South Atlantic Black Sea Bass Annual Catch Limit Closure Projection – 2012/13 Fishing Year

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Background

NOAA Fisheries Service published a final rule on December 30, 2010, implementing Amendment 17B to the Fishery Management Plan for the Snapper-Grouper Fishery of the South Atlantic Region. This final rule became effective January 31, 2011. The rule established annual catch limits (ACLs) and accountability measures (AMs) for nine Snapper-Grouper stocks, including black sea bass, as required by the Magnuson-Stevens Fishery Conservation and Management Act. ACLs are set at levels that prevent overfishing and AMs are management controls established to ensure that ACLs are not exceeded, or are used to correct for overages if ACLs are exceeded during a fishing season.

For the black sea bass recreational sector, the ACL for the 2010/11 fishing season (June 1-May 31) was 0.409 million pounds gutted weight (mp gw). This ACL was projected to be met in January 2011 and the recreational black sea bass sector was closed on February 12, 2011. The recreational sector remained closed until June 1, 2011. Landings reported for the 2010/11 fishing year indicated the ACL was exceeded by 0.067 mp gw. Accountability measures for black sea bass require the ACL in the following fishing season to be reduced by the amount of the overage in the prior fishing season. On October 4, 2011, NOAA Fisheries Service announced that the 2011/12 ACL would be reduced from 0.409 to 0.342 mp gw to account for the overage. The recreational sector was closed on October 17, 2011, with estimated 2011 landings totaling 0.458 mp gw. As such, under current management guidelines, the 2012/13 ACL would be reduced to 0.359 mp gw to account for the overage. However, NOAA Fisheries Service anticipates that SAFMC Amendment 18A will be implemented by July 1, 2012. Amendment 18A proposes implementing a 0.409 mp gw ACL for the 2012/13 fishing season. This ACL is based on a 2011 black sea bass stock assessment and projections which already account for the 2011/12 landings overage. The purpose of this analysis is to project when the Amendment 18A 2012/13 recreational sector ACL for black sea bass will be met.

Data Sources

Recreational black sea bass landings were obtained from two data sources:

1. Marine Recreational Fisheries Statistics Survey (MRFSS), including For-hire survey; and,
2. Southeast Fisheries Science Center (SEFSC) Headboat Survey (HBS).

MRFSS and For-hire black sea bass landings are estimated using a combination of dockside intercepts (landings data) and phone surveys (effort data). Landings are estimated in both numbers and whole weight (lbs) by two-month wave (e.g., Wave 1 = Jan/Feb, … Wave 6 = Nov/Dec), area fished (inland, state, and federal waters), mode of fishing (charter, private/rental, shore), and state (east Florida, Georgia, South Carolina, and North Carolina).

Headboat landings are collected through logbooks completed by headboat operators. Landings (numbers and lbs) are reported by vessel, day/month, and statistical reporting area (i.e., area 1 = Hatteras, N.C., …, area 17 = Dry Tortugas (South Atlantic waters)).

Reported Landings

The fishing year for recreational black sea bass is June 1 through May 31 each year. Because MRFSS and For-hire survey landings are reported by two-month wave and not monthly, landings during May-June were all assumed to come from the month of June for 2011, because the recreational sector was closed during May. During periods without quota closures, wave landings were assumed to be uniformly distributed across days within months. Landings from North Carolina were post-stratified to remove landings north of Cape Hatteras using MRFSS post-stratification procedures (T. Sminkey, pers. comm.). Headboat landings from Key West to North Carolina were provided by the SEFSC (SEFSC ACL Dataset, April 2012). All landings for all modes were reported in pounds whole weight and converted to gutted pounds using a conversion factor of 1.18. This conversion factor is consistent with the ACL calculation in Amendment 17B. Reported landings are summarized in Table 1.

Table 1. Total 2011-2012 fishing season recreational landings of black sea bass (pounds gutted weight) in South Atlantic waters.

Year	Month	HBS	MRFSS	TOTAL
2011	6	70,798	87,087	157,885
	7	49,168	74,751	123,919
	8	29,194	74,751	103,945
	9	18,724	20,966	39,690
	10	10,366	21,665	32,031
	11	17	586	603
	12	4	606	609
	TOTAL	**178,271**	**280,412**	**458,683**

Change in Size Limit

NOAA Fisheries Service anticipates that SAFMC Amendment 18A will be implemented by July 1, 2012. Amendment 18A will increase the recreational size limit from 12 inches to 13 inches total length. This increased size limit is predicted to have a weighted average reduction in landings across sectors of 19.6% (Table 2).

Table 2. Anticipated reductions in black sea bass landings resulting from a recreational size limit increase from 12 to 13 inches total length (from Amendment 18A). Based on 7,302 headboat samples (2009-2010) and 3,372 MRFSS intercepts (2009-2011).

Sector	Release Mortality	Reduction	Percent of 2011 Landings
Headboat	7%	20.9%	39%
MRFSS	7%	18.8%	61%
Weighted Avg.		**19.6%**	

Projection Methods

Three different projection methods were employed in this analysis. Each considered status quo management measures and also reductions associated with the increase from a 12 to 13 inch minimum size limit that is anticipated to be implemented via Amendment 18A on July 1, 2012. Each projection method estimated how long it would take to reach the 0.409 mp gw ACL proposed in Amendment 18A.

Method 1: Using 2011/12 Landings as Proxy

The first method simply assumed that 2012/13 landings were best represented by 2011/12 landings with no trends or adjustments for changes in effort or stock size (Table 1). In this scenario, landings for June-October were projected for the 2012/13 season. Because the 2011/12 fishing season closed October 17, 2011, monthly landings for October were expanded by the total number of days in October (n=31) divided by the number of days open (n=16). Projections were conducted assuming the size limit increase has no effect and assuming the size limit increase results in a 19.6% reduction in landings beginning July 1, 2012.

Method 2: Using 2011/12 Landings Adjusted by Change in SSB

The second method was similar to method 1 and increased 2011/12 landings by the proportional increase in spawning stock biomass (SSB) predicted from the SEDAR-25 Stock Assessment (2011). The proportional increase in SSB between 2011 and 2012 was 2.8%. Projections for method 2 were conducted assuming the size limit has no effect and assuming the increased size limit will result in a 19.6% reduction in landings beginning July 1, 2012.

Method 3: SARIMA Model

Because black sea bass landings have a long-term time-series trend and a seasonal trend, forecasting future catches is particularly well-suited to a seasonal auto-regressive integrated moving average (SARIMA) model (Box and Jenkins 1976). A SARIMA model analyzes and forecasts equally-spaced univariate time series data, predicting a value in a response time series as a linear combination of its own past values, past errors, and past, current, and projected future values of other time series. Because the time series of black sea bass recreational catch per day shows strong seasonality, a SARIMA (p,d,q)*(P,D,Q) model was used. The auto-regressive component, designated as p, represents the lingering effects of previous observations. The integrated component, designated as d, represents trends, including seasonality. The moving average component, designated as q, represents lingering effects of previous random shocks (or error). In the SARIMA model, monthly catch, in pounds whole weight of recreational black sea bass were projected as a linear combination of past values.

Because the SARIMA model also allows for a predictive covariate, abundance at age was obtained from the most recent black sea bass stock assessment (K. Shertzer, SEFSC, pers. comm.) and converted to exploitable abundance using the selectivity at age for the recreational sector (Figure 1).

The SARIMA model was implemented using Proc ARIMA in SAS v9.2 for Windows (SAS Institute, Inc., Cary, NC). SARIMA model selection was guided by examination of autocorrelations, inverse autocorrelations, partial autocorrelations, and cross-correlations. Stationarity tests were used to guide differencing selection. Residual diagnostics and Akaike Information Criterion (AIC) values were used to select the final model (Table 3), which was specified as a SARIMA(0,1,1)X(0,1,1)*s* model where *s*=12 months, with model fit using conditional least squares. The final model incorporated exploitable abundance as a predictor and explained 61% of the variability in non-seasonal and seasonal trends in monthly catch using an MA(1) model (Moving Average Operator: 1 + 0.08797 B**(1)), an SMA(1) model at a 12 month lag (Moving Average Operator: 1 - 0.9192 B**(12)), and a predictor term for exploitable abundance (Regression Factor: 0.056458). Projected values of exploitable abundance from Black Sea Bass SEDAR Assessment Projection Scenario 2 ($F=F_{rebuild}$) were used to seed the forecast of the final model (K. Shertzer, SEFSC, pers. comm.). It should be noted that the assessment model predicts two poor recruitment years progressing through the fishery, resulting in slightly lower exploitable abundance in 2012 relative to 2011 due to a decrease in ages 3 and 4 fish.

Similar to methods 1 and 2, projections for method 3 assumed the size limit would either have no effect or would reduce landings by 19.6% beginning July 1, 2012.

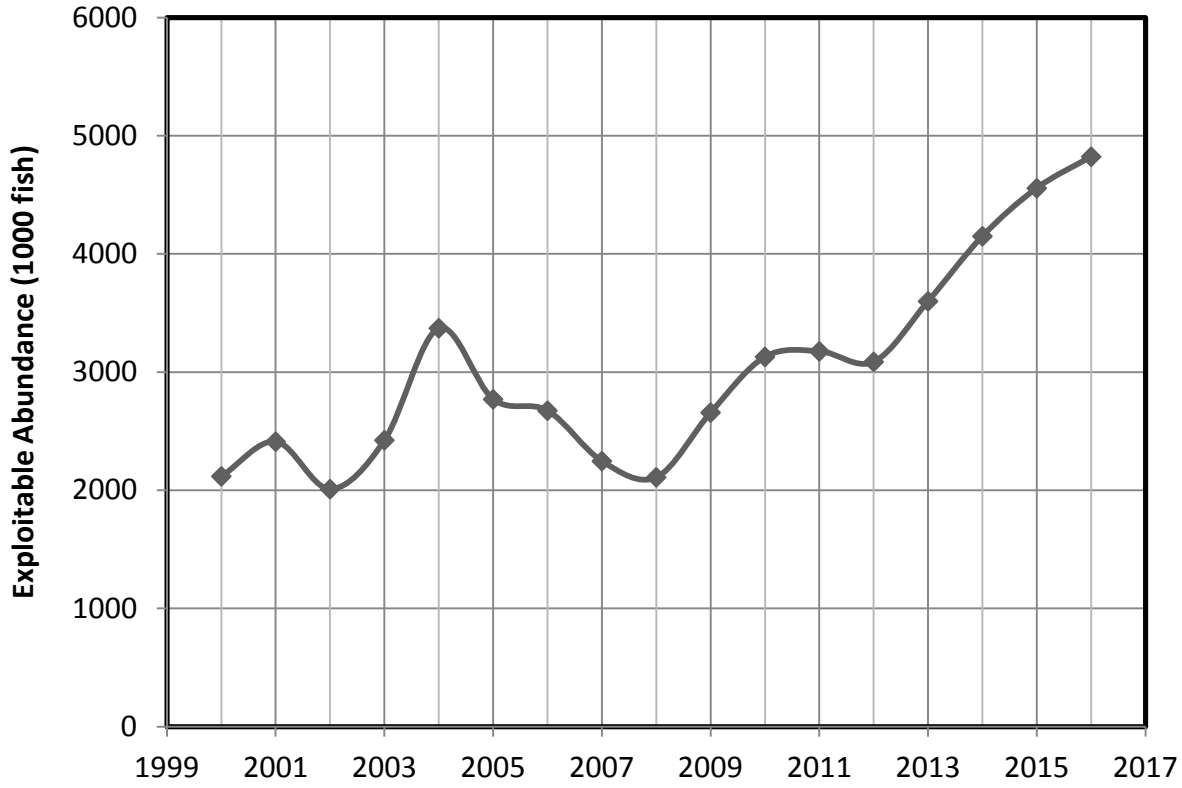

Figure 1. Projected change in abundance of recreationally exploitable South Atlantic black sea bass (Black sea bass SEDAR Update; K. Shertzer, SEFSC, pers. comm.).

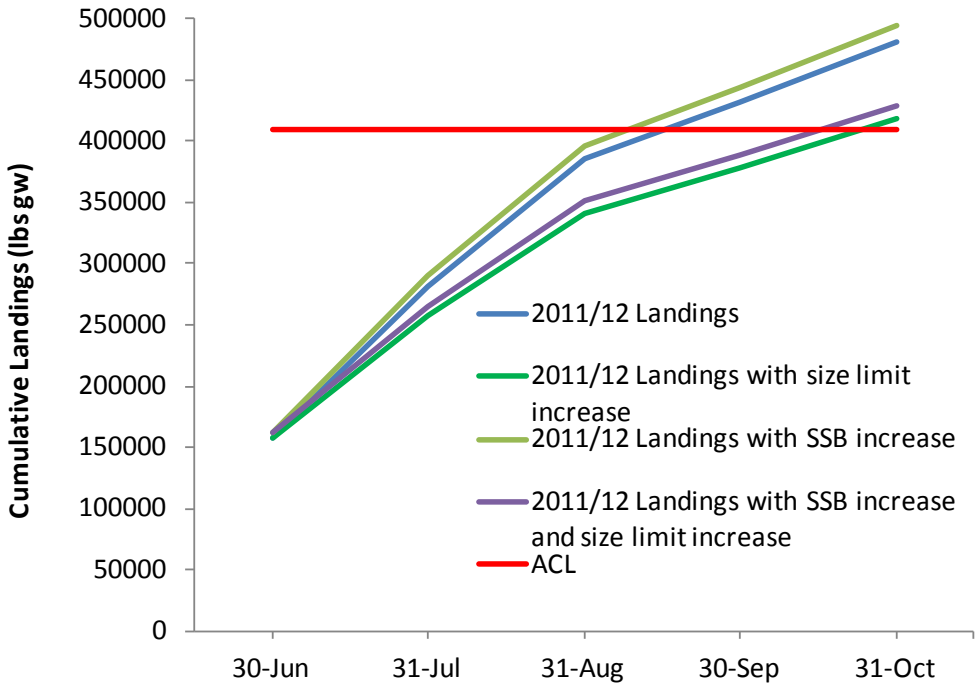

Figure 2. Cumulative 2011/12 recreational black sea bass landings relative to the ACL.

Table 3. Akaike Information Criterion (AIC) values for various SARIMA models explored; lowest AIC denotes best model fit.

ModelNum	ModelName	AIC
2	ARIMA(0,1,1)X(0,1,1)s	2007.64
4	ARIMA(1,1,0)X(0,1,1)s	2007.87
3	ARIMA(1,0,0)X(0,1,1)s	2019.8
1	ARIMA(0,0,1)X(0,1,1)s	2019.88
5	ARIMA(0,0,1)X(1,1,0)s	2042.75
6	ARIMA(0,1,1)X(1,1,0)s	2045.95
8	ARIMA(1,1,0)X(1,1,0)s	2046.05
7	ARIMA(1,0,0)X(1,1,0)s	2054.52

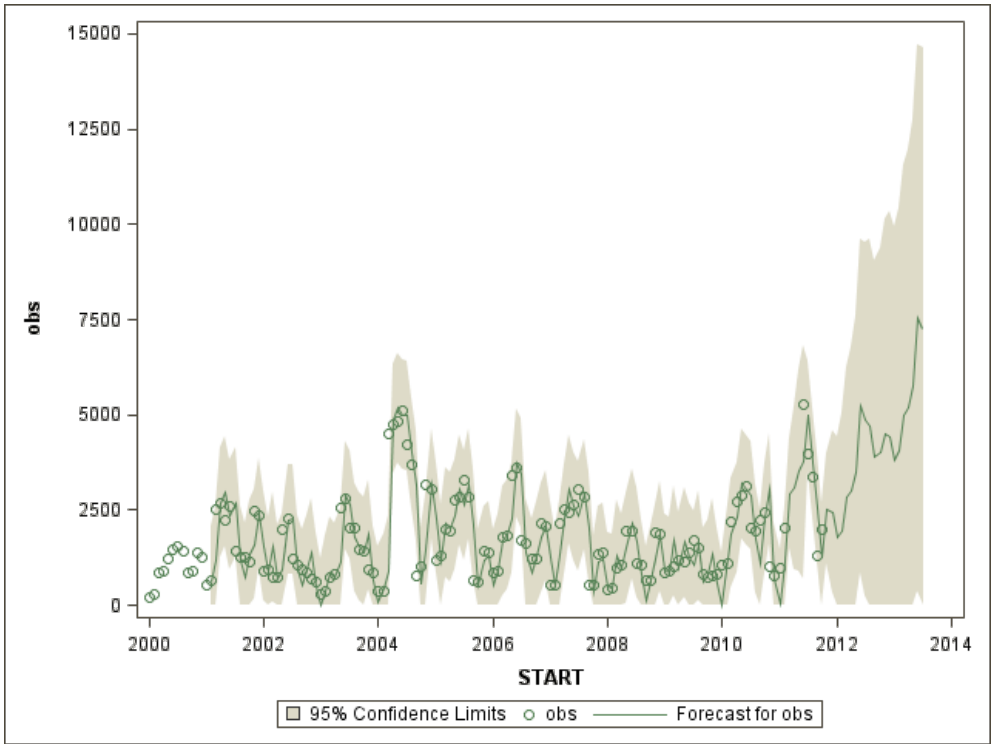

Figure 3. SARIMA model fit to recreational black sea bass monthly catch (in pounds gw). Bands indicate 95% confidence limits.

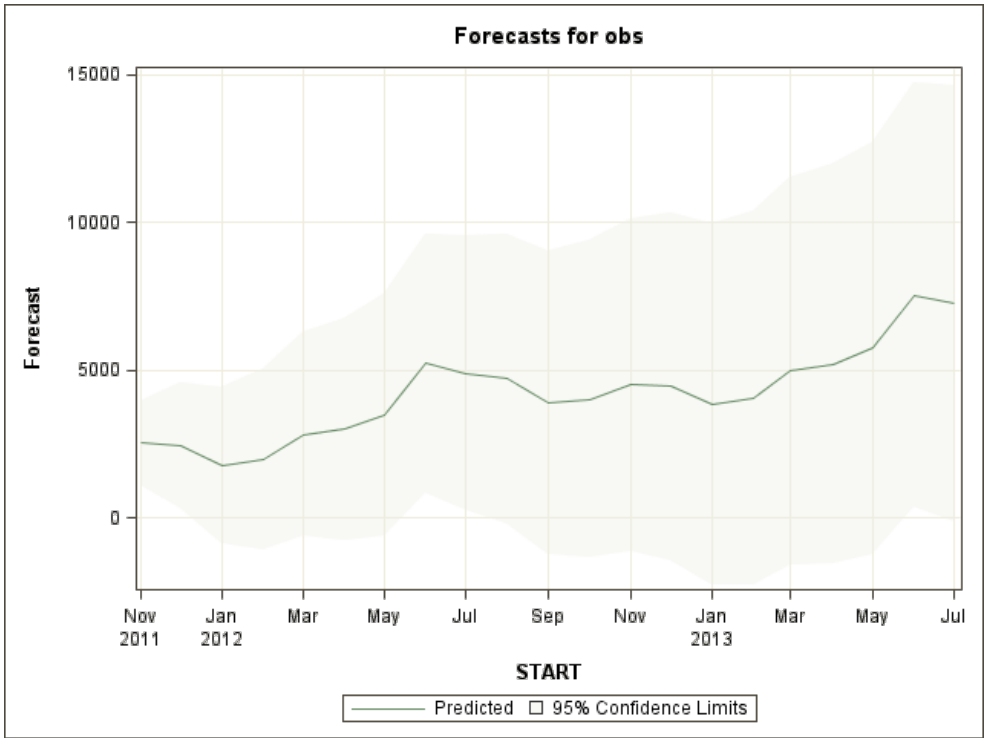

Figure 4. SARIMA model forecast for recreational landings. Bands indicate 95% confidence limits.

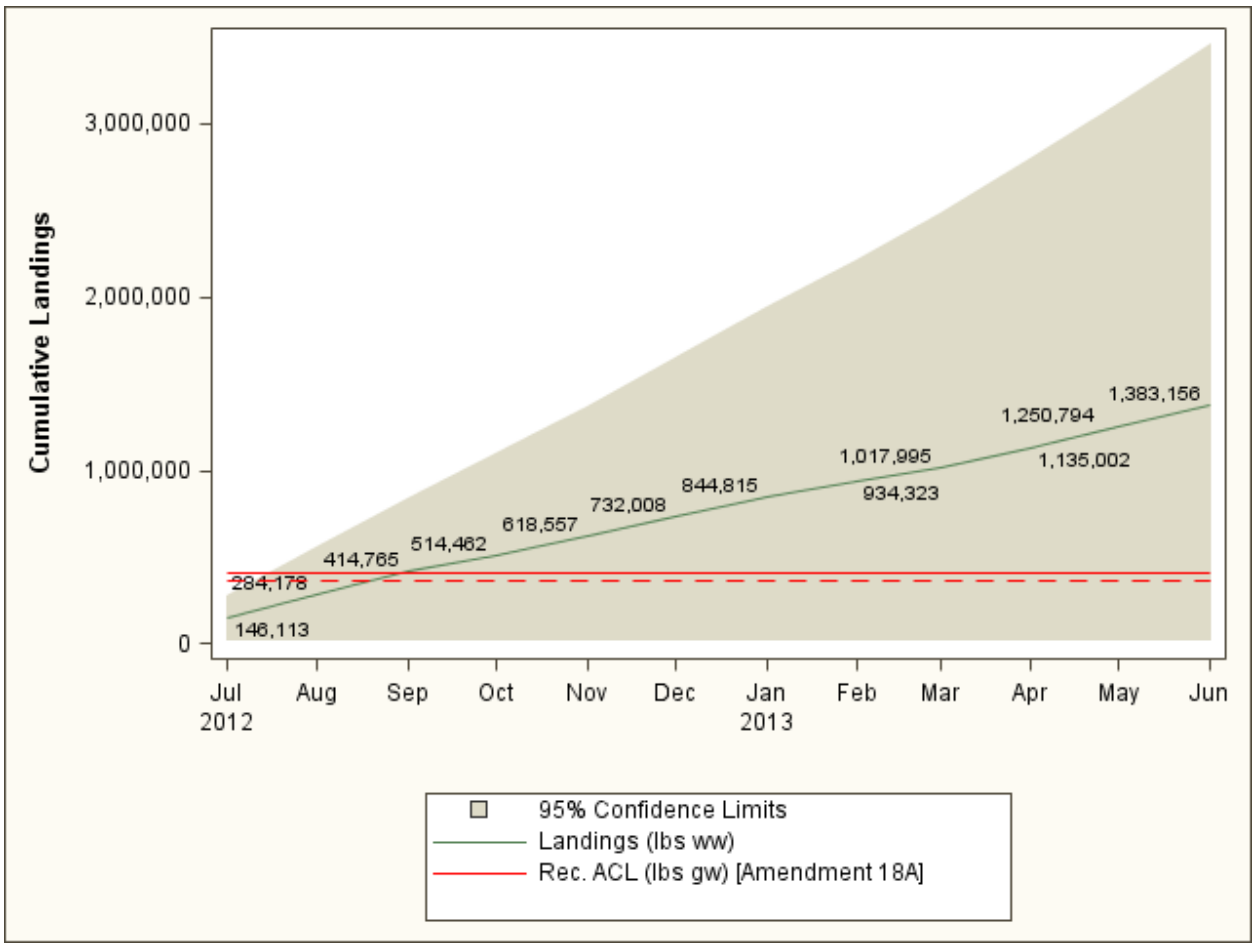

Figure 5. SARIMA model cumulative recreational landings forecast relative to proposed Amendment 18A recreational ACL.

Results

Method 1: Using 2011/12 Landings as Proxy

Assuming landings in 2012/13 will follow the same pattern as 2011/12, the Amendment 18A ACL of 0.409 mp gw would be met by September 15, 2012 (Figure 2; Table 4). Assuming a 19.6% reduction in landings from July 1 forward due to the size limit increase, the Amendment 18A ACL would be met by October 24, 2012 (Figure 2; Table 4).

Method 2: Using 2011/12 Landings Adjusted by Change in SSB

Assuming landings in 2012/13 increase 2.8% from 2011/12 levels, in correspondence with projected increases in black sea bass SSB, the Amendment 18A ACL would be met by September 8, 2012 (Figure 2; Table 4). Assuming an increase in landings of 2.8% from June 1 forward and a 19.6% reduction in landings from July 1 forward due to the size limit increase, the Amendment 18A ACL would be met by October 16, 2012 (Figure 2; Table 4).

Method 3: SARIMA Model

Diagnostic plots suggested a (0,1,1)X(0,1,1) SARIMA model for monthly recreational black sea bass landings was an appropriate model structure (Figure 3 and Appendix). The model indicates a strong seasonal trend, with the highest landings during May-July (Figure 3-4). The Amendment 18A ACL is projected to be met by August 22, 2012 (Figure 4; Table 4). Assuming a 19.6% reduction in harvest from July 1 forward, the Amendment 18A ACL is projected to be met by September 4, 2012 (Table 4).

Table 4. Projected quota closure dates for South Atlantic recreational black sea bass under various projection methods, with and without an increase in the minimum size limit from 12 to 13 inches total length being implemented on July 1, 2012.

Method	No Size Limit Change	Size Limit Increase July 1
1	September 15, 2012	October 24, 2012
2	September 8, 2012	October 16, 2012
3	August 22, 2012	September 4, 2012

Discussion

The mean output from the three projection methods considered suggest a quota closure will be necessary for the South Atlantic black sea bass recreational sector between August 22, 2012-September 15, 2012 for the Amendment 18A ACL (Table 4). Method 1 uses 2011/12 landings as a proxy for 2012/13 patterns, without accounting for any trends in effort or changes in underlying exploitable stock size. Method 2 accounts for underlying changes in stock size, but not historical trends in the fishery. Method 3, the SARIMA model, estimates the shortest 2012/13 season length at 86 days. This method uses historical trends in landings over the long-term and the immediate past to influence model dynamics, while also accounting for changes in underlying stock size. If 2012 effort is lower than projected, owing to high fuel prices and other socioeconomic factors, then longer seasons than those presented in this report might be required to catch the entire recreational quota. Similarly, if biomass is rebuilding at a faster rate than projected, then shorter seasons than those presented in this report might be required to prevent the recreational ACL from being exceeded.

References

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Hanson PJ, Vaughan DS, Narayan S. 2006. Forecasting annual harvests of Atlantic and South Atlantic menhaden. North American Journal of Fisheries Management 26: 753-764.

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Appendix

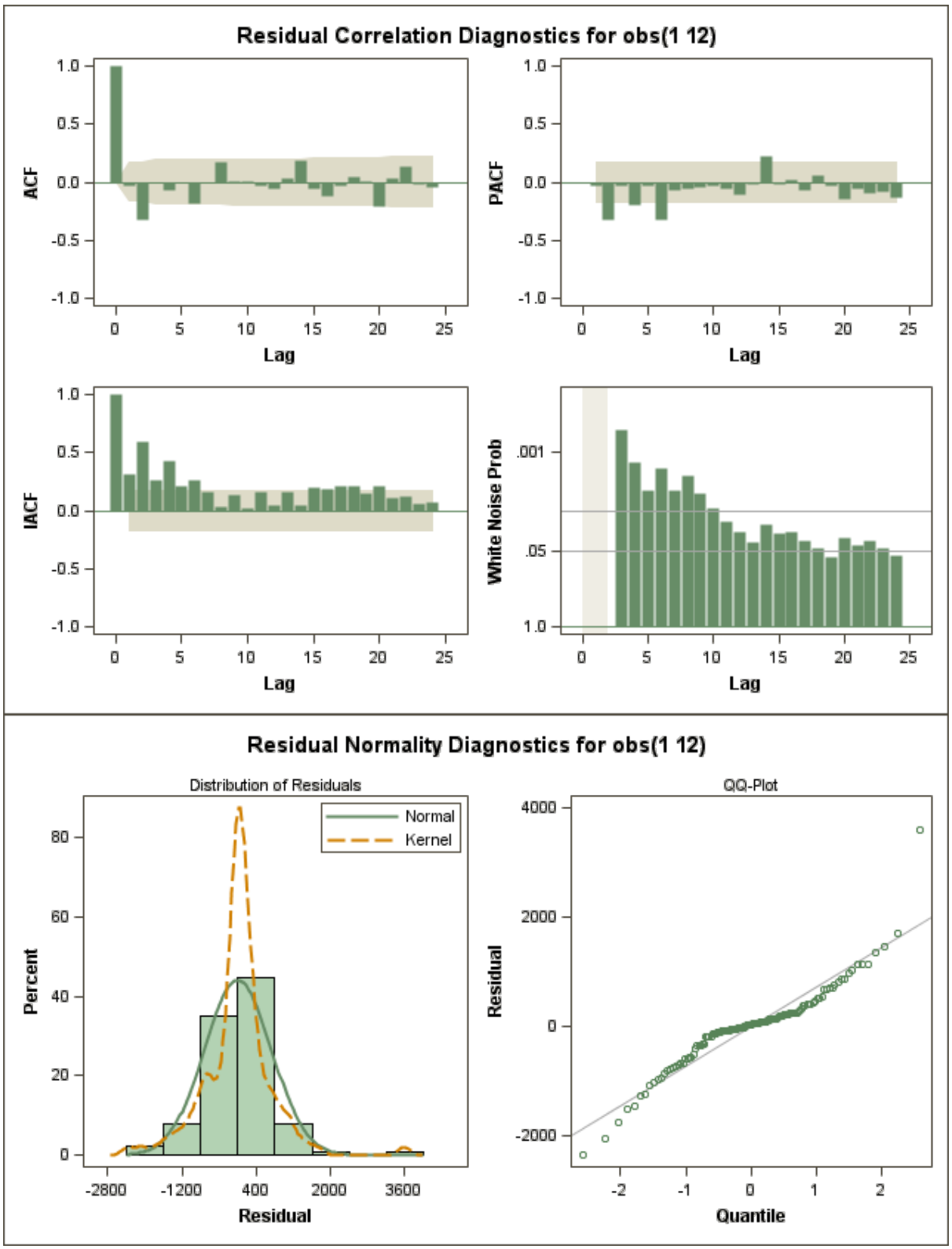

Figure A1. Model diagnostics for South Atlantic black sea bass recreational catch-per-day in pounds gutted weight, fit to a SARIMA(0,1,1)(0,1,1) model.