0.00000       0.00000
       0.00295       0.00000       0.00000       0.00295       0.01475       0.04425
       0.03245       0.05015       0.12094       0.12094       0.15044       0.20944
       0.13569       0.08555       0.01180       0.01475       0.00295       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1979   1      4      0      0      182.2  0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.01342       0.01678       0.03691
       0.03859       0.05034       0.07886       0.10403       0.19128       0.15772
       0.17114       0.11577       0.02013       0.00503       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1980   1      4      0      0      77.9   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00758       0.00758       0.02196       0.06026
       0.06026       0.12489       0.11692       0.14685       0.13646       0.12770
       0.10614       0.06823       0.01516       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1981   1      4      0      0      55.0   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.04394       0.07689       0.08802       0.07703       0.19772       0.13195
       0.19772       0.09886       0.05492       0.00000       0.01098       0.01098
       0.00000       0.00000       0.01098       0.00000       0.00000
1982   1      4      0      0      59.0   0.00000       0.00274       0.00000
       0.00000       0.00274       0.00000       0.00000       0.00274       0.03611
       0.04158       0.10394       0.12199       0.14551       0.13731       0.15263
       0.05416       0.09026       0.05416       0.01805       0.00000       0.00000
       0.00000       0.00000       0.01805       0.01805       0.01805
1983   1      4      0      0      75.3   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.01727       0.06798       0.05989
       0.08896       0.07606       0.11869       0.12350       0.14995       0.16503
       0.12350       0.00918       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1984   1      4      0      0      125.2  0.00000       0.00000       0.00000
       0.00000       0.00000       0.00491       0.00000       0.03161       0.06362
       0.08620       0.11369       0.12193       0.10838       0.15354       0.13096
       0.05871       0.05871       0.04064       0.02710       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1985   1      4      0      0      390.6  0.00000       0.00000       0.00000
       0.00000       0.00118       0.01065       0.01932       0.02997       0.05599
       0.07400       0.09083       0.11172       0.11935       0.12815       0.13775
       0.11080       0.06874       0.03312       0.00355       0.00473       0.00000
       0.00000       0.00000       0.00013       0.00000       0.00000
1986   1      4      0      0      302.0  0.00000       0.00000       0.00000
       0.00000       0.00000       0.00663       0.01161       0.03483       0.03981
       0.06621       0.11672       0.12064       0.12683       0.10768       0.15428
       0.11265       0.06530       0.01855       0.01493       0.00166       0.00166
       0.00000       0.00000       0.00000       0.00000       0.00000
1987   1      4      0      0      55.0   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.03547       0.05911
       0.08275       0.06590       0.15033       0.11151       0.14698       0.11654
       0.04561       0.16215       0.02364       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1988   1      4      0      0      50.5   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.04082       0.05102       0.03061
       0.04082       0.08163       0.05102       0.13265       0.10204       0.18367
       0.11224       0.12245       0.05102       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1989   1      4      0      0      67.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00931       0.04655       0.07449
       0.06877       0.07020       0.14183       0.15331       0.14183       0.08454
       0.14183       0.03296       0.02650       0.00788       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
```

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1990  1    4     0     0     73.4  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00402      0.01606      0.05221      0.05622
      0.06024      0.13655      0.16466      0.17269      0.14859      0.08032
      0.06426      0.04016      0.00402      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1991  1    4     0     0     102.0 0.00000      0.00000      0.00000
      0.00000      0.00637      0.00425      0.02335      0.04883      0.05308
      0.08493      0.11040      0.20382      0.15074      0.10828      0.06794
      0.07856      0.04883      0.00849      0.00212      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1992  1    4     0     0     216.3 0.00000      0.00000      0.00000
      0.00122      0.00244      0.00731      0.02923      0.04750      0.05968
      0.09622      0.12180      0.14495      0.15104      0.13155      0.10353
      0.05968      0.03167      0.01096      0.00122      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1993  1    4     0     0     279.4 0.00000      0.00000      0.00000
      0.00000      0.00229      0.01606      0.02746      0.06451      0.08293
      0.09239      0.12791      0.12033      0.11727      0.13556      0.10121
      0.05798      0.03935      0.01105      0.00334      0.00000      0.00035
      0.00000      0.00000      0.00000      0.00000      0.00000
1994  1    4     0     0     205.0 0.00000      0.00000      0.00000
      0.00109      0.00000      0.01859      0.03937      0.10178      0.11927
      0.13240      0.13124      0.10718      0.10615      0.08865      0.06453
      0.05468      0.02844      0.00663      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1995  1    4     0     0     174.4 0.00000      0.00000      0.00000
      0.00000      0.00699      0.01118      0.04194      0.08967      0.13622
      0.13146      0.13342      0.13648      0.11132      0.09035      0.05856
      0.03179      0.01481      0.00300      0.00140      0.00140      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1996  1    4     0     0     135.7 0.00000      0.00000      0.00000
      0.00000      0.00662      0.02385      0.04538      0.04538      0.10070
      0.15568      0.13382      0.14541      0.09440      0.08513      0.06293
      0.04869      0.03710      0.01325      0.00166      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1997  1    4     0     0     123.6 0.00000      0.00000      0.00000
      0.00191      0.00191      0.01145      0.03625      0.03435      0.11830
      0.14120      0.19081      0.15845      0.12593      0.08586      0.04587
      0.02099      0.01526      0.00954      0.00191      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1998  1    4     0     0     68.4  0.00000      0.00000      0.00000
      0.00000      0.00533      0.02667      0.04267      0.05334      0.03734
      0.09132      0.13932      0.18199      0.18668      0.10134      0.06934
      0.04267      0.01131      0.01067      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1999  1    4     0     0     289.1 0.00000      0.00000      0.00000
      0.00000      0.00000      0.01028      0.03941      0.05717      0.07368
      0.12400      0.18631      0.16251      0.14817      0.10939      0.04283
      0.02741      0.01028      0.00857      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2000  1    4     0     0     93.4  0.00000      0.00000      0.00000
      0.00000      0.00000      0.01310      0.03276      0.08789      0.07862
      0.11681      0.14302      0.20086      0.13647      0.12336      0.04474
      0.00927      0.00655      0.00655      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2001  1    4     0     0     99.9  0.00000      0.00000      0.00000
      0.00000      0.00517      0.00000      0.05170      0.05801      0.10567
      0.15107      0.11892      0.14994      0.16141      0.09937      0.07062
      0.02068      0.00744      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2002  1    4     0     0     39.7  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.01786      0.14286      0.14286
      0.12500      0.12500      0.16071      0.19643      0.07143      0.01786
```

```
        0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2004    1     4      0     0      -10.2  0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.05323      0.00000
        0.00000      0.21903      0.08290      0.15968      0.15968      0.00000
        0.13613      0.13613      0.00000      0.05323      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2005    1     4      0     0      -13.6  0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
        0.00000      0.03390      0.13898      0.27797      0.13898      0.00000
        0.00000      0.30847      0.03390      0.00000      0.03390      0.03390
        0.00000      0.00000      0.00000      0.00000      0.00000
2006    1     4      0     0      -11.7  0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
        0.03317      0.03317      0.00000      0.28010      0.37347      0.28010
        0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2007    1     4      0     0      22.9   0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.02133      0.02400
        0.04800      0.22933      0.13867      0.25600      0.19200      0.09067
        0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2008    1     4      0     0      42.0   0.00000      0.00000      0.00000
        0.00000      0.04530      0.11325      0.22650      0.13590      0.00958
        0.01916      0.04530      0.07753      0.08362      0.10277      0.05139
        0.03832      0.00958      0.02265      0.01916      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2009    1     4      0     0      38.2   0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00775      0.01549      0.04652
        0.04652      0.06976      0.15504      0.27133      0.11629      0.17051
        0.03876      0.05427      0.00775      0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000
2010    1     4      0     0      22.6   0.00000      0.00000      0.00000
        0.02127      0.00000      0.00000      0.00000      0.06383      0.02127
        0.04254      0.10639      0.21279      0.23404      0.25533      0.00000
        0.02127      0.02127      0.00000      0.00000      0.00000      0.00000
        0.00000      0.00000      0.00000      0.00000      0.00000

# NWFSC_Trawl_Survey_N
#year   Season Fleet  gender part  nSamps U8     U10    U12    U14    U16    U18    U20
        U22    U24    U26    U28    U30    U32    U34    U36    U38    U40    U42    U44
        U46    U48    U50    U52    U54    U56    U58
2003    1      6      0      0      21.67  0.0000 0.0000 0.0000 0.4785 1.1884 2.1182 3.5403
        3.5602 7.8550 12.4067       12.2860       9.5941 11.2688       8.2762 12.1904
        5.3693 3.4200 5.0688 1.1517 0.0000 0.2273 0.0000 0.0000 0.0000 0.0000 0.0000
2004    1      6      0      0      33.13  0.0000 0.0000 0.0000 0.9223 1.5527 7.5090 6.6495
        11.2750       10.5068       10.7518       14.2702       10.4928       10.6444
        7.5986 4.6457 1.1073 0.7632 0.8745 0.4363 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2005    1      6      0      0      9.84   0.0000 0.0000 0.0000 2.2243 0.0000 2.1878 2.1878
        8.1983 19.6925       3.3106 10.1338       6.7987 6.7952 5.6200 6.9776 5.1143 3.3389
        13.5526       1.9180 1.9496 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
2006    1      6      0      0      24.84  0.0000 0.0000 0.6188 2.5433 3.1802 6.8160 8.0481
        6.8435 5.5559 9.5365 4.9675 12.0430       14.7482       8.5636 6.7592 3.7718 1.7751
        2.3306 0.7045 0.7963 0.3981 0.0000 0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      18.48  0.0000 1.4372 0.0000 1.2897 4.2105 6.7130 4.6459
        4.3543 7.0225 6.1176 3.8362 11.8749       12.4550       14.0786       8.5328 5.4307
        2.9518 2.9506 1.6475 0.4512 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
2008    1      6      0      0      30.61  0.0000 1.5279 7.3572 8.6355 8.1452 9.5498 3.4065
        6.2935 6.0817 6.4501 3.7248 5.3394 9.3050 6.8788 5.3734 6.5542 3.7387 1.6386 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
```

```
2009   1      6      0      0      42.08  0.0000 0.6088 1.0107 4.3233 4.6018 5.2308 4.2127
       3.7039 6.4406 6.8805 4.3058 11.8102       10.6901       11.5076       11.5768
       7.9894 3.4373 1.2987 0.2098 0.1612 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
2010   1      6      0      0      34.01  0.0000 0.6558 0.6789 2.7880 5.9954 7.8918 9.6062
       5.5383 8.1635 8.4148 6.4986 7.7020 11.0698       10.6826       6.5480 2.8505 1.6334
       1.9036 1.3789 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

# AGE COMPOSITION SET-UP
# ----------------------
52     #_N_age_bins
# vector with lower edge of observed age (age') bins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 55 60

# AGEING ERROR
# -------------------------------------------
1      #_N_ageerror_definitions

# Ageing error based on within-reader error
0.5    1.5    2.5    3.5    4.5    5.5    6.5    7.5    8.5    9.5    10.5   11.5   12.5
       13.5   14.5   15.5   16.5   17.5   18.5   19.5   20.5   21.5   22.5   23.5   24.5
       25.5   26.5   27.5   28.5   29.5   30.5   31.5   32.5   33.5   34.5   35.5   36.5
       37.5   38.5   39.5   40.5   41.5   42.5   43.5   44.5   45.5   46.5   47.5   48.5
       49.5   50.5   51.5   52.5   53.5   54.5   55.5   56.5   57.5   58.5   59.5   60.5
       61.5   62.5   63.5   64.5   65.5
0.052  0.052  0.105  0.157  0.210  0.263  0.315  0.369  0.422  0.476  0.530  0.585  0.640
       0.695  0.752  0.809  0.866  0.925  0.985  1.047  1.110  1.174  1.241  1.310  1.381
       1.455  1.533  1.615  1.702  1.793  1.891  1.995  2.107  2.227  2.358  2.500  2.655
       2.825  3.011  3.217  3.445  3.698  3.979  4.293  4.643  5.034  5.474  5.967  6.521
       7.144  7.847  8.639  9.532  10.541 11.681 12.969 14.425 16.072 17.935 20.043 22.429
       25.129 28.186 31.647 35.565 40.000

# AGE COMPOSITION DATA
# --------------------
98     #_N_Agecomp_obs

3      #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1      #_combine males into females at or below this bin number

# "unconditional" age comps from rec CPFV, 1977-79
#year  Season Fleet  gender part   ageErr LbinLo LbinHi nSamps 1      2      3      4
       5      6      7      8      9      10     11     12     13     14     15     16
       17     18     19     20     21     22     23     24     25     26     27     28
       29     30     31     32     33     34     35     36     37     38     39     40
       41     42     43     44     45     46     47     48     49     50     55     60
1977   1      4      0      0      1      -1     -1     84.7   0      0      0      0
       0      0      0      0      1      0      1      1      0      1      2      4
       10     21     11     22     33     24     24     19     14     15     12     8
       5      2      2      1      4      3      0      1      1      2      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
1978   1      4      0      0      1      -1     -1     84.7   0      0      0      0
       0      0      0      1      0      0      0      0      0      1      1      6
       11     12     18     13     17     18     19     18     8      10     5      5
       6      4      3      3      3      1      4      2      3      0      1      0
       1      1      0      0      0      1      0      1      0      0      0      0
1979   1      4      0      0      1      -1     -1     84.7   0      0      0      0
       0      0      0      0      0      0      0      1      0      1      1      4
       3      6      3      4      5      7      6      6      2      3      3      1
       1      0      1      0      1      1      2      0      0      1      0      0
       0      0      0      0      0      0      0      0      0      0      0      0

# conditional comps for rec CPFV, 1978-1982
```

#year	Season	Fleet	gender	part	ageErr	LbinLo	LbinHi	nSamps	1	2	3	4
	5	6	7	8	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28
	29	30	31	32	33	34	35	36	37	38	39	40
	41	42	43	44	45	46	47	48	49	50	55	60
1978	1	4	0	0	1	22	22	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	30	30	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	1	1	0	0	0	0	0
	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	32	32	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	0	0	0	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	34	34	10	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	1	2	2	2	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
1978	1	4	0	0	1	36	36	18	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	1	0	3	2	1	4	1
	1	0	0	1	0	0	0	1	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	38	38	9	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	1	2	0	0	0	1	1
	0	0	0	0	1	0	0	2	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	40	40	6	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	1	0	0	1	0	0
	0	0	0	1	0	0	1	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
1978	1	4	0	0	1	42	42	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	22	22	2	0	0	0	0
	0	0	0	0	0	1	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	26	26	3	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	0	1
	0	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	28	28	9	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	1	3	1	0	0	0	0	2	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	30	30	13	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	2	1	4	1	0	2	2	0	0	0	1

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	32	32	17	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	2	1	4	5	3	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	34	34	32	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	3	2	2	2	5	4	3	2	2
	1	0	3	1	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	36	36	19	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	3	1	1	3	2
	1	3	2	1	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	38	38	30	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	1	1	5	0	1	2
	0	2	5	2	1	1	0	1	1	1	4	0
	0	0	0	1	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	40	40	20	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	1	1	0
	2	2	1	0	6	0	2	0	1	0	0	0
	2	0	0	1	0	0	0	0	0	0	0	0
1979	1	4	0	0	1	42	42	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	1	0
	0	0	0	0	0	1	0	0	0	0	0	0
1979	1	4	0	0	1	44	44	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	20	20	2	0	0	0	0
	0	0	1	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	22	22	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	1
	2	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	24	24	5	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	1	1
	0	0	0	1	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	26	26	6	0	0	0	0
	0	0	1	0	0	0	0	0	2	1	0	0
	0	0	1	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	28	28	11	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	3	2	4	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

1980	1	4	0	0	1	30	30	18	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	2
	2	1	3	3	3	1	0	1	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	32	32	17	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	4	0	2	1	0	1	5	2	0	0
	0	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	34	34	22	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	1	9	1	4	3	0	1
	1	0	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	36	36	19	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	1	2	2	6	1	1	0
	1	1	1	0	1	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	38	38	18	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	2	2	0	0	1
	2	0	1	1	0	0	2	2	0	1	1	0
	2	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	40	40	12	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	1	0	4
	0	1	0	0	3	0	0	1	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1980	1	4	0	0	1	42	42	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	20	20	1	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	22	22	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	24	24	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	26	26	3	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0
	0	0	0	0	1	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	28	28	4	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	1	0
	0	1	0	0	0	0	0	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	30	30	5	0	0	0	0
	0	0	0	0	0	0	0	1	0	1	0	0
	0	0	0	0	0	1	0	1	1	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	32	32	9	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	1	1
	0	1	0	1	0	0	1	0	1	2	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	34	34	16	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	2	0	1	2	1	0	0	3	3	2	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	36	36	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	1	0	0	0	0	2
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	38	38	9	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	1	0	0	0	0	0	0	0	0	0	0	1
	1	0	0	0	0	1	1	0	1	1	0	0
	1	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	40	40	5	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	0	1	0	0	1	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
1981	1	4	0	0	1	42	42	6	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	1	0	0	0	0
	0	1	0	0	1	0	0	0	1	0	0	0
	0	1	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	24	24	1	0	0	0	0
	0	0	0	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	26	26	2	0	0	0	0
	0	0	0	0	1	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	28	28	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	0	0	0	0	0	0	0	1	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	30	30	9	0	0	0	0
	0	0	0	0	0	0	0	1	2	1	1	0
	2	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	32	32	10	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	2	0
	1	0	2	0	0	0	0	0	0	1	2	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	0	0	0	0	0
1982	1	4	0	0	1	34	34	8	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	2	0	0	0	1
	1	1	0	0	0	0	1	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

```
1982    1      4      0      0      1      36     36     4      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      1      0      1      1      1      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
1982    1      4      0      0      1      38     38     8      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      1      0      0      0      2
        1      0      1      0      1      2      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
1982    1      4      0      0      1      40     40     5      0      0      0      0
        0      0      0      0      0      0      0      0      0      1      0      0
        0      0      0      0      0      0      0      0      0      1      1      0
        0      0      0      0      1      0      0      0      0      0      0      1
        0      0      0      0      0      0      0      0      0      0      0      0
1982    1      4      0      0      1      42     42     3      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      1      0      0      0
        0      1      0      0      0      0      0      0      0      1      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
1982    1      4      0      0      1      44     44     1      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      1      0      0      0      0      0      0      0      0
1982    1      4      0      0      1      50     50     1      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      0      0      0      0      0      0      0      0      0      0      0
        0      1      0      0      0      0      0      0      0      0      0      0

# conditional age comps for NWFSC trawl survey 2005, 2007, 2009
#year   Season Fleet  gender part   ageErr LbinLo LbinHi nSamps A1     A2     A3     A4
        A5     A6     A7     A8     A9     A10    A11    A12    A13    A14    A15    A16
        A17    A18    A19    A20    A21    A22    A23    A24    A25    A26    A27    A28
        A29    A30    A31    A32    A33    A34    A35    A36    A37    A38    A39    A40
        A41    A42    A43    A44    A45    A46    A47    A48    A49    A50    A55    A60
2005    1      6      0      0      1      22     22     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 100.0000      0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2005    1      6      0      0      1      24     24     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2005    1      6      0      0      1      26     26     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2005    1      6      0      0      1      28     28     2      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
2005    1      6      0      0      1      30     30     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
```

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        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
2005    1      6      0      0      1      32     32     4      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 9.4194 0.0000 9.4194 0.0000
        9.4194 0.0000 71.7419       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2005    1      6      0      0      1      34     34     3      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 33.1028       33.1028
        0.0000 0.0000 33.7944       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2005    1      6      0      0      1      36     36     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
2005    1      6      0      0      1      38     38     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2007    1      6      0      0      1      10     10     2      0.0000 0.0000 100.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2007    1      6      0      0      1      14     14     1      0.0000 0.0000 0.0000
        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
2007    1      6      0      0      1      16     16     4      0.0000 0.0000 0.0000
        24.3135       0.0000 0.0000 0.0000 0.0000 40.1683       0.0000 35.5182       0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      1      18     18     7      0.0000 0.0000 0.0000 0.0000
        0.0000 9.5504 0.0000 0.0000 17.6283       35.2566       17.6283       19.9363
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      1      20     20     3      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 33.3333       33.3333       33.3333       0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2007    1      6      0      0      1      24     24     6      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 33.5767       32.8466       0.0000
        0.0000 12.5946       20.9821       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
```

```
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      1      26     26     2      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 64.5780       0.0000 0.0000 0.0000 0.0000
        0.0000 35.4220       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
2007    1      6      0      0      1      28     28     3      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 46.5382
        0.0000 27.9348       25.5269       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2007    1      6      0      0      1      30     30     7      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 18.9666
        7.1144 37.1884       7.1144 29.6163       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2007    1      6      0      0      1      32     32     9      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        23.9997       23.7043       23.9997       0.0000 28.2962       0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      1      34     34     9      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        38.3396       0.0000 24.0710       9.2098 4.6049 23.7747       0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2007    1      6      0      0      1      36     36     4      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 25.0000       0.0000 0.0000 0.0000 0.0000 25.0000       0.0000
        25.0000       0.0000 25.0000       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000
2007    1      6      0      0      1      38     38     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2007    1      6      0      0      1      40     40     4      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 28.9383       0.0000 0.0000 0.0000 14.4691       56.5926
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000
2007    1      6      0      0      1      44     44     1      0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 100.0000      0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000
2009    1      6      0      0      1      10     10     2      0.0000 0.0000 0.0000
        100.0000      0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
        0.0000 0.0000
```

```
2009 1 6 0 0 1 14 14 8 0.0000 0.0000 0.0000 0.0000
43.0839 12.1910 8.0841 36.6410 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000
2009 1 6 0 0 1 16 16 6 0.0000 0.0000 0.0000 7.9423
0.0000 8.2696 29.8481 11.9010 0.0000 42.0389 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000
2009 1 6 0 0 1 18 18 17 0.0000 0.0000 0.0000 0.0000
0.0000 3.7120 6.5318 17.8972 50.1255 0.0000 19.4036 0.0000 0.0000
2.3300 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000
2009 1 6 0 0 1 20 20 8 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 6.1158 19.4878 18.5152 55.8811 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000
2009 1 6 0 0 1 22 22 4 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 20.2536 19.0494 0.0000 0.0000
30.3485 0.0000 30.3485 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
2009 1 6 0 0 1 24 24 13 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 1.2705 0.0000 0.0000 16.2975 18.1259
17.5680 19.3964 20.8832 6.4586 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
2009 1 6 0 0 1 26 26 8 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 16.2888 37.0233
37.0237 0.0000 3.8533 5.8109 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000
2009 1 6 0 0 1 28 28 3 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 43.8002
0.0000 0.0000 56.1998 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000
2009 1 6 0 0 1 30 30 19 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 12.1076 4.4333
12.1076 5.4552 24.2152 21.3685 14.1560 4.7982 1.3583 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
2009 1 6 0 0 1 32 32 14 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.8123
14.6061 33.7980 21.9006 16.4036 11.4795 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
2009 1 6 0 0 1 34 34 18 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 2.4020
17.7287 1.6100 31.8806 18.6373 7.4396 11.4993 1.2427 1.2427
```

```
       6.3171 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000
2009   1      6      0      0      1      36     36     16     0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 1.3037
       2.2213 2.9094 2.9094 0.0000 20.1062       12.8019       17.1968       0.0000
       24.0118       2.9094 6.8150 0.0000 6.8150 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000
2009   1      6      0      0      1      38     38     12     0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 12.2587       0.0000 4.0378 25.8974       25.8974       2.0189 2.6157 0.0000
       0.0000 2.9054 2.0189 10.2630       1.8237 0.0000 0.0000 10.2630       0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000
2009   1      6      0      0      1      40     40     1      0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 100.0000      0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000
2009   1      6      0      0      1      42     42     2      0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 60.3721       39.6279       0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
       0.0000 0.0000

# MEAN LENGTH OR BODYWEIGHT-AT-AGE
# --------------------------------
-1 #_N_MeanSize-at-Age_obs

# ENVIRONMENTAL DATA
# ------------------
0 #_N_environ_variables
0 #_N_environ_obs

# GENERALIZED SIZE COMPOSTION DATA
# --------------------------------
0 # N WtFreq methods

# TAG-RECAPTURE
# -------------
0 # Do_Tags (0=omit, 1=enter conditional data per manual)

# STOCK COMPOSITION
# -----------------
0 # no morphcomp data

999 # end of data file marker

ENDDATA
```

Data file for southern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters between Point Conception and the U.S.-Mexico border

# MODEL DIMENSIONS
# ----------------
1916   #_styr
2010   #_endyr
1      #_nseas
12     #_months/season
1      #_spawn_seas
5      #_Nfleet
3      #_Nsurveys
1      #_N_areas

# FLEET/SURVEY NAMES, TIMING, ETC.
# -------------------------------
# Fishery & survey names separated by "%"
ComTrawl_S%ComHook_S%ComNet_S%RecCPFV_S%RecPriv_S%RecDockside_S%NWFSC_Trawl_Survey_S%N
WFSC_HKL_Survey_S
0.5    0.5    0.5    0.5    0.5    0.5    0.5    0.5    #_surveytiming_in_season
1      1      1      1      1      1      1      1
       #_area_assignments_for_each_fishery_and_survey
1      1      1      1      1                            #_units of catch: 1=bio; 2=num
0.05   0.05   0.05   0.05   0.05                         #_se of log(catch) only used for
init_eq_catch and for Fmethod 2 and 3

1      #_Ngenders
65     #_Nages

0      0      0      0      0      #_init_equil_catch_for_each_fishery

95     #_N_lines_of_catch_to_read

# Catch in biomass (mt)
# --------------------------
#ComTrawl_S  ComHook_S    ComNet_S     RecCPFV_S    RecPriv_S    Year   Season
0      35.36  0      0      0      1916   1
0      56.99  0      0      0      1917   1
0      52.00  0      0      0      1918   1
0      31.10  0      0      0      1919   1
0      33.80  0      0      0      1920   1
0      29.54  0      0      0      1921   1
0      29.02  0      0      0      1922   1
0      38.90  0      0      0      1923   1
0      52.10  0      0      0      1924   1
0      57.20  0      0      0      1925   1
0      71.03  0      0      0      1926   1
0      58.97  0      0      0      1927   1
0      50.23  0      0.06   0      1928   1
0      50.86  0      0.11   0      1929   1
0      51.79  0      0.17   0      1930   1
0      59.49  0      0.22   0      1931   1
0      45.66  0      0.28   0      1932   1
0      30.06  0      0.33   0      1933   1
0      30.99  0      0.39   0      1934   1
0      23.61  0      0.44   0      1935   1
0      10.61  0      0.44   0      1936   1
0      10.09  0      0.66   0      1937   1
0      6.45   0      0.63   0      1938   1
0      7.28   0      0.52   0      1939   1
0      14.56  0      0.41   0      1940   1
```

0	18.93	0	0.38	0	1941	1
0	7.59	0	0.20	0	1942	1
0	8.42	0	0.19	0	1943	1
0	1.56	0	0.16	0	1944	1
0	3.74	0	0.21	0	1945	1
0	7.59	0	0.37	0	1946	1
0	10.30	0	1.44	0	1947	1
0	15.81	0	3.62	0	1948	1
0	17.16	0	4.24	0	1949	1
0	11.23	0	5.64	0	1950	1
0.11	20.59	0	4.52	0	1951	1
0.11	14.56	0	6.79	0	1952	1
0	10.82	0	7.96	0	1953	1
0.42	14.46	0	15.78	0	1954	1
0.11	13.10	0	28.49	0	1955	1
0.42	14.46	0	32.77	0	1956	1
0.95	12.27	0	20.74	0	1957	1
1.80	9.98	0	16.39	0	1958	1
0.95	12.38	0	9.45	0	1959	1
2.44	12.79	0	10.37	0	1960	1
2.54	11.86	0	13.23	0.03	1961	1
1.48	10.40	0	14.00	0.45	1962	1
1.59	14.25	0	13.32	0.83	1963	1
0.74	12.38	0	20.36	1.93	1964	1
1.38	16.74	0	25.32	3.27	1965	1
1.06	11.54	0	38.02	6.28	1966	1
2.44	14.56	0	50.67	10.31	1967	1
3.39	15.29	0	52.71	12.86	1968	1
92.86	16.74	0.21	38.22	10.97	1969	1
46.75	11.44	0.10	51.70	17.21	1970	1
69.01	13.10	0.10	48.57	18.54	1971	1
100.17	19.45	0.10	61.47	26.68	1972	1
111.19	18.41	0.31	74.65	36.57	1973	1
118.40	16.02	1.25	82.10	45.16	1974	1
87.66	28.70	1.04	81.49	50.09	1975	1
113.00	35.36	1.14	66.59	45.59	1976	1
139.92	29.95	1.56	63.20	48.04	1977	1
108.01	40.98	3.85	58.02	48.87	1978	1
69.85	66.98	10.50	75.81	70.65	1979	1
12.51	61.98	8.22	38.51	44.59	1980	1
19.61	67.60	9.67	24.70	19.31	1981	1
45.05	92.66	5.51	82.41	70.64	1982	1
71.87	22.67	2.70	75.68	23.44	1983	1
13.78	53.35	5.72	104.15	36.39	1984	1
6.47	42.95	24.44	111.62	60.77	1985	1
27.14	48.26	6.66	27.52	34.80	1986	1
13.99	14.46	8.74	0.08	8.82	1987	1
7.53	13.42	1.66	2.00	15.13	1988	1
4.66	20.80	8.63	8.62	27.06	1989	1
2.65	32.45	1.87	6.88	25.61	1990	1
3.92	16.22	2.08	8.62	30.26	1991	1
0	5.20	1.87	10.36	34.92	1992	1
0	4.26	1.25	6.99	36.85	1993	1
0	0.31	1.04	28.01	37.56	1994	1
0	43.47	0.62	6.51	58.28	1995	1
0	29.95	0.62	7.28	19.04	1996	1
0.11	17.16	0.31	3.27	8.78	1997	1
4.77	38.06	0.21	5.31	4.92	1998	1
2.33	4.47	0.00	11.09	15.96	1999	1
0.64	2.91	0.00	5.47	8.42	2000	1
0.21	0.21	0.10	2.53	10.45	2001	1
0.42	0.62	0	5.06	4.68	2002	1
0	0.00	0	0.03	0.54	2003	1

```
0      0.10   0      10.86  3.60   2004   1
0      0.31   0      23.04  2.42   2005   1
0      0.52   0      4.66   1.99   2006   1
0      0.62   0      10.60  2.55   2007   1
0      0.73   0      7.46   2.75   2008   1
0      0.62   0      10.93  3.17   2009   1
0      0.83   0      8.45   2.05   2010   1

# ABUNDANCE INDICES
# -----------------
27     #_N_cpue_and_surveyabundance_observations

#_Units:  0=numbers; 1=biomass; 2=F
#_Errtype:  -1=normal; 0=lognormal; >0=T
#_Fleet Units Errtype
1 1 0  # 1 ComTrawl_S
2 1 0  # 2 ComHook_S
3 1 0  # 3 ComNet_S
4 1 0  # 4 RecCPFV_S
5 1 0  # 5 RecPriv_S
6 0 0  # 6 RecDockside_S
7 1 0  # 7 NWFSC_Trawl_Survey_S
8 0 0  # 8 NWFSC_HKL_Survey_S

# RecFIN Dockside Index
#year  seas   fleet  Index  SE
1980   1      6      0.0919 0.4070
1981   1      6      0.0111 0.7094
1982   1      6      0.0078 0.8748
1983   1      6      0.0323 0.8292
1984   1      6      0.0757 0.4971
1985   1      6      0.0998 0.4852
1986   1      6      0.0466 0.4078
1996   1      6      0.0114 0.8617
1998   1      6      0.0357 0.7519
1999   1      6      0.0418 0.4605
2000   1      6      0.0660 0.3533
2001   1      -6     0.0456 0.7720

# NWFSC trawl survey (metric tons)
#Year  Season Fleet  Value  seLogB
2003   1      7      587.1  0.392
2004   1      7      897.7  0.697
2005   1      7      1184.1 0.422
2006   1      7      1516.1 0.407
2007   1      7      2481.0 0.351
2008   1      7      610.9  0.346
2009   1      7      849.9  0.251
2010   1      7      1399.6 0.494

# NWFSC hook and line survey
#year  seas   fleet  Median_index  log-SD
2004   1      8      0.0375 0.4860
2005   1      8      0.0178 0.5024
2006   1      8      0.0215 0.5170
2007   1      8      0.0147 0.5077
2008   1      8      0.0161 0.5034
2009   1      8      0.0185 0.5201
2010   1      8      0.0115 0.5213

# DISCARDED CATCH
# ---------------
0      # N fleets with discard
```

```
0      # N discard observations

# MEAN BODY WEIGHT
# ----------------

0      # N meanbodywt obs
30     # (NOT COND, but ignored if Nobs=0); deg of freedom for t dist of bodyweight
deviations

# LENGTH COMPOSITION SET-UP
# ------------------------
# population length bins (not necessarily same as data bins, below)
2      # length bin method: 1=use databins; 2=generate from binwidth,min,max below;
3=read vector
2      # binwidth for population size comp (must be factor or min size and max size
4      # minimum size in the population (lower edge of first bin and size at age 0.00)
58     # maximum size in the population (lower edge of last bin)

-0.0001       #_comp_tail_compression; neg. value disables (disable for sparse data,
e.g. cond'l age-at-length)
1e-007 #_add_to_comp
0      #_combine males into females at or below this bin number

# LENGTH COMPOSITION DATA
# ----------------------
26     #_N_LengthBins
# vector of length N_LengthBins with lower edges of each bin
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

101    #_N_Length_obs

# ComTrawl_S
#Year  Seas   Flt    Gender Part   Nsamp  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
1983   1      1      0      0      16.1   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.01948       0.00974       0.12838       0.06419
       0.05253       0.13812       0.13620       0.07201       0.16733       0.03113
       0.10698       0.00974       0.02140       0.04279       0.00000
1984   1      1      0      0      9.3    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.02891       0.01446       0.00723       0.03614
       0.05782       0.06505       0.05782       0.20492       0.29635       0.17347
       0.05782       0.00000       0.00000       0.00000       0.00000
1985   1      1      0      0      4.9    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.04348       0.00000       0.13043       0.23913       0.19565
       0.00000       0.23913       0.15217       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1987   1      1      0      0      4.0    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.09091       0.13636
       0.27273       0.27273       0.09091       0.04545       0.09091       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2001   1      1      0      0      6.8    0.00000       0.02381       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.02381       0.04762       0.07143       0.14286       0.16667
       0.28571       0.14286       0.04762       0.04762       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000

# ComHook_S
```

```
#Year  Seas   Flt    Gender Part   Nsamp  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
1983   1      2      0      0      3.2    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.06250       0.06250       0.43750
       0.31250       0.06250       0.06250       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1984   1      2      0      0      18.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00731       0.00000       0.00063
       0.00127       0.00985       0.10749       0.07588       0.29265       0.25404
       0.12542       0.05360       0.04074       0.00833       0.00000       0.00000
       0.01972       0.00000       0.00306       0.00000       0.00000
1985   1      2      0      0      14.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00827       0.00000
       0.00788       0.02585       0.05699       0.03345       0.19468       0.20923
       0.21205       0.08538       0.05443       0.06708       0.02236       0.02236
       0.00000       0.00000       0.00000       0.00000       0.00000
1986   1      2      0      0      71.1   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00282
       0.00733       0.02263       0.04347       0.12303       0.23829       0.25132
       0.19032       0.09009       0.02594       0.00423       0.00054       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1987   1      2      0      0      35.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.02455       0.03943
       0.09431       0.08882       0.18645       0.18125       0.16060       0.15352
       0.03856       0.00693       0.00939       0.00087       0.00000       0.01531
       0.00000       0.00000       0.00000       0.00000       0.00000
1988   1      2      0      0      17.2   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.12437       0.07620       0.24327       0.04685       0.08034       0.07770
       0.16068       0.12230       0.01656       0.01637       0.01637       0.01355
       0.00000       0.00546       0.00000       0.00000       0.00000
1989   1      2      0      0      25.5   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00445       0.00000
       0.01334       0.02988       0.04939       0.08619       0.01828       0.10571
       0.15806       0.24426       0.07730       0.04791       0.05508       0.08940
       0.01037       0.01037       0.00000       0.00000       0.00000
1990   1      2      0      0      3.7    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.26122       0.08707       0.00000       0.08707       0.08707
       0.08707       0.30342       0.08707       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1992   1      2      0      0      3.5    0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.18907       0.18907       0.03417       0.36446       0.22323
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1995   1      2      0      0      56.4   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00142       0.08648       0.10219       0.28931       0.25902       0.14126
       0.07785       0.03369       0.00878       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1996   1      2      0      0      62.3   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00741       0.00000       0.01483       0.07832
       0.13763       0.15455       0.12103       0.09428       0.09992       0.07994
       0.08735       0.07252       0.04061       0.01160       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1997   1      2      0      0      86.9   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.05450
       0.05148       0.12263       0.15973       0.14913       0.11582       0.16200
       0.09992       0.04542       0.02877       0.01060       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
```

```
1998  1     2     0     0     231.7  0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00393      0.02416
      0.06735      0.10940      0.16353      0.17758      0.16716      0.14020
      0.09234      0.02945      0.02016      0.00257      0.00121      0.00098
      0.00000      0.00000      0.00000      0.00000      0.00000
1999  1     2     0     0     17.7   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.16791      0.18715      0.22005      0.08194      0.14215
      0.09683      0.04314      0.04593      0.00993      0.00000      0.00497
      0.00000      0.00000      0.00000      0.00000      0.00000
2002  1     2     0     0     6.1    0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.01951
      0.33171      0.14797      0.18862      0.31220      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2006  1     2     0     0     4.5    0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.17466      0.39327      0.26417      0.00861      0.02582      0.09560
      0.00000      0.00000      0.00000      0.03787      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2008  1     2     0     0     19.8   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.02804      0.08411
      0.21495      0.24299      0.18692      0.15888      0.05607      0.02804
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2009  1     2     0     0     34.7   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.02080      0.10720      0.09280
      0.19840      0.20480      0.15360      0.12320      0.09760      0.00160
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2010  1     2     0     0     47.9   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.01291      0.08983      0.16366
      0.25555      0.13887      0.15178      0.13320      0.04646      0.00774
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# ComNet_S
#Year Seas  Flt   Gender Part  Nsamp  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
1983  1     3     0     0     13.0   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.01214      0.38266      0.38266
      0.00650      0.11861      0.02626      0.06326      0.00395      0.00395
      0.00000      0.00000      0.00000      0.00000      0.00000
1984  1     3     0     0     13.1   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.12318      0.23669      0.11727      0.34669
      0.06616      0.11001      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1985  1     3     0     0     35.1   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00791      0.02926      0.08076      0.12579      0.15744      0.20001
      0.18508      0.08130      0.09935      0.01655      0.01655      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1986  1     3     0     0     22.1   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.02228      0.04456      0.14807      0.21116      0.24980
      0.14255      0.12106      0.02070      0.03707      0.00000      0.00000
      0.00000      0.00276      0.00000      0.00000      0.00000
1987  1     3     0     0     10.0   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.03364      0.10021      0.14674      0.19900
```

```
       0.13887       0.14603       0.10093       0.13457       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1988   1      3      0      0      14.7  0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.08653       0.00000       0.25788       0.09054       0.17650       0.34384
       0.00057       0.04413       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1989   1      3      0      0      2.7   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.08333       0.00000       0.16667       0.08333       0.08333       0.16667
       0.41667       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1996   1      3      0      0      7.6   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.15476       0.23214       0.14881       0.17857
       0.20238       0.07143       0.01190       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000

# CDFG onboard CPFV sampling
#Year  Seas   Flt    Gender Part   Nsamp  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
1975   1      4      0      0      244.1  0.00000       0.00000       0.00000
       0.00438       0.00875       0.02298       0.05142       0.04923       0.07987
       0.10394       0.13786       0.15755       0.12473       0.07987       0.04923
       0.05142       0.03501       0.01969       0.00766       0.00547       0.00656
       0.00219       0.00000       0.00109       0.00109       0.00000
1976   1      4      0      0      350.5  0.00000       0.00000       0.00000
       0.00070       0.00492       0.02528       0.04213       0.07163       0.08497
       0.10674       0.13272       0.14607       0.12360       0.08989       0.06110
       0.05688       0.02949       0.01124       0.00492       0.00140       0.00211
       0.00211       0.00140       0.00000       0.00070       0.00000
1977   1      4      0      0      324.9  0.00000       0.00000       0.00000
       0.00064       0.00700       0.01463       0.03372       0.05216       0.05852
       0.08461       0.10051       0.10369       0.12786       0.11832       0.09860
       0.09924       0.05916       0.03244       0.00573       0.00191       0.00064
       0.00064       0.00000       0.00000       0.00000       0.00000
1978   1      4      0      0      332.1  0.00000       0.00000       0.00063
       0.00251       0.00878       0.02257       0.05768       0.07586       0.07712
       0.09091       0.09781       0.11473       0.10031       0.08464       0.08840
       0.06897       0.06395       0.02696       0.01003       0.00313       0.00376
       0.00125       0.00000       0.00000       0.00000       0.00000

# RecCPFV_S, RecFIN 1980-2003
#Year  Seas   Flt    Gender Part   Nsamp  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
1980   1      4      0      0      65.2   0.00000       0.00000       0.00000
       0.00000       0.00000       0.02083       0.05208       0.11458       0.07292
       0.17708       0.19792       0.10417       0.11458       0.07292       0.05208
       0.01042       0.00000       0.01042       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1981   1      4      0      0      78.0   0.00000       0.00000       0.00000
       0.00862       0.00000       0.00000       0.01724       0.04310       0.07759
       0.17241       0.16379       0.12931       0.09483       0.11207       0.11207
       0.04310       0.00862       0.00862       0.00862       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
1982   1      4      0      0      125.7  0.00000       0.00000       0.00000
       0.00000       0.00410       0.00410       0.00820       0.04098       0.02869
       0.04918       0.06967       0.12705       0.12295       0.20492       0.20082
       0.09426       0.02049       0.00410       0.00000       0.01639       0.00410
       0.00000       0.00000       0.00000       0.00000       0.00000
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1983  1     4     0     0     204.4  0.00000      0.00000      0.00000
      0.00000      0.01683      0.01923      0.06010      0.04087      0.05529
      0.03606      0.07692      0.06490      0.13462      0.09856      0.16587
      0.09375      0.08413      0.02885      0.00962      0.00962      0.00240
      0.00000      0.00000      0.00240      0.00000      0.00000
1984  1     4     0     0     317.8  0.00000      0.00000      0.00000
      0.00582      0.02620      0.08151      0.09316      0.10917      0.07860
      0.07569      0.07132      0.07132      0.06114      0.07132      0.11936
      0.08297      0.03930      0.00873      0.00291      0.00000      0.00000
      0.00000      0.00146      0.00000      0.00000      0.00000
1985  1     4     0     0     251.1  0.00000      0.00000      0.00000
      0.00755      0.02453      0.06226      0.06415      0.09623      0.08302
      0.08679      0.05472      0.03962      0.05472      0.05094      0.10000
      0.06792      0.07547      0.04340      0.03774      0.02075      0.01698
      0.01132      0.00189      0.00000      0.00000      0.00000
1986  1     4     0     0     97.1   0.00000      0.00000      0.00000
      0.04032      0.04032      0.04032      0.11290      0.09677      0.15323
      0.12097      0.12903      0.11290      0.03226      0.04839      0.04032
      0.01613      0.00806      0.00000      0.00806      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
#1987 1     4     0     0     -1.1   0.00000      0.00000      0.00000
      0.00000      0.00000      1.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
#1989 1     4     0     0     -3.4   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.33333      0.00000
      0.00000      0.33333      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.33333      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1993  1     4     0     0     21.6   0.00000      0.00000      0.00000
      0.00000      0.06061      0.03030      0.09091      0.06061      0.15152
      0.06061      0.06061      0.15152      0.06061      0.06061      0.09091
      0.03030      0.03030      0.00000      0.03030      0.00000      0.00000
      0.00000      0.00000      0.03030      0.00000      0.00000
1994  1     4     0     0     74.4   0.00000      0.00000      0.01351
      0.02027      0.00676      0.02703      0.03378      0.11486      0.10135
      0.07432      0.06081      0.08108      0.14865      0.07432      0.09459
      0.12838      0.01351      0.00676      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1995  1     4     0     0     17.1   0.00000      0.00000      0.00000
      0.00000      0.03333      0.10000      0.06667      0.13333      0.06667
      0.20000      0.16667      0.16667      0.03333      0.03333      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1996  1     4     0     0     52.6   0.00000      0.00000      0.00000
      0.00000      0.04839      0.04839      0.11290      0.30645      0.12903
      0.17742      0.06452      0.04839      0.03226      0.01613      0.01613
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
#1997 1     4     0     0     -14.2  0.00000      0.00000      0.00000
      0.06250      0.12500      0.06250      0.06250      0.25000      0.12500
      0.06250      0.06250      0.18750      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1998  1     4     0     0     72.3   0.00000      0.00000      0.00000
      0.00000      0.04082      0.08163      0.14286      0.15646      0.14966
      0.17007      0.05442      0.07483      0.03401      0.05442      0.02041
      0.00680      0.01361      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1999  1     4     0     0     197.3  0.00000      0.00000      0.00000
      0.02181      0.06231      0.12150      0.19003      0.07165      0.12461
      0.09657      0.07788      0.12150      0.05919      0.02181      0.02181
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      0.00623      0.00312      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2000  1     4     0     0     188.9  0.00000      0.00000      0.00943
      0.01572      0.02830      0.06918      0.12264      0.16038      0.17610
      0.16352      0.12893      0.05346      0.03145      0.02201      0.00629
      0.00629      0.00629      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2001  1     4     0     0     81.2   0.00000      0.00000      0.00000
      0.00909      0.06364      0.10000      0.14545      0.18182      0.19091
      0.10000      0.09091      0.08182      0.03636      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2002  1     4     0     0     111.8  0.00000      0.00000      0.00000
      0.01899      0.00633      0.08228      0.10127      0.15190      0.18987
      0.16456      0.15823      0.04430      0.04430      0.02532      0.00000
      0.00000      0.01266      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
#2003 1     4     0     0     -8.0   0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.28571      0.00000
      0.28571      0.14286      0.28571      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2004  1     4     0     0     309.9  0.00000      0.00000      0.00000
      0.00192      0.00192      0.01919      0.05950      0.08061      0.12284
      0.21497      0.23033      0.15163      0.05950      0.02879      0.01536
      0.00960      0.00000      0.00000      0.00384      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2005  1     4     0     0     319.7  0.00000      0.00000      0.00000
      0.00171      0.00171      0.00513      0.02393      0.08205      0.15043
      0.15897      0.23932      0.17436      0.08718      0.04444      0.02735
      0.00342      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2006  1     4     0     0     447.0  0.00000      0.00000      0.00000
      0.00000      0.01131      0.01244      0.04638      0.09842      0.15837
      0.21719      0.20023      0.14253      0.06335      0.03620      0.01018
      0.00226      0.00000      0.00113      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2007  1     4     0     0     495.4  0.00000      0.00000      0.00000
      0.00118      0.00823      0.01410      0.03290      0.07051      0.13514
      0.19389      0.20564      0.16569      0.10106      0.03878      0.02115
      0.00588      0.00235      0.00235      0.00000      0.00118      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2008  1     4     0     0     453.4  0.00000      0.00000      0.00000
      0.00250      0.01125      0.01000      0.05250      0.09250      0.14875
      0.16000      0.15875      0.19750      0.11125      0.04250      0.00750
      0.00375      0.00125      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2009  1     4     0     0     568.1  0.00000      0.00000      0.00000
      0.00198      0.01984      0.03869      0.07242      0.09623      0.13591
      0.11607      0.11806      0.14484      0.15179      0.06151      0.02480
      0.01190      0.00099      0.00397      0.00099      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2010  1     4     0     0     587.1  0.00000      0.00000      0.00000
      0.01457      0.03924      0.08744      0.10650      0.14462      0.15471
      0.11435      0.10426      0.08184      0.07287      0.04821      0.02018
      0.00897      0.00000      0.00000      0.00224      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# RecPriv_S, RecFIN 1980-2003
#Year Seas  Flt   Gender Part  Nsamp 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
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1980  1     5      0      0      49.7  0.00000     0.00000     0.00000
      0.00000      0.00000      0.00877      0.06140      0.08772      0.14912
      0.13158      0.09649      0.12281      0.14035      0.07895      0.06140
      0.02632      0.02632      0.00877      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1981  1     5      0      0      27.8  0.00000     0.00000     0.00000
      0.00000      0.01563      0.00000      0.09375      0.04688      0.18750
      0.12500      0.10938      0.12500      0.03125      0.06250      0.06250
      0.04688      0.03125      0.00000      0.03125      0.01563      0.01563
      0.00000      0.00000      0.00000      0.00000      0.00000
1982  1     5      0      0      96.8  0.00000     0.00000     0.00000
      0.00000      0.00478      0.02392      0.05742      0.08134      0.10048
      0.11005      0.11005      0.12440      0.12440      0.05742      0.08134
      0.06220      0.03349      0.01914      0.00478      0.00478      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1983  1     5      0      0      36.9  0.00000     0.00000     0.00000
      0.00990      0.00000      0.03960      0.03960      0.03960      0.14851
      0.04950      0.04950      0.12871      0.19802      0.11881      0.10891
      0.00990      0.01980      0.00990      0.00990      0.01980      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1984  1     5      0      0      34.8  0.00000     0.00000     0.00000
      0.00000      0.00000      0.03226      0.10753      0.12903      0.07527
      0.11828      0.10753      0.11828      0.09677      0.04301      0.08602
      0.04301      0.02151      0.02151      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1985  1     5      0      0      52.2  0.00000     0.00000     0.00000
      0.00000      0.01515      0.02273      0.09848      0.13636      0.12121
      0.22727      0.09848      0.04545      0.03788      0.03030      0.08333
      0.03788      0.00758      0.01515      0.01515      0.00758      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1986  1     5      0      0      19.5  0.00000     0.00000     0.00000
      0.00000      0.00000      0.00000      0.03704      0.11111      0.20370
      0.14815      0.24074      0.12963      0.00000      0.00000      0.09259
      0.03704      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1987  1     5      0      0      8.2   0.00000     0.00000     0.00000
      0.00000      0.00000      0.08696      0.04348      0.04348      0.26087
      0.13043      0.17391      0.08696      0.08696      0.04348      0.04348
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1988  1     5      0      0      13.7  0.00000     0.00000     0.00000
      0.00000      0.11111      0.11111      0.03704      0.00000      0.00000
      0.00000      0.14815      0.33333      0.14815      0.03704      0.07407
      0.00000      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1989  1     5      0      0      26.5  0.00000     0.00000     0.00000
      0.00000      0.01449      0.01449      0.08696      0.04348      0.18841
      0.11594      0.20290      0.15942      0.08696      0.02899      0.01449
      0.02899      0.00000      0.00000      0.01449      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
1993  1     5      0      0      55.9  0.00000     0.00000     0.00000
      0.01739      0.01739      0.02609      0.04348      0.04348      0.12174
      0.08696      0.11304      0.12174      0.11304      0.10435      0.02609
      0.04348      0.02609      0.06087      0.00000      0.02609      0.00870
      0.00000      0.00000      0.00000      0.00000      0.00000
1994  1     5      0      0      62.7  0.00000     0.00000     0.00000
      0.00000      0.00781      0.03125      0.12500      0.07031      0.10156
      0.15625      0.08594      0.11719      0.11719      0.07813      0.03125
      0.03125      0.02344      0.00000      0.01563      0.00000      0.00781
      0.00000      0.00000      0.00000      0.00000      0.00000
1995  1     5      0      0      54.7  0.00000     0.00000     0.00000
      0.01010      0.01010      0.05051      0.02020      0.09091      0.13131
      0.12121      0.14141      0.12121      0.11111      0.11111      0.02020
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      0.04040     0.01010     0.00000     0.00000     0.01010     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1996  1     5     0     0     39.5  0.00000     0.00000     0.02632
      0.00000     0.05263     0.02632     0.05263     0.11842     0.11842
      0.23684     0.11842     0.13158     0.03947     0.02632     0.02632
      0.02632     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1997  1     5     0     0     12.2  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.04348     0.17391
      0.26087     0.26087     0.08696     0.17391     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1998  1     5     0     0     22.7  0.00000     0.00000     0.00000
      0.00000     0.00000     0.02941     0.05882     0.05882     0.11765
      0.20588     0.14706     0.08824     0.23529     0.02941     0.02941
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
1999  1     5     0     0     75.9  0.00000     0.00000     0.00000
      0.00000     0.01807     0.04819     0.06024     0.13855     0.13253
      0.22892     0.15060     0.10843     0.06024     0.00602     0.03012
      0.01205     0.00000     0.00602     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2000  1     5     0     0     30.6  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.11290     0.11290     0.06452
      0.17742     0.16129     0.24194     0.04839     0.03226     0.03226
      0.01613     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2001  1     5     0     0     16.0  0.00000     0.00000     0.00000
      0.06897     0.00000     0.06897     0.06897     0.03448     0.13793
      0.13793     0.13793     0.20690     0.03448     0.06897     0.00000
      0.00000     0.00000     0.00000     0.03448     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2002  1     5     0     0     16.5  0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.02500     0.20000     0.25000
      0.17500     0.17500     0.02500     0.10000     0.05000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
#2003 1     5     0     0     -10.8 0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.15385     0.00000     0.00000
      0.30769     0.30769     0.15385     0.00000     0.00000     0.00000
      0.07692     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2004  1     5     0     0     130.7 0.00000     0.00000     0.00000
      0.00000     0.00000     0.04641     0.04219     0.10549     0.15190
      0.23629     0.14768     0.13080     0.07595     0.04219     0.01688
      0.00422     0.00000     0.00000     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2005  1     5     0     0     120.9 0.00000     0.00433     0.00000
      0.00000     0.02165     0.01299     0.02165     0.03463     0.16450
      0.16883     0.17316     0.16450     0.09524     0.06926     0.04329
      0.00866     0.01299     0.00433     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
2006  1     5     0     0     166.3 0.00000     0.00000     0.00000
      0.00259     0.01036     0.02591     0.03627     0.09326     0.15285
      0.20207     0.20466     0.17617     0.03368     0.02850     0.01813
      0.00259     0.00777     0.00259     0.00000     0.00000     0.00000
      0.00000     0.00000     0.00259     0.00000     0.00000
2007  1     5     0     0     169.5 0.00273     0.00000     0.00000
      0.00000     0.01093     0.01639     0.06557     0.07923     0.13388
      0.19126     0.19399     0.15301     0.08470     0.03005     0.02186
      0.01093     0.00000     0.00273     0.00273     0.00000     0.00000
      0.00000     0.00000     0.00000     0.00000     0.00000
```

```
2008  1     5     0     0     173.7 0.00000      0.00000      0.00000
      0.00621      0.01656      0.03727      0.04348      0.05383      0.08489
      0.17184      0.20704      0.19876      0.09110      0.04348      0.02277
      0.01242      0.01035      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2009  1     5     0     0     180.9 0.00000      0.00000      0.00271
      0.00271      0.00542      0.01897      0.05962      0.05691      0.11924
      0.10298      0.16531      0.14634      0.17886      0.07859      0.03252
      0.01897      0.01084      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2010  1     5     0     0     147.2 0.00000      0.00000      0.00000
      0.01170      0.04678      0.06433      0.06725      0.09649      0.09649
      0.15789      0.14327      0.12281      0.12573      0.04678      0.01170
      0.00292      0.00000      0.00292      0.00292      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# NWFSC_Trawl_Survey_S
#Year Seas  Fleet Gend  Part  Nsamp 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
2003  1     7     0     0     25.3  0.00000      0.00000      5.53205
      9.58291      11.63307     14.90130     10.38151     7.37494      12.48171
      7.71294      7.08043      3.68635      2.11882      4.26358      1.08978
      1.08030      0.00000      1.08030      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2004  1     7     0     0     15.1  0.00000      0.00000      3.41688
      7.67275      5.35652      12.18126     25.73229     20.12686     3.00161
      1.86276      4.17866      3.02298      3.43696      3.52388      1.84337
      1.87561      1.55404      0.41527      0.41527      0.38303      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2005  1     7     0     0     27.3  0.51691      4.92229      6.09533
      18.28701     17.91462     7.50551      4.83086      1.32443      6.86195
      3.81541      7.57569      8.79083      2.43581      5.35912      2.20635
      1.28230      0.27558      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2006  1     7     0     0     31.8  0.00000      2.20819      6.17414
      17.07479     9.40031      2.87672      2.12170      3.20379      3.77586
      8.19494      11.51446     9.35253      5.11986      6.30264      5.88430
      2.30675      2.34604      1.62524      0.25482      0.26291      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2007  1     7     0     0     57.8  0.22674      4.12196      4.90066
      6.17359      4.21059      5.68902      4.86893      3.96262      4.10714
      5.19980      7.36459      8.49424      9.10996      9.30525      9.55626
      6.91690      2.67662      2.67624      0.21086      0.22803      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2008  1     7     0     0     41.1  0.00000      3.38952      9.36073
      20.46076     18.88946     13.94265     9.96204      6.27098      3.87142
      1.02084      1.97889      2.30747      3.60655      3.50105      0.74262
      0.69502      0.00000      0.00000      0.00000      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2009  1     7     0     0     45.1  0.00000      0.73853      5.31239
      12.92076     18.66107     10.57599     6.58571      4.47307      8.29635
      3.99776      8.71492      3.12244      3.06420      5.81553      1.77868
      3.15333      1.68427      0.76813      0.33686      0.00000      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000
2010  1     7     0     0     34.1  0.00000      0.92146      3.85764
      17.33683     10.55890     7.22269      5.04437      2.89833      2.67980
      1.25158      3.03815      2.39641      7.93910      4.94678      9.30268
      6.55048      4.85644      3.46790      4.18918      1.54129      0.00000
      0.00000      0.00000      0.00000      0.00000      0.00000

# NWFSC_HKL_Survey_S
```

```
#Year  Seas   Fleet  Gend   Part   Nsamp  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
2004   1      8      0      0      53.8   0.00000       0.00000       0.00000
       0.00000       0.00000       0.00900       0.01350       0.04930       0.07620
       0.08520       0.14800       0.17940       0.15250       0.12110       0.12560
       0.03140       0.00450       0.00450       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2005   1      8      0      0      53.3   0.00000       0.00000       0.00000
       0.00000       0.00000       0.02270       0.00760       0.02270       0.03790
       0.11360       0.12880       0.15910       0.14390       0.15910       0.09850
       0.06060       0.04550       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2006   1      8      0      0      67.1   0.00000       0.00000       0.00000
       0.00000       0.00000       0.02340       0.04210       0.04210       0.07940
       0.12150       0.11680       0.09810       0.15420       0.14950       0.08880
       0.06540       0.01870       0.00000       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2007   1      8      0      0      57.4   0.00000       0.00000       0.00000
       0.00530       0.00000       0.01060       0.04230       0.03700       0.06880
       0.04230       0.09520       0.11640       0.19050       0.15340       0.11640
       0.07410       0.04230       0.00530       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2008   1      8      0      0      74.8   0.00000       0.00000       0.00000
       0.00000       0.01260       0.02100       0.05040       0.05460       0.07980
       0.08400       0.13870       0.17650       0.11760       0.13450       0.05880
       0.03780       0.02520       0.00420       0.00420       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2009   1      8      0      0      78.4   0.00000       0.00000       0.00000
       0.00364       0.01091       0.03273       0.04727       0.08000       0.06909
       0.08727       0.09091       0.11273       0.16727       0.15636       0.09091
       0.04000       0.00364       0.00364       0.00000       0.00364       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000
2010   1      8      0      0      69.7   0.00000       0.00000       0.00000
       0.00000       0.00481       0.01923       0.05769       0.05769       0.06250
       0.07212       0.11058       0.12981       0.11058       0.19712       0.10577
       0.04808       0.00481       0.01923       0.00000       0.00000       0.00000
       0.00000       0.00000       0.00000       0.00000       0.00000

# AGE COMPOSITION SET-UP
# ----------------------
52     #_N_age_bins
# vector with lower edge of observed age (age') bins
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32
33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 55 60

# AGEING ERROR
# ------------------------------------------
1      #_N_ageerror_definitions

# Ageing error based on within-reader error
0.5    1.5    2.5    3.5    4.5    5.5    6.5    7.5    8.5    9.5    10.5   11.5   12.5
       13.5   14.5   15.5   16.5   17.5   18.5   19.5   20.5   21.5   22.5   23.5   24.5
       25.5   26.5   27.5   28.5   29.5   30.5   31.5   32.5   33.5   34.5   35.5   36.5
       37.5   38.5   39.5   40.5   41.5   42.5   43.5   44.5   45.5   46.5   47.5   48.5
       49.5   50.5   51.5   52.5   53.5   54.5   55.5   56.5   57.5   58.5   59.5   60.5
       61.5   62.5   63.5   64.5   65.5
0.052  0.052  0.105  0.157  0.210  0.263  0.315  0.369  0.422  0.476  0.530  0.585  0.640
       0.695  0.752  0.809  0.866  0.925  0.985  1.047  1.110  1.174  1.241  1.310  1.381
       1.455  1.533  1.615  1.702  1.793  1.891  1.995  2.107  2.227  2.358  2.500  2.655
       2.825  3.011  3.217  3.445  3.698  3.979  4.293  4.643  5.034  5.474  5.967  6.521
       7.144  7.847  8.639  9.532  10.541 11.681 12.969 14.425 16.072 17.935 20.043 22.429
       25.129 28.186 31.647 35.565 40.000
```

```
# AGE COMPOSITION DATA
# --------------------
105    #_N_Agecomp_obs

3      #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths
1      #_combine males into females at or below this bin number

# conditional age comps for NWFSC trawl survey 2005, 2007, 2009
#year  Season Fleet  gender part   ageErr LbinLo LbinHi nSamps A1     A2     A3     A4
       A5     A6     A7     A8     A9     A10    A11    A12    A13    A14    A15    A16
       A17    A18    A19    A20    A21    A22    A23    A24    A25    A26    A27    A28
       A29    A30    A31    A32    A33    A34    A35    A36    A37    A38    A39    A40
       A41    A42    A43    A44    A45    A46    A47    A48    A49    A50    A55    A60
2005   1      7      0      0      1      10     10     4      0.000  0.000  26.700 26.700
       46.600 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      12     12     8      0.000  0.000  0.000  39.727
       0.000  6.928  3.483  3.445  43.072 0.000  3.345  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      14     14     12     0.000  0.000  0.000  0.000
       0.000  14.438 2.421  13.479 41.570 13.479 14.612 0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      16     16     11     0.000  0.000  0.000  0.000
       0.000  0.000  0.000  20.214 0.000  51.559 14.683 13.545 0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      18     18     3      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  30.128 39.744 30.128 0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      20     20     5      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  42.016 31.495 0.000  26.489 0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      22     22     2      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  88.027 0.000  11.973 0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      24     24     7      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  12.794 40.727 28.713 2.518  15.249 0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      26     26     4      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  5.487  27.885 0.000  38.743 27.885 0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2005   1      7      0      0      1      28     28     6      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  17.410 0.000  42.471
       37.134 0.000  0.000  2.985  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
```

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	30	30	4	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	12.615	0.000
	0.000	0.000	50.000	37.385	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	32	32	2	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16.443	0.000	0.000	0.000
	0.000	0.000	0.000	83.557	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	34	34	2	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	25.231	0.000	0.000	74.769	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	36	36	2	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	50.000	0.000	0.000	50.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	38	38	3	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	14.121	71.758	0.000	14.121	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2005	1	7	0	0	1	8	8	1	0.000	0.000	100.000	
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000											
2007	1	7	0	0	1	10	10	10	0.000	9.351	49.316	0.000
	20.666	10.333	10.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	12	12	10	0.000	0.000	7.820	19.893
	42.974	19.413	0.000	0.000	9.899	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	14	14	13	0.000	0.000	0.000	11.175
	52.522	15.738	10.528	10.037	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	16	16	16	0.000	0.000	0.000	0.000
	0.000	0.000	17.332	41.093	24.312	0.000	17.264	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	18	18	11	0.000	0.000	0.000	0.000
	0.000	0.000	20.759	26.676	13.303	8.767	8.018	9.174	13.303	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	20	20	15	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	2.191	22.812	5.686	15.465	10.868	21.722	12.583	8.672	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

2007	1	7	0	0	1	22	22	6	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	68.663	0.000	24.129	0.000
	7.207	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	24	24	10	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	6.008	0.000	0.000	20.911	30.733	10.998	0.000
	21.941	0.000	9.408	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	26	26	16	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.897	14.209	12.151	9.751	9.751
	0.000	14.177	13.386	13.386	0.000	0.000	5.395	0.000	0.000	0.000	0.000	3.897
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	28	28	13	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.617	3.258	5.268	8.482	0.000
	11.783	8.525	5.268	0.000	7.726	10.683	0.000	18.095	7.293	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	30	30	11	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.503	6.503	14.750	9.537
	10.523	23.710	13.187	5.748	0.000	0.000	9.537	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	32	32	19	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.297	0.000	12.321
	0.000	5.686	20.712	28.513	4.115	12.660	0.000	5.696	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	34	34	16	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.374
	12.465	2.628	3.756	29.995	13.685	19.602	0.000	6.877	8.618	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	36	36	15	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.065	0.000
	5.375	7.960	2.065	14.805	28.308	18.236	2.951	0.000	18.236	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	38	38	12	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	15.329	0.000	42.572	3.407	6.178	6.545	15.329	4.463	6.178	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	40	40	4	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	48.483	31.978	0.000	0.000	0.000	0.000
	0.000	19.539	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	42	42	3	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	59.027	0.000	23.788	0.000	0.000	0.000	0.000
	17.185	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	1	7	0	0	1	8	8	2	0.000	0.000	47.504	52.496
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	10	10	4	0.000	0.000	31.349	44.461
	24.191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	12	12	19	0.000	0.000	0.000	33.184
	26.607	28.167	12.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	14	14	30	0.000	0.000	3.105	11.766
	11.133	23.395	12.138	15.556	12.318	5.295	5.295	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	16	16	33	0.000	0.000	0.000	0.000
	6.763	16.167	20.588	30.984	4.701	10.727	1.847	8.224	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	18	18	27	0.000	0.000	0.000	0.000
	0.000	0.000	5.084	15.045	13.577	34.404	7.687	3.885	2.374	13.515	4.428	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	20	20	17	0.000	0.000	0.000	0.000
	0.000	0.000	5.355	15.517	5.891	35.663	13.446	6.489	8.820	0.000	0.000	0.000
	8.820	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	22	22	10	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	5.765	34.801	6.986	9.495	42.952	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	24	24	14	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	8.466	0.000	0.000	40.205	21.734	10.867	0.000
	7.384	0.000	11.343	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	26	26	9	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.062	0.000	37.016	9.770	16.122
	23.047	5.983	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	28	28	10	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.327	0.000	31.688	0.000
	6.455	31.903	7.357	7.357	0.000	0.000	0.000	0.000	4.914	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	30	30	7	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.630	18.985	0.000
	60.611	0.000	0.000	11.774	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	32	32	5	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	33.138	0.000	0.000
	41.801	0.000	0.000	0.000	0.000	0.000	25.061	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2009	1	7	0	0	1	34	34	6	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7.543	0.000	0.000	0.000	6.881
	7.543	0.000	0.000	23.173	11.293	43.567	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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2009   1      7      0      0      1      36     36     1      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  100.000       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000
2009   1      7      0      0      1      38     38     4      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  17.551
       0.000  0.000  0.000  53.922 0.000  0.000  0.000  12.571 15.955 0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2009   1      7      0      0      1      40     40     3      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  33.333
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  33.333
       0.000  0.000  33.333 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
2009   1      7      0      0      1      42     42     1      0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       100.000       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
       0.000

# conditional age comps for NWFSC HKL survey 2004, 2006, 2008, 2010
#year  Season Fleet  gender part   ageErr LbinLo LbinHi nSamps A1     A2     A3     A4
       A5     A6     A7     A8     A9     A10    A11    A12    A13    A14    A15    A16
       A17    A18    A19    A20    A21    A22    A23    A24    A25    A26    A27    A28
       A29    A30    A31    A32    A33    A34    A35    A36    A37    A38    A39    A40
       A41    A42    A43    A44    A45    A46    A47    A48    A49    A50    A55    A60
2004   1      8      0      0      1      18     18     1      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      1
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
2004   1      8      0      0      1      20     20     4      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       1      2      0      1      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
2004   1      8      0      0      1      22     22     14     0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       1      5      2      2      0      1      2      1      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
2004   1      8      0      0      1      24     24     14     0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       1      1      2      3      1      3      0      2      1      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
2004   1      8      0      0      1      26     26     24     0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      3      3      4      2      1      5      1      2      2      1      0
       0      0      0      0      0      0      0      0      0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
2004   1      8      0      0      1      28     28     39     0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      2
       0      1      1      1      7      3      5      2      2      5      6      3
       1      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      8      0      0      1      30     30     45     0      0      0      0
       0      0      0      0      0      0      0      0      0      0      0      0
       1      2      1      2      4      3      8      9      6      3      2      2
```

	2	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	8	0	0	1	32	32	42	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	3	3	6	5	8	3	4
	2	2	1	0	2	0	1	0	0	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	8	0	0	1	34	34	32	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	2	6	3	5	3	5
	5	1	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	8	0	0	1	36	36	29	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	2	0	2	2	2	5	5
	2	4	2	1	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	8	0	0	1	38	38	7	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	3	1	0	0	0	0	0	0	1	0
	0	0	0	0	0	0	1	0	0	0	0	0
2004	1	8	0	0	1	40	40	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2004	1	8	0	0	1	42	42	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	18	18	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	1
	1	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	20	20	9	0	0	0	0
	0	0	0	0	0	1	0	0	1	1	1	3
	1	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	22	22	9	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	0
	1	6	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	24	24	16	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	4
	1	3	5	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
2006	1	8	0	0	1	26	26	26	0	0	0	0
	0	0	0	0	0	0	0	0	0	1	0	2
	2	7	5	2	4	1	2	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	28	28	24	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	2	3	7	7	2	0	3	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

2006	1	8	0	0	1	30	30	20	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	0	0	1	6	0	5	2	3	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	32	32	33	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	2	0	3	8	2	3	5	4	3	2	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	34	34	30	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	2	4	4	4	3	3	3	3	2	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	36	36	18	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	0	3	5	3	2	1	1	0	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	38	38	14	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	1	1	1	2	2	2	2	1	0	1
	0	0	0	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2006	1	8	0	0	1	40	40	4	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	2	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
2008	1	8	0	0	1	16	16	3	0	0	0	0
	0	0	0	0	0	1	0	0	0	0	1	0
	0	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	18	18	4	0	0	0	0
	0	0	0	0	0	0	0	1	1	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	20	20	11	0	0	0	0
	0	0	0	0	0	0	1	0	1	0	3	1
	3	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
2008	1	8	0	0	1	22	22	13	0	0	0	0
	0	0	0	0	0	0	0	0	0	3	1	2
	4	2	1	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	24	24	18	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	5
	1	2	6	0	3	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	26	26	19	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	2
	1	1	6	3	1	1	2	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
2008	1	8	0	0	1	28	28	33	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	1
	2	4	4	11	4	3	1	1	2	0	0	0

	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	30	30	42	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	2	2
	1	3	8	7	4	8	3	2	1	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	32	32	28	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	1	0
	0	2	2	3	3	2	6	5	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	34	34	32	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	1	2	3	1	3	8	2	6	1	2	1	1
	0	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	36	36	14	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	2	2	2	0	0	1	1	1	5	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	38	38	9	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	0	0	2	1	1	2	0	1
	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	40	40	6	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	1	0	0	1	0	0	0	0
	2	0	1	0	1	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	42	42	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2008	1	8	0	0	1	44	44	1	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2010	1	8	0	0	1	16	16	1	0	0	0	0
	0	0	0	0	0	0	0	0	1	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2010	1	8	0	0	1	18	18	4	0	0	0	0
	0	0	0	0	0	0	1	1	1	0	1	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2010	1	8	0	0	1	20	20	12	0	0	0	0
	0	0	0	0	1	1	0	2	1	1	3	0
	2	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
2010	1	8	0	0	1	22	22	12	0	0	0	0
	0	0	0	0	0	0	0	1	4	1	2	0
	2	0	1	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0

```
2010  1   8   0   0   1   24  24  13  0   0   0   0
      0   0   0   0   0   0   0   2   0   1   3   0
      1   2   2   0   0   0   1   0   1   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   26  26  14  0   0   0   0
      0   0   0   0   0   0   0   0   1   1   3   3
      1   3   0   0   0   0   1   0   0   0   1   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   28  28  23  0   0   0   0
      0   0   0   0   0   0   0   0   0   3   2   4
      3   1   1   0   3   1   2   1   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
2010  1   8   0   0   1   30  30  27  0   0   0   0
      0   0   0   0   0   0   0   0   0   1   1   3
      3   1   7   1   0   1   3   1   2   1   1   1
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   32  32  23  0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   1
      1   1   6   1   0   2   2   6   1   1   1   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   34  34  41  0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   1
      1   8   2   3   4   2   3   4   2   4   3   2
      2   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   36  36  22  0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      1   0   0   0   3   4   0   3   1   4   0   1
      2   1   1   0   1   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   38  38  10  0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   2   0   1   2   0   0   1   1   0
      0   0   1   1   1   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   40  40  1   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   1   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
2010  1   8   0   0   1   42  42  4   0   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0
      0   0   0   0   2   0   1   0   0   0   0   0
      0   0   0   0   0   0   0   0   1   0   0   0
      0   0   0   0   0   0   0   0   0   0   0   0

# MEAN LENGTH OR BODYWEIGHT-AT-AGE
# -------------------------------
-1 #_N_MeanSize-at-Age_obs

# ENVIRONMENTAL DATA
# ------------------
0 #_N_environ_variables
0 #_N_environ_obs

# GENERALIZED SIZE COMPOSTION DATA
# -------------------------------
0 # N WtFreq methods
```

```
# TAG-RECAPTURE
# -------------
0 # Do_Tags (0=omit, 1=enter conditional data per manual)

# STOCK COMPOSITION
# -----------------
0 # no morphcomp data

999 # end of data file marker

ENDDATA
```

Appendix H: Stock Synthesis control files

Control file for northern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters off California, north of Point Conception

1      #_N_Growth_Patterns
1      #_N_Morphs_Within_GrowthPattern

# Define time block designs
3      #_Nblock_Patterns (0=omit conditional data)
2      # Number of Blocks in Design 1
1      # Number of Blocks in Design 2
2      # Number of Blocks in Design 3

# Begin/End Years for each block design
1988 2002    # Design 1: trawl selex blocks
2003 2011

1988 2011    # Design 2: HKL selex block (NOT IN BASE MODEL)

1992 1998    # Design 3: time block growth (NOT IN BASE MODEL)
1999 2011

0.5    #_fracfemale
0      #_natM_type:_0=1Parm;
1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
# (COND) enter conditional values if natM_type > 0

1      # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented;
4=not implemented
0      #_Growth_Age_for_L1
999    #_Growth_Age_for_L2 (999 to use as Linf)
0      #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0      #_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A); 4
SD=lognormal=SD[log(size-at-age)]
1      #_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity
matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern

1      #_First_Mature_Age
1      #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0      #_hermaphroditism option:  0=none; 1=age-specific fxn (0=no gender Change)
1      #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1,
3=like SS2 V1.x)
2      #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base
parm bounds)

#_growth_parms
#_LO   HI     INIT   PRIOR  PR_type      SD     PHASE  env-var use_dev dev_minyr
dev_maxyr dev_stddev Block Block_Fxn
0.01   0.3    0.065  0.065  -1     0.00912      -2     0 0 0 0 0.5 0 0            #
NatM_p_1_Fem_GP_1
0.001  10     0.01   0.01   -1     10     -3     0 0 0 0 0.5 0 0            #
L_at_Amin_Fem_GP_1
30     70     39.08  39.08  -1     10     3      0 0 0 0 0.5 0 0            #
L_at_Amax_Fem_GP_1
0.01   0.2    0.062  0.062  -1     10     3      0 0 0 0 0.5 0 0            #
VonBert_K_Fem_GP_1
0.01   0.3    0.10   0.10   -1     10     3      0 0 0 0 0.5 0 0            #
CV_young_Fem_GP_1
```

```
0.01   0.3    0.10   0.10   -1     10     3      0 0 0 0 0.5 0 0            #
CV_old_Fem_GP_1

# weight-length relationship
-3     3 1.32337E-5 1.32337E-5    -1     10     -1     0 0 0 0 0.5 0 0            #
Wtlen_1_Fem (length in cm, weight in kg)
2      4      3.108         3.108  -1     10     -1     0 0 0 0 0.5 0 0            #
Wtlen_2_Fem

# proportion mature at length
1      50     26.2          26.2   -1     10     -1     0 0 0 0 0.5 0 0            #
Mat50%_Fem
-3     3      -0.4   -0.4   -1     10     -1     0 0 0 0 0.5 0 0            #
Mat_slope_Fem

# fecundity option 1, parm values from dissertation (units of millions of eggs per kg)
0      1      0.234  0.234  -1     10     -1     0 0 0 0 0.5 0 0            #
Eg/gm_inter_Fem
0      1      0.1328 0.1328 -1     10     -1     0 0 0 0 0.5 0 0            #
Eg/gm_slope_wt_Fem

# recruitment apportionment
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_GP_1
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_Area_1
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_Seas_1

# cohort growth deviation (fix value at 1 with negative phase; needed for blocks or
annual devs)
1      1      1      1      -1     0      -1     0 0 0 0 0.5 0 0            #
CohortGrowDev

#_seasonal_effects_on_biology_parms (always 10 integers)
0 0 0 0 0 0 0 0 0 0
       #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,Malewtlen1,malewtlen2,L1,K

# Spawner-Recruitment
# -------------------
3      #_SR_function 1=B-H with flat top beyond B0, 2=Ricker, 3=standard B-H,
4=unconstrained, 5=hockey stick

#_LO   HI     INIT   PRIOR  PR_ty  SD     PHASE
3      20     8      8      -1     10     1      # SR_logR0
0.2    1.0    0.76   0.76   -2     0.17   -2     # SR_steepness with 2011 Dorn prior
0      2      0.7    0.7    -1     10     -1     # SR_sigmaR
-5     5      0      0      -1     10     -1     # SR_envlink
-5     5      0      0      -1     10     -1     # SR_R1_offset
0      0      0      0      -1     10     -1     # SR_autocorr

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

1      #do_recdev:  0=none; 1=devvector; 2=simple deviations
1993   # first year of main recr_devs; early devs can preceed this era
2010   # last year of main recr_devs; forecast devs start in following year
-6            #_recdev phase

1             # (0/1) to read 13 advanced options
0             #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4            #_recdev_early_phase
```

```
0             #_forecast_recruitment phase (incl. late recr) (0 value resets to
maxphase+1)
1             #_lambda for prior_fore_recr occurring before endyr+1
1994   #_last_early_yr_nobias_adj_in_MPD
2001   #_first_yr_fullbias_adj_in_MPD
2004   #_last_yr_fullbias_adj_in_MPD
2010   #_first_recent_yr_nobias_adj_in_MPD
0.65   #_max_bias_adj_in_MPD
0      # period of cycle in recruitment
-5     # min value for recruitment devs
5      # max value for recruitment devs
0      # number of explicit recruitment devs to read
#_end of advanced SR options

#Fishing Mortality info
0.1    # F ballpark for tuning early phases
-2001  # F ballpark year (neg value to disable)
3      # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9    # max F or harvest rate, depends on F_Method

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

#_initial_F_parms for each fleet
#_LO   HI     INIT   PRIOR  PR_type      SD     PHASE
0      1      0      0      -1     99     -1     # InitF_1_ComTrawl_N
0      1      0      0      -1     99     -1     # InitF_2_ComHook_N
0      1      0      0      -1     99     -1     # InitF_3_ComNet_N
0      1      0      0      -1     99     -1     # InitF_4_Rec_N

#_Q_setup for fleets and surveys
# A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand,
4=randwalk)
#_A    B      C      D
0      0      0      0      # 1 ComTrawl_N
0      0      0      0      # 2 ComHook_N
0      0      0      0      # 3 ComNet_N
0      0      0      0      # 4 Rec_N
0      0      0      0      # 5 RecDockside_N
0      0      0      0      # 6 NWFSC_Trawl_Survey_N
0      0      0      0      # 7 RecOnboard_N

#_size_selex_types
#_Pattern Retention Male Special
24 0 0 0      # 1 ComTrawl_N
24 0 0 0      # 2 ComHook_N
24 0 0 0      # 3 ComNet_N
24 0 0 0      # 4 Rec_N
15 0 0 4      # 5 RecDockside_N
 1 0 0 0      # 6 NWFSC_Trawl_Survey_N
15 0 0 4      # 7 RecOnboard_N

#_age_selex_types
#_Pattern Retention Male Special
10 0 0 0      # 1 ComTrawl_N
10 0 0 0      # 2 ComHook_N
10 0 0 0      # 3 ComNet_N
10 0 0 0      # 4 Rec_N
10 0 0 0      # 5 RecDockside_N
10 0 0 0      # 6 NWFSC_Trawl_Survey_N
10 0 0 0      # 7 RecOnboard_N
```

```
# LENGTH-BASED SELECTIVITY
# double-normal parameters:
# p1 = peak
# p2 = width of peak
# p3 = ascending width
# p4 = descending width
# p5 = selex at lowest bin
# p6 = selex at highest bin
# ComTrawl_N double-normal (forced asymptotic, but time-varying)
#_LO  HI    INIT   PRIOR  PR_type      SD     PHASE  env-var use_dev dev_minyr
dev_maxyr dev_stddev Block_Design Block_Type
10    57    40     40     -1     10     4      0 0 0 0 0.5 1 2
-10   5     -3     -3     -1     10     -4     0 0 0 0 0.5 0 0
-10   10    5      5      -1     10     4      0 0 0 0 0.5 1 2
-10   10    4      4      -1     10     -4     0 0 0 0 0.5 1 2
-11   11    -9     -9     -1     10     -4     0 0 0 0 0.5 0 0
-11   11    9      9      -1     10     -4     0 0 0 0 0.5 1 2

# ComHook_N double-normal parameters (forced asymptotic)
10    57    35     35     -1     10     5      0 0 0 0 0.5 0 0
-10   5     -3     -3     -1     10     -4     0 0 0 0 0.5 0 0
-10   10    3      3      -1     10     5      0 0 0 0 0.5 0 0
-10   10    4      4      -1     10     -4     0 0 0 0 0.5 0 0
-11   11    -9     -9     -1     10     -4     0 0 0 0 0.5 0 0
-11   11    9      9      -1     10     -4     0 0 0 0 0.5 0 0

# ComNet_N double-normal parameters
10    57    40     40     -1     10     4      0 0 0 0 0.5 0 0
-10   5     -3     -3     -1     10     -4     0 0 0 0 0.5 0 0
-10   10    5      5      -1     10     4      0 0 0 0 0.5 0 0
-10   10    4      4      -1     10     4      0 0 0 0 0.5 0 0
-11   11    -9     -9     -1     10     -4     0 0 0 0 0.5 0 0
-11   11    0      0      -1     10     4      0 0 0 0 0.5 0 0

# Rec_N double-normal parameters
10    57    40     40     -1     10     4      0 0 0 0 0.5 0 0
-10   5     -3     -3     -1     10     -4     0 0 0 0 0.5 0 0
-10   10    5      5      -1     10     4      0 0 0 0 0.5 0 0
-10   10    4      4      -1     10     4      0 0 0 0 0.5 0 0
-11   11    -9     -9     -1     10     -4     0 0 0 0 0.5 0 0
-11   11    0      0      -1     10     4      0 0 0 0 0.5 0 0

# NWFSC_Trawl_Survey_N logistic parameters
10    57    20     20     -1     10     4      0 0 0 0 0.5 0 0
0.1   30    5      5      -1     10     4      0 0 0 0 0.5 0 0

1 # selex block setup; 0=read one and apply to all; 1=read one line for each parm

# One parameter line for each time-blocked selectivity parm
#_LO  HI    INIT   PRIOR  PR_type      SD     PHASE
20    57    40     40     -1     10     4 # ComTrawl_N 1988 2002 peak
20    57    40     40     -1     10     4 # ComTrawl_N 2003 2011 peak
-10   10    5      5      -1     10     4 # ComTrawl_N 1988 2002 asc width
-10   10    5      5      -1     10     4 # ComTrawl_N 2003 2011 asc width
-10   10    4      4      -1     10     -4 # ComTrawl_N 1988 2002 desc width
-10   10    4      4      -1     10     4 # ComTrawl_N 2003 2011 desc width
-11   11    9      9      -1     10     -4 # ComTrawl_N 1988 2002 selex at highest bin
-11   11    -7.5   -7.5   -1     10     -4 # ComTrawl_N 2003 2011 selex at highest bin

1 # Selex parm method; 1=no constraint using base param bounds, 2=impose bounds from
base parm (logit transform)
```

```
# Tag loss and Tag reporting parameters go next
0  # TG_custom:  0=no read; 1=read if tags exist

1      #_Variance_adjustments_to_input_values

#fleet 1, fleet 2, etc
0 0 0 0 0.23 0.37 0.23     #_add_to_survey_CV
0 0 0 0 0 0 0 #_add_to_discard_CV
0 0 0 0 0 0 0 #_add_to_bodywt_CV

0.52 0.32 1 0.45 1 1 1     #_mult_by_lencomp_N
1 1 1 0.26 1 .36 1  #_mult_by_agecomp_N
1 1 1 1 1 1 1 #_mult_by_size-at-age_N

4      #_maxlambdaphase
1      #_sd_offset

# EMPHASIS FACTORS (LIKELIHOOD WEIGHTS)
14     # number of changes to make to default Lambdas (default value is 1.0)

# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;
# ---------------   9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen;
#                   14=Morphcomp; 15=Tag-comp; 16=Tag-negbin

# ComTrawl_N
#Like_comp fleet  phase  value  sizefreq_method
8      1      1      1      1      # catch
4      1      1      1      1      # length

# ComHook_N
#Like_comp fleet  phase  value  sizefreq_method
8      2      1      1      1      # catch
4      2      1      1      1      # length

# ComNet_N
#Like_comp fleet  phase  value  sizefreq_method
8      3      1      1      1      # catch
4      3      1      1      1      # length

# Rec_N
#Like_comp fleet  phase  value  sizefreq_method
8      4      1      1      1      # catch
4      4      1      1      1      # length
5      4      1      1      1      # age comps

# RecDockside_N
#Like_comp fleet  phase  value  sizefreq_method
1      5      1      1      1      # index

# NWFSC_Trawl_Survey_N
#Like_comp fleet  phase  value  sizefreq_method
1      6      1      1      1      # index
4      6      1      1      1      # length comps
5      6      1      1      1      # age comps

# RecOnboard_N
#Like_comp fleet  phase  value  sizefreq_method
1      6      1      1      1      # index

0 # (0/1) read specs for more stddev reporting
```

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

Control file for southern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters off California, south of Point Conception

1      #_N_Growth_Patterns
1      #_N_Morphs_Within_GrowthPattern

# Define time block designs
1      #_Nblock_Patterns (0=omit conditional data)
1      # Design 1 has 1 block

# Begin/End Years for each block design
2001 2011          # Design 1: effects of CCA, RCAs, and rec regs; extends into
forecast

# Natural Mortality and Growth options
0.5    #_fracfemale at birth
0      #_natM_type:_0=1Parm;
1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate
# (COND) enter conditional values if natM_type > 0
1      # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented;
4=not implemented
7      #_Growth_Age_for_L1
30     #_Growth_Age_for_L2 (999 to use as Linf)
0      #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)
0      #_CV_Growth_Pattern:  0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A); 4
SD=lognormal=SD[log(size-at-age)]
1      #_maturity_option:  1=length logistic; 2=age logistic; 3=read age-maturity
matrix by growth_pattern; 4=read age-fecundity
#_placeholder for empirical age-maturity by growth pattern

# Maturity options
1      #_First_Mature_Age
1      #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b
0      #_hermaphroditism option:  0=none; 1=age-specific fxn (0=no gender Change)
1      #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1,
3=like SS2 V1.x)
2      #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base
parm bounds)

#_growth_parms
#_LO  HI    INIT   PRIOR  PR_type      SD     PHASE  env-var use_dev dev_minyr
dev_maxyr dev_stddev Block Block_Fxn
0.01  0.3   0.065  0.065  -1    0.00912      -3     0 0 0 0 0.5 0 0          #
NatM_p_1_Fem_GP_1
10    30    15.91  15.91  -1    10     -2     0 0 0 0 0.5 0 0          #
L_at_Amin_Fem_GP_1
20    50    36.38  36.38  -1    10     -2     0 0 0 0 0.5 0 0          #
L_at_Amax_Fem_GP_1
0.03  0.1   0.042  0.042  -1    10     -2     0 0 0 0 0.5 0 0          #
VonBert_K_Fem_GP_1
0.01  0.3   0.10   0.10   -1    10     2      0 0 0 0 0.5 0 0          #
CV_young_Fem_GP_1
0.01  0.3   0.10   0.10   -1    10     3      0 0 0 0 0.5 0 0          #
CV_old_Fem_GP_1
```

```
# weight-length relationship
# (length in cm, weight in kg)
-3     3      1.0547E-5    1.0547E-5    -1     10     -3     0 0 0 0 0.5 0 0     #
Wtlen_1_Fem
2      4      3.1367       3.1367       -1     10     -3     0 0 0 0 0.5 0 0     #
Wtlen_2_Fem

# proportion mature at length
1      50     21.5   21.5   -1     10     -1     0 0 0 0 0.5 0 0            # Mat50%_Fem
-3     3      -0.4   -0.4   -1     10     -1     0 0 0 0 0.5 0 0            #
Mat_slope_Fem

# fecundity option 1
0      1      0.234  0.234  -1     10     -1     0 0 0 0 0.5 0 0            #
Eg/gm_inter_Fem
0      1      0.1328 0.1328 -1     10     -1     0 0 0 0 0.5 0 0            #
Eg/gm_slope_wt_Fem

# recruitment apportionment
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_GP_1
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_Area_1
-4     4      0      0      -1     0      -1     0 0 0 0 0.5 0 0            #
RecrDist_Seas_1

# cohort growth deviation (fix value at 1 with negative phase; needed for blocks or
annual devs)
1      1      1      1      -1     0      -1     0 0 0 0 0.5 0 0            #
CohortGrowDev

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

# Spawner-Recruitment
# -------------------
3      #_SR_function 1=B-H with flat top beyond B0, 2=Ricker, 3=standard B-H,
4=unconstrained, 5=hockey stick

#_LO   HI     INIT   PRIOR  PR_ty  SD     PHASE
4      10     9      9      -1     10     1      # SR_logR0
0.2    1.0    0.76   0.76   -2     0.17   -3     # SR_steepness with 2011 Dorn prior
0      2      0.7    0.7    -1     10     -1     # SR_sigmaR
-5     5      0      0      -1     10     -1     # SR_envlink
-5     5      0      0      -1     10     -1     # SR_R1_offset
0      0      0      0      -1     10     -1     # SR_autocorr

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

1      #do_recdev:  0=none; 1=devvector; 2=simple deviations
1993   # first year of main recr_devs; early devs can preceed this era
2010   # last year of main recr_devs; forecast devs start in following year
-6     #_recdev phase

1      # (0/1) to read 13 advanced options
0      #_recdev_early_start (0=none; neg value makes relative to recdev_start)
-4     #_recdev_early_phase
0      #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)
1      #_lambda for prior_fore_recr occurring before endyr+1
1994   #_last_early_yr_nobias_adj_in_MPD
```

```
2001   #_first_yr_fullbias_adj_in_MPD
2004   #_last_yr_fullbias_adj_in_MPD
2010   #_first_recent_yr_nobias_adj_in_MPD
0.65   #_max_bias_adj_in_MPD
0      # period of cycle in recruitment
-5     # min value for recruitment devs
5      # max value for recruitment devs
0      # number of explicit recruitment devs to read
#_end of advanced SR options

#Fishing Mortality info
0.1    # F ballpark for tuning early phases
-2001  # F ballpark year (neg value to disable)
3      # F_Method:  1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)
2.9    # max F or harvest rate, depends on F_Method

# no additional F input needed for Fmethod 1
5  # N iterations for tuning F in hybrid method (recommend 3 to 7)

#_initial_F_parms for each fleet
#_LO   HI     INIT   PRIOR  PR_type      SD     PHASE
0      1      0      0      -1     99     -2     # InitF_1_ComTrawl_S
0      1      0      0      -1     99     -2     # InitF_2_ComHook_S
0      1      0      0      -1     99     -2     # InitF_3_ComNet_S
0      1      0      0      -1     99     -2     # InitF_4_RecCPFV_S
0      1      0      0      -1     99     -2     # InitF_5_RecPriv_S

#_Q_setup for fleets and surveys
# A=do power, B=env-var, C=extra SD, D=devtype(<0=mirror, 0/1=none, 2=cons, 3=rand,
4=randwalk)
#_A    B      C      D
0      0      0      0      # 1 ComTrawl_S
0      0      0      0      # 2 ComHook_S
0      0      0      0      # 3 ComNet_S
0      0      0      0      # 4 RecCPFV_S
0      0      0      0      # 5 RecPriv_S
0      0      0      0      # 6 RecDockside_S
0      0      0      0      # 7 NWFSC_Trawl_Survey_S
0      0      0      0      # 8 NWFSC_HKL_Survey_S

#_size_selex_types
#_Pattern Retention Male Special
24 0 0 0     # 1 ComTrawl_S
24 0 0 0     # 2 ComHook_S
24 0 0 0     # 3 ComNet_S
24 0 0 0     # 4 RecCPFV_S
24 0 0 0     # 5 RecPriv_S
15 0 0 4     # 6 RecDockside_S
24 0 0 0     # 7 NWFSC_Trawl_Survey_S
24 0 0 0     # 8 NWFSC_HKL_Survey_S

#_age_selex_types
#_Pattern Retention Male Special
10 0 0 0     # 1 ComTrawl_S
10 0 0 0     # 2 ComHook_S
10 0 0 0     # 3 ComNet_S
10 0 0 0     # 4 RecCPFV_S
10 0 0 0     # 5 RecPriv_S
10 0 0 0     # 6 RecDockside_S
10 0 0 0     # 7 NWFSC_Trawl_Survey_S
10 0 0 0     # 8 NWFSC_HKL_Survey_S

# LENGTH-BASED SELECTIVITY
```

```
# double-normal selectivity parameter descriptions:
# p1 = peak
# p2 = width of peak
# p3 = ascending width
# p4 = descending width
# p5 = selex at lowest bin
# p6 = selex at highest bin

# ComTrawl_S double-normal parameters (fixed asymptotic)
#_LO   HI     INIT   PRIOR  PR_type      SD     PHASE  env-var use_dev dev_minyr
dev_maxyr dev_stddev Block_Design Block_Type
10     57     43     43     -1     10     -4     0 0 0 0 0.5 1 2
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     3.8    3.8    -1     10     -5     0 0 0 0 0.5 1 2
-10    10     4      4      -1     10     -5     0 0 0 0 0.5 1 2
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     9      9      -1     10     -5     0 0 0 0 0.5 1 2

# ComHook_S double-normal parameters (forced asymptotic)
10     57     40     40     -1     10     4      0 0 0 0 0.5 1 2
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 1 2
-10    10     4      4      -1     10     -5     0 0 0 0 0.5 1 2
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     9      9      -1     10     -5     0 0 0 0 0.5 1 2

# ComNet_S double-normal parameters
10     57     40     40     -1     10     4      0 0 0 0 0.5 0 0
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 0 0
-10    10     4      4      -1     10     5      0 0 0 0 0.5 0 0
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     0      0      -1     10     5      0 0 0 0 0.5 0 0

# RecCPFV_S double-normal parameters
10     57     40     40     -1     10     4      0 0 0 0 0.5 1 2
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 1 2
-10    10     4      4      -1     10     5      0 0 0 0 0.5 1 2
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     0      0      -1     10     5      0 0 0 0 0.5 1 2

# RecPriv_S double-normal parameters
10     57     40     40     -1     10     4      0 0 0 0 0.5 1 2
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 1 2
-10    10     4      4      -1     10     5      0 0 0 0 0.5 1 2
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 1 2

# NWFSC_Trawl_Survey_S double-normal parameters
10     57     40     40     -1     10     4      0 0 0 0 0.5 0 0
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 0 0
-10    10     4      4      -1     10     5      0 0 0 0 0.5 0 0
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     0      0      -1     10     5      0 0 0 0 0.5 0 0

# NWFSC_HKL_Survey_S double-normal parameters
10     57     40     40     -1     10     4      0 0 0 0 0.5 0 0
-10    5      -4     -4     -1     10     -5     0 0 0 0 0.5 0 0
-10    10     5      5      -1     10     5      0 0 0 0 0.5 0 0
-10    10     4      4      -1     10     5      0 0 0 0 0.5 0 0
```

```
-11    11     -9     -9     -1     10     -5     0 0 0 0 0.5 0 0
-11    11     0      0      -1     10     5      0 0 0 0 0.5 0 0

1 # selex block setup; 0=read one and apply to all; 1=read one line for each parm

# One parameter line for each time-blocked selectivity parm
#_LO   HI     INIT   PRIOR  PR_type       SD     PHASE
20     50     30     30     -1     10     4 # ComTrawl_S 2001-2011 peak
-10    10     3      3      -1     10     5 # ComTrawl_S 2001-2011 asc width
-10    10     3      3      -1     10     5 # ComTrawl_S 2001-2011 desc width
-11    11     -9     -9     -1     10     -5 # ComTrawl_S 2001-2011 selex at highest bin

20     57     40     40     -1     10     4 # ComHook_S 2001-2011 peak
-10    10     5      5      -1     10     5 # ComHook_S 2001-2011 asc width
-10    10     4      4      -1     10     5 # ComHook_S 2001-2011 desc width
-11    11     0      0      -1     10     5 # ComHook_S 2001-2011 selex at highest bin

20     57     40     40     -1     10     4 # RecCPFV_S 2001-2011 peak
-10    10     5      5      -1     10     5 # RecCPFV_S 2001-2011 asc width
-10    10     4      4      -1     10     5 # RecCPFV_S 2001-2011 desc width
-11    11     0      0      -1     10     5 # RecCPFV_S 2001-2011 selex at highest bin

20     57     40     40     -1     10     4 # RecPriv_S 2001-2011 peak
-10    10     5      5      -1     10     5 # RecPriv_S 2001-2011 asc width
-10    10     4      4      -1     10     5 # RecPriv_S 2001-2011 desc width
-11    11     0      0      -1     10     5 # RecPriv_S 2001-2011 selex at highest bin

1 # Selex parm method; 1=no constraint using base param bounds, 2=impose bounds from
base parm (logit transform)

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

1      #_Variance_adjustments_to_input_values

#fleet 1, fleet 2, etc
0 0 0 0 0 0.34 0 0  #_add_to_survey_CV
0 0 0 0 0 0 0 0     #_add_to_discard_CV
0 0 0 0 0 0 0 0     #_add_to_bodywt_CV

1 0.4 1 0.18 0.6 1 1 1     #_mult_by_lencomp_N
1 1 1 1 1 1 0.35 0.2       #_mult_by_agecomp_N
1 1 1 1 1 1 1 1            #_mult_by_size-at-age_N

7      #_maxlambdaphase
1      #_sd_offset

6      # number of changes to make to default Lambdas (default value is 1.0)

# Like_comp codes:  1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage;
8=catch;
# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp;
15=Tag-comp; 16=Tag-negbin
#like_comp fleet/survey  phase  value  sizefreq_method

# NWFSC_Trawl_Survey_S
#Like_comp fleet  phase  value  sizefreq_method
1      7      1      1      1      # survey
4      7      1      1      1      # length
5      7      1      1      1      # age

# NWFSC_HKL_Survey_S
```

```
#Like_comp fleet  phase  value  sizefreq_method
1      8      1      1      1      # survey
4      8      1      1      1      # length
5      8      1      1      1      # age

0 # (0/1) read specs for more stddev reporting

999
```

Appendix I: Stock Synthesis starter files

Starter file for northern California model

```
#C Greenspotted rockfish
#C Stock assessment for U.S. waters off California, north of Point Conception
#C E.J. Dick, August 2011
#C SS3 v3.21f 64-bit

GSPT_N.dat
GSPT_N.ctl
0      # 0=use init values in control file; 1=use ss3.par
1      # run display detail (0,1,2)
1      # detailed age-structured reports in REPORT.SSO (0,1)
0      # write detailed checkup.sso file (0,1)
1      # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all;
3=every_iter,all_parms; 4=every,active)
2      # write cumulative report to cumreport.sso (0=omit, 1=brief; 2=full)
0      # Include prior_like for non-estimated parameters (0,1)
1      # Use Soft Boundaries to aid convergence (0,1) (recommended)
1      # Data file output (0=none, 1=replicate input with annotations, 2=expected
values w/o error, 3+=add N-2 bootstrap data files)
8      # Turn off estimation for parameters entering after this phase
10     # MCMC burn interval
1      # MCMC thin interval
0      # jitter initial parm value by this fraction
-1     # min yr for sdreport outputs (-1 for styr)
-2     # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs)
0      # Extra SD report years
# (COND) vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0      # retrospective year relative to end year (e.g. -4)
13     # min age for calc of summary biomass
1      # Depletion basis:  denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
(X defined next line)
1      # Fraction (X) for Depletion denominator (e.g. 0.4)
4      # SPR_report_basis:  0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY);
3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
1      # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(full
F's by fleet); 4=Pop'n F for age range
# (COND) range of ages for Pop'n F; upper age must be less than accumulator age in
model
0      # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999    # check value for end of file
```

Starter file for southern California model

```
#C Greenspotted rockfish
#C Stock assessment for U.S. waters off California, south of Point Conception
#C E.J. Dick, August 2011
#C SS3 v3.21f 64-bit

GSPT_S.dat
GSPT_S.ctl
0      # 0=use init values in control file; 1=use ss3.par
1      # run display detail (0,1,2)
1      # detailed age-structured reports in REPORT.SSO (0,1)
0      # write detailed checkup.sso file (0,1)
1      # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all;
3=every_iter,all_parms; 4=every,active)
2      # write cumulative report to cumreport.sso (0=omit, 1=brief; 2=full)
0      # Include prior_like for non-estimated parameters (0,1)
1      # Use Soft Boundaries to aid convergence (0,1) (recommended)
1      # Data file output (0=none, 1=replicate input with annotations, 2=expected
values w/o error, 3+=add N-2 bootstrap data files)
8      # Turn off estimation for parameters entering after this phase
10     # MCMC burn interval
1      # MCMC thin interval
0      # jitter initial parm value by this fraction
-1     # min yr for sdreport outputs (-1 for styr)
-2     # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs)
0      # Extra SD report years
# (COND) vector of year values
0.0001 # final convergence criteria (e.g. 1.0e-04)
0      # retrospective year relative to end year (e.g. -4)
13     # min age for calc of summary biomass
1      # Depletion basis:  denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr
(X defined next line)
1      # Fraction (X) for Depletion denominator (e.g. 0.4)
4      # SPR_report_basis:  0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY);
3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR
1      # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(full
F's by fleet); 4=Pop'n F for age range
# (COND) range of ages for Pop'n F; upper age must be less than accumulator age in
model
0      # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt
999    # check value for end of file
```

Appendix J: Stock Synthesis forecast files

Forecast file for northern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters off California, north of Point Conception

# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0
for endyr, neg number for rel. endyr
1      # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2      # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.50)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter
actual year, or values of 0 or -integer to be rel. endyr)
2009 2010 2009 2010 2009 2010
2 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below

#
1      # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF
yrs); 5=input annual F scalar
12     # N forecast years
1      # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or
values of 0 or -integer to be rel. endyr)
0 0 -1 0
1            # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.40         # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.10         # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1            # Control rule target as fraction of Flimit (e.g. 0.75)

3            #_N forecast loops (1-3) (fixed at 3 for now)
3            #_First forecast loop with stochastic recruitment
0            #_Forecast loop control #3 (reserved for future bells&whistles)
0            #_Forecast loop control #4 (reserved for future bells&whistles)
0            #_Forecast loop control #5 (reserved for future bells&whistles)

2013         #FirstYear for caps and allocations (should be after years with fixed
inputs)
0.0          # stddev of log(realized catch/target catch) in forecast (set value>0.0
to cause active impl_error) (if=0, there will be N_forecase_years less parameters
estimated)
0            # Do West Coast gfish rebuilder output (0/1)
-1           # Rebuilder:  first year catch could have been set to zero (Ydecl)(-1 to
set to 1999)
-1           # Rebuilder:  year for current age structure (Yinit) (-1 to set to
endyear+1)
1            # fleet relative F:  1=use first-last alloc year; 2=read seas(row) x
fleet(col) below

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

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

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

8            # Number of forecast catch levels to input (else calc catch from forecast
F)
2            # basis for input Fcast catch:  2=dead catch; 3=retained catch; 99=input
Hrate(F) (units are from fleetunits; note new codes in SSV3.20)

# Input fixed catch values
# Average catch per fleet, 2009-2010
#Year  Seas   Fleet  Catch
2011   1      1      0.12
2011   1      2      0.05
2011   1      3      0.00
2011   1      4      0.58
2012   1      1      0.12
2012   1      2      0.05
2012   1      3      0.00
2012   1      4      0.58


999 # verify end of input
```

Forecast file for southern California model

```
# Greenspotted rockfish
# Stock assessment for U.S. waters off California, south of Point Conception

# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0
for endyr, neg number for rel. endyr
1      # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy
2      # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)
0.5 # SPR target (e.g. 0.50)
0.4 # Biomass target (e.g. 0.40)
#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter
actual year, or values of 0 or -integer to be rel. endyr)
2009 2010 2009 2010 2009 2010
2 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below

#
1      # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF
yrs); 5=input annual F scalar
12     # N forecast years
1      # F scalar (only used for Do_Forecast==5)
#_Fcast_years:  beg_selex, end_selex, beg_relF, end_relF  (enter actual year, or
values of 0 or -integer to be rel. endyr)
0 0 -1 0
1             # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )
0.4           # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40)
0.1           # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)
1             # Control rule target as fraction of Flimit (e.g. 0.75)

3             #_N forecast loops (1-3) (fixed at 3 for now)
3             #_First forecast loop with stochastic recruitment
0             #_Forecast loop control #3 (reserved for future bells&whistles)
0             #_Forecast loop control #4 (reserved for future bells&whistles)
0             #_Forecast loop control #5 (reserved for future bells&whistles)

2013          #FirstYear for caps and allocations (should be after years with fixed
inputs)
0.0           # stddev of log(realized catch/target catch) in forecast (set value>0.0
to cause active impl_error) (if=0, there will be N_forecase_years less parameters
estimated)
0             # Do West Coast gfish rebuilder output (0/1)
-1            # Rebuilder:  first year catch could have been set to zero (Ydecl)(-1 to
set to 1999)
-1            # Rebuilder:  year for current age structure (Yinit) (-1 to set to
endyear+1)
1             # fleet relative F:  1=use first-last alloc year; 2=read seas(row) x
fleet(col) below

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

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

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

```
0 0 0 0 0

10          # Number of forecast catch levels to input (else calc catch from forecast F)
2           # basis for input Fcast catch:  2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)

# Input fixed catch values
# Average catch per fleet, 2009-2010
#Year  Seas   Fleet  Catch
2011   1      1      0.0
2011   1      2      0.7
2011   1      3      0.0
2011   1      4      9.7
2011   1      5      2.6
2012   1      1      0.0
2012   1      2      0.7
2012   1      3      0.0
2012   1      4      9.7
2012   1      5      2.6

999 # verify end of input
```

Appendix K: Annual estimates of numbers at age

Numbers at age (1000s) from northern California model

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1916	467.5	438.1	410.5	384.7	360.5	337.8	316.5	296.6	278.0	260.5	244.1	228.7	214.3	200.8	188.2	176.4	165.3	154.9	145.1	136.0	127.4	119.4	111.9	104.8	98.2	92.1	86.3	80.8	75.8	71.0	66.5	62.3	58.4	54.7
1917	467.5	438.1	410.5	384.7	360.5	337.8	316.5	296.6	278.0	260.5	244.1	228.7	214.3	200.8	188.2	176.3	165.2	154.8	145.0	135.9	127.3	119.3	111.8	104.7	98.1	91.9	86.1	80.7	75.6	70.8	66.4	62.2	58.3	54.6
1918	467.3	438.0	410.5	384.7	360.5	337.8	316.5	296.6	278.0	260.5	244.1	228.7	214.3	200.8	188.1	176.2	165.1	154.7	144.9	135.7	127.1	119.1	111.6	104.5	97.9	91.7	85.9	80.5	75.4	70.6	66.2	62.0	58.1	54.4
1919	467.2	437.9	410.5	384.7	360.5	337.8	316.5	296.6	278.0	260.4	244.0	228.7	214.2	200.7	188.0	176.2	165.0	154.6	144.8	135.6	127.0	118.9	111.4	104.3	97.7	91.5	85.7	80.2	75.2	70.4	65.9	61.8	57.8	54.2
1920	467.1	437.8	410.4	384.6	360.5	337.8	316.5	296.6	278.0	260.5	244.0	228.7	214.2	200.7	188.0	176.1	165.0	154.5	144.7	135.5	126.9	118.8	111.3	104.2	97.6	91.4	85.6	80.1	75.0	70.3	65.8	61.6	57.7	54.1
1921	467.0	437.7	410.2	384.5	360.4	337.8	316.5	296.6	278.0	260.5	244.0	228.7	214.2	200.7	188.0	176.1	165.0	154.5	144.7	135.5	126.9	118.8	111.2	104.1	97.5	91.3	85.4	80.0	74.9	70.1	65.7	61.5	57.6	53.9
1922	466.9	437.6	410.2	384.4	360.3	337.7	316.5	296.6	278.0	260.5	244.0	228.7	214.2	200.7	188.0	176.1	165.0	154.5	144.7	135.5	126.8	118.7	111.2	104.1	97.4	91.2	85.4	79.9	74.8	70.0	65.6	61.4	57.5	53.8
1923	466.9	437.6	410.1	384.3	360.2	337.7	316.5	296.6	278.0	260.5	244.1	228.7	214.3	200.7	188.1	176.2	165.0	154.5	144.7	135.5	126.8	118.7	111.2	104.0	97.4	91.2	85.3	79.9	74.7	70.0	65.5	61.3	57.4	53.7
1924	466.8	437.5	410.0	384.3	360.2	337.6	316.4	296.6	278.0	260.5	244.1	228.7	214.3	200.7	188.1	176.2	165.0	154.5	144.7	135.5	126.8	118.7	111.1	104.0	97.4	91.1	85.3	79.8	74.7	69.9	65.4	61.2	57.3	53.7
1925	466.8	437.4	410.0	384.2	360.1	337.5	316.3	296.5	277.9	260.5	244.1	228.7	214.3	200.8	188.1	176.2	165.0	154.6	144.8	135.5	126.9	118.8	111.2	104.1	97.4	91.1	85.3	79.8	74.7	69.9	65.4	61.2	57.3	53.6
1926	466.7	437.4	409.9	384.2	360.0	337.4	316.3	296.4	277.8	260.4	244.1	228.7	214.3	200.8	188.1	176.2	165.0	154.6	144.8	135.5	126.9	118.8	111.2	104.1	97.4	91.1	85.3	79.8	74.7	69.9	65.4	61.2	57.2	53.6
1927	466.7	437.4	409.9	384.1	360.0	337.4	316.2	296.3	277.7	260.3	244.0	228.7	214.3	200.7	188.1	176.2	165.0	154.5	144.7	135.5	126.9	118.7	111.1	104.0	97.3	91.1	85.2	79.7	74.6	69.8	65.3	61.1	57.1	53.5
1928	466.6	437.3	409.8	384.1	359.9	337.3	316.1	296.3	277.7	260.3	243.9	228.6	214.3	200.7	188.1	176.2	165.0	154.5	144.7	135.5	126.8	118.7	111.1	104.0	97.3	91.0	85.2	79.7	74.5	69.7	65.2	61.0	57.1	53.4
1929	466.5	437.2	409.8	384.1	359.9	337.3	316.1	296.2	277.6	260.2	243.9	228.6	214.2	200.7	188.0	176.1	165.0	154.5	144.7	135.4	126.8	118.7	111.1	103.9	97.2	91.0	85.1	79.6	74.4	69.6	65.1	60.9	57.0	53.3
1930	466.4	437.2	409.7	384.0	359.9	337.3	316.1	296.2	277.6	260.2	243.8	228.5	214.1	200.7	188.0	176.1	164.9	154.4	144.6	135.4	126.7	118.6	111.0	103.9	97.2	90.9	85.0	79.5	74.4	69.5	65.0	60.8	56.9	53.2
1931	466.3	437.1	409.6	383.9	359.8	337.2	316.0	296.2	277.6	260.1	243.8	228.4	214.0	200.6	187.9	176.1	164.9	154.4	144.5	135.3	126.6	118.5	110.9	103.7	97.0	90.8	84.9	79.4	74.2	69.4	64.9	60.7	56.7	53.1
1932	466.2	437.0	409.6	383.9	359.8	337.2	316.0	296.1	277.5	260.1	243.7	228.4	214.0	200.5	187.8	175.9	164.8	154.3	144.4	135.2	126.5	118.3	110.7	103.6	96.9	90.6	84.7	79.2	74.0	69.2	64.7	60.5	56.5	52.9
1933	466.1	436.8	409.5	383.8	359.7	337.1	316.0	296.1	277.5	260.0	243.7	228.3	213.9	200.4	187.8	175.9	164.8	154.3	144.4	135.1	126.5	118.3	110.7	103.5	96.8	90.5	84.7	79.2	74.0	69.2	64.7	60.4	56.5	52.8
1934	466.1	436.8	409.3	383.7	359.6	337.1	315.9	296.1	277.5	260.0	243.7	228.3	213.9	200.4	187.8	175.9	164.7	154.3	144.4	135.2	126.5	118.3	110.7	103.5	96.8	90.5	84.7	79.1	74.0	69.2	64.6	60.4	56.5	52.8
1935	466.0	436.7	409.3	383.6	359.5	337.0	315.9	296.0	277.4	260.0	243.6	228.3	213.9	200.4	187.7	175.8	164.6	154.2	144.4	135.1	126.4	118.3	110.6	103.5	96.8	90.5	84.6	79.1	73.9	69.1	64.6	60.4	56.4	52.7
1936	465.9	436.7	409.2	383.5	359.4	336.9	315.8	296.0	277.4	259.9	243.6	228.3	213.8	200.3	187.7	175.8	164.6	154.1	144.3	135.1	126.4	118.2	110.6	103.4	96.7	90.4	84.6	79.0	73.9	69.1	64.5	60.3	56.4	52.7
1937	465.9	436.6	409.2	383.5	359.4	336.8	315.7	295.9	277.3	259.9	243.6	228.2	213.8	200.3	187.6	175.7	164.5	154.0	144.2	135.0	126.3	118.2	110.5	103.4	96.7	90.4	84.5	79.0	73.8	69.0	64.5	60.3	56.3	52.6
1938	465.8	436.6	409.1	383.4	359.4	336.8	315.6	295.8	277.3	259.9	243.5	228.2	213.8	200.2	187.5	175.6	164.4	153.9	144.1	134.9	126.2	118.1	110.5	103.3	96.6	90.3	84.4	78.9	73.8	68.9	64.4	60.2	56.3	52.6
1939	465.8	436.5	409.1	383.4	359.3	336.7	315.6	295.7	277.2	259.8	243.5	228.1	213.7	200.2	187.5	175.6	164.4	153.9	144.0	134.8	126.1	118.0	110.4	103.2	96.5	90.2	84.3	78.8	73.7	68.8	64.3	60.1	56.2	52.5
1940	465.7	436.4	409.0	383.3	359.3	336.7	315.5	295.7	277.1	259.7	243.4	228.1	213.7	200.2	187.5	175.5	164.3	153.8	143.9	134.7	126.0	117.9	110.2	103.1	96.4	90.1	84.2	78.7	73.5	68.7	64.2	60.0	56.1	52.4
1941	465.6	436.3	409.0	383.3	359.2	336.7	315.5	295.7	277.1	259.6	243.3	228.0	213.6	200.1	187.4	175.5	164.2	153.7	143.8	134.6	125.9	117.7	110.1	102.9	96.2	90.0	84.1	78.6	73.4	68.6	64.1	59.9	55.9	52.3
1942	465.5	436.3	408.9	383.2	359.2	336.6	315.5	295.6	277.1	259.6	243.3	228.0	213.6	200.1	187.3	175.4	164.2	153.7	143.8	134.5	125.8	117.6	110.0	102.8	96.1	89.8	84.0	78.5	73.3	68.5	64.0	59.8	55.9	52.2
1943	465.5	436.2	408.8	383.2	359.1	336.6	315.4	295.6	277.0	259.6	243.3	227.9	213.6	200.1	187.4	175.5	164.3	153.7	143.9	134.6	125.9	117.7	110.1	102.9	96.2	89.9	84.0	78.5	73.4	68.6	64.1	59.8	55.9	52.2
1944	465.4	436.2	408.7	383.1	359.0	336.5	315.4	295.6	277.0	259.6	243.2	227.9	213.5	200.1	187.4	175.5	164.3	153.8	143.9	134.6	125.9	117.7	110.0	102.9	96.1	89.8	84.0	78.5	73.3	68.5	64.0	59.8	55.8	52.1
1945	465.0	436.1	408.8	383.0	359.0	336.4	315.3	295.5	277.0	259.5	243.2	227.9	213.5	200.0	187.3	175.4	164.2	153.7	143.7	134.4	125.6	117.4	109.7	102.5	95.7	89.4	83.4	77.9	72.7	67.9	63.4	59.2	55.2	51.6
1946	464.0	435.7	408.7	383.0	358.9	336.4	315.3	295.5	276.9	259.5	243.2	227.8	213.4	199.9	187.2	175.2	163.9	153.3	143.3	133.9	125.0	116.7	108.8	101.5	94.6	88.2	82.2	76.6	71.4	66.6	62.1	57.8	53.9	50.3
1947	463.2	434.8	408.3	383.0	358.9	336.3	315.2	295.4	276.9	259.5	243.1	227.8	213.4	199.8	187.0	175.0	163.7	153.1	143.0	133.5	124.6	116.1	108.2	100.8	93.9	87.4	81.4	75.7	70.5	65.6	61.1	56.8	52.9	49.3
1948	462.7	434.0	407.4	382.6	358.9	336.3	315.2	295.4	276.8	259.4	243.1	227.8	213.3	199.8	187.0	175.0	163.7	153.0	142.9	133.4	124.5	116.0	108.1	100.6	93.6	87.1	81.0	75.3	70.0	65.1	60.6	56.3	52.4	48.7
1949	462.4	433.6	406.7	381.8	358.5	336.3	315.2	295.3	276.7	259.3	243.0	227.7	213.3	199.7	186.9	174.9	163.6	152.9	142.8	133.3	124.3	115.9	107.9	100.5	93.5	86.9	80.8	75.1	69.8	64.8	60.2	56.0	52.1	48.4
1950	462.0	433.3	406.3	381.1	357.7	335.9	315.1	295.3	276.7	259.3	242.9	227.6	213.1	199.6	186.8	174.7	163.4	152.7	142.6	133.1	124.1	115.6	107.7	100.2	93.2	86.6	80.5	74.7	69.4	64.4	59.9	55.6	51.6	48.0
1951	461.6	432.9	406.0	380.7	357.1	335.2	314.8	295.2	276.7	259.2	242.8	227.5	213.0	199.4	186.6	174.5	163.1	152.4	142.2	132.7	123.7	115.3	107.3	99.8	92.8	86.2	80.0	74.3	68.9	64.0	59.4	55.1	51.1	47.5
1952	460.9	432.5	405.7	380.5	356.8	334.7	314.1	295.0	276.6	259.2	242.8	227.3	212.8	199.2	186.3	174.2	162.7	151.9	141.8	132.2	123.1	114.6	106.6	99.1	92.1	85.5	79.3	73.5	68.2	63.2	58.6	54.3	50.4	46.7
1953	460.5	431.9	405.3	380.2	356.5	334.3	313.6	294.3	276.4	259.1	242.8	227.3	212.8	199.1	186.2	174.1	162.6	151.8	141.6	131.9	122.9	114.4	106.4	98.8	91.8	85.2	79.0	73.2	67.9	62.9	58.3	54.0	50.0	46.4
1954	460.1	431.5	404.7	379.8	356.2	334.1	313.3	293.8	275.8	258.9	242.7	227.3	212.8	199.1	186.2	174.0	162.6	151.7	141.5	131.8	122.8	114.2	106.2	98.7	91.6	85.0	78.8	73.0	67.6	62.6	58.0	53.7	49.7	46.1
1955	459.8	431.2	404.4	379.2	355.9	333.8	313.1	293.5	275.3	258.3	242.5	227.3	212.8	199.0	186.1	173.9	162.4	151.6	141.3	131.7	122.6	114.0	106.0	98.4	91.4	84.8	78.6	72.8	67.4	62.4	57.8	53.4	49.5	45.8
1956	459.2	430.9	404.0	378.9	355.4	333.5	312.8	293.3	275.0	257.9	241.9	227.0	212.6	198.9	185.9	173.7	162.2	151.3	141.0	131.3	122.1	113.5	105.5	97.9	90.8	84.2	78.0	72.2	66.8	61.8	57.2	52.9	48.9	45.2
1957	458.7	430.3	403.8	378.6	355.1	333.0	312.5	293.1	274.8	257.6	241.5	226.5	212.4	198.8	185.8	173.5	161.9	151.0	140.6	130.9	121.7	113.1	105.0	97.4	90.3	83.6	77.5	71.7	66.3	61.3	56.7	52.4	48.4	44.8
1958	458.0	429.8	403.2	378.3	354.8	332.7	312.0	292.8	274.6	257.4	241.2	226.0	211.8	198.5	185.6	173.3	161.7	150.7	140.3	130.5	121.3	112.6	104.4	96.8	89.7	83.0	76.8	71.0	65.7	60.7	56.1	51.8	47.8	44.2
1959	457.1	429.2	402.8	377.9	354.5	332.5	311.8	292.3	274.3	257.1	241.0	225.7	211.3	197.8	185.1	172.8	161.1	150.0	139.5	129.6	120.3	111.6	103.4	95.7	88.6	81.9	75.7	69.9	64.6	59.6	55.1	50.8	46.9	43.3
1960	456.5	428.4	402.2	377.4	354.1	332.2	311.5	292.1	273.9	256.9	240.7	225.5	211.0	197.3	184.5	172.4	160.8	149.6	139.1	129.2	119.8	111.0	102.8	95.1	87.9	81.2	75.0	69.3	63.9	59.0	54.4	50.2	46.3	42.7
1961	456.0	427.8	401.4	376.9	353.7	331.8	311.3	291.9	273.7	256.5	240.5	225.3	210.9	197.2	184.3	172.1	160.7	149.6	139.1	129.1	119.7	110.9	102.6	94.9	87.7	80.9	74.7	68.9	63.6	58.6	54.0	49.8	45.9	42.3

Numbers at age (1000s) from northern California model (continued)

Year	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1916	51.3	48.1	45.0	42.2	39.5	37.1	34.7	32.5	30.5	28.6	26.8	25.1	23.5	22.0	20.6	19.3	18.1	17.0	15.9	14.9	14.0	13.1	12.3	11.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	108.7
1917	51.2	47.9	44.9	42.1	39.4	37.0	34.6	32.4	30.4	28.5	26.7	25.0	23.4	22.0	20.6	19.3	18.1	16.9	15.9	14.9	13.9	13.1	12.2	11.5	10.7	10.1	9.4	8.8	8.3	7.8	7.3	108.3
1918	51.0	47.8	44.7	41.9	39.3	36.8	34.5	32.3	30.3	28.4	26.6	24.9	23.3	21.9	20.5	19.2	18.0	16.9	15.8	14.8	13.9	13.0	12.2	11.4	10.7	10.0	9.4	8.8	8.2	7.7	7.2	107.8
1919	50.8	47.6	44.5	41.7	39.1	36.6	34.3	32.2	30.1	28.2	26.4	24.8	23.2	21.8	20.4	19.1	17.9	16.8	15.7	14.7	13.8	12.9	12.1	11.3	10.6	10.0	9.3	8.7	8.2	7.7	7.2	107.2
1920	50.6	47.4	44.4	41.6	39.0	36.5	34.2	32.0	30.0	28.1	26.4	24.7	23.1	21.7	20.3	19.0	17.8	16.7	15.7	14.7	13.7	12.9	12.1	11.3	10.6	9.9	9.3	8.7	8.2	7.7	7.2	106.8
1921	50.5	47.3	44.3	41.5	38.9	36.4	34.1	31.9	29.9	28.0	26.3	24.6	23.1	21.6	20.2	19.0	17.8	16.6	15.6	14.6	13.7	12.8	12.0	11.3	10.6	9.9	9.3	8.7	8.1	7.6	7.1	106.3
1922	50.4	47.2	44.2	41.4	38.8	36.3	34.0	31.9	29.8	28.0	26.2	24.5	23.0	21.5	20.2	18.9	17.7	16.6	15.5	14.6	13.6	12.8	12.0	11.2	10.5	9.9	9.2	8.7	8.1	7.6	7.1	106.0
1923	50.3	47.1	44.1	41.3	38.7	36.2	33.9	31.8	29.8	27.9	26.1	24.5	22.9	21.5	20.1	18.9	17.7	16.5	15.5	14.5	13.6	12.8	11.9	11.2	10.5	9.8	9.2	8.6	8.1	7.6	7.1	105.7
1924	50.2	47.0	44.0	41.2	38.6	36.2	33.9	31.7	29.7	27.8	26.1	24.4	22.9	21.4	20.1	18.8	17.6	16.5	15.5	14.5	13.6	12.7	11.9	11.2	10.5	9.8	9.2	8.6	8.1	7.6	7.1	105.4
1925	50.2	47.0	44.0	41.2	38.6	36.1	33.8	31.7	29.7	27.8	26.0	24.4	22.8	21.4	20.0	18.8	17.6	16.5	15.4	14.5	13.5	12.7	11.9	11.1	10.4	9.8	9.2	8.6	8.0	7.5	7.1	105.1
1926	50.1	46.9	43.9	41.1	38.5	36.1	33.8	31.6	29.6	27.7	26.0	24.3	22.8	21.3	20.0	18.7	17.5	16.4	15.4	14.4	13.5	12.7	11.9	11.1	10.4	9.8	9.1	8.6	8.0	7.5	7.0	104.8
1927	50.0	46.8	43.8	41.0	38.4	36.0	33.7	31.5	29.5	27.6	25.9	24.2	22.7	21.3	19.9	18.7	17.5	16.4	15.3	14.4	13.5	12.6	11.8	11.1	10.4	9.7	9.1	8.5	8.0	7.5	7.0	104.4
1928	50.0	46.8	43.8	40.9	38.3	35.9	33.6	31.4	29.4	27.6	25.8	24.2	22.6	21.2	19.9	18.6	17.4	16.3	15.3	14.3	13.4	12.6	11.8	11.0	10.3	9.7	9.1	8.5	8.0	7.5	7.0	104.0
1929	49.9	46.7	43.6	40.8	38.2	35.8	33.5	31.3	29.3	27.5	25.7	24.1	22.6	21.1	19.8	18.5	17.4	16.3	15.2	14.3	13.4	12.5	11.7	11.0	10.3	9.6	9.0	8.5	7.9	7.4	7.0	103.6
1930	49.8	46.5	43.5	40.7	38.1	35.7	33.4	31.2	29.2	27.4	25.6	24.0	22.5	21.0	19.7	18.5	17.3	16.2	15.2	14.2	13.3	12.5	11.7	10.9	10.2	9.6	9.0	8.4	7.9	7.4	6.9	103.1
1931	49.6	46.4	43.4	40.6	38.0	35.5	33.3	31.1	29.1	27.3	25.5	23.9	22.4	20.9	19.6	18.4	17.2	16.1	15.1	14.1	13.2	12.4	11.6	10.9	10.2	9.5	8.9	8.4	7.9	7.4	6.9	102.5
1932	49.4	46.2	43.2	40.4	37.8	35.4	33.1	31.0	29.0	27.1	25.4	23.8	22.2	20.8	19.5	18.3	17.1	16.0	15.0	14.0	13.1	12.3	11.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	6.8	101.8
1933	49.4	46.2	43.2	40.4	37.7	35.3	33.0	30.9	28.9	27.0	25.3	23.7	22.2	20.8	19.4	18.2	17.0	16.0	14.9	14.0	13.1	12.3	11.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	6.8	101.5
1934	49.3	46.1	43.1	40.3	37.7	35.3	33.0	30.9	28.9	27.0	25.3	23.6	22.1	20.7	19.4	18.2	17.0	15.9	14.9	14.0	13.1	12.2	11.5	10.7	10.1	9.4	8.8	8.3	7.8	7.3	6.8	101.2
1935	49.3	46.1	43.1	40.3	37.6	35.2	32.9	30.8	28.8	26.9	25.2	23.6	22.1	20.7	19.3	18.1	17.0	15.9	14.9	13.9	13.0	12.2	11.4	10.7	10.0	9.4	8.8	8.2	7.7	7.2	6.8	100.8
1936	49.2	46.0	43.0	40.2	37.6	35.2	32.9	30.7	28.7	26.9	25.2	23.5	22.0	20.6	19.3	18.1	16.9	15.8	14.8	13.9	13.0	12.2	11.4	10.7	10.0	9.4	8.8	8.2	7.7	7.2	6.8	100.5
1937	49.2	46.0	43.0	40.2	37.6	35.1	32.8	30.7	28.7	26.8	25.1	23.5	22.0	20.6	19.3	18.0	16.9	15.8	14.8	13.8	13.0	12.1	11.4	10.6	10.0	9.3	8.7	8.2	7.7	7.2	6.7	100.2
1938	49.1	45.9	42.9	40.1	37.5	35.1	32.8	30.6	28.6	26.8	25.1	23.4	21.9	20.5	19.2	18.0	16.8	15.7	14.7	13.8	12.9	12.1	11.3	10.6	9.9	9.3	8.7	8.2	7.7	7.2	6.7	99.8
1939	49.1	45.9	42.9	40.0	37.4	35.0	32.7	30.6	28.6	26.7	25.0	23.4	21.9	20.5	19.2	17.9	16.8	15.7	14.7	13.8	12.9	12.1	11.3	10.6	9.9	9.3	8.7	8.1	7.6	7.1	6.7	99.5
1940	49.0	45.7	42.7	39.9	37.3	34.9	32.6	30.5	28.5	26.6	24.9	23.3	21.8	20.4	19.1	17.8	16.7	15.6	14.6	13.7	12.8	12.0	11.2	10.5	9.9	9.2	8.6	8.1	7.6	7.1	6.7	98.9
1941	48.8	45.6	42.6	39.9	37.2	34.8	32.5	30.4	28.4	26.6	24.8	23.2	21.7	20.3	19.0	17.8	16.6	15.6	14.6	13.6	12.8	12.0	11.2	10.5	9.8	9.2	8.6	8.1	7.6	7.1	6.6	98.5
1942	48.8	45.6	42.6	39.8	37.2	34.7	32.5	30.3	28.4	26.5	24.8	23.2	21.7	20.3	19.0	17.7	16.6	15.5	14.5	13.6	12.7	11.9	11.2	10.4	9.8	9.2	8.6	8.0	7.5	7.1	6.6	98.1
1943	48.8	45.6	42.6	39.8	37.2	34.8	32.5	30.4	28.4	26.5	24.8	23.2	21.7	20.3	19.0	17.7	16.6	15.5	14.5	13.6	12.7	11.9	11.2	10.4	9.8	9.2	8.6	8.0	7.5	7.0	6.6	98.0
1944	48.7	45.5	42.5	39.7	37.1	34.7	32.4	30.3	28.3	26.4	24.7	23.1	21.6	20.2	18.9	17.7	16.5	15.5	14.5	13.5	12.7	11.9	11.1	10.4	9.7	9.1	8.5	8.0	7.5	7.0	6.6	97.4
1945	48.1	44.9	42.0	39.2	36.6	34.2	31.9	29.8	27.9	26.0	24.3	22.7	21.2	19.9	18.6	17.4	16.2	15.2	14.2	13.3	12.4	11.6	10.9	10.2	9.5	8.9	8.4	7.8	7.3	6.9	6.4	95.4
1946	46.9	43.7	40.8	38.0	35.5	33.1	30.9	28.8	26.9	25.1	23.5	21.9	20.5	19.1	17.9	16.7	15.6	14.6	13.6	12.8	11.9	11.2	10.4	9.8	9.1	8.6	8.0	7.5	7.0	6.6	6.2	91.3
1947	45.9	42.7	39.8	37.1	34.6	32.3	30.1	28.1	26.2	24.4	22.8	21.3	19.9	18.6	17.3	16.2	15.1	14.1	13.2	12.4	11.6	10.8	10.1	9.5	8.8	8.3	7.7	7.2	6.8	6.4	5.9	88.1
1948	45.4	42.2	39.3	36.6	34.1	31.8	29.6	27.6	25.7	24.0	22.4	20.9	19.5	18.2	17.0	15.9	14.8	13.8	12.9	12.1	11.3	10.6	9.9	9.2	8.6	8.1	7.6	7.1	6.6	6.2	5.8	86.1
1949	45.0	41.9	39.0	36.3	33.8	31.4	29.3	27.3	25.4	23.7	22.1	20.6	19.3	18.0	16.8	15.7	14.6	13.7	12.8	11.9	11.1	10.4	9.7	9.1	8.5	8.0	7.5	7.0	6.5	6.1	5.7	84.6
1950	44.6	41.5	38.6	35.9	33.4	31.1	28.9	26.9	25.1	23.4	21.8	20.3	19.0	17.7	16.5	15.4	14.4	13.4	12.6	11.7	11.0	10.2	9.6	9.0	8.4	7.8	7.3	6.9	6.4	6.0	5.6	83.0
1951	44.1	41.0	38.1	35.4	32.9	30.6	28.5	26.5	24.7	23.0	21.5	20.0	18.7	17.4	16.2	15.2	14.1	13.2	12.3	11.5	10.8	10.0	9.4	8.8	8.2	7.7	7.2	6.7	6.3	5.9	5.5	81.3
1952	43.4	40.3	37.4	34.7	32.3	30.0	27.9	26.0	24.2	22.5	21.0	19.5	18.2	17.0	15.8	14.8	13.8	12.9	12.0	11.2	10.5	9.8	9.1	8.5	8.0	7.5	7.0	6.5	6.1	5.7	5.3	78.9
1953	43.0	39.9	37.0	34.4	31.9	29.7	27.6	25.6	23.8	22.2	20.7	19.3	17.9	16.7	15.6	14.5	13.6	12.7	11.8	11.0	10.3	9.6	9.0	8.4	7.8	7.3	6.9	6.4	6.0	5.6	5.2	77.4
1954	42.7	39.6	36.7	34.0	31.6	29.3	27.2	25.3	23.5	21.9	20.4	19.0	17.7	16.5	15.3	14.3	13.3	12.4	11.6	10.8	10.1	9.4	8.8	8.2	7.7	7.2	6.7	6.3	5.9	5.5	5.1	75.8
1955	42.4	39.3	36.4	33.7	31.3	29.0	27.0	25.0	23.3	21.6	20.1	18.7	17.4	16.2	15.1	14.1	13.1	12.3	11.4	10.7	10.0	9.3	8.7	8.1	7.6	7.1	6.6	6.2	5.8	5.4	5.1	74.4
1956	41.9	38.7	35.9	33.2	30.8	28.6	26.5	24.6	22.8	21.2	19.7	18.4	17.1	15.9	14.8	13.8	12.9	12.0	11.2	10.4	9.7	9.1	8.5	7.9	7.4	6.9	6.4	6.0	5.6	5.3	4.9	72.4
1957	41.4	38.3	35.4	32.8	30.4	28.1	26.1	24.2	22.5	20.9	19.4	18.0	16.8	15.6	14.5	13.5	12.6	11.7	10.9	10.2	9.5	8.9	8.3	7.7	7.2	6.7	6.3	5.9	5.5	5.1	4.8	70.6
1958	40.8	37.7	34.8	32.2	29.8	27.6	25.6	23.7	22.0	20.4	18.9	17.6	16.4	15.2	14.2	13.2	12.3	11.4	10.7	9.9	9.3	8.6	8.1	7.5	7.0	6.6	6.1	5.7	5.3	5.0	4.7	68.5
1959	39.9	36.9	34.1	31.5	29.1	26.9	24.9	23.1	21.4	19.8	18.4	17.1	15.9	14.8	13.7	12.8	11.9	11.1	10.3	9.6	9.0	8.4	7.8	7.3	6.8	6.3	5.9	5.5	5.2	4.8	4.5	66.1
1960	39.4	36.3	33.5	31.0	28.6	26.5	24.5	22.7	21.0	19.5	18.0	16.7	15.5	14.4	13.4	12.5	11.6	10.8	10.1	9.4	8.7	8.2	7.6	7.1	6.6	6.2	5.8	5.4	5.0	4.7	4.4	64.2
1961	39.0	36.0	33.2	30.6	28.3	26.1	24.2	22.3	20.7	19.2	17.8	16.5	15.3	14.2	13.2	12.3	11.4	10.6	9.9	9.2	8.6	8.0	7.4	6.9	6.5	6.0	5.6	5.3	4.9	4.6	4.3	62.7

Numbers at age (1000s) from northern California model (continued)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1962	455.9	427.3	400.8	376.1	353.2	331.4	310.9	291.7	273.5	256.4	240.2	225.2	210.8	197.2	184.3	172.1	160.6	149.7	139.3	129.3	119.9	111.1	102.8	95.0	87.8	81.0	74.8	69.0	63.6	58.6	54.0	49.8	45.9	42.3
1963	455.7	427.2	400.4	375.6	352.5	330.9	310.5	291.3	273.3	256.2	240.1	224.9	210.7	197.1	184.2	172.0	160.4	149.6	139.3	129.5	120.1	111.2	102.9	95.1	87.9	81.1	74.8	69.0	63.6	58.6	54.0	49.7	45.8	42.2
1964	455.3	427.0	400.3	375.2	352.0	330.3	310.1	291.0	272.9	256.0	239.9	224.7	210.4	197.0	184.1	172.0	160.4	149.4	139.1	129.4	120.1	111.2	102.9	95.1	87.8	81.0	74.7	68.8	63.4	58.4	53.7	49.5	45.5	41.9
1965	455.2	426.6	400.1	375.1	351.6	329.8	309.5	290.6	272.6	255.7	239.7	224.6	210.3	196.8	184.1	172.0	160.5	149.5	139.2	129.5	120.3	111.6	103.2	95.4	88.1	81.3	74.9	69.0	63.6	58.5	53.9	49.6	45.6	42.0
1966	455.0	426.6	399.8	374.9	351.5	329.5	309.1	290.0	272.2	255.4	239.4	224.4	210.1	196.5	183.7	171.7	160.2	149.3	138.9	129.2	120.0	111.4	103.2	95.3	88.0	81.2	74.8	68.9	63.5	58.4	53.8	49.5	45.5	41.9
1967	454.7	426.3	399.7	374.6	351.3	329.4	308.7	289.6	271.7	255.0	239.1	224.0	209.8	196.2	183.4	171.3	159.9	149.0	138.6	128.8	119.6	111.0	102.9	95.1	87.8	81.0	74.7	68.8	63.3	58.3	53.6	49.3	45.3	41.7
1968	454.2	426.1	399.5	374.6	351.1	329.2	308.6	289.3	271.3	254.4	238.7	223.7	209.4	195.9	183.1	170.9	159.3	148.5	138.2	128.3	119.1	110.4	102.2	94.6	87.4	80.6	74.3	68.4	62.9	57.9	53.2	48.9	45.0	41.3
1969	453.7	425.6	399.3	374.4	351.0	329.0	308.5	289.2	271.0	254.0	238.2	223.3	209.1	195.5	182.7	170.5	158.9	147.9	137.6	127.8	118.6	109.8	101.6	94.0	86.9	80.1	73.8	67.9	62.5	57.4	52.8	48.5	44.6	41.0
1970	453.4	425.1	398.8	374.1	350.8	328.9	308.2	289.0	270.9	253.8	237.8	222.8	208.7	195.2	182.3	170.1	158.5	147.5	137.1	127.3	118.1	109.3	101.1	93.5	86.3	79.7	73.5	67.6	62.2	57.2	52.5	48.3	44.3	40.7
1971	452.8	424.8	398.4	373.7	350.6	328.7	308.2	288.8	270.7	253.6	237.5	222.3	208.1	194.6	181.8	169.5	157.9	146.8	136.3	126.4	117.2	108.5	100.3	92.6	85.4	78.8	72.7	66.9	61.5	56.5	51.9	47.7	43.8	40.2
1972	452.3	424.3	398.1	373.3	350.2	328.5	308.0	288.7	270.5	253.5	237.4	222.1	207.8	194.3	181.5	169.2	157.6	146.5	136.0	126.1	116.7	108.0	99.8	92.1	85.0	78.3	72.2	66.5	61.1	56.2	51.6	47.4	43.5	39.9
1973	451.6	423.9	397.6	373.0	349.8	328.2	307.8	288.6	270.5	253.3	237.2	222.0	207.5	193.8	180.9	168.7	157.0	145.8	135.3	125.3	115.9	107.1	98.9	91.2	84.0	77.4	71.2	65.5	60.3	55.4	50.8	46.7	42.8	39.3
1974	450.2	423.1	397.2	372.6	349.6	327.8	307.5	288.4	270.2	253.1	236.9	221.6	207.0	193.1	179.9	167.5	155.8	144.5	133.8	123.8	114.3	105.4	97.1	89.4	82.3	75.6	69.4	63.8	58.6	53.9	49.4	45.3	41.6	38.1
1975	448.7	421.9	396.5	372.2	349.1	327.6	307.1	288.0	270.0	252.9	236.7	221.2	206.5	192.5	179.1	166.4	154.4	143.1	132.3	122.1	112.6	103.6	95.2	87.4	80.3	73.7	67.6	62.0	56.8	52.1	47.8	43.8	40.2	36.8
1976	446.9	420.4	395.3	371.6	348.8	327.1	306.9	287.7	269.7	252.7	236.4	220.9	206.1	192.0	178.4	165.5	153.3	141.7	130.8	120.5	110.8	101.7	93.3	85.4	78.2	71.6	65.6	60.0	54.9	50.2	46.0	42.2	38.6	35.4
1977	444.6	418.8	394.0	370.4	348.2	326.8	306.5	287.5	269.4	252.3	236.1	220.5	205.6	191.2	177.6	164.4	151.9	140.0	128.9	118.4	108.6	99.4	90.9	83.0	75.7	69.1	63.1	57.6	52.6	48.0	43.8	40.1	36.7	33.6
1978	442.5	416.6	392.4	369.2	347.1	326.2	306.2	287.1	269.2	252.1	235.9	220.4	205.4	191.0	177.1	163.9	151.2	139.1	127.7	117.0	107.1	97.7	89.1	81.2	73.8	67.2	61.1	55.6	50.6	46.1	42.0	38.3	35.0	32.0
1979	441.2	414.6	390.4	367.7	345.9	325.3	305.7	286.8	268.8	251.9	235.6	220.2	205.3	190.9	177.1	163.7	151.0	138.8	127.2	116.4	106.3	97.0	88.3	80.2	72.9	66.2	60.1	54.5	49.6	45.1	41.0	37.3	34.0	31.1
1980	438.1	413.5	388.5	365.8	344.6	324.2	304.7	286.3	268.5	251.5	235.4	219.8	204.9	190.5	176.5	163.0	150.0	137.6	125.9	114.7	104.4	94.8	86.0	77.9	70.4	63.7	57.5	52.0	47.1	42.6	38.7	35.1	31.9	29.0
1981	434.9	410.5	387.4	364.1	342.8	322.9	303.7	285.5	268.1	251.3	235.1	219.7	204.8	190.4	176.5	162.9	149.9	137.3	125.4	114.0	103.4	93.5	84.5	76.2	68.6	61.7	55.5	49.9	44.9	40.5	36.6	33.0	29.9	27.1
1982	425.3	407.5	384.7	363.1	341.1	321.2	302.5	284.5	267.3	250.8	234.7	219.1	204.1	189.5	175.2	161.3	147.8	134.7	122.1	110.3	99.1	88.7	79.2	70.6	62.8	55.8	49.5	44.0	39.1	34.8	31.0	27.7	24.8	22.3
1983	419.9	398.5	381.9	360.5	340.2	319.7	300.9	283.3	266.4	250.1	234.4	219.0	204.0	189.4	175.1	161.2	147.6	134.3	121.5	109.3	97.9	87.2	77.4	68.5	60.5	53.3	47.0	41.4	36.5	32.2	28.4	25.2	22.4	19.9
1984	415.6	393.5	373.4	357.8	337.8	318.8	299.5	281.9	265.3	249.2	233.7	218.7	203.8	189.2	175.1	161.1	147.5	134.2	121.3	109.0	97.3	86.4	76.3	67.2	59.0	51.7	45.2	39.6	34.6	30.3	26.6	23.4	20.6	18.2
1985	413.3	389.4	368.7	349.9	335.3	316.5	298.7	280.6	264.0	248.4	233.2	218.5	204.1	189.9	175.9	162.2	148.7	135.5	122.7	110.3	98.5	87.3	77.1	67.6	59.1	51.6	44.9	39.1	34.0	29.6	25.8	22.5	19.7	17.3
1986	407.1	387.2	364.9	345.5	327.9	314.2	296.5	279.7	262.5	246.7	231.6	216.7	202.1	187.8	173.6	159.5	145.7	132.3	119.3	106.9	95.0	83.9	73.6	64.3	55.9	48.4	41.8	36.1	31.2	27.0	23.4	20.3	17.6	15.4
1987	403.4	381.5	362.9	341.9	323.7	307.2	294.3	277.6	261.7	245.2	229.9	215.1	200.4	185.9	171.7	157.5	143.6	130.1	117.1	104.7	93.0	82.0	71.8	62.6	54.3	46.9	40.4	34.7	29.9	25.7	22.2	19.1	16.6	14.4
1988	401.0	378.0	357.5	340.0	320.4	303.3	287.9	275.7	260.0	245.0	229.4	214.8	200.6	186.5	172.5	158.7	144.9	131.5	118.4	105.9	94.0	82.8	72.5	63.0	54.4	46.8	40.1	34.3	29.3	25.0	21.4	18.3	15.7	13.6
1989	389.5	375.7	354.2	335.0	318.6	300.2	284.2	269.6	258.0	242.9	228.2	212.8	197.9	183.1	168.1	153.1	138.3	123.9	110.0	97.0	84.9	73.9	64.0	55.0	47.2	40.2	34.3	29.1	24.7	21.0	17.9	15.3	13.1	11.2
1990	373.8	365.0	352.1	331.9	313.9	298.5	281.2	266.1	252.3	241.1	226.4	211.8	196.0	180.4	164.5	148.3	132.2	116.6	101.8	88.0	75.6	64.6	54.9	46.5	39.3	33.1	27.8	23.4	19.7	16.6	14.0	11.8	10.1	8.6
1991	362.3	350.3	342.0	329.9	311.0	294.1	279.7	263.4	249.0	235.7	224.6	210.0	195.0	178.8	162.5	146.0	129.3	113.0	97.6	83.4	70.6	59.4	49.8	41.6	34.6	28.8	24.0	19.9	16.6	13.8	11.6	9.7	8.2	6.9
1992	341.7	339.5	328.3	320.4	309.1	291.4	275.4	261.7	246.0	231.9	218.5	206.7	191.2	175.2	157.8	140.5	123.1	106.1	90.1	75.5	62.6	51.4	42.0	34.2	27.8	22.5	18.3	14.9	12.2	9.9	8.2	6.7	5.6	4.6
1993	328.5	320.2	318.1	307.6	300.3	289.6	272.9	257.8	244.6	229.4	215.3	201.5	189.0	172.8	155.9	137.9	120.2	103.0	86.6	71.7	58.5	47.3	37.9	30.2	24.0	19.1	15.2	12.2	9.8	7.8	6.3	5.1	4.2	3.4
1994	318.0	307.9	300.0	298.1	288.2	281.3	271.3	255.5	241.0	228.2	213.2	199.0	184.6	171.1	154.0	136.4	118.1	100.5	83.9	68.7	55.4	44.1	34.8	27.2	21.3	16.6	13.0	10.2	8.0	6.4	5.1	4.0	3.3	2.6
1995	309.9	298.0	288.5	281.1	279.3	270.0	263.5	254.0	238.9	224.9	212.2	197.1	182.5	167.4	152.9	135.3	117.4	99.3	82.5	67.2	53.6	42.2	32.8	25.2	19.3	14.8	11.3	8.7	6.7	5.2	4.1	3.2	2.5	2.0
1996	297.7	290.4	279.2	270.3	263.4	261.7	252.9	246.6	237.3	222.6	208.5	195.2	179.4	163.6	147.3	131.5	113.3	95.4	78.3	62.9	49.6	38.4	29.3	22.1	16.5	12.4	9.2	6.9	5.2	4.0	3.1	2.4	1.8	1.4
1997	280.3	279.0	272.1	261.7	253.3	246.8	245.1	236.7	230.5	221.3	206.6	192.0	177.5	160.2	142.6	124.5	107.1	88.6	71.5	56.0	43.0	32.5	24.1	17.6	12.8	9.3	6.7	4.9	3.6	2.7	2.0	1.5	1.1	0.9
1998	281.6	262.7	261.4	255.0	245.2	237.3	231.2	229.5	221.4	215.2	205.9	191.3	176.4	161.5	143.9	126.1	108.1	91.2	73.9	58.3	44.7	33.7	24.9	18.1	13.0	9.3	6.7	4.8	3.4	2.5	1.8	1.4	1.0	0.8
1999	291.6	263.9	246.1	245.0	238.9	229.7	222.3	216.5	214.9	207.1	201.1	192.0	177.8	163.3	148.6	131.5	114.3	97.1	81.1	65.0	50.8	38.5	28.7	21.0	15.1	10.8	7.7	5.5	3.9	2.8	2.0	1.5	1.1	0.8
2000	299.6	273.3	247.3	230.6	229.5	223.9	215.2	208.2	202.5	200.6	192.9	186.5	177.1	163.0	148.5	134.0	117.5	101.1	85.0	70.3	55.9	43.2	32.6	24.1	17.5	12.6	8.9	6.3	4.5	3.2	2.3	1.7	1.2	0.9
2001	309.3	280.7	256.1	231.7	216.1	215.1	209.7	201.5	194.8	189.3	187.1	179.4	172.8	163.3	149.5	135.4	121.4	105.7	90.4	75.6	62.2	49.1	37.8	28.4	20.9	15.2	10.9	7.7	5.5	3.9	2.7	2.0	1.4	1.0
2002	320.8	289.8	263.0	240.0	217.1	202.5	201.5	196.5	188.7	182.3	177.0	174.7	167.1	160.6	151.4	138.2	124.8	111.5	96.8	82.5	68.8	56.4	44.4	34.2	25.6	18.8	13.7	9.8	6.9	4.9	3.5	2.5	1.8	1.3
2003	333.3	300.6	271.6	246.5	224.9	203.5	189.8	188.8	184.1	176.8	170.8	165.7	163.6	156.4	150.3	141.6	129.1	116.5	104.0	90.2	76.8	63.9	52.4	41.3	31.7	23.7	17.5	12.6	9.0	6.4	4.5	3.2	2.3	1.6
2004	345.0	312.3	281.7	254.5	231.0	210.7	190.7	177.8	176.9	172.5	165.7	160.0	155.3	153.2	146.6	140.8	132.6	120.9	109.1	97.4	84.4	71.9	59.9	49.1	38.6	29.7	22.2	16.3	11.8	8.5	6.0	4.3	3.0	2.1
2005	355.3	323.3	292.7	264.0	238.5	216.4	197.5	178.7	166.6	165.8	161.6	155.3	149.9	145.5	143.6	137.3	131.9	124.2	113.2	102.2	91.2	79.1	67.3	56.1	45.9	36.2	27.8	20.8	15.3	11.1	7.9	5.6	4.0	2.8
2006	364.5	333.0	302.9	274.2	247.4	223.5	202.8	185.0	167.4	156.1	155.4	151.5	145.5	140.5	136.3	134.5	128.6	123.5	116.4	106.1	95.7	85.4	74.1	63.1	52.5	43.0	33.9	26.0	19.5	14.3	10.4	7.4	5.3	3.7
2007	372.6	341.6	312.0	283.9	257.0	231.8	209.4	190.1	173.4	156.9	146.3	145.6	141.9	136.3	131.6	127.8	126.0	120.5	115.7	109.0	99.4	89.7	80.0	69.4	59.1	49.2	40.3	31.7	24.4	18.2	13.4	9.7	7.0	4.9
2008	379.7	349.2	320.1	292.4	266.0	240.8	217.2	196.2	178.1	162.5	147.0	137.1	136.4	133.0	127.7	123.3	119.6	118.0	112.8	108.3	102.0	93.0	83.9	74.9	64.9	55.3	46.0	37.7	29.7	22.8	17.1	12.6	9.1	6.5
2009	385.9	355.8	327.2	299.9	274.0	249.3	225.6	203.5	183.9	166.9	152.2	137.7	128.4	127.8	124.6	119.6	115.5	112.0	110.5	105.7	101.4	95.5	87.0	78.5	70.1	60.7	51.7	43.1	35.3	27.8	21.3	16.0	11.8	8.5
2010	391.4	361.6	333.4	306.6	281.1	256.7	233.6	211.4	190.7	172.3	156.4	142.6	129.0	120.3	119.7	116.7	112.0	108.2	104.9	103.5	98.9	95.0	89.4	81.5	73.5	65.6	56.9	48.4	40.3	33.0	26.0	20.0	15.0	11.0

Numbers at age (1000s) from northern California model (continued)

Year	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1962	39.0	35.9	33.1	30.5	28.2	26.0	24.0	22.2	20.5	19.0	17.6	16.3	15.1	14.0	13.0	12.1	11.3	10.5	9.7	9.1	8.5	7.9	7.3	6.8	6.4	6.0	5.6	5.2	4.8	4.5	4.2	61.6
1963	38.9	35.8	33.0	30.4	28.1	25.9	23.9	22.1	20.4	18.9	17.5	16.2	15.0	13.9	12.9	12.0	11.1	10.4	9.6	9.0	8.3	7.8	7.2	6.8	6.3	5.9	5.5	5.1	4.8	4.5	4.2	60.5
1964	38.6	35.6	32.8	30.2	27.8	25.7	23.7	21.8	20.2	18.6	17.2	16.0	14.8	13.7	12.7	11.8	11.0	10.2	9.5	8.8	8.2	7.6	7.1	6.6	6.2	5.8	5.4	5.0	4.7	4.4	4.1	59.1
1965	38.7	35.6	32.8	30.2	27.8	25.6	23.6	21.8	20.1	18.6	17.2	15.9	14.7	13.6	12.6	11.7	10.9	10.1	9.4	8.7	8.1	7.5	7.0	6.5	6.1	5.7	5.3	4.9	4.6	4.3	4.0	58.2
1966	38.5	35.5	32.6	30.0	27.7	25.5	23.5	21.7	20.0	18.4	17.0	15.7	14.6	13.5	12.5	11.6	10.7	10.0	9.3	8.6	8.0	7.4	6.9	6.4	6.0	5.6	5.2	4.9	4.5	4.2	4.0	57.2
1967	38.4	35.3	32.5	29.9	27.5	25.4	23.4	21.5	19.9	18.3	16.9	15.6	14.4	13.4	12.4	11.5	10.6	9.9	9.1	8.5	7.9	7.3	6.8	6.4	5.9	5.5	5.1	4.8	4.5	4.2	3.9	56.1
1968	38.0	35.0	32.2	29.6	27.2	25.1	23.1	21.3	19.6	18.1	16.7	15.4	14.2	13.2	12.2	11.3	10.4	9.7	9.0	8.3	7.7	7.2	6.7	6.2	5.8	5.4	5.0	4.7	4.4	4.1	3.8	54.8
1969	37.6	34.6	31.8	29.3	26.9	24.8	22.8	21.0	19.4	17.8	16.5	15.2	14.0	12.9	12.0	11.1	10.3	9.5	8.8	8.2	7.6	7.1	6.6	6.1	5.7	5.3	4.9	4.6	4.3	4.0	3.7	53.4
1970	37.4	34.4	31.6	29.1	26.7	24.6	22.7	20.9	19.2	17.7	16.3	15.1	13.9	12.8	11.9	11.0	10.1	9.4	8.7	8.1	7.5	7.0	6.5	6.0	5.6	5.2	4.8	4.5	4.2	3.9	3.7	52.4
1971	37.0	34.0	31.2	28.7	26.4	24.3	22.3	20.6	19.0	17.5	16.1	14.8	13.7	12.6	11.7	10.8	10.0	9.2	8.6	7.9	7.4	6.8	6.3	5.9	5.5	5.1	4.7	4.4	4.1	3.8	3.6	51.1
1972	36.7	33.7	30.9	28.4	26.1	24.0	22.1	20.4	18.7	17.3	15.9	14.7	13.5	12.5	11.5	10.6	9.8	9.1	8.4	7.8	7.2	6.7	6.2	5.8	5.4	5.0	4.7	4.3	4.0	3.8	3.5	50.0
1973	36.1	33.1	30.4	27.9	25.7	23.6	21.7	20.0	18.4	16.9	15.6	14.4	13.2	12.2	11.3	10.4	9.6	8.9	8.2	7.6	7.1	6.5	6.1	5.6	5.2	4.9	4.5	4.2	3.9	3.6	3.4	48.4
1974	35.0	32.1	29.4	27.0	24.8	22.8	21.0	19.3	17.8	16.4	15.1	13.9	12.8	11.8	10.9	10.0	9.3	8.6	7.9	7.3	6.8	6.3	5.8	5.4	5.0	4.7	4.3	4.0	3.8	3.5	3.3	46.3
1975	33.7	30.9	28.4	26.1	23.9	22.0	20.2	18.6	17.1	15.7	14.5	13.3	12.3	11.3	10.5	9.7	8.9	8.2	7.6	7.0	6.5	6.0	5.6	5.2	4.8	4.5	4.2	3.9	3.6	3.3	3.1	44.1
1976	32.4	29.7	27.2	24.9	22.9	21.0	19.3	17.7	16.3	15.0	13.8	12.7	11.7	10.8	10.0	9.2	8.5	7.9	7.3	6.7	6.2	5.7	5.3	4.9	4.6	4.2	3.9	3.7	3.4	3.2	3.0	41.7
1977	30.7	28.1	25.7	23.6	21.6	19.9	18.2	16.8	15.4	14.2	13.0	12.0	11.1	10.2	9.4	8.7	8.0	7.4	6.8	6.3	5.8	5.4	5.0	4.6	4.3	4.0	3.7	3.4	3.2	3.0	2.8	39.0
1978	29.3	26.7	24.5	22.4	20.5	18.8	17.3	15.9	14.6	13.4	12.3	11.3	10.4	9.6	8.9	8.2	7.6	7.0	6.4	6.0	5.5	5.1	4.7	4.4	4.0	3.8	3.5	3.2	3.0	2.8	2.6	36.5
1979	28.4	26.0	23.7	21.7	19.9	18.2	16.7	15.4	14.1	13.0	11.9	11.0	10.1	9.3	8.6	7.9	7.3	6.7	6.2	5.8	5.3	4.9	4.6	4.2	3.9	3.6	3.4	3.1	2.9	2.7	2.5	35.0
1980	26.4	24.1	22.0	20.1	18.4	16.8	15.4	14.1	13.0	11.9	10.9	10.1	9.3	8.5	7.9	7.3	6.7	6.2	5.7	5.3	4.9	4.5	4.2	3.8	3.6	3.3	3.1	2.8	2.6	2.4	2.3	31.7
1981	24.6	22.3	20.4	18.6	16.9	15.4	14.1	12.9	11.8	10.9	10.0	9.1	8.4	7.7	7.1	6.6	6.0	5.6	5.1	4.8	4.4	4.1	3.7	3.5	3.2	3.0	2.7	2.5	2.4	2.2	2.0	28.3
1982	20.0	18.0	16.3	14.8	13.4	12.1	11.0	10.0	9.2	8.4	7.6	7.0	6.4	5.9	5.4	5.0	4.6	4.2	3.9	3.6	3.3	3.0	2.8	2.6	2.4	2.2	2.0	1.9	1.8	1.6	1.5	20.9
1983	17.8	15.9	14.3	12.9	11.6	10.5	9.5	8.6	7.8	7.1	6.5	5.9	5.4	5.0	4.5	4.2	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.2	2.0	1.8	1.7	1.6	1.5	1.3	1.2	17.1
1984	16.2	14.4	12.8	11.5	10.3	9.3	8.4	7.6	6.8	6.2	5.6	5.1	4.7	4.3	3.9	3.6	3.3	3.0	2.8	2.5	2.3	2.2	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.1	14.4
1985	15.2	13.5	11.9	10.6	9.5	8.5	7.6	6.9	6.2	5.6	5.1	4.6	4.2	3.8	3.5	3.2	2.9	2.7	2.5	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	12.5
1986	13.5	11.8	10.4	9.2	8.2	7.3	6.6	5.9	5.3	4.8	4.3	3.9	3.6	3.2	3.0	2.7	2.5	2.3	2.1	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.8	10.5
1987	12.5	11.0	9.6	8.5	7.5	6.7	6.0	5.3	4.8	4.3	3.9	3.5	3.2	2.9	2.7	2.4	2.2	2.0	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.7	0.7	9.3
1988	11.7	10.2	8.9	7.8	6.8	6.0	5.3	4.8	4.2	3.8	3.4	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.5	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.7	0.7	0.6	0.6	7.8
1989	9.6	8.3	7.2	6.3	5.5	4.9	4.3	3.8	3.4	3.1	2.7	2.5	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.5	6.2
1990	7.3	6.3	5.4	4.7	4.1	3.6	3.2	2.8	2.5	2.2	2.0	1.8	1.6	1.5	1.3	1.2	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	4.4
1991	5.9	5.0	4.3	3.7	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	3.2
1992	3.9	3.3	2.8	2.4	2.0	1.7	1.5	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	1.8
1993	2.8	2.4	2.0	1.7	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.1
1994	2.2	1.8	1.5	1.2	1.0	0.9	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.7
1995	1.6	1.3	1.1	0.9	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.5
1996	1.1	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1997	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1998	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1999	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2000	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2001	0.8	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2002	0.9	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2003	1.2	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2004	1.5	1.1	0.8	0.6	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2005	2.0	1.4	1.0	0.8	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2006	2.6	1.9	1.3	1.0	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2007	3.5	2.5	1.8	1.3	0.9	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2008	4.6	3.3	2.3	1.6	1.2	0.9	0.6	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2009	6.1	4.3	3.1	2.2	1.5	1.1	0.8	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2010	8.0	5.7	4.0	2.9	2.0	1.4	1.0	0.7	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Numbers at age (1000s) from southern California model

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1916	775.7	726.9	681.2	638.3	598.1	560.5	525.2	492.2	461.2	432.2	405.0	379.5	355.6	333.2	312.3	292.6	274.2	256.9	240.8	225.6	211.4	198.1	185.6	174.0	163.0	152.8	143.1	134.1	125.7	117.8	110.4	103.4	96.9	90.8
1917	775.2	726.9	681.2	638.3	598.1	560.5	525.2	492.2	461.2	432.2	404.9	379.4	355.5	333.1	312.0	292.3	273.8	256.4	240.1	224.8	210.6	197.2	184.7	172.9	162.0	151.7	142.1	133.1	124.7	116.8	109.4	102.5	96.0	90.0
1918	774.4	726.4	681.2	638.3	598.1	560.5	525.2	492.2	461.2	432.1	404.9	379.4	355.4	332.9	311.7	291.8	273.2	255.6	239.2	223.7	209.3	195.8	183.2	171.4	160.3	150.0	140.4	131.4	123.1	115.2	107.9	101.0	94.6	88.6
1919	773.6	725.6	680.7	638.3	598.1	560.5	525.2	492.2	461.2	432.1	404.9	379.4	355.4	332.8	311.6	291.6	272.8	255.1	238.5	223.0	208.4	194.7	182.0	170.1	159.0	148.7	139.0	130.0	121.7	113.8	106.5	99.7	93.3	87.4
1920	773.2	724.9	680.0	637.9	598.1	560.5	525.2	492.2	461.2	432.2	404.9	379.4	355.4	332.9	311.7	291.7	272.9	255.2	238.5	222.8	208.2	194.4	181.6	169.6	158.5	148.1	138.4	129.4	121.0	113.1	105.8	99.0	92.7	86.7
1921	772.7	724.5	679.3	637.2	597.7	560.5	525.2	492.2	461.2	432.2	404.9	379.4	355.4	332.9	311.7	291.7	272.9	255.1	238.4	222.7	208.0	194.1	181.2	169.2	157.9	147.5	137.7	128.7	120.2	112.4	105.1	98.3	91.9	86.0
1922	772.3	724.1	678.9	636.6	597.1	560.1	525.2	492.2	461.2	432.2	404.9	379.4	355.4	332.9	311.7	291.8	273.0	255.2	238.5	222.8	208.0	194.1	181.1	168.9	157.6	147.1	137.3	128.2	119.7	111.8	104.5	97.7	91.3	85.4
1923	772.0	723.7	678.5	636.2	596.5	559.5	524.9	492.2	461.2	432.2	404.9	379.4	355.4	332.9	311.8	291.8	273.0	255.3	238.6	222.8	208.0	194.1	181.0	168.8	157.4	146.8	136.9	127.8	119.2	111.3	104.0	97.2	90.8	84.9
1924	771.4	723.4	678.2	635.8	596.2	559.0	524.3	491.8	461.2	432.1	404.9	379.4	355.4	332.9	311.7	291.8	273.0	255.2	238.5	222.7	207.8	193.8	180.7	168.4	157.0	146.3	136.4	127.1	118.6	110.6	103.3	96.4	90.1	84.1
1925	770.7	722.9	677.9	635.5	595.8	558.6	523.8	491.3	460.9	432.1	404.9	379.4	355.4	332.8	311.6	291.6	272.7	254.9	238.1	222.3	207.3	193.3	180.1	167.8	156.2	145.5	135.5	126.2	117.6	109.6	102.2	95.4	89.0	83.1
1926	769.9	722.2	677.4	635.2	595.5	558.3	523.5	490.8	460.4	431.9	404.9	379.3	355.3	332.7	311.5	291.4	272.5	254.6	237.7	221.8	206.8	192.7	179.4	167.0	155.4	144.6	134.5	125.2	116.6	108.6	101.1	94.3	87.9	82.0
1927	768.8	721.4	676.7	634.8	595.2	558.0	523.2	490.5	459.9	431.4	404.6	379.3	355.3	332.6	311.3	291.1	272.1	254.1	237.1	221.1	206.0	191.7	178.4	165.9	154.3	143.4	133.3	123.9	115.2	107.2	99.7	92.9	86.5	80.7
1928	768.0	720.4	676.0	634.2	594.8	557.8	522.9	490.2	459.7	430.9	404.2	379.1	355.3	332.6	311.3	291.1	272.0	253.9	236.9	220.8	205.6	191.3	177.9	165.3	153.6	142.7	132.5	123.1	114.3	106.2	98.8	91.9	85.5	79.7
1929	767.3	719.7	675.1	633.5	594.2	557.4	522.7	490.0	459.4	430.7	403.8	378.7	355.1	332.7	311.3	291.1	272.1	254.0	236.9	220.7	205.5	191.2	177.7	165.1	153.3	142.3	132.1	122.6	113.8	105.7	98.2	91.2	84.8	78.9
1930	766.7	719.1	674.4	632.6	593.6	556.8	522.3	489.8	459.1	430.5	403.6	378.3	354.7	332.5	311.3	291.2	272.1	254.0	236.9	220.7	205.5	191.1	177.6	164.9	153.1	142.0	131.7	122.2	113.3	105.1	97.6	90.6	84.2	78.3
1931	766.0	718.4	673.8	631.9	592.8	556.3	521.8	489.4	458.9	430.2	403.3	378.1	354.3	332.1	311.1	291.2	272.1	254.0	236.9	220.7	205.4	191.0	177.4	164.7	152.8	141.7	131.4	121.8	112.9	104.7	97.1	90.0	83.6	77.6
1932	765.2	717.8	673.2	631.4	592.2	555.5	521.2	489.0	458.6	430.0	403.1	377.8	354.1	331.7	310.7	290.9	272.0	253.9	236.7	220.5	205.2	190.7	177.1	164.3	152.4	141.2	130.9	121.2	112.3	104.0	96.4	89.3	82.8	76.9
1933	764.7	717.1	672.6	630.9	591.7	554.9	520.5	488.4	458.2	429.7	402.9	377.6	353.9	331.6	310.5	290.7	271.9	254.0	236.9	220.7	205.3	190.8	177.2	164.4	152.4	141.2	130.8	121.1	112.2	103.8	96.2	89.1	82.5	76.5
1934	764.5	716.6	671.9	630.3	591.2	554.4	520.0	487.8	457.7	429.3	402.7	377.5	353.8	331.5	310.5	290.6	271.9	254.2	237.3	221.2	205.9	191.5	177.8	165.0	153.0	141.8	131.3	121.6	112.6	104.2	96.4	89.3	82.7	76.6
1935	764.3	716.4	671.5	629.7	590.6	553.9	519.5	487.2	457.1	428.9	402.3	377.2	353.6	331.3	310.3	290.6	271.8	254.2	237.5	221.6	206.4	192.0	178.4	165.6	153.6	142.3	131.8	122.1	113.0	104.5	96.7	89.5	82.8	76.7
1936	764.3	716.2	671.3	629.2	590.0	553.5	519.1	486.8	456.6	428.3	401.8	376.9	353.4	331.2	310.3	290.5	271.9	254.3	237.7	221.9	206.9	192.6	179.1	166.3	154.4	143.1	132.6	122.7	113.6	105.1	97.2	90.0	83.2	77.0
1937	764.5	716.2	671.1	629.1	589.6	552.9	518.6	486.4	456.2	427.8	401.3	376.5	353.1	331.1	310.3	290.6	272.1	254.6	238.0	222.4	207.6	193.6	180.1	167.4	155.5	144.3	133.7	123.9	114.7	106.1	98.2	90.8	84.0	77.7
1938	764.7	716.4	671.1	628.9	589.5	552.5	518.1	486.0	455.8	427.5	400.9	376.0	352.8	330.8	310.2	290.6	272.1	254.7	238.3	222.7	208.1	194.2	181.0	168.4	156.5	145.3	134.8	124.9	115.7	107.1	99.1	91.7	84.8	78.5
1939	765.0	716.6	671.3	628.9	589.3	552.4	517.7	485.5	455.4	427.1	400.5	375.6	352.3	330.5	309.9	290.5	272.2	254.9	238.5	223.1	208.5	194.7	181.8	169.4	157.6	146.4	135.9	126.1	116.8	108.2	100.2	92.7	85.7	79.3
1940	765.3	716.9	671.5	629.0	589.3	552.2	517.6	485.2	454.9	426.7	400.2	375.3	351.9	330.1	309.6	290.3	272.1	254.9	238.6	223.3	208.8	195.1	182.2	170.0	158.4	147.4	136.9	127.1	117.9	109.2	101.2	93.6	86.6	80.1
1941	765.4	717.1	671.8	629.2	589.5	552.2	517.5	485.0	454.6	426.3	399.8	375.0	351.6	329.7	309.2	290.0	271.8	254.7	238.5	223.2	208.8	195.2	182.3	170.2	158.8	147.9	137.6	127.8	118.6	110.0	101.9	94.4	87.3	80.8
1942	765.5	717.3	672.0	629.5	589.6	552.4	517.4	484.9	454.5	426.0	399.4	374.6	351.3	329.4	308.8	289.5	271.4	254.3	238.2	223.0	208.6	195.1	182.3	170.2	158.9	148.2	138.0	128.3	119.1	110.6	102.5	94.9	87.9	81.3
1943	765.8	717.3	672.1	629.7	589.9	552.5	517.6	484.9	454.4	425.9	399.2	374.3	351.0	329.1	308.6	289.3	271.2	254.2	238.2	223.0	208.7	195.2	182.5	170.5	159.2	148.6	138.6	129.0	119.9	111.4	103.4	95.8	88.8	82.2
1944	766.0	717.6	672.2	629.8	590.1	552.7	517.7	485.0	454.4	425.8	399.1	374.0	350.7	328.9	308.4	289.1	270.9	253.9	238.0	223.0	208.8	195.3	182.7	170.7	159.5	148.9	138.9	129.5	120.6	112.1	104.1	96.6	89.6	83.0
1945	766.4	717.8	672.4	629.9	590.2	552.9	518.0	485.2	454.5	425.8	399.0	374.0	350.5	328.6	308.2	288.9	270.8	253.8	237.9	223.0	208.9	195.6	183.0	171.1	159.9	149.4	139.5	130.1	121.3	113.0	105.0	97.5	90.5	83.9
1946	766.7	718.2	672.6	630.1	590.2	553.0	518.1	485.4	454.6	425.9	399.0	373.9	350.4	328.4	307.9	288.7	270.7	253.7	237.8	222.8	208.8	195.6	183.1	171.3	160.2	149.7	139.9	130.6	121.8	113.6	105.7	98.3	91.3	84.7
1947	767.0	718.5	673.0	630.3	590.4	553.1	518.2	485.5	454.8	426.0	399.1	373.8	350.3	328.3	307.7	288.4	270.4	253.5	237.6	222.6	208.6	195.4	183.0	171.3	160.3	149.9	140.0	130.8	122.1	113.9	106.2	98.9	91.9	85.3
1948	767.1	718.7	673.2	630.6	590.6	553.3	518.3	485.6	455.0	426.1	399.2	373.9	350.2	328.1	307.5	288.1	270.0	253.2	237.2	222.3	208.2	195.1	182.7	171.1	160.1	149.8	140.0	130.8	122.2	114.0	106.4	99.2	92.3	85.8
1949	767.1	718.8	673.5	630.9	590.9	553.5	518.4	485.6	455.0	426.2	399.2	373.9	350.2	328.0	307.2	287.8	269.6	252.6	236.7	221.7	207.7	194.5	182.1	170.5	159.6	149.3	139.6	130.5	121.9	113.8	106.2	99.1	92.4	86.0
1950	767.1	718.9	673.6	631.1	591.2	553.7	518.6	485.8	455.0	426.3	399.3	373.9	350.2	327.9	307.0	287.5	269.2	252.1	236.1	221.1	207.1	193.8	181.4	169.8	159.0	148.8	139.2	130.1	121.6	113.5	106.0	98.9	92.2	86.0
1951	767.2	718.8	673.6	631.2	591.4	553.9	518.8	485.9	455.1	426.2	399.3	374.0	350.2	327.8	306.9	287.3	269.0	251.8	235.7	220.6	206.6	193.4	181.0	169.4	158.5	148.3	138.8	129.8	121.3	113.3	105.9	98.8	92.2	86.0
1952	767.1	718.9	673.6	631.2	591.5	554.1	519.1	486.1	455.3	426.4	399.3	374.0	350.2	327.9	306.9	287.2	268.7	251.4	235.3	220.1	205.9	192.7	180.3	168.7	157.8	147.6	138.1	129.2	120.8	112.9	105.4	98.4	91.9	85.7
1953	767.0	718.8	673.7	631.2	591.5	554.2	519.2	486.3	455.4	426.5	399.4	373.9	350.2	327.8	306.8	287.1	268.5	251.2	234.9	219.7	205.4	192.2	179.8	168.1	157.2	147.0	137.5	128.6	120.3	112.4	105.1	98.1	91.6	85.5
1954	767.1	718.8	673.6	631.3	591.5	554.2	519.3	486.5	455.6	426.6	399.4	374.0	350.1	327.8	306.8	287.0	268.4	251.0	234.7	219.4	205.1	191.8	179.3	167.7	156.8	146.6	137.0	128.1	119.9	112.1	104.7	97.9	91.4	85.3
1955	766.8	718.8	673.5	631.2	591.5	554.2	519.3	486.5	455.6	426.6	399.4	373.8	349.8	327.3	306.3	286.5	267.9	250.4	234.0	218.7	204.3	190.9	178.4	166.7	155.8	145.6	136.1	127.2	118.9	111.2	104.0	97.2	90.8	84.8
1956	766.4	718.6	673.6	631.1	591.4	554.2	519.1	486.3	455.4	426.4	399.0	373.3	349.2	326.6	305.3	285.5	266.8	249.3	232.8	217.4	202.9	189.5	176.9	165.2	154.3	144.2	134.7	125.9	117.6	109.9	102.8	96.1	89.8	83.9
1957	765.9	718.2	673.4	631.2	591.4	554.1	519.1	486.1	455.2	426.1	398.7	372.9	348.6	325.8	304.4	284.4	265.6	248.0	231.4	215.9	201.4	187.9	175.3	163.6	152.6	142.5	133.1	124.3	116.1	108.5	101.4	94.8	88.6	82.8
1958	765.6	717.7	673.0	631.0	591.4	554.1	519.1	486.2	455.2	426.1	398.7	372.9	348.6	325.8	304.3	284.1	265.2	247.5	230.9	215.4	200.8	187.2	174.5	162.7	151.8	141.6	132.1	123.4	115.2	107.6	100.5	94.0	87.9	82.1
1959	765.4	717.4	672.5	630.6	591.3	554.1	519.1	486.3	455.4	426.2	398.9	373.1	348.8	326.0	304.4	284.2	265.2	247.4	230.8	215.2	200.6	186.9	174.2	162.3	151.3	141.1	131.6	122.7	114.6	107.0	99.9	93.3	87.2	81.6
1960	765.4	717.3	672.3	630.2	590.9	554.0	519.2	486.4	455.5	426.5	399.2	373.5	349.3	326.4	304.9	284.7	265.6	247.8	231.0	215.4	200.8	187.1	174.3	162.3	151.2	140.9	131.3	122.4	114.2	106.6	99.5	93.0	86.8	81.1
1961	765.2	717.2	672.1	630.0	590.5	553.7	519.1	486.4	455.6	426.6	399.4	373.7	349.5	326.8	305.3	285.1	266.0	248.1	231.3	215.6	200.9	187.2	174.3	162.3	151.1	140.7	131.1	122.2	113.9	106.2	99.1	92.5	86.4	80.7

Numbers at age (1000s) from southern California model (continued)

Year	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1916	85.1	79.7	74.7	70.0	65.6	61.5	57.6	54.0	50.6	47.4	44.4	41.6	39.0	36.6	34.3	32.1	30.1	28.2	26.4	24.7	23.2	21.7	20.4	19.1	17.9	16.8	15.7	14.7	13.8	12.9	12.1	180.3
1917	84.3	79.0	74.0	69.3	65.0	60.9	57.0	53.4	50.1	46.9	44.0	41.2	38.6	36.2	33.9	31.8	29.8	27.9	26.1	24.5	22.9	21.5	20.1	18.9	17.7	16.6	15.5	14.6	13.6	12.8	12.0	178.3
1918	83.0	77.7	72.8	68.2	63.9	59.9	56.1	52.5	49.2	46.1	43.2	40.5	37.9	35.5	33.3	31.2	29.2	27.4	25.7	24.1	22.5	21.1	19.8	18.5	17.4	16.3	15.3	14.3	13.4	12.6	11.8	175.2
1919	81.8	76.6	71.8	67.2	63.0	59.0	55.2	51.7	48.5	45.4	42.5	39.9	37.3	35.0	32.8	30.7	28.8	27.0	25.3	23.7	22.2	20.8	19.5	18.2	17.1	16.0	15.0	14.1	13.2	12.4	11.6	172.3
1920	81.2	76.0	71.2	66.6	62.4	58.4	54.7	51.3	48.0	45.0	42.1	39.5	37.0	34.7	32.5	30.4	28.5	26.7	25.0	23.4	22.0	20.6	19.3	18.1	16.9	15.9	14.9	13.9	13.1	12.2	11.5	170.6
1921	80.5	75.3	70.5	66.0	61.8	57.9	54.2	50.8	47.6	44.5	41.7	39.1	36.6	34.3	32.1	30.1	28.2	26.4	24.8	23.2	21.7	20.4	19.1	17.9	16.8	15.7	14.7	13.8	12.9	12.1	11.3	168.8
1922	79.9	74.8	70.0	65.5	61.3	57.4	53.8	50.3	47.1	44.2	41.4	38.7	36.3	34.0	31.8	29.8	27.9	26.2	24.5	23.0	21.5	20.2	18.9	17.7	16.6	15.5	14.6	13.6	12.8	12.0	11.2	167.1
1923	79.4	74.3	69.5	65.0	60.8	57.0	53.3	49.9	46.7	43.8	41.0	38.4	36.0	33.7	31.6	29.6	27.7	25.9	24.3	22.8	21.3	20.0	18.7	17.5	16.4	15.4	14.4	13.5	12.7	11.9	11.1	165.6
1924	78.7	73.5	68.8	64.3	60.2	56.3	52.7	49.4	46.2	43.3	40.5	37.9	35.5	33.3	31.2	29.2	27.4	25.6	24.0	22.5	21.1	19.7	18.5	17.3	16.2	15.2	14.3	13.4	12.5	11.7	11.0	163.5
1925	77.7	72.6	67.8	63.4	59.3	55.5	51.9	48.6	45.5	42.6	39.9	37.3	35.0	32.7	30.7	28.7	26.9	25.2	23.6	22.1	20.7	19.4	18.2	17.0	16.0	15.0	14.0	13.1	12.3	11.5	10.8	160.7
1926	76.6	71.5	66.8	62.5	58.4	54.6	51.1	47.8	44.7	41.9	39.2	36.7	34.3	32.2	30.1	28.2	26.4	24.7	23.2	21.7	20.3	19.0	17.8	16.7	15.7	14.7	13.7	12.9	12.1	11.3	10.6	157.6
1927	75.3	70.2	65.6	61.2	57.2	53.5	50.0	46.8	43.8	40.9	38.3	35.9	33.6	31.4	29.4	27.6	25.8	24.2	22.6	21.2	19.9	18.6	17.4	16.3	15.3	14.3	13.4	12.6	11.8	11.0	10.3	153.8
1928	74.2	69.2	64.6	60.3	56.3	52.6	49.2	46.0	43.0	40.2	37.6	35.2	32.9	30.8	28.9	27.0	25.3	23.7	22.2	20.8	19.5	18.2	17.1	16.0	15.0	14.0	13.2	12.3	11.5	10.8	10.1	150.7
1929	73.5	68.5	63.8	59.6	55.6	51.9	48.5	45.3	42.4	39.6	37.0	34.7	32.4	30.3	28.4	26.6	24.9	23.3	21.8	20.4	19.1	17.9	16.8	15.7	14.7	13.8	12.9	12.1	11.3	10.6	10.0	148.1
1930	72.8	67.8	63.1	58.8	54.9	51.2	47.8	44.7	41.7	39.0	36.5	34.1	31.9	29.9	27.9	26.1	24.5	22.9	21.5	20.1	18.8	17.6	16.5	15.5	14.5	13.6	12.7	11.9	11.1	10.4	9.8	145.4
1931	72.1	67.1	62.4	58.2	54.2	50.5	47.2	44.0	41.1	38.4	35.9	33.6	31.4	29.4	27.5	25.7	24.1	22.5	21.1	19.7	18.5	17.3	16.2	15.2	14.2	13.3	12.5	11.7	10.9	10.3	9.6	142.8
1932	71.4	66.3	61.7	57.4	53.4	49.8	46.4	43.3	40.4	37.7	35.3	33.0	30.8	28.8	26.9	25.2	23.6	22.1	20.7	19.3	18.1	17.0	15.9	14.9	13.9	13.0	12.2	11.4	10.7	10.0	9.4	139.7
1933	71.0	65.9	61.2	56.9	52.9	49.3	45.9	42.8	39.9	37.3	34.8	32.5	30.4	28.4	26.6	24.8	23.2	21.7	20.3	19.0	17.8	16.7	15.6	14.6	13.7	12.8	12.0	11.3	10.5	9.9	9.2	137.4
1934	71.0	65.8	61.1	56.8	52.8	49.1	45.7	42.6	39.7	37.0	34.5	32.3	30.1	28.2	26.3	24.6	23.0	21.5	20.2	18.9	17.6	16.5	15.5	14.5	13.6	12.7	11.9	11.1	10.4	9.8	9.1	135.9
1935	71.0	65.8	61.1	56.7	52.6	48.9	45.5	42.4	39.5	36.8	34.3	32.0	29.9	27.9	26.1	24.4	22.8	21.3	20.0	18.7	17.5	16.4	15.3	14.3	13.4	12.6	11.8	11.0	10.3	9.7	9.0	134.4
1936	71.3	66.0	61.2	56.7	52.7	48.9	45.5	42.3	39.4	36.7	34.2	31.9	29.7	27.8	25.9	24.2	22.7	21.2	19.8	18.5	17.3	16.2	15.2	14.2	13.3	12.5	11.7	10.9	10.2	9.6	9.0	133.2
1937	71.9	66.6	61.7	57.1	53.0	49.2	45.6	42.4	39.5	36.7	34.2	31.9	29.8	27.8	25.9	24.2	22.6	21.1	19.8	18.5	17.3	16.2	15.1	14.2	13.3	12.4	11.6	10.9	10.2	9.5	8.9	132.7
1938	72.6	67.2	62.2	57.6	53.3	49.5	45.9	42.6	39.6	36.8	34.3	31.9	29.8	27.8	25.9	24.2	22.6	21.1	19.7	18.5	17.3	16.1	15.1	14.1	13.2	12.4	11.6	10.9	10.2	9.5	8.9	132.2
1939	73.4	67.9	62.8	58.1	53.8	49.9	46.2	42.9	39.8	37.0	34.4	32.1	29.9	27.8	26.0	24.2	22.6	21.1	19.7	18.5	17.3	16.1	15.1	14.1	13.2	12.4	11.6	10.8	10.1	9.5	8.9	131.9
1940	74.1	68.6	63.4	58.7	54.3	50.3	46.6	43.2	40.1	37.2	34.6	32.2	30.0	27.9	26.0	24.3	22.6	21.1	19.7	18.4	17.2	16.1	15.1	14.1	13.2	12.4	11.6	10.8	10.1	9.5	8.9	131.6
1941	74.7	69.1	63.9	59.1	54.7	50.6	46.9	43.4	40.3	37.4	34.7	32.3	30.0	27.9	26.0	24.2	22.6	21.1	19.7	18.4	17.2	16.1	15.0	14.1	13.1	12.3	11.5	10.8	10.1	9.4	8.8	130.9
1942	75.2	69.6	64.4	59.5	55.1	50.9	47.1	43.7	40.4	37.5	34.8	32.3	30.0	27.9	26.0	24.2	22.6	21.0	19.6	18.3	17.1	16.0	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.8	130.1
1943	76.0	70.3	65.1	60.2	55.6	51.5	47.6	44.1	40.8	37.8	35.0	32.5	30.2	28.1	26.1	24.3	22.6	21.1	19.7	18.4	17.1	16.0	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.8	129.8
1944	76.8	71.1	65.7	60.8	56.2	52.0	48.1	44.5	41.2	38.1	35.3	32.7	30.4	28.2	26.2	24.4	22.7	21.1	19.7	18.4	17.1	16.0	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.8	129.4
1945	77.7	71.9	66.5	61.6	56.9	52.6	48.7	45.0	41.7	38.6	35.7	33.1	30.7	28.4	26.4	24.5	22.8	21.3	19.8	18.5	17.2	16.1	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.8	129.4
1946	78.5	72.7	67.3	62.3	57.6	53.3	49.3	45.6	42.1	39.0	36.1	33.4	30.9	28.7	26.6	24.7	23.0	21.4	19.9	18.5	17.3	16.1	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.8	129.3
1947	79.2	73.4	68.0	62.9	58.2	53.8	49.8	46.0	42.6	39.4	36.4	33.7	31.2	28.9	26.8	24.9	23.1	21.5	20.0	18.6	17.3	16.1	15.0	14.0	13.1	12.2	11.4	10.7	10.0	9.4	8.7	129.0
1948	79.7	73.9	68.5	63.4	58.7	54.3	50.3	46.5	43.0	39.7	36.8	34.0	31.5	29.1	27.0	25.0	23.2	21.6	20.0	18.6	17.3	16.2	15.1	14.0	13.1	12.2	11.4	10.7	10.0	9.3	8.7	128.6
1949	79.9	74.2	68.8	63.8	59.1	54.7	50.6	46.8	43.3	40.0	37.0	34.2	31.7	29.3	27.1	25.1	23.3	21.6	20.1	18.7	17.4	16.2	15.0	14.0	13.1	12.2	11.4	10.6	9.9	9.3	8.7	127.9
1950	80.0	74.4	69.0	64.0	59.4	55.0	50.9	47.1	43.5	40.3	37.2	34.4	31.8	29.5	27.3	25.2	23.4	21.7	20.1	18.7	17.4	16.1	15.0	14.0	13.1	12.2	11.4	10.6	9.9	9.3	8.7	127.1
1951	80.1	74.6	69.3	64.3	59.7	55.3	51.2	47.4	43.9	40.6	37.5	34.7	32.1	29.7	27.5	25.4	23.5	21.8	20.2	18.8	17.4	16.2	15.1	14.0	13.1	12.2	11.3	10.6	9.9	9.2	8.6	126.5
1952	79.9	74.5	69.3	64.4	59.8	55.5	51.4	47.6	44.1	40.8	37.7	34.9	32.3	29.8	27.6	25.5	23.6	21.9	20.3	18.8	17.4	16.2	15.0	14.0	13.0	12.1	11.3	10.5	9.8	9.2	8.6	125.6
1953	79.8	74.4	69.3	64.5	60.0	55.7	51.6	47.9	44.3	41.0	38.0	35.1	32.5	30.0	27.8	25.7	23.8	22.0	20.4	18.9	17.5	16.2	15.1	14.0	13.0	12.1	11.3	10.5	9.8	9.2	8.6	124.9
1954	79.7	74.3	69.3	64.6	60.1	55.8	51.8	48.1	44.6	41.3	38.2	35.4	32.7	30.2	28.0	25.9	23.9	22.1	20.5	19.0	17.6	16.3	15.1	14.0	13.0	12.1	11.3	10.5	9.8	9.1	8.5	124.4
1955	79.2	73.9	68.9	64.3	59.9	55.8	51.8	48.1	44.6	41.4	38.3	35.5	32.8	30.4	28.1	26.0	24.0	22.2	20.6	19.0	17.6	16.3	15.1	14.0	13.0	12.1	11.3	10.5	9.8	9.1	8.5	123.5
1956	78.4	73.2	68.3	63.7	59.4	55.4	51.6	47.9	44.5	41.3	38.3	35.5	32.8	30.4	28.1	26.0	24.0	22.2	20.6	19.0	17.6	16.3	15.1	14.0	13.0	12.1	11.2	10.4	9.7	9.1	8.4	122.4
1957	77.4	72.3	67.5	63.0	58.8	54.9	51.1	47.6	44.3	41.1	38.1	35.4	32.8	30.3	28.1	26.0	24.0	22.2	20.6	19.0	17.6	16.3	15.1	14.0	13.0	12.0	11.2	10.4	9.7	9.0	8.4	121.1
1958	76.8	71.7	67.0	62.6	58.4	54.5	50.9	47.4	44.1	41.0	38.1	35.4	32.8	30.4	28.1	26.0	24.1	22.3	20.6	19.1	17.7	16.3	15.1	14.0	13.0	12.0	11.2	10.4	9.6	9.0	8.4	120.2
1959	76.2	71.3	66.6	62.2	58.1	54.2	50.6	47.2	44.0	41.0	38.1	35.4	32.9	30.5	28.2	26.1	24.2	22.4	20.7	19.2	17.7	16.4	15.2	14.1	13.0	12.1	11.2	10.4	9.6	9.0	8.3	119.6
1960	75.9	70.9	66.3	61.9	57.9	54.0	50.5	47.1	43.9	41.0	38.1	35.5	32.9	30.6	28.3	26.3	24.3	22.5	20.8	19.3	17.8	16.5	15.3	14.1	13.1	12.1	11.2	10.4	9.7	9.0	8.3	119.0
1961	75.4	70.5	65.9	61.6	57.6	53.8	50.2	46.9	43.8	40.8	38.1	35.4	32.9	30.6	28.4	26.3	24.4	22.6	20.9	19.4	17.9	16.6	15.3	14.2	13.1	12.2	11.3	10.4	9.7	9.0	8.3	118.4

Numbers at age (1000s) from southern California model (continued)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1962	765.1	717.1	672.1	629.8	590.3	553.3	518.8	486.3	455.6	426.6	399.4	373.8	349.7	326.9	305.5	285.3	266.2	248.3	231.5	215.7	200.9	187.1	174.3	162.2	151.0	140.5	130.8	121.8	113.5	105.8	98.6	92.1	85.9	80.2
1963	765.0	716.9	672.0	629.8	590.2	553.1	518.4	486.0	455.4	426.6	399.4	373.8	349.7	327.0	305.6	285.4	266.4	248.5	231.6	215.8	201.0	187.1	174.2	162.2	150.9	140.4	130.6	121.6	113.2	105.5	98.3	91.6	85.5	79.8
1964	764.8	716.8	671.8	629.7	590.1	553.0	518.2	485.6	455.2	426.5	399.4	373.8	349.7	327.0	305.6	285.5	266.5	248.6	231.7	215.9	201.0	187.1	174.1	162.0	150.7	140.2	130.4	121.3	112.9	105.1	97.9	91.2	85.0	79.3
1965	764.5	716.7	671.7	629.5	590.0	552.9	518.0	485.4	454.7	426.1	399.1	373.5	349.4	326.7	305.3	285.1	266.1	248.2	231.3	215.5	200.6	186.7	173.7	161.5	150.2	139.7	129.9	120.8	112.4	104.5	97.3	90.6	84.4	78.7
1966	764.0	716.4	671.6	629.4	589.9	552.8	517.9	485.1	454.4	425.5	398.5	373.0	348.9	326.1	304.6	284.4	265.3	247.4	230.5	214.7	199.8	185.8	172.8	160.6	149.3	138.8	129.0	119.9	111.5	103.7	96.4	89.8	83.6	77.9
1967	763.2	715.9	671.3	629.3	589.8	552.6	517.7	484.9	453.9	424.9	397.5	371.9	347.8	324.9	303.3	282.9	263.8	245.8	228.9	213.0	198.2	184.2	171.2	159.1	147.8	137.3	127.6	118.6	110.2	102.4	95.2	88.6	82.5	76.8
1968	762.0	715.2	670.8	629.0	589.6	552.5	517.5	484.5	453.4	424.1	396.5	370.5	346.1	323.0	301.2	280.7	261.4	243.3	226.3	210.4	195.5	181.6	168.7	156.6	145.3	134.9	125.3	116.4	108.1	100.4	93.4	86.8	80.8	75.2
1969	760.7	714.1	670.2	628.6	589.4	552.3	517.3	484.3	453.0	423.5	395.6	369.3	344.5	321.2	299.2	278.5	258.9	240.7	223.6	207.6	192.7	178.8	165.9	153.9	142.7	132.4	122.8	114.0	105.8	98.3	91.3	84.9	78.9	73.4
1970	757.7	712.8	669.1	628.0	589.0	552.1	517.3	484.3	453.0	423.4	395.5	368.9	343.9	320.3	298.1	277.2	257.5	239.0	221.6	205.4	190.2	176.1	163.0	150.8	139.5	129.1	119.4	110.5	102.3	94.8	87.9	81.5	75.6	70.2
1971	755.2	710.0	667.9	627.0	588.4	551.7	517.0	484.0	452.7	423.0	394.8	368.0	342.7	318.8	296.2	275.1	255.2	236.5	219.0	202.6	187.4	173.2	160.0	147.8	136.5	126.0	116.4	107.5	99.4	91.9	85.1	78.8	73.0	67.7
1972	752.2	707.7	665.3	625.9	587.5	551.2	516.6	483.7	452.4	422.6	394.3	367.4	341.8	317.6	294.7	273.2	253.1	234.2	216.5	199.9	184.5	170.2	156.9	144.6	133.2	122.7	113.1	104.2	96.1	88.7	81.9	75.7	70.0	64.8
1973	747.4	704.9	663.2	623.4	586.4	550.2	515.9	483.1	451.8	421.8	393.3	366.0	340.1	315.4	292.1	270.2	249.6	230.4	212.4	195.6	180.0	165.5	152.0	139.6	128.2	117.7	108.1	99.3	91.3	83.9	77.3	71.2	65.7	60.7
1974	741.2	700.4	660.5	621.4	584.0	549.1	514.9	482.2	450.7	420.5	391.6	363.9	337.4	312.2	288.4	265.9	244.8	225.1	206.9	189.9	174.0	159.3	145.8	133.4	122.0	111.5	102.0	93.3	85.5	78.3	71.8	65.9	60.6	55.8
1975	733.5	694.5	656.3	618.9	582.1	546.9	513.7	480.9	449.4	418.9	389.6	361.3	334.2	308.3	283.8	260.8	239.1	219.0	200.3	183.0	167.1	152.3	138.7	126.3	114.9	104.6	95.2	86.7	79.0	72.1	65.9	60.2	55.2	50.6
1976	725.3	687.3	650.8	615.0	579.8	545.1	511.5	479.7	448.0	417.4	387.6	358.8	331.0	304.4	279.2	255.5	233.3	212.6	193.5	176.0	159.9	145.1	131.5	119.2	108.0	97.8	88.6	80.4	72.9	66.3	60.3	54.9	50.1	45.8
1977	715.6	679.7	644.0	609.8	576.1	542.9	509.9	477.8	447.1	416.4	386.5	357.4	329.2	302.0	276.2	251.8	228.9	207.7	188.1	170.1	153.6	138.6	125.0	112.6	101.4	91.3	82.2	74.1	66.9	60.4	54.7	49.5	45.0	40.9
1978	703.4	670.6	636.9	603.5	571.3	539.4	507.9	476.2	445.2	415.3	385.2	355.9	327.3	299.7	273.3	248.3	224.8	203.0	182.8	164.3	147.4	132.1	118.2	105.7	94.5	84.4	75.4	67.5	60.4	54.2	48.7	43.8	39.5	35.7
1979	690.8	659.1	628.4	596.8	565.3	534.9	504.6	474.2	443.6	413.3	384.0	354.4	325.6	297.5	270.5	244.9	220.8	198.4	177.7	158.7	141.4	125.8	111.8	99.2	88.0	78.0	69.2	61.4	54.6	48.6	43.3	38.7	34.7	31.2
1980	673.6	647.4	617.7	588.8	559.0	529.1	499.9	470.4	440.4	409.9	379.5	349.9	320.1	291.1	263.2	236.7	211.9	188.8	167.7	148.4	131.1	115.5	101.7	89.4	78.6	69.1	60.8	53.5	47.2	41.7	36.9	32.8	29.2	26.1
1981	665.1	631.2	606.6	578.8	551.6	523.5	495.1	467.0	438.4	409.2	379.3	349.4	320.2	291.0	262.8	235.8	210.4	186.8	165.1	145.4	127.7	112.0	98.0	85.7	74.9	65.5	57.4	50.3	44.1	38.8	34.2	30.2	26.8	23.9
1982	658.4	623.2	591.5	568.4	542.2	516.7	490.1	463.1	436.3	408.8	380.7	351.9	323.0	294.7	266.5	239.3	213.3	189.0	166.5	146.1	127.7	111.3	96.8	84.1	73.1	63.5	55.3	48.1	42.0	36.7	32.2	28.3	24.9	22.1
1983	634.8	617.0	584.0	554.2	532.4	507.3	482.5	456.1	428.9	401.5	373.2	344.1	314.3	284.8	256.2	228.2	201.6	176.9	154.2	133.7	115.5	99.4	85.4	73.3	62.9	54.1	46.5	40.1	34.7	30.0	26.1	22.8	19.9	17.5
1984	619.6	594.8	578.1	547.2	519.1	498.2	474.0	449.7	423.6	396.6	369.4	341.1	312.3	283.0	254.2	226.6	199.8	174.8	151.7	130.8	112.2	95.7	81.5	69.2	58.8	49.9	42.5	36.2	30.9	26.5	22.8	19.7	17.1	14.9
1985	600.7	580.6	557.4	541.7	512.4	485.4	464.7	440.5	415.6	388.9	361.1	333.0	304.0	274.7	245.6	217.4	190.8	165.7	142.8	122.1	103.8	87.8	74.0	62.3	52.4	44.1	37.1	31.4	26.6	22.6	19.3	16.6	14.3	12.4
1986	572.9	562.9	544.1	522.2	507.1	478.9	452.2	430.7	405.2	378.8	350.3	320.7	291.0	261.0	231.4	202.8	175.9	151.3	128.8	108.8	91.3	76.2	63.4	52.6	43.7	36.3	30.3	25.3	21.2	17.9	15.2	12.9	11.1	9.6
1987	560.2	536.8	527.4	509.8	489.2	474.8	447.9	422.1	400.8	375.6	349.3	320.9	291.5	262.1	232.7	204.1	176.7	151.3	128.4	107.8	89.8	74.3	61.2	50.2	41.2	33.8	27.8	22.9	19.0	15.8	13.3	11.2	9.5	8.1
1988	566.8	524.9	503.1	494.2	477.7	458.4	444.8	419.5	395.2	375.0	351.1	326.1	299.2	271.3	243.3	215.4	188.3	162.4	138.4	116.9	97.6	80.8	66.5	54.4	44.4	36.2	29.6	24.2	19.9	16.4	13.6	11.3	9.5	8.1
1989	575.0	531.2	491.9	471.4	463.1	447.6	429.4	416.5	392.5	369.4	350.0	327.0	303.0	277.3	250.7	224.2	197.9	172.3	148.1	125.8	105.8	88.1	72.7	59.6	48.6	39.6	32.2	26.2	21.4	17.5	14.4	11.9	10.0	8.3
1990	578.2	538.9	497.7	460.9	441.7	433.8	419.1	401.7	389.0	365.8	343.3	324.1	301.6	278.1	253.2	227.6	202.4	177.5	153.7	131.2	110.8	92.6	76.6	62.9	51.3	41.7	33.8	27.4	22.2	18.1	14.8	12.2	10.0	8.4
1991	581.6	541.8	504.9	466.4	431.9	413.8	406.2	392.1	375.3	362.7	340.2	318.2	299.2	277.1	254.2	230.1	205.7	181.7	158.4	136.3	115.7	97.1	80.8	66.5	54.3	44.1	35.7	28.9	23.3	18.9	15.3	12.5	10.3	8.5
1992	586.3	545.0	507.7	473.2	437.0	404.6	387.4	380.0	366.2	349.7	337.0	314.9	293.3	274.5	253.0	231.0	208.1	185.1	162.7	141.2	120.9	102.2	85.5	70.9	58.1	47.4	38.4	31.0	25.0	20.2	16.3	13.3	10.8	8.9
1993	592.1	549.4	510.7	475.8	443.3	409.4	378.8	362.3	354.7	341.0	324.6	311.6	289.9	268.8	250.4	229.7	208.8	187.4	166.0	145.5	125.9	107.6	90.8	75.8	62.7	51.4	41.9	33.9	27.4	22.1	17.8	14.4	11.7	9.6
1994	598.0	554.9	514.8	478.6	445.8	415.3	383.3	354.3	338.3	330.5	316.7	300.4	287.2	266.0	245.5	227.7	208.1	188.5	168.6	149.0	130.3	112.5	96.0	80.9	67.5	55.8	45.7	37.2	30.1	24.3	19.6	15.9	12.8	10.4
1995	600.9	560.4	519.9	482.4	448.3	417.5	388.6	358.0	330.1	314.2	305.7	291.6	275.0	261.4	240.8	221.0	203.9	185.5	167.3	149.1	131.4	114.6	98.8	84.1	70.8	59.0	48.8	39.9	32.5	26.3	21.3	17.2	13.9	11.2
1996	597.6	563.1	525.1	487.2	452.0	420.0	390.8	363.2	333.8	306.8	290.6	281.1	266.2	249.2	234.9	214.5	195.3	178.7	161.3	144.4	127.8	111.9	97.0	83.2	70.5	59.1	49.1	40.5	33.1	26.9	21.8	17.6	14.2	11.4
1997	601.5	560.0	527.7	492.0	456.5	423.5	393.3	365.8	339.6	311.7	285.9	270.2	260.6	246.0	229.4	215.4	195.8	177.4	161.7	145.2	129.5	114.1	99.5	86.0	73.5	62.2	52.0	43.1	35.5	29.0	23.5	19.0	15.3	12.4
1998	608.9	563.6	524.7	494.5	461.1	427.7	396.7	368.4	342.4	317.7	291.4	266.9	252.0	242.6	228.6	212.7	199.3	180.8	163.4	148.6	133.2	118.5	104.2	90.7	78.3	66.8	56.5	47.2	39.1	32.1	26.2	21.3	17.2	13.9
1999	613.0	570.6	528.2	491.7	463.3	432.0	400.7	371.6	344.9	320.4	297.1	272.1	249.0	234.5	225.2	211.6	196.3	183.2	165.5	148.9	134.8	120.3	106.6	93.4	81.0	69.6	59.3	49.9	41.6	34.4	28.2	23.0	18.6	15.0
2000	619.3	574.5	534.7	494.9	460.7	434.1	404.6	375.1	347.4	322.1	298.8	276.5	252.8	230.7	216.8	207.7	194.7	180.2	167.9	151.4	136.0	122.9	109.6	96.9	84.8	73.5	63.2	53.7	45.2	37.7	31.1	25.6	20.8	16.9
2001	627.1	580.3	538.3	501.1	463.7	431.7	406.6	378.9	351.1	325.0	301.1	279.0	257.9	235.5	214.7	201.5	192.9	180.6	167.0	155.4	140.0	125.7	113.6	101.2	89.5	78.3	67.8	58.3	49.5	41.7	34.7	28.7	23.6	19.2
2002	634.8	587.6	543.8	504.4	469.5	434.5	404.4	380.8	354.6	328.3	303.6	280.8	259.8	239.8	218.6	199.0	186.6	178.4	167.0	154.4	143.6	129.5	116.3	105.1	93.6	82.9	72.6	62.9	54.1	46.0	38.7	32.3	26.7	21.9
2003	642.2	594.8	550.7	509.6	472.7	440.0	407.1	378.8	356.5	331.8	306.9	283.4	261.8	241.9	223.0	203.1	184.7	173.1	165.5	154.8	143.1	133.2	120.1	107.9	97.5	87.0	77.0	67.5	58.5	50.3	42.8	36.1	30.1	24.9
2004	650.2	601.8	557.4	516.0	477.5	442.9	412.3	381.5	355.0	334.1	310.9	287.5	265.5	245.3	226.6	208.9	190.2	173.0	162.1	155.0	145.0	134.0	124.7	112.5	101.1	91.4	81.5	72.1	63.2	54.8	47.1	40.1	33.8	28.2
2005	656.3	609.3	563.9	522.3	483.5	447.4	415.0	386.1	357.0	331.8	311.9	289.7	267.5	246.6	227.4	209.8	193.2	175.8	159.8	149.7	143.2	134.0	123.9	115.4	104.1	93.6	84.7	75.6	67.0	58.7	50.9	43.8	37.3	31.5
2006	660.8	615.0	571.0	528.5	489.4	453.0	419.1	388.4	360.9	333.1	308.8	289.4	268.0	246.7	226.8	208.6	192.1	176.7	160.6	146.0	136.8	130.9	122.6	113.5	105.9	95.6	86.1	78.0	69.7	61.8	54.2	47.1	40.6	34.6
2007	666.8	619.3	576.3	535.0	495.2	458.6	424.5	392.6	363.7	337.8	311.6	288.7	270.3	250.1	230.0	211.3	194.3	178.9	164.4	149.5	135.9	127.4	121.9	114.2	105.8	98.7	89.2	80.3	72.8	65.0	57.7	50.6	44.0	37.9
2008	671.7	624.8	580.3	540.0	501.3	464.0	429.7	397.5	367.4	340.1	315.5	290.6	268.8	251.3	232.1	213.2	195.7	179.8	165.4	152.1	138.3	125.7	117.9	112.9	105.9	98.1	91.6	82.8	74.6	67.7	60.5	53.7	47.2	41.0
2009	676.6	629.5	585.5	543.8	506.0	469.8	434.7	402.5	372.2	343.8	317.9	294.5	270.9	250.3	233.7	215.7	197.9	181.6	166.8	153.4	141.1	128.3	116.7	109.5	104.9	98.4	91.2	85.2	77.1	69.5	63.0	56.4	50.1	44.0
2010	680.9	634.0	589.8	548.6	509.5	474.1	440.1	407.1	376.7	348.0	321.0	296.4	274.1	251.8	232.2	216.5	199.6	183.1	167.9	154.2	141.9	130.5	118.7	108.0	101.4	97.2	91.3	84.7	79.1	71.6	64.6	58.7	52.5	46.6

Numbers at age (1000s) from southern California model (continued)

Year	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
1962	74.9	70.0	65.5	61.2	57.2	53.4	49.9	46.6	43.5	40.6	37.9	35.3	32.9	30.6	28.4	26.4	24.5	22.7	21.0	19.4	18.0	16.6	15.4	14.2	13.2	12.2	11.3	10.5	9.7	9.0	8.3	117.8
1963	74.5	69.6	65.0	60.8	56.8	53.1	49.6	46.4	43.3	40.5	37.8	35.2	32.8	30.6	28.4	26.4	24.5	22.7	21.1	19.5	18.1	16.7	15.5	14.3	13.2	12.3	11.3	10.5	9.7	9.0	8.4	117.3
1964	74.1	69.1	64.6	60.3	56.4	52.7	49.3	46.1	43.0	40.2	37.5	35.0	32.7	30.5	28.4	26.4	24.5	22.8	21.1	19.6	18.1	16.8	15.5	14.4	13.3	12.3	11.4	10.5	9.8	9.0	8.4	116.7
1965	73.5	68.6	64.0	59.8	55.9	52.3	48.9	45.7	42.7	39.9	37.3	34.8	32.5	30.3	28.3	26.3	24.5	22.7	21.1	19.6	18.1	16.8	15.6	14.4	13.3	12.3	11.4	10.6	9.8	9.1	8.4	116.1
1966	72.6	67.8	63.3	59.1	55.2	51.6	48.2	45.1	42.2	39.4	36.8	34.4	32.1	30.0	28.0	26.1	24.3	22.6	21.0	19.5	18.1	16.8	15.5	14.4	13.3	12.3	11.4	10.6	9.8	9.0	8.4	115.2
1967	71.6	66.7	62.3	58.2	54.3	50.8	47.4	44.4	41.5	38.8	36.3	33.9	31.7	29.6	27.6	25.8	24.1	22.4	20.9	19.4	18.0	16.7	15.5	14.3	13.3	12.3	11.4	10.5	9.7	9.0	8.3	114.1
1968	70.0	65.3	60.9	56.9	53.1	49.6	46.4	43.4	40.6	37.9	35.5	33.2	31.0	29.0	27.1	25.3	23.6	22.1	20.6	19.1	17.8	16.5	15.3	14.2	13.2	12.2	11.3	10.4	9.7	8.9	8.3	112.5
1969	68.4	63.7	59.4	55.4	51.8	48.4	45.2	42.3	39.5	37.0	34.6	32.4	30.3	28.3	26.5	24.8	23.1	21.6	20.2	18.8	17.5	16.3	15.1	14.0	13.0	12.0	11.2	10.3	9.6	8.9	8.2	110.7
1970	65.2	60.7	56.5	52.6	49.0	45.8	42.7	39.9	37.3	34.8	32.6	30.5	28.5	26.7	24.9	23.3	21.8	20.3	19.0	17.7	16.5	15.4	14.3	13.3	12.3	11.4	10.6	9.8	9.1	8.4	7.8	104.4
1971	62.8	58.4	54.3	50.5	47.0	43.8	40.9	38.2	35.7	33.3	31.1	29.1	27.3	25.5	23.8	22.3	20.8	19.5	18.2	17.0	15.9	14.8	13.8	12.8	11.9	11.0	10.2	9.5	8.8	8.1	7.5	100.5
1972	60.1	55.7	51.7	48.0	44.7	41.6	38.7	36.1	33.7	31.5	29.4	27.5	25.7	24.1	22.5	21.0	19.7	18.4	17.2	16.1	15.0	14.0	13.0	12.1	11.3	10.5	9.7	9.0	8.4	7.7	7.2	95.3
1973	56.1	51.9	48.0	44.5	41.4	38.4	35.7	33.3	31.0	29.0	27.0	25.2	23.6	22.1	20.6	19.3	18.0	16.9	15.8	14.7	13.8	12.9	12.0	11.2	10.4	9.7	9.0	8.3	7.7	7.2	6.6	87.8
1974	51.5	47.5	43.9	40.6	37.6	34.9	32.4	30.1	28.0	26.1	24.4	22.7	21.2	19.8	18.5	17.3	16.2	15.2	14.2	13.2	12.4	11.6	10.8	10.1	9.4	8.7	8.1	7.5	7.0	6.5	6.0	79.4
1975	46.5	42.8	39.4	36.4	33.6	31.1	28.8	26.8	24.9	23.1	21.6	20.1	18.8	17.5	16.4	15.3	14.3	13.4	12.5	11.7	10.9	10.2	9.5	8.9	8.3	7.7	7.2	6.7	6.2	5.8	5.4	70.5
1976	42.0	38.5	35.4	32.6	30.1	27.8	25.7	23.8	22.1	20.5	19.1	17.8	16.6	15.5	14.4	13.5	12.6	11.8	11.0	10.3	9.7	9.0	8.4	7.9	7.4	6.9	6.4	6.0	5.5	5.2	4.8	62.8
1977	37.3	34.1	31.2	28.7	26.4	24.3	22.4	20.7	19.2	17.8	16.5	15.3	14.3	13.3	12.4	11.6	10.8	10.1	9.5	8.8	8.3	7.7	7.2	6.8	6.3	5.9	5.5	5.1	4.8	4.4	4.1	54.2
1978	32.4	29.4	26.8	24.5	22.4	20.6	18.9	17.4	16.1	14.9	13.8	12.8	11.9	11.0	10.3	9.6	8.9	8.3	7.8	7.3	6.8	6.4	6.0	5.6	5.2	4.9	4.5	4.2	3.9	3.7	3.4	44.8
1979	28.1	25.4	23.0	20.9	19.1	17.4	16.0	14.6	13.5	12.4	11.5	10.6	9.8	9.1	8.5	7.9	7.4	6.9	6.4	6.0	5.6	5.2	4.9	4.6	4.3	4.0	3.7	3.5	3.3	3.0	2.8	37.1
1980	23.4	21.0	19.0	17.2	15.6	14.2	13.0	11.9	10.9	10.0	9.2	8.5	7.9	7.3	6.8	6.3	5.9	5.5	5.1	4.8	4.5	4.2	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.4	2.3	29.9
1981	21.3	19.1	17.1	15.5	14.0	12.7	11.6	10.6	9.7	8.9	8.2	7.6	7.0	6.5	6.0	5.6	5.2	4.8	4.5	4.2	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	2.0	26.6
1982	19.6	17.5	15.6	14.0	12.7	11.4	10.4	9.5	8.6	7.9	7.3	6.7	6.2	5.7	5.3	4.9	4.6	4.2	4.0	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	2.0	1.9	1.8	23.4
1983	15.5	13.7	12.2	10.9	9.8	8.8	8.0	7.2	6.6	6.0	5.5	5.1	4.7	4.3	4.0	3.7	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	17.8
1984	13.0	11.4	10.1	9.0	8.0	7.1	6.4	5.8	5.3	4.8	4.4	4.0	3.7	3.4	3.1	2.9	2.7	2.5	2.3	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	13.8
1985	10.8	9.4	8.3	7.3	6.5	5.8	5.2	4.7	4.2	3.8	3.5	3.2	2.9	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.9	0.9	0.8	11.1
1986	8.3	7.2	6.3	5.6	4.9	4.4	3.9	3.5	3.2	2.9	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	8.6
1987	6.9	6.0	5.2	4.5	4.0	3.5	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.1	1.0	0.9	0.9	0.8	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.5	6.6
1988	6.9	5.9	5.1	4.4	3.8	3.4	3.0	2.6	2.4	2.1	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.4	5.9
1989	7.0	6.0	5.1	4.4	3.8	3.3	2.9	2.6	2.3	2.1	1.8	1.7	1.5	1.4	1.2	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	5.5
1990	7.0	5.9	5.0	4.3	3.7	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.4	1.3	1.1	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	5.0
1991	7.1	5.9	5.0	4.2	3.6	3.1	2.7	2.4	2.1	1.8	1.6	1.5	1.3	1.2	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	4.6
1992	7.3	6.1	5.1	4.3	3.7	3.1	2.7	2.3	2.0	1.8	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	4.2
1993	7.8	6.5	5.4	4.5	3.8	3.2	2.8	2.4	2.1	1.8	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	4.1
1994	8.5	7.0	5.8	4.8	4.0	3.4	2.9	2.5	2.1	1.9	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	4.0
1995	9.1	7.5	6.1	5.1	4.2	3.6	3.0	2.6	2.2	1.9	1.6	1.4	1.3	1.1	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	3.8
1996	9.3	7.5	6.2	5.1	4.2	3.5	2.9	2.5	2.1	1.8	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2	3.4
1997	10.0	8.1	6.6	5.4	4.4	3.7	3.0	2.6	2.2	1.8	1.6	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.2	3.2
1998	11.2	9.0	7.3	5.9	4.8	4.0	3.3	2.8	2.3	2.0	1.7	1.4	1.2	1.1	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	3.1
1999	12.1	9.7	7.8	6.3	5.2	4.2	3.5	2.9	2.4	2.0	1.7	1.4	1.2	1.1	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	2.8
2000	13.6	11.0	8.8	7.1	5.8	4.7	3.8	3.1	2.6	2.2	1.8	1.5	1.3	1.1	1.0	0.8	0.7	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	2.8
2001	15.5	12.5	10.1	8.1	6.6	5.3	4.3	3.5	2.9	2.4	2.0	1.7	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	2.7
2002	17.8	14.5	11.7	9.4	7.6	6.1	4.9	4.0	3.3	2.7	2.2	1.9	1.6	1.3	1.1	1.0	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	2.7
2003	20.4	16.6	13.5	10.9	8.8	7.1	5.7	4.6	3.8	3.1	2.5	2.1	1.7	1.5	1.2	1.1	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	2.7
2004	23.3	19.1	15.6	12.6	10.2	8.2	6.6	5.3	4.3	3.5	2.9	2.4	2.0	1.6	1.4	1.2	1.0	0.8	0.7	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	2.8
2005	26.2	21.7	17.8	14.5	11.8	9.5	7.7	6.2	5.0	4.0	3.3	2.7	2.2	1.8	1.5	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	2.8
2006	29.2	24.4	20.2	16.6	13.5	11.0	8.9	7.1	5.8	4.7	3.8	3.1	2.5	2.1	1.7	1.4	1.2	1.0	0.9	0.7	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	2.8
2007	32.3	27.3	22.8	18.8	15.5	12.6	10.3	8.3	6.7	5.4	4.4	3.5	2.9	2.3	1.9	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	2.8
2008	35.3	30.1	25.4	21.2	17.6	14.5	11.8	9.6	7.7	6.2	5.0	4.1	3.3	2.7	2.2	1.8	1.5	1.2	1.0	0.9	0.8	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	2.8
2009	38.3	33.0	28.1	23.8	19.8	16.4	13.5	11.0	8.9	7.2	5.8	4.7	3.8	3.1	2.5	2.0	1.7	1.4	1.2	1.0	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.2	2.8
2010	41.0	35.7	30.8	26.2	22.2	18.5	15.3	12.6	10.3	8.4	6.8	5.5	4.4	3.6	2.9	2.3	1.9	1.6	1.3	1.1	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2	2.9

Appendix L: Catch-based allocation of the Overfishing Limit (OFL) for greenspotted rockfish (*Sebastes chlorostictus*) in northern California, and a yield estimate for U.S. waters off Oregon and Washington

Catch-based allocation of OFL from the northern California assessment model

The assessment of greenspotted rockfish between Point Conception and the California-Oregon border spans two management areas, separated at 40° 10′ N. latitude, for species in the "minor shelf rockfish" stock complexes. In order to estimate OFL contributions from greenspotted rockfish to each of these complexes, we queried commercial landings by year and port complex from the CALCOM database. Port sampling in northern California began in 1978, so prior years were excluded from the analysis. Rockfish Conservation Areas (RCAs) were implemented after 2001, so later years were also excluded. Recreational landings in northern California are only available in aggregated form (i.e. not by port or county) prior to 2004, and since then depth restrictions exclude sport fisheries from areas that might be representative of greenspotted rockfish abundance. For these reasons, recreational landings were not used in the catch-based allocation method.

We summed commercial greenspotted rockfish landings (1978-2001) from the Eureka (ERK) and Crescent City (CRS) port complexes, and calculated the ratio of this sum to the sum of all California greenspotted landings north of Port Conception over the same time period (Table L1). This ratio (0.222) was applied to the 2013 OFL (SPR 50%) from the northern California assessment model (42.2 mt), yielding an estimated "OFL" of 9.36 metric tons in the area between 40° 10′ and 42° N. latitude.

The 2013 OFL contribution from greenspotted rockfish to the "minor shelf rockfish south" complex is then the sum of the OFL south of Point Conception (47.5 mt) and 77.8% of the northern California OFL (32.8 mt), for a total of 80.3 mt. The greenspotted rockfish contribution to the 2013 OFL for "minor shelf rockfish north" is the sum of 22.2% of the northern California OFL (9.4 mt) and the estimated sustainable yield from greenspotted rockfish north of 42° N. latitude (see below for details).

Commercial landings by port may not be proportional to regional abundances of greenspotted rockfish in northern California. Catch rates from fishery-independent surveys, along with estimates of suitable habitat area, could also be used to allocate the OFL among management areas. This approach could provide an improved allocation relative to the catch-based method, and should be considered for future assessments. The survey-based approach will require a definition of suitable habitat, area estimation based on that definition, and consideration of factors affecting survey catch rates.

Table L1. Commercial landings (mt) of greenspotted rockfish in northern California, by year and port complex. Trawl-caught "china" rockfish are also included (see main text for details). Source: CALCOM.

	CALCOM Port Complex							
Year	**MRO**	**MNT**	**OSF**	**BDG**	**BRG**	**ERK**	**CRS**	**Grand Total**
1978	4.92	3.83	3.23	0.57	8.88	5.25	1.31	28.0
1979	12.93	3.12	25.15	5.15	17.42	7.22	2.28	73.3
1980	5.83	19.43	5.70	0.00	39.89	4.09	7.75	82.7
1981	41.72	20.03	11.72	0.86	46.37	80.57	5.95	207.2
1982	33.07	18.60	7.91	0.13	40.46	13.54	4.60	118.3
1983	21.85	6.06	2.26	1.46	40.04	19.86	1.38	92.9
1984	2.20	15.23	5.62	5.83	26.18	14.63	2.81	72.5
1985	3.49	12.63	7.93	0.41	35.62	18.54	0.62	79.2
1986	2.52	4.35	0.07	5.73	24.84	4.91	0.66	43.1
1987	2.69	4.16	0.56	10.15	42.26	11.08	1.19	72.1
1988	7.48	14.36	3.33	76.61	32.59	6.60	2.71	143.7
1989	7.50	9.47	4.44	98.89	35.80	7.61	16.52	180.2
1990	11.04	7.48	16.05	39.03	28.06	15.10	6.60	123.4
1991	7.25	4.76	74.84	10.11	79.49	131.55	100.94	408.9
1992	11.65	15.22	44.19	7.07	23.32	8.49	0.48	110.4
1993	5.37	7.18	70.22	1.48	11.00	1.10	0.43	96.8
1994	15.43	7.84	44.52	8.78	13.82	1.04	0.00	91.4
1995	4.01	31.79	39.21	5.40	15.76	1.96	0.09	98.2
1996	3.63	24.89	56.61	2.75	36.84	3.36	0.48	128.6
1997	2.51	14.31	11.58	0.73	19.21	1.34	0.77	50.5
1998	0.65	2.26	10.72	2.08	9.15	2.17	0.06	27.1
1999	0.36	2.65	3.00	1.57	0.85	1.96	0.03	10.4
2000	0.07	0.80	0.81	1.02	0.90	0.00	0.00	3.6
2001	0.02	0.35	0.65	0.46	0.00	0.14	0.59	2.2
Grand Total	**208.2**	**250.8**	**450.3**	**286.3**	**628.7**	**362.1**	**158.3**	**2344.7**

Sustainable yield of greenspotted rockfish in U.S. waters off Oregon and Washington

Life history information and landings of greenspotted rockfish north of the assessed area were used to generate estimates of sustainable yield for U.S. waters between the U.S.-Canada border and the California-Oregon border. Recent commercial landings (1987-2010) of greenspotted rockfish north of 42° N. latitude have only been recorded in Oregon, which is not surprising given the primarily southern distribution of this species. Recent landings in Oregon were appended to estimates from a historical catch reconstruction project for Oregon (1892-1986), provided by V. Gertseva (NMFS NWFSC) (Figure L1).

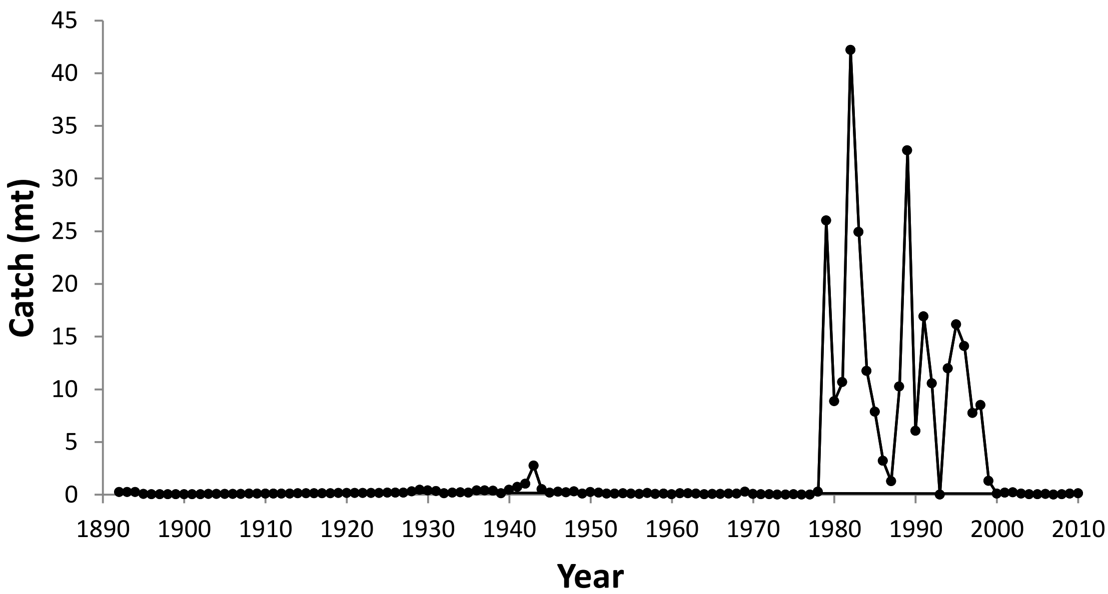

Figure L1. Commercial landings of greenspotted rockfish in Oregon, 1892-2010.

The sudden increase in landings in 1979 (Fig. L1) is difficult to interpret. The majority of greenspotted catches in the late 1970s/early 1980s came from bottom trawl gear, so the pattern does not appear to be related to the development of the widow rockfish fishery. ODFW changed species composition sampling programs in 1977, so the increase in 1979 is not clearly associated with a change in sampling (V. Gertseva, pers. comm.). Further investigation of historical greenspotted landings in Oregon is warranted.

Due to the uncertainty in historical landings, we estimated sustainable yield using MacCall's (2009) Depletion-Corrected Average Catch (DCAC). The sum of landings from 1979-1999 is approximately 273 mt, with an average annual catch of 13 mt. DCAC requires an estimate of fractional depletion ("delta," which is the change in relative biomass, in units of unfished relative biomass). Our delta estimate is based on the difference in relative spawning output from 1979 to 1999 in the northern California assessment (see Table 45 in main document; 57% – 11.6% = 45.4%). Our point estimate for natural mortality was identical to the stock assessment (0.065), and other DCAC parameters were set to be consistent with Dick and MacCall (2010). DCAC was implemented with software available from the NMFS toolbox (Figure L2). The median of the DCAC distribution was 6.1 mt.

Using the same set of input parameters and an estimated age at maturity of 15 years, we also estimated yield from the entire time series of catch using Depletion-Based Stock Reduction Analysis (DB-SRA; Dick and MacCall, 2011). DB-SRA assumes that a reasonably accurate record of historical catch is available from the beginning of the fishery. We assumed that relative abundance of greenspotted rockfish in Oregon and Washington was equal to the northern California stock (30.6% in 2011).

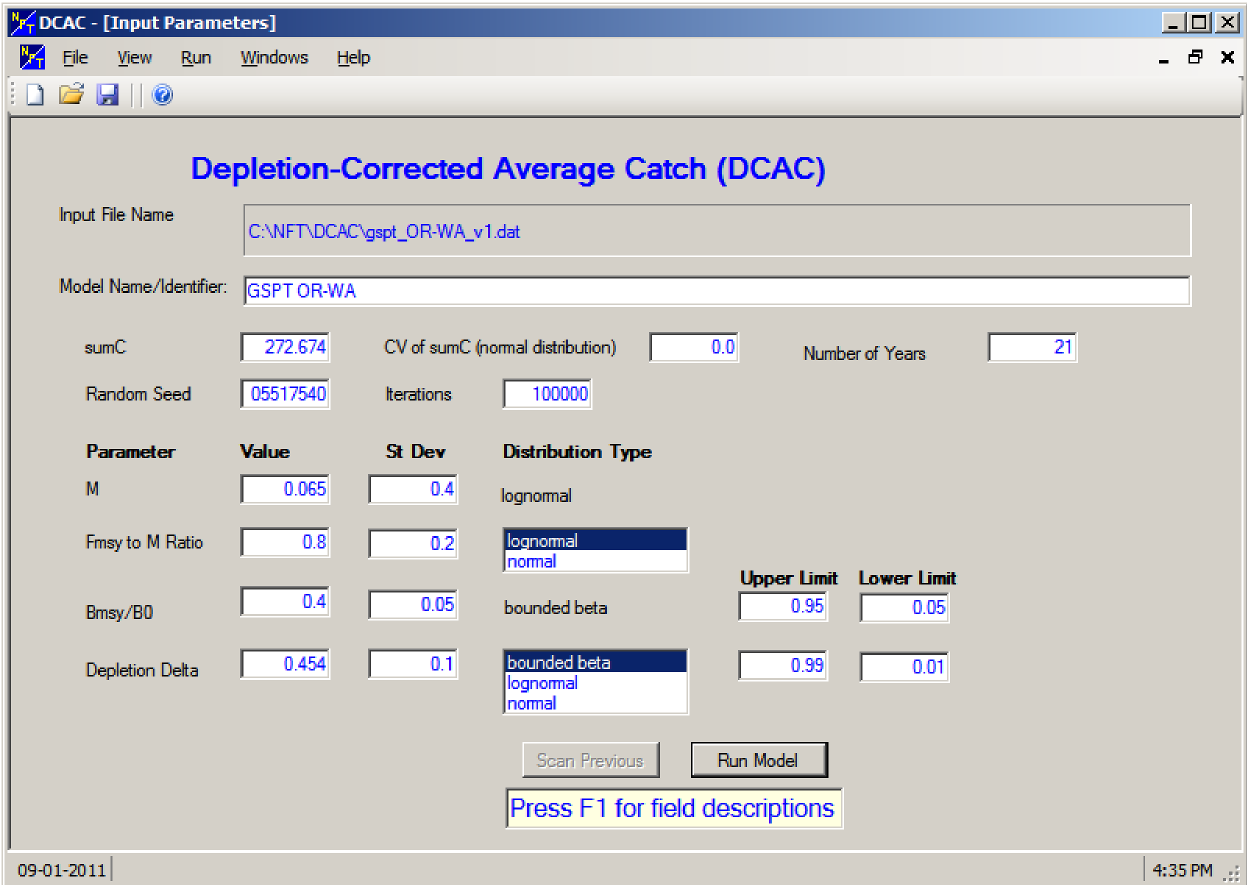

Figure L2. DCAC input settings for greenspotted rockfish in Oregon and Washington (DCAC version 2.1, NMFS Toolbox)

The distribution of DCAC has a median of 6.1 mt, about half of the average catch from 1979-1999 (Figure L3, Table L2). Yield estimates from DB-SRA (both MSY and OFL in 2013) are lower than DCAC because DB-SRA assumes the stock has been depleted to 30.6% of its unfished level, with only minor removals prior to 1979.

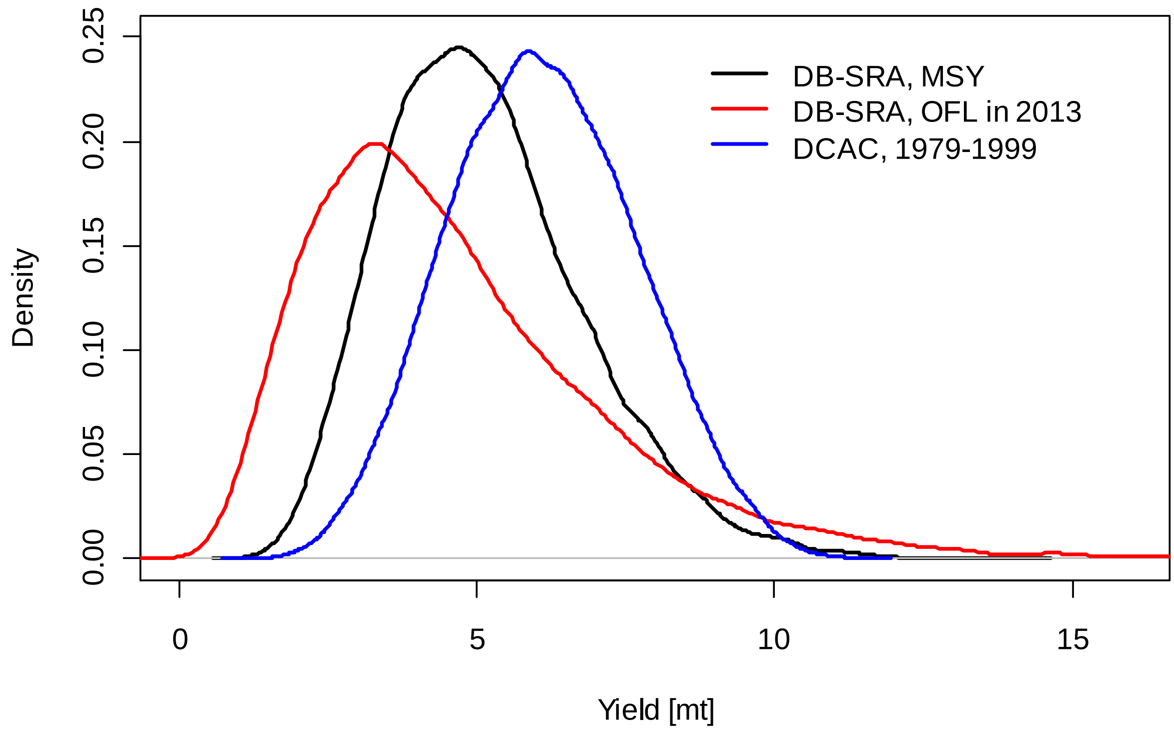

Figure L3. Comparison of yield distributions for greenspotted rockfish in Oregon and Washington from DB-SRA and DCAC.

Table L2. Summary statistics of yield estimates [mt] from DCAC and DB-SRA.

Quantity	**2.5%**	**Median**	**Mean**	**95%**
DCAC	3.2	6.1	6.1	9.2
DB-SRA, OFL in 2013	1.3	4.1	4.6	10.9
DB-SRA, MSY	2.4	4.9	5.1	8.9