

Supplement and Corrigenda to SEDAR 15A Mutton Snapper Update Assessment

May 5, 2015

Subsequent to presentations to the Statistical and Scientific Committees (SSC) of the Gulf of Mexico Fishery Management Council (GMFMC) and South Atlantic Fishery Management Council (SAFMC) on March 11 and April 28, 2015, respectively, Gulf SSC members requested a value for the F at 75% of the MSY proxy and had questions regarding various aspects of the assessment particularly related to age compositions and model fits using direct ageing compared with that of age-length keys, and South Atlantic SSC had editorial suggestions to clarify wording regarding benchmarks in the executive summary and Table 4.8.1 of the Update Assessment Report. This supplement is intended to provide follow-up information to the SSCs regarding their questions about the methods used to derive age compositions and for the direct ageing and stochastic age-length key model configurations. In addition, the corrigenda (i.e., “corrections to a printed or published report”) supplied in this supplement updates some values that were from older model configurations in a few figures and tables which were overlooked in the final production of the Update Assessment Report dated February 23, 2015. None of the updated values in the tables or figures change the conclusions in the final report.

Section 1 – Changes to clarify wording contained in Update Assessment Report

First, SSC-recommended changes to the Executive Summary:

Page 2: Original wording

“The Overfishing Limit (OFL) was defined as the yield associated the MFMT and the value from the base run was 413,900 mt (912,500 lb) and the Acceptable Biological Catch (ABC) was the yield at a fishing mortality rate associated with a spawning potential ratio of 40% and the value from the base run was 396,400 mt (874,000 lb). The Annual Catch Limit was set to the same value as the ABC.”

Because the values cited in the paragraph above (see Table 4.8.1 in the Update Assessment Report) were yields at equilibrium (i.e., long-term averages), the SSC suggested that these not be termed OFL and ABC to avoid potential confusion with recommendations of OFL and ABC levels over the next few years by the SSC. With this in mind, the paragraph is revised to read:

*“The **Maximum Sustainable Yield (MSY)** was defined as the yield associated with the MFMT (**currently, the fishing mortality rate (F) corresponding to a spawning potential ratio (SPR) of 30%**) and the value from the base run was 413,900 mt (912,500 lb). The **Optimum Yield (OY) proxy was the yield at the F corresponding to a SPR of 40%** and the value from the base run was 396,400 mt (874,000 lb). **These are long-term values at equilibrium conditions, and may differ from shorter term annual projections of yields (the Overfishing Limit [OFL], Acceptable Biological Catch [ABC], and Annual Catch Limit [ACL]) decided upon by the SSCs.**”*

Table 4.8.1. Sustainable Fisheries Act parameters for Mutton Snapper from the ASAP base run. Both councils have adopted $F_{30\%}$ as their proxy for F_{MSY} . $F_{current}$ is the geometric mean of fishing mortality rates on age-3 from 2011-2013. Note that the yields are the directed landings and do not include discards.

Parameter	Value	English equivalents
Overfishing Limit = Maximum Sustainable Yield (OFL, $Yield_{F30\%}$)	413,900 (kg)	912,500 (lb)
Spawning biomass at OFL (SSB_{OFL} , $SSB_{F30\%}$)	2,108,800 (kg)	4,649,200 (lb)
Maximum Fishing Mortality Threshold (MFMT, $F_{30\%}$)	0.18	Per year
Minimum Spawning Stock Threshold (MSST, $(1-0.11)*SSB_{OFL}$)	1,877,000 (kg)	4,137,700 (lb)
Acceptable Biological Catch (ABC, $Yield_{F40\%}$)	396,400 (kg)	874,000 (lb)
$F_{current}/F_{30\%}$	0.65	--
SSB_{2013}/SSB_{OFL}	1.13	--

The revised table with requested changes and additions (**shown in boldface**):

Parameter	Value	English equivalents
Maximum Sustainable Yield (<i>MSY</i> , $Yield_{F30\%}$)	413,900 (kg)	912,500 (lb)
Spawning biomass at <i>MSY</i> (SSB_{MSY} , $SSB_{F30\%}$)	2,108,800 (kg)	4,649,200 (lb)
Maximum Fishing Mortality Threshold (MFMT, $F_{30\%}$)	0.18	Per year
Minimum Spawning Stock Threshold (MSST, $(1-0.11)*SSB_{OFL}$)	1,877,000 (kg)	4,137,700 (lb)
<i>Optimum Yield (OY)</i> , $Yield_{F40\%}$)	396,400 (kg)	874,000 (lb)
$F_{current}/F_{30\%}$	0.65	--
SSB_{2013}/SSB_{MSY}	1.13	--
$F_{40\% SPR}$ (OY proxy)	0.13	--
$F_{0.75 \text{ of } 30\% SPR}$ (75% of MSY proxy)	0.13	--

Section 2 – Age-length keys and Direct Ageing

There were four variations to the assessment model configuration of age compositions: a stochastic age-length key derived from the observed length compositions from each fleet and a growth curve adjusted for natural mortality, a fishery age-length key using the observed length compositions from each fleet, age compositions from the sampling of specimens from each fleet (“direct ageing”), and an age-structured surplus production model without any observed age or length information. A question was asked regarding the criteria for the selection of the stochastic ageing configuration for the base run over the configuration using direct ageing. Using age-length keys for deriving age compositions can result in the loss of information regarding year class strength because length compositions are divided into the observed proportions of age at length (and there can be multiple ages represented in a single length class) whereas direct ageing results in the age compositions representing that observed

from sampling and should preserve year class strength. If age sampling is adequate and representative of fleet catches, direct ageing should result in a superior model configuration and performance compared with that of length sampling and age-length keys. However, much of the older portions of the time series of fleet catches in the Southeast Region have measured lengths but did not have age information from specimens, and this is the case for mutton snapper (see Table 2.2.6 in the Update Assessment Report for the number of observed ages by fleet and year). In addition, the age sampling of released/discarded fish is typically not done and has to be estimated in some way, and estimating the sizes and ages of releases may necessitate some compromise between using direct ageing and age-length keys.

Relevant to inclusion of age composition data into models is the relative weighting of the information supplied as inputs to the model to define the relative degree of confidence in the age data. In the ASAP model as in others, weights for each fleet and year combination can be entered, and the proportions of the ages by fleet and year are treated as coming from multinomial distribution. The model calculates predicted age compositions and uses the differences between the observed and predicted values (age compositions, catches, indices, etc.) to produce a “best fit” which is accomplished through a minimization procedure which is a function of both the observed data, the weights (sample sizes, coefficients of variation or standard deviations, or priors). An integral part of the fitting process is often an iterative process [e.g., stage-1 multipliers of Francis (2011)] that “tunes” the model and often results in improved fitting (lower totals for the model’s objective function). In this tuning process, the input weights for age compositions are compared with the “effective sample size” or ESS (McAllister and Ianelli 1997) of those data.

The initial observed proportions of ages for a fleet and year in the original samples are:

$$obs_{a,y}^i = \frac{x_{a,y}^i}{n_{i,y}}, \quad (2.1)$$

where I = fleet or index, a = age, y = year, x = number of specimens of age a from the ith fleet in year y, and n is the total number of specimens measured from the ith fleet in year y. The total number of specimens aged (or in the Mutton Snapper Update Assessment, the square root of the number of specimens) for each fleet and year are used as weights (lambdas or stage-1 multipliers) by ASAP to weight the contribution of the residuals to the objective function in the fitting process. The residuals are calculated from the predicted proportions (multinomially distributed) of fish from fleet i and year y, by:

$$pred_{a,y}^i = \frac{N_{a,y}^i}{\sum_{a=1}^A N_{a,y}^i}, \quad (2.2)$$

where A is the maximum age or the plus group and N is the number of individuals of age a estimated to be caught by fleet i in year y (i.e., the model solves for each of the fleet catches using the Baranov catch equation). The residuals for the age compositions are calculated as:

$$ESS_{i,y} = \frac{\sum_{a=1}^A pred_{a,y}^i (1 - pred_{a,y}^i)}{\sum_{a=1}^A (obs_{a,y}^i - pred_{a,y}^i)^2}, \quad (2.3)$$

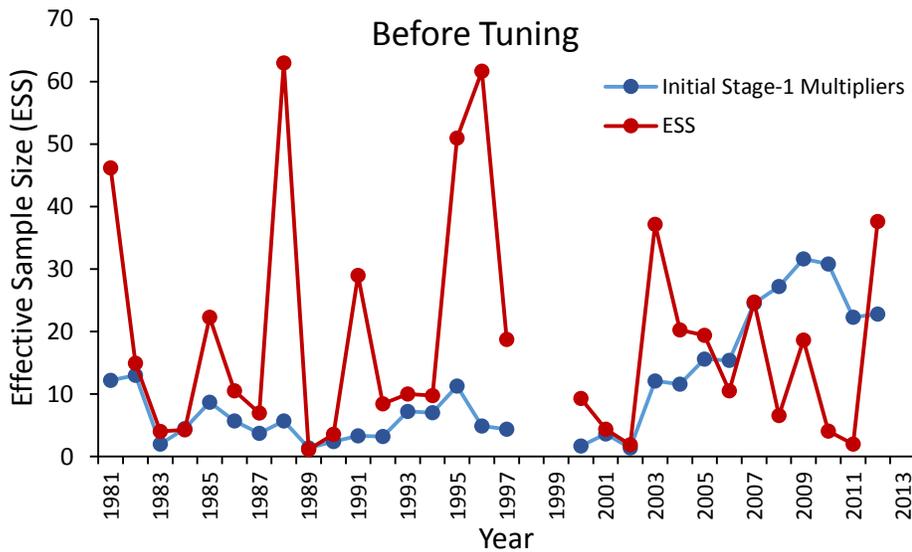
The model estimates the effective number of fish of each age for fleet I in year y as:

$$obs'_{a,y}^i = ESS'_i * obs_{a,y}^i, \quad (2.4)$$

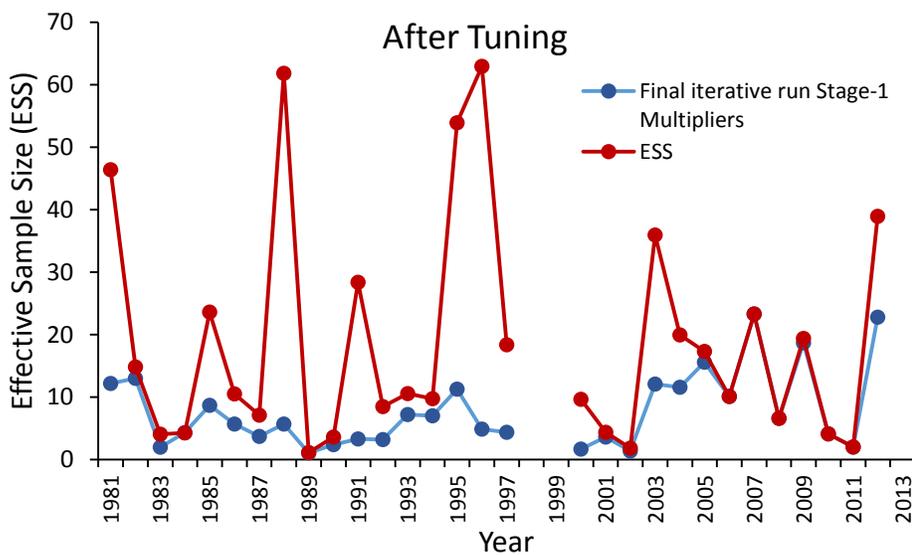
and results in a new series of estimated weights ((lambdas or stage-1 multipliers). The new $obs_{a,y}^i$ is compared to the previously input effective number of fish ($obs_{a,y}^i$) and is substituted into the sample weights if the $obs_{a,y}^i > obs_{a,y}^i$ (Fig. 2.1a), else the $obs_{a,y}^i$ is kept for the next iterative run. When all of the $obs_{a,y}^i$ are less than or equal to the $obs_{a,y}^i$, then the model is considered to be 'tuned' and the weights (stage-1 multipliers) are set to the last iteration's set of $obs_{a,y}^i$ (Fig. 2.1b, in blue).

Figure 2.1. An example of input sample weights for age compositions and effective sample size (ESS).

a. Initial (before tuning) model run with input weights and resulting ESS.



b. Final (after tuning) model run with iteratively tuned input weights and resulting ESS.



The ASAP manual and technical document (NOAA Fisheries Toolbox, 2014a,b) allows zero values for years where no ages were sampled, and suggests 50-200 as a general rule of thumb for weights. However, this suggestion can lead to rather arbitrary weighting regimes, with smaller values indicating less confidence and larger values (say, 100-200) leading to tighter fits. We used a less subjective procedure by using the square root of the number of age samples taken from a fleet in a year as an initial sample size for the first run, and then iteratively comparing the run ESS of the age compositions for each fleet and year with the run input sample size, using the lesser of the input sample size or ESS of the run (Fig. 2.1). The rationale was that the run input values should never be greater than the number of ages actually sampled from a fleet in a year, and fits to age comps were kept relatively loose because sampling may not always represent age compositions precisely.

Table 2.1 Number of age samples by year from each fleet and input values (square root of number of ages) to ASAP model configurations.

Year	Comm HL	Comm LL	Head boat	MRFSS /MRIP	Total	Comm HL	Comm LL	Head boat	MRFSS /MRIP
1981	0	0	150	0	150	0.0	0.0	12.2	0.0
1982	0	0	169	0	169	0.0	0.0	13.0	0.0
1983	0	0	4	0	4	0.0	0.0	2.0	0.0
1984	0	0	20	0	20	0.0	0.0	4.5	0.0
1985	0	0	76	0	76	0.0	0.0	8.7	0.0
1986	0	0	33	0	33	0.0	0.0	5.7	0.0
1987	0	0	14	0	14	0.0	0.0	3.7	0.0
1988	0	0	33	0	33	0.0	0.0	5.7	0.0
1989	0	0	2	0	2	0.0	0.0	1.4	0.0
1990	0	0	6	0	6	0.0	0.0	2.4	0.0
1991	0	0	11	0	11	0.0	0.0	3.3	0.0
1992	51	1	10	0	62	7.1	1.0	3.2	0.0
1993	38	11	52	0	101	6.2	3.3	7.2	0.0
1994	63	5	49	0	117	7.9	2.2	7.0	0.0
1995	36	2	127	0	165	6.0	1.4	11.3	0.0
1996	152	0	24	0	176	12.3	0.0	4.9	0.0
1997	208	24	19	0	251	14.4	4.9	4.4	0.0
1998	209	3	0	0	212	14.5	1.7	0.0	0.0
1999	232	5	0	0	237	15.2	2.2	0.0	0.0
2000	224	9	3	0	236	15.0	3.0	1.7	0.0
2001	259	59	13	5	336	16.1	7.7	3.6	2.2
2002	334	101	2	118	555	18.3	10.0	1.4	10.9
2003	261	146	146	238	791	16.2	12.1	12.1	15.4
2004	169	150	135	129	583	13.0	12.2	11.6	11.4
2005	199	147	242	264	852	14.1	12.1	15.6	16.2
2006	137	401	237	87	862	11.7	20.0	15.4	9.3
2007	179	233	599	21	1032	13.4	15.3	24.5	4.6
2008	374	208	742	52	1376	19.3	14.4	27.2	7.2
2009	280	135	998	97	1510	16.7	11.6	31.6	9.8
2010	526	359	946	97	1928	22.9	18.9	30.8	9.8
2011	543	231	497	200	1471	23.3	15.2	22.3	14.1
2012	319	258	521	72	1170	17.9	16.1	22.8	8.5

For the direct ageing configuration, we used the values from Table 2.1 (above) for the initial sample sizes for weights of the age compositions by fleet and year. In years where not age samples were obtained, the weights were zero and, while the model calculates a predicted age composition for fleet catches and population estimates, the residuals were not included in the model fitting process. The observed age compositions for each fleet and year are shown in Fig. 2.2-2.5 (below). The direct ageing method uses the ages of sampled specimens in a year weighted by landings for deriving age compositions whereas the stochastic age-length key method uses the observed lengths of sampled specimens in a year along with a growth curve adjusted for natural mortality. Note that when no observed age composition data were available for a year the corresponding portions of the plots are either blank (direct ageing) or are represented in gray (age-length keys), whereas years when observations were available bubbles are represented in blue (20 or more age samples) or orange (fewer than 20 age samples). Also note that the predicted age compositions using either method will show estimates (in gray) even when no observed data existed, but those estimates (actually, the residuals) do not contribute in the fitting process.

In the direct ageing plots, there are suggestions of cohorts (i.e., stronger year-classes). The stochastic ageing method tends to blur or smear the age distributions from the observed lengths because multiple ages are represented in most length classes. Cohorts (same year classes) would most likely be apparent, if the cohort was exceptionally strong or weak (perhaps the 2008 and 2010 cohorts, which look especially weak in Fig. 2.2-2.5), in younger age classes using the stochastic ageing method. Compare the direct ageing plots with the corresponding stochastic ageing plots as a check on year-class strength and how the age-length key can mask cohorts in the age compositions. The predicted age compositions from both methods illustrate the model's attempts at reconciling the differences between all of the model's input data (weights at age, catch and discard amounts, age compositions, indices, etc.) and the associated weighting factors (coefficients of variation on landings, discards, and indices; input sample sizes for age composition data; priors or starting values for quantities like steepness, selectivities, etc.) and the model's predicted values to produce an optimal fit through a minimization process. One set of outcomes of this process is both the predicted age compositions and the calculated residuals show in Fig. 2.2-2.5. The larger the bubbles in the residual plot, the larger the difference between the observed and predicted values. The smaller the bubbles (residual values), the better the fit to the observed data. Neither the residuals from the direct ageing method nor the stochastic ageing method were particularly noteworthy, which is not surprising since the quantity of age data especially in the earlier portion of the time series was limited or non-existent. As additional age sampling occurs in future years, however, it may be possible to rely on predictions from the direct ageing method in future assessments.

Lastly, the root mean square error (RMSE) of the model fit (Table 2.2) provides a relatively objective measure of the fit of particular components (catches, discards, age compositions, indices, etc.) in the model. The stochastic ageing method generally showed lower RMSE for most components than did the direct ageing method. Generally speaking, the differences lay in the quantity of age composition data available for fitting to use for direct ageing as much of the differences in the RMSE were in the fleet catch totals and age compositions, discard totals and age compositions, and index totals and age compositions. We expect that as additional data is added in the future and better methods to estimate discards are developed that direct ageing may be a more viable configuration to use for Mutton Snapper Assessments.

Figure 2.2. Commercial Hook and Line fleet, proportions of catch at age observed and predicted (and residuals) from direct ageing and stochastic ageing. Grey spheres show years in which there were no age samples, golden spheres when there were fewer than 20 specimens aged, and blue spheres when there were 20 or more specimens aged. The size of the spheres indicate relative magnitude of the proportions at age. In the plots of residuals (observed proportions-predicted), colored spheres indicate more in the observed than in the predicted, dark ringed residuals indicate more in the predicted proportions than in the observed. The magnitude of the residuals is indicated by the relative size of the spheres.

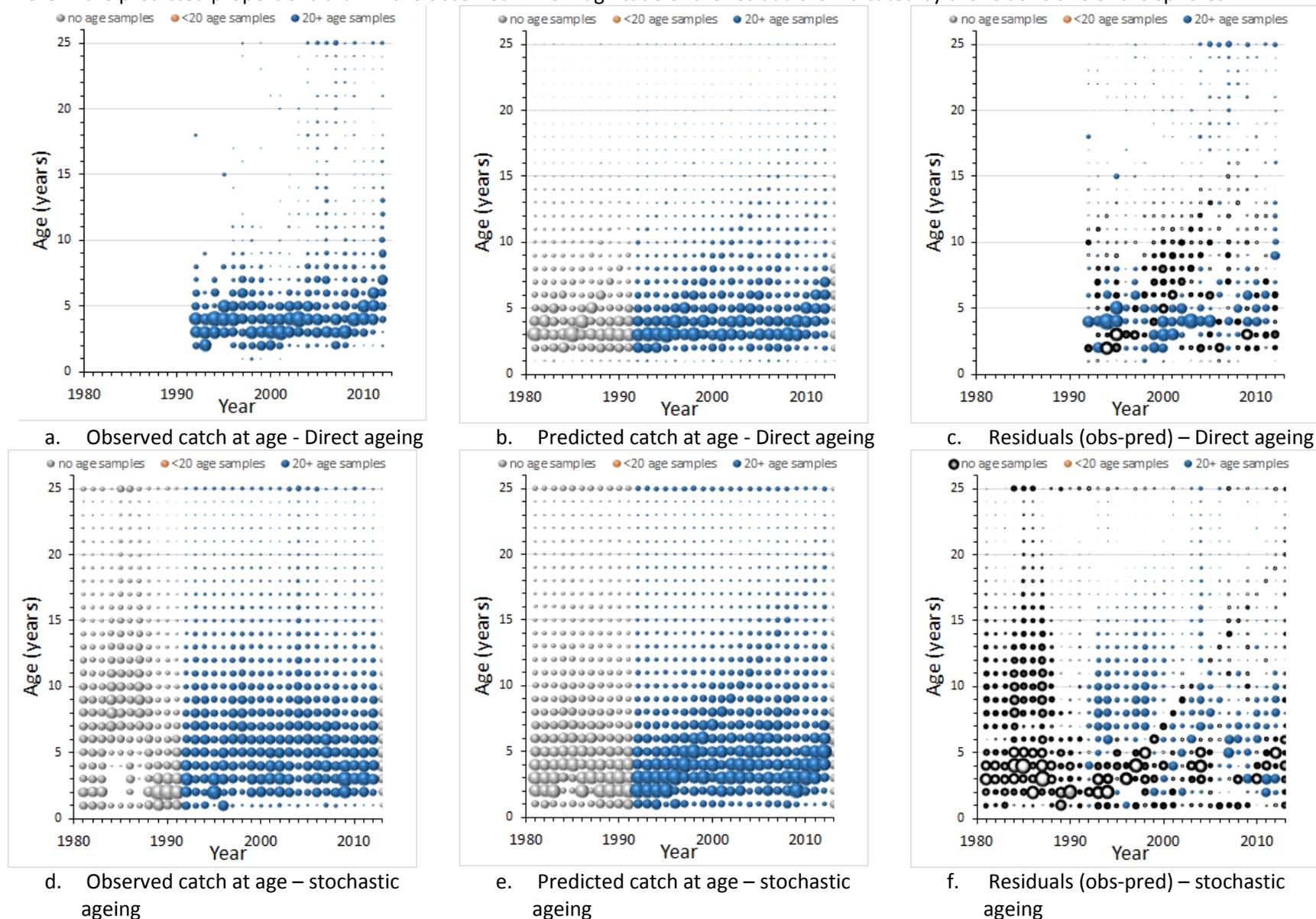
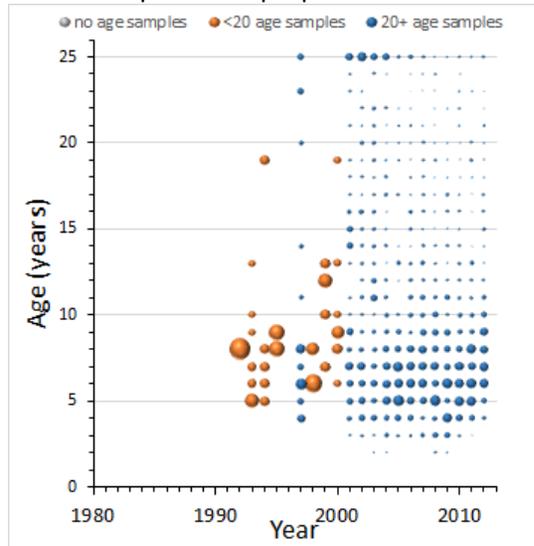
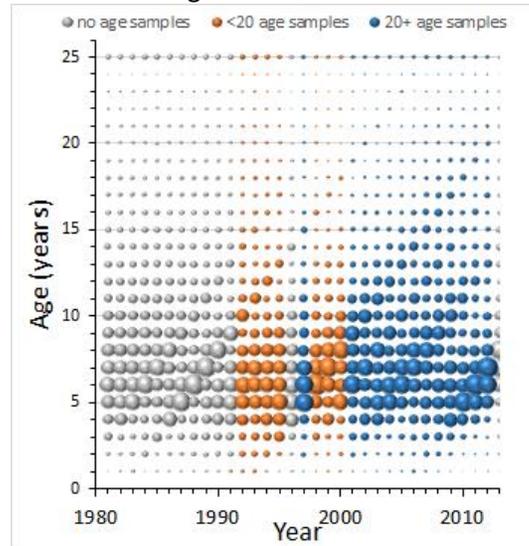


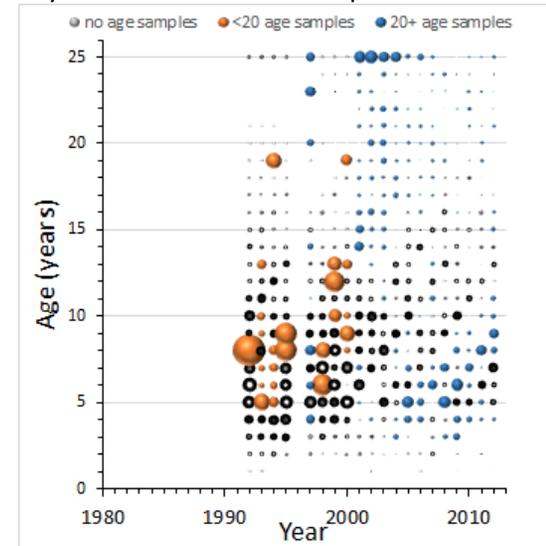
Figure 2.3. Commercial Longline fleet, proportions of catch at age observed and predicted (and residuals) from direct ageing and stochastic ageing. Grey spheres show years in which there were no age samples, golden spheres when there were fewer than 20 specimens aged, and blue spheres when there were 20 or more specimens aged. The size of the spheres indicate relative magnitude of the proportions at age. In the plots of residuals (observed proportions-predicted), colored spheres indicate more in the observed than in the predicted. Dark ringed residuals indicate more in the predicted proportions than in the observed. The magnitude of the residuals is indicated by the relative size of the spheres.



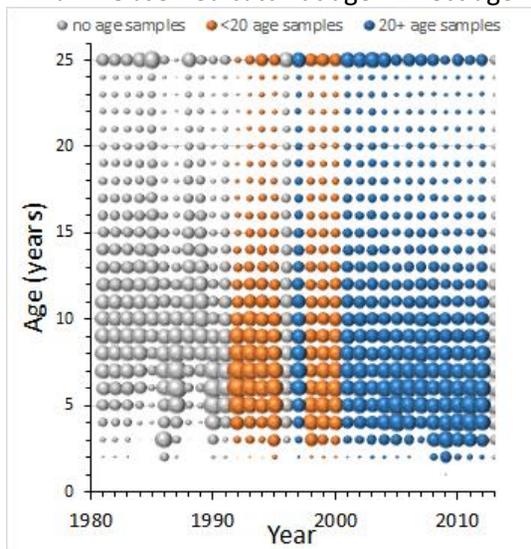
a. Observed catch at age - Direct ageing



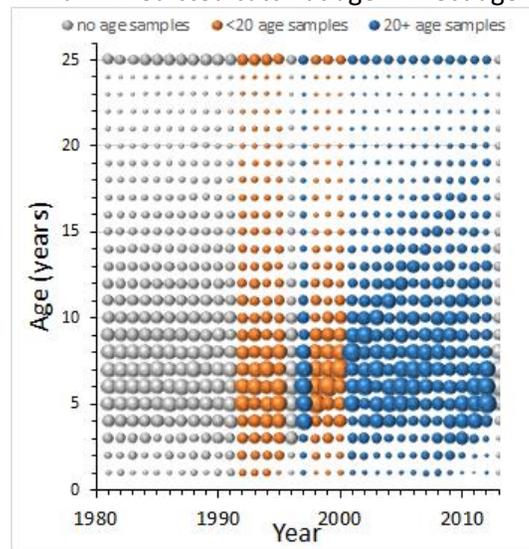
b. Predicted catch at age - Direct ageing



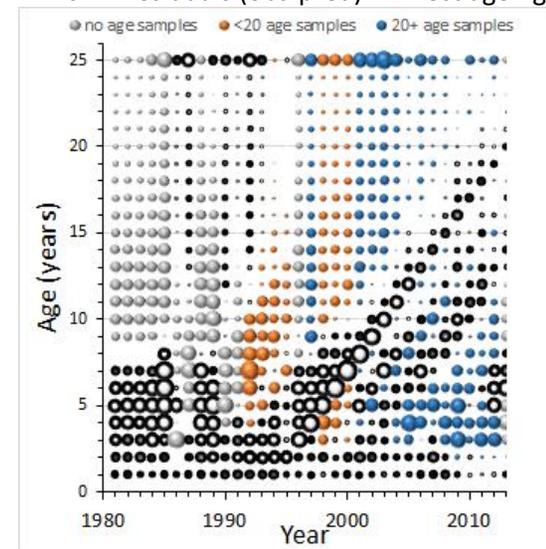
c. Residuals (obs-pred) - Direct ageing



d. Observed catch at age - stochastic ageing



e. Predicted catch at age - stochastic ageing



f. Residuals (obs-pred) - stochastic ageing

Figure 2.4. Head Boat fleet, proportions of catch at age observed and predicted (and residuals) from direct ageing and stochastic ageing. Grey spheres show years in which there were no age samples, golden spheres when there were fewer than 20 specimens aged, and blue spheres when there were 20 or more specimens aged. The size of the spheres indicate relative magnitude of the proportions at age. In the plots of residuals (observed proportions-predicted), colored spheres indicate more in the observed than in the predicted. Dark ringed residuals indicate more in the predicted proportions than in the observed. The magnitude of the residuals is indicated by the relative size of the spheres.

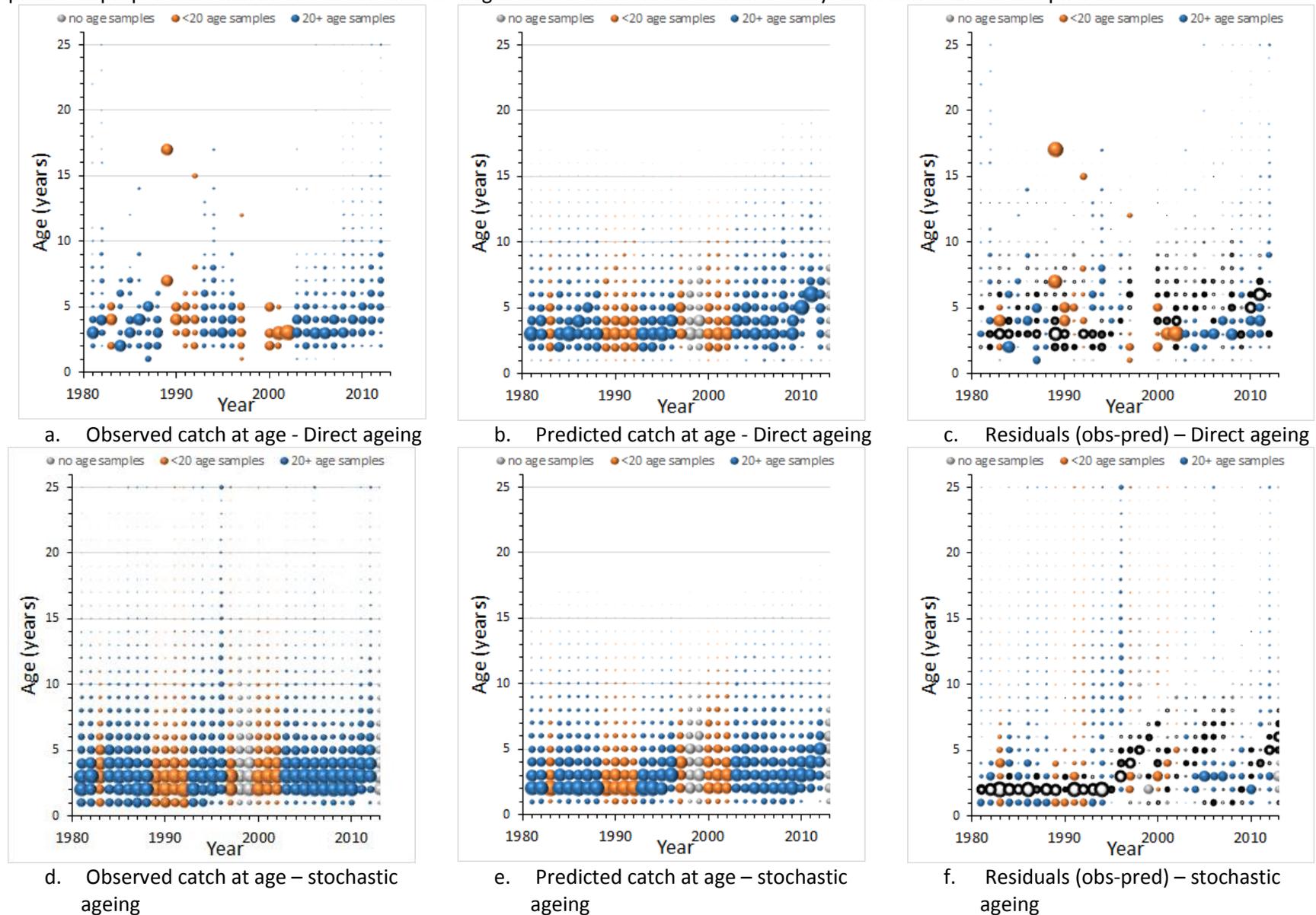
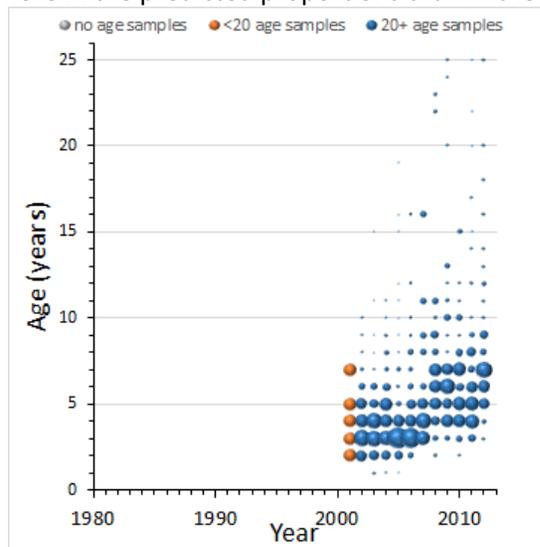
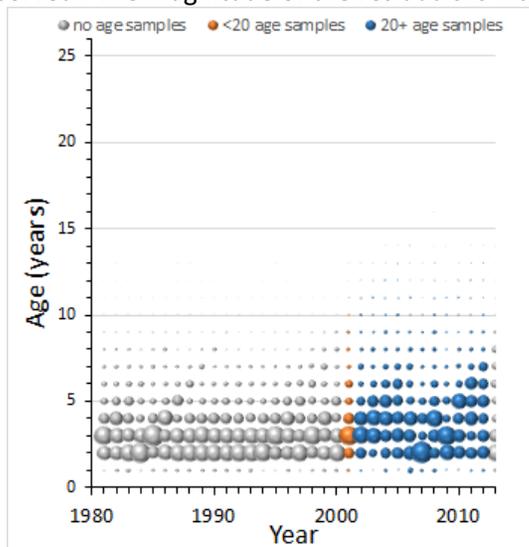


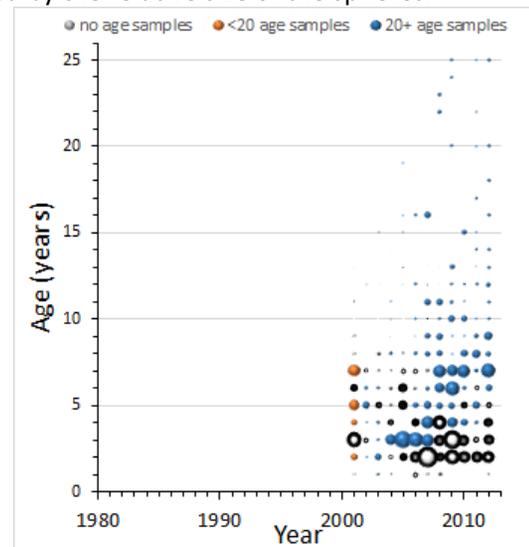
Figure 2.5. Recreational (MRFSS/MRIP) fleet, proportions of catch at age observed and predicted (and residuals) from direct ageing and stochastic ageing. Grey spheres show years in which there were no age samples, golden spheres when there were fewer than 20 specimens aged, and blue spheres when there were 20 or more specimens aged. The size of the spheres indicate relative magnitude of the proportions at age. In the plots of residuals (observed proportions-predicted), colored spheres indicate more in the observed than in the predicted, dark ringed residuals indicate more in the predicted proportions than in the observed. The magnitude of the residuals is indicated by the relative size of the spheres.



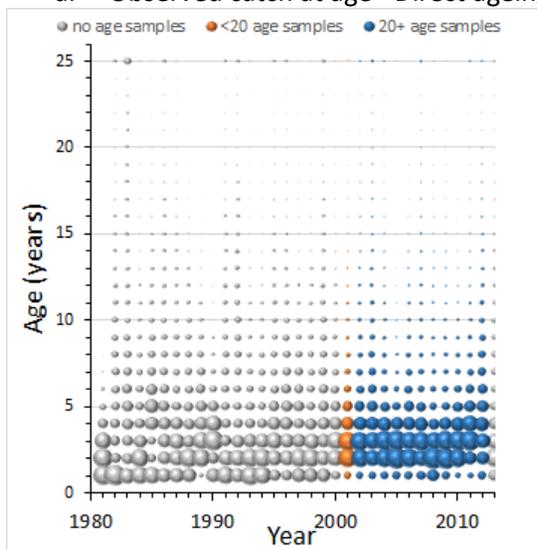
a. Observed catch at age - Direct ageing



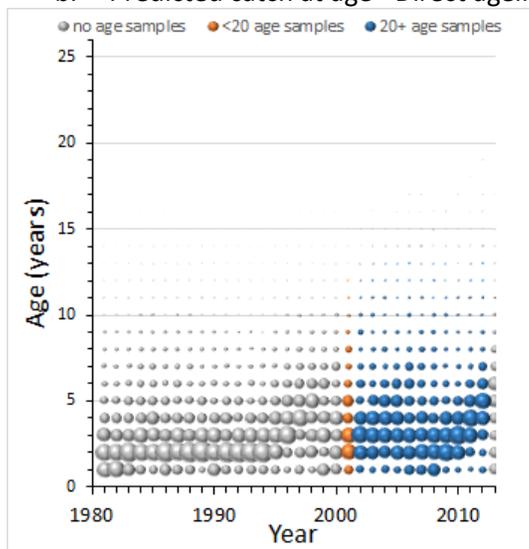
b. Predicted catch at age - Direct ageing



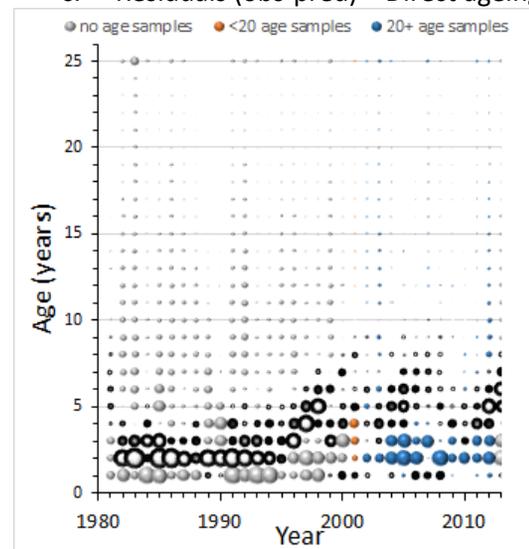
c. Residuals (obs-pred) - Direct ageing



d. Observed catch at age - stochastic ageing



e. Predicted catch at age - stochastic ageing



f. Residuals (obs-pred) - stochastic ageing

Table 2.2. Estimates of model root mean square error (RMSE), a measure of the degree of model fit, for direct ageing and age-length key configurations.

Component	Stochastic Age- Length Keys		Direct Ageing	
	nobs	MSE	nobs	MSE
Catch_Fleet_Total	132	0.585	132	1.389
Discard_Fleet_Total	132	0.709	132	45.677
Commercial hook-and-line index	23	1.018	23	1.030
Commercial longline index	23	1.069	23	1.306
Headboat index	19	2.135	19	2.835
MRFSS/MRIP index	27	1.755	27	1.559
FIM age-1	16	1.529	16	2.509
NMFS UM Reef Visual Census	15	0.378	15	0.365
Riley's Hump index	9	1.810	9	2.107
Catch Comm HL - age composition*	525	1.003	525	0.982
Catch Comm LL - age composition*	450	1.393	500	1.967
Catch HB - age composition*	750	0.753	750	1.758
Catch MRIP/MRFSS – age composition*	750	1.046	300	1.934
Discards Comm HL - age composition*	525	0.295	350	0.280
Discards Comm LL - age composition*	0	0	0	0
Discards HB - age composition*	750	0.160	750	0.243
Discards MRIP/MRFSS-age composition*	750	0.176	300	0.294
Index age composition - NMFS-UM RVC	375	0.476	0	0
Numbers-at-age 1981	24	0.484	24	0.590
Recruitment deviations	33	0.670	33	0.686
Steepness	1	0.592	1	0.732
Unfished spawning biomass	1	2.055	1	1.839

*Calculated from formulas in Francis (2011)

The original wording:

“With an estimate of $F_{30\%}$ (MFMT) of 0.18 per year; the F-ratio was 0.66 indicating that Mutton Snapper was not undergoing overfishing. The estimated spawning biomass in 2013 was 2,354 mt and the equilibrium spawning biomass at $F_{30\%}$ was 2,109 mt for a biomass ratio of 1.13 indicating that for the base run, Mutton Snapper was not overfished.”

The revised wording (**with changes shown in boldface**):

*“With an estimate of $F_{30\%}$ (MFMT) of 0.18 per year; the F-ratio was **0.65** indicating that Mutton Snapper was not undergoing overfishing. The estimated spawning biomass in 2013 was **2,387** mt and the equilibrium spawning biomass at $F_{30\%}$ was 2,109 mt for a biomass ratio of 1.13 indicating that for the base run, Mutton Snapper was not overfished.”*

The original wording:

“The sensitivity runs that used direct aging gave a different picture of the stock (Table 4.8.2, runs 74-81). For example, using the run that corresponds to the base run except that the age compositions came from direct aging, the management goal of $F_{30\%}$ was 0.26 per year and the $F_{current}$ was 0.29 per year such that the F-ratio was 1.12 indicating that Mutton Snapper was undergoing overfishing and the spawning biomass in 2013 for was 1,144 mt and the equilibrium spawning biomass at the corresponding $F_{30\%}$ was 1,939 mt for a biomass ratio of 0.59.”

The revised wording (**with changes shown in boldface**):

*“The sensitivity runs that used direct aging gave a different picture of the stock (Table 4.8.2, runs 74-81). For example, using the run that corresponds to the base run except that the age compositions came from direct aging, the management goal of $F_{30\%}$ was 0.26 per year and the $F_{current}$ was **0.17** per year such that the F-ratio was **0.67** indicating that Mutton Snapper was **not** undergoing overfishing. **The** spawning biomass in 2013 **using the direct aging model configuration** was **1,418** mt and the equilibrium spawning biomass at the corresponding $F_{30\%}$ was **1,957** mt for a biomass ratio of **0.72 indicating an overfished condition.** ”*

Pages 60 and 62, Table 4.8.2 (original, excerpted):

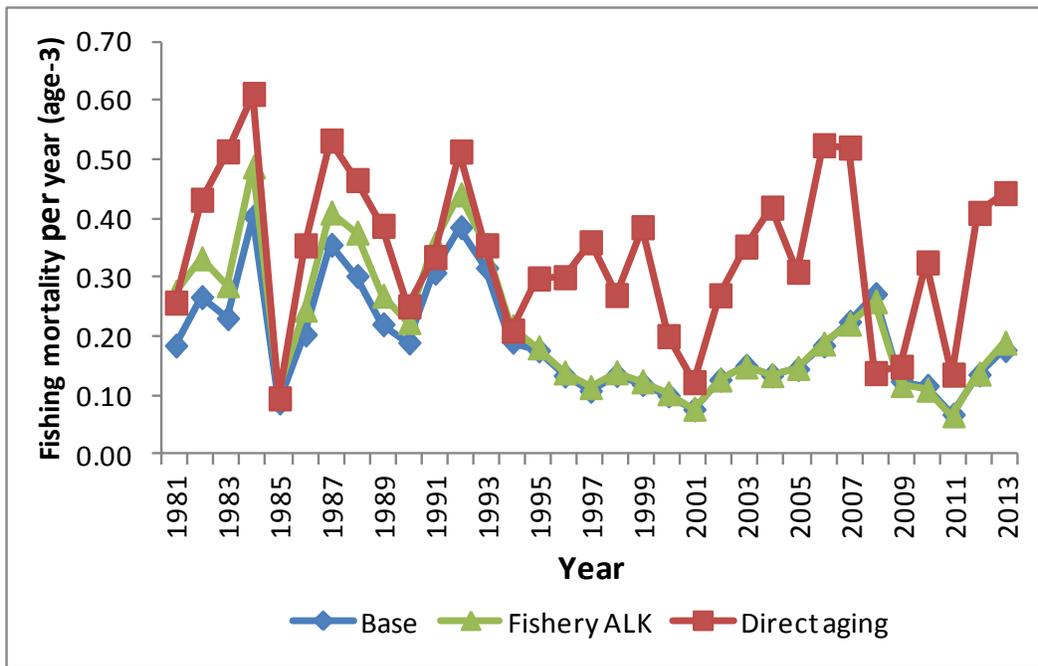
Table 4.8.2. Results of ASAP runs showing the composite fishing mortality rate on fully selected ages (F_{current} , geometric mean 2011-2013)

Run	Aging methods	Configuration	Steepness	F_{current} per year	$F_{30\%}$ per year	SSB ₂₀₁₃ (mt)	SSB _{F30%} (mt)	F-Ratio $F_{\text{current}}/F_{30\%}$	Biomass-Ratio SSB ₂₀₁₃ /SSB _{F30%}	$F_{40\%}$ Per year
1	Stochastic ALK	h=Free, Initial value=0.75	0.81	0.12	0.18	2,354	2,094	0.66	1.12	0.13
....
74	Direct	h=Free, Initial value=0.75	0.83	0.29	0.26	1,144	1,939	1.12	0.59	0.19
75		h=0.40	0.66	0.28	0.26	1,193	2,464	1.09	0.48	0.19
76		h=0.50	0.70	0.29	0.26	1,163	2,283	1.11	0.51	0.19
77		h=0.60	0.75	0.29	0.26	1,148	2,125	1.12	0.54	0.19
78	Direct	h=0.70	0.80	0.29	0.26	1,143	1,994	1.12	0.57	0.19
79		h=0.80	0.86	0.29	0.26	1,147	1,890	1.12	0.61	0.19
80		h=0.90	0.93	0.29	0.26	1,158	1,810	1.11	0.64	0.19
81		h=1.00	1.00	0.29	0.26	1,171	1,759	1.10	0.67	0.19

The revised excerpts from the table (with changes shown in boldface):

Run	Aging methods	Configuration	Steepness	F_{current} per year	$F_{30\%}$ per year	SSB ₂₀₁₃ (mt)	SSB _{F30%} (mt)	F-Ratio $F_{\text{current}}/F_{30\%}$	Biomass-Ratio SSB ₂₀₁₃ /SSB _{F30%}	$F_{40\%}$ Per year
1	Stochastic ALK	h=Free, Initial value=0.75	0.81	0.12	0.18	2,387	2,109	0.65	1.13	0.13
....
74	Direct	h=Free, Initial value=0.75	0.89	0.17	0.26	1,418	1,957	0.67	0.72	0.19
75		h=0.40	0.70	0.17	0.25	1,385	2,688	0.68	0.52	0.19
76		h=0.50	0.74	0.17	0.25	1,383	2,426	0.69	0.57	0.19
77		h=0.60	0.79	0.17	0.26	1,390	2,208	0.68	0.63	0.19
78	Direct	h=0.70	0.80	0.17	0.26	1,406	2,032	0.68	0.69	0.19
79		h=0.80	0.86	0.17	0.26	1,435	1,836	0.67	0.76	0.19
80		h=0.90	1.00	0.17	0.26	1,436	1,850	0.67	0.78	0.19
81		h=0.99	1.00	0.17	0.26	1,436	1,850	0.67	0.78	0.19

Pages 124, Figure 4.6.2a (original):



The revised Figure 4.6.2a showing the correct time series for average F at age-3 (in red):

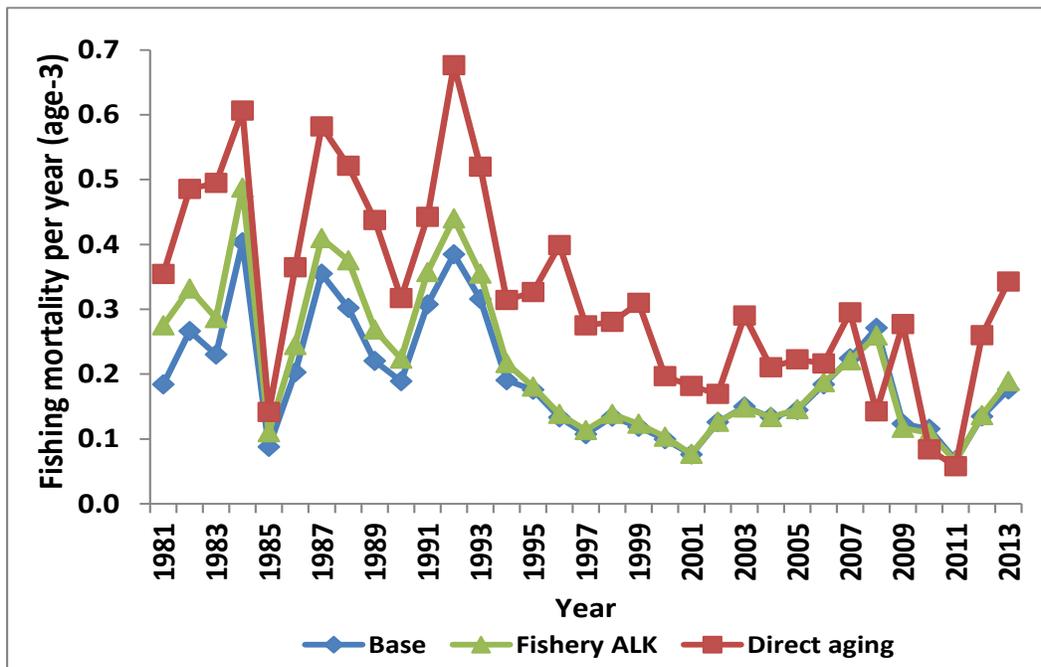
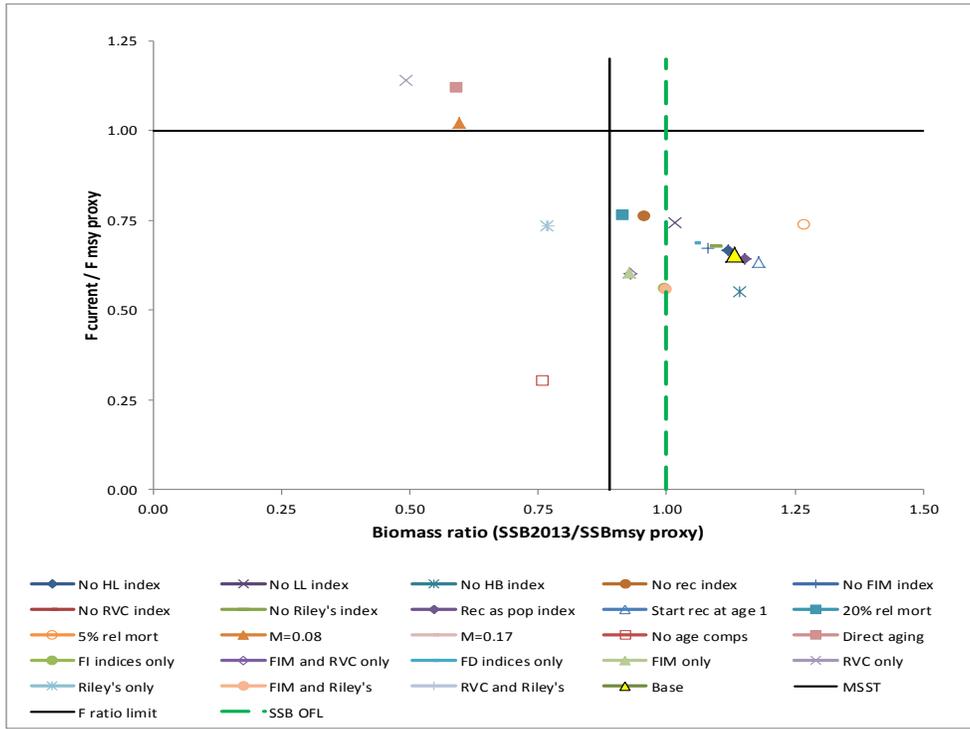
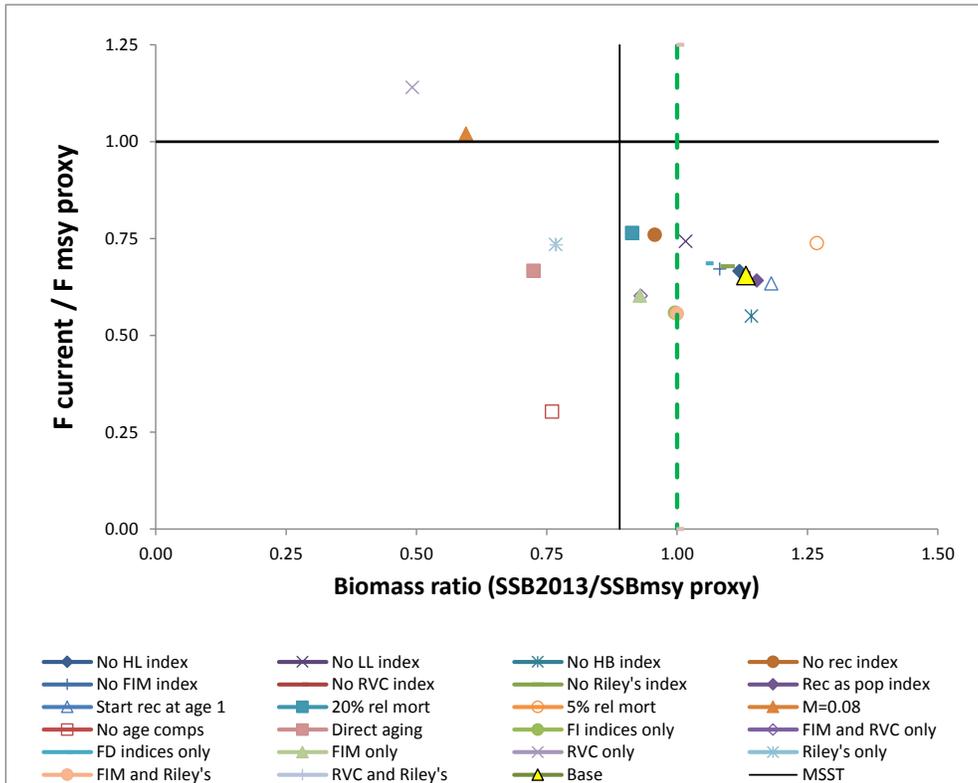


Figure 4.8.3 (original):



Revised Figure 4.8.3 with correct location of ratios for Direct Ageing run:



References

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NOAA Fisheries Toolbox. 2012b. User Manual for ASAP Version 3.0. (Internet address: <http://nft.nefsc.noaa.gov/ASAP.html>).