

Analysis of Red Snapper Federal For-Hire Split Season Alternatives

LAPP/DM Branch
NOAA Fisheries Service
Southeast Regional Office
St. Petersburg, Florida

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 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 \(Reef Fish FMP\) \(FB15-006\)](#). The rulemaking for Amendment 40 provided a basis for increased flexibility in management of the recreational sector, and reduced the chance for recreational quota overruns, which could jeopardize the rebuilding of the red snapper stock. The rule established sub-quotas for federally permitted for-hire vessels and private anglers who fish for red snapper. The federal for-hire component is comprised of all for-hire operators with a valid or renewable federal reef fish charter vessel/headboat permit. The red snapper federal for-hire and private angler recreational fishing seasons open each year on June 1 and close when their respective recreational annual catch targets (ACTs) are projected to be reached.

The Council is currently considering alternative management measures such as allocation-based programs for federally-permitted charter vessels through [Amendment 41 to the Reef Fish FMP](#) and for federally-permitted headboats through [Amendment 42 to the Reef Fish FMP](#). The goals of these revisions are to provide flexibility, reduce management uncertainty, improve economic conditions, and increase fishing opportunities for charter for-hire operators and their angler passengers. During discussion of these amendments, the Council asked for an analysis of a federal for-hire split season as a comparison measure to the allocation-based programs. Two split season options proposed are:

Option 1: Open federal for-hire red snapper season April 20 – May 31, reopen September 1 until ACT projected to be exceeded.

Option 2: Open federal for-hire red snapper season June 1 – June 30, reopen October 1 until ACT projected to be exceeded.

The primary analytical challenge associated with evaluating the federal for-hire season length under these split season alternatives is the lack of recent federal for-hire catch rate data outside of June-July. Although various Gulf states have had openings outside of the federal season, fishing during those periods has been restricted to state waters. Additionally, the final rule for Amendment 30B to the Reef Fish FMP requires federally permitted reef fish for-hire vessels to comply with the more restrictive federal regulations when fishing in state waters; thus, federally-permitted vessels have been unable to fish outside the recent June-July federal

seasons. This report evaluates the anticipated federal for-hire season length under the proposed split season options by considering a broad suite of plausible scenarios and discussing the uncertainty associated with those projections.

Methods

Data Sources

Recreational red snapper landings were obtained from four data sources:

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 (“LA Creel”).
4. Texas Parks and Wildlife Department (TPWD) charter and private/rental creel survey.

MRIP for-hire red snapper landings are estimated using a combination of dockside intercepts (landings data) and a for-hire phone survey (effort data). Landings are estimated in both numbers and pounds whole weight (lb ww) by two-month waves (e.g., Wave 1 = Jan/Feb, ..., Wave 6 = Nov/Dec), area fished (inland, state, and federal waters), mode of fishing (charter, private angler mode/rental, shore), and state (west Florida, Alabama, Mississippi, and Louisiana). 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 2016 season length projections in this report. MRIP data for 2004-2015 were obtained from the Southeast Fisheries Science Center (SEFSC) Recreational Annual Catch Limit (ACL) Data (accessed March 2016).

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 2014 and 2015 [Headboat Collaborative Exempted Fishing Permit](#) (HBC) were included in the SRHS data. Headboat expanded landings were obtained through 2015 from the SEFSC Recreational ACL Data (accessed March 2016).

LDWF’s quota monitoring survey (“LA Creel”) provides estimates of the number of red snapper landed in Louisiana during the 2014 and 2015 recreational seasons. Dockside interviews were conducted by state personnel at sites that are stratified by fishing activity (Offshore Charter, Offshore Private Angler, Inshore Charter, Inshore Private Angler). Stratifying dockside sampling for sites where anglers commonly land offshore species increased the probability of encountering anglers landing red snapper. Charter captains holding a Louisiana Guide License were contacted weekly by LDWF to collect information on the total number of for-hire trips

they took the previous week. Those captains holding a Louisiana Recreational Offshore Landing Permit were surveyed at a higher rate than those not holding the permit. 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 and estimated fishing effort (as adjusted for private anglers not possessing a Louisiana saltwater fishing license or charter captains not having a Louisiana guide license). There was no MRIP sampling in Louisiana in 2014; the LA Creel survey was considered to represent the best available data for both charter and private angler modes in 2014. MRIP 2015 Louisiana charter estimates were not available at the time of projections; therefore, 2015 LA Creel survey charter estimates were used. The LA Creel survey is currently under review and undergoing certification from NOAA Fisheries.

The TPWD creel survey generates estimates of landings in numbers for charter vessels fishing off Texas. Landings are reported in numbers by high- (May 15-November 20) and low-use (November 21-May 14) time periods, area fished (state versus federal waters), and mode of fishing (charter versus private angler mode). 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. TPWD data 2004-2014 were obtained from the SEFSC Recreational ACL data. TPWD staff also provided preliminary 2015 landings for this analysis, which were parsed to MRIP wave using observed ratios from 2014.

Catch Rate Projections

A tiered projection approach was taken for forecasting red snapper recreational average weight and catch rates in the Gulf for 2016. Because state seasons are assumed to be inconsistent with federal seasons in 2016, state season average weights and daily catch rates for 2016 were based on observed values from 2015. Ten projection scenarios were developed for determining federal season length for the private angler and federal for-hire modes; five were based on recent years' data and five were based on regression methods using year, year of rebuilding, spawning stock biomass, fuel prices, per capita gross domestic product, and state and federal season lengths as predictive covariates. Catch rate projections, bootstrapping runs, and associated metrics of uncertainty are described in detail in [SERO-LAPP/DM-2016-04](#).

Out-of-Season Catch Rates

Given the lack of recent federal catch rate data outside of June-July, seven plausible states of reality were considered to scale June-July federal for-hire catch rates to other months:

1. **Unscaled**
2. **Historic (by State)**
3. **Historic (Gulf-wide)**
4. **Wind Speed (Beaufort 6)**
5. **Wave Height (Beaufort 6)**
6. **Wind Speed (Beaufort 5)**
7. **Wave Height (Beaufort 5)**

The first approach (“Unscaled”) assumes that catch rates do not vary by month, applying the catch rates projected by SERO-LAPP/DM-2016-04 in all months, by state. The second approach [“Historic (by State)”] assumes that the mean seasonal distribution of federal for-hire catch rates during the 2004-2007 federal seasons, which were open April 15-October 31, is a reasonable proxy for the seasonal distribution of catch rates under a federal for-hire split season. Under this approach, catch per open federal day was computed for each wave, by state, and the ratio of wave-specific daily catch rates for Wave 2 and Wave 5 relative to the mean daily catch rate for Waves 3-4 was averaged across years 2004-2007. The mean ratio of Wave 2 catch rates to Wave 3-4 catch rates was used as a proxy for Wave 1 and the mean ratio of Wave 5 catch rates to Wave 3-4 catch rates was used as a proxy for Wave 6. The third approach [“Historic (Gulf-wide)”] was very similar to the second, but catch rate ratios were evaluated across all Gulf states rather than by state. This provided a somewhat smoother annual trend in catch rate, especially for states with high variability and relatively low landings.

Approaches 4-7 were based on weather data obtained from the [NOAA Data Buoy Center](#). Spatially-explicit landings locations for red snapper from the Reef Fish Observer Program and the NOAA Fisheries Bottom Longline Survey were used to guide selection of data buoys with sufficient historical time series in areas near core federal red snapper catch locations off each Gulf state. Most buoys had data on hourly or half-hourly intervals from 2007-2015. For many states, multiple buoys were used (**Figure 1, Table 1**). The Beaufort Scale was used to determine seasonal trends in weather suitability for offshore fishing (**Table 2**). The Beaufort Scale was developed in 1805 by Sir Francis Beaufort for measuring sea state and associated nautical wind speeds. A Beaufort Scale 5 measurement corresponds to moderate waves taking a more pronounced long form with many white horses and some spray. A Beaufort Scale 6 measurement corresponds to large wave formation with extensive white foam crests and spray. In the United States, a Beaufort Scale wind force measurement of 6 corresponds to a Small Craft Advisory. For the fourth approach [“Wind Speed (Beaufort 6)”], the ratio of sustained wind speed measurements below a Beaufort 6 wind force (e.g., 22 knots = 11.32 m/s) to valid measurements of sustained wind speed was averaged by month, across years, over a buoy’s historical time series (2007-2015). This was used as a proxy for fishing opportunities, by month, and was averaged across buoys within states and expressed as a ratio relative to the mean of observations from June and July. A similar method was used for the fifth approach [“Wave Height (Beaufort 6)”], with fishing opportunities expressed as measurements of sustained wave heights beneath a Beaufort number 6 (e.g., 8 ft = 2.4 m mean wave height). The sixth approach [“Wind Speed (Beaufort 5)”] was less conservative about fishing opportunities, with a cut-off of Beaufort 5 wind force (e.g., 17 knots = 8.75 m/s). The seventh approach [“Wave Height (Beaufort 5)”] applied a cut-off of sustained wave heights exceeding a Beaufort number 5 (e.g., 4 ft = 1.2 m).

Projected Season Lengths

Using a Microsoft Excel-based projection tool, daily catches were tallied for each of the ten projected catch rate scenarios, scaled to each of the seven out-of-season catch rate scenarios.

The projected quota closure date and total days open were noted for each combination for both proposed split season alternatives.

Results

Catch Rate Projections

Federal for-hire catch rates were projected by state and scenario as described in [SERO-LAPP/DM-2016-04](#). Projected Gulf wide daily catch rates ranged from 42,916 to 62,828 lb ww per open federal day (lb/day), with a median daily catch rate of 50,672 lb ww/day (**Figure 2**). The median season length with a June 1 start date was projected as 48 days (range: 38-56 days). The season length of 46 days in 2016 was set based on the mean of the first two projection scenarios (i.e., “2015” and “2014”). Under most scenarios, federal for-hire catch rates were projected to be highest off Florida, followed closely by Alabama, then Texas, with relatively low catch rates off Louisiana and very low catch rates off Mississippi.

Out-of-Season Catch Rates

The “Historic (by State)” approach indicated that from 2004-2007, for most states, federal catch rates during Wave 2 (e.g., April) were comparable and occasionally higher than Waves 3 and 4 catch rates (**Figure 3**). Wave 5 catch rates were consistently the lowest for all states except Mississippi, which showed great variability due to low landings. The “Historic (Gulf-wide)” approach smoothed this variability and indicated a relatively constant catch rate from Wave 2 to Wave 4 (**Figure 3**: black line).

Most NOAA Data Buoys contained information on sustained wind speed and wave height for multiple years in the 2007-2015 period (**Figure 4**). There was relatively little variability across years with regards to fishing opportunities within months, as indicated by the relatively small standard error bars in **Figure 4**. Using a Beaufort Scale 6 cut-off, there were around 10% fewer fishing opportunities in the winter relative to the summer based on wind speed (**Figure 5A**) and around 5% fewer fishing opportunities in the winter based on wave height (**Figure 5B**). Using a Beaufort Scale 5 cut-off, there were around 30% fewer fishing opportunities in the winter relative to the summer based on wind speed (**Figure 6A**) and around 40% fewer fishing opportunities in the winter based on wave height (**Figure 6B**). Based on weather, there appeared to be slightly more fishing opportunities in the western Gulf in August as compared to June and July. Mean catch rates with confidence limits are shown in **Figure 7**.

Projected Season Lengths

For both split season alternatives, the minimum projected season length was 38 days, which was based on an unscaled catch rate and corresponded to the minimum projected season length from the ten catch rate projection scenarios presented in [SERO-LAPP/DM-2016-04](#) (**Tables 3-4, Figure 8**). There was substantial variability across model runs, as denoted by the standard errors shown in **Tables 3-4**. The Beaufort Scale 6 cut-offs for wind speed and wave

height had little impact on the projected season length relative to the “Unscaled” scenario. The Beaufort Scale 5 cut-offs predicted slightly longer second seasons. The “Historic (by State)” and “Historic (Gulf-wide)” scenarios predicted much longer seasons if catches are shifted outside the June-July period. These scenarios also had the highest variability associated with their season length predictions (**Figure 8**).

The median across all projection scenarios and catch rate scalars for split season Option 1 was 52 days; four additional days beyond the median of the 2016 federal for-hire season projections (**Table 3**). The maximum projected season length under split season Option 1 was 78 days. The 2016 federal for-hire season of 46 days was based on the mean of the projected season length under model scenarios “2015” and “2014.” Applying the same logic, split season Option 1 would result in a median season length of 50 days with an 8-day second season.

The median across all projection scenarios and catch rate scalars for split season Option 2 was 51 days; three additional days beyond the median of the 2016 federal for-hire season projections (**Table 4**). The maximum projected season length under split season Option 2 was 95 days. Applying the logic used to establish the 2016 federal for-hire season, split season Option 2 would result in a median season length of 49 days with a 19-day second season.

Discussion

Retrospective analyses in [SERO-LAPP/DM-2016-04](#) indicate that federal catch rate projections have been accurate within approximately 5% in recent years. 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 catch rates increase as the stock rebuilds and season is shortened ([SERO-LAPP/DM-2012-01](#)). These dynamics are implicitly incorporated into the generalized linear regression approaches described by [SERO-LAPP/DM-2016-04](#). The projections presented in [SERO-LAPP/DM-2016-04](#) utilized bootstrapping in combination with regression and input data uncertainty and indicated the mean risk of exceeding the ACL at a 20 percent ACT buffer was approximately 15 percent for federal for-hire component.

Substantial additional uncertainty exists for the season projections in this report, as no recent federal for-hire catch rate data are available for months outside of June and July for the entire Gulf region. Although some catch data exists outside the June and July period in state waters, no meaningful comparison could be developed with federal season catch rates due to differences in the geographic region open to fishing. Similarly, the federal season reopening in late 2010 could not be meaningfully compared to the June federal season in 2010 due to the impacts of the BP/DWH oil spill.

Since the revision of the rebuilding plan in 2007 and subsequent rebuilding of the red snapper stock ([SEDAR-31 Update 2014](#)), little data exist to inform whether there is a seasonal dynamic to red snapper catches. There are a variety of factors that could impact red snapper catch rates by month, including: 1) higher catch rates at the start of the season due to increased availability

of the stock, 2) weather impacting the ability of fishermen to safely reach locations where they can catch red snapper, 3) changes in red snapper catchability due to fish movement or behavior, and 4) scheduling conflicts (e.g., school, hunting season, football season) reducing effort outside the June-July period. This report attempted to account for the first two factors.

It is reasonable to expect that early season catch rates would be higher than later season catch rates after some portion of the exploitable stock has been removed from the water. This trend was implicitly considered in approaches 2-3 [e.g., “Historic (by State)” and “Historic (Gulf-wide)”], but was not incorporated into any of the weather-based scalars (e.g., approaches 4-7). Data from 2004-2007 suggested catch rates in Wave 2 could exceed those in Waves 3 and 4; however, this observation is based on data when the red snapper stock was more depleted in the Gulf. In a less-depleted stock, this trend may be less pronounced than it appears based on historical data. If fishermen compensate for an earlier season start date by exerting more effort in the earlier portion of the season, approaches 4-7 may underestimate potential early season catch rates and overestimate resultant season length. Similarly, if the drop-off in catch rates as the season is less pronounced in a more rebuilt stock, the substantial reductions in Waves 5-6 catch rates predicted by approaches 2-3 may be unrealistic and lead to over-estimates of season length.

Approaches 4-7 accounted for potential differences in fishing effort due to weather conditions. A cut-off at Beaufort Number 6 suggested a subtle seasonal trend with lower catch rates outside June-July due to less available fishing opportunities. This trend was much more pronounced using a cut-off at Beaufort Number 5. It seems likely that the true impacts of weather lie in between, and vary depending on the size of the for-hire vessel, with larger vessels more likely to fish in inclement conditions.

It is unknown if red snapper stock catchability varies by season, either due to behavioral differences at different water temperatures or stock movement in response to differing environmental conditions. This analysis was unable to account for these trends; however, anecdotal information suggests that fish may be less likely to bite during temperature extremes. It is unknown if the cooler weather conditions in the Gulf during the earlier and later seasons proposed in Options 1 and 2 would represent larger temperature extremes impacting catchability than the typically hot conditions during June and July.

Scheduling conflicts outside the summer months may make it more difficult for for-hire operators to book trips, leading to reduced fishing pressure and corresponding reductions in catch rates. Tourism in most Gulf states is highest in the spring and summer months when school is out. Additionally, hunting season and football season may reduce motivation to fish in fall months. If these socioeconomic factors are applicable to red snapper, the red snapper season projections in this report may be overly conservative.

In conclusion, these analyses suggest a federal for-hire split season for Gulf red snapper might result in more fishing days than the standard June-July federal season. However, the number of additional days might be limited, with some scenarios indicating little to no change in season

length (e.g., “Unscaled”, “Wind Speed: Beaufort 6”, and “Wave Height: Beaufort 6”). Substantial uncertainty exists in the length of the federal for-hire season under each split season option, with higher uncertainty for Option 2. Given the high level of uncertainty associated with season length estimates for federal for-hire split season options under consideration, caution should be used in the selection of a split season. The benefits of a limited number of extra days should be weighed against the potential drawbacks of having a smaller customer base later in the year and the increased potential for inclement weather leading to cancelation of trips.

References

- Gulf of Mexico Fishery Management Council (Gulf Council). 2014. Recreational red snapper sector separation: Final Amendment 40 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida. 306 pp.
- Gulf of Mexico Fishery Management Council (Gulf Council). 2016. Red Snapper Management for Federally Permitted Charter Vessels: Proposed Amendment 41 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida.
- Gulf of Mexico Fishery Management Council (Gulf Council). 2016. Federal Headboat Reef Fish Management: Proposed Amendment 42 to the Fishery Management Plan for the Reef Fish Resources of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida.
- SEDAR-31 Update. 2014. Gulf of Mexico Red Snapper: Stock Assessment Report. SEDAR, North Charleston, SC. Available online:
http://sedarweb.org/docs/suar/SEDARUpdateRedSnapper2014_FINAL_9.15.2015.pdf
- SERO-LAPP/DM-2013-02 Addendum. 2013. Updated 2013 Gulf of Mexico Red Snapper Recreational Season Length Estimates. NOAA Fisheries Service, Southeast Regional Office, St. Petersburg, FL, May 21, 2013; updated June 4, 2013.
- SERO-LAPP/DM-2016-04. 2016. 2016 Gulf of Mexico Red Snapper Recreational Season Length Estimates. NOAA Fisheries Service, Southeast Regional Office, St. Petersburg, FL, May 2, 2016.

Table 1. NOAA Data Buoys used as sources for archived offshore sustained wind speed and wave height information.

Station	Lat	Long	Comment
42099	27.341	-84.272	Offshore St Petersburg FL
42039	28.739	-86.006	Pensacola 115 nm SSE Of Pensacola FL
42012	30.065	-87.555	Orange Beach 44 nm SE Of Mobile AL
42040	29.203	-88.203	Luke Offshore Test Platform 63 nm South Of Dauphin Island AL
BURL1	28.905	-89.428	Southwest Pass, LA
42047	27.896	-93.597	HI-A389 TABS V South Of Lake Charles LA
42019	27.907	-95.352	Freeport TX 60 nm S
42020	26.968	-96.694	Corpus Cristi TX 60 nm SE
LOPL1	28.885	-90.025	Louisiana Offshore Oil Port

Source: NOAA Data Buoy Center (<http://www.ndbc.noaa.gov/>)

Table 2. Beaufort Scale used to determine fishing opportunities based on historical weather data¹. Source: [Encyclopedia Britannica](#).

Beaufort Number	Wind Description	Wind Speed knots	Wind Speed m/s*	Sea Disturbance #	Mean Wave Height ft	Mean Wave Height m*	Description of Sea Surface
0	calm	<1	< 0.28	0	0	0	sea like a mirror
1	light air	1–3	0.3 - 1.5	0	0	0	ripples with appearance of scales are formed, without foam crests
2	light breeze	4–6	2.1 - 3.1	1	0–1	0–0.3	small wavelets still short but more pronounced; crests have a glassy appearance but do not break
3	gentle breeze	7–10	3.6 - 5.1	2	1–2	0.3–0.6	large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses
4	moderate breeze	11–16	5.7 - 8.2	3	2–4	0.6–1.2	small waves becoming longer; fairly frequent white horses
5	fresh breeze	17–21	8.7 - 10.8	4	4–8	1.2–2.4	moderate waves taking a more pronounced long form; many white horses are formed; chance of some spray
6	strong breeze	22–27	11.3 - 13.9	5	8–13	2.4–4	large waves begin to form; the white foam crests are more extensive everywhere; probably some spray
7	moderate gale (or near gale)	28–33	14.4 - 17.0	6	13–20	4–6	sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind; spindrift begins to be seen
8	fresh gale (or gale)	34–40	17.5 - 20.6	6	13–20	4–6	moderately high waves of greater length; edges of crests break into spindrift; foam is blown in well-marked streaks along the direction of the wind
9	strong gale	41–47	21.1 - 24.2	6	13–20	4–6	high waves; dense streaks of foam along the direction of the wind; sea begins to roll; spray affects visibility
10	whole gale (or storm)	48–55	24.7 - 28.3	7	20–30	6–9	very high waves with long overhanging crests; resulting foam in great patches is blown in dense white streaks along the direction of the wind; on the whole the surface of the sea takes on a white appearance; rolling of the sea becomes heavy; visibility affected
11	storm (or violent storm)	56–63	28.8 - 32.4	8	30–45	9–14	exceptionally high waves; small- and medium-sized ships might be for a long time lost to view behind the waves; sea is covered with long white patches of foam; everywhere the edges of the wave crests are blown into foam; visibility affected
12–17	hurricane	64+	32.9+	9	over 45	over 14	the air is filled with foam and spray; sea is completely white with driving spray; visibility very seriously affected

*converted from English units

¹ Previous versions of this analysis used a Beaufort Scale source that incorrectly assigned sea disturbance numbers to Beaufort numbers, resulting in a disjunction between wind speed and wave height estimates that has been corrected here.

Table 3. Projected season lengths (days) and closure dates for federal for-hire split season Option 1: Open federal for-hire red snapper season Apr 20 – May 31, reopen September 1 until ACT projected to be exceeded. BN: Beaufort Number, EW: East/West, HBC: Headboat Collaborative.

Season Length (days)

Model	Unscaled	Historic by State	Historic Gulf-wide	Wind Speed BN=6	Wave Height BN=6	Wind Speed BN=5	Wave Height BN=5
2015	53	70	71	54	54	57	62
2014	38	38	38	39	39	42	48
2013	46	55	54	47	47	50	54
2014-2015	44	46	47	44	44	47	53
2013-2015	44	48	49	45	45	48	53
Regression (base)	49	61	60	50	49	53	57
Reg. (drop 2014)	55	74	74	55	55	59	64
Reg. (EW scaled HBC)	46	51	52	46	46	49	54
Reg. (EW)	50	63	62	51	50	54	58
Reg. (EW drop 2014)	56	77	78	57	57	60	65
Mean	48	58	59	49	49	52	57
SD	6	13	13	6	6	6	5
Median	48	58	57	49	48	52	56
Min	38	38	38	39	39	42	48
Max	56	77	78	57	57	60	65
Mean 2014-2015	46	54	55	47	47	50	55

Closure Date

Model	Unscaled	Historic by State	Historic Gulf-wide	Wind Speed BN=6	Wave Height BN=6	Wind Speed BN=5	Wave Height BN=5
2015	12-Sep	29-Sep	30-Sep	13-Sep	13-Sep	16-Sep	21-Sep
2014	28-May	28-May	28-May	29-May	29-May	1-Sep	7-Sep
2013	5-Sep	14-Sep	13-Sep	6-Sep	6-Sep	9-Sep	13-Sep
2014-2015	3-Sep	5-Sep	6-Sep	3-Sep	3-Sep	6-Sep	12-Sep
2013-2015	3-Sep	7-Sep	8-Sep	4-Sep	4-Sep	7-Sep	12-Sep
Regression (base)	8-Sep	20-Sep	19-Sep	9-Sep	8-Sep	12-Sep	16-Sep
Reg. (drop 2014)	14-Sep	3-Oct	3-Oct	14-Sep	14-Sep	18-Sep	23-Sep
Reg. (EW scaled HBC)	5-Sep	10-Sep	11-Sep	5-Sep	5-Sep	8-Sep	13-Sep
Reg. (EW)	9-Sep	22-Sep	21-Sep	10-Sep	9-Sep	13-Sep	17-Sep
Reg. (EW drop 2014)	15-Sep	6-Oct	7-Oct	16-Sep	16-Sep	19-Sep	24-Sep
Mean	28-Aug	8-Sep	8-Sep	29-Aug	29-Aug	10-Sep	15-Sep
SD	33	38	38	33	33	6	5
Median	6-Sep	17-Sep	16-Sep	7-Sep	7-Sep	10-Sep	14-Sep
Min	28-May	28-May	28-May	29-May	29-May	1-Sep	7-Sep
Max	15-Sep	6-Oct	7-Oct	16-Sep	16-Sep	19-Sep	24-Sep
Mean 2014-2015	5-Sep	14-Sep	14-Sep	6-Sep	6-Sep	8-Sep	14-Sep

Table 4. Projected season lengths (days) and closure dates for federal for-hire split season Option 2: Open federal for-hire red snapper season June 1-30, reopen October 1 until ACT projected to be exceeded. BN: Beaufort Number, EW: East/West, HBC: Headboat Collaborative.

Season Length (days)

Model	Unscaled	Historic by State	Historic Gulf-wide	Wind Speed BN=6	Wave Height BN=6	Wind Speed BN=5	Wave Height BN=5
2015	53	86	88	54	54	57	61
2014	38	48	51	39	39	40	42
2013	46	72	71	47	47	49	52
2014-2015	44	61	64	44	44	46	49
2013-2015	44	63	66	45	45	47	50
Regression (base)	49	77	77	50	50	52	55
Reg. (drop 2014)	55	90	91	56	56	59	63
Reg. (EW scaled HBC)	46	67	69	46	46	48	51
Reg. (EW)	50	79	80	51	51	53	57
Reg. (EW drop 2014)	56	94	95	57	57	61	66
Mean	48	74	75	49	49	51	55
SD	6	14	14	6	6	6	7
Median	48	75	74	49	49	51	54
Min	38	48	51	39	39	40	42
Max	56	94	95	57	57	61	66
Mean 2014-2015	46	67	70	47	47	49	52

Closure Date

Model	Unscaled	Historic by State	Historic Gulf-wide	Wind Speed BN=6	Wave Height BN=6	Wind Speed BN=5	Wave Height BN=5
2015	24-Oct	26-Nov	28-Nov	25-Oct	25-Oct	28-Oct	1-Nov
2014	9-Oct	19-Oct	22-Oct	10-Oct	10-Oct	11-Oct	13-Oct
2013	17-Oct	12-Nov	11-Nov	18-Oct	18-Oct	20-Oct	23-Oct
2014-2015	15-Oct	1-Nov	4-Nov	15-Oct	15-Oct	17-Oct	20-Oct
2013-2015	15-Oct	3-Nov	6-Nov	16-Oct	16-Oct	18-Oct	21-Oct
Regression (base)	20-Oct	17-Nov	17-Nov	21-Oct	21-Oct	23-Oct	26-Oct
Reg. (drop 2014)	26-Oct	30-Nov	1-Dec	27-Oct	27-Oct	30-Oct	3-Nov
Reg. (EW scaled HBC)	17-Oct	7-Nov	9-Nov	17-Oct	17-Oct	19-Oct	22-Oct
Reg. (EW)	21-Oct	19-Nov	20-Nov	22-Oct	22-Oct	24-Oct	28-Oct
Reg. (EW drop 2014)	27-Oct	4-Dec	5-Dec	28-Oct	28-Oct	1-Nov	6-Nov
Mean	19-Oct	13-Nov	15-Nov	19-Oct	19-Oct	22-Oct	25-Oct
SD	6	14	14	6	6	6	7
Median	18-Oct	14-Nov	14-Nov	19-Oct	19-Oct	21-Oct	24-Oct
Min	9-Oct	19-Oct	22-Oct	10-Oct	10-Oct	11-Oct	13-Oct
Max	27-Oct	4-Dec	5-Dec	28-Oct	28-Oct	1-Nov	6-Nov
Mean 2014-2015	16-Oct	7-Nov	9-Nov	17-Oct	17-Oct	19-Oct	22-Oct

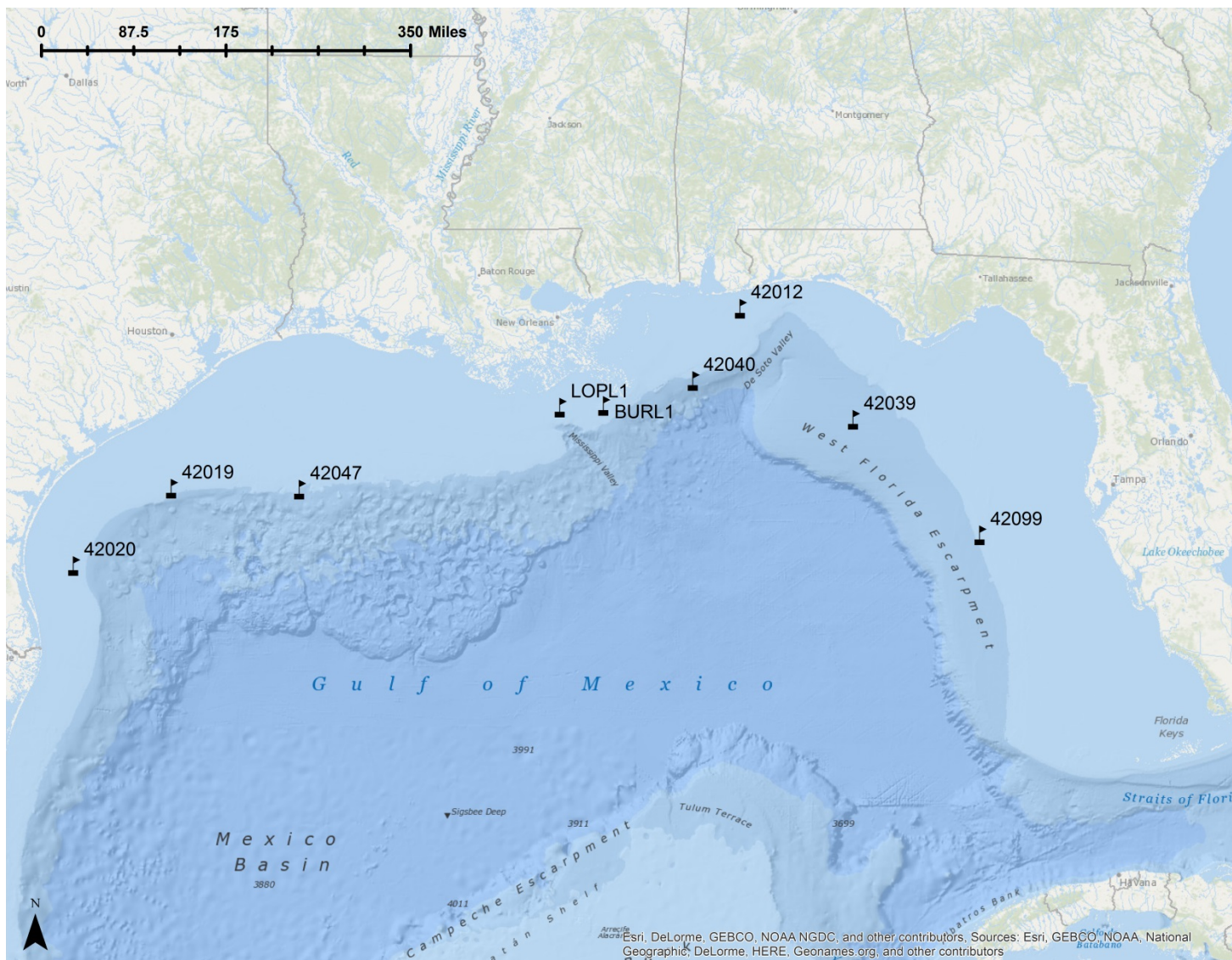


Figure 1. Locations of NOAA Data Buoys used as sources for archived sustained wind speed and wave height data.

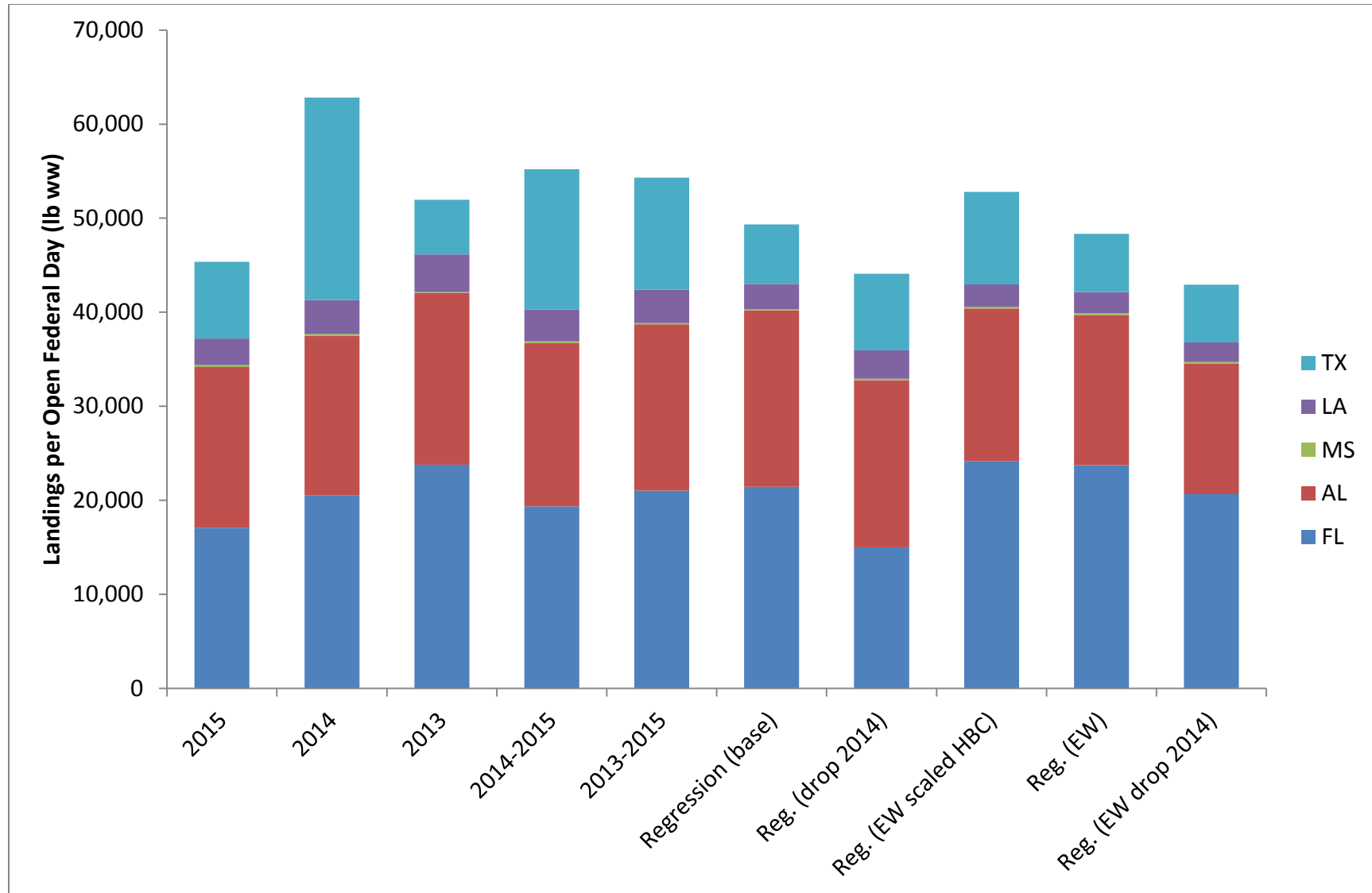


Figure 2. Projected catch rates (landed pounds whole weight per open federal day) by state under the various catch rate projection scenarios described in [SERO-LAPP/DM-2016-04](#). EW: East/West, HBC: Headboat Collaborative.

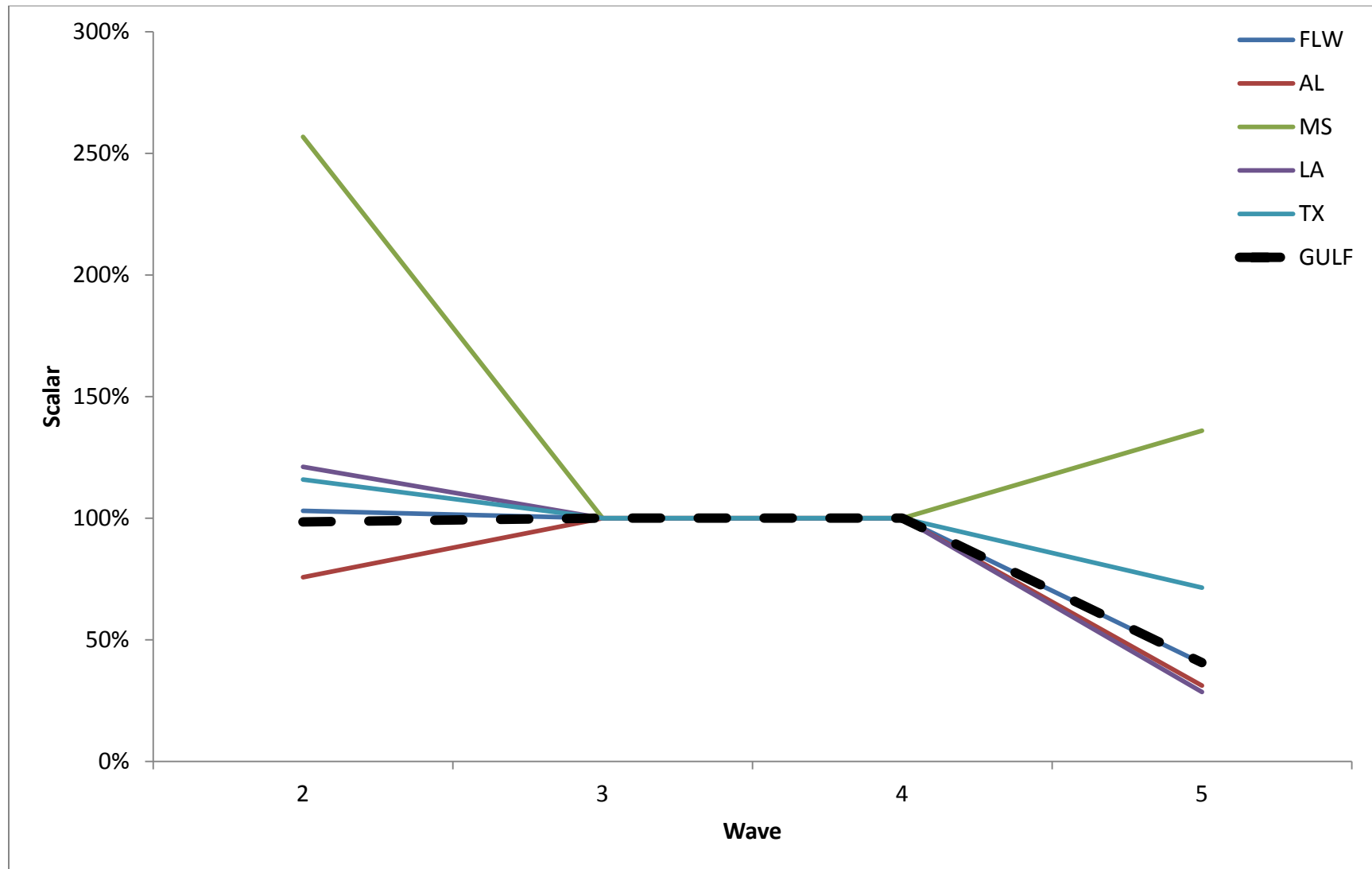


Figure 3. Scalars for catch rates outside the June-July period based on the mean ratio of landings of Wave 2 to Waves 3-4 and Wave 5 to Waves 3-4 from 2004-2007 when the federal recreational red snapper season was April 15-October 31, by state [“Historic (by State)”] and Gulf-wide [“Historic (Gulf-wide)”].

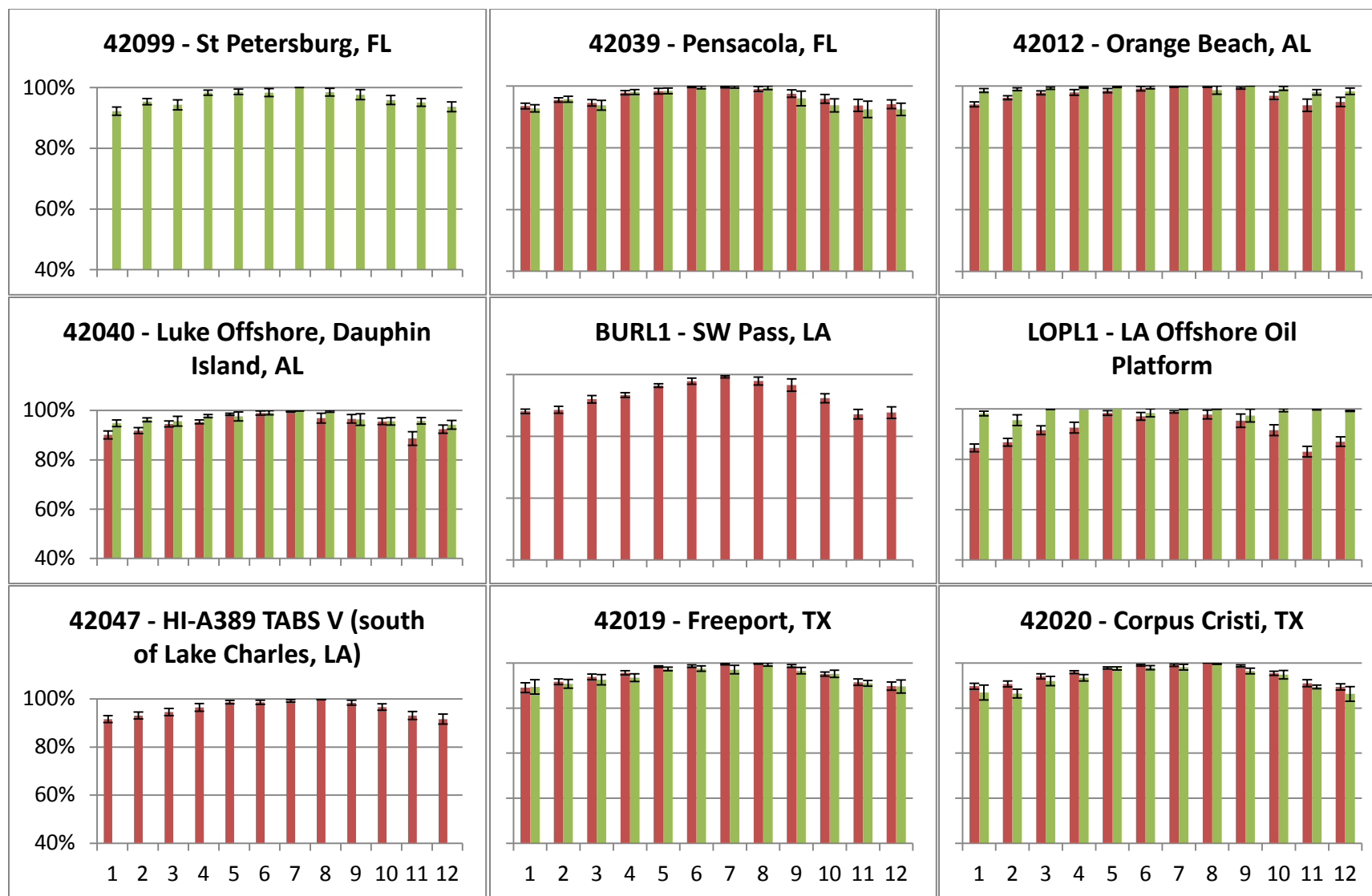


Figure 4A. Percent fishing opportunities by month, based on mean 2004-2007 archived NOAA offshore buoy data, using a Beaufort Number 6 cut-off for wind speed (red) and wave height (green).

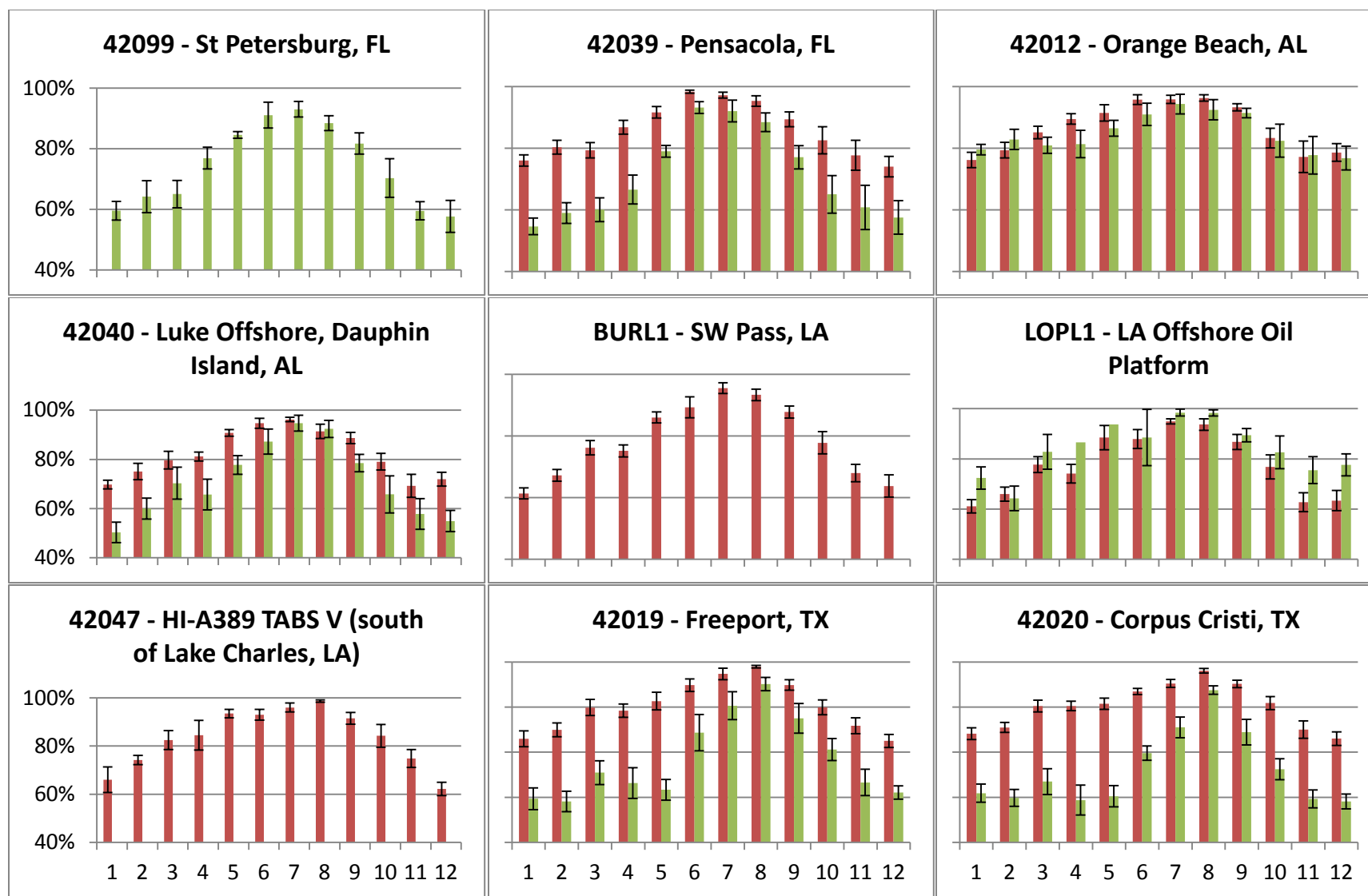


Figure 4B. Percent fishing opportunities by month, based on mean 2004-2007 archived NOAA offshore buoy data, using a Beaufort Number 5 cut-off for wind speed (red) and wave height (green).

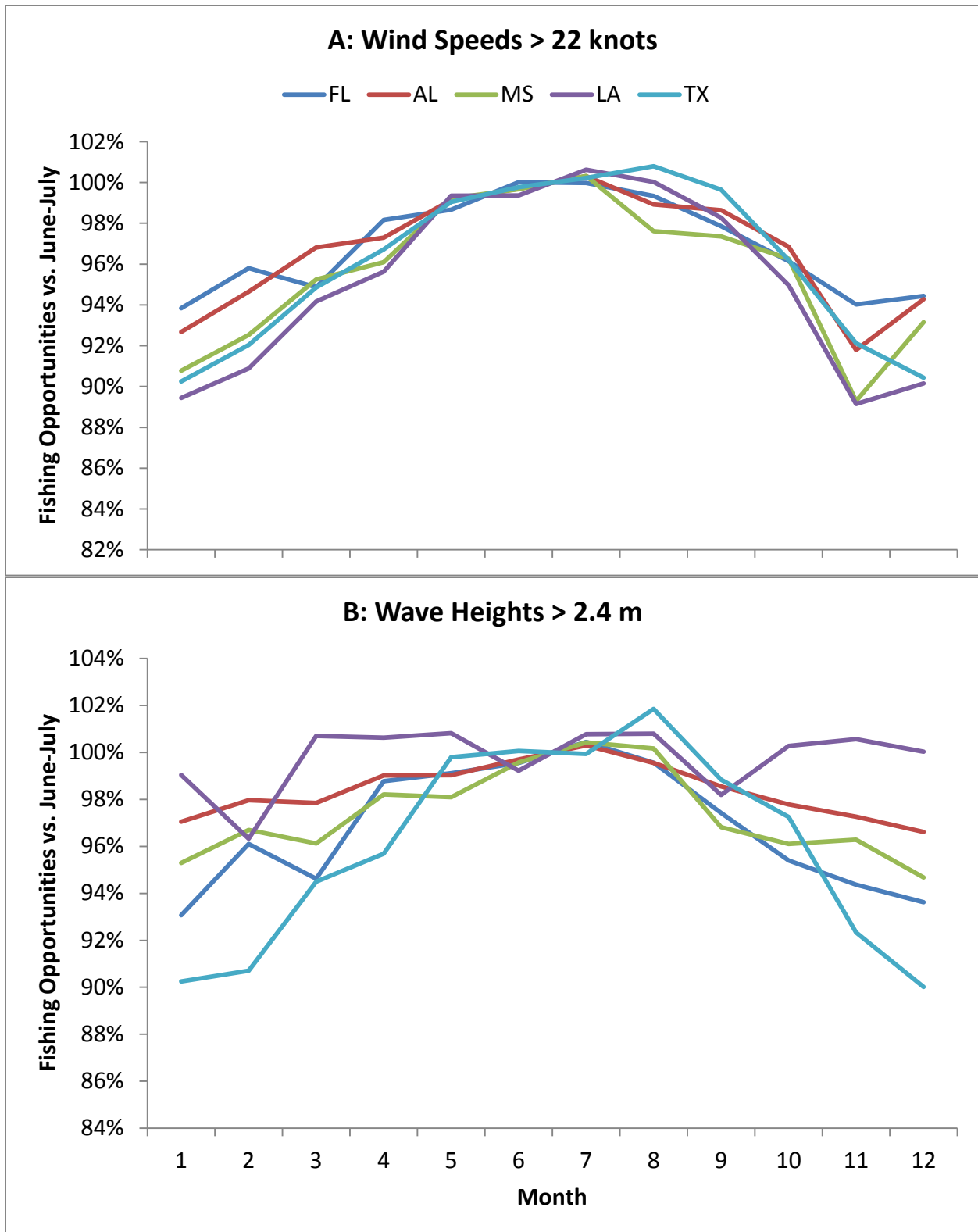


Figure 5. Percent fishing opportunities by month scaled to June-July averages, based on mean 2004-2007 archived NOAA offshore buoy data, using a Beaufort Number 6 cut-off for A) wind speed and B) wave height.

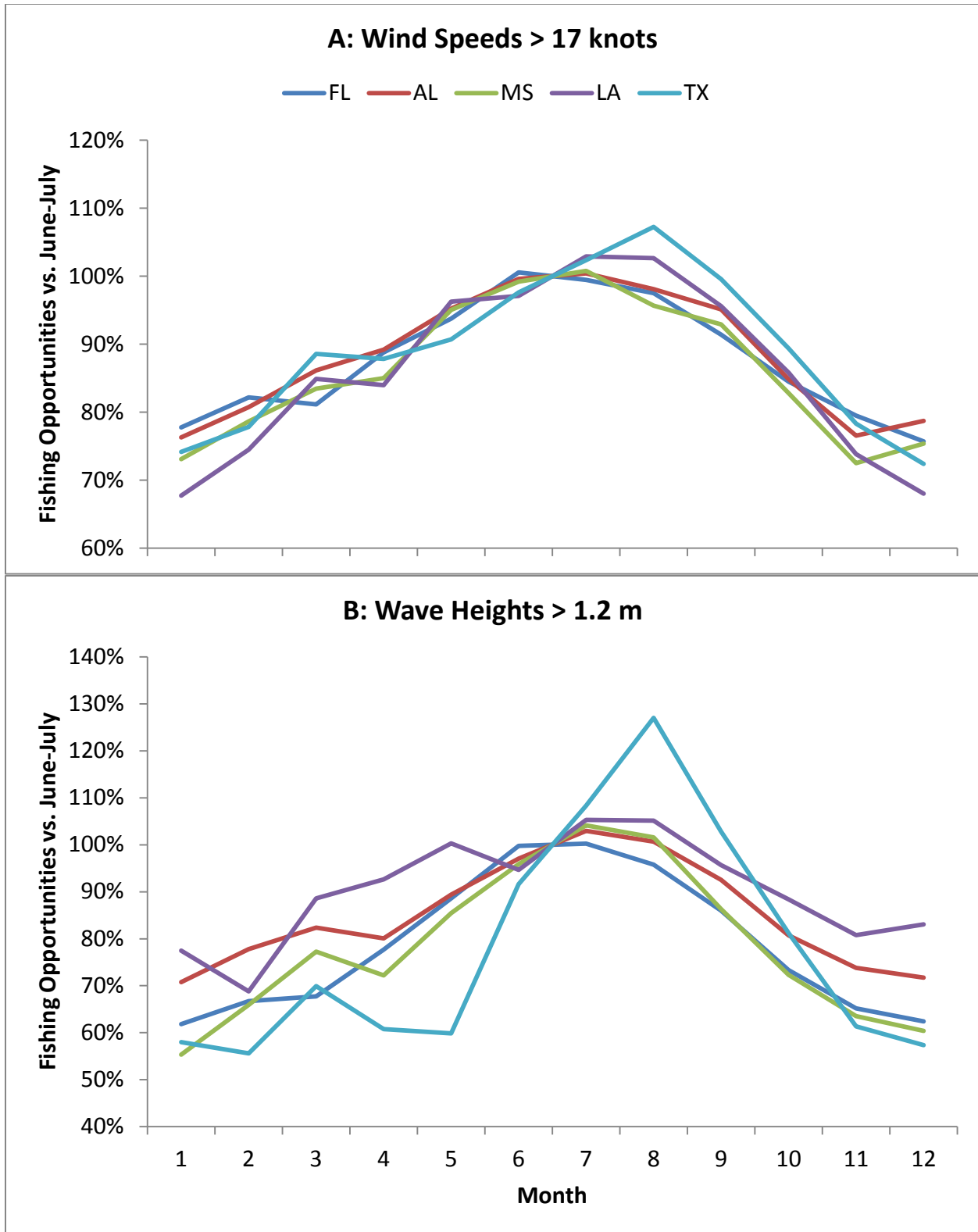


Figure 6. Percent fishing opportunities by month scaled to June-July averages, based on mean 2004-2007 archived NOAA offshore buoy data, using a Beaufort Number 5 cut-off for A) wind speed and B) wave height.

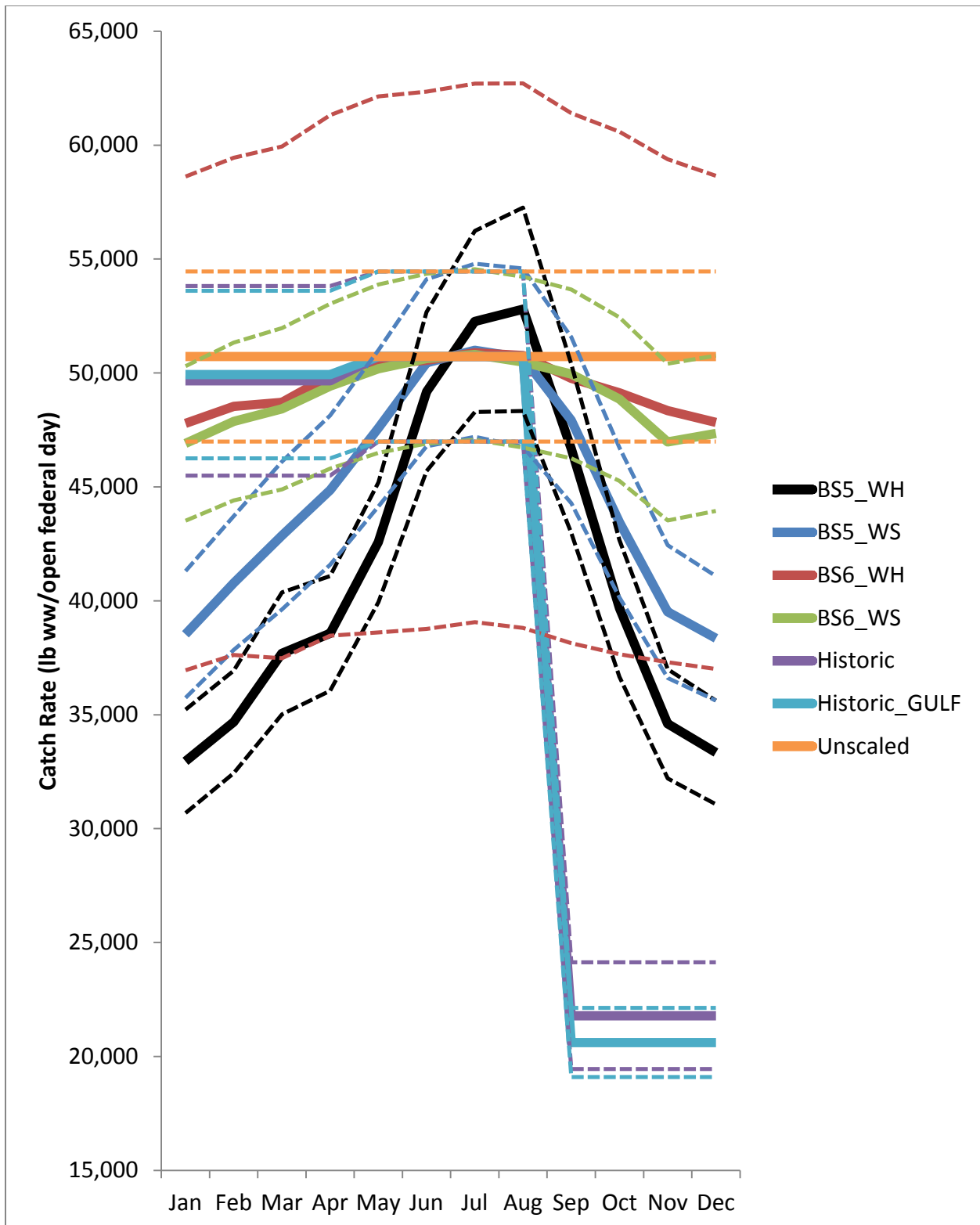


Figure 7. Mean (thick lines) and 95% confidence limits (dashed lines) for out-of-season scaled catch rates across the ten catch rate projection scenarios. BS5: Beaufort Scale number 5, BS6: Beaufort Scale number 6, Historic: Historic by state, Historic_GULF: Historic (Gulf-wide), WH: wave height, WS: wind speed.

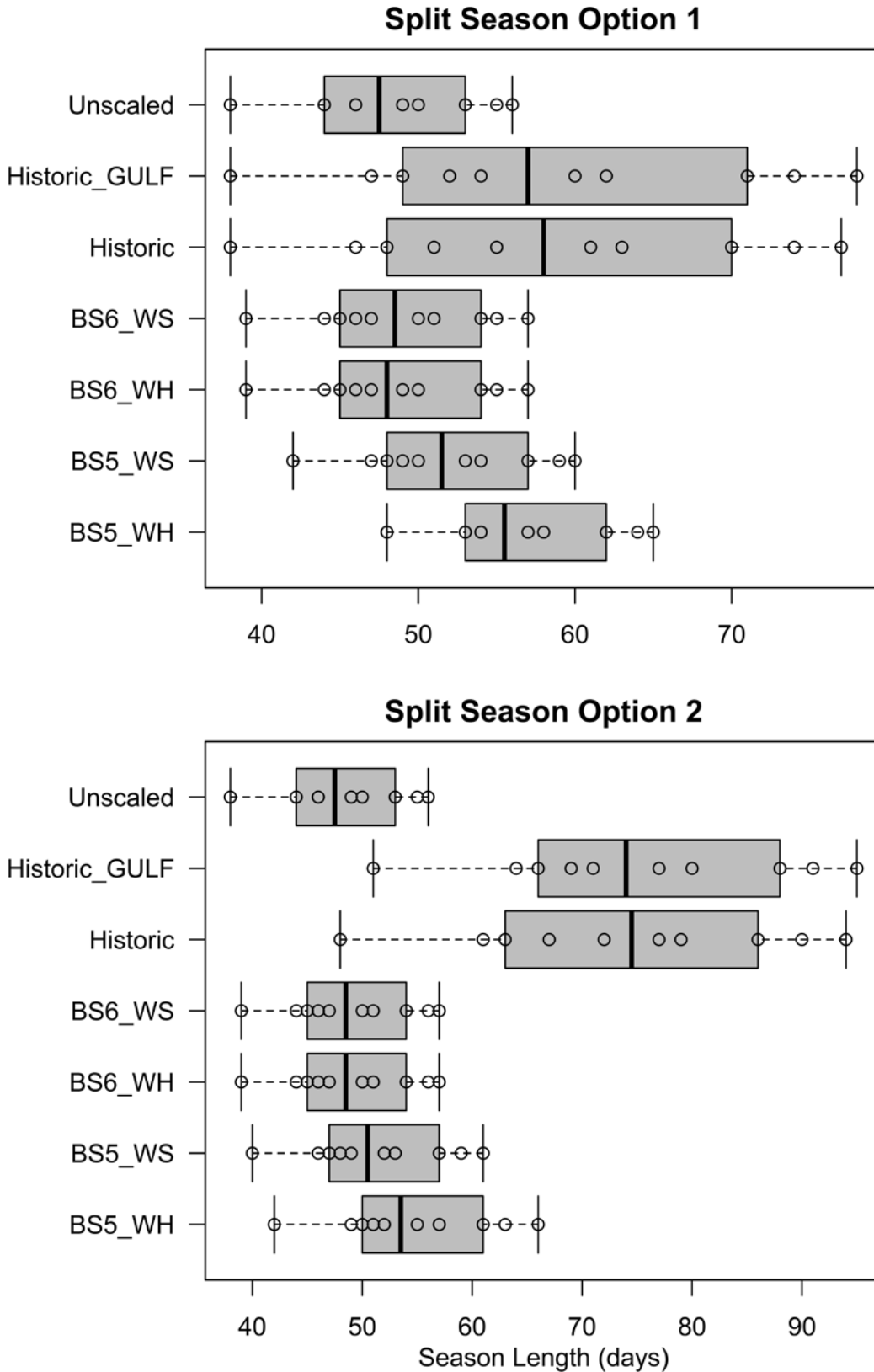


Figure 8. Projected season lengths (open days) for federal for-hire split season options 1 and 2 across ten base catch rate projection scenarios and seven seasonal catch scalar scenarios.