Status of the widow rockfish resource in 2007
An Update

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Executive Summary

Stock: This assessment applies to widow rockfish (*Sebastes entomelas*) located in the territorial waters of the U.S., including the Vancouver, Columbia, Eureka, Monterey, and Conception areas designated by the International North Pacific Fishery Commission (INPFC). The stock is assumed to be a single mixed stock and subject to four major fisheries (see figure below).

Catches: The earliest records of foreign landings of widow rockfish were in 1966. U.S. catches of widow rockfish began in 1973, peaking in 1981. Since the 1981 peak there has been a steady decline in the landings of widow rockfish to 55 mt in 2003 and to 281 mt in 2006. Catches were mostly from commercial fisheries. Catches from recreational fisheries ranged from less than 2 mt in 2003 to 375 mt in 1982. The dominant gear type historically has been the midwater trawl. During the early 1990s, bottom trawl catches nearly matched the midwater trawl catches.

Table E1. Recent landings (mt) of widow rockfish by four fisheries from 1990 to 2006.

Year	Vancouver, Columbia	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey, and Conception	Total
1990	2241	3214	2167	2672	10293
1991	1250	2146	1935	1456	6788
1992	1206	1243	2632	1324	6405
1993	1813	1844	3386	1348	8391
1994	1250	1818	2382	1248	6699
1995	1202	1508	2295	1926	6931
1996	1164	1481	2137	1530	6311
1997	1155	1593	2245	1705	6698
1998	757	890	1330	1304	4280
1999	733	1733	796	901	4162
2000	588	2352	16	1141	4097
2001	383	1109	39	504	2035
2002	118	323	3	64	508
2003	23	27	0	5	55
2004	36	42	2	28	109
2005	72	134	1	12	219
2006	92	175	2	12	281

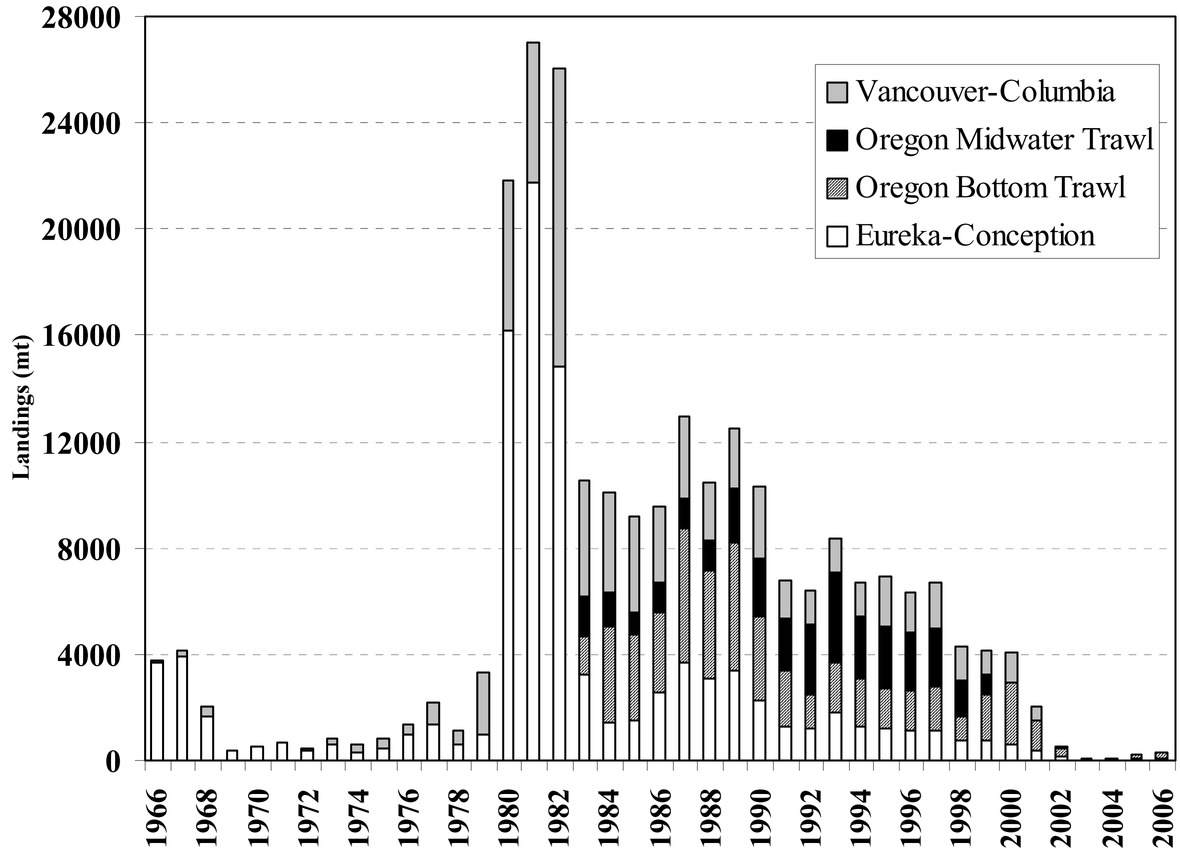


Figure E1. Total landings of widow rockfish from 1966 to 2006

Data and assessment: The last assessment of widow rockfish was conducted in 2005 using an age-based population model (written in ADMB, He et al. 2006). All fishery data, including landings, age composition, and logbook catch rates, were recently downloaded from the PacFIN, CALCOM, and NORPAC databases, or provided by state and federal agencies. Since this assessment is an update assessment, the same assessment model and data compiling procedures were used in this assessment. New data from 2005 and 2006, including catches, age composition, and CPUE time series, were included in this assessment.

Unresolved problems and major uncertainties:

1. The primary source of information on trends in abundance of widow rockfish comes from the Oregon bottom trawl logbook data, which is a questionable source of information for widow rockfish. In addition, no information after 1999 in the Oregon bottom trawl logbook data can be used in the assessment because the catch rates were very low due to trip limits and other management regulations. Based on a recommendation by the 2003 STAR panel, triennial survey indices have been used in this assessment as an additional abundance index.
2. Natural mortality was fixed at 0.15 in previous assessments. The 2005 STAR panel recommended natural mortality to be fixed at 0.125, but the validity of this estimate is still uncertain.

3. There exist uncertainties in estimating stock-recruitment relationships. Similar to other rockfish species in the area, the biomass of widow rockfish has decreased steadily since the early 1980s and recruitment during early 1990s is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment during the period could be due to lower spawning stock biomass, but it could also be due to a lower productivity regime. However, there is evidence that recruitment of many rockfish species since 1999 has been higher than the average of the 1990s. This is also supported by the most recent juvenile survey data and age composition data.
4. The uncertainties in stock-recruitment relationship would lead to greater uncertainties in the rebuilding analysis because it largely depends on how future recruitments are generated.
5. There was considerable discussion about the appropriate use of the Santa Cruz juvenile survey data in the 2003 and 2005 STAR Panel reviews. It was noted that the survey indices are highly variable, that the index has not always identified strong year-classes, and that power transformation of this index has some influences on the results. It has been suggested that the area coverage of the Santa Cruz juvenile survey might not be sufficient to monitor coast-wide distribution of widow rockfish and oceanographic conditions. The Pre-recruit Survey Workshop held in September 2006 suggested using only coast-wide pre-recruit survey indices, which are only available from 2001 to 2006. Since the assessment model uses 3 to 20+ age groups, only pre-recruit data from 2001 to 2003 can be used in the assessment model. It is a very short time series data. Nevertheless, a model run with only 2001-2006 coast-wide pre-recruit survey indices is included for reference (Appendix B).
6. Stock structure issues, in particular the relationship to the Canadian stock, remain an important source of uncertainty.

Reference points: The percentage ratio of spawning output in 2006 to unfished spawning output (B_0) is the population status ("depletion rate"). A depletion rate below 25% indicates an overfished stock, and depletion rates between 25% and 40% indicate a precautionary zone. A depletion rate over 40% is a healthy stock. The following reference points were obtained from the assessment model:

Table E2. Estimated reference points from the assessment.

Quantity	Value
Unfished spawning output (B_0)(millions of eggs)	50746
Current spawning output (B_t) (millions of eggs)	17999
Depletion rate ($100*B_t/B_0$)	35.5
Spawning output at MSY (B_{msy}) (millions of eggs)	20298
Basis for B_{msy}	$B_{40\%\ proxy}$
F_{msy}	0.1210
Basis for F_{msy}	$F_{50\%\ proxy}$

Stock biomass: Stock biomass has shown a steady decline between 1977 and 2001, soon after the fisheries for widow rockfish began. Since 2001, stock biomass has shown an increasing trend. The following table and figure show time series of estimated catches, discards, stock biomass, fishing mortality, and recruitments from the assessment model.

Table E3. Estimated biomass, recruitment, discard, and other annual parameters from the stock assessment from 1990 to 2006.

Year	Total biomass (mt)	Spawning biomass (mt)	Recruitment (*1000)	Landing (mt)	Discard (mt)	Fishing Mortality	Exploitation rate	Depletion (%)
1990	145047	65108	24898	10285	1959	0.1759	0.1572	49.5
1991	133802	60851	16128	6792	1294	0.1258	0.1144	46.9
1992	126355	58084	16102	6409	1221	0.1279	0.1191	45.3
1993	123358	54928	29824	8377	1596	0.1885	0.1708	43.1
1994	123673	50630	45363	6678	1272	0.1666	0.1508	39.8
1995	118715	47835	13939	6911	1316	0.1841	0.1698	37.4
1996	113625	45917	15758	6295	1199	0.1704	0.1566	35.3
1997	108063	45600	13534	6680	1272	0.1639	0.1504	34.6
1998	99972	45148	7470	4281	815	0.1005	0.0942	34.3
1999	94495	44774	7663	4167	794	0.1076	0.0966	34.4
2000	89355	43209	9847	4109	783	0.1182	0.1031	33.8
2001	87514	40888	22504	2038	388	0.0647	0.0574	32.4
2002	88277	39419	18126	508	97	0.0183	0.0158	31.5
2003	105582	39194	66180	55	11	0.002	0.0018	31.3
2004	110688	40131	16045	109	21	0.0035	0.0033	31.5
2005	116042	43017	17236	219	42	0.0067	0.0058	32.8
2006	120132	47478	16393	281	53	0.0065	0.0057	35.5

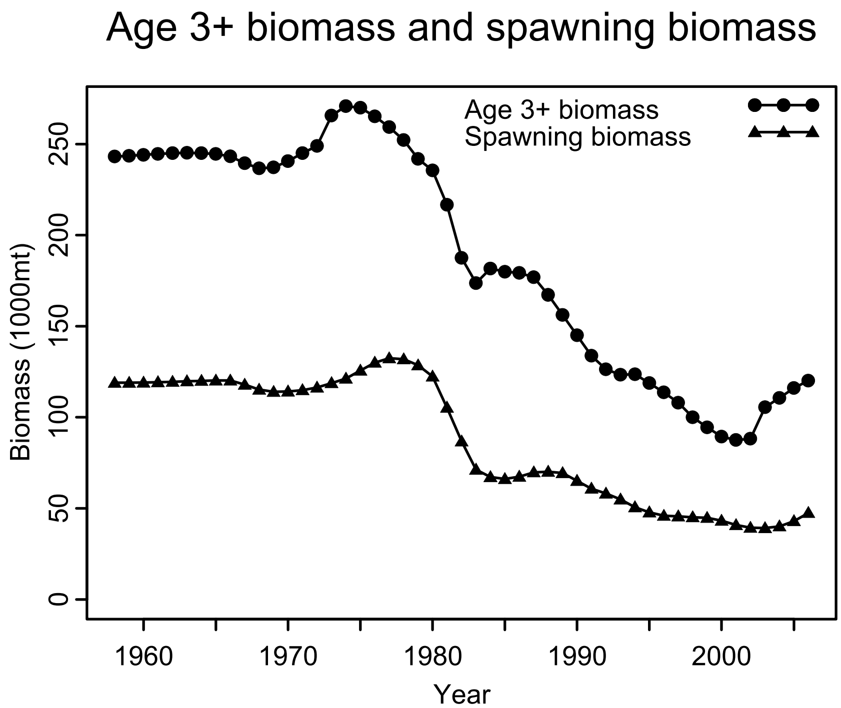


Figure E2. Age 3+ biomass (1000mt) and spawning biomass (1000mt) from 1958 to 2006 estimated from the assessment model.

Recruitment: The model estimated time series of recruitment of age 3 fish from 1958 to 2006. The highest recruitment occurred in 1972. Recruitments remained generally low in the early 1990s as compared to the long-term average, but showed an increasing trend in recent years. Figure E3 shows that recruitment of age 3 in 2003 (born in 2000) is relatively high. This relative strong recruitment class is one of main reasons that the current spawning biomass is higher than that in the 2005 assessment. However, there are uncertainties about how strong this recruitment class really is. One reason is that we have small ageing samples from the most recent years to better measure this recruitment class.

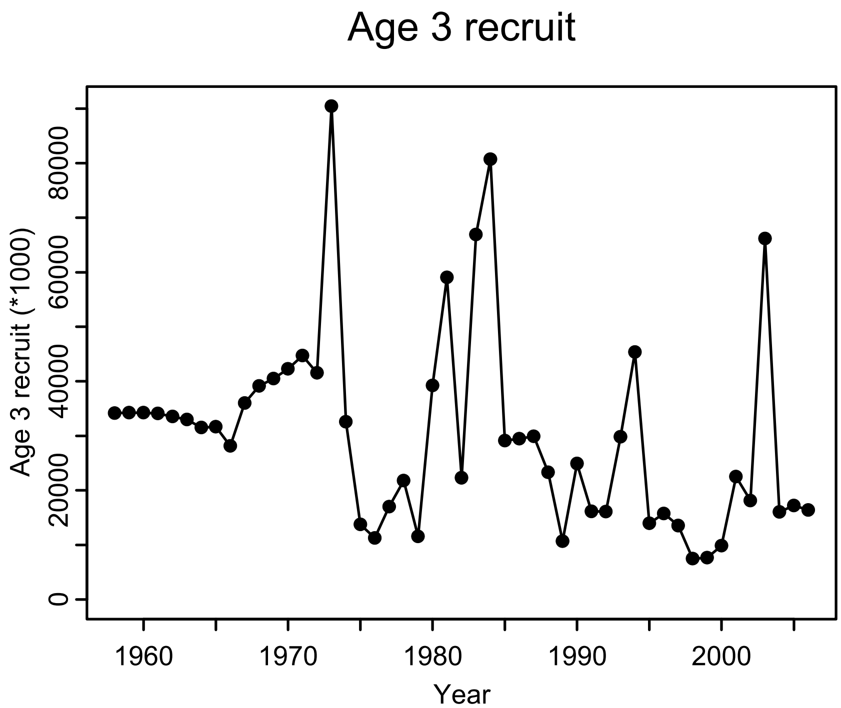


Figure E3. Age 3 recruits (*1000) from 1958 to 2006 estimates from the assessment model.

Exploitation status: The point estimate of the current spawning output is at 35.5% of the unfished level (see table above).

Management Performance: See below.

Table E4. Management performance from 1989 to 2007.

Year	Harvest Guideline	Allowable Biological Catch	Landings
1989	12100	12400	12489
1990	12400	8900	10293
1991	7000	7000	6788
1992	7000	7000	6405
1993	7000	7000	8391
1994	6500	6500	6699
1995	6500	7700	6931
1996	6500	7700	6311
1997	6500	7700	6698
1998	5090	5750	4280
1999	5090	5750	4162
2000	5090	5750	4097
2001	2300	3727	2035
2002	856	3727	508
2003	832	3871	55
2004	284	3460	109
2005	285	3218	219
2006	289	3059	281
2007	368	5334	

Forecasts: The estimated current depletion rate is 35.5% of unfished (virgin) spawning output with 95% confidence level ranged from 22.9% to 48.1%. It is estimated that the population will recover to the target (40% of unfished spawning output) in 2009. Forecasts of future biomass at five constant catch levels (ranged from 500mt to 4000mt each year) are presented in the following tables and figures. They show that the biomass will not fall below the target biomass (40% of unfishing level) if future catches remain at or below 2000mt per year.

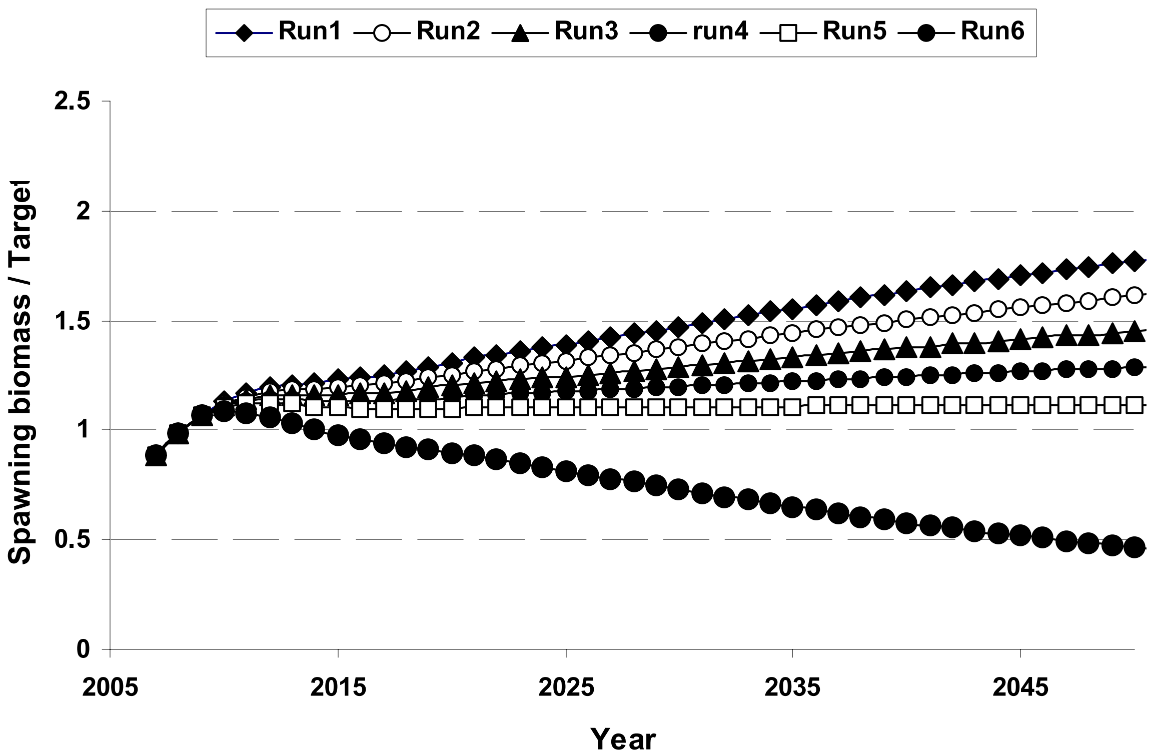
Table E5. Specifications of six rebuilding simulation runs based on different annual catch for future years. Future recruitments are generated using the stock-recruitment relationship estimated in the stock assessment. Maximum fishing mortalities for all future years are set to *Fmsy*.

Run name	Start Year	Catch time series
Run1	2007	368 mt of catch in 2007, and then no catch thereafter
Run2	2007	368 mt of catches in 2007 and 2008, 500 mt thereafter
Run3	2007	368 mt of catches in 2007 and 2008, 1000 mt thereafter
Run4	2007	368 mt of catches in 2007 and 2008, 1500 mt thereafter
Run5	2007	368 mt of catches in 2007 and 2008, 2000 mt thereafter
Run6	2007	368 mt of catches in 2007 and 2008, 4000 mt thereafter

Table E6. Proposed future catches (mt) and estimated exploitable biomass (mt) for six rebuilding runs from 2009 to 2018. The estimated target exploitable biomass is about 26,790 mt, which is roughly corresponding to 40% of virgin spawning output. The population is estimated to recover in 2009. SPR rates and fishing mortalities are average values from 2007 to 2018.

	Run1		Run2		Run3		Run4		Run5		Run6	
Probability of recovery	1.0		1.0		1.0		1.0		1.0		1.0	
Recovery time	2009		2009		2009		2009		2009		2009	
SPR rate	1.000		0.9479		0.8863		0.8356		0.7861		0.6020	
Fishing mortality	0.0000		0.0081		0.0155		0.0232		0.0313		0.0681	
	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass	Catch	Biomass
2009	0	67193	500	66703	1000	66501	1500	66299	2000	66097	4000	61109
2010	0	65869	500	65052	1000	64489	1500	63926	2000	63363	4000	56296
2011	0	63346	500	62275	1000	61420	1500	60565	2000	59710	4000	51885
2012	0	60671	500	59416	1000	58342	1500	57267	2000	56192	4000	48512
2013	0	58624	500	57239	1000	55995	1500	54749	2000	53508	4000	46276
2014	0	57431	500	55937	1000	54554	1500	53173	2000	51809	4000	45039
2015	0	57020	500	55442	1000	53985	1500	52503	2000	51020	4000	44389
2016	0	57275	500	55598	1000	54022	1500	52427	2000	50831	4000	43937
2017	0	57891	500	56093	1000	54400	1500	52690	2000	50962	4000	43381
2018	0	58480	500	56533	1000	54700	1500	52855	2000	50986	4000	42897

Figure E4. Time series of spawning biomass over target for proposed six simulation runs. Note that only Run6 (annual catch of 4000mt) results in the spawning biomass fell below the target level (spawning biomass over target equals to 1).



Recommendations:

1. There are increasingly fewer reliable abundance indices for widow rockfish. Recent management measures have undermined the ability to continue fishery dependent time series of relative abundance from the Oregon bottom trawl fishery and Pacific whiting fishery since 1999. The constant flux of the management regime suggests that there is little likelihood that meaningful CPUE indices can be developed from these fisheries in the future. More analysis should be done to either calibrate or compare triennial survey results with those from the NWFSC Combined survey.
2. Long-term recruitment index is a key datum series in the stock assessment. Continuation of the midwater juvenile trawl survey and recent increases in sampling intensity and spatial coverage will improve estimation confidence and data quality. Comparison and possibly integration of the existing juvenile survey results with a recently initiated survey by the fishing industry (See Report on Pre-recruit Survey Workshop, September 2006) could also broaden the spatial extent of this index. The ability to infer direct and indirect estimates of year class strengths from surveys and other sources, as well as to better understand the relationship between environmental conditions in the California Current

System, should improve short-term forecasts of productivity, biomass levels and allowable catches from stock assessments.

3. Preliminary information from recent bycatch monitoring suggest that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.
4. The utility of hydro-acoustic surveys on widow rockfish abundance should be evaluated in future assessments.
5. Sample sizes for existing age-collection programs (by fishery and survey) should be increased substantially.
6. The age-composition for the triennial survey should be determined by applying year-specific age-length keys to the survey length-frequencies, and included in future assessments as a basis for estimating survey selectivity.

Introduction

Widow rockfish (*Sebastes entomelas*) is an important commercial groundfish species belonging to the scorpionfish family (Scorpaenidae). It ranges from southeastern Alaska to northern Baja California, where it frequents rocky banks at depths of 25-370m (Eschemeyer et al. 1983, Wilkins 1986). In those habitats it feeds on small pelagic crustaceans and fishes, including especially *Sergestes similis*, myctophids, and euphausiids (Adams 1987). There is no evidence that separate genetic stocks of widow rockfish occur along the Pacific coast and the species has been treated as one stock with four separate fisheries (Hightower and Lenarz 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al. 2002).

A midwater trawl fishery for widow rockfish developed rapidly in the late 1970s and increased rapidly in 1980-82 (Gunderson 1984, Fig. 1 and Table 1). Large concentrations of widow rockfish had evidently gone undetected because aggregations of this species form at night and disperse at dawn, an atypical pattern for rockfish. Since the fishery first developed, substantial landings of widow rockfish have been made in all three west-coast states.

Management of the fishery began in 1982 when 75,000 lbs trip limits were introduced in an effort to curb the rapid expansion of the fishery (Tables 2-3). These were reduced to 30,000 lbs in 1983 and the fishery was managed by alteration of trip limits within the fishing season. A 10,500 mt/yr Allowable Biological Catch (ABC) for widow rockfish was instituted in 1983 (Table 3), but no harvest guideline was established. This form of management continued with alterations in ABC and trip limits until 1989 when a 12,100 mt/yr harvest guideline was implemented (Tables 2-3). From 1994-1997 the harvest guideline was changed to 6,500 mt and then reduced to 5090 mt/yr for 1998 to 2000. Based on the 2000 stock assessment and the rebuilding analysis of 2001 and 2003, the harvest guidelines were further reduced to 2,300 mt for 2001, 856 mt for 2002, 832 mt for 2003, 284 mt for 2004 and 2005, and 386 mt for 2006 and 2007 (He et al. 2003a, He et al. 2003b, He et al. 2006a, He at al. 2006b).

This assessment used an age-based population model similar to those used in previous assessments (Ralston and Pearson 1997, Williams et al. 2000, He et al. 2003b, He et al. 2006a). Since this is an update assessment, the model structure and code were same as in the 2005 assessment (He et al. 2006a). The new data from 2005 to 2007, including catches, age compositions, CPUE estimates, and bycatch estimates were added to this update assessment.

Data

Biological information

Growth in length for widow rockfish has been described using von Bertalanffy growth equations in two papers by Lenarz (1987) and Pearson and Hightower (1991). In their analyses it was determined that females attain a larger size compared to males and fish from the northern part of the range tend to be larger at age compared to those in the south. For these reasons we chose to use the sex-specific and area-specific estimates for length-at-age. Furthermore, we chose to use the estimates listed in Pearson and Hightower (1991), shown below and in Figure 2, because they are from a more recent and comprehensive analysis of widow rockfish growth compared to the analysis by Lenarz (1987). In order to match the fisheries, we used the Columbia-Eureka INPFC area border (43^{o} Lat.) to delineate north from south.

Parameter	Females (north)	Males (north)	Females (south)	Males (south)
L_{inf} (cm)	50.54	44.0	47.55	41.5
K	0.14	0.18	0.2	0.25
t_0	-2.68	-2.81	-0.17	-0.28

Sex-specific weight-at-age estimates were computed using the length-at-age estimates above with sex-specific length-weight regressions for widow rockfish developed by Barss and Echeverria (1987) (Figure 2). The length-weight regression equation is $W = \alpha L^{\beta}$, where W is the weight (g) and L is the length (cm). The sex-specific parameter values used in this assessment are listed below:

Parameter	Females	Males
α	0.00545	0.01188
β	3.28781	3.06631

Estimates of maturity and fecundity of female widow rockfish were obtained from Barss and Echeverria (1987) and Boehlert et al. (1982), respectively. Age-specific maturity estimates were taken directly from the literature instead of fitting a parametric model (Figure 3), while age-specific fecundity was computed using the weight-fecundity regression:

$$F = 605.71W - 261830.7 \tag{1}$$

where F is fecundity (number of eggs) and W is weight (g). The weight-fecundity regression applied to the southern weight-at-age estimates resulted in negative values for ages 3 and 4. The weight-fecundity regression developed by Boehlert et al. (1982) was based on fish captured from Oregon and apparently does not apply to widow rockfish in the south. The maturity estimates shown in Figure 3 indicate a substantial difference in maturity-at-age between the north and south, with the northern fish maturing at an older age. Lacking any other estimate of fecundity for the south, we applied the weight-fecundity regression from the north and modified the estimates for ages 3-5 to approximate an asymptote to 0 (Figure 3).

Landings

All landings for the period 1966-2006 were summarized into four areas (fisheries): (1) Vancouver-Columbia (VC); (2) Oregon mid-water trawl (ORMWT); (3) Oregon bottom trawl (ORBTWL); and (4) Eureka, Monterey, and Conception (EMC). Landings statistics used in this assessment were derived from four sources. First, all commercial landings from 1981 were extracted from the PacFIN database. Second, the very small annual recreational take of widow rockfish was extracted from the Marine Recreational Fishing Statistics Survey (MRFSS) database. Third, all landings from 1966 to 1972, and some landings from 1973 to 1976 were directly taken from a summary table in Rogers (2003), who recently compiled summaries of foreign catches in the period. Fourth, some landing from 1973 to 1976 and all landings from 1977 to 1979 were directly copied from the last assessment (Williams et al. 2000). Summarized landings by year are presented in Table 1 and Figure 1.

As in the last assessments of widow rockfish, the data were pooled over states into INPFC area blocks. These in turn were collapsed into northern and southern areas, representing the U.S. Vancouver and Columbia areas (VC, ORMWT, and ORBTWL) and the Eureka, Monterey, and Conception areas (EMC), respectively. The northern and southern areas are conveniently delineated by the 43^{o} latitude line. Within the southern area, widow rockfish landings were further condensed by summing over gears (i.e., trawl, other commercial, and recreational), providing annual estimates of landings from the southern area fishery. In the northern area, however, landings were partitioned into three separate fisheries; the Oregon midwater trawl fishery, the Oregon bottom trawl fishery, and the remaining catch of widow rockfish, referred to as the Vancouver-Columbia fishery. Because identification of gear types in Oregon (midwater or bottom trawl) did not begin until 1983, all landings in the northern area prior to that time were assigned to the Vancouver-Columbia "trawl" fishery.

It should be noted that there are some differences in the landing statistics between this assessment and that used in the last assessment (He et al. 2006a). First, landings from California waters in early years were corrected by using new catch composition data. These changes, however, are very small (Don Pearson, Personal communication). Second, it was discovered during the June 2007 review meeting that catches in recent years from at-sea processing vessels were not included in the total landings because they were not being reported by state. These landings are relatively small compared to the total landings (Table 1a) and they are now included in total landing estimates. Third, newly estimated bycatches on widow rockfish from 1991 to 2006 were provide by the Northwest Fisheries Science Center and are included in the total landing estimates (Jim Hastie, NMFS Northwest Fisheries Science Center, personal communications). These landings were grouped into either the Vancouver-Columbia fishery or the Oregon mid-water trawl fishery, proportioned by number of hauls observed north or south of latitude of 46 degrees.

Age composition data

Widow rockfish otolith samples collected coastwide since 1989 have been aged at the NMFS Fisheries Ecology Division in Santa Cruz (Tiburon) using the break and burn aging method (Pearson and Hightower 1991). Prior to 1989, the ages of all Vancouver-Columbia fish were obtained by researchers in the State of Washington, who used surface readings. Prior to 1987, Oregon widow rockfish were aged by investigators in Oregon, who used the break and burn aging method. All California fish were aged by Fisheries Ecology Division in Santa Cruz using the break and burn aging technique.

Age validation of widow rockfish was conducted by marginal increment analysis (Lenarz 1987). Hyaline-zone formation, the measure of annual growth, appears to occur between December and April (Pearson 1996). For convenience all widow rockfish are assumed to be born on January 1. Variation in the timing of the hyaline-zone formation occurs between fish from Washington and California, which could affect age determination. Knowledge of the timing variation can be used to avoid mis-ageing and ultimately the variation in hyaline-zone formation is not likely to result in major age discrepancies (Pearson 1996).

Washington provided ageing data from samples collected during commercial market sampling. The data were then expanded using relative catches from US Vancouver and Columbia areas. Oregon provided raw sample data which were expanded using methods described in Sampson and Crone (1997). California age data was extracted and expanded from the CALCOM database (Pearson and Erwin 1997).

In 2005 assessment, new otolith samples from the Eureka-Conception area from 1978 and 1979 were discovered last year. The samples were analyzed and included in the 2005 assessment. For this update assessment, only three sets of age composition data are available. There are age compositions data from US Vancouver and Columbia fisheries in 2005 and 2006, and from Oregon midwater trawl in 2006. The complete sex specific age composition data and sample size information for the four fisheries are presented in Tables 4-8 and Figures 4-7.

Midwater trawl pelagic juvenile survey

Every year since 1983 the Groundfish Analysis Branch at NMFS Fisheries Ecology Division in Santa Cruz/Tiburon Laboratory has conducted a midwater trawl survey, which is designed to assess the reproductive success of rockfish, including widow rockfish. The survey is conducted during May-June, the time of year when the pelagic juvenile stage is most susceptible to capture. Studies have shown that abundance statistics summarized from the survey gauge impending recruitment (Adams 1995; Ralston and Howard 1995; Ralston et al. 1996). Recent efforts to quantify spatial patterns of recruitment variability also suggests that there is substantial synchrony in year class strength over spatial scales on the order of 500-1000 km for widow, as well as chilipepper (*S. goodei*) and yellowtail (*S. flavidus*) rockfish (Field and Ralston 2005). Although much of the spatial variability in year class strength that does exist is associated with major geographic features such as Cape Mendocino and Cape Blanco, these results support the argument that recruitment variability is driven to a large extent by forcing factors operating over large spatial scales.

The survey index is calculated after the raw catch data are adjusted to a common age of 100-days to account for interannual differences in age structure. The abundance data are gathered during three consecutive sweeps of a series of 36 fixed stations that are arrayed over 7 spatial strata that extend from Carmel (36^{o}30'N) to Bodega (38^{o}20'N). As in the previous assessment, the index is calculated using Delta-GLM (Generalized Linear Model) method with lognormal error structure (Pennington 1986, 1996, Stefansson 1996):

$$\log(density) = \mu + Y_i + L_k + \varepsilon \qquad (2)$$

where u is the average $\log(density)$, Y_i is a year effect, L_k is a 'period' (bins of 10-julian days) effect, and ε is a normal error tern with mean zero and variance σ^2. The back-transformed year-specific index, with bias-correction, was then calculated as:

$$Index_i = \exp\left(\mu + Y_i + \bar{L} + \frac{\sigma^2}{2}\right)\pi_i \qquad (3)$$

where $\bar{L}$ is the mean period effect, and π_i is the predicted proportion of positive tows in year i:

$$\pi_i = \frac{\exp(\mu' + y_i' + \bar{L})}{1 + \exp(\mu' + y_i' + \bar{L})} \qquad (4)$$

where μ' is the average, y' is the year effect, and $\bar{L}$ is the average period effect of the logit-transformed probabilities. The coefficient of variation (CV) for each index value was computed from the jack-knife method.

Data from 1983 were deleted from the analysis because of a small total number of datum points. Because no juvenile widow rockfish were caught in 1992, 1996, and 1998, index values for those years were set to one half of the historical low value, and CVs for those years were set to a high value of 2.0. The resulting indices were entered into the model as relative indices of one-year juvenile abundance (Table 9 and Figure 8). The index time series (1984-2006) was then shifted forward three years (1986-2009) to represent the abundance of age-3 widow rockfish, the age of recruitment in the assessment model.

Oregon bottom trawl logbook

Oregon logbook data from 1984 to 1986 were provided by the Oregon Department of Fish and Wildlife, and data from 1987 to 2002 were extracted from the PacFIN database. Catch per unit effort (CPUE) was computed as pounds of fish caught per hour trawled. The data were filtered before the analysis. Only records meeting the following criteria were used in the analysis: (1) the fishing gear code corresponded to bottom trawl or roller gear, (2) hauls were conducted during the months of January, February, or March, and (3) the location of the reported haul fell in the range of 42°30’N to 46°30’N latitude and 124°36’W to 124°54’W longitude. In addition, records associated with any vessel code or spatial unit that had less than 1000 pounds of widow catch over the entire period (1984 to 2002) were also deleted. Data from 2000 to 2002 were not used in the analysis because widow catches in those three years were very low due to trip limits and other management regulations (Tables 2 and 3).

Annual CPUE indices were derived using the Delta-GLM (Generalized Linear Model) method similar to that used for deriving midwater trawl pelagic juvenile survey (see previous section), with an additional factor (vessel) included:

$$\log(CPUE) = \mu + Y_i + V_j + L_k + \varepsilon_{ijkl} \qquad (5)$$

where u is the average $\log(CPUE)$, Y_i is a year effect, V_j is a vessel effect, L_k is a spatial (latitude and longitude) effect, and ε_{ijkl} is a normal error tern with mean zero and variance σ_ε^2. The back-transformed year-specific CPUE, with bias-correction, was then calculated as:

$$CPUE_i = \exp\left(\mu + Y_i + \overline{V} + \overline{L} + \frac{\sigma_\varepsilon^2}{2}\right)\pi_i \qquad (6)$$

where $\overline{V}$ and $\overline{L}$ are mean effects of vessel and spatial unit, respectively, and π_i is binomial coefficient:

$$\pi_i = \frac{\exp(\mu^{'} + y_i^{'} + \overline{V}^{'} + \overline{L})}{1 + \exp(\mu^{'} + y_i^{'} + \overline{V}^{'} + \overline{L})} \qquad (7)$$

where $\mu^{'}$ is the average, $y^{'}$ is year effect, $\overline{V}^{'}$ is average vessel effect, and $\overline{L}$ is average spatial effect. Derived annual CPUE indices are presented in Table 10 and Figure 9, which are same as in the 2003 assessment.

Pacific whiting bycatch indices

As in the previous assessments (Rogers and Lenarz 1993, Ralston and Pearson 1997, Williams et al. 2002), CPUE indices were computed that measured the incidental catch rate of widow rockfish in the at-sea pacific whiting fishery. Data from the foreign fishery, joint-venture fishery and recent domestic fishery were extracted from the NORPAC database.

Full descriptions on how the CPUE indices were derived are in Appendix A of the 2005 Assessment (He et al. 2006a). Similar Delta-GLM approaches as used for the Oregon bottom trawl logbook is used in the analysis. Annual CPUE indices for the foreign fishery, joint-venture fishery, and domestic fisheries are presented in Table 11 and Figure 10. As recommended by the 2003 STAR Panel, annual CPUE indices from the domestic fishery after 1998 were excluded from the analysis because changes in management measures are expected to have more influence on the CPUE than changes in stock size.

Triennial trawl survey index

The AFSC/NWFSC triennial trawl survey index was not used in the 2003 assessment because of very limited widow catches by the survey and very poor fit of the index in the assessment model (He et al. 2003). The 2003 STAR panel recommended the index be analyzed further and be considered for inclusion in the assessment. Another important reason to include the triennial survey index in the assessment is that the index is likely going to be the only abundance index available in the future because other abundance indices from commercial fisheries will not be suitable for the assessment due to management regulations. The analysis of the triennial survey data uses the similar Delta-GLM method as for other indices, the results are presented in Table 12 and Figure 11, and detailed description of the analysis is in Appendix B of the 2005 assessment (He et al. 2006a).

History of modeling approaches

Previous assessments for widow rockfish have been performed in 1989, 1990, 1993, 1997, 2000, 2003, and 2005 (Hightower and Lenarz 1989, 1990; Rogers and Lenarz 1993; Ralston and Pearson 1997, Williams et al 2000, He et al. 2003, He et al. 2006a). In 1989 the assessment involved the use of cohort analysis and the stock synthesis program (Methot 1998). In 1993 and 1997, the age-based version of the stock synthesis program was used to assess the status of widow rockfish. In 2000 and 2003, the assessment of widow rockfish utilized AD Model Builder (ADMB) software (Otter Research, Ltd. 2001), and applied an age-based analysis of the population with methods very similar to those used in the stock synthesis program. The differences between the ADMB model and stock synthesis are minor. The ADMB model estimates landings with a very low coefficient of variation (0.05), while stock synthesis treats landings in a slightly different manner and the initial age composition estimation process is slightly different in the two models. A full description of the ADMB model follows and should clarify any further differences between this model and the stock synthesis program used in past assessments of widow rockfish.

Model description

General

Since this is an update assessment, this assessment uses the same age-structured population model that was used in the 2005 assessment (He et al. 2005a). Full descriptions of the population dynamics, catch equations, and associated likelihood functions are given in Appendix C of the 2005 assessment. The model is written in a C++ software language extension, AD Model Builder (ADMB) (Otter Research, Ltd. 2001), which utilizes automatic differentiation programming (Greiwank and Corliss 1991; Fournier 1996). The ADMB software allows for more rapid and accurate computation of derivative calculations used in the quasi-

Newton optimization routine (Chong and Zak 1996). Further advantages of this software include the ability to estimate the variance-covariance matrix for all dependent and independent parameters of interest, likelihood profiling, and a Markov chain-Monte Carlo re-sampling algorithm for probability distribution determination.

The population model begins in 1958 and tracks numbers and catches of male and female widow rockfish in age classes 3-20 (age 20 is an age-plus group). In the 2000 assessment, a starting year of 1968 was chosen based on the assumption that the 1965 year class was the earliest recruitment which could be reasonably estimated given a starting year of 1980 for the age composition information. In the 2003 assessment and this assessment, the starting year was extended backward to 1958 because the new landing data from 1966 to 1972 were added. Recruitment estimates prior to 1958 are assumed equal to the 1958 estimate in the model, so that the model is estimating recruitment at age 3 for the years 1958-1999.

The data used in this model include 4 fishery catch-at-age compositions (sum across sexes equal to one), landings in weight for each fishery, NMFS Fisheries Ecology Division's midwater juvenile survey index, Oregon bottom trawl logbook CPUE, three whiting bycatch indices, and triennial survey indices. Predicted catch in each year is scaled to the fishery landings assuming a coefficient of variation of 5%. Double logistic selectivity functions by age were estimated for each fishery.

Natural mortality

Natural mortality (M) is assumed to be constant for all ages and in all years. The initial model allowed the model to estimate a slightly higher natural mortality for males than females based on the observation that there were more old females than males in the age data. The model was presented to the 2003 STAR Panel. It was noted that greater proportions of males at younger ages could be due to differences in selectivity by gender. Allowing for different natural mortality had little impact on model results and the differences in M were small (<0.01). The 2003 STAR Panel considered that until the reason for the difference in age composition has been elucidated, the same natural mortality value should be used for both sexes. Therefore, natural mortality was fixed at 0.15 for the 2003 assessment. The 2005 STAR Panel requested that natural mortality be estimated in the model. After a series of model runs, it was decided natural mortality to be fixed at 0.125 for the assessment model.

Age compositions

The age data are modeled as multinomial random variables, with the year-specific sample sizes set equal to the number of samples collected, rather than the number of fish, which often overstates the confidence of the data (Table 8) (Quinn and Deriso 1999). However, this assessment also examined an iterative-reweighting method to determine the effective sample size in the likelihood functions (details in the Likelihood component weighting section).

Ageing error

The only information available for determination of ageing error was based on two point estimates of percent ageing agreement from the last two assessments (Rogers and Lenarz 1993; Ralston and Pearson 1997). From the previous assessments an estimate of 75% agreement for age 5 fish and 66% agreement for age 20 fish was modeled by assuming a linear relationship of percent agreement with age. These estimates of percent agreement at age were then fit to a set of age-specific normal distributions, which approximated the level of ageing agreement. The resulting matrix of true age versus reader age was then placed in the model

$$A_t = EA_r \tag{8}$$

where A_t and A_r are n*n matrices for true age and reader age, respectively, n is number of age classes, and E is a n*n matrix for ageing error with the sum across each column equals to one.

Landings

A constant CV of 0.05 is assumed for landing estimates. Year-specific fishing mortalities are computed for each fishery for those years in which there are landings estimates available. Fishing mortalities were zero from 1958 to 1965 since there are no landings estimates for those years.

Fraction of landings in the north

Since there are area specific (north and south) estimates for weight-at-age and maturity, it is necessary to determine the fraction of the population to which each of these area-specific estimates apply. We used the sum of the domestic landings in the Vancouver-Columbia and both Oregon trawl fisheries relative to the total landings as an estimate of the proportion of the population to which the northern weight-at-age and maturity functions could be applied. Foreign landings from 1966 to 1976 from Rogers (2003) were not used in computing the fractions. The annual change in this fraction seemed highly variable and not likely to be indicative of true declines in area abundances. For this reason, the time series of proportions of landings in the north were smoothed using a 7-year moving average (Figure 12). The results from the moving average were then put directly into the model, applying the 1973 value to the earlier years.

Discards

The level of discards of widow rockfish is virtually unknown in most of years. Age compositions in discards and landings can be very different (typically small fish are discarded) and can be important in determining discard rates (Williams et al. 1999). In past assessments a value of 6% of total weight was assumed for years 1958-1982 and 16% of total weight for the years 1983-2002 (Hightower and Lenarz 1990, Williams et al. 2000, He et al. 2003). The same discard rates (16%) were also applied for the years 2003-2004 in this assessment. The 16% estimate of discards is based on a dated study by Pikitch et al. (1988), which indicated most of the discards of widow rockfish were induced by regulations. The earlier 6% estimated is based on an ad hoc adjustment of the 16% by previous assessment authors (Hightower and Lenarz 1990). The 16% assumed value has likely become more uncertain in recent years due changes in regulations. For example, the most recent estimate on discard rate from the 2002 observer data, based on 89mt of widow rockfish catch, was 0.1%, which is much lower than the 16% assumed value.

Midwater juvenile trawl survey

The NMFS Fisheries Ecology Division's midwater trawl juvenile survey is scaled to represent an index of 100 day-old larvae. For inclusion in the model the time series was lagged to correspond with the appropriate year class. Within the model a catchability coefficient is estimated. In past assessments (Williams et al. 2002, He et al. 2006a), a power coefficient was used for the midwater trawl survey. The power transformation was included to account for possible density dependent mortality occurring between 100 days of age and age 3 (the age of recruitment in the model), which likely results in higher variance levels in the survey time series relative to age 3 recruitment time series. However, the 2003 STAR panel argued that using power coefficient might dampen the estimate of recruitment variability. In the 2005 assessment, the power transformation is re-examined (see details in the Model Selection section). Test runs also showed that the results were only slightly different between using the power coefficient of 1.0 and 3.0, which was the default value in the 2003 assessment. In this assessment, the power transformation is used as in the 2005 assessment.

Logbook and bycatch indices

The Oregon bottom trawl logbook indices and whiting bycatch indices are treated as biomass indices and are estimated in the model with a catchability parameter for each index. Because there were no new data since the 2003 assessment, the same Oregon bottom trawl logbook indices from the last assessment are used in this assessment. The whiting bycatch indices are recalculated according to the 2003 STAR panel recommendations, however the results are very similar. Details on the calculations of the whiting bycatch indices using Delta-GLM methods are in the Appendix A of the 2005 Assessment.

Calculation of depletion rate

Depletion rate is calculated as ratio of current spawning output over unfished spawning output. In the 2003 assessment, the depletion rate was calculated as ratio of the 2002 spawning output over the 1958 (first year in the model) spawning output. In this assessment, we calculate depletion rates using the same method as in the 2003 rebuilding analysis (He et al. 2003) and in the 2005 assessment, which used the average of spawning outputs from 1958 to 1982 as unfished spawning output. This same calculation method will also be used for rebuilding analysis in 2005 and this year's (2007) rebuilding analysis.

Likelihood component weighting

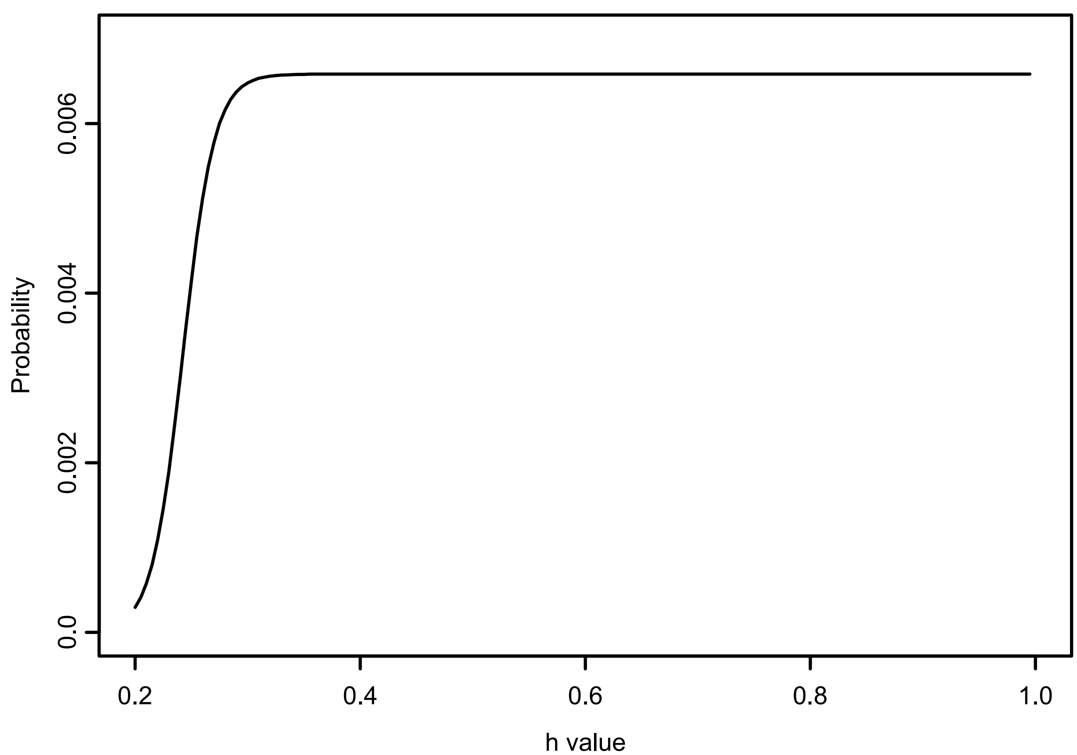
There are nine likelihood components in the model: age-composition data, landings, recruitment residuals, midwater juvenile trawl survey index, four fisheries CPUE indices, and triennial survey indices. Weighting in this assessment model has two levels. First, contribution of each datum point to its likelihood component is weighted by a fixed CV associated with the datum point. Details on how a fixed CV is determined for each component are discussed later. Second, a weighting factors is assumed for each likelihood component and the final likelihood value for each component is multiplied by its weighting factor (Appendix C, He et al. 2006a). In this assessment model, all weighting factor have been set to 1, except for the recruitment residual component and the midwater juvenile survey index component, whose weighting factors are 0.5.

For age composition data, this assessment used the same weighting method as in the 2006 assessment. It examines an iterative-reweighting method to determine the effective sample size in the likelihood functions (McAllister and Ianelli 1997, Maunder, in preparation) for each year in each fishery. Initial sample size for each age composition data is taken directly from real sample sizes of the fishery. After the model is fitted to the data, the observed and predicted proportions at age are used in the following equation to calculate effective sample size (T):

$$T = \frac{\sum_a \hat{p}_a \left(1 - \hat{p}_a\right)}{\sum_a \left(p_a - \hat{p}_a\right)^2} \qquad (9)$$

where $\hat{p}_a$ is the predicted proportion and p_a is the observed proportion at age a. The new sample size is then used in the model and the model is re-run. This process is repeated until the change in effective sample size is less than one percent between two consecutive runs. Because the sample size can differ substantially from year to year in a fishery, a linear regression of effective sample size versus observed sample size is used to obtain predicted effective sample size (MacCall 2003), which is then used in each iteration of the model run.

A prior for the steepness parameter in the stock-recruitment relations is also added in the likelihood functions (He at al. 2006c). The prior is based on a persistence principle that persistence of any species, given its life history and its exposure to recruitment variability, requires a minimum recruitment compensation that enables the species to rebound consistently from very low abundances. The prior curve for widow rockfish-like species has the following form:



A logistic equation that fits well with the curve is used in the likelihood function of the assessment model.

Results

Results of the update assessment model run are presented in Tables 13-14 and Figures 13-27. The resulting time series of total biomass, spawning biomass, spawning output, recruitment, and fishing mortality are presented in Table 13 and Figures 13-16. Estimated parameter values and their standard deviations are presented in Table 14. The fishery-specific selectivity curves are shown in Figure 17. The stock-recruitment relationship is shown in Figure 18. The fits to the landings are shown in Figures 19-20, and the fits to the various indices are shown in Figures 21-26. The fits of the age composition data are shown in Figure 27.

Comparisons between 2005 and 2007 assessments

Comparisons of main model outputs between this assessment and the 2005 base model are presented in Table 15 and Figure 28. Overall, estimated key parameters, such as unfished spawning outputs and recruitment steepness, are very similar. Time series of total biomass from 1958 to present year are also similar (Figure 28). But this assessment indicates that the population recovers quicker in the most recent years (especially in 2003 and 2004) than those estimated in the 2005 base model (Figure 28). The estimated current depletion rate (100*$Bt/B0$) is 35.5% as compared to the 2005 estimate of 31.09%. There are three reasons that might lead to this quick recovery. First, total catches in the past few years, particularly in 2005 and 2006, have been very low (Table 1 and Table 2). They were lower than the harvest guidelines set by the Council. Second, perhaps more importantly, recruitment classes of the late 1990's (mostly likely the 1999 year class), have entered the spawning biomass which will also be dominating the spawning biomass in the next few years. Third, there are no other data in the most recent years suggest any declining trends of the population.

Rebuilding parameters

Unfished spawning output (B_0) was calculated as an average from the first year (1958) to 1982, which is the same period used in the 2003 and 2005 rebuilding analysis (He et al. 2003a, He et al. 2005b). Other rebuilding parameters were calculated in the same way as in the 2005 assessment. A separate C++ program was written (embedded in the ADMB program) to produce a data file ("rebuild.dat") that can be directly inputted into the rebuilding program written by Punt (2007).

Status of the stock

The percentage ratio of spawning output in 2006 to B_0 is the population status. The point estimate for the population status in 2006 is 35.5% (Table 15). Given that the population was declared as an overfished stock in previous assessments (Williams 2000, He et al. 2003), and the population status is within the precautionary zone (>25% and <40%), rebuilding analysis is needed to determine harvest projections and target fishing mortalities.

Management Recommendations

The stock has declined since fishing began in the later 1970's. The 2003 assessment showed that the spawning output in 2002 was just below 25% of unfished spawning output. This assessment shows that the spawning output in 2006 was within the precautionary zone. Therefore, it is necessary to conduct rebuilding analysis to determine harvest levels and related risks of each harvest levels (He et al. 2003).

Future research

1. There are increasingly fewer reliable abundance indices for widow rockfish. Recent management measures have undermined the ability to continue fishery dependent time series of relative abundance from the Oregon bottom trawl fishery and Pacific whiting fishery since 1999. The constant flux of the management regime suggests that there is little likelihood that meaningful CPUE indices can be developed from these fisheries in the future. The triennial bottom trawl survey may be the only data that can provide abundance indices in the future. More analysis should be done to either calibrate or compare triennial survey results with those from the NWFSC Combined survey.
2. The long-term recruitment index is a key datum series in the stock assessment. Continuation of the midwater juvenile trawl survey and recent increases in sampling intensity and spatial coverage will improve estimation confidence and data quality. Comparison and possibly integration of the existing juvenile survey results with a recently initiated survey by the fishing industry (Vidar Wespestad, pers. comm.) could also broaden the spatial extent of this index. The ability to infer direct and indirect estimates of year class strengths from surveys and other sources, as well as to better understand the relationship between environmental conditions in the California Current System, should improve short-term forecasts of productivity, biomass levels and allowable catches from stock assessments.
3. Preliminary information from recent bycatch monitoring suggests that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.
4. The utility of hydro-acoustic surveys on widow rockfish abundance should be evaluated in future assessments.
5. Sample sizes for existing age-collection programs (by fishery and survey) should be increased substantially.
6. The age-composition for the triennial survey should be determined by applying year-specific age-length keys to the survey length-frequencies, and included in future assessments as a basis for estimating survey selectivity.

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Table 1. U.S. total landings (mt) of widow rockfish by four fisheries from 1966 to 2006.

Year	Vancouver, Columbia	Oregon Midwater Trawl	Oregon Bottom Trawl	Eureka, Monterey, and Conception	Total
1966	3670	0	0	96	3766
1967	3900	0	0	249	4149
1968	1693	0	0	336	2029
1969	356	0	0	21	377
1970	554	0	0	1	555
1971	701	0	0	1	702
1972	410	0	0	13	423
1973	617	0	0	207	824
1974	293	0	0	280	573
1975	454	0	0	358	812
1976	948	0	0	412	1360
1977	1318	0	0	883	2201
1978	605	0	0	502	1107
1979	966	0	0	2326	3292
1980	16190	0	0	5666	21856
1981	21779	0	0	5226	27005
1982	14802	0	0	11261	26063
1983	3222	1452	1488	4402	10564
1984	1450	3568	1334	3719	10072
1985	1537	3185	871	3596	9188
1986	2559	2977	1171	2819	9526
1987	3722	4986	1166	3071	12945
1988	3078	4102	1121	2144	10445
1989	3378	4857	1974	2280	12489
1990	2241	3214	2167	2672	10293
1991	1250	2146	1935	1456	6788
1992	1206	1243	2632	1324	6405
1993	1813	1844	3386	1348	8391
1994	1250	1818	2382	1248	6699
1995	1202	1508	2295	1926	6931
1996	1164	1481	2137	1530	6311
1997	1155	1593	2245	1705	6698
1998	757	890	1330	1304	4280
1999	733	1733	796	901	4162
2000	588	2352	16	1141	4097
2001	383	1109	39	504	2035
2002	118	323	3	64	508
2003	23	27	0	5	55
2004	36	42	2	28	109
2005	72	134	1	12	219
2006	92	175	2	12	281

Table 1a. Annual landing (mt) from at-sea processing (ASP) retrieved from the PacFIN database and bycatch estimates (mt) provided by the Northwest Fisheries Science Center for widow rockfish from 1991 to 2006. These data are included in the catches by fisheries in Table 1.

Year	ASP Catch	Bycatch estimate
1991	150	272
1992	5	348
1993	4	151
1994	27	288
1995	33	195
1996	4	212
1997	3	205
1998	66	259
1999	33	186
2000	77	207
2001	50	173
2002	77	155
2003	13	15
2004	14	21
2005	26	80
2006	67	143

Table 2. Management performance in obtaining the harvest guideline for widow rockfish. Harvest guideline and allowable biological catch (ABC) are taken from Council documents.

Year	Harvest Guideline	Allowable Biological Catch	Landings
1989	12100	12400	12489
1990	12400	8900	10293
1991	7000	7000	6788
1992	7000	7000	6405
1993	7000	7000	8391
1994	6500	6500	6699
1995	6500	7700	6931
1996	6500	7700	6311
1997	6500	7700	6698
1998	5090	5750	4280
1999	5090	5750	4162
2000	5090	5750	4097
2001	2300	3727	2035
2002	856	3727	508
2003	832	3871	55
2004	284	3460	109
2005	285	3218	219
2006	289	3059	281
2007	368	5334	

Table 3. Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
10/13/82	75,000 lb trip limit
1/30/83	30,000 lb trip limit
9/10/83	1,000 lb trip limit
1/1/84	50,000 lb trip limit once per week
5/6/84	40,000 lb trip limit once per week
8/1/84	closed fishery with 1,000 trip limit for incidental catch
9/9/84	closed fishery
1/10/85	30,000 lb trip limit once a week or 60,000 lb trip limit once per two weeks, unlimited trips of less than 3,000 lbs
4/28/85	dropped 60,000 lb biweekly option
7/21/85	3,000 lb trip limit, unlimited number of trips
1/1/86	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
9/28/86	3,000 lb trip limit, unlimited number of trips
1/1/87	30,000 lb trip limit, only one weekly landing greater than 3000 lbs
11/25/87	closed fishery
1/1/88	30,000 lb trip limit, only one weekly landing greater than 3000 lbs, unlimited number of trips less than 3,000 lbs
9/21/88	3,000 lb trip limit, unlimited number of trips
1/1/89	30,000 lb trip limit, only one weekly landing greater than 3,000 lbs
4/26/89	10,000 lb trip limit once per week
10/11/89	3,000 lb trip limit with unlimited number of trips
1/1/90	15,000 lb trip limit once per week or 25,000 lb trip limit once per two weeks with only one landing greater than 3,000 lbs each week
12/12/90	closed fishery
1/1/91	10,000 lb trip limit per week or 20,000 lb trip limit every two weeks with only one landing greater than 3,000 lbs per week
9/25/91	3,000 lb trip limit with unlimited number of trips
1/1/92	30,000 lbs cumulative landings every 4 weeks
5/9/92	change from 3" mesh to 4.5" mesh in codend for roller gear north of Point Arena
8/12/92	3,000 lb trip limit with unlimited number of trips
12/2/92	30,000 lb cumulative trip limit per 4 weeks
12/1/93	3,000 lb trip limit with unlimited number of trips
1/1/94	30,000 lb cumulative limit per calendar month
12/1/94	3,000 lb trip limit with unlimited number of trips
1/1/95	30,000 lb cumulative limit per calendar month
4/14/95	45,000 lb cumulative limit per calendar month
9/8/95	4.5" mesh applies to entire net and bottom trawl
1/1/96	70,000 lb cumulative limit per two months
9/1/96	50,000 lb cumulative limit per two months
11/1/96	25,000 lb cumulative limit per two months
1/1/97	70,000 lb cumulative limit per two months
5/1/97	60,000 lb cumulative limit per two months
1/1/98	limited entry: 25,000 lb cumulative per two month period, open access: 12,500 lb cumulative per two month period
5/1/98	limited entry: 30,000 lb cumulative per two month period

Table 3 (continued). Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
7/1/98	open access: 3,000 lb cumulative per month
10/1/98	limited entry: 19,000 cumulative per month
1/1/99	limited entry: cumulative limits: phase 1 - 70,000 lbs per period, phase 2 - 16,000 lbs per period, phase 3 - 30,000 lbs per period. Open access: 2,000 lbs per month
5/1/99	limited entry: decrease phase 2 and phase 3 limits to 11,000 lbs
7/2/99	open access: 8,000 lb cumulative limit per month
10/1/99	limited entry: vessels in Oregon and Washington using 30,000 lb cumulative monthly limit must have midwater trawl gear aboard or a state cumulative limit will be imposed
1/1/00	Widow rockfish classified as a shelf species for regulatory purposes, 30,000 lbs/2 months for limited entry trawl, 3,000 lbs/month for limited entry fixed gear and open access
1/1/01	20,000 lbs/2 months for months of Jan-Apr and Sep-Oct; otherwise 10,000 lbs/2 months for midwater limited entry. 1,000 lbs/months for small footrope limited entry. 3,000 lbs/month for fixed gear limited entry. Open access: north - 3,000 lbs/month, south - 3,000 lbs per month with some monthly closures in some areas.
7/1/01	North - limited entry midwater trawl limits: 1,000 lbs/month
10/1/01	closed fishery for all except midwater, which may land 2,000 lbs/month in north for October, then 25,000 lbs/2 months.
1/1/02	North - limited entry trawl: closed through November to midwater trawl except for small bycatch in whiting fishery, in November 13,000 lbs/2 month with no more than 2 trips, small footrope trawl1000 lbs/month through September, then closed Sept-Oct, then 500 lbs/month Nov-Dec. South - limited entry trawl: midwater closed year round except for a small bycatch in the whiting fishery, small footrope trawl 1,000 lbs/month through July, then closed
1/1/03	North - limited entry trawl: midwater trawl closed through November except for small amount of bycatch in whiting fishery, 12,000 lbs/2 months for Nov-Dec. small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: same as north for midwater and small footrope trawl. South - limited entry fixed gear: closed Mar-Apr, then variable 100 lbs/2 months to 250 lbs/2 months. South - - open access gear: same as limited entry fixed gear.
1/1/04	North - limited entry trawl: midwater trawl closed through November except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting), 12,000 lbs/2 months for Nov-Dec. small footrope trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: closed. South - limited entry fixed gear between 40E10’ and 34E27’ N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27’ N lat.: closed Jan-Feb, 2,000 lbs/2 months Mar-Dec. South - - open access gear between 40E10’ and 34E27’ N lat.: same as limited entry fixed gear. South – open access gear south of 34E27’ N lat.: closed Jan-Feb, 500 lbs/2 months Mar-Dec.

Table 3 (continued). Chronology of the regulatory history of widow rockfish by the Pacific Fishery Management Council.

Date	Regulation
1/1/05 (regs. for 2005 and 2006)	North - limited entry trawl: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month. South - limited entry fixed gear between 40E10’ and 34E27’ N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27’ N lat.: 2,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr. South - - open access gear between 40E10’ and 34E27’ N lat.: same as limited entry fixed gear. South – open access gear south of 34E27’ N lat.: 500 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.
7/1/05	South - limited entry fixed gear south of 34E27’ N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish/2 months Jul-Dec. South – open access gear south of 34E27’ N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jul-Dec.
10/1/05	North of 38E N lat.: limited entry trawl RCA extended from shoreline to 250 fm; 36E N lat. to 38E N lat.: limited entry trawl RCA extended from shoreline to 200 fm; South of 36E N lat.: limited entry trawl RCA extended from 50 fm to 200 fm.
1/1/06	South - limited entry fixed gear south of 34E27’ N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb. South – open access gear south of 34E27’ N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Jan-Feb.
3/1/06	South - limited entry fixed gear south of 34E27’ N lat.: 3,000 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec. South – open access gear south of 34E27’ N lat.: 750 lbs of shelf rockfish, shortbelly rockfish, and widow rockfish /2 months Mar.-Dec.
10/1/06	Widow bycatch cap in the non-tribal limited entry whiting trawl fishery increased from 200 mt to 220 mt.
1/1/07 (regs. for 2007 and 2008)	North - limited entry trawl: large and small footrope trawl- 300 lbs/2 months; midwater trawl- closed except for small amount of bycatch in whiting fishery (500 lbs/month during primary whiting season; combined widow and yellowtail trip limit of 500 lbs/trip with trips of at least 10,000 lbs of whiting; cumulative widow limit of 1,500 lbs/month); selective flatfish trawl - 300 lbs/month Jan-Apr and Nov-Dec, 1,000 lbs/month May-Oct. North - limited entry fixed gear: 200 lbs/month. North - open access gear: 200 lbs/month. South - limited entry trawl: large footrope and midwater trawl- closed; small footrope trawl- 300 lbs/month. South - limited entry fixed gear between 40E10’ and 34E27’ N lat.: 300 lbs/2 months Jan-Feb and Sep-Dec, closed Mar-Apr, 200 lbs/2 months May-Aug. South - limited entry fixed gear south of 34E27’ N lat.: 3,000 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr. South - - open access gear between 40E10’ and 34E27’ N lat.: same as limited entry fixed gear. South – open access gear south of 34E27’ N lat.: 750 lbs/2 months Jan-Feb and May-Dec, closed Mar-Apr.

4/17/07 Widow bycatch cap in the non-tribal limited entry whiting trawl fishery increased from 200 mt to 220 mt.

North – limited entry trawl: RCA extended to the shore from Cape Alava (48E10’ N lat.) to U.S.-Canada border and from Cape Arago (43°20.83' N. lat.) to Humbug Mountain (42°40.50' N. lat.); the shoreward boundary of the trawl RCA is shifted shoreward to 60 fm from April 17 through October 31, 2007 between Leadbetter Point (46°38.17' N. lat.) and the Oregon/Washington border (46°16’ N. lat.); shoreward boundary of the trawl RCA shifted shoreward to 75 fm in all other areas through Dec.; the seaward boundary of the trawl RCA is shifted shoreward to 150 fm from the U.S.-Canada Border to Cascade Head (45°03.83’ N. lat.) from April 17 through August 31, 2007;, the seaward boundary of the trawl RCA is shifted shoreward to 200 fm between Cascade Head (45°03.83’ N. lat.) and 40°10 N. lat. from April 17 through April 30, 2007.

Table 4a. Propotional age composition of males for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2006.

	Age																	
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.022	0.020	0.056	0.096	0.111	0.046	0.029	0.012	0.013	0.006	0.004	0.002	0.002	0.001	0.003
1981	0.000	0.007	0.024	0.064	0.046	0.024	0.048	0.088	0.068	0.047	0.026	0.017	0.012	0.005	0.004	0.003	0.003	0.009
1982	0.000	0.008	0.030	0.084	0.031	0.045	0.021	0.021	0.033	0.072	0.045	0.034	0.035	0.021	0.014	0.009	0.005	0.017
1983	0.000	0.008	0.154	0.113	0.028	0.017	0.014	0.013	0.014	0.018	0.020	0.015	0.015	0.009	0.006	0.007	0.006	0.020
1984	0.000	0.003	0.054	0.161	0.083	0.033	0.014	0.004	0.006	0.007	0.008	0.013	0.013	0.011	0.007	0.008	0.008	0.029
1985	0.000	0.008	0.075	0.080	0.125	0.066	0.022	0.009	0.004	0.006	0.005	0.006	0.005	0.003	0.006	0.005	0.003	0.028
1986	0.000	0.007	0.060	0.174	0.075	0.049	0.014	0.006	0.005	0.005	0.003	0.003	0.005	0.006	0.003	0.002	0.002	0.029
1987	0.000	0.006	0.024	0.120	0.194	0.046	0.013	0.009	0.003	0.004	0.006	0.004	0.003	0.004	0.004	0.002	0.002	0.011
1988	0.000	0.000	0.015	0.060	0.137	0.199	0.035	0.013	0.005	0.002	0.001	0.003	0.003	0.001	0.000	0.001	0.001	0.014
1989	0.000	0.003	0.018	0.093	0.095	0.157	0.087	0.009	0.004	0.001	0.000	0.001	0.000	0.001	0.000	0.000	0.002	0.008
1990	0.000	0.000	0.025	0.077	0.153	0.068	0.097	0.030	0.011	0.005	0.001	0.000	0.000	0.000	0.001	0.001	0.001	0.007
1991	0.000	0.001	0.010	0.062	0.114	0.107	0.074	0.044	0.050	0.010	0.004	0.003	0.002	0.001	0.004	0.001	0.001	0.018
1992	0.000	0.003	0.020	0.031	0.072	0.077	0.082	0.049	0.052	0.029	0.020	0.008	0.005	0.003	0.002	0.000	0.001	0.012
1993	0.000	0.000	0.016	0.058	0.051	0.063	0.057	0.035	0.029	0.031	0.023	0.020	0.012	0.007	0.005	0.004	0.002	0.013
1994	0.000	0.001	0.011	0.041	0.087	0.057	0.045	0.037	0.028	0.023	0.026	0.016	0.013	0.011	0.005	0.004	0.003	0.017
1995	0.001	0.010	0.031	0.056	0.096	0.100	0.064	0.029	0.031	0.019	0.015	0.024	0.010	0.007	0.006	0.007	0.002	0.012
1996	0.001	0.012	0.059	0.112	0.104	0.058	0.033	0.018	0.013	0.010	0.008	0.006	0.008	0.002	0.003	0.003	0.002	0.008
1997	0.000	0.003	0.037	0.149	0.129	0.050	0.015	0.010	0.006	0.007	0.007	0.008	0.001	0.003	0.003	0.001	0.001	0.004
1998	0.000	0.001	0.014	0.043	0.146	0.110	0.040	0.015	0.007	0.009	0.008	0.003	0.002	0.002	0.007	0.001	0.000	0.006
1999	0.000	0.002	0.011	0.041	0.081	0.107	0.082	0.041	0.023	0.010	0.010	0.009	0.005	0.005	0.004	0.005	0.002	0.005
2000	0.000	0.000	0.005	0.058	0.113	0.071	0.073	0.073	0.038	0.013	0.012	0.005	0.002	0.009	0.006	0.003	0.002	0.005
2001	0.000	0.000	0.004	0.051	0.126	0.084	0.062	0.054	0.037	0.039	0.033	0.008	0.017	0.006	0.006	0.006	0.002	0.006
2002	0.000	0.002	0.022	0.027	0.061	0.106	0.068	0.056	0.026	0.027	0.012	0.015	0.002	0.002	0.005	0.002	0.002	0.003
2003	0.000	0.005	0.087	0.115	0.120	0.087	0.024	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.035	0.102	0.044	0.040	0.028	0.010	0.013	0.005	0.003	0.005	0.003	0.002	0.103	0.003	0.000	0.106
2005	0.000	0.008	0.100	0.035	0.110	0.051	0.018	0.022	0.014	0.005	0.003	0.005	0.002	0.003	0.002	0.002	0.002	0.024
2006	0.000	0.013	0.020	0.167	0.070	0.054	0.020	0.015	0.006	0.005	0.007	0.002	0.004	0.002	0.001	0.002	0.003	0.006

Table 4b. Propotional age composition of females for the Vancouver-Columbia fishery with the sum across sexes equal to 1. Data are from 1980 to 2006.

	Age																	
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1980	0.000	0.000	0.009	0.018	0.014	0.026	0.088	0.142	0.085	0.063	0.035	0.018	0.021	0.019	0.005	0.007	0.006	0.013
1981	0.000	0.007	0.017	0.047	0.044	0.020	0.020	0.062	0.078	0.071	0.037	0.028	0.019	0.010	0.005	0.006	0.005	0.027
1982	0.000	0.008	0.018	0.060	0.029	0.042	0.019	0.015	0.015	0.049	0.040	0.040	0.033	0.032	0.017	0.015	0.006	0.037
1983	0.000	0.006	0.153	0.114	0.040	0.021	0.009	0.014	0.013	0.016	0.029	0.023	0.022	0.013	0.010	0.007	0.005	0.028
1984	0.001	0.002	0.044	0.152	0.075	0.026	0.018	0.005	0.006	0.007	0.011	0.017	0.025	0.024	0.020	0.011	0.014	0.081
1985	0.000	0.008	0.071	0.081	0.117	0.058	0.028	0.009	0.007	0.005	0.008	0.005	0.012	0.010	0.011	0.007	0.008	0.099
1986	0.000	0.002	0.053	0.178	0.091	0.070	0.020	0.013	0.004	0.007	0.008	0.006	0.009	0.008	0.008	0.009	0.003	0.061
1987	0.000	0.004	0.014	0.095	0.224	0.057	0.037	0.026	0.009	0.007	0.004	0.002	0.007	0.008	0.005	0.008	0.004	0.035
1988	0.000	0.002	0.007	0.056	0.151	0.206	0.035	0.017	0.012	0.008	0.003	0.000	0.003	0.001	0.000	0.001	0.000	0.007
1989	0.000	0.003	0.007	0.076	0.093	0.184	0.104	0.009	0.010	0.006	0.001	0.001	0.001	0.002	0.000	0.001	0.004	0.020
1990	0.000	0.001	0.028	0.062	0.116	0.078	0.119	0.059	0.012	0.006	0.003	0.003	0.000	0.001	0.002	0.001	0.001	0.029
1991	0.000	0.000	0.004	0.054	0.084	0.099	0.066	0.057	0.054	0.011	0.009	0.005	0.004	0.002	0.001	0.003	0.002	0.040
1992	0.000	0.003	0.023	0.025	0.055	0.091	0.082	0.057	0.069	0.046	0.030	0.012	0.008	0.004	0.001	0.004	0.002	0.024
1993	0.000	0.001	0.008	0.059	0.038	0.068	0.070	0.054	0.050	0.085	0.048	0.030	0.015	0.009	0.003	0.005	0.002	0.029
1994	0.004	0.003	0.013	0.047	0.074	0.068	0.044	0.054	0.041	0.043	0.052	0.035	0.025	0.016	0.013	0.008	0.004	0.031
1995	0.001	0.009	0.032	0.050	0.078	0.082	0.055	0.037	0.023	0.027	0.017	0.021	0.010	0.007	0.011	0.005	0.002	0.014
1996	0.000	0.002	0.068	0.112	0.108	0.064	0.054	0.024	0.014	0.018	0.013	0.011	0.017	0.005	0.004	0.002	0.002	0.019
1997	0.000	0.001	0.029	0.167	0.142	0.053	0.033	0.024	0.017	0.018	0.017	0.010	0.007	0.011	0.005	0.002	0.003	0.029
1998	0.000	0.001	0.012	0.048	0.165	0.153	0.047	0.020	0.023	0.023	0.020	0.021	0.014	0.004	0.011	0.005	0.002	0.017
1999	0.000	0.001	0.012	0.046	0.067	0.127	0.105	0.053	0.033	0.023	0.015	0.013	0.014	0.009	0.006	0.011	0.005	0.018
2000	0.000	0.000	0.002	0.053	0.088	0.097	0.077	0.069	0.046	0.021	0.010	0.009	0.006	0.006	0.006	0.009	0.002	0.007
2001	0.000	0.000	0.002	0.025	0.053	0.090	0.057	0.014	0.031	0.025	0.048	0.035	0.017	0.019	0.004	0.006	0.008	0.023
2002	0.000	0.002	0.026	0.027	0.029	0.111	0.106	0.046	0.048	0.036	0.031	0.027	0.024	0.010	0.002	0.012	0.005	0.022
2003	0.005	0.019	0.144	0.077	0.067	0.082	0.058	0.014	0.038	0.010	0.010	0.010	0.005	0.005	0.000	0.000	0.005	0.005
2004	0.000	0.002	0.031	0.123	0.054	0.061	0.068	0.038	0.031	0.016	0.020	0.012	0.007	0.002	0.002	0.002	0.013	0.016
2005	0.000	0.006	0.101	0.175	0.059	0.056	0.032	0.027	0.016	0.018	0.018	0.014	0.011	0.010	0.010	0.008	0.003	0.030
2006	0.000	0.000	0.040	0.285	0.068	0.082	0.013	0.016	0.017	0.008	0.008	0.008	0.011	0.009	0.007	0.003	0.005	0.021

Table 5a. Propotional age composition of males for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2006. Note that there were no 2003 and 2005 ageing data.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.002	0.019	0.163	0.109	0.010	0.019	0.008	0.007	0.008	0.019	0.023	0.002	0.009	0.003	0.002	0.001	0.013
1985	0.000	0.002	0.065	0.070	0.223	0.065	0.008	0.006	0.003	0.000	0.002	0.005	0.013	0.003	0.002	0.000	0.000	0.010
1986	0.000	0.000	0.006	0.093	0.083	0.196	0.064	0.005	0.006	0.005	0.000	0.000	0.001	0.012	0.004	0.002	0.001	0.007
1987	0.000	0.000	0.014	0.125	0.218	0.074	0.042	0.022	0.002	0.003	0.003	0.000	0.000	0.002	0.004	0.000	0.001	0.003
1988	0.000	0.001	0.014	0.077	0.244	0.129	0.034	0.020	0.008	0.000	0.001	0.000	0.001	0.000	0.003	0.002	0.000	0.003
1989	0.000	0.006	0.019	0.054	0.121	0.199	0.068	0.016	0.010	0.003	0.001	0.001	0.001	0.001	0.002	0.002	0.004	0.006
1990	0.000	0.003	0.028	0.029	0.057	0.099	0.133	0.067	0.032	0.015	0.007	0.004	0.000	0.001	0.000	0.002	0.000	0.004
1991	0.000	0.000	0.008	0.064	0.100	0.107	0.065	0.089	0.039	0.010	0.011	0.003	0.002	0.002	0.001	0.000	0.001	0.009
1992	0.000	0.000	0.036	0.040	0.087	0.083	0.080	0.041	0.086	0.030	0.022	0.014	0.002	0.004	0.000	0.000	0.001	0.013
1993	0.000	0.000	0.016	0.071	0.055	0.081	0.049	0.039	0.034	0.060	0.026	0.018	0.015	0.006	0.000	0.003	0.001	0.010
1994	0.000	0.002	0.009	0.076	0.156	0.080	0.047	0.041	0.012	0.020	0.031	0.000	0.002	0.005	0.000	0.000	0.000	0.009
1995	0.000	0.004	0.017	0.025	0.131	0.095	0.048	0.043	0.032	0.023	0.030	0.007	0.001	0.001	0.000	0.005	0.000	0.001
1996	0.000	0.008	0.073	0.093	0.071	0.065	0.049	0.034	0.014	0.008	0.024	0.009	0.017	0.008	0.003	0.000	0.005	0.005
1997	0.000	0.002	0.031	0.240	0.116	0.043	0.026	0.027	0.016	0.013	0.009	0.003	0.014	0.013	0.000	0.000	0.001	0.002
1998	0.000	0.000	0.012	0.081	0.194	0.112	0.054	0.015	0.025	0.015	0.003	0.007	0.001	0.001	0.009	0.002	0.001	0.004
1999	0.000	0.001	0.025	0.038	0.109	0.181	0.087	0.022	0.005	0.006	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.002
2000	0.000	0.000	0.013	0.054	0.078	0.084	0.119	0.071	0.028	0.021	0.005	0.005	0.006	0.003	0.000	0.001	0.000	0.002
2001	0.000	0.000	0.001	0.018	0.098	0.099	0.120	0.062	0.050	0.042	0.017	0.006	0.002	0.003	0.002	0.002	0.004	0.004
2002	0.000	0.009	0.009	0.044	0.090	0.148	0.118	0.033	0.013	0.009	0.010	0.007	0.000	0.009	0.005	0.000	0.007	0.002
2004	0.000	0.080	0.140	0.203	0.081	0.026	0.015	0.002	0.002	0.002	0.001	0.002	0.001	0.000	0.000	0.001	0.001	0.001
2006	0.000	0.000	0.019	0.206	0.112	0.111	0.017	0.009	0.019	0.007	0.024	0.013	0.008	0.014	0.000	0.000	0.002	0.033

Table 5b. Propotional age composition of females for the Oregon midwater trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 2006. Note that there were no 2003 and 2005 ageing data.

	Age																	
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.001	0.019	0.166	0.175	0.014	0.031	0.007	0.006	0.004	0.029	0.067	0.018	0.008	0.007	0.006	0.007	0.021
1985	0.000	0.000	0.050	0.067	0.253	0.087	0.011	0.011	0.009	0.000	0.001	0.007	0.018	0.002	0.001	0.001	0.002	0.005
1986	0.000	0.000	0.010	0.122	0.084	0.167	0.073	0.005	0.011	0.005	0.000	0.001	0.004	0.017	0.002	0.002	0.002	0.009
1987	0.000	0.001	0.017	0.113	0.198	0.080	0.038	0.020	0.002	0.005	0.002	0.000	0.001	0.002	0.003	0.001	0.000	0.002
1988	0.001	0.005	0.015	0.077	0.192	0.099	0.026	0.017	0.009	0.004	0.004	0.000	0.001	0.000	0.001	0.004	0.003	0.004
1989	0.000	0.004	0.026	0.036	0.079	0.197	0.086	0.024	0.011	0.006	0.004	0.002	0.000	0.001	0.001	0.002	0.001	0.007
1990	0.000	0.000	0.018	0.034	0.054	0.079	0.151	0.104	0.037	0.022	0.009	0.002	0.002	0.001	0.001	0.000	0.000	0.004
1991	0.000	0.000	0.010	0.062	0.096	0.061	0.069	0.098	0.043	0.014	0.010	0.004	0.003	0.001	0.000	0.000	0.002	0.015
1992	0.000	0.000	0.023	0.030	0.070	0.075	0.042	0.064	0.089	0.031	0.015	0.006	0.001	0.002	0.002	0.002	0.000	0.008
1993	0.000	0.001	0.010	0.068	0.036	0.080	0.065	0.036	0.046	0.067	0.034	0.024	0.020	0.010	0.004	0.005	0.002	0.007
1994	0.000	0.000	0.008	0.049	0.158	0.064	0.056	0.041	0.035	0.025	0.029	0.015	0.021	0.005	0.000	0.000	0.002	0.003
1995	0.000	0.005	0.005	0.031	0.059	0.088	0.089	0.057	0.043	0.039	0.032	0.046	0.013	0.007	0.014	0.001	0.000	0.009
1996	0.000	0.007	0.067	0.059	0.077	0.080	0.049	0.024	0.039	0.016	0.018	0.023	0.018	0.006	0.001	0.001	0.001	0.027
1997	0.000	0.003	0.012	0.170	0.082	0.038	0.038	0.017	0.014	0.012	0.013	0.013	0.007	0.017	0.001	0.002	0.000	0.005
1998	0.000	0.000	0.004	0.037	0.158	0.092	0.048	0.031	0.032	0.015	0.015	0.012	0.004	0.002	0.007	0.001	0.003	0.005
1999	0.000	0.000	0.023	0.036	0.081	0.186	0.093	0.041	0.020	0.008	0.011	0.007	0.001	0.007	0.004	0.001	0.000	0.001
2000	0.000	0.000	0.015	0.046	0.075	0.086	0.081	0.095	0.039	0.024	0.011	0.006	0.007	0.004	0.003	0.002	0.006	0.008
2001	0.000	0.000	0.000	0.013	0.067	0.067	0.071	0.069	0.049	0.060	0.016	0.010	0.008	0.008	0.014	0.008	0.006	0.004
2002	0.000	0.003	0.009	0.018	0.065	0.114	0.091	0.082	0.036	0.033	0.015	0.005	0.009	0.000	0.005	0.000	0.002	0.002
2004	0.005	0.111	0.075	0.152	0.071	0.023	0.006	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2006	0.000	0.000	0.016	0.135	0.028	0.043	0.037	0.014	0.021	0.009	0.024	0.005	0.004	0.008	0.011	0.011	0.011	0.028

Table 6a. Propotional age composition of males for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.002	0.034	0.158	0.115	0.018	0.017	0.004	0.004	0.002	0.021	0.015	0.011	0.009	0.007	0.003	0.001	0.010
1985	0.000	0.003	0.049	0.097	0.195	0.049	0.003	0.005	0.002	0.000	0.001	0.004	0.026	0.000	0.007	0.001	0.000	0.007
1986	0.000	0.002	0.014	0.200	0.081	0.085	0.058	0.003	0.018	0.005	0.002	0.000	0.001	0.018	0.002	0.001	0.003	0.016
1987	0.000	0.000	0.011	0.111	0.204	0.072	0.040	0.016	0.003	0.002	0.007	0.000	0.000	0.006	0.005	0.002	0.000	0.008
1988	0.002	0.011	0.017	0.080	0.208	0.102	0.022	0.011	0.007	0.003	0.000	0.000	0.001	0.000	0.002	0.004	0.001	0.006
1989	0.000	0.009	0.025	0.051	0.094	0.176	0.064	0.027	0.014	0.008	0.000	0.005	0.000	0.000	0.001	0.001	0.006	0.007
1990	0.000	0.004	0.047	0.045	0.056	0.068	0.116	0.058	0.021	0.020	0.010	0.004	0.001	0.003	0.000	0.000	0.000	0.012
1991	0.000	0.000	0.004	0.066	0.100	0.072	0.042	0.078	0.037	0.010	0.012	0.003	0.001	0.004	0.000	0.000	0.001	0.011
1992	0.000	0.000	0.017	0.022	0.084	0.073	0.059	0.034	0.048	0.018	0.029	0.016	0.004	0.004	0.006	0.002	0.003	0.017
1993	0.000	0.000	0.006	0.035	0.035	0.088	0.091	0.047	0.033	0.054	0.035	0.023	0.014	0.004	0.002	0.004	0.000	0.017
1994	0.000	0.003	0.014	0.057	0.107	0.069	0.042	0.017	0.021	0.029	0.024	0.008	0.006	0.005	0.009	0.002	0.000	0.011
1995	0.000	0.003	0.034	0.109	0.074	0.135	0.039	0.044	0.021	0.018	0.007	0.012	0.005	0.005	0.005	0.000	0.000	0.002
1996	0.000	0.002	0.079	0.082	0.059	0.058	0.022	0.017	0.017	0.020	0.016	0.002	0.017	0.005	0.002	0.011	0.001	0.007
1997	0.000	0.006	0.044	0.230	0.118	0.047	0.031	0.021	0.009	0.018	0.007	0.006	0.001	0.006	0.002	0.000	0.000	0.004
1998	0.000	0.000	0.008	0.051	0.183	0.116	0.035	0.022	0.017	0.020	0.006	0.009	0.000	0.002	0.007	0.000	0.003	0.008
1999	0.000	0.004	0.028	0.066	0.118	0.177	0.072	0.027	0.009	0.000	0.000	0.007	0.001	0.000	0.000	0.000	0.007	0.003

Table 6b. Propotional age composition of females for the Oregon bottom trawl fishery with the sum across sexes equal to 1. Data are from 1984 to 1999.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1984	0.000	0.000	0.033	0.135	0.188	0.031	0.018	0.013	0.008	0.005	0.014	0.034	0.017	0.009	0.005	0.006	0.003	0.049
1985	0.001	0.000	0.023	0.062	0.199	0.121	0.016	0.007	0.007	0.000	0.001	0.026	0.038	0.006	0.006	0.004	0.004	0.030
1986	0.000	0.001	0.025	0.106	0.062	0.096	0.068	0.007	0.018	0.013	0.000	0.000	0.004	0.044	0.010	0.007	0.005	0.025
1987	0.000	0.002	0.010	0.119	0.167	0.060	0.051	0.030	0.004	0.004	0.002	0.003	0.000	0.005	0.017	0.014	0.003	0.023
1988	0.010	0.014	0.009	0.077	0.172	0.103	0.041	0.027	0.015	0.010	0.005	0.006	0.001	0.002	0.006	0.010	0.003	0.010
1989	0.000	0.001	0.027	0.028	0.068	0.146	0.090	0.038	0.041	0.016	0.006	0.004	0.004	0.004	0.006	0.004	0.010	0.018
1990	0.000	0.000	0.046	0.036	0.037	0.068	0.137	0.107	0.036	0.017	0.009	0.005	0.007	0.002	0.002	0.001	0.001	0.024
1991	0.000	0.000	0.007	0.055	0.060	0.065	0.074	0.109	0.058	0.034	0.034	0.007	0.005	0.005	0.002	0.001	0.003	0.037
1992	0.000	0.000	0.010	0.008	0.082	0.089	0.069	0.058	0.090	0.048	0.032	0.020	0.014	0.005	0.006	0.001	0.003	0.031
1993	0.000	0.000	0.000	0.025	0.025	0.076	0.073	0.044	0.040	0.066	0.043	0.029	0.017	0.021	0.006	0.009	0.006	0.032
1994	0.000	0.002	0.009	0.043	0.100	0.063	0.057	0.063	0.046	0.026	0.065	0.029	0.020	0.012	0.012	0.007	0.006	0.016
1995	0.000	0.005	0.013	0.037	0.109	0.084	0.051	0.039	0.045	0.026	0.017	0.025	0.004	0.002	0.013	0.002	0.000	0.015
1996	0.000	0.007	0.076	0.102	0.082	0.086	0.051	0.028	0.041	0.032	0.008	0.004	0.040	0.000	0.002	0.010	0.003	0.011
1997	0.000	0.008	0.031	0.104	0.094	0.030	0.047	0.031	0.019	0.015	0.008	0.013	0.010	0.016	0.005	0.001	0.005	0.014
1998	0.000	0.000	0.012	0.047	0.141	0.110	0.054	0.024	0.030	0.017	0.026	0.013	0.016	0.003	0.008	0.002	0.001	0.009
1999	0.000	0.000	0.023	0.058	0.068	0.147	0.063	0.042	0.039	0.009	0.012	0.006	0.008	0.002	0.000	0.001	0.001	0.001

Table 7a. Propotional age composition of males for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1978 to 2004.

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1978	0.000	0.000	0.000	0.000	0.039	0.062	0.114	0.039	0.047	0.016	0.016	0.000	0.016	0.039	0.000	0.023	0.000	0.055
1979	0.000	0.000	0.000	0.000	0.011	0.012	0.049	0.017	0.020	0.016	0.009	0.017	0.002	0.019	0.011	0.020	0.000	0.048
1980	0.000	0.000	0.002	0.014	0.003	0.007	0.040	0.032	0.051	0.031	0.025	0.029	0.010	0.053	0.004	0.016	0.005	0.060
1981	0.001	0.008	0.010	0.027	0.025	0.028	0.026	0.030	0.043	0.047	0.024	0.033	0.016	0.029	0.012	0.004	0.014	0.025
1982	0.000	0.000	0.044	0.007	0.037	0.033	0.030	0.014	0.043	0.076	0.036	0.030	0.020	0.014	0.017	0.010	0.008	0.032
1983	0.000	0.000	0.023	0.140	0.032	0.033	0.013	0.005	0.008	0.009	0.020	0.020	0.012	0.012	0.005	0.023	0.002	0.027
1984	0.000	0.000	0.022	0.137	0.145	0.028	0.036	0.014	0.014	0.002	0.010	0.030	0.014	0.004	0.005	0.004	0.004	0.030
1985	0.000	0.000	0.009	0.062	0.163	0.145	0.013	0.025	0.011	0.002	0.003	0.010	0.022	0.002	0.005	0.003	0.003	0.027
1986	0.000	0.003	0.042	0.046	0.082	0.124	0.129	0.014	0.022	0.017	0.001	0.001	0.008	0.029	0.006	0.009	0.004	0.038
1987	0.001	0.000	0.055	0.114	0.044	0.060	0.091	0.112	0.020	0.030	0.021	0.003	0.000	0.019	0.015	0.003	0.011	0.026
1988	0.000	0.035	0.000	0.066	0.061	0.090	0.061	0.051	0.034	0.014	0.009	0.008	0.003	0.004	0.006	0.016	0.002	0.016
1989	0.000	0.005	0.109	0.073	0.078	0.119	0.046	0.050	0.020	0.012	0.020	0.016	0.008	0.000	0.000	0.007	0.006	0.009
1990	0.000	0.000	0.045	0.116	0.029	0.047	0.038	0.056	0.030	0.025	0.016	0.023	0.019	0.014	0.004	0.002	0.008	0.006
1991	0.000	0.002	0.015	0.119	0.120	0.049	0.038	0.065	0.022	0.016	0.020	0.012	0.002	0.004	0.004	0.003	0.003	0.017
1992	0.000	0.001	0.011	0.019	0.138	0.095	0.038	0.017	0.044	0.028	0.021	0.019	0.011	0.005	0.016	0.001	0.002	0.023
1993	0.000	0.000	0.085	0.163	0.096	0.078	0.010	0.002	0.009	0.007	0.011	0.001	0.021	0.005	0.002	0.004	0.001	0.033
1994	0.002	0.004	0.007	0.070	0.148	0.110	0.065	0.021	0.024	0.007	0.008	0.005	0.006	0.009	0.001	0.005	0.000	0.005
1995	0.000	0.033	0.039	0.034	0.056	0.197	0.045	0.066	0.058	0.003	0.028	0.007	0.021	0.001	0.004	0.008	0.000	0.003
1996	0.004	0.006	0.046	0.045	0.067	0.114	0.118	0.033	0.027	0.018	0.015	0.003	0.025	0.007	0.002	0.002	0.009	0.013
1997	0.000	0.002	0.008	0.108	0.041	0.051	0.052	0.048	0.050	0.036	0.027	0.023	0.013	0.005	0.004	0.012	0.006	0.012
1998	0.000	0.008	0.082	0.061	0.093	0.069	0.054	0.021	0.045	0.025	0.018	0.018	0.005	0.007	0.009	0.000	0.000	0.013
1999	0.001	0.001	0.019	0.072	0.059	0.101	0.069	0.051	0.027	0.022	0.030	0.016	0.006	0.006	0.006	0.012	0.005	0.031
2000	0.000	0.000	0.004	0.044	0.061	0.116	0.055	0.044	0.027	0.028	0.009	0.000	0.003	0.003	0.008	0.002	0.002	0.002
2001	0.000	0.000	0.000	0.010	0.073	0.012	0.064	0.092	0.035	0.040	0.032	0.030	0.042	0.021	0.004	0.003	0.000	0.007
2002	0.000	0.010	0.002	0.002	0.015	0.035	0.044	0.104	0.029	0.021	0.098	0.032	0.061	0.002	0.030	0.000	0.033	0.036
2003	0.000	0.279	0.013	0.009	0.009	0.035	0.040	0.040	0.000	0.018	0.000	0.004	0.013	0.013	0.000	0.000	0.000	0.004
2004	0.000	0.000	0.023	0.000	0.015	0.031	0.054	0.070	0.039	0.015	0.047	0.023	0.007	0.032	0.039	0.000	0.007	0.007

Table 7b. Propotional age composition of females for the Eureka-Conception fishery with the sum across sexes equal to 1. Data are from 1978 to 2004.

	Age																
Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20+
1978	0.000	0.000	0.000	0.000	0.124	0.206	0.041	0.041	0.018	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.042
1979	0.000	0.000	0.000	0.000	0.029	0.067	0.158	0.062	0.061	0.040	0.075	0.011	0.019	0.036	0.011	0.023	0.030	0.127
1980	0.000	0.000	0.001	0.006	0.004	0.024	0.063	0.098	0.097	0.039	0.051	0.062	0.018	0.013	0.029	0.040	0.007	0.066
1981	0.000	0.003	0.005	0.014	0.036	0.019	0.025	0.055	0.073	0.091	0.027	0.056	0.046	0.039	0.025	0.040	0.011	0.035
1982	0.000	0.000	0.032	0.009	0.035	0.031	0.024	0.008	0.036	0.102	0.051	0.036	0.034	0.032	0.023	0.025	0.017	0.052
1983	0.000	0.010	0.075	0.167	0.047	0.048	0.015	0.009	0.002	0.008	0.037	0.022	0.012	0.028	0.020	0.016	0.026	0.071
1984	0.000	0.000	0.025	0.124	0.113	0.027	0.029	0.012	0.007	0.003	0.020	0.045	0.010	0.011	0.007	0.007	0.010	0.050
1985	0.000	0.000	0.002	0.039	0.153	0.144	0.020	0.039	0.006	0.002	0.003	0.010	0.023	0.002	0.006	0.007	0.009	0.031
1986	0.000	0.001	0.032	0.027	0.073	0.082	0.100	0.007	0.021	0.009	0.005	0.002	0.002	0.028	0.003	0.004	0.004	0.026
1987	0.001	0.000	0.047	0.095	0.021	0.051	0.051	0.055	0.011	0.010	0.004	0.002	0.001	0.004	0.003	0.006	0.001	0.011
1988	0.000	0.086	0.037	0.076	0.072	0.055	0.033	0.037	0.021	0.004	0.014	0.020	0.004	0.007	0.004	0.006	0.009	0.039
1989	0.000	0.003	0.082	0.043	0.042	0.081	0.054	0.038	0.021	0.010	0.008	0.004	0.006	0.006	0.000	0.001	0.001	0.022
1990	0.000	0.003	0.051	0.109	0.056	0.037	0.089	0.071	0.037	0.024	0.010	0.008	0.006	0.001	0.003	0.001	0.002	0.012
1991	0.000	0.007	0.008	0.113	0.128	0.061	0.030	0.033	0.023	0.017	0.013	0.011	0.008	0.008	0.007	0.001	0.002	0.018
1992	0.000	0.000	0.015	0.031	0.108	0.086	0.039	0.030	0.037	0.026	0.026	0.044	0.015	0.000	0.001	0.001	0.006	0.042
1993	0.000	0.004	0.033	0.135	0.124	0.097	0.037	0.004	0.001	0.010	0.008	0.001	0.001	0.001	0.001	0.005	0.005	0.007
1994	0.002	0.002	0.022	0.067	0.161	0.066	0.051	0.020	0.026	0.017	0.015	0.007	0.009	0.008	0.006	0.000	0.002	0.023
1995	0.000	0.008	0.009	0.015	0.050	0.137	0.050	0.068	0.023	0.005	0.008	0.002	0.005	0.008	0.000	0.008	0.000	0.001
1996	0.005	0.007	0.040	0.043	0.042	0.081	0.058	0.050	0.038	0.030	0.011	0.010	0.012	0.003	0.001	0.007	0.005	0.004
1997	0.000	0.001	0.007	0.083	0.038	0.056	0.053	0.042	0.065	0.048	0.030	0.020	0.005	0.021	0.006	0.007	0.005	0.014
1998	0.000	0.002	0.054	0.029	0.076	0.030	0.046	0.045	0.053	0.060	0.028	0.008	0.010	0.006	0.007	0.002	0.003	0.013
1999	0.000	0.002	0.010	0.074	0.046	0.094	0.042	0.047	0.038	0.022	0.021	0.015	0.014	0.014	0.004	0.009	0.002	0.013
2000	0.000	0.000	0.007	0.033	0.099	0.073	0.075	0.057	0.039	0.027	0.059	0.033	0.033	0.021	0.002	0.001	0.024	0.007
2001	0.000	0.000	0.000	0.008	0.060	0.099	0.037	0.065	0.064	0.032	0.038	0.023	0.021	0.001	0.013	0.023	0.034	0.018
2002	0.000	0.010	0.002	0.001	0.031	0.015	0.038	0.112	0.049	0.074	0.004	0.034	0.031	0.033	0.004	0.003	0.000	0.008
2003	0.013	0.412	0.040	0.000	0.000	0.013	0.004	0.022	0.004	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000
2004	0.000	0.000	0.015	0.016	0.015	0.016	0.038	0.038	0.068	0.060	0.067	0.076	0.015	0.053	0.046	0.031	0.007	0.030

Table 8. Number of samples collected for each year and fishery of age composition data used in the widow rockfish assessment.

	Vancouver-Columbia	Oregon midwater trawl	Oregon bottom trawl	Eureka-Conception
1978				7
1979				11
1980	18			26
1981	31			44
1982	40			149
1983	25			189
1984	22	32	27	169
1985	16	53	23	175
1986	27	56	22	154
1987	36	68	34	135
1988	20	39	33	127
1989	30	65	45	170
1990	41	61	49	155
1991	35	59	78	95
1992	31	43	82	55
1993	36	50	61	22
1994	28	22	63	28
1995	33	30	43	11
1996	27	32	27	35
1997	30	47	40	61
1998	22	41	30	37
1999	29	62	26	31
2000	21	55		17
2001	10	40		7
2002	12	17		14
2003	5			3
2004	20	4		7
2005	11			
2006	10	13		

Table 9. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater trawl pelagic juvenile survey from 1984 to 2006.

Year	Index value	CV
1984	2.854	0.425
1985	20.445	0.411
1986	0.099	0.392
1987	2.421	0.254
1988	2.140	0.256
1989	0.065	0.436
1990	0.075	0.449
1991	0.565	0.335
1992	0.028	2.000
1993	0.372	0.312
1994	0.028	0.491
1995	0.080	0.515
1996	0.028	2.000
1997	0.085	0.451
1998	0.028	2.000
1999	0.082	0.533
2000	0.093	0.366
2001	0.485	0.288
2002	2.971	0.328
2003	0.797	0.291
2004	0.962	0.300
2005	0.028	2.000
2006	0.028	2.000

Table 10. Oregon bottom trawl logbook catch-per-unit-effort index from 1984 to 1999.

Year	CPUE (lbs./hr.)	CV
1984	331.47	0.2121
1985	100.88	0.1875
1986	227.08	0.2928
1987	169.08	0.2730
1988	93.97	0.2897
1989	164.10	0.1749
1990	78.49	0.1348
1991	73.59	0.1275
1992	83.16	0.1179
1993	53.58	0.1314
1994	100.34	0.1128
1995	109.96	0.1387
1996	94.81	0.1357
1997	97.23	0.1502
1998	56.56	0.1718
1999	84.46	0.1684

Table 11. Scaled indices of widow rockfish catches derived from bycatch in three sectors of the Pacific whiting fisheries. Note that index values after 1998 were not used in this assessment.

Year	Index	CV
Foreign		
1977	0.770	0.115
1978	1.205	0.112
1979	0.703	0.119
1980	1.993	0.131
1981	0.728	0.126
1982	0.243	0.247
1984	2.937	0.125
1985	0.407	0.107
1986	1.111	0.103
1987	0.390	0.088
1988	0.513	0.124
Joint venture		
1983	2.889	0.120
1985	0.776	0.117
1986	0.823	0.081
1987	0.320	0.087
1988	0.659	0.077
1989	0.824	0.064
1990	0.710	0.074
Domestic		
1991	1.264	0.125
1992	0.781	0.125
1993	0.801	0.104
1994	1.465	0.068
1995	0.455	0.106
1996	1.018	0.082
1997	0.886	0.077
1998	1.330	0.079

Table 12. Indices of widow rockfish catches derived from triennial surveys from 1977 to 2004. Detailed description of the analysis is in Appendix B.

Year	Index	CV
1977	0.506	0.247
1980	0.382	0.332
1983	0.565	0.289
1986	0.353	0.351
1989	0.390	0.477
1992	0.461	0.364
1995	0.305	0.317
1998	0.692	0.313
2001	0.112	0.350
2004	0.126	0.461

Table 13. Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2006 from the assessment model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1958	34152	243145	119006	47481	0.0000
1959	34221	243566	119023	47481	0.0000
1960	34248	244070	119097	47488	0.0000
1961	34108	244594	119252	47514	0.0000
1962	33555	244999	119483	47576	0.0000
1963	32982	245222	119766	47670	0.0000
1964	31526	244993	120023	47776	0.0000
1965	31650	244611	120198	47875	0.0000
1966	28162	243212	120204	47941	0.0362
1967	35997	239524	117920	47125	0.0409
1968	39154	236741	115239	46127	0.0202
1969	40511	237264	113944	45536	0.0039
1970	42282	240653	114140	45384	0.0057
1971	44704	245021	114905	45410	0.0070
1972	41551	248982	116329	45694	0.0041
1973	90448	265665	118737	46298	0.0074
1974	32579	270818	121270	47013	0.0048
1975	13728	269950	125645	48104	0.0065
1976	11264	265211	130035	49697	0.0101
1977	17009	259292	132416	51534	0.0157
1978	21795	252209	131923	52503	0.0083
1979	11539	241942	128581	52133	0.0258
1980	39262	235543	122405	50269	0.2227
1981	59049	216720	105278	43657	0.3579
1982	22302	187527	86732	35867	0.4336
1983	66907	173672	71221	28812	0.2358
1984	80725	181730	67197	26352	0.2234
1985	29116	179879	66185	25142	0.1883
1986	29471	179346	67421	24840	0.1733
1987	29931	176892	69818	25488	0.1995
1988	23296	167232	70119	25960	0.1531
1989	10683	156146	69371	26185	0.1973
1990	24898	145047	65108	25053	0.1759

Table 13 (continued). Estimated age 3 recruits, age 3+ biomass, spawning biomass, spawning outputs, and annual fishing mortality of widow rockfish from 1958 to 2006 from the assessment model.

Year	Age 3 Recruits (10^3)	Age 3+ Biomass (mt)	Spawning Biomass (mt)	Spawning Output (10^6 eggs)	Fishing Mortality
1991	16128	133802	60851	23792	0.1258
1992	16102	126355	58084	22929	0.1279
1993	29824	123358	54928	21803	0.1885
1994	45363	123673	50630	20150	0.1666
1995	13939	118715	47835	18887	0.1841
1996	15758	113625	45917	17764	0.1704
1997	13534	108063	45600	17372	0.1639
1998	7470	99972	45148	17280	0.1005
1999	7663	94495	44774	17387	0.1076
2000	9847	89355	43209	17107	0.1182
2001	22504	87514	40888	16444	0.0647
2002	18126	88277	39419	16040	0.0183
2003	66180	105582	39194	15905	0.0020
2004	16045	110688	40131	15963	0.0035
2005	17236	116042	43017	16544	0.0067
2006	16393	120132	47478	17839	0.0065

Table 14. Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Mean recruitment	10.4020	0.1052
Recruitment steepness	0.2904	0.0580
Recruitment deviation in 1958	0.0370	0.4695
Recruitment deviation in 1959	0.0390	0.4693
Recruitment deviation in 1960	0.0399	0.4687
Recruitment deviation in 1961	0.0357	0.4666
Recruitment deviation in 1962	0.0194	0.4621
Recruitment deviation in 1963	0.0021	0.4554
Recruitment deviation in 1964	-0.0434	0.4431
Recruitment deviation in 1965	-0.0403	0.4174
Recruitment deviation in 1966	-0.1582	0.3842
Recruitment deviation in 1967	0.0859	0.3303
Recruitment deviation in 1968	0.1687	0.2861
Recruitment deviation in 1969	0.2019	0.2499
Recruitment deviation in 1970	0.2552	0.2193
Recruitment deviation in 1971	0.3241	0.1930
Recruitment deviation in 1972	0.2589	0.1969
Recruitment deviation in 1973	1.0388	0.1192
Recruitment deviation in 1974	0.0174	0.1713
Recruitment deviation in 1975	-0.8507	0.2064
Recruitment deviation in 1976	-1.0567	0.2013
Recruitment deviation in 1977	-0.6540	0.1673
Recruitment deviation in 1978	-0.4201	0.1405
Recruitment deviation in 1979	-1.0757	0.1658
Recruitment deviation in 1980	0.1272	0.0997
Recruitment deviation in 1981	0.5244	0.0863
Recruitment deviation in 1982	-0.4452	0.1194
Recruitment deviation in 1983	0.6751	0.0761
Recruitment deviation in 1984	0.9494	0.0604
Recruitment deviation in 1985	0.0580	0.0858
Recruitment deviation in 1986	0.2231	0.0875
Recruitment deviation in 1987	0.3038	0.0889
Recruitment deviation in 1988	0.0881	0.0954
Recruitment deviation in 1989	-0.6825	0.1293
Recruitment deviation in 1990	0.1444	0.0922
Recruitment deviation in 1991	-0.3034	0.1070
Recruitment deviation in 1992	-0.3115	0.1120
Recruitment deviation in 1993	0.3378	0.0969
Recruitment deviation in 1994	0.7961	0.0931
Recruitment deviation in 1995	-0.3558	0.1367
Recruitment deviation in 1996	-0.1944	0.1335
Recruitment deviation in 1997	-0.2850	0.1526

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Recruitment deviation in 1998	-0.8279	0.1949
Recruitment deviation in 1999	-0.7532	0.2145
Recruitment deviation in 2000	-0.4845	0.2237
Recruitment deviation in 2001	0.3464	0.1865
Recruitment deviation in 2002	0.1250	0.2549
Recruitment deviation in 2003	1.4333	0.1893
Recruitment deviation in 2004	0.0485	0.3758
Recruitment deviation in 2005	0.1405	0.3946
Recruitment deviation in 2006	0.0974	0.3928
Selectivity parameter 1 for fishery 1	2.5842	0.1439
Selectivity parameter 2 for fishery 1	5.8275	0.0573
Selectivity parameter 3 for fishery 1	0.1506	0.0118
Selectivity parameter 4 for fishery 1	0.0000	0.0011
Selectivity parameter 1 for fishery 2	2.4188	0.1419
Selectivity parameter 2 for fishery 2	6.2552	0.0860
Selectivity parameter 3 for fishery 2	0.2622	0.0288
Selectivity parameter 4 for fishery 2	6.0700	2.9527
Selectivity parameter 1 for fishery 3	2.4544	0.1835
Selectivity parameter 2 for fishery 3	6.0356	0.0920
Selectivity parameter 3 for fishery 3	0.1999	0.0394
Selectivity parameter 4 for fishery 3	8.9373	4.1376
Selectivity parameter 1 for fishery 4	2.3908	0.2937
Selectivity parameter 2 for fishery 4	5.6595	0.1210
Selectivity parameter 3 for fishery 4	0.3247	0.0897
Selectivity parameter 4 for fishery 4	16.9250	1.3464
Average fishing mortality for fishery 1	-4.1735	0.1154
Average fishing mortality for fishery 2	-3.4852	0.1420
Average fishing mortality for fishery 3	-5.1849	0.1411
Average fishing mortality for fishery 4	-5.1393	0.1257
Deviation of fishing mortality for Fishery 1 in 1966	0.8341	0.1188
Deviation of fishing mortality for Fishery 1 in 1967	0.9253	0.1134
Deviation of fishing mortality for Fishery 1 in 1968	0.1159	0.1076
Deviation of fishing mortality for Fishery 1 in 1969	-1.4296	0.1026
Deviation of fishing mortality for Fishery 1 in 1970	-0.9963	0.0965
Deviation of fishing mortality for Fishery 1 in 1971	-0.7886	0.0914
Deviation of fishing mortality for Fishery 1 in 1972	-1.3600	0.0873
Deviation of fishing mortality for Fishery 1 in 1973	-0.9888	0.0841
Deviation of fishing mortality for Fishery 1 in 1974	-1.7729	0.0819
Deviation of fishing mortality for Fishery 1 in 1975	-1.3831	0.0808
Deviation of fishing mortality for Fishery 1 in 1976	-0.7517	0.0802
Deviation of fishing mortality for Fishery 1 in 1977	-0.4497	0.0832
Deviation of fishing mortality for Fishery 1 in 1978	-1.1528	0.0867

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 1 in 1979	-0.5685	0.0899
Deviation of fishing mortality for Fishery 1 in 1980	2.4283	0.0897
Deviation of fishing mortality for Fishery 1 in 1981	2.9761	0.0844
Deviation of fishing mortality for Fishery 1 in 1982	2.8770	0.0760
Deviation of fishing mortality for Fishery 1 in 1983	1.5520	0.0700
Deviation of fishing mortality for Fishery 1 in 1984	0.6385	0.0675
Deviation of fishing mortality for Fishery 1 in 1985	0.6560	0.0654
Deviation of fishing mortality for Fishery 1 in 1986	1.0280	0.0633
Deviation of fishing mortality for Fishery 1 in 1987	1.2309	0.0614
Deviation of fishing mortality for Fishery 1 in 1988	1.0328	0.0594
Deviation of fishing mortality for Fishery 1 in 1989	1.2096	0.0572
Deviation of fishing mortality for Fishery 1 in 1990	0.8926	0.0562
Deviation of fishing mortality for Fishery 1 in 1991	0.3922	0.0564
Deviation of fishing mortality for Fishery 1 in 1992	0.4635	0.0568
Deviation of fishing mortality for Fishery 1 in 1993	0.9632	0.0589
Deviation of fishing mortality for Fishery 1 in 1994	0.6845	0.0628
Deviation of fishing mortality for Fishery 1 in 1995	0.7290	0.0691
Deviation of fishing mortality for Fishery 1 in 1996	0.6775	0.0780
Deviation of fishing mortality for Fishery 1 in 1997	0.5630	0.0879
Deviation of fishing mortality for Fishery 1 in 1998	0.1410	0.0961
Deviation of fishing mortality for Fishery 1 in 1999	0.1709	0.1055
Deviation of fishing mortality for Fishery 1 in 2000	0.0338	0.1171
Deviation of fishing mortality for Fishery 1 in 2001	-0.2940	0.1263
Deviation of fishing mortality for Fishery 1 in 2002	-1.3957	0.1294
Deviation of fishing mortality for Fishery 1 in 2003	-3.0200	0.1295
Deviation of fishing mortality for Fishery 1 in 2004	-2.6359	0.1323
Deviation of fishing mortality for Fishery 1 in 2005	-2.0922	0.1369
Deviation of fishing mortality for Fishery 1 in 2006	-2.1358	0.1492
Deviation of fishing mortality for Fishery 2 in 1983	0.4482	0.1008
Deviation of fishing mortality for Fishery 2 in 1984	1.1761	0.0949
Deviation of fishing mortality for Fishery 2 in 1985	0.9254	0.0911
Deviation of fishing mortality for Fishery 2 in 1986	0.7414	0.0881
Deviation of fishing mortality for Fishery 2 in 1987	1.0368	0.0842
Deviation of fishing mortality for Fishery 2 in 1988	0.7476	0.0808
Deviation of fishing mortality for Fishery 2 in 1989	1.0019	0.0763
Deviation of fishing mortality for Fishery 2 in 1990	0.7067	0.0707
Deviation of fishing mortality for Fishery 2 in 1991	0.3939	0.0666
Deviation of fishing mortality for Fishery 2 in 1992	-0.0379	0.0638
Deviation of fishing mortality for Fishery 2 in 1993	0.4927	0.0600
Deviation of fishing mortality for Fishery 2 in 1994	0.5731	0.0564
Deviation of fishing mortality for Fishery 2 in 1995	0.4876	0.0551
Deviation of fishing mortality for Fishery 2 in 1996	0.4814	0.0566

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 2 in 1997	0.4252	0.0622
Deviation of fishing mortality for Fishery 2 in 1998	-0.2413	0.0701
Deviation of fishing mortality for Fishery 2 in 1999	0.4874	0.0763
Deviation of fishing mortality for Fishery 2 in 2000	0.8902	0.0858
Deviation of fishing mortality for Fishery 2 in 2001	0.2460	0.0940
Deviation of fishing mortality for Fishery 2 in 2002	-0.8840	0.0963
Deviation of fishing mortality for Fishery 2 in 2003	-3.3002	0.0962
Deviation of fishing mortality for Fishery 2 in 2004	-2.9352	0.1000
Deviation of fishing mortality for Fishery 2 in 2005	-1.9247	0.1091
Deviation of fishing mortality for Fishery 2 in 2006	-1.9381	0.1220
Deviation of fishing mortality for Fishery 3 in 1983	1.8054	0.1002
Deviation of fishing mortality for Fishery 3 in 1984	1.6036	0.0937
Deviation of fishing mortality for Fishery 3 in 1985	1.1130	0.0894
Deviation of fishing mortality for Fishery 3 in 1986	1.3007	0.0864
Deviation of fishing mortality for Fishery 3 in 1987	1.1172	0.0829
Deviation of fishing mortality for Fishery 3 in 1988	1.0250	0.0796
Deviation of fishing mortality for Fishery 3 in 1989	1.6588	0.0751
Deviation of fishing mortality for Fishery 3 in 1990	1.8411	0.0696
Deviation of fishing mortality for Fishery 3 in 1991	1.8022	0.0657
Deviation of fishing mortality for Fishery 3 in 1992	2.2061	0.0628
Deviation of fishing mortality for Fishery 3 in 1993	2.5624	0.0591
Deviation of fishing mortality for Fishery 3 in 1994	2.3028	0.0558
Deviation of fishing mortality for Fishery 3 in 1995	2.3585	0.0543
Deviation of fishing mortality for Fishery 3 in 1996	2.2992	0.0556
Deviation of fishing mortality for Fishery 3 in 1997	2.2540	0.0606
Deviation of fishing mortality for Fishery 3 in 1998	1.6951	0.0685
Deviation of fishing mortality for Fishery 3 in 1999	1.2321	0.0748
Deviation of fishing mortality for Fishery 3 in 2000	-2.5819	0.0835
Deviation of fishing mortality for Fishery 3 in 2001	-1.6224	0.0914
Deviation of fishing mortality for Fishery 3 in 2002	-4.0445	0.0935
Deviation of fishing mortality for Fishery 3 in 2003	-6.7855	0.0935
Deviation of fishing mortality for Fishery 3 in 2004	-4.3569	0.0968
Deviation of fishing mortality for Fishery 3 in 2005	-5.8709	0.1043
Deviation of fishing mortality for Fishery 3 in 2006	-4.9150	0.1184
Deviation of fishing mortality for Fishery 4 in 1966	-2.0158	0.1119
Deviation of fishing mortality for Fishery 4 in 1967	-1.0357	0.1084
Deviation of fishing mortality for Fishery 4 in 1968	-0.7126	0.1041
Deviation of fishing mortality for Fishery 4 in 1969	-3.4726	0.0999
Deviation of fishing mortality for Fishery 4 in 1970	-6.5212	0.0950
Deviation of fishing mortality for Fishery 4 in 1971	-6.5381	0.0905
Deviation of fishing mortality for Fishery 4 in 1972	-3.9981	0.0867
Deviation of fishing mortality for Fishery 4 in 1973	-1.2604	0.0838
Deviation of fishing mortality for Fishery 4 in 1974	-0.9923	0.0819
Deviation of fishing mortality for Fishery 4 in 1975	-0.7918	0.0808

Table 14 (continued). Estimated parameter values and their standard deviations for the base model.

Parameter description	Estimated value	Estimated standard deviation
Deviation of fishing mortality for Fishery 4 in 1976	-0.73333	0.08035
Deviation of fishing mortality for Fishery 4 in 1977	-0.00135	0.08253
Deviation of fishing mortality for Fishery 4 in 1978	-0.53079	0.08587
Deviation of fishing mortality for Fishery 4 in 1979	1.07210	0.08924
Deviation of fishing mortality for Fishery 4 in 1980	2.10340	0.09002
Deviation of fishing mortality for Fishery 4 in 1981	2.25440	0.08623
Deviation of fishing mortality for Fishery 4 in 1982	3.30730	0.07807
Deviation of fishing mortality for Fishery 4 in 1983	2.62660	0.07249
Deviation of fishing mortality for Fishery 4 in 1984	2.43750	0.06889
Deviation of fishing mortality for Fishery 4 in 1985	2.39460	0.06571
Deviation of fishing mortality for Fishery 4 in 1986	2.04680	0.06454
Deviation of fishing mortality for Fishery 4 in 1987	1.99900	0.06313
Deviation of fishing mortality for Fishery 4 in 1988	1.61680	0.06181
Deviation of fishing mortality for Fishery 4 in 1989	1.72030	0.05972
Deviation of fishing mortality for Fishery 4 in 1990	1.94100	0.05815
Deviation of fishing mortality for Fishery 4 in 1991	1.39170	0.05791
Deviation of fishing mortality for Fishery 4 in 1992	1.36880	0.05798
Deviation of fishing mortality for Fishery 4 in 1993	1.46450	0.05953
Deviation of fishing mortality for Fishery 4 in 1994	1.47800	0.06354
Deviation of fishing mortality for Fishery 4 in 1995	1.99280	0.06933
Deviation of fishing mortality for Fishery 4 in 1996	1.77660	0.07784
Deviation of fishing mortality for Fishery 4 in 1997	1.83310	0.08789
Deviation of fishing mortality for Fishery 4 in 1998	1.57160	0.09766
Deviation of fishing mortality for Fishery 4 in 1999	1.23790	0.10699
Deviation of fishing mortality for Fishery 4 in 2000	1.53400	0.11819
Deviation of fishing mortality for Fishery 4 in 2001	0.78809	0.12695
Deviation of fishing mortality for Fishery 4 in 2002	-1.22780	0.12919
Deviation of fishing mortality for Fishery 4 in 2003	-3.75050	0.12834
Deviation of fishing mortality for Fishery 4 in 2004	-2.08450	0.12926
Deviation of fishing mortality for Fishery 4 in 2005	-3.04910	0.13313
Deviation of fishing mortality for Fishery 4 in 2006	-3.24200	0.14389
Power coefficient for SC Lab index	0.08680	0.08769
Catchbility for SC Lab index	-10.29500	0.25288
Catchbility for Oregon bottom trawl fishery	-6.43600	0.16225
Catchbility for whiting bycatch (foreign)	-11.48100	0.23276
Catchbility for whiting bycatch (joint venture)	-11.27900	0.31769
Catchbility for whiting bycatch (domestic)	-10.81400	0.17976
Catchbility for triennial trawl survey	-12.21600	0.19412

Table 15. Comparisons of key parameters between this assessment (2007 model) and the base model of the 2005 assessment (2005 base model).

Parameter and estimate	2005 base model	2007 model
Number of parameters	198	208
Steepness (h)	0.2810	0.2904
Unfished spawning output (B_0) (million of eggs)	49676	50746
Current spawning output (B_t) (million of eggs)	15444	17999
Depletion ($100*B_t/B_0$)	31.09	35.47
Standard deviation of depletion	5.92	6.32

Figure 1. U.S. landings (mt) of widow rockfish by four fisheries from 1966 to 2006. Four fisheries are defined by area and gear type.

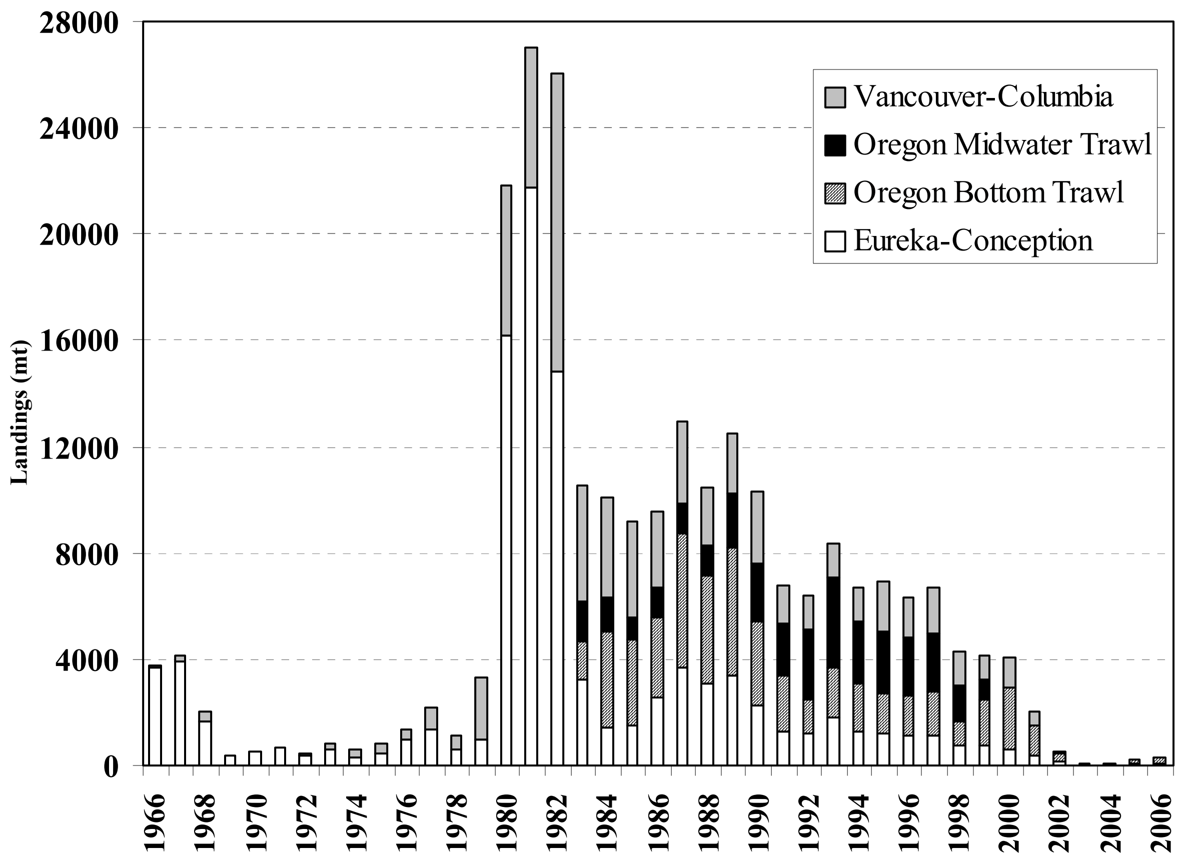
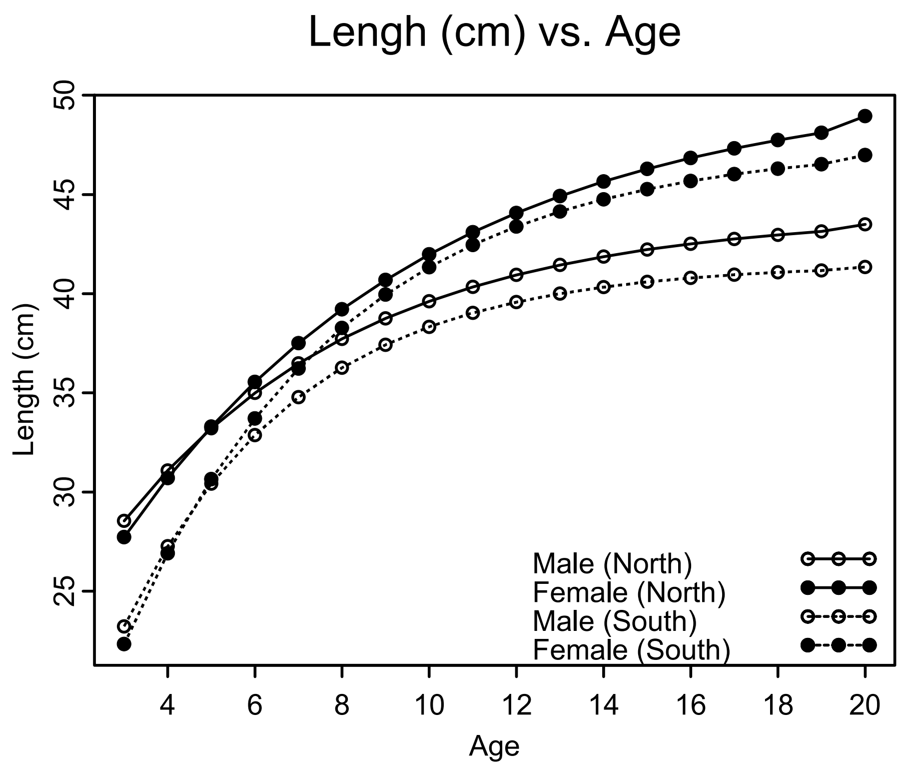


Figure 2. Growth functions for widow rockfish by sex from north and south of 43^{o} latitude used in this assessment.



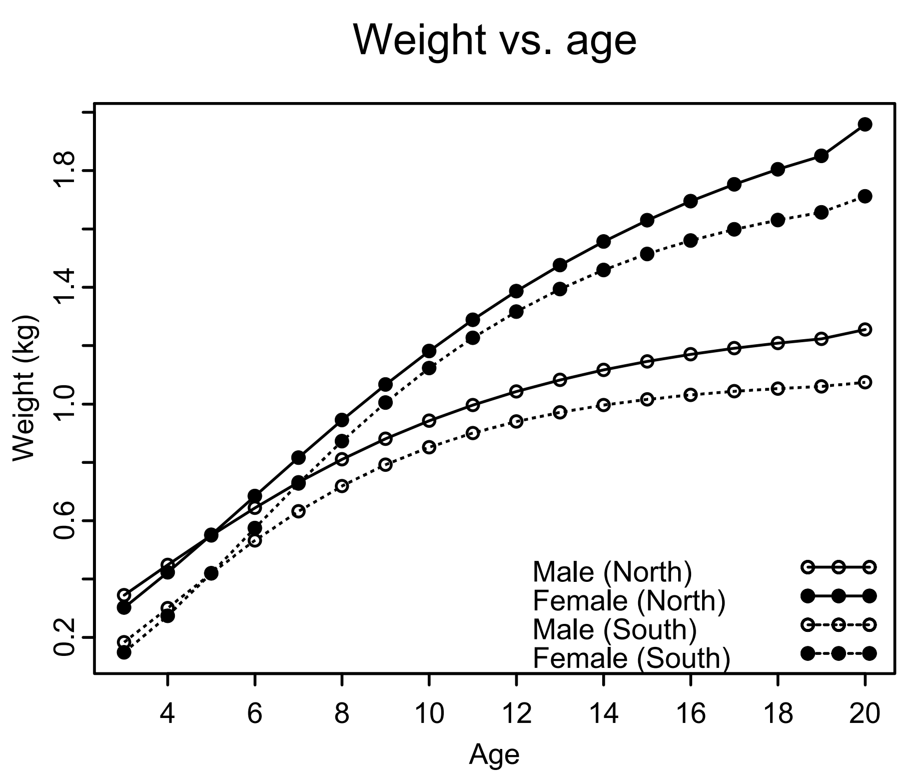


Figure 3. Fecundity and maturity for widow rockfish from north and south of 43° latitude used in this assessment.

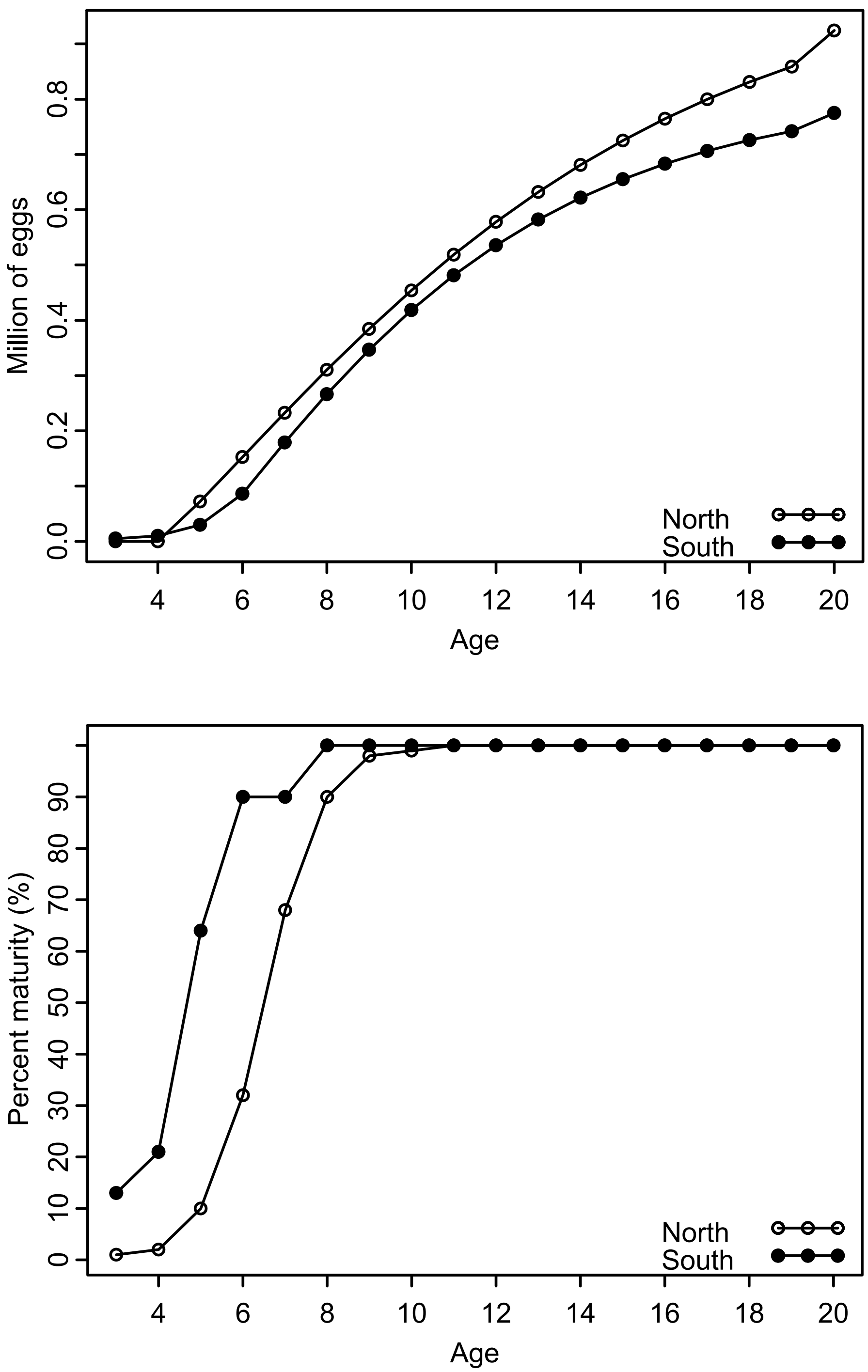


Figure 4. Proportional age composition data for the Vancouver-Columbia combined fishery, by sex and year with the sum across sexes equal to 1.

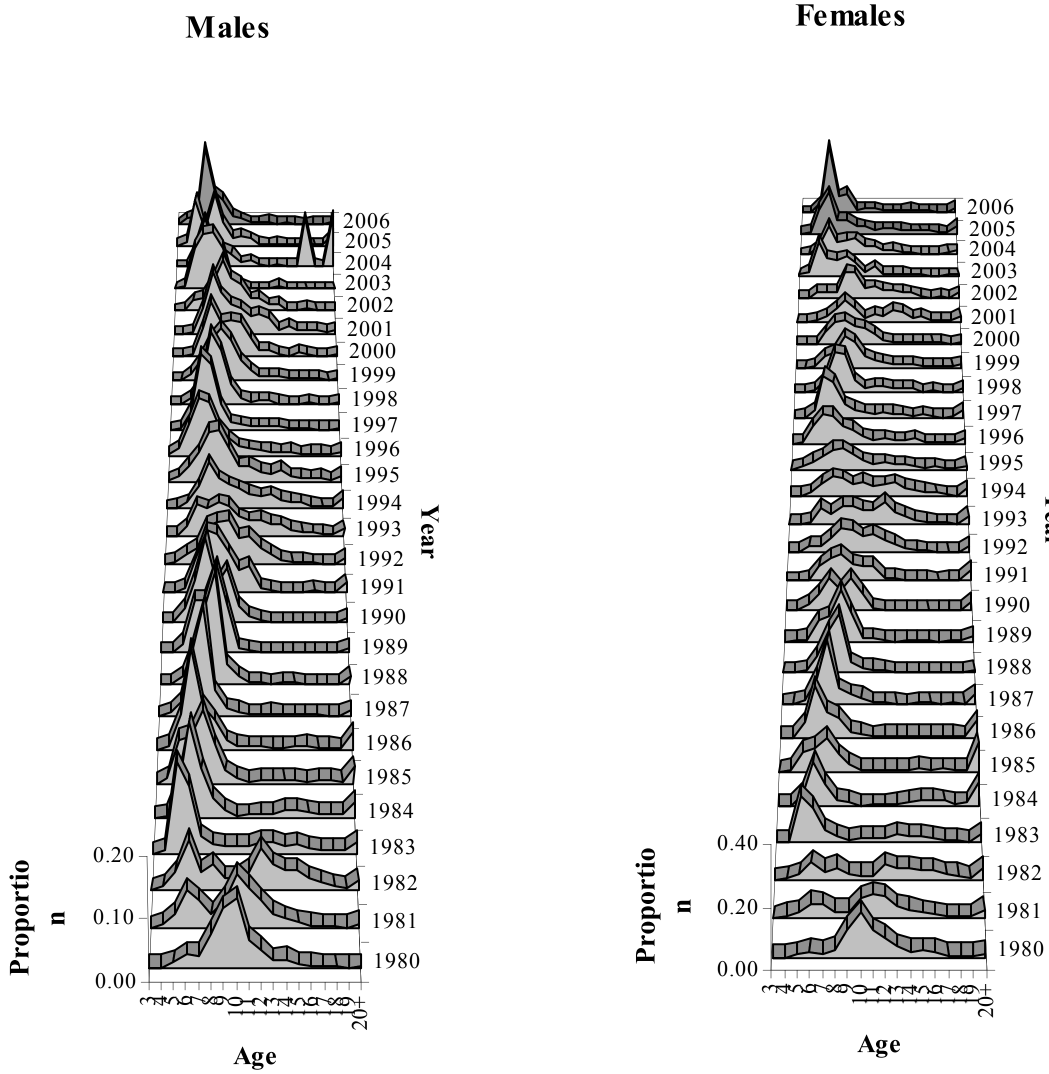


Figure 5. Proportional age composition data for the Oregon midwater trawl fishery, by sex and year with the sum across sexes equal to 1.

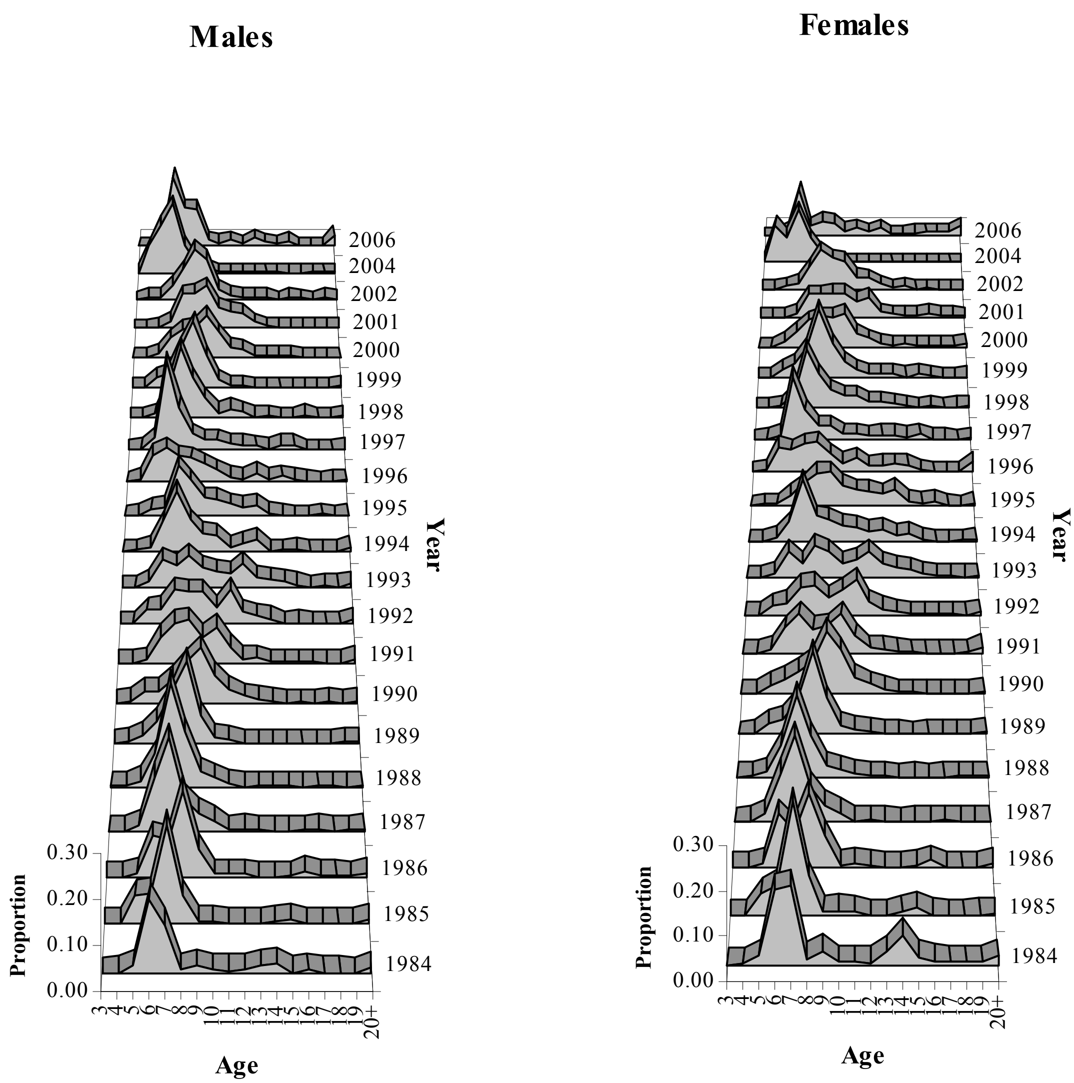


Figure 6. Proportional age composition data for the Oregon bottom trawl fishery, by sex and year with the sum across sexes equal to 1.

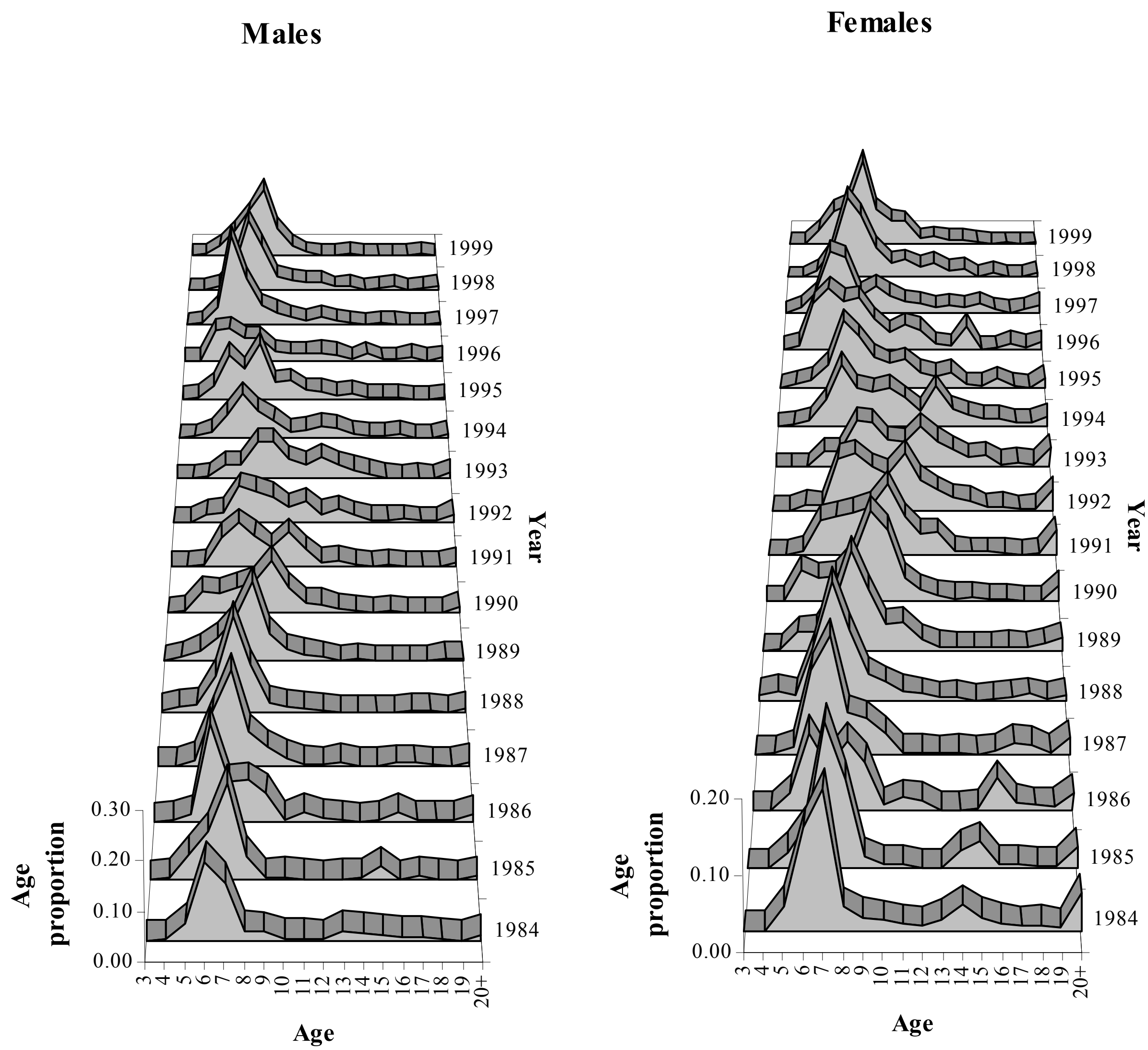


Figure 7. Proportional age composition data for the Eureka-Conception combined fishery, by sex and year with the sum across sexes equal to 1.

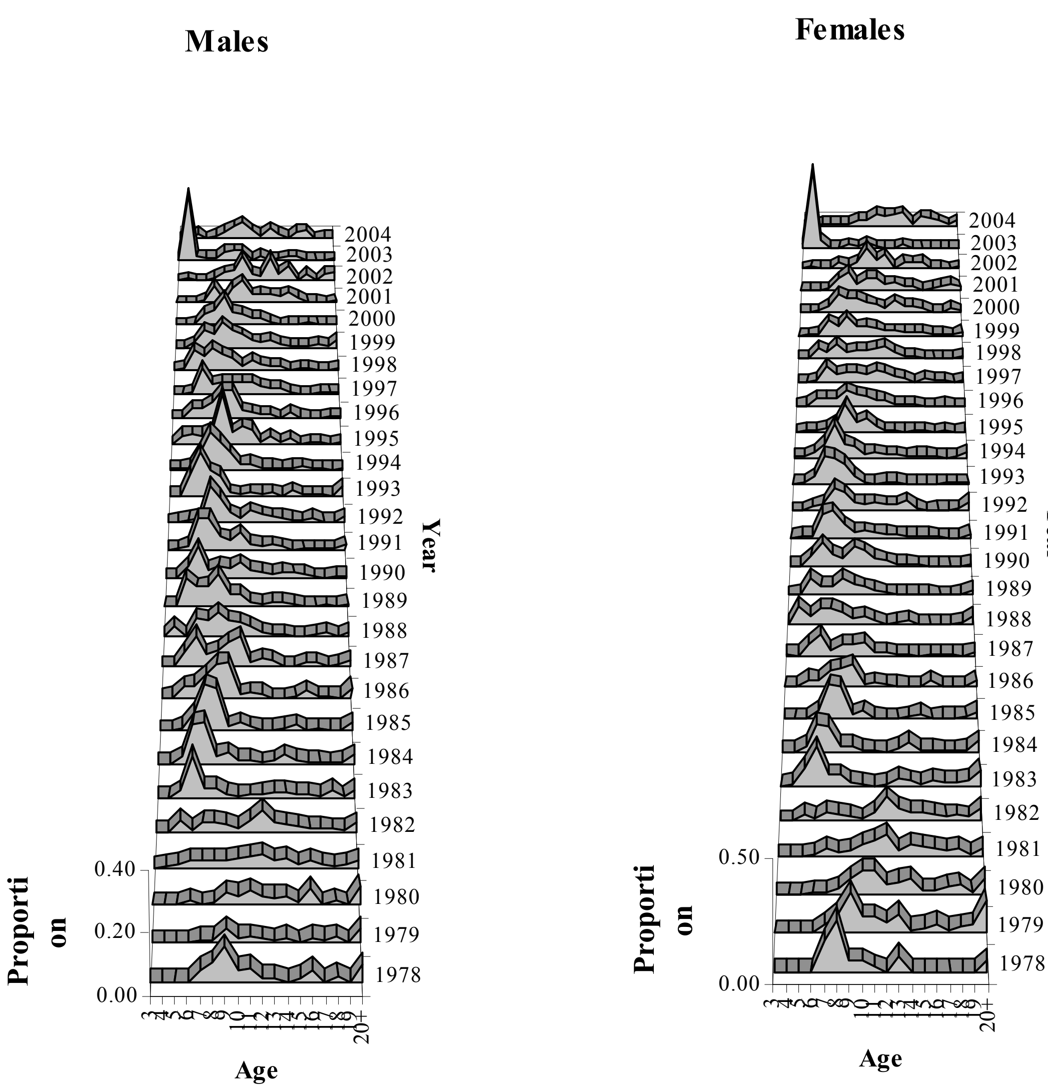


Figure 8. Yearly index estimates from the Santa Cruz/Tiburon Laboratory midwater juvenile trawl survey from 1984 to 2006.

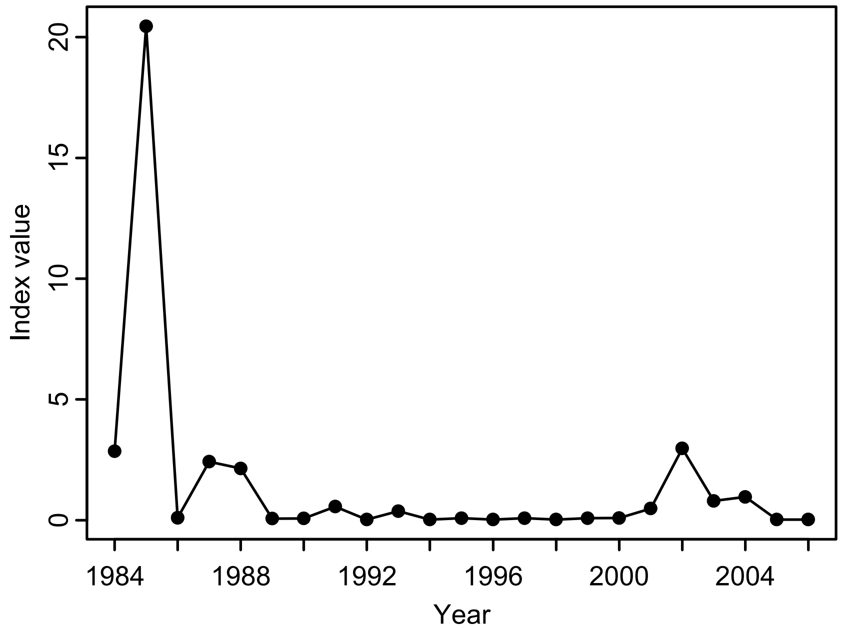


Figure 9. Catch per unit effort of widow rockfish from Oregon bottom trawl fishery from 1984 to 1999.

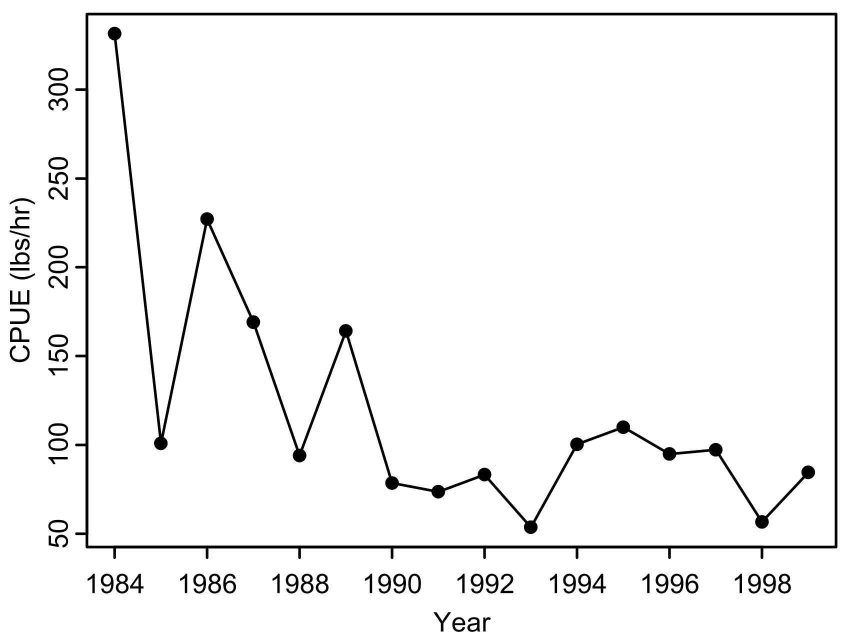


Figure 10. Scaled index values of catch per unit effort of widow rockfish abundance derived from bycatch in the Pacific whiting fisheries.

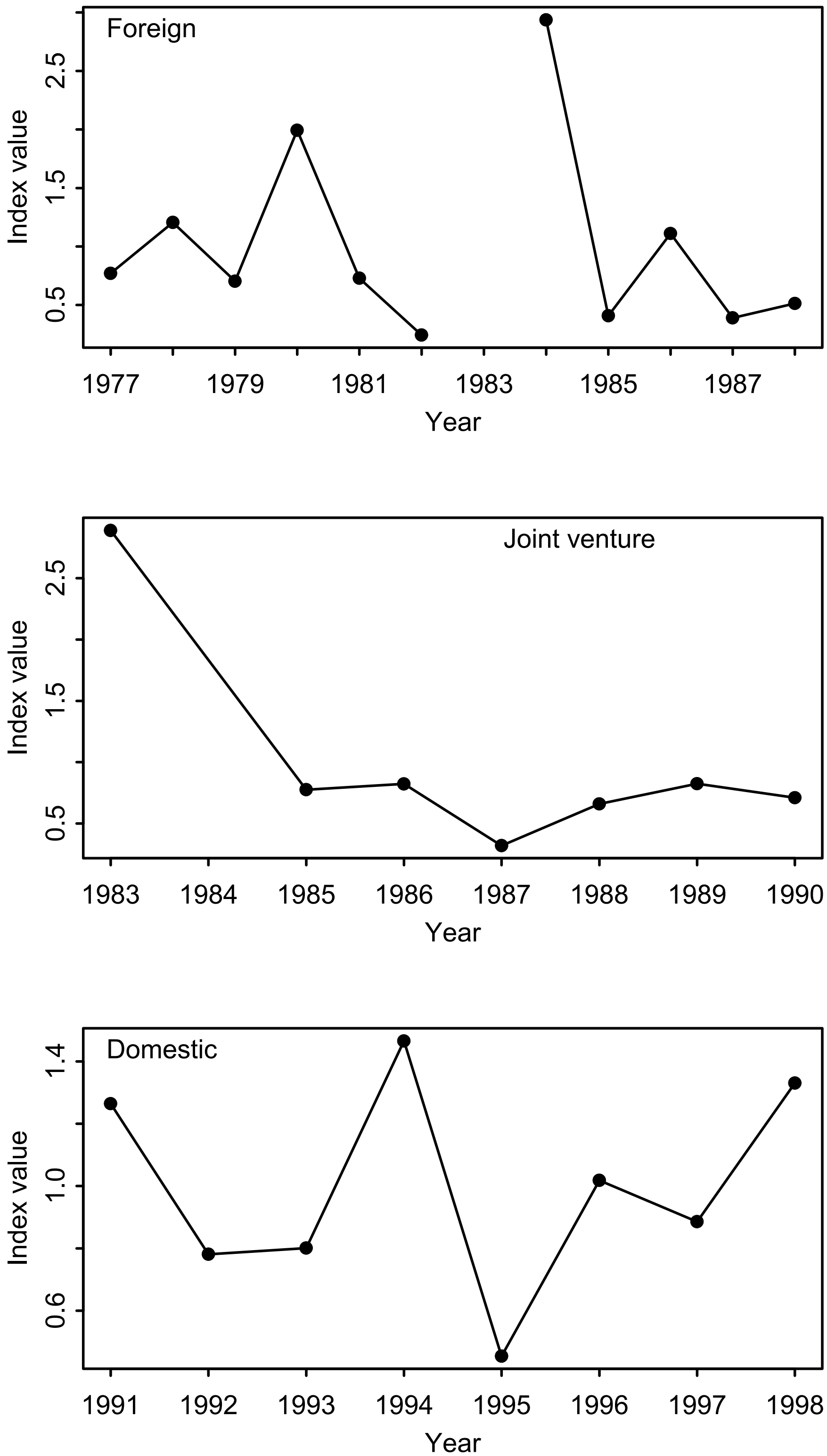


Figure 11. Index values of catch per unit effort of widow rockfish abundance derived from triennial surveys.

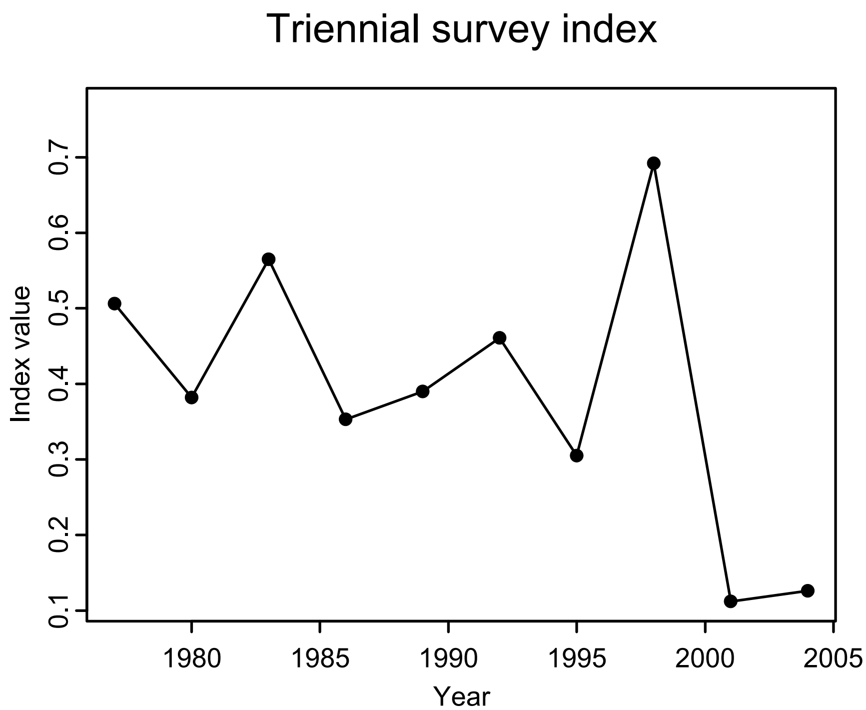


Figure 12. Fraction of landings in the north area, defined as the Vancouver-Columbia and Oregon trawl fisheries, with a 7-year moving average. Note that the fractions before 1977 were fixed at the value computed before the foreign landings (Rogers 2003) were added.

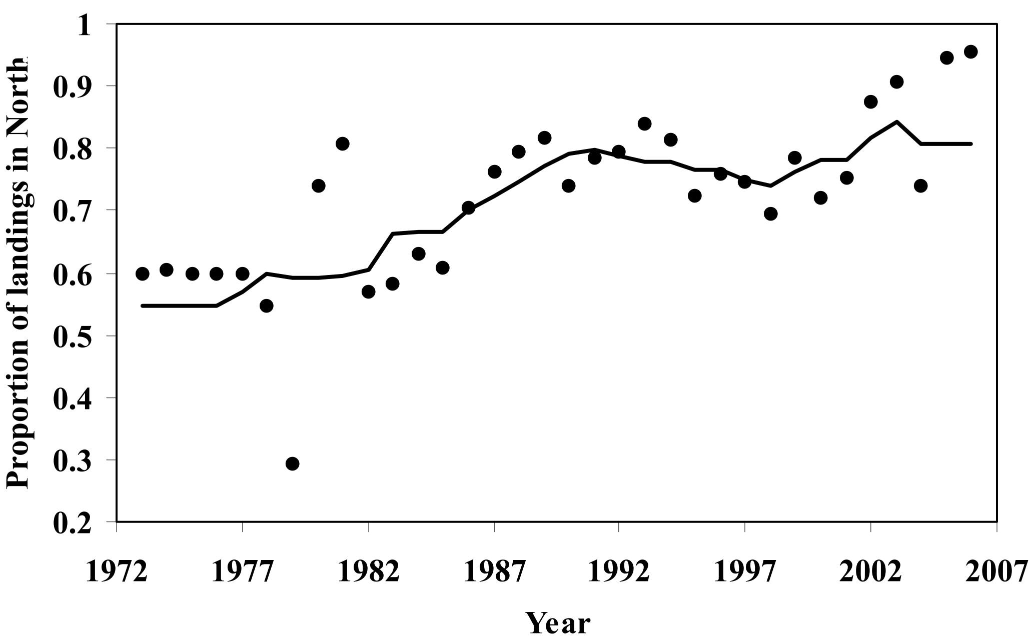


Figure 13. Age 3+ biomass (1000mt) and spawning biomass (1000mt) from 1958 to 2006 estimated from the assessment model.

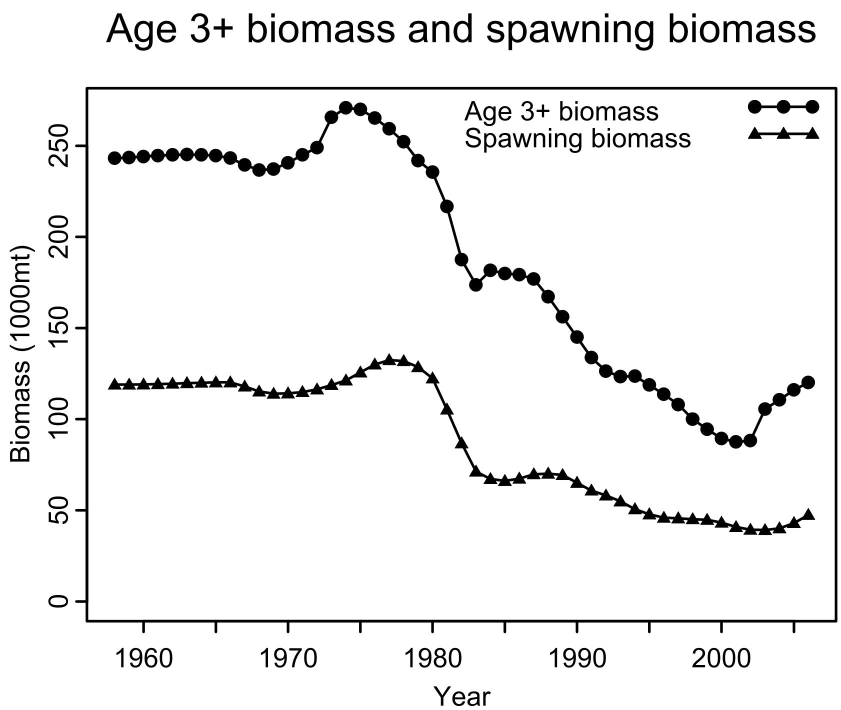


Figure 14. Spawning output (million of eggs) from 1958 to 2006 estimated from the assessment model.

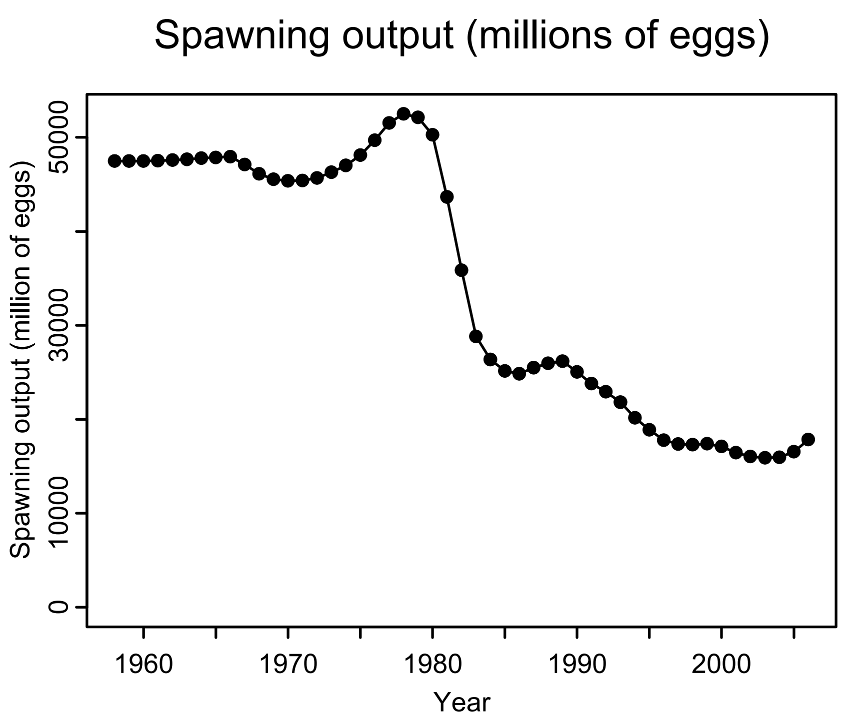


Figure 15. Age 3 recruits (*1000) from 1958 to 2006 estimates from the assessment model.

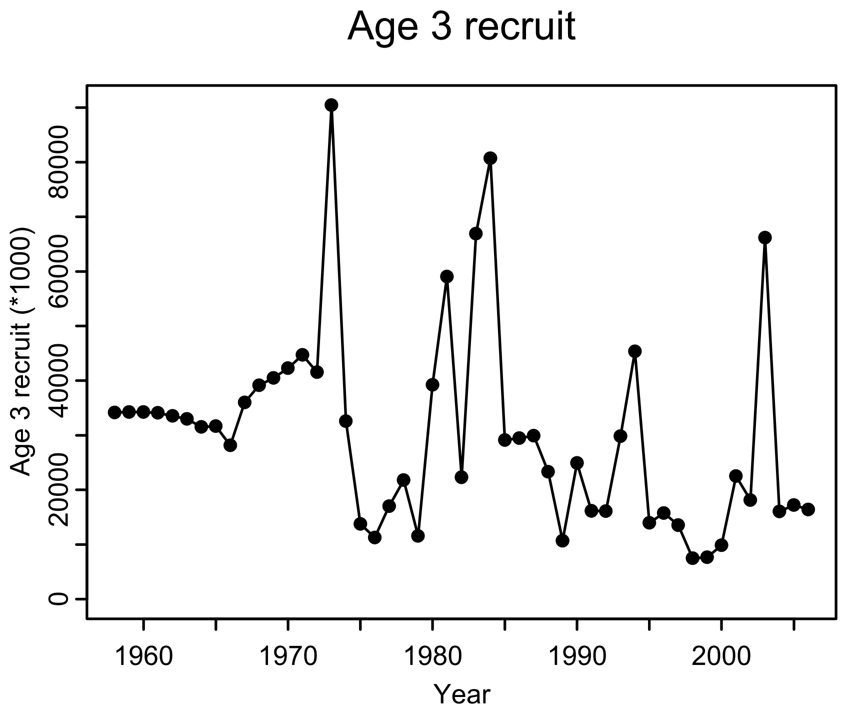


Figure 16. Fishing mortality by four fisheries from 1958 to 2006 estimates from the assessment model.

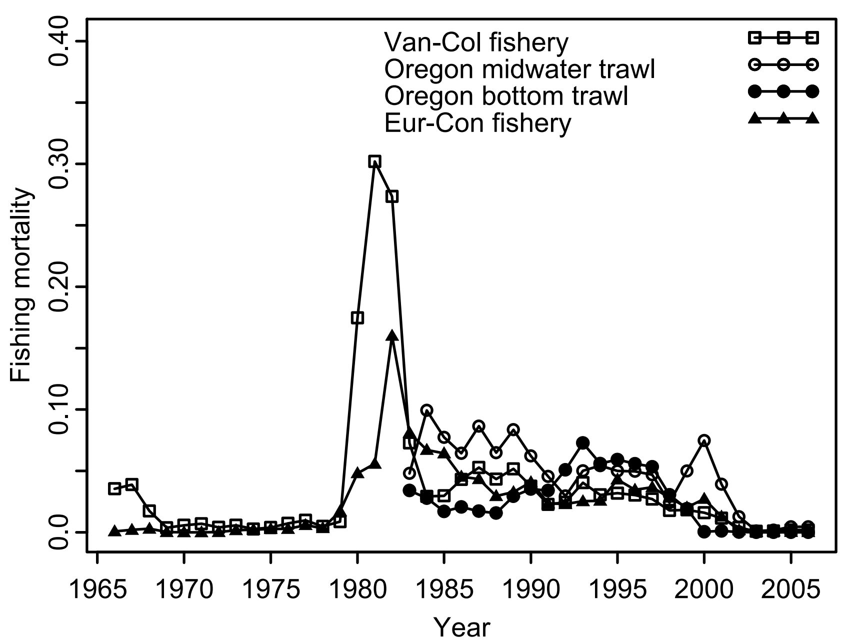


Figure 17. Fishery-specific selectivity estimates from the assessment model.

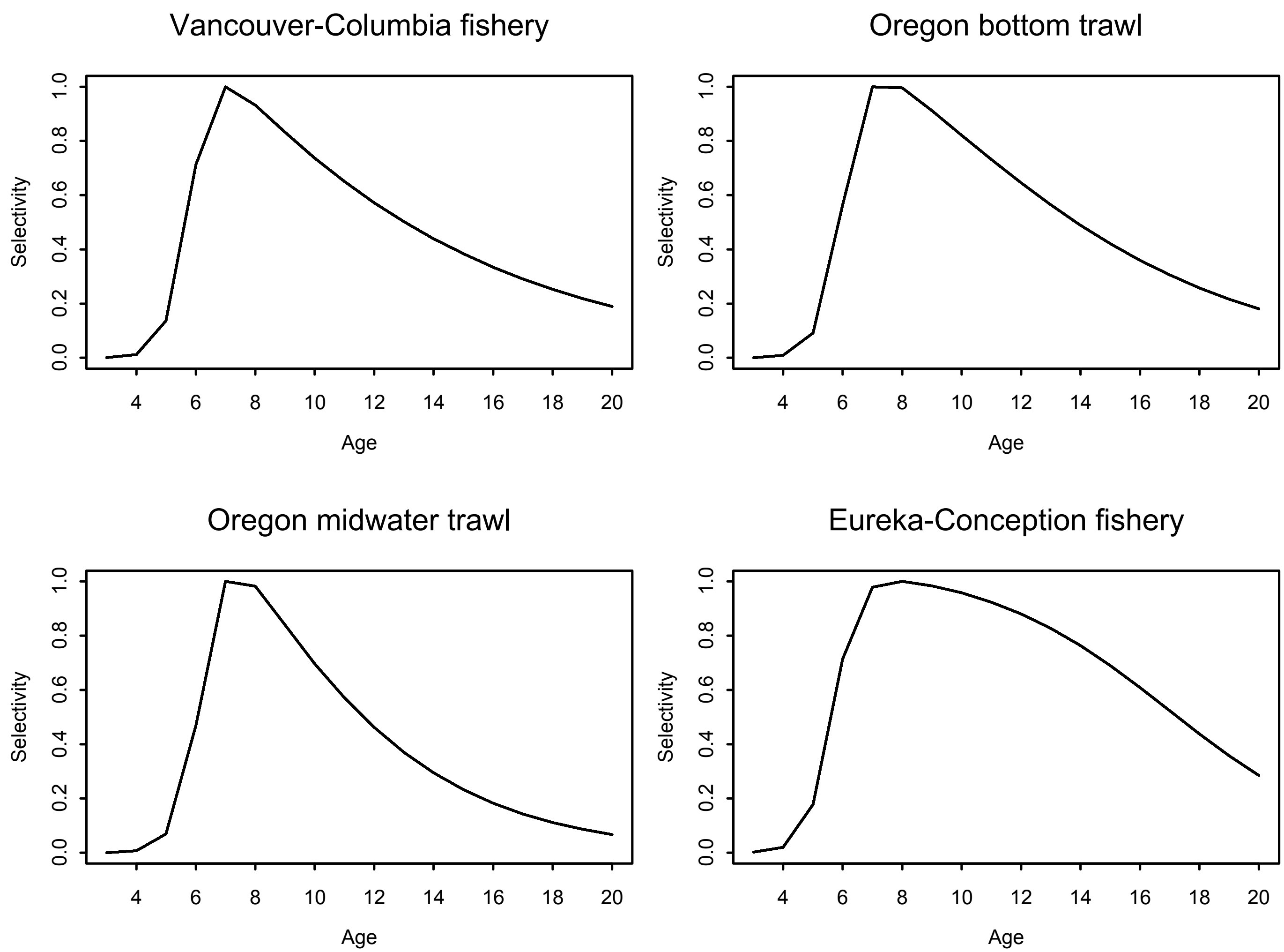


Figure 18. Stock-recruitment relationship from the assessment model. Estimated +Residual = predicted values plus annual recruitment residuals; Estimated = estimated values from stock-recruitment relationship.

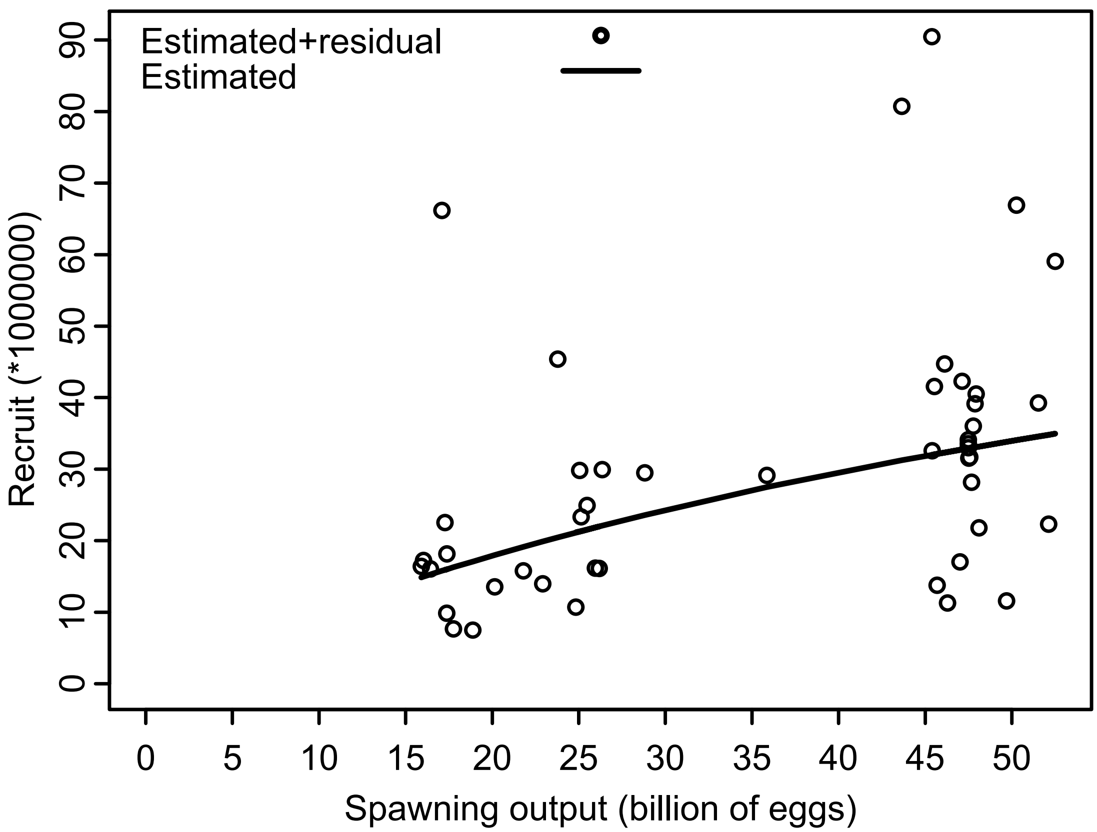
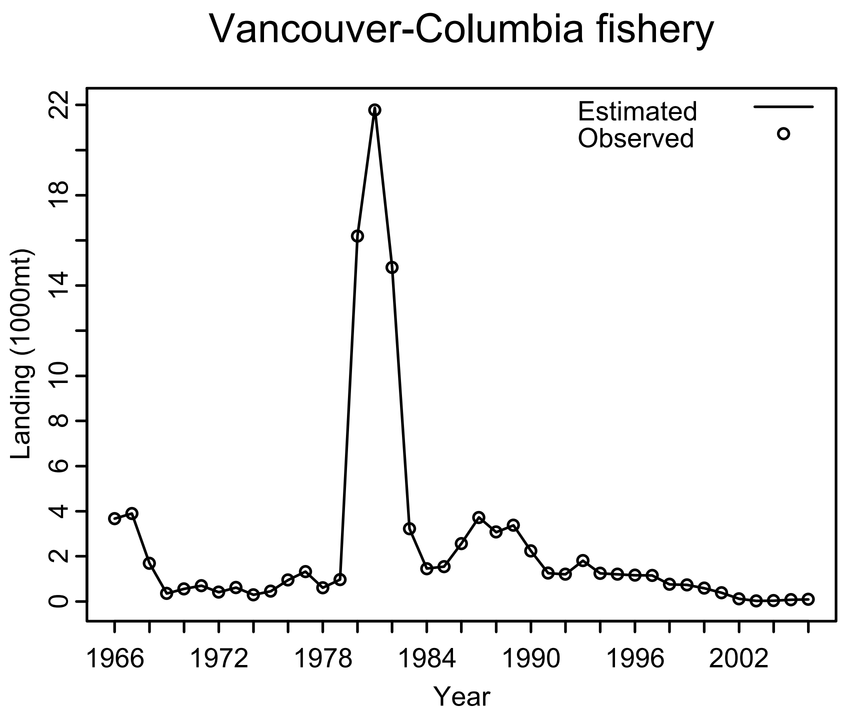


Figure 19. Model fits to the Vancouver-Columbia and Oregon midwater trawl fisheries landings data.



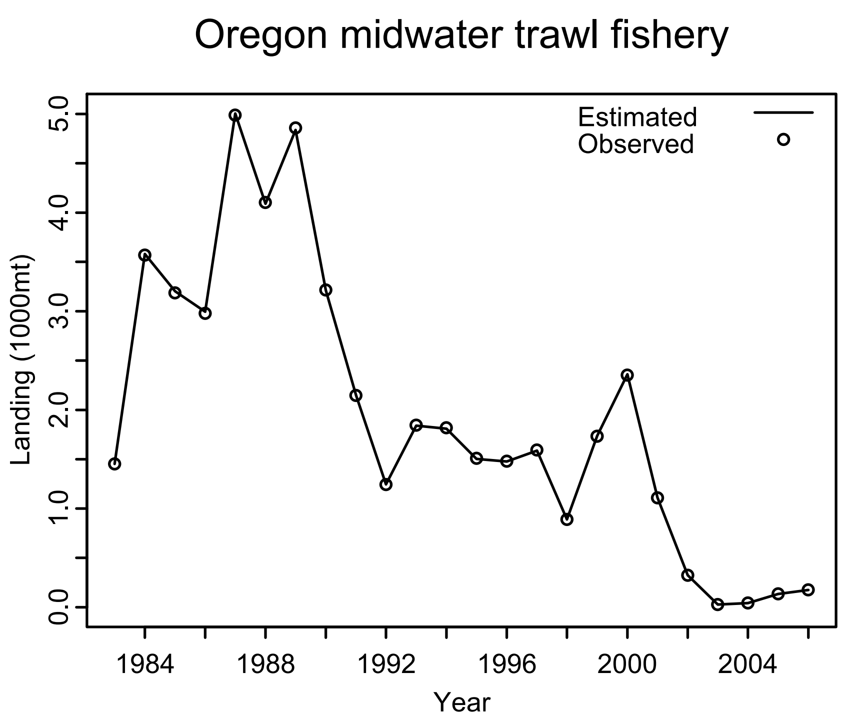


Figure 20. Model fits to the Oregon bottom trawl and Eureka-Conception fisheries landings data.

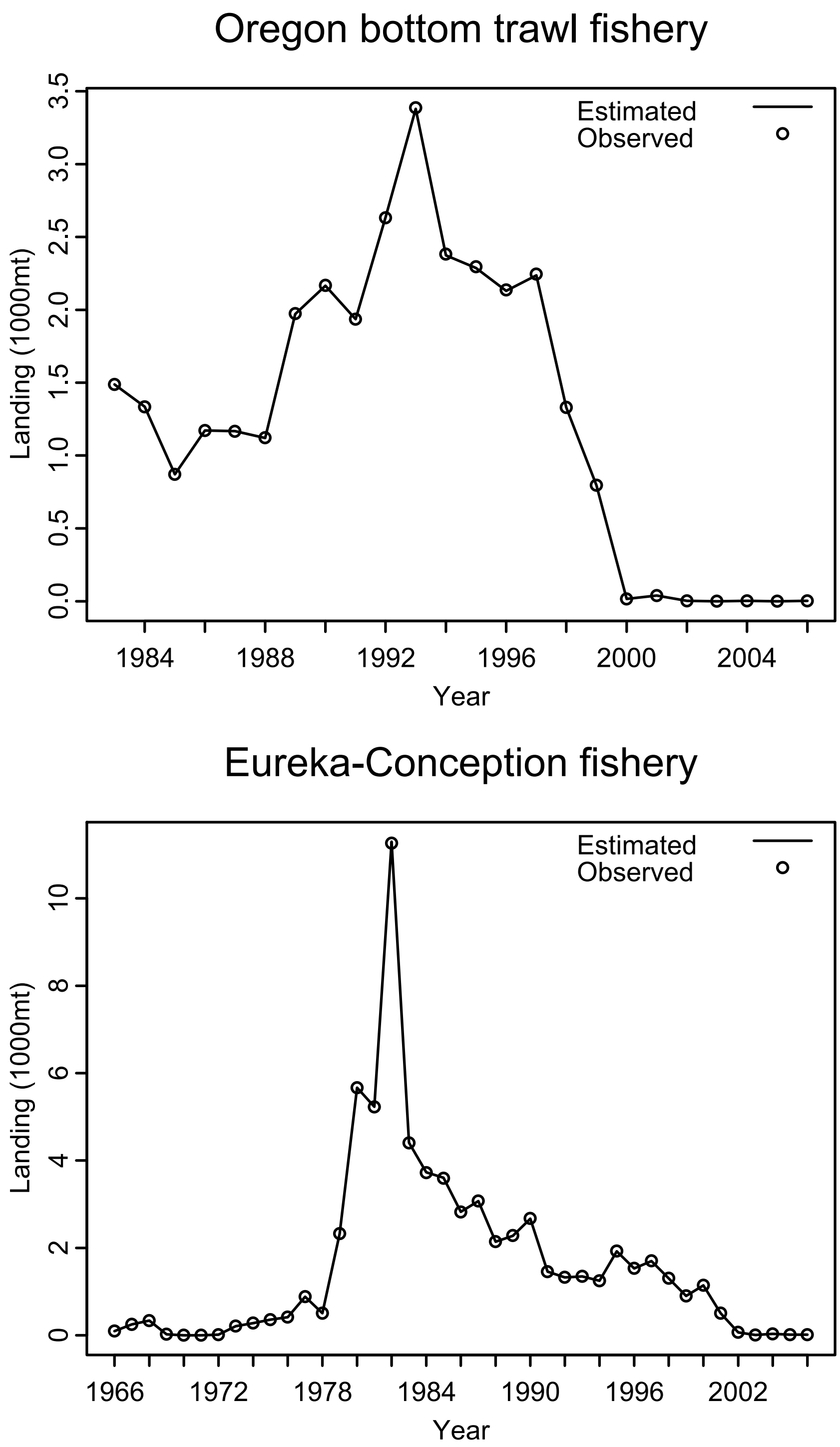


Figure 21. Model fits to the midwater trawl juvenile survey index.

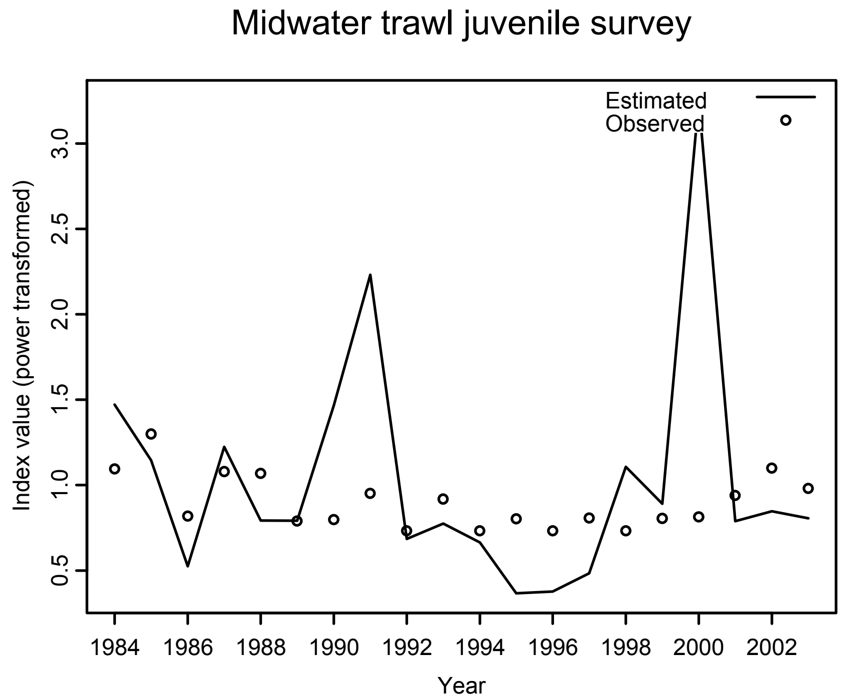


Figure 22. Model fits to the Oregon bottom trawl logbook index.

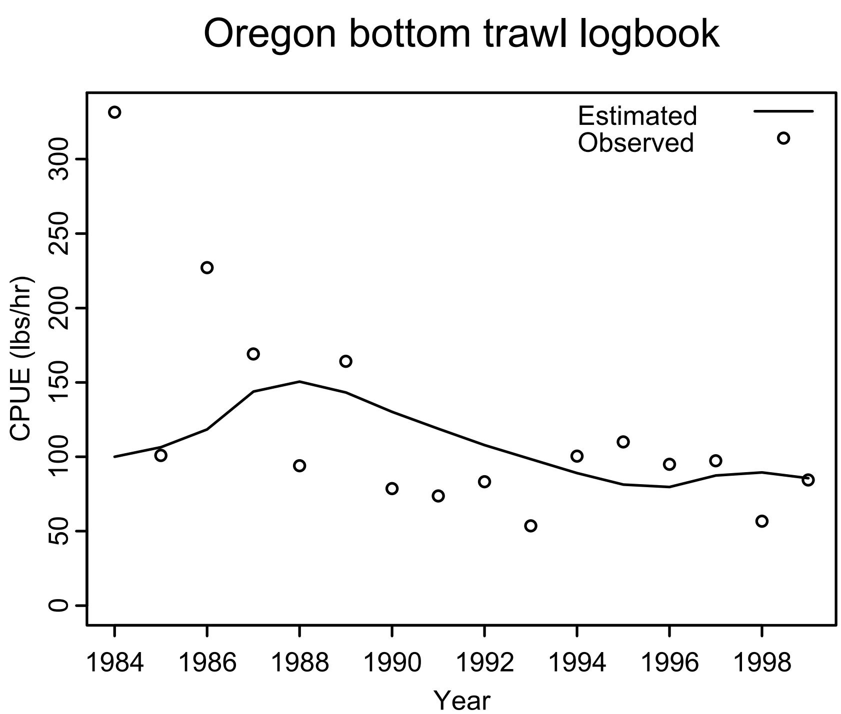


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Figure 23. Model fits to the Pacific whiting foreign fishery bycatch index.

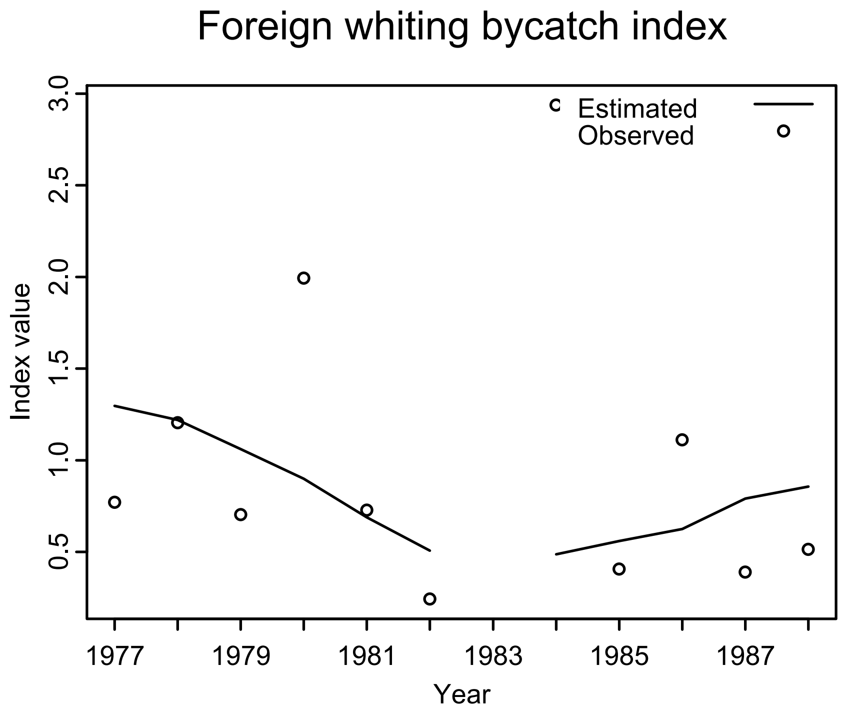
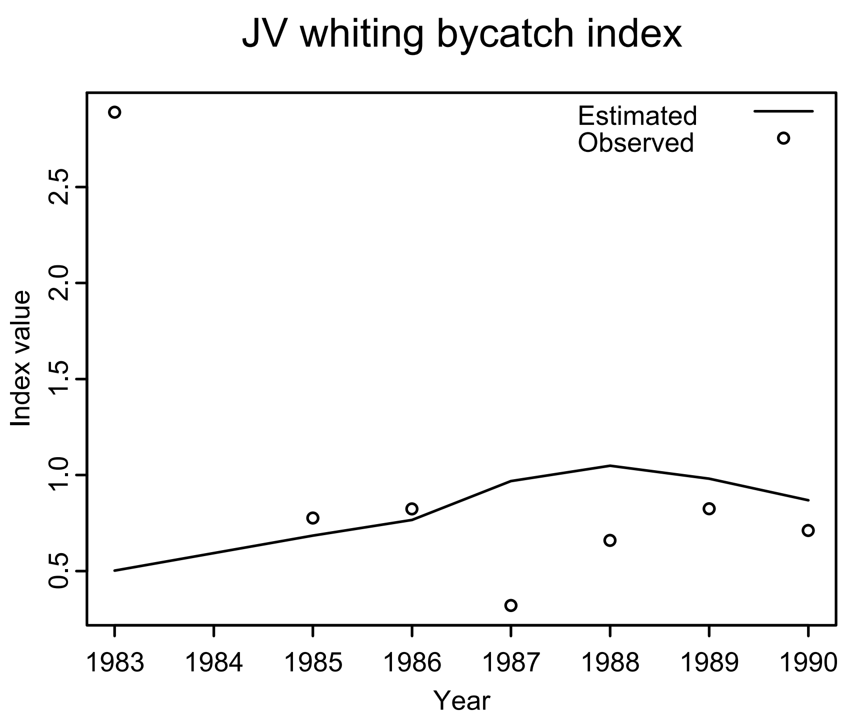


Figure 24. Model fits to the Pacific whiting joint venture (JV) fishery bycatch index.



.

Figure 25. Model fits to the Pacific whiting domestic fishery index.

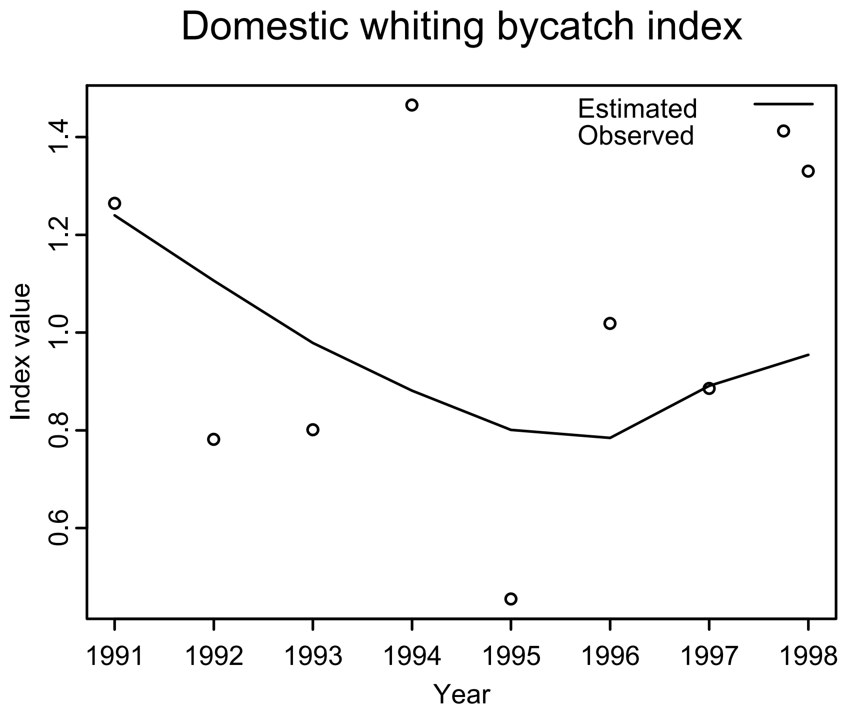


Figure 26. Model fits to triennial survey index.

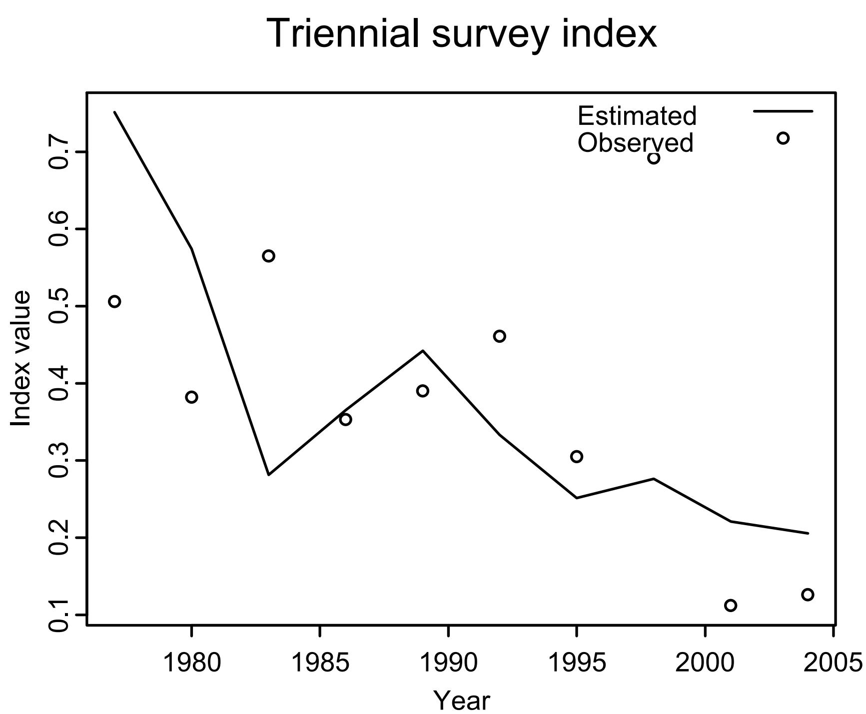
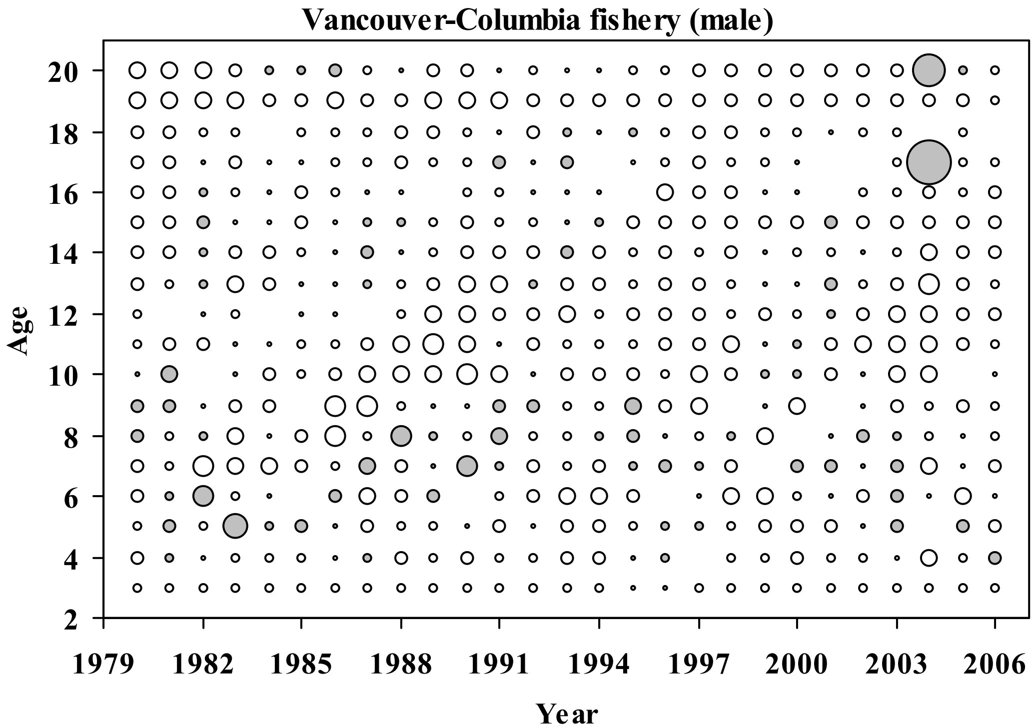


Figure 27a. Age composition residuals for the Vancouver-Columbia fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



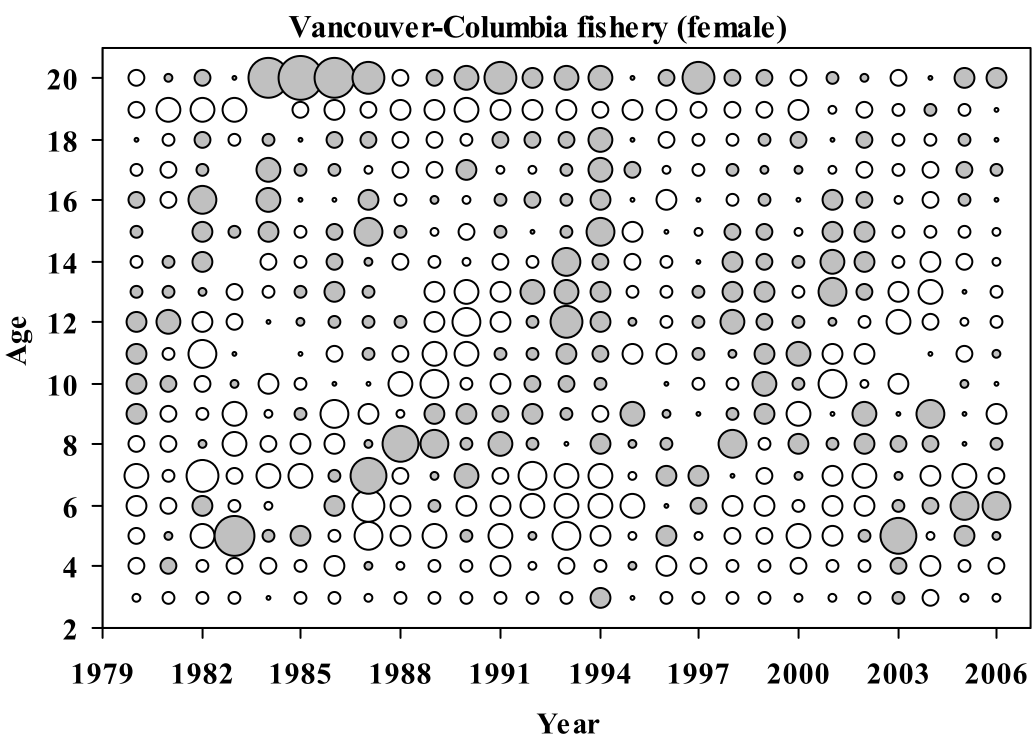
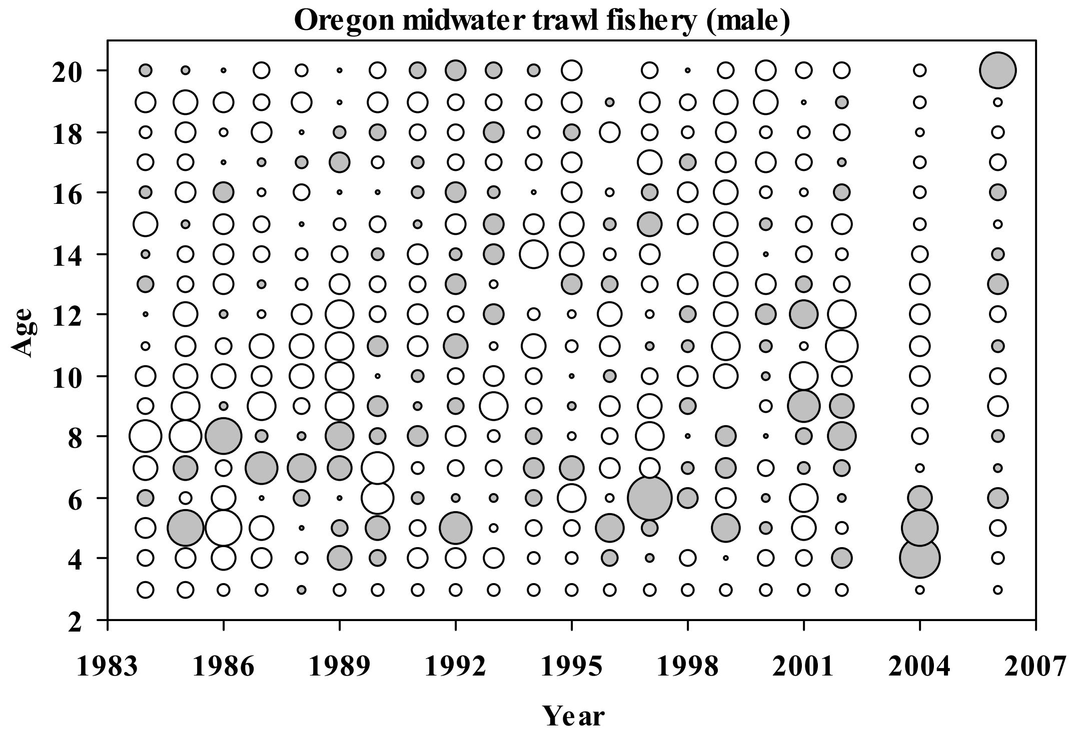


Figure 27b. Age composition residuals for the Oregon midwater trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



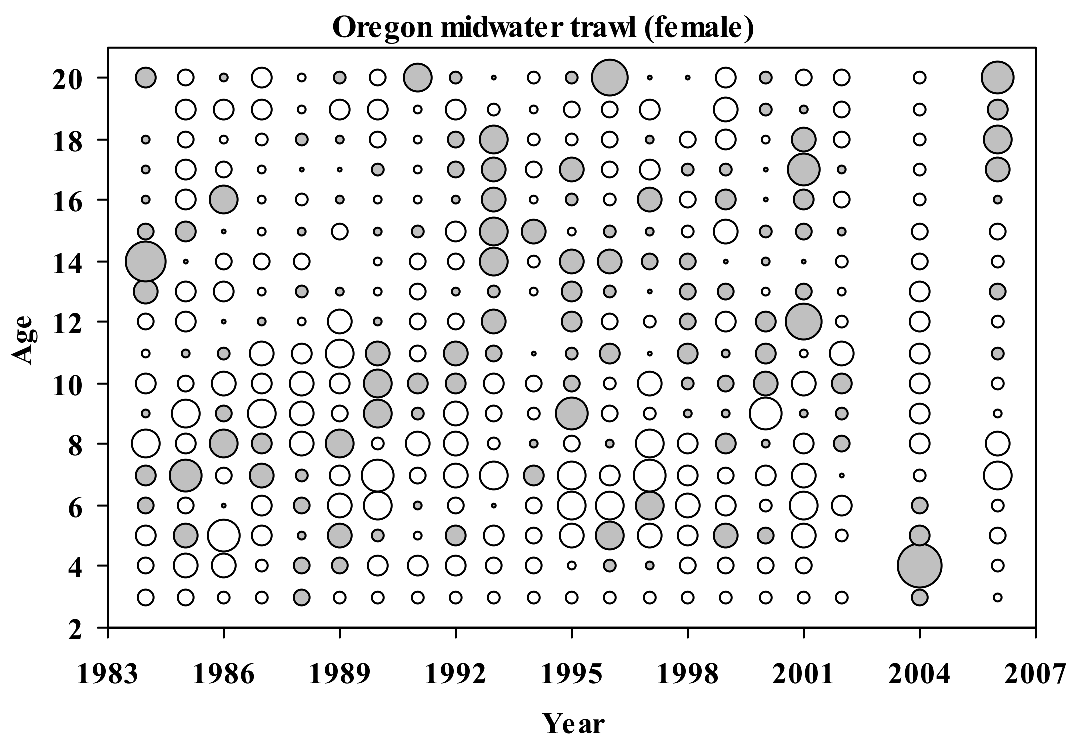
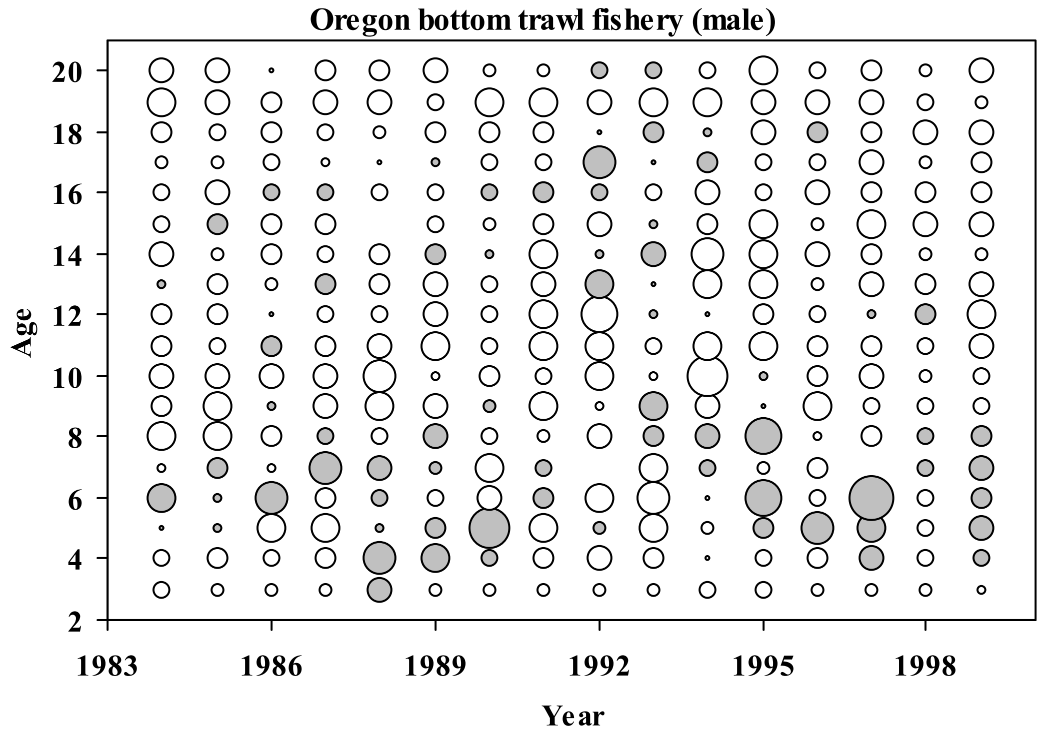


Figure 27c. Age composition residuals for the Oregon bottom trawl fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



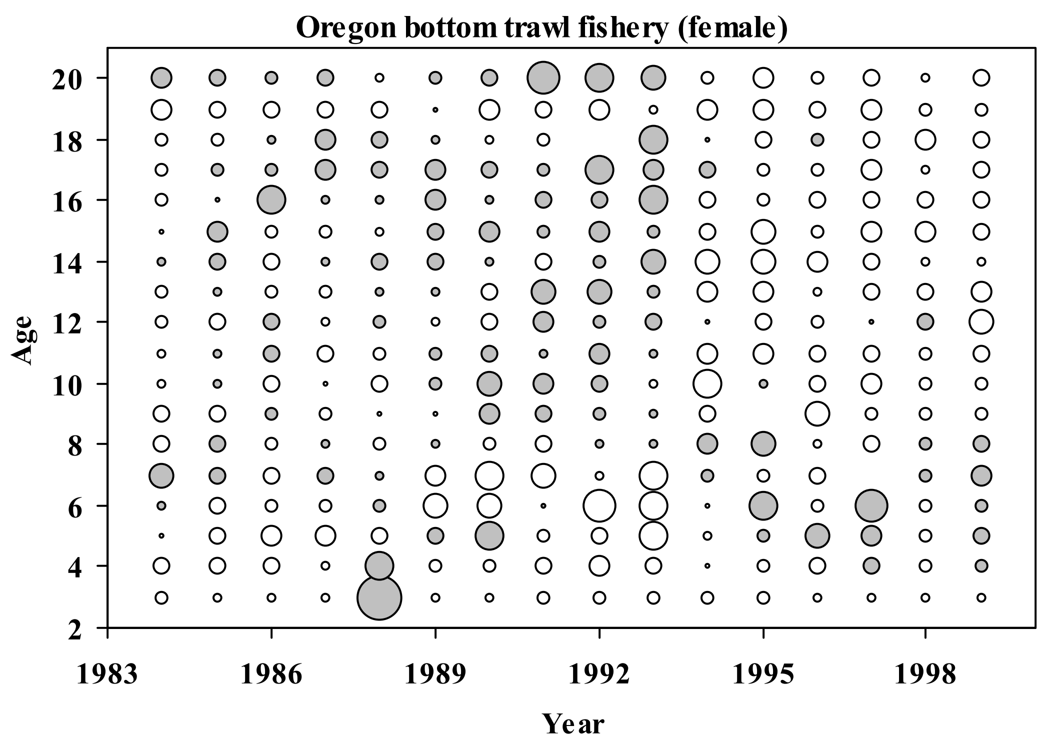
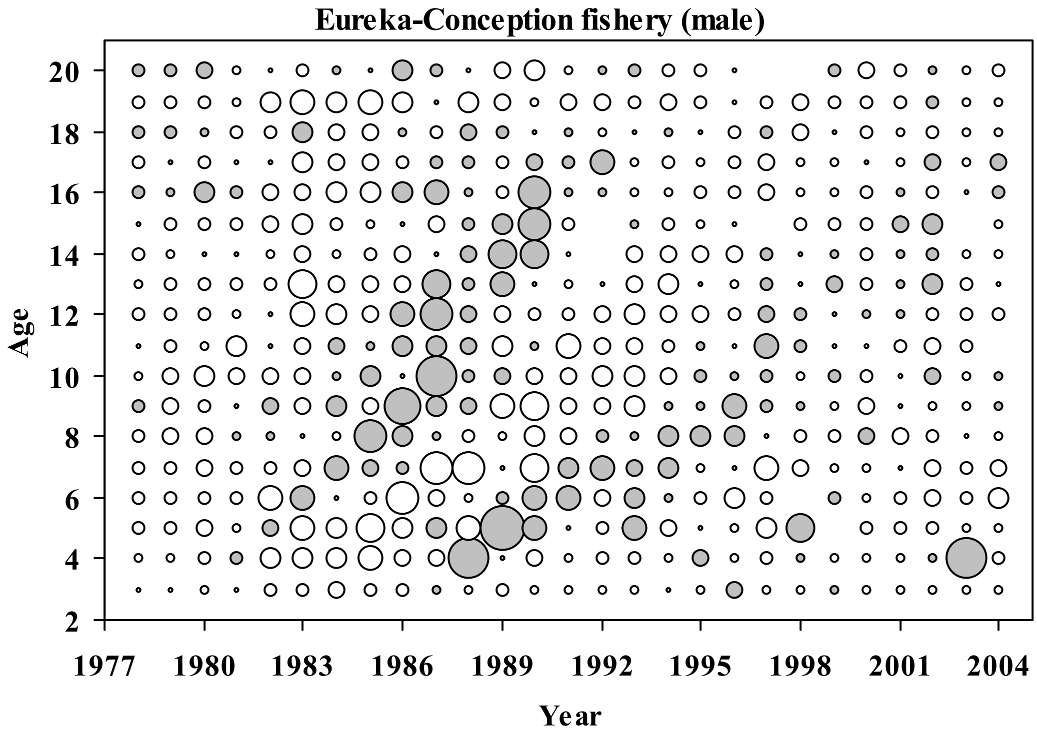


Figure 27d. Age composition residuals for the Eureka-Conception fishery from the base model. Residuals are standardized differences (observed – estimated). Dark circles are positive residuals and open circles are negative residuals.



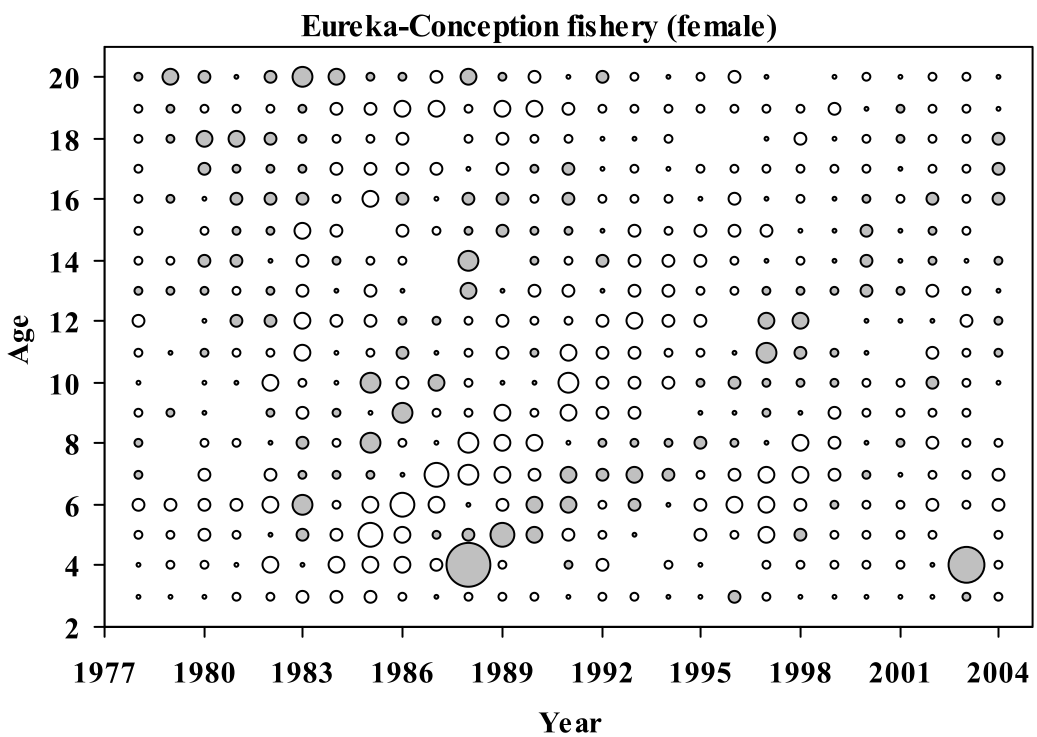
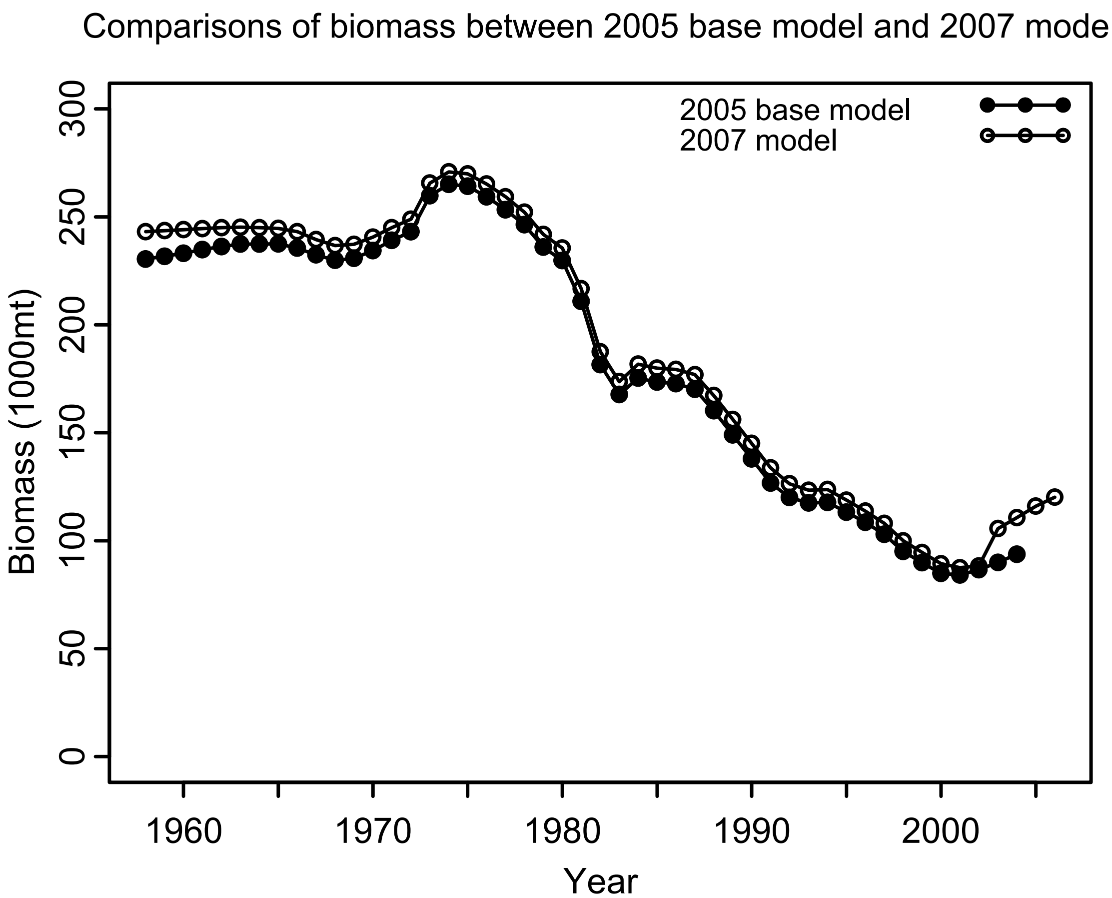


Figure 28. Comparisons of age 3+ biomass between this assessment (2007 model) and the base model of the 2005 assessment (2005 base model).



Appendix A. Input data for widow rockfish stock assessment base model.

```
# *****************************************************************
#  Widow rockfish stock assessment data
#  Xi He
#  National Marine Fisheries Service
#  Southwest Fisheries Science Center
#  Fisheries Ecology Division
#  xi.he@noaa.gov
#  July 2007
#  Filename: wdwmaster.dat
# *****************************************************************

# number of region
2
# number of fishery
4
# number of sex
2
# number of observed indexes
6
# Starting and ending year of the model
1958
2006
49
# Recruitment age and total number of age bins
3
18
# Vector of ages for age bins
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

# number of likelihood components
9

# Natural mortality
0.125 0.125

# Discard rate (D value) by year (landing = catch * (1-D) )
0.06	0.06	0.06	0.06	0.06
0.06	0.06	0.06	0.06	0.06
0.06	0.06	0.06	0.06	0.06
0.06	0.06	0.06	0.06	0.06
0.06	0.06	0.06	0.06	0.06
0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16

# Smoothed fraction of total landings in the north\
# fractions from 1968-77 was used in years before 1968, same as in 2000 assessment
# foreign landings from Jean Rogers were not used to compute fractions before 1968
# old data
# 0.548	0.548	0.548	0.548	0.548
# 0.548	0.548	0.548	0.548	0.548
# 0.548	0.548	0.548	0.548	0.548
# 0.548	0.548	0.548	0.548	0.569
# 0.598	0.593	0.592	0.598	0.607
# 0.666	0.670	0.668	0.703	0.726
# 0.746	0.770	0.789	0.795	0.783
# 0.773	0.771	0.755	0.754	0.735
# 0.723	0.738	0.748	0.731	0.731
# 0.731	0.731	0.731	0.731


# new data as computed in 7/12/2007
0.548	0.548	0.548	0.548	0.548
```

```
0.548	0.548	0.548	0.548	0.548
0.548	0.548	0.548	0.548	0.548
0.548	0.548	0.548	0.548	0.569
0.598	0.593	0.591	0.596	0.604
0.663	0.666	0.665	0.700	0.723
0.745	0.771	0.790	0.798	0.787
0.779	0.780	0.767	0.765	0.748
0.740	0.761	0.783	0.782	0.817
0.842	0.806	0.806	0.806


# Biological information
# Growth parameters (Linf,K,t0 for male north, female north, male south, female south)
# age 22 used for wgt of 20+
44.00	50.54	41.50	47.55
0.18	 0.14	 0.25	 0.20
-2.81	-2.68	-0.28	-0.17

# Length weight parameters (b and a for male and female)
0.01188	0.00545
3.06631	3.28781

# proportions of maturity of females
# north
0.01	0.02	0.10	0.32	0.68	0.90	0.98	0.99	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
# south
0.13	0.21	0.64	0.90	0.90	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

# fecundity of females (millions of eggs)
# north
0.0000	0.0000	0.0723	0.1526	0.2325	0.3102	0.3843	0.4540	0.5186
0.5780	0.6322	0.6812	0.7253	0.7648	0.8000	0.8313	0.8590	0.9241
# south
0.0050	0.0100	0.0300	0.0861	0.1788	0.2664	0.3466	0.4184	0.4813
0.5358	0.5824	0.6219	0.6552	0.6831	0.7064	0.7258	0.7419	0.7751

# index values 1968-1999 (-1 = no data)
# NMFS Tiburon/Santa Cruz Lab midwater trawl index
# data copied from Excel file "compare_time_series_with-without_stations.xls" sent by EJ 5-9-2004"
# note that there were no estimates in 1992, 1996, and 1998 because of no positive catches
# 1/2 of historical low estimates (value in 1994) were uesed in those years.
# CVs were set very high.
# only last 2 years data added, proportioan to old data from data sent by EJ 4-28-2004
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
-1.000000	-1.000000	-1.000000	-1.000000	-1.000000
#-1.000000	4.456287 14.319479	0.152868 4.809881
#3.757728	0.206186 0.230129 1.452406 0.067504
#0.878655	0.135008 0.230438 0.067504 0.283063
#0.067504	0.296648 0.287885 1.311048 6.561266
#1.742240	2.379322 0.067504 0.067504
-1.000000	2.853805 20.444666	0.099049 2.421329
2.140435 0.065438 0.075297 0.564927 0.027700
0.372279 0.027699 0.080096 0.027700 0.085343
0.027700 0.081705 0.093390 0.484904 2.971037
0.797075 0.961509 0.027700 0.027700


# Oregon bottom trawl index
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000  -1.00000
-1.00000  331.47	100.88	227.08	169.08
```

```
93.97            164.10           78.49            73.59            83.16
53.58            100.34           109.96           94.81            97.23
56.56            84.46            -1.00000  -1.00000  -1.00000
-1.00000  -1.00000  -1.00000  -1.00000

# Whiting bycatch index - foreign
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000         0.770
1.205             0.703            1.993            0.728            0.243
-1.000000         2.937            0.407            1.111            0.390
0.513            -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000

# Whiting bycatch index - joint venture (JV)
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
2.889            -1.000000         0.776            0.823            0.320
0.659             0.824            0.710           -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000

# Whiting bycatch index - domestic
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        1.2642           0.7812
0.8009           1.4653           0.4546           1.0182           0.8855
1.3301           -1.000000        -1.000000        -1.000000        -1.000000
-1.000000        -1.000000        -1.000000        -1.000000

# Triennual Survey index
# July 7 2005 results from John, base model 1
-1       -1       -1       -1       -1
-1       -1       -1       -1       -1
-1       -1       -1       -1       -1
-1       -1       -1       -1       0.506
-1       -1       0.382    -1       -1
0.565    -1       -1       0.353    -1
-1       0.390    -1       -1       0.461
-1       -1       0.305    -1       -1
0.692    -1       -1       0.112    -1
-1       0.126    -1       -1


# cv for each index
# cv for NMFS Tiburon/Santa Cruz Lab midwater trawl index
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.0000   -1.0000   -1.0000   -1.0000   -1.0000
-1.000000           0.424963 0.411120 0.391504 0.253674
0.256064 0.435949 0.448930 0.335098 2.000000
0.311950 0.491489 0.515161 2.000000 0.450671
2.000000 0.533355 0.366159 0.287519 0.328020
0.290935 0.300290 2.000000 2.000000
```

```
# cv for Oregon bottom trawl index
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1.0    0.2121  0.1875  0.2928  0.2730
0.2897  0.1749  0.1348  0.1275  0.1179
0.1314  0.1128  0.1387  0.1357  0.1502
0.1718  0.1684  -1.0    -1.0    -1.0
-1              -1      -1      -1

# cv for Whiting bycatch index - foreign
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1      0.1153162
0.1118053       0.1186495       0.1311275       0.1257054       0.2466747
-1              0.1253805       0.1074312       0.1026710       0.0880962
0.1243402               -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1

# cv for Whiting bycatch index - joint venture (JV)
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
0.12015916      -1      0.11650305      0.08088591      0.08748436
0.07741054      0.06352467      0.07400396      -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1

# cv for Whiting bycatch index - domestic
# 2005 new index - same as in 2003 but with STAR recom. and rescaled to mean
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              -1              -1
-1              -1              -1              0.1251  0.1251
0.1038  0.0685  0.1057  0.0824  0.0767
0.0786          -1              -1              -1              -1
-1              -1              -1              -1

# Triennual Survey CV
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      -1
-1      -1      -1      -1      0.1647139
-1      -1      0.17362109      -1      -1
0.20646497      -1      -1      0.13429315      -1
-1      0.20142058      -1      -1      0.17819659
-1      -1      0.1330084       -1      -1
0.24706085      -1      -1      0.04130032      -1
-1      0.3     -1      -1

# VAL-COL Fishery landings from AllLanding for model.sas
     -1.0     -1.0     -1.0     -1.0     -1.0
     -1.0     -1.0     -1.0   3670.0   3900.0
   1693.0    356.0    554.0    701.0    410.0
    617.0    293.0    454.0    948.0   1318.0
```

```
   605.0     966.0   16190.0   21779.3   14802.4
  3222.4    1450.4    1537.0    2559.1    3721.9
  3078.1    3378.3    2240.7    1250.2    1206.0
  1813.3    1249.6    1201.8    1163.8    1154.9
   757.0     732.6     588.1     383.1     117.9
    22.8      36.4      72.4      91.7

# OR midwater trwal fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
  1452.0    3567.6    3185.0    2976.9    4985.9
  4101.6    4856.9    3213.9    2146.1    1243.4
  1843.6    1818.4    1508.3    1480.6    1593.4
   889.6    1732.7    2351.9    1109.1     323.0
    27.3      41.6     134.3     174.6

# OR bottom trwal fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      -1.0      -1.0
  1487.6    1334.2     870.8    1170.7    1166.2
  1121.0    1973.6    2167.1    1935.4    2631.7
  3386.2    2382.5    2295.4    2136.8    2244.7
  1329.7     795.8      16.3      38.9       3.2
     0.2       2.4       0.6       2.0

# EUR-CON fishery landings from AllLanding for model.sas
    -1.0      -1.0      -1.0      -1.0      -1.0
    -1.0      -1.0      -1.0      96.0     249.0
   336.0      21.0       1.0       1.0      13.0
   207.0     280.0     358.0     412.0     883.0
   502.0    2326.0    5666.0    5225.7   11260.9
  4402.2    3719.5    3595.5    2819.1    3071.0
  2144.0    2279.9    2671.6    1456.4    1324.2
  1348.3    1248.5    1925.7    1530.1    1704.6
  1303.8     900.6    1141.2     504.5      64.1
     5.1      28.5      12.1      12.3

# Age compositions from four fisheries

# VAN-COL Fishery, data copied from "WAAge5.txt"
# number of years of age comps
27
# years of age comps
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
2003 2004 2005 2006
# number of sampled trips, data copied from "nSample_trip.txt"
# next line: real number of trips
# 18  31  40  25  22  16  27  36  20  30  41  35  31  36  28  33  27  30  22  29  21  10  12   5  20  11  10
# next line: fitted effective sample sizes
# 99  171  220  136  120  87  147  198  110  164  225  192  171  198  152  182  147  164  120  158  115  54  66  26  110  61  54
# Dont change formats of next 2 lines (read by effective sample size programs)
# VAN-COL Fishery new sample counts
99  169  221  136  120  87  146  198  110  164  226  192  169  198  152  181  146  164  120  159  115  54  66  26  110  60  54

# male age comps
  0.00000   0.00000   0.00936   0.02151   0.02034   0.05554   0.09555   0.11058   0.04602   0.02920   0.01189   0.01306   0.00585
0.00410   0.00234   0.00234   0.00117   0.00293
  0.00044   0.00661   0.02443   0.06374   0.04552   0.02404   0.04774   0.08777   0.06757   0.04708   0.02576   0.01710   0.01166
0.00533   0.00428   0.00339   0.00289   0.00850
  0.00016   0.00849   0.03050   0.08438   0.03069   0.04496   0.02057   0.02149   0.03265   0.07169   0.04494   0.03431   0.03486
0.02110   0.01407   0.00881   0.00547   0.01688
  0.00000   0.00757   0.15372   0.11349   0.02842   0.01747   0.01426   0.01310   0.01359   0.01836   0.02014   0.01478   0.01532
0.00881   0.00634   0.00669   0.00567   0.01989
```

```
 0.00000  0.00335  0.05370  0.16103  0.08334  0.03342  0.01385  0.00439  0.00560  0.00680  0.00752  0.01293  0.01279
0.01068  0.00680  0.00768  0.00768  0.02856
 0.00000  0.00830  0.07482  0.08042  0.12478  0.06645  0.02161  0.00947  0.00356  0.00591  0.00532  0.00605  0.00546
0.00266  0.00591  0.00472  0.00251  0.02834
 0.00000  0.00700  0.06018  0.17364  0.07517  0.04895  0.01438  0.00597  0.00529  0.00522  0.00346  0.00312  0.00463
0.00607  0.00322  0.00230  0.00154  0.02948
 0.00000  0.00626  0.02405  0.12001  0.19421  0.04619  0.01287  0.00853  0.00284  0.00419  0.00554  0.00421  0.00301
0.00405  0.00375  0.00211  0.00150  0.01125
 0.00000  0.00000  0.01486  0.06014  0.13687  0.19886  0.03497  0.01327  0.00455  0.00245  0.00086  0.00262  0.00314
0.00086  0.00017  0.00052  0.00069  0.01404
 0.00000  0.00256  0.01760  0.09336  0.09497  0.15702  0.08737  0.00920  0.00372  0.00116  0.00000  0.00128  0.00023
0.00093  0.00023  0.00046  0.00151  0.00846
 0.00000  0.00046  0.02508  0.07734  0.15251  0.06807  0.09741  0.02997  0.01148  0.00453  0.00098  0.00046  0.00000
0.00046  0.00051  0.00098  0.00103  0.00747
 0.00000  0.00124  0.01005  0.06167  0.11410  0.10725  0.07367  0.04353  0.04959  0.01028  0.00395  0.00290  0.00166
0.00062  0.00405  0.00114  0.00114  0.01829
 0.00000  0.00262  0.01954  0.03090  0.07154  0.07726  0.08193  0.04874  0.05152  0.02944  0.01979  0.00793  0.00491
0.00270  0.00172  0.00000  0.00090  0.01162
 0.00019  0.00019  0.01642  0.05843  0.05075  0.06302  0.05670  0.03519  0.02906  0.03079  0.02292  0.02033  0.01221
0.00651  0.00533  0.00434  0.00198  0.01338
 0.00000  0.00133  0.01058  0.04137  0.08687  0.05705  0.04536  0.03711  0.02812  0.02280  0.02596  0.01647  0.01295
0.01115  0.00493  0.00360  0.00270  0.01747
 0.00069  0.01025  0.03094  0.05624  0.09620  0.09981  0.06392  0.02860  0.03060  0.01866  0.01497  0.02361  0.01040
0.00741  0.00614  0.00722  0.00246  0.01198
 0.00082  0.01212  0.05914  0.11186  0.10422  0.05756  0.03292  0.01833  0.01345  0.01036  0.00793  0.00635  0.00793
0.00237  0.00316  0.00319  0.00240  0.00793
 0.00000  0.00283  0.03676  0.14894  0.12910  0.04963  0.01522  0.00955  0.00624  0.00681  0.00663  0.00814  0.00133
0.00332  0.00265  0.00066  0.00075  0.00398
 0.00000  0.00109  0.01427  0.04277  0.14569  0.10966  0.03977  0.01453  0.00714  0.00853  0.00770  0.00331  0.00248
0.00248  0.00661  0.00083  0.00000  0.00579
 0.00000  0.00183  0.01104  0.04093  0.08073  0.10702  0.08193  0.04142  0.02262  0.00991  0.00980  0.00915  0.00458
0.00522  0.00366  0.00458  0.00183  0.00522
 0.00000  0.00000  0.00459  0.05788  0.11276  0.07104  0.07347  0.07257  0.03842  0.01260  0.01233  0.00525  0.00210
0.00912  0.00630  0.00315  0.00210  0.00525
 0.00000  0.00000  0.00412  0.05142  0.12557  0.08423  0.06177  0.05357  0.03715  0.03934  0.03311  0.00831  0.01654
0.00623  0.00619  0.00623  0.00208  0.00623
 0.00000  0.00170  0.02215  0.02726  0.06133  0.10562  0.06814  0.05622  0.02555  0.02726  0.01193  0.01533  0.00170
0.00170  0.00511  0.00170  0.00170  0.00341
 0.00000  0.00481  0.08654  0.11538  0.12019  0.08654  0.02404  0.00481  0.00000  0.00000  0.00000  0.00481  0.00000
0.00000  0.00000  0.00000  0.00000  0.00000
 0.00000  0.00000  0.03458  0.10209  0.04446  0.03952  0.02799  0.00988  0.01317  0.00494  0.00329  0.00494  0.00329
0.00165  0.10317  0.00329  0.00000  0.10646
 0.00000  0.00802  0.09963  0.03527  0.10971  0.05131  0.01764  0.02245  0.01443  0.00481  0.00321  0.00481  0.00160
0.00321  0.00160  0.00160  0.00160  0.02405
 0.00000  0.01321  0.02020  0.16706  0.06996  0.05446  0.02026  0.01484  0.00627  0.00470  0.00706  0.00235  0.00392
0.00235  0.00078  0.00235  0.00314  0.00627

# female age comps
 0.00000  0.00000  0.00915  0.01848  0.01356  0.02572  0.08794  0.14181  0.08461  0.06275  0.03471  0.01774  0.02125
0.01851  0.00527  0.00702  0.00644  0.01325
 0.00000  0.00749  0.01721  0.04658  0.04392  0.02038  0.02043  0.06235  0.07845  0.07129  0.03738  0.02832  0.01854
0.01016  0.00539  0.00578  0.00517  0.02730
 0.00031  0.00756  0.01837  0.05959  0.02884  0.04157  0.01882  0.01498  0.01468  0.04925  0.03998  0.04034  0.03274
0.03228  0.01656  0.01511  0.00593  0.03709
 0.00000  0.00557  0.15331  0.11397  0.04033  0.02055  0.00918  0.01352  0.01333  0.01629  0.02928  0.02280  0.02159
0.01315  0.01031  0.00688  0.00452  0.02781
 0.00106  0.00194  0.04400  0.15202  0.07538  0.02555  0.01816  0.00527  0.00650  0.00701  0.01138  0.01683  0.02513
0.02372  0.02010  0.01089  0.01354  0.08140
 0.00000  0.00830  0.07081  0.08146  0.11726  0.05756  0.02751  0.00857  0.00695  0.00532  0.00753  0.00546  0.01239
0.00959  0.01092  0.00722  0.00753  0.09934
 0.00000  0.00202  0.05331  0.17762  0.09124  0.06975  0.02015  0.01325  0.00395  0.00697  0.00765  0.00614  0.00888
0.00840  0.00772  0.00916  0.00350  0.06065
 0.00015  0.00447  0.01390  0.09509  0.22405  0.05680  0.03697  0.02557  0.00942  0.00674  0.00375  0.00196  0.00706
0.00754  0.00483  0.00752  0.00422  0.03537
 0.00000  0.00245  0.00735  0.05615  0.15087  0.20625  0.03527  0.01727  0.01207  0.00820  0.00296  0.00034  0.00262
0.00052  0.00034  0.00086  0.00017  0.00743
 0.00000  0.00256  0.00710  0.07590  0.09290  0.18362  0.10439  0.00897  0.00979  0.00582  0.00070  0.00105  0.00105
0.00151  0.00000  0.00093  0.00361  0.02000
 0.00000  0.00144  0.02760  0.06204  0.11559  0.07780  0.11935  0.05906  0.01220  0.00551  0.00252  0.00293  0.00046
0.00103  0.00247  0.00098  0.00093  0.02934
```

0.00000 0.00000 0.00385 0.05429 0.08432 0.09903 0.06562 0.05673 0.05360 0.01080 0.00933 0.00466 0.00414
0.00248 0.00062 0.00300 0.00238 0.04001
0.00000 0.00303 0.02347 0.02534 0.05535 0.09135 0.08186 0.05667 0.06935 0.04588 0.02985 0.01169 0.00785
0.00442 0.00090 0.00360 0.00212 0.02421
0.00000 0.00099 0.00824 0.05949 0.03773 0.06809 0.06964 0.05408 0.04986 0.08460 0.04758 0.02967 0.01536
0.00885 0.00291 0.00452 0.00192 0.02874
0.00353 0.00266 0.01335 0.04676 0.07388 0.06786 0.04380 0.05438 0.04144 0.04327 0.05212 0.03475 0.02463
0.01604 0.01295 0.00759 0.00443 0.03075
0.00069 0.00937 0.03205 0.05033 0.07766 0.08161 0.05547 0.03681 0.02349 0.02722 0.01720 0.02054 0.00967
0.00687 0.01075 0.00476 0.00157 0.01386
0.00000 0.00158 0.06843 0.11211 0.10759 0.06434 0.05369 0.02392 0.01438 0.01825 0.01345 0.01112 0.01743
0.00477 0.00394 0.00158 0.00240 0.01901
0.00000 0.00066 0.02872 0.16724 0.14184 0.05282 0.03318 0.02357 0.01685 0.01799 0.01733 0.01004 0.00729
0.01061 0.00539 0.00199 0.00265 0.02927
0.00000 0.00109 0.01205 0.04774 0.16517 0.15343 0.04665 0.02032 0.02276 0.02306 0.01954 0.02145 0.01427
0.00440 0.01127 0.00466 0.00248 0.01701
0.00000 0.00124 0.01222 0.04600 0.06684 0.12652 0.10482 0.05295 0.03286 0.02284 0.01508 0.01319 0.01438
0.00856 0.00582 0.01131 0.00549 0.01836
0.00000 0.00000 0.00177 0.05344 0.08826 0.09723 0.07692 0.06925 0.04609 0.02138 0.00984 0.00945 0.00630
0.00630 0.00630 0.00945 0.00210 0.00702
0.00000 0.00000 0.00208 0.02465 0.05342 0.09023 0.05742 0.01435 0.03108 0.02488 0.04777 0.03527 0.01661
0.01869 0.00415 0.00619 0.00831 0.02281
0.00000 0.00170 0.02555 0.02726 0.02896 0.11073 0.10562 0.04600 0.04770 0.03578 0.03066 0.02726 0.02385
0.01022 0.00170 0.01193 0.00511 0.02215
0.00481 0.01923 0.14423 0.07692 0.06731 0.08173 0.05769 0.01442 0.03846 0.00962 0.00962 0.00962 0.00481
0.00481 0.00000 0.00000 0.00481 0.00481
0.00000 0.00165 0.03129 0.12349 0.05434 0.06092 0.06751 0.03787 0.03129 0.01647 0.01976 0.01153 0.00659
0.00165 0.00165 0.00165 0.01317 0.01647
0.00000 0.00641 0.10123 0.17475 0.05932 0.05612 0.03207 0.02726 0.01603 0.01764 0.01764 0.01443 0.01122
0.00962 0.00962 0.00802 0.00321 0.03046
0.00000 0.00000 0.04041 0.28515 0.06839 0.08166 0.01327 0.01562 0.01719 0.00784 0.00784 0.00784 0.01092
0.00862 0.00706 0.00314 0.00470 0.02117

OR Midwater Trawl Fishery
note that there are no age samples in 2003 and 2005, so agecomp=(-1) for 2003 & 2005, numbers of trip for 2003 and 2005 are set to (-1)
number of years of age comps
23
years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
next line: real number of trips
32 53 56 68 39 65 61 59 43 50 22 30 32 47 41 62 55 40 17 -1 4 -1 13
next line: fitted effective sample sizes
112 187 199 241 138 229 217 209 153 178 76 107 112 167 144 220 195 142 59 -1 14 -1 45
Dont change formats of next 2 lines (read by effective sample size programs)
OR Midwater Trawl Fishery new sample counts
112 187 198 241 138 229 216 210 153 178 77 107 112 167 144 220 195 142 59 -1 14 -1 45

male age comps
0.000000 0.001697 0.018827 0.162810 0.108622 0.009541 0.018878 0.007612 0.007060 0.007934 0.018659 0.023167
0.002377 0.009381 0.002624 0.002415 0.001036 0.012689
0.000000 0.002160 0.065439 0.069821 0.223067 0.065409 0.007588 0.005755 0.002951 0.000000 0.001683 0.004717
0.012976 0.002557 0.002244 0.000000 0.000000 0.009796
0.000000 0.000000 0.006348 0.092848 0.083102 0.196392 0.064126 0.005321 0.005748 0.005387 0.000000 0.000332
0.001114 0.012367 0.003862 0.002128 0.001175 0.007500
0.000000 0.000000 0.014196 0.125268 0.217513 0.074011 0.041905 0.022240 0.002491 0.003416 0.002991 0.000421
0.000236 0.001845 0.003615 0.000000 0.001370 0.003318
0.000463 0.001134 0.013597 0.076953 0.244116 0.129001 0.033834 0.020208 0.007744 0.000000 0.001440 0.000441
0.000851 0.000000 0.002627 0.002040 0.000000 0.003489
0.000000 0.005576 0.018629 0.054351 0.121196 0.199054 0.068330 0.016187 0.009606 0.002806 0.000780 0.000588
0.000503 0.000680 0.002170 0.002169 0.003530 0.005834
0.000000 0.003259 0.027658 0.029435 0.056774 0.099210 0.133459 0.067073 0.032413 0.015428 0.007388 0.003535
0.000000 0.000956 0.000000 0.001783 0.000000 0.004200
0.000000 0.000000 0.007865 0.064272 0.099804 0.106824 0.065076 0.089038 0.038706 0.009747 0.011371 0.003156
0.002466 0.001678 0.001335 0.000000 0.000553 0.009008
0.000000 0.000000 0.035945 0.039720 0.087052 0.083027 0.080416 0.041211 0.085709 0.030049 0.021923 0.013500
0.002018 0.004160 0.000000 0.000000 0.001193 0.013024
0.000000 0.000000 0.016302 0.070921 0.055203 0.081487 0.049299 0.038564 0.034325 0.059574 0.026062 0.017941
0.014803 0.006404 0.000000 0.003025 0.001142 0.010385

0.000060 0.001656 0.008803 0.075885 0.155556 0.079729 0.046850 0.041458 0.011685 0.019825 0.031305 0.000000 0.001604 0.005385 0.000000 0.000000 0.000000 0.009487
0.000031 0.004062 0.016837 0.024621 0.130919 0.094844 0.048282 0.043438 0.032006 0.022568 0.029549 0.006968 0.001389 0.000584 0.000199 0.005330 0.000099 0.001390
0.000000 0.008243 0.073067 0.092792 0.070761 0.065215 0.049392 0.033786 0.013582 0.008126 0.023971 0.009317 0.017184 0.008103 0.003180 0.000000 0.004503 0.005028
0.000000 0.002472 0.031114 0.240239 0.116098 0.042764 0.026053 0.026697 0.016128 0.013262 0.008786 0.003029 0.013826 0.012758 0.000238 0.000317 0.000627 0.002079
0.000000 0.000000 0.011590 0.081244 0.194209 0.111829 0.054206 0.014576 0.025467 0.014974 0.003056 0.007315 0.000585 0.000827 0.008645 0.002236 0.000510 0.004328
0.000000 0.001307 0.025490 0.038238 0.109048 0.181498 0.087210 0.021738 0.004939 0.005506 0.000349 0.000900 0.001168 0.000127 0.000704 0.000518 0.000027 0.002181
0.000000 0.000000 0.012889 0.053820 0.078489 0.084174 0.118748 0.070706 0.028318 0.021247 0.005465 0.005220 0.006090 0.002900 0.000269 0.001264 0.000008 0.001656
0.000000 0.000000 0.001239 0.018103 0.098269 0.099225 0.120104 0.061746 0.050100 0.042098 0.016837 0.005975 0.002014 0.003145 0.001507 0.001553 0.004036 0.004132
0.000000 0.008723 0.008813 0.043887 0.089952 0.148003 0.117899 0.033222 0.013022 0.008925 0.009604 0.006716 0.000000 0.008839 0.004705 0.000000 0.007456 0.001564
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.080014 0.140150 0.202790 0.080660 0.026095 0.014545 0.001682 0.002243 0.001682 0.001121 0.001682 0.001121 0.000000 0.000000 0.000561 0.001121 0.000561
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.000000 0.018510 0.206143 0.112214 0.111277 0.016569 0.009068 0.019236 0.007282 0.023503 0.012957 0.008097 0.014340 0.000000 0.000468 0.001870 0.032592

female age comps
0.000000 0.001232 0.018975 0.165746 0.174835 0.013607 0.031065 0.006897 0.006394 0.004037 0.028644 0.066621 0.017824 0.008463 0.007004 0.005679 0.006654 0.020991
0.000000 0.000000 0.049584 0.066563 0.253371 0.087381 0.010712 0.010895 0.008817 0.000000 0.000539 0.007171 0.017507 0.001968 0.000746 0.001331 0.001956 0.005298
0.000000 0.000000 0.009540 0.122232 0.083948 0.166685 0.072663 0.005029 0.010945 0.004726 0.000000 0.000693 0.004019 0.017453 0.001919 0.002055 0.001795 0.008547
0.000000 0.001290 0.016675 0.112688 0.198001 0.080151 0.038100 0.020477 0.001549 0.004767 0.001785 0.000132 0.000917 0.001633 0.002851 0.001500 0.000435 0.002213
0.000984 0.004680 0.014524 0.076746 0.192350 0.099018 0.025664 0.016977 0.008845 0.004252 0.004467 0.000000 0.001045 0.000000 0.001373 0.004050 0.002694 0.004392
0.000000 0.004348 0.026249 0.036418 0.079465 0.197050 0.086376 0.023765 0.011445 0.005620 0.004468 0.001832 0.000000 0.000745 0.000509 0.001577 0.001323 0.006822
0.000000 0.000000 0.018125 0.033563 0.054101 0.079333 0.150790 0.103895 0.037364 0.021728 0.009049 0.002238 0.001919 0.000577 0.000840 0.000000 0.000000 0.003908
0.000000 0.000000 0.010207 0.061722 0.096026 0.060650 0.068546 0.098079 0.042946 0.013639 0.009989 0.004482 0.003192 0.000781 0.000484 0.000484 0.002413 0.015458
0.000000 0.000000 0.023080 0.029597 0.070216 0.075317 0.042247 0.063636 0.088798 0.031001 0.015295 0.006497 0.001193 0.001984 0.002030 0.002224 0.000000 0.007939
0.000000 0.000619 0.010235 0.067949 0.036055 0.079940 0.065430 0.035775 0.045776 0.067009 0.033835 0.023914 0.020267 0.010147 0.004298 0.005024 0.001773 0.006514
0.000000 0.000060 0.008346 0.048716 0.157869 0.064175 0.055961 0.041445 0.034903 0.024695 0.028568 0.014965 0.020718 0.004541 0.000000 0.000000 0.002325 0.003423
0.000000 0.004768 0.005481 0.030657 0.058610 0.087557 0.088895 0.056843 0.042520 0.038741 0.032444 0.046168 0.012590 0.007441 0.014045 0.001228 0.000153 0.008744
0.000000 0.007131 0.067434 0.059398 0.076746 0.079752 0.049421 0.023895 0.038792 0.016466 0.018451 0.023365 0.018283 0.005841 0.000700 0.000878 0.000572 0.026625
0.000000 0.002580 0.012439 0.169835 0.081572 0.038429 0.037679 0.017000 0.014256 0.011551 0.013032 0.013201 0.006873 0.016518 0.001471 0.002426 0.000000 0.004652
0.000000 0.000037 0.004497 0.036935 0.158466 0.091903 0.047566 0.030986 0.031988 0.014652 0.014922 0.012049 0.003880 0.001903 0.006640 0.000777 0.002699 0.004503
0.000000 0.000166 0.022686 0.036414 0.081014 0.185689 0.092911 0.040511 0.019957 0.008138 0.011300 0.006752 0.000919 0.007343 0.003825 0.000516 0.000007 0.000904
0.000000 0.000000 0.014792 0.045920 0.075338 0.086096 0.081487 0.094960 0.038853 0.024377 0.010573 0.005971 0.006954 0.004270 0.003098 0.001850 0.006177 0.008021
0.000000 0.000000 0.000000 0.012725 0.066942 0.066872 0.071082 0.068574 0.049240 0.060062 0.016389 0.009506 0.008355 0.008059 0.013737 0.008272 0.005784 0.004316
0.000000 0.002825 0.009167 0.017950 0.065404 0.114271 0.090580 0.082117 0.036436 0.033172 0.014684 0.004683 0.009396 0.000044 0.004637 0.000044 0.001564 0.001696
-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.005417 0.110513 0.075197 0.151982 0.070732 0.022576 0.005871 0.000561 0.000561 0.000561 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000

-1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000 -1.000000
0.000000 0.000000 0.016244 0.135195 0.027939 0.042968 0.037277 0.014209 0.021045 0.009438 0.023701 0.004646 0.004178 0.008228 0.010520 0.011038 0.011033 0.028216

OR Bottom Trawl Fishery
number of years of age comps
16
years of age comps
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
next line: real number of trips
27 23 22 34 33 45 49 78 82 61 63 43 27 40 30 26
next line: fitted effective sample sizes
94 81 78 118 116 157 172 273 288 215 222 150 94 139 105 91
Dont change formats of next 2 lines (read by effective sample size programs)
OR Bottom Trawl Fishery new sample counts
94 81 77 118 116 157 172 273 287 215 222 150 94 139 105 91

male age comps
0.000000 0.002000 0.030445 0.189548 0.117081 0.016035 0.015324 0.003114 0.003439 0.001948 0.018194 0.013253 0.009686 0.007799 0.006124 0.002928 0.001011 0.009201
0.000000 0.002502 0.036013 0.074608 0.200140 0.051173 0.001874 0.004660 0.004952 0.000000 0.001042 0.008356 0.028493 0.000000 0.005334 0.003539 0.000143 0.007644
0.000000 0.002454 0.013907 0.200127 0.081379 0.084660 0.058424 0.002879 0.018185 0.005389 0.002106 0.000000 0.001445 0.017611 0.002031 0.001018 0.002843 0.015694
0.000000 0.000000 0.011118 0.109017 0.203522 0.070081 0.039469 0.015803 0.002859 0.002428 0.006852 0.000000 0.000000 0.005938 0.005288 0.001991 0.000000 0.007686
0.001871 0.011031 0.016633 0.079520 0.207515 0.102423 0.021828 0.011340 0.007407 0.003053 0.000490 0.000111 0.001142 0.000177 0.002442 0.003514 0.001270 0.006522
0.000000 0.008833 0.024646 0.049996 0.092063 0.174036 0.067810 0.031354 0.014894 0.008040 0.000000 0.006094 0.000196 0.000020 0.001275 0.000668 0.006091 0.006210
0.000000 0.003583 0.046610 0.044816 0.055997 0.068434 0.115960 0.057955 0.020822 0.019537 0.009585 0.004483 0.001307 0.002656 0.000000 0.000000 0.000000 0.011648
0.000000 0.000147 0.004189 0.070284 0.100833 0.070524 0.042126 0.076314 0.037653 0.009481 0.011792 0.003212 0.001068 0.003579 0.000182 0.000000 0.001193 0.011880
0.000000 0.000210 0.017104 0.021507 0.083738 0.072799 0.059036 0.034356 0.048167 0.017539 0.028795 0.015892 0.004209 0.004150 0.005980 0.001566 0.002672 0.017018
0.000000 0.000000 0.005855 0.035253 0.034549 0.088243 0.091091 0.046518 0.033369 0.054327 0.034564 0.022812 0.013524 0.004287 0.002129 0.003937 0.000464 0.016873
0.000000 0.003066 0.014275 0.056658 0.107092 0.068690 0.042280 0.016704 0.020763 0.028991 0.023737 0.008231 0.006195 0.004521 0.008745 0.002407 0.000000 0.010728
0.000000 0.002979 0.033648 0.108932 0.073740 0.135371 0.039055 0.044337 0.020910 0.017927 0.007067 0.012256 0.004705 0.005004 0.005162 0.000343 0.000000 0.002308
0.000000 0.001546 0.078624 0.082232 0.058865 0.058378 0.022296 0.017354 0.016860 0.020354 0.015502 0.002110 0.016646 0.004691 0.001983 0.010887 0.000918 0.007283
0.000000 0.006259 0.044095 0.229768 0.118118 0.047116 0.031456 0.020552 0.009284 0.017502 0.007340 0.006334 0.000686 0.005679 0.001947 0.000212 0.000000 0.003644
0.000000 0.000000 0.008048 0.051295 0.182533 0.115763 0.034581 0.021837 0.017118 0.020333 0.006225 0.009028 0.000040 0.001808 0.007220 0.000000 0.003032 0.007934
0.000000 0.004410 0.028185 0.065780 0.117624 0.177422 0.072072 0.027160 0.008664 0.000260 0.000000 0.007039 0.001389 0.000369 0.000145 0.000260 0.006664 0.002549

female age comps
0.000000 0.000000 0.029195 0.150224 0.185481 0.027626 0.015787 0.011391 0.007173 0.004612 0.012420 0.029933 0.015032 0.008095 0.004631 0.005248 0.002645 0.043377
0.000442 0.000000 0.019813 0.048296 0.197706 0.126662 0.014812 0.017391 0.011417 0.000077 0.007641 0.022032 0.036411 0.010210 0.013434 0.002712 0.003324 0.037146
0.000000 0.001065 0.024770 0.106380 0.062244 0.095632 0.067643 0.006899 0.017635 0.013058 0.000257 0.000000 0.003719 0.043899 0.009910 0.006981 0.004659 0.025100
0.000000 0.001576 0.010234 0.117399 0.171871 0.063467 0.050337 0.029975 0.003580 0.003687 0.001518 0.003055 0.000272 0.004721 0.016566 0.013579 0.003342 0.022768
0.009606 0.014331 0.009403 0.077325 0.171310 0.103797 0.040625 0.026669 0.015156 0.010274 0.004624 0.005987 0.000830 0.002484 0.006360 0.010148 0.002759 0.010020
0.000000 0.001242 0.025824 0.027018 0.064659 0.144556 0.088917 0.041537 0.039946 0.014916 0.006732 0.006454 0.005084 0.003964 0.005380 0.003800 0.009658 0.018086
0.000000 0.000346 0.045983 0.035820 0.037131 0.067841 0.137383 0.107247 0.036003 0.017221 0.008657 0.004878 0.006605 0.002256 0.002494 0.001175 0.001334 0.024232
0.000000 0.000276 0.008559 0.057365 0.061216 0.065968 0.073102 0.107811 0.057796 0.032714 0.032940 0.007005 0.004608 0.004366 0.002101 0.000526 0.003298 0.035890

0.000000 0.000000 0.009753 0.008144 0.081541 0.088796 0.068771 0.057565 0.089954 0.047986 0.031772 0.019963
0.014438 0.004916 0.006446 0.001441 0.002506 0.031269
0.000000 0.000000 0.000299 0.025279 0.025262 0.075644 0.073311 0.044332 0.040169 0.066328 0.042838 0.028744
0.017316 0.020636 0.005716 0.008841 0.005620 0.031867
0.000000 0.002217 0.008820 0.042980 0.100462 0.063347 0.056897 0.063275 0.046037 0.026311 0.064738 0.028538
0.019849 0.012475 0.012450 0.006566 0.006008 0.015944
0.000000 0.004849 0.012570 0.037066 0.109137 0.084212 0.050834 0.038905 0.045410 0.025559 0.017455 0.024881
0.003947 0.002003 0.013073 0.001605 0.000000 0.014750
0.000097 0.007272 0.076010 0.101629 0.082023 0.086098 0.050735 0.028263 0.040649 0.032268 0.008394 0.004318
0.039893 0.000000 0.001771 0.010131 0.002891 0.011030
0.000000 0.008041 0.030840 0.103883 0.094444 0.030399 0.046719 0.030626 0.019097 0.014813 0.008142 0.013020
0.009741 0.016087 0.004702 0.000592 0.005036 0.013827
0.000000 0.000000 0.011607 0.047322 0.140566 0.110448 0.053762 0.024241 0.030259 0.017303 0.025682 0.013208
0.015729 0.002847 0.008011 0.001866 0.001373 0.008983
0.000000 0.000000 0.023360 0.057678 0.067752 0.146783 0.062621 0.042079 0.039373 0.008637 0.011882 0.006203
0.007617 0.002111 0.000000 0.001389 0.001141 0.001385

EUR-CON Fishery
Note: there are no age data for 2005 and 2006
number of years of age comps
27
years of age comps
1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
2001 2002 2003 2004
number of trips sampled
next line: real number of trips
7 11 26 44 149 189 169 175 154 135 127 170 155 95 55 22
28 11 35 61 37 31 17 7 14 3 7
next line: fitted effective sample sizes
5 7 16 26 90 115 103 106 93 81 77 103 94 58 33 14 18 7 21 37 22 19 11 5 8 2 5
Dont change formats of next 2 lines (read by effective sample size programs)
EUR-CON Fishery new sample counts
5 7 16 26 90 115 103 106 93 81 77 103 94 59 33 14 18 7 21 37 22 19 11 5 8 2 5

male age comps
0.000000 0.000000 0.000000 0.000167 0.038794 0.061910 0.113807 0.038798 0.047047 0.016198 0.015682 0.000104
0.015850 0.038590 0.000104 0.022908 0.000376 0.055254
0.000000 0.000000 0.000000 0.000000 0.011438 0.011620 0.048578 0.016812 0.020248 0.015707 0.009403 0.017248
0.001826 0.019215 0.010845 0.019730 0.000012 0.047583
0.000000 0.000000 0.001824 0.014065 0.002924 0.006643 0.039520 0.032312 0.050845 0.031275 0.025393 0.028792
0.009843 0.052786 0.003750 0.016236 0.004651 0.060013
0.000799 0.008361 0.010002 0.027066 0.025037 0.027711 0.025569 0.030219 0.042947 0.046706 0.023835 0.032838
0.015918 0.028874 0.012306 0.004370 0.013545 0.025365
0.000000 0.000106 0.043649 0.007338 0.036963 0.033485 0.030316 0.013544 0.043159 0.076267 0.035984 0.029549
0.019650 0.013771 0.016956 0.010418 0.008094 0.031557
0.000000 0.000086 0.022886 0.140348 0.031918 0.033224 0.012798 0.005381 0.007744 0.009472 0.019691 0.020034
0.012469 0.012446 0.004708 0.023251 0.002119 0.027271
0.000000 0.000000 0.022177 0.136865 0.144882 0.027534 0.035797 0.014452 0.013815 0.001723 0.010158 0.030363
0.014161 0.004130 0.005053 0.003807 0.004250 0.029903
0.000000 0.000227 0.008622 0.062244 0.162794 0.144850 0.012740 0.025432 0.011326 0.002269 0.002575 0.010161
0.021668 0.002268 0.004800 0.003061 0.003256 0.026758
0.000000 0.002672 0.041614 0.045810 0.082096 0.123917 0.129130 0.013757 0.021789 0.017389 0.001018 0.000893
0.008456 0.029102 0.005577 0.008659 0.003709 0.037843
0.001179 0.000152 0.054998 0.114196 0.043553 0.059667 0.090873 0.112021 0.019943 0.029954 0.021102 0.002845
0.000000 0.018666 0.014648 0.002809 0.011094 0.025925
0.000044 0.035380 0.000332 0.065560 0.060575 0.090206 0.060701 0.051129 0.034404 0.014184 0.008844 0.007881
0.003430 0.003586 0.006491 0.016135 0.001500 0.016273
0.000000 0.004922 0.108813 0.072992 0.077959 0.119011 0.046296 0.050071 0.019741 0.011676 0.020419 0.015728
0.008211 0.000000 0.000338 0.007197 0.005816 0.008951
0.000198 0.000005 0.045231 0.116161 0.029490 0.046574 0.037731 0.056019 0.029941 0.024640 0.016278 0.022979
0.019002 0.014258 0.003722 0.002474 0.008377 0.005882
0.000000 0.002436 0.015488 0.119032 0.119577 0.049449 0.037842 0.065086 0.022067 0.016393 0.020120 0.012377
0.001613 0.003541 0.003664 0.002594 0.002776 0.017436
0.000000 0.001110 0.011299 0.018839 0.138318 0.094889 0.037718 0.016739 0.044004 0.027766 0.021343 0.019358
0.011102 0.005458 0.016019 0.001048 0.001845 0.023196
0.000000 0.000000 0.084585 0.163306 0.095533 0.077734 0.009972 0.001732 0.009303 0.006881 0.010719 0.000920
0.020993 0.004707 0.001861 0.004059 0.000628 0.032682
0.001882 0.003574 0.007108 0.070279 0.148029 0.109588 0.064736 0.021235 0.023515 0.006816 0.007885 0.004744
0.006368 0.008510 0.000880 0.004805 0.000299 0.005238

0.000000 0.033490 0.039138 0.033789 0.056445 0.196870 0.044622 0.066035 0.057784 0.003157 0.028233 0.006769
0.020519 0.001013 0.004425 0.008088 0.000051 0.003038
0.003544 0.005653 0.046056 0.045052 0.066636 0.114331 0.117781 0.033128 0.026658 0.018426 0.015394 0.003008
0.024927 0.006853 0.002391 0.002031 0.008824 0.013330
0.000000 0.001634 0.008364 0.108288 0.040725 0.051077 0.052119 0.048417 0.049544 0.035874 0.026884 0.022934
0.012512 0.005025 0.004030 0.012426 0.006304 0.012199
0.000000 0.007713 0.081754 0.060620 0.092682 0.068982 0.053847 0.020544 0.045442 0.025031 0.018261 0.017733
0.005455 0.007462 0.009450 0.000313 0.000000 0.012849
0.000792 0.001303 0.018542 0.072137 0.059251 0.100602 0.069004 0.051386 0.026777 0.022079 0.029557 0.016272
0.006032 0.005804 0.005619 0.012011 0.004983 0.031026
0.000000 0.000000 0.003526 0.043905 0.060881 0.116213 0.055216 0.044377 0.027284 0.028240 0.009386 0.000345
0.002868 0.003058 0.008237 0.002356 0.002153 0.001940
0.000000 0.000172 0.000000 0.010409 0.072637 0.012072 0.064488 0.092402 0.034594 0.039625 0.032375 0.030079
0.041966 0.021130 0.004095 0.003259 0.000000 0.006689
0.000000 0.010264 0.001604 0.001684 0.015276 0.034963 0.043864 0.104166 0.028628 0.020809 0.097590 0.031715
0.060703 0.001604 0.030191 0.000000 0.032557 0.035925
0.000000 0.278761 0.013274 0.008850 0.008850 0.035398 0.039823 0.039823 0.000000 0.017699 0.000000 0.004425
0.013274 0.013274 0.000000 0.000000 0.000000 0.004425
0.000000 0.000000 0.023237 0.000000 0.014953 0.030713 0.053950 0.069711 0.038998 0.014953 0.047282 0.023237
0.007476 0.031522 0.038998 0.000000 0.007476 0.007476

female age comps
0.000000 0.000000 0.000104 0.000000 0.123507 0.205950 0.041377 0.041169 0.018469 0.000000 0.061665 0.000208
0.000104 0.000000 0.000000 0.000208 0.000104 0.041545
0.000000 0.000000 0.000000 0.000000 0.028922 0.067305 0.158389 0.061886 0.061392 0.039940 0.075410 0.011394
0.019222 0.036234 0.011029 0.022589 0.029519 0.126505
0.000000 0.000000 0.000955 0.005649 0.003696 0.024150 0.063373 0.097604 0.097413 0.039497 0.051375 0.061888
0.017530 0.013496 0.029120 0.040354 0.006779 0.066250
0.000000 0.003318 0.004867 0.013777 0.035738 0.019389 0.024915 0.054715 0.072763 0.090769 0.026772 0.055740
0.045834 0.039020 0.025392 0.039669 0.010802 0.035053
0.000000 0.000304 0.032146 0.009081 0.035448 0.031095 0.024213 0.007839 0.036008 0.101644 0.051171 0.036445
0.034257 0.032311 0.023285 0.024933 0.016688 0.052326
0.000000 0.009591 0.075351 0.167412 0.047273 0.048111 0.015052 0.008820 0.002312 0.008036 0.037318 0.021821
0.012045 0.028244 0.019692 0.016134 0.025748 0.071191
0.000000 0.000000 0.025400 0.124378 0.113089 0.026752 0.029462 0.011598 0.007136 0.003342 0.019946 0.045211
0.009560 0.010595 0.006944 0.007132 0.010240 0.050144
0.000000 0.000151 0.001560 0.038649 0.152562 0.144097 0.019940 0.038756 0.006481 0.001962 0.002983 0.010131
0.022748 0.001717 0.006368 0.006675 0.009452 0.030716
0.000000 0.001094 0.032346 0.027042 0.073440 0.081848 0.100382 0.007086 0.021131 0.009354 0.004758 0.001774
0.001549 0.027713 0.003342 0.003768 0.003633 0.026310
0.001179 0.000098 0.047208 0.095361 0.021292 0.050757 0.050894 0.055412 0.011451 0.010172 0.004021 0.002340
0.000793 0.004487 0.002818 0.005991 0.000865 0.011236
0.000140 0.085843 0.037469 0.075957 0.071866 0.055259 0.032502 0.037143 0.021209 0.003896 0.014219 0.019743
0.004235 0.006851 0.003575 0.006002 0.008808 0.038628
0.000000 0.003411 0.081763 0.042605 0.042417 0.081496 0.053703 0.037811 0.021243 0.009702 0.007578 0.003805
0.006337 0.005543 0.000000 0.000650 0.001295 0.022498
0.000005 0.003187 0.050819 0.108911 0.056288 0.036766 0.088722 0.070834 0.037058 0.024351 0.009827 0.008493
0.006215 0.001197 0.003355 0.001205 0.002170 0.011633
0.000226 0.007123 0.008134 0.112901 0.128173 0.060714 0.030229 0.033110 0.023240 0.016982 0.013082 0.010959
0.008170 0.008172 0.006845 0.000731 0.001688 0.018028
0.000000 0.000232 0.015337 0.031121 0.108172 0.086481 0.039057 0.030308 0.037403 0.026187 0.025779 0.043862
0.015023 0.000488 0.001450 0.001391 0.005892 0.041767
0.000000 0.004208 0.033435 0.135163 0.123584 0.096949 0.036693 0.004437 0.001141 0.009519 0.007614 0.001330
0.000782 0.000971 0.001365 0.005160 0.005189 0.006846
0.001882 0.001724 0.022476 0.067422 0.161344 0.066366 0.050772 0.019637 0.025889 0.016917 0.015069 0.006851
0.009371 0.007548 0.006287 0.000228 0.001724 0.023001
0.000000 0.008129 0.009087 0.015496 0.050148 0.136555 0.049764 0.068335 0.023258 0.004577 0.007731 0.002032
0.005057 0.007653 0.000000 0.007704 0.000000 0.001013
0.005316 0.007498 0.039650 0.042831 0.041834 0.081434 0.058032 0.049604 0.037617 0.029501 0.010778 0.009947
0.012242 0.002580 0.001429 0.007214 0.004894 0.003579
0.000076 0.001013 0.007263 0.082973 0.037783 0.055790 0.052979 0.041542 0.064828 0.047760 0.030352 0.020260
0.004756 0.021095 0.006388 0.006955 0.005416 0.014417
0.000000 0.001686 0.053952 0.029427 0.075695 0.029682 0.045987 0.045308 0.052631 0.060361 0.028177 0.007907
0.009615 0.006146 0.006612 0.001982 0.003342 0.013353
0.000193 0.001612 0.010229 0.073635 0.045978 0.093642 0.041606 0.047047 0.038160 0.022148 0.021134 0.015287
0.014316 0.014162 0.003980 0.008607 0.001844 0.013246
0.000000 0.000000 0.006821 0.032812 0.098604 0.073335 0.075038 0.056790 0.039492 0.027416 0.059198 0.032557
0.032994 0.021127 0.002356 0.000562 0.023627 0.007284
0.000000 0.000000 0.000000 0.008190 0.060086 0.098599 0.036981 0.065238 0.063643 0.032407 0.037632 0.022603
0.020863 0.000945 0.012646 0.022527 0.033776 0.017871

```
0.000000  0.010264  0.001604  0.001403  0.031113  0.014715  0.038210  0.111904  0.048715  0.073654  0.004090  0.033960
0.030753  0.033399  0.003769  0.003368  0.000000  0.007538
0.013274  0.411504  0.039823  0.000000  0.000000  0.013274  0.004425  0.022124  0.004425  0.000000  0.000000  0.013274
0.000000  0.000000  0.000000  0.000000  0.000000  0.000000
0.000000  0.000000  0.014953  0.015761  0.014953  0.015761  0.038190  0.038190  0.068499  0.059810  0.066882  0.075571
0.014548  0.052738  0.046474  0.030713  0.007476  0.029501

# Ageing Error Matrix
# row is true age, column is observed age (column sums to 1)
0.7620  0.1217  0.0006  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.2315  0.7560  0.1244  0.0006  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0065  0.1217  0.7500  0.1274  0.0007  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0005  0.1244  0.7440  0.1303  0.0008  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0006  0.1274  0.7380  0.1332  0.0009  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0006  0.1303  0.7320  0.1361  0.0010  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0007  0.1332  0.7260  0.1390  0.0011  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0008  0.1361  0.7200  0.1419  0.0012  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0009  0.1390  0.7140  0.1448  0.0014  0.0000  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0010  0.1419  0.7080  0.1476  0.0015  0.0000
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0011  0.1448  0.7020  0.1505  0.0017
        0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0012  0.1476  0.6960  0.1533
        0.0019  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0014  0.1505  0.6900
        0.1561  0.0020  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0015  0.1533
        0.6840  0.1590  0.0023  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0017
        0.1561  0.6780  0.1617  0.0026  0.0007
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0019  0.1590  0.6720  0.1657  0.0313
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0020  0.1617  0.6660  0.3080
0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
        0.0000  0.0000  0.0023  0.1657  0.6600

# UseXHhPrior (0=no, 1=yes)
1
# To replace cv for indices with estimated RMSE (0=no, 1=yes)
1
# RMSE for index data
0.504666  0.461798  0.741004  0.810624  0.338874  0.501206
# Power coefficient Readin value for SC Lab index (PowCoefficientSCLabIndexReadin)
1.0
# Power coefficient to be estimated? (-1=no, 2=yes) (PowCoefficientSCLabIndexEstimated) => this set estimation phase
2
# Include triennial survey index (IncludeTriSurvey)
1

# Rebuilding options: Parameter for rebuilding data output
# end year for B0 calculation
1982
# start year for recruitment resampling
1986
# number of recent years for weighting fecundity, weight, and selectivity
7
# recruitment overidding for rebuilding analysis (1 = yes, 0 = no)
0
# First year of the projection
2007
```

Year declared overfished
2001
Generate future recruitments using historical recruitments (1), historical recruits/spawner (2), or a stock-recruitment (3)
3
Year for Tmin Age-structure
2001
Number of simulations
5000

Appendix B. Model run with only 2001-2006 coastwide pre-recruit survey indices

Pre-recruit Survey Workshop, which was held in Santa Cruz, California, from September 13-15, 2006, suggested that using only coastwide pre-recruit survey indices from 2001 to 2006 would be more appropriate for widow rockfish than using the Santa Cruz midwater juvenile survey indices from 1984 to 2006. Main outputs from this model run (named as Coastwide Survey Model) are presented here and are compared with those from the model run using data from all survey data from 1984 to 2006 (2007 main model). In this run, only the Santa Cruz survey indices were changed. All other model settings, including relative weighting of CPUE indices, remained same as in the 2007 main model.

Table B1. Comparisons of assessment results between 2007 Main Model and Coastwide Survey Model.

Parameter and estimate	2007 Main Model	Coastwide Survey Model
Number of parameters	208	208
Steepness (*h*)	0.2865	0.2904
Unfished spawning output (B_0) (million of eggs)	49918	50746
Current spawning output (B_t) (million of eggs)	17448	17999
Depletion ($100*B_t/B_0$)	34.95	35.47
Standard deviation of depletion	6.39	6.32

The results indicate that parameters and estimates between these two models are very similar. It is important to point out that since the assessment model uses 3 to 20+ age groups, only pre-recruit data from 2001 to 2003 were actually included in the model. That is, only three datum points (2001 to 2003) were used in the model fitting.