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2015 Gulf of Mexico Red Snapper Recreational Season Length Estimates
NOAA Fisheries, Southeast Regional Office

Executive Summary

The Gulf of Mexico (Gulf) red snapper recreational fishing season in federal waters opens each year on June 1 and closes when the recreational quota is met or projected to be reached. Prior to June 1 each year, NOAA Fisheries projects the season closing date based on previous years of data, and notifies the public of the closing date for the upcoming season. On April 1, 2015, NOAA Fisheries published a letter seeking comments on changes to the red snapper quota in response to an updated stock assessment. If this quota increase is implemented, the recreational annual catch target (ACT) in 2015 would be 5.608 mp ww. On April 10, 2015, the Secretary of Commerce approved Amendment 40 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico (RF-40). RF-40 allocates 2,372,184 lb ww (42.3%) of the recreational ACT to the for-hire sector and 3,235,816 lb ww (57.7%) to the private sector (including state-licensed charter vessels). The purpose of this report is to project the 2015 federal fishing season length based on the proposed 2015 recreational ACTs with and without the implementation of RF-40's sector-specific sub-quotas, and with and without compatible fishing seasons in Gulf state waters. In 2014, with incompatible state seasons and a 9-day federal season, approximately 3.853 mp ww of red snapper were recreationally landed in the Gulf (89% of the 2014 ACT). For 2015 projections, a similar approach was followed. The analysis projected Eastern and Western Gulf catch rates and average weights by mode of fishing using the previous year's landings, the mean of the past two years, and regression modeling incorporating uncertainty in landings estimates from the various recreational fishing surveys used to provide information on harvest of Gulf red snapper during the federal season. A range of projection scenarios were used to encompass uncertainty in catch rates due to uncertainty in recreational catch estimates, potential reductions in the rate of average weight increase, changes in state seasons and catch rates. For 2015, projections showed that states adopting incompatible seasons could reduce the federal season length by 22-30% in the absence of RF-40, and by 29-45% for private and state-licensed charter vessels if RF-40 is implemented. In the absence of RF-40, the federal season in 2015 was projected to be between 9-21 days (up to 2.3 times longer than 2014). The implementation of RF-40 allows a much longer federal season for federally-permitted for-hire vessels (40-67 days; median = 46 days), with private seasons between 5-16 days, depending on catch rates and state compatibility. Several issues emerged during the regression modeling process incorporating the 2004-2014 data, including poor or insignificant model fits and potentially unrealistic trends. To address this uncertainty, projections scenarios were developed using only 2013-2014 data. Mean season lengths for projections based on recent data only, assuming RF-40 is implemented and state seasons are incompatible, were 44 days for for-hire and 10 days for private vessels.

Introduction

Red snapper are managed in Gulf of Mexico (Gulf) federal waters from the west coast of Florida to Texas by the Gulf of Mexico Fishery Management Council (Council). On October 1, 2013, NOAA Fisheries published a final rule (78 FR 57314) implementing an 11 million pound whole weight (mp ww) total allowable catch for Gulf red snapper. On April 20, 2015, a final rule (80 FR 06294) will establish a red snapper recreational annual catch target (ACT) by applying a buffer to the recreational quota, which is based on the Council's annual catch limit (ACL)/ACT control rule developed in the Generic ACL Amendment (76 FR 82044). The ACL/ACT control rule used to determine the appropriate target catch levels that account for management uncertainty to maintain catches at or below the ACL (quota).

For the recreational sector, the control rule specifies a 20% buffer to constrain landings below the quota. In 3 of the last 4 years landings have exceeded the recreational quota. This final rule (80 FR 06294) also revises the procedure for determining the recreational season length (closure date). The red snapper recreational season closure date will be based on when the recreational ACT will be met or projected to be reached instead of when the recreational quota will be met. Using the ACT to set the season length serves as an in-season accountability measure (AM) and reduces the probability of exceeding the recreational quota during a fishing year from 50 percent to 15 percent. This final rule also revises the recreational AMs to include a quota overage adjustment (payback). If red snapper are overfished and the recreational quota is exceeded, then in the year following the overage, the recreational quota will be reduced by the amount of the recreational quota overage in the prior fishing year, unless the best scientific information available determines that a greater, lesser, or no overage adjustment is necessary. If the quota is adjusted, the recreational ACT will also be reduced to maintain the 20-percent buffer between the ACT and the adjusted quota.

The red snapper recreational fishing season opens each year on June 1 and closes when the recreational quota is met or projected to be reached. Prior to June 1 each year, NOAA Fisheries projects the season closing date based on previous years of data, and notifies the public of the closing date for the upcoming season. If subsequent data indicate that the quota has not been reached, NOAA Fisheries may re-open the season. In 2014, the red snapper ACL was 5.390 mp ww, and the ACT was 4.312 mp ww. The federal season was open for 9 days, from June 1-June 9 (SERO-LAPP-2014-04). Additionally, the state of Texas had a year round (365 day) state waters season with a 4-fish bag limit and 15-inch minimum size limit (MSL). The state of Louisiana had 286-day state water season (3-day weekends Feb 21-Apr 13, all days Apr 14-Dec 31). The state of Florida had a 52-day state water season (May 24-July 15). The state of Alabama had a 21-day state water season (June 1-9; 3-day weekends in July). The state of Mississippi had a 36-day state water season (June 1-9; 3-day weekends in July and Oct-Nov 2). Alabama, Florida, Mississippi, and Louisiana also had a 2-fish bag limit and a 16-inch MSL.

On April 1, 2015, NOAA Fisheries published a letter seeking comments on changes to the red snapper quota (FB15-025) in response to an updated stock assessment (SEDAR-31 Update 2014). The proposed quota would increase to 14.30 mp ww, the highest ever for Gulf red

snapper, and would be allocated 51% (7.293 mp ww) to the commercial sector and 49% (7.007 mp ww) to the recreational sector. If this quota increase is implemented, the recreational ACT in 2015 would be 5.608 mp ww. On April 10, 2015, the Secretary of Commerce approved Amendment 40 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico (RF-40; FB15-006). This rulemaking provides a basis for increased flexibility in future management of the recreational sector, and reduce the chance for recreational quota overruns, which could jeopardize the rebuilding of the red snapper stock. The rule would establish sub-quotas for federally permitted for-hire vessels and private anglers who fish for red snapper for a three-year period beginning in 2015. The federal for-hire component would be comprised of all for-hire operators with a valid or renewable federal reef fish charter vessel/headboat permit. The private angling component would be comprised of private recreational anglers and other for-hire operators who do not have a federal reef fish charter vessel/headboat permit. The rule would implement sub-quotas using RF-40's allocation of 42.3% to the federal for-hire component and 57.7% to the private angling component. RF-40 allocates 2,372,184 lb ww (42.3%) to the for-hire sector and 3,235,816 lb ww (57.7%) to the private sector (including state-licensed charter vessels). The purpose of this report is to project the 2015 recreational red snapper federal fishing season length based on the proposed 2015 recreational ACTs with and without the implementation of RF-40's sector-specific sub-quotas, and with and without compatible fishing seasons in Gulf of Mexico state waters.

State Regulations

In 2015, as in previous years, Texas will have a 365-day state waters red snapper season with 4-fish bag limit and a 15-inch total length MSL. Louisiana will have a 287-day season from March 20 through December 31. The Florida Fish and Wildlife Commission has approved a 70-day state waters fishing season beginning Memorial Day weekend (May 23) and ending on July 12 with Labor Day weekend (Sept 5-7) and two-day weekends in Sept-Oct open as well. Mississippi has yet to specify their season length. Analyses herein presume Mississippi will have a similar season as they did in 2014.. This analysis assumes Alabama will implement regulations consistent with the federal season implemented by NOAA Fisheries, and seasons, bag limits, and size limits for other Gulf states will be consistent with those summarized in **Table 1** below.

Table 1. Potential Gulf state water recreational red snapper regulations for 2015. Cells highlighted in gray indicate regulations incompatible with 2015 federal regulations.

State	Size Limit	Bag Limit	Season	Days Open
Florida	16" TL	2-fish	Open May 23 - July 12, resume Sept. 5-7 and finish with Saturdays and Sundays throughout Sept.-Oct., closes Nov. 1.	70
Alabama*	16" TL	2-fish	Same as federal season	Same as federal season
Mississippi*	16" TL	2-fish	Open federal season, 3-day weekends July, Oct	Federal season plus ~24 days
Louisiana	16" TL	2-fish	Opens March 20	287
Texas	15" TL	4-fish	Jan 1-Dec 31	365

**Not finalized*

Data Sources

Recreational red snapper landings were obtained from four data sources (**Table 2**):

1. Marine Recreational Information Program (MRIP), including the For-hire charter survey.
2. Southeast Region Headboat survey (SRHS).
3. Louisiana Department of Wildlife and Fisheries (LDWF) creel survey.
4. Texas Parks and Wildlife Department (TPWD) charter and private/rental creel survey.

MRIP and for-hire red snapper 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 (west Florida, Alabama, Mississippi, and Louisiana). Uncertainty in MRIP mean estimates in average weights, numbers of fish landed, and pounds of fish landed are expressed as percent standard error (PSE). MRIP has replaced the Marine Recreational Fisheries Statistics Survey program as the primary methodology for collecting and estimating recreational catches in the Gulf. In 2013, MRIP implemented changes to the Access Point Angler Intercept Survey (APAIS). These changes to APAIS required a recalibration of historical landings to account for biases in sampling time period; these re-calibrated landings were incorporated into the SEDAR-31 Update (2014) stock assessment and were used to generate the inputs for the 2015 season length projections in this report. These recalibrated landings were distributed to waves using proportions from MRIP data in the Southeast Fisheries Science Center (SEFSC) Recreational Data (accessed Feb 2015). MRIP data for 2014 were obtained both for Wave 3 and for June 1-9 (federal season only).

Headboat landings are collected through logbooks completed by headboat operators and submitted to the SRHS. Landings (lbs ww) are reported by vessel, day/month, and statistical reporting area (i.e., area 18 = Dry Tortugas off west coast of Florida, …, area 27 = Southeast

Texas). Landings from vessels participating in the 2015 Headboat Collaborative Exempted Fishing Permit (http://gulfheadboat.com/) were deducted from the projection inputs, and their harvest was also deducted from the recreational for-hire sub-quota (http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/reef_fish/2013/headboat_efp/). No estimates of uncertainty are generated by the SRHS. Headboat landings were obtained through 2013 from the SEFSC Recreational ACL Dataset (accessed Feb 2015) and 2014 landings were obtained directly from SRHS staff.

Louisiana's quota monitoring survey was designed to estimate the number of red snapper landed in Louisiana during the 2014 recreational season. Dockside interviews were conducted by state personnel at sites commonly reporting offshore species. To estimate fishing effort of private anglers, LDWF personnel contacted a random portion of those anglers holding a Louisiana Recreational Offshore Landing Permit by phone and/or email on a weekly basis. Permit holders were asked if they fished offshore, how many trips were taken the previous week, if they landed at a public site, what time they returned to the dock, and whether they fished on a paid charter. The randomly selected permit holders were notified by e-mail each Wednesday of their selection to be surveyed. Those selected permit holders had the option to answer the effort survey questions by reply e-mail. If an e-mail was not received, they were contacted by phone. Charter captains holding a Louisiana Recreational Offshore Landing Permit were also contacted by LDWF weekly to collect information on the total number of red snapper caught the previous week. Charter captains had the option to respond via e-mail prior to LDWF personnel contacting them via phone. Estimated landings were produced based on observed catch rates, average weights, and estimated fishing effort (as adjusted for persons not possessing an offshore landing permit). Weekly estimates of uncertainty in LDWF survey average weights, numbers of fish landed, and pounds of fish landed are expressed as PSE. There was no MRIP sampling in Louisiana in 2014.

The TPWD creel survey generates estimates of landings in numbers for private/rental boats and charter vessels fishing off Texas. Landings are reported in numbers by high (May 15-November 20) and low-use time periods (November 21-May 14), area fished (state versus federal waters), and mode of fishing (private versus charter). To convert TPWD landings in numbers to landings in pounds, red snapper average lengths by mode, wave, and area fished are converted to weights using a length-weight conversion formula. High- and low-use estimates of uncertainty in TPWD numbers of fish landed are expressed as PSE and were obtained from TPWD staff for this analysis. TPWD landings were not available for the high-use period in 2014; 2013 high-use data were used as a proxy.

Table 2. Data inputs used in projections.

Source	Time Period	Details
Marine Recreational Information Program (MRIP)	2004-2014	Landings and PSE by wave, recalibrated for changes in angler intercept survey
Texas Parks and Wildlife Department (TPWD)	2004-2014	Landings by wave from SEFSC Recreational ACL dataset, with 2013 used as a proxy for May-Dec 2014; CVs (define)from TPWD staff
Louisiana Department of Wildlife and Fisheries (LDWF)	2013-2014	Weekly landings and error estimates from LDWF staff
Southeast Region Headboat Survey (SRHS)	2004-2014	Monthly landings through 2013 from SEFSC Recreational ACL Data (Feb 2015) and 2014 landings from SRHS staff
SEFSC Recreational ACL Dataset	2004-2014	Average weights by year and mode of fishing

Methods

2014 Landings and Retrospective

Landings from 2014 were obtained from the various data sources described in **Table 2**. Federal in-season catch rates were determined using MRIP, LDWF, SRHS, and TPWD estimates. These were compared to federal season catch rates projected in SERO-LAPP-2014-04.

2015 Projections: Average Weights and Catch Rates

A tiered projection approach was taken for forecasting recreational red snapper average weight and in-season catch rates in the Gulf of Mexico for 2015. Average weights and in-season catch rates were computed using the same methodology as 2013 projections (see SERO-LAPP-2013-02 Addendum). Since 2007, the recreational fishing season has decreased from 194 days to 9 days (2014 season length). Because federal waters were only open in June 2014, only federal in-season catch rates, expressed as landings per open day, from June 2004-2014 were used as regression inputs. Because the Eastern and Western Gulf states have differing data collection programs, average weights and catch rates were projected separately for the Eastern and Western Gulf. Different projections were done for Headboat, Charter, and Private modes to account for differences in the effort dynamics of these modes, the potential implementation of RF-40, and the availability and completeness of data.

Generalized linear regression models were implemented using R (R Core Team 2014). The best-fitting models for each of the model scenarios in SERO-LAPP-2013-10 were identified based on significance of parameter terms, adjusted Akaike information criterion (AICc; Burnham & Anderson 2002), and Bayesian information criterion (Schwarz 1978). Parametric bootstrapping techniques were applied, where the mean and variance per year were used to define a

distribution of possible values at each observed point. This extension allowed different variance estimates at each point, directly incorporating variance estimates from the surveys (e.g., MRIP, LDWF, and TPWD) into the projection framework. Because catch rates and average weights for many region-mode combinations appeared stabilized over the 2013-2014 period, additional sensitivity runs were performed using the mean of 2013-2014, 2014 (June 1-9 only), and 2014 (Wave 3) catch rates and average weights.

To generate a mean estimate with variance for 2015 Eastern and Western Gulf average weights for the Private and Charter modes, 1,000 bootstrapped time series were generated around the mean in-season average weights for the Eastern and Western Gulf, by mode of fishing. These bootstrapped time series incorporated uncertainty using weighted mean percent standard error (PSE) for red snapper average weights from the Eastern and Western Gulf. State- and mode-specific average weight PSE estimates were obtained from the MRIP website (www.countmyfish.noaa.gov), LDWF, and TPWD staff. PSE estimates were weighted by landings in pounds when aggregated to the region-mode level. Generalized linear model regressions with a Gaussian distribution were fit to each of the 1,000 bootstrapped time series and forecast to 2015. Residual diagnostics were used to verify goodness-of-fit. Each time series considered multiple input streams (e.g., 2004-2014, 2007-2014) with AIC and significance of parameter estimates used to guide selection of the appropriate input time series.

To generate a mean estimate with variance for 2015 Eastern and Western Gulf red snapper catch rates in numbers of fish for the Private and Charter modes, 1,000 bootstrapped time series were generated around the mean in-season catch rates in numbers for the Eastern and Western Gulf. These bootstrapped time series incorporated uncertainty using weighted mean Eastern Gulf MRIP and Western Gulf MRIP/LDWF/TPWD PSEs. For the Eastern Gulf, state-specific PSE estimates for landings (in numbers) were obtained from the MRIP website (www.countmyfish.noaa.gov) and weighted by landings in numbers. For the Western Gulf, MRIP (2004-2012), LDWF (2013-2014) and TPWD (2004-2013) survey estimates of landed (numbers of fish) PSE were weighted by landings in numbers. Generalized linear model regressions with a log-linked negative binomial distribution were fit to each of the 1,000 bootstrapped time series and forecast to 2015. Predictive covariates considered were model-estimated and model-projected spawning stock biomass (from the SEDAR-31 Update stock assessment), annual mean fuel prices (http://www.eia.gov/petroleum/data.cfm#prices), and annual per capita Gross Domestic Product (GDP; http://data.worldbank.org/country/united-states). Trends in these covariates are shown in **Figure 1**. Spawning stock biomass (SSB) was included to potentially account for changes in stock size (and corresponding availability) as the population rebuilds. Mean fuel prices were included because they are believed to have an influence on the ability of recreational fishermen to fish offshore where higher catch rates of red snapper are possible. Per Capita GDP was included because it is an indicator of the economic status of the United States overall, which may predict the ability of recreational anglers to afford to take trips for red snapper. For simplicity, 2015 projections assumed fuel prices and per capita GDP would remain stable at 2014 levels. Residual diagnostics were used to verify goodness of fit. Each time series considered multiple input streams (e.g., 2004-2014,

2007-2014) with AIC and significance of parameter estimates used to guide selection of the appropriate input time series and inclusion of covariates.

Mean and variance estimates for 2015 Eastern/Western Gulf catch per day (in pounds per day), by mode, were computed by running summary statistics on the product of the 1,000 bootstrapped forecasts for 2015 average weight and the 1,000 bootstrapped forecasts for 2015 catch rate in numbers for both the Eastern and Western Gulf.

Uncertainty estimates are not generated for headboat survey catches. Due to differences in observed trends, it was still useful to project the changes in average weight and catch rate in numbers separately, then combine them for a forecast of catch rate in pounds. To generate a mean estimate with variance for 2015 Eastern/Western Gulf headboat average weights, a generalized linear regression model with a Gaussian distribution was fit to input data for 2007-2014 and forecast to 2015 for both regions. To generate a mean estimate with variance for 2015 Eastern/Western Gulf headboat catch rate in numbers, a generalized linear regression model with a Gaussian distribution was fit to input data for 2007-2014 and forecast to 2015 for both regions. Landings from Headboat Collaborative vessels were excluded from input data before fitting regression models. To appropriately express the combined uncertainty in the projected average weight and catch rate in numbers to generate a catch rate in pounds per day, 1,000 bootstrapped time series were generated around the mean projected 2015 average weight and catch rate in numbers for the Eastern and Western Gulf. These bootstrapped time series incorporated uncertainty using the standard error in the forecast from the regression model.

Mean and variance estimates for 2015 Eastern/Western Gulf headboat catch per day (in pounds per day) were computed by running summary statistics on the product of the 1,000 bootstrapped forecasts for 2015 average weight and the 1,000 bootstrapped forecasts for 2015 catch rate in numbers for both the Eastern and Western Gulf.

Because several Gulf states had adopted or suggested they might have fishing seasons for red snapper in state waters that would be incompatible with the federal season, separate out-of-season catch rates were computed for each state and mode using the most recent available data. For Alabama, Florida, and Mississippi, catch rates during Waves 2 and 4-5 in 2014 were used as proxies for catch rates in those waves in 2015. For Wave 3, catch rates from June 10-30, 2014, were used as proxies for out-of-season catch rates in Wave 3 of 2015. None of these states are anticipated to have openings in Waves 1 or 6 of 2015. For Louisiana, LDWF weekly catch rates from 2014 were used as proxies for out-of-season catch rates in 2015. For Texas, TPWD catch rates reported for Waves 1-2 2014 and Waves 4-6 of 2013 were used as proxies for those Waves in 2015, and state waters catch rates from Wave 3 2013 were used as a proxy for out-of-season landings that might take place outside the federal season during Wave 3 2015.

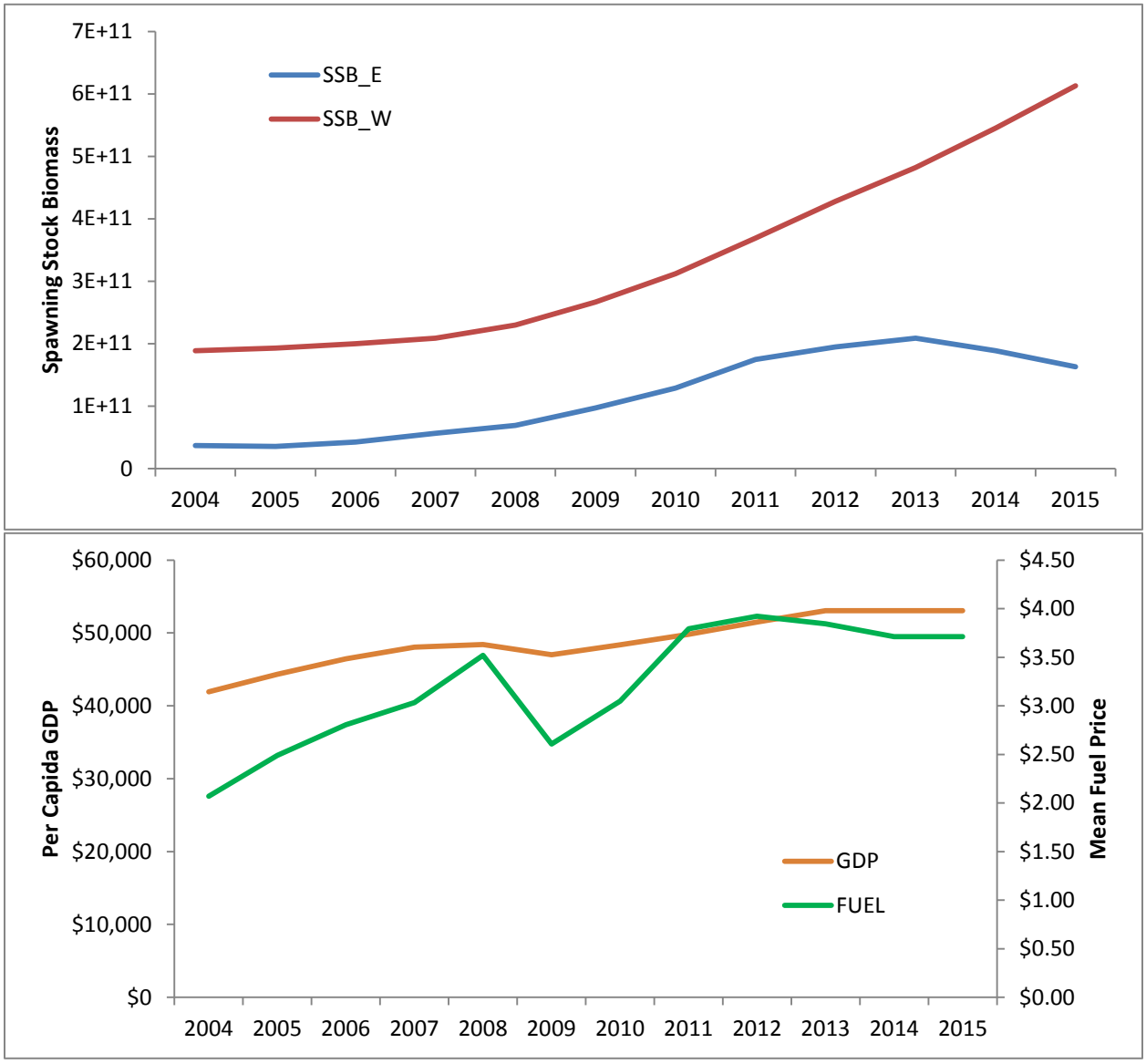

Figure 1. *Projection covariates.* Top: Spawning stock biomass (SSB) estimates, in billions of eggs, from SEDAR-31 Update (2014) stock assessment model for Eastern (blue) and Western (red) Gulf of Mexico red snapper stock, Bottom: U.S. Gross Domestic Product (orange) and mean unleaded fuel price (green).

Additionally, in 2014 NOAA Fisheries approved the Gulf Headboat Collaborative exempted fishing permit (EFP). In 2015, this EFP authorizes participating vessels to harvest 279,657 lb ww of the red snapper quotaHeadboats participating in the program could harvest red snapper beginning January 1. NOAA Fisheries is actively tracking landings (in numbers) in near real time and landings are being converted to pounds based on dockside sampling estimates. Projections accounted for the red snapper to be landed by the Headboat Collaborative. When estimating 2015 catch rates and average weights for headboats, historical landings by Collaborative vessels were removed from catch per day and average weight computations.

2015 Projections: Season Length

Forecasts of catch rates and average weights from best-fitting models were incorporated, along with their variance, into an Excel-based season length projection model to determine the federal season length under each scenario. This model accounted for out-of-season catch rates and state incompatibility with federal season length as described previously. Scenarios evaluated are presented in **Table 3**.

Table 3. Season length projection scenarios (A-F) evaluated. 'PRJ' denotes projected.

	Mode	A	B	C	D	E	F
Catch Rate	Charter	2014	2014	2014	Avg. 2013-14	PRJ (June 1-9)	PRJ (Wave 3)
	Private	2014	2014	2014	Avg. 2013-14	PRJ (June 1-9)	PRJ (Wave 3)
	HB	2014	2014	2014	Avg. 2013-14	PRJ	PRJ
Avg. Weight	Charter	PRJ	PRJ	2014	PRJ	PRJ (June 1-9)	PRJ (Wave 3)
	Private	2014	PRJ	2014	Avg. 2013-14	PRJ (June 1-9)	PRJ (Wave 3)
	HB	2014	PRJ	2014	Avg. 2013-14	PRJ	PRJ

Note: "June 1-9" denotes use of MRIP June 1-9 2014 federal season data, "Wave 3" denotes use of all Wave 3 data from 2014 to as input for MRIP 2014 catch rates and average weights.

Results

2014 Landings and Retrospective

Approximately 3.853 mp ww of red snapper were recreationally landed in the Gulf in 2014 (**Table 3**). These landings represented approximately 89% of the ACT and 71% of the ACL. The mean projected federal catch rate in 2014 was 226,011.4 lb ww per federal day. The observed federal catch rate in 2014 was 233,958.3 lb ww (a 3.5% overestimate). This level of forecasting precision was well within the uncertainty in observed federal catch rates.

Table 3. 2014 preliminary totals for Gulf recreational red snapper landings (pounds whole weight), by wave (1-6) and sector/mode.

Source	Sector	1	2	3	4	5	6	Total
MRIP	Private	0	14,173	2,017,009	320,215	5,034	0	2,356,431
	For-Hire	0	0	190,239	63,927	0	0	254,166
LA-DWF Creel	Private	0	58,995	280,491	90,665	71,611	26,467	528,229
	For-Hire	17,266	0	70,342	3,674	799	1,043	93,124
TPWD Creel	Private	5,089	3,562	*100,385*	*48,521*	*24,270*	*21,267*	203,094
	For-Hire	644	854	*15,157*	*7,418*	*8,253*	*3,073*	35,399
HBS	For-Hire	39,180	46,230	189,127	93,887	8,425	5,444	382,293
Total	Private	5,089	76,730	2,397,885	459,400	100,916	47,734	3,087,754
	For-Hire	57,090	47,084	464,865	168,905	17,477	9,560	764,982
	All Modes	**62,179**	**123,814**	**2,862,750**	**628,306**	**118,393**	**57,294**	**3,852,736**

MRIP: Marine Recreational Information Program (from Feb 2015 SEFSC ACL Dataset); LA-DWF Creel: Louisiana Department of Wildlife and Fisheries Creel Survey; TPWD Creel: Texas Parks and Wildlife Department Creel Survey.
Note: TPWD landings for Waves 3-6 2014 were not available at the time this report was prepared; 2013 used as proxy.

2015 Projections: Average Weights and Catch Rates

The bootstrapped distribution of average weights input into the projection model is shown in **Figure 2**. Generalized linear regression model fits to mean average weights, by mode and region, are shown in **Figure 3**.

In 2014, average weights for private, charter, and headboat in the Eastern Gulf were 7.50, 8.50, and 4.90 lb ww, respectively. Projected average weights for 2015 for private, charter, and headboat in the Eastern Gulf were 9.08, 8.85, and 5.48 lb ww, respectively (**Figure 3**: Top). In 2014, average weights for private, charter, and headboat in the Western Gulf were 6.98, 10.0, and 5.40 lb ww, respectively. Projected average weights for 2015 for private, charter, and headboat in the Western Gulf were 8.61, 10.56, and 6.98 lb ww, respectively (**Figure 3**: Bottom). Both Eastern and Western Gulf private and headboat model fits to 2014 data were overestimated, suggesting projected private and headboat 2015 average weights might be overestimates.

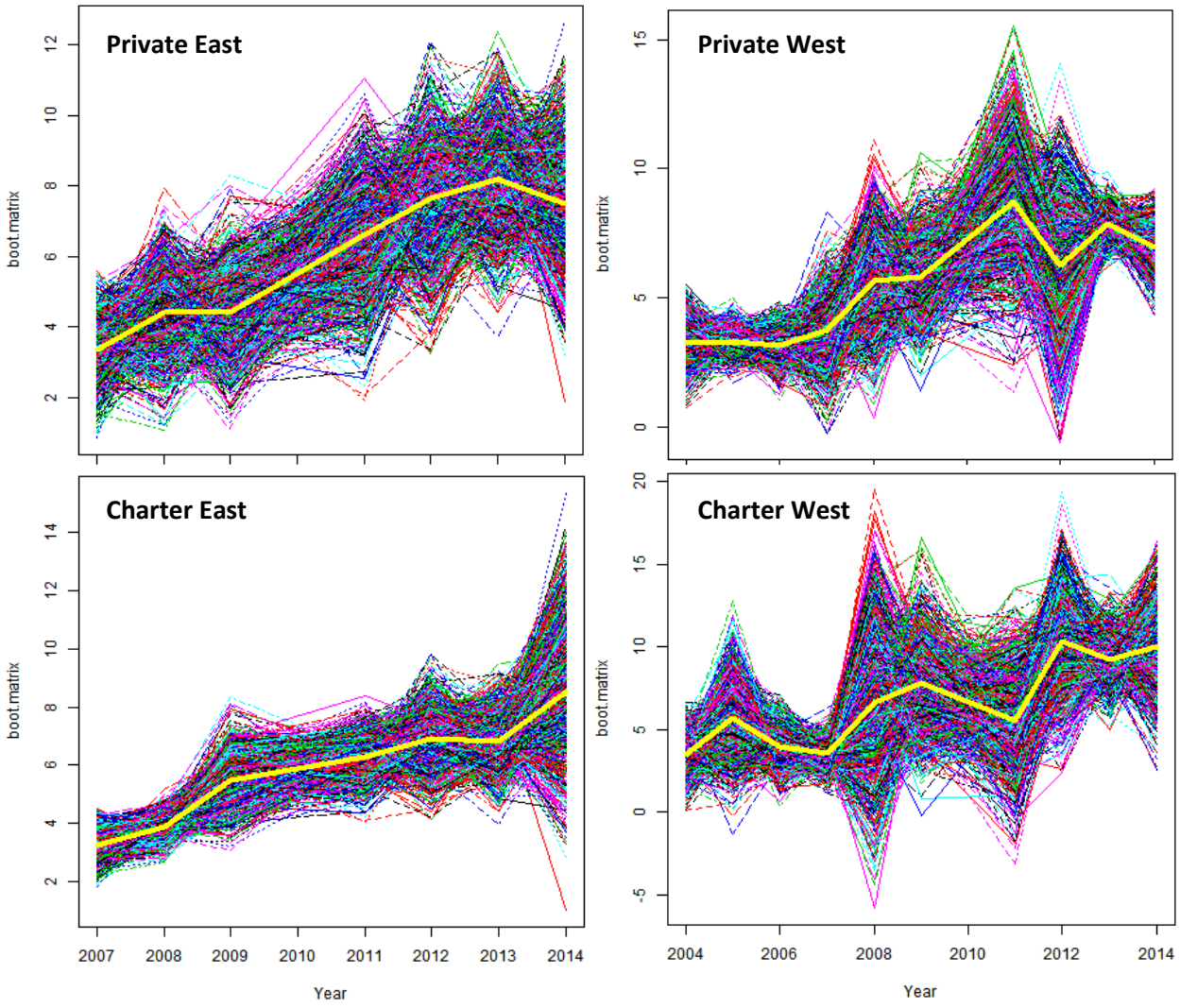

Figure 2. *Average weight uncertainty.* Bootstrapped distribution of average weights for recreational red snapper sampled by MRIP/LA Creel/TPWD in the Eastern and Western Gulf, with mean (yellow line) and time series generated using PSE (other colors).

The 2004-2014 observed private, charter, and headboat catch rates are shown in **Figure 4**. Not surprisingly, dividing Wave 3 landings by 9 open days resulted in higher catch rate estimates (**Figure 4**: red circles) for 2014 than doing the same to landings estimates from just June 1-9, 2014 (**Figure 4**: blue circles). The bootstrapped distribution of private and charter catch per day (in numbers) input into the projection model is shown in **Figure 5**. Uncertainty was high for private Eastern Gulf 2014 catch rates. Charter Eastern Gulf catch rates in 2014 were much lower than observed in 2013. Generalized linear regression model fits to mean catch per day (in numbers), by region, are shown in **Figure 6**.

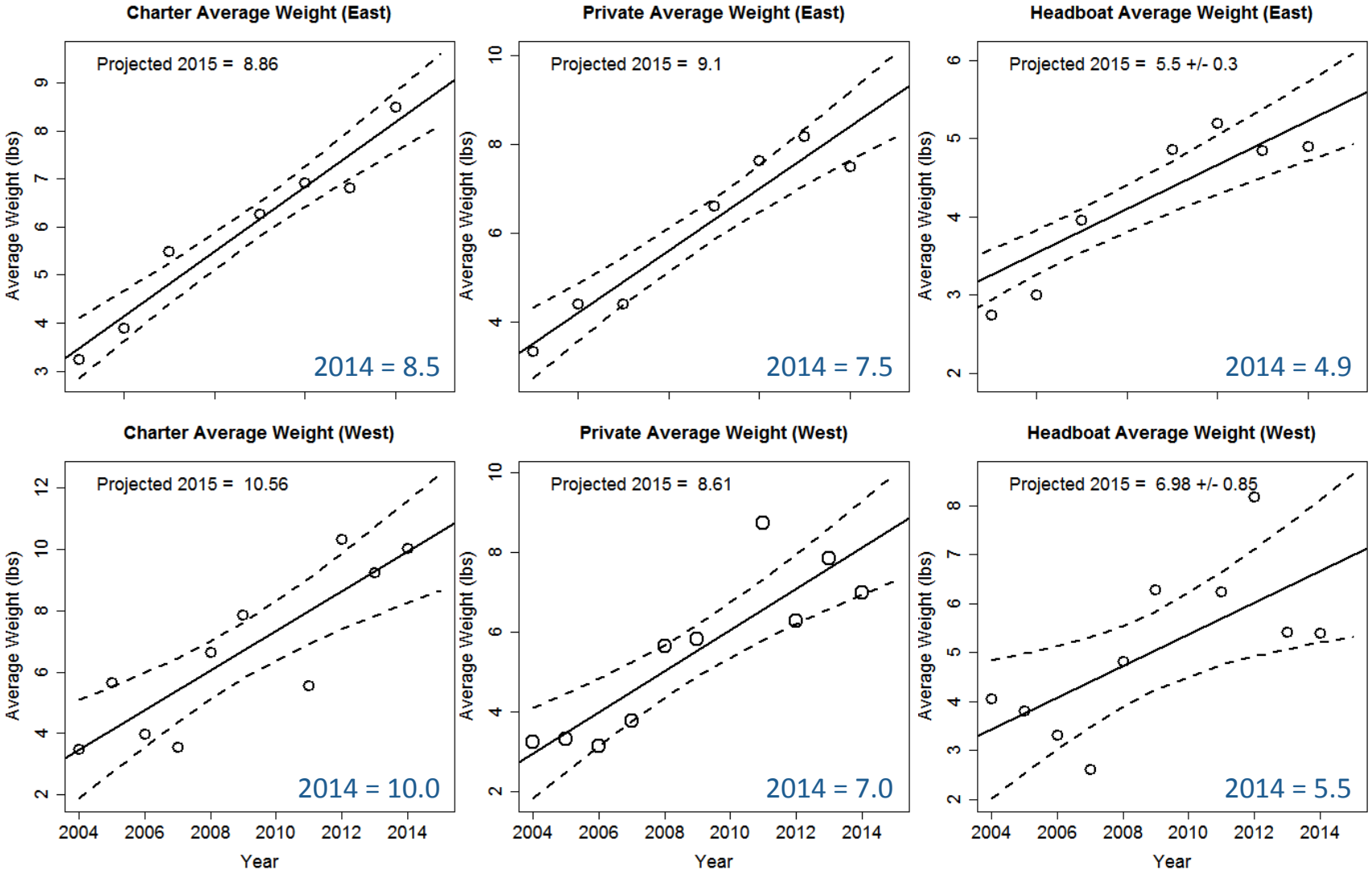

Figure 3. *Average weight projections.* Generalized linear regression fits to mean average weights for recreational red snapper sampled by MRIP/LA Creel/TPWD in the Eastern and Western Gulf. Dashed lines denote 95% confidence limits.

In 2014, in-season catch per federal day (in numbers) for private, charter, and headboat in the Eastern Gulf were 24,673, 1,848, and 1,120 fish/day, respectively, using June 1-9 post-stratified MRIP data. Using Wave 3 2014 MRIP data, the private catch rate increased to 31,581 fish/day, and the charter catch rate increased to 3,178 fish/day. Using June 1-9 post stratified MRIP input data for 2014, projected 2015 catch (in numbers) per day for Eastern Gulf private, charter, and headboats were 38,176, 945 and 1,268 fish/day, respectively (**Figure 6**). Eastern Gulf private catch rate projections included mean fuel prices as a significant predictor explaining 49.9% of the marginal deviance. This regression showed a dramatic increase. Eastern Gulf charter catch rate projections included SSB and GDP as significant predictors, explaining 47.9% and 37.4% of the marginal deviance, respectively. This regression showed a very steep decline. Eastern Gulf headboat catch rate regressions had no significant predictors, and the model fits were above the observed values in the final three years of the regression. In 2014, catch rates for private, charter, and headboats in the Western Gulf were 2,073, 483 and 1,574 fish/day, respectively. Projected 2015 catch (in numbers) per day for Western Gulf private was 2,503 fish/day (**Figure 6**). Western Gulf private catch rate model fits were above observed values in the final two years of the time series. No statistically significant regressions could be fit to Western Gulf charter or headboat catch rates.

The product of the bootstrapped distributions for average weights and catch (in numbers) per day yielded a distribution of projected catch (in pounds) per day. The distribution of projected 2015 catch (in pounds) per day for the private/charter sector in the Eastern and Western Gulf is shown in **Figure 7**. **Table 4** summarizes mean estimates of federal season catches per day from bootstrapped projections, by region and mode for the scenarios presented in **Table 2**. Estimated federal season lengths under different catch rate and average weight scenarios (A-F) and regulatory assumptions (with and without RF-40 implementation, with and without compatible state seasons) are presented in **Table 5**. In the absence of RF-40, the federal season in 2015 was projected to be between 9-21 days (up to 2.3 times longer than 2014). The median season length in the absence of RF-40 was projected at 13 days with states adopting incompatible seasons; 44% longer than the 2014 season. The implementation of RF-40 allows a much longer federal season for federally-permitted for-hire vessels (40-67 days; **Figure 8: top**), with private seasons between 5-16 days, depending on catch rates and state compatibility. Under RF-40, states adopting compatible seasons would gain 2-5 days of fishing in federal waters for private and state-licensed charter vessels, extending the federal season by 29-45% (**Table 5**, **Figure 8: middle**). In the absence of RF-40, states adopting compatible seasons would gain 2-4 days of fishing in federal waters for all vessels, extending the federal season by 22-30% (**Table 5**, **Figure 8: bottom**).

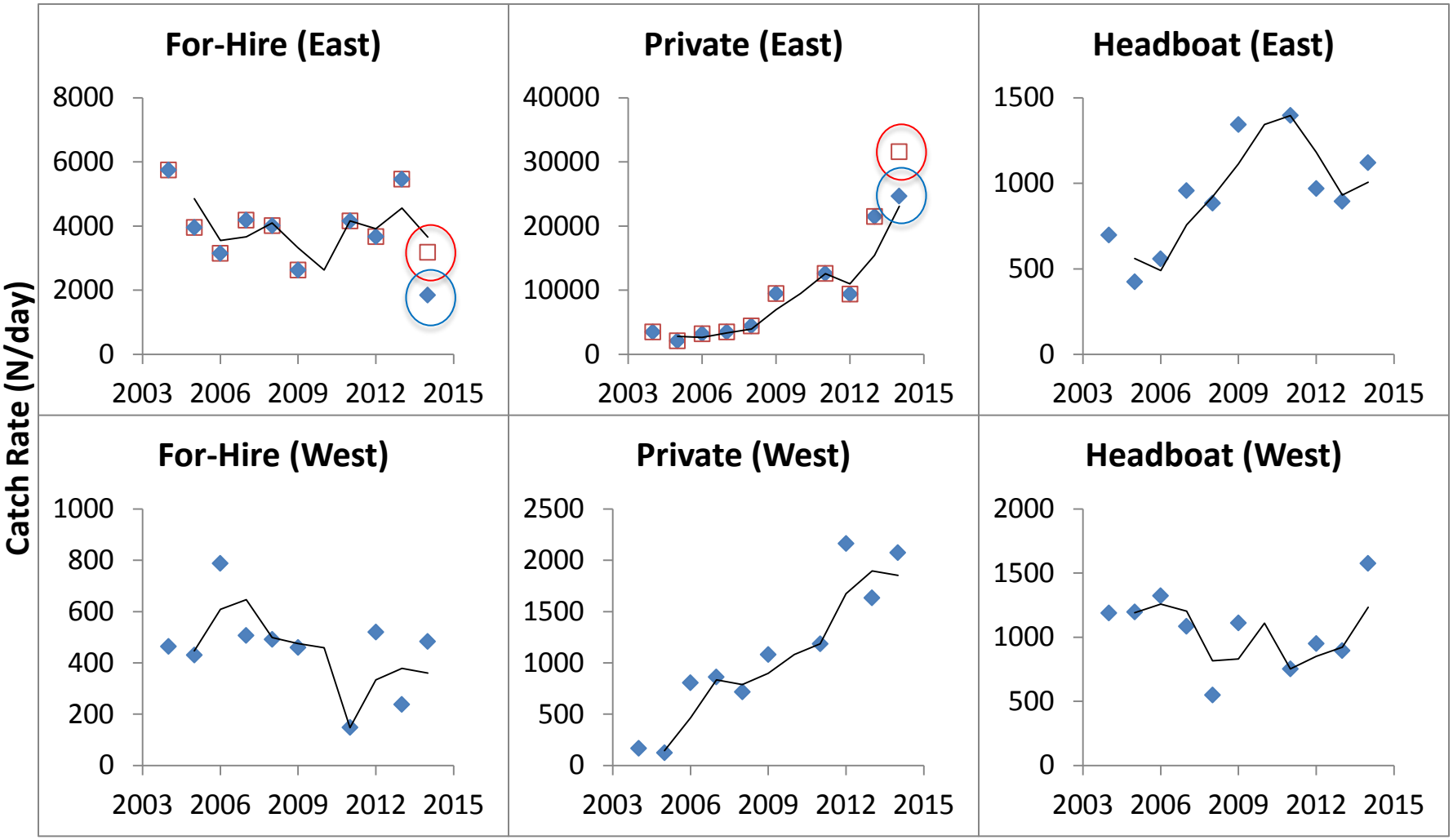

Figure 4. *Observed catch federal season catch rates.* Catch rates (catch in numbers per open federal day) from June 2004-2014 by mode and region are shown, with emphasis on differences between MRIP Wave 3 (red circles) and MRIP June 1-9 (blue circles).

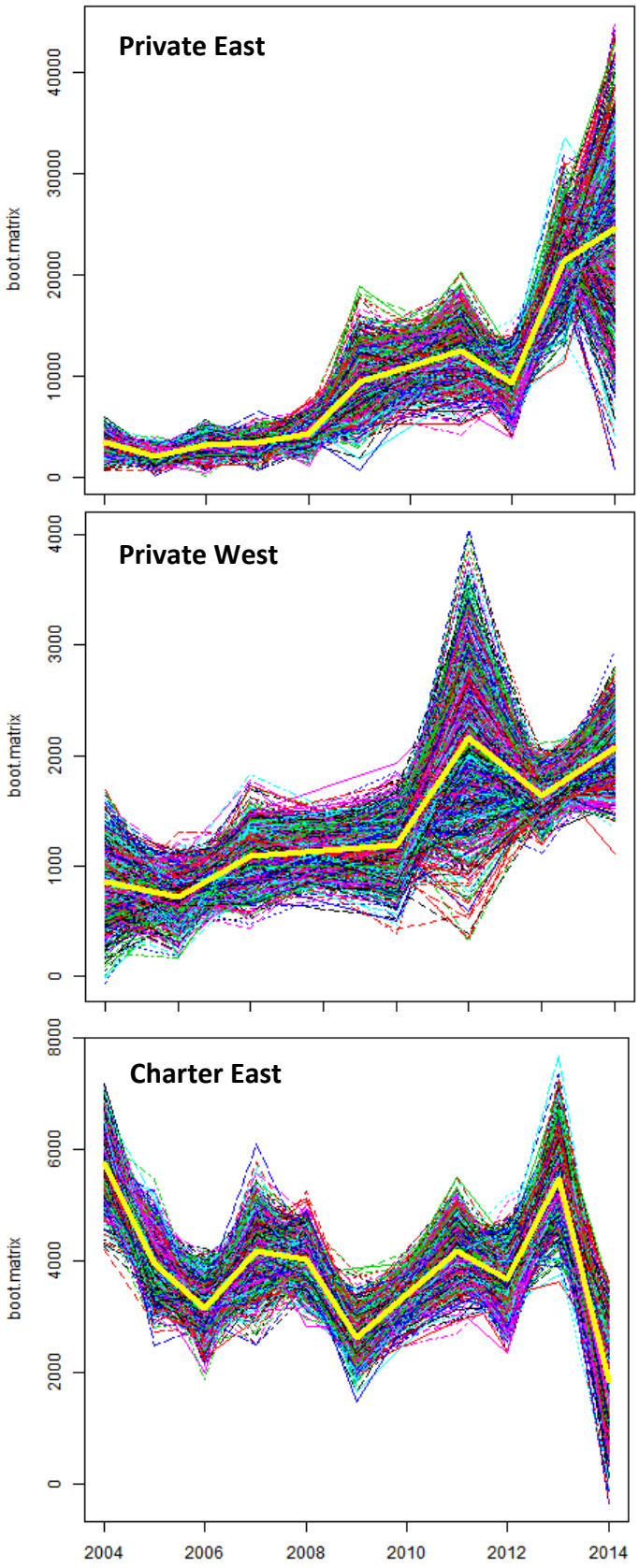

Figure 5. *Uncertainty in catch rates.* Bootstrapped distribution of catch (in numbers) per day, for recreational red snapper sampled by MRIP/LA Survey/TPWD in the Eastern and Western Gulf, with mean (yellow line) and time series generated using PSE (other colors). Note no significant regression fits were possible for Charter West.

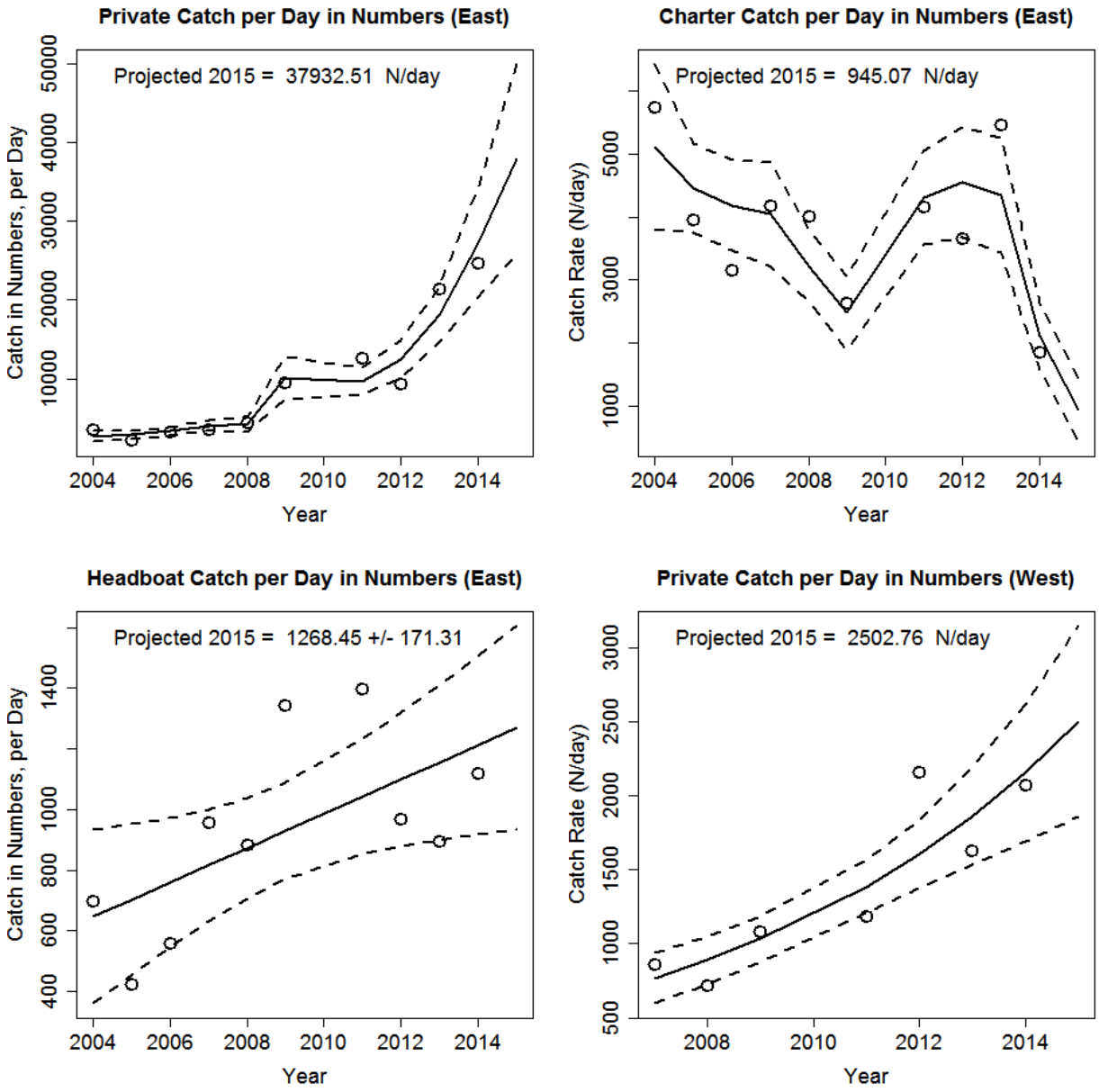

Figure 6. *Catch rate projections.* Generalized linear regression fits to mean catch (in numbers) per day for recreational red snapper sampled by MRIP/LA Creel/TPWD in the Eastern and Western Gulf. Note that headboat regressions incorporate spawning stock biomass as a predictive covariate. Dashed lines denote 95% confidence limits.

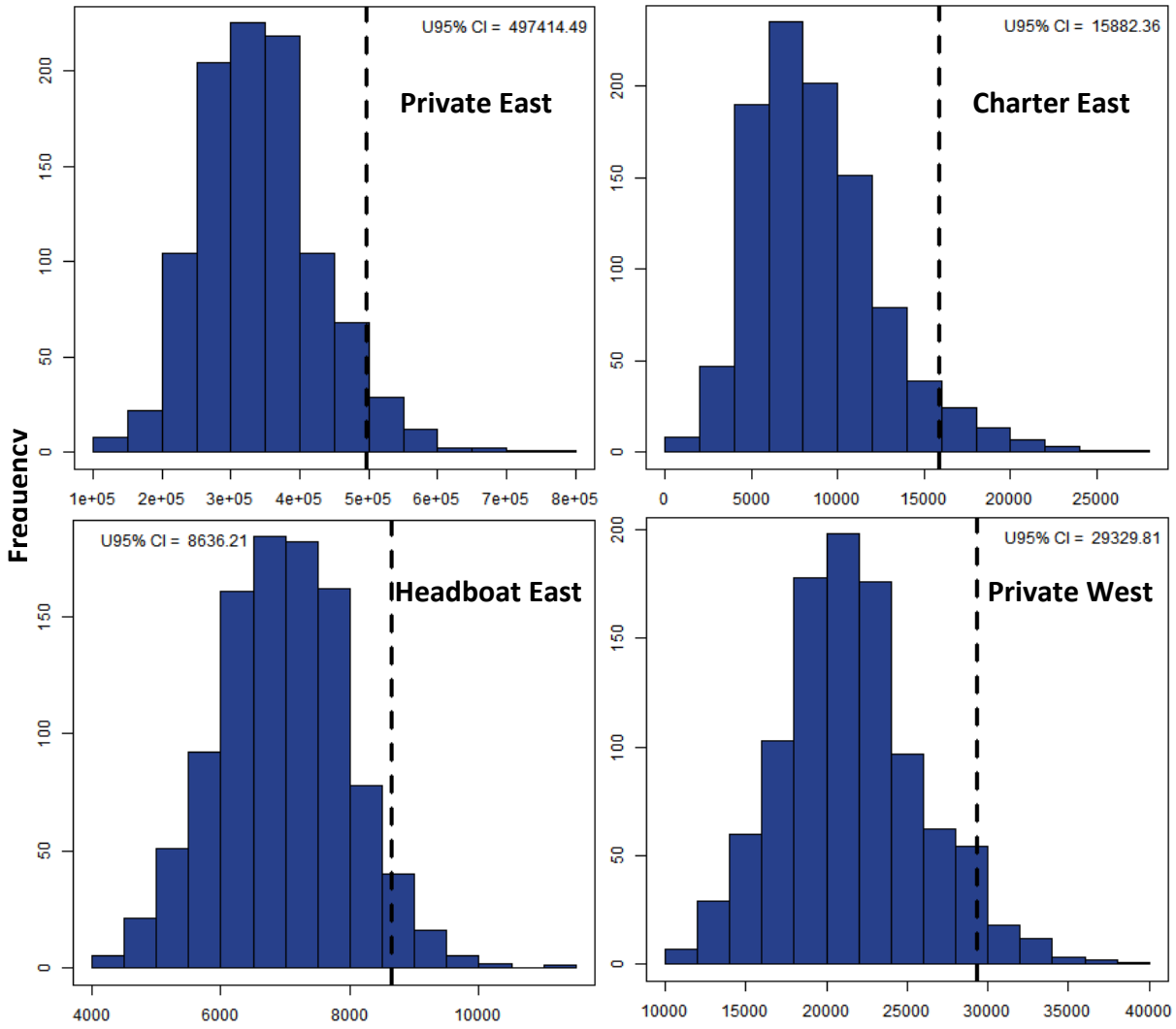

Figure 7. *Projected catch (in pounds) per federal day.* Projected catch rates from generalized linear regression fits to 1,000 bootstrapped distributions of average weight and catch (in numbers) per day for recreational red snapper in the Eastern and Western Gulf, by mode. Dashed lines denote 95% confidence limits. Note there were no significant regression fits for charter or headboat catch rates in the Western Gulf.

Table 4. Projected average weights (lb/fish) and catch rates (in numbers and lb ww) under different projection scenarios, by mode and region.

EAST	Mode	A	B	C	D	E	F
Catch (N/day)	Charter	3,178	3,178	3,178	4,319	1,003	1,767
	Private	24,673	31,581	31,581	23,070	38,176	43,738
Avg. Weight	Charter	8.85	8.85	8.50	8.85	8.85	8.85
	Private	7.50	9.08	7.50	7.84	9.08	9.08
Catch (lb ww/day)	Charter	28,124	28,124	27,007	38,215	8,879	15,636
	Private	184,951	286,896	236,740	180,876	346,803	397,339
	HB	5,486	5,486	5,486	4,905	6,959	6,957

WEST	Mode	A	B	C	D	E	F
Catch (N/day)	Charter	483	483	483	360	483	483
	Private	2,073	2,073	2,073	1,853	2,509	2,509
Avg. Weight	Charter	10.56	10.56	10.04	10.56	10.56	10.56
	Private	6.98	8.61	6.98	7.41	8.61	8.61
Catch (lb ww/day)	Charter	5,102	5,102	4,852	3,804	5,102	5,102
	Private	14,466	17,845	14,466	13,736	21,601	21,601
	HB	8,504	8,504	8,504	6,677	10,987	10,987

Table 5. Projected Gulf red snapper recreational season lengths (days) under different catch and average weight scenarios (A-F) and different assumptions regarding the implementation of Amendment 40 to the Reef Fish Fishery Management Plan (RF-40: "Sector Separation") and the compatibility of state seasons with the federal season in 2015.

State Seasons	RF-40	Sector	A	B	C	D	E	F	Mean	Median	Mode
Compatible	Implemented	For-Hire	45	45	46	40	67	55	50	46	45
		Private	16	9	12	16	8	7	11	11	16
Compatible	Not implemented	All	21	15	18	21	13	11	17	17	21
Incompatible	Implemented	For-Hire	45	45	46	40	67	55	50	46	45
		Private	11	7	9	11	6	5	8	8	11
Incompatible	Not implemented	All	17	12	14	17	10	9	13	13	17

Note: "Incompatible" state seasons assumes states implement seasons presented in Table 1.

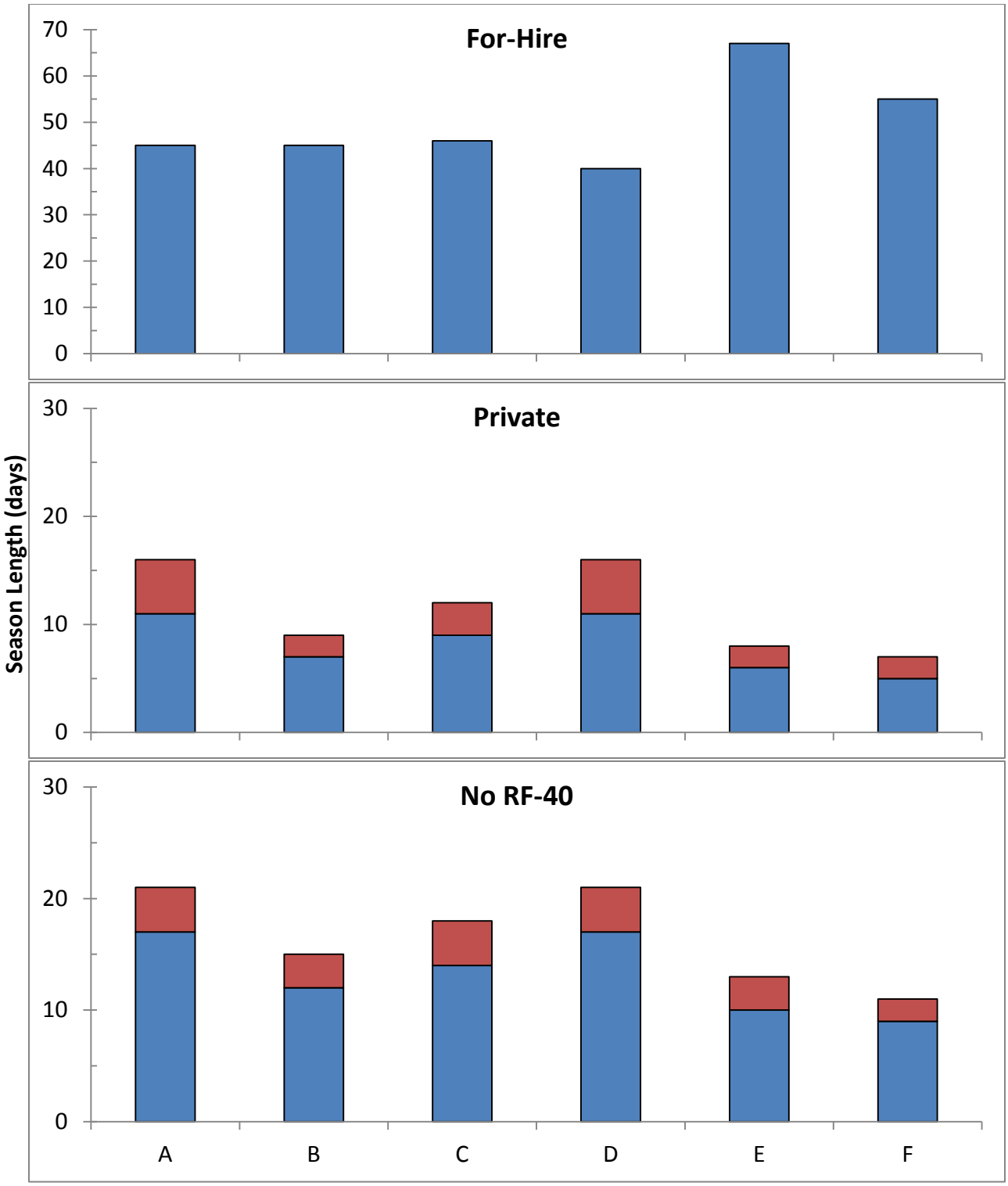

Figure 8. Projected Gulf red snapper recreational season lengths (days), by sector, under different catch and average weight scenarios (A-F) without (blue) and with (red) compatible seasons from the Gulf states. Bottom figure shows season lengths without implementation of Reef Fish Amendment 40. Note vertical axis scale is different in top figure.

Discussion

In previous years, the Gulf recreational red snapper quota has been exceeded for a variety of reasons, including challenges with predicting angler behavior and landing rates, inconsistent state regulations, and rapidly increasing fish sizes. Projection assumptions have been refined to better account for increases in landings per day and changes in average weights. These refinements have led to increasingly more accurate predictions as described in SERO-LAPP-2013-10, SERO-LAPP-2014-04, and this document's retrospective analysis. Additionally, the implementation of a 20% buffer between the ACL and ACT has accounted for management uncertainty inherent in a protracted fishing season where the majority of landings are estimated by surveys.

There is considerable uncertainty in 2015 out-of-season state waters catch rates for the season length projection scenarios presented. Limited data exist to inform this uncertainty, so the most recent data (2014: FL-LA, 2013/14: TX) were used as a proxy for anticipated 2015 out-of-season catch rates. If daily out-of-season catches in state waters are higher in 2015 than in previous years, the season lengths presented in Table 6 may be overestimates. This could happen if more anglers participate in state seasons or if red snapper population rebuilding results in higher catch rates in state waters. States adopting incompatible seasons could reduce the federal season length by 22-30% (2-4 days) in the absence of RF-40, and by 29-45% (2-5 days) for private and state-licensed charter vessels if RF-40 is implemented. RF-40 would result in a much longer federal fishing season for federally-permitted for-hire vessels (median = 46 days), with a median private season length of 11 days if states adopt compatible seasons and 8 days if states adopt the seasons presented in **Table 2**.

As with any projection model, the approaches discussed herein are dependent upon assumptions that historical data are accurately estimated and that historical trends are representative of future dynamics. Previous evaluations of Gulf recreational red snapper catch rates have indicated that effort compression (i.e., fishing pressure intensifies during open days as the season shortens) is occurring in the fishery (SERO-LAPP-2012-01). These dynamics are implicitly incorporated into the generalized linear regression approaches described by this document. Regression modeling approaches for the 2014 season (SERO-LAPP-2014-04) generated a catch rate estimate that was within 3.5% of the observed 2014 federal catch rate.

Although regression models for red snapper catch rates have provided compelling results in previous reports, several issues emerged during the regression modeling process incorporating the 2014 data. Western Gulf charter and headboat catch rate models failed to provide significant regression fits. The Western Gulf private catch rate model overestimated the final two years in the time series. The Eastern Gulf headboat catch rate model had no significant predictors and overestimated the final three years in the time series. The Eastern Gulf private catch rate model predicted catch rates in 2015 would be nearly double those in 2014, and the Eastern Gulf charter catch rate model predicted a dramatic decline. For these reasons, Scenarios E-F were considered potentially unreliable estimators for the 2015 season.

Several sensitivity runs used 2013 and 2014 data as predictors for 2015 (i.e., Scenarios A-D). Visual inspection of the catch rates presented in **Figure 4** suggested some stabilization in catch rates between the 2013-2014 seasons. This may be due to trends in red snapper recruitment to the recreational sector, reductions in the Eastern Gulf population (see **Figure 2**), or possible saturation in effort compression in the 2014 season, which was only 9 days long. Additionally, state seasons in 2013 and 2014 were longer than the federal season, which may have decelerated effort compression in the federal season. In general, season lengths based on regression models were longer for for-hire and shorter for private modes than those based on 2013-2014 data. For Scenarios A-D, under RF-40 and assuming states implement the seasons presented in **Table 2**, mean season lengths were 44 days for for-hire and 10 days for private.

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