STATUS OF THE YELLOWEYE ROCKFISH RESOURCE IN 2001 FOR NORTHERN CALIFORNIA AND OREGON WATERS

Farron R. Wallace

Washington Department of Fish and Wildlife
48 Devonshire Road
Montesano, Washington 98563

Appendix to:
Status of the Pacific Coast Groundfish Fishery Through 2001 and Recommended Acceptable Catches for 2002

August 30, 2001

Executive Summary

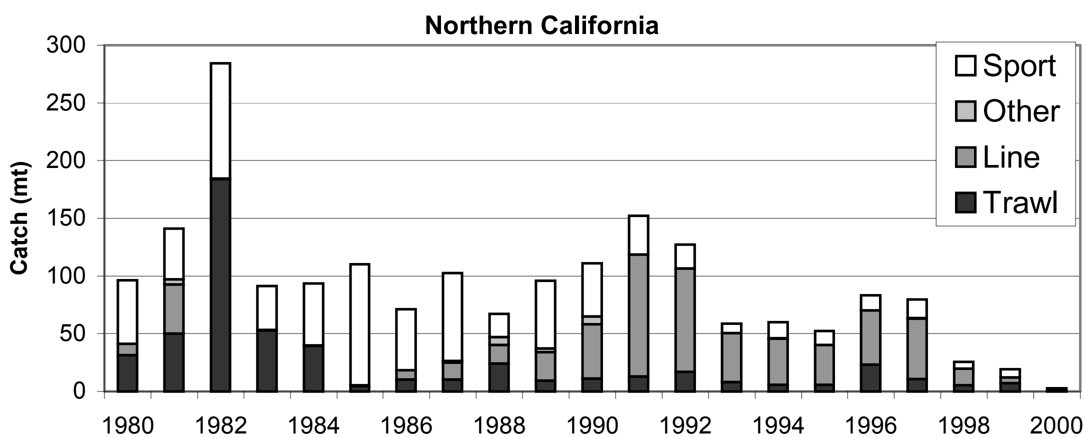
Stock

This assessment incorporates two separate assessments corresponding to yelloweye rockfish (*Sebastes ruberrimus*) found in waters off the northern California coast (PMFC areas 1B and 1C) and from waters off the Oregon coast. An assessment model was not developed for Washington due to limited length and age composition time series. Because of differing sport CPUE trends, aggregating Washington and Oregon data into a single model was not justified.

Catches

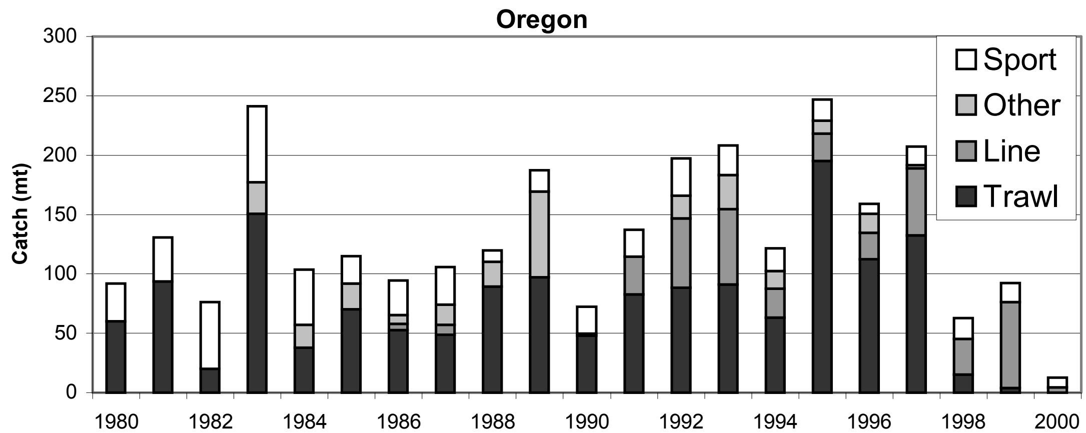
Northern California

Trawl landings of yelloweye rockfish declined from an average of 42 mt in the 1980s to less than 11 mt in the 1990s. A commercial line fishery developed in the late 1980s peaked at 100 mt in 1991 and declined to less than 10 mt by 1999. Sport catches of yelloweye rockfish averaged 60 mt during the 1980s and precipitously declined to less than 18 mt in the 1990s averaging only 5 mt 1998-2000.



Oregon

Trawl landings of yelloweye rockfish averaged over 70 mt since 1980 declining abruptly to less than 16 mt in 1998. A commercial line fishery developed in the early 1990s and has averaged 35 mt until management restrictions in 2000 reduced catches to less than 5 mt. Sport catches of yelloweye rockfish averaged 34 mt during the 1980s and declined to 20 mt in the 1990s.



	S. California (PFMC Area1A)				N. California (PFMC Area's 1B&1C)				Oregon (PFMC Area 2A,2B,2C)				Washington (PFMC Area 3A,3B,3C)			
Year	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport
1980				15.0	31.4	9.7	0.0	55.0	60.2			31.7	29.2	1.5	0	2.9
1981	6.1	166.4	29.9	3.0	50.3	42.4	4.4	44.0	93.7	0		36.7	2.8	0.8	0	4.2
1982	6.7	5.3	1.6	2.0	184.1	0.0	0.3	100.0	19.9	0	0.1	56.0	4.4	0.9	0	3.5
1983	0.0	3.0	0.5	12.0	52.7	0.0	0.8	38.0	150.6	0	26.8	63.8	33.2	1.2	0	5.9
1984	0.0	3.0	1.4	21.0	39.5	0.0	0.3	54.0	38.0	0	19.0	46.6	19.5	2.0	0	11.2
1985	0.0	2.7	0.5	16.0	4.7	0.5	0.0	105.0	70.2	0	21.7	23.3	31.4	6.3	0	8.4
1986	0.0	3.4	0.3	12.0	10.4	7.8	0.0	53.0	52.5	5.6	7.3	29.1	9.4	6.4	0	11.1
1987	0.0	5.3	1.2	0.0	10.2	15.0	1.3	76.0	48.6	8.6	16.9	31.5	22.9	8.1	0	12.5
1988	0.0	0.4	3.5	0.0	24.3	15.8	7.1	20.0	89.2	0	20.9	9.5	36.7	4.3	0	6.6
1989	0.0	1.2	3.2	1.0	9.3	24.6	3.1	59.0	97.3	0	72.2	17.6	99.0	2.5	0	12.7
1990	0.1	1.8	1.4	0.8	11.1	47.2	6.6	46.3	48.0	1.7	0.0	22.5	32.0	1.7	0	10.8
1991	0.0	6.2	1.2	0.5	12.8	105.8	0.0	33.5	82.6	31.8	0.0	22.8	37.7	1.8	0	14.8
1992	0.0	5.3	0.0	0.3	16.9	89.7	0.0	20.8	88.6	58	19.2	31.6	44.2	3.3	0	12.4
1993	0.7	7.7	0.0	0.0	8.1	42.5	0.1	8.0	90.9	63.7	28.7	25.0	44.7	9.0	0	11.1
1994	0.1	25.5	0.0	0.0	5.6	40.2	0.4	14.0	63.0	24.7	14.6	19.4	21.3	2.8	0	6.0
1995	0.1	19.5	0.0	0.0	5.6	34.7	0.1	12.1	194.9	23.4	10.6	18.0	16.7	0.1	0	8.1
1996	1.1	3.6	0.0	0.0	23.5	46.9	0.0	13.0	112.3	22.2	16.1	8.2	24.4	0.0	0	6.1
1997	0.0	3.1	0.0	0.0	10.9	52.4	0.4	16.0	132.4	56.6	2.5	15.7	9.0	12.2	0	7.3
1998	0.1	2.1	0.0	0.0	5.2	14.4	0.0	6.0	15.3	30.1	0.1	17.3	4.7	0.7	0	9.0
1999	0.0	0.0	0.0	2.0	7.1	5.2	0.0	7.0	4.1	71.9	0.0	16.5	9.8	23.0	0	8.6
2000	0.0	0.0	0.0	0.0	0.5	0.3	0.0	2.0	0.1	4.2	0.0	8.2	0.2	7.7	0	9.4
Mean ('81-'00)	0.8	13.3	2.2	3.5	24.6	29.3	1.2	36.4	74.6	20.1	14.6	26.0	25.2	4.7	0.0	9.0
Last 10 y	0.2	7.3	0.1	0.3	9.6	43.2	0.1	13.2	78.4	38.7	9.2	18.3	21.3	6.1	0.0	9.3
Last 5 y	0.2	1.8	0.0	0.4	9.4	23.8	0.1	8.8	52.8	37.0	3.7	13.2	9.6	8.7	0.0	8.1

Data and assessment

This is the first time yelloweye rockfish have been formally assessed in Pacific Council managed waters. Rogers et al. (1996) estimated a yelloweye rockfish ABC of 39 mt for the Northern area (Columbia and Vancouver) based on biomass estimates from the triennial trawl survey and assumptions about natural mortality (M) and catchability (Q).

Two length-based Stock Synthesis models were used to derive population trends for northern California and Oregon. Auxiliary indices of abundance from the NMFS triennial trawl survey and halibut longline survey (Halibut Commission) were examined but rejected. The northern California assessment includes two sport CPUE indices constructed from Marine Recreational Fishery Statistical Survey (MRFSS) sample data and CDFG data collected on-board Commercial Passenger Fishing Vessels (CPFV). The Oregon assessment model includes a sport CPUE index derived from ODFW estimated bottomfish effort and yelloweye catch. Both assessment models are for combined sexes, include two fisheries, sport and commercial spanning 1970-2000. Length composition data are available beginning 1978 and 1980 for the northern California and Oregon assessment, respectively.

Unresolved problems and major uncertainties

There are a number of uncertainties that contribute to interpretation of results presented in this assessment. Some were explored through sensitivity analysis including natural mortality, selectivity and level of historical catch. Data on growth, maturity, movement and age were very limited precluding formal analysis. Length composition data have been collected for two decades, but sample sizes are small. Yelloweye can live over 100 years and information derived from length composition data is limited beyond age 25-30 as yelloweye approach asymptotic length.

There are also concerns that fisheries dependent indices of abundance may introduce bias resulting from annual variability in fishery catchability. No indication of bias was found, but data are likely imprecise. The Oregon recreational CPUE data provided by ODFW did not allow for complete review due to the aggregate nature of the data. For this reason, there is some uncertainty associated with these data.

Little is known about yelloweye stock structure. The specific habitat requirement for yelloweye rockfish support hypothesis for site fidelity, and little mixing may occur after settlement. It is likely that discrete sub-populations corresponding to high-relief rocky areas form a much larger meta-population.

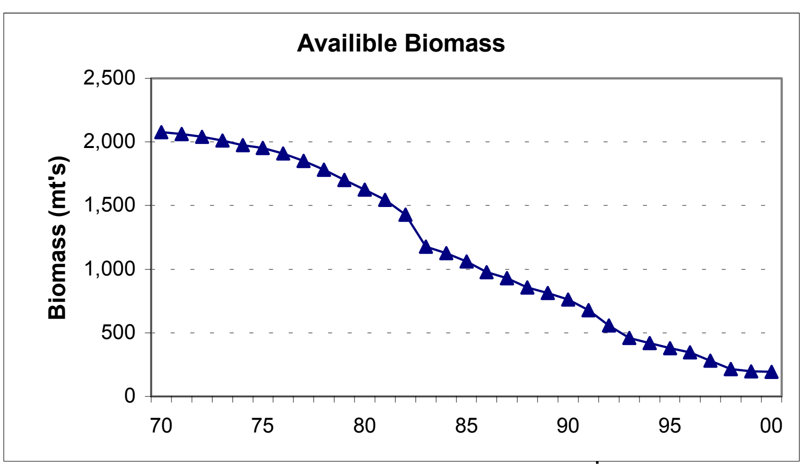
Reference points

The proxy target fishing mortality rate for rockfish allowable catch is $F_{50\%}$. This represents a SPR rate that would reduce the spawning biomass 50% from its unfished level. The rate can be further reduced by a precautionary “40-10 default OY” such that the further the stock is below $B_{40\%}$ the greater the reduction in harvest until at B10% all harvest is prohibited. A formal rebuilding plan is required in the stock falls below $B_{25\%}$.

Stock Biomass

Northern California

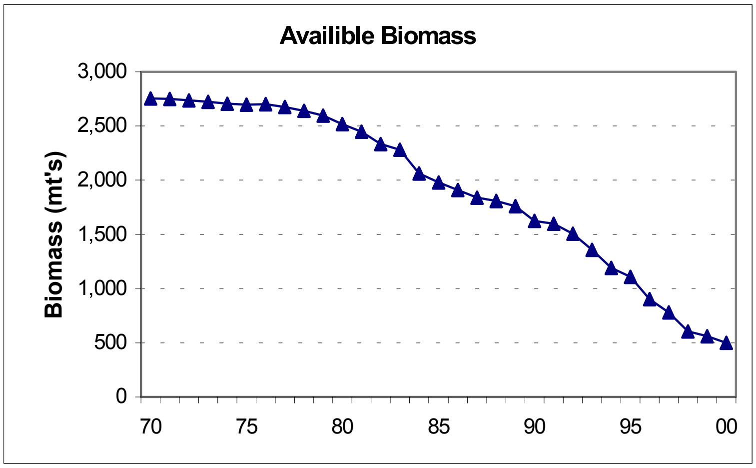
Results from the Stock Synthesis model indicate that stock biomass has significantly declined throughout the time series. Current spawning biomass is estimated to be approximately 7% of the unfished spawning biomass.



	Biomass (mt)	
Year	Begin Year	Spawning
90	760	280
91	678	245
92	558	199
93	458	164
94	420	151
95	380	137
96	346	123
97	280	99
98	214	79
99	198	74
00	194	73

Oregon

Results from the Stock Synthesis model indicate that stock biomass has significantly declined throughout the time series. Current spawning biomass is estimated to be approximately 13% of the unfished spawning biomass.

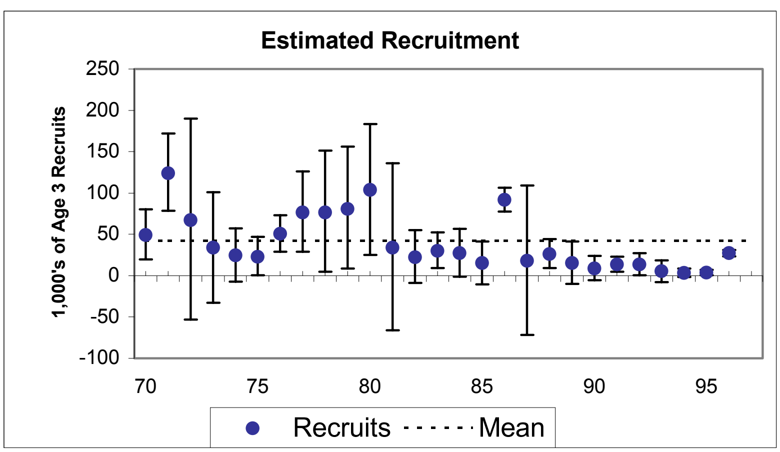


	Biomass (mt)	
Year	Begin Year	Spawning
90	1626	593
91	1600	569
92	1508	520
93	1357	454
94	1193	397
95	1110	362
96	903	296
97	778	255
98	603	207
99	562	198
00	500	182

Recruitment

Northern California

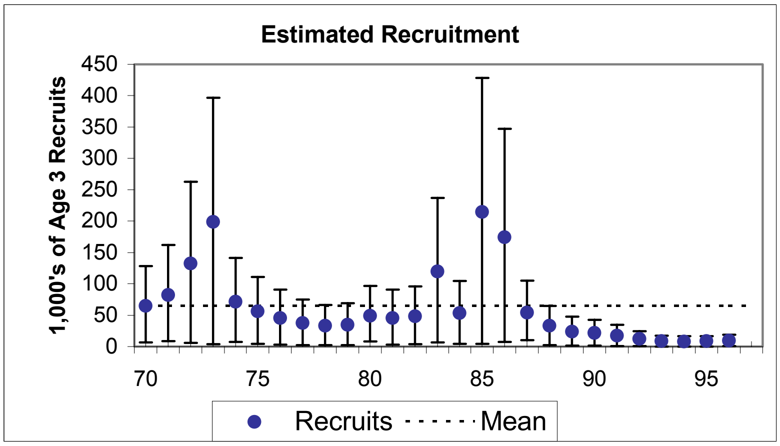
Recruitment is variable across the time series and parallels a decreasing trend in population biomass. The last above average recruitment was 1987 (age 3 recruits) and recruitment failure is apparent during the last decade.



1,000's of Age 3 Recruits	
Year	Recruitment
86	15.1
87	91.5
88	18.1
89	26.3
90	15.4
91	8.8
92	13.8
93	13.6
94	5.2
95	3.4
96	3.8

Oregon

Recruitment estimates are quite variable and imprecise across the time series. Above average recruitment (age 3 recruits) occurred during 1986 and 1987, but recruitment failure is evident during the last decade.



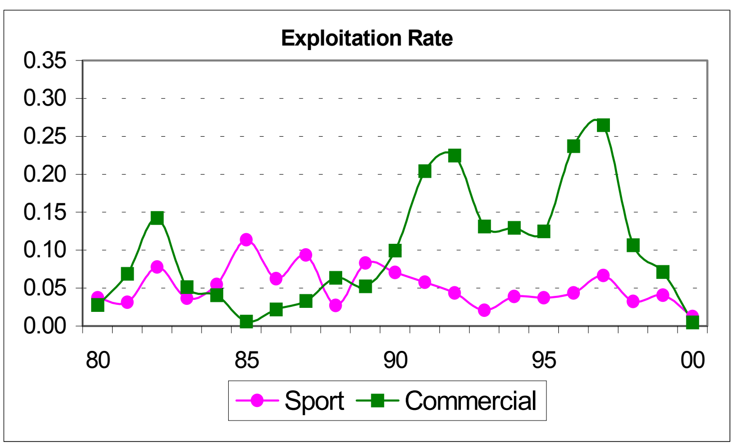
1,000's of Age 3 Recruits

Year	Recruitment
86	174.6
87	53.9
88	32.9
89	23.8
90	21.3
91	17.5
92	12.2
93	8.8
94	8.2
95	8.3
96	9.5

Exploitation status

Northern California

Commercial exploitation rate peaked at over 25% in 1997 decreasing to less that 1% in 2000. Exploitation rate in the sport fishery peaked at over 10% in 1985 decreasing to less than 5% in recent years.

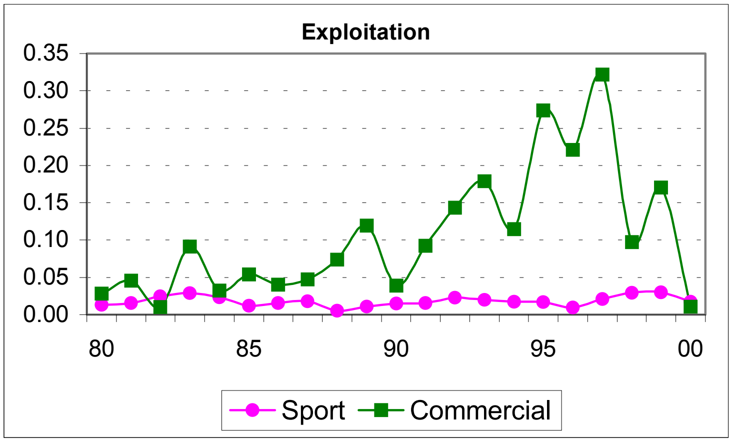


Exploitation Rate

Year	Sport	Commercial
90	0.071	0.099
91	0.057	0.204
92	0.044	0.225
93	0.021	0.131
94	0.039	0.130
95	0.037	0.125
96	0.044	0.237
97	0.066	0.265
98	0.033	0.106
99	0.041	0.071
100	0.012	0.005

Oregon

Commercial exploitation rate peaked at over 30% in 1997 decreasing to less that 2% in 2000. Exploitation rate in the sport fishery has been at or below 3% across the time series.



Exploitation Rate

Year	Sport	Commercial
90	0.015	0.039
91	0.016	0.092
92	0.023	0.144
93	0.020	0.179
94	0.017	0.115
95	0.017	0.274
96	0.010	0.221
97	0.021	0.322
98	0.030	0.098
99	0.030	0.170
100	0.017	0.011

Management performance

Base run estimates indicate harvest levels well above natural mortality since 1980. This coupled with recent poor recruitment may have led to population decline and over-exploitation. This is of concern because, like many other species of rockfish, yelloweye have been managed as part of a complex with little attention given to individual species. Yelloweye rockfish can be characterized as relatively small population(s) of fish that are long-lived, late maturing, slow growing, and susceptible to overfishing. Recent management decisions have greatly restricted "shelf" rockfish catch, which is reflected in recent low level of yelloweye landings by commercial fisheries.

Decision Table and Forecasts

Northern California

Forming the basis for a decision table, five-year yield projections ($F_{50\%}$) are provided representing three assumed levels of recruitment including mean recruitment across the time series, mean recruitment in the most recent 10 years and recruitment estimated from a Beverton-Holt stock recruitment relationship.

Northern California yelloweye yield forecast with no 40/10 reduction (SPR rate of 0.50).

Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Yield Total	Yield Sport	Yield Commercial
Average recruitment across time series.							
2002	211	79	43	0.037	7.8	3.9	3.9
2003	230	81	43	0.036	8.3	4.2	4.1
2004	251	85	43	0.035	8.8	4.5	4.3
2005	273	89	43	0.035	9.5	4.8	4.7
2006	296	95	43	0.034	10.2	5.2	5.0
Average recruitment of last 10 years.							
2002	211	78	20	0.036	7.6	3.8	3.8
2003	220	80	20	0.036	7.9	4.0	3.9
2004	229	83	20	0.036	8.2	4.1	4.1
2005	238	86	20	0.036	8.5	4.3	4.2
2006	248	89	20	0.036	8.8	4.4	4.4
Recruitment estimated from a Beverton-Holt stock recruitment relationship.							
2002	211	78	22	0.036	7.6	3.8	3.8
2003	221	80	22	0.036	7.9	4.0	3.9
2004	231	83	22	0.036	8.2	4.1	4.1
2005	242	86	22	0.036	8.6	4.3	4.3
2006	252	89	22	0.036	9.0	4.5	4.4

[1] Recruitments in 1,000's of age 3 recruits.

Oregon

Decision table for the Oregon yelloweye assessment also provides five-year yield projections ($F_{50\%}$) representing three assumed levels of recruitment including mean recruitment across the time series, mean recruitment in the most recent ten years and recruitment estimated from a Beverton-Holt S-R relationship.

Oregon yelloweye yield forecast with no 40/10 reduction (SPR rate of 0.50).

Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Yield Total	Yield Sport	Yield Commercial
Average recruitment across time series.							
2002	497	194	61	0.031	15.4	8.3	7.1
2003	519	197	61	0.030	15.7	8.5	7.3
2004	543	199	61	0.030	16.1	8.8	7.4
2005	570	201	61	0.029	16.6	9.1	7.5
2006	599	203	61	0.029	17.2	9.5	7.6
Average recruitment of last 10 years.							
2002	497	194	33	0.031	15.3	8.2	7.1
2003	506	197	33	0.030	15.5	8.3	7.2
2004	515	199	33	0.030	15.7	8.4	7.2
2005	524	200	33	0.030	15.9	8.6	7.3
2006	534	201	33	0.030	16.1	8.7	7.4
Recruitment estimated from a stock recruitment relationship.							
2002	497	194	38	0.031	15.3	8.2	7.1
2003	508	197	38	0.030	15.5	8.3	7.2
2004	519	199	38	0.030	15.7	8.5	7.3
2005	531	200	38	0.030	16.0	8.7	7.3
2006	544	201	38	0.030	16.3	8.9	7.4

[1] Recruitment in 1,000's of age 3 recruits.

Recommendations: research and data needs

Additional effort to collect age and maturity data is essential for improved population assessment. Collection of these data may be necessary by onboard observers if this species becomes prohibited. Increased effort toward habitat mapping will provide information on essential habitat and distribution for this species. Development of fishery independent indices will be necessary as allowable catch becomes restricted. A study of the role of MPAs in harvest management will be beneficial for yelloweye rockfish and other sedentary species. Genetic study is required as a first step in delimiting stock boundaries for this species.

Sources of additional information

STAR panel report

Rogers, J.B., M. Wilkins, D. Kamakawa, F. Wallace, T. Builder, M. Zimmerman, M. Kander and B. Culver. 1996. Status of the Remaining Rockfish in the Sebastes Complex in 1996 and recommendations for management in 1997. Pacific Fishery Management Council 2130 SW fifth Ave. Suite 224, Portland, Ore. 97210.

Introduction

General Description

Yelloweye rockfish (*Sebastes ruberrimus*) are highly prized by sport fishers due to their size, beauty and quality and by commercial fishers due to high market demand and ex-vessel value. This species ranges from northern Baja to the Aleutian Islands inhabiting high-relief rocky areas in depths 15 to 550 meters (Rosenthal et al. 1982, Eschemeyer, et al. 1983, Love, et al., 2000). Yelloweye are carnivorous feeding primarily on other rockfishes, herring, sand lance, crab and shrimp (Washington et al., 1978, Rosenthal et al.1988, Reilly et al. 1994, Love 1996).

Stock Structure and Management Units

Genetic appraisal of yelloweye rockfish by Yamanaka, et al. (2001) provided no evidence of differences in stock structure among sampling locations in northern Vancouver, B.C. and SE Alaskan waters. Authors found little variability among samples concluding that yelloweye rockfish, within the sampling area, forms a well-mixed panmictic stock.

Evaluation of stock boundaries is also dependent upon life history traits associated with a population or sub-population. Data for assessment of stock boundaries for coastal Washington, Oregon and California (W-O-C) yelloweye stock(s) were limited such that comparison of biological parameters among areas was not possible. Specific habitat requirement for yelloweye rockfish support hypothesis for site fidelity, and little mixing may occur after settlement. It is likely that discrete sub-populations corresponding to high-relief rocky areas form a much larger genetically diverse meta-population.

Data in this assessment were compiled for three separate stock units corresponding to yelloweye rockfish found in waters off the northern California coast (PMFC areas 1B and 1C) and from waters off the Oregon and Washington coast (Figure 1).

Life History

Yelloweye rockfish can be characterized as relatively low in abundance, long-lived, late maturing, slow growing, and susceptible to overfishing. They exclusively inhabit high-relief rocky areas and there may be little mixing after settlement. Management must take this into account or risk serial depletion if a broad-area management approach is used.

Management History

Management of rockfish has had a long history beginning in 1983 when the Pacific Fisheries Management Council (PFMC) first imposed trip limits on landings from the *Sebastes* complex (Figure 2). Yelloweye were managed as part of the *Sebastes* complex until 2000, when the Council abandoned the *Sebastes* complex in favor of a finer scale portioning of rockfish stocks. Rockfish are now managed independently or part of three species-specific minor rockfish groupings Nearshore, Shelf and Slope. Yelloweye rockfish are currently managed as part of the Minor Shelf Rockfish group.

Prior to 2000 trip limit regulations on the *Sebastes* complex probably had little or no impact in restricting harvest of yelloweye in the trawl fishery. Yelloweye rockfish inhabit areas typically inaccessible to trawl gear, were likely never targeted and individual landings were typically quit small.

Open access and limited entry line gear trip limits for rockfish remained at or above 10,000 lbs in all years prior to 1999 (Figure 2). This probably did not constrain yelloweye catch since landings exceeding 10,000 lbs of yelloweye were extremely rare.

Sport CPUE indices used in this assessment indicate that catch rates for yelloweye rockfish are low. Sport rockfish limits for W-O-C have remained at or above ten-fish until 2000 (Figure 2). Although no formal bag limit analysis have been done, it is likely that a ten-fish bag limit had little effect on restricting yelloweye harvest. Washington adopted a two-fish bag limit for yelloweye in 2000, and an either/or two fish limit for yelloweye or canary rockfish in 2001.

Management Performance

Regulations have most likely been ineffective in constraining yelloweye catch until most recent years. Base run model estimates indicate over-exploitation during the last two decades. It is important to note that recent management decisions have greatly restricted "shelf" rockfish catch and is reflected in recent low level of yelloweye landings. Nevertheless, high market demand and price for yelloweye rockfish relative to other shelf species may cause fishers to concentrate their limited shelf rockfish opportunities on yelloweye.

Data

Data were compiled and analyzed for three independent areas: Northern California (PFMC areas 1B and 1C), Oregon and Washington (Figure 1).

California Department of Fish and Game (CDFG) and/or the Marine Recreational Fishery Statistical Survey (MRFSS) intermittently collected length, weight, effort and catch data on recreational fisheries in northern California ports of landing beginning in 1978. CDFG also collected catch and effort data onboard Commercial Passenger Fishing Vessels (CPFV) since 1987. The northern California assessment includes two sport CPUE indices constructed from MRFSS and CPFV data sources. These data provide the most complete and longest time series of information on yelloweye rockfish. Data collection by MRFSS and ODFW in Oregon spans back to the early 1980s, but sampling levels were low and sporadic until most recent years. Washington data (MRFSS and WDFW) is essentially limited to most recent years.

Synthesis models were not developed for Washington due to limited length composition data. Fisheries statistics and tuning indices are compared to provide information on stock trends between areas.

Catch

Yelloweye catch data prior to 1980 do not exist with the exception of Oregon and Washington trawl catch during the 1970s as estimated by Tagart and Kimura, 1982 (Table 1 and Figure 3).

Northern California

Trawl landings of yelloweye rockfish declined from an average of 42 mt in the 1980s to less than 11 mt in the 1990s. A commercial line fishery developed in the late 1980s peaked at 100 mt in 1991 and declined to less than 10 mt by 1999. Sport catches of yelloweye rockfish averaged 60 mt during the 1980s and precipitously declined to less than 18 mt in the 1990s averaging only 5 mt 1998-2000.

Oregon

Trawl landings of yelloweye rockfish averaged over 70 mt since 1980 declining abruptly to less than 16 mt in 1998. A commercial line fishery developed in the early 1990s and has averaged 35 mt until management restrictions in 2000 reduced catches to less than 5 mt. Sport catches of yelloweye rockfish averaged 34 mt during the 1980s and declined to 20 mt in the 1990s.

Washington

With the exception of 1989 when 99 mt were landed, trawl landings of yelloweye rockfish have been variable and less than 45 mt annually. Trawl landings since 1997 have declined to less than 10 mt. Commercial line fishery catch has been less than 15 mt since 1980 with the exception of 1999 when 23 mt was landed. Sport yelloweye rockfish landings peaked in 1991 at 14 mt and have declined to less than 10 mt in the last five years.

Mean length of catch

Observed mean length in the northern California sport fishery indicates a decreasing trend since 1980. The mean, median and maximum length in the 1980s was 44.6 cm, 43.0 cm and 100 cm, respectively. In the 1990s these statistics had declined to 41.9 cm, 41.8 cm and 69.9 cm, respectively. (Figure 4). Mean length in the Oregon sport fishery shows a similar declining trend. A time series of length data was not available to make similar comparison in Washington.

Decreasing mean length may reflect either effects of fishing or changes in growth or both. Decreasing trends in mean length have been observed in other rockfish species such as yellowtail rockfish. Yellowtail mean size-at-age has decreased approximately 2 cm over the last decade and this decrease has been interpreted as indicative of a decrease in the growth rate (Tagart et al., 2000). If the growth rate for yelloweye has also decreased in like manner, then application of a single growth curve over the entire time series will result in overestimating current biomass and underestimating the change in biomass from start to end of series.

Weight-at-age

Synthesis uses a growth function in conjunction with the length-weight relationship to predict weight-at-age for the stock biomass estimate. An allometric length/weight function was computed (from over 3,000 observations) to estimate weight for a fish of known length for combined sexes. The von Bertalanffy growth function ($Linf(1-e^{-k(age-to)})$) was used to estimate the length of a fish of a known age. Estimated parameter values are compared to estimates derived from age data collected from other locales in Table 2.

A single length-weight function is used for both northern California and Oregon assessments (Figure 5). Growth function parameter inputs for the northern California assessment were derived from California age data. Washington age data were used to estimate growth parameter inputs for the Oregon assessment (Table 2 and Figure 6).

Maturity-at-age

Length and age at 50% maturity for female yelloweye collected from coastal waters off Vancouver Island, B.C., was estimated to be 42.1-42.4 cm and 16.5-17.2 years of age (Yamanaka and Kronlund, 1997). This compares to 41 cm (Barss, 1989) and 45 cm (McClure, 1982) for fishes collected off Oregon and 40 cm (Reilly et al., 1994) for fish collected off California (Table 3). Mis-specification of length at 50% maturity at a larger size than actual will tend to lower allowable rates of fishing.

Natural mortality

Several procedures to derive estimates of natural mortality were explored. Robson and Chapman (1961) method was investigated, but Chi-square testing indicated that at least one of the critical assumptions of the data was not met.

Catch curve estimates (Ricker, 1975) of total mortality were derived from age data collected from various locales (Table 4). Estimates of mortality from an exploited stock off Neah Bay (0.076), Washington were higher compared to mortality estimates of an unexploited stock (0.025) located at the Bowie Seamount, Queen Charlotte Islands, B.C. (data provided by Yamanaka, DFO). Mortality estimates from Bowie Seamount using five-year age bins (0.086 males and 0.043 females; Yamanaka, 2000) and no age bins were quite different (0.021 males and 0.033 females). Differences in estimates are probably due to bin specification of large year class(s) recruited in the late 1960s (Figure 7). Catch curve estimates of natural mortality assume constant recruitment and large variation in recruitment makes it difficult to interpret results derived from catch curve procedures.

A natural mortality rate of 0.04 was used implicitly in all model configurations as the constant rate. This rate is a compromise between low (0.02, O'Connell et al., 2000) and high estimates (0.0431 for females and 0.0861 for males, Yamanaka et al., 2001) and is equivalent to that estimated using Hoenig's (1983) method (Table 5).

Sample size

Northern California data provide the most complete and longest time series of length information for yelloweye rockfish. Data collection in Oregon began in the early 1980s, though sampling levels were low and sporadic until most recent years. Washington data is essentially limited to the last three years (Table 6).

Less than 300 fish from northern California fisheries were sampled for age, and all of the samples were collected prior to 1986. WDFW began sampling yelloweye rockfish for age in 1998 and approximately 300 fish have been collected through 2000 (Table 7).

Catch-at-length

Sample frequency distribution data are used to estimate proportion at each length for combined sexes and gear for each assessment area. Total catch is distributed across the length proportions and divided by the mean weight-at-length to compute the numbers of fish caught at length (Tables 8 and 9).

Abundance Indices

NMFS Triennial Survey

The NMFS triennial trawl survey has covered a wide range of depths off California, Oregon and Washington since 1977. Yelloweye rockfish inhabit areas typically inaccessible to trawl gear and as a result yelloweye rockfish were infrequently caught. Estimated biomass and CV by depth zone and state are summarized in Table 10 and Figure 8. Given the low frequency of positive tows, NMFS trawl survey probably does not consistently sample yelloweye habitat annually and may not be a reliable indicator of abundance. NMFS trawl survey data were not incorporated into the assessment.

Sport CPUE indices

Abundance indices are assumed to be proportional to absolute population abundance. A critical assumption of a population index is that catchability remains constant. Significant bias may result if this assumption is false. Sport fishery catch rates will be influenced by undocumented search time, unreported discard, and change in target species and bag limits. It is unlikely that discard or bag limits influenced CPUE because yelloweye are a highly valued species and fishers rarely caught their bag limit of yelloweye. Search time has likely to have increased in recent years, which if accounted for, would increase the observed decline in CPUE indices. There is no information to evaluate annual differences in effort for specific individual target species such as yelloweye. To minimize influence of non-bottomfish effort, data were restricted to rockfish or bottomfish-targeted trips.

The northern California assessment includes two sport CPUE indices constructed from MRFSS data and CDFG data collected onboard Commercial Passenger Fishing Vessels (CPFV). The Oregon assessment model includes a sport CPUE index derived from ODFW estimated bottomfish effort and yelloweye catch. Total yelloweye catch and effort from bottomfish and halibut trips are used to construct the Washington sport CPUE time series. Sport CPUE indices are summarized in Table 11 and Figure 9.

In each case, index data were modeled as a survey index with selectivity equal to that estimated for the sport fishery. Index variance estimates were directly estimated from $\log_e$ transformed CPUE data and provided data input into model(s) as index CV.

Previous rockfish assessments have expressed concerns that fisheries dependent indices of abundance may introduce bias resulting from annual variability in fishery catchability. No indication of bias was found for the indices used in this assessment, but fishery independent data are weak and likely imprecise.

Northern California MRFSS CPUE

With the exception of 1990-1992, MRFSS has collected effort and catch data from coastal marine recreational fishers since 1980. The MRFSS recreational CPUE index was constructed from sampler observed effort where rockfish were the primarily targeted and at least one rockfish was caught. Catch included sampler-examined yelloweye for Type 1 (observed) and Type 2 (information from fisher) catch. Data were obtained directly from the RecFIN web page. CPUE was calculated as yelloweye catch per 100 sampled anglers. Annual catch rates were applied in the model as a survey index with selectivity equal to that estimated for the sport fishery. Yelloweye catch rate increased substantially between 1980 and 1983 then declined significantly through 2000 (Table 11 and Figure 9).

Northern California CPFV CPUE

The CDFG Central California Marine Sport Fish Project has been collecting catch and effort data onboard recreational Commercial Passenger Fishing Vessels (CPFV) from 1988 to 1998. Data were collected from trips originating out of northern California ports from Port San Luis to Fort Bragg. Observers collected data on the number of fishers and time spent fishing at each location fished for the entire day. CPUE was calculated as yelloweye catch per 1000 angler hours. Data from ports that were not sampled annually or southern ports where yelloweye catch was absent were filtered from the analysis.

A General Linear Model (delta method) was used on $\log_e$ transformed catch rates to estimate annual catch rates. The GLM included a year, month and port effect which were significant. Marginal means (for year effect) were back-transformed to the arithmetic scale, with bias correction (Gavaris, 1980) and applied in the model as a survey index with selectivity equal to that estimated for the sport fishery. Results indicate catch rates have declined significantly over the entire time period (Table 11 and Figure 9).

Oregon CPUE

Annual catch rates of yelloweye rockfish were derived from data assembled by ODFW personnel. Data included aggregate statistics for estimated number of boats, anglers and yelloweye rockfish catch by year, month, trip type. The data series begins in 1979, but information on trip type was not collected after 1987. For this reason, years with significant salmon effort, 1988-1993 and 1997 and records from Brookings and Astoria were excluded from the analysis. Per recommendation of ODFW staff, CPUE was calculated as yelloweye catch per angler trip. Annual catch rates were applied in the model as a survey index and selectivity set equal to that estimated for the sport fishery. Catch rates in earlier years (1980-1987) declined sharply from an average 0.25 to 0.09 yelloweye per angler trip in most recent six years (Table 11 and Figure 9).

Washington CPUE

April-September estimates of catch and effort (by trip type) for coastal Washington ports are available from the WDFW Ocean Sampling Program since1984. Estimated halibut and bottomfish trip effort and yelloweye catch are used to construct the index. CPUE was calculated as yelloweye catch per angler trip. CPUE is observed to decline, but not as sharply relative to northern California and Oregon indices (Table 11 and Figure 9).

Other

Rockfish caught incidental to the International Pacific Halibut Commission (IPHC) halibut survey were recorded, but not identified to species until 1999. In1999 rockfish were identified to species and catch recorded for the first 20 hooks per skate at each station (140 of the potential 700 hooks). Yelloweye catch during the 1999 was low (Table 12). A longer time series of data, and probably full accounting of yelloweye, will be needed to assess the merit of using the halibut survey as a yelloweye index index.

Validation and Aging Error

Break-and-burn aging techniques for yelloweye rockfish were recently validated. Employing radiometric aging techniques Andrews et al. (2001) verified growth zone age estimates between 30 and 100 years, substantiating that longevity likely exceeds 100 years.

Aging error was assessed using data collected from an exchange of 100 otoliths between the Department of Fisheries and Oceans, Canada (DFO) and WDFW. Aging error increased with age and was assumed unbiased, but imprecise and equivalent differences between DFO and WDFW age readings (Table 13 and Figure 10). Comparison of DFO and WDFW age readings indicate that 75% of fish 9-13 years old and 89% of fish older than 70 years of age are mis-aged by at least one year. Predicted value of mis-aging a one-year old fish 69%.

Assessment

History of modeling approaches

Yelloweye were first addressed as part of the “remaining rockfish” assessment completed in 1996. This assessment included a number of previously un-assessed rockfish species managed as the “*Sebastes* complex”. Rogers et al. (1996) estimated a yelloweye rockfish ABC of 39 mt for the Northern area (Columbia and Vancouver) based on biomass estimates from the triennial trawl survey and assumptions about natural mortality (M) and catchability (Q). No separate yelloweye ABC was estimated for the Southern area (Monterey and Conception) but incorporated with the “other rockfish” assemblage ABC.

Model description

Analyses in this assessment were developed using the length-based version of Stock Synthesis and provided by R. Methot (updated version for 2001). The modeling period for both northern California and Oregon begins in 1970. Sex data were typically not available and, as a result, available male and female data were pooled.

Comparison of independent logistic fits to the hook-and-line and trawl length composition data indicate similar selectivity patterns (Table 14). Consequently, hook-and-line, trawl and other miscellaneous gear data were combined into a single "commercial" fishery.

Northern California and Oregon models include two fisheries, sport and commercial. Catch data are treated as known without error and due to the high market value for yelloweye rockfish, discarding was assumed to have not occurred.

Recruitment and Stock-Recruitment relationship

Yelloweye are first recruited to the fishery at age three and models are set accordingly to estimate three-year-old recruits. Since there is little information in the length composition data in most recent years to estimate three-year-old recruits, recruitment beyond 1996 is assumed to be equal to the average recruitment across the time series. A Beverton-Holt stock recruitment relationship was used, but given minimal emphasis (in effect no influence).

Length Composition Data and Sample Sizes

Length composition data are treated as multinomial. Determination of appropriate sample size has been problematic in maximum likelihood models. It was especially complicated in this assessment since it was difficult to determine what represented a "sample". Yelloweye are relatively uncommon in the catch and the number of fish sampled in a sampling unit (sport or commercial landing) was very low. In most cases the number of fish sampled per landing was less than two or three fish.

Sample sizes used in synthesis are the product of observed sample sizes and the ratio of sum of total number of fish sampled/sum N_{eff} estimated in Synthesis (Figure 11). This approach is analogous to that specified in the Bocaccio assessment (MacCall et al., 1999) and provides "smoothing" of actual sample size estimates.

Northern California

Synthesis iteratively searches for parameter values that maximize the weighted likelihood components to estimate unknown values. The northern California assessment model includes seven likelihood component functions. For each fishery there is a length likelihood component, one component for the CPFV CPUE index, one component for the MRFSS CPUE index, one component for a penalty function and two stock recruitment likelihood components (individual and mean recruitment). The penalty likelihood component was given an emphasis value of 0.0001 and essentially had no influence. Model convergence criterion was set to stop model iterations when the relative change in total likelihood was less than 0.1%.

The size-based version of Stock Synthesis maintains age-based population dynamics by employing an explicit growth function to translate length observations into age. Von Bertalanffy growth parameters (L_{inf}, K and T_0) are assumed known and set equal to that estimated for California age data (non-linear regression, SPSS version 8.0). Since most of the catch during the early 1980s was commercial, it is assumed that the historical fishery prior to 1970 has the same selectivity as the commercial fishery.

Oregon

The Oregon assessment model includes six likelihood component functions. For each fishery there is a length likelihood component, one component for the ODFW CPUE index, one component for a penalty function and two stock-recruitment likelihood components (individual and mean recruitment). The penalty likelihood component was given an emphasis value of 0.0001 and essentially had no influence. Model convergence criterion was set to stop model iterations when the relative change in total likelihood was less than 0.1%.

Von Bertalanffy growth parameters (L_{inf}, K and T_0) are assumed known and set equal to that estimated for Washington age data (non-linear regression, SPSS version 8.0). Sport and commercial catch was similar during the early 1980s and it is assumed that the historical fishery prior to 1970 has the same selectivity as the sport fishery.

Model selection and evaluation

Natural mortality and selectivity

Initial exploratory runs were conducted to evaluate model fit to asymptotic (logistic) and double logistic selectivity curves for both fisheries. When natural mortality (0.04) was assumed to be constant and selectivity forced to be asymptotic, fit to the CPUE indices, sport length composition and commercial length composition was degraded (Table 15). Dome-shaped selectivity(s) was necessary to account for the low occurrence of older (larger) fish in the length composition data for either fishery. If selectivity was not constrained, but freely estimated both the sport and commercial fishery selectivity was dome-shaped implying that older age fish were not available to the fishery.

There may be several plausible explanations for dome-shaped selectivity in both the sport and commercial fisheries. 1) The trawl fishery can only catch fish at the “fringe” of rough non-trawlable habitat. 2) Hook size(s) in both the sport and commercial line fisheries do not “select” largest individuals. 3) Yelloweye rockfish inhabit high relief (canyons) and rocky bottom habitats and at least some of this habitat may form natural refugia from fishing. 4) Older fishes could be bathymetrically isolated in a portion of their range.

There has been lingering debate in recent rockfish assessment discussions over whether natural mortality increases with age or lack of older age fish in the catch is related to fishery selectivity. Because natural mortality is confounded with selectivity in age-structured models alternative assumptions of increasing natural mortality with age was evaluated. For yelloweye rockfish the "senescent" mortality hypothesis fit the fishery length composition well, and was a better explanation for the lack of older fish than not being vulnerable to the fishery. The preferred and base model(s) for northern California and Oregon, natural mortality was assumed to be constant until 50% maturity and linearly increasing to a model determined maximum rate at age 70.

Alternate assumptions on selectivity/natural mortality had significant impact on some of the model outputs, but had little effect on overall biomass trend. Results from alternative constant natural mortality rate models are provided for contrast, but were not subject to full evaluation.

Historical catch

Model sensitivity to assumed level of historical catch was evaluated for both the Northern California and Oregon models. Model runs with historical catch levels ranging from 5 to 40 mt in 5 mt intervals were contrasted.

Northern California Base Model

The Northern California model was relatively insensitive to the assumed level of historical catch. Increasing historical catch levels resulted in very modest changes in the overall likelihood values. Model estimates of recruitment and ending biomass were similarly unchanged as were fit to the data (Figure 12). Historical catch was established at 20 mt because it was a reasonable estimate based on observed catches in the early 1980s.

Oregon Base Model

The Oregon model was also relatively insensitive to the level of historical catch and model estimates of recruitment and ending biomass were relatively unchanged. As historical catch was increased fit to the sport CPUE data increased by a small margin, but fit to the length composition data degraded (Figure 13). Assumed historical catch was established at 25 mt because it was a reasonable estimate based on observed catches in the early 1980s.

Convergence

Convergence properties of the base models were verified by adjusting starting parameters by plus-or-minus 30%. Results from random start runs indicate a single global "best" estimate was found for both the Northern California (Figure 14) and the Oregon base model (Figure 15). There is no apparent trend or observed clustering of likelihood values and results were similar for all runs.

Results

Northern California

Base Model

Time series of total and female spawning biomass, recruitment and the relationship between recruitment and female spawning biomass are shown in Figure 16. Estimated selectivity, fishing mortality, fit to sport CPUE indices, observed and predicted mean lengths are shown in Figure 17. Fit to the sport and commercial fishery length composition data are shown in Figure 18 and 19.

Constant Mortality Model

Time series of total and female spawning biomass, recruitment and the relationship between recruitment and female spawning biomass are shown in Figure 20. Estimated selectivity, fishing mortality, fit to sport CPUE indices, observed and predicted mean lengths are shown in Figure 21.

Oregon

Base Model

Time series of total and female spawning biomass, recruitment and the relationship between recruitment and female spawning biomass are shown in Figure 22. Estimated selectivity, fishing mortality, fit to sport CPUE indices, observed and predicted mean lengths are shown in Figure 23. Fit to the sport and commercial fishery length composition data are shown in Figure 24 and 25.

Constant Mortality Model

Time series of total and female spawning biomass, recruitment and the relationship between recruitment and female spawning biomass are shown in Figure 26. Estimated selectivity, fishing mortality, fit to sport CPUE indices, observed and predicted mean lengths are shown in Figure 27.

Uncertainty and sensitivity analyses

Northern California Base Model

Model uncertainty surrounding natural mortality rate was examined through a range of model iterations at alternate assumptions. To explore model sensitivity to the initial natural mortality rate independently, natural mortality rate for old fish was fixed at base model estimate of 0.143 for all model runs. Model fit improved for initial rates greater than 0.01, but remain unchanged for values exceeding 0.035 (Figure 28). SPB/SPB_0 remained below 25% for the most optimistic model where initial natural mortality rate was assumed 0.01.

Uncertainty about initial natural mortality rate was further evaluated in model runs where natural mortality rate of old fish was re-estimated for each model run. Best fit to the CPUE indices and sport length composition data occurred at an initial natural mortality rate of 0.035. Fit to the commercial length composition data declined with increasing initial natural mortality rate. Fished to unfished spawning biomass ratio remained unchanged from the base model (Figure 29). The model essentially estimated higher natural mortality rates for older fish as the initial rate declined.

Model sensitivity to likelihood component emphasis was explored by systematically increasing emphasis from a low value (0.0001) for essentially no effect, to high values that forced model fit to the likelihood component. Model fit improved to sport composition data, but declined for the commercial length composition data as CPFV

CPUE index weighting was increased (Figure 30). As the MRFSS CPUE index emphasis increased, model fit to the commercial length composition data improved, but degraded fit to the sport composition data (Figure 31). Comparatively similar results occurred when equal weighting was applied to both sport CPUE indices (Figure32). Model fit improved as length composition likelihood weighting was increased to 1.0 and remained relatively unchanged thereafter (Figure 33).

A retrospective analysis was preformed by repeated deletion of end year data. Model results indicate that the model was very stable as data were sequentially omitted back to 1995 (Figure 34).

Oregon Base Model

A parallel analysis of model uncertainty surrounding natural mortality rate was examined for the Oregon base model. To explore model sensitivity of the initial rate independently, natural mortality rate for old fish was fixed at base model estimate of 0.097. Model fit to sport length composition data improved for initial rates greater than 0.01, but remain unchanged for values exceeding 0.035. Fit to the commercial length composition data degraded as initial rates increased beyond 0.02 and fit to the sport CPUE index remained unchanged for initial natural mortality rates greater than 0.03. The most optimistic outcome (SPB/SPB_0 = 0.45) occurred at an initial natural mortality rate of 0.01 (Figure 35).

Uncertainty about initial natural mortality rate was further evaluated in model runs where natural mortality rate of old fish was re-estimated. Fit to the sport length composition data and sport CPUE index improved with increasing initial natural mortality rates. Model fit to the commercial length composition data improved to an initial natural mortality rate of approximately 0.025 and declined thereafter. Ending to unfished spawning biomass ratio ranged from 0.14 to 0.11 (Figure 36). Model estimates of natural mortality rates for older fish increased as the initial rate declined.

Model sensitivity to likelihood component emphasis was explored by systematically increasing factors from a low value (0.0001) for essentially no effect, to high values that forced model fit to the likelihood component. Fit to sport length composition data was relatively unchanged as the sport CPUE was de-emphasized (below a value of 1), but declined with increased CPUE weighting. Model fit to the commercial length composition declined with increased CPUE weighting, but improved as the CPUE index value weighting increased eight-to-sixteen times the original value (Figure 37). Overall model fit improved as length composition likelihood weighting was increased but fit to the sport CPUE index was degraded (Figure 38).

A retrospective analysis was preformed by repeated deletion of end year data. Model results indicate that the model was very stable as data were sequentially omitted back to 1995 (Figure 39).

Harvest projections and decision tables.

Council recently revised target fishing mortality rates in 2000 setting rockfish target spawning biomass level at SPB $_{40\%}$. Due to low productivity of Pacific coast rockfish stocks a 50% spawner-per-recruit (SPR) fishing mortality rate may in fact reduce the unfished stock size to SPB $_{40\%.}$ Consequently, $F_{50\%}$ and is considered as the appropriate harvest level. This rate can be further reduced by a precautionary “40-10 default OY” such that the further the stock is below $B_{40\%}$ the greater the reduction in harvest until at B10% all harvest is prohibited. Rebuilding plans are required for stocks falling below 25%.

Yield is projected for 5 years based on a $F_{50\%}$ SPR rate for three alternative recruitment scenarios; average recruitment across the time series, average recruitment in the most recent 10 years and estimated recruitment from S-R relationship. Projected yield provides the basis of the decision table.

Northern California Base Model

Five-year biomass and yield projections are summarized in Table 16. Current spawning biomass level is estimated to be 6.8% of the unfished level.

Oregon Base Model

Five-year biomass and yield projections are summarized in Table 17. Current spawning biomass level is estimated to be 12.7% of the unfished level. Projected 2002 yield is for all alternate recruitment scenarios is approximately 7 mt increasing to 11 mt by 2006.

Washington

Sport and Commercial catch data were appended to the Oregon base model to provide an additional forecast for comparative purposes. The outcome assumes that the yelloweye population in Washington waters conforms to Oregon abundance trend and length composition data. The STAR panel reviewed neither this model nor the results (Table 18) and is only intended to provide management with an alternative yield scenario.

Management recommendations

Although management decisions have greatly restricted recent yelloweye rockfish catch, yield projections warrant further reductions. It is important to note that high market demand and price for yelloweye rockfish relative to other shelf species may cause fishers to concentrate their limited shelf rockfish opportunities on yelloweye in future years. Furthermore, because of specific rocky habitat requirement and patchy abundance, a broad area management approach for yelloweye rockfish is not recommended and may risk serial depletion.

Rebuilding Parameters

Northern California

A formal rebuilding analysis for yelloweye rockfish in northern California waters is not complete. The estimated virgin spawning stock size (B_o) is 1,074 mt. B target ($F_{50\%}$) is

537 mt and the ratio SSB_{2000}/B_o was 0.068. Mean generation time for an unfished population is 25 years.

Oregon

A formal rebuilding analysis for yelloweye rockfish in Oregon waters is not complete. The estimated virgin spawning stock size (B_o) is 1,432 mt. B target ($F_{50\%}$) is 716 mt and the ratio SSB_{2000}/B_o was 0.127.

Research needs

Additional effort to collect age and maturity data is essential for improved population assessment. Collection of these data may be necessary by onboard observers if this species becomes prohibited. Increased effort toward habitat mapping will provide information on the essential habitat and distribution for this species. Development of fishery independent indices will be necessary as allowable catch becomes restricted. Alternative methods for estimating biomass such as in-situ studies to estimate density are needed. A study of the role of MPAs in harvest management will be beneficial for sedentary species like yelloweye rockfish. Genetic study is required as a first step in delimiting stock boundaries for this species.

Acknowledgements

I would like to thank members of the stock assessment review (STAR) panel Erik Williams, Stephen Smith, Rick Stanley, John Geibel, Tom Jagielo (SSC) and Council advisory members Kelly Smotherland (GAP) and Dave Thomas (GMT) for making the meeting a valuable process. I would also like to thank Rick Methot for his insightful comments and assistance, Lynne Yamanaka (DFO) and Tory O'Connell (ADFG) for providing essential information concerning yelloweye life history and Deborah Wilson-Vandenberg for providing CPFV data. I am also grateful to Mark Wilkins and Mark Zimmermann (NMFS) for providing survey data, Don Bodenmiller and Mark Freeman (ODFW) for providing Oregon catch and effort data, and Don Pearson (NMFS) for providing catch, age and length data for California. There are also a great number of WDFW, ODFW and CDFG personnel who collected, documented and provided necessary information used in this stock assessment, which I would like to express thanks. I am also indebted to Jack Tagart for his valuable assistance in all aspects of this assessment.

Literature cited

Andrews, A.H., G. Cailliet, K. Cole, K. Munk, M. Mahoney and v. O'Connell. 2001. Radiometric age validation of the yelloweye rockfish (*Sebastes ruberrimus*) from southeastern Alaska. Manuscript recently submitted to the Indo-Pacific Fish Conference Proceedings.

Barss, W.H. 1989. Maturity and reproductive cycle for 35 species from the family Scorpaenidae found off Oregon. Portland, OR: Oregon Department of Fish and Game. Report No. 89-7. 36 p.

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

Gavaris, S. 1980. Use of a multiplicative model to estimate catch rate and effort from commercial data. Canadian Journal of Fisheries and Aquatic Science. Vol. 37: 2272—2275.

Heincke, F., 1913. Investigations on the plaice. Plaice Fisheries and Protective Measures. Report 1. Rapp. P-V. Reun. Cons. Perm. Int. Explor. Mer. 16. 67p.

Hoenig, J.M. 1983. Empirical use of longevity data to estimate mortality rates. Fish. Bull. 82(10):898-903.

Love, M.S., L. Thorsteinson, C.W. Mecklenburg, and T.A. Mecklenburg. *In Preparation (January 2000)*. A checklist of marine and estuarine fishes of the Northeast Pacific, from Alaska to Baja California. National Biological Service. Located at website http://id-www.ucsb.edu/lovelab/home.html

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.

MacCall A.D., S.Ralston, D. Pearson and E. Williams. 1999. Status of Boccaccio off California in 1999 and Outlook for the next Millennium. *In* Appendix to the Status of the Pacific Coast Groundfish Fishery Through 1999 and Recommended Acceptable Biological Catches for 2000 Stock Assessment and Fishery Evaluation. Pacific Fishery Management Council 2130 SW fifth Ave. Suite 224, Portland, Ore. 97210.

McClure, R.E. 1982. Neritic reef fishes off central Oregon: Aspects of life histories and the recreational fishery. M.S. Thesis, Oregon State University. 94 p.

Reilly, P.N. D. Wilson-Vandenberg, R.N. Lea, C. Wilson, and M. Sullivan. 1994. Recreational angler's guide to the common nearshore fishes of Northern and Central California. California Department of Fish and Game, Marine Resources Leaflet.

Ricker, W.E. 1975. Computation And interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191 p.

Robson, D.S. and D.G. Chapman, 1961. Catch curves and mortality rates. Trans. Am. Fish. Soc. 90(2): 181-189

Rogers, J.B., M. Wilkins, D. Kamakawa, F. Wallace, T. Builder, M. Zimmerman, M. Kander and B. Culver. 1996. Status of the Remaining Rockfish in the Sebastes Complex in 1996 and recommendations for management in 1997. Pacific Fishery Management Council 2130 SW fifth Ave. Suite 224, Portland, Ore. 97210.

Rosenthal, R.J., L.J. Field, D. Myer. 1981. Survey of nearshore bottomfish in the outside waters of southeastern Alaska. Alaska Department of Fish and Game. 91 p.

Rosenthal, R.J., L. Haldorson, L.J. Field, V. Moran-O'Connell, and M.G. LaRiviere. 1982. Inshore and shallow offhshore bottomfish resources in the southeastern Gulf of Alaska. Alaska Coastal Research. 166 p.

Rosenthal, R.J., V. Moran-O'Connell, and M.C. Murphy. 1988. Feeding ecology of ten species of rockfishes (Scorpaenidae) from the Gulf of Alaska. California Department of Fish and Game 74(1):16-37.

Tagart J.V., F. Wallace and J. Ianelli. 2000. Status of the yellowtail rockfish resource in 2000. *In* Appendix to the Status of the Pacific Coast Groundfish Fishery Through 2000 and Recommended Acceptable Biological Catches for 2001 Stock Assessment anf Fishery Evaluation. Pacific Fishery Management Council 2130 SW fifth Ave. Suite 224, Portland, Ore. 97210.

Tagart J.V. and D.K. Kimura. 1982. Review of Washington's coastal trawl fisheries. Wash. Dept. Fisheries Tech. Rept. No. 68, 66p.

Washington, P.M., R. Gowan, and D.H. Ito. 1978. A biological report on eight species of rockfish (*Sebastes* spp.) from Puget Sound, Washington. NOAA/NMFS, Northwest and Alaska Fisheries Center Processed Report, Reprint F, 50 p.

Yamanaka, L., R. Withler, and K. Miller. 2001. Limited genetic structure in yelloweye rockfish (*Sebastes rubberimus*) populations of British Columbia. Abstract, 11th Western Groundfish Conference, April 24-28, 2000, Sitka, Alaska, p. 123.

Yamanaka, K.L. and A.R. Kronlund. 1997. Inshore rockfish stock assessment for the west coast of Canada in 1996 and recommended yields for 1997. Canadian Technical Report of Fisheries and Aquatic Sciences No. 2175, 80 p.

Table 1. Estimated yelloweye rockfish catch by state and fishery from 1972-2000.

Coastal Washington, Oregon and California Yelloweye Rockfish Landings

	S. California (PFMC Area1A)				N. California (PFMC Area's 1B&1C)				Oregon (PFMC Area 2A,2B,2C)				Washington (PFMC Area 3A,3B,3C)				Totals			
Year	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport	Trawl	Line	Other	Sport
1972									0				1.7				1.7	0.0	0.0	0.0
1975									0				2.8			4.7	2.8	0.0	0.0	4.7
1976									0				3.3			5.1	3.3	0.0	0.0	5.1
1977									0				0	0.9		10.4	0.0	0.9	0.0	10.4
1978									21.5				0	1.2		5.4	21.5	1.2	0.0	5.4
1979									54.7			49.1	2	4.0		0.0	56.7	4.0	0.0	49.1
1980				15.0	31.4	9.7	0.0	55.0	60.2			31.7	29.2	1.5	0	2.9	120.8	11.2	0.0	104.5
1981	6.1	166.4	29.9	3.0	50.3	42.4	4.4	44.0	93.7	0		36.7	2.8	0.8	0	4.2	152.9	209.6	34.3	87.9
1982	6.7	5.3	1.6	2.0	184.1	0.0	0.3	100.0	19.9	0	0.1	56.0	4.4	0.9	0	3.5	215.1	6.2	2.0	161.5
1983	0.0	3.0	0.5	12.0	52.7	0.0	0.8	38.0	150.6	0	26.8	63.8	33.2	1.2	0	5.9	236.5	4.2	28.1	119.7
1984	0.0	3.0	1.4	21.0	39.5	0.0	0.3	54.0	38.0	0	19.0	46.6	19.5	2.0	0	11.2	97.0	5.0	20.7	132.8
1985	0.0	2.7	0.5	16.0	4.7	0.5	0.0	105.0	70.2	0	21.7	23.3	31.4	6.3	0	8.4	106.3	9.5	22.2	152.6
1986	0.0	3.4	0.3	12.0	10.4	7.8	0.0	53.0	52.5	5.6	7.3	29.1	9.4	6.4	0	11.1	72.3	23.2	7.6	105.2
1987	0.0	5.3	1.2	0.0	10.2	15.0	1.3	76.0	48.6	8.6	16.9	31.5	22.9	8.1	0	12.5	81.7	37.0	19.4	120.0
1988	0.0	0.4	3.5	0.0	24.3	15.8	7.1	20.0	89.2	0	20.9	9.5	36.7	4.3	0	6.6	150.2	20.5	31.5	36.1
1989	0.0	1.2	3.2	1.0	9.3	24.6	3.1	59.0	97.3	0	72.2	17.6	99.0	2.5	0	12.7	205.6	28.3	78.5	90.3
1990	0.1	1.8	1.4	0.8	11.1	47.2	6.6	46.3	48.0	1.7	0.0	22.5	32.0	1.7	0	10.8	91.2	52.4	8.0	41.3
1991	0.0	6.2	1.2	0.5	12.8	105.8	0.0	33.5	82.6	31.8	0.0	22.8	37.7	1.8	0	14.8	133.1	145.6	1.2	51.6
1992	0.0	5.3	0.0	0.3	16.9	89.7	0.0	20.8	88.6	58	19.2	31.6	44.2	3.3	0	12.4	149.7	156.3	19.2	56.1
1993	0.7	7.7	0.0	0.0	8.1	42.5	0.1	8.0	90.9	63.7	28.7	25.0	44.7	9.0	0	11.1	144.4	122.9	28.8	49.1
1994	0.1	25.5	0.0	0.0	5.6	40.2	0.4	14.0	63.0	24.7	14.6	19.4	21.3	2.8	0	6.0	90.0	93.2	15.0	41.4
1995	0.1	19.5	0.0	0.0	5.6	34.7	0.1	12.1	194.9	23.4	10.6	18.0	16.7	0.1	0	8.1	217.3	77.7	10.7	32.1
1996	1.1	3.6	0.0	0.0	23.5	46.9	0.0	13.0	112.3	22.2	16.1	8.2	24.4	0.0	0	6.1	161.3	72.7	16.1	23.2
1997	0.0	3.1	0.0	0.0	10.9	52.4	0.4	16.0	132.4	56.6	2.5	15.7	9.0	12.2	0	7.3	152.3	124.3	2.9	25.1
1998	0.1	2.1	0.0	0.0	5.2	14.4	0.0	6.0	15.3	30.1	0.1	17.3	4.7	0.7	0	9.0	25.3	47.3	0.1	32.3
1999	0.0	0.0	0.0	2.0	7.1	5.2	0.0	7.0	4.1	71.9	0.0	16.5	9.8	23.0	0	8.6	21.0	100.1	0.0	34.1
2000	0.0	0.0	0.0	0.0	0.5	0.3	0.0	2.0	0.1	4.2	0.0	8.2	0.2	7.7	0	9.4	0.8	12.2	0.0	19.6
Mean ('81-'00)	0.8	13.3	2.2	3.5	24.6	29.3	1.2	36.4	74.6	20.1	14.6	26.0	25.2	4.7	0.0	9.0	125.2	67.4	17.3	70.6
Last 10 y	0.2	7.3	0.1	0.3	9.6	43.2	0.1	13.2	78.4	38.7	9.2	18.3	21.3	6.1	0.0	9.3	109.5	95.2	9.4	36.5
Last 5 y	0.2	1.8	0.0	0.4	9.4	23.8	0.1	8.8	52.8	37.0	3.7	13.2	9.6	8.7	0.0	8.1	72.1	71.3	3.8	26.8

Note on sport data: I used MRFSS estimates for California sport catch with the following exceptions; No data collected 1991-1992 and data for these years are interpolated between 1989 and 1993 catch
collected during wave 1 in 1995 so 1994 wave 1 estimate used. Oregon sport data supplied by ODFW and Washington catch data provided by WDFW Ocean Sampling Program.
No catch estimates are availible for empty cells.

Table 2. Yelloweye rockfish von Bertalanffy growth function parameters (cm) by Area and sex.

von Bertalanffy Growth Parameters

	Males						Females						Combined Sexes					
Area	**Linf**	**K**	**t_0**	**t_{20}**	**t_{40}**	**N**	**Linf**	**K**	**t_0**	**t_{20}**	**t_{40}**	**N**	**Linf**	**K**	**t_0**	**t_{20}**	**t_{40}**	**N**
California	67.3	0.054	-5.0	49.9	61.4	50	66.3	0.048	-7.8	49.0	59.7	79	65.4	0.052	-7.1	49.2	59.6	160
Neah Bay, Washington	70.6	0.045	-6.2	49.0	61.8	173	68.0	0.043	-8.2	47.7	59.4	176	68.6	0.046	-6.5	48.4	60.6	349
Top Knot, N. Vancouver Is.[1]	70.6	0.046	-5.2	48.5	61.8	131	67.2	0.044	-7.0	46.7	58.7	159						
Triangle, N. Vancouver Is. [1]	64.4	0.075	-0.6	50.7	61.3	292	64.9	0.058	-2.6	47.4	59.4	206						
St. James, S. Queen Charlotte [1]	68.1	0.055	-4.9	50.8	62.3	292	71.5	0.036	-13.0	49.7	60.9	319						
Tasu, S. Queen Charlotte [1]	75.0	0.039	-9.9	51.6	64.3	195	66.5	0.054	-5.5	49.7	60.8	238						
Bowie Seamount (Bright)[1]	80.3	0.045	-6.2	55.6	70.3	143	82.8	0.037	-7.6	53.0	68.6	121						
Bowie Seamount[2]	79.3	0.043	-6.0	53.8	68.6	240	82.4	0.035	-7.8	50.9	66.6	228	81.0	0.038	-7.1	52.3	67.7	468
SE Alaska[3]	64.4	0.051	-5.4	46.9	58.1	1112	65.9	0.037	-11.6	45.6	56.3	1091	64.4	0.046	-7.6	46.2	57.1	2203

[1] Yamanaka et.al., 2001
[2] Combined dark and bright phenotypes
[3] O'Connel et.al., 2000

Table 3. Length and age at 50% maturity for yelloweye rockfish by area and source.

		Male		Female	
Source	**Area**	**A_{50}**	**L_{50}**	**A_{50}**	**L_{50}**
O' Connell et.al. 2000	SE Alaska	23	50	21	45
Rosenthal et.al., 1982	SE Alaska	-	52-60	-	50-52
Kronlund and Yamanaka, 2000	Queen Charolotte Is.	-	-	18.9-20.3	48.5-49.1
Kronlund and Yamanaka, 2000	Vancouver Is.	-	-	16.5-17.2	42.1-42.4
Barss, 1989	Oregon	-	45	-	41
McClure, 1982 [1]	Oregon	12	56	11	45
Reilly et al. 1994 [2]	California		40		40
Watters, 1992 [1]	California	7	40	7	40

[1] Surface age reading of otoliths
[2] Sex unspecified

Table 4. Catch curve estimates of natural mortality.

Ricker Catch Curve Analyses

Area	Year	Age Range	Combined Sexes	Males	Females
Neah Bay, Washington	2000	16-34	0.076	0.060	0.083
		17-34	0.065	0.049	0.074
		18-34	0.048	0.036	0.056
		19-34	0.048	0.049	0.049
Bowie Seamount [1]	1999	19-46	0.025	0.021	0.033
		20-46	0.011	0.008	0.020
		21-46	-0.003	-0.007	0.009
Bowie Seamount-bright [2]	1999	>=20, 5yr Bins	-	0.086	0.043
SE Alaska [3]	1988	36-96,2yr Bins	0.02	-	-

[1] Data provide by Yamanaka, DFO Canada

[2] Yamanaka ,2000

[3] O'Connel et.al., 2000

Table 5. Natural mortality estimates derived from maximum age (Hoenig, 1983).

Empiracle use of longevity data to estimate natural mortality (Hoenig,1983)

			Sexes Combined				Males				Females			
Area	Year	Gear	Mean	Max	Mortality	N	Mean	Max	Mortality	N	Mean	Max	Mortality	N
California	77-85	Sport	25.8	122	0.038	163								
Neah Bay, Washington	98-00	Sport	25.8	87	0.053	296	25.2	79	0.058	152	26.6	87	0.053	144
N. Vancouver Island	97-98	Set Line	23.8	95	0.048	1129	23.8	109	0.042	577	24.9	94	0.049	552
Queen Charelotte	97-98	Set Line	24.3	115	0.040	1407	22.6	95	0.048	716	25.2	89	0.051	684
Bowie Seamount	99	Set Line	28.6	99	0.046	851	26.9	92	0.050	427	30.4	99	0.046	424
SE Alaska														

Note: Natural mortality was estimated using Hoenig's "all groups" a and b parameters.

Table 6. Number of fish sampled for length by State and fishery.

Number of fish sampled for length.

	California				Oregon			Washington		
Year	Hook	Other	Trawl	Sport	Hook	Trawl	Sport	Trawl	Sport	Total
1978	0	0	15	81	0	0	0	0	0	96
1979	3	1	5	119	0	0	0	0	0	128
1980	8	0	11	124	0	0	25	0	58	226
1981	2	0	3	83	0	0	13	0	46	147
1982	0	0	8	106	0	0	54	0	24	192
1983	0	0	22	105	0	0	17	0	23	167
1984	0	0	18	169	0	0	137	0	40	364
1985	0	0	11	300	0	0	98	0	28	437
1986	7	3	13	206	0	0	37	0	0	266
1987	3	1	22	98	0	0	39	0	30	193
1988	3	5	13	317	0	0	38	0	3	379
1989	22	21	8	385	0	0	80	0	0	516
1990	4	14	10	89	0	0	0	0	0	117
1991	209	0	15	112	0	0	0	0	0	336
1992	440	40	13	164	0	0	0	0	0	657
1993	650	30	30	236	0	0	148	0	1	1095
1994	736	7	12	250	0	0	151	0	1	1157
1995	370	6	13	199	58	40	110	0	12	808
1996	471	7	63	239	115	46	73	266	8	1288
1997	284	2	14	250	78	178	98	118	1	1023
1998	45	8	9	125	21	82	147	40	46	523
1999	488	0	19	88	101	76	246	45	95	1158
2000	0	28	0	26	121	3	4	361	176	719
	3745	173	347	3871	494	425	1515	830	592	11992

Table 7. Number of fish sampled for age by state and fishery.

Number of fish sampled for Age

	California		Washington	
Year	Commercial	Sport	Sport	Total
1977	2	47		49
1978	8	38		46
1979		18		18
1980	17	10		27
1981	11	28		39
1982	10	20		30
1983	12	5		17
1984	20	4		24
1985	34	5		39
1986	4			4
1987				
1988				
1989				
1990				
1991				
1992				
1993				
1994				
1995				
1996				
1997				
1998			25	25
1999			95	95
2000			176	176
	118	175	296	589

Table 8. Northern California catch-at-length for combined gear.

Year	Length (cm)												
	25	26	27	28	29	30	31	32	33	34	35	36	37
1978	0	0	0	0	20	0	20	80	20	20	40	0	80
1979	0	0	44	0	0	0	87	131	44	44	175	87	44
1980	325	0	108	0	217	217	0	434	217	217	650	434	434
1981	750	0	0	0	0	0	375	0	375	375	750	1125	1125
1982	211	211	0	0	0	211	211	423	423	211	211	846	211
1983	187	0	0	560	560	560	746	560	560	373	0	187	373
1984	425	170	340	425	170	595	340	680	425	255	595	170	170
1985	991	434	186	558	496	558	558	929	805	124	619	805	743
1986	316	127	127	443	127	253	253	316	380	569	316	316	633
1987	253	126	0	253	126	505	505	253	253	253	253	379	379
1988	821	164	164	547	602	328	656	274	602	821	766	328	602
1989	274	164	219	384	658	439	603	603	768	1042	1206	1042	1097
1990	1035	148	148	148	444	0	0	444	444	1035	591	887	887
1991	238	0	79	79	159	317	159	793	476	635	873	1348	635
1992	435	348	261	87	174	565	826	261	913	695	739	913	739
1993	408	299	354	681	599	517	626	1007	871	871	653	844	1089
1994	206	79	206	158	332	396	348	491	538	728	617	633	680
1995	330	124	289	330	413	619	619	909	661	785	330	1280	1074
1996	550	150	300	325	325	500	550	525	650	625	550	600	951
1997	809	405	162	283	445	405	405	769	607	607	1052	526	971
1998	133	0	44	133	133	178	0	178	311	178	222	178	489
1999	94	37	112	75	75	56	94	187	187	374	374	225	393
2000	0	127	64	64	0	127	0	0	64	0	127	64	0

Year	38	39	40	41	42	43	44	45	46	47	48	49	50
1978	20	20	0	0	60	0	40	40	60	80	100	20	159
1979	437	87	44	0	87	44	87	44	131	0	87	87	87
1980	434	542	650	542	325	434	108	325	976	434	325	325	325
1981	1125	750	750	375	2251	3376	750	1125	1876	1125	750	375	1125
1982	1057	846	0	634	1268	634	211	634	634	423	634	634	423
1983	373	560	560	1119	560	746	746	1119	560	560	1493	187	560
1984	765	510	765	680	595	340	255	340	340	425	255	85	255
1985	743	867	496	1053	496	434	496	310	496	619	248	434	496
1986	759	633	1076	506	506	127	696	316	506	443	569	316	63
1987	379	505	253	0	758	885	253	253	379	379	379	379	505
1988	602	711	602	602	547	492	219	547	438	328	274	492	383
1989	1042	987	1097	768	713	877	822	768	548	768	877	548	603
1990	887	2218	591	887	739	887	148	444	296	148	148	148	296
1991	714	1348	1111	555	1190	793	714	1666	1031	1348	397	714	476
1992	956	956	1217	1260	1043	1565	1652	956	869	739	1130	652	826
1993	844	790	1198	817	980	1144	844	1035	817	490	681	708	817
1994	538	696	680	696	633	807	744	617	554	617	459	570	285
1995	950	950	826	1198	1156	1322	826	826	1115	867	537	661	578
1996	1151	1001	1101	951	826	650	801	776	525	450	625	500	375
1997	890	1092	526	566	485	809	769	688	485	930	971	728	647
1998	267	311	267	133	400	311	444	578	489	311	222	311	178
1999	393	412	655	580	637	562	487	599	562	393	356	468	356
2000	64	64	0	64	127	127	191	381	64	127	381	64	64

Table 8. Northern California catch-at-length for combined gear (continued).

Year	Length (cm)												
	51	52	53	54	55	56	57	58	59	60	61	62	63
1978	100	100	100	80	119	139	100	40	60	40	100	0	0
1979	219	437	393	262	262	0	131	393	262	131	131	262	175
1980	325	650	650	217	542	325	434	217	217	542	434	542	434
1981	1501	1876	2251	375	375	750	375	0	1125	375	750	0	375
1982	846	1268	1057	634	423	423	211	846	1057	423	211	846	846
1983	933	1119	933	187	187	933	746	0	187	187	1119	187	560
1984	255	425	595	510	255	595	340	170	255	595	85	0	255
1985	0	310	186	124	186	186	248	248	248	248	248	619	62
1986	316	443	253	253	127	569	190	127	380	127	190	253	127
1987	505	632	632	253	379	1011	253	1011	379	0	379	126	0
1988	328	821	328	602	328	602	328	274	274	219	383	55	219
1989	713	384	548	603	219	274	384	219	274	439	219	219	55
1990	0	148	296	148	148	887	444	0	148	296	148	0	0
1991	793	635	1111	555	793	793	793	952	317	317	635	397	79
1992	826	1043	782	652	652	608	478	522	565	348	130	522	87
1993	545	545	735	490	354	463	191	354	463	354	163	381	163
1994	380	269	190	285	174	79	158	95	127	158	95	142	95
1995	661	372	454	454	496	372	330	289	248	83	83	330	83
1996	475	425	400	175	275	225	175	225	175	225	125	25	75
1997	647	688	607	566	243	202	324	283	405	243	121	121	121
1998	133	178	311	267	178	178	44	178	133	0	0	44	44
1999	393	262	318	206	225	281	94	112	131	112	37	37	19
2000	191	127	127	64	191	64	64	0	0	64	0	64	64

Year	64	65	66	67	68	69	70	71	72	73	74	75+
1978	0	0	0	20	0	0	0	20	0	0	0	20
1979	175	175	87	87	0	0	0	0	44	44	0	44
1980	325	217	0	0	217	0	0	217	0	0	0	0
1981	1501	750	0	0	0	0	0	0	0	0	0	0
1982	1480	0	423	0	1057	211	211	0	0	0	0	423
1983	373	373	187	187	187	560	187	0	187	0	0	373
1984	255	255	85	85	0	255	0	0	0	85	85	85
1985	124	372	0	0	248	186	124	0	62	0	0	248
1986	63	63	0	63	63	63	0	0	0	0	0	127
1987	253	505	126	0	0	379	0	0	0	0	0	0
1988	274	164	109	164	55	0	0	0	55	0	0	0
1989	110	110	110	55	0	0	0	0	55	0	0	0
1990	148	296	148	0	0	0	0	0	0	0	0	0
1991	238	159	79	0	0	159	0	0	0	0	0	0
1992	217	87	130	43	43	43	0	0	0	0	0	0
1993	163	82	191	54	54	27	0	0	0	0	0	0
1994	190	63	16	32	16	0	32	0	0	0	0	0
1995	0	83	165	0	41	0	83	0	0	0	0	83
1996	50	50	50	25	0	0	0	0	0	0	0	0
1997	243	81	40	81	40	81	0	0	0	0	0	81
1998	44	44	0	44	44	44	0	0	0	0	0	0
1999	19	19	37	19	0	19	19	0	19	0	0	19
2000	0	0	0	0	64	0	0	0	0	0	0	0

Table 9. Oregon catch-at-length for combined gear.

Year	Length (cm)												
	25	26	27	28	29	30	31	32	33	34	35	36	37
1980	96	0	0	0	0	287	0	96	0	0	96	0	0
1981	0	0	0	0	0	0	0	574	1147	574	0	0	574
1982	0	0	381	381	762	762	381	762	1143	762	381	1905	0
1983	2594	0	0	0	0	0	2594	0	0	0	2594	0	0
1984	981	490	245	245	736	490	1962	1962	1962	245	1226	2452	1717
1985	0	324	973	649	973	0	649	1622	649	649	1622	973	2271
1986	1606	0	0	0	535	535	0	535	0	0	535	535	0
1987	0	0	609	609	609	0	0	0	1828	609	0	1218	609
1988	0	0	1506	502	502	502	0	1506	502	502	1004	0	0
1989	1842	790	0	263	790	526	1053	263	526	526	526	263	790
1993	1178	841	505	1514	1178	2019	1178	1346	673	2355	1682	1009	841
1994	851	426	638	1490	1277	2128	1064	1915	3192	1702	1702	638	2128
1995	427	0	107	427	853	213	640	640	1813	640	1173	1813	427
1996	751	0	150	451	300	150	901	2253	1652	1352	1953	1802	3004
1997	430	215	323	323	538	1291	645	1076	1613	2151	1721	2581	2796
1998	270	135	405	405	540	675	810	270	2025	1485	1890	2700	945
1999	97	97	97	290	97	580	435	483	531	1063	1014	1111	1014
2000	0	246	246	246	246	984	246	984	984	984	2460	1476	1230

Year	38	39	40	41	42	43	44	45	46	47	48	49	50
1980	96	0	96	96	0	96	0	0	0	0	192	0	0
1981	0	0	0	574	0	574	0	574	574	0	0	0	0
1982	762	381	0	0	762	1524	762	762	762	381	762	1524	1143
1983	0	7781	0	5188	0	5188	0	2594	2594	2594	2594	0	0
1984	1962	2697	490	981	1226	736	736	981	490	245	490	245	490
1985	973	649	973	324	1298	1622	1298	973	1947	2271	973	324	0
1986	535	0	535	535	535	1070	0	1070	535	1070	0	535	1606
1987	609	1218	609	609	1828	0	0	609	0	609	609	609	0
1988	1004	0	502	2008	1506	1004	1004	502	0	1004	0	502	0
1989	790	1053	526	1053	1053	263	790	526	526	526	790	790	263
1993	673	336	336	673	505	336	336	336	336	0	505	168	336
1994	1915	851	1064	638	851	426	638	1064	213	638	851	851	426
1995	747	640	747	427	853	427	1173	640	533	853	533	853	427
1996	2704	901	901	2103	2103	1051	451	601	601	601	601	300	901
1997	2689	2151	2151	1828	1721	1506	645	1291	1076	1076	860	215	753
1998	1485	1890	2160	1485	1215	2160	1485	675	1080	1080	1350	540	270
1999	918	918	1111	918	869	628	918	676	531	1014	483	483	580
2000	1968	1476	1968	1968	1722	738	984	1722	738	984	738	1230	738

Table 9. Oregon catch-at-length for combined gear (continued).

Year	Length (cm)												
	51	52	53	54	55	56	57	58	59	60	61	62	63
1980	96	0	0	0	0	192	192	0	0	96	287	96	96
1981	0	0	0	574	0	0	0	574	0	0	0	0	0
1982	0	0	381	381	381	0	381	0	381	381	0	0	381
1983	0	2594	0	2594	0	0	2594	0	0	0	0	0	0
1984	245	736	981	245	0	245	490	490	736	0	245	490	245
1985	324	324	0	324	649	649	649	0	324	973	324	649	324
1986	0	1070	1070	535	535	0	535	0	535	0	0	1606	1070
1987	1828	1218	1828	0	609	609	609	0	609	609	609	0	609
1988	0	502	0	502	1004	502	502	0	0	0	502	0	0
1989	790	0	263	0	263	263	263	526	526	0	0	0	263
1993	336	168	673	168	336	336	168	336	0	168	168	168	0
1994	213	213	213	851	213	0	0	0	213	0	213	0	426
1995	533	107	427	427	320	320	533	640	213	213	213	0	0
1996	751	601	0	601	300	300	601	451	601	451	150	150	150
1997	538	860	323	215	645	108	215	323	108	215	215	108	0
1998	135	945	405	270	675	270	405	135	135	405	135	0	135
1999	435	386	580	241	386	290	145	241	193	241	97	48	0
2000	984	492	246	0	738	0	246	0	0	246	246	492	0

Year	64	65	66	67	68	69	70	71	72	73	74	75+
1980	0	0	0	0	192	0	0	0	0	0	0	0
1981	0	574	0	0	0	0	0	574	0	0	0	0
1982	0	0	0	0	0	0	381	0	0	0	0	381
1983	0	0	0	0	0	0	0	0	0	0	0	0
1984	245	490	245	245	245	0	0	0	245	0	245	0
1985	0	324	0	973	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	535	0	0	0	0
1987	0	609	0	0	0	0	0	0	0	0	0	609
1988	0	0	0	0	0	0	0	0	0	0	0	0
1989	0	0	0	263	0	0	263	0	0	0	0	263
1993	0	168	168	0	168	0	0	0	0	0	0	168
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	213	0	0	0	0	0	0	0	0	0	0	0
1996	150	451	0	150	150	0	0	150	150	150	150	0
1997	323	108	0	0	0	108	0	0	0	0	0	0
1998	135	0	0	135	0	0	0	0	0	0	0	0
1999	0	48	48	0	0	0	48	0	0	48	0	0
2000	0	0	246	0	0	246	0	0	0	0	0	0

Table 10. Estimated biomass (mt), coefficient of variation (CV) and number of positive tows by depth zone based on NMFS triennial trawl surveys, 1977-1998.

	California			Oregon			Washington			Canada		
YEAR	**Biomass**	**CV**	**Tows**	**Biomass**	**CV**	**Tows**	**Biomass**	**CV**	**Tows**	**Biomass**	**CV**	**Tows**
						Depth Zone 55-183m						
1977[a]	0		0	68	0.78	2	158	0.37	8	0		0
1980	25	1.00	1	234	0.65	11	76	0.77	7	5	0.55	5
1983	0		0	54	0.51	7	461	0.63	9	4	0.50	4
1986	299	0.70	2	136	0.47	6	154	0.32	28	0		0
1989	83	0.55	7	176	0.55	10	460	0.36	7	16	0.63	16
1992	11	0.65	4	213	0.58	11	98	0.32	10	11	0.43	11
1995	18	1.00	1	44	0.96	3	22	0.60	3	6	0.58	6
1998	0		0	24	0.75	3	60	0.37	5	9	0.50	9
						Depth Zone 184-366m						
1977[a]	0		0	0		0	23	0.61	3	0		0
1980	34	1.00	1	0		0	6	1.00	1	2	0.67	2
1983	4	1.00	1	126	0.58	4	49	0.75	5	0		0
1986	0		0	0		0	27	1.00	1	0		0
1989	1	1.00	1	12	1.00	1	2	0.79	1	1	1.00	1
1992	0		0	0		0	10	0.72	1	1	0.96	1
1995	0		0	0		0	0		0	0		0
1998	4	1.00	1	0		0	1	1.00	0	1	1.00	1
						Depth zone 367-475						
1977[a]							52	0.60	3			

[a] Shallow depth zone did not include waters less than 91 m.

Table 11. Yelloweye CPUE indices by area and data source

Yelloweye CPUE indices.

Data Source: State:	MRFSS[1] N.California	CPFV[2] N.California	ODFW Oregon[3]	WDFW Washington [5]
1980	11.5		21.6	
1981	16.3		21.0	
1982	35.9		26.6	
1983	30.3		39.3	
1984	22.0		23.6	19.4
1985	25.0		21.6	13.1
1986	16.7		20.7	11.6
1987	17.3		28.5	11.0
1988	6.3	37.5		8.2
1989	10.7	42.2		15.1
1990		38.0		12.6
1991		51.7		17.3
1992		33.3		13.8
1993	2.9	29.3		13.7
1994	6.8	27.8	14.7	8.4
1995	5.0	23.6	11.5	9.6
1996	4.4	22.3	5.9	8.8
1997	3.0	19.2		9.7
1998	3.9	18.0	10.4	11.2
1999	3.6		6.7	7.3
2000	2.3		3.2	10.4

[1] Yelloweye catch per 100 anglers for sampler examined boat-based trips where rockfish are the primary target and present in catch.

[2] Yelloweye catch per 1000 angler hours of onboard observed sport fishing trips.

[3] Yelloweye catch per 100 estimated bottomfish angler trips.

[4] Yelloweye catch per 100 estimated bottomfish and halibut angler trips.

Table 12. Sampled and expanded yelloweye catch by station in the 1999 IPHC Survey.

1999 IPHC Survey			
Station	State	# of Yelloweye Sampled	# of Yelloweye Per Station
1031	Oregon	7	35
1027	Oregon	19	95
1024	Oregon	24	120
1020	Oregon	8	40
1010	Oregon	4	20
1081	Washington	1	5
1084	Washington	1	5
1049	Washington	3	15
Total		67	335

Table 13. Comparison between Department of Fisheries and Oceans (DFO, Canada) and Washington Department of Fish and Wildlife (WDFW) age readings.

Age Bin	Mean Age	N	Mean Deviation	STD	Predicted STD	Calc Z	Probability of Z > Calc Z	Proportion Misaged
DFO (vs) WDFW Age Readings								
9-13	12.4	7	1.00	1.53	1.56	0.32	0.3745	74.9%
14-18	16.5	13	0.69	1.32	1.70	0.29	0.3859	77.2%
19-26	22.9	14	-0.29	2.97	2.05	0.24	0.4052	81.0%
27-35	31.9	19	-0.42	2.34	2.31	0.22	0.4129	82.6%
40-48	43.1	21	-0.29	1.95	2.89	0.17	0.4325	86.5%
49+	59.1	26	-1.69	4.02	3.62	0.14	0.4443	88.9%

Table 14. Cumulative length frequencies (of the ascending limb) and predicted values of the logistic fit.

Fishery logistic selectivity at Length: S_L = 1/ (1+EXP($-\delta$ (Length - ϕ))

					Predicted			
Length	**AllFish**	**Sport**	**Trawl**	**Hook**	**AllFish**	**Sport**	**Trawl**	**Hook**
25	0.03	0.04	0.00	0.01	0.02	0.02	0.00	0.02
26	0.04	0.05	0.01	0.02	0.03	0.04	0.01	0.03
27	0.06	0.07	0.01	0.03	0.04	0.05	0.01	0.03
28	0.09	0.10	0.03	0.05	0.06	0.07	0.01	0.04
29	0.12	0.13	0.03	0.07	0.09	0.11	0.02	0.06
30	0.16	0.16	0.05	0.10	0.13	0.15	0.03	0.08
31	0.20	0.21	0.07	0.13	0.18	0.21	0.04	0.10
32	0.26	0.27	0.10	0.17	0.25	0.28	0.06	0.13
33	0.34	0.33	0.14	0.22	0.33	0.37	0.08	0.17
34	0.41	0.39	0.18	0.27	0.42	0.46	0.11	0.21
35	0.49	0.47	0.24	0.32	0.52	0.56	0.16	0.27
36	0.58	0.55	0.30	0.38	0.62	0.65	0.22	0.33
37	0.67	0.63	0.36	0.44	0.71	0.74	0.29	0.40
38	0.78	0.73	0.45	0.50	0.78	0.81	0.38	0.47
39	0.89	0.82	0.55	0.57	0.84	0.86	0.47	0.54
40	1.00	0.91	0.66	0.65	0.89	0.90	0.57	0.61
41	1.00	1.00	0.75	0.72	1.00	0.93	0.66	0.68
42	1.00	1.00	0.86	0.78	1.00	0.95	0.74	0.74
43	1.00	1.00	1.00	0.85	1.00	0.97	0.81	0.79
44	1.00	1.00	1.00	0.93	1.00	0.98	0.86	0.84
45	1.00	1.00	1.00	1.00	1.00	0.99	0.90	0.87
46	1.00	1.00	1.00	1.00	1.00	0.99	0.93	0.90
47	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.93
48	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94
49	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96
50	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.97
51	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98
52	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98
53	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
54	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
55	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
56	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
57	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
58	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
59	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S_l parameter δ	0.37367	0.395662	0.389796	0.293931				
S_l parameter ϕ	35.888696	34.38145	39.261	38.41375				
$L_{inflection}$	36	35	40	39				

Table 15. Model fit to three selectivity scenarios including 1) double logistic for both fisheries, 2) double logistic for commercial and logistic for sport and 3) logistic for both fisheries.

Likelihood	**Force Asymptotic Selectivity?**		
Component	**None**	**Sport**	**Sport and Commercial**
Total	-904.1	-1100.6	-1114.2
Sport Length Comps.	-632.5	-779.7	-737.7
Commercial Length Comps.	-266.8	-272.1	-322.3
CPUE Index	-5.5	-19.3	-21.5

Table 16. Projected yield ($F_{50\%}$) with and without 40/10-policy reduction for northern California yelloweye rockfish based on three recruitment scenarios.

Northern California yelloweye yield forecast with no 40/10 reduction (SPR rate of 0.50).

					Yield		
Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Total	Sport	Commercial
Average recruitment across time series.							
2002	211	79	43	0.037	7.8	3.9	3.9
2003	230	81	43	0.036	8.3	4.2	4.1
2004	251	85	43	0.035	8.8	4.5	4.3
2005	273	89	43	0.035	9.5	4.8	4.7
2006	296	95	43	0.034	10.2	5.2	5.0
Average recruitment of last 10 years.							
2002	211	78	20	0.036	7.6	3.8	3.8
2003	220	80	20	0.036	7.9	4.0	3.9
2004	229	83	20	0.036	8.2	4.1	4.1
2005	238	86	20	0.036	8.5	4.3	4.2
2006	248	89	20	0.036	8.8	4.4	4.4
Recruitment estimated from a Beverton-Holt stock recruitment relationship.							
2002	211	78	22	0.036	7.6	3.8	3.8
2003	221	80	22	0.036	7.9	4.0	3.9
2004	231	83	22	0.036	8.2	4.1	4.1
2005	242	86	22	0.036	8.6	4.3	4.3
2006	252	89	22	0.036	9.0	4.5	4.4

[1] Recruitments in 1,000's of age 3 recruits.

Northern California yelloweye yield forecast with 40/10 reduction (SPR rate of 0.50).

					Yield		
Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Total	Sport	Commercial
Average recruitment across time series.							
2002	218	82	43	0.000	0.0	0	0
2003	244	88	43	0.000	0.0	0	0
2004	273	94	43	0.000	0.0	0	0
2005	304	102	43	0.000	0.0	0	0
2006	337	112	43	0.002	0.5	0.3	0.3
Average recruitment of last 10 years.							
2002	218	82	20	0.000	0.0	0	0
2003	234	87	20	0.000	0.0	0	0
2004	251	93	20	0.000	0.0	0	0
2005	269	99	20	0.000	0.0	0	0
2006	286	106	20	0.000	0.0	0	0
Recruitment estimated from a Beverton-Holt stock recruitment relationship.							
2002	218	82	22	0.000	0.0	0	0
2003	235	87	22	0.000	0.0	0	0
2004	253	93	22	0.000	0.0	0	0
2005	272	99	22	0.000	0.0	0	0
2006	291	106	22	0.000	0.0	0	0

[1] Recruitments in 1,000's of age 3 recruits.

Table 17. Projected yield ($F_{50\%}$) with and without 40/10-policy reduction for Oregon yelloweye rockfish based on three recruitment scenarios.

Oregon yelloweye yield forecast with no 40/10 reduction (SPR rate of 0.50).

Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Yield Total	Yield Sport	Yield Commercial
Average recruitment across time series.							
2002	497	194	61	0.031	15.4	8.3	7.1
2003	519	197	61	0.030	15.7	8.5	7.3
2004	543	199	61	0.030	16.1	8.8	7.4
2005	570	201	61	0.029	16.6	9.1	7.5
2006	599	203	61	0.029	17.2	9.5	7.6
Average recruitment of last 10 years.							
2002	497	194	33	0.031	15.3	8.2	7.1
2003	506	197	33	0.030	15.5	8.3	7.2
2004	515	199	33	0.030	15.7	8.4	7.2
2005	524	200	33	0.030	15.9	8.6	7.3
2006	534	201	33	0.030	16.1	8.7	7.4
Recruitment estimated from a stock recruitment relationship.							
2002	497	194	38	0.031	15.3	8.2	7.1
2003	508	197	38	0.030	15.5	8.3	7.2
2004	519	199	38	0.030	15.7	8.5	7.3
2005	531	200	38	0.030	16.0	8.7	7.3
2006	544	201	38	0.030	16.3	8.9	7.4

[1] Recruitment in 1,000's of age 3 recruits.

Oregon yelloweye yield forecast with 40/10 reduction (SPR rate of 0.50).

Year	Available Biomass	Spawning Biomass	Assumed [1] Recruitment	Exploitation	Yield Total	Yield Sport	Yield Commercial
Average recruitment across time series.							
2002	511	199	61	0.011	5.8	3.1	2.7
2003	543	206	61	0.012	6.6	3.6	3.0
2004	576	212	61	0.013	7.3	4.0	3.4
2005	612	218	61	0.013	8.1	4.4	3.7
2006	649	223	61	0.014	8.9	4.9	4.0
Average recruitment of last 10 years.							
2002	511	199	33	0.011	5.8	3.1	2.7
2003	529	206	33	0.012	6.5	3.5	3.0
2004	547	212	33	0.013	7.1	3.8	3.3
2005	565	217	33	0.014	7.7	4.1	3.5
2006	583	221	33	0.014	8.2	4.4	3.8
Recruitment estimated from a stock recruitment relationship.							
2002	511	199	38	0.011	5.8	3.1	2.7
2003	532	206	38	0.012	6.5	3.5	3.0
2004	552	212	38	0.013	7.1	3.8	3.3
2005	572	217	38	0.013	7.7	4.2	3.6
2006	593	222	38	0.014	8.3	4.5	3.8

[1] Recruitment in 1,000's of age 3 recruits.

Table 18. Projected yield ($F_{50\%}$) for the Oregon base model with Washington catch data appended and assuming mean recruitment across the time series.

Year	Available Biomass	Spawning Biomass	Assumed Recruitment	Exploitation	Yield Total	Yield Sport	Yield Commercial
No reduction in yield.							
2002	614	242	83	0.031	19.3	10.3	8.9
2003	642	246	83	0.030	19.6	10.6	9.0
2004	673	248	83	0.030	20.1	10.9	9.2
2005	707	250	83	0.029	20.6	11.3	9.3
2006	744	253	83	0.029	21.4	11.9	9.5
Yield reduced by 40/10 policy.							
2002	632	248	83	0.012	7.7	4.1	3.6
2003	671	257	83	0.013	8.6	4.6	4.0
2004	713	264	83	0.013	9.5	5.1	4.3
2005	757	271	83	0.014	10.4	5.7	4.7
2006	804	277	83	0.014	11.3	6.3	5.1

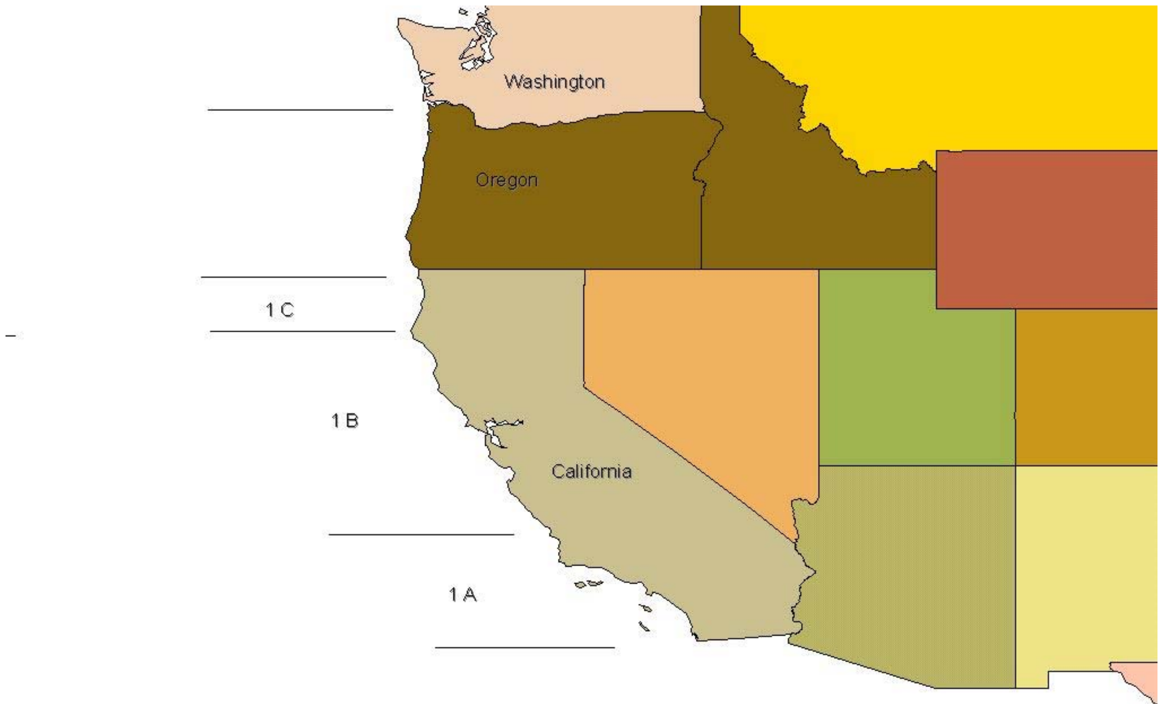
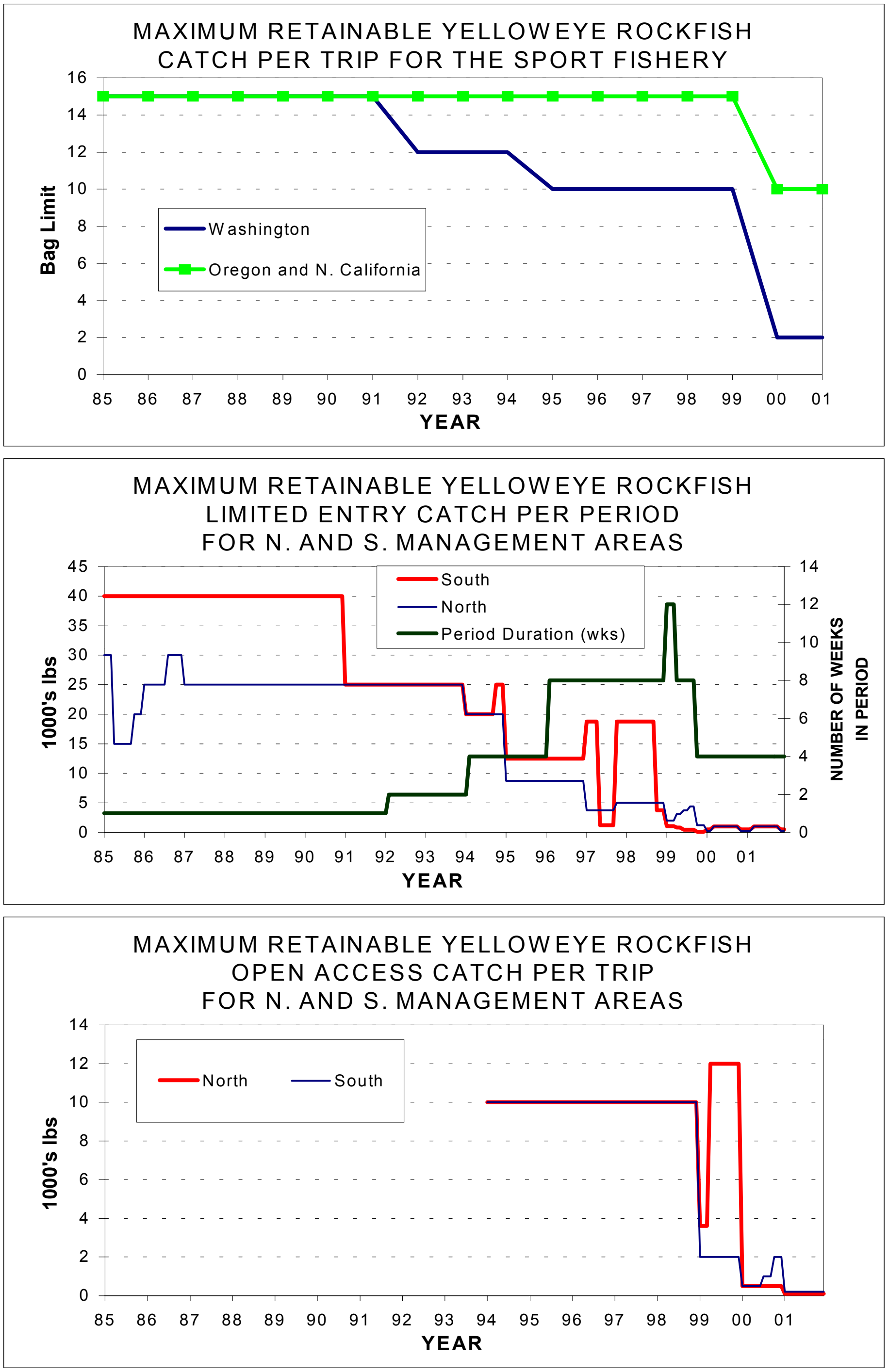


Figure 1. PFMC area codes for coastal California waters.



Note: The PFMC N/S Management border shifted North from Cape Mendencio to 40° 10' in 2000. Between Cape Mendocino and N of 36' N, recreational rockfish fishing is closed 3/1 - 4/30; S of 36' N, recreational rockfish fishing is closed 1/1 - 2/29

Figure 2. Yelloweye management history by fishery and area 1985-2000.

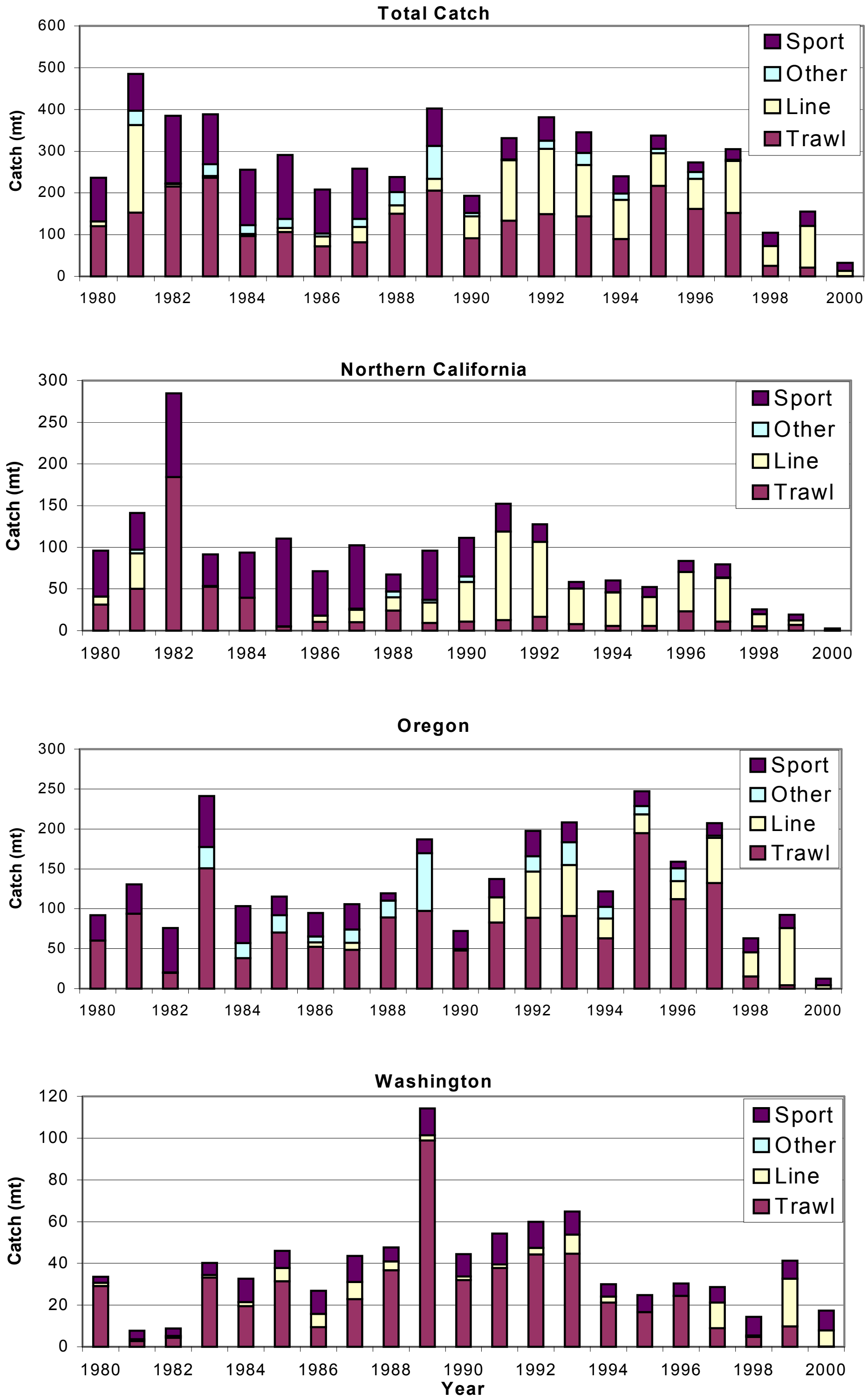


Figure 3. Yelloweye landings (mt) by fishery and state 1980-2000.

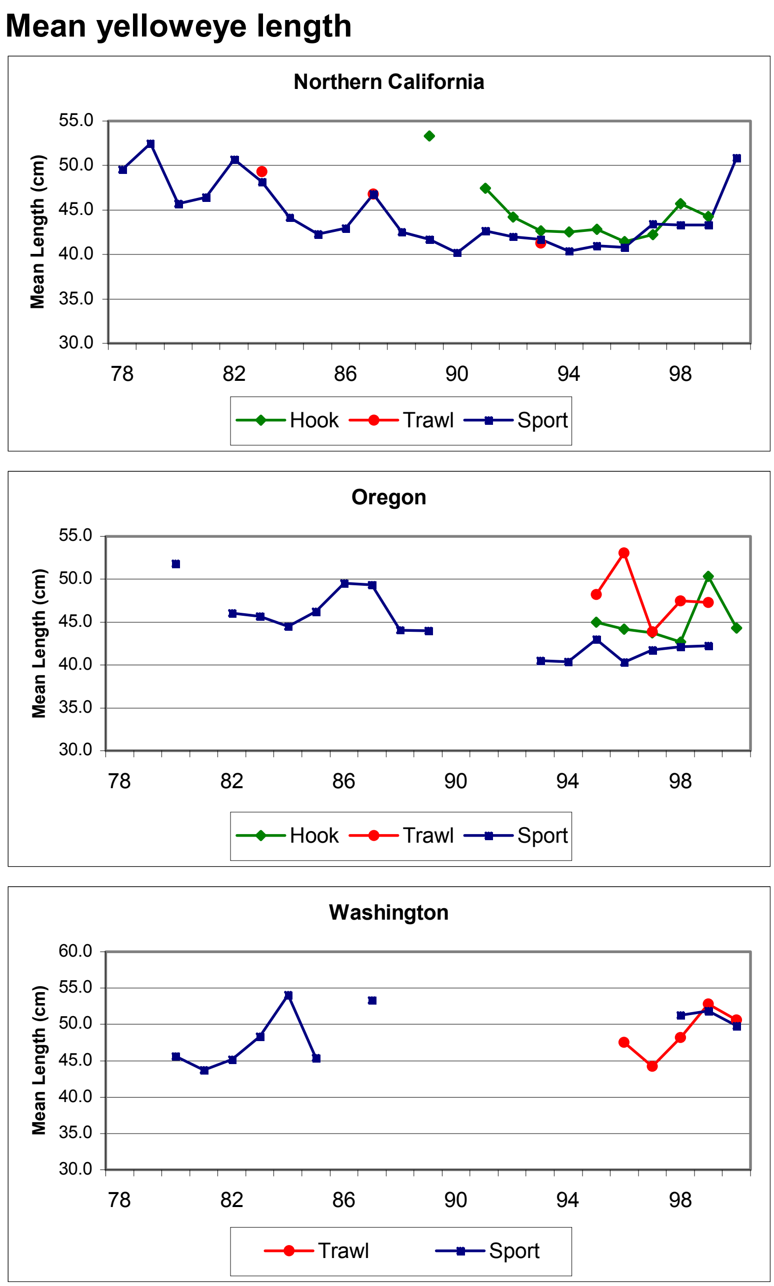


Figure 4. Time series of yelloweye mean length by fishery and state for years when more than 20 fish were sampled.

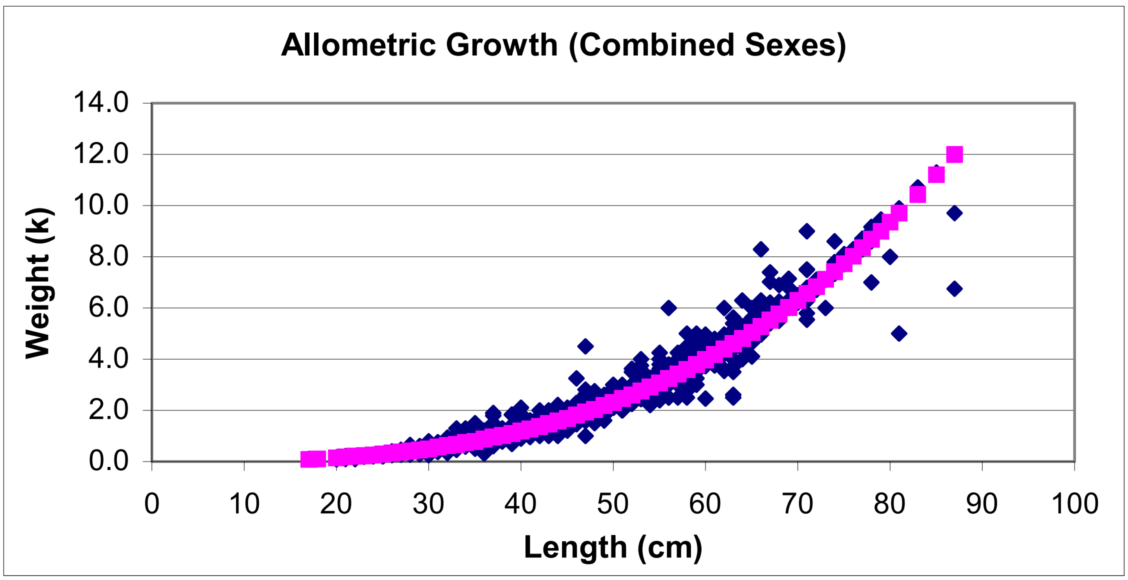


Figure 5. Yelloweye allometric growth for combined sexes (weight= $0.000021*\text{length}^{2.9659}$)

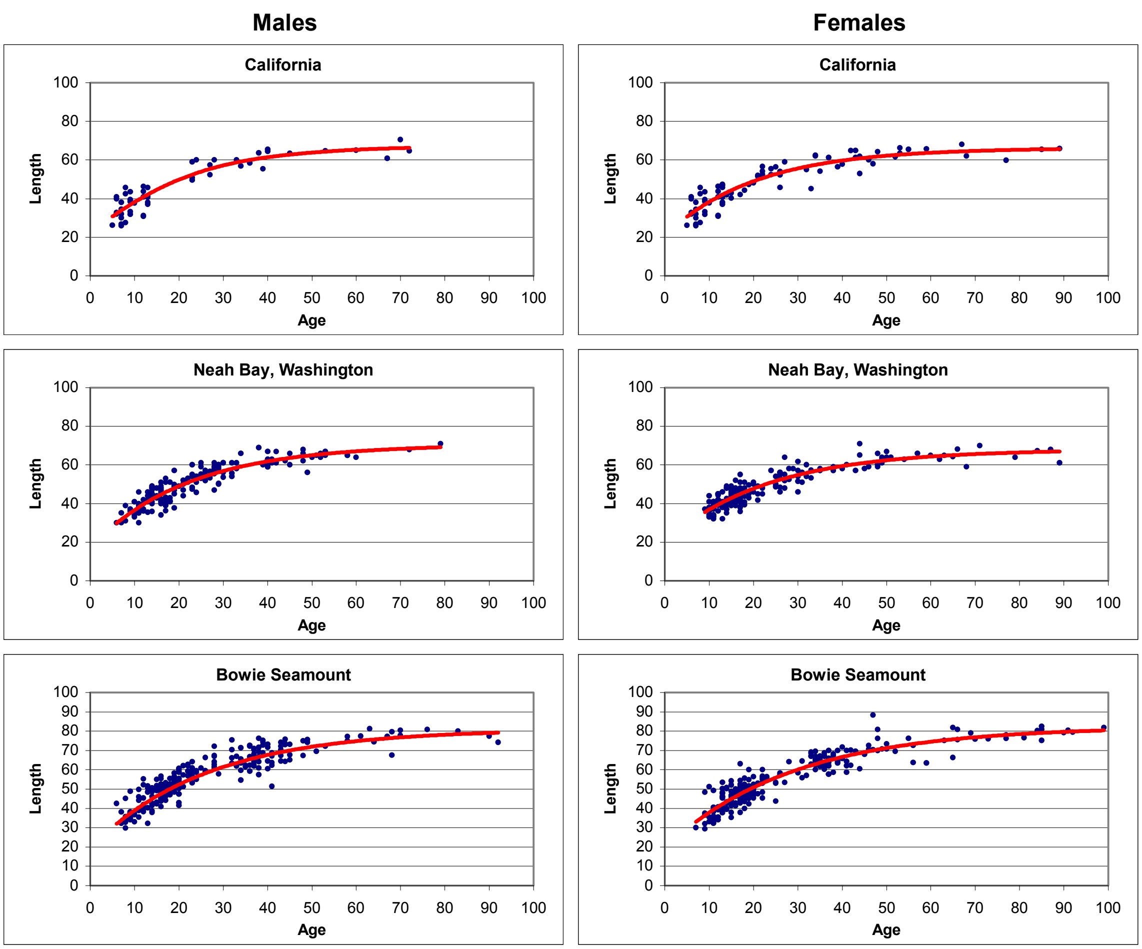


Figure 6. Observed and predicted Yelloweye rockfish length-at-age.

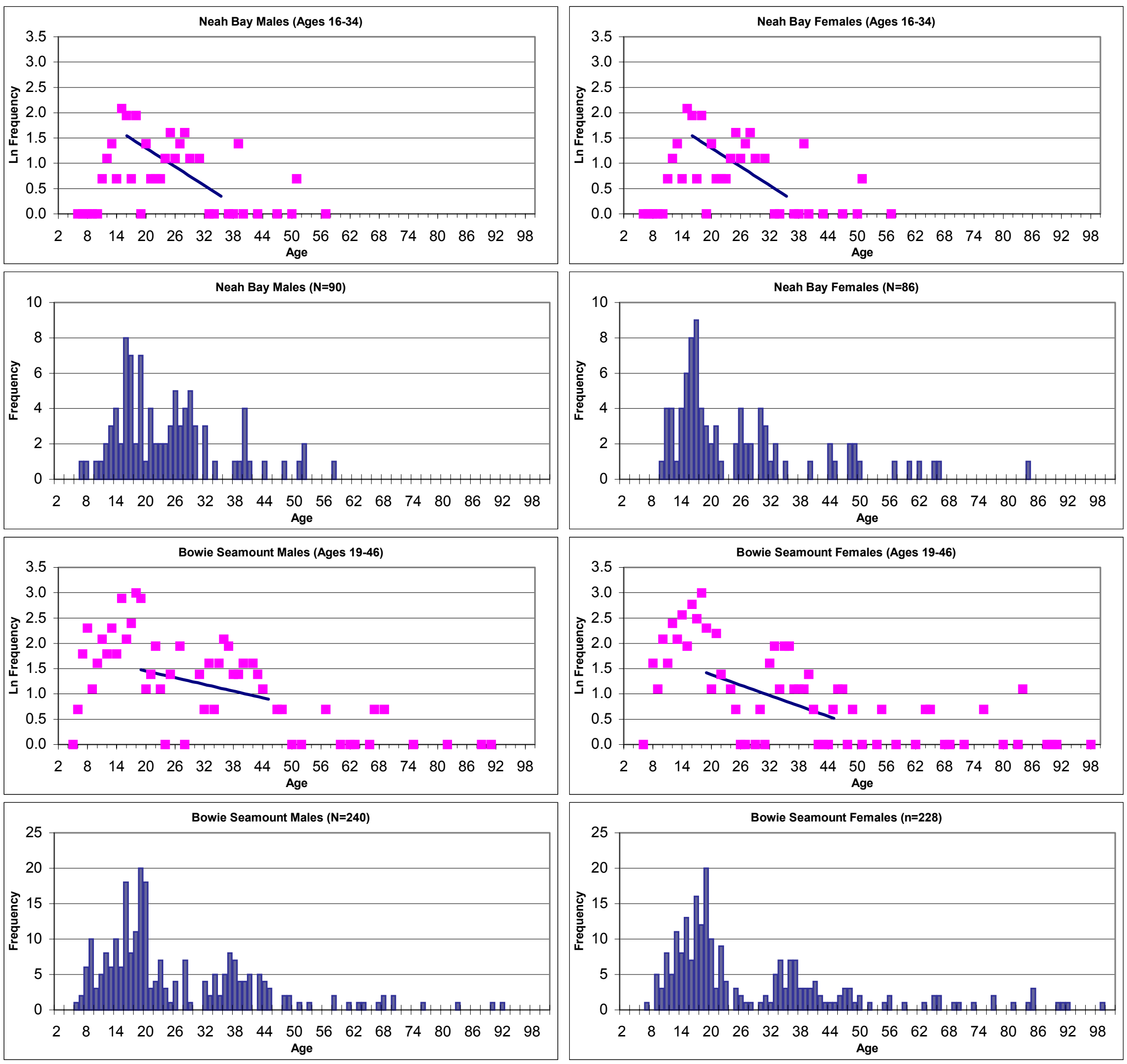
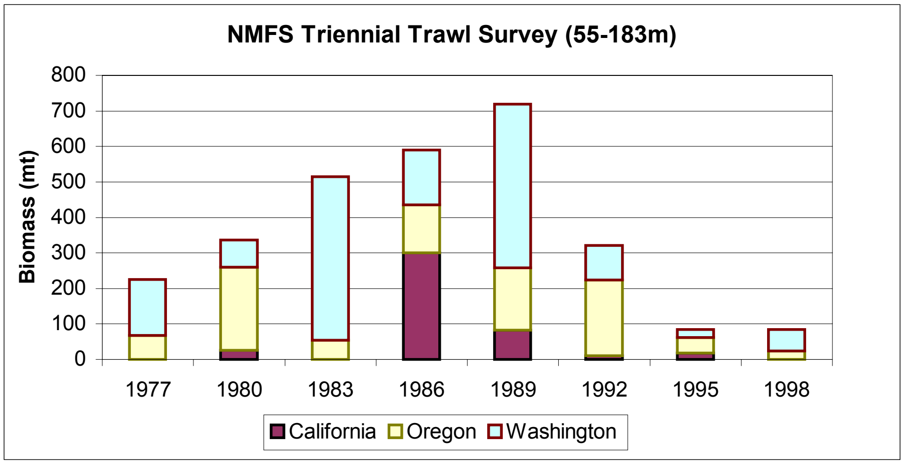
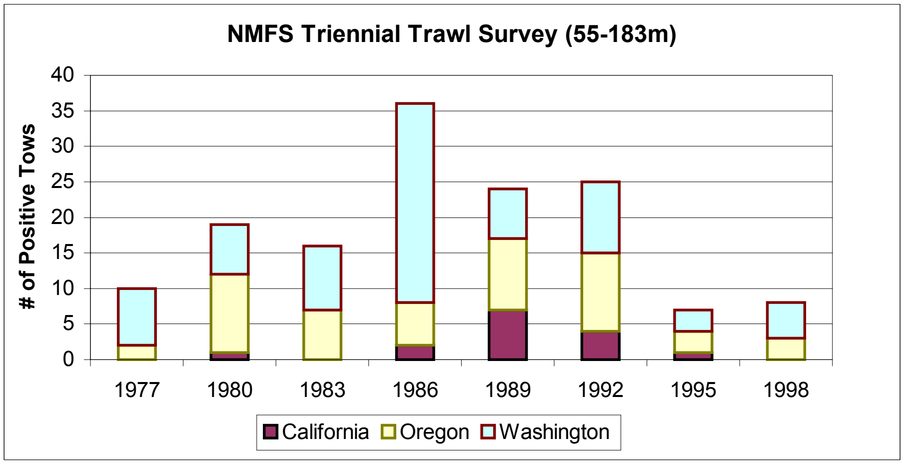
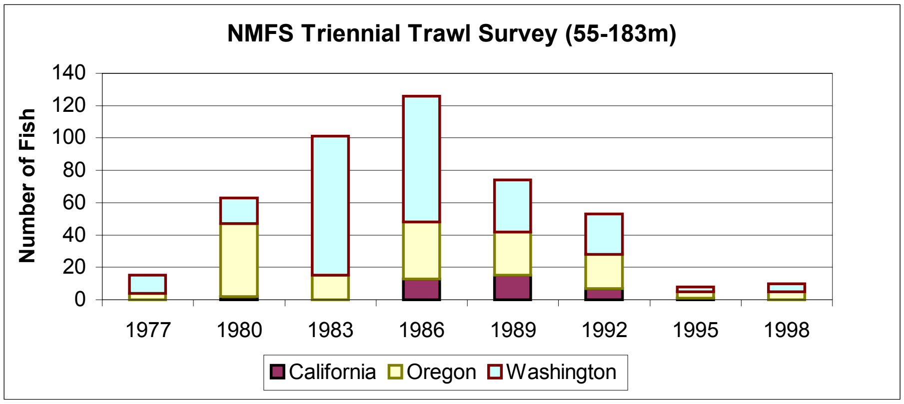


Figure 7. Plots of age frequency data and catch curve fits of a lightly exploited (Bowie Sea Mount, Queen Charlotte Islands, B.C.) and exploited (Neah Bay, Washington) yelloweye stock.







Note: In 1977, shallow depth zone did not include waters less than 91 m.

Figure 8. NMFS triennial survey estimated yelloweye biomass for depths between 55 and 182 meters (US portion only).

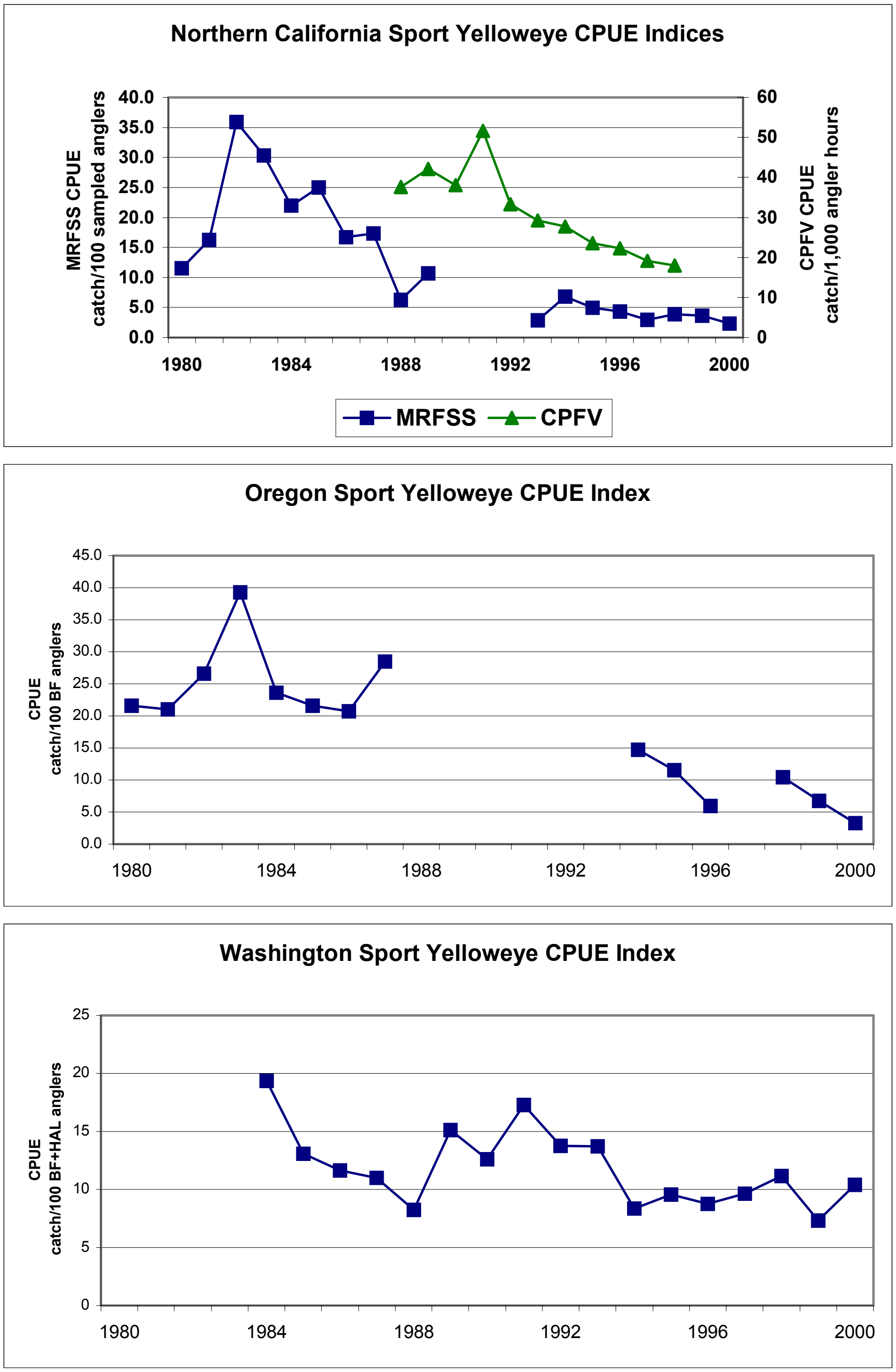
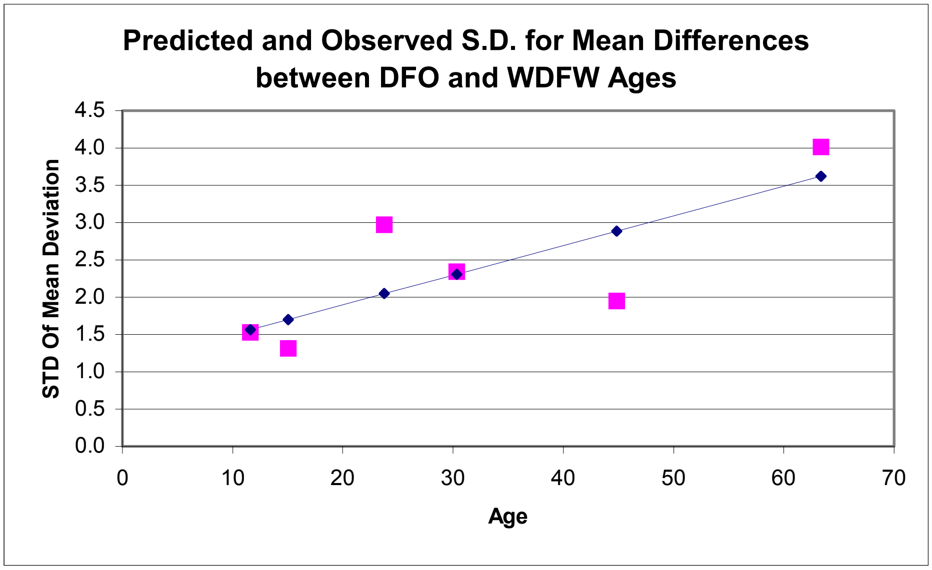


Figure 9. Time series of yelloweye CPUE indices by State. Northern California MRFSS CPUE corresponds to yelloweye catch per 100 sampled angler boat-based trips targeting and landing rockfish. Northern California CPFV CPUE represents GLM marginal means (year effect) for on-board observed yelloweye catch per 1,000 angler hours. Oregon yelloweye CPUE (ODFW) for 100 angler trips targeting bottomfish and Washington CPUE for 100 angler trips targeting halibut or bottomfish.



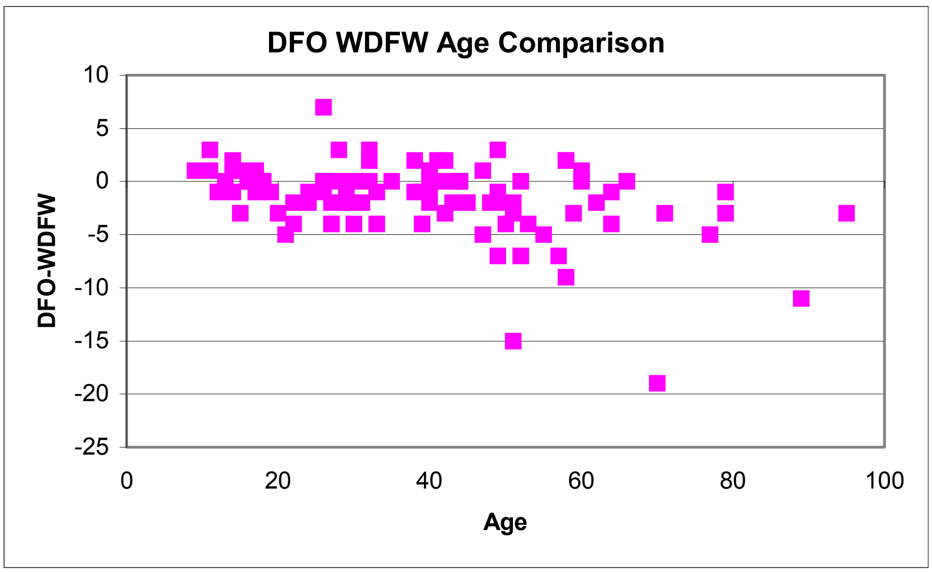


Figure 10. Standard deviations (S.D.) for mean difference in age readings between WDFW and DFO.

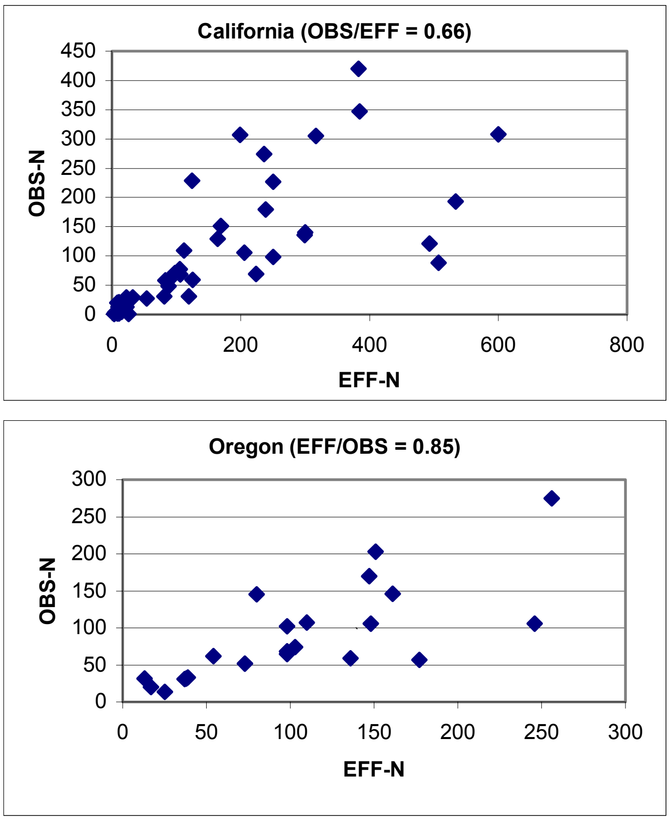


Figure 11. Relationship between number of fish sampled (OBS-N) and effective sample sizes (EFF-N) for length compositions.

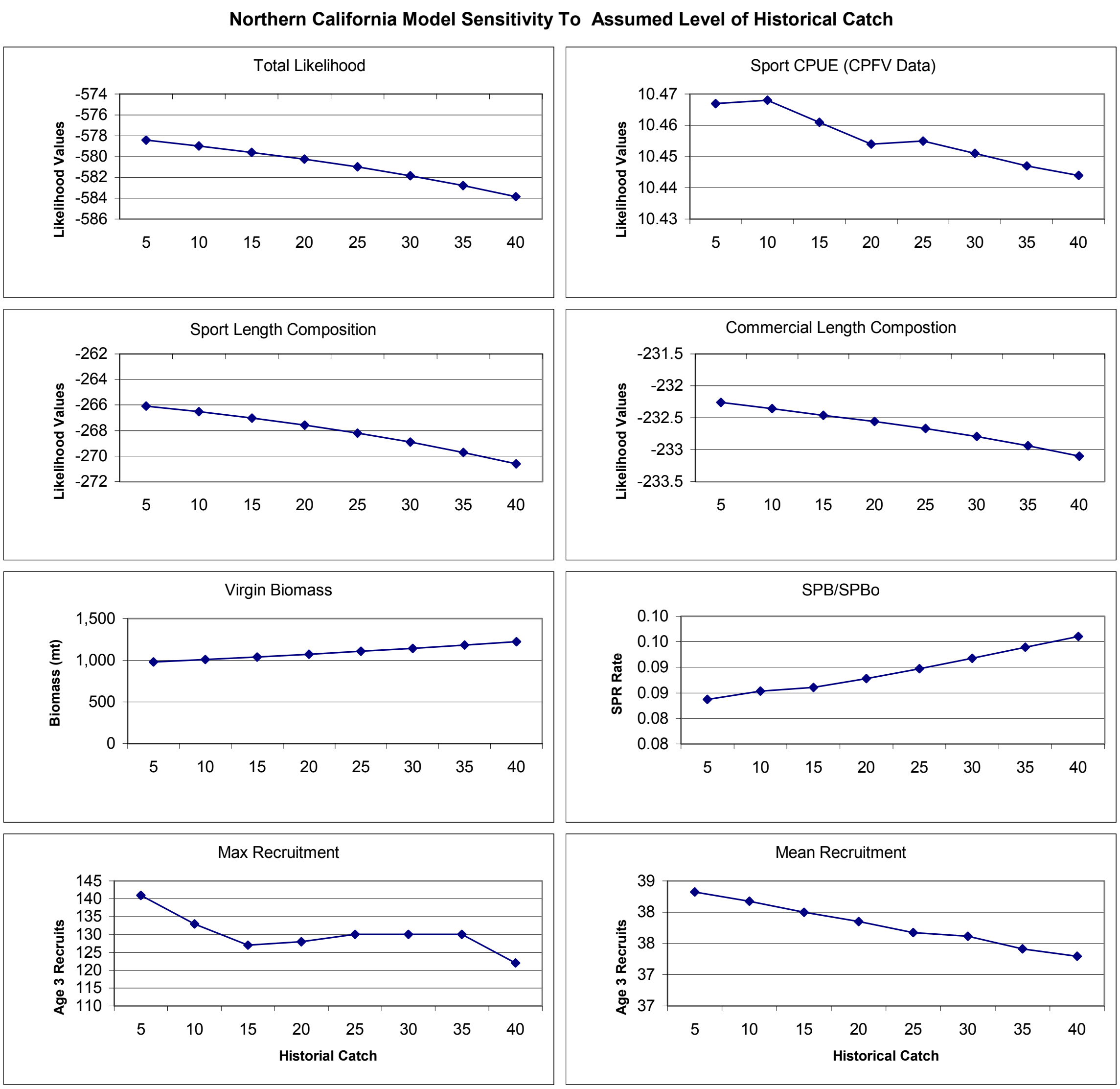


Figure 12. Northern California model fit to the CPFV CPUE index, sport and commercial length composition at increasing levels of historical catch (mt).

Oregon Model Sensitivity To Assumed Level of Historical Catch

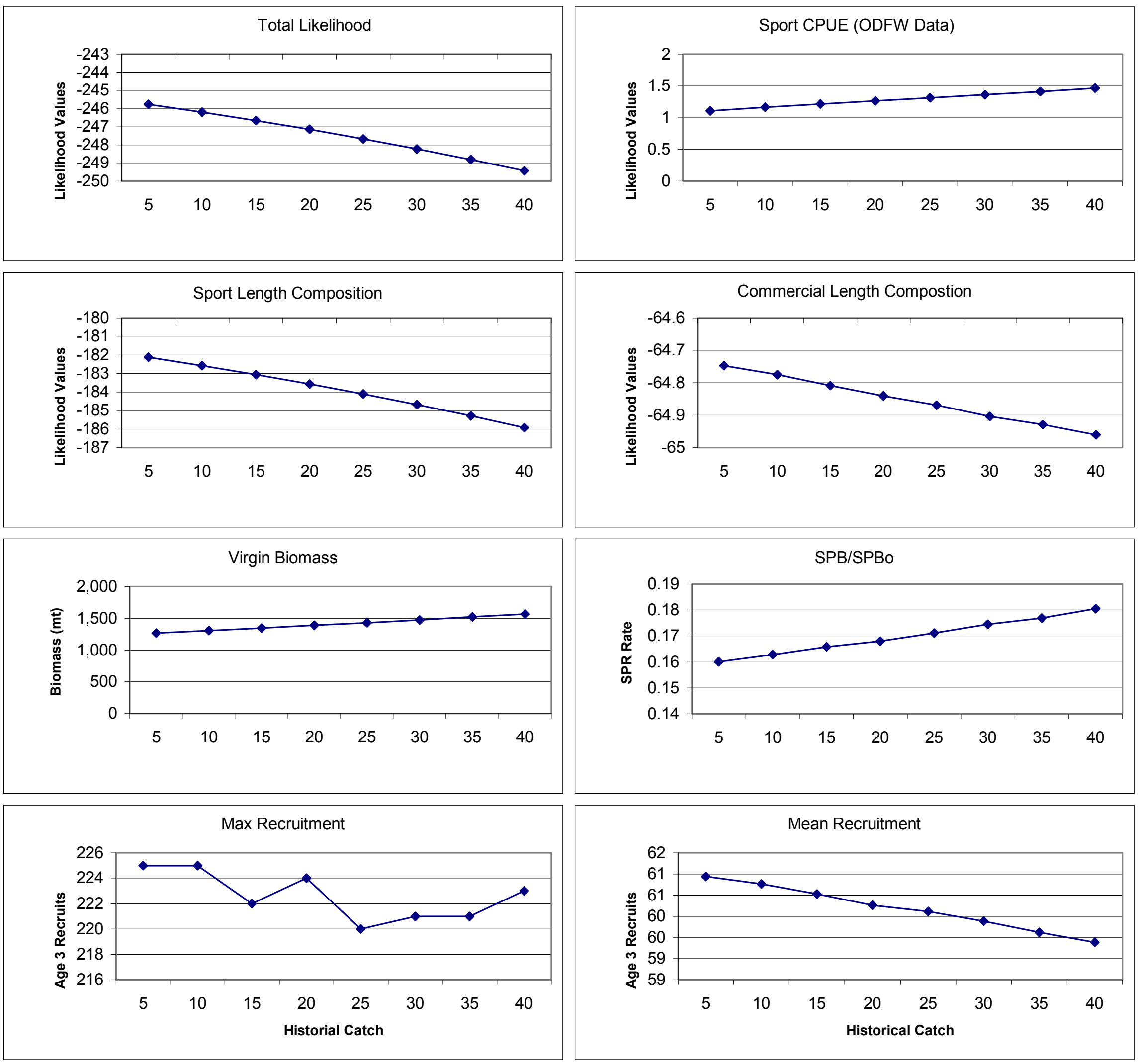


Figure 13. Oregon model fit to the CPUE index, sport and commercial length composition at increasing levels of historical catch (mt).

Northern California Model Random Starts (+/- 30%)

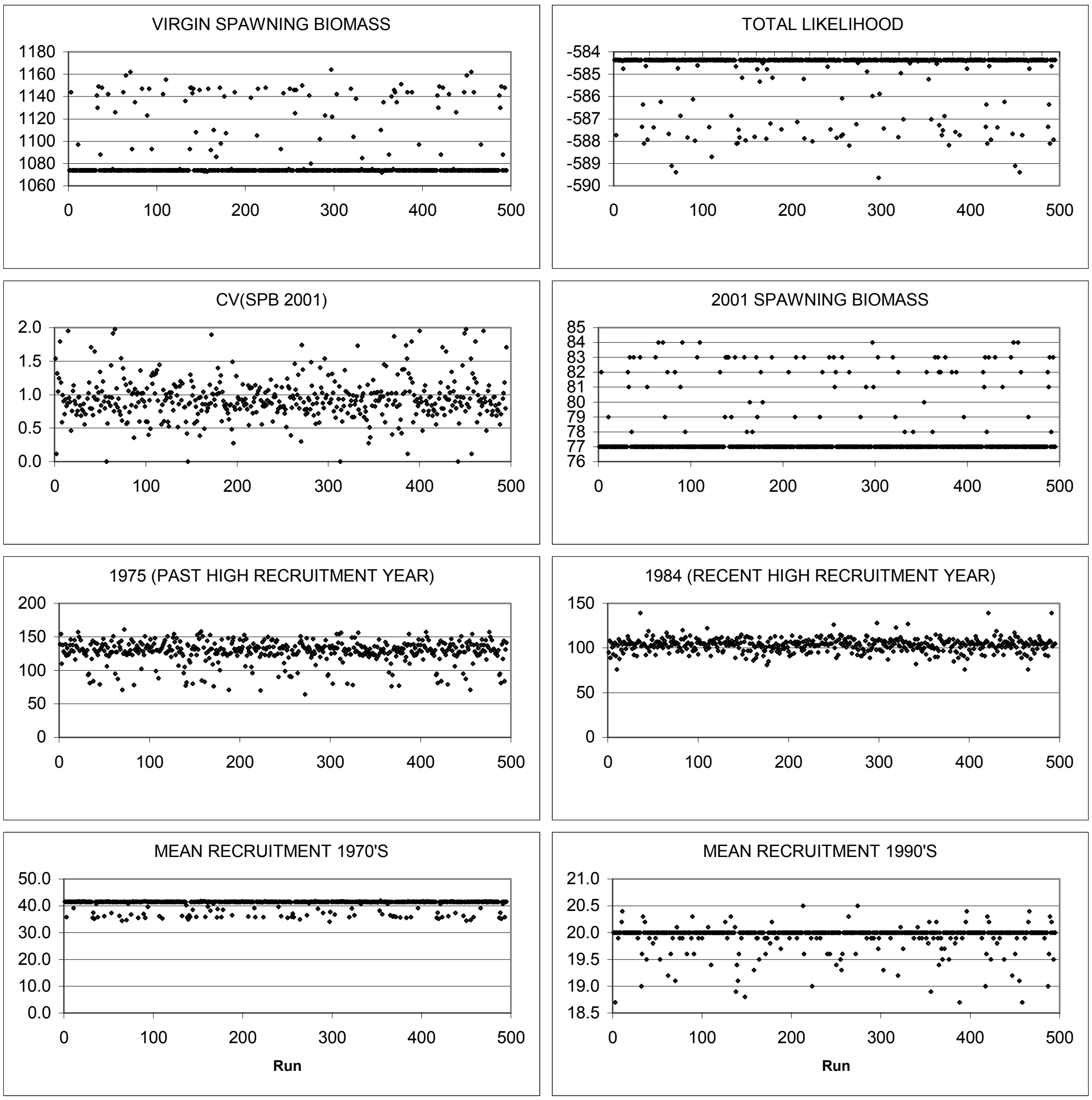


Figure 14. Northern California results from 500 synthesis runs with starting parameters randomized + or -30%.

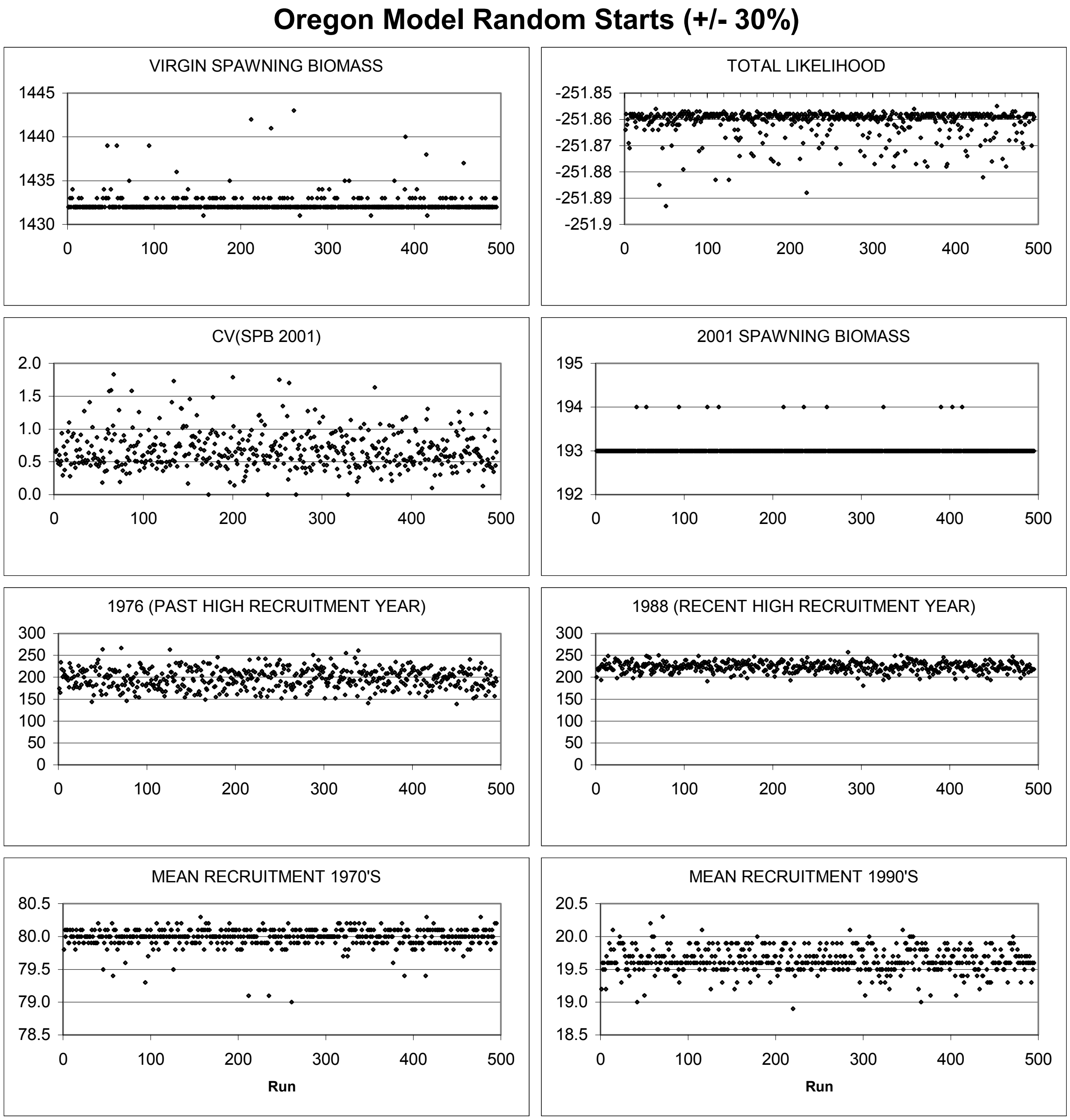


Figure 15. Oregon model results from 500 synthesis runs with starting parameters randomized + or -30%.

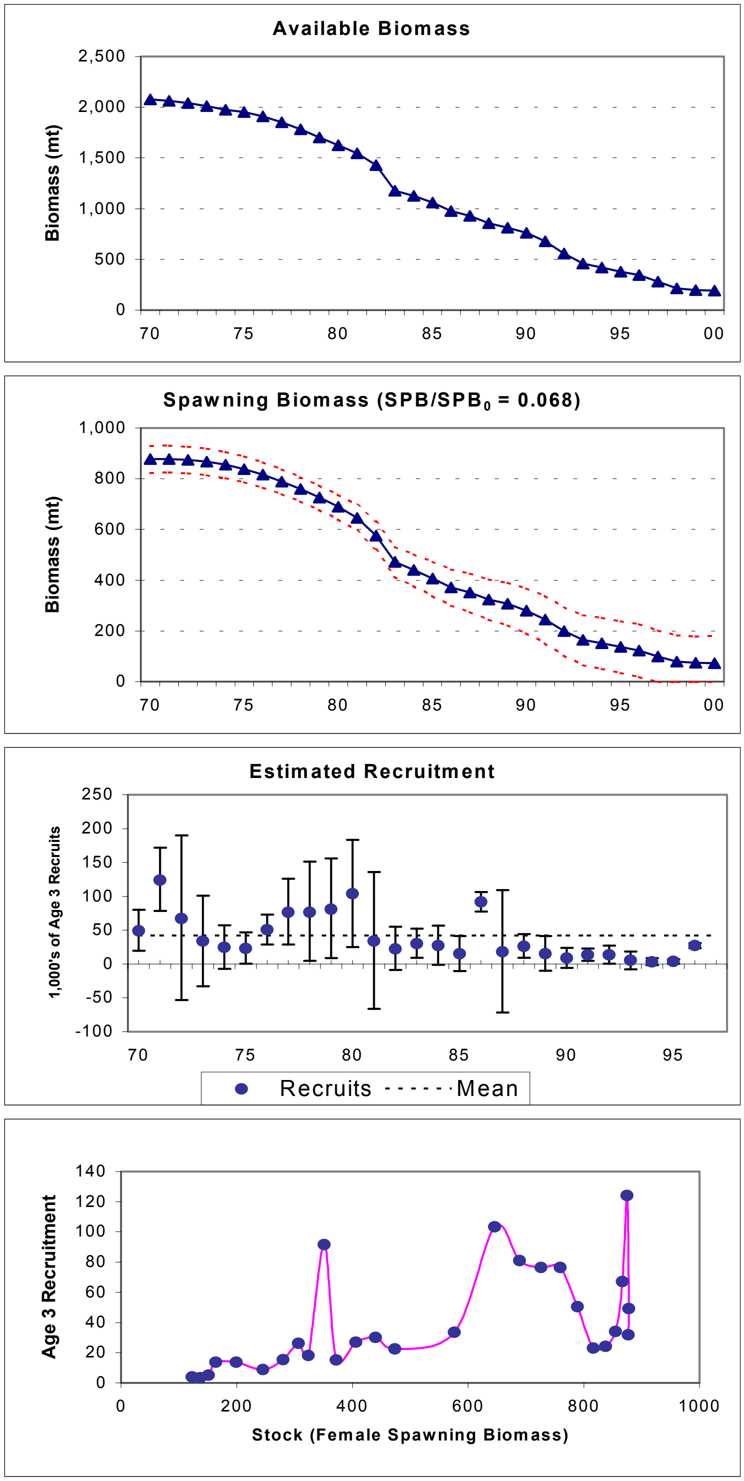


Figure 16. Trends in estimated biomass and recruitment for the northern California base model.

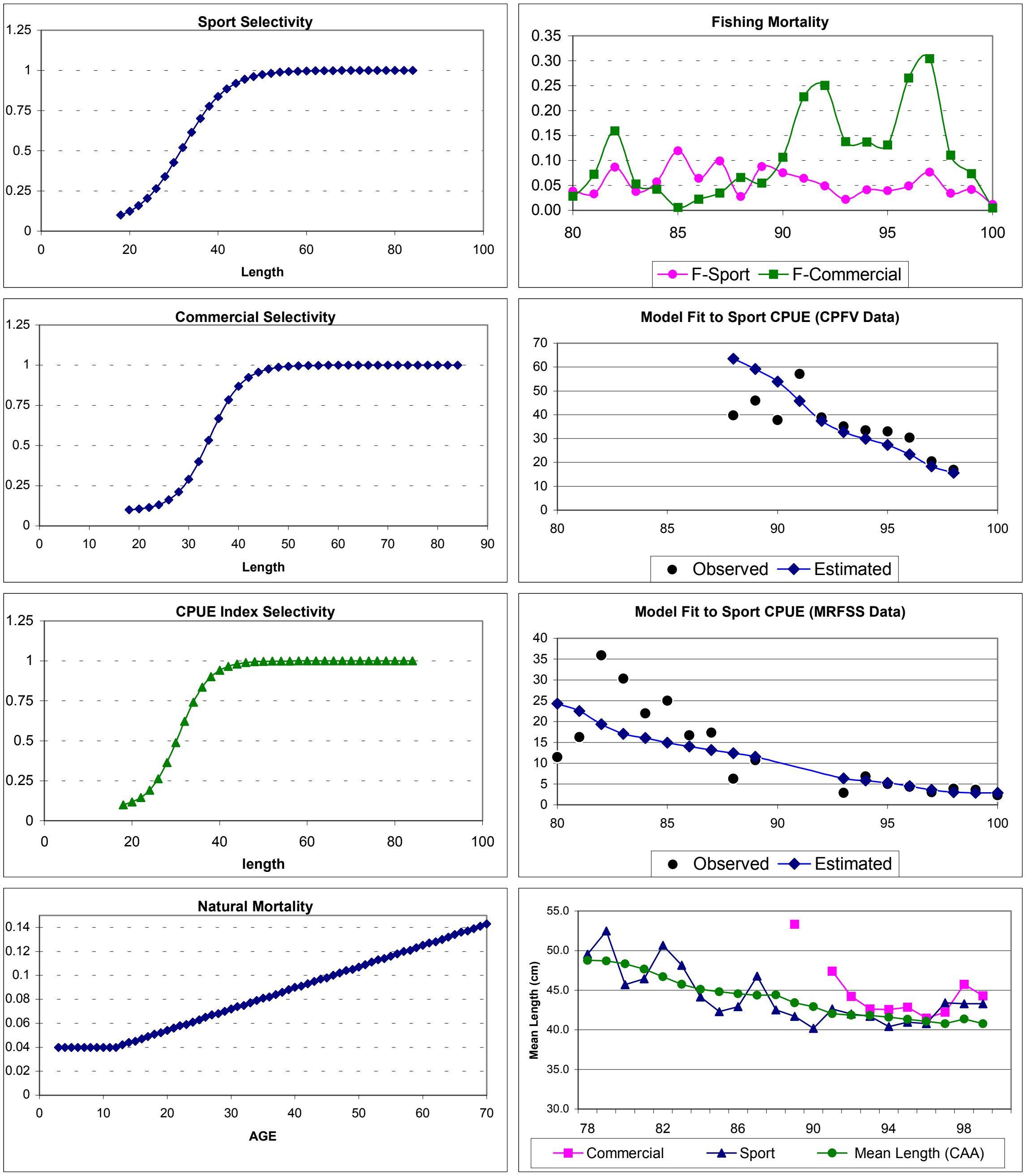


Figure 17. Estimated selectivity, fishing mortality, fit to sport CPUE indices, observed and predicted mean length trend for the northern California base model.

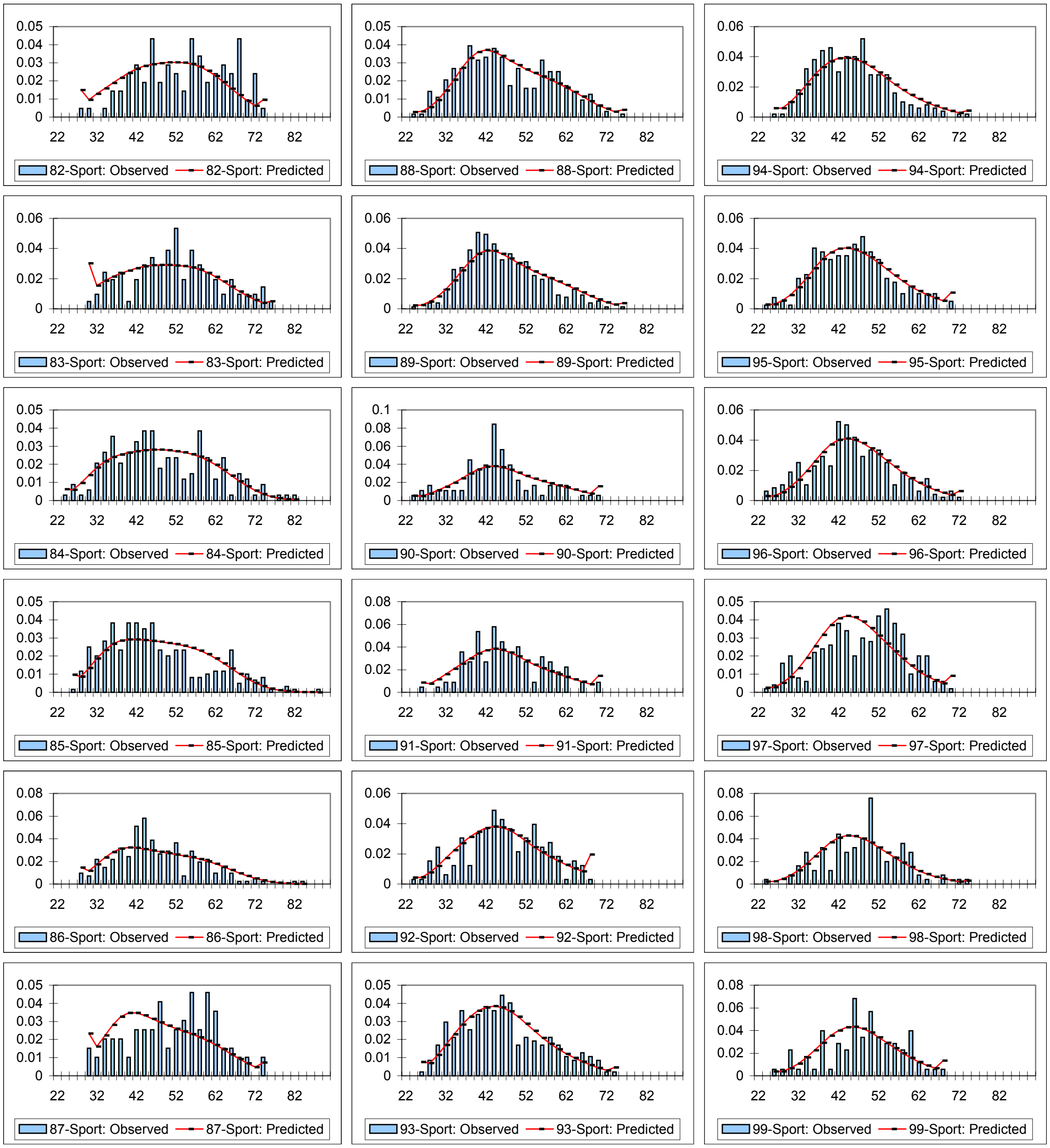


Figure 18. Observed and model fit to the sport length composition data for the northern California base model.

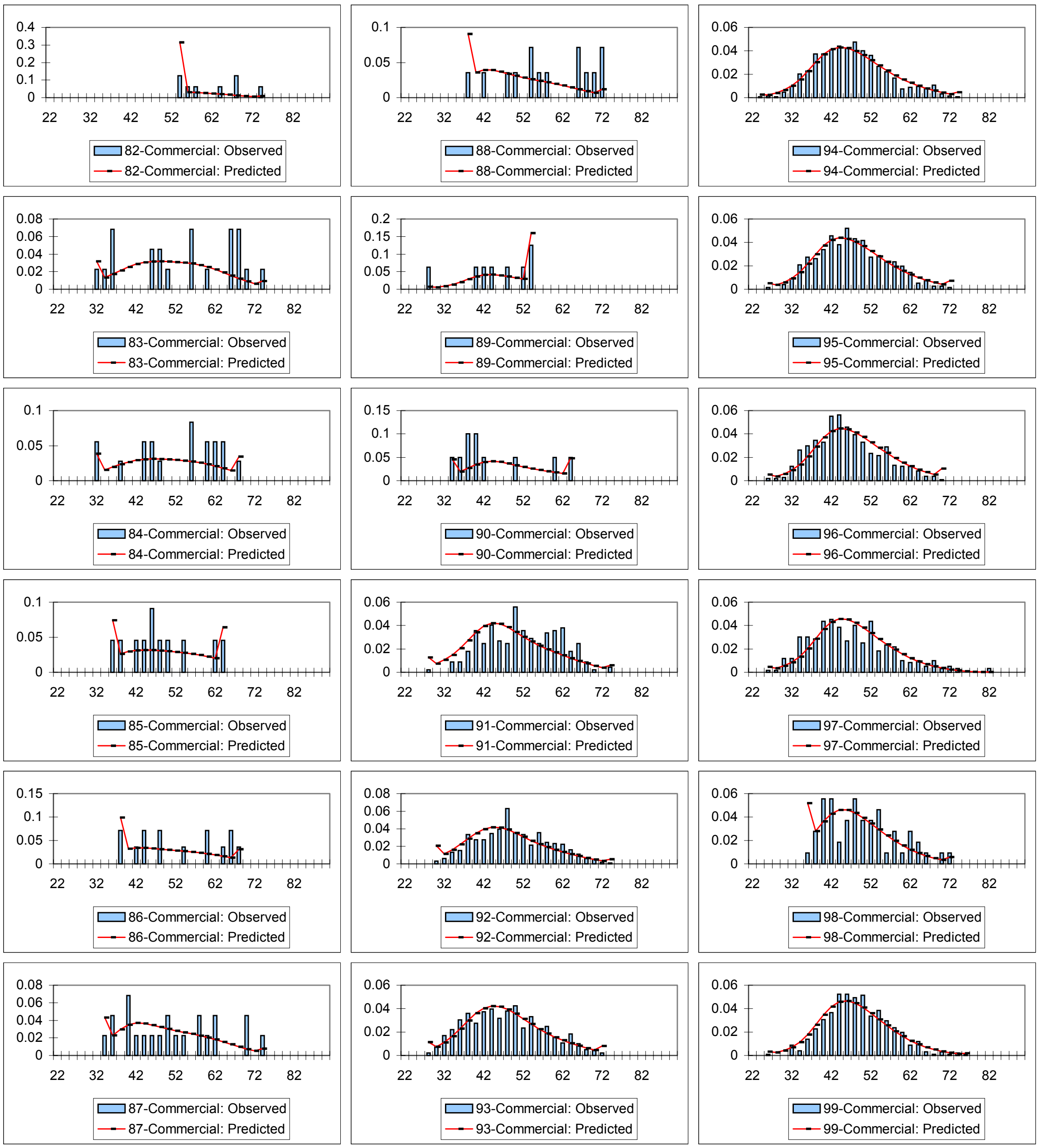


Figure 19. Observed and model fit to the commercial length composition data for the northern California base model.

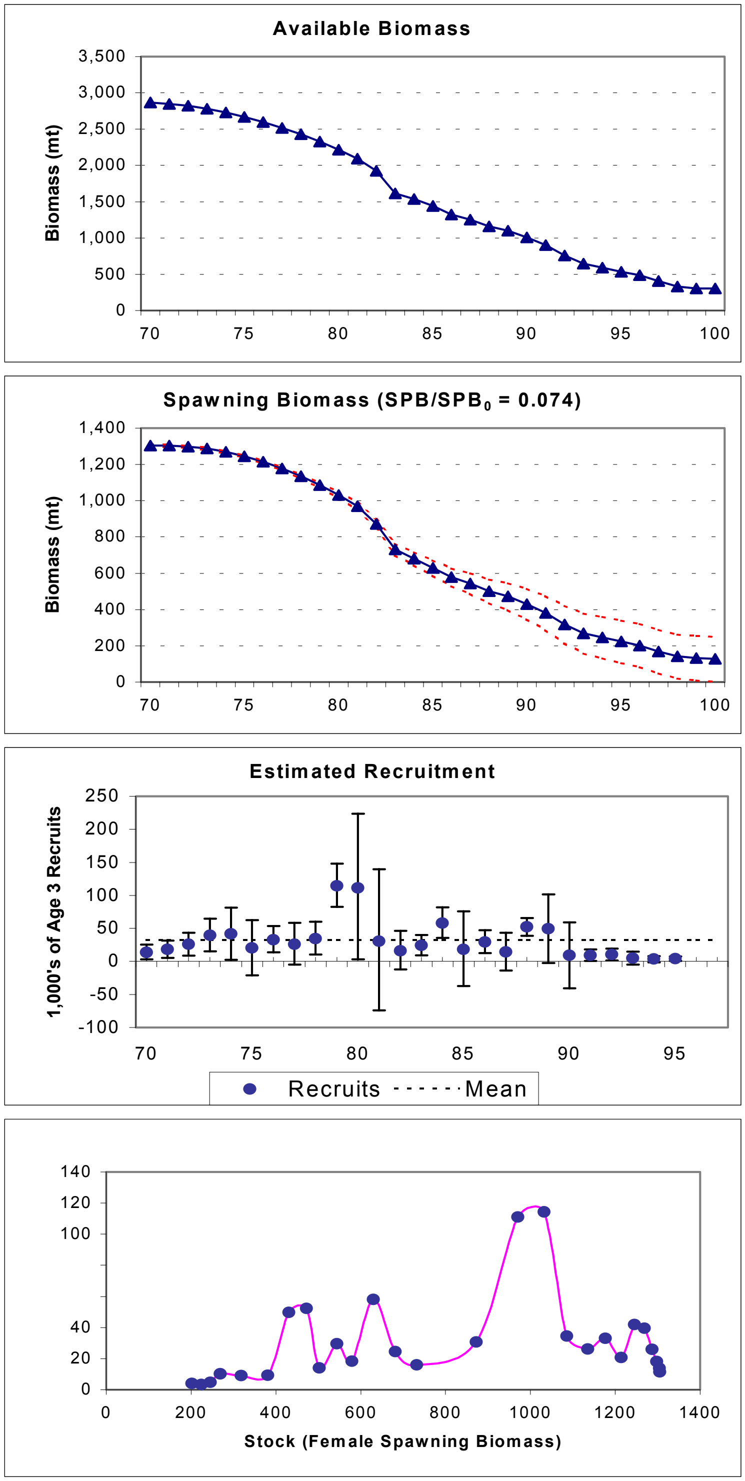


Figure 20. Trends in estimated biomass and recruitment for the northern California constant natural mortality rate model.

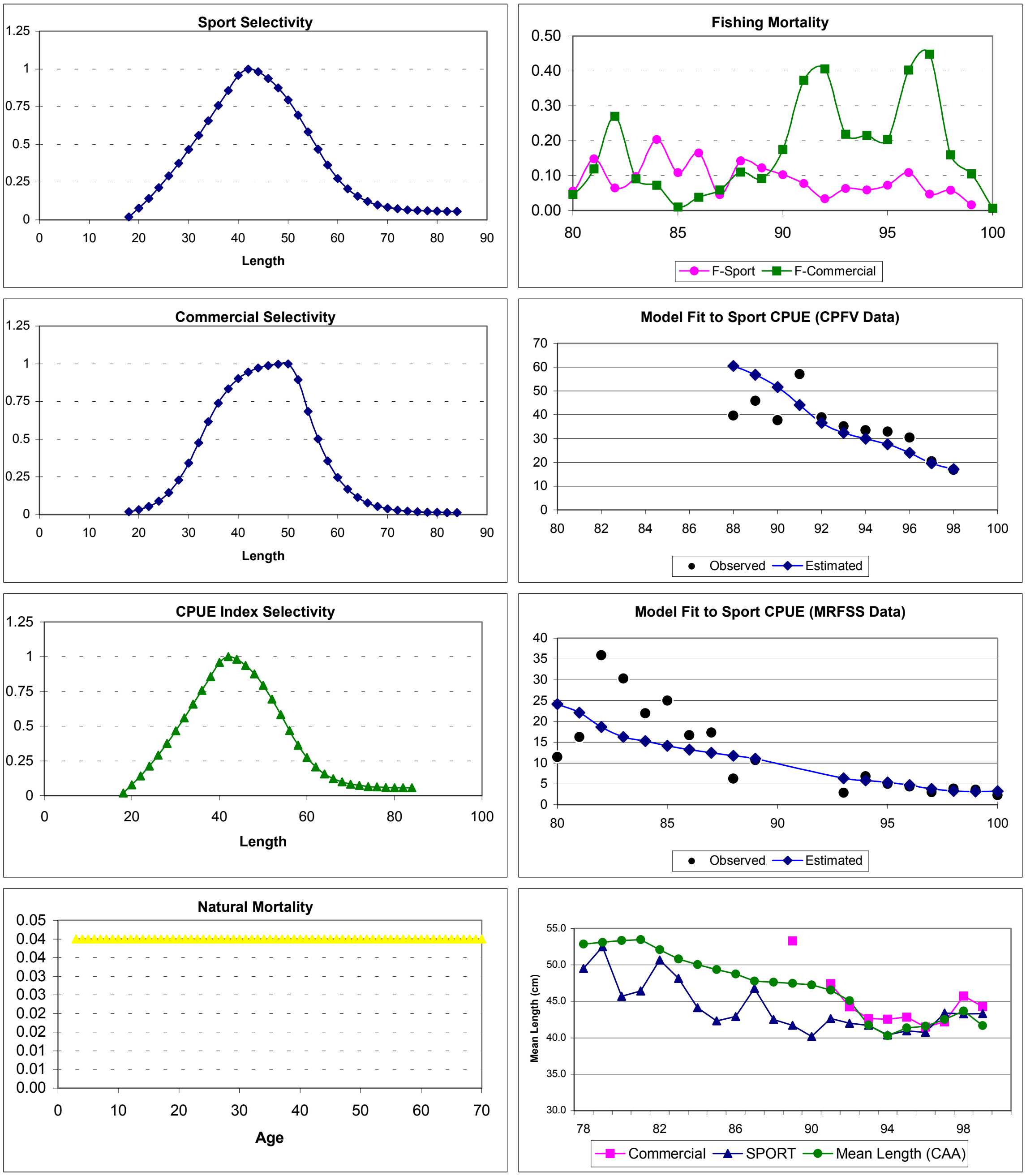


Figure 21. Estimated selectivity, fit to sport CPUE index, length composition data and observed trend in mean length for the northern California constant natural motility rate model.

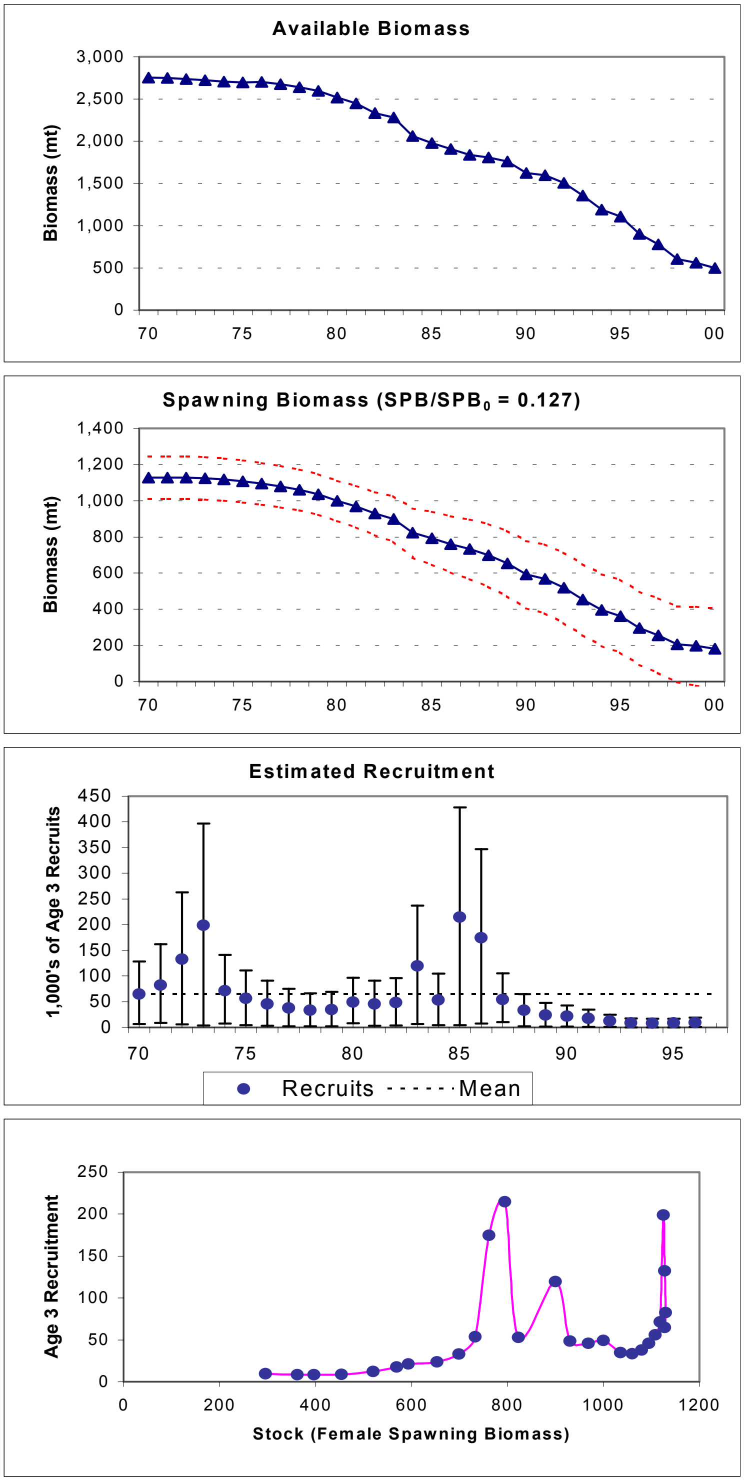


Figure 22. Trends in estimated biomass and recruitment for the Oregon base model.

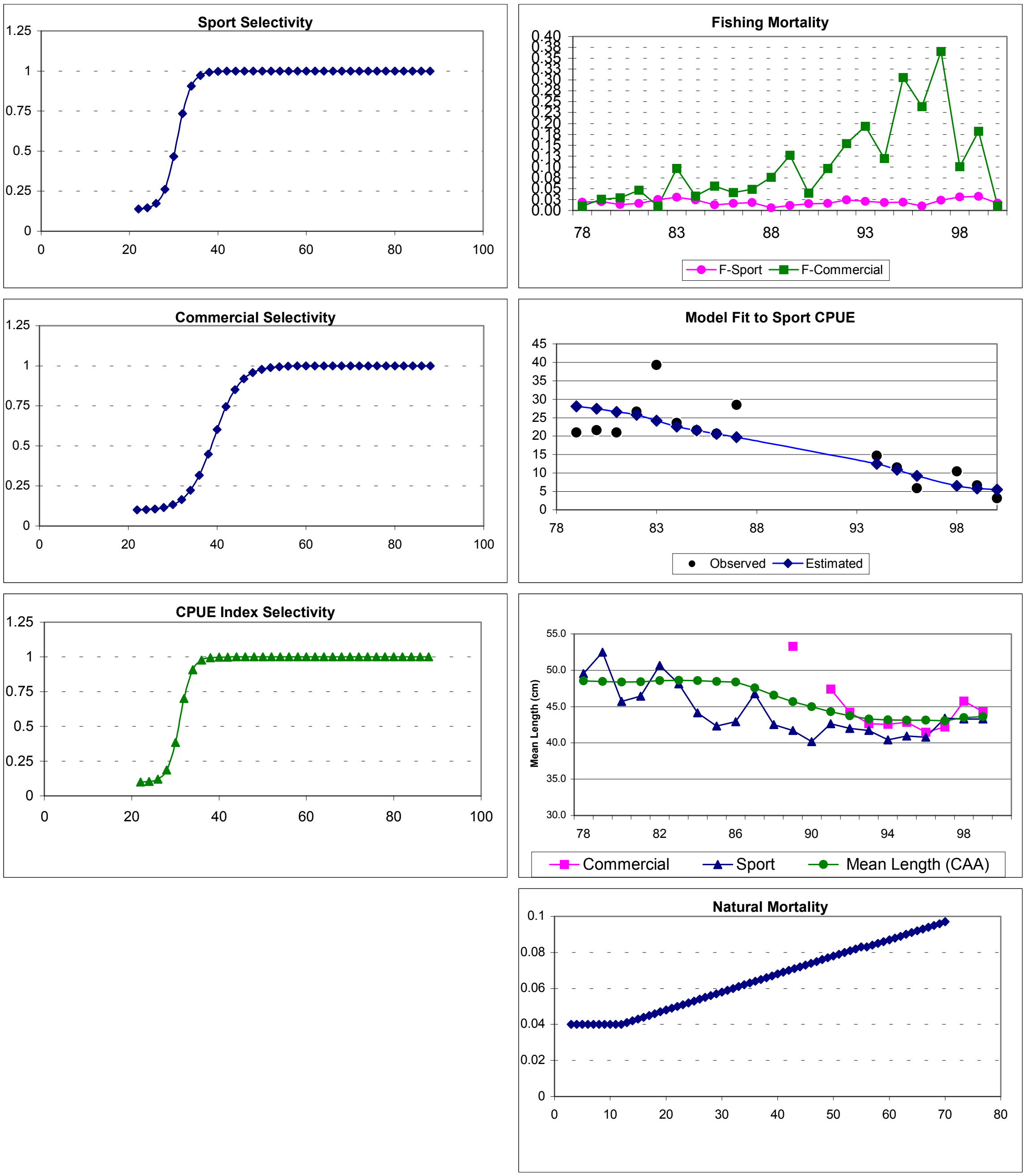


Figure 23. Estimated selectivity, model fit to sport CPUE index, length composition data, observed and estimated trend in mean length for the Oregon base model.

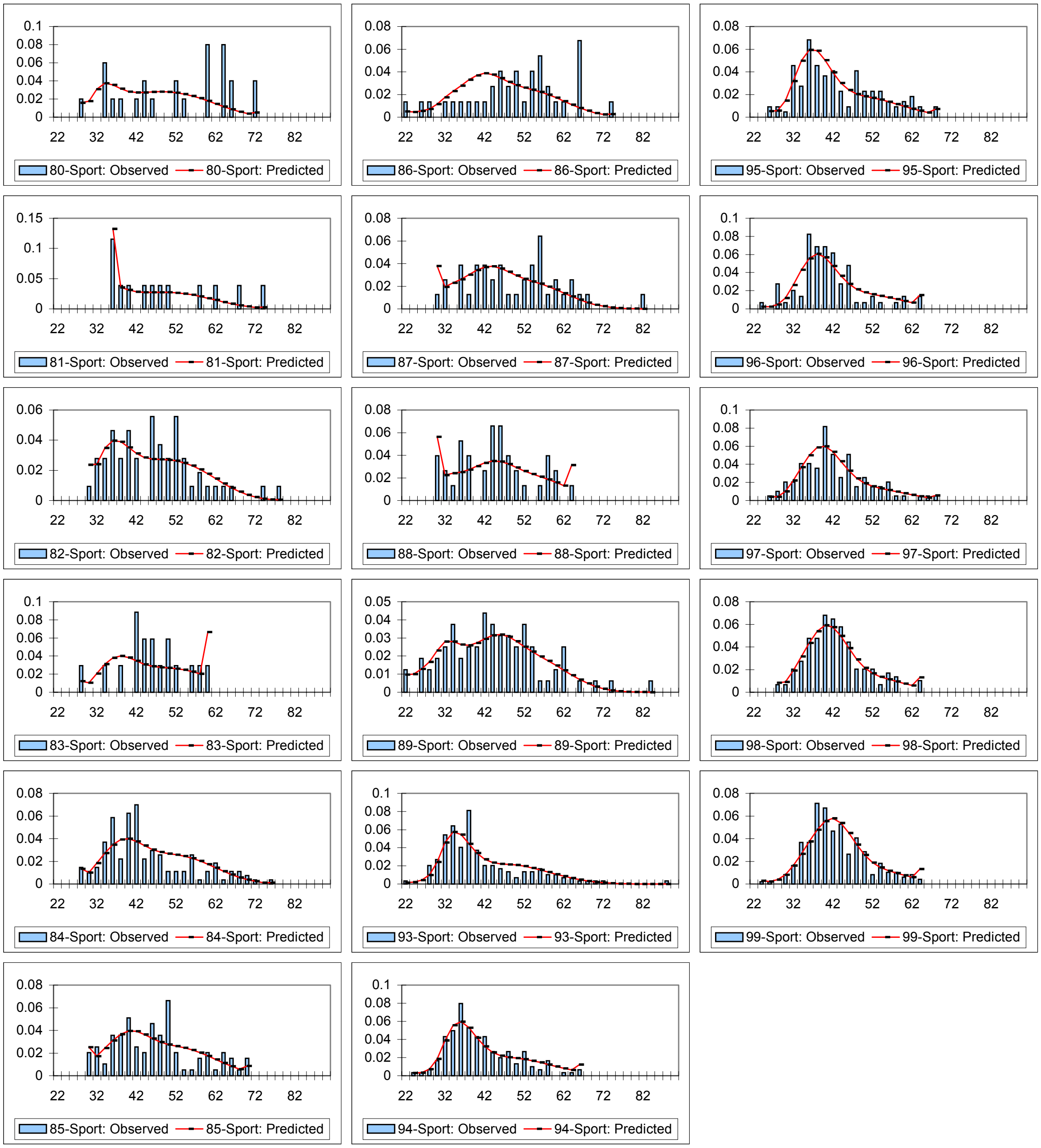


Figure 24. Model fit to observed sport fishery length composition for the Oregon base model.

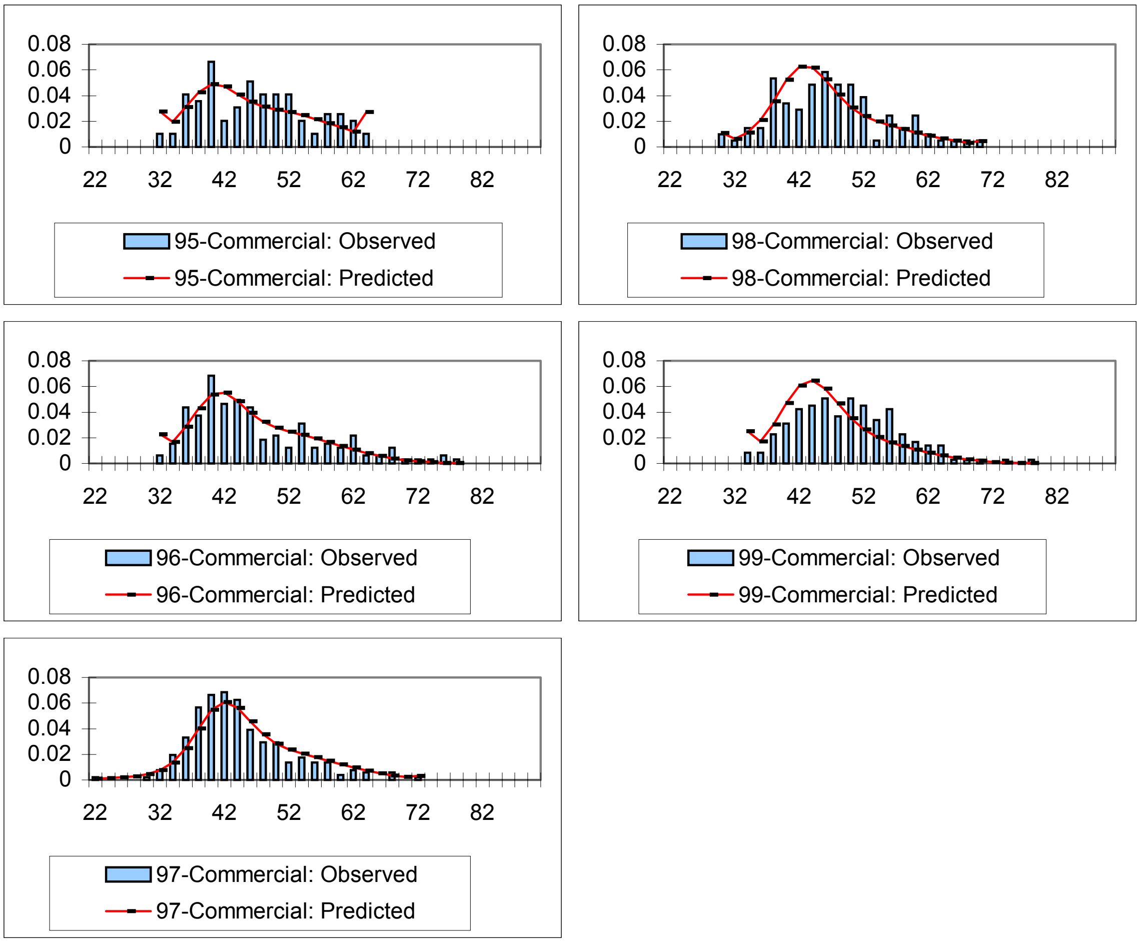


Figure 25. Model fit to the observed commercial length composition for the Oregon base model.

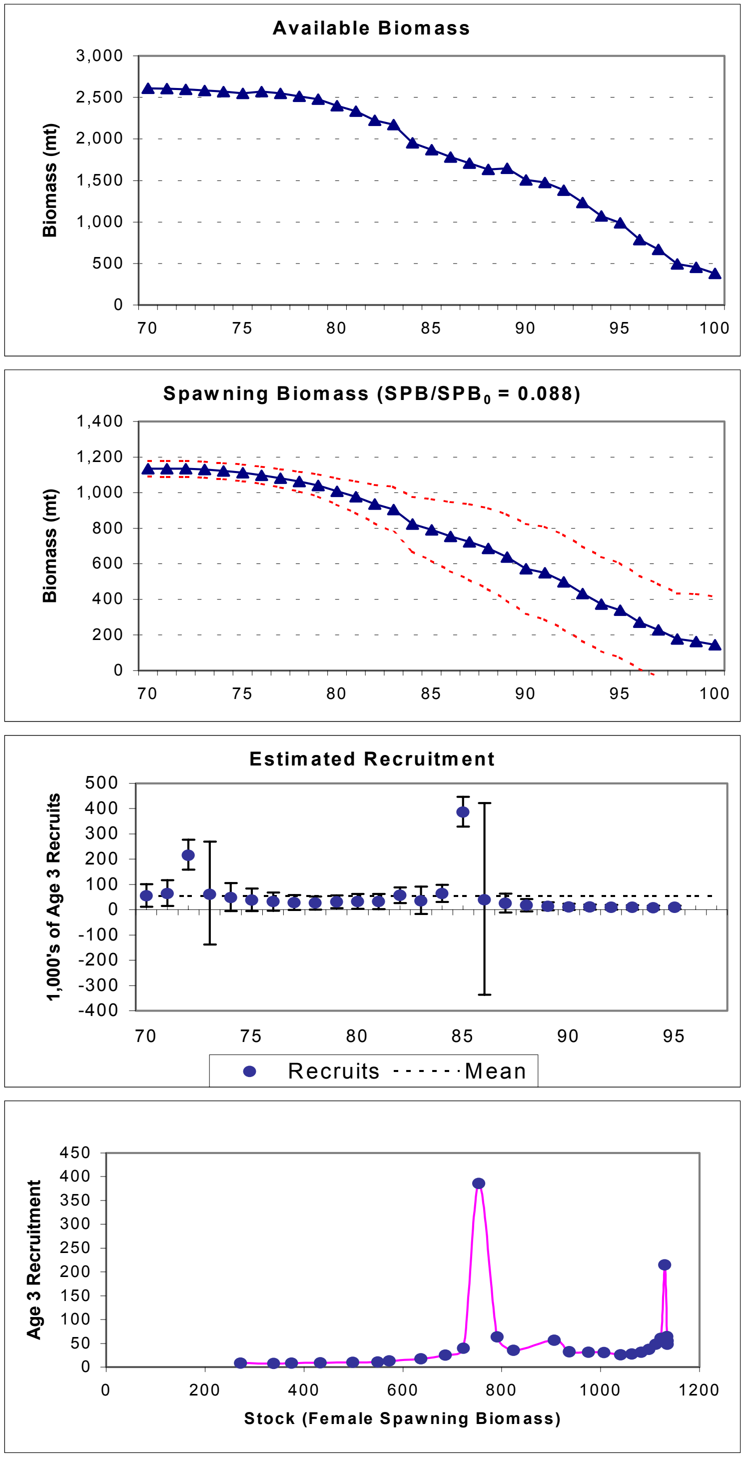


Figure 26. Trends in estimated biomass and recruitment for the Oregon constant natural mortality rate model.

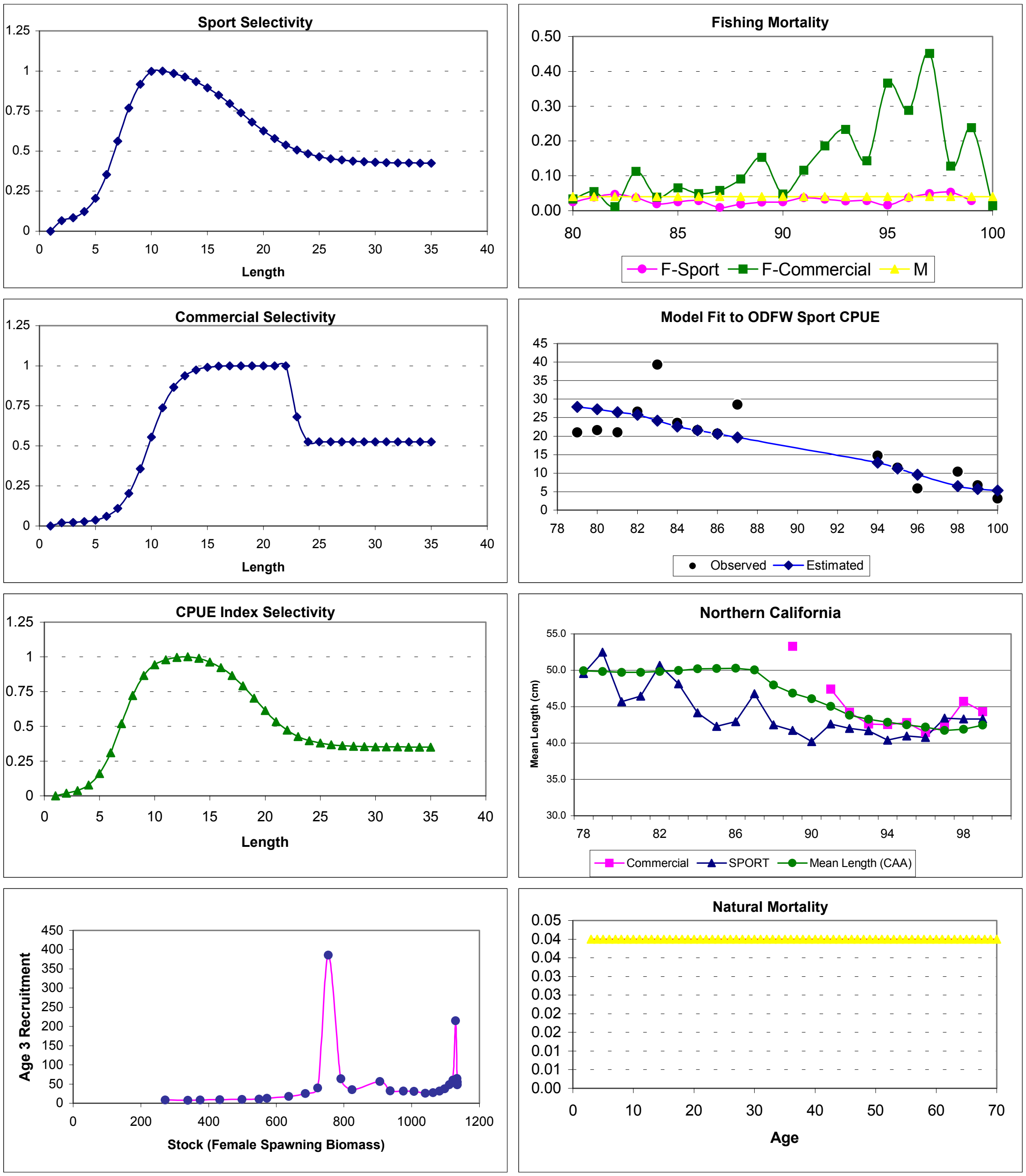


Figure 27. Estimated selectivity, fit to sport CPUE index, length composition data, observed and estimated trend in mean length for the Oregon constant natural mortality rate model.

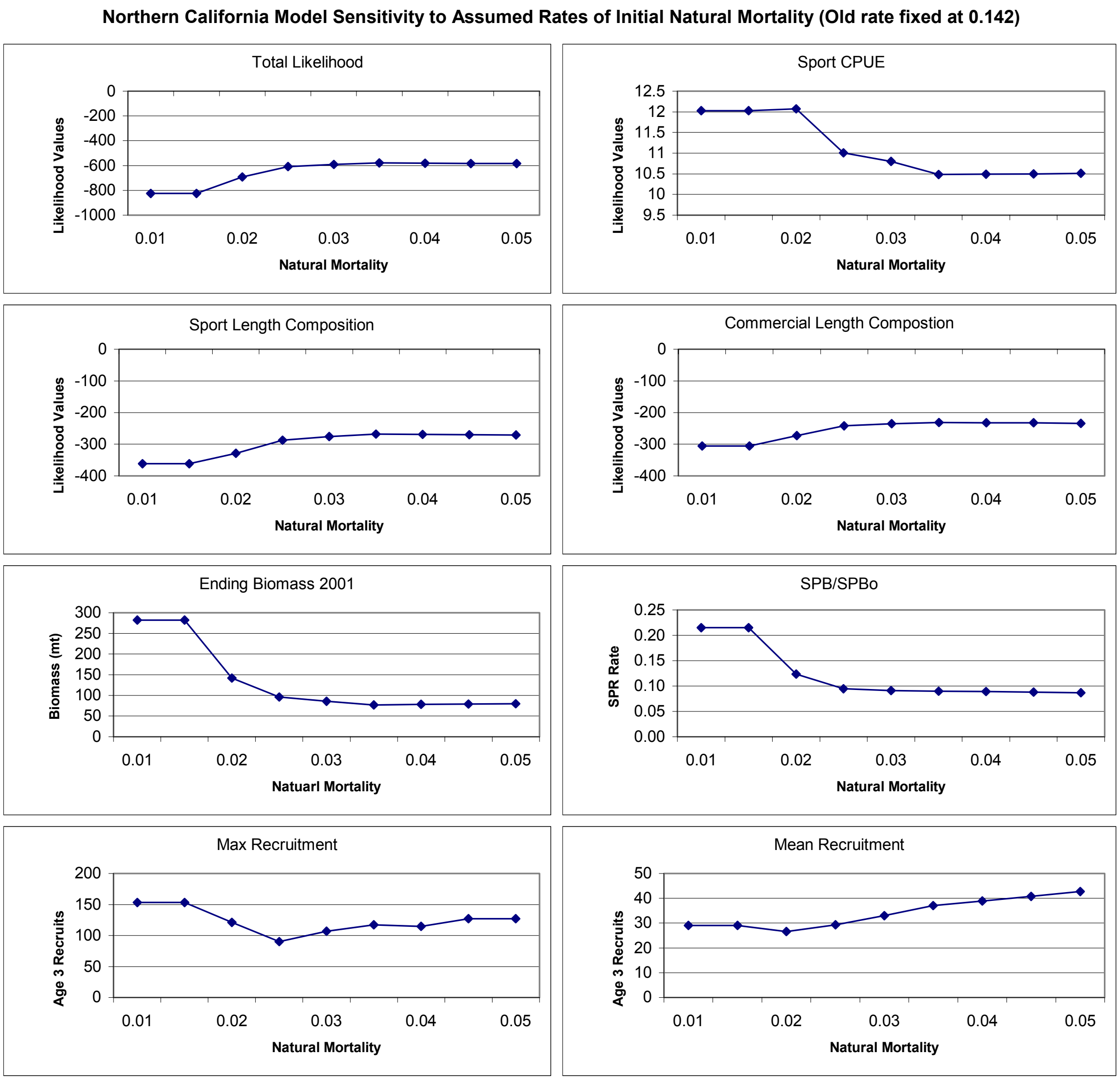


Figure 28. Comparison of alternate assumptions about initial natural mortality rates for the northern California base model when natural mortality rate of old fish is fixed at the base model estimate (0.143).

Northern California Model Sensitivity to Assumed rates of Initial Natural Mortality (Re-estimating Old Rate)

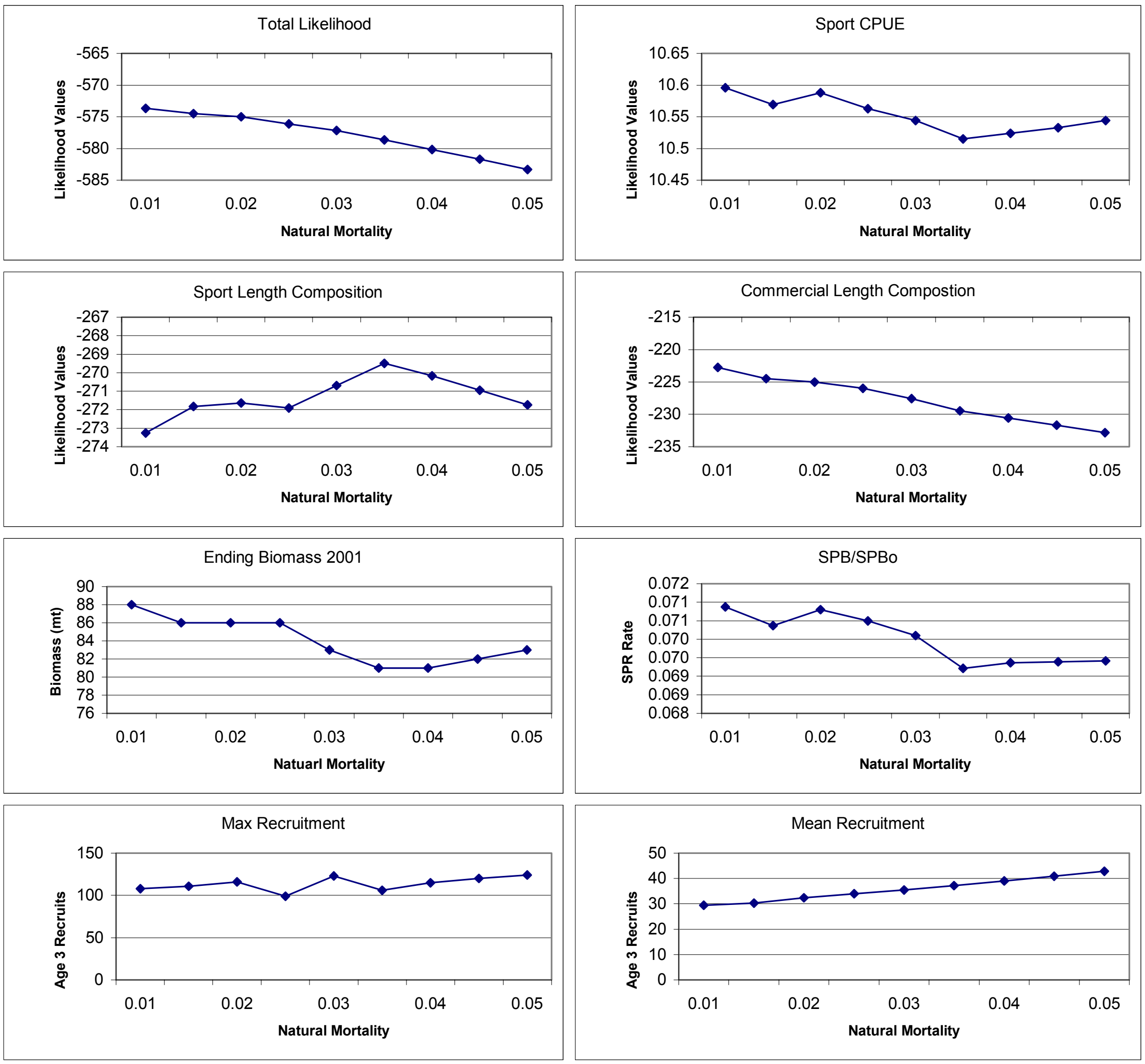


Figure 29. Comparisons of alternate assumptions about initial natural mortality rates for the northern California base model when natural mortality rate of old fish is re-estimated each run.

Northern California Model Sensitivity to CPUE Index (CPFV Data) Likelihood Component Emphasis

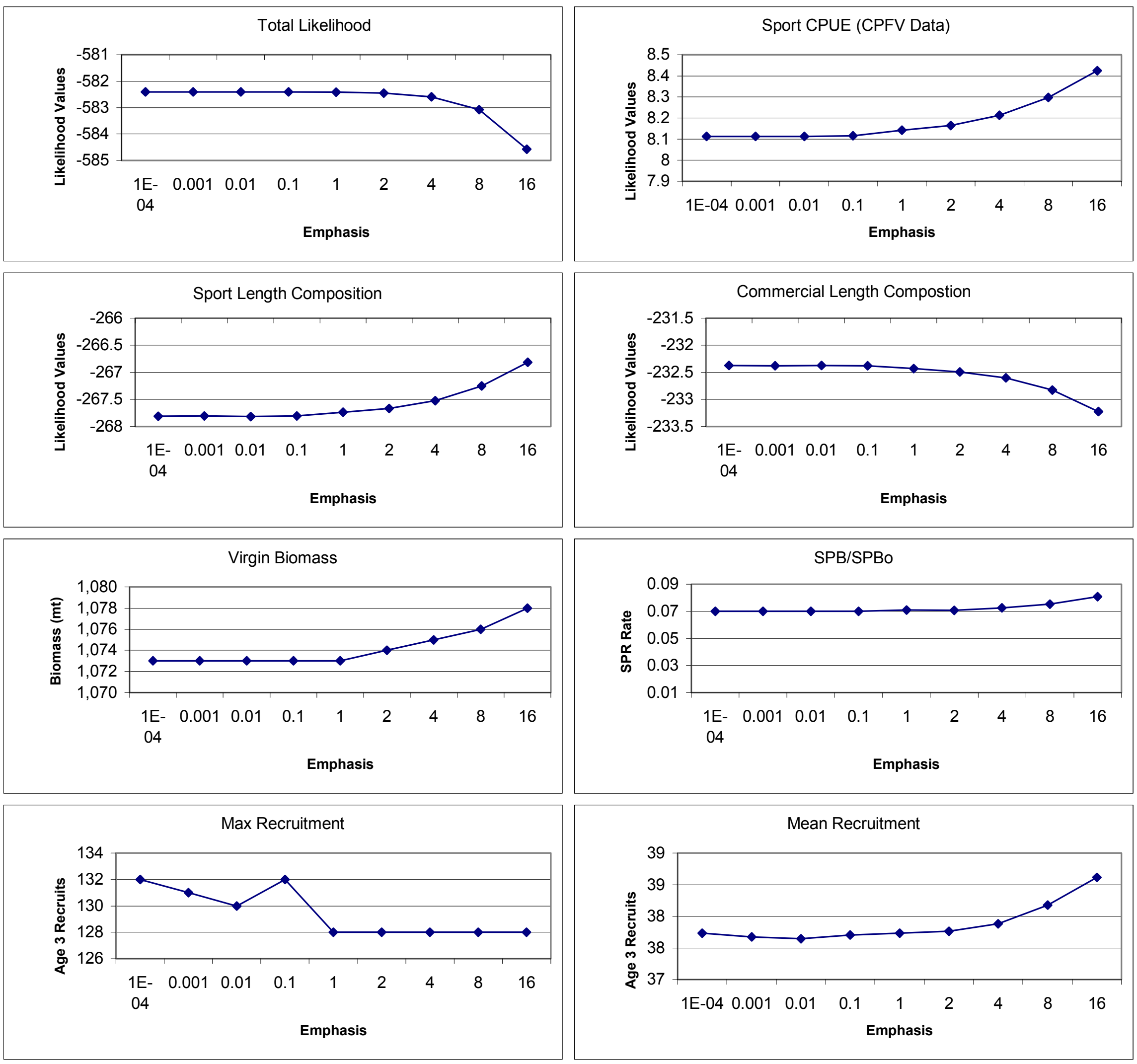


Figure 30. Northern California base model sensitivity to sport CPFV CPUE index weighting.

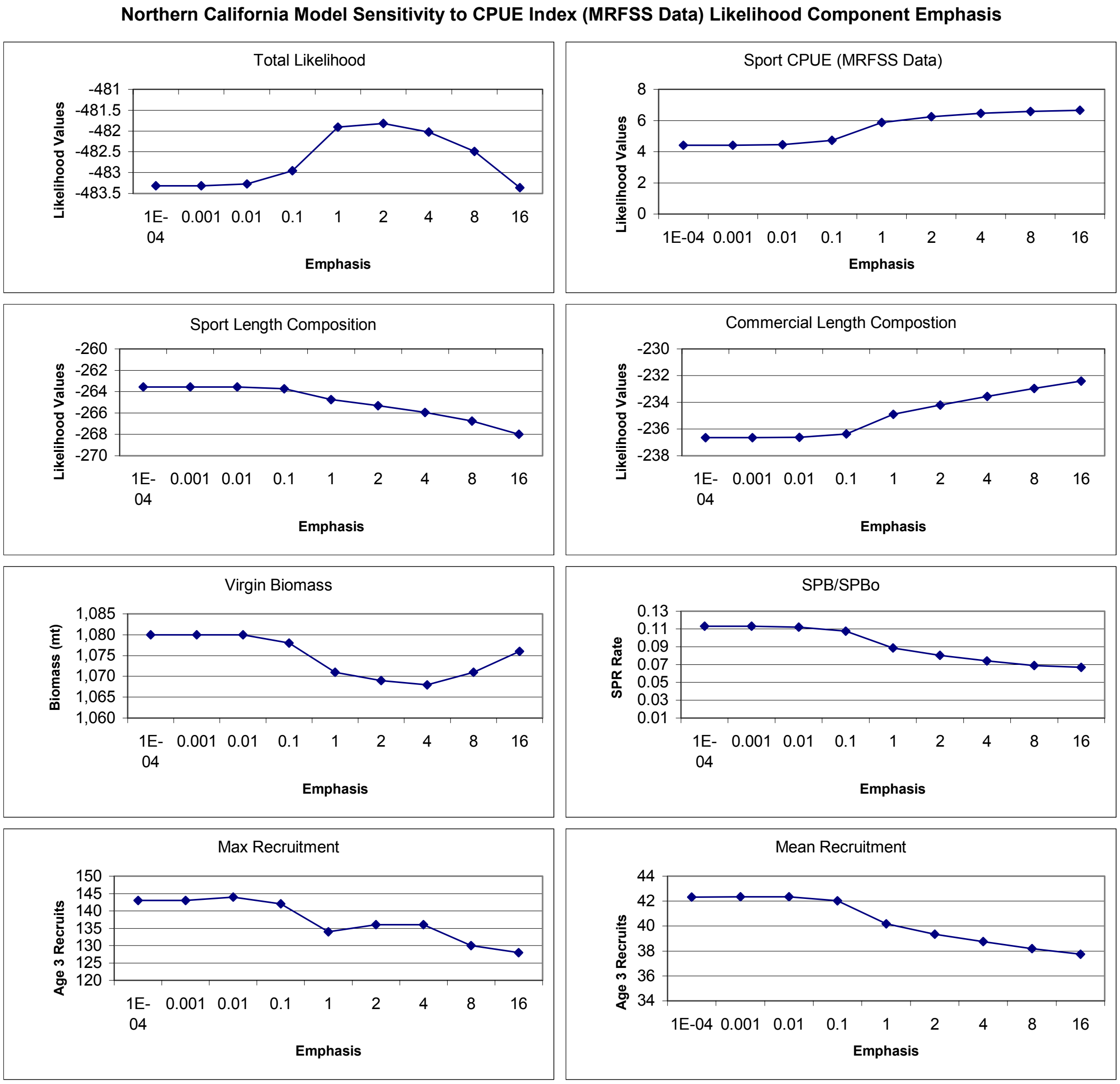


Figure 31. Northern California base model sensitivity to sport MRFSS CPUE index weighting.

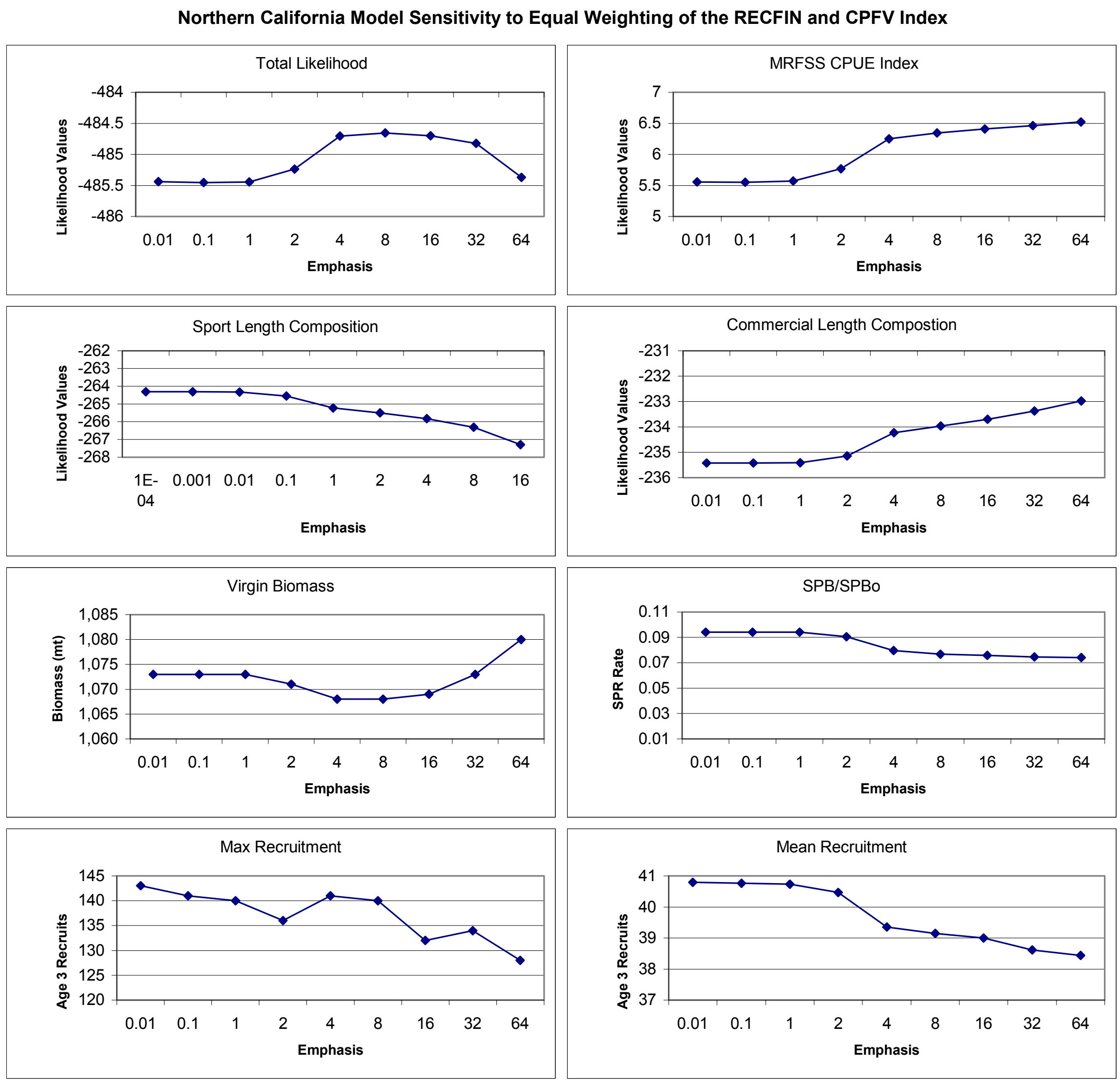


Figure 32. Northern California base model sensitivity to equal weighting of both sport CPUE indices (MRFSS and CPFV data).

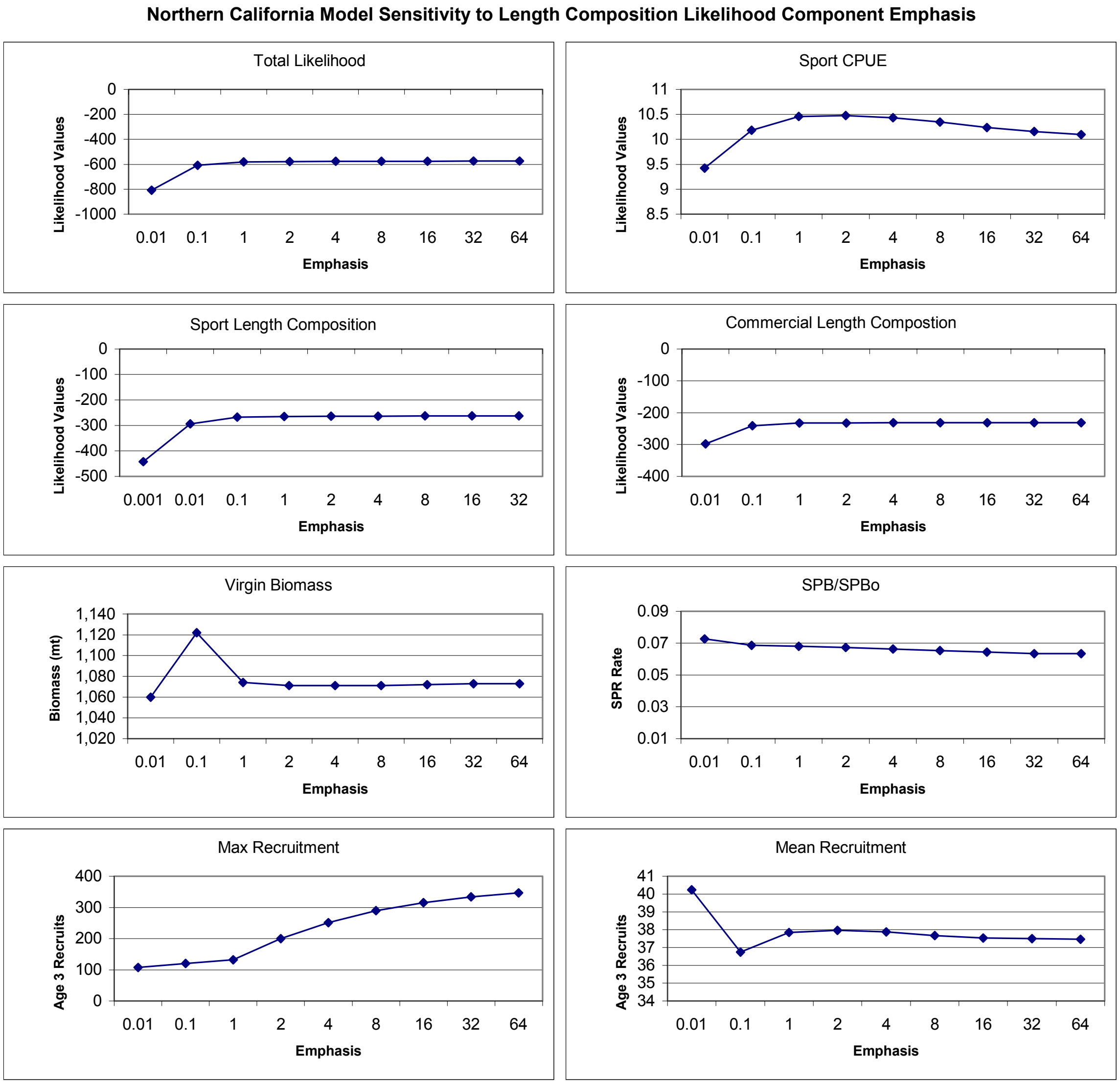


Figure 33. Northern California base model sensitivity to length composition likelihood weighting.

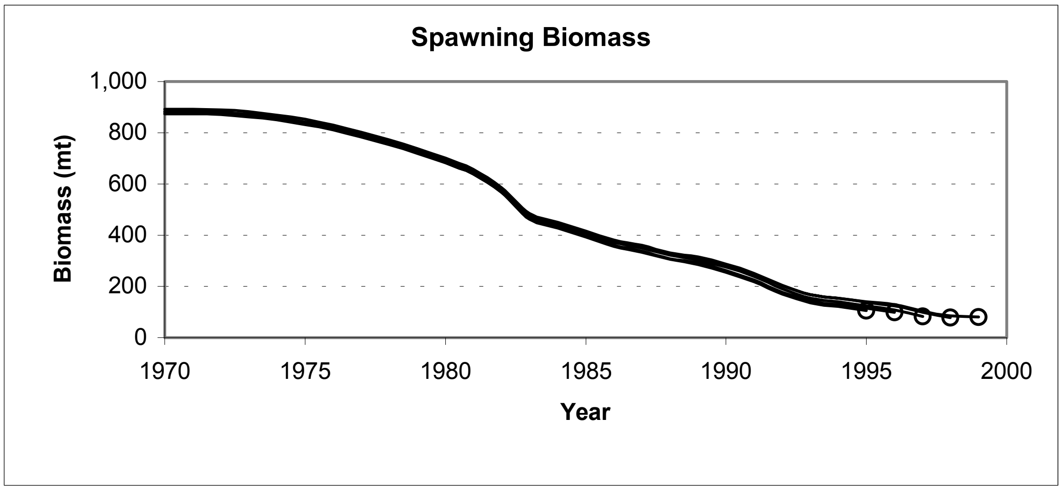


Figure 34. Retrospective analysis of the northern California base model.

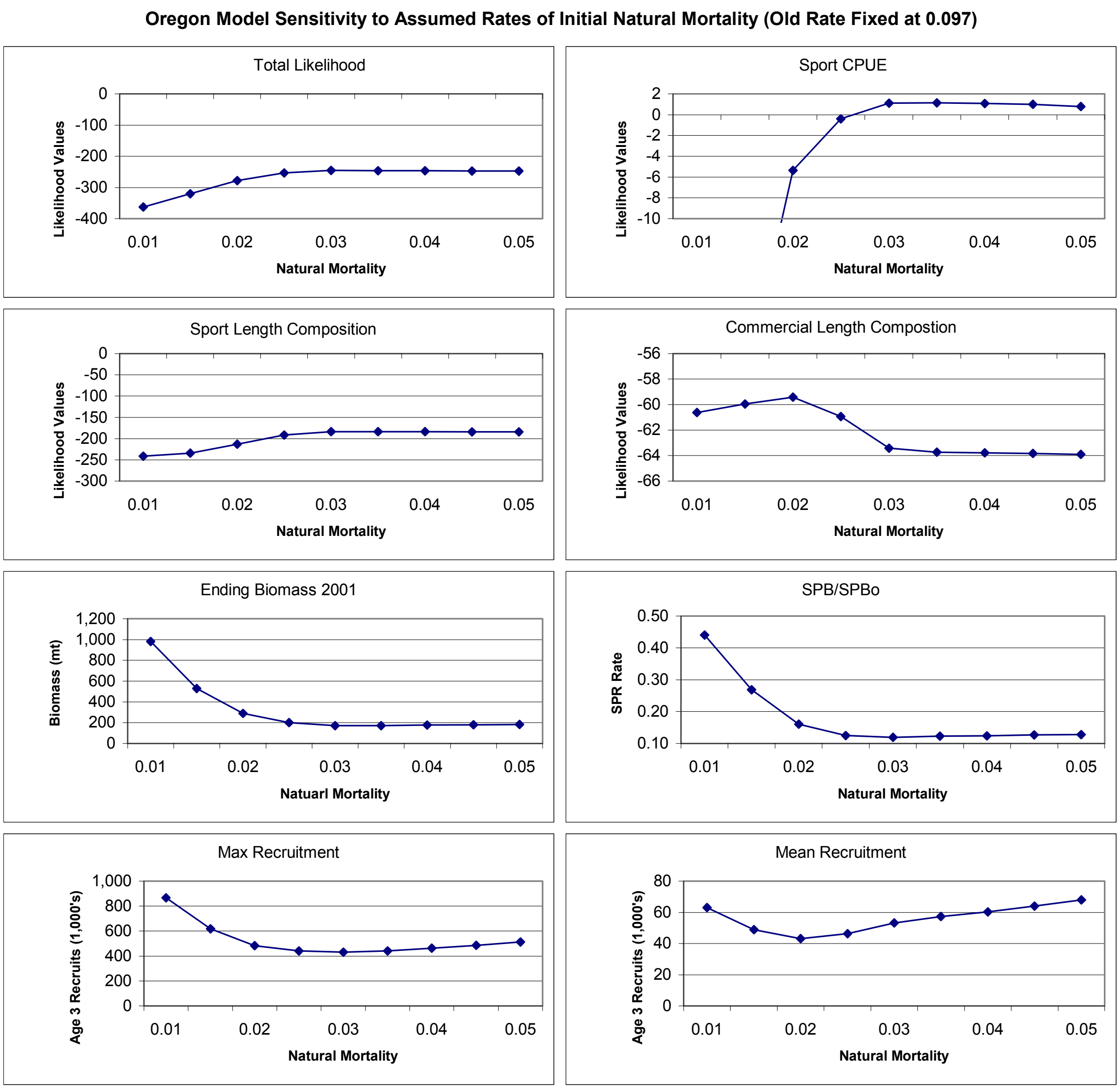


Figure 35. Comparison of alternate assumptions about initial natural mortality rates for the Oregon base model when natural mortality rate of old fish is fixed at the base model estimate (0.097).

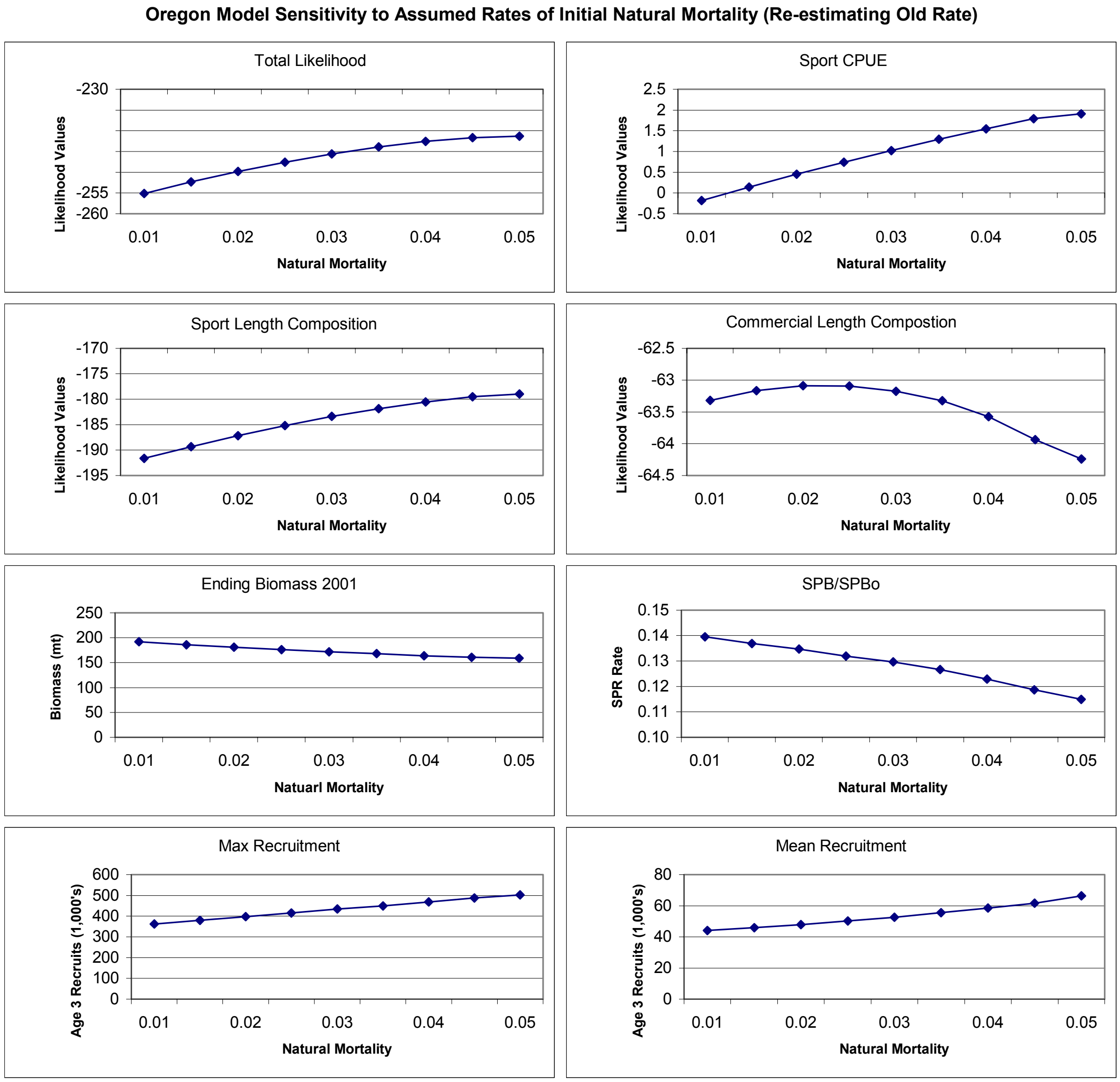


Figure 36. Comparison of alternate assumptions about initial natural mortality rates for the Oregon base model when natural mortality rate of old fish is re-estimated for each model run.

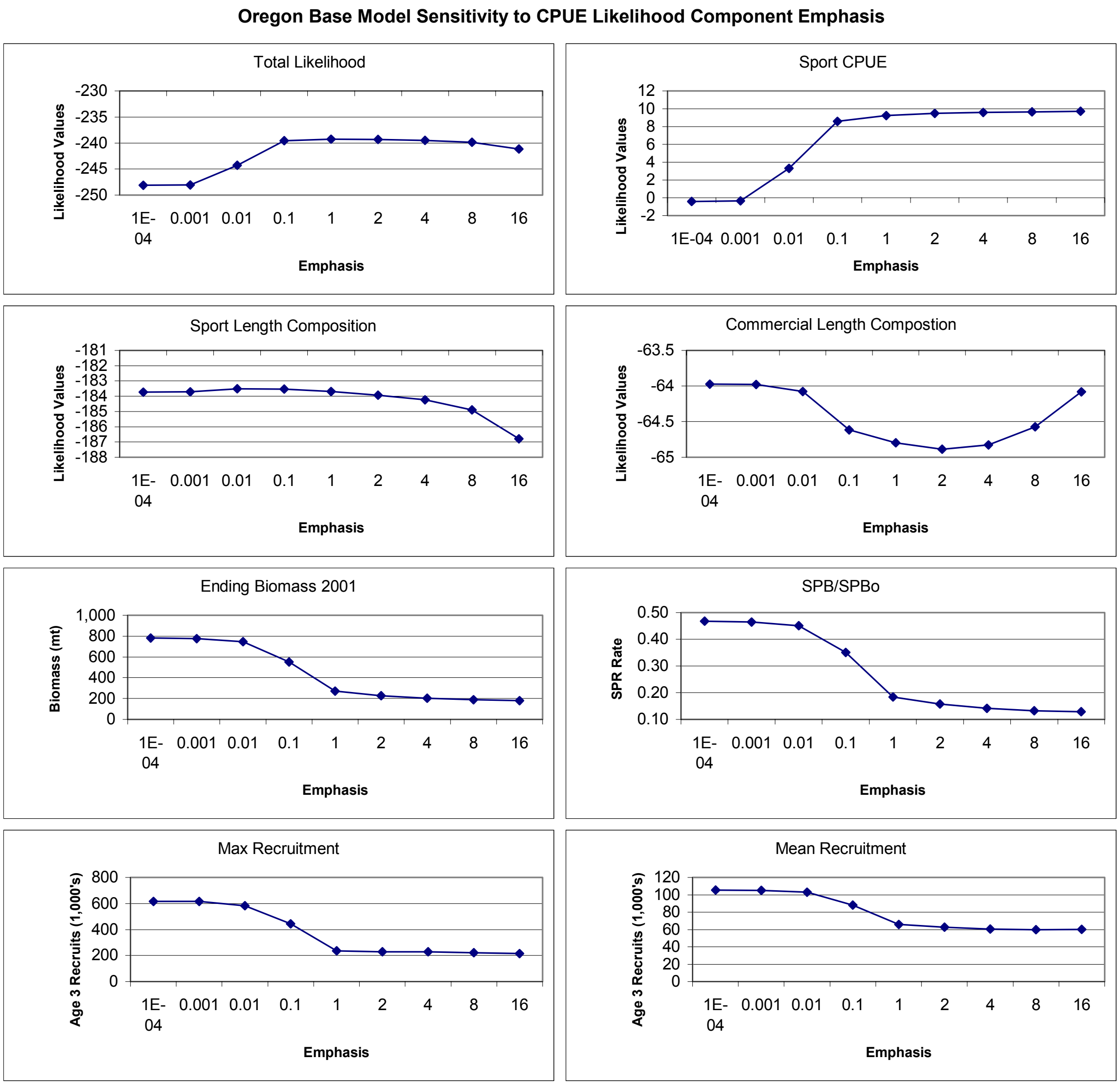


Figure 37. Oregon base model sensitivity to sport CPUE index weighting.

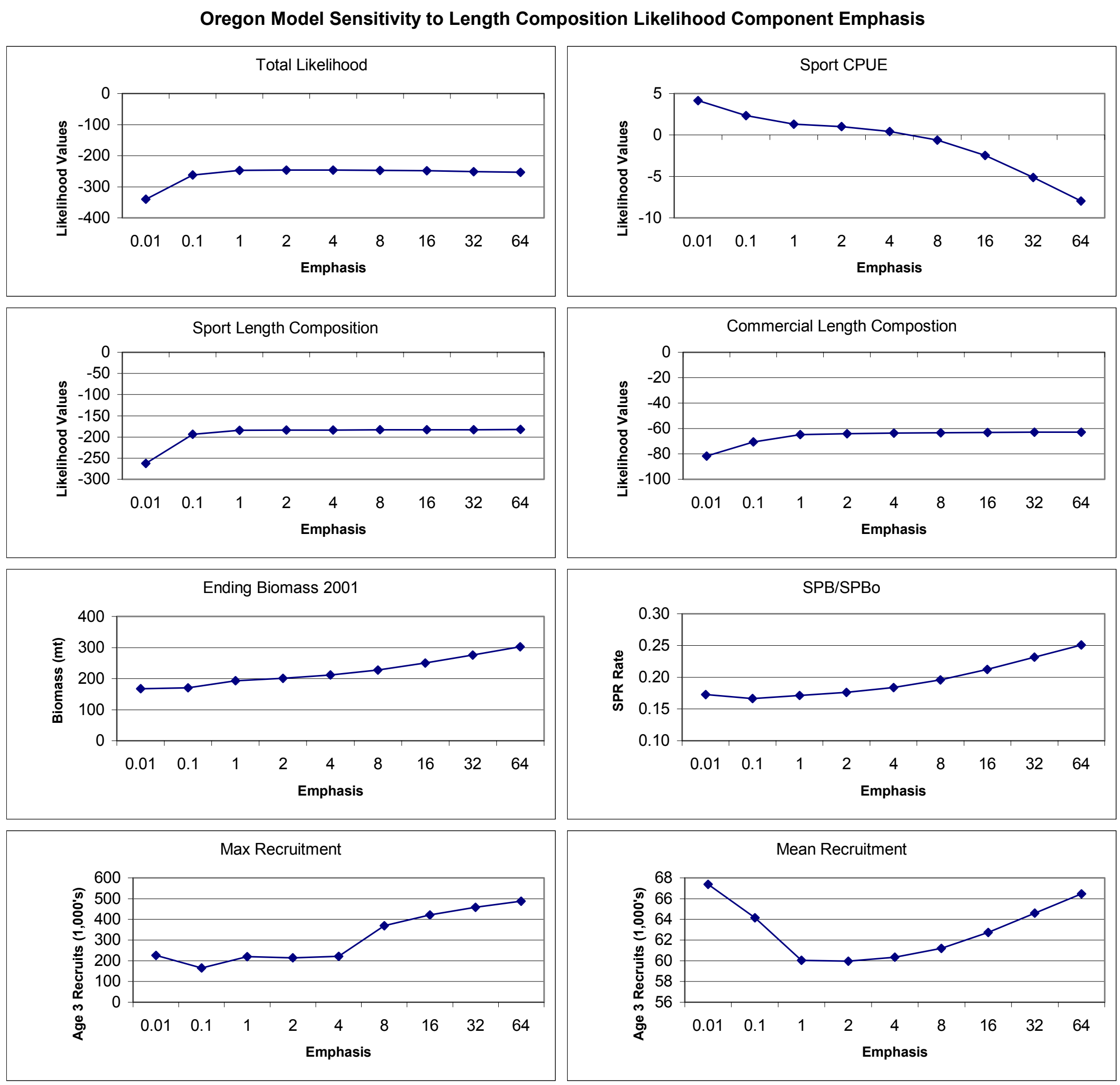


Figure 38. Oregon base model sensitivity to length composition weighting.

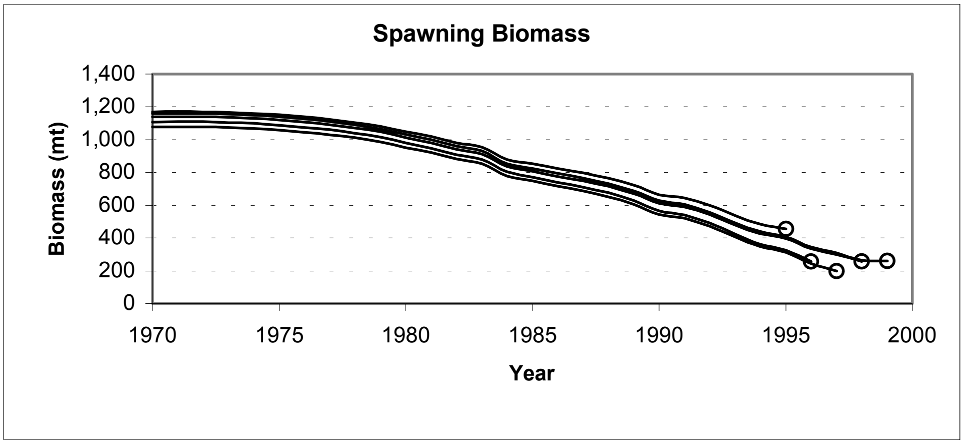


Figure 39. Retrospective analysis of the Oregon base mode

Appendix A. Stock Synthesis Parameter Files

Stock Synthesis parameter file for northern California base model

```
camorti.dat       LOOP1:  7  LIKE:  -584.36904  DELTA LIKE:      .00070 ENDBIO:      184.
CA_Final.run
CA_Final.S01
3 Fishery, Sport A. Sel, Est. Recruits (B-H emphasis=.1),CA Von B data, Sport CP
     100.000000        .001000     BEGIN AND END DELTA F PER LOOP1
   3   .95               FIRST LOOP1 FOR LAMBDA & VALUE
   1.200                 MAX VALUE FOR CROSS DERIVATIVE
   1 READ HESSIAN
yeye.h01
   1 WRITE HESSIAN
yeye.h01
    .000                 MIN SAMPLE FRAC. PER AGE
   3  70   5  70         MINAGE, MAXAGE,  SUMMARY AGE RANGE
  70 100                 BEGIN YEAR, END YEAR
  1       12  0  0  0    NPER, MON/PER
  3.00                   SPAWNMONTH
  2  2 NFISHERY, NSURVEY
  1 N SEXES
   1000.  REF RECR LEVEL
  1 MORTOPT
     .040000     .010000     .250000 'F-NMORT_YNG     '   0  70  0     .000000   .0000 !   1 NO PICK    .000      -1.       .0000000
     .142598     .010000     .800000 'F-NMORT_OLD     '   0  70  0     .000000   .0000 !   2 NO PICK    .000      -1.       .0000000
   12.001000    4.000000   25.000000 'F-NMORT_INFL    '   0  70  0     .000000   .0000 !   3 NO PICK    .000      -1.       .0000000
 Sport:     TYPE:  1
  7 SELECTIVITY PATTERN
   0   0   0   2   0   0   0  AGE TYPES USED
     1.00000       .02 'SPORT CATCH BIOMAS  '  ! # =  1 VALUE:         .00000
     1.00000     -1.00 'SPORT LENGTH COMPS  '  ! # =  2 VALUE:     -267.59667
  1  0  0  0  0  0  SEL. COMPONENTS
     .100000     .100000   40.000000 'Min size selecti'   2  70  0     .000000   .0000 !   4 BOUND      .000      -1.       .0000000
   32.056151     .050000   70.000000 'Size@ascend infl'   2  70  0     .000000   .0000 !   5 OK         .000      -3.       .5739842
     .199627     .010000    4.000000 'Ascending slope '   2  70  0     .000000   .0000 !   6 OK         .000   -1633.       .0000000
 COMMER:    TYPE:  2
  7 SELECTIVITY PATTERN
   0   0   0   4   0   0   0  AGE TYPES USED
     1.00000       .02 'COMMER CATCH BIOMAS '  ! # =  3 VALUE:         .00000
     1.00000     -1.00 'COMMER LENGTH COMPS '  ! # =  4 VALUE:     -232.55825
  1  0  0  0  0  0  SEL. COMPONENTS
```

```
      .100000     .100000   40.000000 'Min size selecti'   2  70  0     .000000   .0000 !   7 BOUND      .000      -1.      .0000000
      34.2027     .050000   70.000000 'Size@ascend infl'   2  70  0     .000000   .0000 !   8 OK        -.001     -10.   .2604742
      .306278     .010000    4.000000 'Ascending slope '   2  70  0     .000000   .0000 !   9 OK         .000   -1822.      .0000000
CPFV:      TYPE:  3
 7 SELECTIVITY PATTERN
  0   0   0   0   0   0   0  AGE TYPES USED
    .083829  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    1.00000       .23 'CPFV GLM OF CPUE    '  ! # =  5 VALUE:       10.45538
 1  0  0  0  0  0  SEL. COMPONENTS
    .100000     .100000   40.000000 'Min size selecti'   0  70  0     .000000   .0000 !  10 NO PICK    .000      -1.      .0000000
  30.747326     .050000   70.000000 'Size@ascend infl'   0  70  0     .000000   .0000 !  11 NO PICK    .000      -1.      .0000000
    .291130     .010000    4.000000 'Ascending slope '   0  70  0     .000000   .0000 !  12 NO PICK    .000      -1.      .0000000
RECFIN:    TYPE:  4
 7 SELECTIVITY PATTERN
  0   0   0   0   0   0   0  AGE TYPES USED
    .016324  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    1.00000       .11 'RECFIN CPUE         '  ! # =  6 VALUE:      -90.56529
 1  0  0  0  0  0  SEL. COMPONENTS
    .100000     .100000   40.000000 'Min size selecti'   0  70  0     .000000   .0000 !  13 NO PICK    .000      -1.      .0000000
  30.747326     .050000   70.000000 'Size@ascend infl'   0  70  0     .000000   .0000 !  14 NO PICK    .000      -1.      .0000000
    .291130     .010000    4.000000 'Ascending slope '   0  70  0     .000000   .0000 !  15 NO PICK    .000      -1.      .0000000
 1 AGEERR: 1: MULTINOMIAL,  0: S(LOG(P))=CONSTANT,  -1: S=P*Q/N
400.000 : MAX N FOR MULTINOMIAL
 3 1=%CORRECT, 2=C.V., 3=%AGREE, 4=READ %AGREE @AGE
    .310000     .100000     .950000 '%AGREE @ 1 (MIN)'   0  70  0     .000000   .0000 !  16 NO PICK    .000      -1.      .0000000
    .110000     .100000     .900000 '%AGREE @70 (MAX)'   0  70  0     .000000   .0000 !  17 NO PICK    .000      -1.      .0000000
   1.000000     .001000    4.000000 'POWER           '   0  70  0     .000000   .0000 !  18 NO PICK    .000      -1.      .0000000
    .040000     .010000     .300000 'OLD DISCOUNT    '   0  70  0     .000000   .0000 !  19 NO PICK    .000      -1.      .0000000
    .000000     .001000     .100000 '%MIS-SEXED      '   0  70  0     .000000   .0000 !  20 NO PICK    .000      -1.      .0000000
 0 END OF EFFORT
 0 FIX n FMORTs
 0  CANNIBALISM
 1  GROWTH: 1=CONSTANT, 2=MORT. INFLUENCE
 6.0000 60.0000  AGE AT WHICH L1 AND L2 OCCUR
 1 1=NORMAL, 2=LOGNORMAL
  30.140000   10.000000   40.000000 'FEMALE L1       '   0  70  0     .000000   .0000 !  21 NO PICK    .000      -1.      .0000000
  65.280000   40.000000  100.000000 'FEMALE L2       '   0  70  0     .000000   .0000 !  22 NO PICK    .000      -1.      .0000000
    .054000     .100000     .300000 'FEMALE K        '   0  70  0     .000000   .0000 !  23 NO PICK    .000      -1.      .0000000
    .180000     .010000     .990000 'FEMALE CV1      '   0  70  0     .000000   .0000 !  24 NO PICK    .000      -1.      .0000000
    .098000     .010000     .990000 'FEMALE CV21     '   0  70  0     .000000   .0000 !  25 NO PICK    .000      -1.      .0000000
         0  DEFINE MARKET CATEGORIES
 0 ENVIRONMENTAL FXN:    [-INDEX]  [FXN TYPE(1-4)]  [ENVVAR USED]
 0 ESTIMATE N ENVIRON VALUES
 7 PENALTIES
     .00010      1.00 ' parm penalty       '  ! # =  7 VALUE:        -.00605
-1  1.0  1.0
 8  STOCK-RECR
```

```
 3 1=B-H, 2=RICKER, 3=new B-H
 0 0=USE S-R CURVE, 1=SCALE CURVE
     .00100      -.40 ' SPAWN-RECRUIT indiv'  ! # =  8 VALUE:      -70.64343
     .00100      -.30 ' SPAWN-RECRUIT mean '  ! # =  9 VALUE:    -4033.56154
    .060858     .050000    9.000000 'VIRGIN RECR MULT'   2  70  0     .000000   .0000 !  26 OK          .000-4793305.       .0000022
    .670000     .200000     .900000 'B/H  S/R PARAM  '   0  70  0     .600000   .9000 !  27 NO PICK     .000       -1.       .0000000
    .000000    -.200000     .200000 'BACKG. RECRUIT  '   0  70  0     .000000   .0000 !  28 NO PICK     .000       -1.       .0000000
    .400000     .200000    1.500000 'S/R STD.DEV.    '   0  70  0     .000000   .0000 !  29 NO PICK     .000       -1.       .0000000
    .000000    -.200000     .200000 'RECR TREND      '   0  70  0     .000000   .0000 !  30 NO PICK     .000       -1.       .0000000
   1.000000     .500000    3.000000 'RECR. MULT.     '   0  70  0     .000000   .0000 !  31 NO PICK     .000       -1.       .0000000
-1 INIT AGE COMP
    .018255     .001000   10.000000 'RECRUIT 70      '   2  70  0     .000000   .0000 !  32 OK          .000  -11867.       .0002964
    .020368     .001000   10.000000 'RECRUIT 71      '   2  71  0     .000000   .0000 !  33 OK          .000  -11264.       .0003891
    .024191     .001000   10.000000 'RECRUIT 72      '   2  72  0     .000000   .0000 !  34 OK          .000  -10573.       .0006078
    .031661     .001000   10.000000 'RECRUIT 73      '   2  73  0     .000000   .0000 !  35 OK          .000   -9963.       .0011901
    .049092     .001000   10.000000 'RECRUIT 74      '   2  74  0     .000000   .0000 !  36 OK          .000   -9616.       .0031970
    .124105     .001000   20.000000 'RECRUIT 75      '   2  75  0     .000000   .0000 !  37 OK          .000   -9589.       .0045967
    .066991     .001000   10.000000 'RECRUIT 76      '   2  76  0     .000000   .0000 !  38 OK          .000   -9807.       .0000000
    .033931     .001000   10.000000 'RECRUIT 77      '   2  77  0     .000000   .0000 !  39 OK          .000  -10474.       .0014549
    .024268     .001000   10.000000 'RECRUIT 78      '   2  78  0     .000000   .0000 !  40 OK          .000  -11528.       .0006005
    .023140     .001000   10.000000 'RECRUIT 79      '   2  79  0     .000000   .0000 !  41 OK          .000  -11853.       .0005266
    .050454     .001000   10.000000 'RECRUIT 80      '   2  80  0     .000000   .0000 !  42 OK          .000  -10509.       .0023924
    .076421     .001000   10.000000 'RECRUIT 81      '   2  81  0     .000000   .0000 !  43 OK          .000  -10350.       .0054729
    .076405     .001000   10.000000 'RECRUIT 82      '   2  82  0     .000000   .0000 !  44 OK          .000  -10418.       .0041884
    .081027     .001000   10.000000 'RECRUIT 83      '   2  83  0     .000000   .0000 !  45 OK          .000  -10800.       .0016786
    .103407     .001000   10.000000 'RECRUIT 84      '   2  84  0     .000000   .0000 !  46 OK          .000  -10718.       .0032060
    .033632     .001000   10.000000 'RECRUIT 85      '   2  85  0     .000000   .0000 !  47 OK          .000  -11187.       .0013669
    .022425     .001000   10.000000 'RECRUIT 86      '   2  86  0     .000000   .0000 !  48 OK          .000  -12312.       .0004598
    .030147     .001000   20.000000 'RECRUIT 87      '   2  87  0     .000000   .0000 !  49 OK          .000  -11300.       .0007721
    .027035     .001000   10.000000 'RECRUIT 88      '   2  88  0     .000000   .0000 !  50 OK          .000  -12019.       .0005989
    .015140     .001000   10.000000 'RECRUIT 89      '   2  89  0     .000000   .0000 !  51 OK          .000  -15706.       .0001854
    .091523     .001000   10.000000 'RECRUIT 90      '   2  90  0     .000000   .0000 !  52 OK          .000  -11572.       .0010097
    .018149     .001000   10.000000 'RECRUIT 91      '   2  91  0     .000000   .0000 !  53 OK          .000  -16128.       .0003141
    .026273     .001000   10.000000 'RECRUIT 92      '   2  92  0     .000000   .0000 !  54 OK          .000  -16896.       .0004444
    .015384     .001000   10.000000 'RECRUIT 93      '   2  93  0     .000000   .0000 !  55 OK          .000  -22424.       .0001678
    .008783     .001000   10.000000 'RECRUIT 94      '   2  94  0     .000000   .0000 !  56 OK          .000  -37632.       .0000485
    .013830     .001000   10.000000 'RECRUIT 95      '   2  95  0     .000000   .0000 !  57 OK          .000  -28340.       .0000994
    .013596     .001000   10.000000 'RECRUIT 96      '   2  96  0     .000000   .0000 !  58 OK          .000  -32076.       .0000721
    .005226     .001000   20.000000 'RECRUIT 97      '   2  97  0     .000000   .0000 !  59 OK          .000  -82241.       .0000150
    .003424     .001000   10.000000 'RECRUIT 98      '   2  98  0     .000000   .0000 !  60 OK          .000 -175199.       .0000063
    .003769     .001000   10.000000 'RECRUIT 99      '   2  99  0     .000000   .0000 !  61 OK          .000 -138716.       .0000078
    .027000     .001000   10.000000 'RECRUIT 00      '  -2 100  0     .000000   .0000 !  62 NO PICK     .000       -1.       .0000000
```

Stock Synthesis parameter file for Oregon base model

```
ORMORTI.DAT       LOOP1:  7  LIKE:  -251.85943  DELTA LIKE:      .00061 ENDBIO:      484.
OR_FORSR.run
OR_FORSR.S01
3 Fishery, Sport A. Sel, Est. Recruits (B-H emphasis=.1),CA Von B data, Sport CP
     100.000000        .001000     BEGIN AND END DELTA F PER LOOP1
   3   .95               FIRST LOOP1 FOR LAMBDA & VALUE
   1.200                 MAX VALUE FOR CROSS DERIVATIVE
   1 READ HESSIAN
yeye.h01
   1 WRITE HESSIAN
yeye.h01
    .000                 MIN SAMPLE FRAC. PER AGE
   3  70   5  70         MINAGE, MAXAGE,  SUMMARY AGE RANGE
  70 100                 BEGIN YEAR, END YEAR
  1       12  0  0  0    NPER, MON/PER
  3.00                   SPAWNMONTH
  2  1 NFISHERY, NSURVEY
  1 N SEXES
    1000.  REF RECR LEVEL
  1 MORTOPT
     .040000     .010000     .250000 'F-NMORT_YNG     '   0  70  0     .000000   .0000 !   1 NO PICK    .000      -1.      .0000000
     .097339     .010000     .800000 'F-NMORT_OLD     '   0  70  0     .000000   .0000 !   2 NO PICK    .000      -1.      .0000000
   12.001000    4.000000   25.000000 'F-NMORT_INFL    '   0  70  0     .000000   .0000 !   3 NO PICK    .000      -1.      .0000000
 Sport:     TYPE:  1
  7 SELECTIVITY PATTERN
   0   0   0   2   0   0   0  AGE TYPES USED
     1.00000       .02 'SPORT CATCH BIOMAS  '  ! # =  1 VALUE:         .00000
     1.00000     -1.00 'SPORT LENGTH COMPS  '  ! # =  2 VALUE:     -184.09749
  1  0  0  0  0  0  SEL. COMPONENTS
     .138684     .100000   40.000000 'Min size selecti'   2  70  0     .000000   .0000 !   4 OK         .000   -1023.      .0043140
   30.740560     .050000   70.000000 'Size@ascend infl'   2  70  0     .000000   .0000 !   5 OK        -.001      -5.      .5650147
     .644630     .010000    4.000000 'Ascending slope '   2  70  0     .000000   .0000 !   6 OK         .000     -54.      .0423832
 COMMER:    TYPE:  2
  7 SELECTIVITY PATTERN
   0   0   0   4   0   0   0  AGE TYPES USED
     1.00000       .02 'COMMER CATCH BIOMAS '  ! # =  3 VALUE:         .00000
     1.00000     -1.00 'COMMER LENGTH COMPS '  ! # =  4 VALUE:      -64.87094
  1  0  0  0  0  0  SEL. COMPONENTS
     .100000     .100000   40.000000 'Min size selecti'   2  70  0     .000000   .0000 !   7 BOUND      .000      -1.      .0000000
   39.302966     .050000   70.000000 'Size@ascend infl'   2  70  0     .000000   .0000 !   8 OK        -.007      -2.      .3558864
```

```
    .344223     .010000    4.000000 'Ascending slope '   2  70  0     .000000   .0000 !   9 OK         .000    -515.      .0012965
ORCPUE:    TYPE:  3
 7 SELECTIVITY PATTERN
  0   0   0   0   0   0   0  AGE TYPES USED
    .011620  0  1  1 Q, QUANT, LOGERROR=1, BIO=1 or NUM=2
    1.00000       .16 'ODFW CPUE           '  ! # =  5 VALUE:        1.31392
 1  0  0  0  0  0  SEL. COMPONENTS
    .100000     .100000   40.000000 'Min size selecti'   0  70  0     .000000   .0000 !  10 NO PICK    .000      -1.      .0000000
  31.047326     .050000   70.000000 'Size@ascend infl'  -2  70  0     .000000   .0000 !  11 NO PICK    .000      -1.      .0000000
    .737130     .010000    4.000000 'Ascending slope '   0  70  0     .000000   .0000 !  12 NO PICK    .000      -1.      .0000000
 1 AGEERR: 1: MULTINOMIAL,  0: S(LOG(P))=CONSTANT,  -1: S=P*Q/N
400.000 : MAX N FOR MULTINOMIAL
 3 1=%CORRECT, 2=C.V., 3=%AGREE, 4=READ %AGREE @AGE
    .310000     .100000     .950000 '%AGREE @ 1 (MIN)'   0  70  0     .000000   .0000 !  13 NO PICK    .000      -1.      .0000000
    .110000     .100000     .900000 '%AGREE @70 (MAX)'   0  70  0     .000000   .0000 !  14 NO PICK    .000      -1.      .0000000
   1.000000     .001000    4.000000 'POWER           '   0  70  0     .000000   .0000 !  15 NO PICK    .000      -1.      .0000000
    .040000     .010000     .300000 'OLD DISCOUNT    '   0  70  0     .000000   .0000 !  16 NO PICK    .000      -1.      .0000000
    .000000     .001000     .100000 '%MIS-SEXED      '   0  70  0     .000000   .0000 !  17 NO PICK    .000      -1.      .0000000
 0 END OF EFFORT
 0 FIX n FMORTs
 0  CANNIBALISM
 1  GROWTH: 1=CONSTANT, 2=MORT. INFLUENCE
 6.0000 60.0000  AGE AT WHICH L1 AND L2 OCCUR
 1 1=NORMAL, 2=LOGNORMAL
  30.140000   10.000000   40.000000 'FEMALE L1       '   0  70  0     .000000   .0000 !  18 NO PICK    .000      -1.      .0000000
  65.280000   40.000000  100.000000 'FEMALE L2       '   0  70  0     .000000   .0000 !  19 NO PICK    .000      -1.      .0000000
    .054000     .100000     .300000 'FEMALE K        '   0  70  0     .000000   .0000 !  20 NO PICK    .000      -1.      .0000000
    .110000     .010000     .990000 'FEMALE CV1      '   0  70  0     .000000   .0000 !  21 NO PICK    .000      -1.      .0000000
    .098000     .010000     .990000 'FEMALE CV21     '   0  70  0     .000000   .0000 !  22 NO PICK    .000      -1.      .0000000
         0  DEFINE MARKET CATEGORIES
 0 ENVIRONMENTAL FXN:    [-INDEX]  [FXN TYPE(1-4)]  [ENVVAR USED]
 0 ESTIMATE N ENVIRON VALUES
 6 PENALTIES
     .00010      1.00 ' parm penalty       '  ! # =  6 VALUE:        -.00605
-1  1.0  1.0
 7  STOCK-RECR
 3 1=B-H, 2=RICKER, 3=new B-H
 0 0=USE S-R CURVE, 1=SCALE CURVE
     .00100      -.40 ' SPAWN-RECRUIT indiv'  ! # =  7 VALUE:      -55.74037
     .00100      -.30 ' SPAWN-RECRUIT mean '  ! # =  8 VALUE:    -4149.18296
    .071574     .050000    9.000000 'VIRGIN RECR MULT'   2  70  0     .000000   .0000 !  23 OK         .000 -552587.      .0000084
    .670000     .200000     .900000 'B/H  S/R PARAM  '   0  70  0     .600000   .9000 !  24 NO PICK    .000      -1.      .0000000
    .000000    -.200000     .200000 'BACKG. RECRUIT  '   0  70  0     .000000   .0000 !  25 NO PICK    .000      -1.      .0000000
    .400000     .200000    1.500000 'S/R STD.DEV.    '   0  70  0     .000000   .0000 !  26 NO PICK    .000      -1.      .0000000
    .000000    -.200000     .200000 'RECR TREND      '   0  70  0     .000000   .0000 !  27 NO PICK    .000      -1.      .0000000
   1.000000     .500000    3.000000 'RECR. MULT.     '   0  70  0     .000000   .0000 !  28 NO PICK    .000      -1.      .0000000
-1 INIT AGE COMP
```

.044029	.001000	10.000000	'RECRUIT 70 '	2	70	0	.000000	.0000 !	29	OK	.000	-1235.	.0024512
.048793	.001000	10.000000	'RECRUIT 71 '	2	71	0	.000000	.0000 !	30	OK	.000	-1168.	.0033608
.055058	.001000	10.000000	'RECRUIT 72 '	2	72	0	.000000	.0000 !	31	OK	.000	-1112.	.0042791
.064870	.001000	10.000000	'RECRUIT 73 '	2	73	0	.000000	.0000 !	32	OK	.000	-1070.	.0107887
.082260	.001000	10.000000	'RECRUIT 74 '	2	74	0	.000000	.0000 !	33	OK	.000	-1046.	.0171610
.132383	.001000	20.000000	'RECRUIT 75 '	2	75	0	.000000	.0000 !	34	OK	.000	-1047.	.0088940
.198794	.001000	10.000000	'RECRUIT 76 '	2	76	0	.000000	.0000 !	35	OK	.000	-1096.	.0031322
.071623	.001000	10.000000	'RECRUIT 77 '	2	77	0	.000000	.0000 !	36	OK	.000	-1258.	.0125139
.056132	.001000	10.000000	'RECRUIT 78 '	2	78	0	.000000	.0000 !	37	OK	.000	-1450.	.0039781
.045680	.001000	10.000000	'RECRUIT 79 '	2	79	0	.000000	.0000 !	38	OK	.000	-1704.	.0023680
.037738	.001000	10.000000	'RECRUIT 80 '	2	80	0	.000000	.0000 !	39	OK	.000	-2037.	.0015123
.033261	.001000	10.000000	'RECRUIT 81 '	2	81	0	.000000	.0000 !	40	OK	.000	-2336.	.0011589
.034841	.001000	10.000000	'RECRUIT 82 '	2	82	0	.000000	.0000 !	41	OK	.000	-2267.	.0014460
.049332	.001000	10.000000	'RECRUIT 83 '	2	83	0	.000000	.0000 !	42	OK	.000	-1750.	.0142588
.045735	.001000	10.000000	'RECRUIT 84 '	2	84	0	.000000	.0000 !	43	OK	.000	-1729.	.0025654
.048351	.001000	10.000000	'RECRUIT 85 '	2	85	0	.000000	.0000 !	44	OK	.000	-1417.	.0030977
.119434	.001000	10.000000	'RECRUIT 86 '	2	86	0	.000000	.0000 !	45	OK	.000	-975.	.0105257
.052979	.001000	20.000000	'RECRUIT 87 '	2	87	0	.000000	.0000 !	46	OK	.000	-1016.	.0051827
.214778	.001000	10.000000	'RECRUIT 88 '	2	88	0	.000000	.0000 !	47	OK	.000	-753.	.0042474
.174576	.001000	10.000000	'RECRUIT 89 '	2	89	0	.000000	.0000 !	48	OK	.000	-859.	.0139920
.053912	.001000	10.000000	'RECRUIT 90 '	2	90	0	.000000	.0000 !	49	OK	.000	-1357.	.0238605
.032899	.001000	10.000000	'RECRUIT 91 '	2	91	0	.000000	.0000 !	50	OK	.000	-2538.	.0011570
.023794	.001000	10.000000	'RECRUIT 92 '	2	92	0	.000000	.0000 !	51	OK	.000	-4602.	.0004580
.021277	.001000	10.000000	'RECRUIT 93 '	2	93	0	.000000	.0000 !	52	OK	.000	-7056.	.0002789
.017482	.001000	10.000000	'RECRUIT 94 '	2	94	0	.000000	.0000 !	53	OK	.000	-10208.	.0001670
.012216	.001000	10.000000	'RECRUIT 95 '	2	95	0	.000000	.0000 !	54	OK	.000	-17127.	.0000795
.008790	.001000	10.000000	'RECRUIT 96 '	2	96	0	.000000	.0000 !	55	OK	.000	-30438.	.0000394
.008162	.001000	20.000000	'RECRUIT 97 '	2	97	0	.000000	.0000 !	56	OK	.000	-36277.	.0000345
.008298	.001000	10.000000	'RECRUIT 98 '	2	98	0	.000000	.0000 !	57	OK	.000	-29686.	.0000462
.009467	.001000	10.000000	'RECRUIT 99 '	2	99	0	.000000	.0000 !	58	OK	.000	-21511.	.0000536
.054000	.001000	10.000000	'RECRUIT 00 '	-2	100	0	.000000	.0000 !	59	NO PICK	.000	-1.	.0000000