STOCK ASSESSMENT of the GOPHER ROCKFISH
(Sebastes carnatus)

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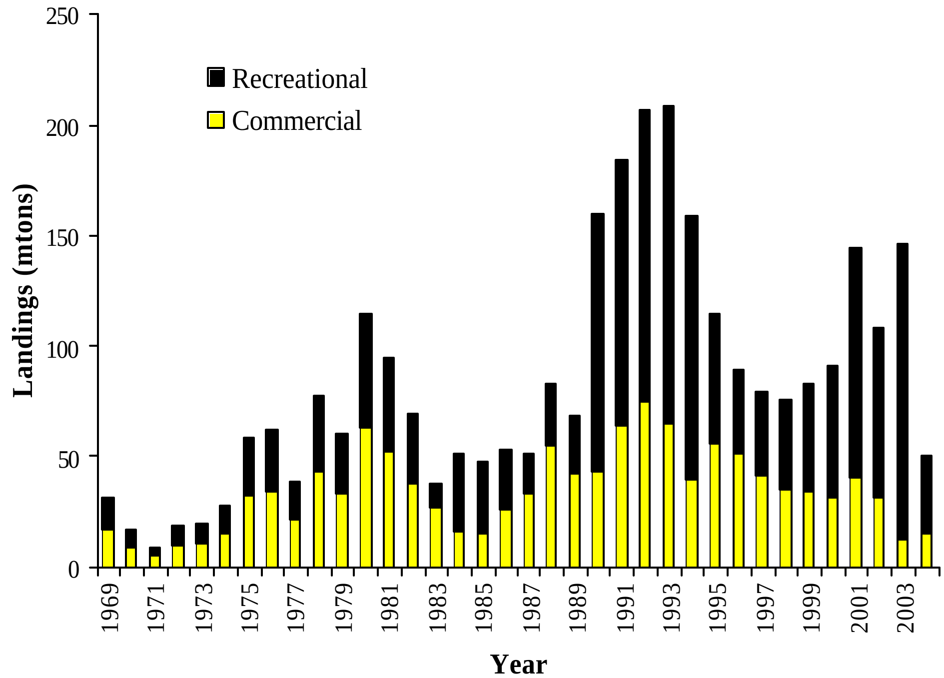
Executive Summary

Stock: This is the first assessment of gopher rockfish (*Sebastes carnatus*) and is restricted to the portion of the stock north of Point Conception (lat. $34^{o}30'$ N). There is evidence that supports differences in size and growth of gopher rockfish in southern California that indicates the need for a separate assessment on the southern California segment. Life history information for the southern segment is not known.

Catches: Catches of gopher rockfish in northern California (north of Point Conception) were classified into two fisheries, commercial and recreational. Gopher rockfish are primarily taken with hook-and-line gears in both fisheries. Commercial landings from 1969-1977 came from California's Commercial Fisheries Information System (CFIS, landing receipts). From 1978-2004, California Cooperative Survey (CALCOM) expansion estimates were used. There were minimal, if any, landings reported in the commercial fishery from 1984-1988. The assumption was made that this was due to the introduction of the group gopher market category during that time. Therefore, we applied CALCOM species compositions in the 1980s to CFIS landings for estimates in those years. Recreational landings from 1969-1982 were estimated by ratio of sums to commercial landings in the 1980s time period. From 1983-2004, Recreational Fisheries Information Network (RecFIN) estimates for gopher rockfish were used. There were no estimates in RecFIN from 1990-1995 data for Commercial Passenger Fishing Vessels (CPFVs) and no 1990-1992 estimates for shore-based and private boats. Therefore, we used CPFV estimates from the Northern and Central California CPFV Sportfish Survey (CDFG) while estimates for shore-based and private boats were based on historical averages from 1990-1992. Estimated discards were included in the recreational catches.

Recent Gopher Rockfish Landings (mtons)

	Commercial	Recreational
1990	43	116
1991	64	120
1992	74	132
1993	65	143
1994	40	119
1995	57	58
1996	51	38
1997	42	38
1998	36	40
1999	35	49
2000	32	59
2001	40	104
2002	31	77
2003	13	134
2004	15	35

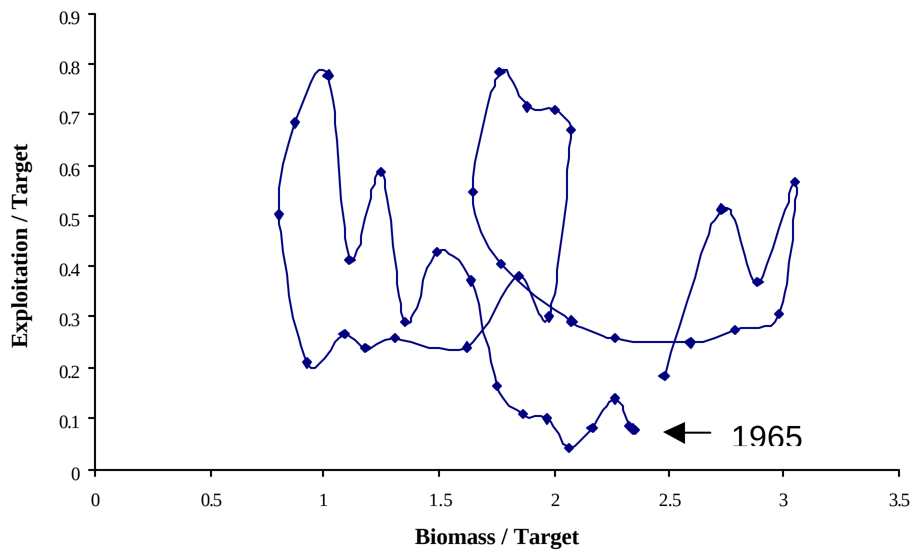


Data and assessment: This is the first evaluation of gopher rockfish. Input data consisted of the following sources: 1) commercial landings and length compositions from the CFIS and CALCOM databases, 2) recreational landings and length compositions from the RecFIN database, and 3) length compositions and recreational CPFV catch per unit effort (CPUE) statistic derived from CDFG's Northern and Central California CPFV Sportfish Survey database. These data sources were used to estimate the population characteristics from the time period 1965 to 2004 in the length-based model of Stock Synthesis 2 (v1.19). The initial pre-1965 conditions were based on 1969-1974 averages for each fishery. Recruitment deviations were estimated from 1965-2000. Selectivity patterns were fixed external to the model after length compositions were evaluated. Growth and other life history parameters were fixed in most cases, primarily based on Lea et al. (1999). Spawner-recruit steepness was fixed (h=0.65) and variability was also held constant (sigma r = 0.5).

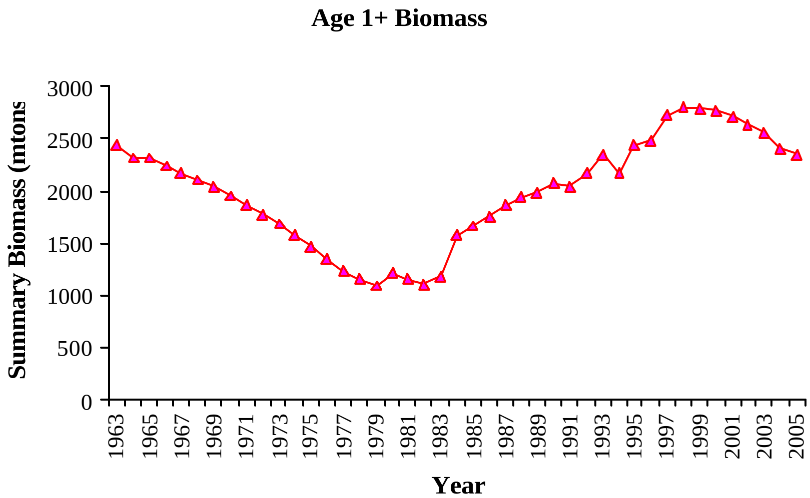
Unresolved problems and uncertainties: The major area of uncertainty the Stock Assessment Review (STAR) Panel and Stock Assessment Team (STAT) agreed upon was the bounding scenarios of the baseline model using the CPFV survey CPUE index for a measure of relative abundance, which brings into question the accuracy of abundance trends derived from this series of information. The emphasis on this data source (with associated relative probabilities in parenthesis) was set at 1 (0.22), 5 (0.40) and 10 (0.38), with 5 being the most likely scenario and used in the baseline model.

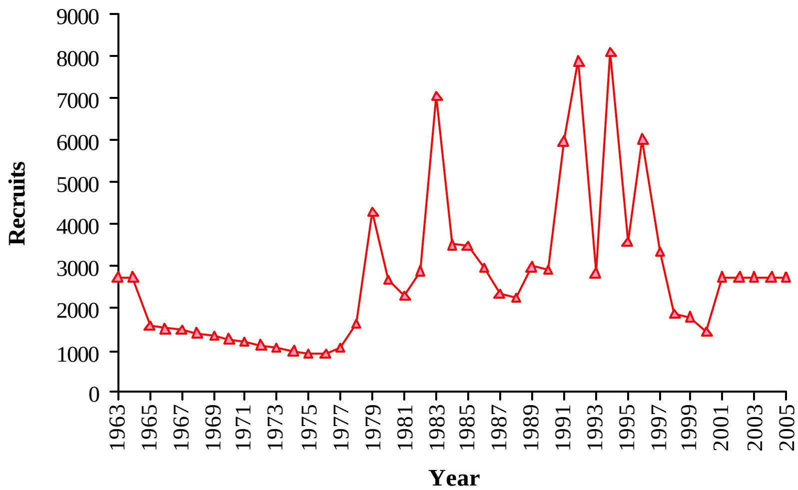
Reference points: Like many rockfish species, the target harvest rate for gopher rockfish is $F_{50\%}$, based on the Pacific Fishery Management Council's (PFMC) guidelines. The following reference points were obtained from the baseline model (emphasis 5 on the CPUE index).

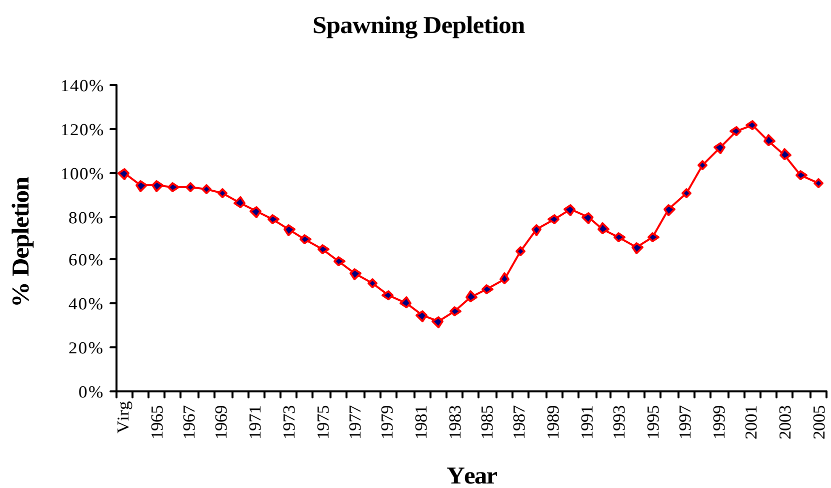
Biological Reference Points	
Unfished spawning biomass (SB_0)	1,995 mtons
Unfished summary (age 1+) biomass (B_0)	2,440 mtons
Unfished recruitment (age 0) (R_0)	2,758 mtons
2005 spawning biomass (SB_{2005})	1,931 mtons
2005 summary (age 1+) biomass (B_{2005})	2,385 mtons
ABC ($F_{50\%}$ * B_{2005})	246 mtons
$SB_{40\%}$ (MSY proxy stock size = 0.4 * SB_0)	798 mtons
Exploitation rate at MSY (rockfish proxy $F_{50\%}$)	10.3 %
MSY ($F_{50\%}$ * 40% * B_0)	101 mtons



Stock biomass: Biomass time series (summary biomass (age 1+), recruitment (age 0), and spawning depletion) for gopher rockfish north of Point Conception produced from the baseline assessment model.







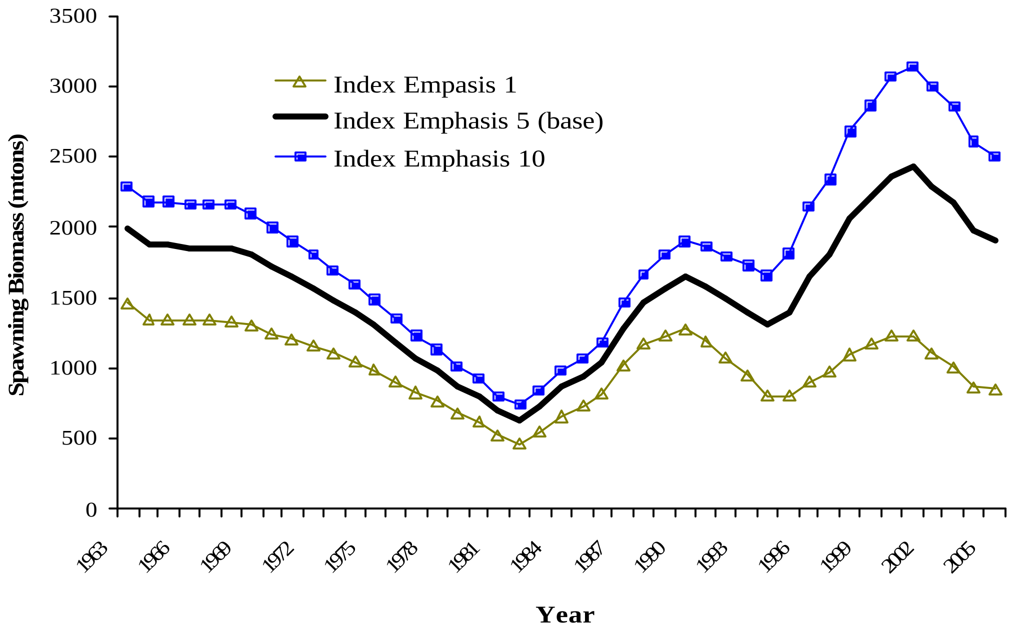
Time series of stock biomass, recruitment, and exploitation rates (1990-2005) produced from the baseline assessment model.

	Total (Age 0+) Biomass	Age 1+ Biomass	Spawning Biomass	Age-0 Recruits	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate	Spawning Stock Depletion
virgin	***2,663***	***2,440***	***1,995***	***2,758***	**--**	**--**	**--**	**--**	***100%***
1990	2,318	2,083	1,651	2,917	43	6.1%	116	13.7%	83%
1991	2,530	2,048	1,594	5,973	64	8.5%	120	14.0%	80%
1992	2,804	2,170	1,498	7,863	74	10.0%	132	16.0%	75%
1993	2,588	2,358	1,406	2,861	65	9.5%	143	19.1%	71%
1994	2,822	2,171	1,312	8,073	40	6.4%	119	17.8%	66%
1995	2,735	2,443	1,408	3,613	57	9.8%	58	9.1%	71%
1996	2,980	2,492	1,656	6,048	51	8.7%	38	5.6%	83%
1997	3,007	2,734	1,806	3,378	42	6.4%	38	4.9%	91%
1998	2,964	2,814	2,065	1,871	36	4.6%	40	4.3%	104%
1999	2,941	2,796	2,219	1,799	35	3.8%	49	4.5%	111%
2000	2,898	2,782	2,376	1,440	32	3.1%	59	4.9%	119%
2001	2,947	2,725	2,432	2,745	40	3.5%	104	7.9%	122%
2002	2,888	2,666	2,327	2,750	31	2.6%	77	5.8%	117%
2003	2,814	2,592	2,201	2,751	13	1.0%	134	10.2%	110%
2004	2,666	2,444	2,002	2,754	15	1.2%	35	2.8%	100%
2005	2,607	2,385	1,931	2,746	--	--	--	--	97%

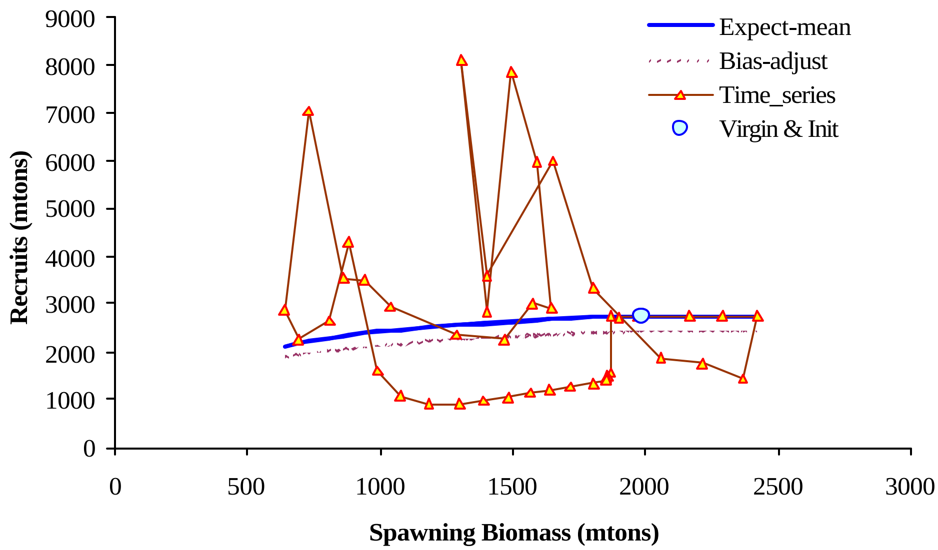
Uncertainty in estimates of stock spawning biomass estimates in the baseline assessment model.

Year	Spawning Biomass	Standard Deviation	CV
1965	1,879	168	0.09
1966	1,865	167	0.09
1967	1,862	167	0.09
1968	1,857	166	0.09
1969	1,808	165	0.09
1970	1,725	163	0.09
1971	1,647	161	0.10
1972	1,572	157	0.10
1973	1,484	151	0.10
1974	1,397	144	0.10
1975	1,305	136	0.10
1976	1,188	126	0.11
1977	1,076	116	0.11
1978	994	106	0.11
1979	884	97	0.11
1980	810	90	0.11
1981	696	85	0.12
1982	642	87	0.14
1983	734	100	0.14
1984	865	107	0.12
1985	943	113	0.12
1986	1,042	121	0.12
1987	1,288	133	0.10
1988	1,472	140	0.10
1989	1,575	141	0.09
1990	1,651	144	0.09
1991	1,594	145	0.09
1992	1,498	148	0.10
1993	1,406	155	0.11
1994	1,312	163	0.12
1995	1,408	189	0.13
1996	1,656	228	0.14
1997	1,806	252	0.14
1998	2,065	290	0.14
1999	2,219	311	0.14
2000	2,376	338	0.14
2001	2,432	352	0.14
2002	2,327	352	0.15
2003	2,201	344	0.16
2004	2,002	329	0.16
2005	1,931	312	0.16

Uncertainty in model estimates of spawning biomass. The baseline model is shown as a solid black line with the emphasis on the CPFV survey CPUE index set at 5. To show the uncertainty in stock size, the emphasis on the CPFV survey CPUE index was also set at a value of 1 (triangles) and 10 (squares).



Recruitment: Recruitments were modeled in this assessment assuming a Beverton-Holt relationship, with steepness fixed at *h*=0.65 and recruitment variability fixed at sigma r = 0.5. Recruitment deviations were estimated for the period 1965-2000. This stock showed evidence of weak recruitment in the 1970s, with peaks in the mid-1980s and mid-1990s. The 1970s time period is not so reliable since length information was not available until the 1980s. Overall, recruitment has been variable throughout the entire time series.



Exploitation status: The gopher rockfish stock north of Point Conception is estimated to be above the precautionary threshold. In addition, recent exploitation rates have been well below the F_{msy} proxy for rockfishes. Recent landings have been between 20% and 60% of the calculated ABC, based on a harvesting rate of $F_{50\%}$.

Management performance: This is the first assessment of gopher rockfish. Gopher rockfish is a federally designated groundfish and part of the *Sebastes* complex managed by the PFMC but has not been managed on an individual species basis.

Forecasts: The gopher rockfish population north of Point Conception was projected under the default PFMC harvest policy (i.e. $F_{50\%}$). Results for changing the emphasis on the CPFV survey CPUE index (1, 5 (baseline), and 10) are presented in the forecast table on the following page.

Decision table: Uncertainty in the stock assessment was based on the emphasis used on the CPFV survey CPUE index in the assessment. To capture the variability in the projection model, the emphasis used for the index was fixed at three levels: 1, 5, and 10. Setting this level at 5 is the baseline model, with 1 and 10 representing the low and high states of nature, respectively. Representatives from the Groundfish Management Team (GMT) requested the first two years in the projections be based on recent averages from the commercial and recreational fisheries. For the commercial fishery, an average based on 2000-2004 was used. The average for the recreational fishery represented the years 2002 and 2004 only.

Research and data needs: The STAR Panel recommended that additional length and age composition data be collected for gopher rockfish throughout California. This would help characterize spatial and possibly temporal variation in growth. An extension of the CPFV survey used in this assessment would be beneficial for updating the CPUE index as well as having a longer time series for this estimate of relative abundance. Discard information for the commercial fishery would also be useful. Future assessments may also want to investigate predator species that have potential in affecting the abundance of the gopher rockfish stock (e.g. lingcod).

Forecasts for gopher rockfish. The baseline model uses emphasis 5 on the CPUE index.

Emphasis on CPUE index = 1

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	1174	862	59.2%	26	5.7%	54	10.7%
2006	1	1147	839	57.6%	26	6.2%	54	11.8%
2007	1	1130	825	56.6%	48	12.5%	105	24.8%
2008	1	1054	751	51.5%	38	12.5%	89	24.8%
2009	1	1011	711	48.8%	33	12.5%	82	24.8%
2010	1	985	689	47.3%	31	12.5%	78	24.8%
2011	1	968	676	46.4%	30	12.5%	76	24.8%
2012	1	956	666	45.7%	29	12.5%	75	24.8%
2013	1	945	657	45.1%	28	12.5%	74	24.8%
2014	1	936	649	44.6%	28	12.5%	73	24.8%
2015	1	929	643	44.1%	28	12.5%	72	24.8%
2016	1	922	637	43.7%	27	12.5%	72	24.8%

Emphasis on CPUE index = 5

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	2385	1931	96.8%	26	2.1%	54	4.7%
2006	1	2304	1850	92.7%	26	2.3%	54	5.1%
2007	1	2235	1781	89.3%	112	10.5%	234	23.9%
2008	1	1931	1480	74.2%	85	10.5%	183	23.9%
2009	1	1736	1292	64.8%	68	10.5%	153	23.9%
2010	1	1609	1174	58.9%	57	10.5%	136	23.9%
2011	1	1525	1099	55.1%	50	10.5%	125	23.9%
2012	1	1466	1049	52.6%	46	10.5%	119	23.9%
2013	1	1422	1011	50.7%	43	10.5%	114	23.9%
2014	1	1387	981	49.2%	42	10.5%	111	23.9%
2015	1	1359	956	47.9%	40	10.5%	108	23.9%
2016	1	1335	935	46.9%	39	10.5%	106	23.9%

Emphasis on CPUE index = 10

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	3058	2533	110.0%	26	1.6%	54	3.5%
2006	1	2940	2414	104.9%	26	1.7%	54	3.9%
2007	1	2836	2310	100.3%	145	9.9%	299	23.5%
2008	1	2409	1883	81.8%	109	9.9%	230	23.5%
2009	1	2131	1611	70.0%	86	9.9%	189	23.5%
2010	1	1949	1439	62.5%	71	9.9%	165	23.5%
2011	1	1827	1329	57.7%	61	9.9%	150	23.5%
2012	1	1742	1255	54.5%	55	9.9%	141	23.5%
2013	1	1681	1201	52.2%	51	9.9%	135	23.5%
2014	1	1633	1160	50.4%	49	9.9%	131	23.5%
2015	1	1595	1126	48.9%	47	9.9%	127	23.5%
2016	1	1563	1098	47.7%	45	9.9%	124	23.5%

Decision table for the gopher rockfish stock assessment model ($F_{50\%}$ and 40:10).

				CPUE emph1 least likely (p=0.22)		CPUE emph5 most likely (p=0.40)		CPUE emph10 less likely (p=0.38)	
Management Action	**Year**	Commercial Catch	Recreational Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	48	105	825	56.6%	1781	89.3%	2310	100.3%
	2008	38	89	751	51.5%	1657	83.1%	2153	93.5%
	2009	33	82	711	48.8%	1576	79.0%	2043	88.7%
	2010	31	78	689	47.3%	1519	76.2%	1962	85.2%
	2011	30	76	676	46.4%	1477	74.0%	1900	82.5%
	2012	29	75	666	45.7%	1443	72.3%	1851	80.4%
	2013	28	74	657	45.1%	1415	70.9%	1810	78.6%
	2014	28	73	649	44.6%	1392	69.8%	1776	77.1%
	2015	28	72	643	44.1%	1372	68.8%	1747	75.9%
	2016	27	72	637	43.7%	1354	67.9%	1723	74.8%
Medium Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	112	234	825	56.6%	1781	89.3%	2310	100.3%
	2008	85	183	575	39.5%	1480	74.2%	1974	85.7%
	2009	68	153	430	29.5%	1292	64.8%	1757	76.3%
	2010	57	136	371	25.5%	1174	58.9%	1615	70.1%
	2011	50	125	356	24.5%	1099	55.1%	1522	66.1%
	2012	46	119	345	23.7%	1049	52.6%	1457	63.3%
	2013	43	114	329	22.6%	1011	50.7%	1409	61.2%
	2014	42	111	310	21.3%	981	49.2%	1373	59.6%
	2015	40	108	292	20.1%	956	47.9%	1342	58.3%
	2016	39	106	280	19.2%	935	46.9%	1318	57.2%
High Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	145	299	825	56.6%	1781	89.3%	2310	100.3%
	2008	109	230	487	33.4%	1389	69.6%	1883	81.8%
	2009	86	189	358	24.6%	1147	57.5%	1611	70.0%
	2010	71	165	369	25.3%	998	50.0%	1439	62.5%
	2011	61	150	350	24.0%	905	45.4%	1329	57.7%
	2012	55	141	343	23.5%	845	42.3%	1255	54.5%
	2013	51	135	319	21.9%	799	40.1%	1201	52.2%
	2014	49	131	300	20.6%	762	38.2%	1160	50.4%
	2015	47	127	283	19.4%	729	36.6%	1126	48.9%
	2016	45	124	275	18.9%	701	35.1%	1098	47.7%

First two years were based on GMT recommendations:
Commercial - the average for the last 5 years (2000-2004) = 26 mtons.
Recreational - the average for 2002 and 2004 only = 54 mtons.

< 40%

INTRODUCTION

This is the first stock assessment of gopher rockfish (*Sebastes carnatus* = "flesh colored"). Gopher rockfish range from Eureka, California, to San Roque, central Baja California (Miller and Lea 1972), but are most common from Mendocino County to Santa Monica Bay, California (Love 1996). During exploratory analyses, we felt it appropriate to assess only the northern California population (north of Point Conception), for there was evidence that fish from southern California are smaller and growth information was not available.

Gopher rockfish is a residential and demersal species, associated with kelp beds or rocky reefs, from the intertidal to about 264 ft (80 m), most commonly between 30 and 120 ft (9-37 m) (Eschmeyer and Herald 1983; Love 1996). One tagging study off central California (Lea et al. 1999) revealed that gopher rockfish exhibit minor patterns of movement (<1.5 nm, 2.8 km) with all fish being recaptured on the same reef system where they were tagged. Another study, conducted by Matthews (1986), reported movements up to 1.2 km (0.65 nm) by gopher rockfish that traveled from a low-relief natural reef to a high-relief artificial reef. The change in substrate type may have been a factor in the movement in the Matthews study.

Gopher rockfish have been a minor component of the commercial and recreational rockfish fishery since at least the late 1960s (CFIS and RecFIN) (Figures 1 a-b). In 1980, an estimated 63 metric tons of gopher rockfish were landed commercially north of Point Conception, with a decrease in landings in the mid-1980s (Figure 2). Landings then began to increase, with a peak in the fishery occurring in 1992 when approximately 74 metric tons were landed. Since then, landings have slightly decreased over time. Lower recent landings in 2003 and 2004 (13 and 15 metric tons, respectively) are in part due to more restrictive federal limits placed on rockfishes. Hook-and-line gears have been the dominant gear type used during the 1969 to 2004 period accounting for 98% of commercial landings.

The recreational gopher rockfish fishery for California ports north of Point Conception peaked during a five-year period in the early 1990s, with 2001 and 2003 also being productive years (Figure 2). Since 1983, anglers caught the greatest proportion of gopher rockfish from private and rental boats (71%), followed next by party and charter boats (27%). However, in more recent years (1997 to 2004) these proportions have changed, with the private and rental boats taking 59% of gopher rockfish in the recreational fishery and 41% by the party and charter boats. Also since 1983, gopher rockfish have ranked 25th in northern California recreational fishery landings, accounting for approximately 1% of the total harvest for all recreationally caught fishes. However, gopher rockfish made up approximately 50% of the estimated take of the shallow nearshore rockfishes and 6% of all nearshore rockfish species combined. Additionally, recent catches have been influenced by size and bag limits.

Starting in the late 1980s (Larson and Wilson-Vandenberg 2001) the premium quality live-fish market developed. Currently, nearly all gopher rockfish are landed in this condition due to a more lucrative high-demand market. As a result of the increasing demand for live-fish the average price per pound has risen steadily from a low of less than $2.00 per pound at the inception of the live-fish market to approximately $6.15 (preliminary) per pound in 2004 (CFIS-CMASTR) (unadjusted for inflation).

Management history:

Gopher rockfish is a federally designated groundfish and part of the *Sebastes* complex, and is managed by the Pacific Fishery Management Council (PFMC). Thus, federal commercial regulations that apply to the *Sebastes* complex apply to gopher rockfish. Additionally, the State of California regulates this species for both the commercial and recreational sectors by means of the State Legislature, the Fish and Game Commission (FGC), and the California Department of Fish and Game (CDFG). Because gopher rockfish are a member of the *Sebastes* complex, the PFMC has actively managed them under the general umbrella of regulatory measures that applied to the *Sebastes* complex until 2000 (PFMC 2002). In 2000, changes in the PFMC's rockfish management structure resulted in the discontinued use of the *Sebastes* complex and minor rockfishes, and were replaced with three species groups: nearshore, shelf, and slope rockfishes (January 4, 2000; 65 FR 221), of which gopher rockfish are included in the nearshore group. Within the nearshore group, they are included in the "shallow nearshore rockfish" component. Additionally, north of 40°10' N. latitude (near Cape Mendocino) gopher rockfish are included in the "other nearshore rockfish" group. However, since gopher rockfish are rarely taken in this area of California they essentially do not contribute to the northern California catch.

Since the early 1980s a variety of federal regulatory measures have been used to manage the rockfishes, including cumulative trip limits (generally for two-month periods) and seasons for the commercial sector. Over the years these cumulative trip limits have steadily decreased. Starting in 1994 the commercial groundfish fishery sector was divided into two components: limited entry and open access with specific regulations designed for each component. Other regulatory actions for the general rockfish categories have included area closures, gear restrictions, and cumulative bimonthly trip limits set for the four different commercial sectors - limited entry fixed gear, limited entry trawl, open access trawl, and open access non-trawl. Harvest guidelines are also used to regulate the annual harvest for both the recreational and commercial sectors. In 2002, allocation harvest guidelines for the shallow nearshore rockfish group were set for the recreational and commercial sectors south of 40°10' N. lat. at 532 and 124 metric tons, respectively. By contrast, the 2003 recreational and commercial harvest guidelines were set at 433 and 108 metric tons, respectively. In 2004, the harvest guidelines were set at 375 and 97 metric tons for the recreational and commercial sectors, respectively. A timeline of recent regulations can be seen in Table 1.

The state of California has also adopted various regulatory measures to manage the fishery over the years. Notably, regulations affecting the recreational sector include changes in bag limits starting in 2000, area and seasonal closures, depth restrictions, the creation of the Rockfish and Lingcod management areas in 2000, and the creation of the Cowcod Conservation Area (CCA) in 2001. In 1998, the Marine Life Management Act (MLMA) was enacted, which paved the way for the development of the Nearshore Fishery Management Plan (CDFG 2001). More recent regulatory actions included the FGC adopting marine reserves for the Channel Islands (became effective January 1, 2003) which closed areas to fishing, and in 2004 additional regulatory measures were adopted to change bag limits, boat limits, closure of the Cordell Bank, and in the CCA fishing was restricted to depths shoreward of 20 fathoms.

Commercial fishery management was enacted primarily through statues adopted by the state Legislature, until the passage of the MLMA in 1998. The MLMA transferred authority to the FGC to regulate the nearshore finfish fishery, including gopher rockfish (CDFG 2001). State commercial regulations include: license and permit regulations, finfish trap permits, a nearshore fishery permit moratorium (2001), the implementation of a nearshore fishery permit restricted access program (2003), gear restrictions, area and season and time closures, regulations pertaining to Marine Protected Areas and Commercial Management areas, depth restrictions, and a minimum total length size limit of 10 inches (254 mm) in 1999.

BIOLOGICAL PARAMETERS

The largest individual observed was 34.8 cm total length (TL) (Lea et al. 1999). Lea et al. (1999) found the relationship (R^2=0.99, n=537) between TL (mm) and weight (W in grams), sexes combined, to be

$$W = 0.00001299 * TL^{3.077} \qquad (1)$$

In this assessment, data were provided in fork length. Using the total length to fork length conversion equation (mm) provided by Echeverria and Lenarz (1984)

$$FL = 0.995TL + 0.768 \qquad (2)$$

we used the following length to weight equation

$$W = 0.00001299 * (FL - 0.768/0.995)^{3.077} \qquad (3)$$

in this assessment. This relationship can be seen in Figure 3.

Age and growth:

Maximum age estimates of gopher rockfish in northern California range from 24 to 30 years (Bloeser 1999; Lea et al. 1999). Based on a calculated age-length relationship using whole otoliths for aging, a 20 cm (8 in) TL gopher rockfish is approximately 3-4 years, and a 25 cm (10 in) TL fish is approximately 9-10 years (Lea et al. 1999). Even though linear regression tests suggest a significant difference in growth between the sexes, calculated length-at-age by sex suggests this difference to be very small (Lea et al. 1999). We used one growth curve for both sexes in this assessment.

The precise length compositions of gopher rockfish in the wild appear to vary among locations. On a large scale, differences can be seen between northern and southern California (Figure 4). For this reason, we only used northern California for this length-based assessment, due to the lack of information on growth for species in southern California. It can also be seen that differences appear in more localized areas. The Southwest Fisheries Science Center (SWFSC), Santa Cruz Laboratory's Groundfish Ecology Cruise Program collected specimens in Davenport and Natural Bridges near Santa Cruz (D. Pearson, NMFS, pers. comm.) and these differences can be seen in Figure 5. Fishermen have also confirmed this. There are limited data on such localized area differences, so without the previous example, this would be difficult to detect.

Parturition, Fecundity and Recruitment:

Spawning for gopher rockfish takes place between January and July, peaking in February, March, and May (Lea et al. 1999). Females ranging between 176 and 307 grams carry approximately 249 eggs per gram of body weight and will spawn hatched larvae once a year (MacGregor 1970). The larval stage lasts one to two months (Moser 1996) and it may take up to 90 days before the larvae settle out of the plankton at 20 - 40 mm (0.8 – 1.6 in) TL (Lea et al. 1999). While young juveniles are pelagic, more mature juveniles settle on rocky reefs or in the kelp canopy (Tenera 2000). While there are no estimates of annual recruitment, it is believed to be highly variable, with El Niño events providing favorable conditions for recruitment (D. VenTresca, CDFG, pers. comm.).

Maturity:

In northern California, half of the population of males and females reach maturity at 4 years (17 cm, TL) (Wyllie Escheverria 1987). By 10 years of age (23.7 cm, TL), the entire population of males will have reached reproductive maturity (Tenera 2000). In southern California waters, both males and females reach first maturity at 3 years (13 cm, TL) (Larson 1980). The approximate spawning ogive used in this assessment was

$$\text{Fraction Mature} = \exp(4.3*(L-17.7))/(1+\exp(4.3*(L-17.7))) \quad (4)$$

where L is FL in cm, and was obtained by fitting the following values given by Wyllie Echeverria (1987): $L_{first\ maturity}$ = 17.7cm, $L_{50\%\ maturity}$ = 17.7cm, and $L_{100\%\ maturity}$ = 21cm. The lengths were converted to fork lengths (Equation 2), and for purposes of estimation, the value of $L_{first\ maturity}$ was reduced to 17cm. The fit to this curve can be seen in Figure 6.

ASSESSMENT

There were two fisheries identified in this assessment, commercial and recreational. For each fishery catch and length data were available. There was also one index of abundance used from CDFG's Northern and Central California Commercial Passenger Fishing Vessel (CPFV) Sportfish Survey. This index was treated as a survey in order to have the model recognize separate information on the same (recreational) fishery. This survey, which will be referred to as the "CPFV survey," represented only the CPFV portion of the recreational fishery. Length information from this survey was also provided and used. The data file used in this assessment is provided in Appendix A.

Landings data

Commercial landings date back to 1969 and come from two sources, all converted from pounds to metric tons. We used landings from 1969 to 1977 that were reported on the commercial fish landing receipts from CFIS. In these years, gopher rockfish are assumed to comprise 100% of the gopher rockfish market category. For a background level (1965-1969), we calculated the mean catch from 1969 to 1973 (11 metric tons), which was used in the baseline model.

We obtained the estimated catch for 1978 to 2004 from the California Cooperative Survey (CALCOM) database (B. Erwin, PSMFC, pers. comm.). Expansion procedures were used to estimate commercial landings from sampling commercial market categories (Pearson and Erwin 1997). The gopher rockfish market category does not accurately represent the take of this species, for many rockfish market categories have a variety of species mixed in, primarily driven by size and price factors. This is particularly an issue for the 1980s and 1990s. During the 1980s, there was an additional market category added, "group gopher rockfish," which appears to have affected reported landings for gopher rockfish starting in the mid 1980s. Estimates were made for the years 1984 to 1988 due to low reported landings, some of which were zero (Figure 7). For these estimates, we used species composition information in the 1980s from the gopher and group gopher market categories. An example of species compositions sampled in the group gopher market category in 1989 can be seen in Table 2.

Figure 7 represents the reported landings of gopher and group gopher market categories, as well as the estimates used in the baseline model for the commercial gopher take. Tonnage falling outside of model estimates represents other species also found in these market categories. Around 1999, fishermen and dealers became more aware of what problems this caused for management, so there has been an increased effort to correctly identify species and report them in their appropriate market categories. Additionally, state regulations mandate that any species of nearshore fishes must be sorted by species prior to weighing and the weight reported separately on the CDFG fish landing receipt (Section 150.16, Title 14, California Code of Regulations).

The recreational catch estimates came from two sources. In 1980, the Marine Recreational Fishing Statistical Survey (MRFSS) began in California, and from 1980 to 2003 (with a hiatus from 1990-1992) estimated landings, effort and discards are available from the RecFIN website (http://www.psmfc.org/recfin). No estimates were available for northern California from 1969 to 1982, so estimates based on the ratio of sums of commercial to recreational catches during the 1980s time period were used. For the years 1990-1995, there were missing CPFV estimates in RecFIN, so we used CPFV survey estimates to fill in for those years. Estimates for 1990-1992 for the shore-based and private boat modes of the recreational fishing were based on historical averages. For the year 2004, catch estimates were provided from the California Recreational Fisheries Survey (CRFS), a newly implemented state program that estimates catch and effort along the coast of California (also available from the RecFIN website). All catch estimates used are in Table 3.

We did not include the removals of gopher rockfish taken by spearfishing in this assessment. We evaluated the Central California Spearfishing Tournament (CenCAL) data from 1959-2003 (D. VenTresca, CDFG, pers. comm.), and a minimal amount of gopher rockfish (n=176) was actually taken in those 45 years.

Recreational discards for this assessment were estimated from RecFIN and were included in the total removals for this fishery. For years where no discard estimates were available, we used the ratio of sums of recreational take to discards (in years where information was available) in the 1980s to estimate discards prior to 1990. The same method was used for estimating discards from 1990 on, using the ratio of sums in the 1990s. Evaluation of discard estimates showed an increase in discards in more recent years, hence the two estimates used in the two time periods. Recent changes in bag limits may have increased discards of gopher rockfish in the recreational fishery, although bag sharing (where a fisherman can give fish to another person on the boat who has not reached their limit) may help to minimize this. No correction for the change in bag limit was made in this assessment. Anecdotal information indicates the number of discarded gopher rockfish in 2004 was high. There is also evidence of this increase in the CPFV logbook data and RecFIN data that supports this concern.

Commercial fishermen also stated that permit requirements have caused an increase in discards. The take of gopher rockfish is limited to individuals with a nearshore fishery permit; however gopher rockfish are also caught by individuals targeting deeper nearshore species for which a separate permit is required. Without both permits, individuals would have to discard all gopher rockfish. The National Marine Fisheries Service (NMFS) has been conducting an onboard survey to estimate discards in recent years; however, this information is not yet available.

Catch per Unit Effort (CPUE)

The CPFV survey provided catch and effort data to produce a CPUE index (catch per angler hour) of relative abundance (D. Wilson-Vandenberg, CDFG, pers. comm.) for the time period 1987 to 1998. In the initial analysis of this time series, we analyzed each area separately (Fort Bragg, Bodega Bay, Año Nuevo, Monterey, and Morro Bay) and found that CPUE was constant through time for each area. For locations where gopher rockfish were not landed for at least 3 years, we removed those locations from the analysis. We then ran a Gaussian Generalized Linear Model (GLM) with year, month and location effects (Table 4). To estimate precision, we used the jackknife function so there would be a variance associated with the index. Fort Bragg "fell out" of the analysis due to a lack of sufficient information to contribute to the GLM. Figure 8 represents the catch per unit effort index from 1987 to 1998 from the CPFV survey.

Another index was considered, using catch and effort information from RecFIN (Figure 9); however after much consideration and a sensitivity analysis removing this index, the STAR Panel requested it be removed from the final baseline model, for it did not provide a reliable measure of relative abundance due to changes in regulations and fishery targeting during the 1990s-2000s. For documentation, the following section explains the analysis performed prior to the removal of this index.

RecFIN CPUE:
Northern California (north of Point Conception) trip-level summaries of partyboat catch and angler effort from the RecFIN database were provided for years up to 2003 (W. VanBuskirk, PSMFC, pers. comm.). These RecFIN intercept data reflect sampling and interviews conducted at the end of a fishing trip, and do not include information on specific fishing locations. Because the data include both relevant trips, in which gopher rockfish were reasonably likely to be taken, and non-relevant trips such as trips targeting salmon or tuna, the logistic regression method of Stephens and MacCall (2004) was used to obtain a subset of the trip data that would be appropriate for calculating gopher rockfish CPUE. This method uses the species composition from each trip catches to determine whether gopher rockfish were likely to have been encountered on that trip.

The top 50 species in frequency of occurrence for each region were extracted, and gopher rockfish were separated as being the target species. The remaining 49 species served as potential explanatory variables. Three species of salmon were combined into a single category. Logistic regression of gopher rockfish presence/absence on categorical presence/absence of these explanatory species provided predicted probabilities that gopher rockfish would be taken on a trip, given the other species that were taken on that trip. Prior to the analysis, some trips were excluded from the data set if they were too short (<0.25hr) or too long (>14hr).

Defining the appropriate subset of the data for use in calculating CPUE requires establishing a threshold probability for inclusion. The threshold probability recommended by Stephens and MacCall (2004) is based on an equal number of false negatives (trips that are excluded from the selected set, but the target is present) and false positives (trips that are included in the selected set, but for which the target is absent). In the case of a relatively rare species it may be desirable to increase the number of positive occurrences of the target species in the subset, i.e., by reducing the number of false negatives despite an increase in false positives. The threshold probability that resulted in the lowest average coefficient of variation (CV) of the annual indexes was used, assuming that up to some point, the CV (as a nominal measure of precision) is marginally improved by the larger numbers of actual positive records more than it is degraded by including a larger number of trips that did not catch the target.

Selection of the threshold probability defines the subset of data to be used for calculation of the CPUE index (catch per angler hour). The abundance index is calculated by a Generalized Linear Model (GLM) using a delta-gamma distribution (R language code provided by Edward Dick, SWFSC). An exploratory GLM including all years, all counties, six two-month waves, and distance from shore (inside/outside three miles from land) effects were first used to determine if the model could be simplified based on similarity of estimated effects. The final GLM was simplified somewhat, and included 17 year effects, six wave effects, six county effects, and two area effects (distance from shore). The year effects served as the abundance time series. Precision of the estimated year effects was estimated by use of a jackknife procedure.

Length Composition Data

Length compositions came from three sources: CALCOM, RecFIN, and CPFV survey data. Since all length composition data were reported in either fork lengths or total lengths (mm), we converted all lengths to fork lengths (Equation 2). Once converted to fork lengths (cm), we set up 2 cm bins to calculate length compositions, starting at 16 cm. We did not have any ages for fish above 40 cm and there were minimal lengths (n=5) above 40 cm, so our range of length bins was from 16-40 cm. Table 5 summarizes the initial sample sizes used in the baseline model. Length compositions for each fishery are also shown in Figures 10a-c.

We obtained commercial length compositions from the CALCOM sampling database that covered years from 1992 to 2004. Length compositions for hook-and-line and trap gears were very similar, so all lengths were combined into one commercial fishery (Figure 11).

We used recreational length information from RecFIN and the CPFV survey. We generated recreational length compositions for the CPFV and private boat sectors from 1993-2004 (as well as 1986) through RecFIN. The 1980s data series in RecFIN showed a weight to length conversion problem, so we did not use that information in this assessment (refer to Figure 9b) except for 1986 data, which appeared to be usable. However, we did provide the model with the mean fish weights for those 1980s years. Length compositions between the CPFV and private boat sectors (Figure 12) were also very similar, so we combined all lengths into one recreational fishery.

Our third source of length information came from the CPFV survey that was conducted from 1987 to 1998 in central and northern California. The minimal length compositions (n=54) from Fort Bragg were removed from this assessment due to the differing size compositions compared to other sources (Figure 13). As explained earlier, the GLM also removed Fort Bragg from the CPUE index, having little, if any, effect.

MODEL DESCRIPTION

We used the size- and age-structured versions of Stock Synthesis 2 (SS2.EXE_v1.18 and 1.19, as of April 27, 2005) (Methot 1990, 1998, 2000) to model the population dynamics of the gopher rockfish stock. The Synthesis model projects the survival, growth and reproduction of individual age classes and incorporates ageing errors and individual variation in growth. It allows a variety of data types to be combined and used to estimate parameters in one formulation. The control file used in this assessment can be seen in Appendix B.

Initial efforts in running the model were to get the model to converge using all data elements (landings of the two fisheries, length compositions of the two fisheries, the CPFV survey CPUE index and lengths, mean weights for recreational). We assumed equal likelihood weights (= 1.0) for all data sources except for the CPFV index of abundance (= 5.0) and used a convergence criterion of 0.001 log-likelihood units for all runs of the model.

For the fisheries and survey selectivities, we started by allowing the selectivities to only fit the ascending portion of the selectivity functions and "mirrored" the selectivity of the CPFV survey to the recreational fleet. We then explored the possibility of allowing both ascending and descending portions of the selectivity function. The recreational fishery and the CPFV survey each supported a descending limb, however the model fit best once the mirror was removed and separate selectivity curves were estimated. The commercial fishery was the only one for which the model did not fit a descending limb. The baseline selectivities can be seen in Figure 14.

We did not have any studies that observed patterns of age structure to estimate (annual) natural mortality (M) or survival (S) for gopher rockfish. The oldest fish reported was 30 years old (Bloeser 1999). However, Lea et al. (1999) reported the oldest observed fish to be 24 years old in his study based on surface aging. Since there were no sample sizes associated with the 30-year-old fish, we used the 24-year-old fish to set a realistic lower bound on mortality. Based on Hoenig (1983), this corresponds with a constant mortality of approximately 0.19. Don Pearson (SWFSC, unpublished data) also aged gopher otoliths (n=100) for this assessment from two sources and found the oldest fish to be 20 years old, using the break and burn aging method. Again, based on Hoenig (1983), this corresponds with a constant mortality of approximately 0.23. Therefore, in our baseline model we set natural mortality at 0.2 and ran sensitivity analyses on M=0.15 and M=0.25.

The growth curves used in this assessment were based on the information from Lea et al. (1999), where surface aging was used. Surface aging tends to estimate fish to be younger than their true age, compared to the break and burn method. Additional gopher otoliths (n=100) from central California were available for aging (D. Pearson, SWFSC, pers. comm.), using both methods of aging. For each otolith aged, a burn to surface ratio was calculated to establish a correction factor. For each age, the average ratio was calculated and applied to each age group. Applying these correction factors increased the age of the fish at a given size. The calibrated ages were used to adjust the growth curve previously published by Lea et al. (1999). Sex information was not available with these data used for calibration, so we used a combined sex growth curve in this assessment.

We found the best-fit estimates of growth parameters of the calibrated growth equation (Figure 15) by minimizing the sum of squared deviations between the predicted and observed size at age (Hilborn and Mangel 1997), then converted from TL to FL using Equation 2. We then fit the Schnute (1981) parameterization with the asymptotic size L_{inf} set to maximum observed size because of difficulties in estimating the asymptotic length. Because Synthesis uses the Schnute parameterization of the von Bertalanffy growth equation (Schnute 1981; Methot 2000), we used the parameters t_1=5 (years), L_1=22.2 (cm FL), t_2=15 (years), L_2=31.2 (cm FL) and k=0.186. We also used the error bars in the mean size at age data given in Lea et al. (1999) to estimate a coefficient of variation (CV) in size.

After initial exploratory runs, the CV of length at age was fixed at a value of 0.06 for all ages and added stability to model estimation. The first year in the model is 1965, at which time age structure is assumed to be in equilibrium with background catch levels and the average unfished level of recruitment. Strong year classes were not clearly visible in the length compositions, so the standard deviation of recruitment deviations (sigma r) is assumed to be 0.5. From 1965 to 2000, recruitments are estimated for individual years as deviations from the fitted stock-recruitment relationship. Population estimates for the 1960s and 1970s should not be considered reliable, and this aspect of the model mainly serves to provide "initial conditions" at the time of the earliest observed data in the 1980s (per recommendation by Richard Methot, NMFS). Diffuse priors were assumed for all estimated parameters.

Baseline model and results

<u>Characteristics</u>:

- Begin model in 1965 at equilibrium catch
- Use Beverton-Holt stock-recruitment curve with fixed steepness (h) = 0.65
- Fix natural mortality (M) = 0.20
- Fix length at age coefficient of variation (CV) = 0.06
- Estimate recruitment for years 1965-2000
- Set CPFV survey CPUE index emphasis = 5 for baseline model (versus 1 for low scenario and 10 for high scenario)

<u>Effective sample sizes</u>:

Observed sample sizes (N fish) for the length compositions were replaced by "effective sample sizes" based on McAllister and Ianelli's (1997) description of the ratio of the variance of the expected proportion (p) from a multinomial distribution from sample size N_{eff} to the mean squared error of the observed proportion (p') relative to the model's predictions (p), i.e., N_{eff} = sum[p(1-p)]/sum[($p - p'$)^2]. However, this relationship is subject to statistical variability, and should hold true only on average. A log-log linear regression was used as a "smoother," and effective sample sizes used in the model were the predicted values from this regression given the year-specific observed sample size. No correction was made for the geometric mean bias associated with the log-transform.

During the exploratory phase of model development, values of effective sample size were recalculated each time a substantial change was made in model specifications, especially in specifications that have a strong effect on predicted length compositions, such as selectivity curves for individual fishery segments.

Results and Reference Points:

The parameter values of the baseline model are given in Table 6. The likelihood components associated with each data source used are given in Table 7.

The stock-recruitment model, a Beverton-Holt stock-recruitment relationship (SRR) was fit with steepness $h = 0.65$ (Figure 16) after evaluation and discussion with the STAR panel. Recruitment estimates are not reliable prior to the 1980s, for there was no length information prior to that time. Recruitment is estimated to be variable throughout the 1980s and 1990s; however, a decrease is seen in recruitment beginning in 1997 (Figure 17). From 2001 on, recruitment is strongly influenced by the stock-recruitment curve because of the lack of data. Figure 18 shows an increasing trend in the estimated spawning biomass since the 1980s.

Results presented in Figures 19a-c depict the fit of the baseline model to all of the compositional data of the commercial and recreational fisheries, as well as the CPFV survey. The standardized residuals are displayed annually as circles (the residual divided by the standard error of the estimated proportion). Open circles represent positive residuals, where filled circles depict negative residuals. In this figure, it can be observed where the model encountered difficulties fitting the data. Also seen in Figures 20a-c, are the standardized residuals and trends for the length frequency composition data for each fishery and survey.

The fit of the model for the CPFV survey CPUE index is shown in Figure 21. The observed and predicted seem to fit abundance trends fairly well, but the abundance index is imprecise. There appear to be inconsistencies in the early 1990s, with rather large standard errors.

The following reference points were obtained from the baseline assessment model for the northern California (north of Point Conception) gopher rockfish population.

Biological Reference Points		
Unfished spawning biomass (SB_0)	1,995	mtons
Unfished summary (age 1+) biomass (B_0)	2,440	mtons
Unfished recruitment (age 0) (R_0)	2,758	mtons
2005 spawning biomass (SB_{2005})	1,931	mtons
2005 summary (age 1+) biomass (B_{2005})	2,385	mtons
ABC ($F_{50\%} * B_{2005}$)	246	mtons
$SB_{40\%}$ (MSY proxy stock size = $0.4 * SB_0$)	798	mtons
Exploitation rate at MSY (rockfish proxy $F_{50\%}$)	10.3	%
MSY ($F_{50\%} * 40\% * B_0$)	101	mtons

Uncertainties and sensitivity analyses

Prior STAR panel:

All sensitivity analyses listed below were made in comparison to the baseline model prior to the STAR panel review. Even though changes were made in the final assessment model, the effect of each source would be the same. The numerical results of each sensitivity analyses are presented in Table 8 (baseline model values bolded). Unless mentioned otherwise, only one aspect of the model was changed at a time.

Natural Mortality:

Since we did not have any studies that observed patterns of age structure to estimate (annual) natural mortality (M) for gopher rockfish, and M strongly influences estimates of productivity and abundance, we conducted two sensitivity analyses to evaluate the effect on current biomass, relative depletion, exploitation rate and the allowable biological catch (ABC). The value of M=0.20 was used in the baseline model, based on Hoenig (1983), as previously discussed. As seen in Table 8, current biomass, relative depletion, exploitation rate and the ABC decreases with M=0.15 and increases with M=0.25 for all cases.

Coefficient of Variation (CV) on Growth:

After allowing the CV to be freely estimated in initial runs of the model, we eventually fixed this value at 0.06 for growth. To test the sensitivity of this parameter on the results, we also evaluated the CV at 0.04 and 0.08. There appears to be little, if any, change in the outcome for current biomass, relative depletion, exploitation rate or the ABC (Table 8), especially for a CV=0.08. Neither alteration improved the fit of the model.

Commercial landings:

Due to the uncertainty of commercial landings being reported under market categories in general and the decrease in commercial landings in the mid-1980s when the “group gopher” market category appeared, we adjusted the estimates for 1984-1988, based on species compositions from CALCOM to “reconstruct” commercial landings throughout the time period. There were no differences in the outcome for current biomass, relative depletion, exploitation rate or the ABC (Table 8) when compared to the baseline model.

Ricker model:

To investigate the outcome of the Ricker curve, we let unfished recruitment (R_0) be estimated, giving an initial $\ln(R_0)$ value of 7.2, instead of the estimated 7.7 in the Beverton-Holt curve. Overall, the Ricker model gave a slightly better fit to the model (1154.10) compared to the Beverton-Holt (1155.17). This sensitivity analysis results in no change of the relative depletion or the exploitation rate; however, there was a significant effect (decrease) in the estimated current biomass and ABC (Table 8).

Emphasis on data sources:

We also conducted a series of runs to investigate the effect of the emphasis for each likelihood component in the baseline model. We set the emphasis at 0.1 and 10 for each component and the results are shown in Table 9. (Note: The emphases presented here were run with version 1.18, prior to all other results presented in this assessment.)

Post-STAR panel:

Emphasis on the CPFV survey CPUE index:

The major area of uncertainty the STAR Panel and STAT agreed upon was the bounding scenarios of the baseline model using the CPFV survey CPUE index for a measure of relative abundance, which brings into question the accuracy of abundance trends derived from this series of information. The emphasis on this data source (with associated relative probabilities in parenthesis) was set at 1 (0.22), 5 (0.40) and 10 (0.38), with 5 being the most likely scenario and used in the baseline model. To show this uncertainty, we present the resulting estimates of spawning biomass in Figure 22. (Note: An error in calculation of the CPFV survey CPUE index was discovered during final document preparation. The consequences of this error are explored in Appendix C.)

STATUS OF THE STOCK AND PROJECTIONS

Considering the results of the baseline model, Table 10 shows the stock projections for the northern California gopher rockfish population, depending on the emphasis used on the CPFV survey CPUE survey (with 5 being most likely and used in the baseline model). The PFMC's harvest policy for rockfish (ABC based on $F_{50\%}$ harvest rate) was used to forecast harvest in the next 12 years (to the year 2016) and a 40:10 precautionary adjustment did not need to be made. Forecasts were based on an allocation between the commercial and recreational fisheries, 26 and 54 metric tons, respectively. GMT members made this recommendation of using the 5-year average take from 2000-2004 for the commercial fishery and the average take in 2002 and 2004 for the recreational fishery to use in these projections. In this assessment, gopher rockfish, in any scenario, do not appear to be below target levels and the stock appears to be healthy.

Decision Table Analysis:

Uncertainty in the stock assessment was based on the emphasis used on the CPFV survey CPUE index in the assessment. The emphasis on this data source (with associated relative probabilities in parenthesis) was set at 1 (0.22), 5 (0.40) and 10 (0.38), with 5 being the baseline model. The range of possible management actions to apply to the three states of nature was based on the averages described above. Decision tables with low, medium and high catches associated with each state of nature can be seen in Table 11. There is no evidence of overfishing (< 25%) in any catch scenario when the emphasis of the CPUE index is set at 5 (baseline) or 10. The only signs of overfishing are seen in the medium and high catch scenarios, when the CPUE emphasis is set = 1.

Forecasts and decision tables based on $F_{50\%}$ and California nearshore 60:20 rule can be seen in Appendix D.

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REFERENCES

Bloesser, J.A. 1999. Diminishing returns: The status of west coast rockfish. Pacific Marine Conservation Council. 94 p.

CDFG. 2002. Nearshore Fishery Management Plan. Marine Region, California Department of Fish and Game: 222.

Eschmeyer, W.N. and E.S. Herald. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin CO., Boston, MA. 336 p.

Eschevarria, T. and W Lenarz. 1984. Conversions between total, fork and standard lengths in 35 species of *Sebastes* from California. Fishery Bulletin 82(1):249-251.

Hilborn, R. and M. Mangel. 1997. The ecological directive: Confronting models with data. Princeton, Princeton University Press.

Hoenig, J.M. 1983. Empirical use of longevity data to estimate mortality rates. Fishery Bulletin. 81(4):898-903.

Larson, R.J. 1980. Territorial behavior of the black and yellow rockfish and gopher rockfish (Scorpaenidae, Sebastes). Marine Biology 58:111-122.

Larson, R.J. and D. Wilson-Vandenberg. 2001. Other nearshore rockfishes. California's Living Marine Resources: A status report. W.S. Leet, R. Klingbeil, and E.J. Larson (Editors). The Resources Agency, The California Department of Fish and Game. 1:185-188.

Lea, R.N., R.D. McAllister, and D.A. VenTresca. 1999. Biological aspects of nearshore rockfishes of the genus *Sebastes* from central California. California Department of Fish and Game Fish Bulletin 177:1-109.

Love, M. 1996. Probably More Than You Want To Know About the Fishes of the Pacific Coast. Really Big Press, Santa Barbara, California, 381 p.

MacGregor, J.S. 1970. Fecundity, multiple spawning, and description of the gonads in Sebastodes. US Fish and Wildlife Service, Report No. 596, 12 p.

Matthews, K.R. 1986. Movement of two nearshore, territorial rockfishes previously reported as non-movers and implications to management. California Department of Fish & Game Bulletin 72(2): 103-109.

McAllister, M.K.and J.N. Ianelli, 1997. Bayesian stock assessment using catch-age data and the sampling-importance resampling algorithm. Canadian Journal of Fisheries and Aquatic Sciences. 54:284-300.

Methot, R. 1990. Synthesis Model: An adaptable framework for analysis of diverse stock assessment data.

Methot, R. 1998. Program Documentation for the stock synthesis model, Northwest Fisheries Science Center, National Marine Fisheries Service. 40 p.

Methot, R. 2000. Technical description of the stock synthesis assessment program, National Marine Fisheries Service. 46p.

Miller, D.J. and R.N. Lea. 1972. Guide to the coastal marine fishes of California. California Department of Fish and Game, Fish Bulletin 157, 249 p.

Moser, H.G. 1996. Scorpaenidae: scorpionfishes and rockfishes. In: H.G. Moser (Editor), The early stages of fishes in the California Current region, California Cooperative Oceanic Fisheries Investigations, Atlas No. 33, p 733-795. Allen Press, Inc., Lawrence, Kansas.

Pearson, D. and B. Erwin. 1997. Documentation of California's commercial market sampling data entry and expansion programs. NOAA.

Pacific Fishery Management Council. 2002. Status of the Pacific Coast Groundfish Fishery Through 2001 and Acceptable Biological Catches for 2002.

Schnute, J.T. 1981. A versatile growth model with statistically stable parameters. Canadian Journal of Fisheries & Aquatic Sciences. 38:1128-1140.

Stevens, A. and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fishery Resources. 70:299-310.

Tenera Environmental Services. 2000. Diablo Canyon Power Plant 316(b) Demonstration Report. Document No. E9-055.0. Tenera Environmental Services, P.O. Box 400, Avila Beach, California, 93424.

Wilson, C.E., Halko L.A., Wilson-Vandenberg D., Reilly P.N. 1996. Onboard sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, 1992. Calif. Dept. Fish and Game Mar. Res. Div. Admin. Rep. 96-2: 103 p.

Wyllie Escheverria, T. 1987. Thirty-four species of California rockfishes: maturity and seasonality of reproduction. Fishery Bulletin 85(2):229-250.

Table 1. Timeline of commercial and recreational regulations.

Commercial	Recreational
1990	
Limits on set line length established Gill nets not allowed within 30 fm	Bag limit for rockfish, 15 fish in combination No gear limitations
1994	
Marine Resources Protection Act (MRPA) established 4 small reserves	Marine Resources Protection Act (MRPA) established 4 small reserves
Sebastes complex split coastwide into limited entry (LE) and open access (OA) LE trip limits = 80,000 pounds per month OA trip limits = 40,000 pounds per month Gillnets not allowed within 3 miles of shore	
1995	
Additional limitations for set lines established No set line fishing on weekends north of Santa Cruz Fishing restricted in Districts 12 & 13	
1996	
Finfish trap permit required Limits on the number of traps established Hook and line limited to 150 hooks within 1 mile of shore	
1999	
Nearshore Fishery Permit (NFP) required NFP holders = 1,110 10 inch size limit established OA trip limits = 2,000 pounds per month south of 40^{o} 10'	
2000	
Sebastes complex split into nearshore, shelf and slope Seasonal closures (two-months) first adopted for some areas	Sebastes complex split into nearshore, shelf and slope Seasonal closures (two-months) first adopted for some areas
	Bag limit for rockfish reduced to 10 fish, in combination Gear limited to one line with three hooks
2001	
Cowcod Conservation Area (CCA) established In addition to seasonal closures, depth restrictions were also adopted	Cowcod Conservation Area (CCA) established In addition to seasonal closures, depth restrictions were also adopted
NFP permit moratorium established NFP holders = 750	Gear limited to one line with two hooks
2002	
Nearshore Fishery Management Plan adopted	Nearshore Fishery Management Plan adopted
100 pound renewal requirement for NFP NFP holders = 525 Commercial nearshore rockfish fishery closed early	
2003	
California Rockfish Conservation Area (RCA) established south of 40°10'N Restricts groundfish fishing by region, season and depth 50% of recent catches used to set harvest targets Nearshore rockfish split into shallow, deep, and CA Scorpionfish	California Rockfish Conservation Area (RCA) established south of 40°10'N Restricts groundfish fishing by region, season and depth 50% of recent catches used to set harvest targets Nearshore rockfish split into shallow, deep, and CA Scorpionfish
Formal restricted access program adopted NFP holders = 200 Commercial nearshore rockfish fishery closed early	Recreational nearshore rockfish fishery closed Jan - June south of 40°10'N Recreational nearshore rockfish fishery closed early
2004	
Two month closures varied by region	Two month closures varied by region

Table 2. Species composition of the Group Gopher Rockfish market category (962) landings in 1989.

Species name	Pounds	Percentage
Gopher rockfish	**94,058**	**73.26%**
China rockfish	6,268	4.88%
Black-and-yellow rockfish	6,170	4.81%
Blue rockfish	5,134	4.00%
Unidentified rockfish	4,366	3.40%
Copper rockfish	2,828	2.20%
Olive rockfish	2,460	1.92%
Quillback rockfish	2,196	1.71%
Kelp rockfish	1,490	1.16%
Brown rockfish	1,152	0.90%
Lingcod	777	0.61%
Vermilion rockfish	500	0.39%
California sheephead	233	0.18%
Grass rockfish	210	0.16%
Black rockfish	100	0.08%
Yellowtail rockfish	96	0.07%
Starry rockfish	95	0.07%
Canary rockfish	80	0.06%
Bronzespotted rockfish	78	0.06%
Kelp greenling	72	0.06%
Treefish	25	0.02%
Rosy rockfish	9	0.01%
Totals	128,397	100.00%

Source: CALCOM

Table 3. Gopher rockfish estimated harvest (mtons) for the commercial and recreational sectors, for ports north of Point Conception, 1969-2004.

	Commercial by gear[1]				Recreational by mode[2]					
Year	**Hook & Line**	**Trap**	**Gillnet**	**Total**	**Shore-based anglers**	**CPFV and charter boats**	**Private and rental boats**	**Sub-total**	**Estimated discards [3]**	**Total**
1969[4]	16.4	0.0	0.7	17.2				11.8	2.0	13.9
1970[4]	9.6	0.0	0.1	9.6				6.6	1.1	7.8
1971[4]	4.8	0.0	0.0	4.8				3.3	0.6	3.9
1972[4]	10.7	0.0	0.0	10.7				7.4	1.3	8.6
1973[4]	10.9	0.1	0.0	10.9				7.6	1.3	8.9
1974[4]	15.4	0.1	0.0	15.5				10.7	1.9	12.5
1975[4]	32.6	0.1	0.0	32.7				22.6	3.9	26.5
1976[4]	34.6	0.0	0.1	34.8				24.0	4.2	28.1
1977[4]	19.4	0.0	2.3	21.7				15.0	2.6	17.6
1978[4]	42.7	0.0	0.3	43.0				29.7	5.1	34.8
1979[4]	33.6	0.0	0.1	33.7				23.2	4.0	27.3
1980[4]	60.6	0.0	2.5	63.1				43.5	7.5	51.1
1981[4]	51.6	0.0	0.6	52.2				36.0	6.2	42.2
1982[4]	37.8	0.0	0.7	38.6				26.6	4.6	31.2
1983	25.0	0.2	1.4	26.6	0.1	0.6	9.0	9.7	1.7	11.4
1984[5]	16.1	0.0	0.6	16.7	0.0	0.4	32.3	32.8	1.8	34.6
1985[5]	15.9	0.0	0.0	15.9	0.0	1.6	25.5	27.1	4.7	31.8
1986[5]	26.0	0.0	0.0	26.0	0.1	2.3	23.0	25.4	1.4	26.8
1987[5]	34.0	0.0	0.0	34.0	1.9	1.6	11.0	14.5	2.5	17.0
1988[5]	55.6	0.0	0.0	55.6	1.1	1.7	14.8	17.6	9.9	27.5
1989	41.0	0.0	1.4	42.3	0.4	2.8	19.5	22.7	3.9	26.6
1990[6,7]	43.4	0.0	0.0	43.4	2.0	21.5	80.0	103.5	12.5	116.0
1991[6,7]	63.9	0.0	0.0	63.9	2.1	20.3	85.0	107.4	12.9	120.3
1992[6,7]	74.4	0.0	0.0	74.4	2.3	25.6	90.0	117.9	14.2	132.1
1993[6]	65.3	0.0	0.0	65.3	0.5	21.8	102.1	124.4	18.9	143.3
1994[6]	39.9	0.0	0.0	39.9	0.3	21.1	77.2	98.6	20.1	118.7
1995[6]	56.2	0.6	0.0	56.7	0.2	23.4	33.9	57.5	0.2	57.7
1996	51.2	0.1	0.1	51.4	0.6	7.1	27.3	34.9	2.9	37.9
1997	41.3	0.1	0.6	42.0	1.4	15.8	18.0	35.2	2.8	38.0
1998	34.0	0.9	0.7	35.6	8.5	7.0	22.5	38.0	2.0	40.0
1999	30.8	3.8	0.0	34.7	0.2	12.6	30.8	43.6	5.3	48.9
2000	28.8	3.4	0.0	32.2	0.0	27.3	31.1	58.4	0.7	59.1
2001	37.9	2.5	0.0	40.4	1.5	72.3	27.5	101.3	2.6	103.9
2002	29.6	1.6	0.0	31.2	0.4	21.3	54.7	76.4	0.6	77.0
2003	12.1	0.8	0.0	12.9	0.5	19.5	79.1	99.0	35.3	134.2
2004	14.8	0.6	0.0	15.4	2.4	18.8	11.0	32.1	2.8	34.9
Total	1218	15	12	1245	27	346	905	1546	206	1752

Notes:

1. CFIS (1969-1977), CALCOM (1978-2004, not including 1984-1988)
2. RecFIN (1983 - 2004, not including 1990-1995 for CPFVs)
3. Estimated discards from RecFIN and STAT.
4. The ratio of sums (commercial to recreational) in the 1980s was used in these years for estimating recreational catches.
5. Commercial estimates for 1984 to 1988 by the STAT were based on CALCOM species compositions to account for minimal reported landings.
6. Recreational estimates for 1990 to 1995 have been supplemented by CPFV data from Wilson et al. 1996.
7. Recreational estimates for 1990 to 1992 for the shore-based and private boat modes are based on historical averages.

Table 4. Analysis of Deviance table for the CPFV survey CPUE index.

Model: Gaussian
Response: Catch per angler hour (CPAH)

	Df	Deviance	Residual DF	Residual Deviance	F	Pr(>F)
NULL			664	140.642		
YEAR	11	12.026	653	128.616	7.1206	2.10E-11
MONTH	11	5.34	642	123.276	3.1619	0.00036
LOCATION	65	34.686	577	88.591	3.4756	9.25E-16

Table 5. Initial sample sizes used for length composition data in the baseline model.

	Commercial	**Recreational**	
Year	CALCOM	RecFIN	CPFV Survey
1986		232	
1987			71
1988			632
1989			715
1990			109
1991			697
1992	628		819
1993	1,440	867	600
1994	1,115	585	719
1995	758	358	1,150
1996	2,495	549	1,439
1997	544	1,388	1,404
1998	1,073	1,348	1,025
1999	1,068	1,009	
2000	3,069	621	
2001	1,629	837	
2002	668	1,548	
2003	274	1,572	
2004	397	3,217	
Totals:	***15,698***	***14,131***	***9,380***

All lengths used: **39,209**

Table 6. Parameter values and estimation status for the baseline model.

PARAMETER	VALUE	STATUS
Natural mortality	0.2	FIXED
Maturity		
L_{50} Maturity	17.7	FIXED
k (slope) maturity	4.3	FIXED
Growth		
L_{min}	22.2	FIXED
L_{max}	31.2	FIXED
k	0.186	FIXED
CV	0.06	FIXED
Recruitment		
Virgin recruitment (SR curve)	7.9	ESTIMATED
Steepness parameter (SR curve)	0.65	FIXED
Standard deviation of recruitment	0.5	FIXED
Background recruitment	0	FIXED
Selectivities		
Commercial: size at inflection	26.5	ESTIMATED
Commercial: width for 95% selection	3.8	ESTIMATED
Recreational: size for peak	27.8	ESTIMATED
Recreational: initial selectivity	0.001	FIXED
Recreational: ascending inflection	1.38	ESTIMATED
Recreational: ascending slope	0.05	ESTIMATED
Recreational: final selectivity	0.09	ESTIMATED
Recreational: descending inflection	-1.55	ESTIMATED
Recreational: descending slope	1.05	ESTIMATED
Recreational: peak width	0.1	FIXED
CPFV Survey: size for peak	26.5	ESTIMATED
CPFV Survey: initial selectivity	0.001	FIXED
CPFV Survey: ascending inflection	1.72	ESTIMATED
CPFV Survey: ascending slope	0.04	ESTIMATED
CPFV Survey: final selectivity	-0.06	ESTIMATED
CPFV Survey: descending inflection	-0.54	ESTIMATED
CPFV Survey: descending slope	1.07	ESTIMATED
CPFV Survey: peak width	0.1	FIXED

Table 7. Likelihood components, emphasis levels and their relative values in the baseline model.

Likelihood component	**Emphasis**	**Value**
Index of Abundance		
CPFV Survey	5	25.54
Length Compositions		375.59
Commercial	1	*163.03*
Recreational	1	*130.87*
CPFV Survey	1	*81.68*
Mean Body Weight	1	33.24
Recruitment	1	29.85
Priors	1	2.67
Forecast Recruitment	1	0.01
Total log-likelihood		466.91

Table 8. Results of sensitivity analysis compared to the baseline model before the STAR Panel review. (Note: Slight changes were made in the final baseline; however, effects would still be the same.)

	Baseline	**Natural Mortality**		**Ricker**	**Commercial**	**Coefficient of Variation**	
	M=0.20	M=0.15	M=0.25	M=0.20	80's adjusted	CV = 0.04	CV = 0.08
LIKELIHOODS	**1155.17**	**1157.95**	**1156.54**	**1154.10**	**1155.62**	**1171.96**	**1156.71**
Current Biomass, 2005	**2371.14**	1817.21	3118.72	1528.31	2352.54	2770.38	2039.95
Relative Depletion, 2004	**1.062**	0.909	1.121	1.042	1.037	1.072	1.040
Exploitation Rate at $F_{50\%}$	**0.103**	0.088	0.113	0.104	0.104	0.101	0.106
ABC/Current OY	**244.23**	159.91	352.42	158.94	244.66	279.81	215.93

Table 9. Results of changing the emphasis for each likelihood component. (Note: These results were run prior to the final baseline in the STAR Panel Review. Effects, in general, would be similar.)

	Emphasis at 0.10					Emphasis at 10				
	B2005	**Depl2005**	**F50%**	**ABC2005**	**Likelihood**	**B2005**	**Depl2005**	**F50%**	**ABC2005**	**Likelihood**
Base model	**2196**	**1.012**	**0.103**	**227**	**1154.34**					
CPUE										
Recreational (RecFIN)	2003	0.939	0.103	207	1118.50	3111	1.296	0.103	319	1469.51
CPFV Survey	1481	0.792	0.105	155	1134.91	3684	1.158	0.101	372	1256.95
Length Composition Data										
Commercial(CALCOM)	3044	1.085	0.102	310	1078.82	1519	0.889	0.105	160	1814.66
Recreational (RecFIN)	2109	0.928	0.101	214	1081.32	2797	1.181	0.103	287	1695.79
CPFV Survey	1872	0.950	0.103	194	1104.82	3107	1.073	0.102	317	1457.90
Mean Weights	2772	1.074	0.103	286	1122.87	1782	0.983	0.103	184	1334.54
Finit*	2196	1.012	0.103	227	1154.34	2196	1.012	0.103	227	1154.34
Stock Recruitment Models										
Ricker (emphasis 1)	1617	0.9999	0.104	168	1153.60					
Ricker	2413	1.359	0.103	250	1126.34	1435	0.789	0.103	148	1231.21
Beverton-Holt (emphasis 1)	**2196**	**1.012**	**0.103**	**227**	**1154.34**					
Beverton-Holt	3526	1.530	0.103	364	1126.45	1592	0.655	0.103	163	1248.94

*initial F makes no difference

Table 10. Forecast results based on changing the emphasis on the CPUE index.

Emphasis on CPUE index = 1

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	1174	862	59.2%	26	5.7%	54	10.7%
2006	1	1147	839	57.6%	26	6.2%	54	11.8%
2007	1	1130	825	56.6%	48	12.5%	105	24.8%
2008	1	1054	751	51.5%	38	12.5%	89	24.8%
2009	1	1011	711	48.8%	33	12.5%	82	24.8%
2010	1	985	689	47.3%	31	12.5%	78	24.8%
2011	1	968	676	46.4%	30	12.5%	76	24.8%
2012	1	956	666	45.7%	29	12.5%	75	24.8%
2013	1	945	657	45.1%	28	12.5%	74	24.8%
2014	1	936	649	44.6%	28	12.5%	73	24.8%
2015	1	929	643	44.1%	28	12.5%	72	24.8%
2016	1	922	637	43.7%	27	12.5%	72	24.8%

Emphasis on CPUE index = 5

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	2385	1931	96.8%	26	2.1%	54	4.7%
2006	1	2304	1850	92.7%	26	2.3%	54	5.1%
2007	1	2235	1781	89.3%	112	10.5%	234	23.9%
2008	1	1931	1480	74.2%	85	10.5%	183	23.9%
2009	1	1736	1292	64.8%	68	10.5%	153	23.9%
2010	1	1609	1174	58.9%	57	10.5%	136	23.9%
2011	1	1525	1099	55.1%	50	10.5%	125	23.9%
2012	1	1466	1049	52.6%	46	10.5%	119	23.9%
2013	1	1422	1011	50.7%	43	10.5%	114	23.9%
2014	1	1387	981	49.2%	42	10.5%	111	23.9%
2015	1	1359	956	47.9%	40	10.5%	108	23.9%
2016	1	1335	935	46.9%	39	10.5%	106	23.9%

Emphasis on CPUE index = 10

Year	40:10	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	3058	2533	110.0%	26	1.6%	54	3.5%
2006	1	2940	2414	104.9%	26	1.7%	54	3.9%
2007	1	2836	2310	100.3%	145	9.9%	299	23.5%
2008	1	2409	1883	81.8%	109	9.9%	230	23.5%
2009	1	2131	1611	70.0%	86	9.9%	189	23.5%
2010	1	1949	1439	62.5%	71	9.9%	165	23.5%
2011	1	1827	1329	57.7%	61	9.9%	150	23.5%
2012	1	1742	1255	54.5%	55	9.9%	141	23.5%
2013	1	1681	1201	52.2%	51	9.9%	135	23.5%
2014	1	1633	1160	50.4%	49	9.9%	131	23.5%
2015	1	1595	1126	48.9%	47	9.9%	127	23.5%
2016	1	1563	1098	47.7%	45	9.9%	124	23.5%

Table 11. Decision table for the gopher rockfish stock assessment model ($F_{50\%}$ and 40:10).

				CPUE emph1 least likely (p=0.22)		CPUE emph5 most likely (p=0.40)		CPUE emph10 less likely (p=0.38)	
Management Action	**Year**	Commercial Catch	Recreational Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
Low Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	48	105	825	56.6%	1781	89.3%	2310	100.3%
	2008	38	89	751	51.5%	1657	83.1%	2153	93.5%
	2009	33	82	711	48.8%	1576	79.0%	2043	88.7%
	2010	31	78	689	47.3%	1519	76.2%	1962	85.2%
	2011	30	76	676	46.4%	1477	74.0%	1900	82.5%
	2012	29	75	666	45.7%	1443	72.3%	1851	80.4%
	2013	28	74	657	45.1%	1415	70.9%	1810	78.6%
	2014	28	73	649	44.6%	1392	69.8%	1776	77.1%
	2015	28	72	643	44.1%	1372	68.8%	1747	75.9%
	2016	27	72	637	43.7%	1354	67.9%	1723	74.8%
Medium Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	112	234	825	56.6%	1781	89.3%	2310	100.3%
	2008	85	183	575	39.5%	1480	74.2%	1974	85.7%
	2009	68	153	430	29.5%	1292	64.8%	1757	76.3%
	2010	57	136	371	25.5%	1174	58.9%	1615	70.1%
	2011	50	125	356	24.5%	1099	55.1%	1522	66.1%
	2012	46	119	345	23.7%	1049	52.6%	1457	63.3%
	2013	43	114	329	22.6%	1011	50.7%	1409	61.2%
	2014	42	111	310	21.3%	981	49.2%	1373	59.6%
	2015	40	108	292	20.1%	956	47.9%	1342	58.3%
	2016	39	106	280	19.2%	935	46.9%	1318	57.2%
High Catch	**2005**	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	145	299	825	56.6%	1781	89.3%	2310	100.3%
	2008	109	230	487	33.4%	1389	69.6%	1883	81.8%
	2009	86	189	358	24.6%	1147	57.5%	1611	70.0%
	2010	71	165	369	25.3%	998	50.0%	1439	62.5%
	2011	61	150	350	24.0%	905	45.4%	1329	57.7%
	2012	55	141	343	23.5%	845	42.3%	1255	54.5%
	2013	51	135	319	21.9%	799	40.1%	1201	52.2%
	2014	49	131	300	20.6%	762	38.2%	1160	50.4%
	2015	47	127	283	19.4%	729	36.6%	1126	48.9%
	2016	45	124	275	18.9%	701	35.1%	1098	47.7%

First two years were based on GMT recommendations:
Commercial - the average for the last 5 years (2000-2004) = 26 mtons.
Recreational - the average for 2002 and 2004 only = 54 mtons.

< 40%

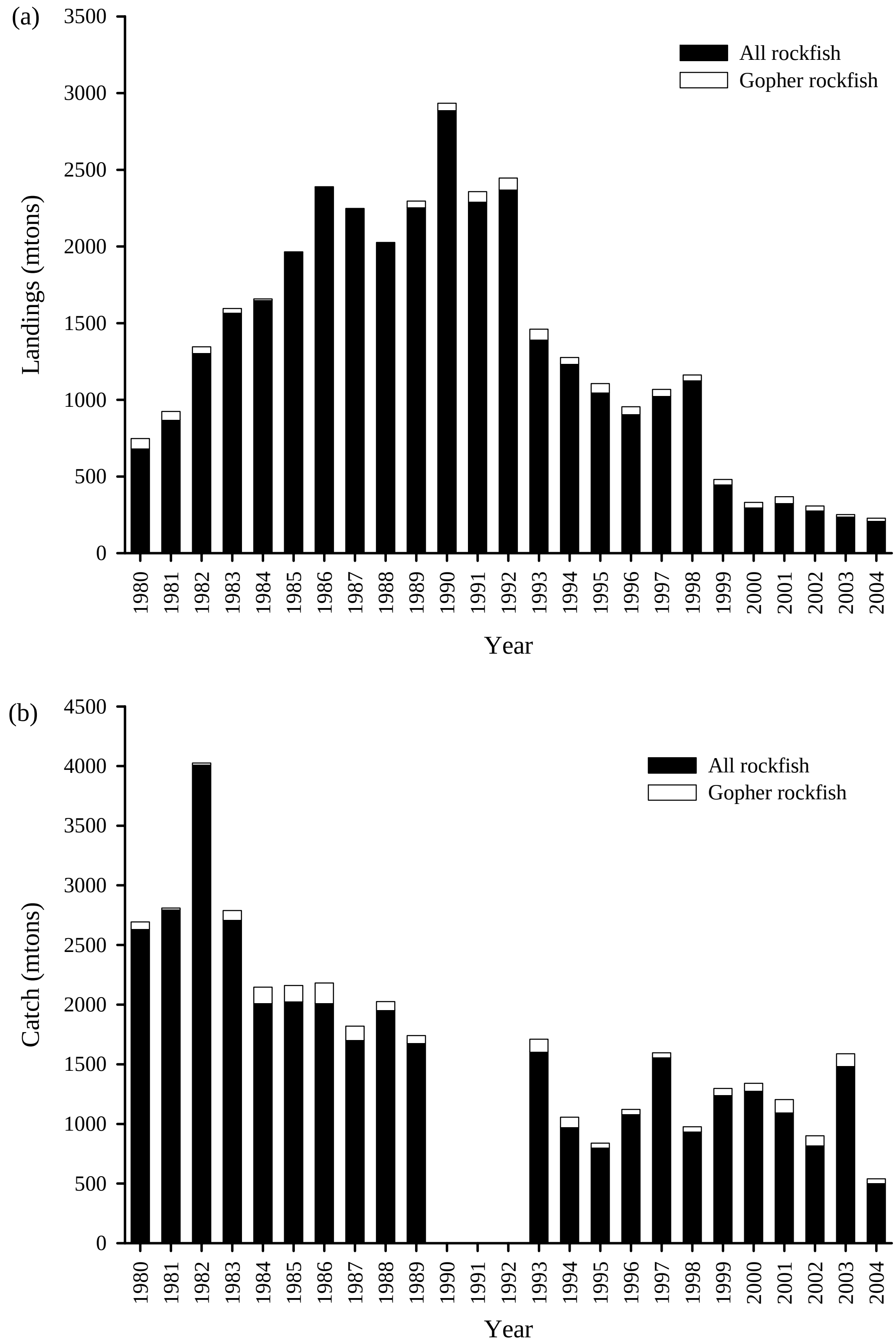


Figure 1 (a-b). Rockfish landings in (a) the commercial (CALCOM) and (b) the recreational (RecFIN) fisheries, 1980 - 2004, showing that gopher rockfish is a minor component of the rockfish catch.

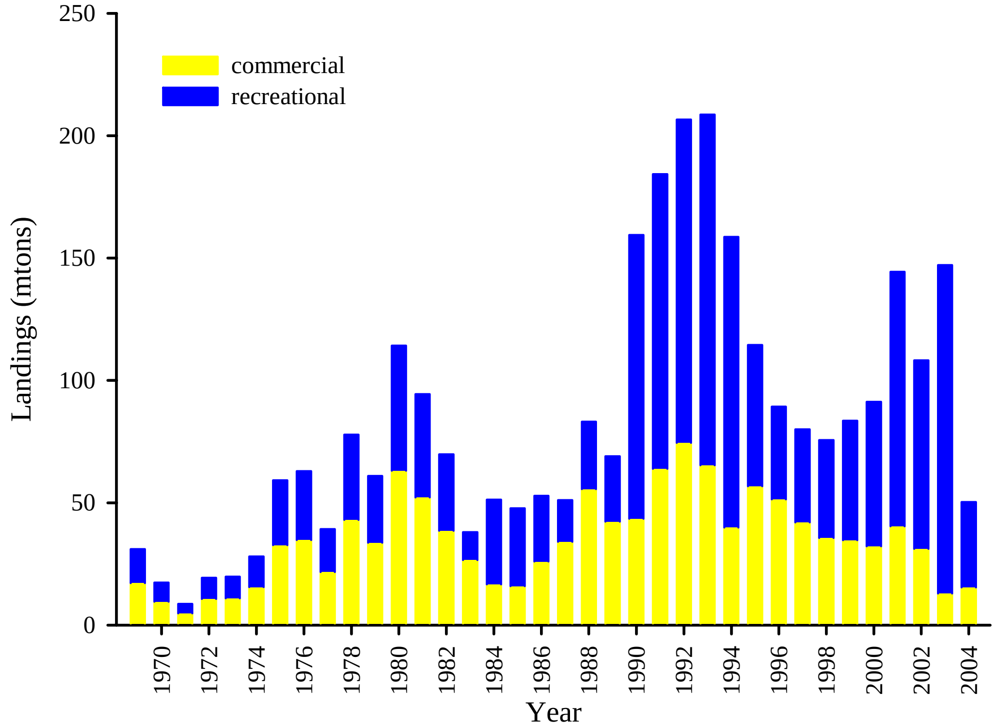


Figure 2. Northern California gopher rockfish taken by the commercial (CALCOM) and recreational (RecFIN) fisheries, 1969 - 2004.

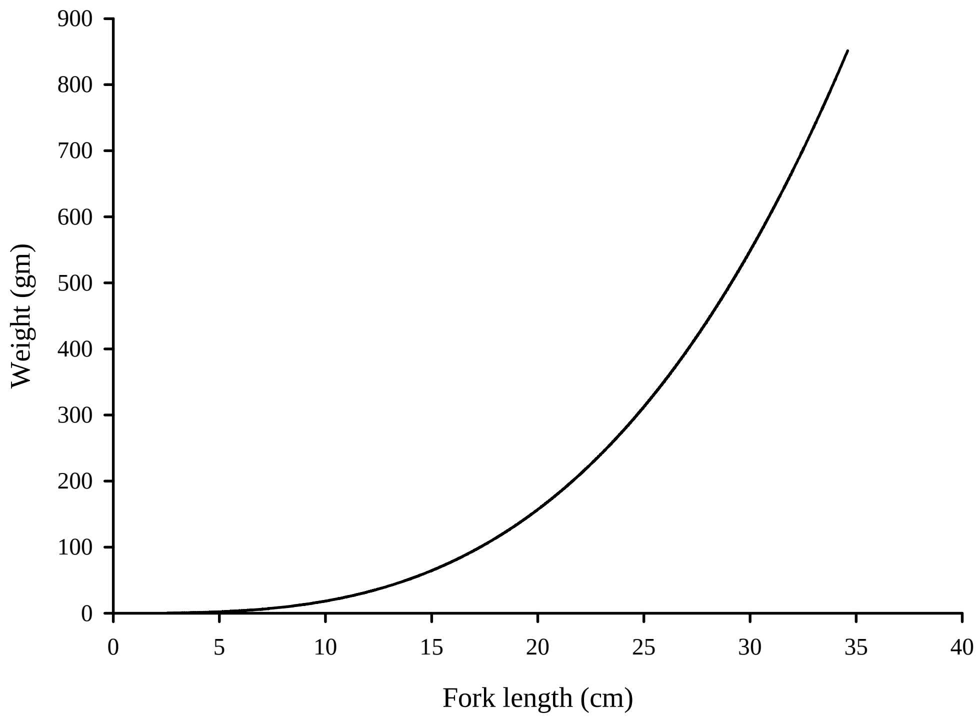


Figure 3. Length to weight relationship for gopher rockfish from Lea et al. 1999. Total length was converted to fork length (Echeverria and Lenarz 1984).

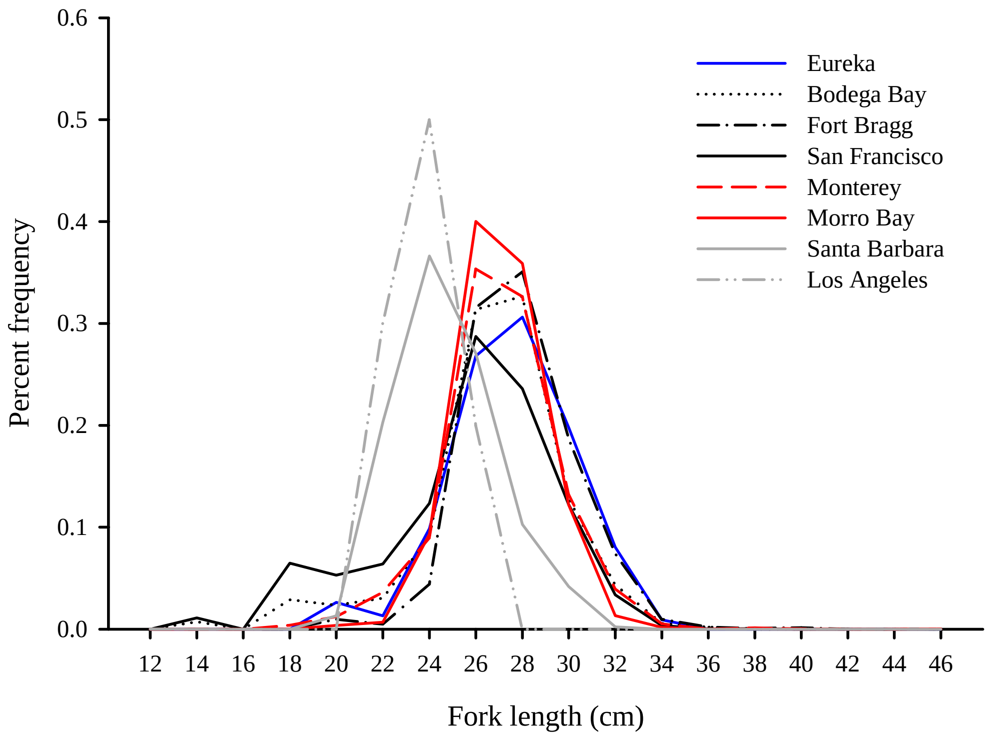


Figure 4. Commercial gopher rockfish length frequencies by port complex (CALCOM), 1992 - 2004, showing differences in size composition between northern and southern California.

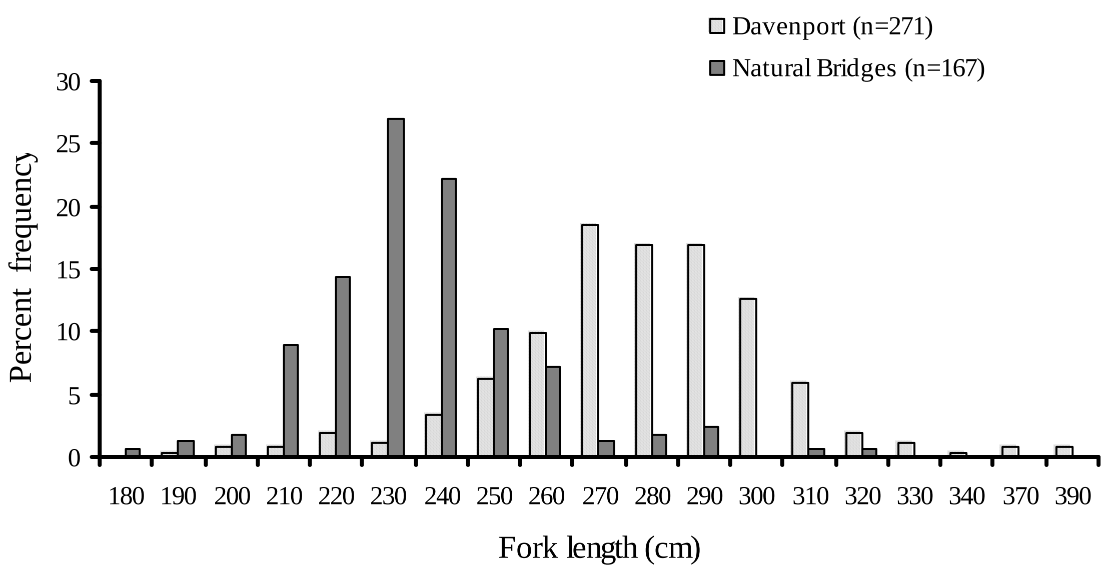


Figure 5. Length composition of gopher rockfish from the Groundfish Ecology Cruise Program (SWFSC), 2001 - 2004, showing variability in length composition in localized areas. (Davenport and Natural Bridges State Beach near Santa Cruz, CA are only nine miles apart.)

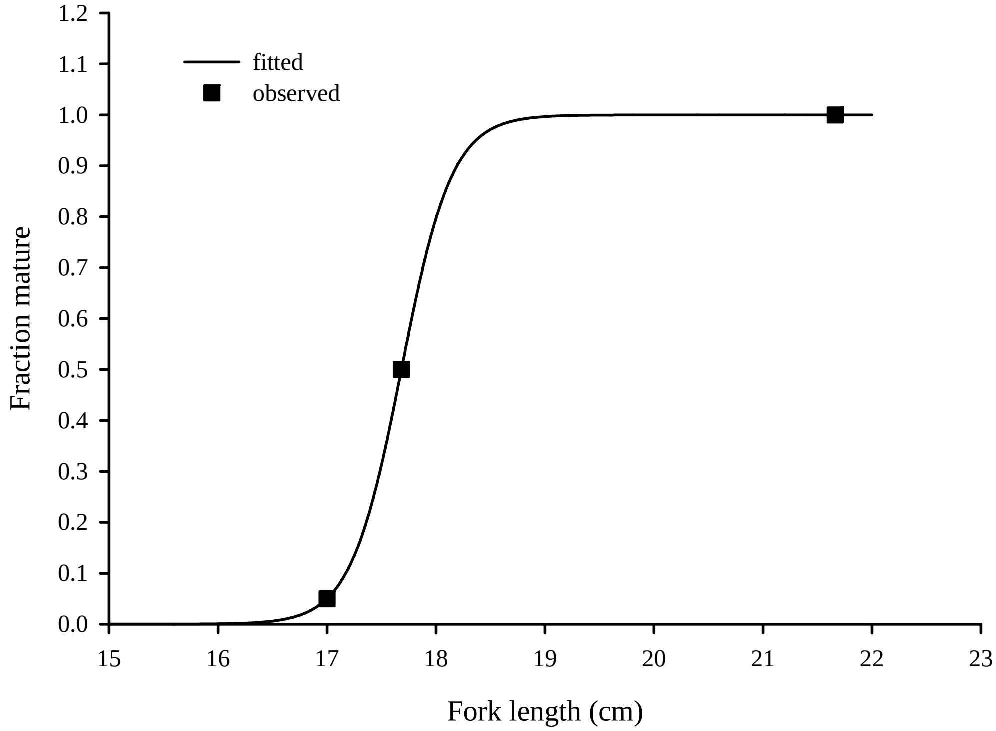


Figure 6. The relationship between gopher rockfish length and maturity from Wyllie Echeverria 1987.

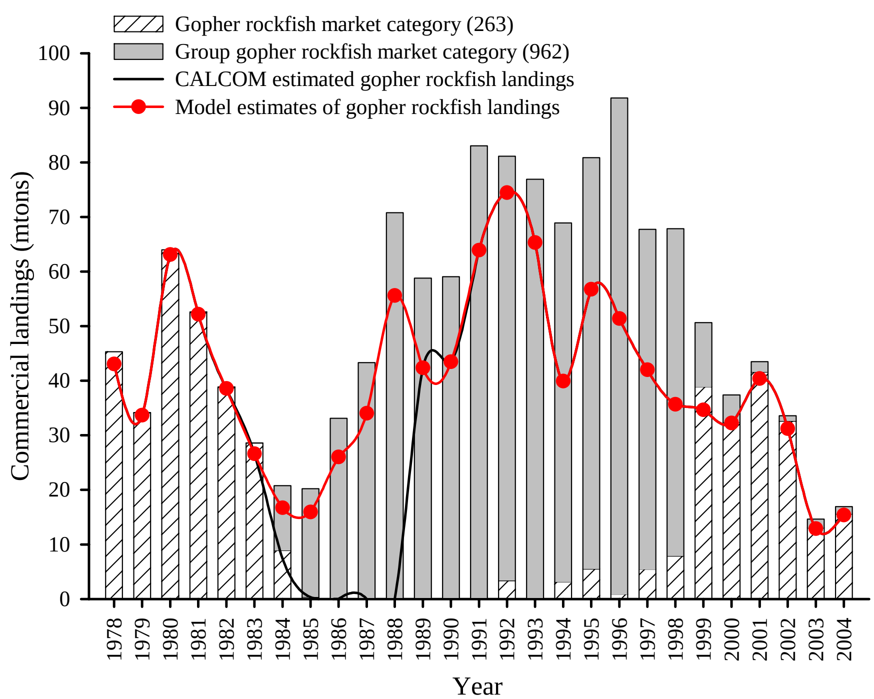


Figure 7. Statewide commercial landings of gopher rockfish by "gopher rockfish" and “group gopher rockfish" market categories (CFIS-CMASTR, CALCOM), 1978 - 2004. This change in the market category labeling could be responsible for the low reported commercial landings from 1984 - 1988, shown above, which were adjusted for the assessment model.

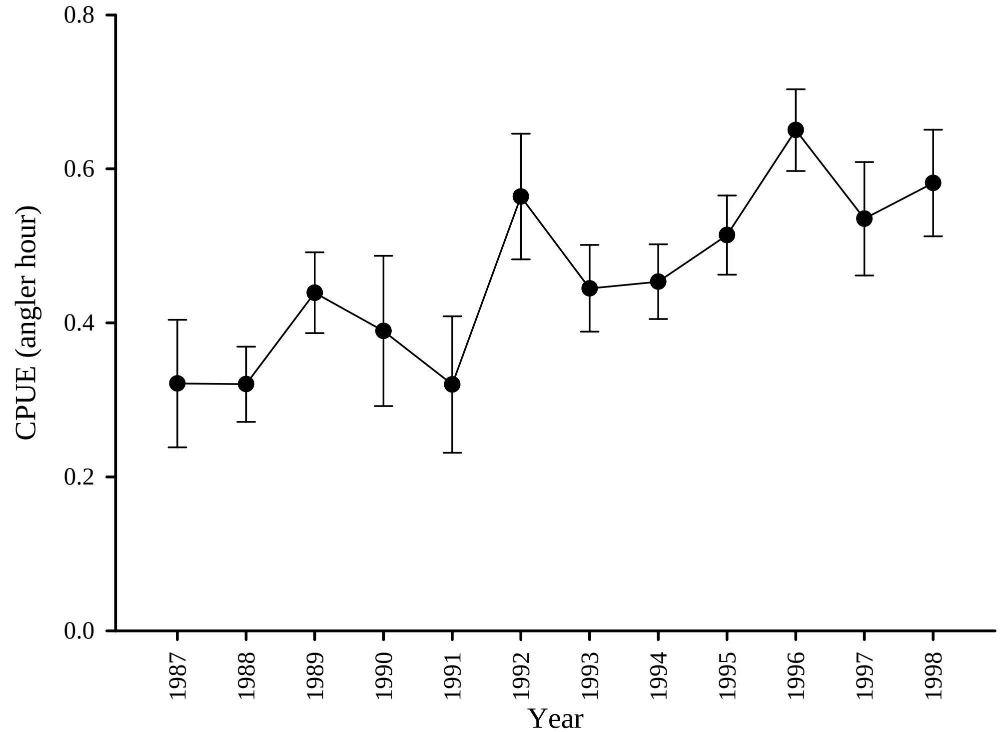


Figure 8. CPFV survey CPUE index 1987 - 1998. Fort Bragg dropped out of the GLM because it had no effect in calculating the index.

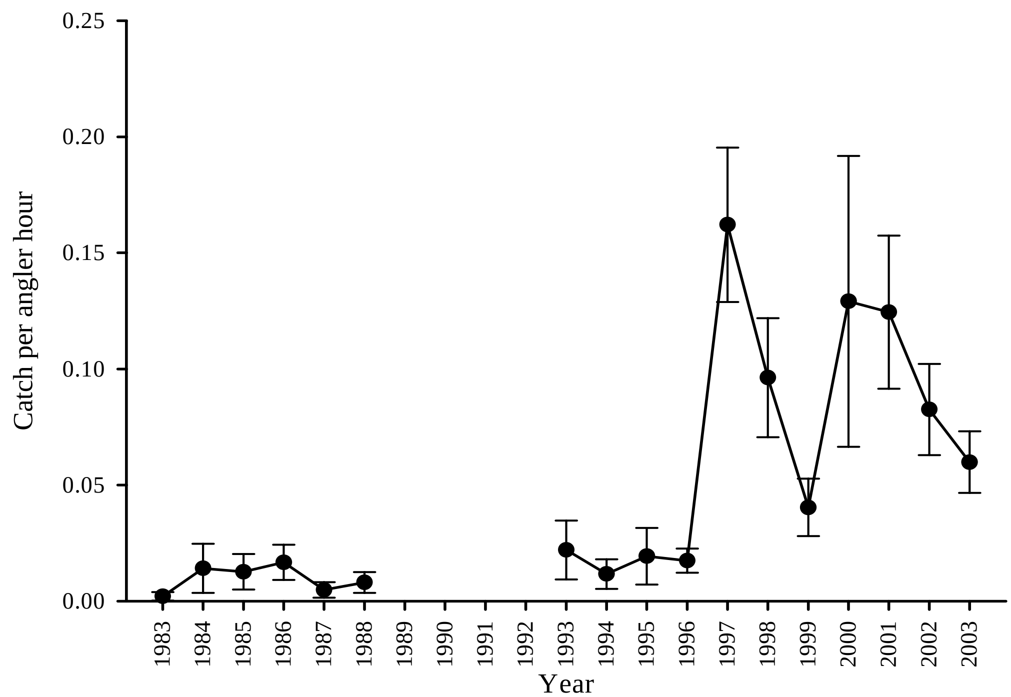


Figure 9. Recreational catch per unit effort index (RecFIN), 1983 - 2003. (This index was removed from the final baseline model, per STAR panel request.)

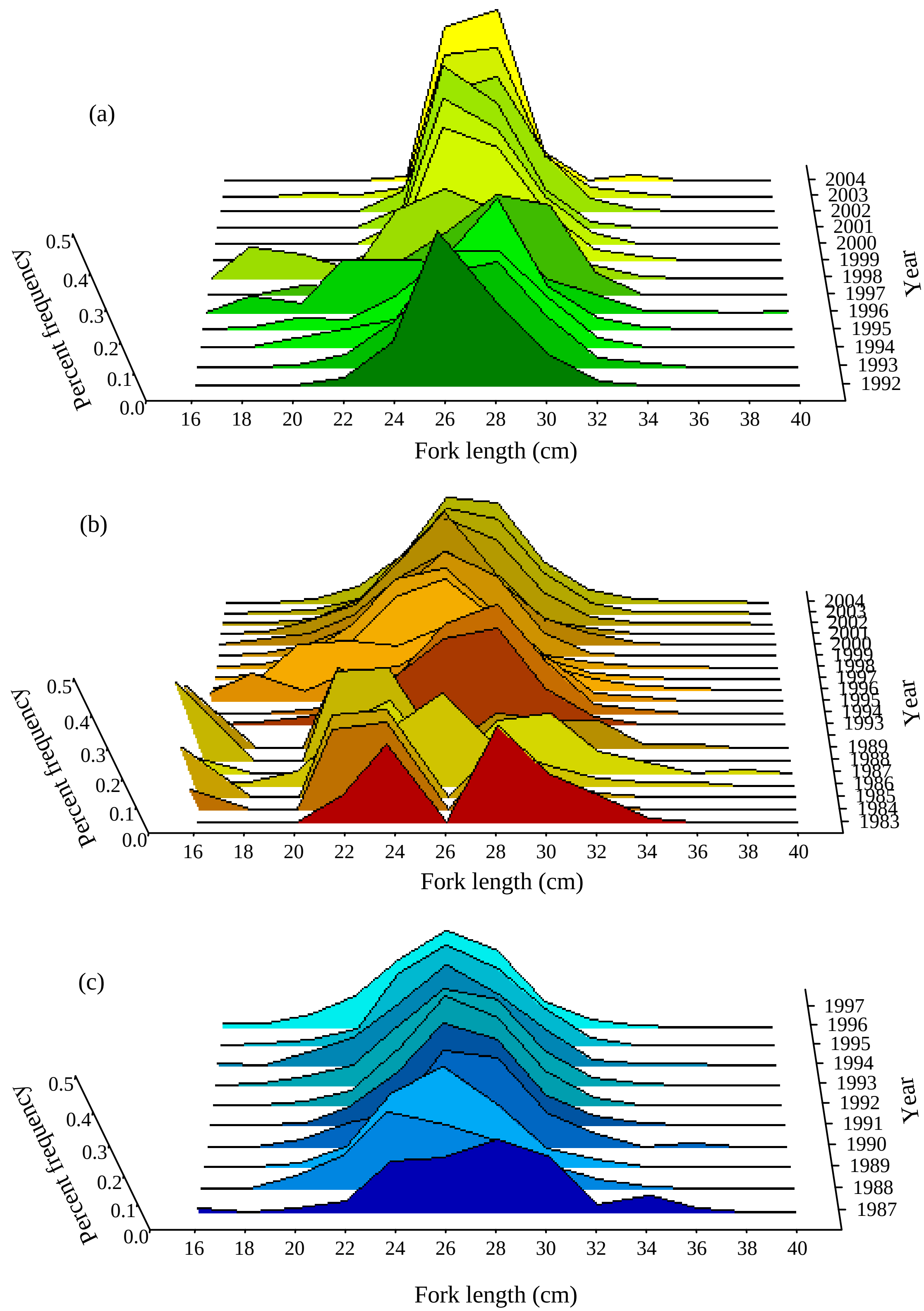


Figure 10 (a-c). Length frequency distributions for the (a) commercial fishery (CALCOM), (b) the recreational fishery (RecFIN), and (c) the CPFV survey. Length compositions from RecFIN in the 1980s (b) were not used due to evidence of a weight to length conversion problem.

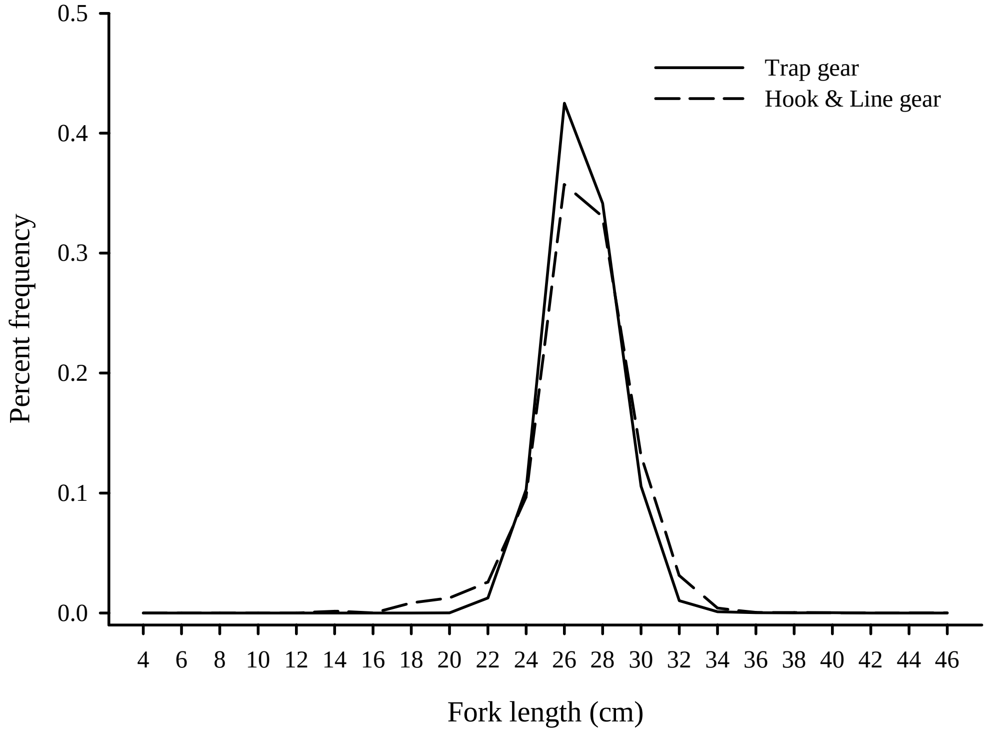


Figure 11. Commercial gopher rockfish length frequency distributions by gear type (CALCOM), 1992 - 2004.

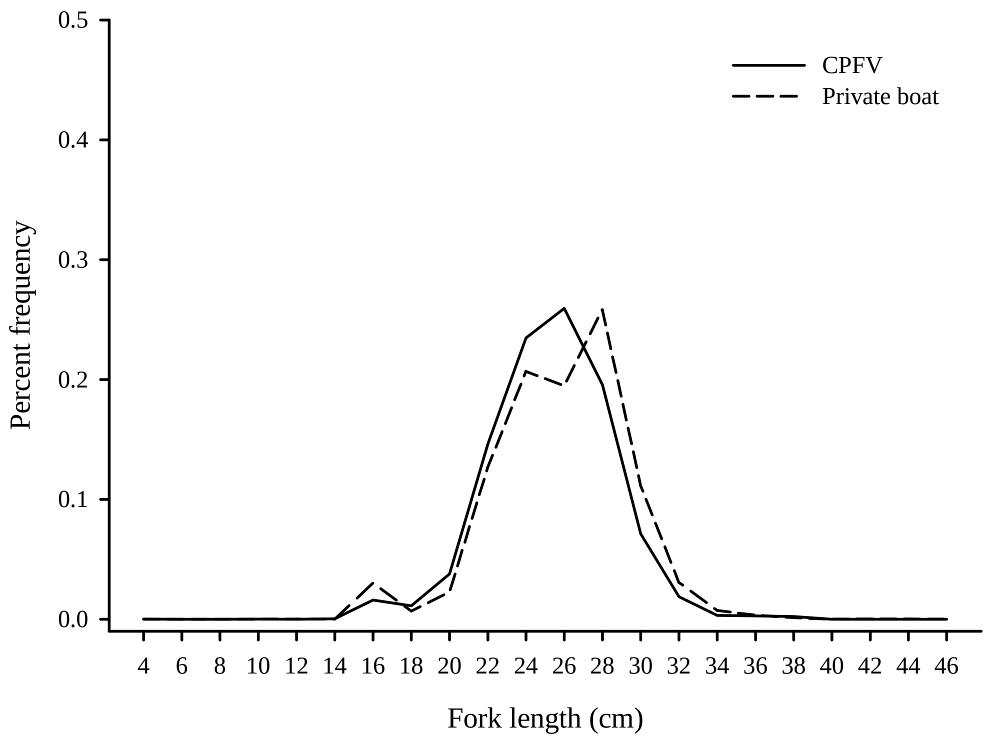


Figure 12. Recreational gopher rockfish length frequency distributions by fishing mode (RecFIN), 1980 - 2003.

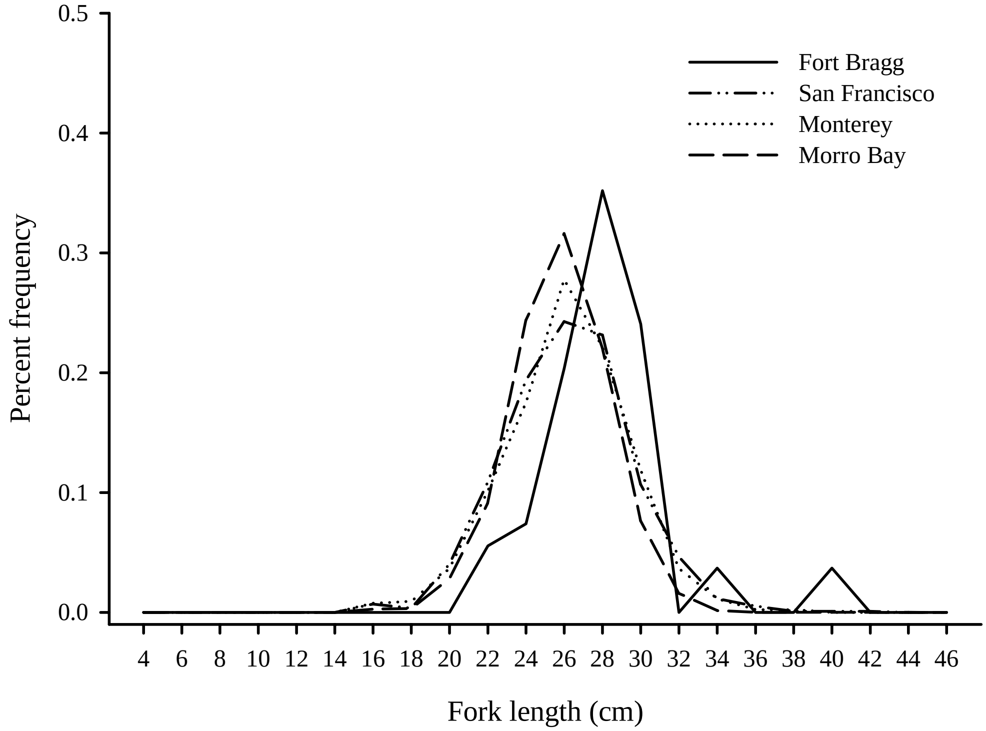


Figure 13. CPFV survey gopher rockfish length frequency distributions by region (CPFV survey), 1987 - 1998. Minimal length compositions from Fort Bragg (n = 54) were removed from the baseline model runs. San Francisco consists of Bodega Bay and Año Nuevo.

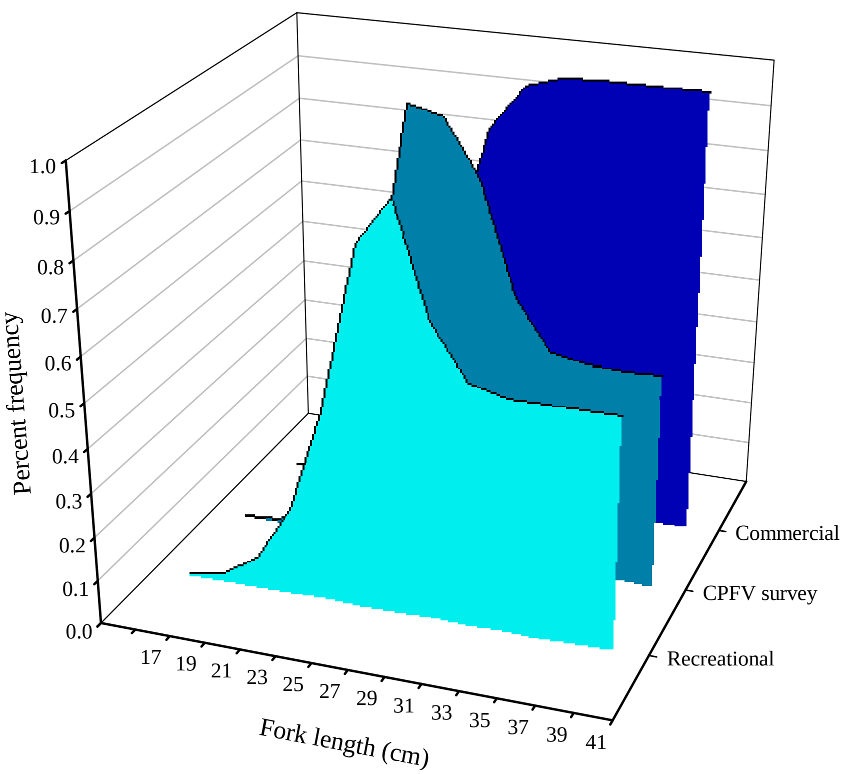


Figure 14. Length frequency selectivities from the commercial (CALCOM) and recreational (RecFIN) fisheries and from the CPFV survey in the baseline model.

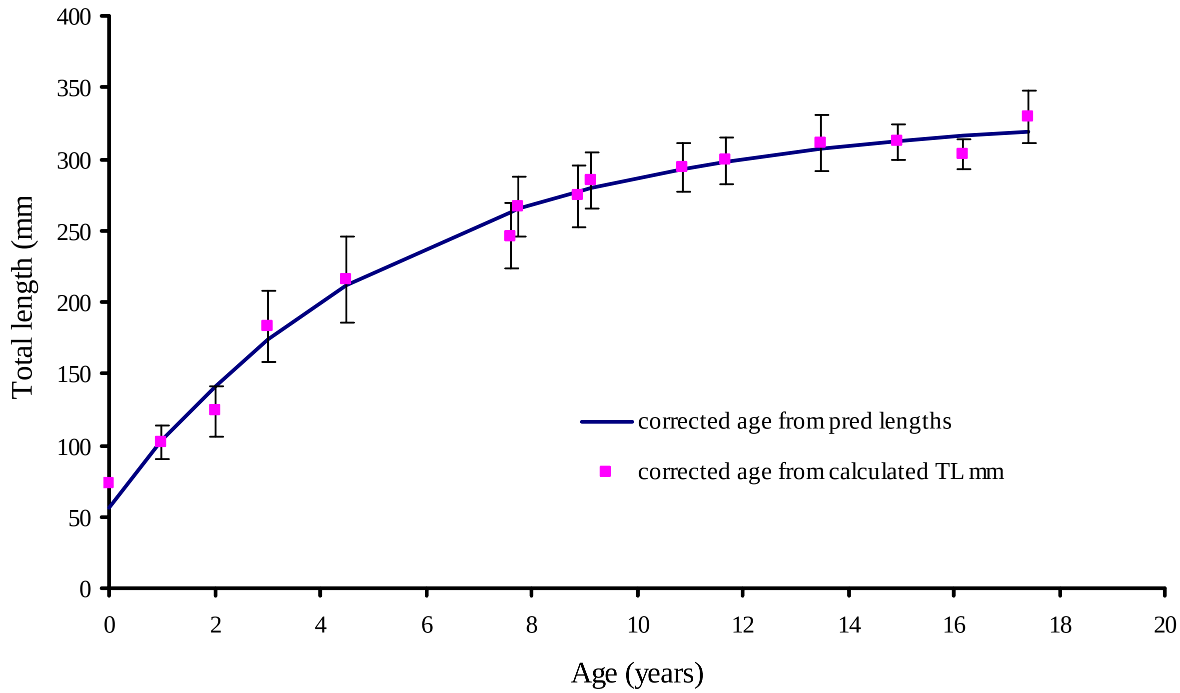


Figure 15. The fit to the adjusted growth equation (observed vs. predicted) given by Lea et al. 1999.

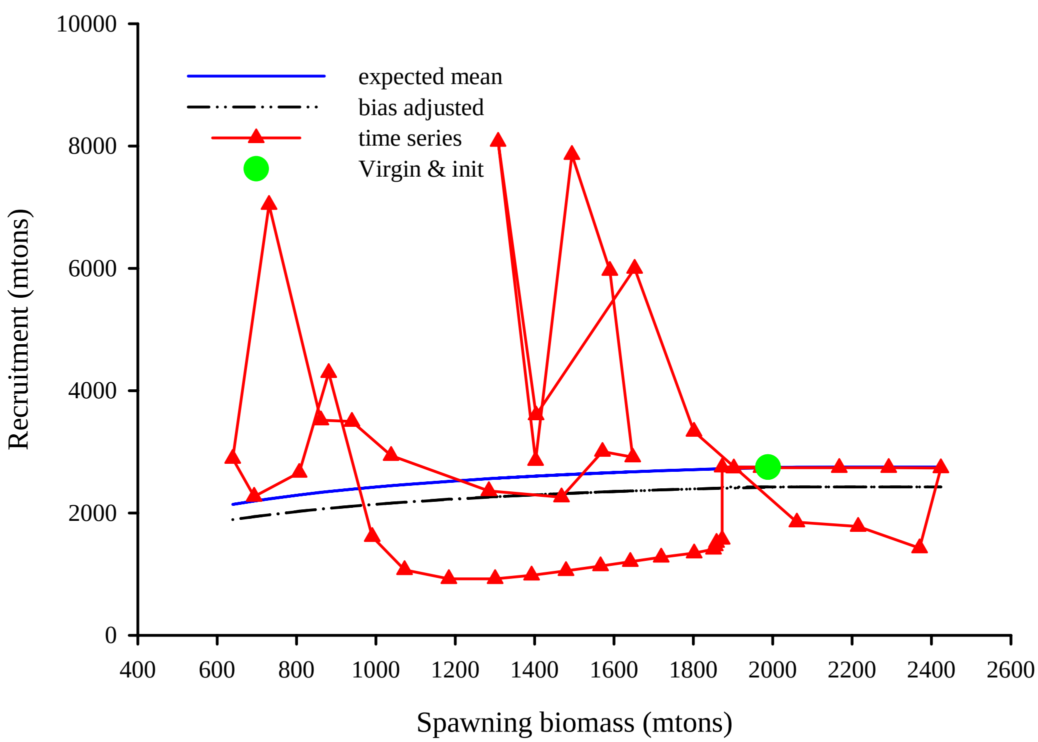


Figure 16. Beverton-Holt stock recruitment relationship with steepness $h = 0.65$.

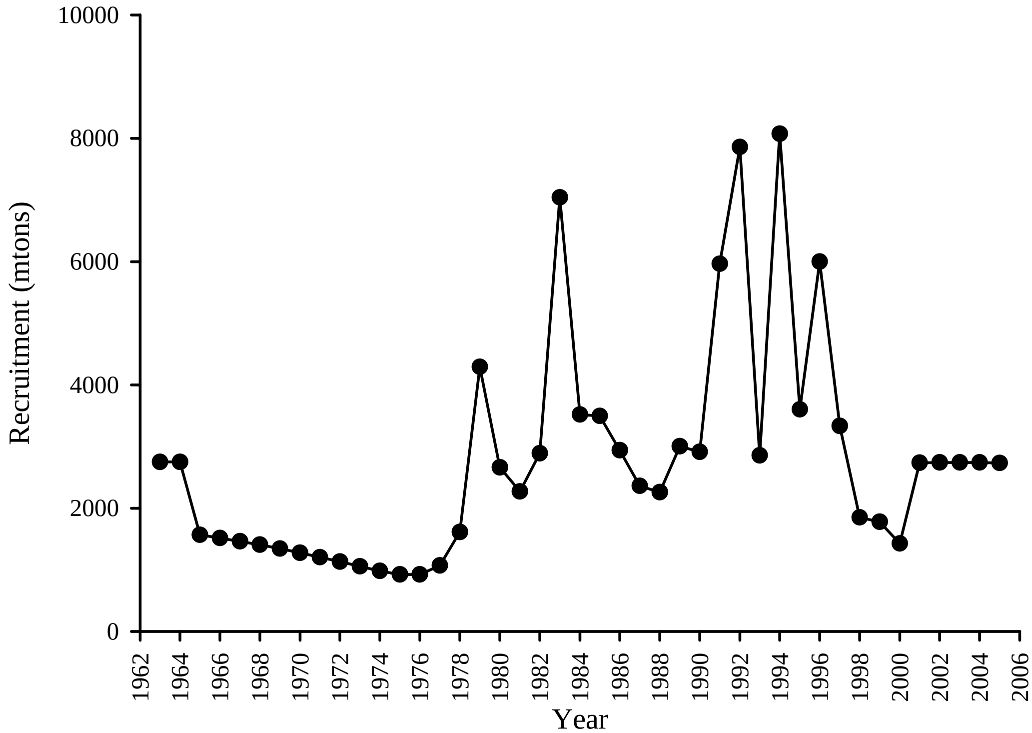


Figure 17. Estimated recruitment (mtons).

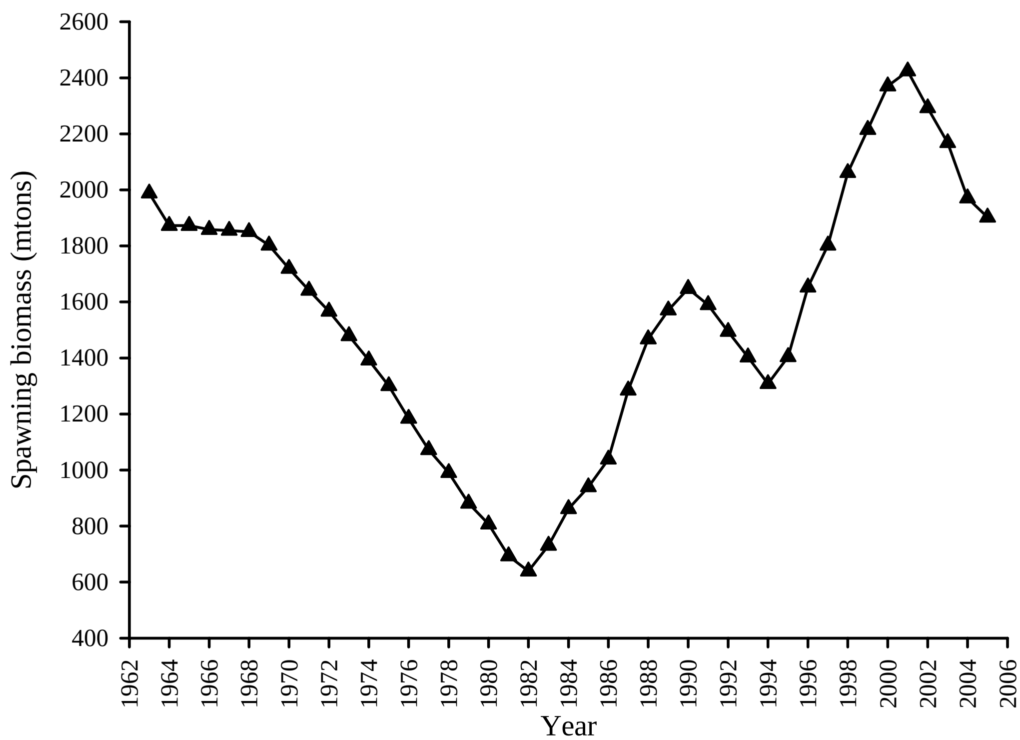


Figure 18. Estimated spawning biomass (mtons).

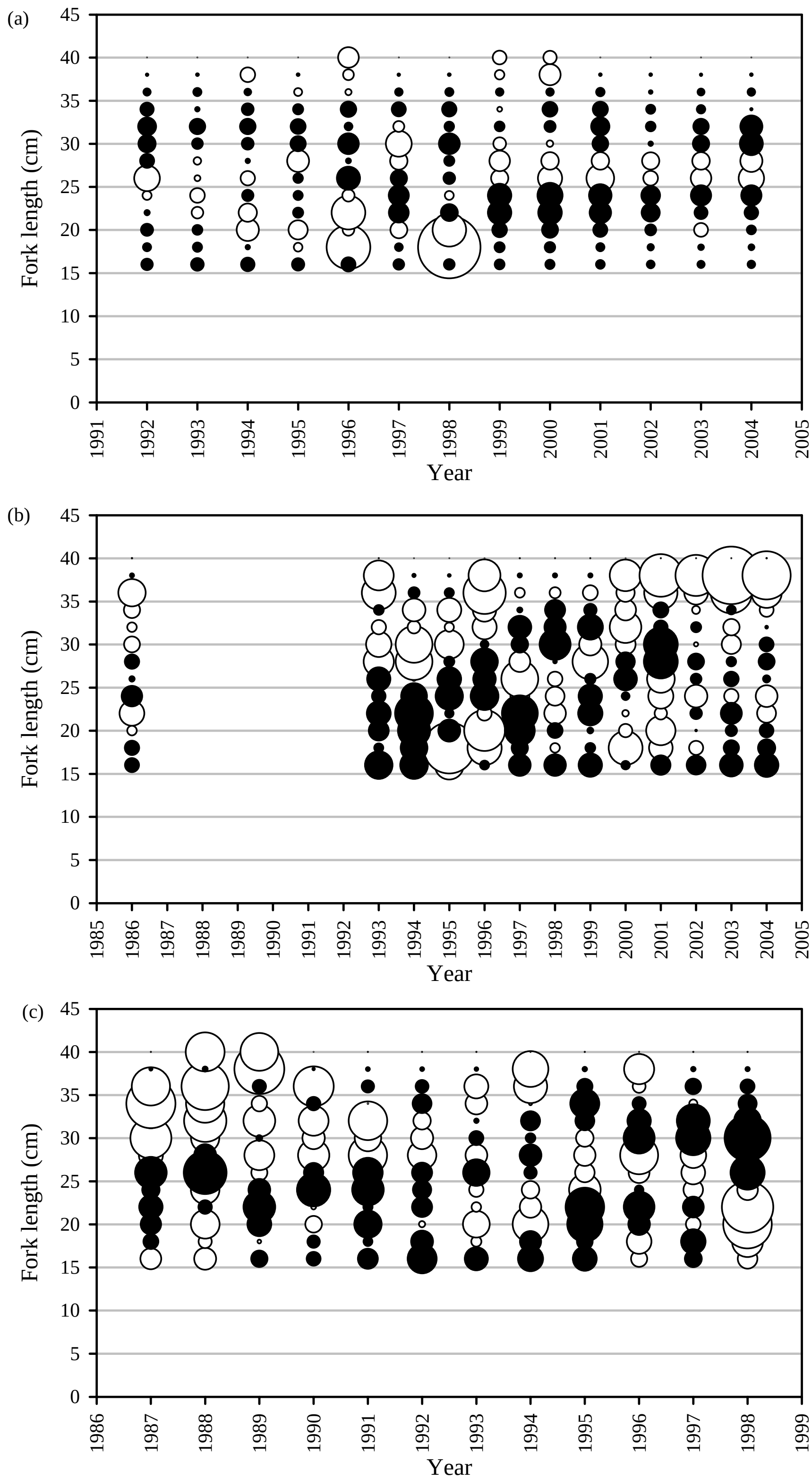


Figure 19 (a-c). Bubble plots for (a) the commercial fishery, (b) the recreational fishery, and (c) the CPFV survey, representing the fit between observed and estimated length composition for the baseline Synthesis model. The area of the circle indicates the deviation between observed and estimated values. Open circles represent positive deviation and solid circles indicate negative deviation.

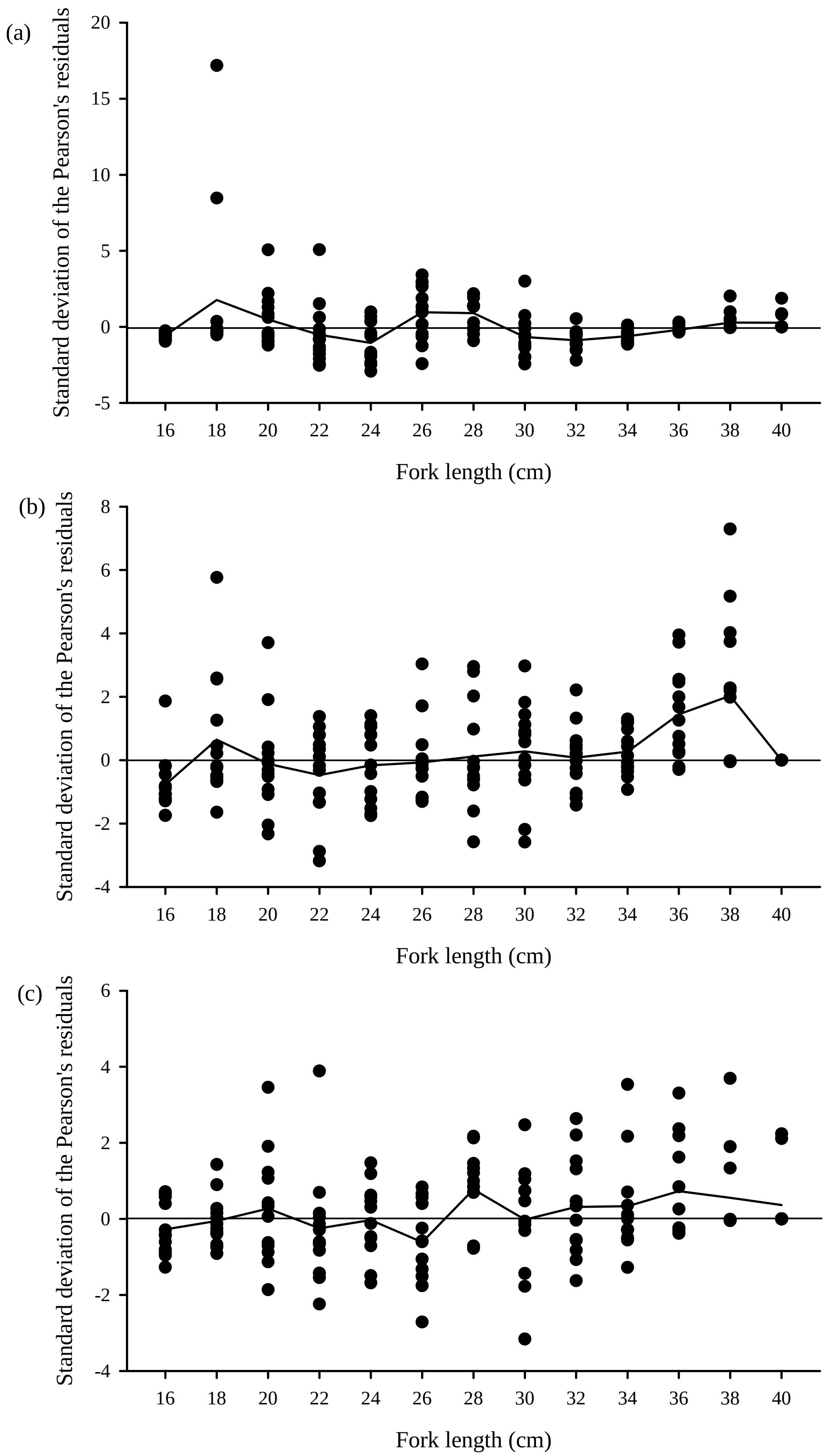


Figure 20 (a-c). Standardized residuals for length composition data from (a) the commercial fishery, (b) the recreational fishery, and (c) the CPFV survey.

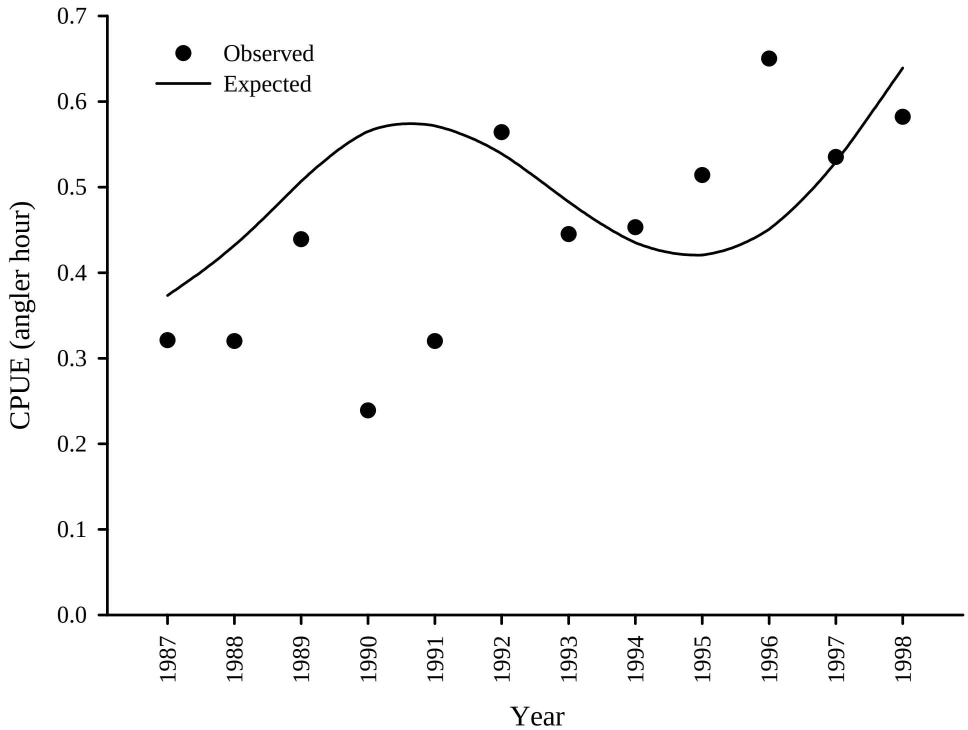


Figure 21. Fit to the CPUE abundance index for the CPFV survey.

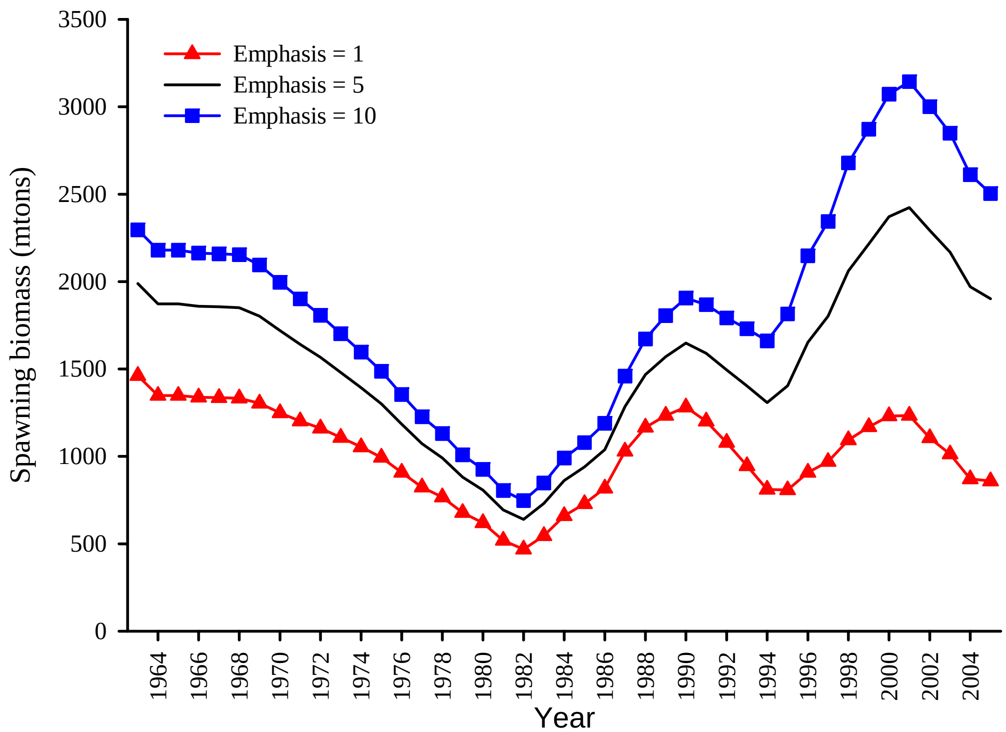


Figure 22. Estimates of spawning biomass (mtons) based on changes in the emphasis of the CPFV survey CPUE index. Emphasis 5 is used in the baseline assessment model.

APPENDIX A - Data file for the northern California (north of Point Conception) gopher rockfish model

```
# norgopherCVs.dat
# v1.19 of SS2 as of May 3, 2005
# STAR panel baseline, emphasis on CPFV survey = 5
# standardized and weighted CVs in survey and samples for lengths
# commercial adjusted landings in 1984-1988;  recreational catches from 1965-1982 reestimated
# discards are in catch - no discard likelihood component
# sigmaR freely estimated from 1965-2000
# h=0.65     M=0.2     CV=0.06
# RecFIN CPUE index removed from final model (STAR request)


#_Number_of_datafiles:  1
#_start_nudata: 1

1965    #_styr_earlier
2004    #_endyr
1       #_nseas
12      #_months/season
1       #_spawn_seas
2       #_Nfleet;  1=commercial, 2=recreational
1       #_Nsurv;  3=CPFV survey

commercial%recreational%Deb'sCPFV
0.5     0.5     0.5     #_surveytiming_in_season

1       #_Ngenders
40      #_Nages

10.638  8.61    #_init_equil_catch_for_each_fishery
#_catch_biomass(mtons):_columns_are_fisheries,_rows_are_year*season
10.638  8.61    #1965_avg69-73
10.638  8.61    #1966_avg69-73
10.638  8.61    #1967_avg69-73
10.638  8.61    #1968_avg69-73
17.155  13.88   #1969_CFIS_RecEst
9.621   7.79    #1970_CFIS_RecEst
4.788   3.87    #1971_CFIS_RecEst
10.682  8.65    #1972_CFIS_RecEst
10.945  8.86    #1973_CFIS_RecEst
15.505  12.55   #1974_CFIS_RecEst
32.699  26.47   #1975_CFIS_RecEst
34.761  28.13   #1976_CFIS_RecEst
21.702  17.57   #1977_CFIS_RecEst
43.025  34.82   #1978_CALCOM_RecEst
33.679  27.26   #1979_CALCOM_RecEst
63.107  51.08   #1980_CALCOM_RecEst
52.171  42.23   #1981_CALCOM_RecEst
38.552  31.2    #1982_CALCOM_RecEst
26.585  11.39   #1983_CALCOM_RecEst
16.69   34.58   #1984_CALCOM_RecEst
15.93   31.81   #1985_CALCOM_RecEst
26.01   26.80   #1986_CALCOM_RecEst
34.01   17.03   #1987_CALCOM_RecEst
55.58   27.54   #1988_CALCOM_RecEst
42.339  26.61   #1989_CALCOM_RecEst
43.429  115.99  #1990_CALCOM_surveyEst
63.905  120.34  #1991_CALCOM_surveyEst
74.444  132.09  #1992_CALCOM_surveyEst
65.295  143.33  #1993_CALCOM_surveyEst
39.898  118.70  #1994_CALCOM_surveyEst
56.726  57.73   #1995_CALCOM_surveyEst
51.365  37.85   #1996_CALCOM_RecFIN
```

```
41.988  37.98   #1997_CALCOM_RecFIN
35.638  40      #1998_CALCOM_RecFIN
34.652  48.86   #1999_CALCOM_RecFIN
32.219  59.05   #2000_CALCOM_RecFIN
40.392  103.9   #2001_CALCOM_RecFIN  --  recreational value and runs corrected for SAFE document (from 130.9)
31.199  76.97   #2002_CALCOM_RecFIN
12.874  134.24  #2003_CALCOM_RecFIN
15.37   34.91   #2004_CALCOM_RecFIN

12      #_N_cpue_and_surveyabundance_observations
#_year  seas    type    value   se(log) #source
1987    1       3       0.321   0.5     #CPAH_jackaddnorm GLM  --  ln correction value = 0.123  (see App.C)
1988    1       3       0.32    0.3     #CPAH_jackaddnorm GLM  --  ln correction value = 0.140  (see App.C)
1989    1       3       0.439   0.2     #CPAH_jackaddnorm GLM  --  ln correction value = 0.239  (see App.C)
1990    1       3       0.239   0.5     #CPAH_jackaddnorm GLM  --  ln correction value = 0.257  (see App.C)
1991    1       3       0.32    0.6     #CPAH_jackaddnorm GLM  --  ln correction value = 0.196  (see App.C)
1992    1       3       0.564   0.3     #CPAH_jackaddnorm GLM  --  ln correction value = 0.362  (see App.C)
1993    1       3       0.445   0.3     #CPAH_jackaddnorm GLM  --  ln correction value = 0.309  (see App.C)
1994    1       3       0.453   0.2     #CPAH_jackaddnorm GLM  --  ln correction value = 0.307  (see App.C)
1995    1       3       0.514   0.2     #CPAH_jackaddnorm GLM  --  ln correction value = 0.332  (see App.C)
1996    1       3       0.65    0.2     #CPAH_jackaddnorm GLM  --  ln correction value = 0.417  (see App.C)
1997    1       3       0.535   0.3     #CPAH_jackaddnorm GLM  --  ln correction value = 0.328  (see App.C)
1998    1       3       0.582   0.2     #CPAH_jackaddnorm GLM  --  ln correction value = 0.380  (see App.C)

0       #_discard_type
0       #_N_discard_obs

7       #_N_meanbodywt_obs;kilograms
#Year   Seas    Type    Partition       Value   CV
1983    1       2       2       0.409   0.06    #RecFIN_samp_Type3
1984    1       2       2       0.311   0.02    #RecFIN_samp_Type3
1985    1       2       2       0.279   0.03    #RecFIN_samp_Type3
1986    1       2       2       -1      -1      #RecFIN_samp_Type3
1987    1       2       2       0.399   0.06    #RecFIN_samp_Type3
1988    1       2       2       0.254   0.05    #RecFIN_samp_Type3
1989    1       2       2       0.329   0.06    #RecFIN_samp_Type3

-1      #  min_proportion_for_compressing_tails_of_observed_composition -1 is no compression
0.0001  #_add_to_comp
13      #_N_LengthBins
16      18      20      22      24      26      28      30      32      34      36      38      40
38      #_N_Length_obs
#Yr     Seas    Flt/Svy Gender  Part    Nsamp   datavector(female-male)
1992    1       1       0       2       75      0       0       0       0.027591474     0.141045222     0.460953583     0.261936384     0.098512517     0.009960821
1993    1       1       0       2       111     0       5.07898E-05     0.004012393     0.040530245     0.145715882     0.288943065     0.327746457     0.154045406
1994    1       1       0       2       99      0       0.002445548     0.031741179     0.065647688     0.096599159     0.303782958     0.301210037     0.159470131
1995    1       1       0       2       81      0       0.007751938     0.039359287     0.033277656     0.113109769     0.228746413     0.393807015     0.138121547
1996    1       1       0       2       143     0       0.049474413     0.029395103     0.169257884     0.167810159     0.161704538     0.25297413      0.105809782
1997    1       1       0       2       69      0       0.001138354     0.032661996     0.018038529     0.102364273     0.195796848     0.302802102     0.274430823
1998    1       1       0       2       97      0       0.100953449     0.075715087     0.02277924      0.213727943     0.274904008     0.209111696     0.061391777
1999    1       1       0       2       117     0       0       0.001091147     0.000872918     0.080235688     0.385102204     0.333927402     0.148323271     0.037353
2000    1       1       0       2       159     0       0       0       0.000835721     0.071565016     0.410339064     0.335038887     0.141560922     0.035816619
2001    1       1       0       2       117     0       0       0       0       0.061783697     0.448104553     0.357168386     0.114525007     0.018418356     0
2002    1       1       0       2       77      0       0       0       0       0.061870857     0.339655455     0.380513954     0.167178165     0.043661511     0.006199
2003    1       1       0       2       50      0       0       0.01008652      0.004034608     0.024073161     0.395929529     0.411171381     0.122024477     0.025552
2004    1       1       0       2       59      0       0       0       0.001462844     0.01170275      0.420421299     0.46489175      0.085137507     0.001462844
1986    1       2       0       2       58      0.004310345     0.00862069      0.051724138     0.176724138     0.198275862     0.306034483     0.13362069      0.073275
1993    1       2       0       2       387     0.001153403     0.006920415     0.024221453     0.059976932     0.162629758     0.280276817     0.311418685     0.117647
1994    1       2       0       2       220     0       0       0.008591065     0.030927835     0.130584192     0.285223368     0.341924399     0.161512027     0.030927
1995    1       2       0       2       109     0.030726257     0.094972067     0.036312849     0.103351955     0.117318436     0.206703911     0.217877095     0.148044
1996    1       2       0       2       201     0.009107468     0.036429872     0.149362477     0.160291439     0.14571949      0.209471767     0.149362477     0.080145
1997    1       2       0       2       500     0.003602305     0.008645533     0.030259366     0.11815562      0.257204611     0.310518732     0.188760807     0.063400
1998    1       2       0       2       500     0.00148368      0.011869436     0.045994065     0.135014837     0.273738872     0.306379822     0.170623145     0.039317
1999    1       2       0       2       482     0       0.006937562     0.038652131     0.099108028     0.198216056     0.32111001      0.246778989     0.075322101
```

```
2000	1	2	0	2	240	0.001610306	0.020933977	0.040257649	0.099838969	0.210950081	0.286634461	0.204508857	0.085346
2001	1	2	0	2	368	0	0.008363202	0.045400239	0.096774194	0.224611708	0.365591398	0.187574671	0.045400239
2002	1	2	0	2	500	0.000645995	0.003875969	0.018087855	0.072351421	0.207364341	0.315245478	0.253229974	0.096899
2003	1	2	0	2	500	0	0.001272265	0.012086514	0.043256997	0.173664122	0.312977099	0.282442748	0.124681934
2004	1	2	0	2	500	0	0.001554243	0.010258004	0.049735779	0.148896487	0.310226919	0.299347218	0.126204538
1987	1	3	0	2	21	0.014084507	0	0.014084507	0.042253521	0.183098592	0.197183099	0.253521127	0.197183099
1988	1	3	0	2	202	0.006339144	0.004754358	0.049128368	0.123613312	0.264659271	0.228209192	0.17274168	0.090332
1989	1	3	0	2	231	0.001398601	0.002797203	0.013986014	0.075524476	0.25034965	0.33006993	0.218181818	0.071328
1990	1	3	0	2	32	0	0	0.027522936	0.082568807	0.119266055	0.311926606	0.293577982	0.110091743	0.045871
1991	1	3	0	2	229	0.00143472	0.00143472	0.005738881	0.065997131	0.173601148	0.329985653	0.279770445	0.101865
1992	1	3	0	2	269	0	0	0.014652015	0.052503053	0.180708181	0.340659341	0.275946276	0.10989011	0.024420
1993	1	3	0	2	195	0.001666667	0.003333333	0.028333333	0.065	0.188333333	0.303333333	0.275	0.103333333	0.023333
1994	1	3	0	2	233	0.002781641	0.001390821	0.040333797	0.087621697	0.191933241	0.307371349	0.225312935	0.114047
1995	1	3	0	2	376	0.003478261	0.005217391	0.017391304	0.056521739	0.225217391	0.308695652	0.23826087	0.121739
1996	1	3	0	2	475	0.008339124	0.008339124	0.038915914	0.102154274	0.211952745	0.293954135	0.231410702	0.079916
1997	1	3	0	2	460	0.003561254	0.001424501	0.031339031	0.126068376	0.274216524	0.301282051	0.185897436	0.060541
1998	1	3	0	2	334	0.004878049	0.008780488	0.060487805	0.16	0.290731707	0.283902439	0.149268293	0.028292683

0	# No age bins, no age info
0	# no ageerr types defined
0	#_N_age_observations
0	#_N_size@age_observations

#_environmental_data
0	#	N_variables
0	#	N_observations

999	# end-of-file-marker
```

APPENDIX B - Control file for the northern California (north of Point Conception) gopher rockfish model

```
# norgopher.ctl
# v1.19 of SS2 as of May 3, 2005
# STAR panel baseline, emphasis on CPFV survey = 5
# standardized and weighted CVs in survey and samples for lengths
# commercial adjusted landings in 1984-1988;  recreational catches from 1965-1982 reestimated
# discards are in catch - no discard likelihood component
# sigmaR freely estimated from 1965-2000
# h=0.65     M=0.2     CV=0.06
# RecFIN CPUE index removed from final model (STAR request)

# datafile: norgopherCVs.dat
1       #_N_growthmorphs

1       #_assign_sex_to each_morph (1=female,2=male)

1       #_N_Areas_(populations)

#_each_fleet/survey_operates_in_just_one_area
#_but_different_fleets/surveys_can be assigned_to_share_same_selex(FUTURE_coding)
1       1       1       # 2 fisheries and 1 survey

0       #do_migration_(0/1)

# time blocks for time varying parameters
0       #_N_Block_Designs

# Natural_mortality_and_growth_parameters_for_each_morph
1               # Last_age_for_natmort_young
2               # First_age_for_natmort_old
5.5             # age_for_growth_Lmin
15.5            # age_for_growth_Lmax
-4              # MGparm_dev_phase

# LO    HI      INIT    PRIOR   P_type  SD      PHASE   env-var use_dev dev_minyr dev_maxyr     dev_stddev      block_type use_block
# morph1 females
0.01    0.3     0.2     0.1     0       0.1     -5      0       0       0       0       0       0       0       #M1_natM_young
0       0       0       0       0       0       -5      0       0       0       0       0       0       0       #M1_natM_old_as_exponential_offset(rel_young)
10      50      22.2    20      0       10      -3      0       0       0       0       0       0       0       #M1_Lmin
20      60      31.2    30      0       10      -3      0       0       0       0       0       0       0       #M1_Lmax
0.05    0.3     0.186   0.18    0       0.05    -3      0       0       0       0       0       0       0       #M1_VBK
0.03    0.3     0.06    0.06    0       0.03    -1      0       0       0       0       0       0       0       #M1_CV-young
-5      0.2     0       0       0       0.03    -1      0       0       0       0       0       0       0       #M1_CV-old_as_exponential_offset(rel_young)

# Add 2+2*gender lines to read the wt-Len and mat-Len parameters
-3      3       1.32E-05        1.32E-05        0       0.1     -3      0       0       0       0       0.5     0       0       #Female wt-len-1
-3      4       3.077   3.077   0       0.8     -3      0       0       0       0       0.5     0       0       #Female wt-len-2
-3      3       17.7    17.7    0       0.8     -3      0       0       0       0       0.5     0       0       #Female mat-len-1
-3      3       -4.3    -4.3    0       0.8     -3      0       0       0       0       0.5     0       0       #Female mat-len-2
-3      3       1       1       0       0.8     -3      0       0       0       0       0.5     0       0       #Female eggs/gm intercept (1 means units of spawning bio
-3      3       0       0       0       0.8     -3      0       0       0       0       0.5     0       0       #Female eggs/gm slope  (0 means units of spawning biomas

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

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

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

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

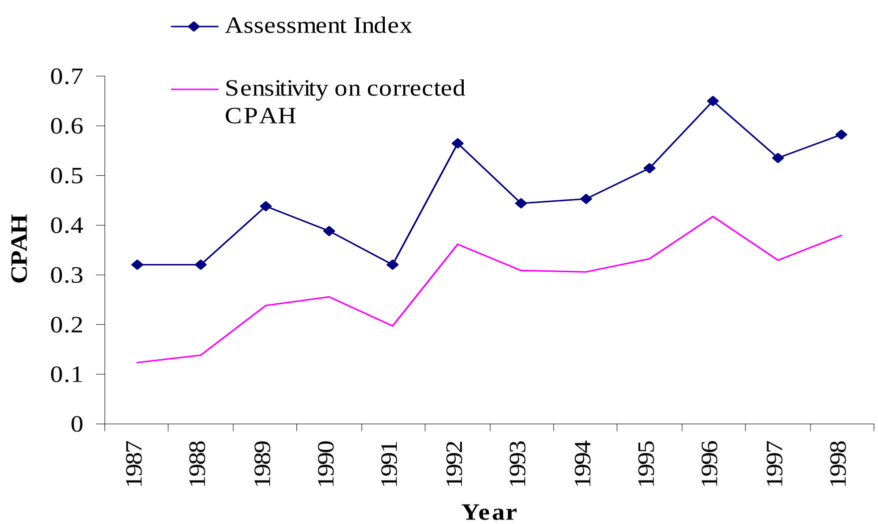
```
#_Spawner-Recruitment_parameters
1       # SR_fxn:  1=Beverton-Holt, 2=Ricker-curve
#LO     HI      INIT    PRIOR   Pr_type SD      PHASE
3       31      7.7     7.7     0       2       1       #Ln(R0) - log of virgin recruitment level
0.2     1       0.65    0.65    0       0.5     -2      #steepness of S-R, bound by 0.2 and 1.0 for B-H
0       2       .5      .5      0       0.8     -3      #SD of log recruitments - used to define offset of S-R curve
-5      5       0       0       0       1       -3      #Env_link coef.
-5      5       0       0       0       1       -3      #init_eq

0   # index of environmental variable to be used

# recruitment_residuals         ** Note: because phase is (-) rec_devs are not estimate -> stock-reduction SR
# start_rec_year        end_rec_year    Lower_limit     Upper_limit     phase
1965    2000    -15     15      2

#init_F_setup, for each fleet
# LO    HI      INIT    PRIOR   P_type  SD      PHASE
0       1       0.017   0.017   0       1       1        # fleet comm
0       1       0.025   0.025   0       1       1        # fleet rec

# Catchability, for each fleet and survey
#_add_parm_row_for_each_positive_entry_below(row_then_column)
# Float(0/1)    #Do-power(0/1)  #Do-env(0/1)    #Do-dev(0/1)    #env parm
0       0       0       0       0       1               # comm
0       0       0       0       0       1               # rec
0       0       0       0       0       1               # survey

# LO    HI      INIT    PRIOR   P_type  SD      PHASE
#  -5   0       -2      -1      0       10      1       # log(Q) survey (not used, need one line for every "1" above)

#_SELEX_&_RETENTION_PARAMETERS, for each fleet and survey
#_Length selex
# Selex_type  Do_retention(0/1)         Do_male         Mirrored_selex_number
1       0       0       0                               # fleet 1 comm, Size selex: 1=logistic
7       0       0       0                               # fleet 2 rec, Size selex: 7= double logistic
7       0       0       0                               # survey 3 rec, Size selex: 7= double logistic
#_Age selex
# Selex_type    Do_retention(0/1)       Do_male         Mirrored_selex_number
10      0       0       0                               # fleet 1 comm, Age selex: 10=flat
10      0       0       0                               # fleet 2 rec, Age selex: 10=flat
10      0       0       0                               # survey 3 rec, Age selex: 10=flat

# LO     HI      INIT   PRIOR   P_type  SD      PHASE  env-var  use_dev dvminyr dvmaxyr dev_sd  Block_type useblock
# comm length selectivity - logistic
10      50      27.3    27.3    0       10      1       0       0       0       0       0       0       0       #L50
0.01    12      3.95    3.95    0       10      1       0       0       0       0       0       0       0       #diff05-95

# rec length selectivity - double logistic
10      70      26.6    26.6    0       10      1       0       0       0       0       0.5     0       0       #peak
0.00001 0.1     0.001   0.001   0       0.5     -1      0       0       0       0       0.5     0       0       #init
-3      10      1.34    1.34    0       0.5     1       0       0       0       0       0.5     0       0       #infl
0.001    5      0.08    0.08    0       0.1     3       0       0       0       0       0.5     0       0       #slope
-5      10      -1.15   -1.15   0       1       3       0       0       0       0       0.5     0       0       #final
-5      10      -2.1    -2.1    0       1       4       0       0       0       0       0.5     0       0       #infl2
.001     5      0.96    0.96    0       0.3     5       0       0       0       0       0.5     0       0       #slope2
0.1     10      0.1     0.1     0       1       -5      0       0       0       0       0.5     0       0       #width of top

# survey length selectivity - double logistic
10      70      27.6    27.6    0       10      1       0       0       0       0       0.5     0       0       #peak
0.00001 0.1     0.001   0.001   0       0.5     -1      0       0       0       0       0.5     0       0       #init
-3      10      1.67    1.67    0       0.5     1       0       0       0       0       0.5     0       0       #infl
0.001    5      .05     .05     0       0.1     3       0       0       0       0       0.5     0       0       #slope
-5      10      -1.32   -1.32   0       1       3       0       0       0       0       0.5     0       0       #final255
```

```
-5      10      0.711   0.711   0       1       4       0       0       0       0       0.5     0       0       #infl2
.001     5      0.97    0.97    0       0.3     5       0       0       0       0       0.5     0       0       #slope2
0.1     10      0.1     0.1     0       1       -5      0       0       0       0       0.5     0       0       #width of top

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

#_custom-block_read
0       # 0=read_one_setup_and_apply_to_all;_1=Custom_so_see_detailed_instructions_for_N_rows_in_Custom_setup

-4      # phase_for_selex_parm_devs

1       #_max_lambda_phases:_read_this_Number_of_values_for_each_componentxtype_below
0       #sd_offset (0/1)  multiple this times Log(sd) when calculating the likelihood - 0 recommended

#_cpue_lambdas (one for each fleet/survey)
0       # fishery comm
0       # fishery rec
5       # survey  --  baseline model set at 5 (set at 1 and 10 for sensitivities)

#_discard lambda
0       # fishery comm
0       # fishery rec
0       # survey

#_meanwtlambda(one_for_all_sources)
1

#_lenfreq_lambdas
1       # fishery comm
1       # fishery rec
1       # survey

#_age_freq_lambdas
0       # fishery comm
0       # fishery rec
0       # survey

#_size@age_lambdas
0       # fishery comm
0       # fishery rec
0       # survey

#_initial F lambda
1       # init equil catch

#_recruitment_deviations_lambda
1

#_parm_prior_lambda
1

#_parm_dev_timeseries_lambda
1

#_crashpen lambda - for recovering from crashes
100

#_max F - no fishery can take more than 90% of stock in a year
0.9

#_end-of-file-marker
999
```

Appendix C: In finalizing this assessment document, an error in calculating the CPFV survey CPUE index that was used and reviewed by the STAR was encountered by the STAT. The correct catch per angler hour (CPAH) used for the GLM should have been log transformed. The following tables and figure show the output from correcting this GLM analysis. The analysis of deviance table can be compared to Table 4 from the original GLM. The difference in the resulting stock assessment is small when comparing the values of the biological reference points below.

Analysis of Deviance Table
Model: gaussian
Response: add5lnCPAH

	Df	Deviance	Resid. Df	Resid. Dev	F	Pr(>F)
NULL			661	774.88		
YEAR	11	107.64	650	667.24	12.3943	2.00E-16
MONTH	11	17.31	639	649.93	1.9929	0.02696
LOC	65	196.77	574	453.17	3.8343	2.00E-16



Biological Reference Points		
	Index used in Assessment	Corrected Index
Unfished spawning biomass (SB_0)	1,995 mtons	2,111 mtons
Unfished summary (age 1+) biomass (B_0)	2,440 mtons	2,582 mtons
Unfished recruitment (age 0) (R_0)	2,758 mtons	2,919 mtons
2005 spawning biomass (SB_{2005})	1,931 mtons	2,281 mtons
2005 summary (age 1+) biomass (B_{2005})	2,385 mtons	2,762 mtons
ABC ($F_{50\%}$ * B_{2005})	246 mtons	284 mtons
$SB_{40\%}$ (MSY proxy stock size = 0.4*SB_0)	798 mtons	844 mtons
Exploitation rate at MSY (rockfish proxy $F_{50\%}$)	10.3 %	10.3 %
MSY ($F_{50\%}$ * 40% * B_0)	101 mtons	106 mtons

Appendix D: Forecasts and decision tables based on $F_{50\%}$ and California nearshore 60:20 rule.

Emphasis on CPUE index = 1

Year	60:20 adjustment	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	0.99	1174	862	59.2%	26	5.7%	54	10.7%
2006	0.98	1147	839	57.6%	26	6.2%	54	11.8%
2007	0.97	1130	825	56.6%	46	12.1%	102	24.1%
2008	0.92	1058	755	51.8%	36	11.5%	83	22.9%
2009	0.90	1023	723	49.6%	31	11.2%	75	22.2%
2010	0.88	1005	708	48.6%	29	11.1%	72	21.9%
2011	0.88	994	700	48.1%	28	11.0%	71	21.7%
2012	0.87	986	695	47.7%	27	10.9%	70	21.6%
2013	0.87	980	690	47.3%	27	10.8%	69	21.5%
2014	0.86	975	685	47.0%	27	10.8%	68	21.4%
2015	0.86	970	681	46.7%	26	10.7%	68	21.3%
2016	0.85	966	677	46.5%	26	10.7%	67	21.2%

Emphasis on CPUE index = 5

Year	60:20 adjustment	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	2385	1931	96.8%	26	2.1%	54	4.7%
2006	1	2304	1850	92.7%	26	2.3%	54	5.1%
2007	1	2235	1781	89.3%	112	10.5%	234	23.9%
2008	1	1931	1480	74.2%	85	10.5%	183	23.9%
2009	1	1736	1292	64.8%	68	10.5%	153	23.9%
2010	0.99	1609	1174	58.9%	56	10.4%	134	23.6%
2011	0.96	1527	1101	55.2%	48	10.0%	120	22.8%
2012	0.93	1474	1057	53.0%	44	9.8%	112	22.3%
2013	0.92	1438	1026	51.5%	41	9.6%	107	21.9%
2014	0.90	1411	1004	50.3%	39	9.5%	104	21.6%
2015	0.89	1390	985	49.4%	38	9.4%	101	21.3%
2016	0.88	1373	970	48.6%	37	9.3%	98	21.1%

Emphasis on CPUE index = 10

Year	60:20 adjustment	Biomass Age 1+	Spawning Biomass	Depletion	Commercial Catch	Commercial Harvest Rate	Recreational Catch	Recreational Harvest Rate
2005	1	3058	2533	110.0%	26	1.6%	54	3.5%
2006	1	2940	2414	104.9%	26	1.7%	54	3.9%
2007	1	2836	2310	100.3%	145	9.9%	299	23.5%
2008	1	2409	1883	81.8%	109	9.9%	230	23.5%
2009	1	2131	1611	70.0%	86	9.9%	189	23.5%
2010	1	1949	1439	62.5%	71	9.9%	165	23.5%
2011	0.98	1827	1329	57.7%	60	9.7%	147	23.0%
2012	0.95	1746	1259	54.7%	53	9.4%	135	22.4%
2013	0.93	1692	1213	52.7%	48	9.2%	127	21.9%
2014	0.91	1654	1180	51.2%	46	9.1%	123	21.5%
2015	0.90	1624	1155	50.1%	44	8.9%	119	21.2%
2016	0.89	1600	1134	49.2%	42	8.8%	116	20.9%

Decision table for the gopher rockfish stock assessment model ($F_{50\%}$ and 60:20).

				CPUE emph1 least likely (p=0.22)		CPUE emph5 most likely (p=0.40)		CPUE emph10 less likely (p=0.38)	
Management Action	**Year**	Commercial Catch	Recreational Catch	Spawning Biomass	Depletion	Spawning Biomass	Depletion	Spawning Biomass	Depletion
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	46	102	825	56.6%	1781	89.3%	2310	100.3%
	2008	36	83	755	51.8%	1662	83.3%	2158	93.7%
Low Catch	**2009**	31	75	723	49.6%	1588	79.6%	2055	89.2%
	2010	29	72	708	48.6%	1537	77.1%	1981	86.0%
	2011	28	71	700	48.1%	1500	75.2%	1924	83.5%
	2012	27	70	695	47.7%	1469	73.7%	1878	81.5%
	2013	27	69	690	47.3%	1445	72.4%	1840	79.9%
	2014	27	68	685	47.0%	1423	71.4%	1808	78.5%
	2015	26	68	681	46.7%	1405	70.4%	1781	77.3%
	2016	26	67	677	46.5%	1390	69.7%	1758	76.3%
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	112	234	825	56.6%	1781	89.3%	2310	100.3%
	2008	85	183	575	39.5%	1480	74.2%	1974	85.7%
Medium Catch	**2009**	68	153	430	29.5%	1292	64.8%	1757	76.3%
	2010	56	134	371	25.5%	1174	58.9%	1615	70.1%
	2011	48	120	356	24.5%	1101	55.2%	1524	66.2%
	2012	44	112	345	23.7%	1057	53.0%	1466	63.7%
	2013	41	107	330	22.6%	1026	51.5%	1425	61.9%
	2014	39	104	312	21.4%	1004	50.3%	1395	60.6%
	2015	38	101	296	20.3%	985	49.4%	1371	59.6%
	2016	37	98	283	19.4%	970	48.6%	1352	58.7%
	2005	26	54	862	59.2%	1931	96.8%	2533	110.0%
	2006	26	54	839	57.6%	1850	92.7%	2414	104.9%
	2007	145	299	825	56.6%	1781	89.3%	2310	100.3%
	2008	109	230	487	33.4%	1389	69.6%	1883	81.8%
High Catch	**2009**	86	189	358	24.6%	1147	57.5%	1611	70.0%
	2010	71	165	369	25.3%	998	50.0%	1439	62.5%
	2011	60	147	350	24.0%	905	45.4%	1329	57.7%
	2012	53	135	343	23.5%	848	42.5%	1259	54.7%
	2013	48	127	319	21.9%	810	40.6%	1213	52.7%
	2014	46	123	300	20.6%	782	39.2%	1180	51.2%
	2015	44	119	283	19.4%	757	38.0%	1155	50.1%
	2016	42	116	275	18.9%	736	36.9%	1134	49.2%

First two years were based on GMT recommendations:
Commercial - the average for the last 5 years (2000-2004) = 26 mtons.
Recreational - the average for 2002 and 2004 only = 54 mtons.

< 60%