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Summer Flounder Assessment and Biological Reference Point Update for 2006

by

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SUMMARY

An update and peer review of the summer flounder assessment and reference points was conducted by the National Marine Fisheries Service (NMFS) Office of Science and Technology (S&T) during September 14-15, 2006. The 2006 S&T Peer Review Panel recommendations required revision to the summer flounder VPA, biological reference point, and projection calculations. The revised analytical results supersede those presented in the Terceiro (2006) assessment. The updated VPA provided estimates of F for 2005 = 0.407 and SSB for 2005 = 47,498 mt (104.7 million lbs). The Panel recommended updated biological reference points from an empirical non-parametric approach (i.e., the product of a reference level of recruitment and yield and biomass per recruit). The updated yield per recruit analysis indicated that F_{max} = 0.280 (the FMP Amendment 12 proxy for F_{MSY}). Yield per Recruit (Y/R) at F_{max} was estimated to be 0.579 kg and Spawning Stock Biomass per Recruit (SSB/R) at F_{max} was estimated to be 2.416 kg. Mean recruitment for 1982-2005 was estimated to be 37.010 million fish. The product of the mean recruitment and Y/R at F_{max} was 21,444 mt (47.276 million lbs; updated proxy for MSY); the product of the mean recruitment and SSB/R at F_{max} was 89,411 mt (197.118 million lbs; updated proxy for B_{MSY}). The biomass threshold proxy of 0.5*SSB_{max} = 0.5*B_{MSY} = 44,706 mt (98.559 million lbs). The estimate of F for 2005 is 45% above the updated F_{MSY} proxy; therefore overfishing is occurring. The estimate of SSB for 2005 is 53% of the updated B_{MSY} proxy; therefore the stock is not overfished. Projections to determine the Total Allowable Landings (TAL) for 2007 and trajectories of the SSB toward SSB_{max} were made incorporating the Panel recommendations. A projection at the updated F_{max} estimate of 0.280 indicates a TAL in 2007 of 11,280 mt (24.868 million lbs). At F_{max} = 0.280, the stock is not expected to rebuild to the updated biomass reference point of SSB_{max} = 89,411 mt (197.118 million lbs) until about 2020. A projection at the F = 0.150 required to rebuild to SSB_{max} by 2010 indicates a TAL in 2007 of 6,421 mt (14.156 million lbs). Fishing at F = 0.150 in 2007 also rebuilds the stock to within 1% of the previous Total Stock Biomass B_{MSY} proxy (92,645 mt; 204.2 million lbs) by 2010. A TAL in 2007 of 5,889 mt (12.983 million lbs) provides an increased chance (75% probability) that F2007 = 0.150.

INTRODUCTION

An update and peer review of the summer flounder assessment and reference points was conducted by the National Marine Fisheries Service (NMFS) Office of Science and Technology (S&T) during September 14-15, 2006. This work documents the update and includes recommendations made by the 2006 S&T Peer Review Panel. The 2006 S&T Peer Review Panel recommendations required revision to the summer flounder VPA, biological reference point, and projection calculations. The revised analytical results supersede those presented in the Terceiro (2006) assessment.

The calculation of biological reference points for summer flounder based on yield per recruit analysis using the Thompson and Bell (1934) model was first detailed in the 1990 Stock Assessment Workshop (SAW) 11 assessment (NEFC 1990). The 1990 analysis estimated that F_{max} = 0.23. In the 1997 SAW 25 assessment (NEFSC 1997), an updated yield per recruit analysis reflecting the partial recruitment pattern and mean weights at age for 1995-1996 estimated that F_{max} = 0.24. The analysis in the Terceiro (1999) assessment, reflecting partial recruitment and mean weights at age for 1997-1998, estimated that F_{max} = 0.263.

The Overfishing Definition Review Panel (Applegate *et al.* 1998) recommended that the Mid-Atlantic Fishery Management Council (MAFMC) base MSY proxy reference points on yield per recruit analysis, and this recommendation was adopted in formulating the FMP Amendment 12 Overfishing Definition (MAFMC 1999). These reference points were based on the 1999 assessment (Terceiro 1999) and followed what would later be described as the "empirical non-parametric approach" (i.e., biomass reference points calculated as the product of biomass per recruit and a reference period recruitment level; NEFSC 2002a). The 1999 assessment indicated that $F_{threshold}$ = F_{target}= F_{max} = 0.263, yield per recruit (Y/R) at F_{max} was 0.55219 kg/recruit, and January 1 Total Stock Biomass per recruit (TSB/R) at F_{max} was 2.8127 kg/recruit. The median number of summer flounder recruits estimated from the 1999 Virtual Population Analysis (VPA) for 1982-1998 was 37.844 million age-0 fish. Based on this median recruitment level, maximum sustainable yield (Y_{max} as a proxy for MSY) was estimated to be 20,897 mt (46 million lbs) at a Total Stock Biomass (TSB_{max} as a proxy for B_{MSY}) of 106,444 mt (235 million lbs). The biomass threshold, one-half TSB_{max} as a proxy for one-half B_{MSY}, was therefore estimated to be 53,222 mt (118 million lbs). The Terceiro (1999) reference points were retained in the 2000 SAW 31 assessment (NEFSC 2000) because of the stability of the input data and resulting biological reference point estimates.

The MAFMC Science and Statistical Committee (SSC) conducted a peer review of the summer flounder Overfishing Definition in concert with the 2001 assessment update (MAFMC 2001a, b). The SSC reviewed six analyses to estimate biological reference points for summer flounder conducted by members of the Atlantic States Marine Fisheries Commission (ASMFC) Summer Flounder Biological Reference Point Working Group. After considerable discussion, the SSC decided that although the new analyses conducted by the ASMFC Working Group had resulted in a wide range of estimates, they did not provide a reliable alternative set of reference points for summer flounder. The SSC therefore recommended that F_{target} remain F_{max} = 0.263 because a better estimate had not been established by any of the new analyses. The SSC also reviewed the biomass target (B_{MSY}) and threshold (one-half B_{MSY}) components of the Overfishing Definition and concluded that the new analyses did not justify an alternative estimate of the B_{MSY} proxy. The SSC endorsed the recommendations of SAW 31 which stated that "the use of F_{max} as a proxy for F_{MSY} should be reconsidered as more information on the dynamics of growth in relation to biomass and the shape of the stock recruitment function become available" (NEFSC 2000). The SSC agreed that additional years of stock and recruitment data should be collected and encouraged further model development, including model evaluation through simulation studies. They also encouraged the evaluation of alternative proxies for biological reference points that might be more appropriate for an early maturing species like summer flounder and the development and evaluation of management strategies for fisheries where B_{MSY} is unknown. The SSC indicated that as the stock size increases, population dynamic processes that could reflect density dependent mechanisms should be more closely monitored and corresponding analyses should be expanded, i.e., rates of size and age, maturity, fecundity, and egg viability should be closely monitored as potential indicators of compensation at higher stock sizes. Finally, the committee recommended that potential environmental influences on recruitment, including oceanographic changes and predation mortality, should be reevaluated as additional recruitment data become available. As a result of the SSC peer review (MAFMC 2001a) the Terceiro (1999) reference points were retained in the 2001 stock assessment (MAFMC 2001b). In the review of the 2002 stock assessment (NEFSC 2002b), SAW 35 concluded that revision of the reference points was not warranted at that time due to the continuing stability of the input data and resulting reference point estimates. The Terceiro (1999) reference points were retained in the 2003 (Terceiro 2003) and 2004 (SDWG 2004) assessment updates.

The biological reference points for summer flounder were next peer-reviewed by the 2005 SAW 41, based on the 2005 assessment update using fishery data through 2004 and research survey data through 2004/2005 (NEFSC 2005). The SAW 41 Review Panel noted that the Beverton-Holt (Beverton and Holt, 1957; BH) model fit the observed stock-recruitment data well, and provided reference points comparable to those derived from an empirical non-parametric (yield and biomass per recruit) approach. The SAW 41 Panel noted, however, that the quantity of observed stock-recruitment data was limited (22 years), and the data during the early part of the time series, when the SSB was at the lowest observed levels, indicated a level of recruitment near the estimated R_{max}, and exerted a high degree of leverage on the estimation of the model parameters. This leverage resulted in a high value (0.984) for the subsequently calculated steepness of the BH curve, which is outside of the $\pm$ one standard interval of Myers (1999) estimate for Pleuronectid flatfish (0.8 $\pm$ 0.1). The BH model results suggest that summer flounder SSB could fall to very low levels (<2,000 mt) and still produce recruitment near that produced at SSB_{MSY}. This result might not be reasonable for the long term, given the recent stock-recruitment history of the stock (i.e., production of a very poor year class in 1988). The BH model estimated parameters might prove to be sensitive to subsequent additional years of S-R data, especially if they accumulate at higher levels of SSB and recruitment in the near term. The BH model fit might also be sensitive to the magnitude of recently estimated spawning stock and recruitment, given the recent retrospective pattern of overestimation of stock size evident in the assessment. The SAW 41 Panel recognized that the limited time series of observed stock-recruitment data impacted both reference point estimation approaches (empirical non-parametric and parametric stock-recruitment model) in terms of the potential spawning stock biomass and recruitment levels that might be realized from the stock if fished at fishing mortality rates in the 0.2-0.3 range over the long term. Given these concerns, the SAW 41 Panel advised that the BH model estimates were not suitable for use as biological reference points for summer flounder, and recommended continued use of reference points developed using the non-parametric model approach. The 2005 assessment update (NEFSC 2005) included updated the input data (1992-2004 averages of mean weights, maturities, and partial recruitment) for use in the yield and biomass per recruit component of the non-parametric approach. The updated 1982-2004 VPA provided an estimate of median recruitment for summer flounder of 33.111 million age 0 fish. FMP biological reference points from the 2005 assessment were $F_{max} = F_{MSY} = 0.276$, Y_{max} = MSY = 19,072 mt (42.0 million lbs), and $TSB_{max} = B_{MSY}$ = 92,645 mt (204.2 million lbs). The biomass threshold of $0.5*TSB_{max}$ = 46,323 mt (102.1 million lbs).

UPDATE OF ASSESSMENT AND REFERENCE POINTS FOR 2006

Estimation Methodology

Two biological reference point estimation approaches were applied so as to be potentially complementary and supportive and because using both should build confidence in the results. Where results differ appreciably, the results of the empirical non-parametric approach were used as a component in final model selection. The automatic objective application of either approach is often compromised by lack of sufficient observation on stock and recruitment over a range of biomass to provide suitable contrast. Thus, it is often necessary to extrapolate beyond the range of observation and to infer the shape of the stock-recruit relationship from limited and variable observations (NEFSC 2002a). The 2001 MAFMC SSC review of summer flounder reference points also noted this concern (MAFMC 2001a).

The empirical non-parametric approach was to evaluate various statistical moments (mean, variance, percentiles) of the observed series of recruitment data and apply the estimated biomass or yield per recruit associated with common F reference points to derive the implied spawning or total biomass and equilibrium yield. The biomass and yield per recruit models were fit using the NOAA Fisheries Toolbox (NFT) YPR version 2.6 software (NFT 2004a). The mean recruitment during 1982-2005 as estimated by the 2006 S&T Peer Review Panel revision (see Appendix) of the Terceiro (2006) NFT ADAPT VPA (NFT 2005, Terceiro 2006) was used in the yield and biomass calculations at fishing mortality reference points as per the Panel recommendation. The empirical non-parametric approach assumes that compensatory mechanisms such as impaired growth, maturity, or recruit survival are negligible over the range of biomass considered (NEFSC 2002a).

The parametric approach used fitted parametric stock-recruitment models along with yield and spawning biomass per recruit information to calculate MSY-based reference points following the procedure of Sissenwine and Shepherd (1987). Stock-recruitment models were fit using the NFT SRFIT version 6.0.3 software (NFT 2004b) and evaluated using the approach described in Brodziak et al. (2001) and Brodziak and Legault (2005). Since a wide range of models (Beverton-Holt and Ricker (1954) models, incorporating autoregressive error, and Bayesian priors for various parameters) had been tested in the 2005 SAW 41 work, the current parametric model exercise was limited to an update of the most-likely modeling result from the 2005 work, the simple Beverton-Holt model (BH; Beverton and Holt 1957, Mace and Doohan 1988).

Fishery and research survey input data for summer flounder

In the 1990 SAW 11 yield and biomass per recruit analysis (NEFC 1990), mean weights at age in the catch and stock were based on fishery mean weights at age (catch number weighted average of commercial and recreational landed weights at age) for ages 0-8, 1982-1988. The 1990 analysis assumed a natural mortality rate of M = 0.2, based an assumed maximum age of about 15 years (Anthony 1982; Penttila et al. 1989). No commercial or research survey estimates for ages 9-15 were available, so a Gompertz model relating age and weight was fit to the age 0-8 mean weight age estimates to develop mean weights for ages 9-15 ($W_t = W_0 * \exp(G(1-\exp(-gt)))$). Maturity at age was estimated from NEFSC Autumn survey data for 1978-1989. Peak spawning was estimated to occur on November 1 (0.83 years). Combined maturities indicated the following estimated percentages mature at age: 38% for age 0, 72% for age 1, 90% for age 2, 97% for age 3, 99% for age 4, and 100% for ages 5 and older. The partial recruitment vector for the 1990 SAW 11 analysis was developed from a separable virtual population analysis (SVPA) employing catch at age data for 1982-1988, with the reference age set at age 2 and selection at age 4 set at 1.0. The analysis indicated the following selection percentages at age: 5% at age 0, 50% at age 1, and 100% at ages 2 and older. As noted in the **Introduction**, the yield and biomass per recruit analysis was updated in the 1999 assessment (Terceiro 1999) using the mean weights at age in the catch and partial recruitment pattern for 1997-1998. Mean weights from the catch and spawning biomass were recalculated for ages 0-8 only; the mean weights from the 1990 analysis were retained for ages 9-15. Mean weights at age on January 1 were estimated from the mid-year catch weights using the Rivard equations (Rivard 1982) to provide input for the calculation of total stock biomass per recruit. Maturities at ages 0-2 were the same as in the 1990 SAW 11 analysis, while maturities at ages 3 and 4 were rounded up to 100%. The 1999 analysis was reviewed in the subsequent assessments (NEFSC 2000; MAFMC 2001b; NEFSC 2002a; Terceiro 2003, SDWG 2004) and the results retained as the basis for biological reference points due to the continuing stability of the input data and resulting parameter estimates.

In the 2005 SAW 41 work (NEFSC 2005), the mean weights at age in the catch and stock, maturity schedule, and partial recruitment pattern were updated and broadened to include data from 1992-2004, covering the year range for individually measured and weighed fish sampled in NEFSC research surveys. The NEFSC research survey data were used to develop estimates of mean weights at age for fish in the total (January 1) and spawning (November 1) biomass and for the maturity schedule. Summer flounder spawning takes place during the annual southern and offshore migration during the autumn and winter months, with peak activity occurring in October and November (O'Brien et al. 1993). Spawning Stock Biomass (SSB) mean weights at age and observed proportions mature at age were therefore estimated from NEFSC autumn survey (1992-2004; September-October) individual fish samples. Total Stock Biomass (TSB) mean weights at age were estimated from the NEFSC winter survey (1993-2004; February) individual fish samples. Estimates of the mean weights in the catch were developed as in previous assessments, using samples from the commercial and recreational fishery landings and discards at length and age and quarterly length-weight relationships from Lux and Porter (1966), for 1992-2004. As in previous work for older aged fish with very limited or missing samples, Gompertz functions based on younger ages were used to estimate mean weights for the older ages (NEFSC Winter survey ages 1-11 for January 1 TSB ages 12-15; n = 11,293 fish, W_0 = 0.0926, G = 4.0758, g = 0.2929, $p < 0.0001$; NEFSC Autumn survey ages 0-8 for catch and November 1 SSB ages 9-15, n = 4601 fish, W_0 = 0.1959, G = 3.5480, g = 0.2662, $p < 0.0001$). The partial recruitment pattern was calculated from fishing mortality rate estimates from the 2005 SAW 41 assessment NFT ADAPT VPA for 1992-2004 (NEFSC 2005). Shorter time periods over which to calculate the partial recruitment pattern were considered in order to reflect the most recent changes in regulations that might impact partial recruitment. However, the average partial recruitment, and thus the estimated yield and biomass per recruit, was not very sensitive to the period of years included in the averaging. There was practically no change in partial recruitment for ages 0, 1, and 3 and older for the three periods examined (1992-2004 as compared to 1997-2004 or 2002-2004). The partial selection for age 2 fish varied from ~60% to ~80%, depending on the year range selected. Further, the partial recruitment pattern (partial fishing mortality at age) in the most recent years of the summer flounder VPA often change and eventually stabilize at higher values as those estimates pass into the converged portion of the VPA, a function of VPA convergence properties and the current pattern of retrospective bias in the assessment. Thus, the 2005 SAW 41 analyses used the same time periods for the partial recruitment as for the mean weights and maturities at age.

The 2002 BRPWG (NEFSC 2002a) fit stock-recruitment models to data sets for some New England groundfish stocks which included “hindcast” estimates of spawning stock and recruitment – estimates derived from NEFSC survey data for years before the start of the respective VPA time series. These “hindcast” estimates were developed in an attempt to enlarge the stock-recruit data sets and include estimates beyond the range of the VPA estimates, thus providing greater contrast in the data used to fit stock-recruitment models. In the 2001 SSC peer review for summer flounder (MAFMC 2001a), “hindcast” estimates for summer flounder were also developed for stock-recruitment model work. The “hindcast” estimates were of limited utility in the 2001 modeling work because the longest available series of research survey indices of spawning stock (NEFSC Spring survey biomass per tow: 1969-2000) and recruitment (MD DNR index of age-0 summer flounder: 1972-2000) did not provides estimates outside the range of the VPA estimates and so failed to increase the contrast in the stock-recruitment data, therefore providing essentially the same stock-recruitment model results. The “hindcast” exercise was attempted again in the preliminary stages of this work, by incorporating the updated VPA estimates and most recent survey indices. While the relationships between the survey indices and VPA estimates continue to be statistically significant (NEFSC biomass: VPA SSB, $r^2 = 0.70$, $p < 0.01$; MDDNR age-0: VPA age-0; $r^2 = 0.41$, $p<0.05$), the pre-VPA “hindcast” estimates of spawning stock and recruitment remain within the range of the VPA estimates and therefore provide similar stock-recruitment model results, and so use of “hindcast” estimates was not continued in developing the current suite of parametric model comparisons. Therefore, the 2005 SAW 41 NFT ADAPT VPA 1982-2004 time series of stock-recruit estimates was used as input in fitting parametric stock-recruit models (NEFSC 2005).

In this work, the 2006 S&T Peer Review Panel recommendations for the calculation of mean weights at age, partial recruitment to the fishery at age, maturity schedule at age, and substitution of “true zero” values in VPA calibration indices were incorporated in the analyses (Tables 1-2). The complete Panel findings and recommendations are detailed in the respective Panel member reports (Hamel 2006; Methot 2006; Powers 2006). The Panel recommendations required revision to the VPA, biological reference point, and projection calculations. The revised analytical results supersede those presented in the Terceiro (2006) assessment.

2006 S&T Peer Review Panel Summary Findings

The Summary Findings of the 2006 S&T Peer Review Panel were:

1. Retain the non-parametric approach to biological reference points; there is insufficient contrast to estimate Spawner-Recruitment steepness.

2. For the non-parametric approach, use SSB to track status of the stock. This is a much more accurate proxy for the reproductive potential of the stock and is consistent with current consideration of spawner-recruitment models as possible replacement for the non-parametric approach. The past use of Jan 1 total stock biomass as the measure of reproductive potential over-represents the contribution of age 0 fish.

3. Use long-term (1982-2005) average body weight-at-age for calculation of biological reference points. The recent downturn in mean weight-at-age is influenced by shifting sex ratio and should only be used for short-term TAL and SSB calculations.

4. Discount the recent downtrend in recruits per spawner. Such a trend is exactly what is expected from near constant recruitment and reduced fishing mortality which allows more spawning biomass per recruit. Further declines are expected as the stock approaches the rebuilt level.

5. Use the arithmetic mean (not median) of long-term (1982-2005) recruitment as the basis for the average level of recruitment expected from a rebuilt stock. Although the five highest recruitments in this time period occur in the first five years, there is no reason to discount the occasional occurrence of such recruitment levels from a rebuilt stock. Median recruitment underestimates the level of biomass expected from a rebuilt stock because most biomass comes from the larger recruitments.

6. Revise the survey input to the VPA model so that observations of zero are replaced with a small positive value. This VPA model, as with most assessment models, fits to the logarithm of the observations so cannot explicitly deal with observations of zero. However, the current VPA practice of treating these observations as missing values is probably underestimating the degree to which the stock has rebuilt since the low level in 1990.

7. Do not make an explicit adjustment for the retrospective pattern in the VPA results. The pattern diminishes in the last year, its cause is not clear, and past patterns in the opposite direction have also diminished after a few years. The several survey indices included in the model increased greatly during the late 1990s and the indices of the oldest age groups have

continued to increase. The current model does not track these changes closely, so exploration of alternative models and data interpretations that better reconcile this recent pattern should be a higher priority than the retrospective pattern.

Results for 2006 incorporating 2006 S&T Peer Review Panel Summary Findings: Updated Virtual Population Analysis (VPA)

The Virtual Population Analysis (VPA) detailed in the Terceiro (2006) assessment was updated to incorporate the 2006 S&T Peer Review Panel recommendations, including use of the 2005 SAW 41 reference point maturity schedule in the VPA, exclusion of age 0 fish from the Jan 1 stock biomass calculations, revision of SSB mean weights at age to better reflect the weight of fish at the time of peak spawning, and substitution of "true zero" values in VPA calibration indices with small positive values.

The 2006 S&T Panel updated VPA runs (Rev_Ind [zeros replaced with small positive values] and Rev_Ind_XW_Mat [zeros replaced with small positive values, revised SSB mean weights updated maturity schedule]) included the same set of indices (n=41) in terms of source and age range as used in the 2002-2006 assessments (NEFSC 2002, Terceiro 2003, SDWG 2004, NEFSC 2005, Terceiro 2006). The final run from the 2006 Panel Review is the Rev_Ind_XW run. The final run in the Terceiro (2006) assessment was called F06_1; other runs examined in the Terceiro (2006) assessment included those with all available indices (F06_ALL), a run including only NEFSC survey indices (F06_NEFSC), and a run including only state agency surveys (F06_STATE). The sensitivity of the summer flounder VPA estimates of F and SSB to these different VPA configurations is illustrated in Figure 1. The complete output for the final 2006 S&T Panel VPA (run Rev_Ind_XW_Mat) is presented in Appendix A.

The estimates of F in 2005 from the two 2006 S&T Panel VPA runs are within the 80% confidence intervals of the runs considered in the Terceiro (2006), as is the 2005 SSB estimate from the Rev_Ind run (Figure 1). The 2005 F point estimate from the 2006 S&T Panel final Rev_Ind_XW_Mat run (0.407) is 23% lower than the 2005 F point estimate from the Terceiro (2006) final F06_1 run (0.528). Incorporation of the 2005 SAW 41 update to the maturity schedule and revisions to the SSB mean weights result in a 2005 SSB point estimate from the final Rev_Ind_XW_Mat run (47,498 mt) that is 55% higher than the 2005 SSB point estimate from the Terceiro (2006) final F06_1 run (30,558 mt)(Figure 1).

Results for 2006 incorporating 2006 S&T Peer Review Panel Summary Findings: Empirical Non-parametric Reference Point Estimation

The updated yield per recruit analysis indicated that F_{max} = 0.280 (the FMP Amendment 12 proxy for F_{MSY}). Yield per Recruit (Y/R) at F_{max} was estimated to be 0.579 kg and Spawning Stock Biomass per Recruit (SSB/R) at F_{max} was estimated to be 2.416 kg (Table 3). Mean recruitment for 1982-2005 was estimated to be 37.010 million fish. The product of the mean recruitment and Y/R at F_{max} was 21,444 mt = 47.276 million lbs (current FMP Amendment 12 proxy for MSY); the product of the mean recruitment and SSB/R at F_{max} was 89,411 mt = 197.118 million lbs (current FMP Amendment 12 proxy for B_{MSY}; Table 4). The biomass threshold proxy of 0.5*SSB_{max} = 0.5*B_{MSY} = 44,706 mt (98.559 million lbs). The 2006 S&T Peer Review Panel recommended adoption of these updated biological reference points from the empirical non-parametric approach for summer flounder, advising:

"The low level of recruitment observed in 2005 is essentially the same as the low 1988 recruitment, so it is within the range of recruitment fluctuation used in calculating the expected time to rebuild this stock. The Panel finds that the most representative approach to calculating BRPs and rebuilding rates would be to use the entire set of recruitments from 1982-2005. The average, not median, of these recruitments should be used for calculation of biological reference points because much of the stock's accumulated biomass comes from the larger recruitments. Random draws from this set of recruitments would provide a probability distribution of rebuilding rates that is consistent with the occasional occurrence of small recruitments (1988 and 2005) and large recruitments (1982-1987). There is no documented and obvious reason why recruitments were higher during 1982-1987. If such recruitment levels become more common as the stock rebuilds, then the stock may rebuild to an even higher level than is currently targeted. If such recruitment levels do not occur during the next few years of the rebuilding, then the rebuilding target may be not be achieved by the target time to rebuild. More precise forecasts than this are not feasible."

Results for 2006 incorporating 2006 S&T Peer Review Panel Summary Findings: Parametric Model Reference Point Estimation

The BH model fits the observed stock-recruitment data well, and reference points are comparable to those derived from the empirical non-parametric approach. The standardized residual plot of the fit of the BH model to the summer flounder stock-recruitment data shows that the residuals lie within ±two standard deviations of zero, with the exception of the 1983, 1988, and 2005 year classes, which are the largest and smallest recruitments of the time series (Figure 2).
However, the quantity of observed stock-recruitment data is limited (23 years; Table 5, Figure 3), and the data during the early part of the time series, when the SSB was at the lowest observed levels, indicates recruitment near the estimated R_{max}, and exerts a high degree of leverage on the estimation of the model parameters. This leverage results in a high value (0.996) for the subsequently calculated steepness of the BH curve, which is outside of the ± one standard interval of Myers (1999) estimate for Pleuronectid flatfish (0.8 ± 0.1). The BH model results suggest that summer flounder SSB could fall to very low levels (<2,000 mt) and still produce recruitment near that produced at SSB_{MSY} (Figure 3). This may not be a reasonable assumption for the long term, given the available stock-recruitment history of the stock. The BH model estimated parameters may prove to be sensitive to subsequent additional years of S-R data, especially if they accumulate at higher levels of SSB and recruitment in the near term. The BH model fit may also be sensitive to the magnitude of recently estimated spawning stock and recruitment, given the recent retrospective pattern of overestimation of stock size evident in the assessment. It should be noted that the limited time series of observed stock-recruitment data

impacts both reference point estimation approaches (empirical non-parametric and parametric stock-recruitment model) in terms of the potential spawning stock biomass and recruitment levels that might be realized from the stock if fished at fishing mortality rates in the 0.2-0.3 range over the long term. The 2006 S&T Peer Review Panel advised:

"The consistent level of recruitment over a long time period coupled with a relatively small range of SSB during that period means that a normal stock-recruitment relationship cannot be estimated. Thus, it is necessary to continue reliance on the non-parametric approach. Observations of recruitment and SSB from a fully rebuilt stock (i.e. at SSB about twice current levels) for a number of years will probably be required before an adequate stock recruitment relationship may be estimated."

UPDATED STATUS OF THE STOCK FOR 2006

The summer flounder stock is not overfished but overfishing is occurring relative to the 2006 S&T Peer Review Panel updated biological reference points. Fishing mortality calculated from the average of the currently fully recruited ages (3-5) was very high during 1982-1997, varying between 0.9 and 2.2. The fishing mortality rate has declined since 1997 and was estimated to be about 0.4 during 2003-2005 (Figure 4). The estimate of F for 2005 (0.407) is 45% above the updated F_{MSY} proxy = F_{max} = 0.280; therefore overfishing is occurring. The estimate of F for 2005 may understate the actual fishing mortality, as retrospective analysis shows that the current assessment method tends to underestimate recent fishing mortality rates, continuing the pattern observed in recent assessments (NEFSC 2000, MAFMC 2001, NEFSC 2002, Terceiro 2003, SDWG 2004, NEFSC 2005, Terceiro 2006). Over the last 5 years, the annual retrospective increase in fishing mortality has averaged 34%.

Stock biomass (Jan 1; age 1+) increased substantially during the 1990s and through 2005 but decreased slightly in 2006 to 51.317 mt (Figure 5). Spawning stock biomass (SSB; Age 0+) declined 69% from 1983 to 1989 (22,582 mt to 7,025 mt), but with improved recruitment and decreased fishing mortality had increased to 47,498 mt by 2005 (Figure 5). The estimate of SSB for 2005 (47,498) is 53% of the updated B_{MSY} proxy = SSB_{max} = 89,411 mt; therefore the stock is not overfished. Retrospective analysis shows a tendency to overestimate the SSB in the most recent years, continuing the pattern observed in recent assessments (NEFSC 2000, MAFMC 2001, NEFSC 2002, Terceiro 2003, SDWG 2004, NEFSC 2005, Terceiro 2006). Over the last 5 years, the annual retrospective decrease in SSB has averaged 12%.

The 1982 and 1983 year classes were the largest of the VPA series, at 74 and 80 million fish, respectively. The 1988 year class was the smallest of the series, at only 13 million fish. The arithmetic average recruitment from 1982 to 2005 is 37 million fish at age 0, with a median of 33 million fish. The 2005 year class is estimated to be the smallest since 1988, at about 15 million fish (Figure 5). Retrospective analysis shows a variable pattern in the estimation of recruitment; over the last 5 years, the annual retrospective increase in recruitment has averaged 4%.

The precision and bias of the 2005 fishing mortality rates, 2006 stock sizes, and 2005 SSB estimates are presented in Appendix A. Bias was generally less than 10% for estimated parameters estimated. The bootstrap estimate of the 2005 SSB was relatively precise, with a corrected CV of 11%. There is an 80% chance that SSB in 2005 was between 39,900 and 57,200 mt. The bootstrap estimate of the 2005 F had a corrected CV of 43%. There is an 80% chance that F in 2005 was between about 0.33 and 0.57.

PROJECTIONS

Previous peer-reviews of the summer flounder biological reference points endorsed use of those estimated by the empirical non-parametric approach (F_{max} as a proxy for F_{MSY}; TSB_{max} as a proxy for B_{MSY}, estimated as the product of biomass per recruit and an historic, median level of recruitment) (MAFMC 2001a, NEFSC 2000, 2002b, 2005). In the current work, endorsement of the empirical non-parametric approach has been continued by the 2006 S&T Peer Review Panel, but with the following revisions to the calculations, as per the Panel Summary Findings:

1) adopt a SSB-based calculation from the empirical non-parametric approach as the basis for the biomass reference point (B_{MSY} proxy), and retain F_{max} from the empirical non-parametric approach as the basis for the fishing mortality reference point (F_{MSY} proxy),

2) use the short term mean (2003-2005) partial recruitment pattern to best reflect current and likely future characteristics of the fishery,

3) use the maturity at age schedule from the 2005 SAW 41 analyses (NEFSC 2005),

4) use the long-term mean (1982-2005) weights at age for long-term (2011+) projections, and use short-term mean (2003-2005) weights at age for short term (2007-2010) projections,
5) use the full VPA time series arithmetic mean (1982-2005) of recruitment at age 0 in the projections, and

6) do not make specific, qualitative adjustments in projection analyses to account for the retrospective pattern, since the underlying causes for the pattern and the likelihood that it will continue are not well known.

Projections to determine the Total Allowable Landings (TAL) for 2007 and trajectories of the SSB toward SSB_{max} have been made incorporating the Peer Review Panel recommendations, and are presented in Table 6, Figures 6-7, and Appendix B. The projections start with 2006 stock size numbers as estimated in the 2006 S&T revised VPA (see above section: Results for 2006 incorporating 2006 S&T Peer Review Panel Summary Findings: Updated Virtual Population Analysis (VPA)), and assume that the TAL in 2006 was landed (10,700 mt = 23.589 million lbs). Two constant fishing mortality rates (F) are projected for 2007-2010 (Appendix B). A projection (A) at the updated F_{max} estimate of 0.280 indicates a TAL in 2007 of 11,280 mt (24.868 million lbs). At F_{max} = 0.280, the stock is not expected to rebuild to the updated biomass reference point of SSB_{max} = 89,411 mt (197.118 million lbs) until about 2020 (Figures 6-7).

A projection (B) at the F = 0.150 required to rebuild to SSB_{max} by 2010 indicates a median (50%

probability that F2007 = 0.150) TAL in 2007 of 6,421 mt (14.156 million lbs; Figure 6). Fishing at F = 0.150 in 2007 also rebuilds the stock to within 1% of the previous Total Stock Biomass B_{MSY} proxy (92,645 mt) by 2010. A TAL in 2007 of 5,889 mt (12.983 million lbs) provides an increased chance (75% probability) that F2007 = 0.150 (Appendix B).

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Table 1. Input data for summer flounder yield and SSB per recruit analyses: mean weights at age. Weights in italics estimated from Gompertz function and/or Rivard equations. Bold italic values for the 2006 update remained unchanged from the 2005 SAW 41 work, due to sample size considerations.

	1990 SAW 11		1999 Assessment			2005 SAW 41			2006 Peer Review		
Age	Catch	Nov 1 SSB	Jan 1 Bio	Catch	Nov 1 SSB	Jan 1 Bio	Catch	Nov 1 SSB	Jan 1 Bio	Catch	Nov 1 SSB
0	0.237	0.237	0.170	0.234	0.234	0.184	0.221	0.184	0.000	0.232	0.292
1	0.432	0.432	0.353	0.471	0.471	0.241	0.499	0.469	0.241	0.465	0.533
2	0.642	0.642	0.556	0.643	0.643	0.577	0.684	0.817	0.577	0.681	0.795
3	1.164	1.164	0.722	0.862	0.862	0.980	1.049	1.402	0.980	1.087	1.220
4	1.811	1.811	1.111	1.277	1.277	1.539	1.489	1.953	1.539	1.549	1.741
5	2.449	2.449	1.860	2.330	2.330	2.136	2.217	2.946	2.136	2.221	2.408
6	3.074	3.074	2.337	2.565	2.565	2.680	2.745	3.073	2.680	2.834	3.347
7	3.434	3.434	3.130	3.537	3.537	3.245	3.515	3.630	3.245	3.502	3.630
8	4.380	4.380	4.120	4.592	4.592	3.576	4.515	4.515	***3.576***	***4.515***	***4.515***
9	*4.841*	*4.841*	*4.671*	*4.841*	*4.841*	3.780	*4.926*	*4.926*	***3.780***	***4.926***	***4.926***
10	*5.336*	*5.336*	*5.162*	*5.336*	*5.336*	4.672	*5.313*	*5.313*	***4.672***	***5.313***	***5.313***
11	*5.767*	*5.767*	*5.590*	*5.767*	*5.767*	5.020	*5.630*	*5.630*	***5.020***	***5.630***	***5.630***
12	*6.135*	*6.135*	*5.957*	*6.135*	*6.135*	5.360	*5.885*	*5.885*	***5.360***	***5.885***	***5.885***
13	*6.445*	*6.445*	*6.266*	*6.445*	*6.445*	*5.553*	*6.089*	*6.089*	***5.553***	***6.089***	***6.089***
14	*6.704*	*6.704*	*6.525*	*6.704*	*6.704*	*5.674*	*6.249*	*6.249*	***5.674***	***6.249***	***6.249***
15	*6.917*	*6.917*	*6.738*	*6.917*	*6.917*	*5.765*	*6.375*	*6.375*	***5.765***	***6.375***	***6.375***

Table 2. Input data for summer flounder yield and SSB per recruit analyses: percent mature and partial recruitment (percent selection) at age.

	1990 SAW 11		1999 Assessment		2005 SAW 41		2006 Peer Review	
Age	Percent Mature	Partial Recruit.	Percent Mature	Partial Recruit.	Percent Mature	Partial Recruit	Percent Mature	Partial Recruit.
0	38	5	38	1	38	1	38	2
1	72	50	72	18	91	19	91	15
2	90	100	90	62	98	77	98	72
3	97	100	100	100	100	100	100	100
4	99	100	100	100	100	100	100	100
5	100	100	100	100	100	100	100	100
6	100	100	100	100	100	100	100	100
7	100	100	100	100	100	100	100	100
8	100	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100	100
11	100	100	100	100	100	100	100	100
12	100	100	100	100	100	100	100	100
13	100	100	100	100	100	100	100	100
14	100	100	100	100	100	100	100	100
15	100	100	100	100	100	100	100	100

Table 3. Summary results for summer flounder yield and biomass per recruit analyses. Yield per Recruit (Y/R), Spawning Stock Biomass per Recruit (SSB/R) and Total Stock Biomass per Recruit (TSB/R) in kilograms.

	1990 SAW 11	1999 Assessment	2005 SAW 41	2006 Peer Review
Fmax	0.232	0.263	0.276	0.280
Y/R @ Fmax	0.574	0.552	0.576	0.579
SSB/R @ Fmax	2.107	2.139	2.466	2.416
TSB/R @ Fmax	not calculated	2.813	2.798	2.633 (Age 1+)

Table 4. Summary results for summer flounder empirical non-parametric biological reference point calculations. Maximum Sustainable Yield (MSY), Spawning Stock Biomass at MSY (SSB_{max}), and Total Stock Biomass at MSY (TSB_{max}) in metric tons.

	1990 SAW 11	1999 Assessment	2005 SAW 41	2006 Peer Review
Recruitment Year Range	1982-1987	1982-1998	1982-2004	1982-2005
Median Recruitment (000s)	58,440	37,844	33,111	37,010 (mean)
Y @ Fmax (MSY)	33,545	20,897	19,072	21,444
SSB @ Fmax (SSB_{max})	123,133	80,948	81,652	89,411
TSB @ Fmax (TSB_{max})	not calculated	106,444	92,645	97,430 (Age 1+)

Table 5. Input spawning stock biomass (metric tons; ages 0-7+) and recruitment (millions of age 0 fish) data for summer flounder parametric stock-recruitment models.

Year Class	Spawning Stock Biomass (000s mt)	Recruitment (millions)
1983	22.582	80.323
1984	24.435	48.380
1985	21.870	48.579
1986	19.853	53.444
1987	18.391	43.921
1988	19.082	13.033
1989	10.883	27.270
1990	7.025	30.352
1991	9.940	28.686
1992	8.743	32.316
1993	9.905	33.158
1994	12.287	35.257
1995	15.100	38.694
1996	18.976	28.258
1997	20.067	29.339
1998	20.413	31.185
1999	22.245	29.433
2000	22.551	39.386
2001	26.130	31.181
2002	33.835	36.047
2003	39.051	25.265
2004	44.786	35.505
2005	43.951	14.965

Table 6. Summary short term projection results incorporating updated biological reference points (F_{max} = 0.280; SSB_{max} = 89,411 metric tons) and recommended recruitment assumption (mean 1982-2005 = 37.010 million). Projections start with Jan 1 2006 stock size numbers and assume the TAL in 2006 was landed (10,700 mt = 23.589 million lbs).

Projection Run Descriptions:

A: Fishing during 2007-2010 at updated F_{max} = 0.280.

B: Fishing during 2007-2010 at F = 0.150 to reach SSB_{max} target in 2010 .

Projection Run	F2007-2010	Median 2010 SSB metric tons (m lbs)	Percent SSB_{max} target	Median TAL for 2007 metric tons (m lbs)
A	0.280	63,547 (140.1)	71	11,280 (24.868)
B	0.150	89,411 (197.1)	100	6,421 (14.156)

Figure 1. Sensitivity of the 2006 summer flounder VPA to alternative input data configurations.

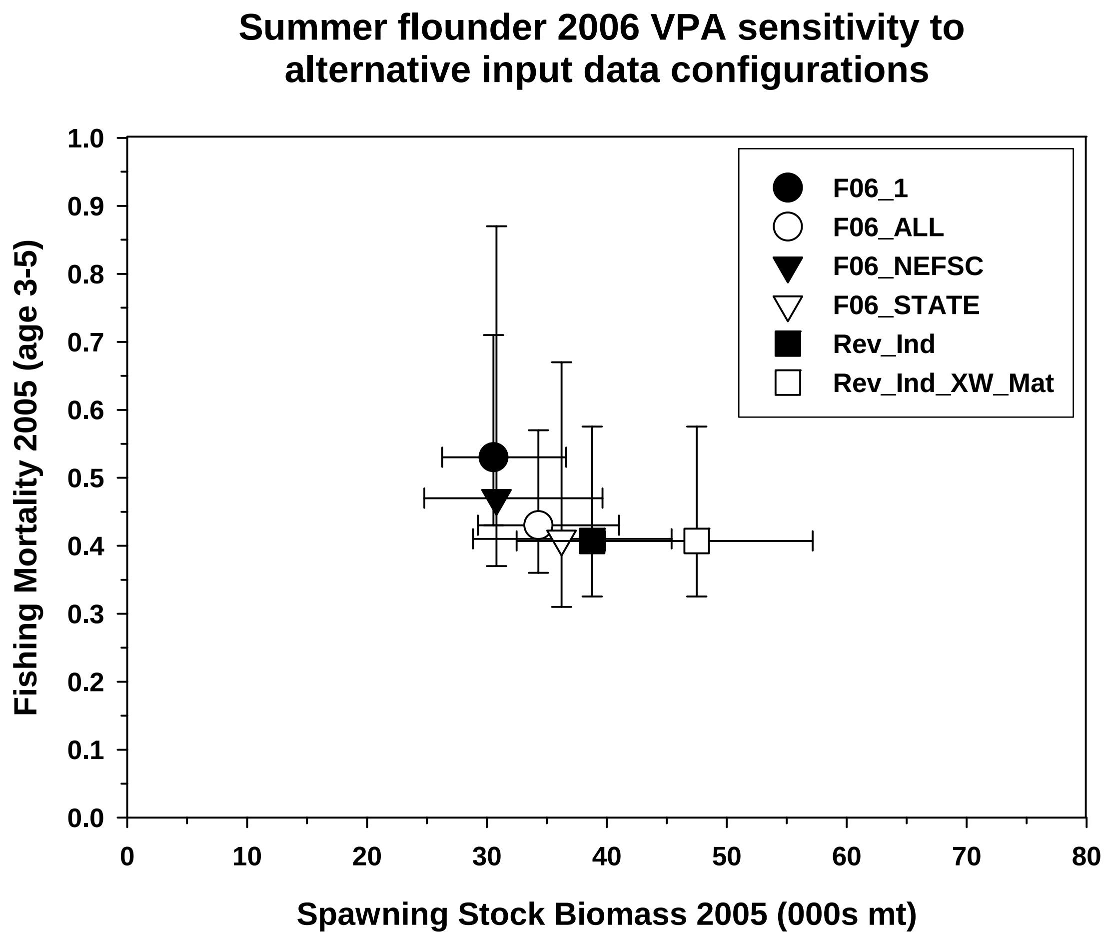


Figure 2. Standardized residuals for the summer flounder BH model fit.

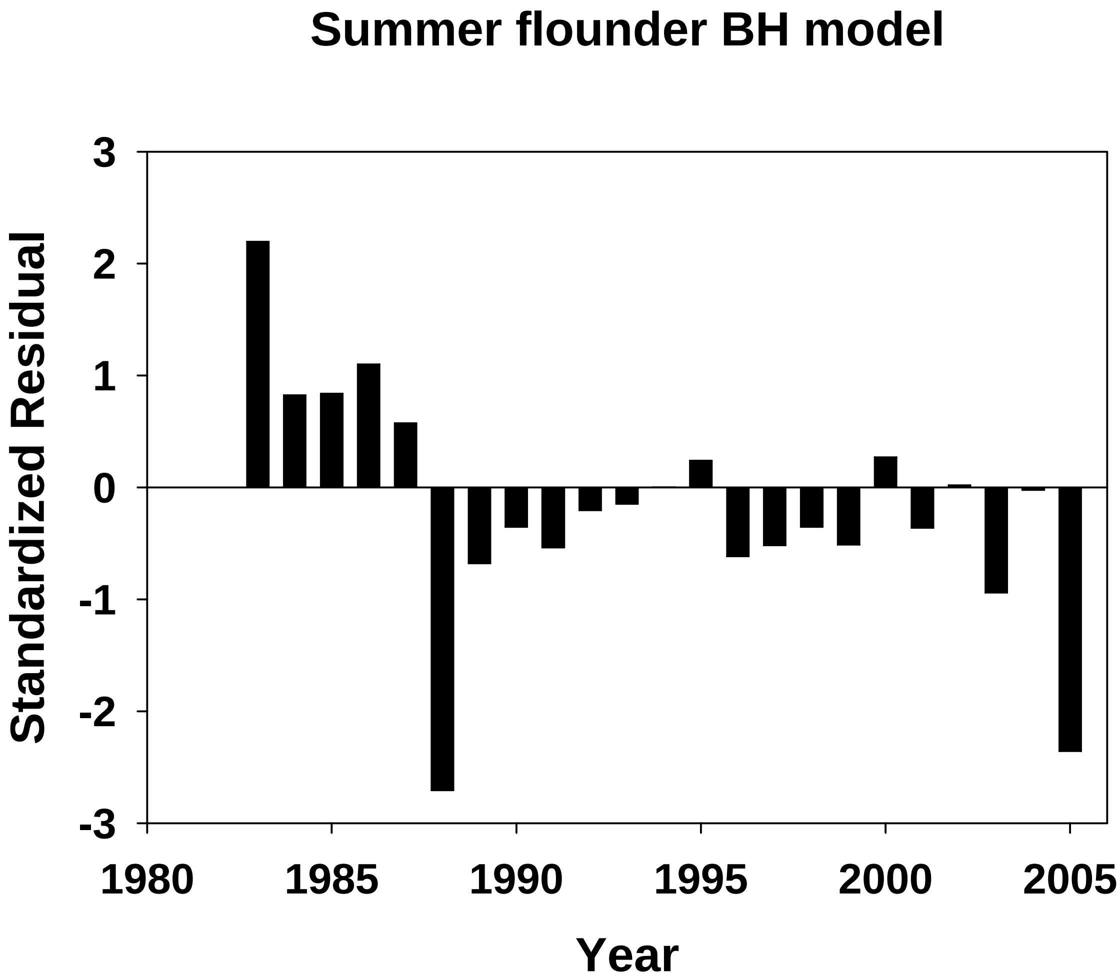


Figure 3. Summer flounder BH model fit and parameter estimates.

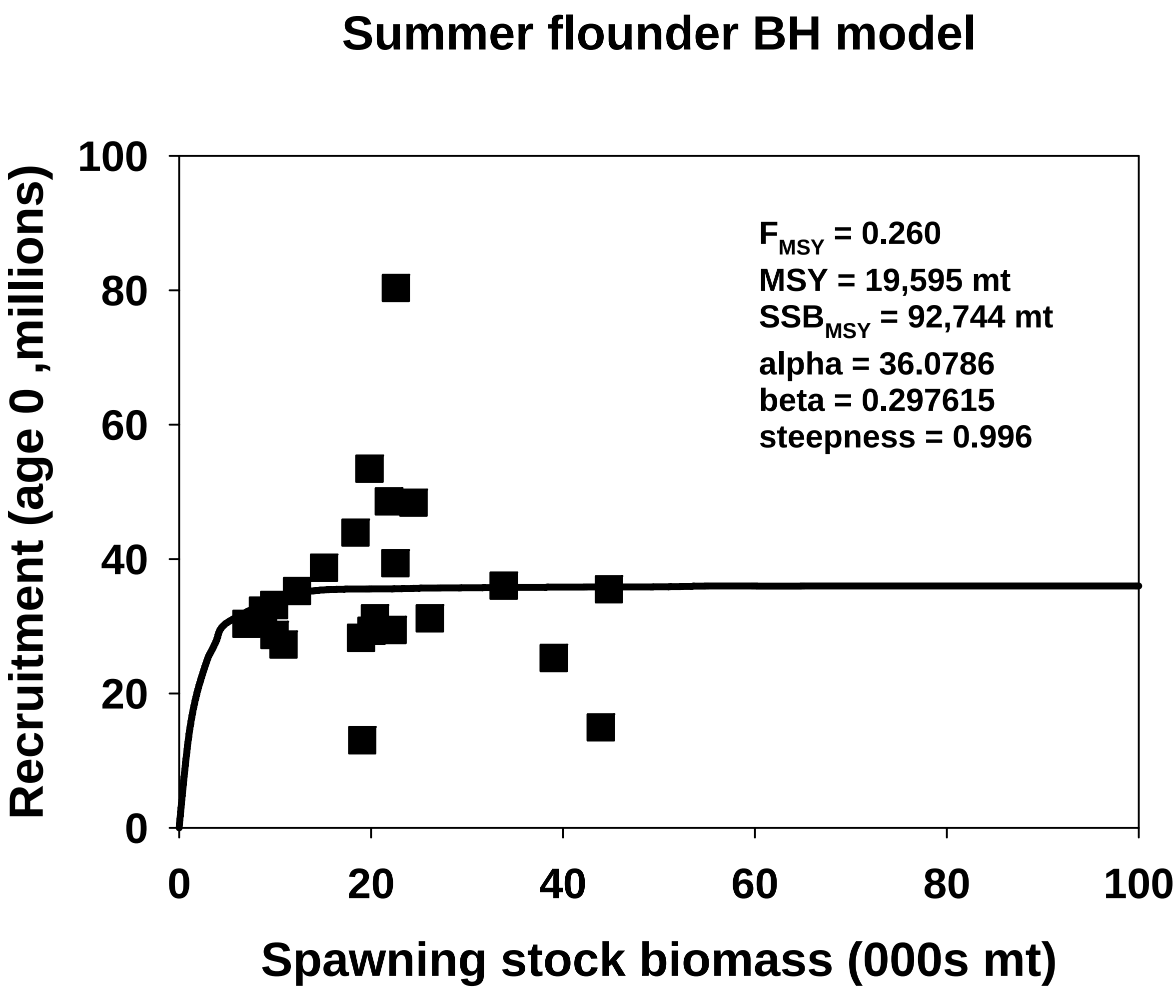


Figure 4. Total catch (landings and discards, 000s mt) and fishing mortality F, ages 3-5, (unweighted) for summer flounder.

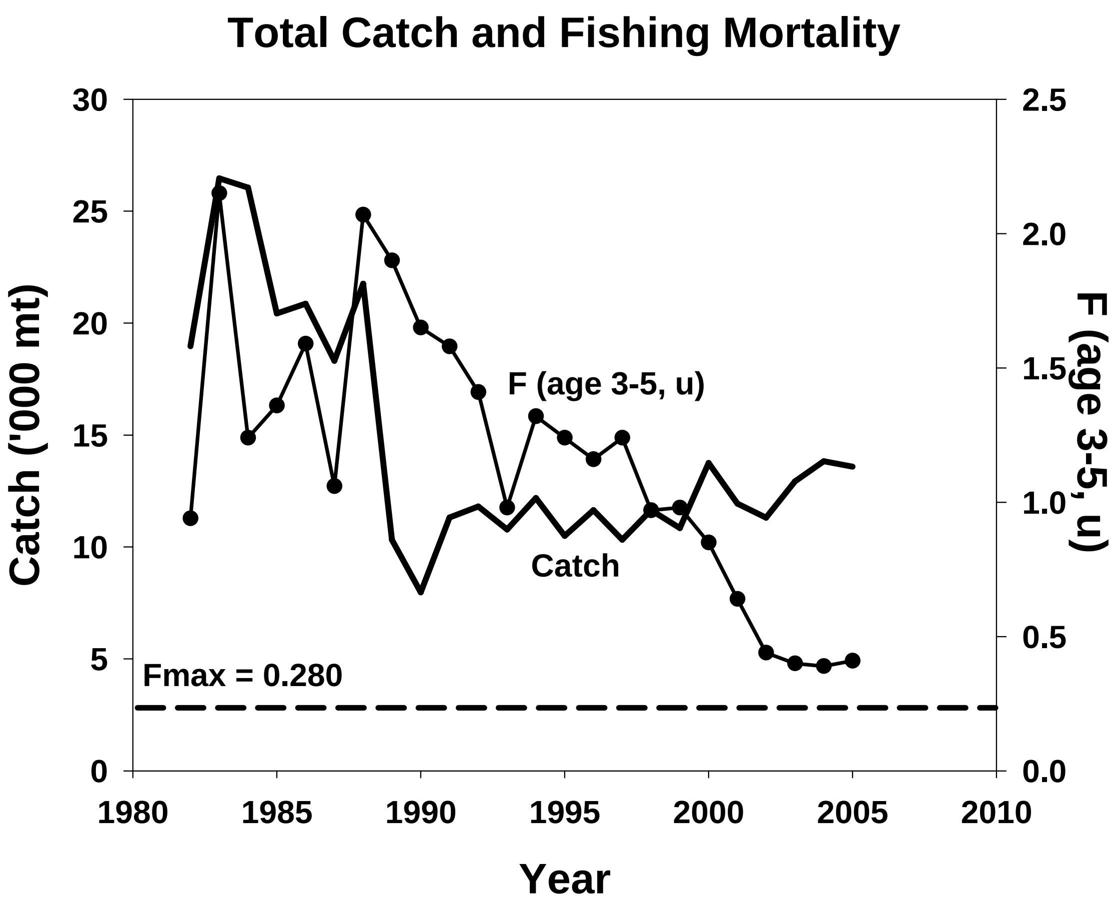


Figure 5. Stock biomass (Jan 1; age 1+; '000 mt; thin line), spawning stock biomass (SSB; Nov 1; '000 mt; thick line; B_{MSY} proxy), and recruitment (millions of fish at age-0; bars).

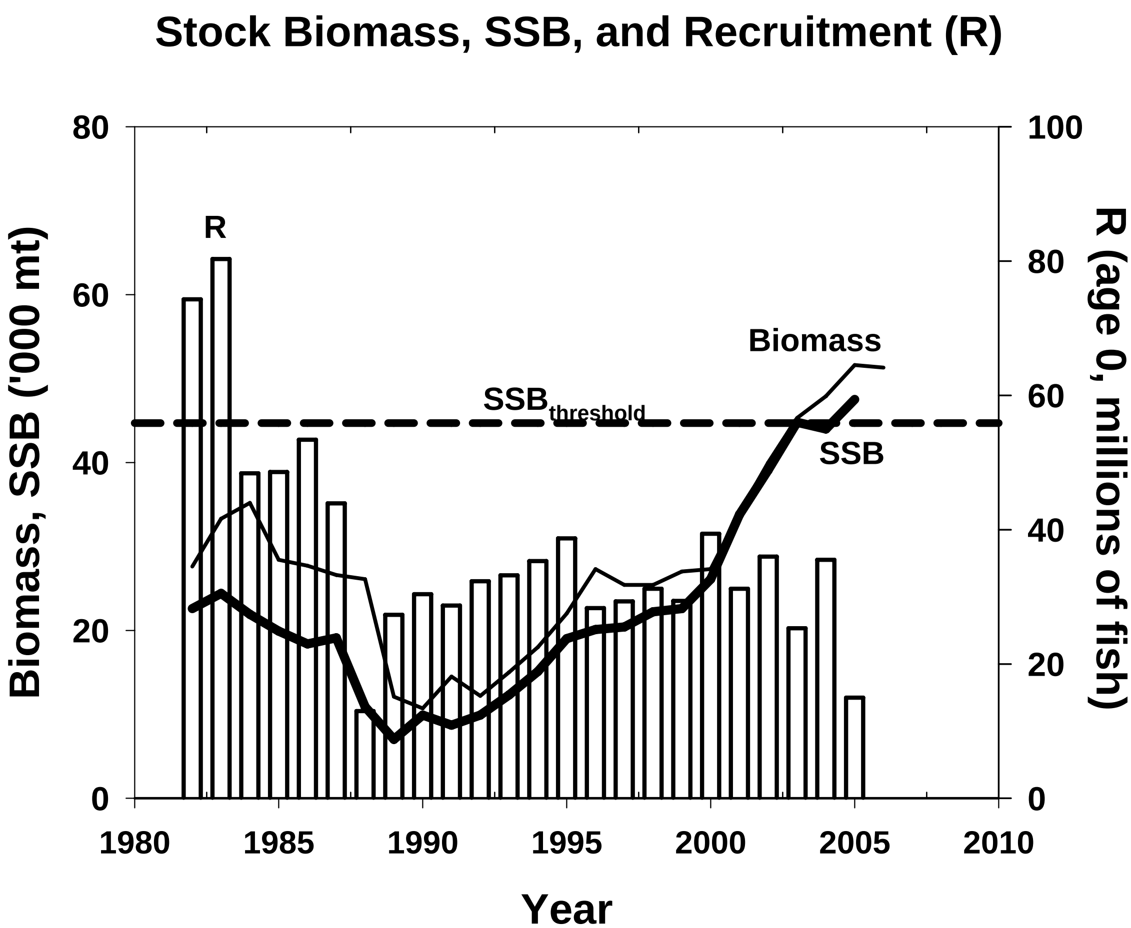


Figure 6. Short term projections of summer flounder SSB.

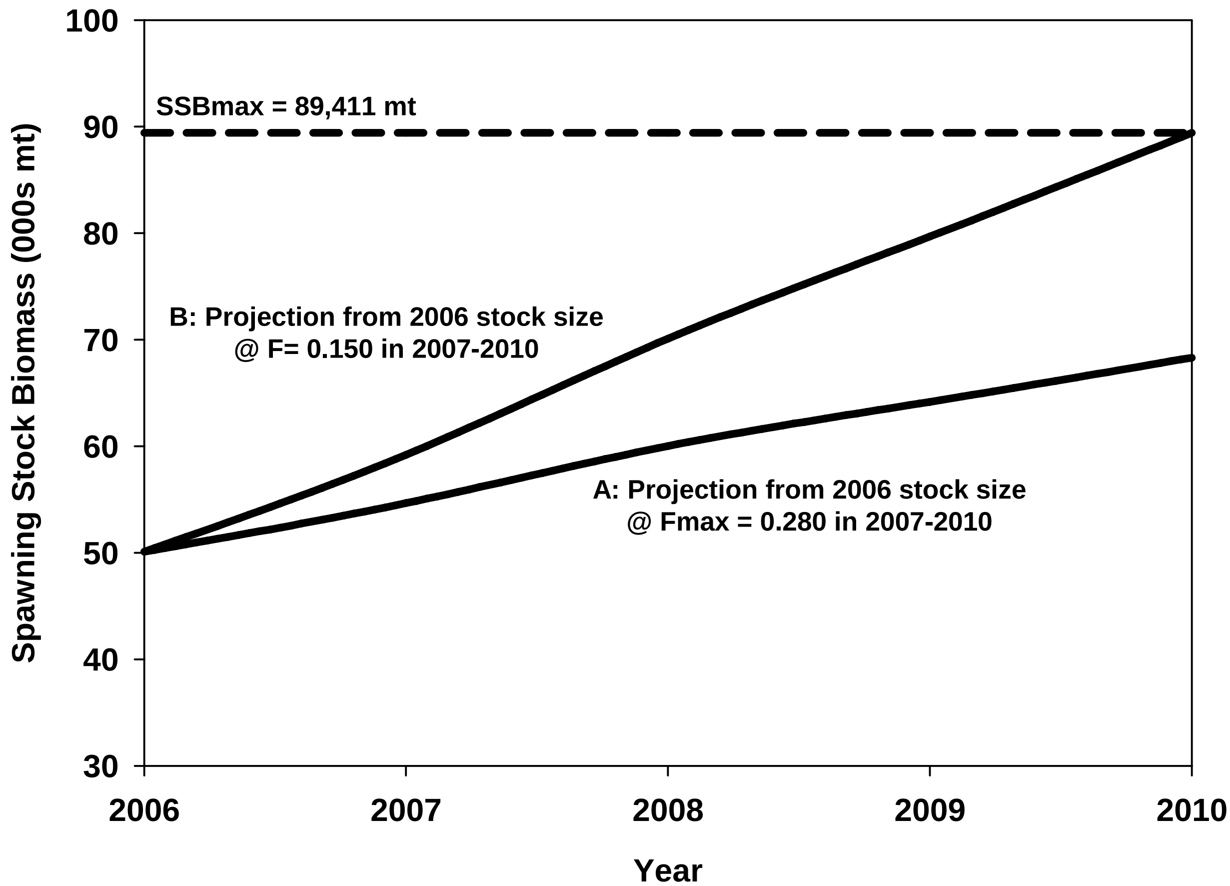
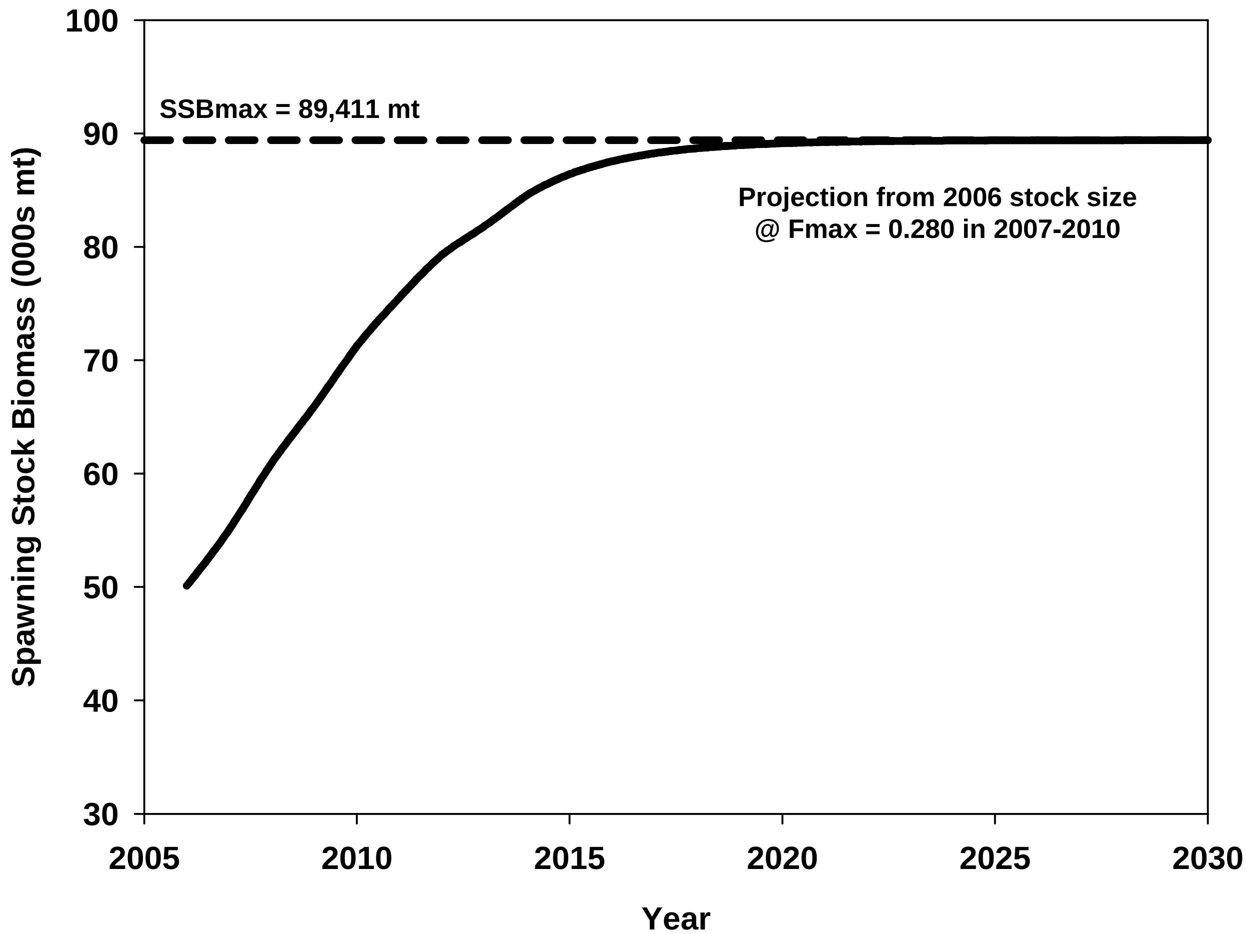


Figure 7. Long term projection of summer flounder SSB.



Appendix A: 2006 S&T Peer Review Panel VPA

Model ID: Summer flounder 2006 S&T Peer Review Panel

Date of Run: 20-SEP-2006 Time of Run: 09:05

```
 Levenburg-Marquardt Algorithm Completed     7 Iterations
 Residual Sum of Squares =     555.464

 Number of Residuals     =    872
 Number of Parameters    =      6
 Degrees of Freedom      =    866
 Mean Squared Residual   =     0.641413
 Standard Deviation      =     0.800883


 Number of Years =    24
 Number of Ages  =     8
 First Year      =  1982
 Youngest Age    =     0
 Oldest True Age =     6

 Number of Survey Indices Available        =    51
 Number of Survey Indices Used in Estimate =    41


 VPA Classic Method - Auto Estimated Q's


 Stock Numbers Predicted in Terminal Year Plus One (2006)
```

Age	Stock Predicted	Std. Error	CV
1	12030.863	0.290092E+04	0.241123E+00
2	22002.213	0.465937E+04	0.211768E+00
3	9582.239	0.193144E+04	0.201564E+00
4	7422.221	0.156569E+04	0.210946E+00
5	2596.429	0.967830E+03	0.372754E+00
6	3272.243	0.995969E+03	0.304369E+00

Catchability Values for Each Survey Used in Estimate

INDEX	Catchability	Std. Error	CV
1	0.144226E-03	0.291484E-04	0.202102E+00
2	0.400431E-03	0.440085E-04	0.109903E+00
3	0.331432E-03	0.451041E-04	0.136089E+00
4	0.321022E-03	0.689839E-04	0.214889E+00
5	0.338636E-03	0.944508E-04	0.278915E+00
6	0.139034E-04	0.198940E-05	0.143088E+00
7	0.367745E-04	0.381359E-05	0.103702E+00
8	0.283582E-04	0.562994E-05	0.198530E+00
9	0.235361E-04	0.448611E-05	0.190605E+00
10	0.324615E-04	0.621164E-05	0.191354E+00
11	0.662412E-04	0.447584E-05	0.675688E-01
12	0.789388E-04	0.105303E-04	0.133398E+00
13	0.588588E-04	0.117521E-04	0.199666E+00
15	0.372899E-04	0.720956E-05	0.193338E+00
16	0.371969E-04	0.637168E-05	0.171296E+00
18	0.131611E-03	0.200735E-04	0.152521E+00
19	0.462610E-04	0.961708E-05	0.207888E+00
21	0.170494E-04	0.281011E-05	0.164821E+00
22	0.186193E-04	0.282085E-05	0.151501E+00
23	0.246752E-04	0.646163E-05	0.261867E+00
24	0.431550E-04	0.690462E-05	0.159996E+00
25	0.109810E-03	0.132364E-04	0.120539E+00
26	0.867058E-04	0.125048E-04	0.144221E+00
27	0.581514E-04	0.111213E-04	0.191248E+00
29	0.146413E-03	0.247253E-04	0.168874E+00
30	0.127862E-03	0.204538E-04	0.159968E+00
32	0.182970E-04	0.419117E-05	0.229063E+00
33	0.147914E-03	0.222264E-04	0.150266E+00

34	0.647775E-04	0.150246E-04	0.231941E+00
37	0.177660E-04	0.429843E-05	0.241947E+00
38	0.221897E-04	0.874766E-05	0.394222E+00
39	0.538536E-05	0.499300E-06	0.927144E-01
41	0.280800E-04	0.337203E-05	0.120086E+00
42	0.248341E-03	0.526660E-04	0.212071E+00
43	0.958154E-04	0.112311E-04	0.117216E+00
44	0.400161E-04	0.635846E-05	0.158897E+00
45	0.805127E-05	0.127485E-05	0.158342E+00
46	0.152109E-03	0.326387E-04	0.214574E+00
48	0.542804E-05	0.667317E-06	0.122939E+00
49	0.188357E-05	0.368973E-06	0.195891E+00
51	0.435601E-05	0.322410E-06	0.740150E-01

-- Non-Linear Least Squares Fit --

Default Tolerances Used

Scaled Gradient Tolerance	=	6.055454E-06
Scaled Step Tolerance	=	3.666853E-11
Relative Function Tolerance	=	3.666853E-11
Absolute Function Tolerance	=	4.930381E-32

VPA Method Options

- Catchability Values Estimated as an Analytic Function of N
- Pope Approximation Used in Cohort Solution
- Plus Group Backward Calculation Method Used
- Rivard Weights Used for JAN-1 Biomass
- Rivard Weights Calculation Used 3 Years for Terminal Year Plus One

- Heincke Rule Used in F-Oldest Calculation
- F-Oldest Calculation in Years Prior to Terminal Year
  Uses Stock Sizes in Ages 3 to 6
- Calculation of Population of Age 0 In Year 2006
  = Geometric Mean of First Age Populations
  Year Range Applied = 1982 to 2005

Stock Estimates

Age 1
Age 2
Age 3
Age 4
Age 5
Age 6

Full F in Terminal Year = 0.4069

F in Oldest True Age in Terminal Year = 0.4069

Full F Calculated Using Classic Method

Age	Input Partial Recruitment	Calc Partial Recruitment	Fishing Mortality	Used In Full F	Comments
0	0.020	0.032	0.0183	NO	Stock Estimate in T+1
1	0.150	0.135	0.0765	NO	Stock Estimate in T+1
2	0.720	0.530	0.3008	NO	Stock Estimate in T+1
3	1.000	0.705	0.4001	YES	Stock Estimate in T+1
4	1.000	1.000	0.5677	YES	Stock Estimate in T+1
5	1.000	0.446	0.2530	YES	Stock Estimate in T+1
6	1.000	0.717	0.4069		Input PR * Full F

Catch At Age - Input Data

AGE	1982	1983	1984	1985	1986
0	5344.0	4925.0	4802.0	2078.0	1942.0
1	19423.0	28441.0	26582.0	14623.0	17140.0
2	10149.0	10911.0	15454.0	17979.0	11055.0
3	935.0	2181.0	3180.0	1767.0	3782.0
4	328.0	693.0	829.0	496.0	316.0
5	116.0	323.0	95.0	252.0	140.0
6	67.0	16.0	4.0	30.0	58.0
7	30.0	43.0	10.0	8.0	15.0

AGE	1987	1988	1989	1990	1991
0	1137.0	795.0	960.0	1856.0	1001.0
1	17212.0	20557.0	4790.0	8808.0	12149.0
2	10838.0	14562.0	7306.0	2187.0	7148.0
3	1648.0	2137.0	1692.0	995.0	742.0
4	544.0	644.0	353.0	221.0	217.0
5	25.0	121.0	55.0	30.0	32.0
6	29.0	19.0	9.0	8.0	3.0
7	44.0	21.0	4.0	3.0	1.0

AGE	1992	1993	1994	1995	1996
0	1368.0	1285.0	1638.0	592.0	162.0
1	11197.0	11235.0	10362.0	5828.0	6925.0
2	6026.0	5601.0	6996.0	7303.0	9278.0
3	1125.0	566.0	982.0	1239.0	1785.0
4	151.0	73.0	205.0	397.0	417.0
5	70.0	45.0	26.0	77.0	71.0
6	2.0	20.0	14.0	2.0	16.0
7	1.0	3.0	5.0	1.0	3.0

AGE	1997	1998	1999	2000	2001
0	30.0	45.0	181.0	22.0	11.0
1	2545.0	2233.0	2185.0	1480.0	2888.0
2	8046.0	6380.0	6260.0	7690.0	4760.0
3	3149.0	5243.0	4018.0	4538.0	3737.0
4	553.0	980.0	1161.0	1495.0	1293.0
5	160.0	138.0	358.0	360.0	363.0
6	11.0	19.0	55.0	73.0	123.0
7	4.0	1.0	14.0	29.0	33.0

AGE	2002	2003	2004	2005
0	272.0	259.0	65.0	245.0
1	1135.0	1583.0	1031.0	1933.0
2	5411.0	4937.0	5437.0	3716.0
3	3839.0	4002.0	4492.0	4036.0
4	1302.0	1579.0	1826.0	2193.0
5	319.0	563.0	732.0	1041.0
6	135.0	233.0	288.0	506.0
7	25.0	86.0	145.0	469.0

Catch Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
0	0.2540	0.2400	0.2480	0.2890	0.2530
1	0.4180	0.4170	0.3960	0.4280	0.4530
2	0.6160	0.7160	0.6320	0.6130	0.6680
3	1.4470	1.0750	1.0460	1.1090	1.1600
4	1.9070	1.2570	1.5000	1.7260	1.7390
5	2.7950	1.4950	2.1630	2.2970	1.9940
6	2.6730	2.5720	3.3020	2.6710	3.3110
7	3.8510	2.5990	3.9200	4.7260	4.0910

AGE	1987	1988	1989	1990	1991
0	0.2590	0.3160	0.2080	0.2520	0.1450
1	0.4420	0.4630	0.4600	0.4310	0.4070
2	0.6510	0.6240	0.7230	0.8100	0.7020
3	1.1400	1.1300	1.0440	1.1690	1.1860
4	1.9410	1.7390	1.4790	1.5380	1.8110
5	2.8620	2.4850	2.2490	2.1210	2.5270
6	3.3370	3.8880	2.3990	3.4610	2.8370
7	3.5140	3.7610	2.7090	4.3660	3.5860

AGE	1992	1993	1994	1995	1996
0	0.2450	0.2640	0.3550	0.3900	0.3300
1	0.4700	0.4860	0.5280	0.5370	0.5100
2	0.7490	0.6990	0.6280	0.6780	0.5700
3	1.2220	1.4610	1.3530	1.0560	1.0800
4	1.3900	1.6590	2.0960	1.6390	1.5450
5	2.6960	1.8590	2.7360	2.6280	1.9570
6	2.3020	2.8160	3.4370	3.7500	2.5460
7	4.4790	2.4760	3.7050	4.0470	2.9890

AGE	1997	1998	1999	2000	2001
0	0.2120	0.2590	0.1430	0.0660	0.1140
1	0.4520	0.4900	0.3710	0.5090	0.5440
2	0.6390	0.6480	0.5940	0.6920	0.7660
3	0.8660	0.8590	0.8960	0.9240	0.9680
4	1.2330	1.3210	1.4390	1.3310	1.4490
5	2.2520	2.4100	1.9980	2.2140	2.1450
6	2.5720	2.5770	2.7160	2.5850	2.5970
7	2.9500	3.9830	3.4990	2.8260	3.3220

AGE	2002	2003	2004	2005
0	0.1470	0.1490	0.2200	0.2020
1	0.4930	0.5070	0.5290	0.4300
2	0.7360	0.7590	0.7370	0.6910
3	0.9580	1.0340	0.9670	0.9260
4	1.3710	1.5310	1.3450	1.1860
5	2.0990	2.0720	1.7500	1.5040
6	2.6660	2.7590	2.3540	1.8910
7	3.7420	3.9520	3.7360	3.6250

JAN-1 Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.3194	0.3255	0.3083	0.3258	0.3618
2	0.4663	0.5471	0.5134	0.4927	0.5347
3	1.5525	0.8138	0.8654	0.8372	0.8433
4	2.1538	1.3487	1.2698	1.3437	1.3887
5	2.9136	1.6885	1.6489	1.8562	1.8552
6	2.7333	2.6812	2.2218	2.4036	2.7578
7	3.8510	2.5990	3.9200	4.7260	4.0910

AGE	1987	1988	1989	1990	1991
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.3344	0.3463	0.3813	0.2994	0.3203
2	0.5430	0.5252	0.5786	0.6104	0.5501
3	0.8727	0.8577	0.8071	0.9193	0.9801
4	1.5005	1.4080	1.2928	1.2672	1.4550
5	2.2309	2.1962	1.9776	1.7711	1.9714
6	2.5795	3.3358	2.4416	2.7899	2.4530
7	3.5140	3.7610	2.7090	4.3660	3.5860

AGE	1992	1993	1994	1995	1996
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.2611	0.3451	0.3734	0.4366	0.4460
2	0.5521	0.5732	0.5525	0.5983	0.5533
3	0.9262	1.0461	0.9725	0.8144	0.8557
4	1.2840	1.4238	1.7499	1.4892	1.2773
5	2.2096	1.6075	2.1305	2.3470	1.7910
6	2.4119	2.7553	2.5277	3.2031	2.5867
7	4.4790	2.4760	3.7050	4.0470	2.9890

AGE	1997	1998	1999	2000	2001
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.3862	0.3223	0.3100	0.2698	0.1895
2	0.5709	0.5412	0.5395	0.5067	0.6244
3	0.7026	0.7409	0.7620	0.7408	0.8184
4	1.1540	1.0696	1.1118	1.0921	1.1571
5	1.8653	1.7238	1.6246	1.7849	1.6897
6	2.2435	2.4090	2.5584	2.2726	2.3979
7	2.9500	3.9830	3.4990	2.8260	3.3220

AGE	2002	2003	2004	2005	2006
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.2371	0.2730	0.2808	0.3076	0.2871
2	0.6328	0.6117	0.6113	0.6046	0.6092
3	0.8566	0.8724	0.8567	0.8261	0.8517
4	1.1520	1.2111	1.1793	1.0709	1.1538
5	1.7440	1.6854	1.6368	1.4223	1.5815
6	2.3914	2.4065	2.2085	1.8191	2.1447
7	3.7420	3.9520	3.7360	3.6250	3.7710

SSB Weights at Age - Input Data

AGE	1982	1983	1984	1985	1986
0	0.3020	0.2860	0.3000	0.3380	0.3080
1	0.5040	0.4820	0.4610	0.4990	0.5130
2	0.7490	0.8160	0.7690	0.7670	0.8050
3	1.3810	1.2060	1.2450	1.2960	1.3880
4	1.7610	1.5200	1.7390	1.8130	2.0690
5	2.7190	1.9820	2.3240	2.6060	2.3860
6	2.6230	3.4750	4.2560	3.6220	3.4470
7	3.8510	2.5990	3.9200	4.7260	4.0910

AGE	1987	1988	1989	1990	1991
0	0.3170	0.3600	0.2690	0.2980	0.2230
1	0.4980	0.5400	0.5610	0.5110	0.5040
2	0.7890	0.7470	0.8550	0.9240	0.8520
3	1.3200	1.2390	1.1940	1.3610	1.2520
4	2.1120	1.8990	1.6750	1.8280	2.0780
5	3.1790	2.4560	2.6110	2.3430	2.4500
6	3.6210	3.0980	3.7170	3.5450	3.9370
7	3.5140	3.7610	2.7090	4.3660	3.5860

AGE	1992	1993	1994	1995	1996
0	0.3120	0.3370	0.4100	0.4280	0.3680
1	0.5390	0.5310	0.5750	0.5480	0.5510
2	0.9480	0.8820	0.7530	0.7970	0.6590
3	1.3570	1.6550	1.4440	1.2040	1.1300
4	1.5360	1.9750	2.2640	1.7410	1.7600
5	2.7360	2.3070	3.0490	2.6000	2.1490
6	2.4190	3.4120	3.8460	3.2400	2.8170
7	4.4790	2.4760	3.7050	4.0470	2.9890

AGE	1997	1998	1999	2000	2001
0	0.2860	0.2930	0.2280	0.1490	0.1960
1	0.5120	0.5230	0.4620	0.5860	0.6030
2	0.7070	0.7240	0.6920	0.7770	0.8270
3	1.0020	1.0280	1.0270	1.0800	1.0910
4	1.5620	1.5240	1.6710	1.5710	1.6470
5	2.3570	2.5090	2.1820	2.3370	2.3100
6	3.5170	3.1950	2.7900	3.0790	3.3640
7	2.9500	3.9830	3.4990	2.8260	3.3220

AGE	2002	2003	2004	2005
0	0.2310	0.2370	0.2790	0.2590
1	0.5730	0.5770	0.5800	0.5500
2	0.8270	0.8240	0.7970	0.7990
3	1.1280	1.1310	1.0370	1.0790
4	1.5820	1.6020	1.3970	1.4510
5	2.3050	2.1630	1.7960	1.9330
6	3.5280	3.4140	3.2060	3.1510
7	3.7420	3.9520	3.7360	3.6250

Natural Mortality - Input Data

AGE	1982	1983	1984	1985	1986
0	0.2000	0.2000	0.2000	0.2000	0.2000
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1987	1988	1989	1990	1991
0	0.2000	0.2000	0.2000	0.2000	0.2000
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1992	1993	1994	1995	1996
0	0.2000	0.2000	0.2000	0.2000	0.2000
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	1997	1998	1999	2000	2001
0	0.2000	0.2000	0.2000	0.2000	0.2000
1	0.2000	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000	0.2000

AGE	2002	2003	2004	2005
0	0.2000	0.2000	0.2000	0.2000
1	0.2000	0.2000	0.2000	0.2000
2	0.2000	0.2000	0.2000	0.2000
3	0.2000	0.2000	0.2000	0.2000
4	0.2000	0.2000	0.2000	0.2000
5	0.2000	0.2000	0.2000	0.2000
6	0.2000	0.2000	0.2000	0.2000
7	0.2000	0.2000	0.2000	0.2000

Proportion of Natural Mortality Before Spawning = 0.8300
Proportion of Fishing Mortality Before Spawning = 0.8300

Maturity - Input Data

AGE	1982	1983	1984	1985	1986
0	0.3800	0.3800	0.3800	0.3800	0.3800
1	0.9100	0.9100	0.9100	0.9100	0.9100
2	0.9800	0.9800	0.9800	0.9800	0.9800
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1987	1988	1989	1990	1991
0	0.3800	0.3800	0.3800	0.3800	0.3800
1	0.9100	0.9100	0.9100	0.9100	0.9100
2	0.9800	0.9800	0.9800	0.9800	0.9800
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1992	1993	1994	1995	1996
0	0.3800	0.3800	0.3800	0.3800	0.3800
1	0.9100	0.9100	0.9100	0.9100	0.9100
2	0.9800	0.9800	0.9800	0.9800	0.9800
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1997	1998	1999	2000	2001
0	0.3800	0.3800	0.3800	0.3800	0.3800
1	0.9100	0.9100	0.9100	0.9100	0.9100
2	0.9800	0.9800	0.9800	0.9800	0.9800
3	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2002	2003	2004	2005
0	0.3800	0.3800	0.3800	0.3800
1	0.9100	0.9100	0.9100	0.9100
2	0.9800	0.9800	0.9800	0.9800
3	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000

SURVEY - INPUT DATA

INDEX	1	2	3	4	5
SURVEY TAG	NEC_W	NEC_W	NEC_W	NEC_W	NEC_W
AGE	1	2	3	4	5 - 7
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.0000	0.0000	0.0000	0.0000	0.0000
1986	0.0000	0.0000	0.0000	0.0000	0.0000
1987	0.0000	0.0000	0.0000	0.0000	0.0000
1988	0.0000	0.0000	0.0000	0.0000	0.0000
1989	0.0000	0.0000	0.0000	0.0000	0.0000
1990	0.0000	0.0000	0.0000	0.0000	0.0000
1991	0.0000	0.0000	0.0000	0.0000	0.0000
1992	7.1500	4.7400	0.3300	0.0400	0.0400
1993	6.5000	6.7000	0.3100	0.0500	0.0400
1994	3.7600	7.2000	0.8200	0.2600	0.0100
1995	6.0700	4.5900	0.2500	0.0200	0.0017
1996	22.1700	8.3300	0.6000	0.1200	0.0300
1997	3.8600	4.8000	1.0400	0.4300	0.1500
1998	1.6800	3.2500	2.2900	0.4200	0.1200
1999	2.1100	4.8000	2.9000	0.8400	0.4100
2000	0.7000	6.5200	4.9600	2.5100	1.0800
2001	3.0700	5.3300	6.4200	2.4400	1.3400
2002	2.7700	10.7400	5.5800	2.2600	1.3300
2003	8.1700	14.3600	8.4800	2.6700	1.9600
2004	1.4500	8.6800	4.5600	1.6400	1.4400
2005	2.9600	4.0300	3.0700	1.3400	1.4900
2006	2.6400	9.0600	4.2900	2.4700	2.5800

SURVEY - INPUT DATA

INDEX	6	7	8	9	10
SURVEY TAG	NEC_S	NEC_S	NEC_S	NEC_S	NEC_S
AGE	1	2	3	4	5 - 7
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	0.7000	1.4300	0.1200	0.0200	0.0017
1983	0.3200	0.3900	0.1900	0.0300	0.0200
1984	0.1700	0.3300	0.0900	0.0500	0.0200
1985	0.5500	1.5600	0.2100	0.0400	0.0200
1986	1.4800	0.4300	0.2000	0.0200	0.0100
1987	0.4700	0.4300	0.0200	0.0100	0.0017
1988	0.6000	0.8100	0.0700	0.0200	0.0017
1989	0.0600	0.2300	0.0200	0.0100	0.0017
1990	0.6300	0.0300	0.0600	0.0017	0.0017
1991	0.7900	0.2700	0.0017	0.0200	0.0017
1992	0.7700	0.4100	0.0100	0.0017	0.0100
1993	0.7300	0.5000	0.0400	0.0017	0.0017
1994	0.3500	0.5300	0.0400	0.0100	0.0017
1995	0.7900	0.2700	0.0200	0.0017	0.0100
1996	1.0800	0.5600	0.1200	0.0017	0.0017
1997	0.2900	0.6700	0.0900	0.0100	0.0017
1998	0.2700	0.5200	0.3200	0.0600	0.0200
1999	0.2200	0.7400	0.4800	0.1300	0.0300
2000	0.1900	1.0300	0.6300	0.1200	0.1700
2001	0.4800	0.8900	1.0200	0.2000	0.1000
2002	0.3400	0.8900	0.7400	0.3100	0.1900
2003	0.5400	1.2900	0.5900	0.2900	0.2100
2004	0.3000	1.4500	0.8500	0.2700	0.1500
2005	0.2600	0.6500	0.5800	0.1500	0.1700
2006	0.0400	1.0400	0.2400	0.2500	0.2000

SURVEY - INPUT DATA

INDEX	11	12	13	14	15
SURVEY TAG	NEC_F	NEC_F	NEC_F	MA_S	MA_S
AGE	2	3	4	1	2
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	0	0
1982	0.0000	0.0000	0.0000	0.3760	1.4240
1983	1.5200	0.4000	0.0300	0.2410	1.3040
1984	1.4600	0.3400	0.1200	0.0420	0.0730
1985	1.3900	0.4300	0.0700	0.1420	1.1910
1986	0.8000	0.4600	0.0500	0.9660	0.5280
1987	0.8300	0.1100	0.1100	0.6150	0.5830
1988	0.5800	0.2000	0.0300	0.1530	0.9660
1989	0.6200	0.1800	0.0300	0.0042	0.3380
1990	0.2100	0.0500	0.0017	0.2470	0.0210
1991	0.3800	0.0300	0.0400	0.0290	0.0480
1992	0.8400	0.0900	0.0017	0.2740	0.3200
1993	1.0400	0.2500	0.0300	0.1200	0.4700
1994	0.8000	0.0300	0.0100	1.7700	1.1600
1995	0.6700	0.0900	0.0100	0.0890	1.2450
1996	1.1600	0.2800	0.0200	0.0720	0.6410
1997	1.2400	0.5700	0.0400	0.5120	1.2120
1998	1.2900	1.1400	0.2900	0.1370	1.1440
1999	2.1300	1.6300	0.3300	0.0730	0.8140
2000	1.7300	1.4900	0.3100	0.2240	1.5660
2001	1.2000	1.2200	0.4000	0.1720	0.9630
2002	1.3600	0.9300	0.3700	0.1420	1.4000
2003	1.1700	0.8600	0.3500	0.1890	1.3280
2004	1.3100	1.0300	0.2500	0.0250	0.2670
2005	1.4900	1.3700	0.6600	0.1240	0.3140
2006	1.1400	0.5400	0.4700	0.0000	0.0000

SURVEY - INPUT DATA

INDEX	16	17	18	19	20
SURVEY TAG	MA_S	MA_F	MA_F	MA_F	CT_S
AGE	3	2	3	4	1
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	1	1	1	0
1982	0.1180	0.3620	0.3670	0.0110	0.0000
1983	0.5440	0.2550	1.7410	0.0160	0.0000
1984	0.0630	0.0260	0.5830	0.1400	0.3140
1985	0.0340	0.4530	0.2490	0.1200	0.0150
1986	0.1400	0.1080	1.6620	0.0330	0.7530
1987	0.0120	2.1490	0.4880	0.1280	0.9510
1988	0.1090	1.1590	0.5980	0.0100	0.2320
1989	0.0790	0.4410	0.4140	0.0180	0.0130
1990	0.0790	0.0018	0.2860	0.0240	0.3040
1991	0.0100	0.1080	0.0117	0.0120	0.3920
1992	0.0800	0.4930	0.2620	0.0100	0.3190
1993	0.0600	1.1100	0.1700	0.0017	0.3200
1994	0.0500	0.3000	0.4300	0.0200	0.4960
1995	0.0500	2.1300	0.0700	0.0017	0.1990
1996	0.1100	0.4010	0.3230	0.0130	0.5780
1997	0.1690	0.7090	1.1650	0.0820	0.3910
1998	0.6300	0.4620	1.3990	0.3230	0.0640
1999	1.0420	0.0110	0.5530	0.2480	0.2450
2000	1.1370	0.3250	0.8780	0.3590	0.3210
2001	0.6870	1.3000	2.1290	0.4430	0.8410
2002	0.3620	1.1660	1.0000	0.2710	1.0570
2003	0.5760	2.5290	1.1950	0.1580	1.6080
2004	0.3060	2.9070	1.1820	0.2350	0.2590
2005	0.9180	0.5730	1.3750	0.1230	0.2530
2006	0.0000	1.7020	2.2350	0.7560	0.0000

SURVEY - INPUT DATA

INDEX	21	22	23	24	25
SURVEY TAG	CT_S	CT_S	CT_S	CT_F	CT_F
AGE	2	3	4	2	3
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	1	1
1982	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.2710	0.0440	0.0007	0.0000	0.0000
1985	0.3250	0.0400	0.0580	0.5710	0.3310
1986	0.1000	0.0820	0.0080	0.3390	0.5280
1987	0.0860	0.0140	0.0040	1.1700	0.2980
1988	0.2230	0.0350	0.0090	1.0670	0.2230
1989	0.0490	0.0240	0.0160	0.8840	0.4810
1990	0.0220	0.0130	0.0060	0.0290	0.0950
1991	0.1890	0.0290	0.0280	0.6740	0.1100
1992	0.1880	0.0210	0.0040	0.8260	0.3400
1993	0.1510	0.0150	0.0180	0.5700	0.3660
1994	0.3140	0.0250	0.0180	0.8270	0.1520
1995	0.0510	0.0200	0.0050	0.3000	0.0850
1996	0.2660	0.0860	0.0230	0.3840	0.1170
1997	0.5070	0.0570	0.0360	0.8870	1.1880
1998	0.5940	0.5030	0.1160	0.6810	1.3730
1999	0.5930	0.3850	0.1390	0.2690	1.0540
2000	0.7260	0.5240	0.0740	0.6790	1.4840
2001	0.3400	0.3650	0.1200	0.3950	0.8710
2002	1.2640	0.4650	0.2330	2.6890	1.1370
2003	1.0160	0.3950	0.2320	3.0870	1.9300
2004	0.8180	0.4100	0.1940	1.4590	1.3190
2005	0.2640	0.1500	0.0330	0.3850	0.7550
2006	0.0000	0.0000	0.0000	1.0930	0.7440

SURVEY - INPUT DATA

INDEX	26	27	28	29	30
SURVEY TAG	CT_F	CT_F	RI_F	RI_F	RI_F
AGE	4	5 - 7	2	3	4
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	1	1	1	1	1
1982	0.0000	0.0000	0.9710	1.7400	0.1990
1983	0.0000	0.0000	0.2090	0.5160	0.0710
1984	0.0000	0.0000	0.1350	0.4200	0.1100
1985	0.0720	0.0250	0.4240	0.7010	0.0920
1986	0.0750	0.0090	0.2180	0.3380	0.0480
1987	0.0720	0.0070	1.1830	1.5180	0.1790
1988	0.0330	0.0030	0.5030	0.5790	0.1210
1989	0.0370	0.0030	0.1670	0.3510	0.0360
1990	0.0150	0.0010	0.0010	0.0370	0.0300
1991	0.0420	0.0120	0.2620	0.4750	0.0420
1992	0.0360	0.0220	0.0600	0.1280	0.0340
1993	0.0460	0.0250	0.3940	0.6850	0.1850
1994	0.0390	0.0070	0.1520	0.3960	0.1390
1995	0.0240	0.0090	0.0450	0.1260	0.0130
1996	0.0120	0.0050	0.1750	0.3930	0.1400
1997	0.0420	0.0050	0.7040	1.3460	0.1710
1998	0.3730	0.0400	0.5570	1.0530	0.1740
1999	0.3210	0.0750	0.0870	0.3590	0.0870
2000	0.3460	0.1270	0.9310	1.8880	0.2540
2001	0.3410	0.1910	0.5060	1.3050	0.6540
2002	0.4360	0.1340	0.5500	0.6400	0.8000
2003	0.4790	0.1830	2.4160	1.3710	0.3850
2004	0.4070	0.2030	2.4670	2.1870	0.4980
2005	0.4400	0.1190	0.3780	1.0220	1.0220
2006	0.3550	0.1510	0.8400	1.3800	0.6900

SURVEY - INPUT DATA

INDEX	31	32	33	34	35
SURVEY TAG	RI_X	RI_X	NJ	NJ	NJ
AGE	1	2 - 7	1	2	3
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	0	0
1982	0.0000	0.0000	0.0000	0.0000	0.0000
1983	0.0000	0.0000	0.0000	0.0000	0.0000
1984	0.0000	0.0000	0.0000	0.0000	0.0000
1985	0.0000	0.0000	0.0000	0.0000	0.0000
1986	0.0000	0.0000	0.0000	0.0000	0.0000
1987	0.0000	0.0000	0.0000	0.0000	0.0000
1988	0.0000	0.0000	3.0600	1.0300	0.0017
1989	0.0000	0.0000	0.5100	0.1800	0.0017
1990	0.1700	0.1000	1.4400	0.1100	0.0300
1991	0.0700	0.0800	2.6900	0.2700	0.0200
1992	0.0100	0.3300	3.0000	0.5700	0.0600
1993	0.1100	0.1400	5.6900	0.2000	0.0100
1994	0.0800	0.0500	1.0700	0.0800	0.0017
1995	0.0200	0.0300	2.9300	0.2800	0.0500
1996	0.4100	0.5300	5.1000	2.7000	0.1800
1997	0.1700	0.5200	8.2500	5.2500	1.0200
1998	0.0700	0.3600	5.8000	2.6700	0.2900
1999	0.2600	0.6100	6.1200	3.4600	0.6500
2000	0.6300	1.8900	3.9100	1.8200	0.4500
2001	0.4200	0.5500	3.3200	1.1800	0.4100
2002	0.8100	1.1100	9.1100	4.1300	1.2800
2003	1.4800	2.2500	5.6100	2.5500	0.5700
2004	0.5400	1.5300	6.2700	2.4900	0.5700
2005	0.5600	1.9000	5.9900	1.2400	0.5300
2006	0.0000	0.0000	0.0000	0.0000	0.0000

SURVEY - INPUT DATA

INDEX	36	37	38	39	40
SURVEY TAG	DE	DE	DE	CT_Y	VA_RY
AGE	1	2	3	0	0
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	0	0
1982	0.0000	0.0000	0.0000	0.0000	4.3000
1983	0.0000	0.0000	0.0000	0.0000	5.2100
1984	0.0000	0.0000	0.0000	0.0000	1.9000
1985	0.0000	0.0000	0.0000	0.3400	1.1100
1986	0.0000	0.0000	0.0000	0.2720	1.2700
1987	0.0000	0.0000	0.0000	0.1750	0.4500
1988	0.0000	0.0000	0.0000	0.1150	0.5400
1989	0.0000	0.0000	0.0000	0.1000	0.9600
1990	0.0000	0.0000	0.0000	0.1320	2.6100
1991	1.1300	0.1800	0.0400	0.1360	1.4200
1992	0.2800	0.0800	0.0000	0.1130	0.4900
1993	1.5600	0.7300	0.0700	0.1840	0.4900
1994	0.1400	0.2200	0.0800	0.2320	1.0800
1995	1.0000	0.2800	0.1000	0.1230	0.7400
1996	0.7300	0.4800	0.1000	0.1690	0.6200
1997	0.1200	0.4900	0.4700	0.1330	0.7000
1998	0.3100	0.8300	0.2900	0.1000	0.1700
1999	0.0600	0.7700	0.4700	0.1440	0.3600
2000	0.2400	0.3000	0.2800	0.2120	0.5200
2001	1.5500	0.4900	0.2600	0.1210	0.5300
2002	0.2300	0.0900	0.0000	0.5420	0.4300
2003	0.1400	0.2900	0.1500	0.1000	0.5000
2004	0.0700	0.0600	0.0100	0.3550	1.3000
2005	0.3000	0.1100	0.0200	0.1670	0.3500
2006	0.0000	0.0000	0.0000	0.0000	0.0000

SURVEY - INPUT DATA

INDEX	41	42	43	44	45
SURVEY TAG	VA_CRY	NC_Y	MD_Y	NJ_Y	NEC_Y
AGE	0	0	0	0	0
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	0	0
1982	2.2700	0.0000	2.0000	0.0000	0.5500
1983	5.0100	0.0000	10.6000	0.0000	0.9600
1984	1.5800	0.0000	5.4000	0.0000	0.1800
1985	1.2600	0.0000	5.6000	0.0000	0.5900
1986	1.2600	0.0000	16.2000	0.0000	0.3900
1987	0.3900	19.8600	4.6000	0.0000	0.0700
1988	0.5400	2.6100	0.5000	0.1700	0.0600
1989	1.2400	6.6300	1.3000	1.0000	0.3100
1990	2.5400	4.2700	2.1000	1.2800	0.4400
1991	2.6400	5.8500	3.1000	1.0000	0.7600
1992	0.8900	9.1400	3.5000	1.1000	0.9900
1993	0.5000	5.1300	1.6000	2.5500	0.2300
1994	2.4100	8.1700	8.2000	1.6600	0.7500
1995	0.6300	6.6500	5.0000	4.9500	0.9300
1996	0.8100	30.6700	2.6000	1.6600	0.1100
1997	0.8900	14.1400	3.3000	1.6500	0.1700
1998	0.7300	10.4400	5.2000	0.6700	0.3800
1999	0.5300	0.4350	3.4000	1.0300	0.2100
2000	0.5700	3.9400	4.1000	0.9500	0.2200
2001	0.4700	22.0300	5.3000	0.6200	0.1200
2002	0.7700	18.2800	2.1000	1.5100	0.0600
2003	0.4400	7.2300	3.7000	0.6000	0.1800
2004	1.3000	5.9000	2.9000	0.9000	0.3600
2005	0.3500	9.8800	0.7000	3.1100	0.1600
2006	0.0000	0.0000	0.0000	0.0000	0.0000

SURVEY - INPUT DATA

INDEX	46	47	48	49	50
SURVEY TAG	MA_Y	DE_Y	RI_Y	DE_EY	DE_BY
AGE	0	0	0	0	0
TIME	JAN-1	JAN-1	JAN-1	JAN-1	JAN-1
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0	0	0	0	0
1982	4.0000	0.0000	0.1240	0.1100	0.0000
1983	4.0000	0.0000	0.1300	0.0310	0.0000
1984	2.0000	0.0000	0.2220	0.0760	0.0000
1985	20.0000	0.0000	0.4420	0.0630	0.0000
1986	6.0000	0.0000	0.6470	0.0960	0.3170
1987	5.0000	0.0000	0.2350	0.1360	0.2580
1988	3.0000	0.0000	0.1140	0.0070	0.0130
1989	4.0000	0.0000	0.1000	0.1150	0.1390
1990	12.0000	0.0000	0.1510	0.2290	0.3610
1991	5.0000	1.4400	0.1020	0.0730	0.3780
1992	1.0000	0.4700	0.1650	0.3150	0.3680
1993	3.0000	0.0400	0.1240	0.0290	0.0470
1994	2.0000	2.2800	0.1050	0.2940	0.5710
1995	14.0000	0.9400	0.1310	0.1700	0.3010
1996	8.0000	0.4600	0.2930	0.0330	0.0800
1997	1.0000	0.0300	0.1800	0.0160	0.2220
1998	13.0000	0.1100	0.1080	0.0250	0.3900
1999	14.0000	0.2000	0.3410	0.0480	0.3500
2000	11.0000	0.7900	0.4650	0.1770	0.2050
2001	2.0000	0.3400	0.1800	0.0740	0.1420
2002	71.0000	0.0400	0.5380	0.0670	0.1250
2003	12.0000	0.1500	0.2000	0.0910	0.2140
2004	5.0000	0.0200	0.1260	0.1010	0.2680
2005	1.0000	0.0000	0.1100	0.0040	0.0120
2006	0.0000	0.0000	0.0000	0.0000	0.0000

INDEX	51				
SURVEY TAG	RI_XY				
AGE	0	NUMBERS	NUMBERS	NUMBERS	NUMBERS
TIME	JAN-1	NUMBERS	NUMBERS	NUMBERS	NUMBERS
TYPE	NUMBERS	NUMBERS	NUMBERS	NUMBERS	NUMBERS
RETRO FLAG	0				

1982	0.0000
1983	0.0000
1984	0.0000
1985	0.0000
1986	0.0000
1987	0.0000
1988	0.0000
1989	0.0000
1990	0.1200
1991	0.1000
1992	0.1000
1993	0.1100
1994	0.1400
1995	0.1300
1996	0.1200
1997	0.1400
1998	0.1000
1999	0.1300
2000	0.1900
2001	0.1100
2002	0.2100
2003	0.1500
2004	0.2000
2005	0.1400
2006	0.0000

Estimation Results

JAN-1 Population Numbers (N)

AGE	1982	1983	1984	1985	1986
0	74269.	80323.	48380.	48579.	53444.
1	42907.	55970.	61306.	35265.	37893.
2	16205.	17555.	20090.	26141.	15641.
3	2203.	4085.	4500.	2465.	5134.
4	807.	957.	1371.	807.	419.
5	161.	364.	157.	372.	212.
6	152.	27.	6.	42.	77.
7	68.	71.	14.	11.	20.
Total	136772.	159352.	135824.	113683.	112841.

AGE	1987	1988	1989	1990	1991
0	43921.	13033.	27270.	30352.	28686.
1	41999.	34931.	9951.	21458.	23171.
2	15515.	18812.	9998.	3813.	9599.
3	2803.	2896.	2226.	1575.	1143.
4	782.	804.	438.	291.	389.
5	57.	148.	75.	39.	38.
6	47.	24.	11.	12.	5.
7	71.	27.	5.	4.	2.
Total	105195.	70675.	49974.	57545.	63032.

AGE	1992	1993	1994	1995	1996
0	32316.	33158.	35257.	38694.	28258.
1	22580.	25220.	25985.	27384.	31144.
2	7978.	8356.	10483.	11899.	17147.
3	1391.	1079.	1773.	2252.	3134.
4	264.	121.	371.	563.	723.
5	122.	80.	33.	119.	102.
6	3.	37.	25.	3.	27.
7	1.	6.	9.	2.	5.
Total	64655.	68056.	73935.	80915.	80539.

AGE	1997	1998	1999	2000	2001
0	29339.	31185.	29433.	39386.	31181.
1	22989.	23993.	25491.	23934.	32226.
2	19233.	16519.	17624.	18893.	18256.
3	5643.	8466.	7752.	8765.	8510.
4	951.	1771.	2187.	2711.	3070.
5	214.	278.	563.	740.	867.
6	19.	31.	103.	137.	280.
7	7.	2.	26.	55.	75.
Total	78395.	82245.	83179.	94621.	94467.

AGE	2002	2003	2004	2005	2006
0	36047.	25265.	35505.	14965.	34238.
1	25519.	29267.	20451.	29010.	12031.
2	23772.	19866.	22529.	15811.	22002.
3	10640.	14566.	11798.	13526.	9582.
4	3586.	5238.	8305.	5595.	7422.
5	1343.	1758.	2859.	5147.	2596.
6	381.	811.	930.	1679.	3272.
7	71.	299.	468.	1537.	1753.
Total	101360.	97071.	102845.	87270.	92897.

Fishing Mortality Calculated (F)

AGE	1982	1983	1984	1985	1986
0	0.0829	0.0702	0.1162	0.0484	0.0410
1	0.6937	0.8246	0.6524	0.6130	0.6929
2	1.1781	1.1613	1.8980	1.4276	1.5192
3	0.6332	0.8918	1.5187	1.5711	1.6825
4	0.5963	1.6093	1.1037	1.1376	1.7873
5	1.6001	3.9505	1.1075	1.3793	1.3116
6	0.6553	1.0601	1.3963	1.4385	1.6732
7	0.6553	1.0601	1.3963	1.4385	1.6732

AGE	1987	1988	1989	1990	1991
0	0.0290	0.0698	0.0397	0.0700	0.0393
1	0.6032	1.0510	0.7592	0.6045	0.8662
2	1.4784	1.9344	1.6481	1.0047	1.7317
3	1.0491	1.6899	1.8336	1.1979	1.2637
4	1.4666	2.1666	2.2217	1.8237	0.9575
5	0.6550	2.3629	1.6410	1.9213	2.5093
6	1.1170	1.7931	1.8802	1.2830	1.1948
7	1.1170	1.7931	1.8802	1.2830	1.1948

AGE	1992	1993	1994	1995	1996
0	0.0479	0.0438	0.0527	0.0171	0.0064
1	0.7941	0.6779	0.5811	0.2682	0.2820
2	1.8006	1.3503	1.3378	1.1342	0.9113
3	2.2436	0.8668	0.9471	0.9365	0.9929
4	0.9970	1.1024	0.9420	1.5109	1.0151
5	1.0008	0.9741	2.0791	1.2659	1.4753
6	1.8129	0.8933	0.9565	1.0366	1.0068
7	1.8129	0.8933	0.9565	1.0366	1.0068

AGE	1997	1998	1999	2000	2001
0	0.0011	0.0016	0.0068	0.0006	0.0004
1	0.1305	0.1085	0.0995	0.0708	0.1043
2	0.6205	0.5566	0.4985	0.5975	0.3399
3	0.9589	1.1534	0.8506	0.8491	0.6641
4	1.0298	0.9455	0.8834	0.9402	0.6264
5	1.7406	0.7958	1.2117	0.7709	0.6214
6	0.9859	1.1043	0.8739	0.8636	0.6517
7	0.9859	1.1043	0.8739	0.8636	0.6517

AGE	2002	2003	2004	2005
0	0.0084	0.0114	0.0020	0.0183
1	0.0504	0.0616	0.0573	0.0765
2	0.2898	0.3211	0.3102	0.3008
3	0.5088	0.3619	0.5461	0.4001
4	0.5129	0.4052	0.2784	0.5677
5	0.3044	0.4368	0.3326	0.2530
6	0.4903	0.3782	0.4145	0.4069
7	0.4903	0.3782	0.4145	0.4069

Average Fishing Mortality For Ages 3-5 (F)

Year	Average F	N Weighted	Biomass Wtd	Catch Wtd
1982	0.9432	0.6728	0.7023	0.7058
1983	2.1505	1.2248	1.4284	1.3564
1984	1.2433	1.4136	1.3781	1.4254
1985	1.3627	1.4555	1.4141	1.4664
1986	1.5938	1.6765	1.6665	1.6780
1987	1.0569	1.1325	1.1663	1.1471
1988	2.0732	1.8153	1.8822	1.8238
1989	1.8988	1.8903	1.9096	1.8938
1990	1.6476	1.3083	1.3467	1.3263
1991	1.5769	1.2184	1.2190	1.2369
1992	1.4138	1.9726	1.8436	2.0391
1993	0.9811	0.8957	0.9048	0.8990
1994	1.3227	0.9633	0.9781	0.9705
1995	1.2378	1.0601	1.1308	1.0844
1996	1.1611	1.0093	1.0215	1.0120
1997	1.2431	0.9934	1.0304	1.0014
1998	0.9649	1.1089	1.0880	1.1136
1999	0.9819	0.8768	0.8949	0.8808
2000	0.8534	0.8646	0.8646	0.8660
2001	0.6373	0.6519	0.6477	0.6522
2002	0.4420	0.4921	0.4791	0.4978
2003	0.4013	0.3785	0.3845	0.3799
2004	0.3857	0.4227	0.3988	0.4546
2005	0.4069	0.4076	0.3971	0.4296

Back Calculated Partial Recruitment (PR)

AGE	1982	1983	1984	1985	1986
0	0.0518	0.0178	0.0612	0.0308	0.0229
1	0.4335	0.2087	0.3437	0.3902	0.3877
2	0.7363	0.2940	1.0000	0.9087	0.8500
3	0.3957	0.2258	0.8002	1.0000	0.9414
4	0.3727	0.4074	0.5815	0.7241	1.0000
5	1.0000	1.0000	0.5835	0.8780	0.7339
6	0.4095	0.2683	0.7357	0.9156	0.9362
7	0.4095	0.2683	0.7357	0.9156	0.9362

AGE	1987	1988	1989	1990	1991
0	0.0196	0.0295	0.0179	0.0364	0.0157
1	0.4080	0.4448	0.3417	0.3146	0.3452
2	1.0000	0.8187	0.7418	0.5230	0.6901
3	0.7096	0.7152	0.8253	0.6235	0.5036
4	0.9920	0.9169	1.0000	0.9492	0.3816
5	0.4430	1.0000	0.7386	1.0000	1.0000
6	0.7555	0.7588	0.8463	0.6678	0.4762
7	0.7555	0.7588	0.8463	0.6678	0.4762

AGE	1992	1993	1994	1995	1996
0	0.0214	0.0324	0.0254	0.0113	0.0043
1	0.3540	0.5021	0.2795	0.1775	0.1912
2	0.8025	1.0000	0.6435	0.7507	0.6177
3	1.0000	0.6419	0.4555	0.6198	0.6730
4	0.4444	0.8164	0.4531	1.0000	0.6881
5	0.4461	0.7214	1.0000	0.8378	1.0000
6	0.8080	0.6616	0.4601	0.6860	0.6825
7	0.8080	0.6616	0.4601	0.6860	0.6825

AGE	1997	1998	1999	2000	2001
0	0.0006	0.0014	0.0056	0.0007	0.0006
1	0.0750	0.0941	0.0821	0.0753	0.1570
2	0.3565	0.4826	0.4114	0.6355	0.5118
3	0.5509	1.0000	0.7020	0.9031	1.0000
4	0.5916	0.8197	0.7290	1.0000	0.9432
5	1.0000	0.6900	1.0000	0.8199	0.9357
6	0.5664	0.9575	0.7212	0.9185	0.9813
7	0.5664	0.9575	0.7212	0.9185	0.9813

AGE	2002	2003	2004	2005
0	0.0163	0.0261	0.0037	0.0322
1	0.0983	0.1411	0.1050	0.1347
2	0.5650	0.7351	0.5681	0.5298
3	0.9920	0.8285	1.0000	0.7048
4	1.0000	0.9278	0.5098	1.0000
5	0.5935	1.0000	0.6090	0.4456
6	0.9560	0.8659	0.7590	0.7168
7	0.9560	0.8659	0.7590	0.7168

JAN-1 Biomass (TSB)

AGE	1982	1983	1984	1985	1986
0	0.	0.	0.	0.	0.
1	13705.	18218.	18901.	11489.	13710.
2	7557.	9604.	10314.	12880.	8363.
3	3420.	3324.	3894.	2064.	4330.
4	1738.	1291.	1741.	1084.	583.
5	468.	615.	259.	691.	393.
6	416.	71.	13.	102.	212.
7	262.	185.	56.	53.	81.
Total	27565.	33309.	35177.	28363.	27671.

AGE	1987	1988	1989	1990	1991
0	0.	0.	0.	0.	0.
1	14045.	12097.	3794.	6425.	7422.
2	8425.	9880.	5785.	2328.	5280.
3	2446.	2484.	1796.	1448.	1120.
4	1173.	1132.	566.	369.	566.
5	128.	324.	149.	69.	76.
6	120.	82.	28.	33.	11.
7	249.	102.	14.	20.	6.
Total	26586.	26100.	12132.	10691.	14481.

AGE	1992	1993	1994	1995	1996
0	0.	0.	0.	0.	0.
1	5896.	8703.	9703.	11956.	13890.
2	4405.	4789.	5792.	7119.	9487.
3	1288.	1129.	1724.	1834.	2682.
4	340.	172.	650.	838.	923.
5	270.	128.	70.	278.	182.
6	6.	101.	62.	11.	71.
7	6.	14.	33.	7.	15.
Total	12210.	15037.	18033.	22043.	27251.

AGE	1997	1998	1999	2000	2001
0	0.	0.	0.	0.	0.
1	8878.	7733.	7902.	6457.	6107.
2	10980.	8940.	9508.	9573.	11399.
3	3965.	6272.	5907.	6493.	6965.
4	1097.	1894.	2432.	2961.	3552.
5	400.	479.	915.	1321.	1465.
6	43.	74.	263.	312.	672.
7	20.	6.	91.	154.	250.
Total	25384.	25400.	27018.	27272.	30410.

AGE	2002	2003	2004	2005	2006
0	0.	0.	0.	0.	0.
1	6051.	7990.	5743.	8923.	3454.
2	15043.	12152.	13772.	9559.	13404.
3	9114.	12708.	10107.	11174.	8161.
4	4132.	6343.	9794.	5992.	8564.
5	2343.	2963.	4680.	7321.	4106.
6	912.	1952.	2054.	3054.	7018.
7	264.	1183.	1749.	5573.	6610.
Total	37858.	45292.	47900.	51596.	51317.

Spawning Stock Biomass (SSB)

AGE	1982	1983	1984	1985	1986
0	6740.	6976.	4242.	5077.	5121.
1	9372.	10489.	12676.	8155.	8430.
2	3790.	4535.	2654.	5089.	2962.
3	1523.	1990.	1345.	735.	1494.
4	734.	324.	808.	482.	167.
5	98.	23.	123.	262.	144.
6	196.	32.	6.	39.	56.
7	129.	65.	15.	14.	17.
Total	22582.	24435.	21870.	19853.	18391.

AGE	1987	1988	1989	1990	1991
0	4375.	1425.	2285.	2747.	1993.
1	9772.	6077.	2291.	5118.	4386.
2	2979.	2342.	1807.	1270.	1613.
3	1312.	748.	491.	672.	425.
4	414.	214.	98.	99.	309.
5	90.	43.	43.	16.	10.
6	57.	14.	8.	12.	6.
7	83.	19.	2.	6.	2.
Total	19082.	10883.	7025.	9940.	8743.

AGE	1992	1993	1994	1995	1996
0	3119.	3468.	4454.	5256.	3330.
1	4853.	5881.	7110.	9259.	10467.
2	1409.	1995.	2158.	3071.	4403.
3	248.	737.	988.	1056.	1316.
4	150.	81.	326.	237.	464.
5	124.	70.	15.	91.	54.
6	1.	51.	36.	4.	28.
7	1.	6.	13.	2.	6.
Total	9905.	12287.	15100.	18976.	20067.

AGE	1997	1998	1999	2000	2001
0	2698.	2937.	2148.	1888.	1967.
1	8141.	8839.	8358.	10194.	13737.
2	6744.	6255.	6693.	7421.	9452.
3	2161.	2830.	3329.	3963.	4532.
4	535.	1043.	1487.	1653.	2546.
5	101.	305.	381.	773.	1013.
6	25.	33.	117.	175.	465.
7	8.	2.	38.	64.	123.
Total	20413.	22245.	22551.	26130.	33835.

AGE	2002	2003	2004	2005
0	2662.	1909.	3183.	1229.
1	10809.	12368.	8718.	11542.
2	12831.	10410.	11522.	8170.
3	6664.	10334.	6587.	8869.
4	3140.	5077.	7800.	4293.
5	2037.	2242.	3301.	6832.
6	758.	1714.	1791.	3196.
7	149.	732.	1051.	3368.
Total	39051.	44786.	43951.	47498.

Bootstrap Summary Report

Bootstrap Output Variable: Stock Estimates (2006) (N)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
N 1	12031.	12286.	2596.	0.2113
N 2	22002.	22285.	3765.	0.1690
N 3	9582.	9715.	1741.	0.1792
N 4	7422.	7537.	1588.	0.2107
N 5	2596.	2694.	1084.	0.4026
N 6	3272.	3356.	1086.	0.3237

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
N 1	255.	82.	2.1166	11776.	0.2205
N 2	283.	119.	1.2845	21720.	0.1733
N 3	133.	55.	1.3841	9450.	0.1843
N 4	115.	50.	1.5488	7307.	0.2173
N 5	97.	34.	3.7472	2499.	0.4339
N 6	84.	34.	2.5720	3188.	0.3408

	LOWER 90. % CI	UPPER 90. % CI
N 1	8484.	16830.
N 2	16479.	28551.
N 3	7062.	12640.
N 4	5159.	10247.
N 5	1083.	4533.
N 6	1652.	5292.

Bootstrap Output Variable: Fishing Mortality (2005) (F)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AGE 0	0.0183	0.0187	0.003933	0.2106
AGE 1	0.0765	0.0776	0.012811	0.1651
AGE 2	0.3008	0.3045	0.047578	0.1563
AGE 3	0.4001	0.4074	0.071620	0.1758
AGE 4	0.5677	0.6458	0.473408	0.7330
AGE 5	0.2530	0.2718	0.094457	0.3475
AGE 6	0.4069	0.4417	0.161389	0.3654
AGE 7	0.4069	0.4417	0.161389	0.3654

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AGE 0	0.000415	0.000125	2.2710	0.0178	0.2204
AGE 1	0.001091	0.000407	1.4258	0.0754	0.1699
AGE 2	0.003709	0.001509	1.2330	0.2971	0.1602
AGE 3	0.007249	0.002276	1.8116	0.3929	0.1823
AGE 4	0.078100	0.015173	13.7567	0.4896	0.9669
AGE 5	0.018859	0.003046	7.4549	0.2341	0.4035
AGE 6	0.034736	0.005221	8.5358	0.3722	0.4336
AGE 7	0.034736	0.005221	8.5358	0.3722	0.4336

	LOWER 90. % CI	UPPER 90. % CI
AGE 0	0.013052	0.025788
AGE 1	0.059440	0.100773
AGE 2	0.235720	0.387761
AGE 3	0.304002	0.535032
AGE 4	0.361710	1.041139
AGE 5	0.163108	0.450483
AGE 6	0.325329	0.575411
AGE 7	0.325329	0.575411

Bootstrap Output Variable: Average F (2005) AGES 3 - 5

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
AVG F	0.4069	0.4417	0.161389	0.3654
N WTD	0.4076	0.4152	0.073614	0.1773
B WTD	0.3971	0.4052	0.075305	0.1858
C WTD	0.4296	0.4599	0.148726	0.3234

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
AVG F	0.034736	0.005221	8.5358	0.3722	0.4336
N WTD	0.007645	0.002340	1.8758	0.3999	0.1841
B WTD	0.008067	0.002395	2.0312	0.3891	0.1935
C WTD	0.030284	0.004800	7.0490	0.3993	0.3724

	LOWER 90. % CI	UPPER 90. % CI
AVG F	0.325329	0.575411
N WTD	0.326546	0.517377
B WTD	0.316996	0.503864
C WTD	0.344572	0.600947

Bootstrap Output Variable: Biomass

JAN-1 Biomass (2006) Mean Biomass & SSB (2005)

	NLLS Estimate	Bootstrap Mean	Bootstrap Std Error	C.V. For NLLS Soln.
JAN-1	51317.	52059.	5645.	0.1084
MEAN	49041.	49626.	4680.	0.0943
SSB	47498.	48127.	5214.	0.1083

	Bias Estimate	Bias Std. Error	Per Cent Bias	NLLS Estimate Corrected For Bias	C.V. For Corrected Estimate
JAN-1	742.	180.	1.4452	50575.	0.1116
MEAN	584.	149.	1.1917	48457.	0.0966
SSB	630.	166.	1.3259	46868.	0.1112

	LOWER 90. % CI	UPPER 90. % CI
JAN-1	43197.	61867.
MEAN	42317.	57798.
SSB	39859.	57161.

Retrospective Summary

Average Fishing Mortality (F)
Ages = 3 - 5

	1982	1983	1984	1985	1986
1998	0.9432	2.1505	1.2433	1.3627	1.5938
1999	0.9432	2.1505	1.2433	1.3627	1.5938
2000	0.9432	2.1505	1.2433	1.3627	1.5938
2001	0.9432	2.1505	1.2433	1.3627	1.5938
2002	0.9432	2.1505	1.2433	1.3627	1.5938
2003	0.9432	2.1505	1.2433	1.3627	1.5938
2004	0.9432	2.1505	1.2433	1.3627	1.5938
2005	0.9432	2.1505	1.2433	1.3627	1.5938

	1987	1988	1989	1990	1991
1998	1.0569	2.0732	1.8987	1.6474	1.5762
1999	1.0569	2.0732	1.8987	1.6474	1.5764
2000	1.0569	2.0732	1.8988	1.6475	1.5766
2001	1.0569	2.0732	1.8988	1.6475	1.5767
2002	1.0569	2.0732	1.8988	1.6476	1.5768
2003	1.0569	2.0732	1.8988	1.6476	1.5768
2004	1.0569	2.0732	1.8988	1.6476	1.5769
2005	1.0569	2.0732	1.8988	1.6476	1.5769

	1992	1993	1994	1995	1996
1998	1.4122	0.9771	1.3097	1.1905	1.0194
1999	1.4126	0.9783	1.3123	1.2007	1.0458
2000	1.4132	0.9796	1.3171	1.2194	1.1088
2001	1.4135	0.9803	1.3203	1.2286	1.1326
2002	1.4137	0.9808	1.3218	1.2346	1.1508
2003	1.4138	0.9810	1.3223	1.2364	1.1571
2004	1.4138	0.9811	1.3227	1.2376	1.1606
2005	1.4138	0.9811	1.3227	1.2378	1.1611

	1997	1998	1999	2000	2001
1998	0.9087	0.4603			
1999	0.9433	0.5029	0.3101		
2000	1.0696	0.6506	0.5061	0.2838	
2001	1.1656	0.8183	0.6572	0.3980	0.2186
2002	1.2089	0.8879	0.8083	0.5655	0.3239
2003	1.2280	0.9278	0.9060	0.7210	0.4459
2004	1.2416	0.9616	0.9726	0.8337	0.6097
2005	1.2431	0.9649	0.9819	0.8534	0.6373

	2002	2003	2004	2005
1998				
1999				
2000				
2001				
2002	0.2343			
2003	0.2896	0.2606		
2004	0.4049	0.3605	0.3273	
2005	0.4420	0.4013	0.3857	0.4069

Spawning Stock Biomass (SSB)

	1982	1983	1984	1985	1986
1998	22582.	24435.	21870.	19853.	18391.
1999	22582.	24435.	21870.	19853.	18391.
2000	22582.	24435.	21870.	19853.	18391.
2001	22582.	24435.	21870.	19853.	18391.
2002	22582.	24435.	21870.	19853.	18391.
2003	22582.	24435.	21870.	19853.	18391.
2004	22582.	24435.	21870.	19853.	18391.
2005	22582.	24435.	21870.	19853.	18391.

	1987	1988	1989	1990	1991
1998	19082.	10884.	7026.	9941.	8749.
1999	19082.	10884.	7026.	9941.	8747.
2000	19082.	10883.	7025.	9940.	8745.
2001	19082.	10883.	7025.	9940.	8744.
2002	19082.	10883.	7025.	9940.	8744.
2003	19082.	10883.	7025.	9940.	8743.
2004	19082.	10883.	7025.	9940.	8743.
2005	19082.	10883.	7025.	9940.	8743.

	1992	1993	1994	1995	1996
1998	9924.	12392.	15854.	21527.	25118.
1999	9921.	12355.	15727.	21416.	25299.
2000	9913.	12335.	15278.	20287.	23901.
2001	9908.	12311.	15215.	19319.	21598.
2002	9906.	12293.	15145.	19187.	20555.
2003	9905.	12290.	15113.	19072.	20345.
2004	9905.	12287.	15102.	18983.	20094.
2005	9905.	12287.	15100.	18976.	20067.

	1997	1998	1999	2000	2001
1998	27445.	30001.			
1999	28923.	34417.	37101.		
2000	27283.	34016.	38283.	45022.	
2001	24574.	30610.	34530.	42077.	54206.
2002	22030.	27442.	30915.	38413.	50260.
2003	20904.	24140.	27123.	33341.	43270.
2004	20485.	22405.	22971.	27375.	35724.
2005	20413.	22245.	22551.	26130.	33835.

	2002	2003	2004	2005
1998				
1999				
2000				
2001				
2002	60562.			
2003	52790.	65114.		
2004	42174.	49229.	49285.	
2005	39051.	44786.	43951.	47498.

Age 0 Population (R)

	1982	1983	1984	1985	1986
1998	74269.	80323.	48380.	48579.	53444.
1999	74269.	80323.	48380.	48579.	53444.
2000	74269.	80323.	48380.	48579.	53444.
2001	74269.	80323.	48380.	48579.	53444.
2002	74269.	80323.	48380.	48579.	53444.
2003	74269.	80323.	48380.	48579.	53444.
2004	74269.	80323.	48380.	48579.	53444.
2005	74269.	80323.	48380.	48579.	53444.

	1987	1988	1989	1990	1991
1998	43922.	13034.	27270.	30361.	28707.
1999	43921.	13033.	27270.	30357.	28706.
2000	43921.	13033.	27270.	30356.	28689.
2001	43921.	13033.	27270.	30354.	28688.
2002	43921.	13033.	27270.	30352.	28687.
2003	43921.	13033.	27270.	30352.	28686.
2004	43921.	13033.	27270.	30352.	28686.
2005	43921.	13033.	27270.	30352.	28686.

	1992	1993	1994	1995	1996
1998	32364.	33789.	38847.	45608.	35523.
1999	32373.	33462.	38812.	46012.	37477.
2000	32358.	33415.	35690.	46005.	36157.
2001	32323.	33323.	35608.	39675.	36298.
2002	32321.	33187.	35486.	39516.	29026.
2003	32319.	33177.	35289.	39228.	28814.
2004	32316.	33161.	35264.	38716.	28382.
2005	32316.	33158.	35257.	38694.	28258.

	1997	1998	1999	2000	2001
1998	26342.	27402.			
1999	36099.	32548.	22696.		
2000	39924.	40728.	25254.	41384.	
2001	38913.	42491.	28993.	44131.	29181.
2002	39124.	42449.	31499.	43736.	37035.
2003	30052.	43066.	31568.	40526.	38362.
2004	29528.	31480.	31824.	39974.	33821.
2005	29339.	31185.	29433.	39386.	31181.

	2002	2003	2004	2005
1998				
1999				
2000				
2001				
2002	55924.			
2003	51704.	29340.		
2004	38367.	27356.	34817.	
2005	36047.	25265.	35505.	14965.

Appendix B: 2006 S&T Peer Review Panel Short Term Projections

Projection A: F = 0.280 during 2007-2010

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
2006	35.997	40.716	42.955	46.317	50.104	54.275	58.695	61.348	66.656
2007	42.770	46.271	48.069	51.257	54.655	58.383	62.187	64.536	69.428
2008	47.817	51.293	53.125	56.307	60.021	64.359	69.296	72.865	78.921
2009	50.643	54.424	56.532	60.004	64.164	69.454	75.778	79.584	86.527
2010	53.465	57.606	59.818	63.547	68.312	74.481	81.134	85.025	93.185

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
2006	10.700	10.700	10.700	10.700	10.700	10.700	10.700	10.700	10.700
2007	7.819	8.993	9.585	10.346	11.280	12.301	13.376	13.962	15.394
2008	9.222	10.034	10.421	11.155	11.918	12.766	13.632	14.141	15.335
2009	10.581	11.308	11.701	12.379	13.170	14.086	15.084	15.768	16.980
2010	11.190	12.030	12.481	13.242	14.144	15.295	16.672	17.570	19.104

Projection B: F = 0.150 during 2007-2010

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
2006	35.997	40.716	42.955	46.317	50.104	54.275	58.695	61.348	66.656
2007	46.040	49.930	51.924	55.460	59.190	63.300	67.526	70.109	75.560
2008	55.779	59.828	61.997	65.735	70.098	75.084	80.455	84.106	90.746
2009	63.557	68.017	70.473	74.699	79.672	85.746	92.461	96.680	104.792
2010	71.264	76.304	78.955	83.609	89.411	96.567	104.040	108.521	117.911

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
2006	10.700	10.700	10.700	10.700	10.700	10.700	10.700	10.700	10.700
2007	4.448	5.117	5.455	***5.889***	***6.421***	7.004	7.617	7.952	8.771
2008	5.764	6.287	6.542	7.016	7.506	8.055	8.614	8.943	9.722
2009	7.185	7.688	7.955	8.428	8.973	9.589	10.224	10.640	11.423
2010	8.217	8.788	9.097	9.630	10.260	11.031	11.885	12.459	13.502