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Attachment 1
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PACIFIC MACKEREL (*Scomber japonicus*) STOCK ASSESSMENT FOR U.S. MANAGEMENT IN THE 2008-09 FISHING SEASON

by

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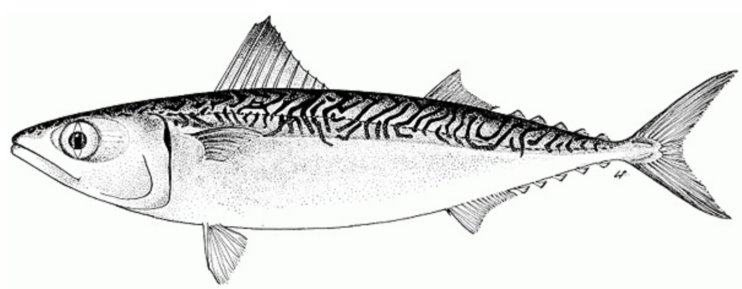

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EXECUTIVE SUMMARY

Stock

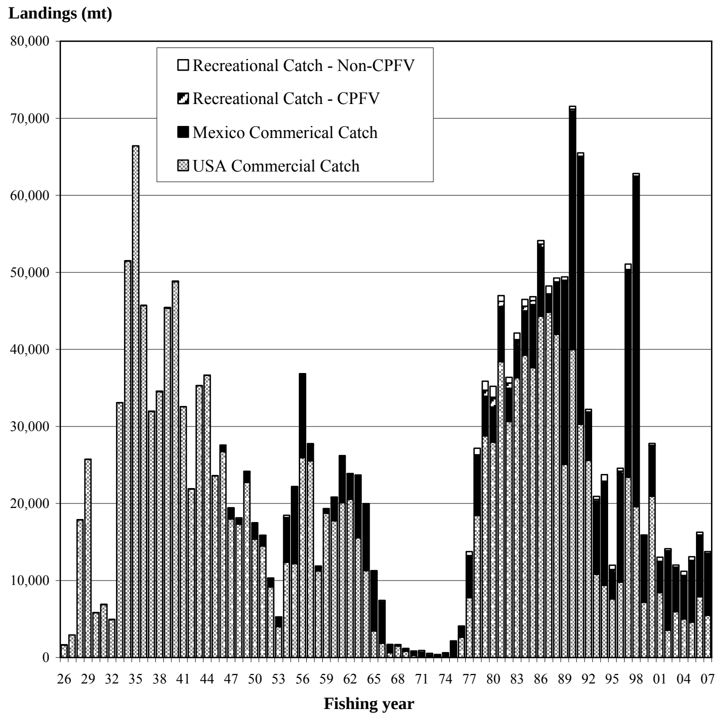
Pacific mackerel (*Scomber japonicus*), in the northeastern Pacific, range from southeastern Alaska to Banderas Bay (Puerto Vallarta), Mexico, including the Gulf of California. They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception, California. There are possibly three spawning stocks along the Pacific coasts of the U.S. and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California. The latter “northeastern Pacific” stock is harvested by fishers in the U.S. and Baja California, Mexico, and is considered in this assessment.

Catches

Catches in the assessment were a combination of U.S. and Mexico commercial catches and U.S. recreational catches. The Mexican commercial fishery for Pacific mackerel is primarily based in Ensenada and Magdalena Bay, Baja California. Most of the U.S. commercial catch is landed in southern California (Monterey and San Pedro). The Mexican purse seine fleet has slightly larger vessels, but is similar to southern California’s with respect to gear (mesh size) and fishing practice. Demand for Pacific mackerel in Baja California increased in the late 1940s. Mexican landings remained stable for several years, rose to 10,725 mt in 1956-57, then declined to a low of 100 tons in 1973-74. Catches were then negligible until the early 1980s. Pacific mackerel in Ensenada peaked twice, first in 1991-92 at 34,557 mt, and again in 1998-99 at 42,815 mt. The U.S. commercial landings peaked in 1935-36 (66,400 mt) and in 1990-91(39,974 mt), and were the lowest from 1970 to 1976, during the moratorium imposed by the State of California. The Ensenada fishery has been comparable in volume to the southern California fishery since 1990.

Table of catches (1992-2007).

Fishing Season	USA -Commercial Catch (mt)	Mexico-Commercial Catch (mt)	Recreational - CPFV Catch (mt)	Recreational - non-CPFV Catch (mt)	Total Catch (mt)
92	25,584	6,170	135	329	32,217
93	10,787	9,524	196	413	20,920
94	9,372	13,302	226	837	23,737
95	7,615	3,368	439	574	11,996
96	9,788	14,089	320	366	24,563
97	23,413	26,860	104	700	51,076
98	19,578	42,815	108	322	62,823
99	7,170	8,587	55	97	15,910
00	20,936	6,530	78	248	27,792
01	8,436	4,003	51	520	13,010
02	3,541	10,328	22	232	14,123
03	5,972	5,728	28	295	12,023
04	5,012	5,624	23	537	11,195
05	4,572	8,024	20	475	13,091
06	7,870	8,024	16	355	16,265
07	5,483	8,024	18	218	13,743



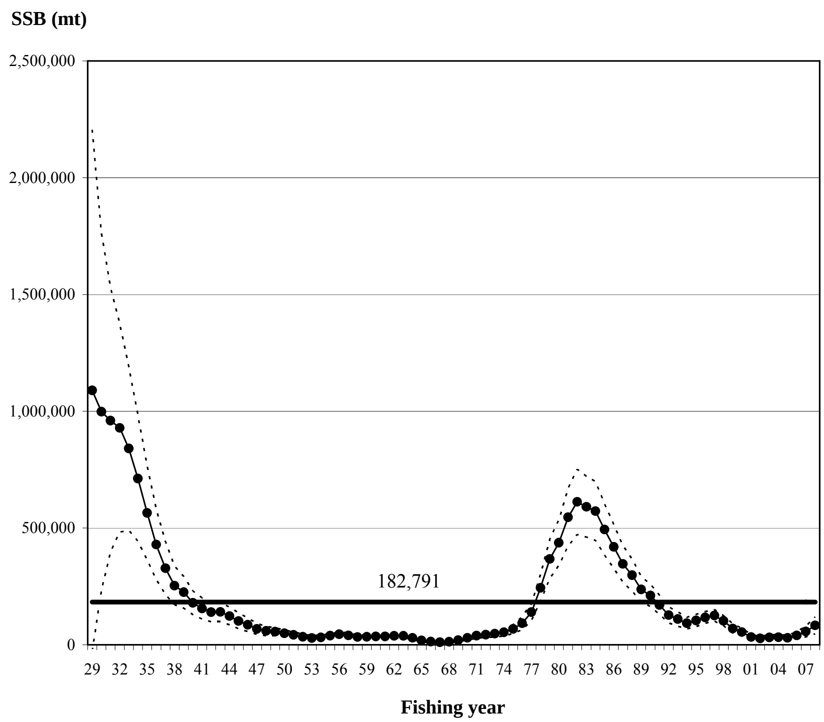
Plot of commercial and recreational landings (mt) of Pacific mackerel in California (USA) and Baja California (Mexico) used in the ASAP-E1 2008 model (1926-08).

Data and assessment:
The last assessment of Pacific mackerel was completed in 2007 for U.S. management in the 2007-08 fishing year. The current assessment is an update based on the Age-Structured-Assessment Program (ASAP)-E1 2007 model recommended by the 2007 Stock Assessment Review (STAR) Panel (La Jolla, May 2007). The assessment includes: catch data (1926-2007); Aerial spotter survey index data (1963-2001); California Passenger Fisheries Vessels (CPFV) recreational CPUE (1935-2007) index data; and California Cooperatives Fisheries Investigations (CalCOFI) larval production at hatching (1951-2006) index data. The final model integrates these data into the ASAP (V.1.3.2), and in this assessment we label this model, "ASAP-E1 2008 model."

Unresolved Problems and Uncertainties:
The assessment suffers from a lack of biological and relative abundance data from Mexico. In particular, there is currently no true fishery-independent index of relative abundance for the whole stock. The 2007 STAR Panels (May and September, La Jolla,) recommended that future stock assessments continue to examine the possibility of using Stock Synthesis2 (SS2) as an alternative to the ASAP platform. Although SS2 and ASAP lead to similar outcomes when configured in a similar manner, SS2 deals better with indices that are not tied to a fishery, can include age-reading error, and allows weight-at-age in the catch to differ from weight-at-age in the population.

Spawning Stock Biomass

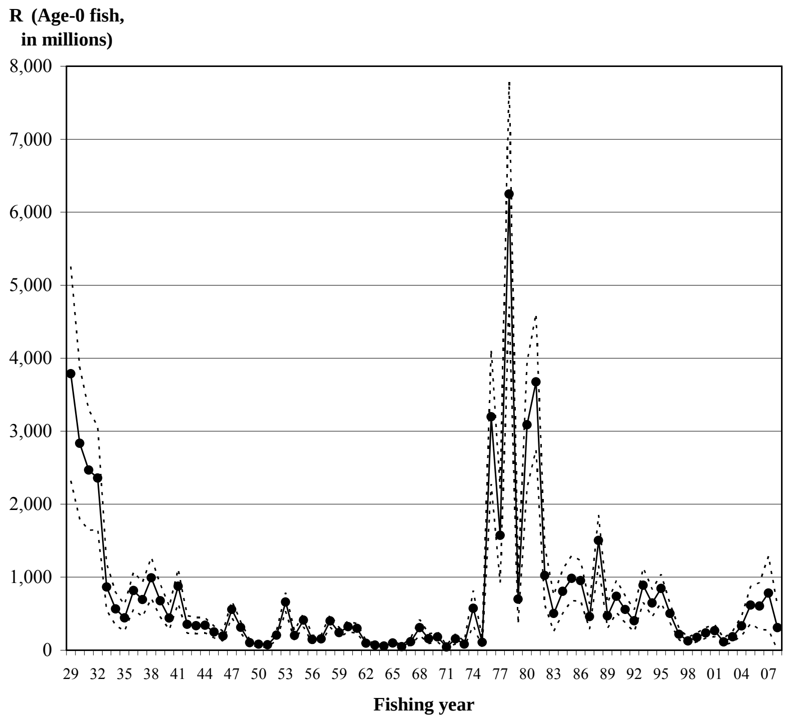
After a period of low abundance (1940-1977) spawning stock biomass (*SSB*) increased in the late 1970s reaching a peak of 611,964 mt in 1982. Since 1982 *SSB* has declined, reaching an estimate of 83,183 mt in 2008. A table of *SSB* estimated in the last 10 years is presented on page 6.



Plot of Pacific mackerel *SSB* (mt) estimated from the ASAP-E1 2008 model (1929-08). The confidence interval (± 2 STD) associated with this time series is also presented. Estimated 'virgin' *SSB* from stock-recruitment relationship is presented as bold horizontal line.

Recruitment

Recruitment was modeled following a standard Beverton & Holt stock-recruit relationship. Steepness was estimated to be 0.32 and Sigma-R (σ_R) was fixed to 0.7. Predicted recruits in the model showed large year classes in 1976, 1978, 1980 and 1981, but low level of recruitment throughout the 1990s and the early 2000s. The number of recruits estimated by the model is presented on page 6.



Plot of Pacific mackerel recruitment (age-0 fish in millions, R) estimated from the ASAP-E1 2008 model (1929-08). The confidence interval (± 2 STD) associated with this time series is also presented.

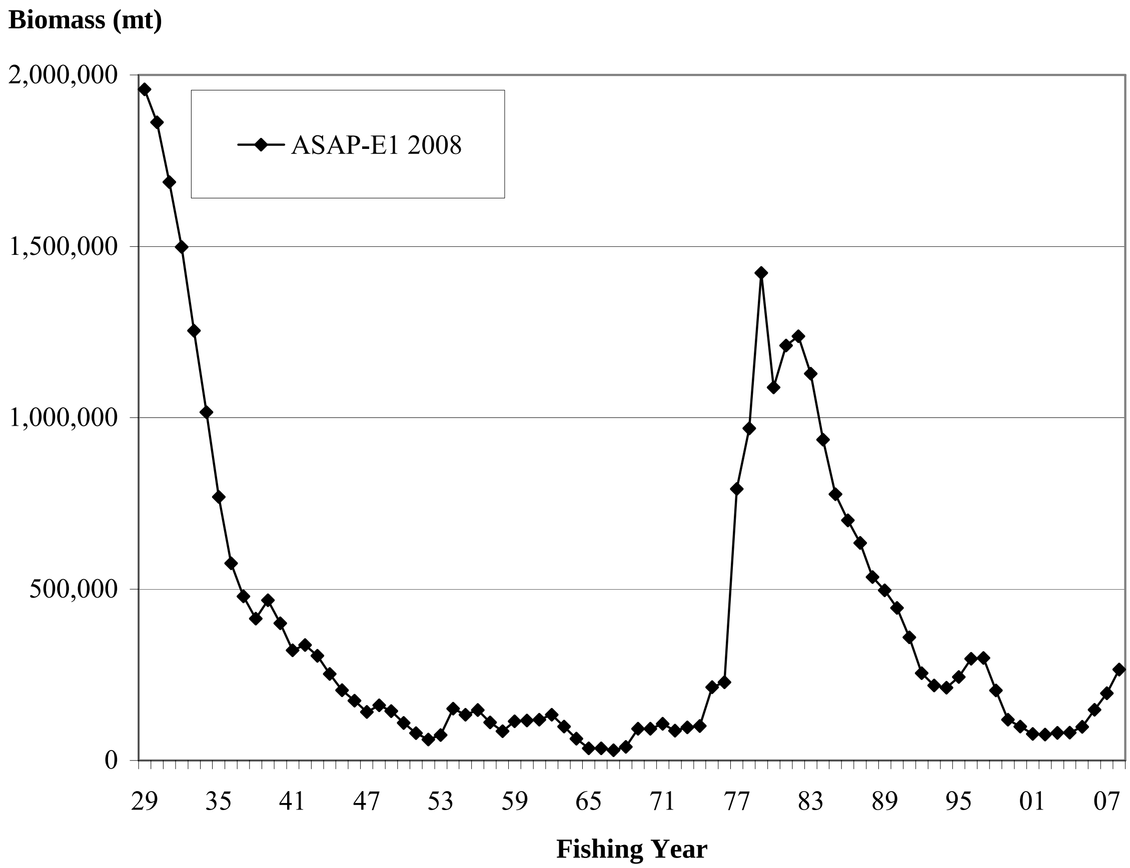
Management performance

Since 2000, Pacific mackerel has been managed based on a Federal Fishery Management Plan (FMP) harvest policy, stipulating that maximum sustainable yield (MSY) control rule for this species should be set to a Harvest Guideline (HG):

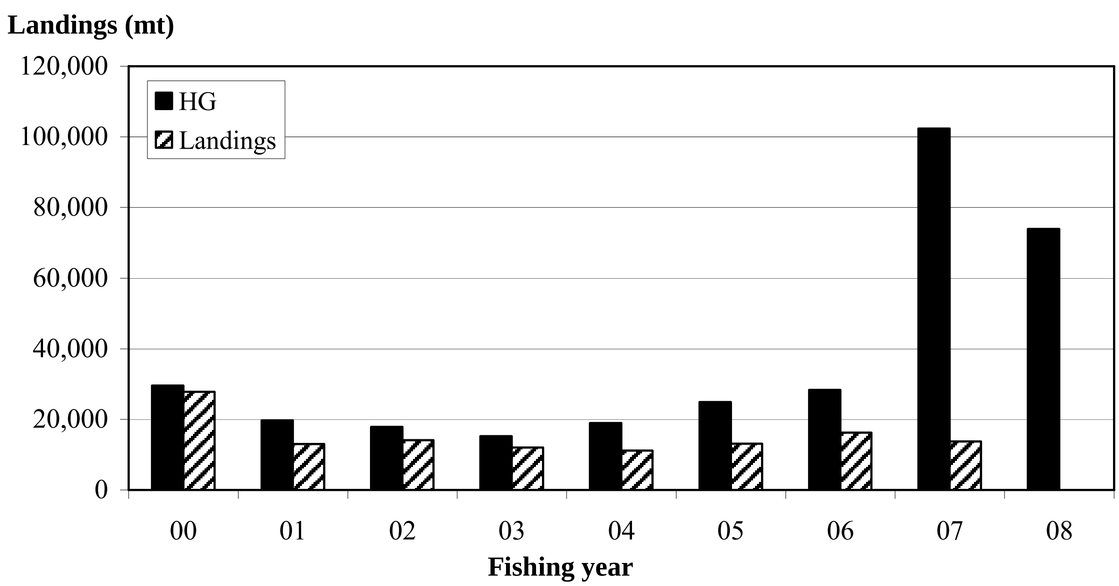
HARVEST = (BIOMASS-CUTOFF) x FRACTION x STOCK DISTRIBUTION,

where HARVEST is the HG, CUTOFF (18,200 mt) is the lowest level of estimated biomass (*B*) at which harvest is allowed, FRACTION (30%) is the fraction of biomass above CUTOFF that can be taken by fisheries, and STOCK DISTRIBUTION (70%) is the average fraction of total BIOMASS (Ages 1+) assumed in U.S. waters (PFMC 1998). Harvest guidelines under the federal FMP are applied to a July-June fishing year.

Age 1+ biomass was low from the late 1940s to the early 1970s, reaching a peak in 1982, and since then generally declined yielding 264,732 mt in 2008. However, landings of Pacific mackerel have been consistently below the HGs since 2001.



Plot of Age-1+ fish *B* (mt) of Pacific mackerel based on population biomass estimated from the ASAP-E1 2008 model (1929-08).



Total landings (mt) and Harvest Guidelines (HG) for Pacific mackerel based on no 'U.S. Distribution' parameter in the harvest control rule (*B*, 2000-08 Fishing years).

Table of estimated recruitment, Age 1+ biomass and spawning stock biomass (1998-2008).

Fishing Year	Recruits (Age-0)	Biomass (Age-1+)	SSB
98	124,650	203,657	102,820
99	175,250	119,155	69,737
00	235,520	98,641	54,266
01	265,960	76,872	32,721
02	113,010	75,701	27,250
03	183,750	79,973	31,670
04	331,430	81,406	32,063
05	615,780	97,727	29,420
06	603,760	147,833	40,167
07	781,550	195,806	56,688
08	307,250	264,732	83,183

Harvest Guideline for the 2008-09 Fishing Season

Biomass (Age-1+)	Cutoff (mt)	Fraction	Distribution	2008-09 Harvest Guideline (mt)
264,732	18,200	30%	70%	51,772

INTRODUCTION

Background

A Pacific mackerel (*Scomber japonicus*) stock assessment is conducted annually in support of the Pacific Fishery Management Council (PFMC) process, which ultimately establishes a harvest guideline (HG) or Optimal Yield (OY) for the Pacific mackerel fishery that operates off the U.S. Pacific coast. The HG for mackerel applies to a fishing year (management season) that begins in July 1st and ends on June 30th of the subsequent year. The main goal of the assessment is to provide an estimate of current abundance (in biomass), which is used in a harvest control rule for calculation of annual-based HGs. For details regarding Pacific mackerel' harvest control rule, see Amendment 8 of the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP), section 4.0 (PFMC 1998).

The last assessment was completed in June 2007, setting an HG of 71,629 mt for the 2007-08 fishing year. However, as a precautionary measure the PFMC concurred with recommendations from the Coastal Pacific Species Management Team (CPSMT), and the Coastal Pacific Species Advisory SubPanel (CPSAS) to set an OY of 40,000 mt for the 2007-08 fishing year. The 2007-08 HG was based on biomass estimated from the ASAP-E1 model that was reviewed and recommended by the May 2007 STAR Panel (La Jolla, CA). This panel also reviewed several Stock Synthesis2 (SS2) model runs, but could not identify an acceptable SS2 model configuration (see STAR Panel report, May 2007). Thus, the STAR Panel recommended that future stock assessments continue to examine the possibility of using SS2 as an alternative to the ASAP platform, and proposed an SS2 methodology review in September 2007. Additional SS2 model runs were examined during the September 2007 STAR Panel in La Jolla, CA; but again the Panel was unable to identify an acceptable base model using SS2. The STAR Panel agreed that SS2 is an appropriate model for the assessment of Pacific mackerel, but further investigations were needed to determine a reliable and stable model configuration (see STAR Panel Report, September 2007).

The 2008-09 stock assessment presented here is an update based on the ASAP-E1 model that was reviewed in May 2007 (STAR Panel, La Jolla) and presented to the PFMC in June 2007 (Dorval et al. 2007). This updated assessment includes updated landings data (1929-06) and an additional year of data (2007) collected from ongoing fishery-dependent sampling programs conducted by the the California Department of Fish and Game (CDFG). Also, prior to adding updated catch and biological data, CDFG made minor updates to the California Commercial Passenger Fishing Vessel (CPFV) time series data, but those changes had no significant effect on the overall trajectory of this index. No new data were added to the aerial spotter index and to the CalCOFI larval production index, thus these input data are similar to the time series used in the 2007 assessment. Model parameterization replicates the ASAP-E1 2007 model, but we also conducted sensitivity analysis showing the performance of the model with and without the updated data stream. In this context we present an updated assessment that follows the "2007 CPS Term of Reference" for off year (i.e., years in which no STAR Panel is conducted). Readers interested in further details regarding the sample data and model parameterization used in this assessment should consult Dorval et al. (2007). Finally, electronic versions of model programs, input data, and displays (Table and Figures) can be obtained from the authors directly.

Distribution and Stock structure

Pacific mackerel, *Scomber japonicus* (a.k.a. ‘chub mackerel’ or ‘blue mackerel’) in the northeastern Pacific range from southeastern Alaska to Banderas Bay (Puerto Vallarta), Mexico, including the Gulf of California (Hart 1973). They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception, California. Pacific mackerel usually occur within 30 km of shore, but have been captured as far as 400 km offshore (Fitch 1969; Frey 1971; Allen et al. 1990; MBC 1987).

There are possibly three spawning stocks along the Pacific coasts of the U.S. and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California (Collette and Nauen 1983; Allen et al. 1990; MBC 1987). The latter “northeastern Pacific” stock is harvested by fishers in the U.S. and Baja California, Mexico, and is considered in this assessment.

The PFMC manages the northeastern Pacific stock as a single unit, with no area- or sector-specific allocations. The PFMC’s harvest control rule does, however, prorate the seasonal HG by a 70% portion assumed to reside in U.S. waters (PFMC 1998).

Fisheries

Pacific mackerel are currently harvested by three fisheries: the California commercial fishery, a sport fishery based primarily in southern California, and the Mexican commercial fishery based in Ensenada and Magdalena Bay, Baja California. In the commercial fisheries, Pacific mackerel are landed by the same boats that catch Pacific sardine, anchovy, jack mackerel, and market squid. There is no directed fishery for mackerel in Oregon or Washington, however, small amounts (100-300 $mt \cdot yr^{-1}$) are taken by whiting trawlers and salmon trollers. Pacific northwest catch peaked at 1,800 mt following the major El Niño event of 1997-98.

ASSESSMENT

Biological Data

Weight-at-age

A year-specific weight-at-age matrix based on fishery samples was developed for use in the ASAP-E1 model. As in the 2007 assessment this matrix was used to calculate spawning stock biomass (*SSB*) and Age 1+ biomass (*B*) from modeled population estimates. Weight-at-age data were updated for the years 2006 and 2007. While it is possible that the population weight-at-age of Pacific mackerel differs from that derived from fishery samples, fishery-independent data do not exist to explore this question. We assumed that fish that occur in the fisheries and in the overall population had similar growth.

Maturity Schedule

As in the 2007 assessment, normalized net fecundity-at-age (fraction mature x spawning frequency x batch fecundity) was used to interpret CalCOFI ichthyoplankton data and calculate *SSB*. Fraction mature was estimated by fitting a logistic regression model to age and fraction mature data in Dickerson et al. (1992). Spawning frequency was estimated by fitting a straight line to age and spawning frequency data from the same study. Following Dickerson et al. (1992), batch fecundity per gram of female body weight was assumed constant.

Natural Mortality

As in the 2007 assessment, natural mortality rate (*M*) was assumed to be constant, 0.5 yr^{-1} for both sexes across all ages (0-8+) and years (1929-08). We refer readers to Dorval et al. (2007) for a review of method applied to derive mortality rate level used in this assessment.

Fishery Data

Landings

The assessment uses commercial and recreational landings in California and commercial landings in Baja California from 1926-27 through 2007-08. Landings were aggregated on a fishing year basis, and the updated time series data are presented in Figure 1. Landings for March-June 2008 were substituted with corresponding months from 2007.

Catch-at-age

As in the 2007 assessment, various sources were used to reconstruct a catch-at-age time series for Pacific mackerel (Dorval et al. 2007). Age compositions were estimated by using the proportions-at-age and average weights-at-age to calculate tonnage per age group. Tons per age was converted to numbers-at-age using average fish weights for each biological year.

Catch-at-age data (in proportion) compiled for the ASAP-E1 2008 model input are displayed in Figure 2. For years where age sampling was carried out (i.e. 1929-30 to

2007-08), an effective sample size (λ) of 45 was used, as in the 2007 assessment. Effective sample size was set to zero for cases with landings but no samples (i.e., 2008-09).

Indices of Relative Abundance

As in the 2007 assessment, survey data of relative abundance used in the ASAP-E1 2008 model include: 1) an aerial sightings by spotter pilots; 2) a larval production at hatching (P_h) from the CalCOFI program; and 3) a standardized, catch-per-unit-effort (CPUE) index developed from the CPFV logbooks (Figure 3).

In this assessment, the spotter index covers the fishing period 1962-63 through 2001-02 and is standardized using a Delta-GLM model as in the 2007 assessment (Dorval et al. 2007). Although data from 2004 through 2006 were available, the 2007 STAR Panel recommended that these data be dropped from the assessment. Therefore, data inputs for the spotter index are similar to inputs used in the 2007 assessment. Further, in 2007 no Pacific mackerel larvae were collected during the CalCOFI survey, consequently the Ph index could not be updated, and this assessment uses the same data inputs as derived in the 2007 assessment (Dorval et al. 2007).

Only the CPFV logbooks data were updated, including minor changes in the 1935-06 time series and new data collected in 2007. The new index was standardized using a Delta-GLM, following the same statistical procedures as in the 2007 assessment (Dorval et al. 2007). Figure 4 compares the 2007 and 2008 CPFV index developed using the Delta-GLM method, and shows that the changes made by CDFG had little effect on the overall trajectory of the index.

As in previous assessments, selectivity for the Spotter, CPFV and CalCOFI indices were fixed outside of the ASAP-E1 2008 model. Figure 5 presents selectivity curves assumed for each index, with time varying selectivity for the CPFV CPUE index.

Survey data for Pacific mackerel vary in quality over space and time, but no single index is proposed to be superior with respect to comprehensiveness or sampling design. Strengths and weaknesses of each survey was thoroughly addressed during the 2007 STAR (May 2007 STAR Panel Report).

ASAP-E1 2008 Model

The ASAP model (Legault and Restrepo 1999) is based on the AD Model Builder (ADMB) software environment, a high-level programming language that utilizes C^{++} libraries for nonlinear optimization (Otter Research 2001). The general estimation approach used in the ASAP is that of a flexible forward-simulation that allows for the efficient and reliable estimation of a large number of parameters. The population dynamics and statistical principles of ASAP are well established and date back to Fournier and Archibald (1982) and Deriso et al. (1985).

The ASAP-E1 2008 model is parameterized similarly to the ASAP-E1 2007 model recommended by the May 2007 STAR Panel. Only the catch, biological, and the CPFV data differ:

- Updated landing time series with additional year (i.e, 2007) of catch, catch-at-age, and weight-at-age data;
- Plus group for age data , 8+ years;
- Effective sample size for age comps iteratively adjusted to 45;
- Fishery selectivity estimated for three time blocks: 1929-69; 1970-77; 1978-08;
- Aerial spotter index, larval production index and updated CPFV index methods were included, with inverse-weighting of observations based on model CVs;
- Survey timings based on fishing year (July 1- June 30);
- Sigma-R for the spawner-recruit model was fixed to 0.7;
- As in the 2007 assessment, ASAP version 1.3.2 (compiled 14 September 2004) was used for all runs presented in this paper.

Results

Catch

The ASAP-E1 2008 model fit to catch data is displayed in Figure 6. The observed and predicted time series essentially overlay each other, indicating precise fit to this data source.

Catch-at-age

Effective sample size for the California catch-at-age data was iteratively adjusted and ultimately set to λ=45 for all years in the input data. Figure 7 presents estimates of Effective sample size from the ASAP-E1 2008 model. Further, Pearson residuals for the catch-at-age fits are displayed in Figure 8. Residual patterns were random, with no obvious trends over age or time. Catch-at-age proportions contributed to 44.8% of the total model likelihood (Table 2).

Fits to Indices

Model fits to the three indices of relative abundance are displayed in Figures 9-11. All three time series have peaks and lows during the same approximate periods of time, however, the magnitude of change for the Aerial Spotter and CalCOFI indices is far greater than that shown for the CPFV index. Index fits contributed to 45.6 % of the total model likelihood (Table 2).

Selectivity Estimates

Fishery selectivities (S_{age}) estimated for the three time blocks are displayed in Figure 12. Selectivities followed a dome-shaped pattern for the two periods of directed fishing (1929-1969 and 1978-2008), with the latter period selecting more fish of the youngest and oldest ages. This difference reflects changes in utilization among the two time periods; fishing primarily for canneries in the early period and a broader range of markets (including pet food) in the latter. During the moratorium (1970-1977), CPS seiners captured Pacific mackerel incidental to other CPS target species (esp. jack mackerel) and tended to be smaller and younger.

Fishing Mortality Rate

The fishing mortality multiplier (Fmult) is displayed in Figure 13, and fishing mortality-at-age is presented in Figure 14. Fmult increased steadily throughout the historic fishery, peaking at close to 0.7 by the mid-1960s. For the recent period, Fmult peaked at 0.62 in 1998 (an El Nino season) when the stock was relatively low but availability was high for the Ensenada fishery.

Spawning Stock Biomass

The time series of *SSB* is presented in Figure 15. *SSB* peaked at 611,964 mt in 1982, declining to 29, 420 mt in 2005 before increasing to the current level of 83,183 mt. B_0 is estimated to be 182,791 mt.

Recruitment

Recruitment time series (age-0 abundance) are displayed in Figure 16. The recruitment trend is closely similar in pattern to that of the 2007 assessment, with large year-classes occurring in 1976, 1978, 1980, and 1981.

Stock-Recruit Relationship

Fit to the stock-recruitment relationship is displayed in Figure 17. In general, estimated recruitment was constrained to a stock-recruitment relationship in the baseline model (Beverton-Holt model; Sigma-R= 0.7). Compensatory productivity ('steepness' parameter) of the population at low adult stock sizes was estimated to be h=0.32 – a very low value for small pelagic species, but similar in range to past assessments for this stock.

Biomass of Age 1+ stock for PFMC Management

Stock biomass (Age 1+) peaked at 1.42 million mt in 1979, declined to a low of about 75,701 mt in 2002, increasing again in the recent most years. While the trend in stock biomass was generally similar to past assessments, the magnitude increased due to changes in Sigma-R and higher estimates of recruitment throughout the time series (see 'Recruitment' and 2007 STAR Panel Report). Age 1+ biomass is projected to be 264,732 mt as of July 1, 2008.

Sensitivity Analyses to Last Year's Data

We performed sensitivity tests to investigate potential effects of updated data stream on parameter estimation and population abundance. In this section we present the results of these tests comparing results of four different model runs:

1) *ASAP-E1 2007 model* : similar input data and model parameterization (i.e., no updated data stream in the 2007 fishing year) as in the final ASAP model recommended by the 2007 STAR Panel.
2) *ASAP-E1a*: updated landings for the 2007 fishing year; no 2007 catch-at-age CPFV index estimates; same parameterization as in the ASAP-E1 2007 model.
3) *ASAP-E1b*: updated landing for 2007; updated catch-at-age for 2007; no 2007 CPFV index estimate; same parameterization as in the ASAP-E1 2007 model.

4) *ASAP-E1 2008 model*: all updated data streams were included; and same parameterization as in the 2007 model (see above).

Parameter estimation, spawning stock biomass and recruitment estimates for this model runs are summarized and compared in Table 1 and Figures 18-19.

Sensitivity Analyses to Years with CalCOFI Survey but no Larvae

We also performed a sentivity test to examine the effect of years where the CalCOFI survey was conducted, but no Pacific mackerel larvae were caught. In the ASAP-E1 model these years (i.e., 1964, 1967, 1968, 1975, 1990, 1999, 2000, 2002, 2004, 2007) were dropped from the CalCOFI larval production index. We performed this model run (ASAP-E1c) assuming that Ph for those years was equal to 0.015 (i.e., the lowest estimated value in the time series).

Parameter estimation, spawning stock biomass and recruitment estimates for this model run is also summarized in Table 1 and Figures 18-19.

Comparison of ASAP-E1 2008 Model Results to Previous Assessments

Age 1+ biomass and *SSB* estimated from the 2007 ASAP-E1 model and 2004 Virtual population model (VPA-ADEPT) are compared to 2008 ASAP-E1 2008 estimates in Figures 20 and 21.

HARVEST CONTROL RULE FOR U.S. MANAGEMENT IN 2008-09

In Amendment 8 to the CPS FMP (PFMC 1998), the recommended maximum sustainable yield (MSY) control rule for Pacific mackerel was:

HARVEST = (BIOMASS-CUTOFF) x FRACTION x DISTRIBUTION,

where HARVEST is the U.S. HG, CUTOFF (18,200 mt) is the lowest level of estimated biomass at which harvest is allowed, FRACTION (30%) is the fraction of biomass above CUTOFF that should be taken by all fisheries, and DISTRIBUTION (70%) is the average fraction of total BIOMASS assumed in U.S. waters. CUTOFF and FRACTION values applied in the PFMC’s harvest policy for mackerel are based on analyses published by MacCall et al. (1985). BIOMASS (264,732 mt) is the estimated biomass of fish age 1 and older for the whole stock projected for July 1, 2008. Based on this formula, the 2008-09 HG is estimated to be 51,772 mt. Figure 22 presents commercial landings, HGs, and OYs for Pacific mackerel from 1992 to 2007. The recommended HG for the 2008-09 fishing season is 27% lower than the 2007-08’ HG, but higher than the OY set by the PFMC for the 2007-08 fishing year and than the maximum yield since 1992-93.

RESEARCH AND DATA NEEDS

CDFG has sampled California's Pacific mackerel fishery for age composition and size-at-age for many decades, and the current stock assessment model incorporates a complete time series of landings and age composition data beginning in 1929. Ensenada landings have rivaled California's for the past decade, but the stock assessment does not include real biological data from the Mexican fishery. Mexican landings are included in the assessment, but must be pooled with the southern California catch. INP (Instituto Nacional de la Pesca)-Ensenada has collected biological samples (size, sex, otoliths) since 1989, but the data have not been available for U.S. stock assessments. There is an urgent need to establish a program of data exchange with Mexican scientists (INP) to fill this information gap. The MexUS-Pacifico (NMFS-INP) meetings are the most appropriate forum for such an exchange.

Weaknesses and strengths of the fishery-independent surveys used in this assessment are highlighted in the 2007 STAR Panel Reports. We summarize below (following bullets excerpted from the report) the most important recommendation of the 2007 Panels.

- Age-reading studies should be conducted to construct an age-reading error matrix for inclusion in future (SS2) assessments.

- The next assessment should continue to examine the possibility of using SS2 as the assessment platform. The analyses presented to the Panels in May and Sepetember suggested that ASAP and SS2 lead to similar outcomes when configured in a similar manner. However, SS2 deals better with indices that are not tied directly to a fishery, can include age-reading error, and allows weight-at-age in the catch to differ from weight-at-age in the population. In principle, it should be easier to represent uncertainty using the MCMC algorithm for assessments based on SS2. Further investigations should be undertaken in an attempt to identify an acceptable SS2 configuration that can form the basis of the 2009-10 harvest guideline

- The construction of the spotter plane index is based on the assumption that blocks are random within region (the data for each region is a “visit” by a spotter plane to a block in that region). The distribution of density-per-block should be plotted or a random effects model fitted in which block is nested within region to evaluate this assumption (e.g. examine whether certain blocks are consistently better or worse than the average).

- The CalCOFI data should be reviewed further to examine the extent to which CalCOFI indices for the Southern California Bight can be used to provide information on the abundance of the coastwide stock.

ACKNOWLEDGEMENTS

This updated stock assessment depends in large part on the diligent efforts of many colleagues and the timely receipt of their data products. Port samples and age data were provided by CDFG Marine Region personnel in Los Alamitos and Monterey, and special thanks go to Leeanne Laughlin, Valerie Taylor, Kelly O'Reilly, Travis Tanaka, Dianna Porzio, Sonia Torres, and Kimberley Pentilla for long dockside and laboratory hours. Wendy Dunlap (CDFG, Los Alamitos) supplied logbook data from California's CPFV logbook program. Ron Dotson, Amy Hays, and Sue Manion (NMFS, La Jolla) provided aerial spotter logbook data. Susan Jacobson (NMFS, La Jolla) extracted CalCOFI larval data. Numerous staff from SIO, NMFS, and CDFG assisted in the ongoing collection and identification of CalCOFI ichthyoplankton samples. We are grateful to Christopher Legault (NMFS, Woods Hole) for providing the ASAP model. Finally we thank André Punt (SSC), Thomas Helser (SSC), and the CPSMT for reviewing an earlier draft of this report.

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Table 1. List of estimated parameters.

Parameters	**Number**
log-sel_year1	9
log_sel_devs_vector:	18
log_Fmult_year1:	1
log_Fmult_devs:	79
log_recruit_devs:	80
log_N_year1_devs:	8
log_q_year1:	3
log_SRR_virgin:	1
SRR_steepness:	1
Total	**200**

Table 2. Comparison of likelihood function components for the ASAP-E1 2008, ASAP-E1a, ASAP-E1b, ASAP-E1c, and ASAP-E1 2007 model runs.

ASAP-E1 2008 Model Run

Component	*n*	*λ*	*RSS*	*L*	% of Total
Catch (weight) - fishery	80	100	0.02	2.36	0.2%
Catch-at-age (proportions) - fishery	720	na	na	530.93	44.8%
Fits - Survey indices					
Spotter	39	1	166.92	119.16	10.1%
CPFV	68	1	16.06	104.85	8.9%
CalCOFI	37	1	76.87	315.54	26.6%
All	144	3	259.85	539.55	45.6%
Recruitment (deviations)	80	1	57.65	57.65	4.9%
Stock-recruit fit	80	1	57.65	53.90	4.6%
F penalty	720	0.001	1.75	0.00	<1%
Number of estimated parameters (Total)	200	na	na	na	
Objective function (Total)	na	na	na	1184.38	100%

ASAP-E1a Model Run

Component	*n*	*λ*	*RSS*	*L*	% of Total
Catch (weight) - fishery	80	100	0.02298	2.298	0.2%
Catch-at-age (proportions) - fishery	720	see_below	na	523.466	44.7%
Fits - Survey indices					
Spotter	39	1	166.557	117.844	10.1%
CPFV	67	1	16.4706	101.298	8.6%
CalCOFI	37	1	76.7361	315.024	26.9%
All	143	3	259.7637	534.166	45.6%
Recruitment (deviations)	80	1	57.483	57.483	4.9%
Stock-recruit fit	80	1	57.483	53.6872	4.6%
F penalty	720	0.001	1.74535	0.001745	<1%
Number of estimated parameters (Total)	200	na	na	na	
Objective function (Total)	na	na	na	1171.1	100.0%

Table 2. cont.

ASAP-E1b Model Run					
Component	***n***	***λ***	***RSS***	***L***	**% of Total**
Catch (weight) - fishery	80	100	0.0230254	2.30254	0.2%
Catch-at-age (proportions) - fishery	720	see_below	na	528.326	44.9%
Fits - Survey indices					
Spotter	39	1	166.509	117.804	10.0%
CPFV	67	1	16.5177	101.799	8.7%
CalCOFI	37	1	76.578	314.643	26.7%
All	143	3	259.604	534.246	45.4%
Recruitment (deviations)	80	1	57.7466	57.7466	4.9%
Stock-recruit fit	80	1	57.7466	54.0177	4.6%
F penalty	720	0.001	1.73547	0.001735	<1%
Number of estimated parameters (Total)	200	na	na	na	
Objective function (Total)	na	na	na	1176.64	100.0%

ASAP-E1c Model Run					
Component	***n***	***λ***	***RSS***	***L***	**% of Total**
Catch (weight) - fishery	80	100	0.0311119	3.11119	0.2%
Catch-at-age (proportions) - fishery	720	see_below	na	532.796	40.3%
Fits - Survey indices					
Spotter	39	1	157.545	112.411	8.5%
CPFV	68	1	17.4904	114.048	8.6%
CalCOFI	47	1	164.818	445.81	33.7%
All	154	3	339.852	672.268	50.8%
Recruitment (deviations)	80	1	59.0798	59.0798	4.5%
Stock-recruit fit	80	1	59.0798	55.6894	4.2%
F penalty	720	0.001	1.3971	0.001397	<1%
Number of estimated parameters (Total)	200	na	na	na	
Objective function (Total)	na	na	na	1322.95	100.0%

Table 2. cont.

ASAP-E1 2007 Model Run					
Component	***n***	***λ***	***RSS***	***L***	**% of Total**
Catch (weight) - fishery	79	100	0.0200987	2.00987	0.2%
Catch-at-age (proportions) - fishery	711	see_below	N/A	524.626	39.7%
Fits - Survey indices					
Spotter	39	1	165.434	119.525	9.0%
CPFV	67	1	15.5464	107.834	8.2%
CalCOFI	37	1	78.0771	318.819	24.1%
All	143	3	259.057	546.179	41.3%
Recruitment (deviations)	79	1	58.803	58.803	4.4%
Stock-recruit fit	79	1	58.803	55.5721	4.2%
F penalty	711	0.001	1.9564	0.001956	<1%
Number of estimated parameters (Total)	198	na	na	na	
Objective function (Total)	na	na	na	1187.19	89.7%

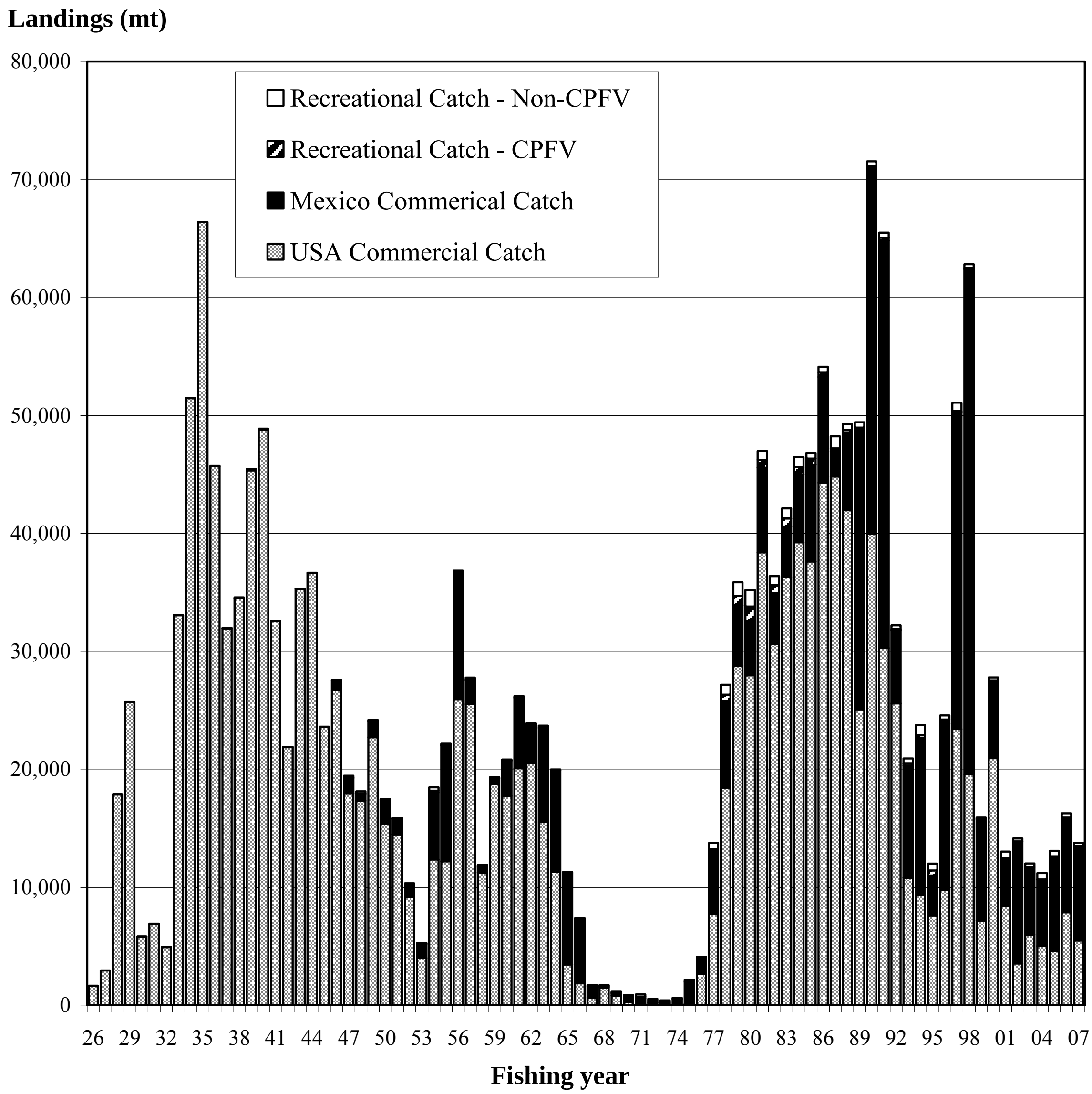

Figure 1. Commercial and recreational landings (mt) of Pacific mackerel in California (CA) and Baja California (MX) used in the ASAP-E1 2008 model (1926-08). See Fishery Data section for descriptions of fishing year.

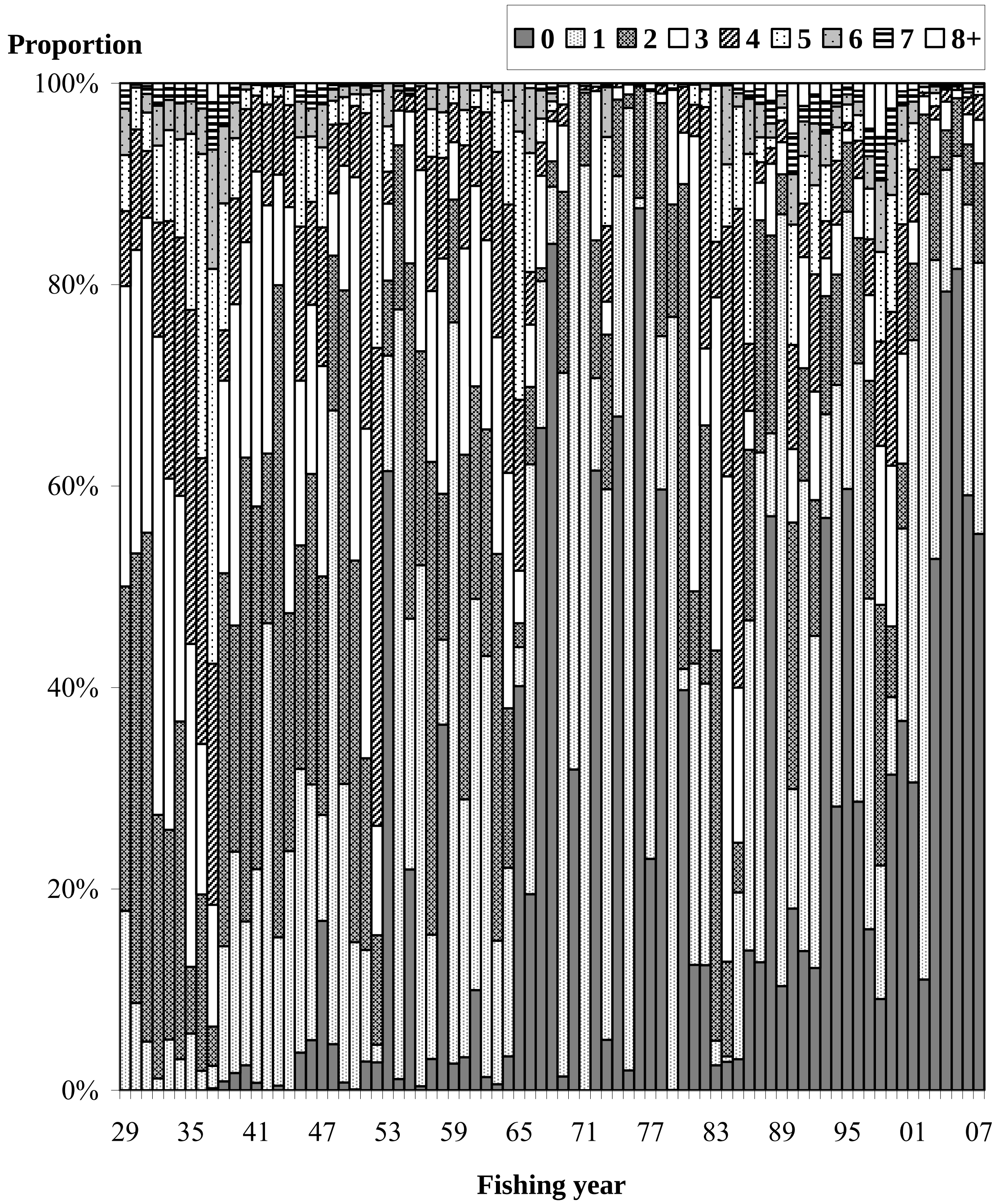

Figure 2. Pacific mackerel catch-at-age (in proportion) estimates used in the ASAP-E1 2008 model (1926-08).

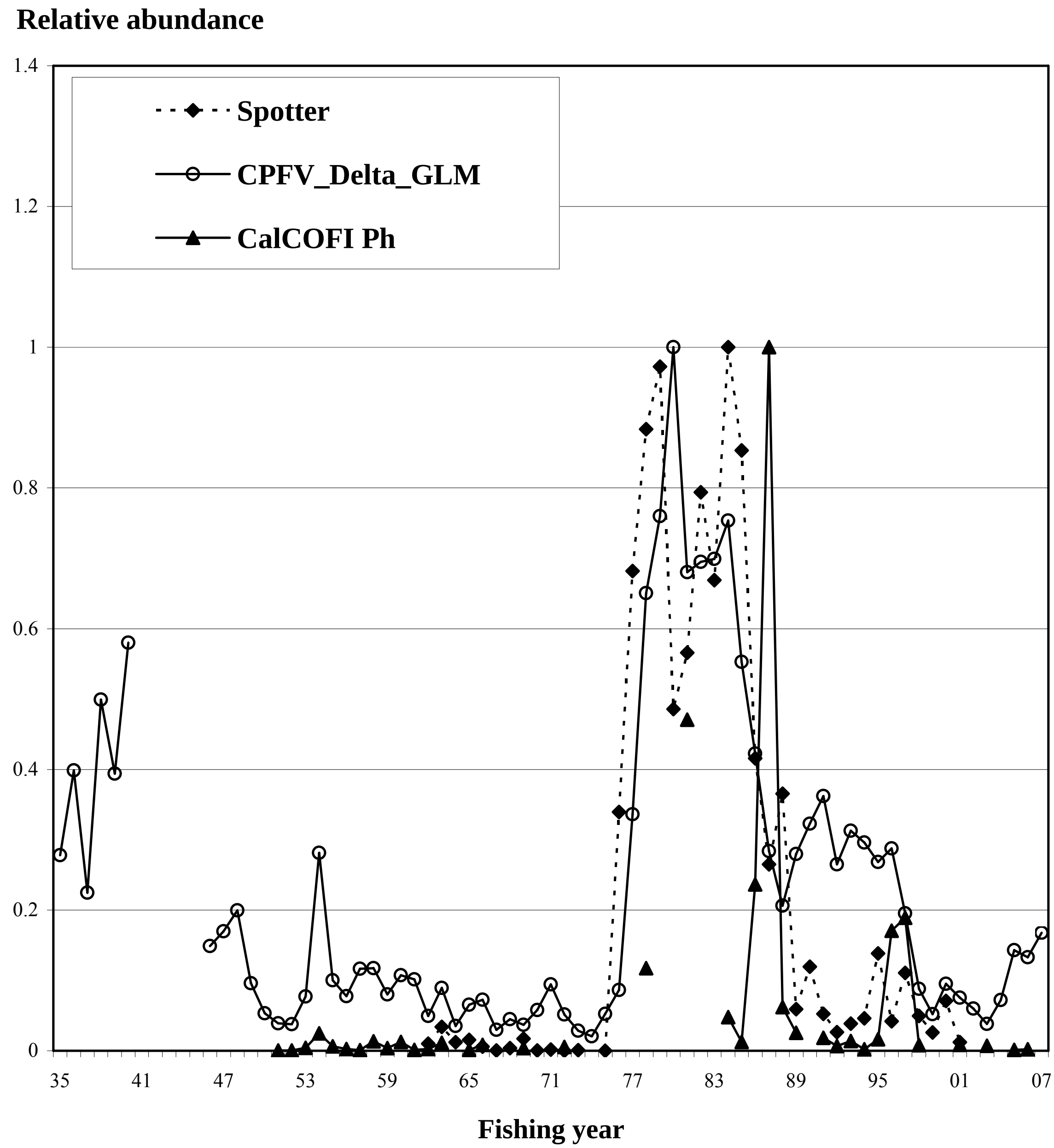

Figure 3. Indices of abundance time series for Pacific mackerel used in the ASAP-E1 2008 model (1926-08). Indices are rescaled (normalized) to a maximum of 1.

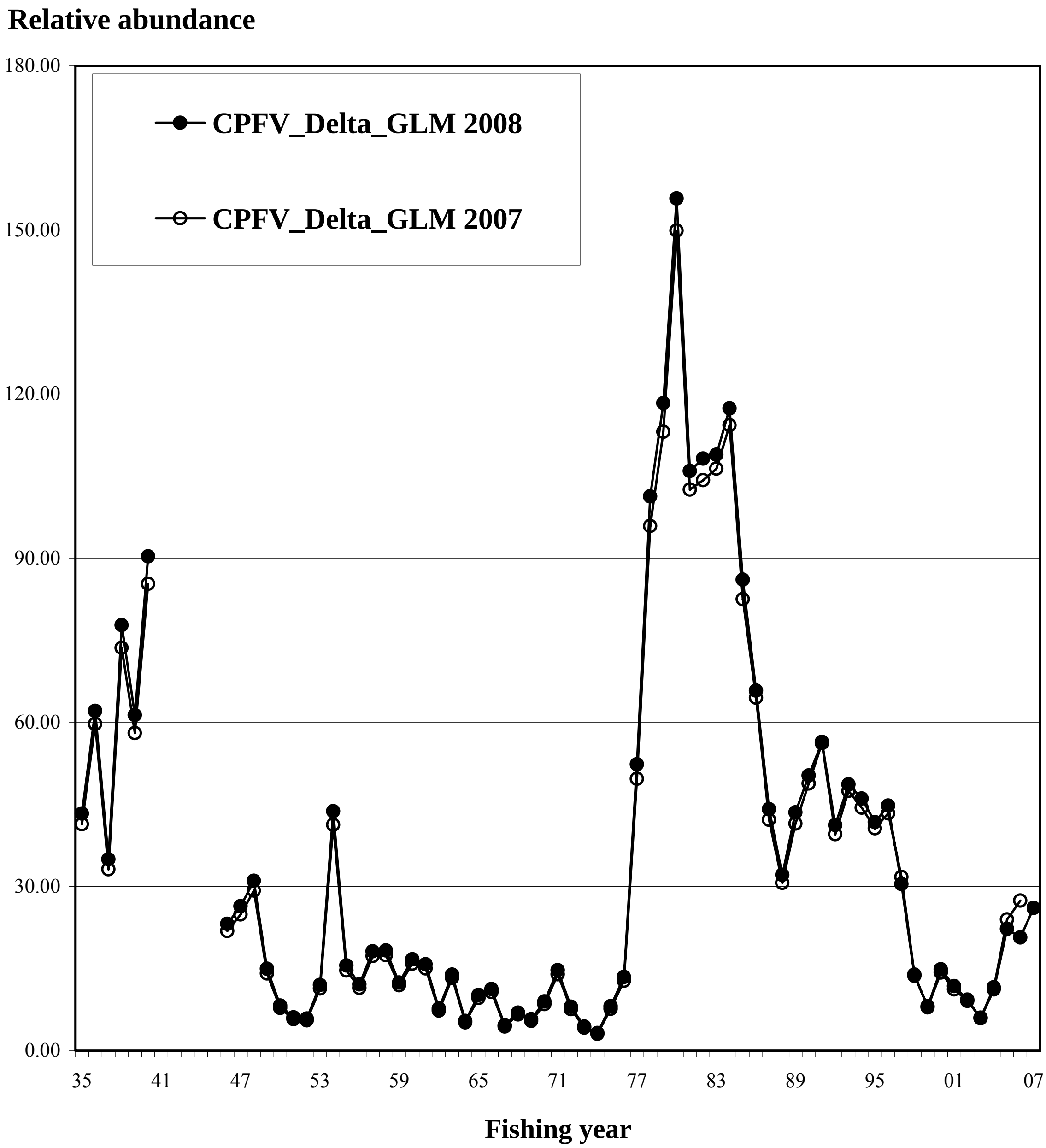

Figure 4. Indices of abundance time series for Pacific mackerel used in the ASAP-E1 and ASAP-E1 2008 models (1926-08) comparing GLM to Delta_GLM.

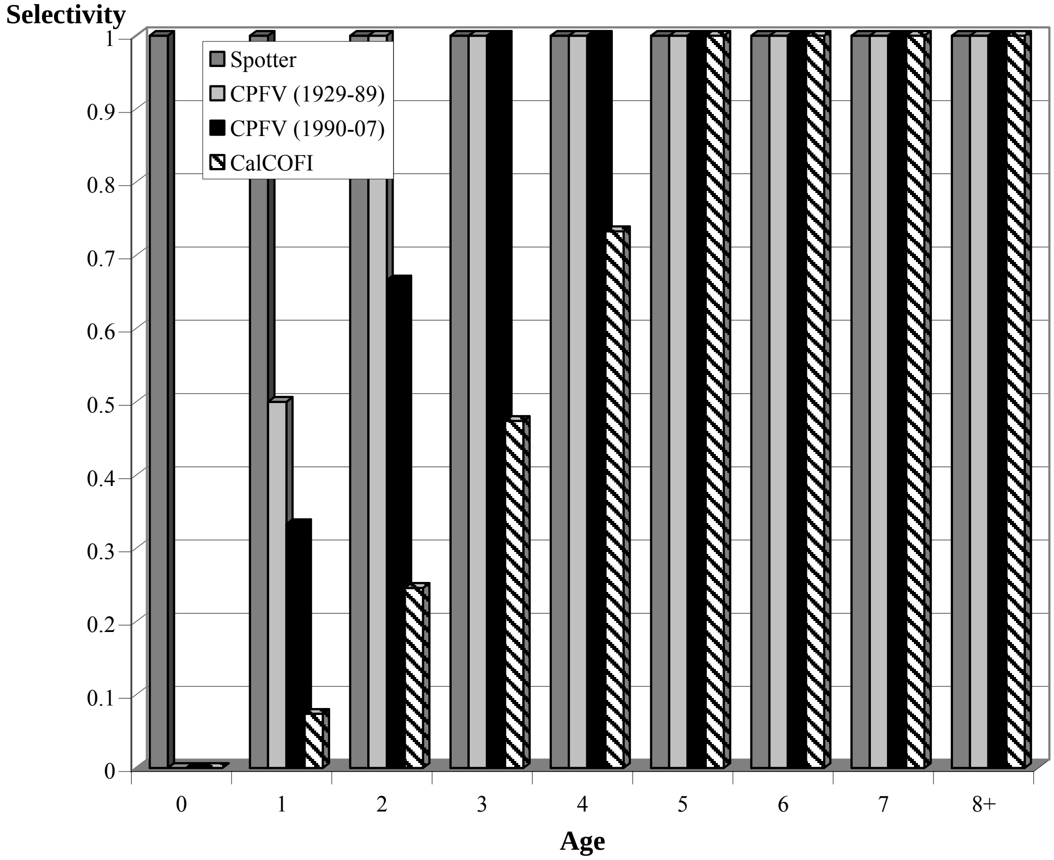

Figure 5. Assumed selectivity ogives for survey-related indices of abundance (Spotter, CPFV, and CalCOFI) from the ASAP-E1 2008 model (1926-08). Note that CPFV ogive represents (1990-07), with ogive for 1929-89 parameterized with slightly different probabilities for ages 1 and 2.

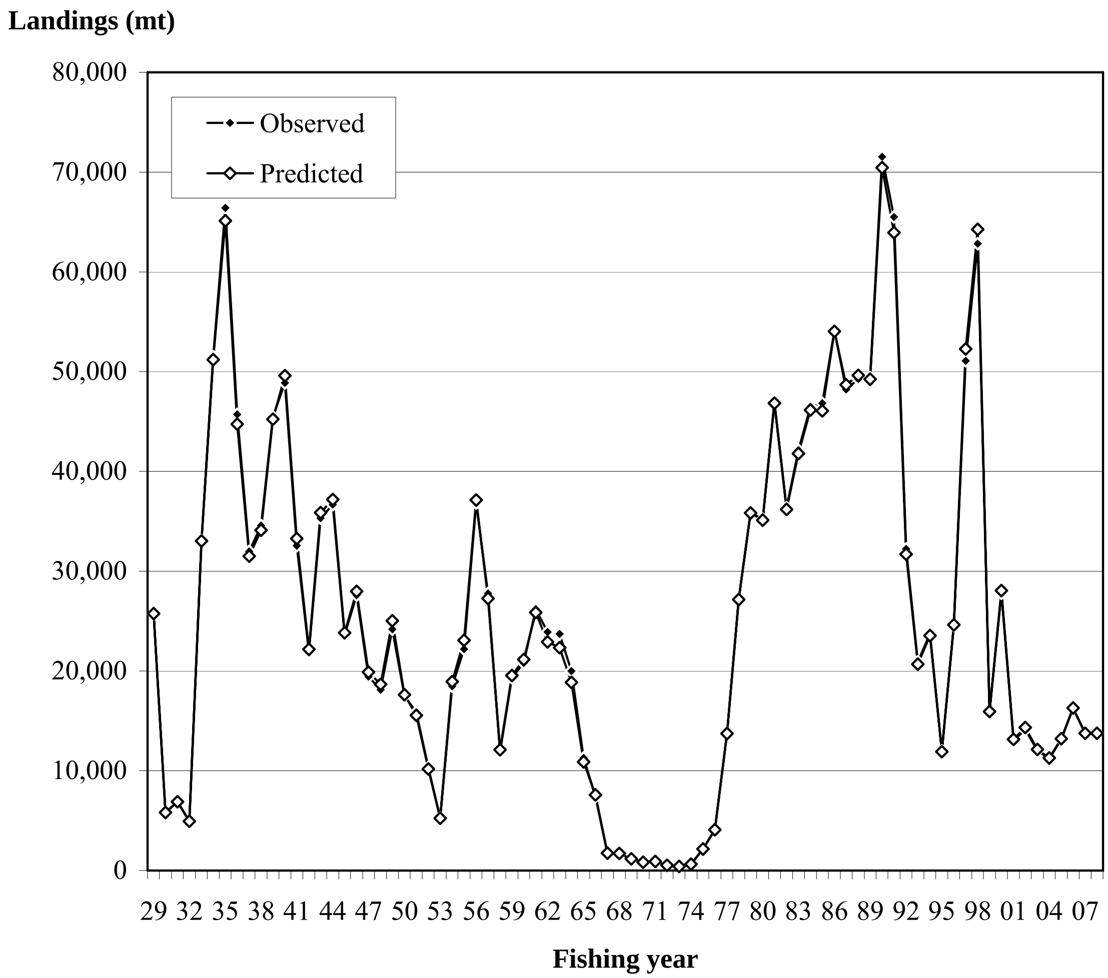

Figure 6. Observed and predicted estimates of total landings (mt) for Pacific mackerel generated from the ASAP-E1 2008 model (1929-08).

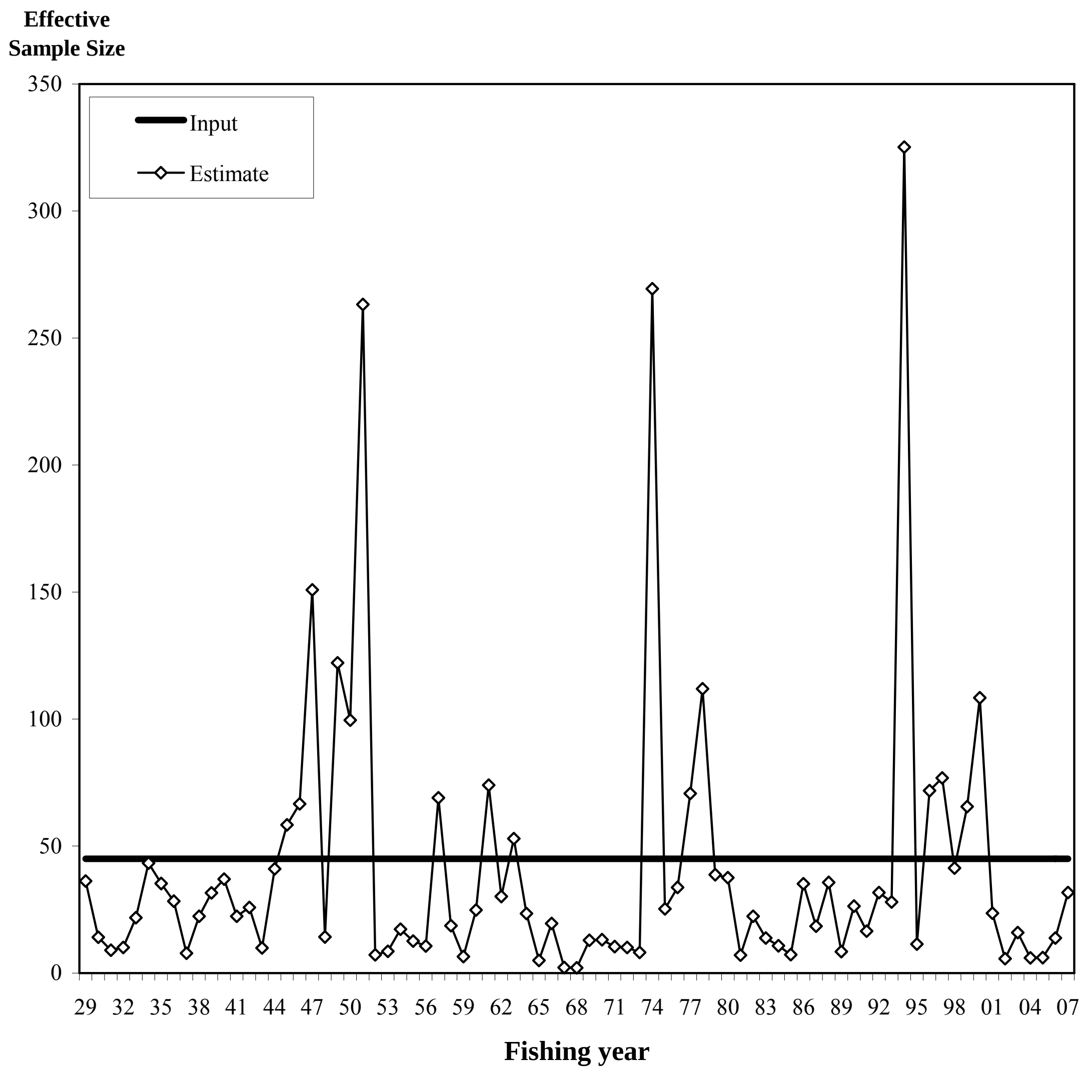

Figure 7. Effective sample sizes estimated for catch-at-age data generated from the ASAP-E1 2008 model (1929-08). Catch-at-age data were given a lamba weighting of '45' for all years.

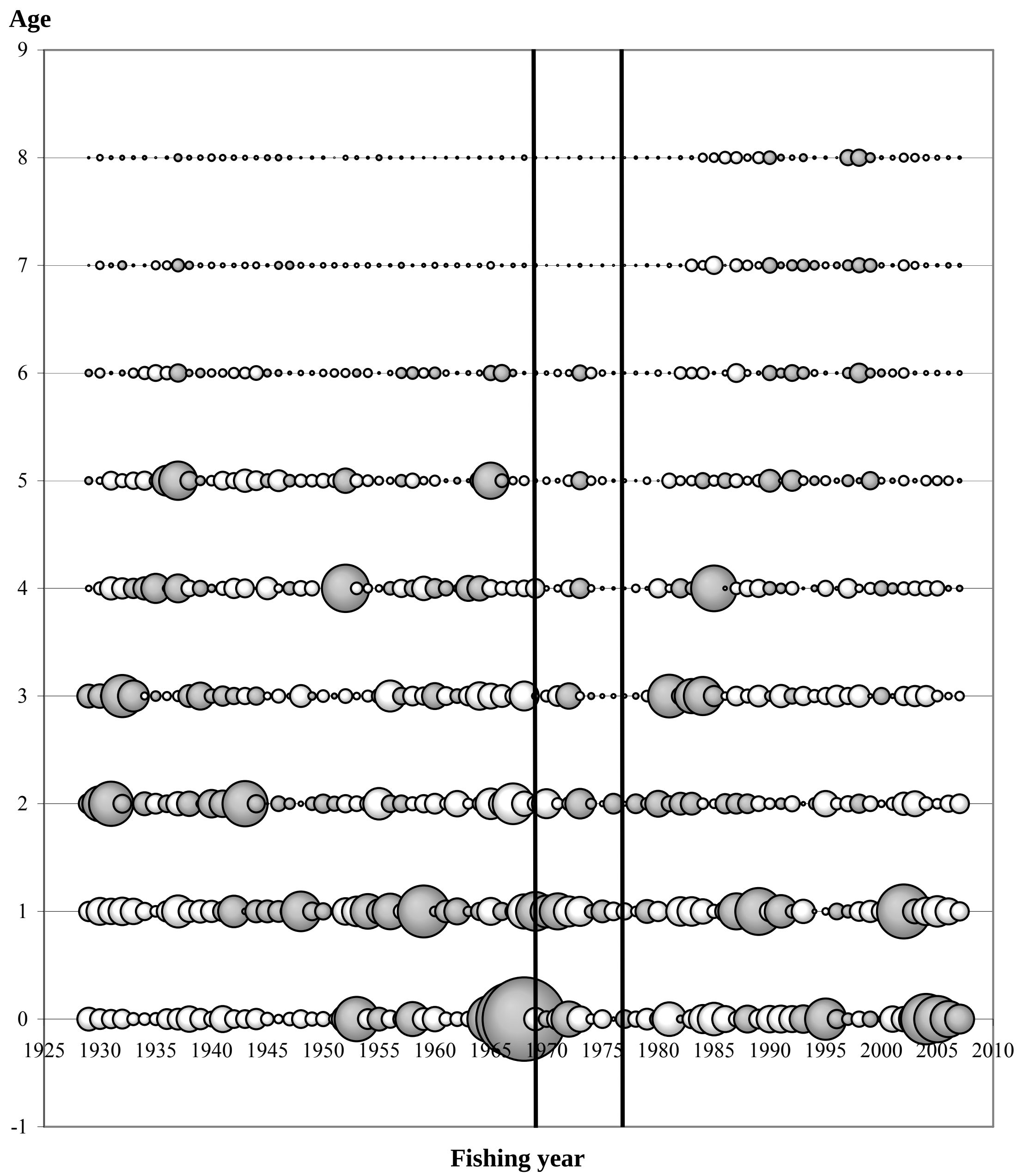

Figure 8. Pearson residual plot for Pacific mackerel catch-at-age fitted to the ASAP-E1 2008 model (1929-08). Dark gray bubbles indicate positive values and white bubbles indicated negative values. Vertical black lines represent periods of major change in fishery selectivity (1929-69, 1970-77, and 1978-07).

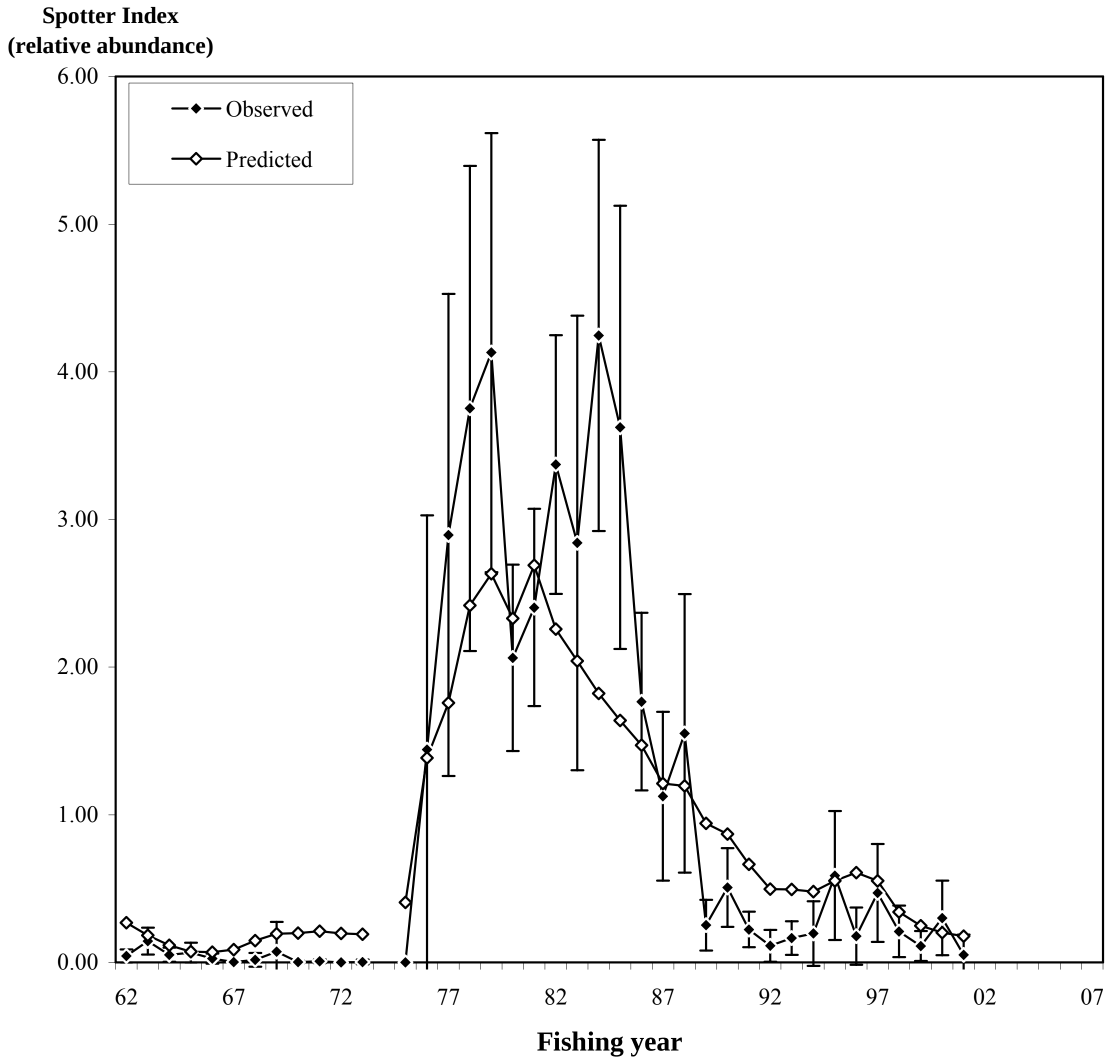

Figure 9. Observed and predicted estimates of the Spotter index of relative abundance for Pacific mackerel generated from the ASAP-E1 2008 model (1962-01). *Note: Observed values were internally re-scaled by ASAP.

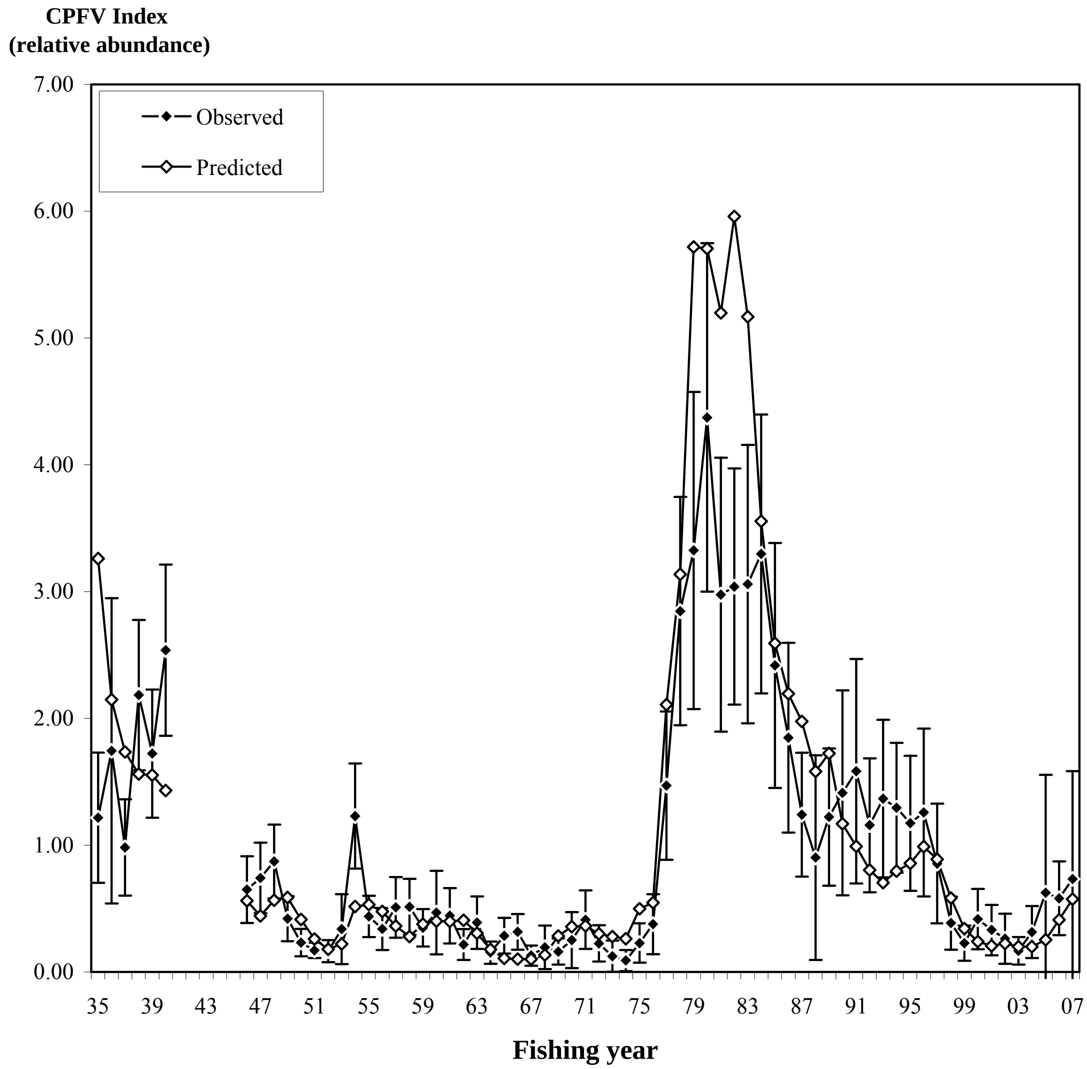

Figure 10. Observed and predicted estimates of the CPFV index of relative abundance for Pacific mackerel generated from the ASAP-E1 2008 model (1935-07). *Note: Observed values were internally re-scaled by ASAP.

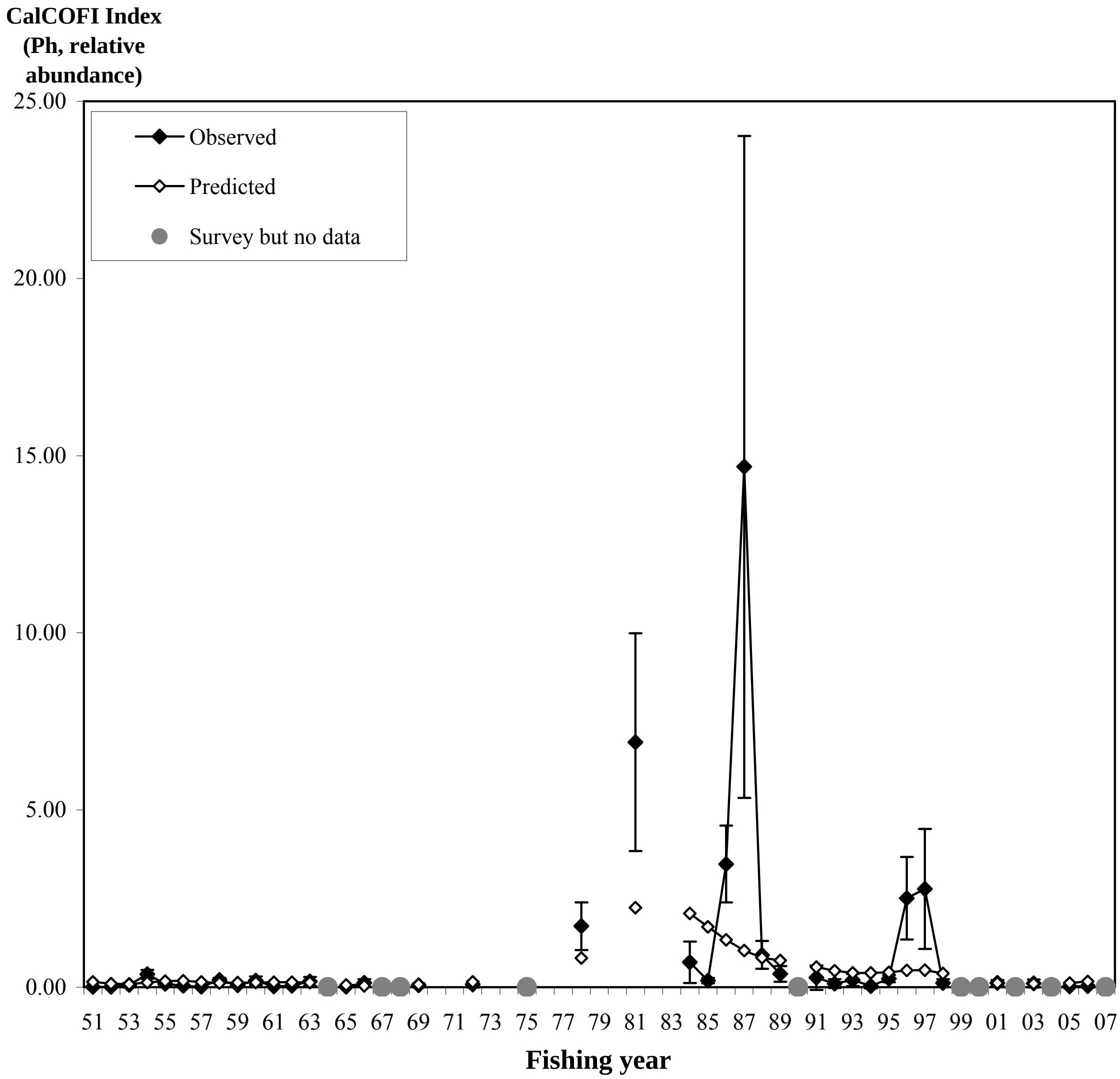

Figure 11. Observed and predicted estimates of the CalCOFI index of relative abundance for Pacific mackerel generated from the ASAP-E1 2008 model (1951-06). *Note: Observed values were internally re-scaled by ASAP.

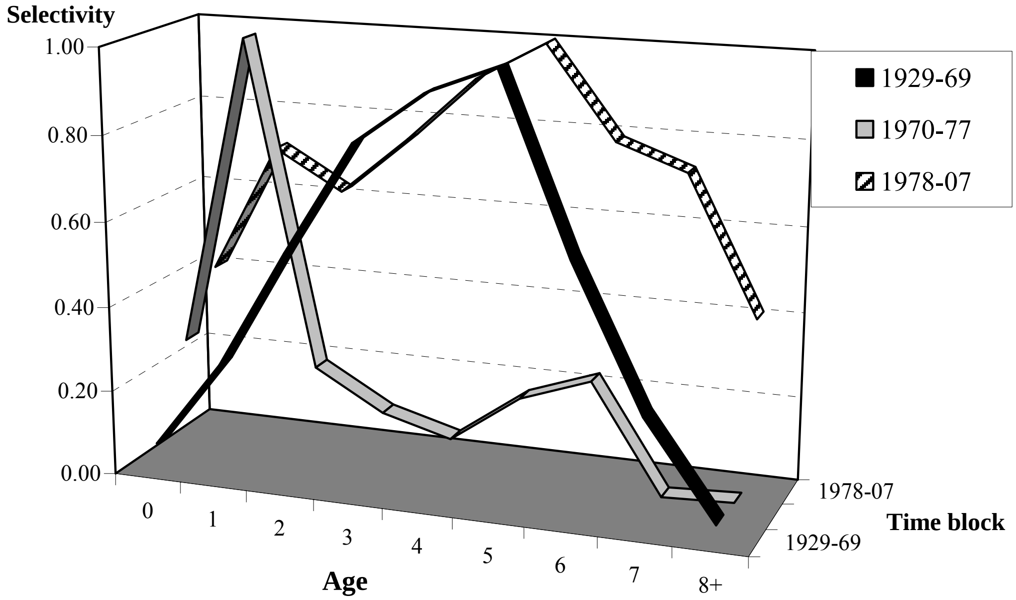

Figure 12. Estimated selectivity schedule for commercial fishery (catch-at-age) data from the ASAP-E1 2008 model (1926-08) based on three time blocks (1929-69, 1970-77, and 1978-07).

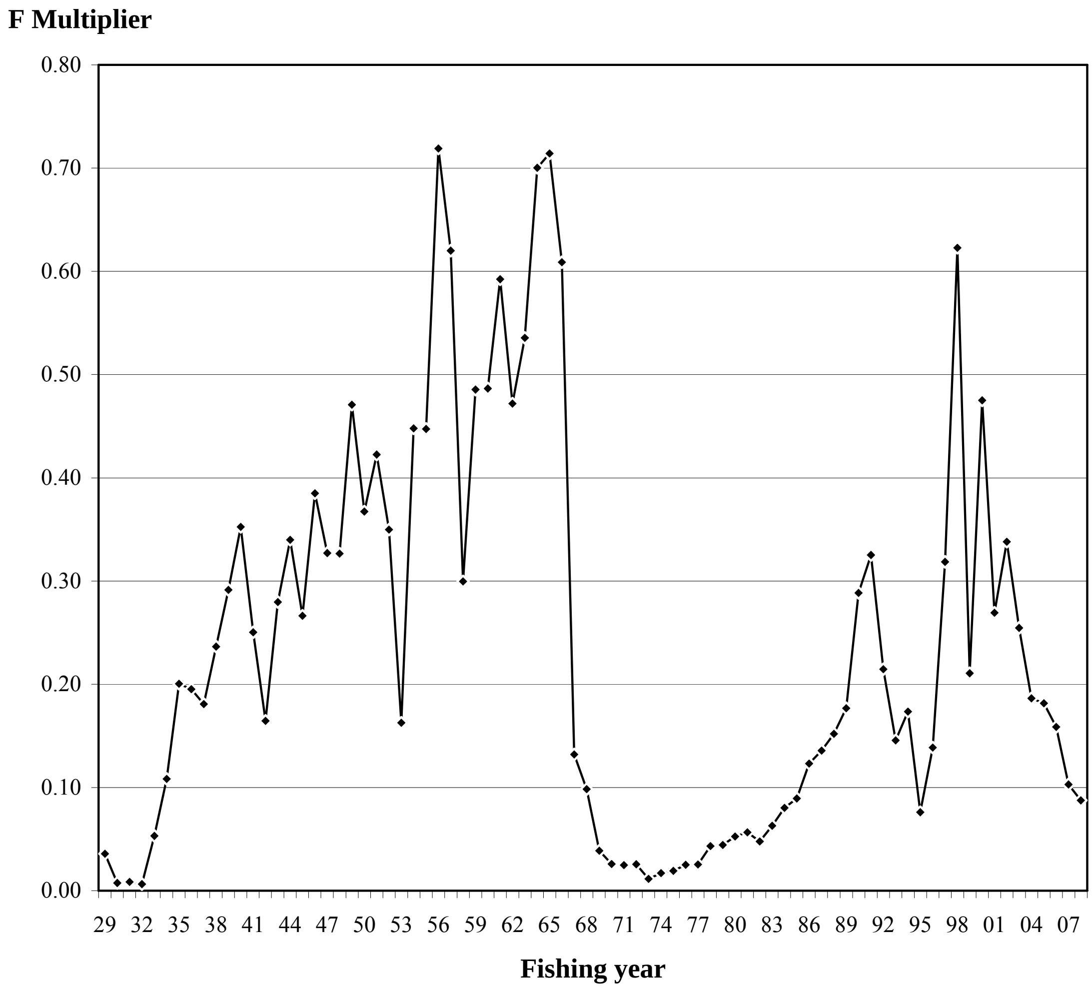

Figure 13. F multiplier for Pacific mackerel generated from the ASAP-E1 08 model (1929-08).

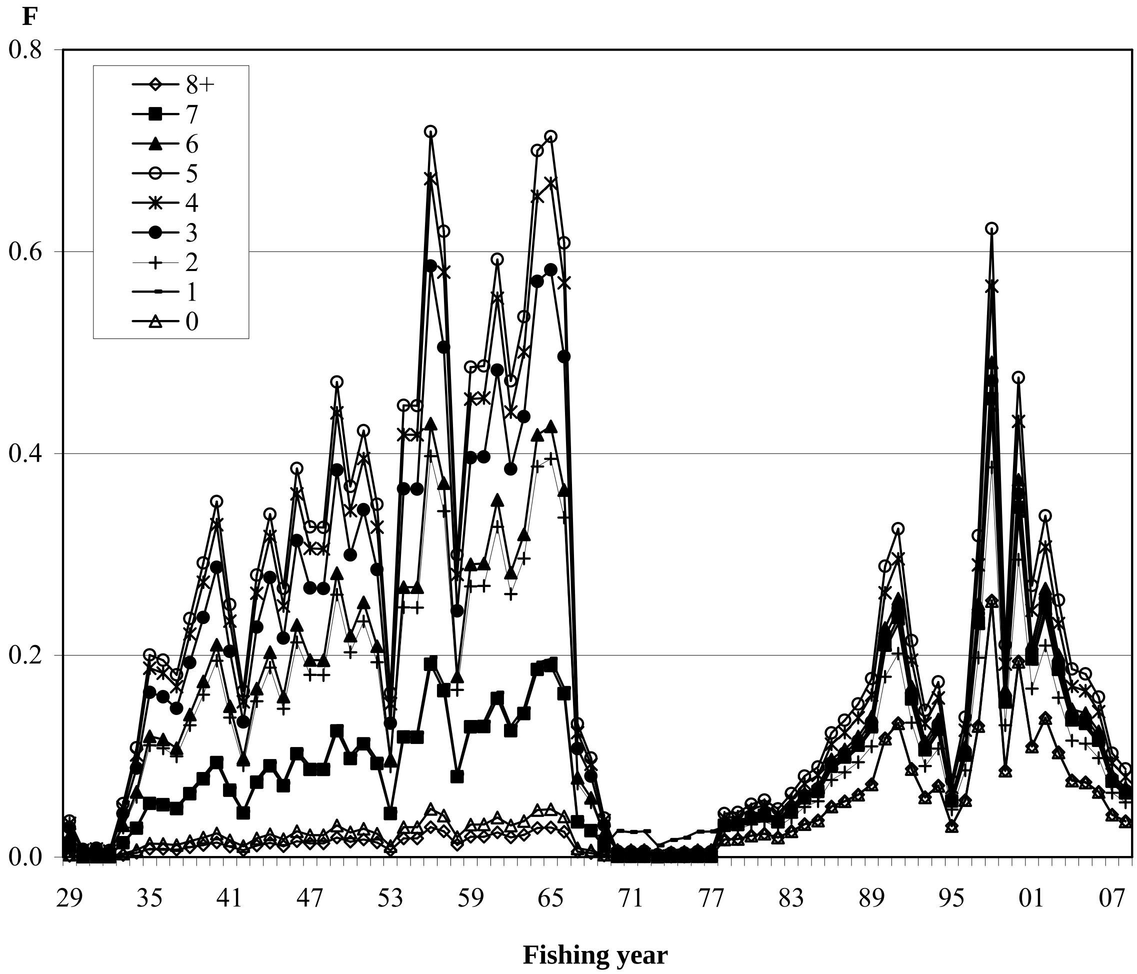

Figure 14. Estimated instantaneous fishing mortality (total) F-at-age for Pacific mackerel generated from the ASAP-E1 2008 model (1929-08).

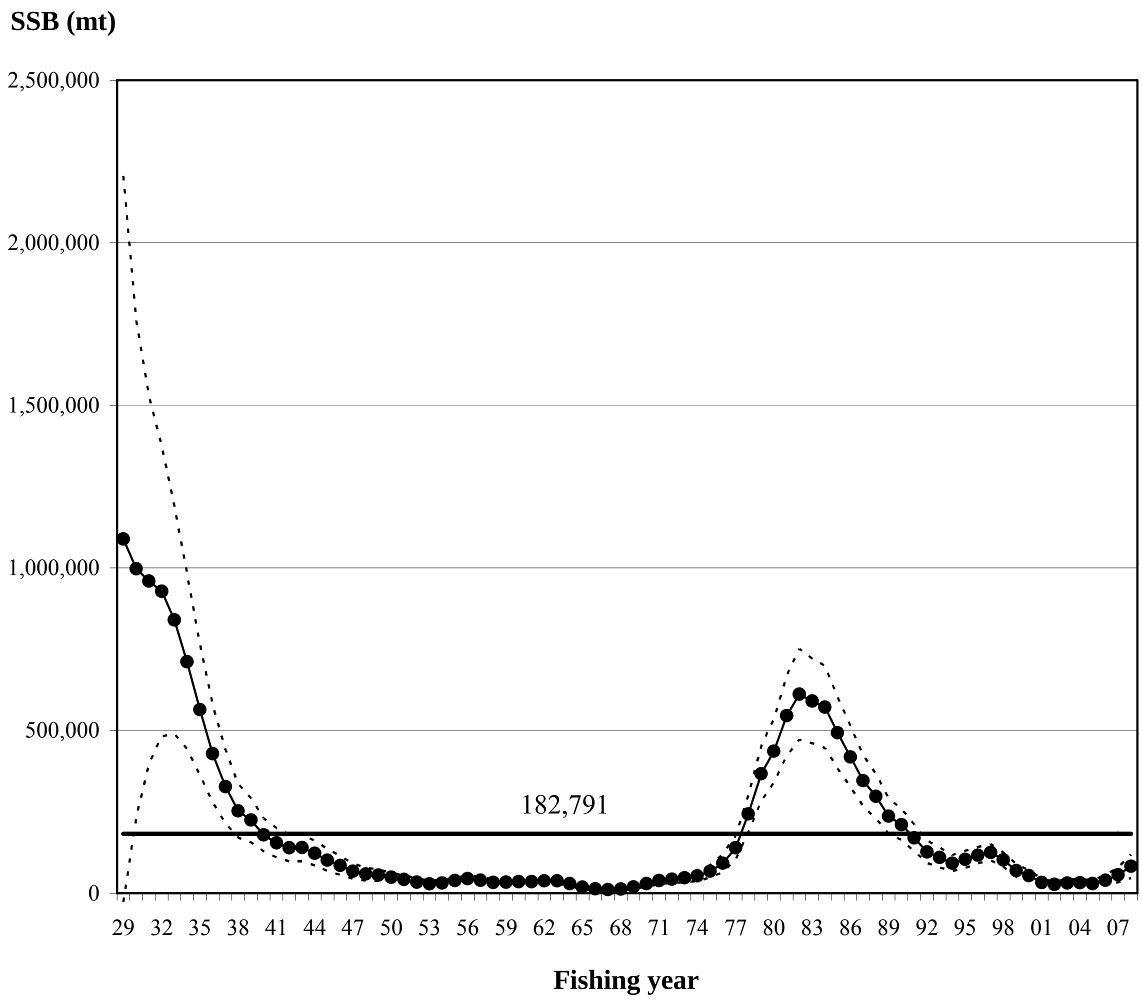

Figure 15. Estimated spawning stock biomass (*SSB*, in mt) of Pacific mackerel generated from the ASAP-E1 2008 model (1929-08). The confidence interval (± 2 STD) associated with this time series is also presented. Estimated 'virgin' *SSB* from stock-recruitment relationship is presented as solid horizontal line.

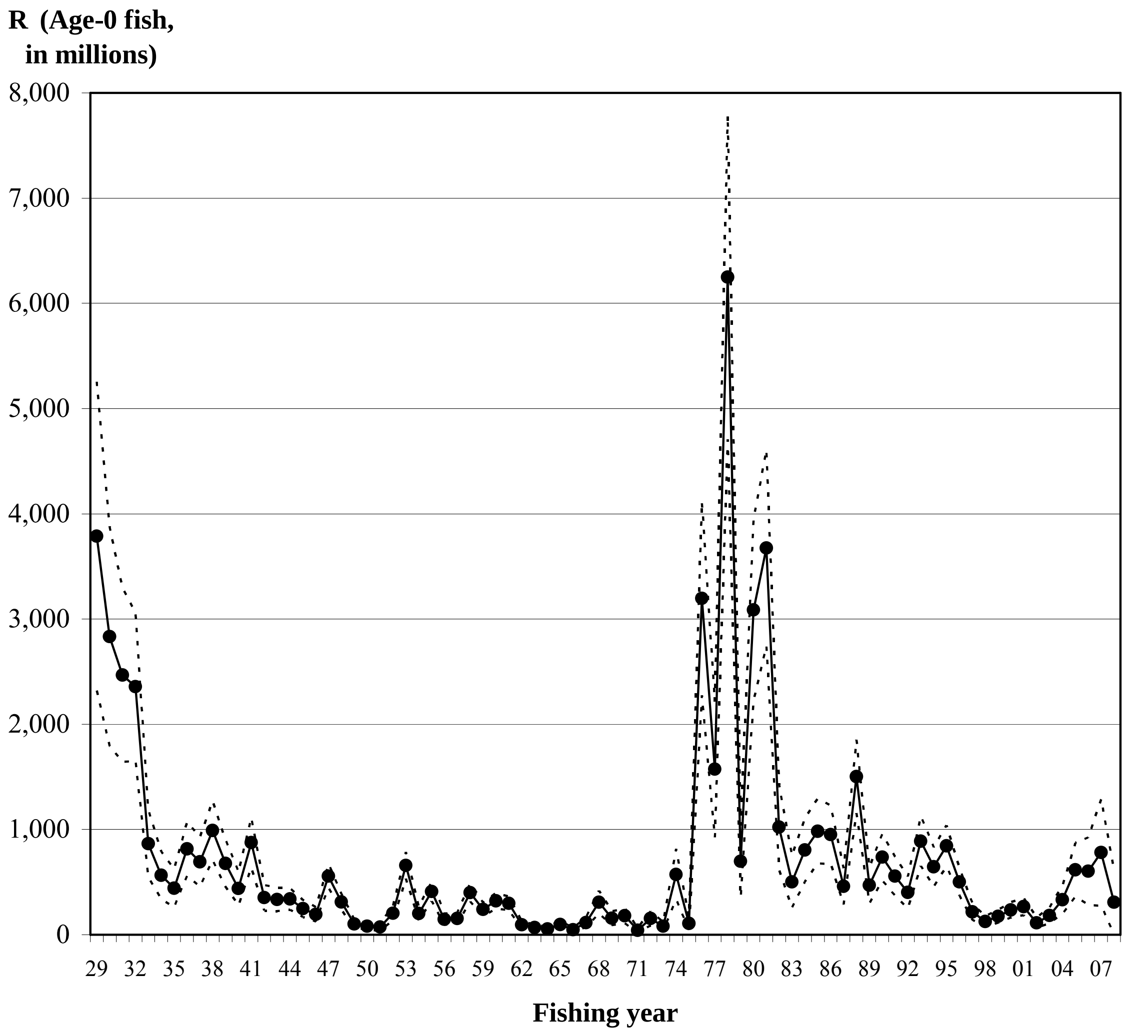

Figure 16. Estimated recruitment (age-0 fish in millions, R) of Pacific mackerel generated from the ASAP-E1 2008 model (1929-08). The confidence interval (± 2 STD) associated with this time series is also presented.

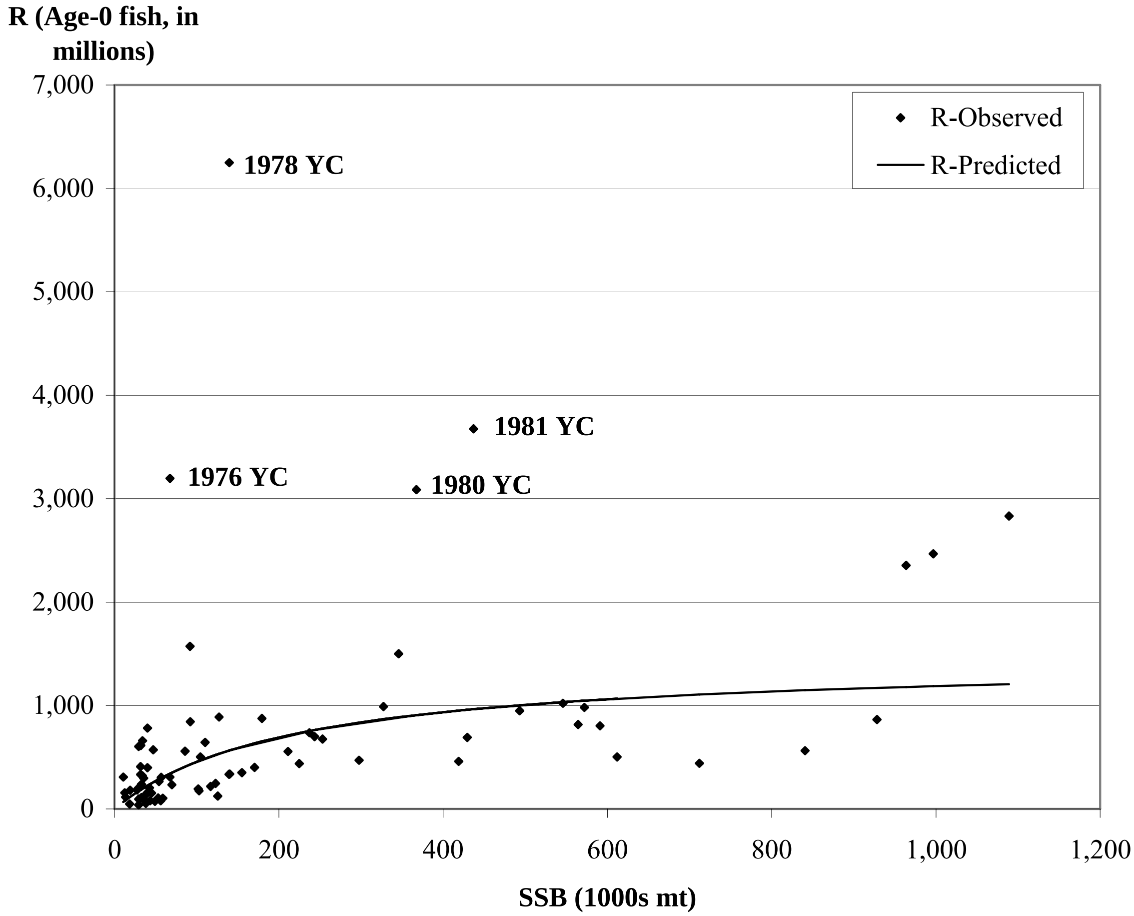

Figure 17. Beverton-Holt stock (*SSB*, in 1000s mt)-recruitment (Age-0 fish (R), in millions) relationship for Pacific mackerel estimated in the ASAP-E1 2008 model (1929-08). Recruitment estimates are presented as (year+1) values. Strong year classes are highlighted. Steepness= 0.32.

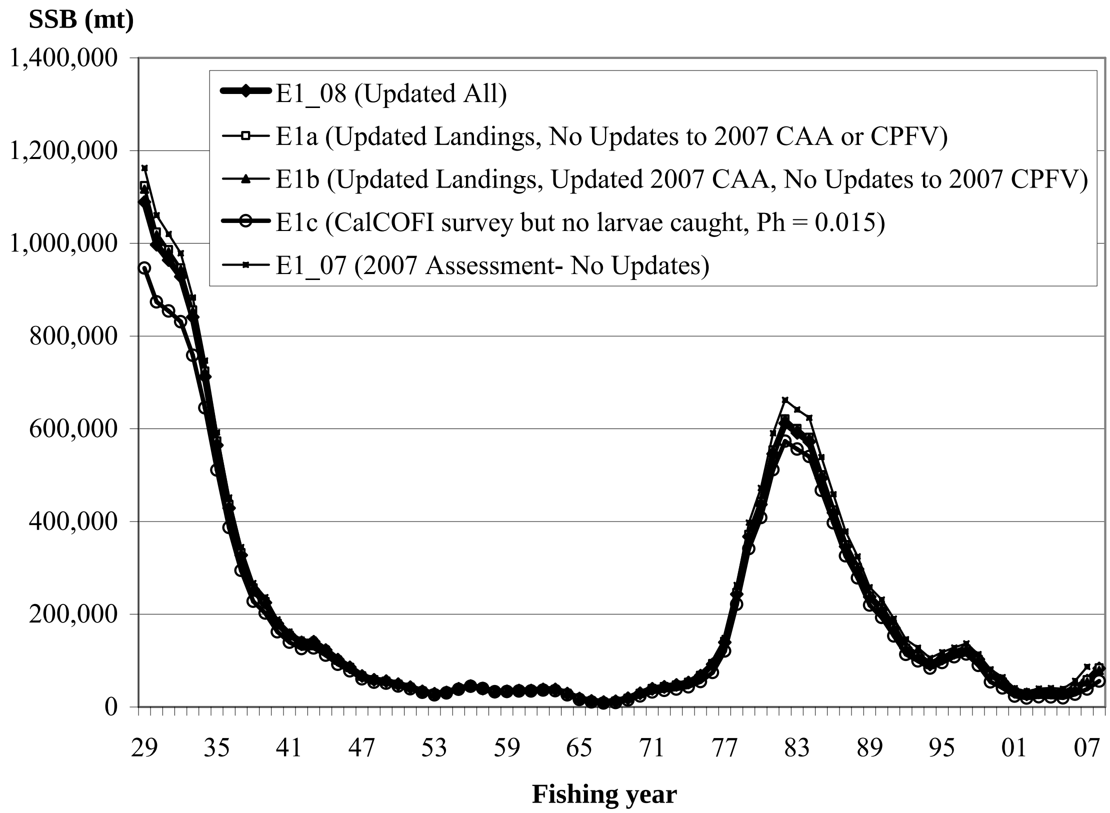

Figure 18. Comparison of spawning stock biomass estimated from sensitivity analyses. See Sensitivity Analysis section for description of each model run.

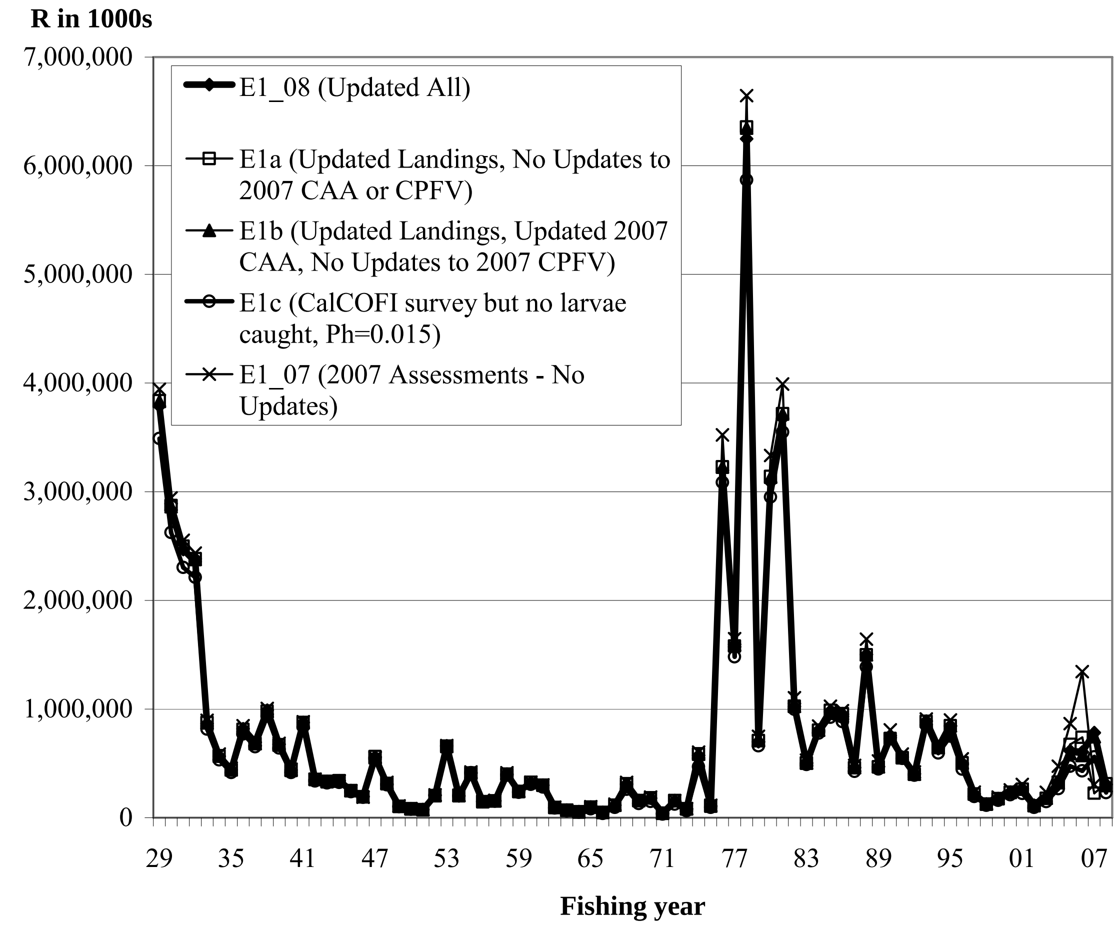

Figure 19. Comparison of recruitment (Age-0 fish) estimated from sensitivity analyses. See Sensitivity Analysis section for description of each model run.

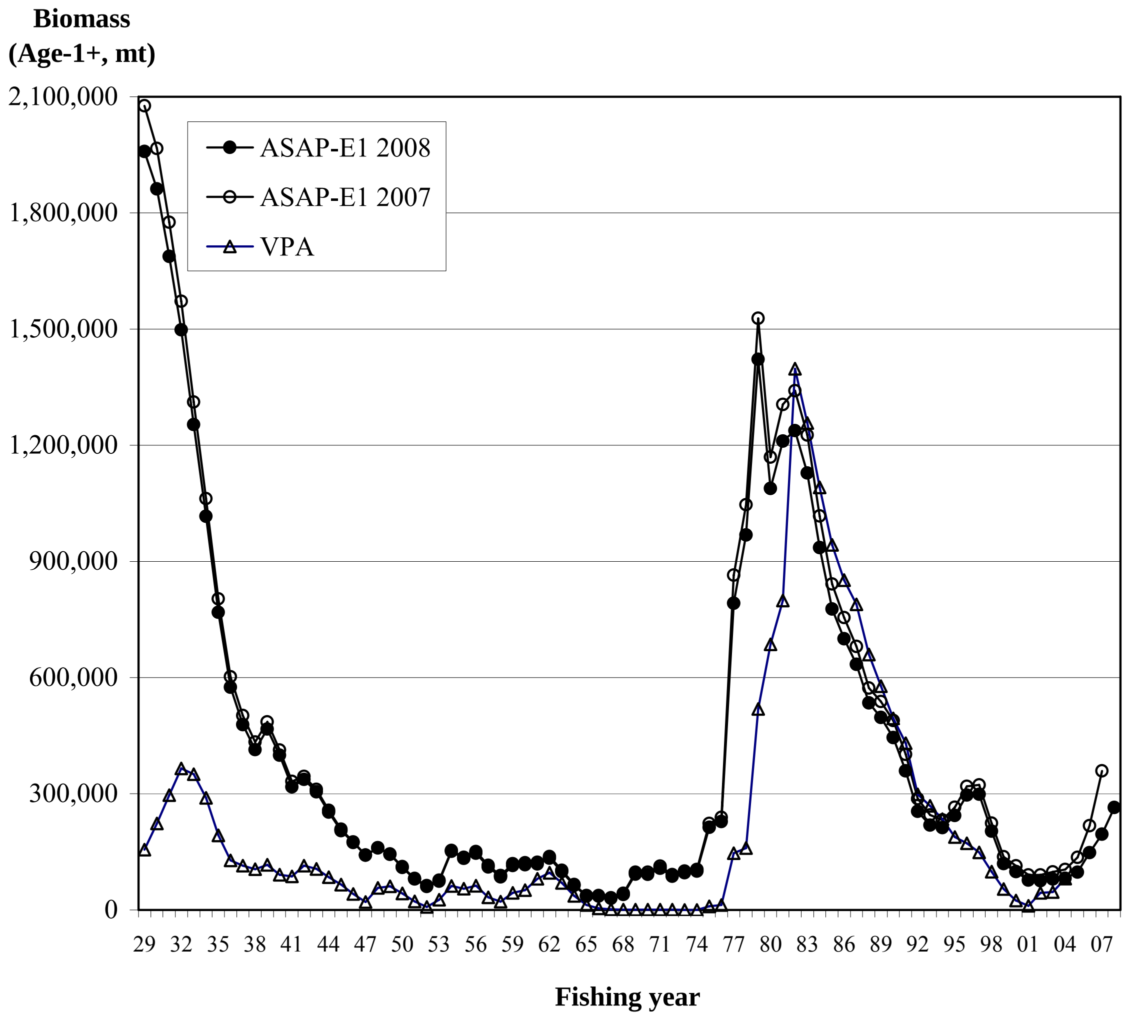

Figure 20. Estimated biomass (Age-1+ fish, in mt) of Pacific mackerel generated from the ASAP-E1 2008, ASAP-E1 2007, and VPA models (1929-08).

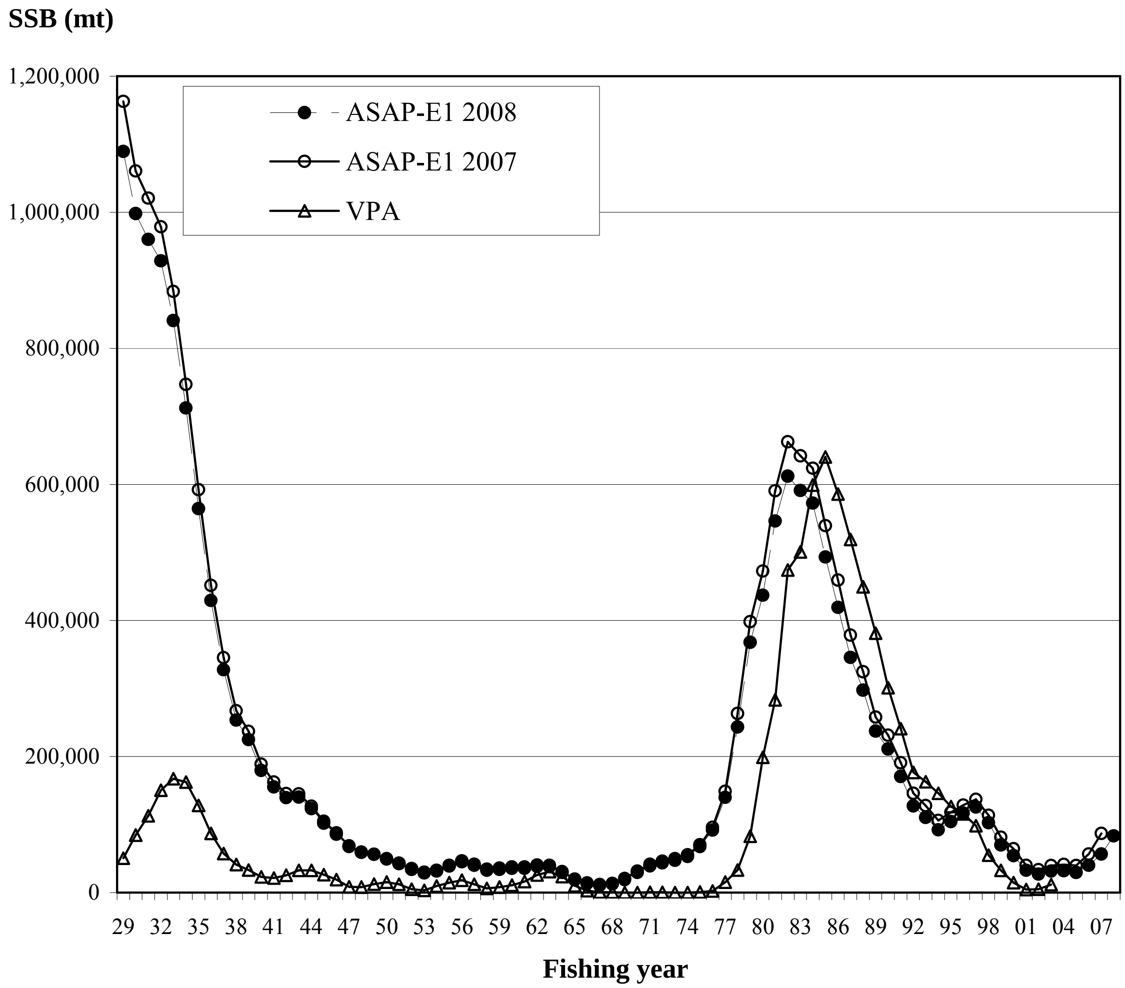

Figure 21. Estimated spawning stock biomass (*SSB*, in mt) of Pacific mackerel generated from the ASAP-E1 2008, ASAP-E1 2007, and VPA models (1929-08).

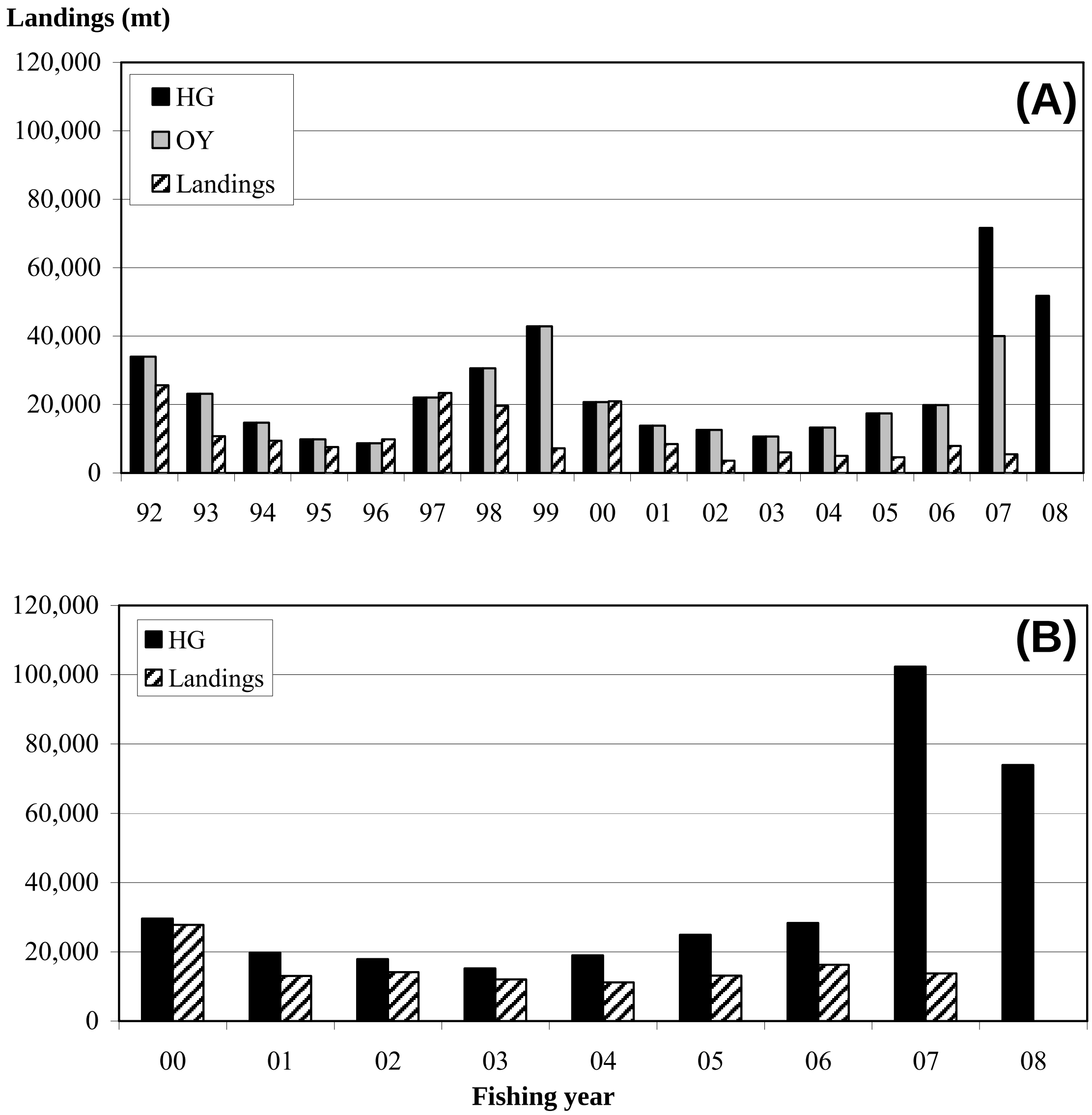

Figure 22. Commercial landings (California directed fishery in mt), Harvest Guidelines (HG in mt), and optimal yield (OY) for Pacific mackerel based on the harvest control rule, display (A, 1992-08 Fishing years). Total landings (mt) and Harvest Guidelines for Pacific mackerel based on no 'U.S. Distribution' parameter in the harvest control rule (B, 2000-08 Fishing years). Note that incidental landings from Pacific Northwest fisheries are not included, but typically range 100 to 300 mt per year.

APPENDIX A

```
# E1: SigR=0.7; M=0.5; update from 07
# Number of Years
   80
# First Year
   1929
# Number of Ages
   9
# Natural Mortality Rate by Age
   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5   0.5
# Fecundity Option
   0
# Maturity Vector
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
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   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
```

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   0.00   0.07   0.25   0.47   0.73   1.00   1.00   1.00   1.00
# Weight at Age Vector
   0.074   0.167   0.297   0.402   0.523   0.615   0.704   0.800   0.830
   0.060   0.139   0.301   0.422   0.511   0.603   0.698   0.800   0.830
   0.077   0.114   0.276   0.399   0.527   0.606   0.701   0.800   0.830
   0.058   0.081   0.277   0.379   0.508   0.604   0.711   0.800   0.830
   0.059   0.083   0.200   0.299   0.493   0.585   0.700   0.800   0.830
   0.065   0.142   0.198   0.233   0.431   0.538   0.683   0.800   0.830
   0.079   0.186   0.217   0.251   0.379   0.472   0.629   0.790   0.830
   0.086   0.193   0.284   0.338   0.393   0.453   0.574   0.750   0.820
   0.119   0.176   0.318   0.429   0.461   0.502   0.575   0.740   0.800
   0.124   0.174   0.310   0.448   0.532   0.582   0.633   0.726   0.790
   0.191   0.246   0.363   0.460   0.583   0.680   0.775   0.795   0.878
   0.180   0.260   0.339   0.442   0.527   0.640   0.729   0.834   0.820
   0.115   0.259   0.343   0.439   0.559   0.650   0.806   0.807   0.850
   0.180   0.236   0.373   0.471   0.546   0.626   0.684   0.909   0.830
   0.165   0.292   0.339   0.474   0.574   0.650   0.629   0.881   1.000
   0.144   0.271   0.379   0.472   0.587   0.660   0.754   0.735   0.948
   0.121   0.234   0.383   0.494   0.611   0.704   0.745   0.819   0.842
   0.125   0.261   0.384   0.487   0.617   0.679   0.736   0.778   0.812
   0.119   0.291   0.400   0.499   0.622   0.709   0.753   0.788   0.818
   0.107   0.227   0.354   0.506   0.616   0.706   0.764   0.895   0.871
   0.109   0.192   0.319   0.456   0.607   0.725   0.799   0.917   0.917
   0.084   0.249   0.323   0.455   0.564   0.664   0.784   0.799   0.871
   0.162   0.255   0.346   0.429   0.569   0.694   0.827   0.835   0.853
   0.173   0.297   0.386   0.471   0.568   0.719   0.832   0.988   0.850
   0.162   0.296   0.411   0.512   0.603   0.763   0.834   0.850   1.100
   0.084   0.257   0.387   0.505   0.585   0.744   0.701   0.879   0.870
   0.140   0.253   0.357   0.484   0.583   0.744   0.762   0.778   0.878
   0.111   0.248   0.373   0.485   0.598   0.752   0.722   0.910   0.870
   0.179   0.310   0.374   0.509   0.602   0.649   0.650   0.700   1.000
   0.176   0.292   0.396   0.488   0.617   0.685   0.775   0.750   0.750
   0.132   0.251   0.398   0.510   0.602   0.702   0.754   0.840   0.850
   0.102   0.276   0.391   0.507   0.611   0.699   0.768   0.820   0.870
   0.144   0.252   0.389   0.495   0.584   0.647   0.817   0.830   0.850
   0.276   0.320   0.420   0.540   0.622   0.712   0.782   0.890   0.860
   0.197   0.298   0.434   0.538   0.627   0.730   0.743   0.840   0.930
   0.181   0.300   0.400   0.503   0.612   0.748   0.812   0.820   0.870
   0.109   0.195   0.384   0.501   0.596   0.723   0.735   0.880   0.850
   0.149   0.273   0.419   0.525   0.658   0.790   0.833   0.850   0.930
   0.166   0.235   0.488   0.510   0.599   0.723   0.869   0.917   0.849
   0.138   0.266   0.391   0.562   0.593   0.709   0.902   0.952   1.070
   0.103   0.322   0.428   0.505   0.662   0.746   0.907   1.000   1.100
   0.099   0.232   0.402   0.584   0.730   0.837   0.850   1.000   1.200
   0.266   0.282   0.457   0.481   0.740   0.955   0.880   0.900   1.200
   0.147   0.266   0.449   0.508   0.552   0.746   1.000   0.900   1.100
   0.119   0.329   0.433   0.609   0.606   0.686   0.758   0.803   0.838
   0.107   0.303   0.604   0.740   0.837   0.800   0.800   0.800   1.000
   0.127   0.361   0.517   0.973   1.053   1.029   1.350   0.900   0.900
   0.170   0.297   0.672   0.864   1.291   1.223   1.531   1.200   1.000
   0.122   0.322   0.600   0.847   1.063   1.100   1.300   1.500   1.300
   0.062   0.334   0.473   0.705   0.908   1.100   1.200   1.400   1.600
   0.082   0.189   0.440   0.598   0.810   0.969   1.200   1.300   1.500
   0.072   0.176   0.270   0.437   0.598   0.874   1.066   1.300   1.400
   0.083   0.190   0.239   0.391   0.597   0.715   0.953   0.929   1.400
   0.032   0.151   0.237   0.345   0.516   0.773   0.916   1.000   1.200
   0.049   0.191   0.302   0.390   0.458   0.511   0.688   0.900   1.100
   0.120   0.235   0.351   0.396   0.505   0.614   0.638   0.871   0.910
   0.157   0.285   0.418   0.461   0.484   0.560   0.612   0.697   0.850
   0.148   0.290   0.408   0.508   0.561   0.595   0.630   0.719   0.784
   0.133   0.272   0.414   0.523   0.600   0.691   0.717   0.766   0.826
   0.101   0.301   0.415   0.576   0.666   0.734   0.806   0.815   0.899
   0.104   0.193   0.381   0.542   0.647   0.749   0.757   0.739   0.827
   0.094   0.267   0.377   0.554   0.649   0.680   0.749   0.775   0.803
   0.071   0.217   0.397   0.514   0.591   0.664   0.724   0.766   0.799
   0.087   0.175   0.330   0.459   0.544   0.661   0.691   0.725   0.805
   0.073   0.228   0.294   0.408   0.583   0.607   0.720   0.756   0.832
   0.100   0.156   0.248   0.361   0.493   0.597   0.644   0.733   0.785
   0.081   0.179   0.275   0.431   0.586   0.689   0.740   0.758   0.920
   0.105   0.182   0.318   0.471   0.589   0.649   0.674   0.705   0.751
   0.149   0.239   0.333   0.446   0.572   0.637   0.719   0.718   0.749
   0.139   0.267   0.325   0.419   0.530   0.615   0.631   0.667   0.689
   0.148   0.228   0.399   0.509   0.575   0.633   0.688   0.754   0.768
   0.114   0.266   0.370   0.550   0.590   0.608   0.646   0.712   0.731
   0.103   0.253   0.347   0.534   0.567   0.619   0.617   0.635   0.627
   0.133   0.218   0.303   0.412   0.552   0.687   0.656   0.728   0.650
   0.125   0.284   0.414   0.603   0.679   0.745   0.809   0.794   0.838
   0.159   0.280   0.407   0.596   0.685   0.821   0.926   0.820   0.902
   0.106   0.267   0.380   0.463   0.556   0.665   0.737   0.797   0.840
   0.126   0.222   0.353   0.522   0.752   0.824   0.848   0.918   0.935
   0.117   0.217   0.359   0.557   0.741   0.878   0.871   0.924   0.935
   0.117   0.217   0.359   0.557   0.741   0.878   0.871   0.924   0.935
# Number of Fleets
   1
#$FLEET-1
# Selectivity Start Age
   1
# Selectivity End Age
   9
# Selectivity Est. Start Age
   1
# Selectivity Est. End Age
   9
# Release Mortality
   0.0
```

Number of Selectivity Changes by Fleet
2
Selectivity Change Years
1970 1978
Fleet 1 Catch at Age - Last Column is Total Weight

9.28	12433.52	22466.85	20819.02	5208.01	3874.57	3198.38	1273.12	506.68	25733.54
0	1392.8	7164.29	4838.4	1916.24	670.23	43.87	17.46	6.95	5825.88
0	957.2	9990.74	6190.18	1307.12	752.89	371.31	147.8	58.82	6890.14
0	144.48	3222	5844.95	1393.72	940.26	489.13	194.7	77.49	4938.95
0	4620.12	19017.01	31887	23363.33	8277	2730.62	1086.93	432.58	33072.19
0	4894.32	53353.79	35598.25	40807.82	15508.13	5669.25	2256.66	898.11	51483.81
0	10871.51	12737.4	61704.13	63819.66	33633.06	6205.69	2470.19	983.09	66417.45
0	2247.75	20403.77	17399.3	33062.36	35158.51	5252.24	2090.67	832.05	45714.21
128.53	1475.8	2592.22	8035.18	15910.37	26039.26	7865.44	3130.86	1246.02	31987.62
771.57	11577.22	31967.43	16527.64	4309.46	10883.8	6608.45	2630.51	1046.89	34561.76
1802.77	23227.99	23713.35	33697.92	11093.97	6309.69	3744.21	1525.42	485.36	45453.99
3199.27	18452.94	59415.03	27593.71	17024.69	2513.71	685.56	114.26	0	48868.18
638.04	18396.72	31228.34	28817.98	6522.15	921.61	70.89	70.89	0	32560.77
0	28454.8	10342.87	15109.17	6148.52	1096.25	142.99	47.66	0	21885.7
426.03	14144.24	62072.75	10522.97	7412.94	1022.47	170.41	85.21	0	35304.7
0	20800.04	20684.8	35319.73	8873.15	1613.3	230.47	0	57.62	36657.1
2034.46	15336.68	12076.33	8920.31	8320.41	4825.32	1930.13	599.9	391.24	23601.43
3289.73	16672.93	20261.72	11040.52	6704.06	4286.61	1819.32	1096.58	548.29	27582.46
7426.5	4645.52	10460.31	9227.83	6067.61	3507.84	1896.13	695.25	221.22	19436.99
2722.71	37272.92	9106.99	3661.57	4037.12	1408.3	657.21	281.66	93.89	18124.69
565.75	21983.49	36329.33	9173.26	3071.22	1980.13	808.22	121.23	80.82	24188.91
44.21	6587.64	17065.97	17154.4	3183.29	530.55	397.91	44.21	44.21	17493.02
1030.94	4004.81	6859.73	11816.18	11300.71	674.08	237.91	79.3	79.3	15857.11
509.56	324.26	1991.91	1991.91	8708.8	4678.66	92.65	46.32	0	10325.76
11077.04	2069.34	1338.98	1379.56	568.05	811.5	770.93	0	0	5265.94
693.87	47799.78	10176.73	2158.7	1233.54	0	308.39	154.19	0	18464.67
15607.86	17730.53	25097.44	10738.21	1123.77	124.86	249.73	124.86	374.59	22200.87
419.64	54867.37	22555.42	19093.43	8812.35	314.73	0	0	0	36834.99
1996.08	7915.49	30078.85	10875.19	8534.96	3028.53	1307.78	344.15	0	27753.42
11505.37	2665.88	4595.13	7401.32	3156.96	1438.17	912.01	0	0	11874.77
1689.97	46896.6	7773.85	3633.43	2450.45	1013.98	253.5	0	0	19332.47
1628.96	12726.27	17002.3	10181.02	5090.51	1730.77	1323.53	0	0	20822.52
7344.83	28679.83	15564.05	14689.67	5770.94	1224.14	524.63	0	0	26199.2
738.58	23298.65	12553.8	10472.06	7072.09	1421.2	186.57	0	0	23900.98
284.46	6843.29	18432.22	10338.63	8843.01	2841.7	424.59	0	0	23702.99
1389.15	7716.49	6521.08	9629.28	10969.27	4240.06	715.11	0	0	19987.93
13074.05	1264.81	766.75	1700.61	5524.52	8676.71	1562.99	0	0	11279.44
3689.34	8093.13	1457.55	1168.16	991.64	2240.26	1219.85	91.12	0	7405.18
4530.49	1003.32	88.34	631.74	228.46	163.44	191.8	45.48	3.9	1713.31
7417.78	499.49	221.14	353.17	89.26	85.63	68.09	51.89	37.44	1695.04
46.32	2354.04	605.77	221.27	70.7	61.36	9.47	0	0	1168.22
1405.04	3004.08	0	0	0	0	0	0	0	835.49
0	2852.62	223.99	9.9	11.85	7.9	0	0	0	911.26
1319.46	197.08	293.14	318	9.27	7.18	0	0	0	532
50.08	546.98	153.25	32.92	74.92	88.38	49.33	2.06	2.06	400.94
2154.23	768.64	244.31	39.29	13.1	0	0	0	0	633.81
129.69	6334.53	89.64	65.67	1.89	3.59	1.8	0	0	2149.3
13973.68	164.16	1763.31	0.75	22.98	0	26.91	0	0	4091.65
11070.92	36733.93	77.95	286.78	0	0	0	0	0	13751.25
73773.14	18836.9	28597.94	1165.54	1006.01	257.27	0	0	0	27172.62
27.3	102761.6	14944.14	15203.87	222.15	674.58	0	0	0	35858.08
63977.75	3375.6	77514.48	8220.94	7378.74	407.32	125.57	0	0	35203.07
19073.13	45821.52	10973.96	69210.11	4792.33	3066.54	75.52	123.26	0	46984.54
16128.82	36225.3	33231.45	9921.13	31045.14	2318.39	768.07	0	0	36371.39
2841.49	2812.44	44335.77	40174.47	6319.26	17770.08	251.37	0	0	42117.51
2874.61	532.91	9588.75	48965.24	25203.82	6271.07	7986.46	197.57	0	46468.33
3250.53	17477.96	5188.93	16256.13	50114.46	10704.47	1388.6	1046.78	0	46827.8
18857.41	44528.39	23015.91	5275.98	9001.56	25599.29	7434.51	1023.53	1085.34	54122.6
18059.02	71919.59	32697.92	5325.97	2861.93	3517.06	4718.34	2063.79	848.6	48222.76
104976.8	15168.1	36143.18	13133.26	2848.62	1942.85	2573.76	4155.11	3178.37	49264.61
21820.5	161290.9	8376.37	6715.48	4513.48	2717.9	2542.54	866.91	1677.31	49405.81
29559.33	19434.09	43284.43	11973.57	16877.91	19587.74	8229.01	6546.39	8186.6	71550.65
27181.03	91781.73	21911.68	21684.28	10412.43	9327.48	6708.83	3023.18	4448.24	65504.89
11121.1	30146.79	12343.23	9853.43	10636.66	8100.2	5593.94	2629.49	1025.04	32217.46
51844.57	9383.17	10677.45	3439.66	3365.54	5042.96	2884.56	2893.11	1650.65	20919.9
25603.69	38016.3	9946.38	4529.72	5751.48	3022.07	1869.19	1484.89	606.29	23737.04
46200.33	21302.37	5280.72	982.52	552.27	1417.41	759.08	529.29	336.18	11995.83
28943.78	43914.05	12553.55	6006.08	3740.6	2567.45	1367.78	1073.12	755.59	24562.68
24318.16	49846.2	32821.51	12958.96	8403.64	7621.77	4900.96	4165.63	6853.01	51076.32
13603.22	19878.34	38777.42	23702.43	15523.39	13343.25	10667.9	6471.86	7980.32	62822.66
11997.3	2949.13	2680.44	6120.22	5834.41	4446.9	1946.44	1330.19	966.05	15909.85
29466.53	15354.87	5178.47	8768.71	10300.19	6637.51	2844.88	1140.63	630.41	27791.9
14207.16	20422.43	3517.09	1951.32	2407.56	2133.99	984.14	555.21	298.61	13010.41
7247.46	51288.5	5175.57	1192.36	228.27	364.9	252.66	0	0	14122.78
26589.82	14955.19	5147.96	1891.02	662.89	651.84	330.95	95.6	65.05	12022.88
46349.62	7066.43	2287.65	1657.83	706.03	141.48	94.32	36.78	94.32	11195.41
71582.68	9838.92	5043.35	729.78	285.3	174.03	89.59	22.52	0	13151.46
48522.75	23717.95	4882.47	2454.61	1395.46	390.63	309.2	443.38	0	16265.15
34690.05	16917.34	6182.45	2734.26	1529.06	505.49	191.43	43.64	0	13743.29
0	0	0	0	0	0	0	0	0	13743.29

Fleet 1 Discards at Age - Last Column is Total Weight

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
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# Number of Indices
3
#$SPOTTER
#$CPFV
#$CALCOFI
# Index Weight Flag
2
# Index Units
1 2 2
# Index Month
4 5 1
# Index Start Age
1 2 2
# Index End Age
9 9 9
# Index Fix Age
-1 -1 -1
# Index Selectivity Choice
-1 -1 -1
# Index Data - Year, Index, CV, Selectivity
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1930 -999 1 1 1 1 1 1 1 1 1 1
1931 -999 1 1 1 1 1 1 1 1 1 1
1932 -999 1 1 1 1 1 1 1 1 1 1
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1943 -999 1 1 1 1 1 1 1 1 1 1
1944 -999 1 1 1 1 1 1 1 1 1 1
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1947	-999	1	1	1	1	1	1	1	1	1	1
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1960	-999	1	1	1	1	1	1	1	1	1	1
1961	-999	1	1	1	1	1	1	1	1	1	1
1962	461.35	0.518	1	1	1	1	1	1	1	1	1
1963	1541.53	0.32	1	1	1	1	1	1	1	1	1
1964	549.34	0.458	1	1	1	1	1	1	1	1	1
1965	707.89	0.508	1	1	1	1	1	1	1	1	1
1966	272.08	0.67	1	1	1	1	1	1	1	1	1
1967	19.88	0.979	1	1	1	1	1	1	1	1	1
1968	178.55	1.42	1	1	1	1	1	1	1	1	1
1969	782.89	1.385	1	1	1	1	1	1	1	1	1
1970	22.03	2.439	1	1	1	1	1	1	1	1	1
1971	76.7	0.89	1	1	1	1	1	1	1	1	1
1972	5.46	2.05	1	1	1	1	1	1	1	1	1
1973	28.95	2.873	1	1	1	1	1	1	1	1	1
1974	-999	1	1	1	1	1	1	1	1	1	1
1975	4.31	3.011	1	1	1	1	1	1	1	1	1
1976	15492.54	0.55	1	1	1	1	1	1	1	1	1
1977	31112.79	0.282	1	1	1	1	1	1	1	1	1
1978	40320.84	0.219	1	1	1	1	1	1	1	1	1
1979	44380.55	0.18	1	1	1	1	1	1	1	1	1
1980	22164.44	0.153	1	1	1	1	1	1	1	1	1
1981	25829.5	0.139	1	1	1	1	1	1	1	1	1
1982	36237.16	0.13	1	1	1	1	1	1	1	1	1
1983	30524.24	0.271	1	1	1	1	1	1	1	1	1
1984	45635.38	0.156	1	1	1	1	1	1	1	1	1
1985	38944.25	0.207	1	1	1	1	1	1	1	1	1
1986	18979.22	0.17	1	1	1	1	1	1	1	1	1
1987	12087.23	0.254	1	1	1	1	1	1	1	1	1
1988	16673.37	0.304	1	1	1	1	1	1	1	1	1
1989	2700.95	0.341	1	1	1	1	1	1	1	1	1
1990	5445.68	0.263	1	1	1	1	1	1	1	1	1
1991	2391.01	0.27	1	1	1	1	1	1	1	1	1
1992	1207.58	0.48	1	1	1	1	1	1	1	1	1
1993	1764.32	0.345	1	1	1	1	1	1	1	1	1
1994	2097.7	0.561	1	1	1	1	1	1	1	1	1
1995	6317.02	0.372	1	1	1	1	1	1	1	1	1
1996	1907.85	0.546	1	1	1	1	1	1	1	1	1
1997	5050.92	0.353	1	1	1	1	1	1	1	1	1
1998	2248.2	0.417	1	1	1	1	1	1	1	1	1
1999	1187.88	0.459	1	1	1	1	1	1	1	1	1
2000	3230.88	0.42	1	1	1	1	1	1	1	1	1
2001	548.8	1.339	1	1	1	1	1	1	1	1	1
2002	-999	1	1	1	1	1	1	1	1	1	1
2003	-999	1	1	1	1	1	1	1	1	1	1
2004	-999	1	1	1	1	1	1	1	1	1	1
2005	-999	1	1	1	1	1	1	1	1	1	1
2006	-999	1	1	1	1	1	1	1	1	1	1
2007	-999	1	1	1	1	1	1	1	1	1	1
2008	-999	1	1	1	1	1	1	1	1	1	1

INDEX - 2

1929	-999	1	0	0.5	1	1	1	1	1	1	1
1930	-999	1	0	0.5	1	1	1	1	1	1	1
1931	-999	1	0	0.5	1	1	1	1	1	1	1
1932	-999	1	0	0.5	1	1	1	1	1	1	1
1933	-999	1	0	0.5	1	1	1	1	1	1	1
1934	-999	1	0	0.5	1	1	1	1	1	1	1
1935	43.31	0.21146	0	0.5	1	1	1	1	1	1	1
1936	62.06	0.34532	0	0.5	1	1	1	1	1	1	1
1937	34.99	0.19303	0	0.5	1	1	1	1	1	1	1
1938	77.75	0.1358	0	0.5	1	1	1	1	1	1	1
1939	61.33	0.14647	0	0.5	1	1	1	1	1	1	1
1940	90.34	0.13289	0	0.5	1	1	1	1	1	1	1
1941	-999	1	0	0.5	1	1	1	1	1	1	1
1942	-999	1	0	0.5	1	1	1	1	1	1	1
1943	-999	1	0	0.5	1	1	1	1	1	1	1
1944	-999	1	0	0.5	1	1	1	1	1	1	1
1945	-999	1	0	0.5	1	1	1	1	1	1	1
1946	23.16	0.20273	0	0.5	1	1	1	1	1	1	1
1947	26.42	0.18721	0	0.5	1	1	1	1	1	1	1
1948	31.04	0.16684	0	0.5	1	1	1	1	1	1	1
1949	14.98	0.21146	0	0.5	1	1	1	1	1	1	1
1950	8.26	0.2328	0	0.5	1	1	1	1	1	1	1
1951	6.09	0.17654	0	0.5	1	1	1	1	1	1	1
1952	5.89	0.2619	0	0.5	1	1	1	1	1	1	1
1953	12.04	0.40643	0	0.5	1	1	1	1	1	1	1
1954	43.78	0.16878	0	0.5	1	1	1	1	1	1	1
1955	15.59	0.18624	0	0.5	1	1	1	1	1	1	1
1956	12.1	0.24347	0	0.5	1	1	1	1	1	1	1
1957	18.17	0.23377	0	0.5	1	1	1	1	1	1	1
1958	18.3	0.21437	0	0.5	1	1	1	1	1	1	1

1959	12.46	0.21049	0	0.5	1	1	1	1	1	1	1
1960	16.7	0.35114	0	0.5	1	1	1	1	1	1	1
1961	15.8	0.24541	0	0.5	1	1	1	1	1	1	1
1962	7.73	0.27839	0	0.5	1	1	1	1	1	1	1
1963	13.89	0.26578	0	0.5	1	1	1	1	1	1	1
1964	5.47	0.28615	0	0.5	1	1	1	1	1	1	1
1965	10.17	0.24638	0	0.5	1	1	1	1	1	1	1
1966	11.29	0.22213	0	0.5	1	1	1	1	1	1	1
1967	4.62	0.30361	0	0.5	1	1	1	1	1	1	1
1968	6.96	0.44038	0	0.5	1	1	1	1	1	1	1
1969	5.74	0.31913	0	0.5	1	1	1	1	1	1	1
1970	8.98	0.43941	0	0.5	1	1	1	1	1	1	1
1971	14.7	0.28033	0	0.5	1	1	1	1	1	1	1
1972	8.05	0.31719	0	0.5	1	1	1	1	1	1	1
1973	4.43	0.49179	0	0.5	1	1	1	1	1	1	1
1974	3.21	0.45881	0	0.5	1	1	1	1	1	1	1
1975	8.13	0.33853	0	0.5	1	1	1	1	1	1	1
1976	13.46	0.31234	0	0.5	1	1	1	1	1	1	1
1977	52.33	0.19885	0	0.5	1	1	1	1	1	1	1
1978	101.33	0.15811	0	0.5	1	1	1	1	1	1	1
1979	118.36	0.18818	0	0.5	1	1	1	1	1	1	1
1980	155.73	0.15714	0	0.5	1	1	1	1	1	1	1
1981	105.97	0.18139	0	0.5	1	1	1	1	1	1	1
1982	108.23	0.15326	0	0.5	1	1	1	1	1	1	1
1983	108.89	0.17945	0	0.5	1	1	1	1	1	1	1
1984	117.36	0.16684	0	0.5	1	1	1	1	1	1	1
1985	86.09	0.19982	0	0.5	1	1	1	1	1	1	1
1986	65.8	0.20273	0	0.5	1	1	1	1	1	1	1
1987	44.16	0.19691	0	0.5	1	1	1	1	1	1	1
1988	32.12	0.44717	0	0.5	1	1	1	1	1	1	1
1989	43.55	0.22116	0	0.5	1	1	1	1	1	1	1
1990	50.29	0.28615	0	0.333	0.666	1	1	1	1	1	1
1991	56.4	0.27936	0	0.333	0.666	1	1	1	1	1	1
1992	41.23	0.22795	0	0.333	0.666	1	1	1	1	1	1
1993	48.69	0.22698	0	0.333	0.666	1	1	1	1	1	1
1994	46.09	0.19788	0	0.333	0.666	1	1	1	1	1	1
1995	41.76	0.22698	0	0.333	0.666	1	1	1	1	1	1
1996	44.8	0.26287	0	0.333	0.666	1	1	1	1	1	1
1997	30.45	0.27548	0	0.333	0.666	1	1	1	1	1	1
1998	13.71	0.27257	0	0.333	0.666	1	1	1	1	1	1
1999	8.12	0.30555	0	0.333	0.666	1	1	1	1	1	1
2000	14.85	0.28421	0	0.333	0.666	1	1	1	1	1	1
2001	11.78	0.29973	0	0.333	0.666	1	1	1	1	1	1
2002	9.31	0.37733	0	0.333	0.666	1	1	1	1	1	1
2003	5.95	0.32204	0	0.333	0.666	1	1	1	1	1	1
2004	11.23	0.32495	0	0.333	0.666	1	1	1	1	1	1
2005	22.27	0.74399	0	0.333	0.666	1	1	1	1	1	1
2006	20.69	0.25026	0	0.333	0.666	1	1	1	1	1	1
2007	26.09	0.58006	0	0.333	0.666	1	1	1	1	1	1
2008	-999	1	0	0.333	0.666	1	1	1	1	1	1

INDEX - 3

1929	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1930	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1931	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1932	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1933	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1934	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1935	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1936	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1937	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1938	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1939	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1940	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1941	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1942	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1943	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1944	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1945	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1946	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1947	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1948	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1949	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1950	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1951	0.015	0.646	0	0.074	0.246	0.474	0.733	1	1	1	1
1952	0.023	0.54	0	0.074	0.246	0.474	0.733	1	1	1	1
1953	0.187	0.533	0	0.074	0.246	0.474	0.733	1	1	1	1
1954	1.148	0.176	0	0.074	0.246	0.474	0.733	1	1	1	1
1955	0.287	0.309	0	0.074	0.246	0.474	0.733	1	1	1	1
1956	0.113	0.317	0	0.074	0.246	0.474	0.733	1	1	1	1
1957	0.044	0.398	0	0.074	0.246	0.474	0.733	1	1	1	1
1958	0.629	0.162	0	0.074	0.246	0.474	0.733	1	1	1	1
1959	0.184	0.216	0	0.074	0.246	0.474	0.733	1	1	1	1
1960	0.585	0.327	0	0.074	0.246	0.474	0.733	1	1	1	1
1961	0.067	0.329	0	0.074	0.246	0.474	0.733	1	1	1	1
1962	0.125	0.426	0	0.074	0.246	0.474	0.733	1	1	1	1
1963	0.517	0.386	0	0.074	0.246	0.474	0.733	1	1	1	1
1964	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1965	0.057	0.542	0	0.074	0.246	0.474	0.733	1	1	1	1
1966	0.381	0.442	0	0.074	0.246	0.474	0.733	1	1	1	1
1967	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1968	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1

1969	0.167	0.493	0	0.074	0.246	0.474	0.733	1	1	1	1
1970	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1971	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1972	0.246	0.55	0	0.074	0.246	0.474	0.733	1	1	1	1
1973	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1974	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1975	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1976	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1977	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1978	5.436	0.196	0	0.074	0.246	0.474	0.733	1	1	1	1
1979	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1980	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1981	21.845	0.222	0	0.074	0.246	0.474	0.733	1	1	1	1
1982	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1983	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1984	2.222	0.417	0	0.074	0.246	0.474	0.733	1	1	1	1
1985	0.579	0.213	0	0.074	0.246	0.474	0.733	1	1	1	1
1986	10.974	0.156	0	0.074	0.246	0.474	0.733	1	1	1	1
1987	46.389	0.318	0	0.074	0.246	0.474	0.733	1	1	1	1
1988	2.876	0.215	0	0.074	0.246	0.474	0.733	1	1	1	1
1989	1.187	0.291	0	0.074	0.246	0.474	0.733	1	1	1	1
1990	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
1991	0.848	0.645	0	0.074	0.246	0.474	0.733	1	1	1	1
1992	0.315	0.636	0	0.074	0.246	0.474	0.733	1	1	1	1
1993	0.643	0.424	0	0.074	0.246	0.474	0.733	1	1	1	1
1994	0.094	1.029	0	0.074	0.246	0.474	0.733	1	1	1	1
1995	0.758	0.207	0	0.074	0.246	0.474	0.733	1	1	1	1
1996	7.922	0.232	0	0.074	0.246	0.474	0.733	1	1	1	1
1997	8.767	0.305	0	0.074	0.246	0.474	0.733	1	1	1	1
1998	0.37	0.451	0	0.074	0.246	0.474	0.733	1	1	1	1
1999	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
2000	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
2001	0.394	0.308	0	0.074	0.246	0.474	0.733	1	1	1	1
2002	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
2003	0.333	0.549	0	0.074	0.246	0.474	0.733	1	1	1	1
2004	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
2005	0.068	0.444	0	0.074	0.246	0.474	0.733	1	1	1	1
2006	0.103	0.554	0	0.074	0.246	0.474	0.733	1	1	1	1
2007	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1
2008	-999	1	0	0.074	0.246	0.474	0.733	1	1	1	1

```
# Phase Control Data
# Phase for Selectivity in 1st Year
   1
# Phase for Selectivity Deviations
   4
# Phase for F mult in 1st Year
   1
# Phase for F mult Deviations
   3
# Phase for Recruitment Deviations
   3
# Phase for N in 1st Year
   2
# Phase for Catchability in 1st Year
   1
# Phase for Catchability Deviations
   -5
# Phase for Stock Recruitment Relationship
   1
# Phase for Steepness
   1
# Recruitment CV by Year
   0.7
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#Lambda for Each Index (cv=0.4)
   1   1   1
# Lambda for Total Catch in Weight
   100
# Lambda for Total Discards at Age
   0
# Lambda for Catch at Age by Year & Fleet
        45
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# Lambda for Discards at Age by Year & Fleet
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# Lambda for F mult Deviations by Fleet
   0
# Lambda for N in 1st Year Deviations
   0
# Lambda for Recruitment Deviations
   1
# Lambda for Catchability Deviations by Index
   1   1   1
# Lambda for Selectivity Deviations by Fleet
   0
# Lambda for Selectivity Curvature at Age
   0
# Lambda for Selectivity Curvature Over Time
   0
# Lambda for Deviations from Initial Steepness
   0
# Lambda for Deviation from Initial log of Virgin Stock Size
   0
# NAA for Year 1
  100000  70000  50000  30000  20000  10000  5000  2500  1250
# Log of F mult in 1st year by Fleet
   -3
# log of Catchability in 1st year by index
   -7   -7   -7
# Initial log of Virgin Stock Size
   10
# Initial Steepness
   0.9
# Selectivity at Age in 1st Year by Fleet
     0.009
     0.092
     0.293
     0.703
         1
         1
         1
         1
         1
# Where to do Extras
   2
# Ignore Guesses
   0
# Projection Control Data
# Year for SSB ratio Calculation
   1929
# Fleet Directed Flag
   1
# Final Year of Projections
   2010
# Year Projected Recruits, What Projected, Target, non- directed F mult
      2009         2       0.3         1        -1
      2010         2       0.3         1        -1
# Test Value
   -23456
#####
# ---- FINIS ----
```

APPENDIX B

```
obj_fun        = 1184.38
Component          RSS      nobs  Lambda  Likelihood
  Catch_Fleet_1        0.0236194   80   100   2.36194
Catch_Fleet_Total     0.0236194   80   100   2.36194
  Discard_Fleet_1        0   80   0   0
Discard_Fleet_Total     0   80   0   0
CAA_proportions      N/A            720    see_below      530.926
Discard_proportions      N/A            720    see_below      0
  Index_Fit_1         166.917   39   1   119.157
  Index_Fit_2         16.057   68   1   104.852
  Index_Fit_3         76.8729   37   1   315.538
Index_Fit_Total     259.847   144   3   539.547
  Selectivity_devs_fleet_1   34.3354  2   0  0
Selectivity_devs_Total   34.3354  2   0  0
  Catchability_devs_index_1  0  39  1  0
  Catchability_devs_index_2  0  68  1  0
  Catchability_devs_index_3  0  37  1  0
Catchability_devs_Total  0  144  3  0
  Fmult_fleet_1     28.344   79   0  0
Fmult_fleet_Total   28.344   79   0  0
N_year_1            2.46086   8   0   0
Stock-Recruit_Fit   57.6502  80   1   53.8968
Recruit_devs        57.6502   80   1   57.6502
SRR_steepness       1.09899       1 0   0
SRR_virgin_stock    4.47778      1 0  0
Curvature_over_age  53.0086   14   0   0
Curvature_over_time 68.6708   702   0   0
F_penalty           1.74589    720     0.001     0.00174589
Mean_Sel_year1_pen  0   9      1000  0
Max_Sel_penalty     0.278802        1       100 0
Fmult_Max_penalty   0        ?       100 0

 Input and Estimated effective sample sizes for fleet 1
1929  45  36.2237
1930  45  14.0491
1931  45  9.04635
1932  45  10.0544
1933  45  21.7624
1934  45  43.2674
1935  45  35.2344
1936  45  28.2955
1937  45  7.80704
1938  45  22.3318
1939  45  31.5594
1940  45  37.0004
1941  45  22.3592
1942  45  25.8035
1943  45  9.88299
1944  45  41.0466
1945  45  58.3799
1946  45  66.6043
1947  45  150.869
1948  45  14.1723
1949  45  122.077
1950  45  99.5503
1951  45  263.272
1952  45  7.12822
1953  45  8.56774
1954  45  17.2541
1955  45  12.5785
1956  45  10.6006
1957  45  69.0312
1958  45  18.6191
1959  45  6.51177
1960  45  24.8915
1961  45  73.9718
1962  45  30.1446
1963  45  52.8996
1964  45  23.4466
1965  45  4.99631
1966  45  19.5674
1967  45  2.14204
1968  45  2.07588
1969  45  12.958
1970  45  13.1248
1971  45  10.4233
1972  45  10.0881
1973  45  8.08927
1974  45  269.388
1975  45  25.2922
1976  45  33.6836
1977  45  70.7012
1978  45  111.908
1979  45  38.7142
1980  45  37.5291
1981  45  7.06002
1982  45  22.3468
1983  45  13.7512
1984  45  10.7567
1985  45  7.2822
1986  45  35.1295
```

1987	45	18.4691
1988	45	35.7076
1989	45	8.48506
1990	45	26.341
1991	45	16.5076
1992	45	31.6193
1993	45	28.026
1994	45	325.181
1995	45	11.3491
1996	45	71.7909
1997	45	76.831
1998	45	41.3082
1999	45	65.4619
2000	45	108.359
2001	45	23.5083
2002	45	5.61202
2003	45	15.9449
2004	45	5.96139
2005	45	6.02485
2006	45	13.7905
2007	45	31.6195
2008	0	2.36347
Total	3555	3263.56

Input and Estimated effective Discard sample sizes for fleet 1

1929	0	1e+15
1930	0	1e+15
1931	0	1e+15
1932	0	1e+15
1933	0	1e+15
1934	0	1e+15
1935	0	1e+15
1936	0	1e+15
1937	0	1e+15
1938	0	1e+15
1939	0	1e+15
1940	0	1e+15
1941	0	1e+15
1942	0	1e+15
1943	0	1e+15
1944	0	1e+15
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1946	0	1e+15
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1958	0	1e+15
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1960	0	1e+15
1961	0	1e+15
1962	0	1e+15
1963	0	1e+15
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1968	0	1e+15
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1971	0	1e+15
1972	0	1e+15
1973	0	1e+15
1974	0	1e+15
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1978	0	1e+15
1979	0	1e+15
1980	0	1e+15
1981	0	1e+15
1982	0	1e+15
1983	0	1e+15
1984	0	1e+15
1985	0	1e+15
1986	0	1e+15
1987	0	1e+15
1988	0	1e+15
1989	0	1e+15
1990	0	1e+15
1991	0	1e+15
1992	0	1e+15
1993	0	1e+15
1994	0	1e+15
1995	0	1e+15
1996	0	1e+15
1997	0	1e+15
1998	0	1e+15

1999	0	1e+15
2000	0	1e+15
2001	0	1e+15
2002	0	1e+15
2003	0	1e+15
2004	0	1e+15
2005	0	1e+15
2006	0	1e+15
2007	0	1e+15
2008	0	1e+15
Total	0	8e+16

Observed and predicted total fleet catch by year

fleet 1 total catches

1929	25733.5	25741.8
1930	5825.88	5826.56
1931	6890.14	6890.57
1932	4938.95	4938.68
1933	33072.2	33026.1
1934	51483.8	51194.2
1935	66417.4	65125.2
1936	45714.2	44728.5
1937	31987.6	31502.6
1938	34561.8	34102
1939	45454	45249.7
1940	48868.2	49589.2
1941	32560.8	33263.3
1942	21885.7	22159.3
1943	35304.7	35855.2
1944	36657.1	37184.6
1945	23601.4	23810.9
1946	27582.5	27969.9
1947	19437	19872
1948	18124.7	18656.5
1949	24188.9	25021.8
1950	17493	17626
1951	15857.1	15540.8
1952	10325.8	10168.5
1953	5265.94	5236.22
1954	18464.7	18934.9
1955	22200.9	23068.4
1956	36835	37140.6
1957	27753.4	27262
1958	11874.8	12102.6
1959	19332.5	19554.3
1960	20822.5	21155.3
1961	26199.2	25858.5
1962	23901	22900
1963	23703	22335
1964	19987.9	18866.1
1965	11279.4	10898.5
1966	7405.18	7581.59
1967	1713.31	1732.8
1968	1695.04	1707.76
1969	1168.22	1171.32
1970	835.49	835.397
1971	911.26	911.794
1972	532	531.976
1973	400.94	401.036
1974	633.81	633.71
1975	2149.3	2148.38
1976	4091.65	4089.82
1977	13751.2	13730.3
1978	27172.6	27154.1
1979	35858.1	35846.7
1980	35203.1	35116.5
1981	46984.5	46846.3
1982	36371.4	36198.9
1983	42117.5	41802.2
1984	46468.3	46153.3
1985	46827.8	46075.7
1986	54122.6	54022.2
1987	48222.8	48682.2
1988	49264.6	49608.1
1989	49405.8	49245.7
1990	71550.6	70424.8
1991	65504.9	63934.7
1992	32217.5	31698.9
1993	20919.9	20683.5
1994	23737	23530.1
1995	11995.8	11919
1996	24562.7	24627.7
1997	51076.3	52266.2
1998	62822.7	64263.4
1999	15909.9	15928.7
2000	27791.9	28050.8
2001	13010.4	13141.7
2002	14122.8	14329.1
2003	12022.9	12128.3
2004	11195.4	11285.7
2005	13151.5	13206.2
2006	16265.1	16296.6
2007	13743.3	13746
2008	13743.3	13743.3

Observed and predicted total fleet Discards by year

```
 fleet 1 total Discards
1929  0  0
1930  0  0
1931  0  0
1932  0  0
1933  0  0
1934  0  0
1935  0  0
1936  0  0
1937  0  0
1938  0  0
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1941  0  0
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2002  0  0
2003  0  0
2004  0  0
2005  0  0
2006  0  0
2007  0  0
2008  0  0

Index data
index number 1
units = 1
month = 4
starting and ending ages for selectivity = 1  9
selectivity choice = -1
 year, sigma2, obs index, pred index
1962  0.237696  0.0429284  0.268188
1963  0.0974896  0.143439  0.182984
1964  0.190425  0.0511159  0.1149
1965  0.229574  0.0658689  0.0730904
1966  0.370805  0.0253169  0.0697859
1967  0.672149  0.00184983  0.0860493
```

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1968  1.10406  0.016614  0.146742
1969  1.07098  0.0728476  0.193622
1970  1.93856  0.00204988  0.197047
1971  0.583388  0.00713691  0.211389
1972  1.64914  0.000508051  0.195614
1973  2.22507  0.00269379  0.189564
1975  2.30918  0.000401044  0.406359
1976  0.264285  1.44157  1.38402
1977  0.0765202  2.89503  1.7583
1978  0.0468464  3.75184  2.41725
1979  0.0318862  4.12959  2.63254
1980  0.0231392  2.06239  2.32948
1981  0.0191367  2.40342  2.68956
1982  0.0167588  3.37185  2.25651
1983  0.0708694  2.84027  2.04102
1984  0.0240446  4.24635  1.82045
1985  0.0419564  3.62375  1.63859
1986  0.0284903  1.76601  1.47004
1987  0.0625202  1.12471  1.21239
1988  0.0883918  1.55145  1.19521
1989  0.110003  0.251322  0.942099
1990  0.0668817  0.506718  0.867667
1991  0.0703653  0.222483  0.664299
1992  0.207339  0.112365  0.495434
1993  0.112458  0.164169  0.493891
1994  0.273624  0.19519  0.478979
1995  0.12961  0.587796  0.551731
1996  0.260914  0.177525  0.60808
1997  0.117435  0.469986  0.552592
1998  0.160322  0.209194  0.341584
1999  0.191183  0.110532  0.248178
2000  0.162459  0.300632  0.202037
2001  1.02709  0.0510656  0.176915
index number 2
units = 2
month = 5
starting and ending ages for selectivity = 2  9
selectivity choice = -1
 year, sigma2, obs index, pred index
1935  0.0437444  1.21646  3.26014
1936  0.112655  1.7431  2.14752
1937  0.0365832  0.982776  1.73522
1938  0.0182737  2.18379  1.56086
1939  0.0212266  1.7226  1.55345
1940  0.0175056  2.53741  1.43095
1946  0.0402773  0.650503  0.562389
1947  0.0344474  0.742067  0.442904
1948  0.0274552  0.871831  0.565511
1949  0.0437444  0.420748  0.58799
1950  0.0527782  0.232001  0.413754
1951  0.0306906  0.171052  0.260908
1952  0.0663415  0.165434  0.18038
1953  0.15288  0.338172  0.221689
1954  0.0280885  1.22966  0.516462
1955  0.0340974  0.437882  0.531292
1956  0.0575872  0.339857  0.477769
1957  0.0532075  0.510347  0.363075
1958  0.0449299  0.513998  0.279651
1959  0.0433526  0.349968  0.378177
1960  0.11627  0.469058  0.401138
1961  0.0584822  0.44378  0.398097
1962  0.0746445  0.217115  0.407661
1963  0.0682557  0.390133  0.305671
1964  0.078702  0.153638  0.178806
1965  0.058932  0.285648  0.108565
1966  0.0481631  0.317106  0.103018
1967  0.0881748  0.129763  0.10114
1968  0.177254  0.195488  0.134086
1969  0.0969851  0.161221  0.285185
1970  0.176539  0.252224  0.358631
1971  0.0756499  0.412884  0.365455
1972  0.0958641  0.226103  0.301137
1973  0.216608  0.124427  0.279559
1974  0.191039  0.0901603  0.263493
1975  0.108498  0.22835  0.499596
1976  0.0930861  0.378056  0.545964
1977  0.0387796  1.46981  2.10855
1978  0.0246914  2.84609  3.13601
1979  0.0347991  3.32442  5.71703
1980  0.024393  4.37404  5.70554
1981  0.0323726  2.97641  5.19734
1982  0.023217  3.03989  5.95925
1983  0.0316947  3.05843  5.16684
1984  0.0274552  3.29633  3.55436
1985  0.0391515  2.41804  2.59132
1986  0.0402773  1.84815  2.1948
1987  0.0380407  1.24034  1.97627
1988  0.182289  0.902165  1.58064
1989  0.0477532  1.2232  1.72395
1990  0.078702  1.41251  1.17016
1991  0.0751464  1.58413  0.991806
1992  0.0506562  1.15804  0.805339
1993  0.0502367  1.36757  0.705475
1994  0.0384093  1.29455  0.795305
1995  0.0502367  1.17293  0.857487
```

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1996  0.0668178  1.25831  0.988486
1997  0.0731475  0.855259  0.888587
1998  0.0716641  0.385077  0.583458
1999  0.0892563  0.228069  0.343589
2000  0.0776787  0.417097  0.241661
2001  0.0860291  0.330869  0.206449
2002  0.133112  0.261493  0.225535
2003  0.098677  0.16712  0.19989
2004  0.100381  0.315421  0.199123
2005  0.440524  0.625505  0.253329
2006  0.060747  0.581127  0.412353
2007  0.290032  0.732799  0.574302
index number 3
units = 2
month = 1
starting and ending ages for selectivity = 2  9
selectivity choice = -1
 year, sigma2, obs index, pred index
1951  0.348765  0.00474773  0.145789
1952  0.255882  0.00727985  0.1038
1953  0.25005  0.0591884  0.0872772
1954  0.0305059  0.36336  0.134718
1955  0.0911935  0.0908399  0.167498
1956  0.0957546  0.0357662  0.178822
1957  0.147043  0.0139267  0.14683
1958  0.0259055  0.199088  0.117815
1959  0.0456003  0.0582388  0.128421
1960  0.10159  0.185161  0.135326
1961  0.102774  0.0212065  0.140097
1962  0.166765  0.0395644  0.139418
1963  0.138889  0.163638  0.128509
1965  0.257556  0.0180414  0.0590616
1966  0.178451  0.120592  0.0415373
1969  0.217567  0.052858  0.0739768
1972  0.264285  0.0778628  0.14546
1978  0.0376965  1.72058  0.8242
1981  0.048108  6.91428  2.24777
1984  0.160322  0.703297  2.0794
1985  0.0443699  0.183262  1.6993
1986  0.0240446  3.47344  1.33724
1987  0.0963315  14.6828  1.03622
1988  0.0451884  0.910298  0.832714
1989  0.0812859  0.375704  0.756381
1991  0.347854  0.268405  0.568572
1992  0.339679  0.0997023  0.463394
1993  0.165325  0.203519  0.406943
1994  0.722143  0.0297524  0.401192
1995  0.0419564  0.239919  0.418104
1996  0.0524255  2.50743  0.473022
1997  0.0889491  2.77489  0.482144
1998  0.185152  0.117111  0.384828
2001  0.0906302  0.124707  0.118829
2003  0.263441  0.1054  0.102402
2005  0.179932  0.021523  0.115245
2006  0.26767  0.0326011  0.162069

Selectivity by age and year for each fleet rescaled so max=1.0
 fleet 1 selectivity at age
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
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 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.0665279 0.275275 0.552692 0.814848 0.934979 1 0.597672 0.265649 0.041441
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.270373 1 0.238174 0.146137 0.102386 0.218185 0.277213 0.0251064 0.0335359
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
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 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
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 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
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 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
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 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864
 0.407434 0.711699 0.620368 0.75767 0.908753 1 0.787272 0.729486 0.40864

Fmult by year for each fleet
1929   0.0357653
1930   0.00757934
1931   0.0086251
1932   0.00646769
1933   0.0529301
1934   0.108351
1935   0.20034
1936   0.195105
1937   0.180744
1938   0.236438
1939   0.291464
1940   0.352304
1941   0.250186
1942   0.164527
1943   0.279614
1944   0.33988
1945   0.266283
1946   0.385029
1947   0.327166
1948   0.326627
1949   0.470767
1950   0.367333
1951   0.422506
1952   0.349676
1953   0.16266
1954   0.447751
1955   0.447379
1956   0.718881
1957   0.620093
1958   0.299561
1959   0.485562
1960   0.486616
1961   0.592254
1962   0.471838
1963   0.535444
1964   0.700192
1965   0.714154
1966   0.608781
1967   0.132015
1968   0.0983321
1969   0.0386934
1970   0.025958
1971   0.0248188
1972   0.0257217
1973   0.0115938
1974   0.0169377
1975   0.0191575
1976   0.0250138
1977   0.0252685
1978   0.043068
```

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1979   0.0442698
1980   0.0524044
1981   0.0566203
1982   0.0478136
1983   0.0629856
1984   0.0802796
1985   0.0892204
1986   0.123188
1987   0.13567
1988   0.151864
1989   0.176843
1990   0.288319
1991   0.325335
1992   0.214636
1993   0.145579
1994   0.173498
1995   0.0759861
1996   0.138543
1997   0.318584
1998   0.622754
1999   0.210548
2000   0.475146
2001   0.26917
2002   0.338106
2003   0.254637
2004   0.18629
2005   0.181456
2006   0.158491
2007   0.102832
2008   0.0873431

Directed F by age and year for each fleet
 fleet 1 directed F at age
 0.00237939 0.00984531 0.0197672 0.0291433 0.0334398 0.0357653 0.021376 0.00950101 0.00148215
 0.000504237 0.0020864 0.00418904 0.00617601 0.00708652 0.00757934 0.00452996 0.00201344 0.000314096
 0.00057381 0.00237427 0.00476702 0.00702815 0.00806428 0.0086251 0.00515498 0.00229124 0.000357433
 0.000430282 0.0017804 0.00357464 0.00527019 0.00604716 0.00646769 0.00386556 0.00171813 0.000268028
 0.00352133 0.0145703 0.029254 0.04313 0.0494885 0.0529301 0.0316349 0.0140608 0.00219348
 0.00720836 0.0298263 0.0598847 0.0882896 0.101306 0.108351 0.0647584 0.0287833 0.00449017
 0.0133282 0.0551486 0.110726 0.163247 0.187313 0.20034 0.119738 0.05322 0.00830229
 0.0129799 0.0537075 0.107833 0.158981 0.182419 0.195105 0.116609 0.0518293 0.00808534
 0.0120245 0.0497543 0.0998956 0.147279 0.168992 0.180744 0.108026 0.0480143 0.00749021
 0.0157297 0.0650854 0.130677 0.192661 0.221064 0.236438 0.141312 0.0628093 0.00979822
 0.0193905 0.0802328 0.16109 0.237499 0.272513 0.291464 0.1742 0.0774271 0.0120786
 0.023438 0.0969804 0.194715 0.287074 0.329396 0.352304 0.210562 0.0935889 0.0145998
 0.0166444 0.0688701 0.138276 0.203864 0.233919 0.250186 0.149529 0.0664617 0.010368
 0.0109457 0.0452902 0.0909328 0.134065 0.153829 0.164527 0.0983334 0.0437064 0.00681818
 0.0186022 0.0769709 0.154541 0.227843 0.261433 0.279614 0.167118 0.0742792 0.0115875
 0.0226115 0.0935605 0.187849 0.276951 0.31778 0.33988 0.203137 0.0902886 0.014085
 0.0177153 0.0733012 0.147173 0.216981 0.248969 0.266283 0.15915 0.0707378 0.011035
 0.0256152 0.105989 0.212802 0.31374 0.359994 0.385029 0.230121 0.102282 0.015956
 0.0217657 0.0900608 0.180822 0.266591 0.305894 0.327166 0.195538 0.0869113 0.0135581
 0.0217298 0.0899122 0.180524 0.266151 0.305389 0.326627 0.195216 0.0867679 0.0135357
 0.0313191 0.12959 0.260189 0.383604 0.440157 0.470767 0.281364 0.125059 0.0195091
 0.0244379 0.101118 0.203022 0.299321 0.343449 0.367333 0.219545 0.0975816 0.0152227
 0.0281084 0.116305 0.233515 0.344278 0.395034 0.422506 0.25252 0.112238 0.0175091
 0.0232632 0.0962572 0.193263 0.284933 0.32694 0.349676 0.208992 0.092891 0.0144909
 0.0108214 0.0447762 0.0899006 0.132543 0.152083 0.16266 0.0972172 0.0432103 0.00674078
 0.0297879 0.123255 0.247468 0.364849 0.418637 0.447751 0.267608 0.118944 0.0185552
 0.0297632 0.123152 0.247263 0.364546 0.41829 0.447379 0.267386 0.118846 0.0185398
 0.0478257 0.19789 0.39732 0.585779 0.672139 0.718881 0.429655 0.19097 0.0297912
 0.0412535 0.170696 0.34272 0.505282 0.579773 0.620093 0.370612 0.164727 0.0256973
 0.0199292 0.0824618 0.165565 0.244097 0.280083 0.299561 0.17904 0.079578 0.0124141
 0.0323034 0.133663 0.268366 0.39566 0.45399 0.485562 0.290207 0.128989 0.0201222
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Population Numbers at the Start of the Year
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 2.46669e+06 1.71715e+06 1.38731e+06 886065 474069 268802 84754.4 46190.6 296824
 2.3567e+06 1.49526e+06 1.03904e+06 837444 533662 285228 161636 51141.8 207920
 866344 1.42879e+06 905310 627959 505266 321731 171884 97659.2 157042
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 3.0875e+06 416312 2.18886e+06 328843 394351 7792.94 25372.5 2160.92 5609.71
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2001  1.96511e-06
2003  1.96511e-06
2005  1.96511e-06
2006  1.96511e-06

Proportions of catch at age by fleet
 fleet 1
Year 1 Obs  =  0.000132971 0.178158 0.321923 0.298312 0.0746246 0.055518 0.045829 0.0182423 0.00726013
Year 1 Pred =  0.0906126 0.240943 0.26074 0.219281 0.0795583 0.0462915 0.0380178 0.0178877 0.00666753
Year 2 Obs  =  0 0.0867775 0.446367 0.301453 0.11939 0.0417583 0.00273329 0.00108783 0.000433015
Year 2 Pred =  0.0646768 0.216395 0.277812 0.219375 0.142797 0.0481684 0.0156639 0.00965308 0.00545888
Year 3 Obs  =  0 0.048402 0.505194 0.313014 0.0660961 0.0380708 0.0187757 0.00747368 0.0029743
Year 3 Pred =  0.0564665 0.162514 0.263326 0.247703 0.151994 0.0921516 0.0173935 0.00421883 0.00423296
Year 4 Obs  =  0 0.0117399 0.261808 0.474939 0.113249 0.0764021 0.0397449 0.0158206 0.00629655
Year 4 Pred =  0.0575737 0.151054 0.210574 0.250026 0.182754 0.10445 0.0354189 0.0049859 0.00316428
Year 5 Obs  =  0 0.0505403 0.20803 0.348817 0.255576 0.0905435 0.0298707 0.0118901 0.00473207
Year 5 Pred =  0.0244541 0.166034 0.209811 0.213212 0.196277 0.133463 0.0430305 0.0109543 0.00276292
Year 6 Obs  =  0 0.0307845 0.335587 0.223908 0.256675 0.0975438 0.0356587 0.0141941 0.00564898
Year 6 Pred =  0.0207999 0.0789924 0.255179 0.231904 0.180964 0.154256 0.0596663 0.0147119 0.00352555
Year 7 Obs  =  0 0.0564975 0.0661942 0.320666 0.33166 0.174786 0.03225 0.0128372 0.00510896
Year 7 Pred =  0.0240764 0.075284 0.133642 0.304622 0.209874 0.150698 0.074119 0.0225022 0.00518217
Year 8 Obs  =  0 0.0193028 0.17522 0.149419 0.283927 0.301928 0.0451043 0.0179539 0.00714533
Year 8 Pred =  0.0681446 0.0895891 0.129662 0.160234 0.273257 0.172183 0.0710308 0.0279749 0.00792517
Year 9 Obs  =  0.001935 0.022218 0.0390255 0.120969 0.239529 0.392018 0.118413 0.0471347 0.0187587
Year 9 Pred =  0.0772983 0.221881 0.135338 0.136692 0.126573 0.197566 0.0713566 0.0234936 0.00980242
Year 10 Obs  =  0.00893818 0.134115 0.370324 0.191463 0.0499225 0.126082 0.0765549 0.0304729 0.0121276
Year 10 Pred =  0.124849 0.211736 0.280511 0.11891 0.0899232 0.0761695 0.0688465 0.0199437 0.00911099
Year 11 Obs  =  0.0170716 0.219961 0.224557 0.319107 0.105056 0.0597505 0.0354563 0.0144452 0.00459618
Year 11 Pred =  0.0865955 0.304538 0.235274 0.213442 0.0670021 0.0461046 0.0227803 0.0168611 0.00740191
Year 12 Obs  =  0.0248007 0.143047 0.460585 0.213906 0.131975 0.0194862 0.00531445 0.000885742 0
Year 12 Pred =  0.0605785 0.222418 0.351478 0.183123 0.121648 0.0345582 0.0139842 0.00578146 0.00643085
Year 13 Obs  =  0.007362 0.21227 0.360327 0.332515 0.0752556 0.010634 0.000817962 0.000817962 0
Year 13 Pred =  0.129227 0.154797 0.256772 0.274159 0.104164 0.0625228 0.0102427 0.00346617 0.00464877
Year 14 Obs  =  0 0.463869 0.168609 0.246309 0.100233 0.017871 0.00233102 0.000776952 0
Year 14 Pred =  0.0531001 0.321198 0.177743 0.204392 0.162327 0.0562612 0.0192619 0.00254438 0.00317336
Year 15 Obs  =  0.00444443 0.147556 0.647556 0.109778 0.0773333 0.0106666 0.00177775 0.000888928 0
Year 15 Pred =  0.0559236 0.142486 0.396427 0.152097 0.130981 0.0951509 0.0192499 0.00529986 0.0023853
Year 16 Obs  =  0 0.2375 0.236184 0.403289 0.101316 0.0184211 0.00263156 0 0.000657919
Year 16 Pred =  0.0700839 0.164766 0.189176 0.356096 0.100281 0.0782427 0.0333716 0.00562346 0.00235966
Year 17 Obs  =  0.0373743 0.281744 0.22185 0.163872 0.152851 0.0886441 0.0354577 0.0110205 0.00718732
Year 17 Pred =  0.0638592 0.208358 0.221187 0.17161 0.23582 0.0600318 0.0270983 0.00965993 0.00237713
Year 18 Obs  =  0.0500569 0.253697 0.308305 0.167994 0.10201 0.0652256 0.027683 0.0166857 0.00834285
Year 18 Pred =  0.0612544 0.186876 0.273694 0.196008 0.111599 0.138909 0.0209279 0.00789534 0.00283618
Year 19 Obs  =  0.168217 0.105226 0.236936 0.209019 0.137437 0.079456 0.0429492 0.0157481 0.00501085
Year 19 Pred =  0.194433 0.160077 0.217758 0.212541 0.11002 0.0563518 0.0409274 0.00525523 0.00263673
Year 20 Obs  =  0.0459588 0.62916 0.153724 0.0618066 0.0681458 0.0237718 0.0110936 0.00475437 0.00158485
Year 20 Pred =  0.0991772 0.424994 0.15707 0.143701 0.10228 0.0478261 0.0143243 0.00874555 0.0018812
Year 21 Obs  =  0.00763357 0.296619 0.490185 0.123773 0.0414394 0.0267176 0.0109052 0.00163574 0.00109049
Year 21 Pred =  0.0345807 0.245411 0.464031 0.113559 0.0752425 0.0481992 0.0134941 0.00346777 0.00201535
Year 22 Obs  =  0.000981302 0.146222 0.378803 0.380766 0.0706575 0.0117763 0.00883216 0.000981302 0.000981302
Year 22 Pred =  0.0346458 0.104347 0.325356 0.402676 0.0701528 0.0415131 0.0155679 0.0038139 0.00192761
Year 23 Obs  =  0.0285714 0.110989 0.19011 0.327473 0.313187 0.0186814 0.00659342 0.00219771 0.00219771
Year 23 Pred =  0.0464092 0.117685 0.156563 0.322856 0.288262 0.0451229 0.0158381 0.00511028 0.00215395
Year 24 Obs  =  0.0277779 0.0176766 0.108586 0.108586 0.474747 0.25505 0.00505068 0.00252507 0
Year 24 Pred =  0.164843 0.141642 0.159029 0.139815 0.206972 0.165695 0.0151687 0.00459343 0.00224116
Year 25 Obs  =  0.614865 0.114865 0.0743242 0.0765767 0.0315314 0.0450448 0.0427928 0 0
Year 25 Pred =  0.37005 0.27644 0.108511 0.0831772 0.0535899 0.071868 0.0326819 0.00246845 0.00121312
Year 26 Obs  =  0.0110974 0.764488 0.162762 0.0345253 0.0197287 0 0.00493225 0.00246605 0
Year 26 Pred =  0.0766298 0.598614 0.201607 0.0538811 0.0306855 0.0180069 0.0144945 0.00542789 0.00065349
Year 27 Obs  =  0.219298 0.249123 0.352632 0.150877 0.0157895 0.00175435 0.00350883 0.00175435 0.00526318
Year 27 Pred =  0.139081 0.158883 0.541561 0.118788 0.0225942 0.0114875 0.00400195 0.00283542 0.000769116
Year 28 Obs  =  0.00395652 0.51731 0.212661 0.18002 0.083086 0.00296739 0 0 0
Year 28 Pred =  0.0546912 0.346652 0.167429 0.361414 0.0557328 0.00940273 0.00295962 0.000942265 0.000776345
Year 29 Obs  =  0.0311493 0.123523 0.469388 0.16971 0.13319 0.0472609 0.0204082 0.00537054 0
Year 29 Pred =  0.0750568 0.161901 0.425151 0.125723 0.183539 0.0246558 0.0025092 0.000761687 0.000702505
Year 30 Obs  =  0.363234 0.084164 0.145072 0.233666 0.0996677 0.0454042 0.0287929 0 0
Year 30 Pred =  0.203812 0.184476 0.173237 0.292904 0.060428 0.0780565 0.00603268 0.000551911 0.000502533
Year 31 Obs  =  0.0265252 0.736074 0.122016 0.0570292 0.0384615 0.0159151 0.00397886 0 0
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Year 31 Pred =  0.110379 0.431757 0.172671 0.107656 0.132273 0.0245978 0.0190887 0.00126046 0.000316861
Year 32 Obs  =  0.0327868 0.256148 0.342213 0.204918 0.102459 0.034836 0.0266393 0 0
Year 32 Pred =  0.139608 0.24101 0.407653 0.105101 0.0462767 0.0505713 0.00560976 0.00388857 0.000280807
Year 33 Obs  =  0.099526 0.388626 0.2109 0.199052 0.078199 0.0165877 0.00710899 0 0
Year 33 Pred =  0.126536 0.31476 0.23205 0.250209 0.0453292 0.0177046 0.011733 0.00118013 0.000497582
Year 34 Obs  =  0.0132497 0.417966 0.225209 0.187863 0.12687 0.0254956 0.00334697 0 0
Year 34 Pred =  0.0433132 0.316927 0.337289 0.157832 0.118265 0.018913 0.00437701 0.00265427 0.00042897
Year 35 Obs  =  0.00592527 0.142545 0.383941 0.215353 0.184199 0.0591923 0.00884417 0 0
Year 35 Pred =  0.0399375 0.127109 0.400509 0.273972 0.0905277 0.0603199 0.00580192 0.0012036 0.000619175
Year 36 Obs  =  0.0337332 0.187382 0.158354 0.233831 0.266371 0.102963 0.0173653 0 0
Year 36 Pred =  0.0496149 0.140863 0.188022 0.370649 0.17596 0.0512609 0.0210127 0.00188229 0.000734742
Year 37 Obs  =  0.401408 0.0388331 0.0235413 0.0522133 0.169618 0.266398 0.047988 0 0
Year 37 Pred =  0.135911 0.171766 0.20031 0.16265 0.216606 0.0895126 0.0159664 0.00636334 0.000914247
Year 38 Obs  =  0.194677 0.427054 0.0769113 0.0616409 0.0523264 0.118213 0.0643685 0.00480818 0
Year 38 Pred =  0.0819762 0.379495 0.199074 0.142415 0.0783066 0.090902 0.0226254 0.00388133 0.00132468
Year 39 Obs  =  0.657835 0.145684 0.0128271 0.0917297 0.0331728 0.0237318 0.0278497 0.00660377 0.000566287
Year 39 Pred =  0.186824 0.182798 0.376588 0.129881 0.0655013 0.0320428 0.020798 0.00452744 0.00103967
Year 40 Obs  =  0.840647 0.0566066 0.0250615 0.0400243 0.0101157 0.00970434 0.00771655 0.00588063 0.00424303
Year 40 Pred =  0.309816 0.283399 0.130917 0.191872 0.0502639 0.0233554 0.00646907 0.00326329 0.000643827
Year 41 Obs  =  0.0137492 0.69875 0.179811 0.0656796 0.0209859 0.0182135 0.00281098 0 0
Year 41 Pred =  0.101385 0.499766 0.218294 0.0726195 0.0814997 0.0197498 0.00514655 0.00108972 0.000449556
Year 42 Obs  =  0.318667 0.681333 0 0 0 0 0 0 0
Year 42 Pred =  0.27978 0.535362 0.152615 0.0202754 0.0031893 0.0066216 0.00190221 7.59802e-05 0.000178028
Year 43 Obs  =  0 0.918346 0.0721092 0.00318711 0.00381488 0.00254325 0 0 0
Year 43 Pred =  0.0759693 0.74302 0.0914067 0.0679231 0.0103224 0.00493523 0.00609506 0.000125067 0.000203605
Year 44 Obs  =  0.615382 0.0919161 0.136717 0.148312 0.00432343 0.00334868 0 0 0
Year 44 Pred =  0.447104 0.262351 0.165091 0.0529178 0.0449795 0.0207752 0.0059088 0.000521311 0.000351179
Year 45 Obs  =  0.050081 0.546991 0.153253 0.0329207 0.0749215 0.0883818 0.049331 0.00206004 0.00206004
Year 45 Pred =  0.163443 0.698865 0.0262456 0.0430231 0.0157707 0.0407724 0.0112063 0.000227313 0.000446484
Year 46 Obs  =  0.669105 0.23874 0.0758828 0.0122035 0.00406887 0 0 0 0
Year 46 Pred =  0.683062 0.211584 0.0583367 0.00567501 0.0106322 0.0118469 0.0182394 0.000357915 0.000264923
Year 47 Obs  =  0.0195705 0.955894 0.0135269 0.00990975 0.000285205 0.000541739 0.000271624 0 0
Year 47 Pred =  0.0733956 0.88096 0.0175722 0.012579 0.00139899 0.00796731 0.0052846 0.000580932 0.000261877
Year 48 Obs  =  0.875994 0.010291 0.11054 4.70167e-05 0.00144059 0 0.00168696 0 0
Year 48 Pred =  0.877649 0.0643564 0.0497996 0.00258205 0.00211363 0.000714376 0.00242108 0.000114731 0.000249414
Year 49 Obs  =  0.229832 0.762596 0.00161824 0.00595355 0 0 0 0 0
Year 49 Pred =  0.179712 0.806837 0.00380569 0.00767353 0.0004551 0.00113228 0.000227655 5.5114e-05 0.00010154
Year 50 Obs  =  0.596692 0.152357 0.231306 0.00942713 0.00813682 0.00208085 0 0 0
Year 50 Pred =  0.633317 0.166713 0.174955 0.00426459 0.0167802 0.00156124 0.00143873 0.000211031 0.00075917
Year 51 Obs  =  0.000203985 0.767831 0.111662 0.113603 0.0016599 0.00504044 0 0 0
Year 51 Pred =  0.0742972 0.687368 0.0898171 0.131983 0.00313968 0.0112735 0.000752022 0.000820695 0.000547934
Year 52 Obs  =  0.397376 0.0209664 0.481455 0.0510616 0.0458306 0.00252993 0.000779936 0 0
Year 52 Pred =  0.355795 0.0831943 0.382112 0.0698827 0.100153 0.00217317 0.00559863 0.000442435 0.000648343
Year 53 Obs  =  0.12455 0.29922 0.0716614 0.451951 0.0312945 0.0200249 0.000493155 0.000804903 0
Year 53 Pred =  0.346695 0.299654 0.0347443 0.223385 0.0398087 0.0519958 0.00080949 0.00247317 0.000434377
Year 54 Obs  =  0.124414 0.279434 0.25634 0.0765293 0.239475 0.0178835 0.00592472 0 0
Year 54 Pred =  0.115233 0.426448 0.182577 0.0296559 0.185844 0.0301837 0.0282565 0.000521832 0.00128024
Year 55 Obs  =  0.0248154 0.0245617 0.387195 0.350854 0.0551877 0.155191 0.00219528 0 0
Year 55 Pred =  0.0818168 0.17135 0.314767 0.188525 0.0298361 0.170422 0.019876 0.0220581 0.00134824
Year 56 Obs  =  0.0282877 0.00524412 0.0943585 0.481844 0.248019 0.0617107 0.0785911 0.0019442 0
Year 56 Pred =  0.170747 0.108831 0.112934 0.290131 0.168919 0.0243188 0.099837 0.0138342 0.0104477
Year 57 Obs  =  0.0308318 0.165781 0.0492178 0.154192 0.475344 0.101534 0.0131711 0.00992887 0
Year 57 Pred =  0.234165 0.194207 0.0611788 0.0888127 0.22137 0.117034 0.0121096 0.0591998 0.0119235
Year 58 Obs  =  0.138839 0.327844 0.169457 0.0388448 0.0662747 0.188477 0.0547372 0.00753582 0.0079909
Year 58 Pred =  0.25801 0.267768 0.109746 0.048286 0.0678086 0.153151 0.0583524 0.00720371 0.0296739
Year 59 Obs  =  0.127165 0.506432 0.230247 0.0375036 0.0201527 0.0247659 0.0332249 0.0145325 0.00597554
Year 59 Pred =  0.161614 0.331053 0.16891 0.0967817 0.0410519 0.0520633 0.084697 0.03867 0.0251592
Year 60 Obs  =  0.570154 0.0823816 0.196302 0.0713299 0.0154715 0.0105521 0.0139787 0.0225674 0.0172625
Year 60 Pred =  0.464115 0.139384 0.140164 0.0999424 0.0550956 0.0210695 0.0192633 0.0376235 0.0233432
Year 61 Obs  =  0.10365 0.76615 0.0397887 0.0318993 0.0214395 0.0129103 0.0120773 0.00411792 0.00796741
Year 61 Pred =  0.162549 0.50405 0.0741851 0.104184 0.0712669 0.0353368 0.00975626 0.0107366 0.0279349
Year 62 Obs  =  0.180593 0.118733 0.264447 0.0731527 0.103116 0.119672 0.0502753 0.0399953 0.0500162
Year 62 Pred =  0.305728 0.185388 0.281775 0.0576084 0.0769107 0.0470173 0.0169796 0.00567543 0.0229173
Year 63 Obs  =  0.138341 0.467133 0.111522 0.110364 0.0529952 0.0474732 0.0341453 0.0153868 0.0226398
Year 63 Pred =  0.266308 0.3175 0.0927166 0.196467 0.0377663 0.0445649 0.0197906 0.00877931 0.0161068
Year 64 Obs  =  0.121609 0.329654 0.134973 0.107747 0.116311 0.0885753 0.0611695 0.0287533 0.0112088
Year 64 Pred =  0.24343 0.302993 0.172103 0.0706617 0.141365 0.0240411 0.0203651 0.0111303 0.0139106
Year 65 Obs  =  0.568585 0.102906 0.117101 0.0377232 0.0369103 0.0553067 0.0316353 0.0317291 0.0181029
Year 65 Pred =  0.458158 0.197623 0.119117 0.094975 0.0373052 0.0668501 0.00815757 0.00837436 0.00943972
Year 66 Obs  =  0.281886 0.418543 0.109505 0.0498703 0.0633214 0.0332717 0.020579 0.016348 0.006675
Year 66 Pred =  0.308944 0.415399 0.0878915 0.0739759 0.0566246 0.0200182 0.0258991 0.00380091 0.00744671
Year 67 Obs  =  0.597211 0.275366 0.0682615 0.0127006 0.00713895 0.0183222 0.00981228 0.00684189 0.00434565
Year 67 Pred =  0.378087 0.282233 0.184535 0.0549251 0.0445745 0.0307558 0.00776751 0.0120965 0.0050263
Year 68 Obs  =  0.286794 0.435129 0.124389 0.0595121 0.0370643 0.0254399 0.0135528 0.0106332 0.00748687
Year 68 Pred =  0.233417 0.395107 0.146167 0.133266 0.0383701 0.0282301 0.0140674 0.00423391 0.00714125
Year 69 Obs  =  0.160104 0.328173 0.216088 0.0853181 0.0553272 0.0501796 0.0322665 0.0274253 0.0451183
Year 69 Pred =  0.137557 0.303888 0.25407 0.130081 0.112863 0.0291024 0.0156674 0.00941532 0.0073556
Year 70 Obs  =  0.0907195 0.132568 0.258606 0.158071 0.103525 0.0889858 0.0711439 0.0431607 0.0532205
Year 70 Pred =  0.128678 0.193053 0.206587 0.237219 0.111918 0.0847067 0.0162372 0.0108527 0.010749
Year 71 Obs  =  0.313482 0.077059 0.0700383 0.159918 0.15245 0.116195 0.0508593 0.0347571 0.0252423
Year 71 Pred =  0.275547 0.156542 0.10611 0.162278 0.171753 0.0697766 0.0372712 0.0091375 0.0115864
Year 72 Obs  =  0.366854 0.191166 0.0644712 0.109169 0.128236 0.0826361 0.0354184 0.0142007 0.00784852
Year 72 Pred =  0.373315 0.253577 0.0707096 0.0659878 0.0945942 0.088609 0.0265958 0.0173458 0.00926581
Year 73 Obs  =  0.305678 0.439405 0.0756729 0.0419842 0.0518005 0.0459145 0.0211745 0.0119458 0.00642483
Year 73 Pred =  0.422165 0.314667 0.0993975 0.0391559 0.0339662 0.0424114 0.0284244 0.0107167 0.00909615
Year 74 Obs  =  0.110228 0.780057 0.0787162 0.0181348 0.0034718 0.00554983 0.00384275 0 0
Year 74 Pred =  0.214219 0.45734 0.164787 0.0724443 0.0268513 0.0206122 0.0187363 0.0153931 0.00961547
Year 75 Obs  =  0.527677 0.296787 0.102162 0.0375274 0.0131551 0.0129358 0.00656773 0.00189719 0.00129092
Year 75 Pred =  0.382544 0.209787 0.213244 0.107846 0.0446015 0.0145864 0.00806157 0.0090419 0.0102879
Year 76 Obs  =  0.79319 0.120929 0.039149 0.0283708 0.0120824 0.00242117 0.00161412 0.000629423 0.00161412
Year 76 Pred =  0.499839 0.258007 0.0681617 0.097219 0.0467655 0.0172362 0.0040514 0.00272966 0.00599075
Year 77 Obs  =  0.815607 0.112104 0.0574635 0.00831505 0.00325068 0.00198288 0.00102078 0.000256591 0
Year 77 Pred =  0.555274 0.286291 0.072013 0.0266087 0.0363017 0.0156574 0.0041607 0.00118219 0.0025106
Year 78 Obs  =  0.590902 0.288833 0.0594579 0.0298918 0.0169937 0.00475702 0.00376538 0.00539941 0
Year 78 Pred =  0.416196 0.408692 0.102673 0.0361622 0.012805 0.0156846 0.00486837 0.00156201 0.00135704
```

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Year 79 Obs  =  0.552445 0.269411 0.0984565 0.0435435 0.0243505 0.00805001 0.00304855 0.000694974 0
Year 79 Pred =  0.430467 0.325631 0.15606 0.0550187 0.0186723 0.00596115 0.00523359 0.00195319 0.00100294
Year 80 Obs  =  0 0 0 0 0 0 0 0 0
Year 80 Pred =  0.182935 0.467104 0.173965 0.116782 0.0398823 0.0122685 0.00281127 0.00294679 0.0013061

Proportions of Discards at age by fleet
 fleet 1
Year 1 Obs  =  0 0 0 0 0 0 0 0 0
Year 1 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 2 Obs  =  0 0 0 0 0 0 0 0 0
Year 2 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 3 Obs  =  0 0 0 0 0 0 0 0 0
Year 3 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 4 Obs  =  0 0 0 0 0 0 0 0 0
Year 4 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 5 Obs  =  0 0 0 0 0 0 0 0 0
Year 5 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 6 Obs  =  0 0 0 0 0 0 0 0 0
Year 6 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 7 Obs  =  0 0 0 0 0 0 0 0 0
Year 7 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 8 Obs  =  0 0 0 0 0 0 0 0 0
Year 8 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 9 Obs  =  0 0 0 0 0 0 0 0 0
Year 9 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 10 Obs  =  0 0 0 0 0 0 0 0 0
Year 10 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 11 Obs  =  0 0 0 0 0 0 0 0 0
Year 11 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 12 Obs  =  0 0 0 0 0 0 0 0 0
Year 12 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 13 Obs  =  0 0 0 0 0 0 0 0 0
Year 13 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 14 Obs  =  0 0 0 0 0 0 0 0 0
Year 14 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 15 Obs  =  0 0 0 0 0 0 0 0 0
Year 15 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 16 Obs  =  0 0 0 0 0 0 0 0 0
Year 16 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 17 Obs  =  0 0 0 0 0 0 0 0 0
Year 17 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 18 Obs  =  0 0 0 0 0 0 0 0 0
Year 18 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 19 Obs  =  0 0 0 0 0 0 0 0 0
Year 19 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 20 Obs  =  0 0 0 0 0 0 0 0 0
Year 20 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 21 Obs  =  0 0 0 0 0 0 0 0 0
Year 21 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 22 Obs  =  0 0 0 0 0 0 0 0 0
Year 22 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 23 Obs  =  0 0 0 0 0 0 0 0 0
Year 23 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 24 Obs  =  0 0 0 0 0 0 0 0 0
Year 24 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 25 Obs  =  0 0 0 0 0 0 0 0 0
Year 25 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 26 Obs  =  0 0 0 0 0 0 0 0 0
Year 26 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 27 Obs  =  0 0 0 0 0 0 0 0 0
Year 27 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 28 Obs  =  0 0 0 0 0 0 0 0 0
Year 28 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 29 Obs  =  0 0 0 0 0 0 0 0 0
Year 29 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 30 Obs  =  0 0 0 0 0 0 0 0 0
Year 30 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 31 Obs  =  0 0 0 0 0 0 0 0 0
Year 31 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 32 Obs  =  0 0 0 0 0 0 0 0 0
Year 32 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 33 Obs  =  0 0 0 0 0 0 0 0 0
Year 33 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 34 Obs  =  0 0 0 0 0 0 0 0 0
Year 34 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 35 Obs  =  0 0 0 0 0 0 0 0 0
Year 35 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 36 Obs  =  0 0 0 0 0 0 0 0 0
Year 36 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 37 Obs  =  0 0 0 0 0 0 0 0 0
Year 37 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 38 Obs  =  0 0 0 0 0 0 0 0 0
Year 38 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 39 Obs  =  0 0 0 0 0 0 0 0 0
Year 39 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 40 Obs  =  0 0 0 0 0 0 0 0 0
Year 40 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 41 Obs  =  0 0 0 0 0 0 0 0 0
Year 41 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 42 Obs  =  0 0 0 0 0 0 0 0 0
Year 42 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 43 Obs  =  0 0 0 0 0 0 0 0 0
Year 43 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 44 Obs  =  0 0 0 0 0 0 0 0 0
Year 44 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
```

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Year 45 Obs  =  0 0 0 0 0 0 0 0 0
Year 45 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 46 Obs  =  0 0 0 0 0 0 0 0 0
Year 46 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 47 Obs  =  0 0 0 0 0 0 0 0 0
Year 47 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 48 Obs  =  0 0 0 0 0 0 0 0 0
Year 48 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 49 Obs  =  0 0 0 0 0 0 0 0 0
Year 49 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 50 Obs  =  0 0 0 0 0 0 0 0 0
Year 50 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 51 Obs  =  0 0 0 0 0 0 0 0 0
Year 51 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 52 Obs  =  0 0 0 0 0 0 0 0 0
Year 52 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 53 Obs  =  0 0 0 0 0 0 0 0 0
Year 53 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 54 Obs  =  0 0 0 0 0 0 0 0 0
Year 54 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 55 Obs  =  0 0 0 0 0 0 0 0 0
Year 55 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 56 Obs  =  0 0 0 0 0 0 0 0 0
Year 56 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 57 Obs  =  0 0 0 0 0 0 0 0 0
Year 57 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 58 Obs  =  0 0 0 0 0 0 0 0 0
Year 58 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 59 Obs  =  0 0 0 0 0 0 0 0 0
Year 59 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 60 Obs  =  0 0 0 0 0 0 0 0 0
Year 60 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 61 Obs  =  0 0 0 0 0 0 0 0 0
Year 61 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 62 Obs  =  0 0 0 0 0 0 0 0 0
Year 62 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 63 Obs  =  0 0 0 0 0 0 0 0 0
Year 63 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 64 Obs  =  0 0 0 0 0 0 0 0 0
Year 64 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 65 Obs  =  0 0 0 0 0 0 0 0 0
Year 65 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 66 Obs  =  0 0 0 0 0 0 0 0 0
Year 66 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 67 Obs  =  0 0 0 0 0 0 0 0 0
Year 67 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 68 Obs  =  0 0 0 0 0 0 0 0 0
Year 68 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 69 Obs  =  0 0 0 0 0 0 0 0 0
Year 69 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 70 Obs  =  0 0 0 0 0 0 0 0 0
Year 70 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 71 Obs  =  0 0 0 0 0 0 0 0 0
Year 71 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 72 Obs  =  0 0 0 0 0 0 0 0 0
Year 72 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 73 Obs  =  0 0 0 0 0 0 0 0 0
Year 73 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 74 Obs  =  0 0 0 0 0 0 0 0 0
Year 74 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 75 Obs  =  0 0 0 0 0 0 0 0 0
Year 75 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 76 Obs  =  0 0 0 0 0 0 0 0 0
Year 76 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 77 Obs  =  0 0 0 0 0 0 0 0 0
Year 77 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 78 Obs  =  0 0 0 0 0 0 0 0 0
Year 78 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 79 Obs  =  0 0 0 0 0 0 0 0 0
Year 79 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15
Year 80 Obs  =  0 0 0 0 0 0 0 0 0
Year 80 Pred =  1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15 1e-15

F Reference Points Using Final Year Selectivity Scaled Max=1.0
 refpt           F        slope to plot on SRR
  F0.1      0.546603     11.8214
  Fmax      9.99999     6364.79
  F30%SPR  0.43591     9.24096
  F40%SPR  0.316978     6.93074
  Fmsy      0.138133     4.26029    SSmsy    122357     MSY   23048.2
  Foy       0.1036     xxxxxx    SSoy    158998     OY   21792
  Fcurrent 0.0873431     3.65958

Stock-Recruitment Relationship Parameters
 alpha     = 1.44455e+06
 beta      = 216717
 virgin    = 182787
 steepness = 0.315471
Spawning Stock, Obs Recruits(year+1), Pred Recruits(year+1)
1929  1.08911e+06  2.83254e+06  1.20481e+06
1930  996757  2.46669e+06  1.18656e+06
1931  963593  2.3567e+06  1.17932e+06
1932  928197  866344  1.17112e+06
1933  840657  564630  1.14848e+06
1934  712147  441430  1.10752e+06
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1935  564283  816214  1.04371e+06
1936  429301  692408  959953
1937  327346  989893  869141
1938  253329  676424  778533
1939  224774  438609  735457
1940  179607  876571  654644
1941  155143  352122  602678
1942  139479  334084  565656
1943  140357  338972  567817
1944  123104  248540  523304
1945  101881  193681  461936
1946  85730.5  557898  409466
1947  67354.4  309960  342508
1948  58863.8  102598  308555
1949  55983.5  80024.9  296556
1950  49164.6  74263.5  267114
1951  42537  204026  237014
1952  33991  659370  195852
1953  28592.7  200881  168373
1954  31721.9  410646  184447
1955  38991.7  147555  220272
1956  45090.2  154403  248790
1957  40031.8  399309  225232
1958  32676.7  239901  189272
1959  33843.3  322528  195116
1960  35366  297979  202663
1961  35607.8  93976.6  203853
1962  38256.4  68283.6  216741
1963  38083  54550.1  215906
1964  29331  96708  172203
1965  18498.5  47216.3  113607
1966  13217.8  114845  83039.7
1967  10701.7  309418  67976.6
1968  12437.3  155927  78402.4
1969  19114.7  180759  117084
1970  29403.1  40830.5  172575
1971  39319.3  153731  221838
1972  43519.9  79784.9  241575
1973  47194.4  572756  258324
1974  52977.2  105878  283759
1975  67411.2  3.19561e+06  342729
1976  91854.8  1.57267e+06  430010
1977  139675  6.24907e+06  566140
1978  243480  698876  764279
1979  367600  3.0875e+06  908782
1980  437089  3.67572e+06  965725
1981  546112  1.02151e+06  1.03416e+06
1982  611964  502391  1.06677e+06
1983  591001  804937  1.05697e+06
1984  572172  982993  1.04772e+06
1985  493089  951396  1.0035e+06
1986  419170  459336  952232
1987  345766  1.50165e+06  887985
1988  297606  470734  835869
1989  237230  735979  754913
1990  211149  556558  712876
1991  170401  402952  635859
1992  127154  888898  534153
1993  110197  644569  486934
1994  92115.1  843485  430865
1995  104429  502186  469732
1996  116908  218035  506196
1997  125597  124645  530013
1998  102816  175248  464812
1999  69736.9  235521  351674
2000  54266.5  265956  289282
2001  32720.8  113006  189493
2002  27249.5  183753  161347
2003  31670.1  331431  184185
2004  32062.8  615782  186174
2005  29420.1  603758  172663
2006  40167.2  781553  225874
2007  56688.2  307250  299515
2008  83183.3       xxxx   400675

average F (ages 4 to 8 unweighted) by year
Projection into Future
Projected NAA
 2 179842 259103 111189 60715.2 17163.2 4777.02 1404.64 2873.52
 2 1.14668 98866.2 144248 60738 32481.3 9066.94 2598.85 2417.52
Projected Directed FAA
 0.05628 0.0983092 0.0856933 0.104659 0.125529 0.138133 0.108748 0.100766 0.0564468
 0.05628 0.0983092 0.0856933 0.104659 0.125529 0.138133 0.108748 0.100766 0.0564468
Projected Discard FAA
 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0
Projected Nondirected FAA
 -0 -0 -0 -0 -0 -0 -0 -0 -0
 -0 -0 -0 -0 -0 -0 -0 -0 -0
Projected Catch at Age
 0.0863326 13305.2 16804.6 8732.4 5665.87 1752.55 389.114 106.399 124.397
 0.0863326 0.0848344 6412.14 11328.7 5668 3316.7 738.55 196.858 104.657
Projected Discards at Age (in numbers)
 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0
```

```
Projected Yield at Age
 0.0101009 2887.23 6032.83 4863.95 4198.41 1538.74 338.918 98.3125 116.312
 0.0101009 0.0184091 2301.96 6310.11 4199.99 2912.06 643.277 181.897 97.8539
Year, Total Yield (in weight), Total Discards (in weight), SSB, proj_what, SS/SSmsy
2009  20074.7  0  111152  0  0.908424
2010  16647.2  0  120568  0  0.985386

M =  0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5
mature =  0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
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 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
 0 0.07 0.25 0.47 0.73 1 1 1 1
Weight at age
 0.074 0.167 0.297 0.402 0.523 0.615 0.704 0.8 0.83
 0.06 0.139 0.301 0.422 0.511 0.603 0.698 0.8 0.83
 0.077 0.114 0.276 0.399 0.527 0.606 0.701 0.8 0.83
 0.058 0.081 0.277 0.379 0.508 0.604 0.711 0.8 0.83
 0.059 0.083 0.2 0.299 0.493 0.585 0.7 0.8 0.83
 0.065 0.142 0.198 0.233 0.431 0.538 0.683 0.8 0.83
```

0.079 0.186 0.217 0.251 0.379 0.472 0.629 0.79 0.83
0.086 0.193 0.284 0.338 0.393 0.453 0.574 0.75 0.82
0.119 0.176 0.318 0.429 0.461 0.502 0.575 0.74 0.8
0.124 0.174 0.31 0.448 0.532 0.582 0.633 0.726 0.79
0.191 0.246 0.363 0.46 0.583 0.68 0.775 0.795 0.878
0.18 0.26 0.339 0.442 0.527 0.64 0.729 0.834 0.82
0.115 0.259 0.343 0.439 0.559 0.65 0.806 0.807 0.85
0.18 0.236 0.373 0.471 0.546 0.626 0.684 0.909 0.83
0.165 0.292 0.339 0.474 0.574 0.65 0.629 0.881 1
0.144 0.271 0.379 0.472 0.587 0.66 0.754 0.735 0.948
0.121 0.234 0.383 0.494 0.611 0.704 0.745 0.819 0.842
0.125 0.261 0.384 0.487 0.617 0.679 0.736 0.778 0.812
0.119 0.291 0.4 0.499 0.622 0.709 0.753 0.788 0.818
0.107 0.227 0.354 0.506 0.616 0.706 0.764 0.895 0.871
0.109 0.192 0.319 0.456 0.607 0.725 0.799 0.917 0.917
0.084 0.249 0.323 0.455 0.564 0.664 0.784 0.799 0.871
0.162 0.255 0.346 0.429 0.569 0.694 0.827 0.835 0.853
0.173 0.297 0.386 0.471 0.568 0.719 0.832 0.988 0.85
0.162 0.296 0.411 0.512 0.603 0.763 0.834 0.85 1.1
0.084 0.257 0.387 0.505 0.585 0.744 0.701 0.879 0.87
0.14 0.253 0.357 0.484 0.583 0.744 0.762 0.778 0.878
0.111 0.248 0.373 0.485 0.598 0.752 0.722 0.91 0.87
0.179 0.31 0.374 0.509 0.602 0.649 0.65 0.7 1
0.176 0.292 0.396 0.488 0.617 0.685 0.775 0.75 0.75
0.132 0.251 0.398 0.51 0.602 0.702 0.754 0.84 0.85
0.102 0.276 0.391 0.507 0.611 0.699 0.768 0.82 0.87
0.144 0.252 0.389 0.495 0.584 0.647 0.817 0.83 0.85
0.276 0.32 0.42 0.54 0.622 0.712 0.782 0.89 0.86
0.197 0.298 0.434 0.538 0.627 0.73 0.743 0.84 0.93
0.181 0.3 0.4 0.503 0.612 0.748 0.812 0.82 0.87
0.109 0.195 0.384 0.501 0.596 0.723 0.735 0.88 0.85
0.149 0.273 0.419 0.525 0.658 0.79 0.833 0.85 0.93
0.166 0.235 0.488 0.51 0.599 0.723 0.869 0.917 0.849
0.138 0.266 0.391 0.562 0.593 0.709 0.902 0.952 1.07
0.103 0.322 0.428 0.505 0.662 0.746 0.907 1 1.1
0.099 0.232 0.402 0.584 0.73 0.837 0.85 1 1.2
0.266 0.282 0.457 0.481 0.74 0.955 0.88 0.9 1.2
0.147 0.266 0.449 0.508 0.552 0.746 1 0.9 1.1
0.119 0.329 0.433 0.609 0.606 0.686 0.758 0.803 0.838
0.107 0.303 0.604 0.74 0.837 0.8 0.8 0.8 1
0.127 0.361 0.517 0.973 1.053 1.029 1.35 0.9 0.9
0.17 0.297 0.672 0.864 1.291 1.223 1.531 1.2 1
0.122 0.322 0.6 0.847 1.063 1.1 1.3 1.5 1.3
0.062 0.334 0.473 0.705 0.908 1.1 1.2 1.4 1.6
0.082 0.189 0.44 0.598 0.81 0.969 1.2 1.3 1.5
0.072 0.176 0.27 0.437 0.598 0.874 1.066 1.3 1.4
0.083 0.19 0.239 0.391 0.597 0.715 0.953 0.929 1.4
0.032 0.151 0.237 0.345 0.516 0.773 0.916 1 1.2
0.049 0.191 0.302 0.39 0.458 0.511 0.688 0.9 1.1
0.12 0.235 0.351 0.396 0.505 0.614 0.638 0.871 0.91
0.157 0.285 0.418 0.461 0.484 0.56 0.612 0.697 0.85
0.148 0.29 0.408 0.508 0.561 0.595 0.63 0.719 0.784
0.133 0.272 0.414 0.523 0.6 0.691 0.717 0.766 0.826
0.101 0.301 0.415 0.576 0.666 0.734 0.806 0.815 0.899
0.104 0.193 0.381 0.542 0.647 0.749 0.757 0.739 0.827
0.094 0.267 0.377 0.554 0.649 0.68 0.749 0.775 0.803
0.071 0.217 0.397 0.514 0.591 0.664 0.724 0.766 0.799
0.087 0.175 0.33 0.459 0.544 0.661 0.691 0.725 0.805
0.073 0.228 0.294 0.408 0.583 0.607 0.72 0.756 0.832
0.1 0.156 0.248 0.361 0.493 0.597 0.644 0.733 0.785
0.081 0.179 0.275 0.431 0.586 0.689 0.74 0.758 0.92
0.105 0.182 0.318 0.471 0.589 0.649 0.674 0.705 0.751
0.149 0.239 0.333 0.446 0.572 0.637 0.719 0.718 0.749
0.139 0.267 0.325 0.419 0.53 0.615 0.631 0.667 0.689
0.148 0.228 0.399 0.509 0.575 0.633 0.688 0.754 0.768
0.114 0.266 0.37 0.55 0.59 0.608 0.646 0.712 0.731
0.103 0.253 0.347 0.534 0.567 0.619 0.617 0.635 0.627
0.133 0.218 0.303 0.412 0.552 0.687 0.656 0.728 0.65
0.125 0.284 0.414 0.603 0.679 0.745 0.809 0.794 0.838
0.159 0.28 0.407 0.596 0.685 0.821 0.926 0.82 0.902
0.106 0.267 0.38 0.463 0.556 0.665 0.737 0.797 0.84
0.126 0.222 0.353 0.522 0.752 0.824 0.848 0.918 0.935
0.117 0.217 0.359 0.557 0.741 0.878 0.871 0.924 0.935
0.117 0.217 0.359 0.557 0.741 0.878 0.871 0.924 0.935
Fecundity
0 0.01169 0.07425 0.18894 0.38179 0.615 0.704 0.8 0.83
0 0.00973 0.07525 0.19834 0.37303 0.603 0.698 0.8 0.83
0 0.00798 0.069 0.18753 0.38471 0.606 0.701 0.8 0.83
0 0.00567 0.06925 0.17813 0.37084 0.604 0.711 0.8 0.83
0 0.00581 0.05 0.14053 0.35989 0.585 0.7 0.8 0.83
0 0.00994 0.0495 0.10951 0.31463 0.538 0.683 0.8 0.83
0 0.01302 0.05425 0.11797 0.27667 0.472 0.629 0.79 0.83
0 0.01351 0.071 0.15886 0.28689 0.453 0.574 0.75 0.82
0 0.01232 0.0795 0.20163 0.33653 0.502 0.575 0.74 0.8
0 0.01218 0.0775 0.21056 0.38836 0.582 0.633 0.726 0.79
0 0.01722 0.09075 0.2162 0.42559 0.68 0.775 0.795 0.878
0 0.0182 0.08475 0.20774 0.38471 0.64 0.729 0.834 0.82
0 0.01813 0.08575 0.20633 0.40807 0.65 0.806 0.807 0.85
0 0.01652 0.09325 0.22137 0.39858 0.626 0.684 0.909 0.83
0 0.02044 0.08475 0.22278 0.41902 0.65 0.629 0.881 1
0 0.01897 0.09475 0.22184 0.42851 0.66 0.754 0.735 0.948
0 0.01638 0.09575 0.23218 0.44603 0.704 0.745 0.819 0.842
0 0.01827 0.096 0.22889 0.45041 0.679 0.736 0.778 0.812
0 0.02037 0.1 0.23453 0.45406 0.709 0.753 0.788 0.818
0 0.01589 0.0885 0.23782 0.44968 0.706 0.764 0.895 0.871

```
 0 0.01344 0.07975 0.21432 0.44311 0.725 0.799 0.917 0.917
 0 0.01743 0.08075 0.21385 0.41172 0.664 0.784 0.799 0.871
 0 0.01785 0.0865 0.20163 0.41537 0.694 0.827 0.835 0.853
 0 0.02079 0.0965 0.22137 0.41464 0.719 0.832 0.988 0.85
 0 0.02072 0.10275 0.24064 0.44019 0.763 0.834 0.85 1.1
 0 0.01799 0.09675 0.23735 0.42705 0.744 0.701 0.879 0.87
 0 0.01771 0.08925 0.22748 0.42559 0.744 0.762 0.778 0.878
 0 0.01736 0.09325 0.22795 0.43654 0.752 0.722 0.91 0.87
 0 0.0217 0.0935 0.23923 0.43946 0.649 0.65 0.7 1
 0 0.02044 0.099 0.22936 0.45041 0.685 0.775 0.75 0.75
 0 0.01757 0.0995 0.2397 0.43946 0.702 0.754 0.84 0.85
 0 0.01932 0.09775 0.23829 0.44603 0.699 0.768 0.82 0.87
 0 0.01764 0.09725 0.23265 0.42632 0.647 0.817 0.83 0.85
 0 0.0224 0.105 0.2538 0.45406 0.712 0.782 0.89 0.86
 0 0.02086 0.1085 0.25286 0.45771 0.73 0.743 0.84 0.93
 0 0.021 0.1 0.23641 0.44676 0.748 0.812 0.82 0.87
 0 0.01365 0.096 0.23547 0.43508 0.723 0.735 0.88 0.85
 0 0.01911 0.10475 0.24675 0.48034 0.79 0.833 0.85 0.93
 0 0.01645 0.122 0.2397 0.43727 0.723 0.869 0.917 0.849
 0 0.01862 0.09775 0.26414 0.43289 0.709 0.902 0.952 1.07
 0 0.02254 0.107 0.23735 0.48326 0.746 0.907 1 1.1
 0 0.01624 0.1005 0.27448 0.5329 0.837 0.85 1 1.2
 0 0.01974 0.11425 0.22607 0.5402 0.955 0.88 0.9 1.2
 0 0.01862 0.11225 0.23876 0.40296 0.746 1 0.9 1.1
 0 0.02303 0.10825 0.28623 0.44238 0.686 0.758 0.803 0.838
 0 0.02121 0.151 0.3478 0.61101 0.8 0.8 0.8 1
 0 0.02527 0.12925 0.45731 0.76869 1.029 1.35 0.9 0.9
 0 0.02079 0.168 0.40608 0.94243 1.223 1.531 1.2 1
 0 0.02254 0.15 0.39809 0.77599 1.1 1.3 1.5 1.3
 0 0.02338 0.11825 0.33135 0.66284 1.1 1.2 1.4 1.6
 0 0.01323 0.11 0.28106 0.5913 0.969 1.2 1.3 1.5
 0 0.01232 0.0675 0.20539 0.43654 0.874 1.066 1.3 1.4
 0 0.0133 0.05975 0.18377 0.43581 0.715 0.953 0.929 1.4
 0 0.01057 0.05925 0.16215 0.37668 0.773 0.916 1 1.2
 0 0.01337 0.0755 0.1833 0.33434 0.511 0.688 0.9 1.1
 0 0.01645 0.08775 0.18612 0.36865 0.614 0.638 0.871 0.91
 0 0.01995 0.1045 0.21667 0.35332 0.56 0.612 0.697 0.85
 0 0.0203 0.102 0.23876 0.40953 0.595 0.63 0.719 0.784
 0 0.01904 0.1035 0.24581 0.438 0.691 0.717 0.766 0.826
 0 0.02107 0.10375 0.27072 0.48618 0.734 0.806 0.815 0.899
 0 0.01351 0.09525 0.25474 0.47231 0.749 0.757 0.739 0.827
 0 0.01869 0.09425 0.26038 0.47377 0.68 0.749 0.775 0.803
 0 0.01519 0.09925 0.24158 0.43143 0.664 0.724 0.766 0.799
 0 0.01225 0.0825 0.21573 0.39712 0.661 0.691 0.725 0.805
 0 0.01596 0.0735 0.19176 0.42559 0.607 0.72 0.756 0.832
 0 0.01092 0.062 0.16967 0.35989 0.597 0.644 0.733 0.785
 0 0.01253 0.06875 0.20257 0.42778 0.689 0.74 0.758 0.92
 0 0.01274 0.0795 0.22137 0.42997 0.649 0.674 0.705 0.751
 0 0.01673 0.08325 0.20962 0.41756 0.637 0.719 0.718 0.749
 0 0.01869 0.08125 0.19693 0.3869 0.615 0.631 0.667 0.689
 0 0.01596 0.09975 0.23923 0.41975 0.633 0.688 0.754 0.768
 0 0.01862 0.0925 0.2585 0.4307 0.608 0.646 0.712 0.731
 0 0.01771 0.08675 0.25098 0.41391 0.619 0.617 0.635 0.627
 0 0.01526 0.07575 0.19364 0.40296 0.687 0.656 0.728 0.65
 0 0.01988 0.1035 0.28341 0.49567 0.745 0.809 0.794 0.838
 0 0.0196 0.10175 0.28012 0.50005 0.821 0.926 0.82 0.902
 0 0.01869 0.095 0.21761 0.40588 0.665 0.737 0.797 0.84
 0 0.01554 0.08825 0.24534 0.54896 0.824 0.848 0.918 0.935
 0 0.01519 0.08975 0.26179 0.54093 0.878 0.871 0.924 0.935
 0 0.01519 0.08975 0.26179 0.54093 0.878 0.871 0.924 0.935

SSmsy_ratio = 0.983427
Fmsy_ratio =  0.632311
that's all
```