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Stock assessment of bigeye tuna (*Thunnus obesus*) in the Indian Ocean using ASAP

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Content

1 Introduction

Bigeye tuna, *Thunnus obesus* (Lowe, 1839), is a large epi- and mesopelagic fish distributed in tropical and subtropical waters of Indian Ocean. The bigeye tuna (BET) resource was initially harvested by longlines since the 1950s and now is one of the main economic tuna recourses in the Indian Ocean. They are currently caught by longliners (deep-freezing and fresh-tuna longliners), purse seiners (free-school and associated school), pole and line, and other small fleets as well.

Stock assessments of BET in the Indian Ocean have been conducted using Virtual population analysis (Nishida and Takeuchi, 1999), Stock Synthesis (Shono et al., 2009; Kolody et al., 2010), and age-structured production model (Nishida and Rademeyer, 2011). These assessments suggested there was a low probability that the Indian Ocean BET stock has been overfished and overfishing was probably not occurring (Kolody et al., 2010; Nishida and Rademeyer, 2011). However, it should be cautious that the BET assessments were associated with many uncertainties according to explorations of extensive sensitivity analysis (Kolody et al., 2010).

Following the uncertainty remaining in the assessments carried out from the previous Working Party on Tropical Tunas (WPTT) meetings in 2010 and 2011, the WPTT recommended that bigeye tuna would be the priority species for stock assessments in 2013 (IOTC–WPTT14, 2012).

This working paper presented a stock assessment of Indian Ocean BET using Age Structured Assessment Program (ASAP, Version 3; NOAA Fisheries Toolbox, 2013). ASAP is a formal stock assessment model and has been used for assessing many commercially exploited stocks, e.g., red grouper, yellowtail flounder, Pacific sardine, Greenland halibut, Gulf of Maine cod, Florida lobster (see NOAA Fisheries Toolbox at http://nft.nefsc.noaa.gov).

The present assessment included a base case model and sensitivity analyses designed for the consideration of alternative key assumption regarding population dynamics (i.e., the steepness parameter of the stock-recruitment relationship), and weighting scheme for the most important two abundance indices being used to tune the model. Stock status was evaluated based on fishing mortality and spawning stock biomass based reference points. Kobe plots were presented to show historical trends in stock status, as recommended by the Scientific Committe.

The present assessment was not considered to be final and it would be improved based on the recommendations and comments reached on the WPTT15 meeting.

2 Biological parameters and assumptions

2.1 Stock structure and movement

Genetic studies have suggested that there is only one population of bigeye tuna in the Inidan Ocean (Appleyard et al., 2002; Chiang et al., 2008). Thus, a single stock was assumed for the present assessment. Movement was not considered since the ASAP does not allow movement to be modelled.

2.2 Growth model and maturity curve

Previous study used classical Von Bertalanffy growth function to model BET growth (see Shono et al., 2009). However, recent studies demonstrated that young bigeye tunas may growth in linear-like pattern (Ref.). Therefore, Von Bertalanffy growth model described in Laslett et al. (2008) (see IOTC-2008-WPTT-09) and W-L relationship (W=3.661×10-5 L2.901) were used for sexes combined **(Figure 1)**. Aging error was not considered.

Maturity-at-length model was adopted as in Shono et al. (2009). Maturity-at-length data (proportion of fish mature at length) was converted into maturity-at-age (proportion of fish mature at age) using von Bertalanffy growth model **(Figure 2)**. The proportion of fishing mortality that occurs before spawning was assumed to be 0.0, i.e., spawning occurring at the beginning of Jan. 1st.

2.3 Natural mortality

Natural mortality was also assumed as in Shono et al. (2009) for both sexes: M=0.8 per year for ages 0 and 1, and M=0.4 per year for ages ≥ 2.

3 Fisheries data

3.1 Fishery history and definition of fisheries in model

Bigeye tuna have been caught by industrial longline fleets since the early 1950's, but before 1970 they only represented an incidental catch. After 1970, the introduction of fishing practices that improved catchability of the bigeye tuna resource, combined with the emergence of a sashimi market, lead bigeye tuna to become a primary target species for the main industrial longline fleets (Herrera et al., 2012). Total annual catches have increased steadily since the start of the fishery, reaching the 100,000 t level in 1993 and peaking at 150,000 t in 1999 **(Figure 3)**. Catches dropped since then to 120,000–140,000 t (2000–2007), further dropping to under 90,000 t in recent years (2010–2011). The Scientific Commitee believes that the recent drop in catches could be related, at least in part, with the expansion of piracy in the northwest Indian Ocean, which has led to a marked drop in the levels of longline effort in the core fishing area of these species (Herrera et al., 2012).

Ideally, the fisheries for stock assessment should be defined to have selectivity and catchability characteristics that do not vary greatly over time, however, defining too many fisheries may cause stock assessment model instability owing to lack of long term data to support parameter estimates. For the present assessment, Indian Ocean BET are assumed to be subject to 7 fisheries, i.e., Deep longline fishery (LL), Purse seine fishery of free-school (PSFS), Purse seine fishery of associated-school (PSLS), Pole-and-line and small seine fisheries (BB), Fresh longline fishery (FL), Line fishery (LINE), and Other fishery (OTHER), according to the available datasets provided by the IOTC Secretariat for WPTT15.

Historically, deep longline fishery contributed most of the total BET catch, followed by fresh longline and log-associated purse seine fishery **(Figure 3)**. The purse fisheries started in 1978, and fresh longline fishery started in 1973. It was also noted that the catches from pole-and-line and small seine fisheries(BB), and Other fishery before 1978 were very low. To decrease the number of model parameters and increase the model converging ability, we developed the BET assessment model on yearly basis from 1978 to 2012, rather than from 1950 (covering 35 years).

3.3 Total catch and catch-at-age data

Fleet-specific annual total catch and catch-at-age for January 1978 through December 2012, estimated and provided by the IOTC Secretariat, were used as basic data for conducting the present stock assessment of BET in the Indian Ocean.

3.4 Indices of abundance

The standardized catch-per-unit-effort (CPUE; number of fish caught per 1000 hooks) from longliners of Japan (Matsumoto et al., 2013) and Taiwan, China (Yeh and Chang, 2013) were used as abundance indices in fitting the model, both including indices for tropical water and the whole Indian Ocean water. Therefore, a total of four index time series were used (**Figure 4**). The index for southern temperate water was not included in current since it may not be representative. Detailed descriptions of how the CPUE standardizations were conducted can be found in Matsumoto et al. (2013) and Yeh and Chang (2013).

4 Stock assessment

4.1 Model description

The ASAP uses forward computations assuming separability of fishing mortality into year and age components to estimate population sizes given observed catches, catch-at-age, and indices of abundance. Technical details of the ASAP model can be found in NOAA Fisheries Toolbox (2013) and the population dynamics model is briefly described in the Appendix of this report.

The objective function in ASAP is the sum of a number of model fits and two penalties. There are two types of error distributions in the calculation of the objective function: lognormal and multinomial. Multinomial distribution is assumed for catch-at-age data, with effective sample size iteratively adjusted based on initial model runs. The lognormal error distribution is assumed for total catch (in weight), abundance indices and stock-recruitment relationship (recruitment deviation).

The CV for total catch in model fit was assumed to be 0.1 for each of seven fisheries and constant for the whole time period. We have tried much lower CVs for the total catch (e.g., 0.01) during initial runs, which caused model not converge.

Since there was no strong evidence supporting which index is more reliable than others, the four indices were equally weighted, i.e. equal lambdas and CVs (=0.05 or iteratively adjusted) for base case, and using more weights on index from longline of Japanese and more weights on index from longline of Taiwan, China in sensitivity analysis, respectively **(Table 1)**.

Beverton-Holt stock recruitment (S-R) model was assumed in the current assessment, as in previous assessments (Shono et al., 2009; Kolody et al., 2010). Steepness was regarded as most important parameter influencing stock assessment results. The steepness for BET model was assumed at 0.7, 0.8, and 0.9. The steepness=0.8 assumption was considered for the base case, and steepness=0.7 and 0.9 for sensitivity analysis. Combining steepness assumptions and abundance index weighting scheme assumptions produced 9 models which were used to evaluate the stock status of present BET assessment **(Table 1)**.

4.2 Parameter estimate

The following parameters are assumed to be known for the present BET stock assessment in the Indian Ocean:

(1) Length-at-age and weight-at-age;
(2) Age-specific maturity;
(3) Age-specific natural mortality rates;
(4) The deviation for indices of abundance;
(5) The steepness of the stock-recruitment relationship.

The following parameters are to be estimated in the present BET stock assessment in the Indian Ocean:

(1) Recruitment in each year from 1978 through 2012;
(2) Catchability coefficients (q, constant over time) for the abundance indices (JPNtro, JPNwhol, TWNtro, TWNwhol);
(3) Selectivity curves for the 7 fisheries. The selectivity curves for LL and FL were assumed to be Single Logistic (two parameters). The selectivity curves for PSFS , PSLS, and LINE was assumed to be Double Logistic (four parameters). Age-specific parameters were defined for BB and OTHER, but selectivity for age 1 was fixed at 1.0 as these two fisheries seem catching high proportion of juveniles. This assumption is arbitrary, but fixing at least one parameter at 1.0 is required by the ASAP model configulation.
(4) Effective sample size (ESS) for catch-at-age for each fishery (iterative adjustment);
(5) Initial population size and age structure;
(6) Fully recruited fishing mortality (*F*mult) for each fleet for the first year, and deviations for *F*mult for the remaining years.

4.3 Management quantities

The program computes a number of biological reference points (BRPs) based on the estimated selectivity pattern, weights at age, natural mortality rate, and relative fishing intensity among fleets in the terminal year of the assessment (2012). The reference points computed are F_{MSY}, $F_{current}/F_{MSY}$, MSY, $C_{current}$/MSY, SSB_{MSY}, $SSB_{current}/SSB_{MSY}$, $SSB_{current}/SSB_0$. The term "current" was defined last year in the model (i.e., the year 2012).

4.4 Stock assessment results

The assessment results presented in the following sections are likely to change in future assessments because (1) future data may provide evidence contrary to these results, and (2) the assumptions and constraints used in the assessment model may change. Future changes are most likely to affect the estimates of biomass, recruitment, and fishing mortality. Most assessment results are presented only for the base case, while the BRPs and Kobe plots were presented for both the base case and sensitivity analyses.

4.4.1 Model fit diagnostics

There were totally 336 parameters estimated for the present model configulations. Model fit diagnostics was based done by looking at the fits of abundance index, total catch, and effective sample size for composition data, but only base case was shown. The model fit to the abundance index data are shown in **Figure 5**. Overall, the model fit the longline CPUE observations closely. However, the indices of TWNtro and TWNwhol did not fit well for the years after 2000, when they tended to underestimate CPUE. Considering the equil weighting among indices implied that the current data sets were consistent with the decline trends of stock abundance as shown by the Japanese longline indices (**Figure 5**). The input and estimated effective sample size for each fleet was shown in **Figure 6**. Overall, the model estimated the ESS well except for Fishery 5. The model fits total catch data closely (**Figure 7**). The model fits to the age composition data was shown in **Figure 8**.

4.4.2 Selectivity, index catchablity and fishing mortality

The selectivity-at-age for each fishery was shown in **Figure 9**. The the selecvitivity curve for fishery PSFS is more like dome-shaped than the PSLS. The selectivity of ages 5 and older for the BB fishery was very low, consistent with the very low proportion for these age groups in the catch data.

The catchability coefficients for the the four abundance indices (JPNtro, JPNwhol, TWNtro, TWNwhol) were 0.000259, 0.000223, 0.000115, and 0.000978, respectively.

The fully recruited fishing mortality for 1978-2012 was shown in **Figure 10**. The fishing mortalities of Fisheries 2, 3, 4, 6, 7 increased from 1978 to 2012. The fishing mortality of Fishery 1 kept at a low level (less than 0.06 per year) from 1978 to 1992; then increased towards about 0.09-0.12 during 2000s.

4.4.3 Spawning stock biomass and stock size

Both the total biomass and spawning stock biomass declined gradually since 1978. The spawning stock biomass decreased from 1,249,120 t in 1978 to 681,694 t in 2012. There was a short increase trend since 2010 (**Figure 11**). The decrease in stock biomass was accompanied by an increasing fishing mortality.

The total stock abundance was stable at about 200 million fishes from 1978 to 1993, then increase towards 250 million at 1997. The stock abundance was decreasing from 2002 to 2012 (**Figure 12**). Compared with the change of stock abundance, the age composition of stock was relatively stable during the assessment period (**Figure 12**).

4.4.4 Recruitment and S-R relationship

In ASAP, the recruits were defined as the first age class fishes in the stock, i.e., here it was the age 0 class for the BET. The strength of recruit class for the base case model was relatively stable compared with the declining trend of SSB (**Figure 13**). The estimated stock-recruitment curve was shown in **Figure 13**.

4.4.5 Biological reference points

Biological references points for BET calculated based on parameter estimates from stock assessment model were given in **Table 2**. It was noted that MSY-related management reference points were sensitive to the steepness parameters which were fixed for the assessment models. When the steepness was assumed to be at 0.7, 0.8 and 0.9, the current level of fishing mortality was lower than that corresponding to MSY, either for the base case or for all sensitivity analysis cases. The current level of SSB was higher than that corresponding to MSY for all cases. The current annual catch was just around the level of MSY.

5 Status of the stock

5.1 Stock status based on SSB_{MSY}

The spawning biomass ratio (the ratio of the spawning stock biomass to that of the unfished stock; SBR), described by (Watters and Maunder 2001), has been used to define reference points in many fisheries. If it is near zero, the population has been severely depleted, and is probably overexploited. If the SBR is one, or slightly less than that, the fishery has probably not reduced the spawning stock. If the SBR is greater than one, it is possible that the stock has entered a regime of increased production.

Previous studies e.g. (Clark, 1991; Thompson, 1993; Mace, 1994) suggest that some fish populations are capable of producing the MSY when the SBR is about 0.3 to 0.5, and that some fish populations are not capable of producing the MSY if the SBR during a period of exploitation is less than about 0.2. Unfortunately, no tuna stocks were included in these studies, and their conclusions are sensitive to assumptions about the relationship between adult biomass and recruitment, natural mortality, and growth rates. Therefore, an estimates of current SBR (SBR_{curr}) compared to an estimate of SBR corresponding to the MSY ($SBR_{MSY} = SSB_{MSY}/SSB_0$) was also used for evaluating the stock status of Indian Ocean BET (Aires-da-Silva and Maunder 2009), i.e., $SBR_{curr}=SSB_{curr}/SSB_{MSY}$. It is important to note that estimates of the MSY and its associated quantities are sensitive to the steepness of the stock-recruitment relationship (**Table 2**).

For the BET base case model (model-4 in Table 2; steepness=0.8), the SBR_{curr} was estimated to be about 0.46, 35% higher than the level corresponding to MSY (SBR_{MSY}=0.34). The SBR_{curr} for sensitivity analysis models were about 24-63% higher than the level corresponding to MSY. Therefore, the BET stock was **not overfished** at the begingin of 2012, based on the present models.

5.2 Stock status based on F_{MSY}

For the BET base case model, the current catches are estimated to have been about 2% higher than the MSY (**Table 2**). The current fishing mortality (F_{curr}) is considered to be 22% lower than F_{MSY}. Both the base case and sensitivity analsises suggested that the overfishing of the BET stock was **not occurring**, at the begingin of 2012. Kobe plots for tracking the stock status of BET from 1978 to 2012 were shown in **Figure 14**, which suggested that the Indian Ocean BET was not overfished and overfishing was not occurring.

Tables

Table 1 Base case (model-4) and sensitivity analysis for BET assessment, defined by different steepness assumptions and abundance index weightings in the objective function

Case	Steepness	Abundance index weighting (lambda)			
		JPNtro	JPNwhol	TWNtro	TWNwhol
Model-1	0.7	1	1	1	1
Model-2	0.7	1	1	2	2
Model-3	0.7	2	2	1	1
Model-4 (base case)	0.8	1	1	1	1
Model-5	0.8	1	1	2	2
Model-6	0.8	2	2	1	1
Model-7	0.9	1	1	1	1
Model-8	0.9	1	1	2	2
Model-9	0.9	2	2	1	1

Table 2 Management related quantities derived from base case assessment model and sensitivity analyses for Indian Ocean BET

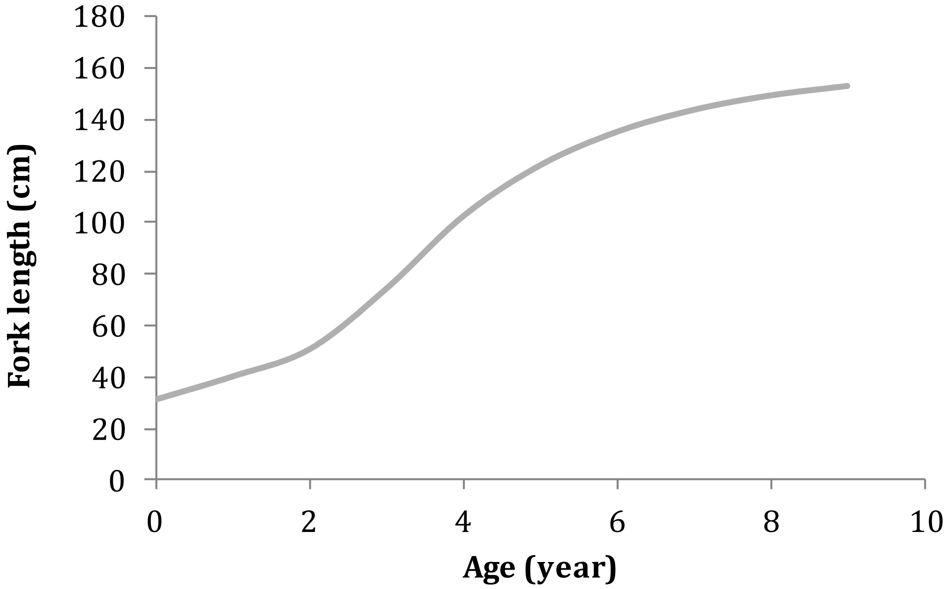
	Model-1	Model-2	Model-3	Model-4 (base case)	Model-5	Model-6	Model-7	Model-8	Model-9
F_{curr}	0.14	0.124	0.129	0.139	0.123	0.129	0.138	0.123	0.129
C_{curr}	97,081	97,081	97,081	97,081	97,081	97,081	97,081	97,081	97,081
SSB_{curr}	680,882	760,570	725,738	681,694	761,438	726,891	683,098	762,090	727,904
SSB_0	1,522,350	1,536,780	1,561,810	1,475,880	1,490,930	1,519,390	1,446,680	1,458,400	1,490,120
F_{MSY}	0.154	0.155	0.155	0.179	0.179	0.179	0.204	0.205	0.205
F_{curr}/F_{MSY}	0.91	0.80	0.83	0.78	0.69	0.72	0.68	0.60	0.63
MSY	89,242	91,073	92,478	95,596	96,693	98,735	101,045	102,153	104,437
C_{curr}/MSY	1.09	1.07	1.05	1.02	1.00	0.98	0.96	0.95	0.93
SSB_{MSY}	549,856	555,043	563,437	503,586	509,264	518,035	464,647	468,818	478,204
SSB_{curr}/SSB_{MSY}	1.24	1.37	1.29	1.35	1.50	1.40	1.47	1.63	1.52
SSB_{curr}/SSB_0	0.45	0.49	0.46	0.46	0.51	0.48	0.47	0.52	0.49

Note: SBR_{curr} = SSB_{curr}/SSB_{MSY}

Unit for catch and biomass: metric ton.

Figures

(a)



(b)

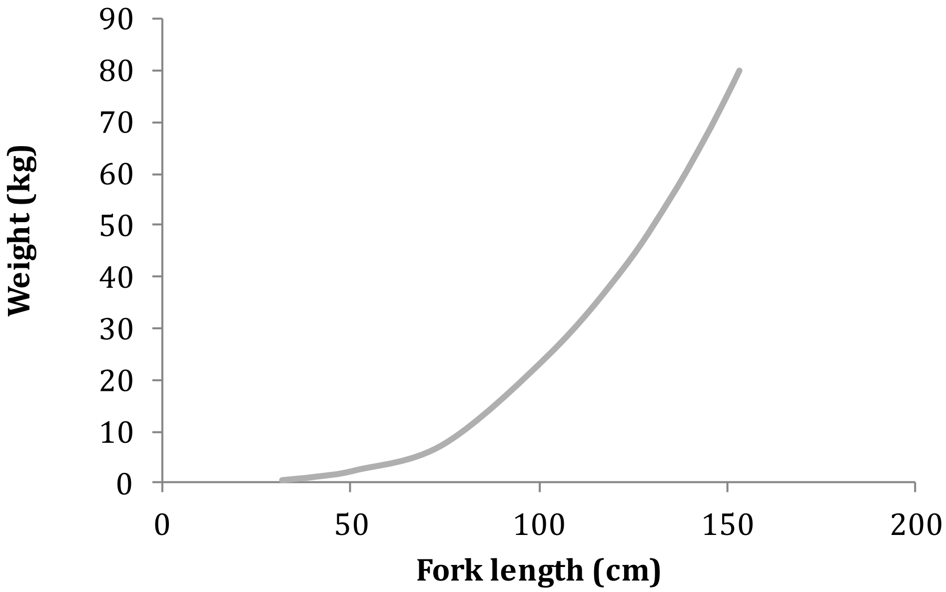


Figure 1 Growth curve and Weight-length relationship used for the BET assessment

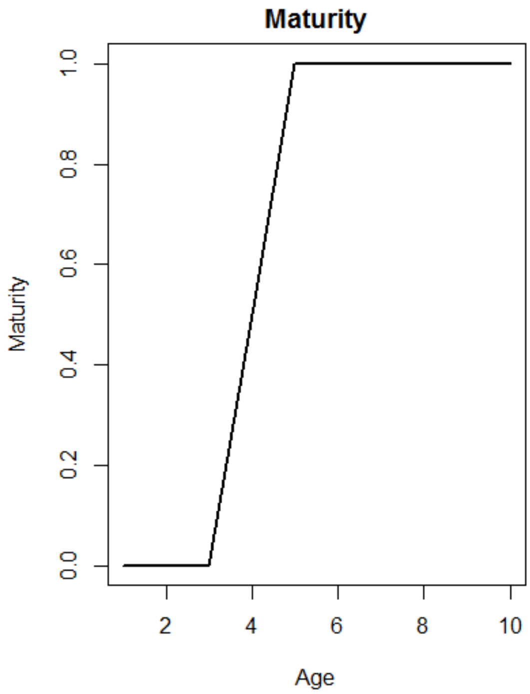


Figure 2 Maturity curve for BET assessment in the Indian Ocean

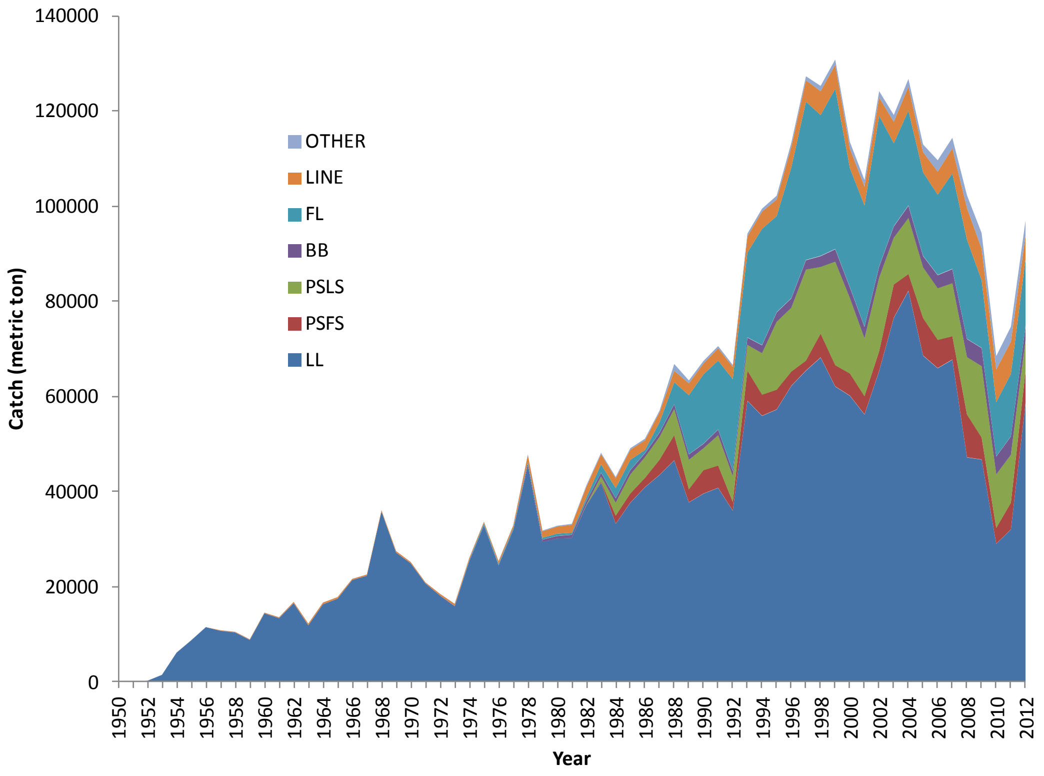


Figure 3 Fleet-specific historical catch of BET in Indian Ocean

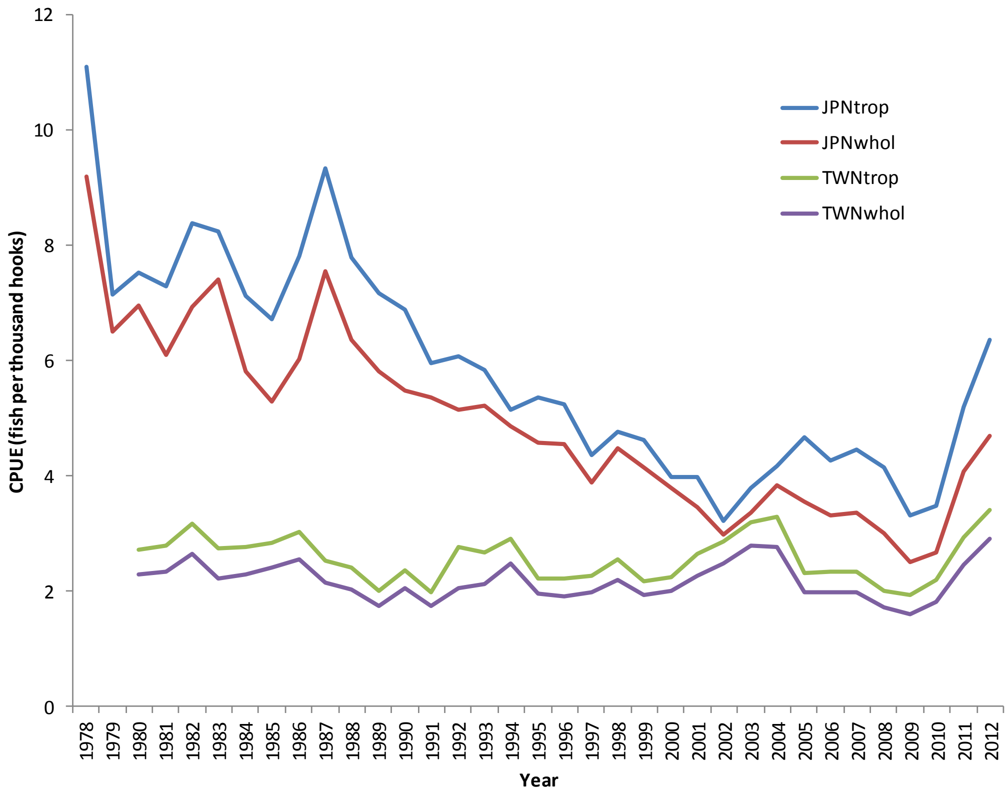


Figure 4 Standardized CPUE from deep longline fisheries of Japan (tropical and whole Indian Ocean) and Taiwan, China (tropical and whole Indian Ocean)

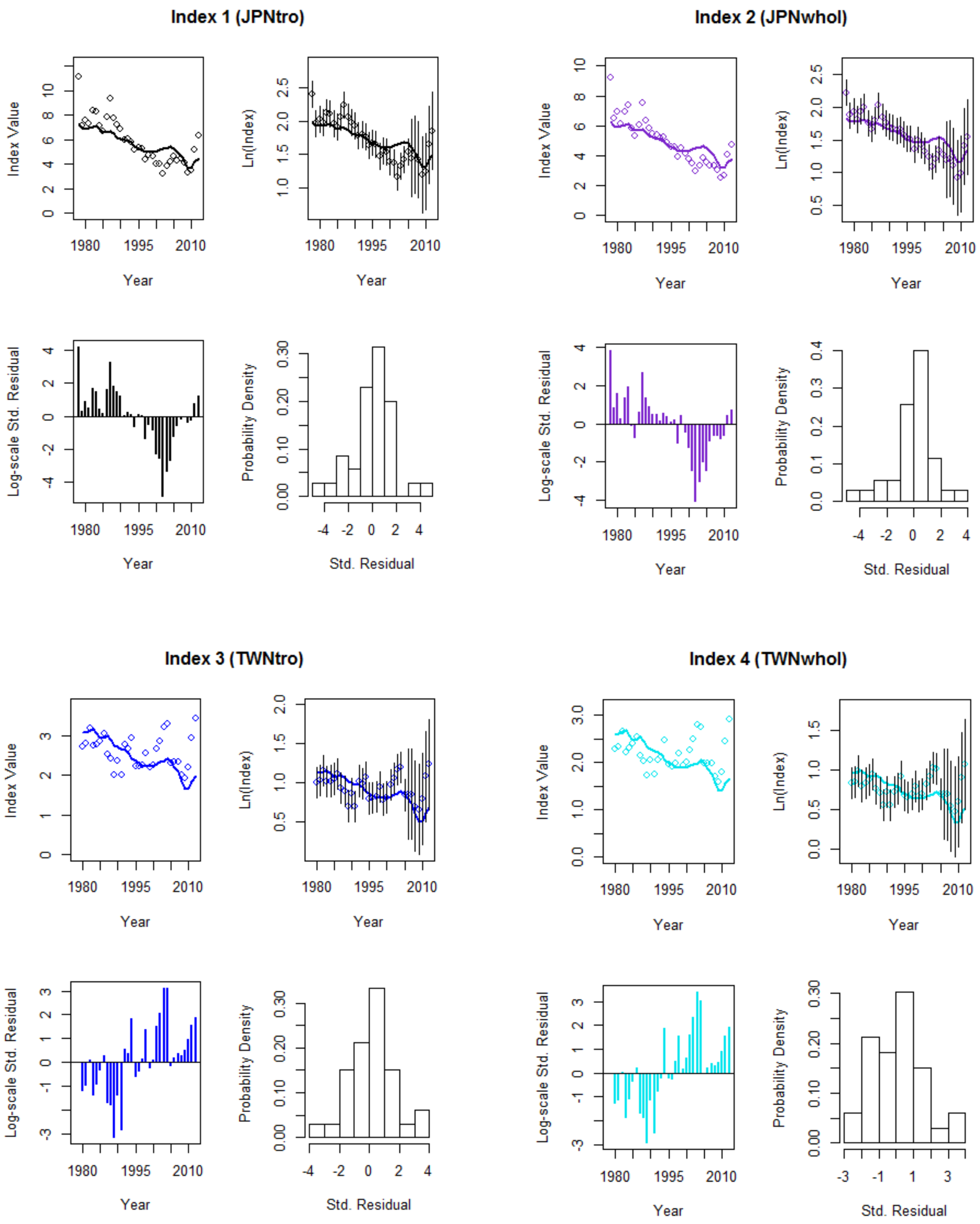


Figure 5 Model fits for the abundance indices (base case)

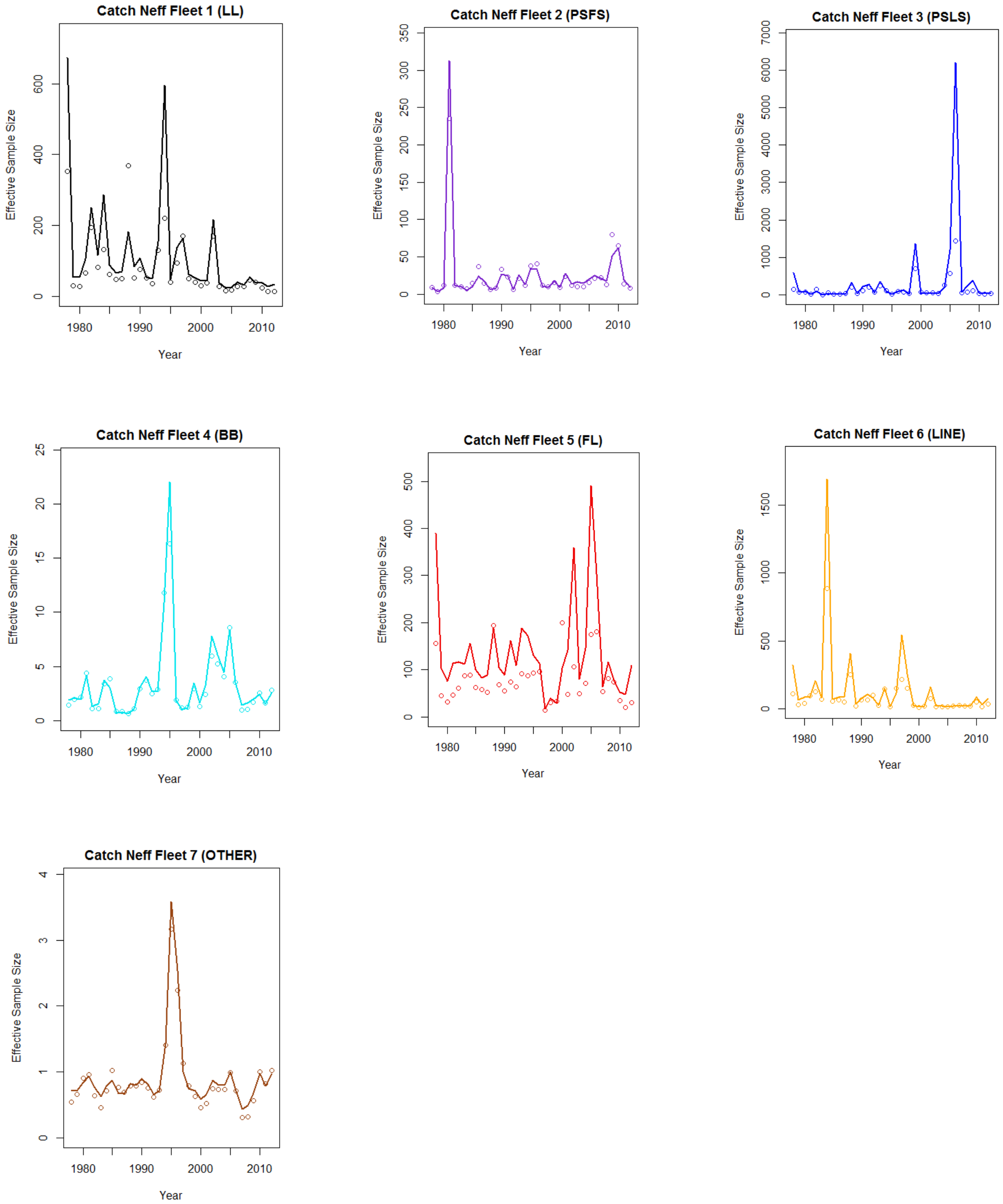


Figure 6 Model fits for effective sample size for the age composition data (base case)

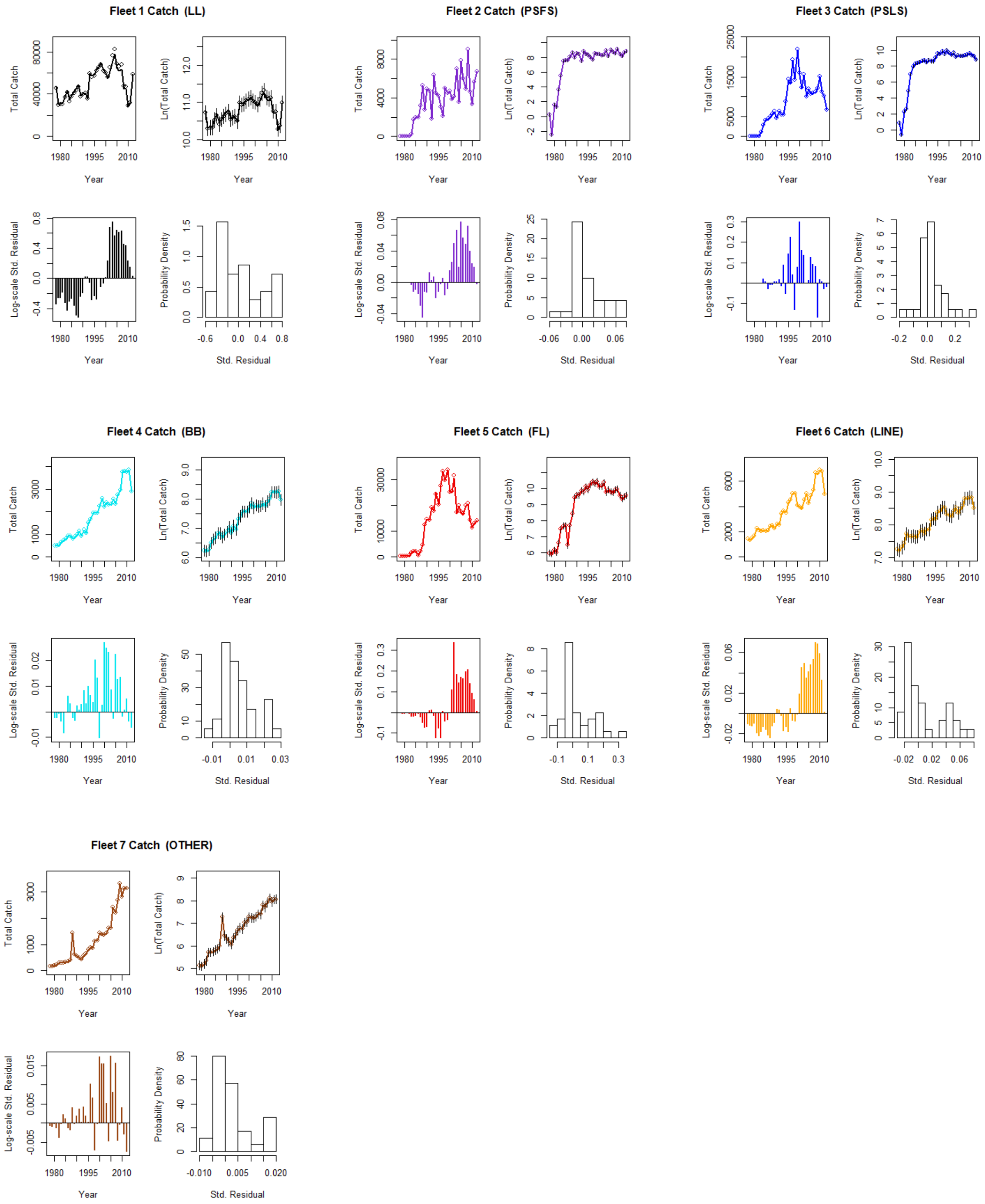
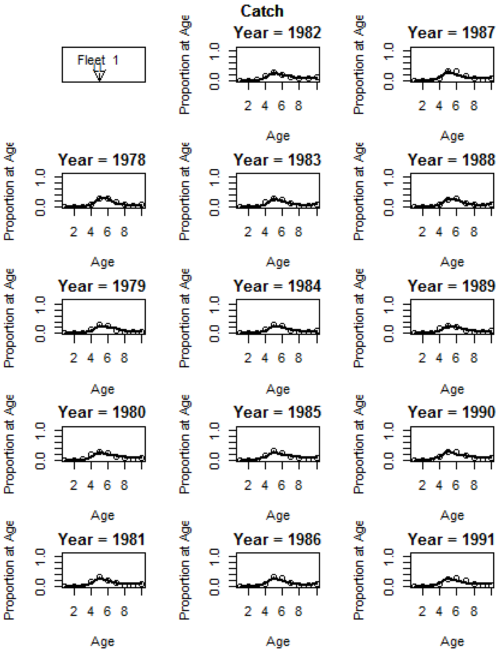
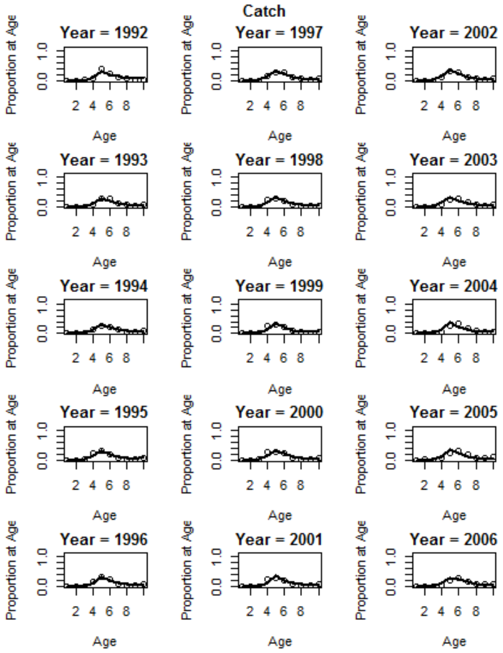
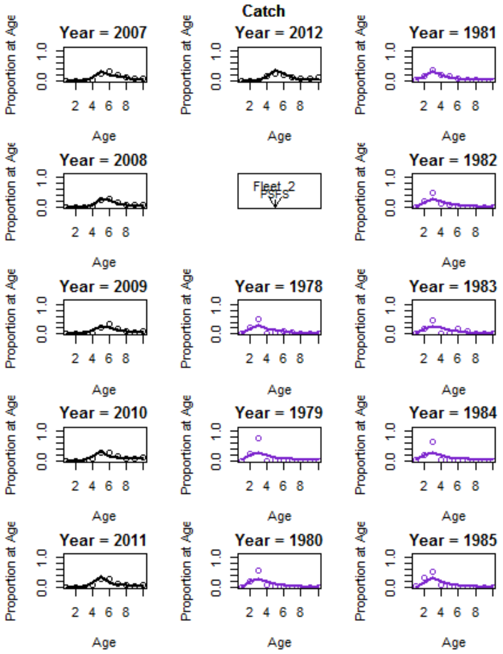


Figure 7 Model fits for annual total catch data (base case)







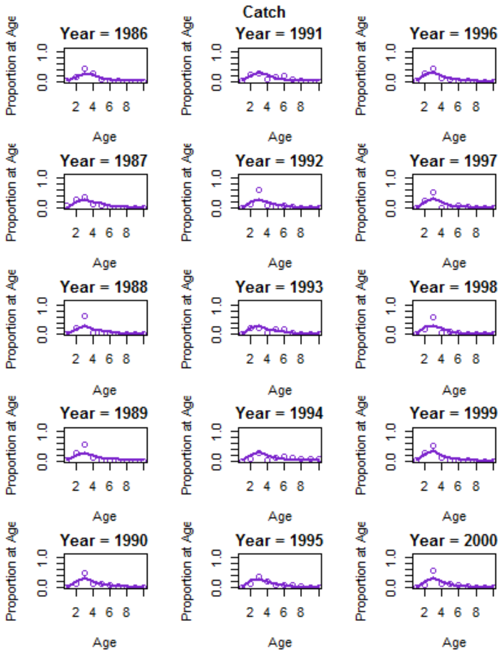
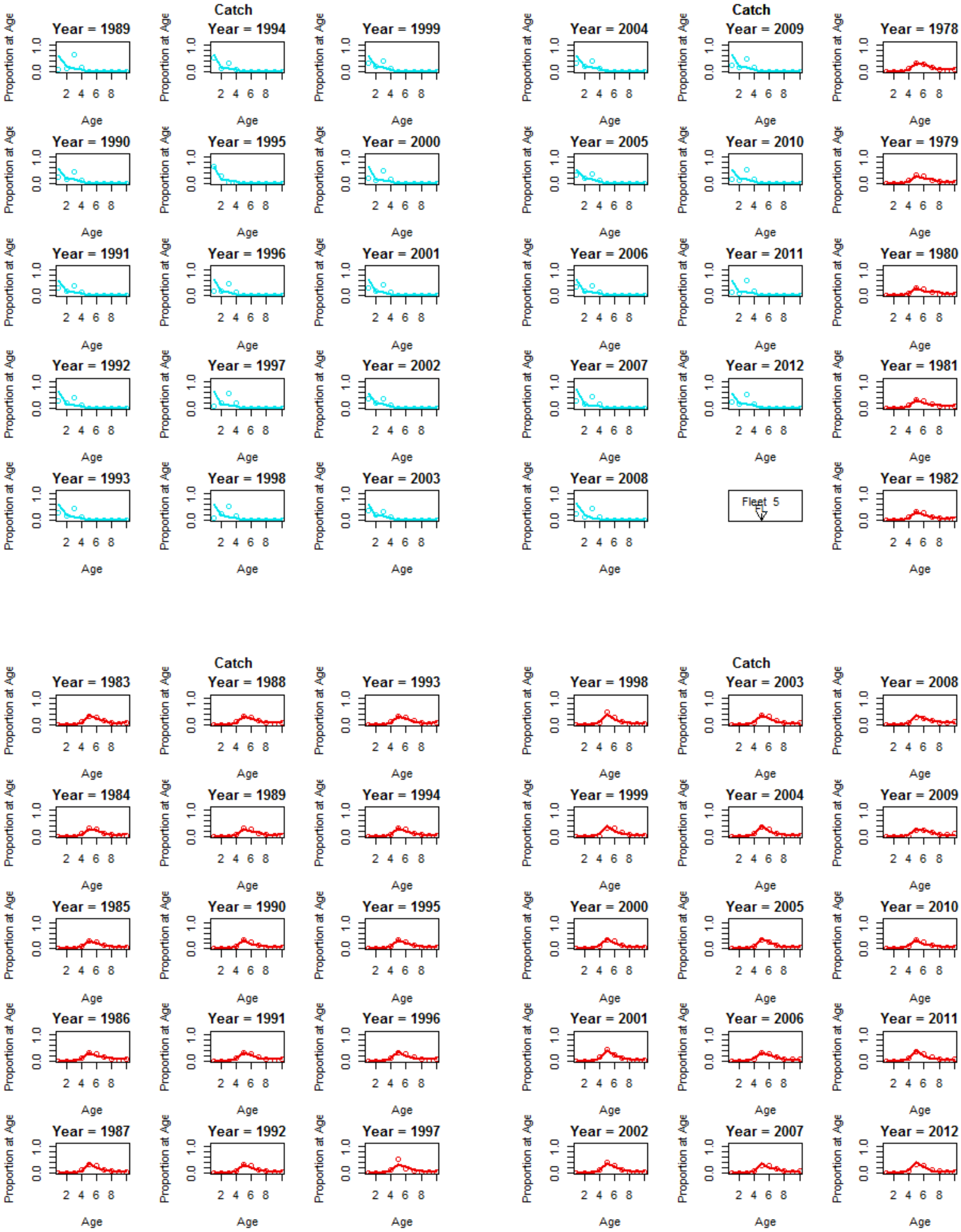


Figure 8 Model fits for age composition data for each fleet

Figure 8 Continued.



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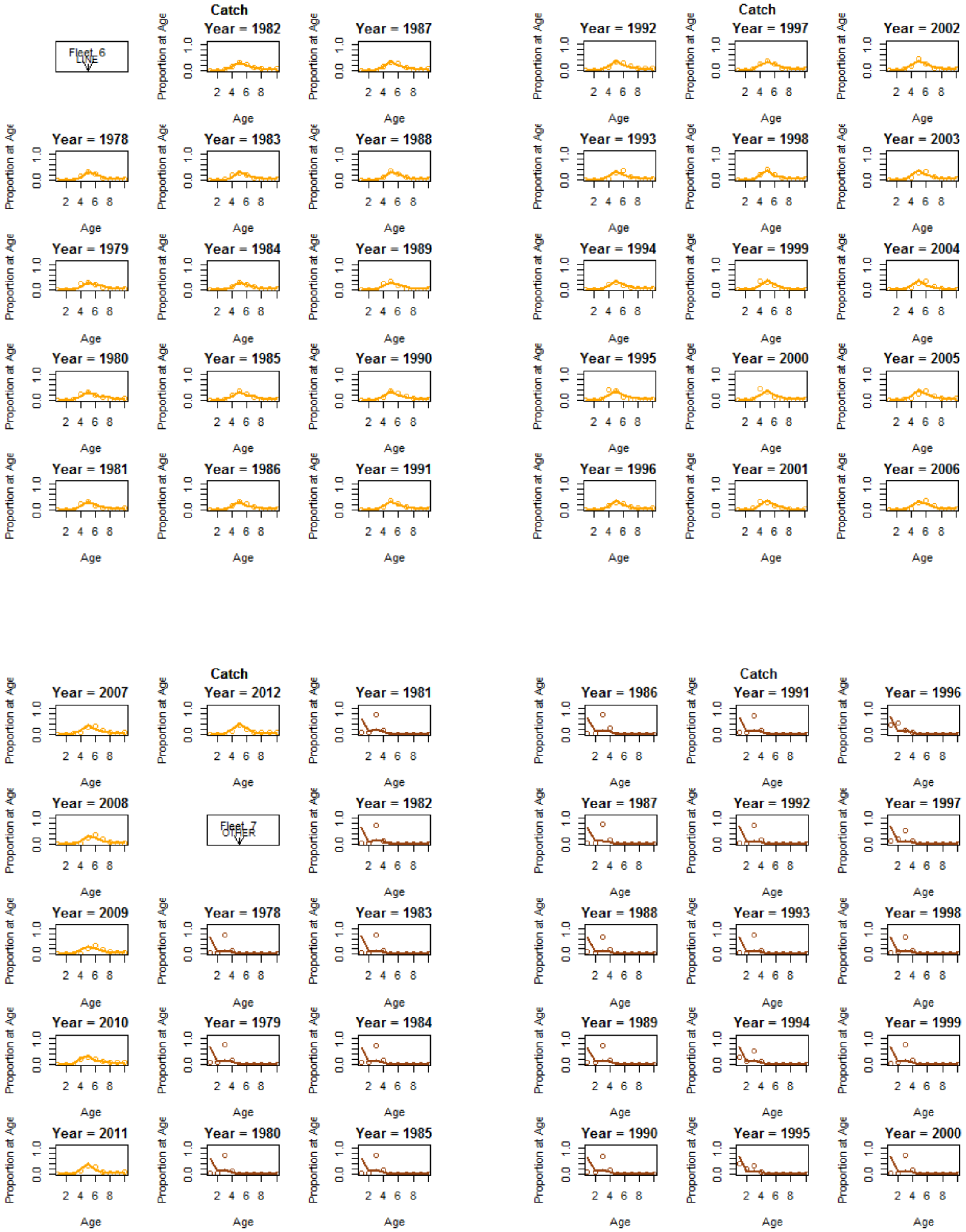

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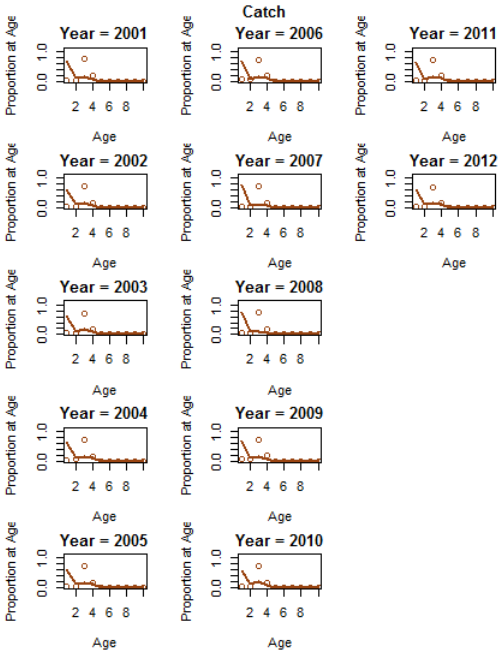

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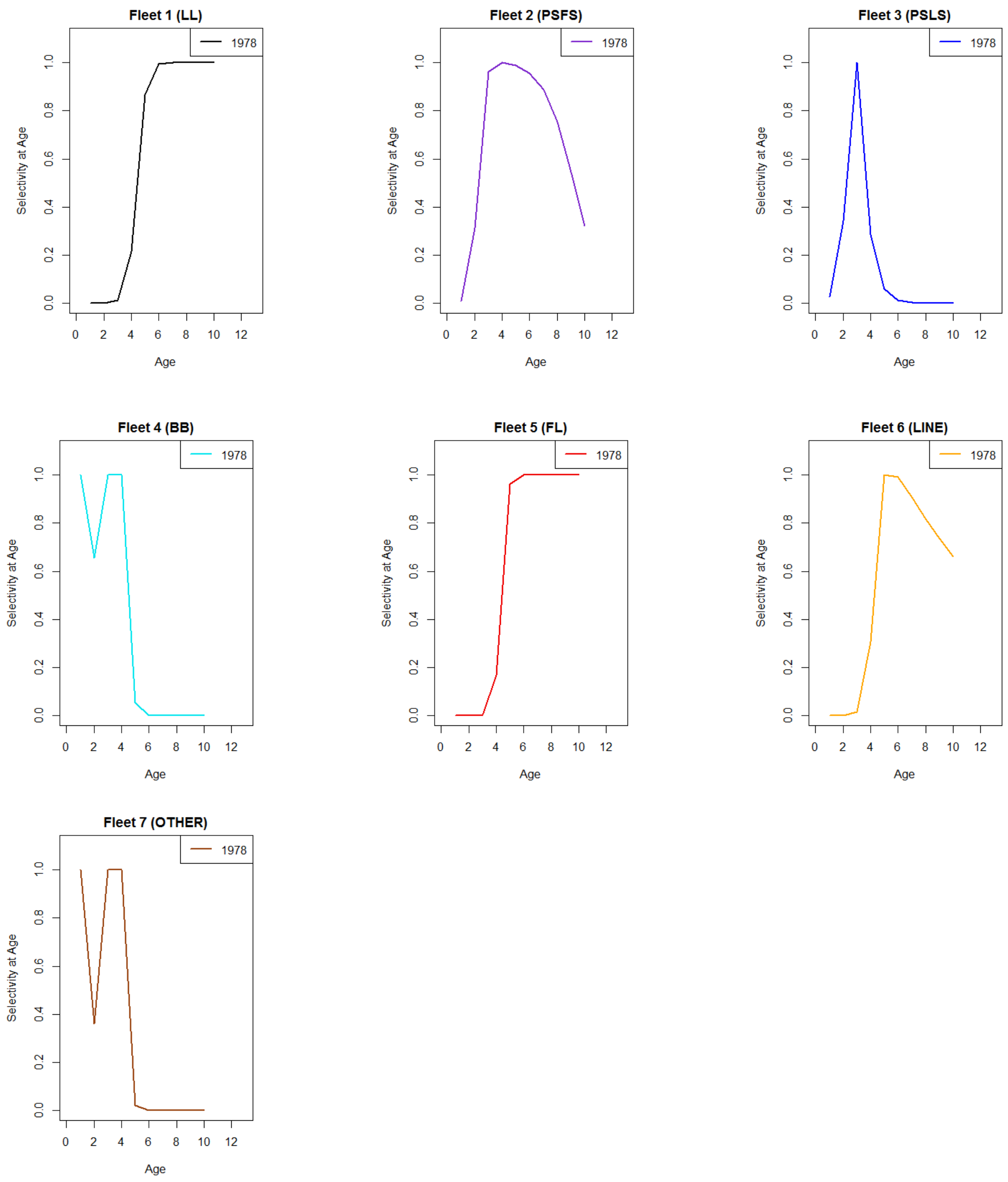

Figure 9 Selectivity curve for each fishery for the first model year (constant during 1978-2012) (base case)

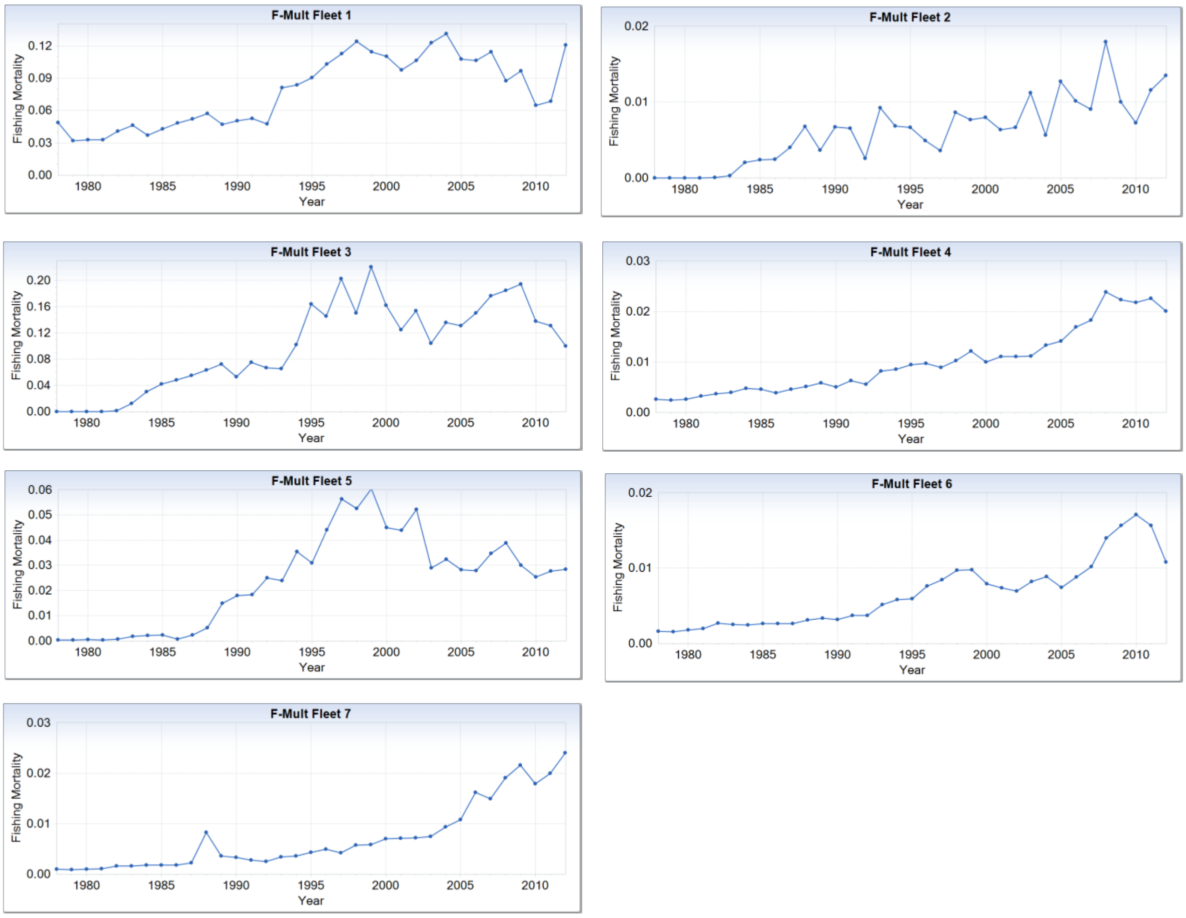

Figure 10 Fully-recruited fishing mortality by fishery (base case)

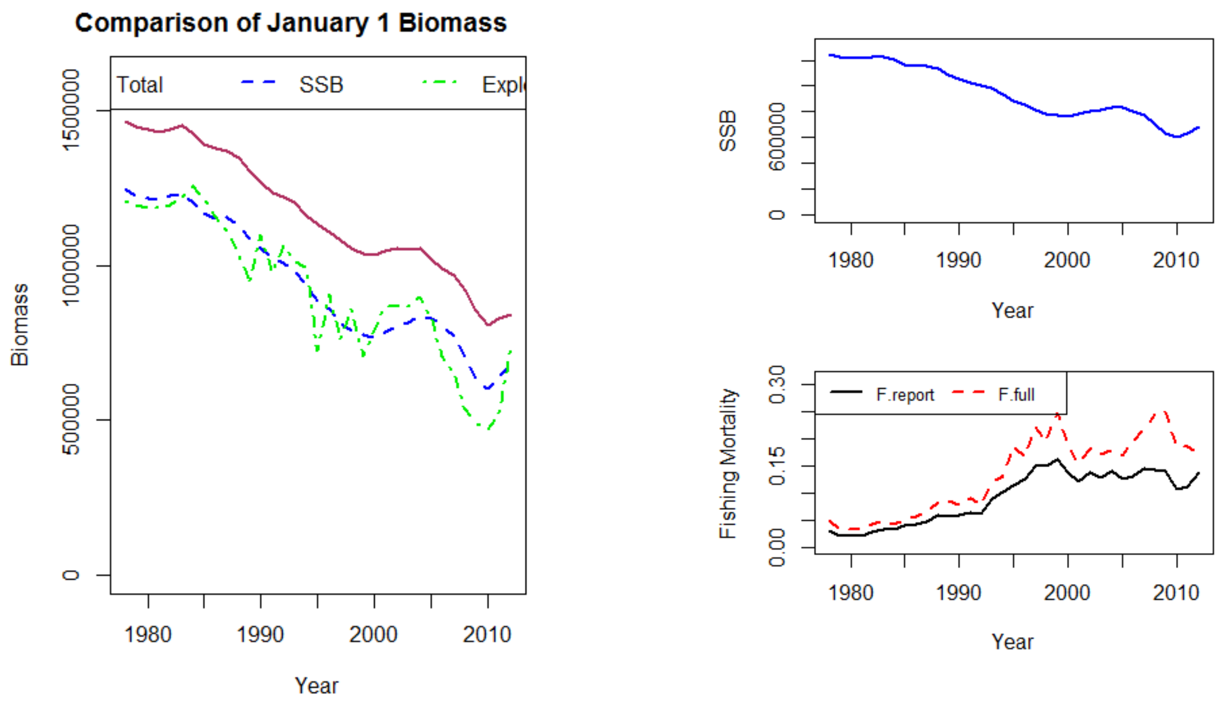

Figure 11 Trends of stock biomass (metric ton) and fishing mortality for BET in the Indian Ocean (base case)

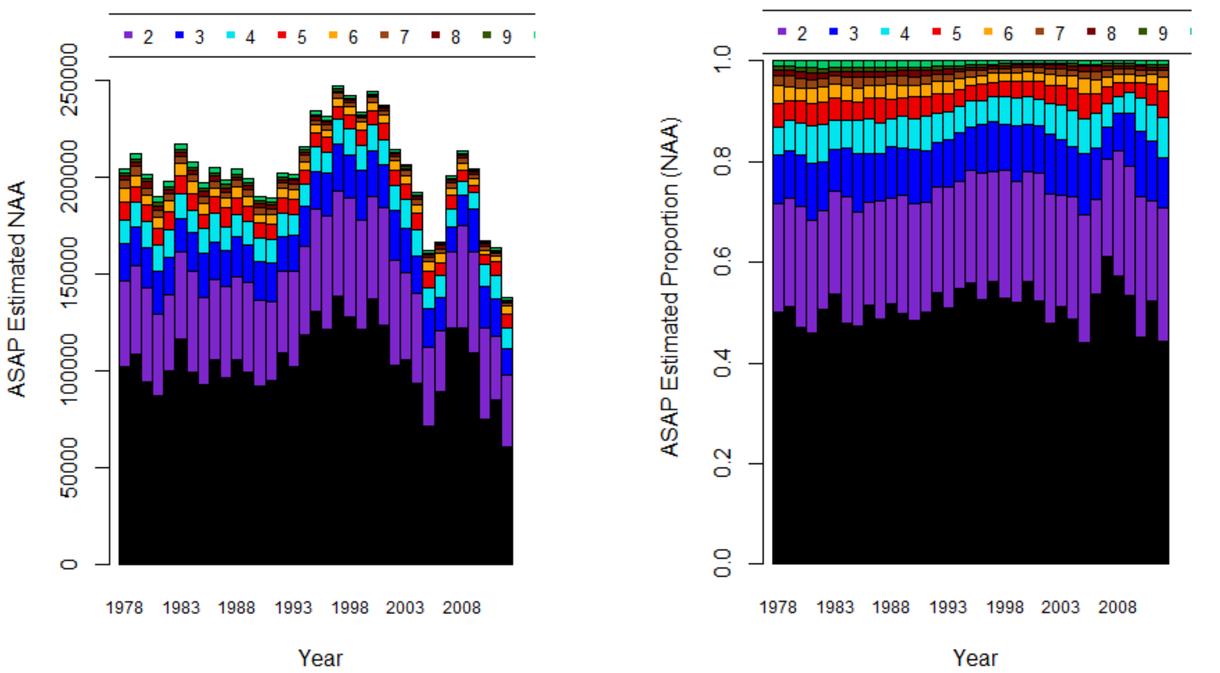

Figure 12 Estimated stock abundance (thousand fish) (left), and proportion of number at age (right) for BET in the Indian Ocean (base case).

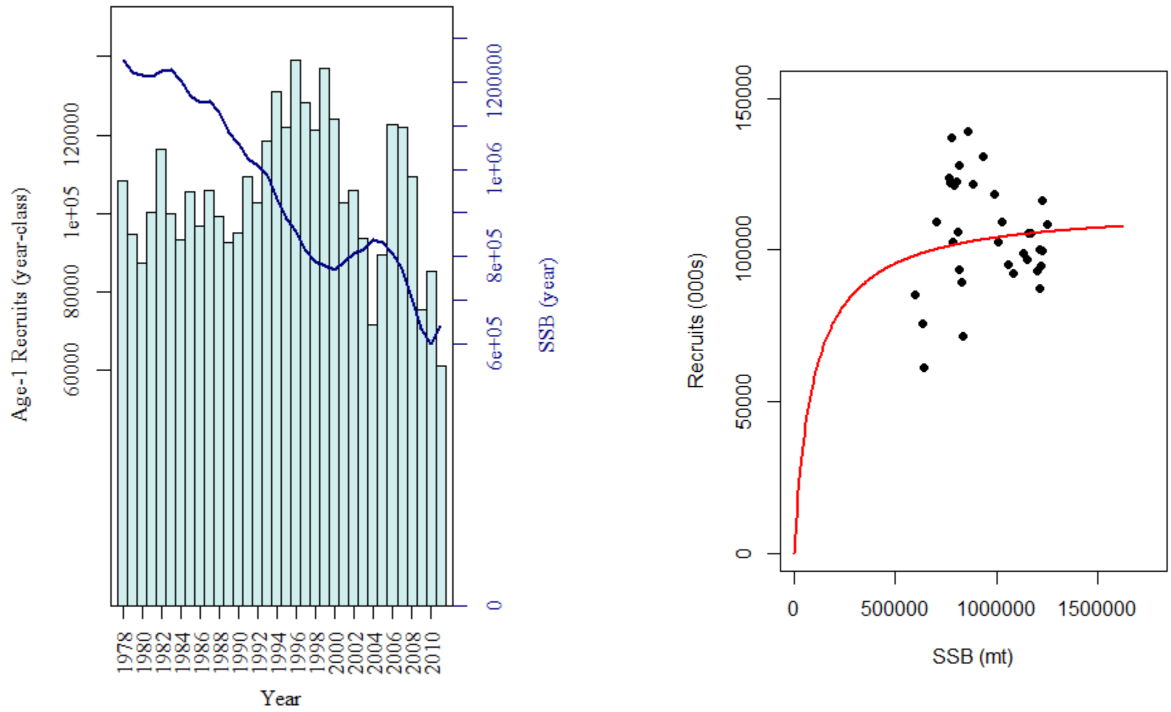

Figure 13 Estimated recruitments (left) and stock-recruitment curve (right) for the base case BET assessment in the Indian Ocean

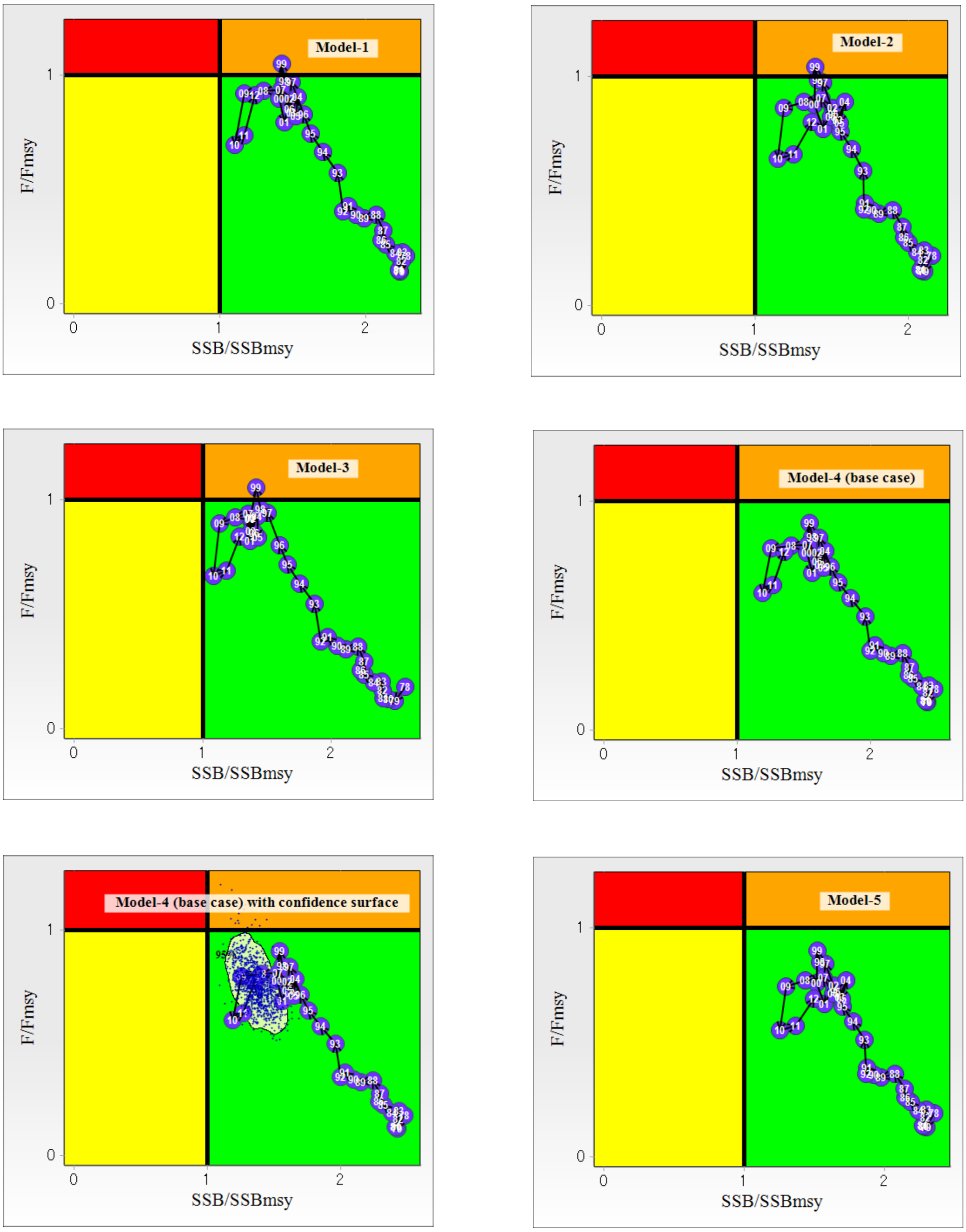

Figure 14 Kobe plots for the BET assessment in the Indian Ocean (confidence surface showed for year 2012 of the base case model)

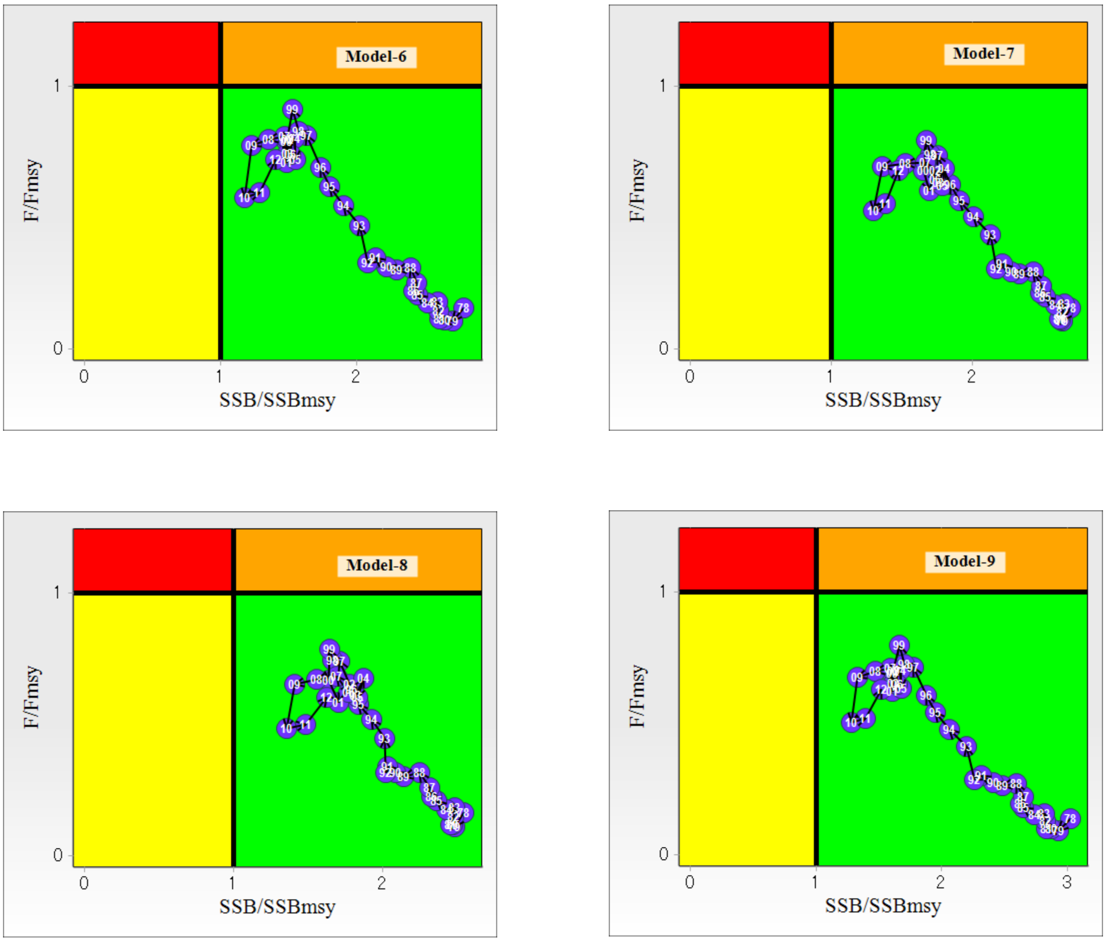

Figure 14 continued.

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Appendix A

Population dynamics model of ASAP

The spawning stock biomass is calculated based on the population abundance at age ($N_{t,a}$), the fecundity ($\Phi_{t,a}$), and the proportion of the total mortality ($Z_{t,a}$) during the year prior to spawning (p_{SSB}) as

$$SSB_t = \sum_a N_{t,a}\Phi_{t,a}\mathrm{e}^{-p_{SSB}Z_{t,a}} \quad (1)$$

The Beverton and Holt stock recruitment relationship is used to calculate the expected recruitment in year t+1 from the spawning stock biomass in year t as

$$\hat{R}_{t+1} = \frac{\alpha SSB_t}{\beta + \mathrm{SSB}_t} \quad (2)$$

The equation is reparameterized to use parameters unexploited spawning stock biomass (SSB_0) and steepness (h) and a constant of unexploited spawning stock biomass per recruit (SPR_0) so that

$$\alpha = \frac{4h(SSB_0/SPR_0)}{5h-1} \text{ and } \beta = \frac{SSB_0(1-h)}{5h-1} \quad (3)$$

SSB_0 is a parameter to be estimated. The recruitments, assumed to occur at age 1, are calculated as

$$N_{t,1} = R_t e^{\log(Dev(R_t))} \quad (4)$$

Selectivity at age for each fishery was modeled as separate blocks. Within each block, there are three selection model options:

(a)Estimate parameters for each age (one parameter for each age, and at least one age should be fixed at 1.0);

(b) Logistic function (2 parameters: α_1, β_1):

$$Sel_a = \frac{1}{1+e^{-(a-\alpha_1)/\beta_1}} \quad (5)$$

(c)Double logistic function (4 parameters: α_1, β_1, α_2, β_2):

$$Sel_a = \left(\frac{1}{1+e^{-(a-\alpha_1)/\beta_1}}\right)\left(\frac{1}{1+e^{-(a-\alpha_1)/\beta_1}}\right) \quad (6)$$

Fishing mortality (F) at age is the product of a fully-recruited fishing mortality ($Fmult$) and selectivity at age. In ASAP, the $Fmult$ for a fleet (i) is determined by two sets of parameters, $F\mathrm{mult}_{i\mathrm{fleet},\,1}$, the parameter for first year for that fleet, and $Dev(F\mathrm{mult}_{i\mathrm{fleet},\,t})$, where t=2 to the number of years, the deviation of the parameter from the value in the first year for that fleet. Both sets of parameters are estimated in log space and then exponentiated as

$$Fmult_{i\mathrm{fleet},1} = \mathrm{e}^{\log(Fmult_{i\mathrm{fleet},1})},\ t{=}1 \quad (7)$$

$$Fmult_{i\mathrm{fleet},t} = Fmult_{i\mathrm{fleet},1}\mathrm{e}^{\log(Dev(Fmult_{i\mathrm{fleet},t}))},\ t \geqslant 2$$

The population abundance in the first year for ages 2 through the maximum age are derived from the initial guesses $Nini_{1,a}$ and the parameters $Dev(N_{1,a})$ as:

$$N_{1,a} = Nini_{1,a}\mathrm{e}^{\log(Dev(N_{1,a}))} \quad (8)$$

Then, a partial spawning stock biomass for ages 2 through the maximum age is calculated and used in the stock recruitment relationship (Eq. 2) to estimate an expected recruitment in the first year. The recruitment deviation for the first year is applied to create the population abundance at age 1 in the first year (Eq. 4). The full spawning stock biomass is then computed for the first year using all ages

(Eq. 1).

The population abundance for years 2 through the end year are filled by first computing the expected recruitment using stock-recruitment relationship (Eq. 2) and then applying the recruitment deviation to create the abundance at age 1 (Eq. 4). Ages 2 through the maximum age are filled using the following set of equations:

$$N_{t,a} = N_{t-1,a-1}e^{-Z_{t-1,a-1}}, \quad 2 \leq a < A \tag{9}$$
$$N_{t,A} = N_{t-1,A-1}e^{-Z_{t-1,A-1}} + N_{t-1,A}e^{-Z_{t-1,A}}, \quad a = A$$

Each year the spawning stock biomass is computed (Eq. 1) and the cycle continued until the end year is reached.

The model predicted catch in units of numbers of fish for each fleet, year, and age are derived from the Baranov catch equation:

$$C_{\text{ifleet},t,a} = N_{\text{ifleet},t,a}F_{\text{ifleet},t,a}(1 - e^{-Z_{t,a}})/Z_{t,a} \tag{10}$$

The predicted total catch in weight is calculated by multiplying the catch in number by weight at age. The predicted catch proportions at age for each fleet and year are computed.

Catchability for each abundance index (*ind*) over time is computed similarly to the *Fmult*, with one parameter for the catchability in the first year ($q_{ind,1}$) and a number of deviation parameters for each additional year of index observations ($\text{Dev}(q_{ind,t})$). These parameters are combined and exponentiated to form the catchability value for the fleet and year as

$$q_{ind,t} = e^{\log(q_{ind,1})+\log(Dev(q_{ind,t}))} \tag{11}$$

Where the parameter for the deviation in the first year $Dev(q_{int,1})$ is defined as one.

The estimated population numbers at age are modified to match the average population numbers, which are used for calculating the abundance index, according to

$$\bar{N}_{ind,t,a} = N_{t,a}\frac{1-e^{-Z_{t,a}}}{Z_{t,a}} \tag{12}$$

The predicted abundance index (I_{pred}) is formed by summing the product of $\bar{N}$ and selectivity associated with each index over the appropriate ages and multiplying by the catchability for the index

$$Ipred_{ind,t} = q_{ind,t}\sum_{a=ind\_start}^{ind\_end}\bar{N}_{ind,t,a}Sel_{ind,t,a} \tag{13}$$

After any index selectivity parameters are estimated, the proportions at age are computed in the same manner as the catch at age.

Appendix B

ASAP Input data sets for the base case of BET assessment.

ASAP VERSION 3.0

betbase2013

#

ASAP GUI 15 AUG 2012

#

Number of Years

35

First Year

1978

Number of Ages

10

Number of Fleets

7

Number of Sensitivity Blocks

7

Number of Available Survey Indices

4

Natural Mortality

0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
0.8	0.8	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4

Fecundity Option

0

Fraction of year that elapses prior to SSB calculation (0=Jan-1)

0.0

Maturity

0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1

0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1
0	0	0	0.5	1	1	1	1	1	1

Number of Weights at Age Matrices

1

Weight Matrix - 1

0.625035289	1.292354651	2.534971777	7.627855072	25.07471395	41.72235659	55.89773596	66.73414664	74.54775469	79.99045112
0.625035289	1.292354651	2.534971777	7.627855072	25.07471395	41.72235659	55.89773596	66.73414664	74.54775469	79.99045112
0.625035289	1.292354651	2.534971777	7.627855072	25.07471395	41.72235659	55.89773596	66.73414664	74.54775469	79.99045112
0.625035289	1.292354651	2.534971777	7.627855072	25.07471395	41.72235659	55.89773596	66.73414664	74.54775469	79.99045112
0.625035289	1.292354651	2.534971777	7.627855072	25.07471395	41.72235659	55.89773596	66.73414664	74.54775469	79.99045112
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Weights at Age Pointers

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Selectivity Block Assignment
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Fleet 2 Selectivity Block Assignment

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Fleet 3 Selectivity Block Assignment

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Fleet 7 Selectivity Block Assignment

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Selectivity Options for each block 1=by age, 2=logisitic, 3=double logistic

2 3 3 1 2 3 1

Selectivity Block #1 Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	2	0	0.5
0.5	2	0	0.5
3	2	0	0.5
1	2	0	0.5
8	2	0	0.5
5	2	0	0.5

Selectivity Block #2 Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
3	2	0	0.5
0.5	2	0	0.5
7	2	0	0.5
6	2	0	0.5

Selectivity Block #3 Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
3	2	0	0.5
0.5	2	0	0.5
7	2	0	0.5
6	2	0	0.5
# Selectivity Block #4 Data			
1	-1	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
# Selectivity Block #5 Data			
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	2	0	0.5
0.5	2	0	0.5
3	2	0	0.5
1	2	0	0.5
8	2	0	0.5

5	2	0	0.5

Selectivity Block #6 Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
3	2	0	0.5
0.5	2	0	0.5
7	2	0	0.5
6	2	0	0.5

Selectivity Block #7 Data

1	-1	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.05	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0.005	2	0	0.5
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Fleet Start Age

1 1 1 1 1 1 1

Fleet End Age

10 10 10 10 10 10 10

Age Range for Average F

1 10

Average F report option (1=unweighted, 2=Nweighted, 3=Bweighted)

1

Use Likelihood constants? (1=yes)

1

Release Mortality by Fleet

0 0 0 0 0 0 0

Catch Data

Fleet-1 Catch Data

0 0.082 4.464 70.244 280.893 295.406 154.278 78.839

59.613 89.432 45398.34486

0.025 0.085 2.256 114.18 244.011 210.331 89.067 44.122

30.661 43.638 29470.22355

0.07 0.534 10.922 151.912 220.741 197.323 91.229 43.572

33.3 59.189 30179.21139

0.017 0.336 8.353 144.58 249.731 162.38 92.685 49.051

37.566 60.983 30294.04133

0.08 0.907 19.046 149.484 273.568 173.993 101.294 60.927

50.937 104.246 37172.72303

0.028 0.462 16.166 178.377 296.061 252.283 126.572 67.127

52.79 88.364 41910.11849

0.043 0.493 11.008 101.679 241.558 197.825 93.758 54.06

44.729 74.272 33238.8898

0.018 0.817 8.766 136.57 303.77 240.08 120.441 60.114

42.819 62.943 37669.60904

0.01 0.618 8.983 104.913 330.227 279.899 134.797 62.105

43.746 65.161 40935.02634

0.001 0.047 1.817 81.76 313.727 308.685 142.881 59.594

46.823 83.663 43520.47104

0 0.04 5.171 93.532 284.64 322.732 149.147 71.053

60.243 96.043 46581.15897

0.005 0.384 10.51 188.389 265.19 230.748 112.018 57.08

50.863 76.754 37743.10687

0 0.07 3.318 95.072 272.461 251.442 147.517 69.705

44.806 66.206 39589.93587

0.02 0.465 3.284 63.199 215.078 258.917 177.031 89.546

48.781 57.583 40800.66999

0.179 3.922 16.094 75.4 391.22 231.543 120.655 50.145

31.301 43.646 36006.77542

0.168 0.614 10.64 109.304 363.347 382.56 192.005 100.52

76.113 125.612 59096.32752

0.149 0.241 10.58 181.878 370.296 325.009 187.845 99.575

77.222 109.748 55940.45289

0.136 1.354 23.553 412.852 552.347 354.72 146.136 71.8

57.252 102.216 57264.90889

0.471 1.509 16.545 290.526 529.314 403.828 171.915 79.494

64.169 126.969 62235.91483

0.011 0.816 14.035 258.919 438.008 469.456 197.269 89.684

66.247	136.305	65434.91154					
0.009	2.33	34.632	483.706	582.629	442.444	193.276	91.687
69.701	115.362	68195.76506					
0.007	0.375	40.48	475.322	579.145	411.914	157.103	79.631
64.617	96.922	62102.40561					
0.019	0.818	34.679	502.882	535.595	428.447	141.629	60.648
55.374	110.554	60165.90493					
0.021	0.551	28.365	433.733	514.708	328.949	156.168	70.018
53.877	109.816	56214.43536					
0.003	0.136	8.875	198.549	506.834	446.499	215.921	98.765
65.704	111.397	65344.16157					
0.02	0.487	18.025	141.321	443.752	533.96	277.485	132.366
87.947	138.755	76528.77658					
0.07	0.144	7.083	109.704	473.461	602.015	324.436	150.61
91.989	116.663	82219.94201					
1.028	14.222	10.311	76.754	319.031	445.993	259.29	131.416
92.893	139.697	68601.16813					
1.849	25.536	11.978	75.502	290.668	422.747	249.774	126.616
91.23	139.589	65945.04805					
0.031	0.096	4.198	64.004	335.332	452.914	260.619	134.034
93.223	118.576	67751.16161					
0.047	0.015	0.954	40.944	237.318	310.589	176.917	93.777
67.986	84.563	47203.79199					
0.066	0.253	2.558	30.144	217.087	325.736	181.351	86.697
59.428	89.169	46756.30784					
0.036	0.459	3.114	51.731	168.607	177.453	97.754	53.787
42.423	60.053	29054.49859					
0.038	0.031	2.872	72.003	204.441	222.737	91.827	52.657
44.834	63.397	32036.35486					
0.049	0.08	9.574	202.886	314.811	279.461	166.003	120.974
104.981	153.667	58595.83511					
# Fleet-2 Catch Data							
0.001	0.022	0.047	0.001	0.004	0.01	0.005	0.002
0.001	0.001	1.240845967					
0	0.006	0.02	0	0.001	0	0	0
0	0	0.083528277					
0.012	0.168	0.428	0.067	0.039	0.022	0.01	0.004
0.001	0.001	4.696908056					
0.003	0.044	0.1	0.061	0.043	0.024	0.008	0.003
0.001	0.001	3.659006839					
0.081	1.022	2.422	0.579	0.371	0.2	0.084	0.033
0.013	0.007	38.00152486					
0.093	2.45	6.249	0.403	0.468	2.363	1.335	0.496
0.117	0.029	251.2297808					

5.269	52.166	155.659	6.783	10.732	12.046	4.984	1.722
0.393	0.097	1719.297392					
13.552	128.44	210.538	26.514	23.08	7.398	1.986	0.591
0.135	0.036	1961.196126					
4.71	37.571	116.157	68.402	18.539	6.91	3.712	1.289
0.416	0.198	1961.238524					
70.894	208.626	258.986	98.822	48.211	5.226	0.723	0.176
0.042	0.009	3207.18039					
4.06	189.533	579.108	51.867	46.403	34.009	6.789	1.767
0.839	0.53	5295.964941					
13.929	177.632	374.618	77.133	24.405	7.237	0.822	0.251
0.118	0.05	2765.662516					
3.21	57.98	193.529	54.765	46.808	30.787	13.537	5.646
2.763	1.994	4942.415574					
2.46	53.894	68.623	19.105	36.934	44.834	16.631	4.903
1.973	1.391	4702.747113					
0.875	22.277	110.144	14.134	7.138	12.242	6.839	2.5
1.267	1.059	1834.390999					
2.488	71.784	69.679	22.444	60.017	50.968	22.673	8.139
3.642	2.476	6353.651396					
0.177	11.368	35.206	5.817	16.772	21.87	15.67	11.323
8.707	8.961	4478.870607					
0.385	25.224	88.07	46.071	21.958	21.838	15.542	7.704
4.823	4.764	4192.741068					
7.628	96.342	155.595	32.39	27.87	17.126	6.706	2.917
1.663	1.852	3025.769272					
4.264	51.148	111.648	2.825	7.428	16.12	8.361	3.288
1.54	1.235	2132.533683					
10.988	126.515	373.832	47.582	55.918	30.391	9.479	2.644
1.275	0.977	5030.58308					
22.058	192.733	351.707	63.59	21.406	17.703	11.579	5.997
3.604	3.406	4503.411392					
0.37	25.05	212.842	42.97	52.102	29.338	10.838	3.951
2.292	2.891	4702.01751					
6.495	26.487	98.729	38.668	26.153	21.61	13.984	6.502
3.528	3.031	3861.953347					
1.594	37.708	46.185	4.229	17.99	30.028	19.089	8.434
4.489	3.73	4165.874242					
1.622	36.715	45.572	51.409	51.24	36.47	22.031	12.137
8.788	12.375	7049.012291					
0.169	9.905	22.938	40.823	31.704	19.008	11.008	5.454
3.636	4.21	3557.578548					
3.001	35.233	89.872	16.199	33.371	48.086	33.281	17.313
10.686	10.749	7913.960885					

3.092	42.184	77.1	21.943	11.717	33.164	27.317	14.5
8.934	9.132	5987.840322					
7.544	129.197	140.449	38.876	17.644	33.065	19.821	8.224
4.349	4.175	4961.165294					
9.636	72.03	90.271	7.703	41.279	71.746	40.993	16.91
8.515	6.996	9029.451901					
7.782	104.15	160.595	19.843	22.154	31.867	18.002	7.492
3.908	3.384	4651.261214					
3.259	59.431	98.027	29.467	11.296	16.585	12.872	6.662
4.104	4.015	3318.522045					
8.765	67.422	117.379	18.162	31.972	40.049	21.516	9.74
5.359	4.689	5628.591457					
3.144	26.918	25.936	17.35	36.433	46.559	27.941	13.385
7.896	7.558	6739.213375					

Fleet-3 Catch Data

0.028	0.274	0.424	0.063	0.012	0.001	0	0
0	0	2.269607989					
0.028	0.068	0.092	0.014	0.003	0	0	0
0	0	0.520612621					
0.323	1.141	1.474	0.363	0.037	0.003	0	0
0	0	9.234854331					
0.052	0.589	2.42	0.786	0.023	0.001	0	0
0	0	13.54226529					
1.378	10.186	18.494	7.015	0.408	0.037	0.003	0
0	0	126.3582982					
0.177	0.695	62.786	89.204	8.795	0.656	0	0
0	0	1088.506715					
24.833	348.958	346.366	145.536	8.653	2.245	0.144	0.004
0	0	2773.608947					
138.575	597.763	555.893	162.016	19.698	0.999	0.022	0
0	0	4040.975791					
11.62	192.108	888.894	180.555	20.623	0.345	0.012	0.021
0.009	0.003	4420.596282					
68.765	399.457	982.021	193.02	11.175	1.22	0.302	0.029
0.002	0	4871.021474					
66.727	689.011	1181.895	173.439	10.155	1.99	0.073	0.007
0.003	0.002	5593.783832					
132.161	1246.503	1172.881	150.35	14.565	0.854	0.662	0.094
0.005	0	6258.091632					
99.286	695.874	963.947	100.27	17.896	1.038	0.02	0.003
0.001	0	4663.234313					
31.665	697.079	1031.961	200.965	45.151	4.153	0.787	0.092
0.012	0.002	6426.195905					
83.278	462.284	971.165	200.764	23.464	1.993	1.201	0.745

0.469	0.354	5494.396509					
83.348	868.164	1023.685	147.235	19.115	1.395	0.742	0.361
0.138	0.061	5510.411049					
58.721	952.075	1838.602	269.315	29.854	1.222	0.039	0.002
0	0	8784.099929					
405.6	1196.609	2881.066	497.9	41.932	4.156	1.498	0.8
0.647	0.743	14370.906					
475.323	1814.331	1927.687	302.045	100.255	17.713	4.442	1.345
0.588	0.616	13516.4973					
349.02	3347.591	4439.567	330.833	28.821	2.042	0.998	0.53
0.264	0.147	19252.61746					
74.783	1085.959	2500.312	474.761	90.098	7.023	2.258	0.468
0.133	0.112	14138.33477					
334.042	2480.812	3876.188	631.922	117.877	14.263	2.686	0.716
0.322	0.444	21869.37471					
576.82	2086.387	2048.938	342.621	168.44	16.605	2.233	0.393
0.11	0.061	15944.85852					
727.823	2125.469	1913.412	235.18	82.496	6.517	0.576	0.162
0.083	0.071	12241.48219					
565.026	2821.773	2947.283	248.514	60.295	10.367	2.933	1.071
0.396	0.193	15591.5956					
271.818	1506.435	1544.405	276.963	64.155	2.552	0.542	0.244
0.187	0.285	9942.861973					
337.455	1206.407	1910.734	402.482	71.529	6.338	1.64	0.465
0.15	0.064	11880.76884					
132.543	1181.937	2007.307	296.065	47.544	8.837	2.834	0.838
0.332	0.244	10776.59092					
274.339	1143.136	2087.599	413.056	29.733	1.866	0.249	0.055
0.024	0.019	10935.8428					
401.914	2324.424	1954.675	245.507	37.535	2.848	0.762	0.245
0.117	0.104	11218.91807					
697.277	2665.486	2688.757	141.963	12.001	1.119	0.294	0.128
0.049	0.02	12157.20977					
431.699	2377.053	3541.487	255.216	21.725	2.35	1.215	0.651
0.42	0.415	15084.80433					
302.566	2113.594	2301.528	290.959	11.731	0.505	0.143	0.114
0.067	0.039	11313.26573					
251.602	1774.945	2070.893	243.217	13.08	3.484	1.005	0.505
0.313	0.299	10166.4644					
229.687	1335.635	1045.087	216.28	11.474	2.556	0.672	0.174
0.075	0.066	6623.090212					
# Fleet-4 Catch Data							
37.878	24.084	93.13	27.949	0.332	0	0	0
0	0	512.3978041					

40.241	29.213	89.574	26.978	0.213	0	0	0
0	0	501.0983516					
32.075	23.708	98.574	29.415	0.171	0	0	0
0	0	529.2305919					
70.404	49.696	112.478	34.347	0.377	0	0	0
0	0	664.805502					
30.81	24.342	145.98	43.219	0.2	0	0	0
0	0	755.4542253					
55.68	41.267	144.543	43.502	0.408	0	0	0
0	0	796.6034244					
108.296	75.654	152.814	47.278	0.782	0	0	0
0	0	933.0779559					
80.875	54.89	163.053	49.984	0.026	0	0	0
0	0	916.7444794					
0.687	3.754	168.207	50.057	0.01	0	0	0
0	0	813.7591848					
3.202	6.315	184.431	53.744	0.044	0	0	0
0	0	888.7446928					
15.121	20.839	327.272	13.263	0.464	0	0	0
0	0	978.8107296					
29.155	40.01	237.072	58.927	0.589	0	0	0
0	0	1135.156465					
92.81	59.045	160.902	48.667	0.88	0	0	0
0	0	935.4892054					
152.788	95.754	192.258	58.99	1.447	0	0	0
0	0	1192.864905					
122.484	77.163	174.216	53.135	1.161	0	0	0
0	0	1052.329249					
161.273	99.345	256.978	78.114	1.519	0	0	0
0	0	1514.553028					
451.278	87.267	267.475	77.879	0.085	0	0	0
0	0	1669.06724					
1044.408	464.241	46.111	29.77	14.266	0	0	0
0	0	1954.443069					
132.884	125.515	320.894	101.825	4.697	0	0	0
0	0	1953.206591					
50.847	109.184	341.206	106.657	3.845	0	0	0
0	0	1947.809613					
53.147	173.319	416.281	118.528	1.483	0	0	0
0	0	2253.769159					
316.554	194.939	424.821	130.563	3.1	0	0	0
0	0	2600.344244					
176.038	111.674	399.884	120.215	1.725	0	0	0
0	0	2228.283508					

289.332	175.041	396.267	121.993	2.947	0	0	0
0	0	2416.023527					
366.848	216.336	350.333	110.001	3.576	0	0	0
0	0	2325.698912					
371.178	208.366	357.988	112.452	3.505	0	0	0
0	0	2354.426025					
338.197	185.404	415.706	128.728	3.163	0	0	0
0	0	2566.025607					
349.635	191.623	367.386	114.561	3.245	0	0	0
0	0	2352.714381					
371.09	204.398	440.98	136.424	3.444	0	0	0
0	0	2740.950721					
312.698	174.355	509.208	154.79	2.889	0	0	0
0	0	2964.760224					
370.815	207.201	658.142	199.563	3.328	0	0	0
0	0	3773.607321					
322.312	190.273	672.778	203.098	3.251	0	0	0
0	0	3783.549817					
237.548	150.453	696.925	207.878	2.696	0	0	0
0	0	3762.864408					
196.284	127.386	729.878	216.517	2.228	0	0	0
0	0	3844.959206					
221.626	138.016	525.753	157.005	2.514	0	0	0
0	0	2910.307923					

Fleet-5 Catch Data

0	0	0.013	1.068	3.045	2.614	1.304	0.645
0.451	0.599	391.0637378					
0	0	0.011	1.025	2.924	2.509	1.252	0.618
0.433	0.575	375.3456476					
0	0	0.015	1.288	3.674	3.153	1.572	0.778
0.543	0.721	471.4807444					
0	0	0.014	1.119	3.191	2.739	1.366	0.675
0.472	0.627	409.6044157					
0	0	0.023	1.988	5.67	4.869	2.429	1.201
0.839	1.114	728.120502					
0	0.002	0.054	4.728	13.483	11.576	5.774	2.856
1.994	2.65	1731.233509					
0	0.003	0.064	5.753	16.403	14.083	7.024	3.475
2.426	3.223	2106.11458					
0	0.003	0.066	5.859	16.711	14.347	7.157	3.541
2.472	3.285	2145.893374					
0	0	0.02	1.767	5.039	4.325	2.158	1.068
0.745	0.99	646.9578018					
0	0.003	0.067	5.894	16.809	14.431	7.198	3.561

2.486	3.303	2158.234871					
0	0.005	0.141	12.505	35.66	30.615	15.271	7.556
5.275	7.008	4578.914492					
0	0.012	0.335	31.695	99.722	83.394	41.183	20.201
14.03	18.635	12409.18443					
0	0.015	0.383	36.738	117.869	98.078	48.338	23.672
16.421	21.812	14579.41505					
0.001	0.014	0.388	36.846	116.4	97.242	48.001	23.537
16.342	21.708	14466.48129					
0.001	0.019	0.528	49.626	154.684	129.671	64.096	31.466
21.862	29.041	19304.18398					
0.001	0.017	0.476	45.318	143.634	119.893	59.162	29.003
20.133	26.742	17833.19524					
0.002	0.023	0.635	61.308	197.926	164.435	80.992	39.642
27.491	36.514	24435.75089					
0.001	0.02	0.524	50.598	163.934	135.951	66.93	32.736
22.685	30.111	20195.65605					
0.002	0.027	0.73	69.504	222.628	184.926	91.123	44.589
30.896	40.968	27479.38953					
0	0	0.036	116.027	529.399	178.12	83.197	38.195
24.446	33.124	33262.67583					
0	0	0.024	50.589	369.72	225.773	84.157	34.192
20.783	24.994	29610.91828					
0	0	0	17.795	267.463	259.185	121.614	54.798
33.707	38.182	33677.92649					
0	0.002	0.636	49.416	198.889	171.426	91.352	42.125
26.595	32.55	25021.76702					
0	0.035	1.589	103.613	335.247	158.598	68.173	31.901
21.129	26.806	25476.66909					
0	0.035	2.397	97.652	337.125	231.568	92.315	40.989
26.468	36.402	31646.38028					
0	0.011	0.412	29.51	144.097	126.182	57.695	26.487
17.976	24.695	17411.99993					
0.001	0.01	0.26	54.414	187.958	139.576	68.079	30.362
18.811	22.103	19954.15836					
0.002	0.015	0.162	41.714	153.397	113.526	56.509	28.99
20.17	25.605	17546.70958					
0.001	0.004	0.12	29.244	125.019	111.121	56.276	28.219
20.48	28.997	16869.51763					
0	0	0.363	32.958	127.131	127.386	66.782	32.663
25.123	43.909	20052.80061					
0	0	0.16	28.074	124.681	109.092	66.652	38.412
31.263	54.259	20852.34201					
0	0	0.056	6.46	73.186	74.386	46.597	27.512

22.416	39.098	14227.28091					
0	0.006	0.211	24.252	100.741	77.961	37.394	17.806
12.076	15.849	11410.81727					
0	0.01	0.28	29.722	112.639	89.149	43.15	20.731
14.157	18.632	13112.54245					
0.001	0.012	0.334	33.586	118.226	95.442	46.548	22.536
15.481	20.429	14097.6475					

Fleet-6 Catch Data

0	0.011	0.757	6.477	12.99	10.052	3.801	1.919
1.406	2.305	1426.174724					
0	0.014	0.207	9.261	10.904	7.785	4.02	2.121
1.469	2.664	1358.264862					
0.004	0.029	0.718	9.941	14.64	9.361	4.095	2
1.48	2.424	1501.94244					
0	0.024	0.832	12.192	15.885	9.137	4.349	2.363
1.91	3.289	1680.934773					
0.007	0.054	1.703	10.18	18.224	15.332	7.034	3.376
2.383	3.5	2254.784574					
0.001	0.026	2.405	13.157	18.084	13.694	6.057	3.084
2.268	3.591	2131.988313					
0.003	0.024	0.565	6.051	15.823	11.709	6.724	3.659
2.712	3.912	2068.038348					
0.001	0.024	0.81	12.482	22.386	15.96	5.894	2.48
1.7	2.207	2122.739261					
0	0.031	0.653	9.872	19.926	15.609	6.336	2.486
1.614	2.33	2054.64757					
0.001	0.02	0.477	7.739	16.271	14.89	6.217	2.709
2.115	3.885	2086.234616					
0	0.021	1.081	8.519	23.305	15.226	7.12	3.427
2.621	4.04	2432.620839					
0	0.031	1.075	22.538	28.782	13.673	5.881	2.846
2.451	4.201	2504.268352					
0	0.001	0.102	7.03	21.656	16.741	8.028	3.126
1.876	2.422	2286.322085					
0	0.007	0.273	9.997	27.695	17.992	8.051	3.13
2.011	3.228	2589.104866					
0	0	0.09	6.714	19.058	16.701	8.257	4.062
3.159	4.776	2576.273003					
0.001	0.029	0.467	5.018	22.74	31.221	10.184	4.514
3.39	5.08	3441.880063					
0.001	0.015	0.975	21.562	27.613	19.235	11.482	6.011
4.785	7.062	3626.441356					
0	0.117	4.029	53.461	51.835	14.44	5.506	3.184
2.74	5.859	3513.555351					

0.001	0.052	0.86	16.144	33.773	26.316	13.732	7.587
5.339	7.381	4332.525508					
0.002	0.101	1.726	30.202	46.778	29.66	11.928	5.647
4.209	6.672	4536.377394					
0	0.007	1.285	34.534	61.523	33.349	12.072	5.481
4.448	5.849	5040.777216					
0	0.02	4.483	59.465	52.114	35.289	12.41	5.657
4.09	5.385	5050.919279					
0.004	0.205	5.522	70.309	50.121	19.398	6.963	3.565
3.295	7.791	4112.636045					
0.001	0.093	9.754	51.451	43.218	23.853	10.491	3.606
2.607	5.83	3983.946866					
0	0.008	1.421	19.215	48.65	25.759	9.133	3.693
2.536	5.682	3845.314861					
0	0.003	0.384	8.821	33.181	37.2	16.045	6.509
4.221	5.561	4543.08307					
0.008	0.57	1.775	12.115	35.357	42.863	19.758	7.763
3.996	4.314	5038.020994					
0.001	0.253	1.126	6.878	22.681	34.407	16.992	6.967
4.094	6.014	4260.919276					
0	0.009	0.501	6.892	32.128	43.989	18.018	7.322
3.882	4.685	4854.720458					
0	0.109	2.422	10.777	34.258	43.373	19.016	8.428
5.312	6.683	5313.079878					
0	0.009	0.37	7.619	34.672	52.918	27.918	11.965
7.141	8.233	6686.254304					
0.002	0.026	0.249	4.339	28.861	49.596	27.36	12.535
8.23	10.167	6619.372161					
0.005	0.396	1.288	34.74	46.96	37.537	20.055	12.838
10.312	14.142	6890.135768					
0	0.033	0.738	22.419	55.178	48.041	15.648	10.841
9.28	11.978	6808.960082					
0.002	0.003	0.239	15.298	44.966	26.236	9.902	8.997
8.519	10.444	4963.83834					
# Fleet-7 Catch Data							
3.102	3.033	41.69	7.739	0.042	0	0	0
0	0	171.6266529					
2.979	2.912	39.952	7.426	0.04	0	0	0
0	0	164.5499496					
3.304	3.231	44.331	8.237	0.044	0	0	0
0	0	182.552478					
3.774	3.69	50.164	9.379	0.051	0	0	0
0	0	207.1124592					
5.749	5.627	72.629	14.104	0.078	0	0	0

0	0	304.5169683					
5.744	5.622	71.908	14.045	0.078	0	0	0
0	0	302.2296233					
5.929	5.802	74.187	14.484	0.08	0	0	0
0	0	311.7538571					
5.116	5.212	79.852	16.033	0.069	0	0	0
0	0	336.3835549					
1.359	2.516	73.135	21.546	0.019	0	0	0
0	0	354.3223331					
2.743	3.456	93.218	19.795	0.038	0	0	0
0	0	394.4320788					
35.185	34.429	308.348	76.625	0.468	0	0	0
0	0	1444.359183					
13.585	13.245	144.307	30.696	0.179	0	0	0
0	0	630.055527					
12.238	11.973	124.767	28.062	0.166	0	0	0
0	0	557.6186393					
10.062	9.845	113.55	23.778	0.136	0	0	0
0	0	491.6436809					
8.668	8.482	99.684	20.62	0.118	0	0	0
0	0	429.3208725					
11.161	10.922	134.775	26.945	0.149	0	0	0
0	0	572.0106249					
66.052	28.007	137.449	28.602	0.163	0	0	0
0	0	648.1682325					
173.953	83.699	130.951	28.935	1.487	0	0	0
0	0	806.8507308					
168.355	199.109	69.338	32.695	4.288	0	0	0
0	0	895.2302263					
42.606	64.596	160.307	39.675	1.294	0	0	0
0	0	851.566745					
22.357	43.606	252.26	55.054	0.227	0	0	0
0	0	1135.436204					
17.281	17.927	264.181	56.845	0.233	0	0	0
0	0	1143.108486					
15.903	18.085	323.867	75.542	0.215	0	0	0
0	0	1435.920366					
15.485	17.608	315.226	73.531	0.21	0	0	0
0	0	1397.672967					
20.478	23.875	307.831	71.187	0.228	0	0	0
0	0	1372.718491					
22.205	25.78	323.978	75.176	0.246	0	0	0
0	0	1448.07091					
23.827	27.742	367.687	85.103	0.269	0	0	0

0	0	1638.719835					
25.082	28.927	359.869	86.023	0.292	0	0	0
0	0	1628.81163					
39.754	42.031	526.66	130.822	0.524	0	0	0
0	0	2425.265254					
29.81	32.763	488.997	118.166	0.393	0	0	0
0	0	2211.774796					
33.635	37.367	597.181	143.949	0.455	0	0	0
0	0	2692.582563					
50.272	54.181	728.535	177.685	0.651	0	0	0
0	0	3319.937572					
34.411	38.453	626.643	150.596	0.465	0	0	0
0	0	2820.109526					
41.32	45.688	697.243	167.942	0.543	0	0	0
0	0	3147.01569					
55.663	58.032	683.925	169.068	0.734	0	0	0
0	0	3151.550878					

Discards

Fleet-1 Discards Data

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Fleet-6 Discards Data

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Fleet-7 Discards Data
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Release Proportion
Fleet-1 Release Data
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Fleet-2 Release Data
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Fleet-3 Release Data
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Fleet-4 Release Data
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Fleet-5 Release Data
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Fleet-6 Release Data
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Fleet-7 Release Data
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0	0						
0	0	0	0	0	0	0	0
0	0						
0	0	0	0	0	0	0	0

0 0

Survey Index Data

Aggregate Index Units

2 2 2 2

Age Proportion Index Units

2 2 2 2

Weight at Age Matrix

1 1 1 1

Index Month

1 1 1 1

Index Selectivity Link to Fleet

1 1 1 1

Index Selectivity Options 1=by age, 2=logisitic, 3=double logistic

2 2 2 2

Index Start Age

1 1 1 1

Index End Age

10 10 10 10

Estimate Proportion (Yes=1)

0 0 0 0

Use Index (Yes=1)

1 1 1 1

Index-1 Selectivity Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	0	0	0
0.5	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-2 Selectivity Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	0	0	0
0.5	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-3 Selectivity Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	0	0	0
0.5	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Index-4 Selectivity Data

0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	0	0	0
0.5	0	0	0
0	0	0	0
0	0	0	0

0 0 0 0

0 0 0 0

Index-1 Data

1978 11.1113 0.1 0 0 0 0 0 0

0 0 0 0 0

1979 7.1484 0.1 0 0 0 0 0 0

0 0 0 0 0

1980 7.5439 0.1 0 0 0 0 0 0

0 0 0 0 0

1981 7.2947 0.1 0 0 0 0 0 0

0 0 0 0 0

1982 8.3869 0.1 0 0 0 0 0 0

0 0 0 0 0

1983 8.2505 0.1 0 0 0 0 0 0

0 0 0 0 0

1984 7.1275 0.1 0 0 0 0 0 0

0 0 0 0 0

1985 6.7287 0.1 0 0 0 0 0 0

0 0 0 0 0

1986 7.809 0.1 0 0 0 0 0 0

0 0 0 0 0

1987 9.3333 0.1 0 0 0 0 0 0

0 0 0 0 0

1988 7.7947 0.1 0 0 0 0 0 0

0 0 0 0 0

1989 7.1871 0.1 0 0 0 0 0 0

0 0 0 0 0

1990 6.8953 0.1 0 0 0 0 0 0

0 0 0 0 0

1991 5.9691 0.1 0 0 0 0 0 0

0 0 0 0 0

1992 6.0693 0.1 0 0 0 0 0 0

0 0 0 0 0

1993 5.8433 0.1 0 0 0 0 0 0

0 0 0 0 0

1994 5.1545 0.1 0 0 0 0 0 0

0 0 0 0 0

1995 5.3555 0.1 0 0 0 0 0 0

0 0 0 0 0

1996 5.2435 0.1 0 0 0 0 0 0

0 0 0 0 0

1997 4.3752 0.1 0 0 0 0 0 0

0 0 0 0 0

1998 4.7748 0.1 0 0 0 0 0 0

0 0 0 0 0

1999 4.6303 0.1 0 0 0 0 0 0

0 0 0 0 0

2000 3.9942 0.1 0 0 0 0 0 0

0 0 0 0 0

2001 3.9847 0.1 0 0 0 0 0 0

0 0 0 0 0

2002 3.2245 0.1 0 0 0 0 0 0

0 0 0 0 0

2003 3.8008 0.1 0 0 0 0 0 0

0 0 0 0 0

2004 4.1753 0.1 0 0 0 0 0 0

0 0 0 0 0

2005 4.6661 0.1 0 0 0 0 0 0

0 0 0 0 0

2006 4.262 0.3 0 0 0 0 0 0

0 0 0 0 0

2007 4.4729 0.3 0 0 0 0 0 0

0 0 0 0 0

2008 4.1479 0.3 0 0 0 0 0 0

0 0 0 0 0

2009 3.3141 0.3 0 0 0 0 0 0

0 0 0 0 0

2010 3.4871 0.3 0 0 0 0 0 0

0 0 0 0 0

2011 5.2006 0.3 0 0 0 0 0 0

0 0 0 0 0

2012 6.3754 0.3 0 0 0 0 0 0

0 0 0 0 0

Index-2 Data

1978 9.202 0.1 0 0 0 0 0 0

0 0 0 0 0

1979 6.4999 0.1 0 0 0 0 0 0

0 0 0 0 0

1980 6.9505 0.1 0 0 0 0 0 0

0 0 0 0 0

1981 6.1135 0.1 0 0 0 0 0 0

0 0 0 0 0

1982 6.942 0.1 0 0 0 0 0 0

0 0 0 0 0

1983 7.412 0.1 0 0 0 0 0 0

0 0 0 0 0

1984 5.812 0.1 0 0 0 0 0 0

0 0 0 0 0

1985	5.2843	0.1	0	0	0	0	0	0	0	0	0	0	0
1986	6.037	0.1	0	0	0	0	0	0	0	0	0	0	0
1987	7.5603	0.1	0	0	0	0	0	0	0	0	0	0	0
1988	6.3615	0.1	0	0	0	0	0	0	0	0	0	0	0
1989	5.8099	0.1	0	0	0	0	0	0	0	0	0	0	0
1990	5.4906	0.1	0	0	0	0	0	0	0	0	0	0	0
1991	5.3754	0.1	0	0	0	0	0	0	0	0	0	0	0
1992	5.1427	0.1	0	0	0	0	0	0	0	0	0	0	0
1993	5.2341	0.1	0	0	0	0	0	0	0	0	0	0	0
1994	4.8785	0.1	0	0	0	0	0	0	0	0	0	0	0
1995	4.587	0.1	0	0	0	0	0	0	0	0	0	0	0
1996	4.5625	0.1	0	0	0	0	0	0	0	0	0	0	0
1997	3.9008	0.1	0	0	0	0	0	0	0	0	0	0	0
1998	4.4761	0.1	0	0	0	0	0	0	0	0	0	0	0
1999	4.1531	0.1	0	0	0	0	0	0	0	0	0	0	0
2000	3.7977	0.1	0	0	0	0	0	0	0	0	0	0	0
2001	3.4535	0.1	0	0	0	0	0	0	0	0	0	0	0
2002	2.997	0.1	0	0	0	0	0	0	0	0	0	0	0
2003	3.3569	0.1	0	0	0	0	0	0	0	0	0	0	0
2004	3.8412	0.1	0	0	0	0	0	0	0	0	0	0	0
2005	3.5636	0.1	0	0	0	0	0	0	0	0	0	0	0
2006	3.3214	0.3	0	0	0	0	0	0	0	0	0	0	0

2007 3.3629 0.3 0 0 0 0 0 0

0 0 0 0 0

2008 3.0166 0.3 0 0 0 0 0 0

0 0 0 0 0

2009 2.5194 0.3 0 0 0 0 0 0

0 0 0 0 0

2010 2.6721 0.3 0 0 0 0 0 0

0 0 0 0 0

2011 4.0715 0.3 0 0 0 0 0 0

0 0 0 0 0

2012 4.6951 0.3 0 0 0 0 0 0

0 0 0 0 0

Index-3 Data

1978 0 0.1 0 0 0 0 0 0

0 0 0 0 0

1979 0 0.1 0 0 0 0 0 0

0 0 0 0 0

1980 2.726434192 0.1 0 0 0 0 0 0

0 0 0 0 0

1981 2.802404229 0.1 0 0 0 0 0 0

0 0 0 0 0

1982 3.175045444 0.1 0 0 0 0 0 0

0 0 0 0 0

1983 2.755186821 0.1 0 0 0 0 0 0

0 0 0 0 0

1984 2.769890911 0.1 0 0 0 0 0 0

0 0 0 0 0

1985 2.84747768 0.1 0 0 0 0 0 0

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1986 3.034031664 0.1 0 0 0 0 0 0

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1987 2.530345202 0.1 0 0 0 0 0 0

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1988 2.41886757 0.1 0 0 0 0 0 0

0 0 0 0 0

1989 2.013284782 0.1 0 0 0 0 0 0

0 0 0 0 0

1990 2.364866738 0.1 0 0 0 0 0 0

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1991 1.997527067 0.1 0 0 0 0 0 0

0 0 0 0 0

1992 2.771311813 0.1 0 0 0 0 0 0

0 0 0 0 0

1993 2.670947082 0.1 0 0 0 0 0 0

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1994 2.92477417 0.1 0 0 0 0 0 0

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1995 2.220010678 0.1 0 0 0 0 0 0

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1996 2.236335906 0.1 0 0 0 0 0 0

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1997 2.26420398 0.1 0 0 0 0 0 0

0 0 0 0 0

1998 2.55646851 0.1 0 0 0 0 0 0

0 0 0 0 0

1999 2.189000043 0.1 0 0 0 0 0 0

0 0 0 0 0

2000 2.251217259 0.1 0 0 0 0 0 0

0 0 0 0 0

2001 2.655664503 0.1 0 0 0 0 0 0

0 0 0 0 0

2002 2.85642932 0.1 0 0 0 0 0 0

0 0 0 0 0

2003 3.208485567 0.1 0 0 0 0 0 0

0 0 0 0 0

2004 3.292755193 0.1 0 0 0 0 0 0

0 0 0 0 0

2005 2.315902657 0.1 0 0 0 0 0 0

0 0 0 0 0

2006 2.344769181 0.3 0 0 0 0 0 0

0 0 0 0 0

2007 2.335949695 0.3 0 0 0 0 0 0

0 0 0 0 0

2008 2.013709784 0.3 0 0 0 0 0 0

0 0 0 0 0

2009 1.928205551 0.3 0 0 0 0 0 0

0 0 0 0 0

2010 2.205479623 0.3 0 0 0 0 0 0

0 0 0 0 0

2011 2.934700686 0.3 0 0 0 0 0 0

0 0 0 0 0

2012 3.42220545 0.3 0 0 0 0 0 0

0 0 0 0 0

Index-4 Data

1978 0 0.1 0 0 0 0 0 0

0 0 0 0 0

1979 0 0.1 0 0 0 0 0 0

0 0 0 0 0

1980	2.292176893	0.1	0	0	0	0	0	0	0	0	0	0	0
1981	2.333623486	0.1	0	0	0	0	0	0	0	0	0	0	0
1982	2.662674424	0.1	0	0	0	0	0	0	0	0	0	0	0
1983	2.215231579	0.1	0	0	0	0	0	0	0	0	0	0	0
1984	2.306655508	0.1	0	0	0	0	0	0	0	0	0	0	0
1985	2.403965011	0.1	0	0	0	0	0	0	0	0	0	0	0
1986	2.550163623	0.1	0	0	0	0	0	0	0	0	0	0	0
1987	2.144959644	0.1	0	0	0	0	0	0	0	0	0	0	0
1988	2.032364269	0.1	0	0	0	0	0	0	0	0	0	0	0
1989	1.740685137	0.1	0	0	0	0	0	0	0	0	0	0	0
1990	2.053407063	0.1	0	0	0	0	0	0	0	0	0	0	0
1991	1.745389874	0.1	0	0	0	0	0	0	0	0	0	0	0
1992	2.060495409	0.1	0	0	0	0	0	0	0	0	0	0	0
1993	2.134973357	0.1	0	0	0	0	0	0	0	0	0	0	0
1994	2.485107043	0.1	0	0	0	0	0	0	0	0	0	0	0
1995	1.95930829	0.1	0	0	0	0	0	0	0	0	0	0	0
1996	1.918151501	0.1	0	0	0	0	0	0	0	0	0	0	0
1997	1.987224125	0.1	0	0	0	0	0	0	0	0	0	0	0
1998	2.197739257	0.1	0	0	0	0	0	0	0	0	0	0	0
1999	1.930405945	0.1	0	0	0	0	0	0	0	0	0	0	0
2000	2.006320724	0.1	0	0	0	0	0	0	0	0	0	0	0
2001	2.263876302	0.1	0	0	0	0	0	0	0	0	0	0	0

2002 2.489010527 0.1 0 0 0 0 0 0
0 0 0 0 0
2003 2.796944948 0.1 0 0 0 0 0 0
0 0 0 0 0
2004 2.764931988 0.1 0 0 0 0 0 0
0 0 0 0 0
2005 1.98722614 0.1 0 0 0 0 0 0
0 0 0 0 0
2006 1.992534277 0.3 0 0 0 0 0 0
0 0 0 0 0
2007 1.987612568 0.3 0 0 0 0 0 0
0 0 0 0 0
2008 1.714149658 0.3 0 0 0 0 0 0
0 0 0 0 0
2009 1.599744234 0.3 0 0 0 0 0 0
0 0 0 0 0
2010 1.81029778 0.3 0 0 0 0 0 0
0 0 0 0 0
2011 2.461491586 0.3 0 0 0 0 0 0
0 0 0 0 0
2012 2.912216635 0.3 0 0 0 0 0 0
0 0 0 0 0
Phase Control
Phase for F mult in 1st Year
1
Phase for F mult Deviations
2
Phase for Recruitment Deviations
2
Phase for N in 1st Year
1
Phase for Catchability in 1st Year
2
Phase for Catchability Deviations
-1
Phase for Stock Recruitment Relationship
1
Phase for Steepness
-1
Recruitment CV by Year
0.6
0.6
0.6
0.6

0.6

0.6

0.6

0.6

0.6

0.6

0.6

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0.6

0.6

0.6

Lambdas by Index

1 1 1 1

Lambda for Total Catch in Weight by Fleet

1 1 1 1 1 1 1

Lambda for Total Discards at Age by Fleet

0 0 0 0 0 0 0

Catch Total CV by Year and Fleet

0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1

0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1

Discard Total CV by Year and Fleet

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Catch Effective Sample Size by Year and Fleet

351.958	9.324	146.133	1.421	156.201	108.634	0.547
29.551	3.44	75.875	1.938	45.002	29.593	0.656
28.493	11.478	60.78	2.174	31.887	40.016	0.901
65.137	235.356	19.337	4.385	46.174	95.04	0.962
194.461	12.098	151.368	1.099	61.656	126.284	0.64
82.138	10.422	1.95	1.113	87.459	70.417	0.461
132.71	6.896	46.58	3.379	88.683	884.18	0.712
60.869	14.491	10.946	3.862	62.473	53.668	1.021
47.54	37.004	13.888	0.835	57.635	62.643	0.77
48.901	15.051	25.463	0.834	52.878	48.828	0.696
368.238	6.229	203.521	0.637	193.296	251.077	0.783
50.913	8.401	38.17	1.089	68.884	20.729	0.786
75.92	33.275	112.826	2.905	54.933	65.336	0.842
51.029	22.991	207.403	3.739	73.708	65.493	0.76
34.803	6.73	65.935	2.458	64.585	101.728	0.617
129.075	21.273	235.805	2.858	91.198	24.594	0.721
220.819	12.021	107.567	11.808	87.787	145.458	1.41
39.453	38.207	20.306	16.323	93.505	13.269	3.165
93.971	40.459	86.511	1.884	95.508	150.905	2.24
169.465	11.531	74.788	1.182	13.663	217.734	1.125
48.771	10.442	27.9	1.222	30.596	148.856	0.786
38.778	15.49	699.102	2.912	33.395	22.442	0.628

30.321	9.281	70.787	1.269	200.453	9.436	0.458
36.684	23.686	52.278	2.411	48.188	18.673	0.522
169.668	11.717	43.382	5.976	106.516	76.418	0.749
26.81	10.31	29.876	5.23	49.121	15.38	0.729
15.332	10.422	249.597	4.057	70.977	13.256	0.738
17.775	15.723	565.06	8.547	175.219	12.692	0.994
27.6	21.628	1436.52	3.515	181.327	19.566	0.708
27.235	21.977	41.902	0.984	53.537	23.988	0.312
44.735	12.87	76.458	1.04	80.875	20.167	0.313
38.876	79.823	107.848	1.689	73.44	17.632	0.566
23.348	65.095	35.186	2.553	35.011	46.716	1.004
12.703	13.689	18.88	1.629	19.687	13.621	0.82
14.1	7.917	25.199	2.81	29.807	34.836	1.024

Discard Effective Sample Size by Year and Fleet

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

Lambda for F Mult in First year by Fleet

0 0 0 0 0 0 0

CV for F Mult in First year by Fleet

0.9 0.9 0.9 0.9 0.9 0.9 0.9

Lambda for F Mult Deviations by Fleet

0 0 0 0 0 0 0

CV for F Mult Deviations by Fleet

0.9 0.9 0.9 0.9 0.9 0.9 0.9

Lambda for N in 1st Year Deviations

0

CV for N in 1st Year Deviations

0.9

Lambda for Recruitment Deviations

1

Lambda for Catchability in First year by Index

0 0 0 0

CV for Catchability in First year by Index

0.9 0.9 0.9 0.9

Lambda for Catchability Deviations by Index

0 0 0 0

CV for Catchability Deviations by Index

0.9 0.9 0.9 0.9

Lambda for Deviation from Initial Steepness

0

CV for Deviation from Initial Steepness

0.9

Lambda for Deviation from Unexploited Stock Size

0

CV for Deviation from Unexploited Stock Size

0.9

NAA Deviations Flag

2

Initial Numbers at Age in 1st Year

1624.483 1771.264 3174.304 1119.587 847.759 531.105 235.612 116.224 88.147 143.693

Initial F Mult in 1st Year by Fleet

0.05 0.05 0.05 0.05 0.05 0.05 0.05

Initial Catchabilty by Index

0.0003 0.0003 0.0004 0.0004

Stock Recruitment Flag

1

Initial Unexploited Stock

2000

Initial Steepness

0.8

Maximum F

5

Ignore Guesses (Yes=1)

0

Projection Control

Do Projections (Yes=1)

1

Fleet Directed Flag

1 1 1 1 1 1 1

Final Year in Projection

2017

Projection Data by Year

2013	-1	4	1	0
2014	-1	4	1	0
2015	-1	4	1	0
2016	-1	4	1	0
2017	-1	4	1	0

Do MCMC (Yes=1)

0

MCMC Year Option

1

MCMC Iterations

0

MCMC Thinning Factor

0

MCMC Random Seed

0

Agepro R Option

-1

Agepro R Option Start Year

0

Agepro R Option End Year

0

Export R Flag

1

Test Value

-23456

######

FINIS

Fleet Names

#$LL

#$PSFS

#$PSLS

#$BB

#$FL

#$LINE

#$OTHER

Survey Names

#$JPNtro

#$JPNwhol

#$TWNtro

#$TWNwhol

#