Standardized Catch Rate Indices for Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) during 1993-2017 by the U.S. Gulf of Mexico Vertical Line and Longline Fisheries

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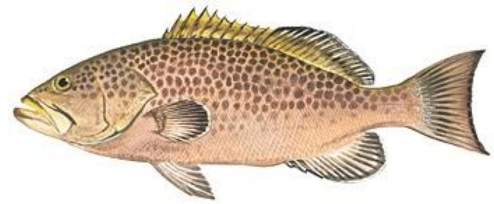

Standardized Catch Rate Indices for Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) during 1993-2017 by the U.S. Gulf of Mexico Vertical Line and Longline Fisheries

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Keywords

Catch, fishing effort, catch-per-unit-effort (CPUE), commercial fisheries, Vertical Line, Longline, Scamp and Yellowmouth Grouper, Individual Fishing Quota (IFQ)

Abstract

Standardized catch rate indices of relative abundance (catch-per-unit-effort; CPUE) were developed independently for the commercial Vertical Line and commercial Longline fisheries in the U.S. Gulf of Mexico for the SEDAR68 Research Track Scamp and Yellowmouth Grouper stock assessment. An individual fishing quota (IFQ) system began January 1, 2010 for the commercial grouper and tilefish fishery, which changed how each fishery operates. A Pre-IFQ Vertical Line index was developed using a delta-lognormal generalized linear model for the years 1993 to 2009. A Post-IFQ Vertical Line index was developed using a delta-lognormal generalized linear model for the years 2010 to 2017. A Pre-IFQ Longline index was developed using a lognormal generalized linear model for the years 1993 to 2009. A Post-IFQ Longline index was developed using a lognormal generalized linear model for the years 2010 to 2017. All indices in this document use data from the Coastal Fisheries Logbook Program and were developed following standardization methodologies consistent with previous analyses for other Gulf grouper species. Improved data filtering techniques and modifications to the trip selection approach were made as implemented in the South Atlantic region.

Introduction

The National Marine Fisheries Service (NMFS) collects information on catch and fishing effort from the commercial fishing industry in the Southeastern Region through the Southeast Fisheries Science Center's Coastal Fisheries Logbook Program (CFLP). Individuals who carry commercial federal fishing permits are required to provide information on their landings and fishing effort for each trip that they take. The CFLP in the U.S. Gulf of Mexico (GOM) began in 1990 with the objective of a complete census of reef fish fishery permitted vessel activity. Florida was the exception, where a 20% sample of vessels was targeted. Beginning in 1993, the sampling in Florida was increased to require reports from all vessels permitted in the reef fish fishery and a complete census was obtained.

Using the catch and effort data available through this program, indices of relative abundance for Scamp and Yellowmouth Grouper were developed for the Vertical Line and Longline fisheries from the U.S. GOM following standardization procedures used for other Gulf grouper species. Given the implementation of the Grouper-Tilefish Individual Fishing Quota (IFQ) program in 2010 by Amendment 29, separate indices were developed both pre-IFQ (through 2009) and post-IFQ (2010 onward). This program aimed to reduce overcapacity of the grouper-tilefish fishing fleet, increase harvesting efficiency, and eliminate the race to fish. Additional information on the IFQ program can be found at the NMFS's Southeast Regional Office webpage on limited access programs at *http://portal.southeast.fisheries.noaa.gov/cs/main.html*.

Materials and Methods

Data Source

The CFLP collects data on the catch and effort for individual commercial fishing trips. Reported information includes a unique trip identifier, the landing date, fishing gear deployed, areas fished (equivalent to NMFS shrimp statistical grids; **Figure 1**), number of days at sea, number of crew, gear specific fishing effort, species caught and whole weight of the landings. Fishing effort data available for handline and electric reel (bandit gear) trips includes the number of lines fished, total hours fished, and the number of hooks per line. Fishing effort data available for longline trips includes the number of sets and number of hooks per set.

Logbook data were used to characterize abundance trends of Scamp and Yellowmouth Grouper in the U.S. GOM. Catch-per-unit-effort (CPUE) was calculated on an individual trip basis for each fishery. Electric reel (bandit) and manual handline were combined into a single Vertical Line fishery as they are often reported together on the same trip, or one gear may be reported in place of the other, and as a result, it is not possible to apportion fishing effort separately by electric or manual handline. For the Vertical Line fishery, CPUE for each trip was defined as the whole weight of Scamp and Yellowmouth Grouper landed on a trip divided by the effort, where effort was the product of the number of lines fished, the hooks per line, and the total hours fished. For the Longline fishery, CPUE for each trip was defined as the whole weight of Scamp and Yellowmouth Grouper landed on a trip divided by the effort, where effort was the product of the number of longline sets and the number of hooks per set.

Data Filtering

General data exclusions for analyses using CFLP data were as follows:

1. Multiple areas fished may be recorded for a single fishing trip. In such cases, assigning catch and effort to specific locations was not possible; therefore, only trips in which one area fished was reported were included.

2. Multiple fishing gears may be recorded for a single fishing trip. In such cases assigning catch and effort to a particular gear type was not possible. Trips fishing multiple gears were excluded in these analyses.

3. Logbook reports submitted 45 days or more after the trip completion data were excluded due to the lengthy gap in reporting time.

4. Trips that fell outside the 99.5th percentile were considered to represent mis-reported data or data entry errors and were excluded for the following variables: number of lines for Vertical Line or number of sets for Longline, number of hooks per line, the hours fished per day, the Longline length, number of hook hours for Vertical Line, the number of days at sea (trip duration), and the number of crew members. In addition, trips fishing more the 24 Longline sets per day were excluded from this analysis. Vertical Line trips with reported fishing more than 24 hours per day were also excluded.

5. Seasonal closures and regulatory closures have been employed to manage the commercial shallow-water grouper fishery. Closures were implemented on the following dates: November 15, 2004 – December 31, 2004; and October 10, 2005 – December 31, 2005. The dataset was restricted to time periods for which fishing on Scamp and Yellowmouth Grouper was allowed.

6. No shallow-water grouper trip limits were reached between 2005 and 2008 for either fishery.

Subsetting Trips: Species Association

A method to infer targeting for each trip was used to develop each index because no direct targeting information was available. The Stephens and MacCall (2004) multispecies approach (‘SM’ Method) was used to restrict the dataset to trips that likely encountered Scamp and Yellowmouth Grouper based on the catch species composition. The SM trip selection procedure is a widely used analytical method used in identifying a set of target trips in the absence of such information. Briefly, this approach uses the species composition of each trip in a logistic regression of species presence/absence to infer if effort on that trip occurred in similar habitat occupied by Scamp and Yellowmouth Grouper. If effort on a trip was determined to occur in similar habitat occupied by Scamp and Yellowmouth Grouper, then that trip was used in the analysis (Stephens and MacCall 2004). This approach was applied separately for the Eastern U.S. GOM and Western U.S. GOM due to suspected differences in species compositions between regions. Substantial differences in habitat type have been noted between regions, as the Eastern U.S. GOM is dominated more by hard bottom habitats whereas the Western U.S. GOM has less hard structure (SEDAR 2011). In applying the Stephens and MacCall (2004) approach, the species considered were limited to reef fish species. Lastly, any trips that may have caught exclusively Scamp and Yellowmouth Grouper were kept in the dataset and included in the analysis following previous decisions for other Gulf grouper analyses.

Standardization: Vertical Line Gear

A two-stage delta-lognormal generalized linear model (GLM; Lo et al. 1992) was used to standardize for variability and non-randomness in CPUE data collection methods not caused by the year effect (i.e., to factor out year to year variations in CPUE not due to changes in abundance). This method combines two separate generalized linear model (GLM) analyses of the proportion of trips that caught at least one Scamp and Yellowmouth Grouper (i.e., proportion of positive trips) and the catch rates of the positive trips to construct a single standardized index of abundance (Lo et al. 1992, Hinton and Maunder 2004, Maunder and Punt 2004). Parameterization of each model was accomplished using a GLM procedure, a stepwise approach and Akaike's information criteria (AIC). In the first step, the proportion positive is modeled using a logit regression assuming a binomial distribution of the response variable in a type-3 model. The response variable was the proportion of successful trips across strata. In the second step, the logarithm of CPUE on positive trips (those that caught the target species) was used as the response variable assuming a normal distribution and an identity link function in a type-3 model. The two models were then combined to provide the final standardized index of abundance. For the lognormal model developed during each IFQ time period, the response variable, ln(*CPUE*) for the Vertical Line fishery, was calculated as:

ln(CPUE)=ln(whole pounds of Scamp and Yellowmouth Grouper)/(number of lines fished x hooks per line x total hours fished))

Standardization: Longline Gear

Given the high proportion of positive trips, a GLM assuming a binomial error distribution was not appropriate for the Longline fishery. A generalized linear model assuming a lognormal error distribution was used. In order to include all Scamp and Yellowmouth Grouper trips identified using the Stephens and MacCall (2004) approach, including trips that did not report Scamp and Yellowmouth Grouper landings, a constant (10% of the mean Scamp and Yellowmouth Grouper CPUE) was added to the CPUE of each trip. For the lognormal model developed during each IFQ time period, the response variable, ln(*CPUE*) for the Longline fishery, was calculated as:

ln(CPUE)=ln(whole pounds of Scamp and Yellowmouth Grouper)/(number of longline sets x number of hooks per set))

Variable Selection

A forward stepwise regression approach was utilized within the GENMOD procedure of SAS 9.2 (SAS Institute, 2008) to quantify the relative importance of the explanatory factors. First a GLM model was fit to the null model (only the intercept) and the AIC, deviance and degrees of freedom were calculated. Next, a suite of models was tested where each potential explanatory factor was added to the null model and the AIC, deviance, and degrees of freedom were recalculated. The model with the factor that had the lowest AIC became the new base model and the process was repeated adding factors individually until either the AIC was no longer further reduced or all the factors were added to the model. In addition to screening using AIC, factors were also screened and not added to the model if the reduction in deviance per degree of freedom was less than one percent. This screening was implemented in order to fit a more parsimonious model, given the fact that factors which reduce the deviance by so little exert little influence on the index trend. Once a set of fixed factors was identified, first level interactions were examined with significance of these interactions evaluated between nested models using the likelihood ratio test. Two-way interactions were screened and were only retained if the model improvement was significant according to the likelihood ratio test ($p< 0.0001$). Significant YEAR*FACTOR interaction terms were modeled as random effects.

Development of Index

For each Vertical Line index, the results of the binomial (proportion positive) and lognormal (mean CPUE on successful trips) models were multiplied to attain a single index of abundance based on the year effect. The final delta-lognormal model was fit using the SAS macro GLIMMIX (glmm800MaOB.sas: Russ Wolfinger, SAS Institute) and the SAS procedure PROC MIXED (SAS Institute Inc. 1997) following the procedures by Lo et al. (1992). For the Longline index, the index was fit using the Proc Mixed procedure in SAS. To facilitate visual comparison, a relative standardized index and relative nominal CPUE series were calculated by dividing each value in the series by the mean value for each time-series.

Results and Discussion

Pre-IFQ Vertical Line Index of Abundance

Eastern U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.44 (**Figure 2A**). The number of predicted trips were generally similar to observed trips, with both increasing until the mid-2000s and declining thereafter (**Figure 2B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 2C**). Changes in nominal CPUE were more pronounced after applying the Stephens and MacCall (2004) approach, as nominal CPUE remained low in the first half of the time series and relatively higher in the latter half of the time series (**Figure 2D**). This method retained 20% of the total trips, and 61.6% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 106,908 trips and the proportion positive was 0.21, and after selection there were 21,365 trips and the proportion positive was 0.65. **Table A1** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 35 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A2**). Bar Jack, Speckled Hind, Silk Snapper, Red Grouper, and Almaco Jack were positively correlated to Scamp and Yellowmouth Grouper whereas Yellowtail Snapper, Bluestriped Grunt, Hogfish, Lg Atlantic Black Sea Bass, and White Grunt were negatively correlated.

Western U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.42 (**Figure 3A**). The number of predicted trips were generally similar to observed trips, with both increasing until the mid 2000s and declining sharply until 2009 (**Figure 3B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 3C**). After applying the Stephens and MacCall (2004) approach, nominal CPUE remained relatively low throughout the 1990s, increased until 2004, and peaked in 2009 (**Figure 3D**). This method retained 20.7% of the total trips, and 58.7% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 32,215 trips and the proportion positive was 0.23, and after selection there were 6,684 trips and the proportion positive was 0.65. **Table A3** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 33 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A4**). Marbled Grouper, Yellowedge Grouper, Vermilion Snapper, Yellowtail Snapper, and Bar Jack were positively correlated to Scamp and Yellowmouth Grouper whereas Blue Runner, Black Snapper, and Gray (mangrove) Snapper were negatively correlated.

Regional Comparison of Species Associations from Stephens and MacCall (2004)

Trends in the U.S. GOM tended to be dominated by the Eastern U.S. GOM (correlation = 0.99). Some differences in species associations were evident between the Western U.S. GOM and Eastern U.S. GOM (correlation = 0.24) (**Figure 4**).

The derived probability threshold, percent of trips retained, and proportion positive after applying the Stephens and MacCall (2004) approach were similar across regions (**Figure 5**). However, the proportion positive before applying the Stephens and MacCall (2004) approach was slightly higher in the Western U.S. GOM compared to the Eastern U.S. GOM (**Figure 5**).

Variable Selection

The following factors were treated as fixed effects and were examined as possible influences on the proportion of positive trips and on the catch rates of positive trips:

Name	DF	Details
Year	17	1993-2009
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	4	1 (areas 1-7), 2 (area 8), 3 (areas 9-11), 4 (areas 12-21)
Crew	3	1 (1-2 crew), 2 (3 crew), 3 (4-6 crew)

Name	DF	Details
Away	4	1 (1-2 days), 2 (3-4 days), 3 (5-6 days), 4 (7-12 days)
Hookhrs*	4	1 (1-180), 2 (181-660), 3 (661-2,400), 4 (2,401-12,400)

*Only explored as factors for modeling success because these factors were confounded with effort for the CPUE response variable in the lognormal model.

The number of trips and proportion positive of trips by factor bins are provided in **Table B1** and **Table B2**, respectively.

Index of Abundance

Final deviance tables are included in **Table 1**. The final models for the binomial (i.e., proportion positive) and lognormal (catch rate of positive trips) components were:

$$ProportionPositive = YEAR + AWAY + HOOKHRS$$

$$ln(CPUE) = YEAR + AREA + AWAY + CREW + YEAR * AREA$$

Diagnostics for each component of the GLM are provided in **Figure 6** and **Figure 7**. The overdispersion parameter for the binomial component was 2.43. The binomial model generally overestimated the proportion of positive trips with the exception of the last few years (**Figure 6A**). The predicted proportion positive ranged from 0.59 to 0.77, and has generally remained between 0.62 and 0.75. Residual analysis of the binomial model showed no obvious patterns in the residuals by year (**Figure 6B**), days away at sea (**Figure 6C**), or hook hours (**Figure 6D**).

The lognormal model results suggest a good fit to the data and indicated that the assumption of a lognormal distribution for positive catch rates was appropriate for the data (**Figure 7A-B**). Residual analysis of the lognormal model also showed no obvious patterns in the residuals by year (**Figure 7C**), area (**Figure 7D**), days away at sea (**Figure 7E**), or crew size (**Figure 7F**).

Table 2 summarizes the standardized index, corresponding lower and upper 95% confidence limits, annual coefficients of variation, nominal CPUE, and number of trips. Nominal CPUE values fell within the 95% confidence interval of the standardized index for all years (**Figure 8**). Relative abundance has remained fairly stable throughout the time series, with peak abundance in 1997 and the lowest value in 2000 (**Figure 8**).

Post-IFQ Vertical Line Index of Abundance

Eastern U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.5 (**Figure 9A**). Both predicted and observed trips were relatively stable over time, with the exception of an increase in 2012 (**Figure 9B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 9C**).

Nominal CPUE was relatively similar both before and after applying the Stephens and MacCall (2004) approach, with the largest value observed in 2013 and relatively low values in the first few years of the time series (**Figure 9D**). This method retained 23.7% of the total trips, and 66.6% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 28,313 trips and the proportion positive was 0.25, and after selection there were 6,704 trips and the proportion positive was 0.72. **Table A5** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 33 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A6**). Speckled Hind, Warsaw Grouper, Bar Jack, Snowy Grouper, and Red Grouper were positively correlated to Scamp and Yellowmouth Grouper whereas Lg Atlantic Black Sea Bass, Hogfish, White Grunt, Yellowtail Snapper, and Blue Runner were negatively correlated.

Western U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.51 (**Figure 10A**). The number of predicted trips were generally similar to observed trips, with both increasing from 2011 to 2016 then declining (**Figure 10B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 10C**). Changes in nominal CPUE were more pronounced after applying the Stephens and MacCall (2004) approach, with lower values in the first few and last years of the time series (**Figure 10D**). This method retained 28% of the total trips, and 79.8% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 5,794 trips and the proportion positive was 0.29, and after selection there were 1,625 trips and the proportion positive was 0.83. **Table A7** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 34 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A8**). Speckled Hind, Yellowedge Grouper, Vermilion Snapper, Almaco Jack, and Banded Rudderfish were positively correlated to Scamp and Yellowmouth Grouper whereas Misty Grouper, Unc Snappers, Queen Snapper, Gray (mangrove) Snapper, and Jolthead Porgy were negatively correlated.

Regional Comparison of Species Associations from Stephens and MacCall (2004)

Trends in the U.S. GOM tended to be dominated by the Eastern U.S. GOM (correlation = 0.98). Some differences in species associations were evident between the Western U.S. GOM and Eastern U.S. GOM (correlation = 0.47 (**Figure 11**).

The derived probability threshold was similar across regions (**Figure 12**). The proportion positive both before and after applying the Stephens and MacCall (2004) approach and the percent of trips retained were higher in the Western U.S. GOM compared to the Eastern U.S. GOM (**Figure 12**).

Variable Selection

The following factors were treated as fixed effects and were examined as possible influences on the proportion of positive trips and on the catch rates of positive trips:

Name	DF	Details
Year	8	2010-2017
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	4	1 (areas 2-6), 2 (areas 7-8), 3 (areas 9-10), 4 (areas 11-21)
Crew	3	1 (1-2 crew), 2 (3 crew), 3 (4-7 crew)
Away	4	1 (1-4 days), 2 (5 days), 3 (6-7 days), 4 (8-14 days)
Scamp IFQ	4	1 (NA), 2 (0-650 pounds), 3 (651-1,659 pounds), 4 (1,660-3,636 pounds), 5 (3,637-129,440 pounds)
Depth	4	1 (0-120 m), 2 (121-175 m), 3 (176-200 m), 4 (201-700 m)
Hookhrs*	4	1 (0.3-300), 2 (301-1,760), 3 (1,761-4,032), 4 (4,033-15,000)

*Only explored as factors for modeling success because these factors were confounded with effort for the CPUE response variable in the lognormal model.

The number of trips and proportion positive of trips by factor bins are provided in **Table B3** and **Table B4**, respectively.

Index of Abundance

Final deviance tables are included in **Table 3**. The final models for the binomial (i.e., proportion positive) and lognormal (catch rate of positive trips) components were:

$$ProportionPositive = YEAR + AWAY + DEPTH + SCAMPIFQ + CREW + DEPTH * CREW$$

$$ln(CPUE) = YEAR + AREA + AWAY + CREW + DEPTH + AREA * DEPTH$$

Diagnostics for each component of the GLM are provided in **Figure 13** and **Figure 14**. The overdispersion parameter for the binomial component was 1.22. The binomial model consistently overestimated the proportion of positive trips (**Figure 13A**). The predicted proportion positive ranged from 0.79 to 0.84, and has generally remained between 0.8 and 0.83. Residual analysis of the binomial model showed a consistent positive bias in the residuals by year (**Figure 13B**), days away at sea (**Figure 13C**), depth (**Figure 13D**), scamp IFQ (**Figure 13E**), or crew size (**Figure 13F**).

The lognormal model results suggest a good fit to the data and indicated that the assumption of a lognormal distribution for positive catch rates was appropriate for the data (**Figure 14A-B**). Residual analysis of the lognormal model also showed no obvious patterns in the residuals by year (**Figure 14C**), area (**Figure 14D**), days away at sea (**Figure 14E**), crew size (**Figure 14F**), or depth (**Figure 14G**).

Table 4 summarizes the standardized index, corresponding lower and upper 95% confidence limits, annual coefficients of variation, nominal CPUE, and number of trips. The majority of nominal values fell outside the 95% confidence interval (**Figure 15**). Relative abundance has remained fairly stable throughout the time series, with peak abundance in 2016 and the lowest value in 2011 (**Figure 15**).

Pre-IFQ Longline Index of Abundance

Eastern U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.56 (**Figure 16A**). Observed and predicted trips were very similar over time, with a gradual increase until 2006 followed by a decline (**Figure 16B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 16C**). Nominal CPUE was very similar both before and after applying the Stephens and MacCall (2004) approach, with a general increasing trend throughout the time series, with the exception of a peak in 1999 and a low value in 2006 (**Figure 16D**). This method retained 43.2% of the total trips, and 75.3% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 17,281 trips and the proportion positive was 0.45, and after selection there were 7,468 trips and the proportion positive was 0.78. **Table A9** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 32 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A10**). Gag Grouper, Bar Jack, Red Grouper, Black Grouper, and Vermilion Snapper were positively correlated to Scamp and Yellowmouth Grouper whereas Lane Snapper and Mutton Snapper were negatively correlated.

Western U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.44 (**Figure 17A**). The number of predicted trips were generally similar to observed trips, with both showing a general decreasing trend throughout the time series (**Figure 17B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 17C**). After applying the Stephens and MacCall (2004) approach, nominal CPUE remained relatively low throughout the time series, with the exception of the last few years (**Figure 17D**). This method retained 18.2% of the total trips, and 62.6% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 2,429 trips and the proportion positive was 0.19, and after selection there were 441 trips and the proportion positive was 0.64. **Table A11** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 25 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A12**). Gag Grouper, Bar Jack, Crevalle, Yellowfin Grouper, and Yellowedge Grouper were positively correlated to Scamp and Yellowmouth Grouper whereas Lesser Amberjack, Gray (mangrove) Snapper and Banded Rudderfish were negatively correlated.

Regional Comparison of Species Associations from Stephens and MacCall (2004)

Trends in the U.S. GOM tended to be dominated by the Eastern U.S. GOM (correlation = 0.98) (**Figure 18**), with associations in the Western U.S. GOM differing considerably from the Eastern U.S. GOM (correlation = 0.25) (**Figure 18**).

The derived probability threshold, percent of trips retained, and proportion positive after applying the Stephens and MacCall (2004) approach were similar between the Eastern U.S. GOM and the U.S. GOM (**Figure 19**). All metrics were much lower for the Western U.S. GOM compared to the Eastern U.S. GOM (**Figure 19**).

Variable Selection

The following factors were treated as fixed effects and were examined as possible influences on the catch rates of positive trips:

Name	DF	Details
Year	17	1993-2009
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	3	1 (areas 1-4), 2 (area 5), 3 (area 6), 4 (areas 7-21)
Length	3	1 (0.5-4), 2 (4.1-5), 3 (5.1-6), 4 (6.1-60)
Crew	4	1 (1-2 crew), 2 (3 crew), 3 (4-6 crew)
Away	4	1 (1-7 days), 2 (8-10 days), 3 (11-13 days), 4 (14-20 days)

The number of trips and proportion positive of trips by factor bins are provided in **Table B5** and **Table B6**, respectively.

Index of Abundance

The final deviance table is included in **Table 5**. The final model for the lognormal (catch rate of positive trips) component was:

$$ln(CPUE) = YEAR + AWAY$$

Diagnostics for the lognormal component of the GLM are provided in **Figure 20**. The lognormal model results suggest a relatively poor fit to the data and indicated that the assumption of a lognormal distribution for positive catch rates may not be appropriate for the data (**Figure 20A-B**). Residual analysis of the lognormal model also showed a negative bias in the residuals by year (**Figure 20C**) and days away at sea (**Figure 20D**).

Table 6 summarizes the standardized index, corresponding lower and upper 95% confidence limits, annual coefficients of variation, nominal CPUE, and number of trips. The majority of nominal values fell within the 95% confidence interval, with the exception of 1993, 1995, 1996, 1998, 1999 and 2009 (**Figure 21**). Relative abundance remained fairly stable throughout the first half of the time series, with peak abundance in 2009 and the lowest value in 1994 (**Figure 21**).

Post-IFQ Longline Index of Abundance

Eastern U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.67 (**Figure 22A**). Observed and predicted trips were nearly identical over time, with a gradual increase throughout the time series (**Figure 22B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 22C**). Nominal CPUE was very similar both before and after applying the Stephens and MacCall (2004) approach, with a general decreasing trend throughout the time series, with the exception of spikes in 2013 and 2016 (**Figure 22D**). This method retained 62.3% of the total trips, and 87.9% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 3,813 trips and the proportion positive was 0.62, and after selection there were 2,374 trips and the proportion positive was 0.87. **Table A13** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 32 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A14**). Red Grouper, Almaco Jack, Gag Grouper, Black Grouper, and Schoolmaster Snapper were positively correlated to Scamp and Yellowmouth Grouper whereas Cubera Snapper, Lane Snapper, Snowy Grouper, Red Hind, and Greater Amberjack were negatively correlated.

Western U.S. GOM Trip Selection using Stephens and MacCall (2004)

The minimum difference between the predicted and the observed number of trips that reported Scamp and Yellowmouth Grouper occurred at the probability threshold of 0.49 (**Figure 23A**). The number of predicted trips were generally similar to observed trips, with both showing a general increasing trend until 2017 (**Figure 23B**). Trips with a predicted probability greater than the critical threshold probability were considered as trips that targeted Scamp and Yellowmouth Grouper (**Figure 23C**). After applying the Stephens and MacCall (2004) approach, nominal CPUE remained relatively low throughout the time series, with the exception of a very large spike in 2011 (**Figure 23D**). This method retained 6.9% of the total trips, and 76.2% of trips that reported Scamp and Yellowmouth Grouper. Prior to trip selection, there were 1,864 trips and the proportion positive was 0.07, and after selection there were 128 trips and the proportion positive was 0.77. **Table A15** provides the total trips after logbook filtering and SM trip selection per year.

The Stephens and MacCall (2004) trip subsetting approach identified 28 reef fish species which were captured with Scamp and Yellowmouth Grouper (**Table A16**). Yellowedge Grouper, Speckled Hind, Black Grouper, Yellowtail Snapper, and Misty Grouper were positively correlated to Scamp and Yellowmouth Grouper whereas Bar Jack, Queen Snapper, Unc Snappers, Blue Runner, and Silk Snapper were negatively correlated.

Regional Comparison of Species Associations from Stephens and MacCall (2004)

Trends in the U.S. GOM tended to be dominated by the Eastern U.S. GOM (correlation = 0.96) (**Figure 24**), with associations in the Western U.S. GOM differing considerably from the Eastern U.S. GOM (correlation = 0.13) (**Figure 24**).

The percent of trips retained and proportion positive after applying the Stephens and MacCall (2004) approach were similar between the Eastern U.S. GOM and the U.S. GOM, although the Eastern U.S. GOM analysis displayed both a higher probability threshold and proportion positive before applying the Stephens and MacCall (2004) approach (**Figure 25**). Reduced metrics were evident for the Western U.S. GOM compared to the Eastern U.S. GOM (**Figure 25**).

Variable Selection

The following factors were treated as fixed effects and were examined as possible influences on the catch rates of positive trips:

Name	DF	Details
Year	8	2010-2017
Month	12	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
Area	3	1 (areas 1-4), 2 (area 5), 3 (area 6-21)
Length	3	1 (1-4), 2 (4.1-5), 3 (5.1-10)
Crew	4	1 (1-2 crew), 2 (3 crew), 3 (4 crew), 4 (5-6 crew)
Away	4	1 (1-9 days), 2 (10-12 days), 3 (13-14 days), 4 (15-21 days)
Depth	4	1 (20-150 m), 2 (151-200 m), 3 (201-250 m), 4 (251-1,000 m)
Season	2	1 (35 ftms), 2 (open)
IFQ	4	1 (NA), 2 (0-1,765 pounds), 3 (1,766-5,145 pounds), 4 (5,146-11,311 pounds), 5 (11,312-171,562 pounds)

The number of trips and proportion positive of trips by factor bins are provided in **Table B7** and **Table B8**, respectively.

Index of Abundance

The final deviance table is included in **Table 7**. The final model for the lognormal (catch rate of positive trips) component was:

$$ln(CPUE) = YEAR + DEPTH$$

Diagnostics for the lognormal component of the GLM are provided in **Figure 26**. The lognormal model results suggest a good fit to the data and indicated that the assumption of a lognormal distribution for positive catch rates was appropriate for the data (**Figure 26A-B**). Residual analysis of the lognormal model also showed no obvious patterns in the residuals by year (**Figure 26C**) or depth (**Figure 26D**).

Table 8 summarizes the standardized index, corresponding lower and upper 95% confidence limits, annual coefficients of variation, nominal CPUE, and number of trips. The majority of nominal values fell outside the 95% confidence interval (**Figure 27**). Relative abundance has remained fairly stable throughout the time series, with peak abundance in 2013 and the lowest value in 2014 (**Figure 27**).

Comments on Adequacy for Assessment

The commercial indices presented in this working paper were developed using continuity approaches applied in previous Gulf grouper stock assessments. However, as discussed in past evaluations, concerns remain over using CFLP data to develop indices reflective of trends in relative abundance of the population. First, CFLP data reflect landings only and do not include reliable data on discarded fish. Second, the data collected on depth fished for a trip may be unreliable when reported. The logbook data forms contain a single line for entry of a single area and a single depth, which may not allow for accurate characterization of the various areas or depths fished during a single trip. Lastly, the implementation of the IFQ program in 2010 changed the way the fisheries operated by reducing the race to fish and striving for reduced discards. Fishermen were allowed more flexibility in their fishing practices (e.g., seasonal targeting or regional targeting depending upon species they have quota for or market prices). As a result, changes in catchability may mask true trends in population abundance.

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Tables

Table 1. Deviance tables for the regression models for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line index. The table shows the order of the factors as they were sequentially added to each model. Fit diagnostics listed for each factor were the diagnostics from a model that included that factor and all of the factors listed above it in the tables below.

Factor	DF	Deviance	Residual DF	Residual Deviance	AIC	Deviance Reduced	Log likelihood	Likelihood Ratio Test
Binomial								
Null	1	36161	28048	36161	36161	-	-18080	-
Away	4	34154	28045	2007	34153	5.54%	-17077	2007
Hookhrs	4	33379	28042	774	33379	2.26%	-16690	774
Year	17	32949	28026	430	32949	1.23%	-16475	430
Lognormal								
Null	1	119927	28045	119927	120343	-	-60172	-
Area	4	108387	28042	11540	117505	9.61%	-58753	2838
Away	4	101519	28039	6868	115670	6.33%	-57835	1836
Crew	3	99951	28037	1569	115233	1.54%	-57616	437
Year	17	98537	28021	1414	114833	1.36%	-57417	400
Area*Year	49	96905	27973	1631	114365	1%	-57183	468

Table 2. Numbers (N) of total and positive trips, proportion of positive trips (PPT), relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line index.

Year	N	Positive N	PPT	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
1993	1006	645	0.641	0.870	0.986	0.591	1.643	0.260
1994	1239	735	0.593	0.857	0.849	0.511	1.410	0.258
1995	1380	867	0.628	1.104	1.254	0.755	2.082	0.258
1996	1475	898	0.609	0.978	1.048	0.631	1.741	0.258
1997	1876	1238	0.660	1.099	1.314	0.792	2.179	0.257
1998	1874	1111	0.593	0.837	0.991	0.598	1.644	0.257
1999	2131	1283	0.602	0.860	0.954	0.576	1.581	0.257
2000	1643	930	0.566	0.538	0.634	0.382	1.052	0.257
2001	1818	1082	0.595	1.095	1.005	0.606	1.666	0.257
2002	2166	1378	0.636	0.923	0.991	0.598	1.642	0.257
2003	2335	1602	0.686	1.007	0.948	0.571	1.571	0.257
2004	1996	1411	0.707	1.270	1.081	0.652	1.795	0.257
2005	1629	1148	0.705	1.299	1.302	0.784	2.162	0.258
2006	1561	1026	0.657	1.116	0.847	0.510	1.405	0.257
2007	1242	953	0.767	1.325	1.001	0.603	1.662	0.257
2008	1274	978	0.768	0.899	0.966	0.581	1.604	0.258
2009	1404	1075	0.766	0.921	0.829	0.499	1.376	0.258

Table 3. Deviance tables for the regression models for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line index. The table shows the order of the factors as they were sequentially added to each model. Fit diagnostics listed for each factor were the diagnostics from a model that included that factor and all of the factors listed above it in the tables below. Note that variable in red was included to force the year effect in the standardization process.

Factor	DF	Deviance	Residual DF	Residual Deviance	AIC	Deviance Reduced	Log likelihood	Likelihood Ratio Test
Binomial								
Null	1	5590	5388	5590	5590	-	-2795	-
Away	4	5260	5385	329	5260	5.85%	-2630	330
Depth	4	5033	5382	226	5033	4.25%	-2516	226.4
Scamp IFQ	4	4949	5379	84	4949	1.62%	-2474	84.4
Crew	3	4887	5377	62	4887	1.22%	-2443	62.2
Year	8	4878	5370	9	4878	0.06%	-2439	9.2
Depth*Crew	7	4820	5364	57	4820	1.08%	-2410	57.8
Lognormal								
Null	1	28417	5385	28417	24242	-	-12121	-
Area	4	24699	5382	3718	23487	13.04%	-11743	755.2
Away	4	23820	5379	878	23292	3.50%	-11646	195.2
Crew	3	23186	5377	634	23147	2.63%	-11573	145.4
Depth	4	22918	5374	267	23084	1.10%	-11542	62.6
Year	8	22842	5367	75	23066	0.20%	-11533	17.8
Area*Depth	10	22179	5358	663	22908	2.74%	-11454	158.6

Table 4. Numbers (N) of total and positive trips, proportion of positive trips (PPT), relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line index.

Year	N	Positive N	PPT	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
2010	924	673	0.728	0.555	0.956	0.811	1.126	0.082
2011	969	698	0.720	0.345	0.632	0.535	0.747	0.084
2012	1256	948	0.755	1.154	1.149	0.995	1.327	0.072
2013	1047	787	0.752	2.187	1.183	1.014	1.381	0.077
2014	1052	778	0.740	0.561	0.903	0.767	1.064	0.082
2015	972	718	0.739	1.640	1.018	0.864	1.199	0.082
2016	1150	881	0.766	0.890	1.274	1.082	1.501	0.082
2017	959	673	0.702	0.669	0.885	0.744	1.051	0.086

Table 5. Deviance tables for the regression models for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Longline index. The table shows the order of the factors as they were sequentially added to each model. Fit diagnostics listed for each factor were the diagnostics from a model that included that factor and all of the factors listed above it in the tables below. Note that variable in red was included to force the year effect in the standardization process.

Factor	DF	Deviance	Residual DF	Residual Deviance	AIC	Deviance Reduced	Log likelihood	Likelihood Ratio Test
Binomial								
Lognormal								
Null	1	58199	7908	58199	38230	-	-19115	-
Away	4	56504	7905	1695	37996	2.88%	-18998	234
Year	17	56116	7889	387	37942	0.48%	-18971	54

Table 6. Numbers (N) of total trips, relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Longline index.

Year	N	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
1993	362	0.521	0.677	0.579	0.790	0.078
1994	378	0.571	0.582	0.498	0.681	0.078
1995	361	0.781	0.667	0.571	0.779	0.078
1996	366	0.517	0.696	0.597	0.812	0.077
1997	494	0.799	0.885	0.778	1.006	0.064
1998	519	1.679	0.935	0.825	1.059	0.062
1999	552	0.954	0.755	0.666	0.855	0.062
2000	473	0.669	0.654	0.570	0.750	0.069
2001	501	0.908	0.893	0.786	1.014	0.064
2002	474	1.128	1.014	0.891	1.153	0.064
2003	574	0.988	1.074	0.956	1.208	0.058
2004	592	1.108	1.215	1.085	1.362	0.057
2005	545	1.501	1.559	1.388	1.751	0.058
2006	605	0.778	0.858	0.763	0.965	0.059
2007	418	1.055	1.098	0.959	1.257	0.068
2008	469	1.340	1.376	1.214	1.560	0.063
2009	226	1.703	2.062	1.734	2.453	0.087

Table 7. Deviance tables for the regression models for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Longline index. The table shows the order of the factors as they were sequentially added to each model. Fit diagnostics listed for each factor were the diagnostics from a model that included that factor and all of the factors listed above it in the tables below.

Factor	DF	Deviance	Residual DF	Residual Deviance	AIC	Deviance Reduced	Log likelihood	Likelihood Ratio Test
Binomial								
Lognormal								
Null	1	7266.400	1662	7266.400	7171.800	-	-3585.900	-
Year	8	7055.000	1655	211.400	7122.600	2.50%	-3561.300	49.2
Depth	4	6955.200	1652	99.800	7099.000	1.24%	-3549.500	23.6

Table 8. Numbers (N) of total trips, relative nominal CPUE, and standardized abundance index statistics for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Longline index.

Year	N	Relative Nominal CPUE	Relative Index	Lower 95% CI	Upper 95% CI	CV
2010	184	1.237	1.181	1.004	1.389	0.081
2011	281	0.998	0.790	0.688	0.908	0.070
2012	246	1.507	1.242	1.079	1.429	0.070
2013	255	1.447	1.329	1.159	1.524	0.069
2014	299	0.484	0.720	0.628	0.825	0.069
2015	371	0.774	0.908	0.805	1.023	0.060
2016	451	1.045	1.101	0.989	1.225	0.054
2017	415	0.508	0.729	0.649	0.820	0.059

Figures

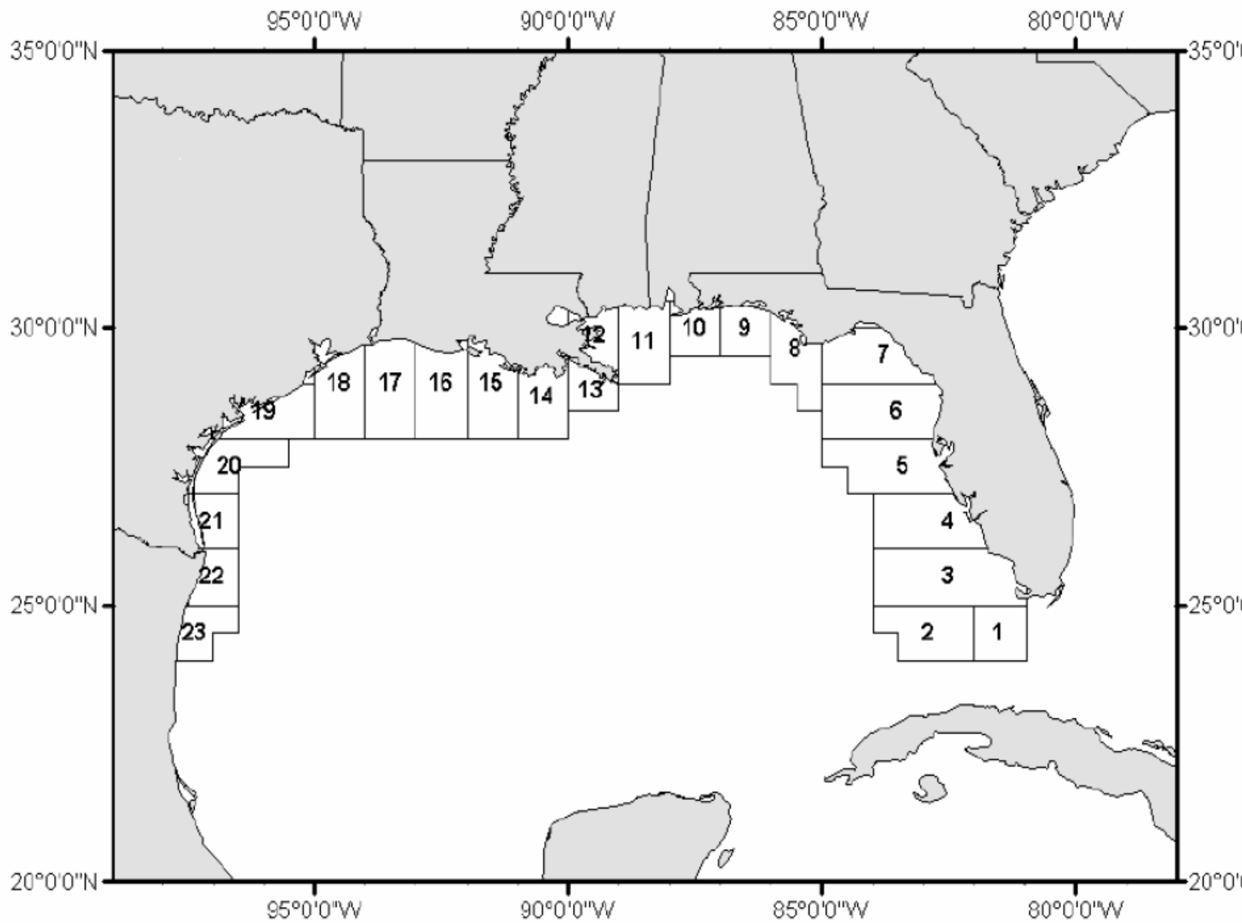

Figure 1. National Marine Fisheries Service statistical shrimp reporting grids.

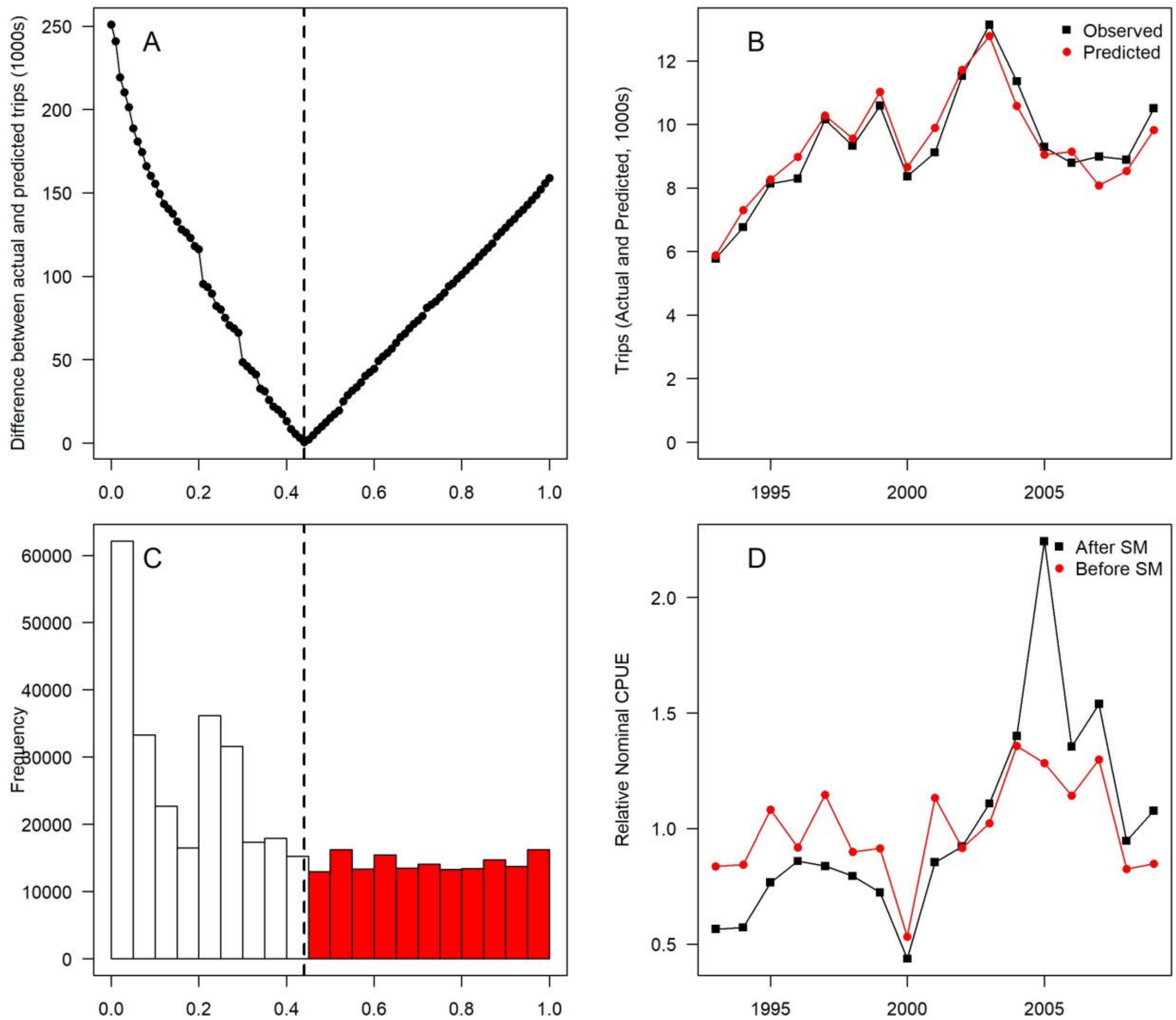

Figure 2. Stephens and MacCall (2004) trip selection diagnostics for the Pre-IFQ Vertical Line for the Eastern U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before ("Before SM") and after ("After SM") Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

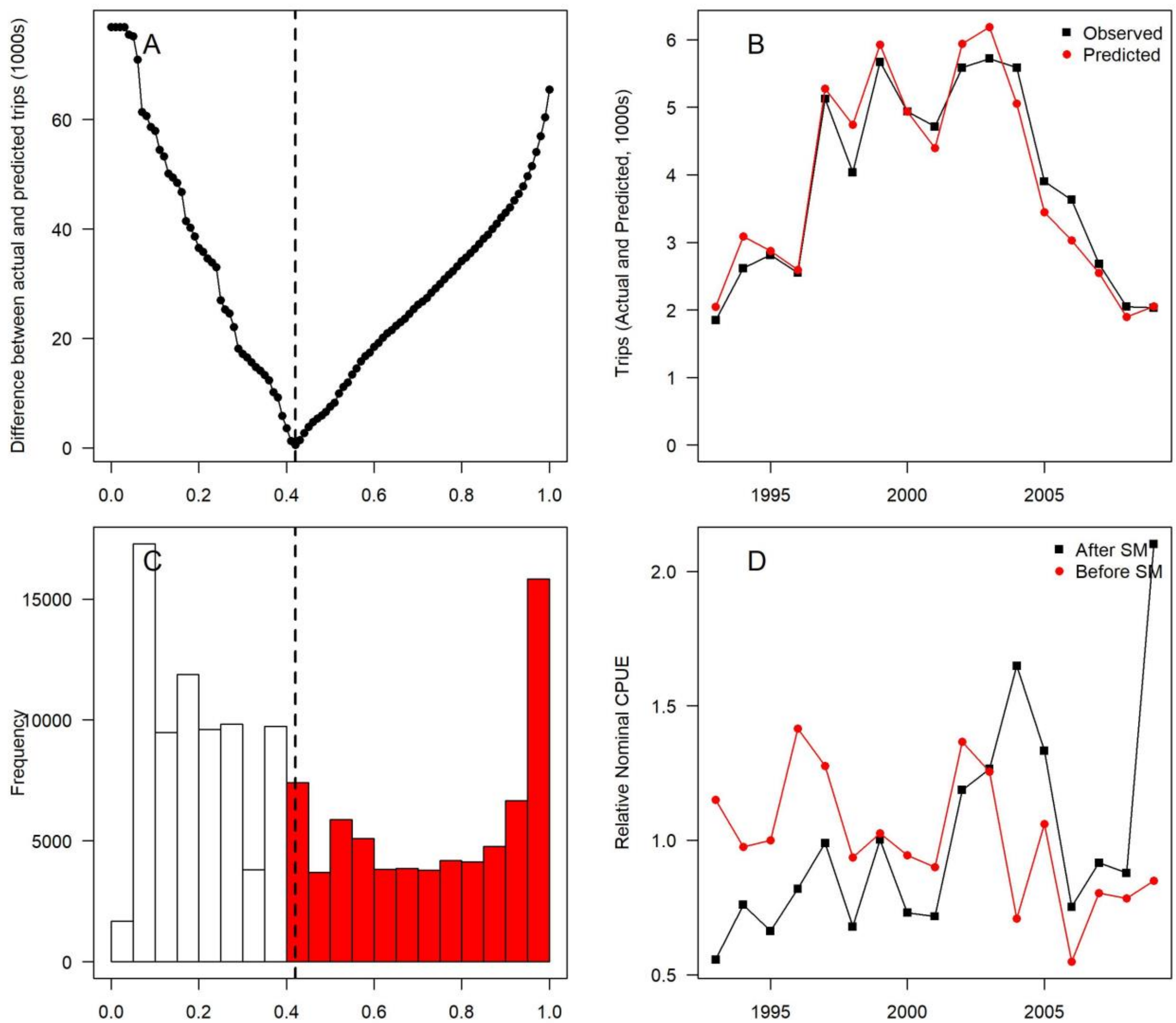

Figure 3. Stephens and MacCall (2004) trip selection diagnostics for the Pre-IFQ Vertical Line for the Western U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before (“Before SM”) and after (“After SM”) Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

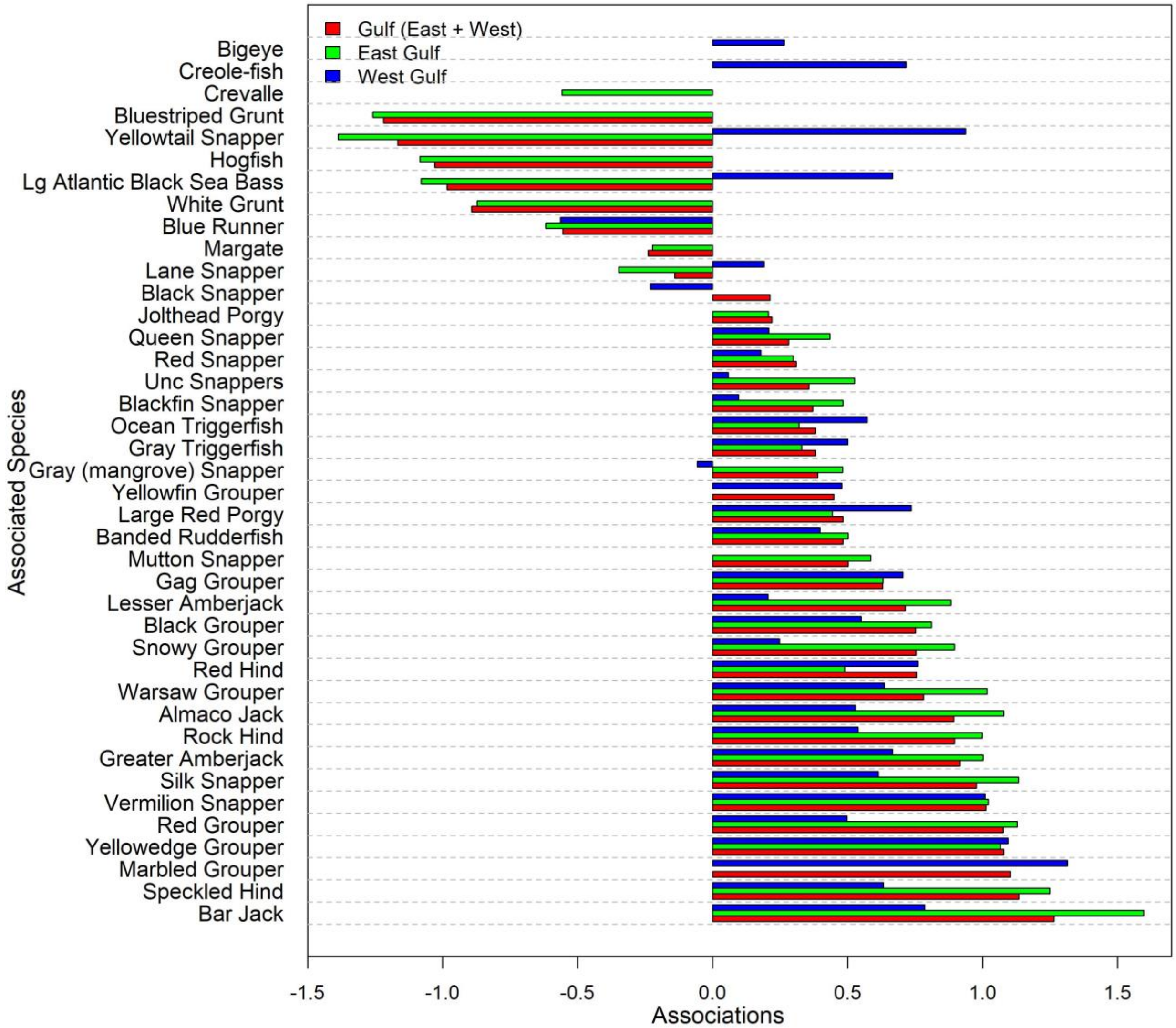

Figure 4. Association coefficients of other species with Scamp and Yellowmouth Grouper across regions in the U.S. GOM for the Pre-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

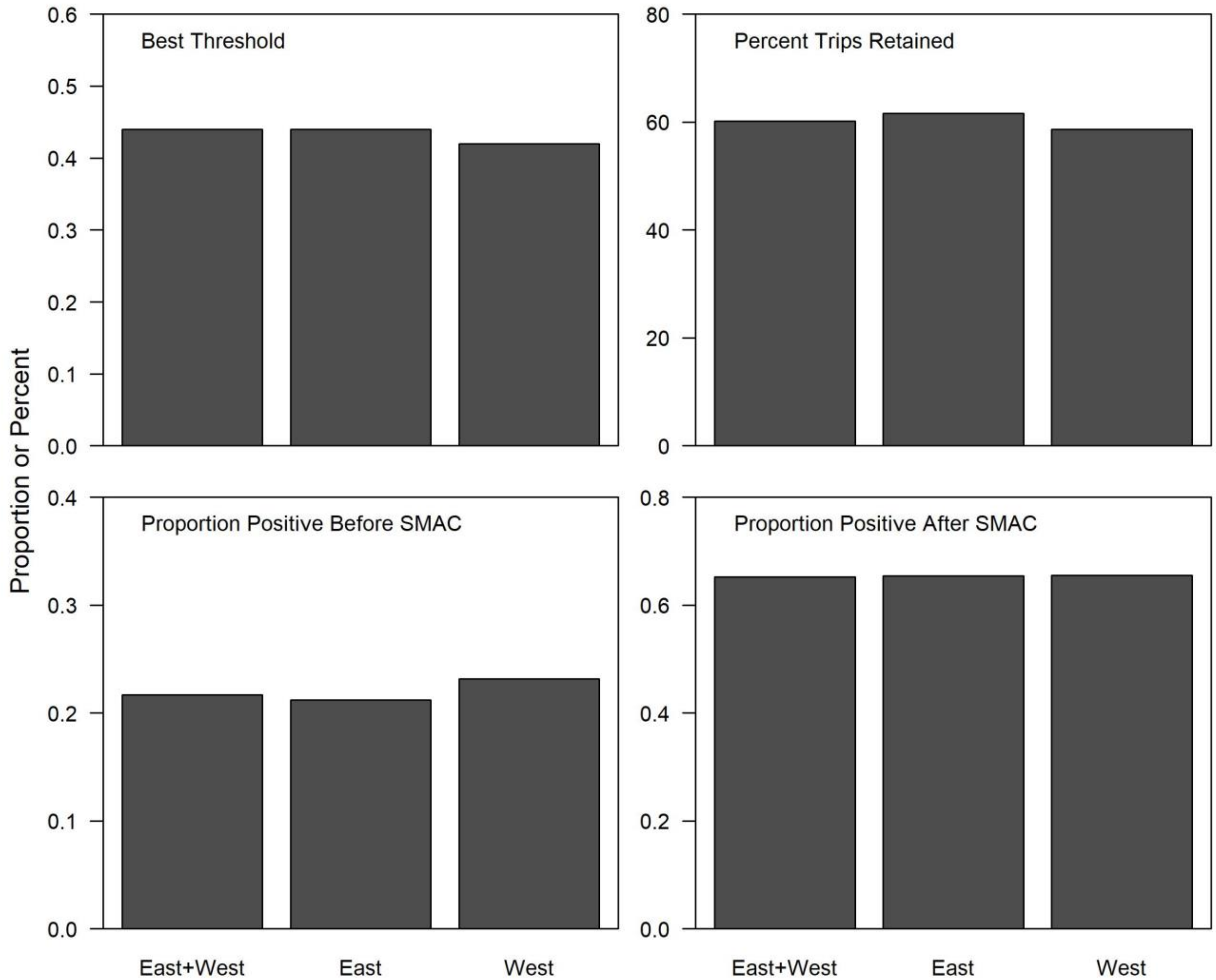

Figure 5. Stephens and MacCall (2004) statistics across regions for associations with Scamp and Yellowmouth Grouper for the Pre-IFQ Vertical Line fishery.

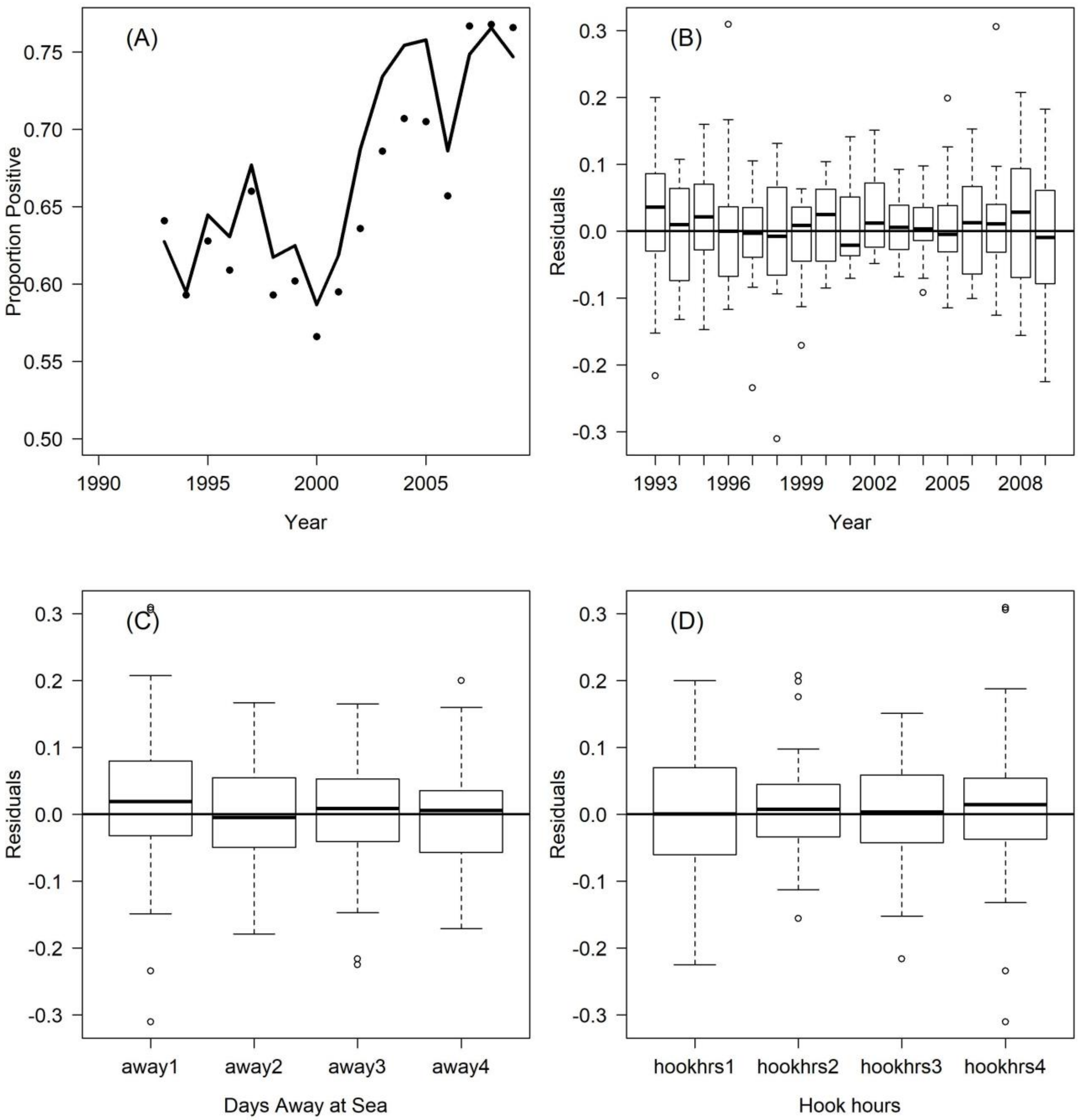

Figure 6. Diagnostic plots for the binomial model for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line fishery. Shown here are the predicted (solid line) and observed proportion of positive trips by year (A) and the residuals from the binomial model by year (B), days away at sea (C), and hook hours (D).

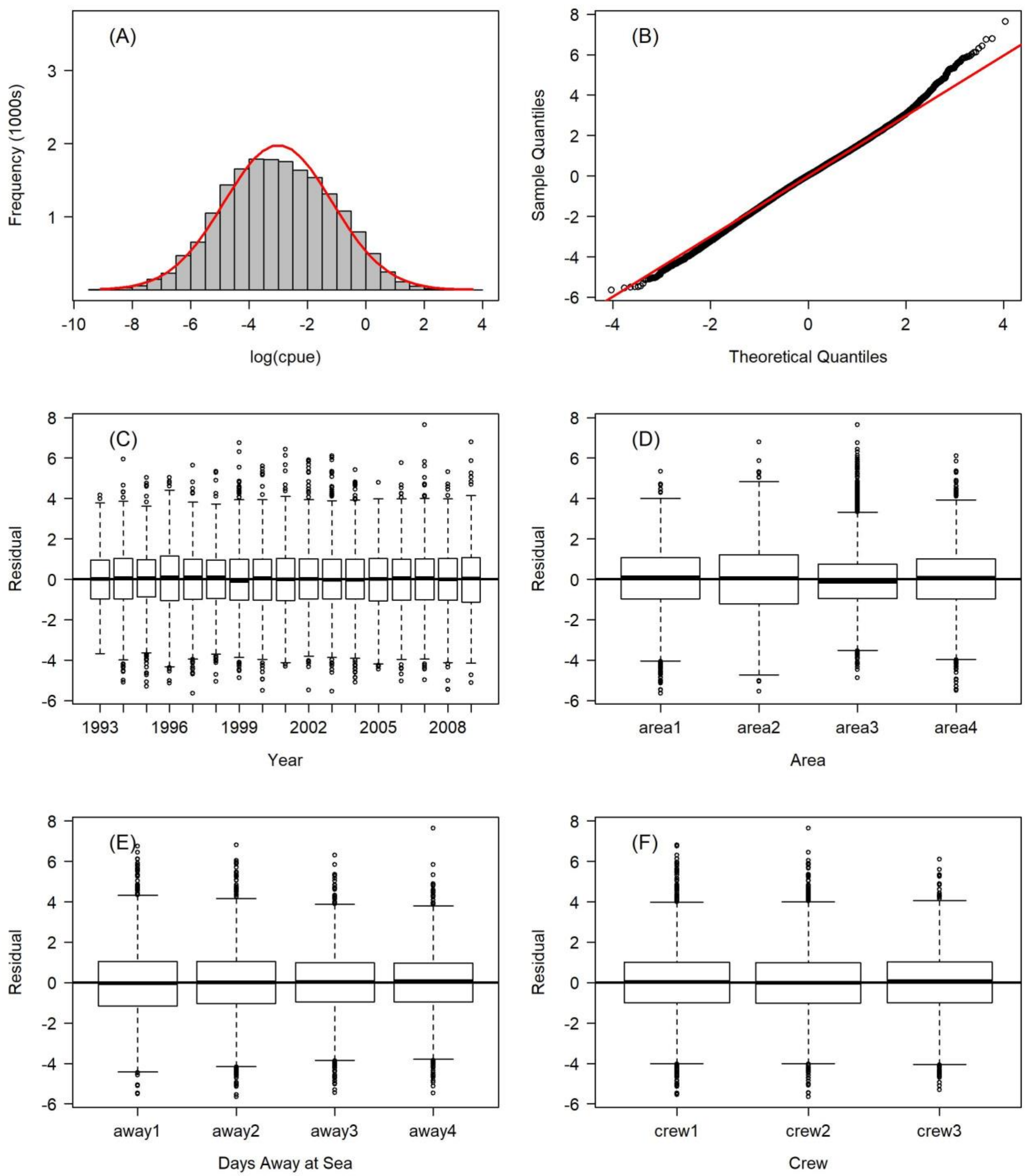

Figure 7. Diagnostic plots for the lognormal model of catch rates on positive trips for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line fishery. Shown here are the frequency distribution of catch rates (A), the cumulative normalized residuals (B), and the distribution of residuals by year (C), area (D), days away at sea (E), and crew size (F). The red lines represent the expected normal distribution.

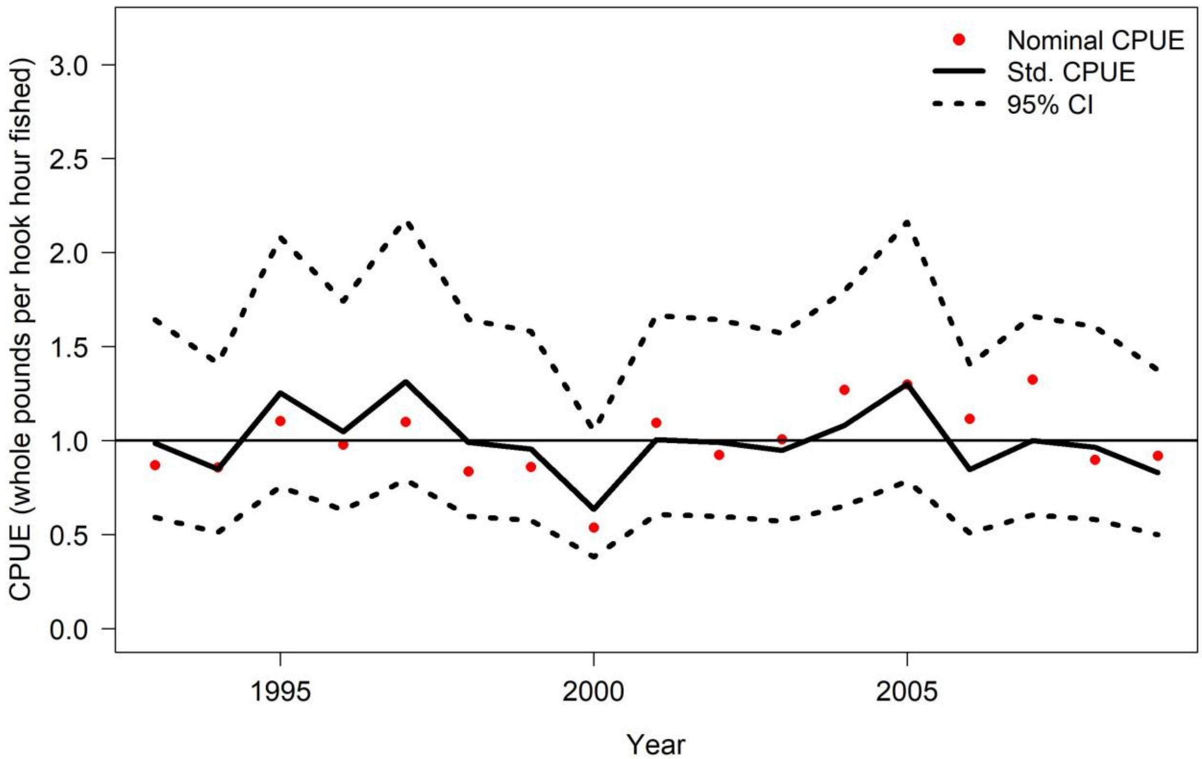

Figure 8. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Vertical Line fishery. The index was scaled to the mean value of the entire time series.

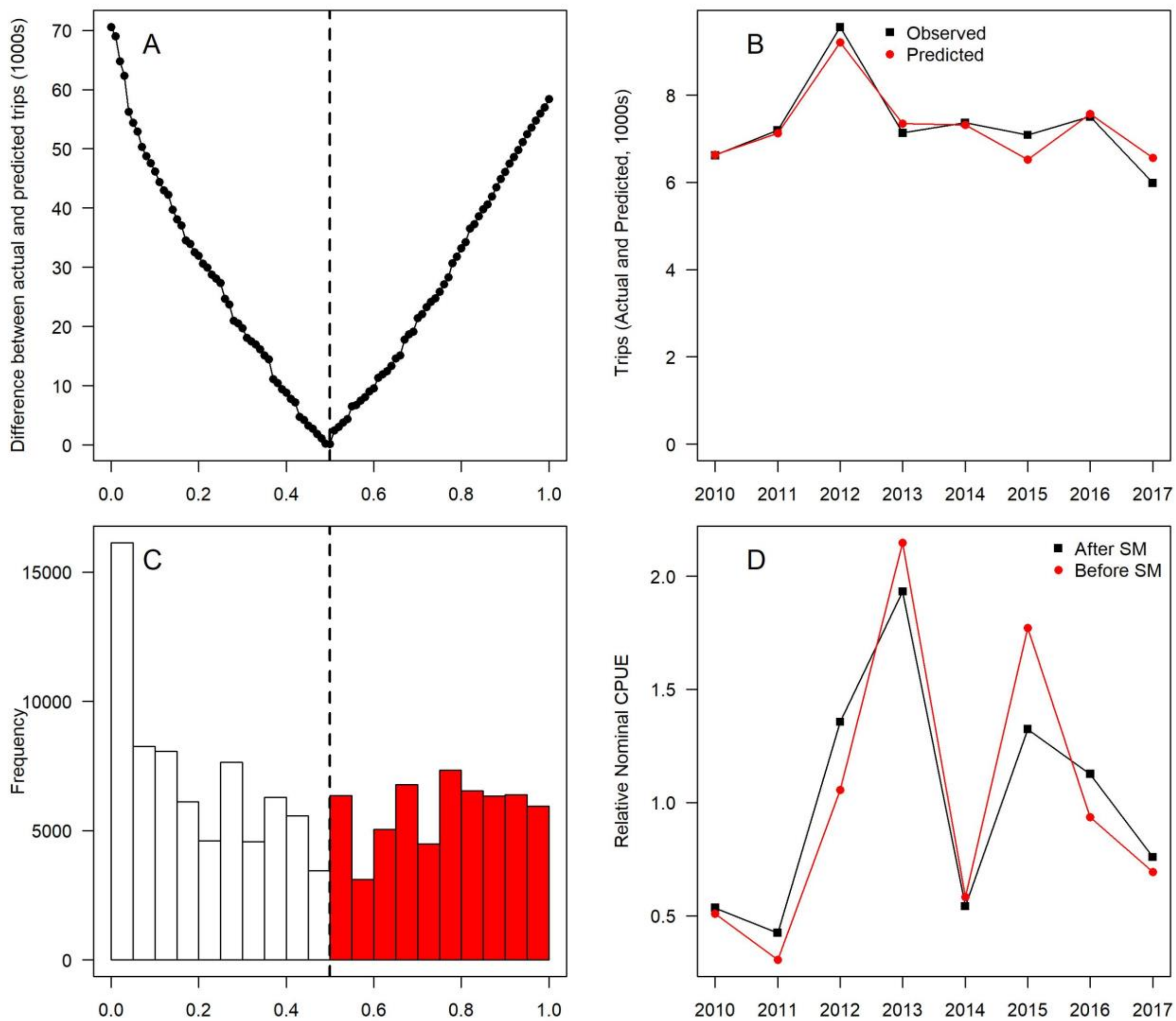

Figure 9. Stephens and MacCall (2004) trip selection diagnostics for the Post-IFQ Vertical Line for the Eastern U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before ("Before SM") and after ("After SM") Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

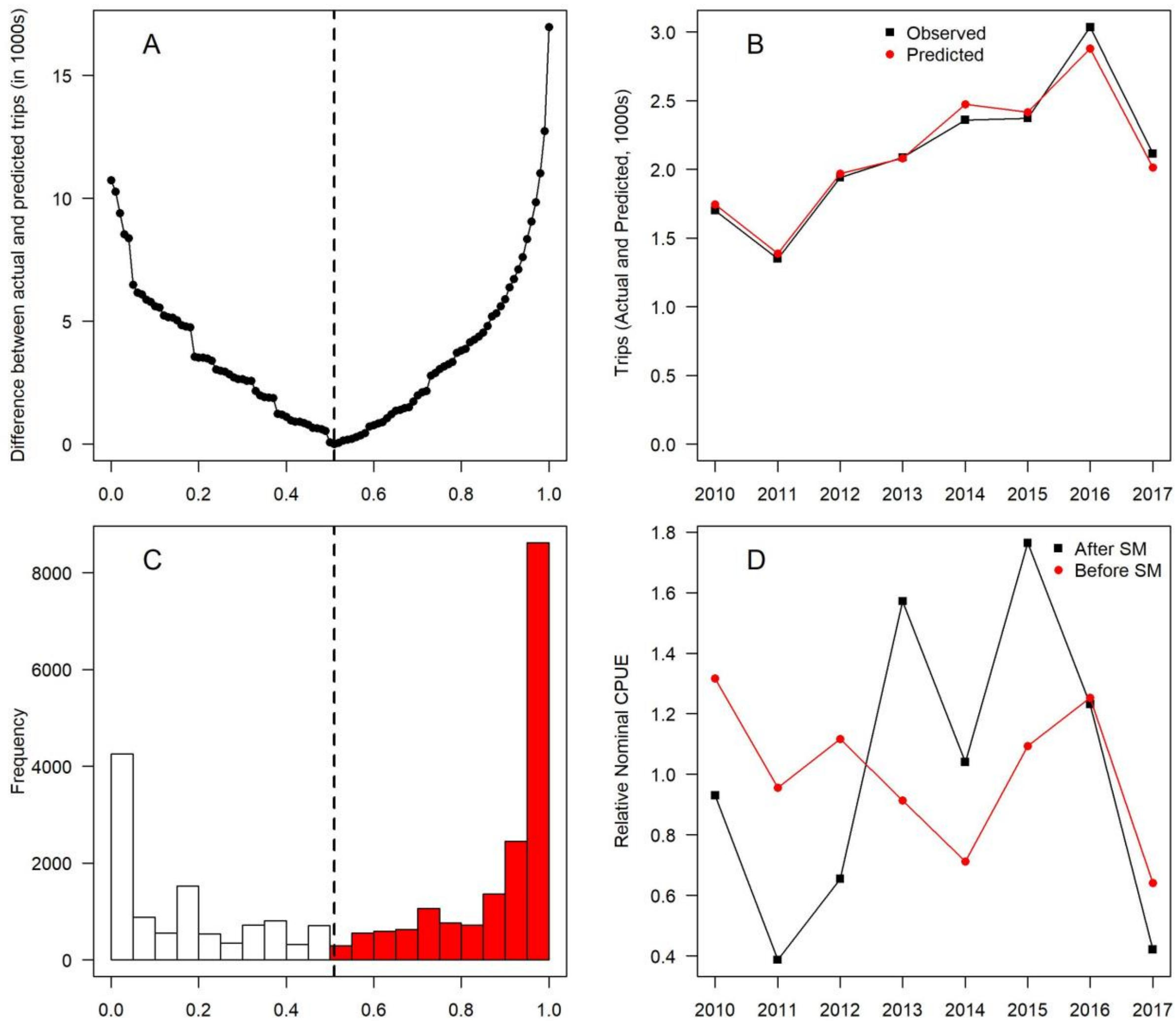

Figure 10. Stephens and MacCall (2004) trip selection diagnostics for the Post-IFQ Vertical Line for the Western U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before (“Before SM”) and after (“After SM”) Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

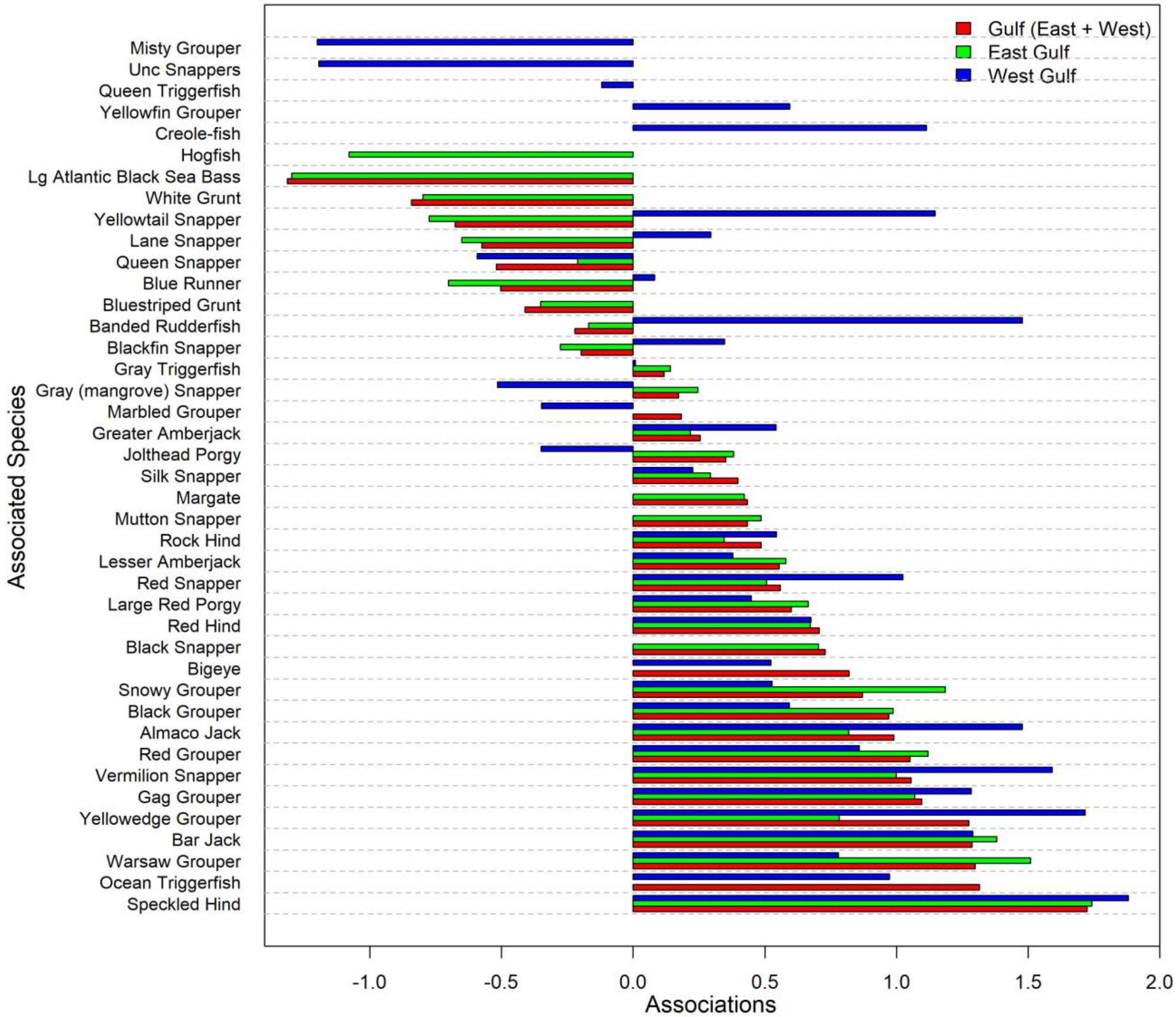

Figure 11. Association coefficients of other species with Scamp and Yellowmouth Grouper across regions in the U.S. GOM for the Post-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

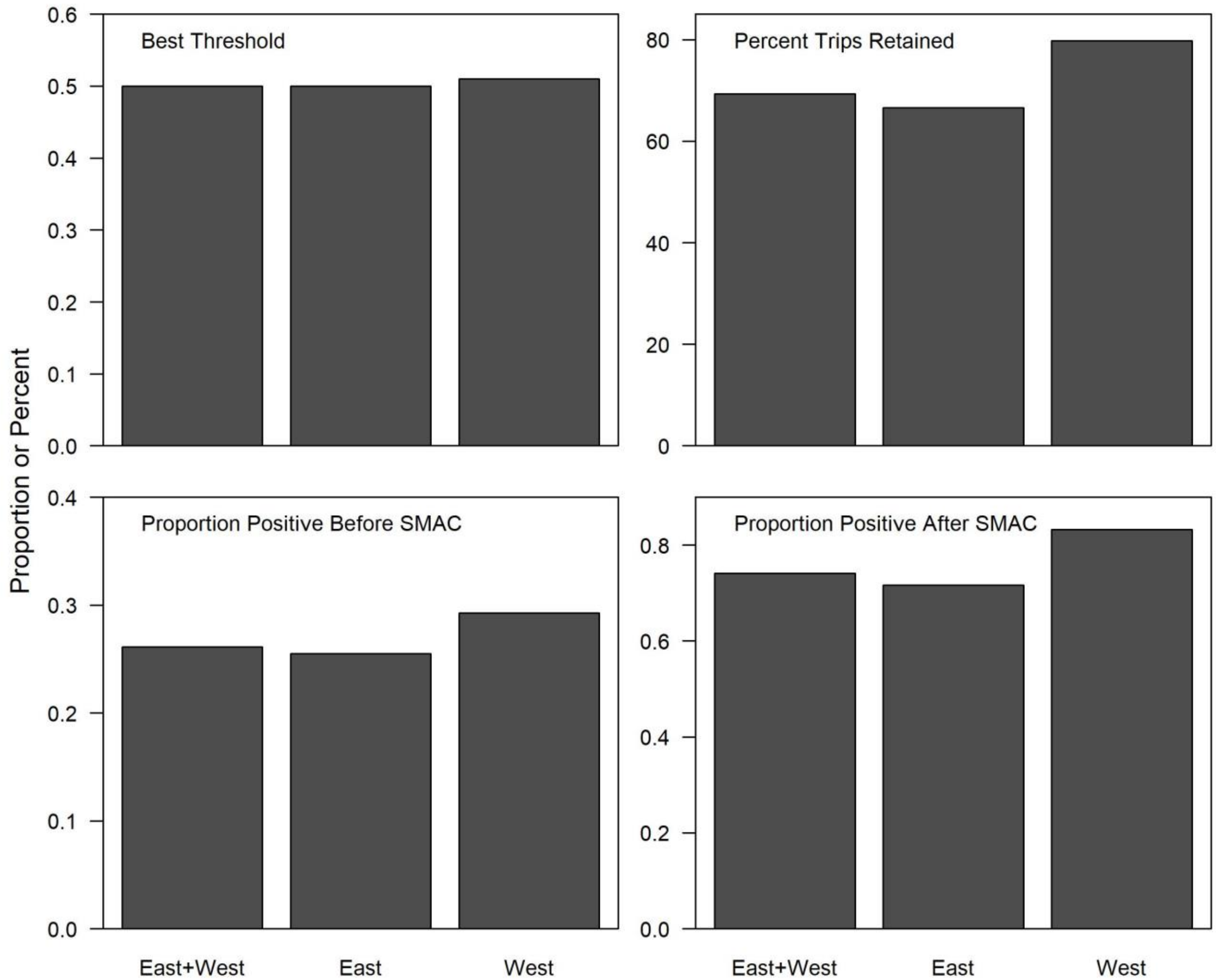

Figure 12. Stephens and MacCall (2004) statistics across regions for associations with Scamp and Yellowmouth Grouper for the Post-IFQ Vertical Line fishery.

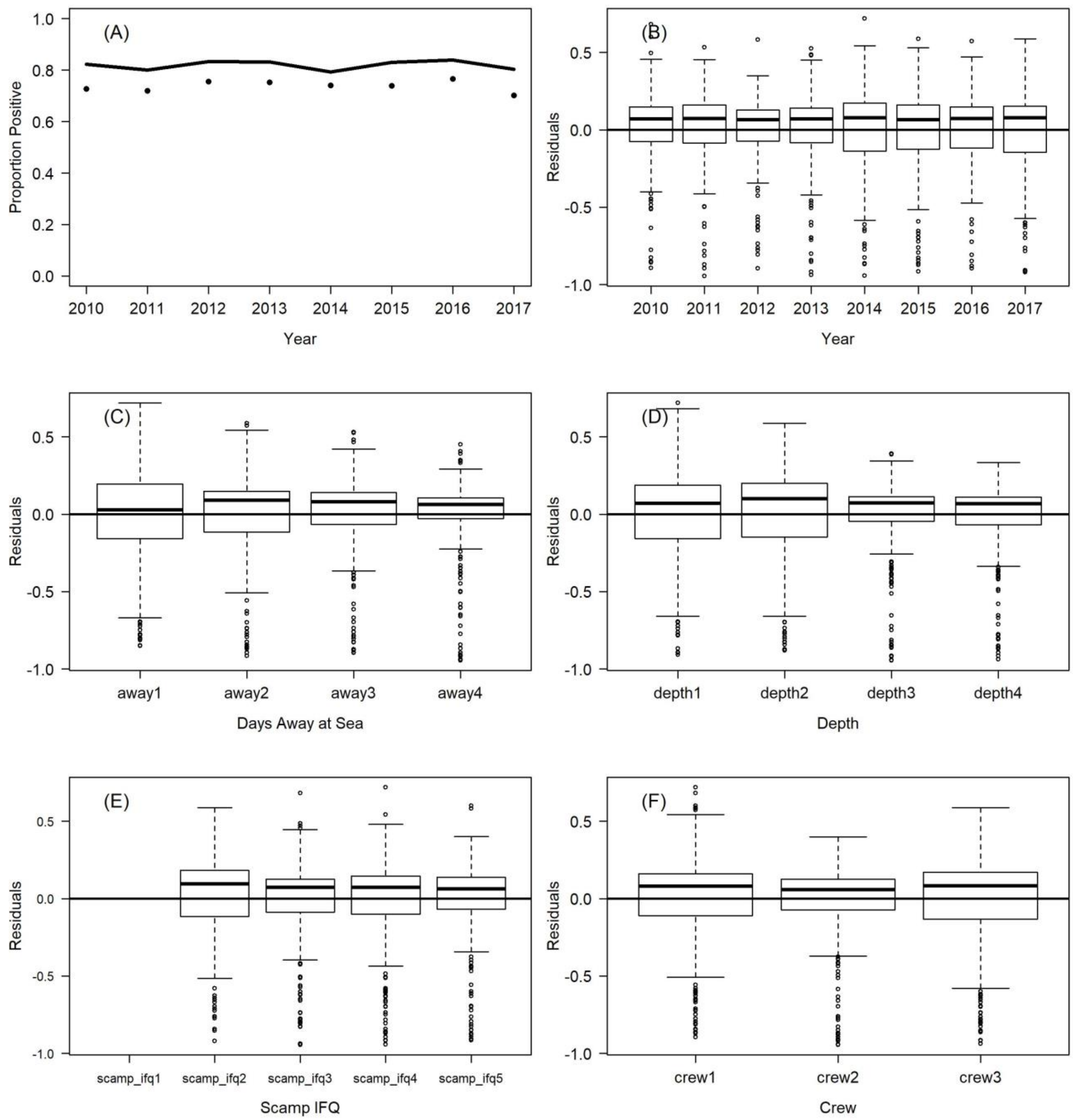

Figure 13. Diagnostic plots for the binomial model for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line fishery. Shown here are the predicted (solid line) and observed proportion of positive trips by year (A) and the residuals from the binomial model by year (B), days away at sea (C), depth (D), scamp IFQ (E) and crew size (F).

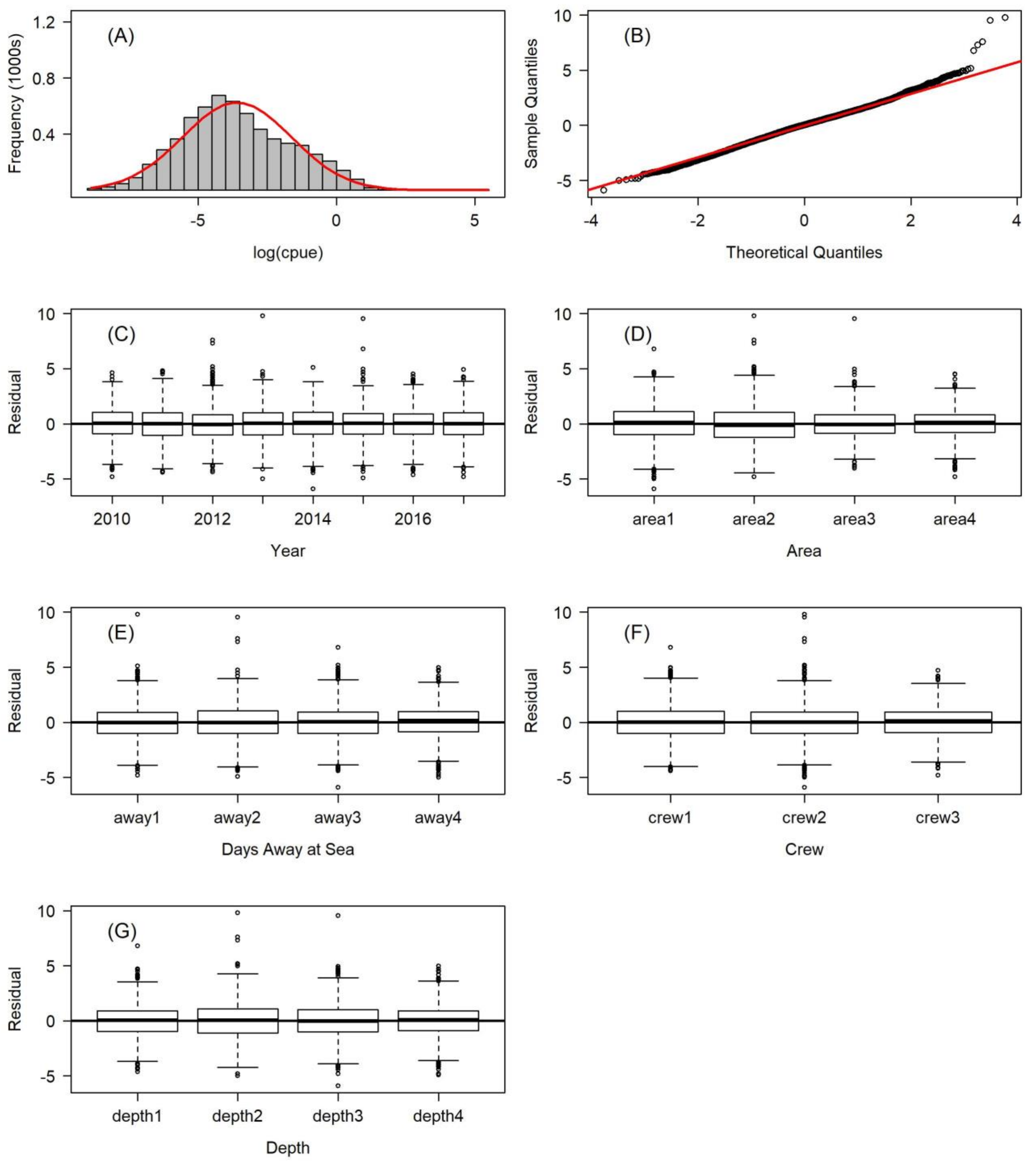

Figure 14. Diagnostic plots for the lognormal model of catch rates on positive trips for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line fishery. Shown here are the frequency distribution of catch rates (A), the cumulative normalized residuals (B), and the distribution of residuals by year (C), area (D), days away at sea (E), crew size (F), and depth (G). The red lines represent the expected normal distribution.

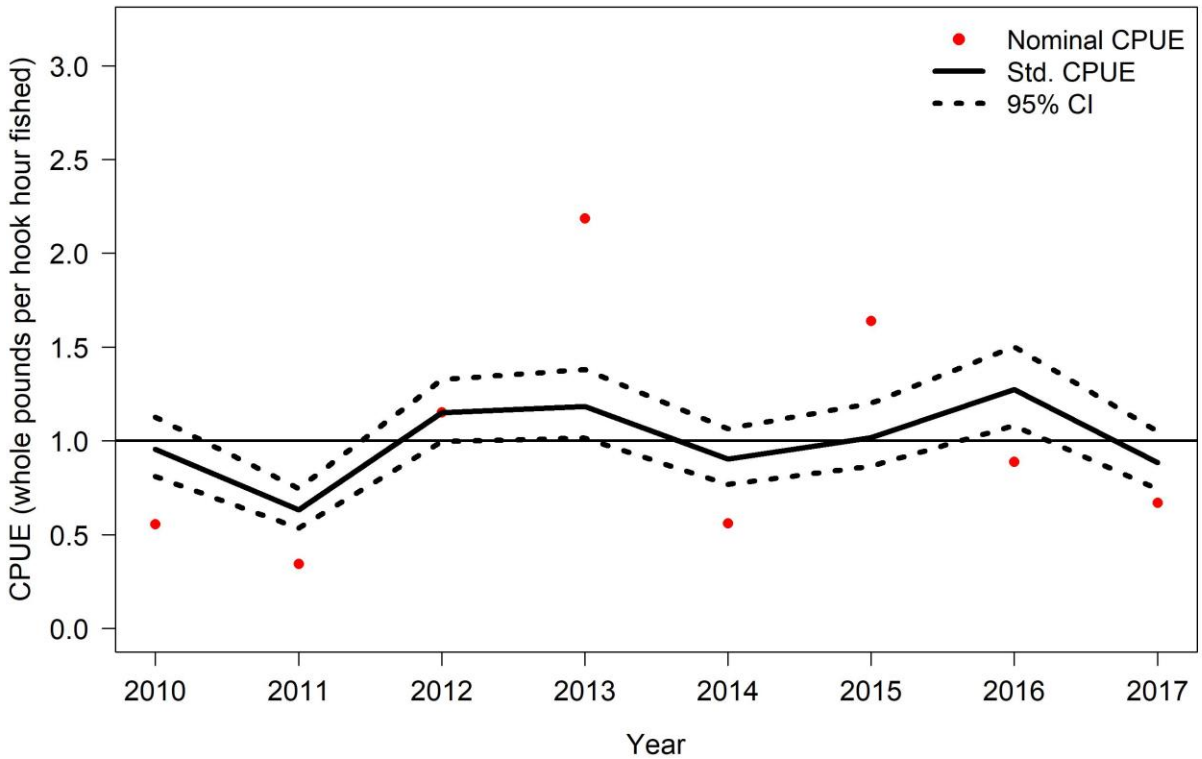

Figure 15. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Vertical Line fishery. The index was scaled to the mean value of the entire time series.

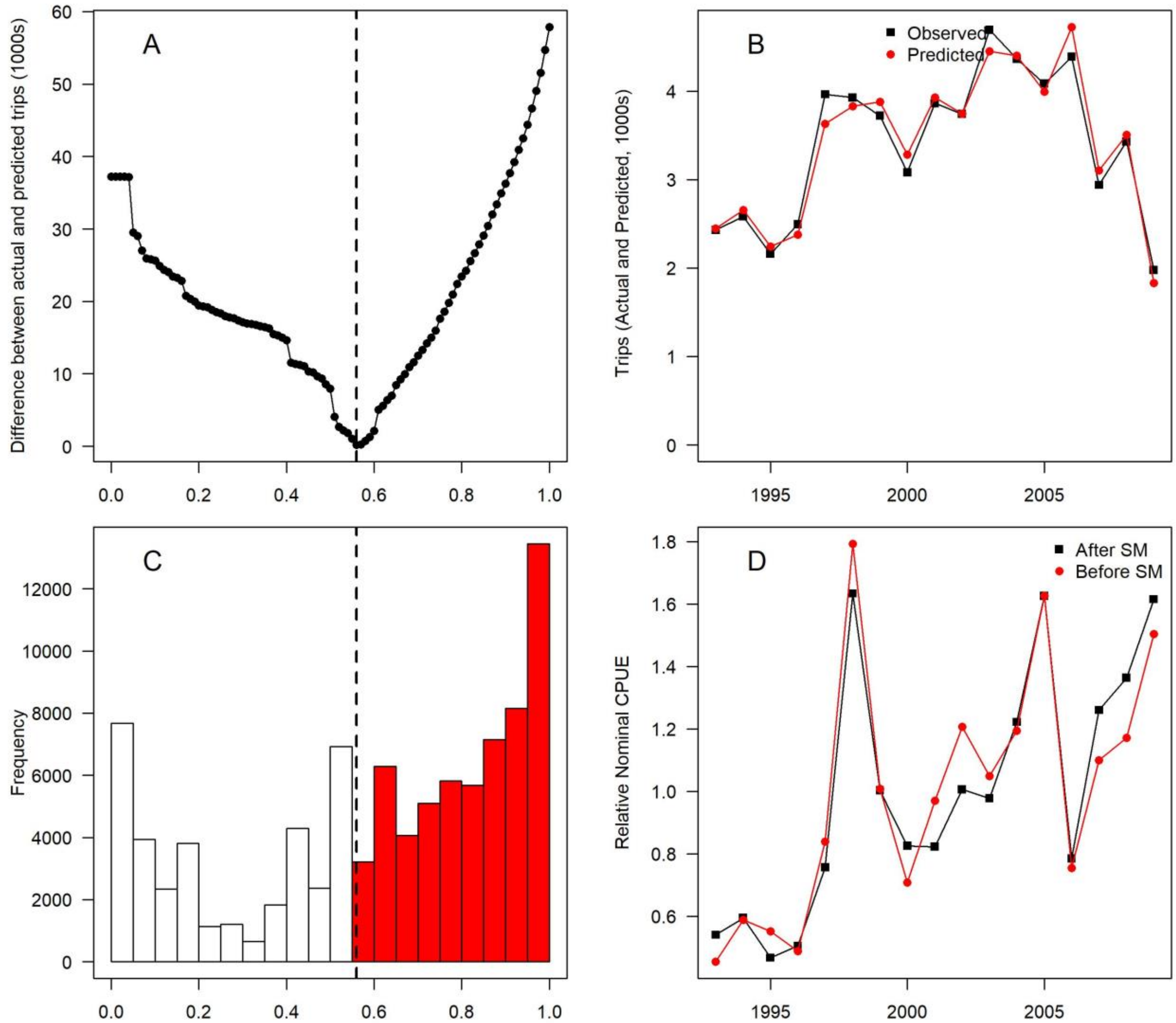

Figure 16. Stephens and MacCall (2004) trip selection diagnostics for the Pre-IFQ Longline for the Eastern U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before ("Before SM") and after ("After SM") Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

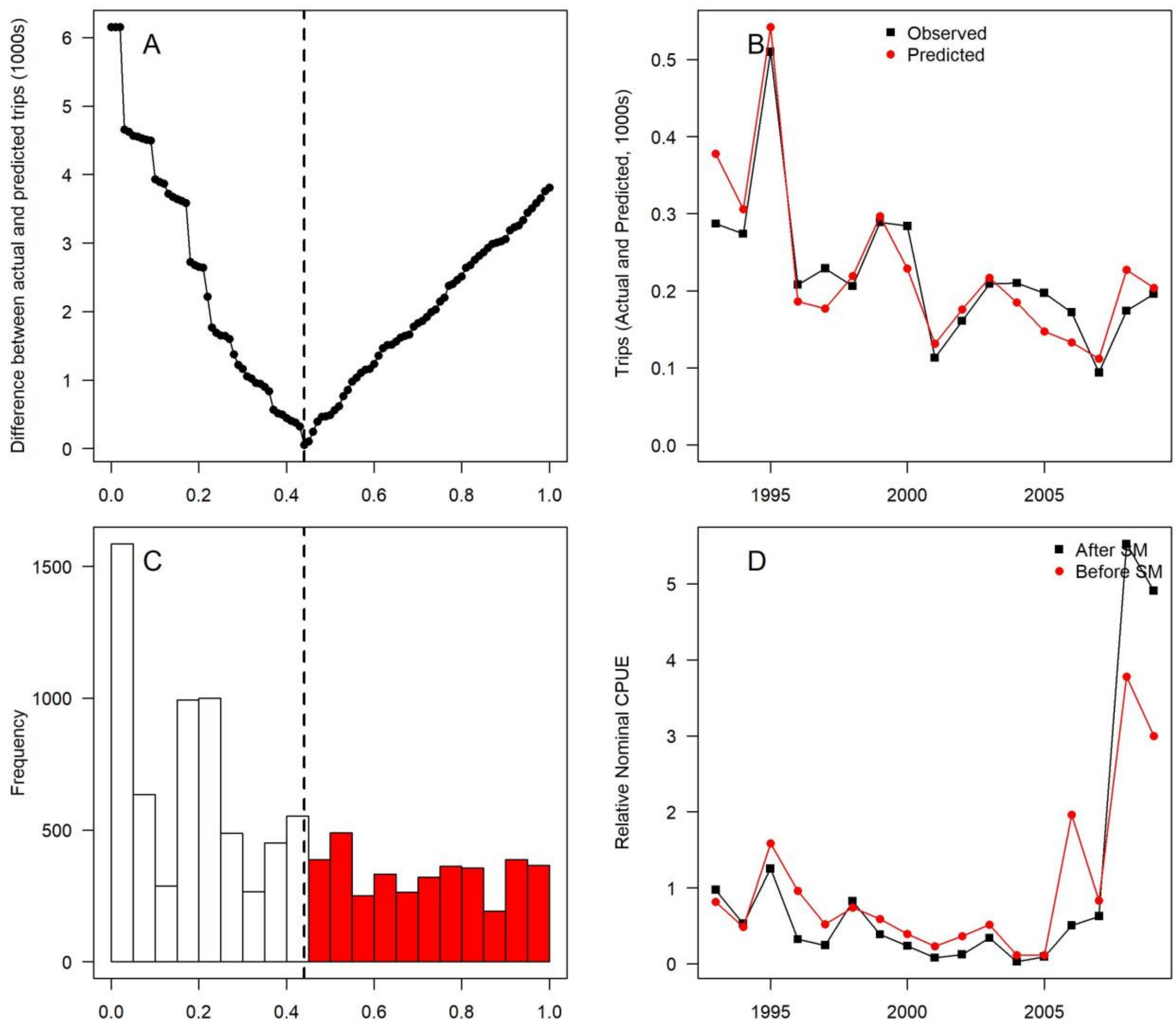

Figure 17. Stephens and MacCall (2004) trip selection diagnostics for the Pre-IFQ Longline for the Western U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before (“Before SM”) and after (“After SM”) Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

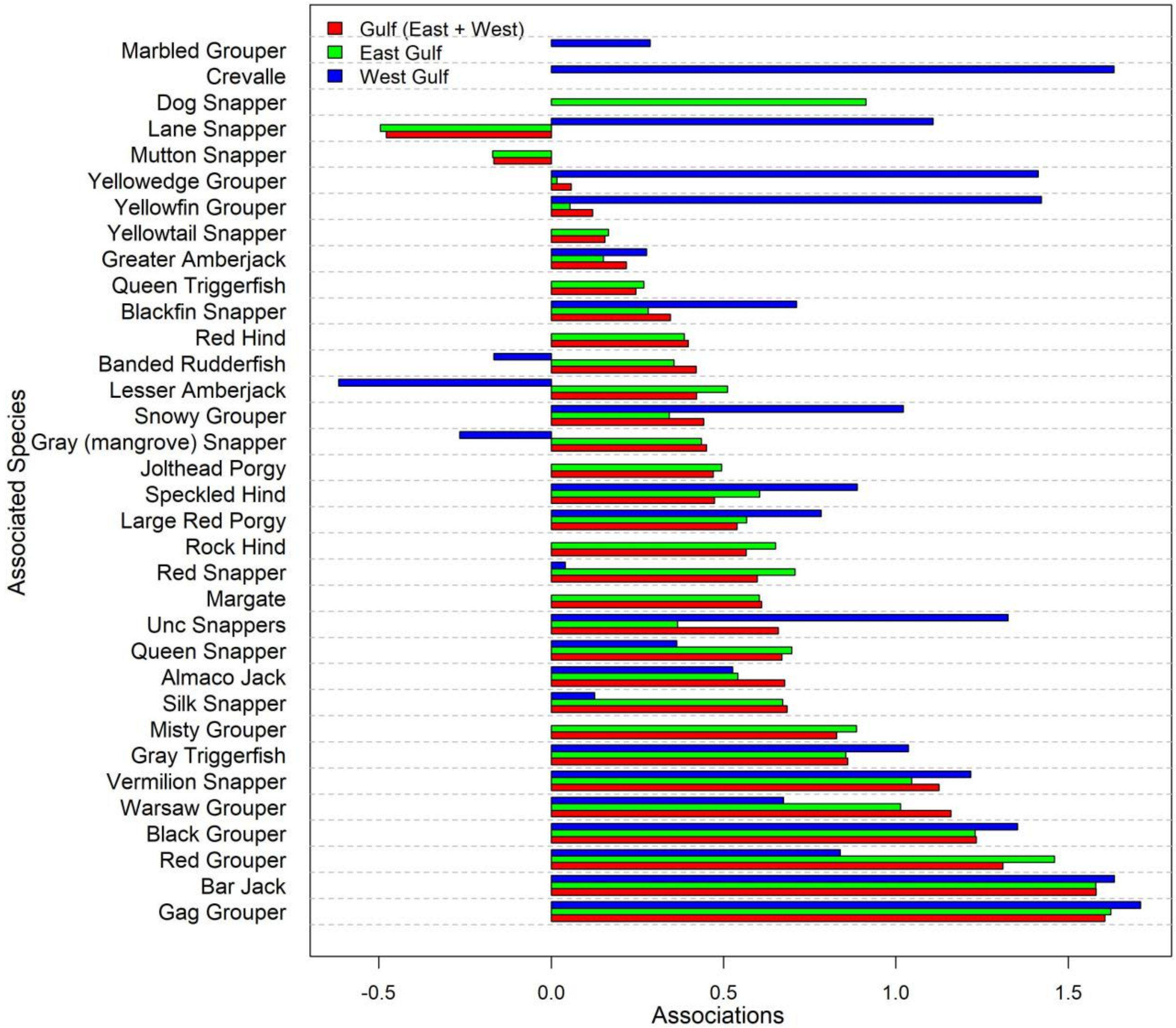

Figure 18. Association coefficients of other species with Scamp and Yellowmouth Grouper across regions in the U.S. GOM for the Pre-IFQ Longline fishery. Positive numbers indicate a positive correlation.

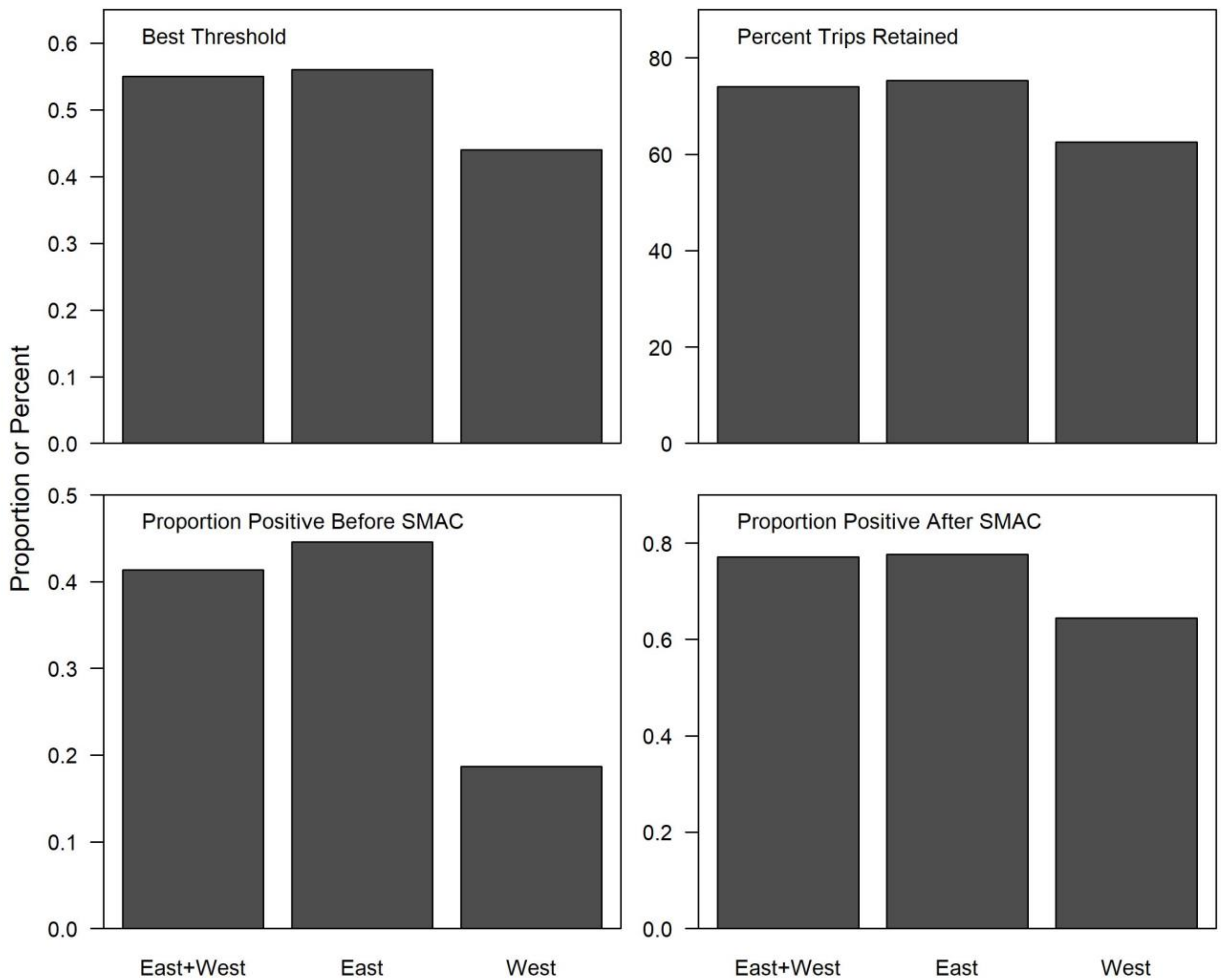

Figure 19. Stephens and MacCall (2004) statistics across regions for associations with Scamp and Yellowmouth Grouper for the Pre-IFQ Longline fishery.

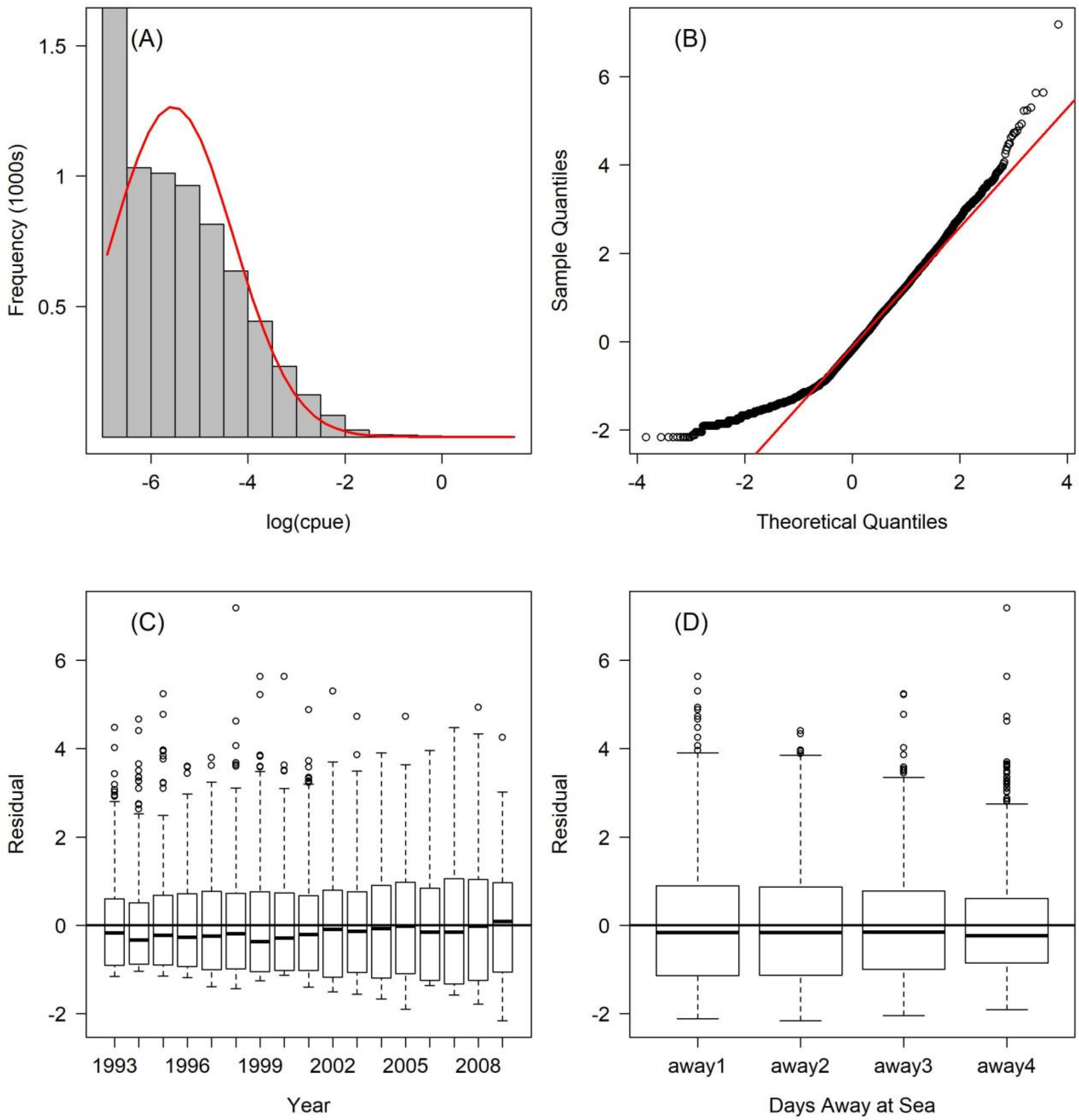

Figure 20. Diagnostic plots for the lognormal model of catch rates on positive trips for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Longline fishery. Shown here are the frequency distribution of catch rates (A), the cumulative normalized residuals (B), and the distribution of residuals by year (C) and days away at sea (D). The red lines represent the expected normal distribution.

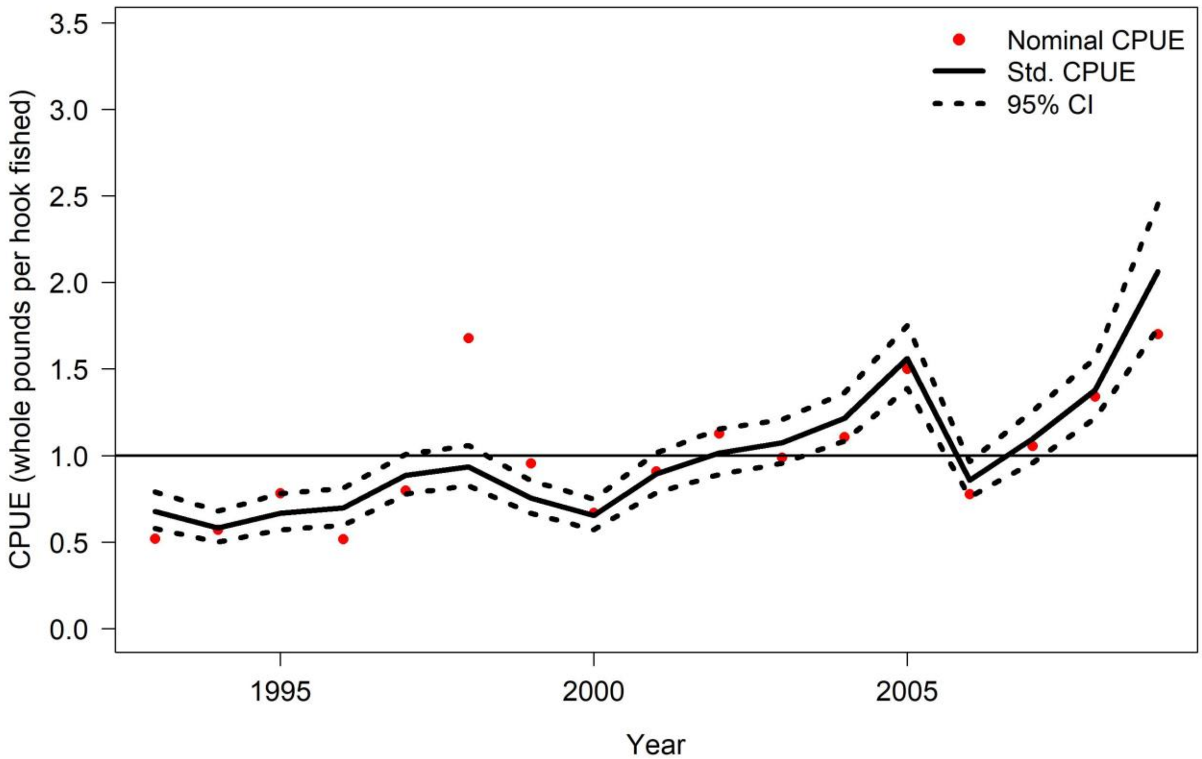

Figure 21. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Pre-IFQ Longline fishery. The index was scaled to the mean value of the entire time series.

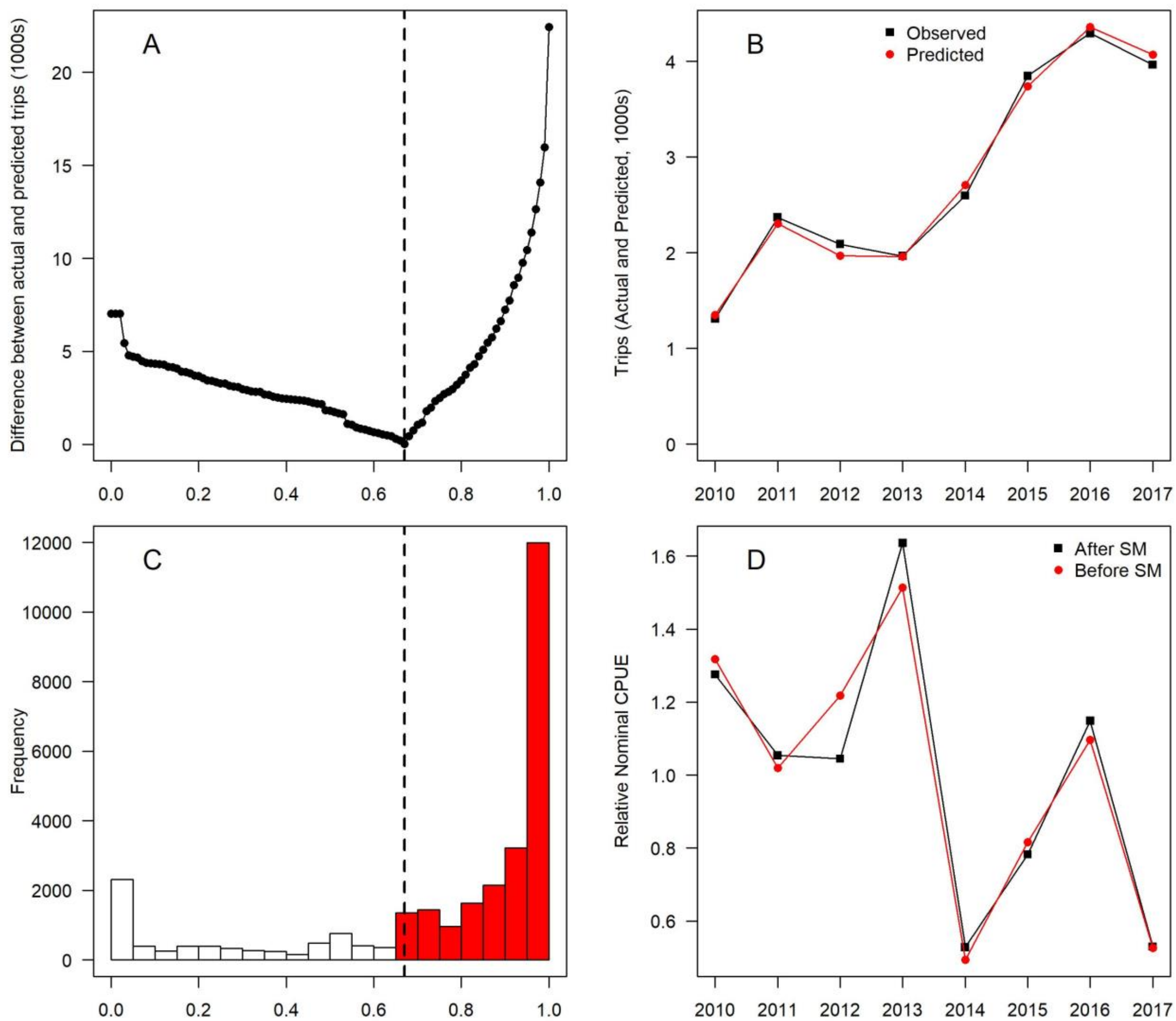

Figure 22. Stephens and MacCall (2004) trip selection diagnostics for the Post-IFQ Longline for the Eastern U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before (“Before SM”) and after (“After SM”) Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

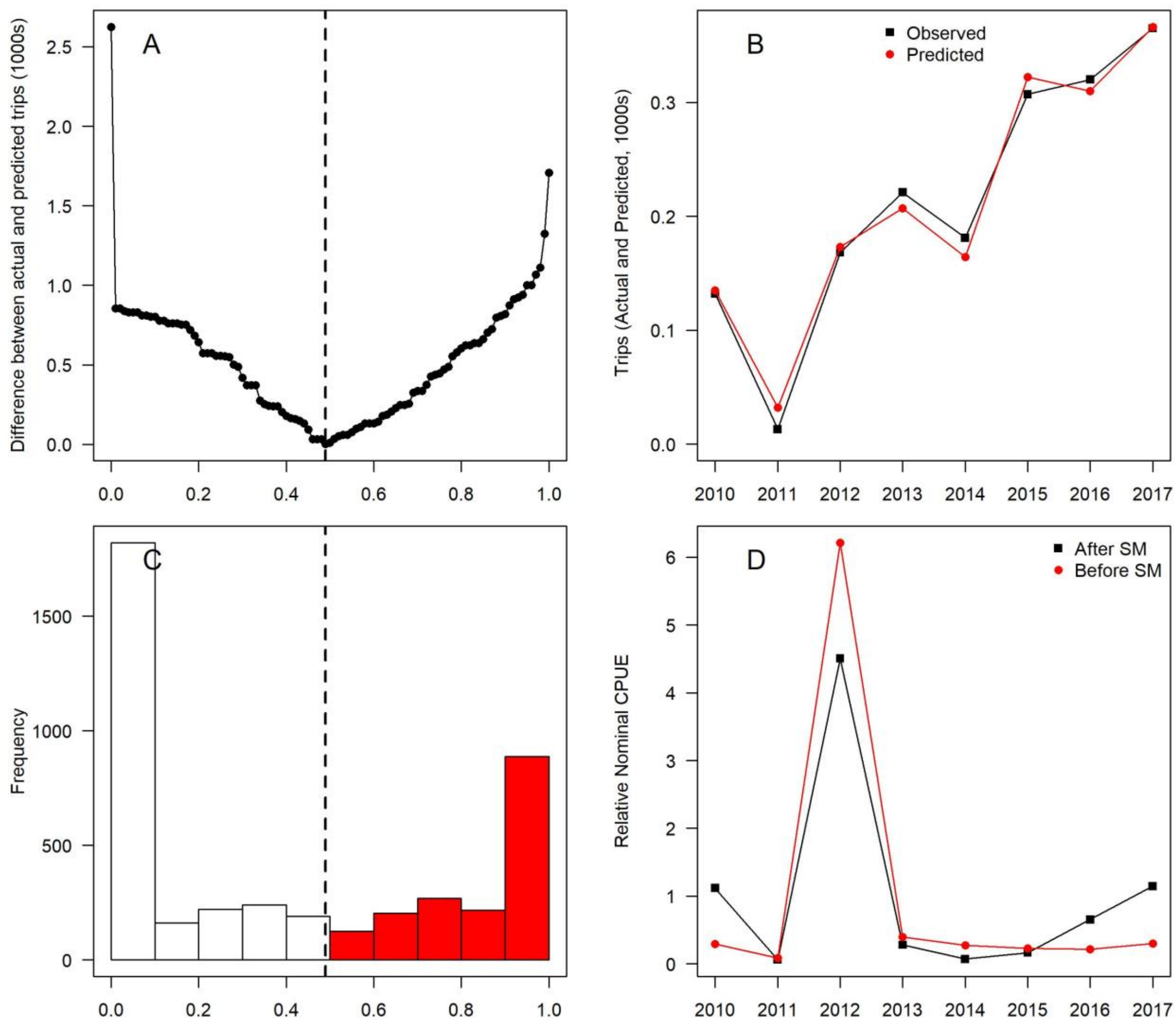

Figure 23. Stephens and MacCall (2004) trip selection diagnostics for the Post-IFQ Longline for the Western U.S. GOM. (A) The difference between the number of records in which Scamp and Yellowmouth Grouper are observed and the number in which they are predicted to occur for each probability threshold; (B) The number of actual and predicted trips; (C) Histogram of probabilities generated by the species-based regression (trips that targeted Scamp and Yellowmouth Grouper given in red); and (D) Nominal CPUE before ("Before SM") and after ("After SM") Stephens and MacCall (2004) trip selection. The dashed vertical line indicates the critical value where false prediction is minimized.

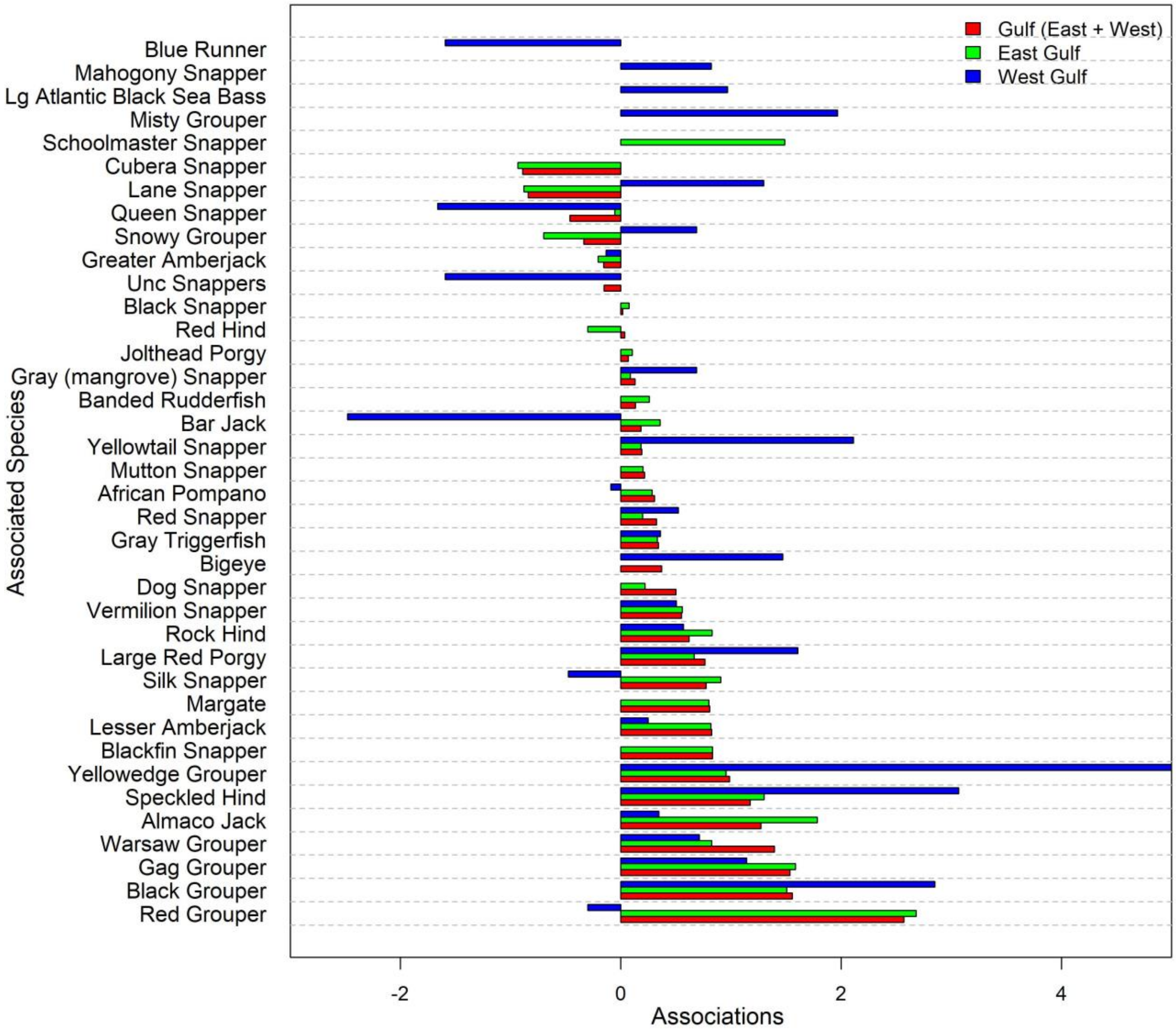

Figure 24. Association coefficients of other species with Scamp and Yellowmouth Grouper across regions in the U.S. GOM for the Post-IFQ Longline fishery. Positive numbers indicate a positive correlation. See **Table A16** for values that fall outside the x-axis as shown.

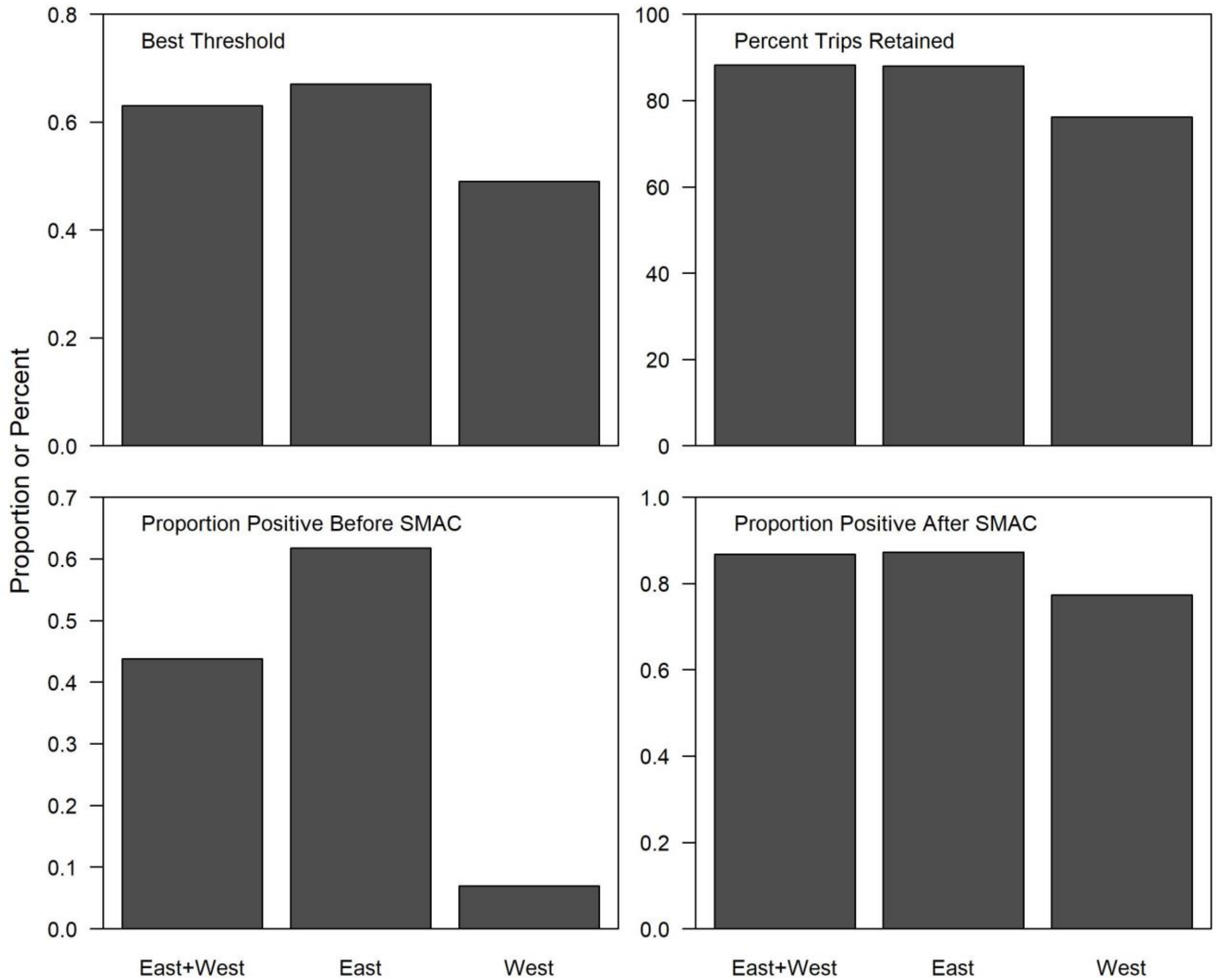

Figure 25. Stephens and MacCall (2004) statistics across regions for associations with Scamp and Yellowmouth Grouper for the Post-IFQ Longline fishery.

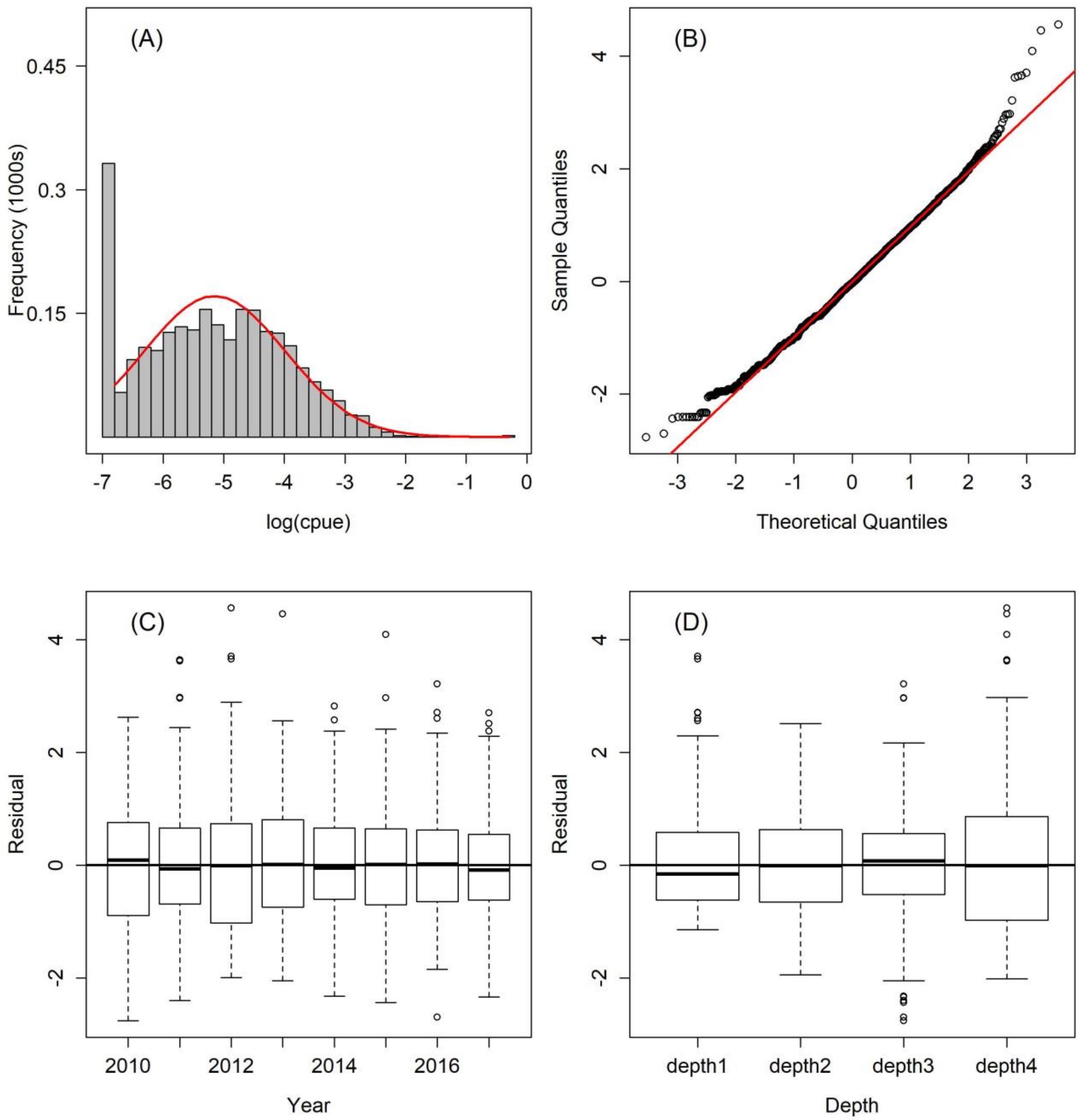

Figure 26. Diagnostic plots for the lognormal model of catch rates on positive trips for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Longline fishery. Shown here are the frequency distribution of catch rates (A), the cumulative normalized residuals (B), and the distribution of residuals by year (C) and depth (D). The red lines represent the expected normal distribution.

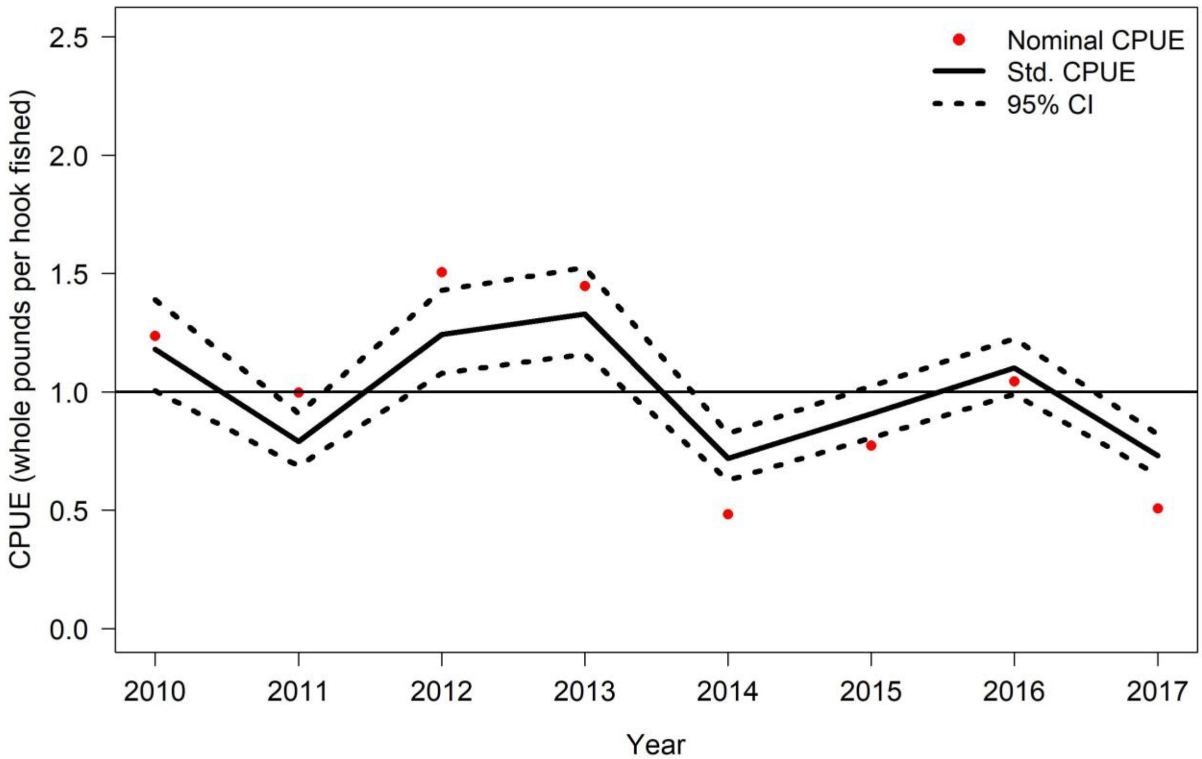

Figure 27. Standardized index with 95% confidence interval, and nominal CPUE for Scamp and Yellowmouth Grouper in the U.S. GOM for the Post-IFQ Longline fishery. The index was scaled to the mean value of the entire time series.

Appendix A

Table A1. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the Eastern U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
1993	4429	812	0.183	794	517	0.651	0.179
1994	5965	915	0.153	966	558	0.578	0.162
1995	6473	1142	0.176	1107	703	0.635	0.171
1996	4913	1129	0.230	1193	744	0.624	0.243
1997	6731	1370	0.204	1340	893	0.666	0.199
1998	6937	1357	0.196	1290	811	0.629	0.186
1999	7914	1472	0.186	1471	892	0.606	0.186
2000	7809	1161	0.149	1149	617	0.537	0.147
2001	7721	1375	0.178	1370	790	0.577	0.177
2002	7975	1684	0.211	1586	1016	0.641	0.199
2003	7810	1912	0.245	1710	1192	0.697	0.219
2004	6745	1705	0.253	1488	1022	0.687	0.221
2005	5244	1468	0.280	1305	893	0.684	0.249
2006	5447	1254	0.230	1230	801	0.651	0.226
2007	4695	1239	0.264	1022	771	0.754	0.218
2008	4857	1253	0.258	1119	843	0.753	0.230
2009	5243	1432	0.273	1225	919	0.750	0.234

Table A2. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Vertical Line trips in the Eastern U.S. GOM for the Pre-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.597	Bar Jack	*Caranx ruber*
1.248	Speckled Hind	*Epinephelus drummondhayi*
1.132	Silk Snapper	*Lutjanus vivanus*
1.127	Red Grouper	*Epinephelus morio*
1.078	Almaco Jack	*Seriola rivoliana*
1.066	Yellowedge Grouper	*Epinephelus flavolimbatus*
1.020	Vermilion Snapper	*Rhomboplites aurorubens*
1.016	Warsaw Grouper	*Epinephelus nigritus*
1.001	Greater Amberjack	*Seriola dumerili*
0.998	Rock Hind	*Epinephelus adscensionis*
0.895	Snowy Grouper	*Epinephelus niveatus*
0.883	Lesser Amberjack	*Seriola fasciata*
0.811	Black Grouper	*Mycteroperca bonaci*
0.631	Gag Grouper	*Mycteroperca microlepis*
0.585	Mutton Snapper	*Lutjanus analis*
0.526	Unc Snappers	*Lutjanidae*
0.502	Banded Rudderfish	*Seriola zonata*
0.489	Red Hind	*Epinephelus guttatus*
0.483	Blackfin Snapper	*Lutjanus buccanella*
0.481	Gray (mangrove) Snapper	*Lutjanus griseus*
0.443	Large Red Porgy	*Pagrus pagrus*
0.434	Queen Snapper	*Etelis oculatus*
0.330	Gray Triggerfish	*Balistes capriscus*
0.319	Ocean Triggerfish	*Canthidermis sufflamen*
0.299	Red Snapper	*Lutjanus campechanus*
0.207	Jolthead Porgy	*Calamus bajonado*
-0.223	Margate	*Haemulon album*
-0.347	Lane Snapper	*Lutjanus synagris*
-0.557	Crevalle	*Caranx hippos*
-0.618	Blue Runner	*Caranx crysos*
-0.872	White Grunt	*Haemulon plumieri*
-1.079	Lg Atlantic Black Sea Bass	*Centropristis striata*
-1.084	Hogfish	*Lachnolaimus maximus*
-1.258	Bluestriped Grunt	*Haemulon sciurus*
-1.386	Yellowtail Snapper	*Ocyurus chrysurus*

Table A3. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the Western U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
1993	1389	191	0.138	212	128	0.604	0.153
1994	951	216	0.227	273	177	0.648	0.287
1995	1648	302	0.183	273	163	0.597	0.166
1996	1658	301	0.182	282	155	0.550	0.170
1997	2809	587	0.209	536	345	0.644	0.191
1998	2995	504	0.168	584	301	0.515	0.195
1999	2749	689	0.251	660	390	0.591	0.240
2000	2716	573	0.211	494	313	0.634	0.182
2001	2537	582	0.229	448	291	0.650	0.177
2002	2425	615	0.254	580	361	0.622	0.239
2003	2464	637	0.259	625	410	0.656	0.254
2004	2322	674	0.290	508	390	0.768	0.219
2005	1511	458	0.303	324	255	0.787	0.214
2006	1995	491	0.246	331	224	0.677	0.166
2007	759	264	0.348	220	182	0.827	0.290
2008	624	194	0.311	155	136	0.877	0.248
2009	663	182	0.275	179	156	0.872	0.270

Table A4. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Vertical Line trips in the Western U.S. GOM for the Pre-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.315	Marbled Grouper	*Epinephelus inermis*
1.094	Yellowedge Grouper	*Epinephelus flavolimbatus*
1.008	Vermilion Snapper	*Rhomboplites aurorubens*
0.936	Yellowtail Snapper	*Ocyurus chrysurus*
0.786	Bar Jack	*Caranx ruber*
0.760	Red Hind	*Epinephelus guttatus*
0.735	Large Red Porgy	*Pagrus pagrus*
0.716	Creole-fish	*Paranthias furcifer*
0.705	Gag Grouper	*Mycteroperca microlepis*
0.667	Greater Amberjack	*Seriola dumerili*
0.666	Lg Atlantic Black Sea Bass	*Centropristis striata*
0.635	Warsaw Grouper	*Epinephelus nigritus*
0.632	Speckled Hind	*Epinephelus drummondhayi*
0.614	Silk Snapper	*Lutjanus vivanus*
0.573	Ocean Triggerfish	*Canthidermis sufflamen*
0.551	Black Grouper	*Mycteroperca bonaci*
0.539	Rock Hind	*Epinephelus adscensionis*
0.528	Almaco Jack	*Seriola rivoliana*
0.500	Gray Triggerfish	*Balistes capriscus*
0.497	Red Grouper	*Epinephelus morio*
0.479	Yellowfin Grouper	*Mycteroperca venenosa*
0.398	Banded Rudderfish	*Seriola zonata*
0.265	Bigeye	*Priacanthus arenatus*
0.248	Snowy Grouper	*Epinephelus niveatus*
0.208	Queen Snapper	*Etelis oculatus*
0.205	Lesser Amberjack	*Seriola fasciata*
0.190	Lane Snapper	*Lutjanus synagris*
0.179	Red Snapper	*Lutjanus campechanus*
0.097	Blackfin Snapper	*Lutjanus buccanella*
0.058	Unc Snappers	*Lutjanidae*
-0.056	Gray (mangrove) Snapper	*Lutjanus griseus*
-0.230	Black Snapper	*Apsilus dentatus*
-0.564	Blue Runner	*Caranx crysos*

Table A5. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the Eastern U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
2010	3532	844	0.239	786	550	0.700	0.223
2011	3612	963	0.267	857	602	0.702	0.237
2012	3694	1224	0.331	1102	815	0.740	0.298
2013	3294	885	0.269	862	632	0.733	0.262
2014	3703	847	0.229	793	573	0.723	0.214
2015	3565	837	0.235	718	519	0.723	0.201
2016	3614	915	0.253	851	625	0.734	0.235
2017	3299	702	0.213	735	489	0.665	0.223

Table A6. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Vertical Line trips in the Eastern U.S. GOM for the Post-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.741	Speckled Hind	*Epinephelus drummondhayi*
1.509	Warsaw Grouper	*Epinephelus nigritus*
1.381	Bar Jack	*Caranx ruber*
1.185	Snowy Grouper	*Epinephelus niveatus*
1.120	Red Grouper	*Epinephelus morio*
1.069	Gag Grouper	*Mycteroperca microlepis*
0.998	Vermilion Snapper	*Rhomboplites aurorubens*
0.987	Black Grouper	*Mycteroperca bonaci*
0.818	Almaco Jack	*Seriola rivoliana*
0.782	Yellowedge Grouper	*Epinephelus flavolimbatus*
0.704	Black Snapper	*Apsilus dentatus*
0.672	Red Hind	*Epinephelus guttatus*
0.664	Large Red Porgy	*Pagrus pagrus*
0.579	Lesser Amberjack	*Seriola fasciata*
0.507	Red Snapper	*Lutjanus campechanus*
0.485	Mutton Snapper	*Lutjanus analis*
0.421	Margate	*Haemulon album*
0.381	Jolthead Porgy	*Calamus bajonado*
0.346	Rock Hind	*Epinephelus adscensionis*
0.293	Silk Snapper	*Lutjanus vivanus*
0.246	Gray (mangrove) Snapper	*Lutjanus griseus*
0.217	Greater Amberjack	*Seriola dumerili*
0.141	Gray Triggerfish	*Balistes capriscus*
-0.169	Banded Rudderfish	*Seriola zonata*
-0.211	Queen Snapper	*Etelis oculatus*
-0.276	Blackfin Snapper	*Lutjanus buccanella*
-0.351	Bluestriped Grunt	*Haemulon sciurus*
-0.650	Lane Snapper	*Lutjanus synagris*
-0.701	Blue Runner	*Caranx crysos*
-0.774	Yellowtail Snapper	*Ocyurus chrysurus*
-0.799	White Grunt	*Haemulon plumieri*
-1.079	Hogfish	*Lachnolaimus maximus*
-1.297	Lg Atlantic Black Sea Bass	*Centropristis striata*

Table A7. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the Western U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
2010	428	136	0.318	138	123	0.891	0.322
2011	616	111	0.180	112	96	0.857	0.182
2012	626	156	0.249	154	133	0.864	0.246
2013	580	196	0.338	185	155	0.838	0.319
2014	772	249	0.323	259	206	0.795	0.335
2015	909	257	0.283	254	199	0.783	0.279
2016	961	341	0.355	299	256	0.856	0.311
2017	902	249	0.276	224	184	0.821	0.248

Table A8. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Vertical Line trips in the Western U.S. GOM for the Post-IFQ Vertical Line fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.880	Speckled Hind	*Epinephelus drummondhayi*
1.716	Yellowedge Grouper	*Epinephelus flavolimbatus*
1.590	Vermilion Snapper	*Rhomboplites aurorubens*
1.477	Almaco Jack	*Seriola rivoliana*
1.477	Banded Rudderfish	*Seriola zonata*
1.290	Bar Jack	*Caranx ruber*
1.284	Gag Grouper	*Mycteroperca microlepis*
1.146	Yellowtail Snapper	*Ocyurus chrysurus*
1.114	Creole-fish	*Paranthias furcifer*
1.024	Red Snapper	*Lutjanus campechanus*
0.973	Ocean Triggerfish	*Canthidermis sufflamen*
0.859	Red Grouper	*Epinephelus morio*
0.780	Warsaw Grouper	*Epinephelus nigritus*
0.675	Red Hind	*Epinephelus guttatus*
0.594	Yellowfin Grouper	*Mycteroperca venenosa*
0.593	Black Grouper	*Mycteroperca bonaci*
0.544	Rock Hind	*Epinephelus adscensionis*
0.543	Greater Amberjack	*Seriola dumerili*
0.528	Snowy Grouper	*Epinephelus niveatus*
0.523	Bigeye	*Priacanthus arenatus*
0.448	Large Red Porgy	*Pagrus pagrus*
0.378	Lesser Amberjack	*Seriola fasciata*
0.347	Blackfin Snapper	*Lutjanus buccanella*
0.295	Lane Snapper	*Lutjanus synagris*
0.226	Silk Snapper	*Lutjanus vivanus*
0.082	Blue Runner	*Caranx crysos*
0.009	Gray Triggerfish	*Balistes capriscus*
-0.120	Queen Triggerfish	*Balistes vetula*
-0.348	Marbled Grouper	*Epinephelus inermis*
-0.350	Jolthead Porgy	*Calamus bajonado*
-0.515	Gray (mangrove) Snapper	*Lutjanus griseus*
-0.592	Queen Snapper	*Etelis oculatus*
-1.194	Unc Snappers	*Lutjanidae*
-1.199	Misty Grouper	*Epinephelus mystacinus*

Table A9. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the Eastern U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
1993	604	341	0.565	317	244	0.770	0.525
1994	896	340	0.379	348	236	0.678	0.388
1995	962	308	0.320	306	208	0.680	0.318
1996	856	372	0.435	345	260	0.754	0.403
1997	1249	550	0.440	476	380	0.798	0.381
1998	1128	548	0.486	493	404	0.819	0.437
1999	1172	501	0.427	517	378	0.731	0.441
2000	1120	429	0.383	445	299	0.672	0.397
2001	1180	500	0.424	485	378	0.779	0.411
2002	1159	461	0.398	455	358	0.787	0.393
2003	1279	601	0.470	545	454	0.833	0.426
2004	1207	586	0.486	572	470	0.822	0.474
2005	1103	562	0.510	524	445	0.849	0.475
2006	1299	542	0.417	588	432	0.735	0.453
2007	835	382	0.457	404	304	0.752	0.484
2008	813	449	0.552	444	366	0.824	0.546
2009	419	230	0.549	204	184	0.902	0.487

Table A10. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Longline trips in the Eastern U.S. GOM for the Pre-IFQ Longline fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.623	Gag Grouper	*Mycteroperca microlepis*
1.580	Bar Jack	*Caranx ruber*
1.460	Red Grouper	*Epinephelus morio*
1.230	Black Grouper	*Mycteroperca bonaci*
1.045	Vermilion Snapper	*Rhomboplites aurorubens*
1.013	Warsaw Grouper	*Epinephelus nigritus*
0.913	Dog Snapper	*Lutjanus jocu*
0.886	Misty Grouper	*Epinephelus mystacinus*
0.854	Gray Triggerfish	*Balistes capriscus*
0.707	Red Snapper	*Lutjanus campechanus*
0.698	Queen Snapper	*Etelis oculatus*
0.672	Silk Snapper	*Lutjanus vivanus*
0.651	Rock Hind	*Epinephelus adscensionis*
0.605	Speckled Hind	*Epinephelus drummondhayi*
0.604	Margate	*Haemulon album*
0.567	Large Red Porgy	*Pagrus pagrus*
0.541	Almaco Jack	*Seriola rivoliana*
0.511	Lesser Amberjack	*Seriola fasciata*
0.494	Jolthead Porgy	*Calamus bajonado*
0.435	Gray (mangrove) Snapper	*Lutjanus griseus*
0.386	Red Hind	*Epinephelus guttatus*
0.366	Unc Snappers	*Lutjanidae*
0.356	Banded Rudderfish	*Seriola zonata*
0.342	Snowy Grouper	*Epinephelus niveatus*
0.281	Blackfin Snapper	*Lutjanus buccanella*
0.269	Queen Triggerfish	*Balistes vetula*
0.166	Yellowtail Snapper	*Ocyurus chrysurus*
0.151	Greater Amberjack	*Seriola dumerili*
0.054	Yellowfin Grouper	*Mycteroperca venenosa*
0.017	Yellowedge Grouper	*Epinephelus flavolimbatus*
-0.170	Mutton Snapper	*Lutjanus analis*
-0.496	Lane Snapper	*Lutjanus synagris*

Table A11. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the Western U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
1993	90	33	0.367	45	23	0.511	0.500
1994	92	30	0.326	30	21	0.700	0.326
1995	175	52	0.297	55	39	0.709	0.314
1996	137	24	0.175	21	16	0.762	0.153
1997	111	27	0.243	18	17	0.944	0.162
1998	119	24	0.202	26	15	0.577	0.218
1999	248	37	0.149	35	22	0.629	0.141
2000	210	38	0.181	28	18	0.643	0.133
2001	173	15	0.087	16	7	0.438	0.092
2002	185	21	0.114	19	10	0.526	0.103
2003	216	25	0.116	29	16	0.552	0.134
2004	249	23	0.092	20	13	0.650	0.080
2005	168	29	0.173	21	13	0.619	0.125
2006	141	24	0.170	17	12	0.706	0.121
2007	48	12	0.250	14	9	0.643	0.292
2008	39	19	0.487	25	14	0.560	0.641
2009	28	21	0.750	22	19	0.864	0.786

Table A12. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Longline trips in the Western U.S. GOM for the Pre-IFQ Longline fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
1.710	Gag Grouper	*Mycteroperca microlepis*
1.634	Bar Jack	*Caranx ruber*
1.633	Crevalle	*Caranx hippos*
1.422	Yellowfin Grouper	*Mycteroperca venenosa*
1.413	Yellowedge Grouper	*Epinephelus flavolimbatus*
1.353	Black Grouper	*Mycteroperca bonaci*
1.325	Unc Snappers	*Lutjanidae*
1.217	Vermilion Snapper	*Rhomboplites aurorubens*
1.108	Lane Snapper	*Lutjanus synagris*
1.036	Gray Triggerfish	*Balistes capriscus*
1.021	Snowy Grouper	*Epinephelus niveatus*
0.888	Speckled Hind	*Epinephelus drummondhayi*
0.838	Red Grouper	*Epinephelus morio*
0.783	Large Red Porgy	*Pagrus pagrus*
0.712	Blackfin Snapper	*Lutjanus buccanella*
0.674	Warsaw Grouper	*Epinephelus nigritus*
0.526	Almaco Jack	*Seriola rivoliana*
0.364	Queen Snapper	*Etelis oculatus*
0.287	Marbled Grouper	*Epinephelus inermis*
0.277	Greater Amberjack	*Seriola dumerili*
0.126	Silk Snapper	*Lutjanus vivanus*
0.041	Red Snapper	*Lutjanus campechanus*
-0.167	Banded Rudderfish	*Seriola zonata*
-0.266	Gray (mangrove) Snapper	*Lutjanus griseus*
-0.616	Lesser Amberjack	*Seriola fasciata*

Table A13. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the Eastern U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
2010	284	159	0.560	171	143	0.836	0.602
2011	462	287	0.621	277	225	0.812	0.600
2012	457	243	0.532	232	203	0.875	0.508
2013	352	233	0.662	242	212	0.876	0.688
2014	441	270	0.612	290	242	0.834	0.658
2015	577	368	0.638	348	315	0.905	0.603
2016	647	424	0.655	428	384	0.897	0.662
2017	593	371	0.626	386	347	0.899	0.651

Table A14. Association coefficients of other species with Scamp and Yellowmouth Grouper for the Eastern U.S. GOM for the Post-IFQ Longline fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
2.680	Red Grouper	*Epinephelus morio*
1.783	Almaco Jack	*Seriola rivoliana*
1.585	Gag Grouper	*Mycteroperca microlepis*
1.507	Black Grouper	*Mycteroperca bonaci*
1.487	Schoolmaster Snapper	*Lutjanus apodus*
1.300	Speckled Hind	*Epinephelus drummondhayi*
0.955	Yellowedge Grouper	*Epinephelus flavolimbatus*
0.908	Silk Snapper	*Lutjanus vivanus*
0.833	Blackfin Snapper	*Lutjanus buccanella*
0.830	Rock Hind	*Epinephelus adscensionis*
0.827	Warsaw Grouper	*Epinephelus nigritus*
0.818	Lesser Amberjack	*Seriola fasciata*
0.801	Margate	*Haemulon album*
0.665	Large Red Porgy	*Pagrus pagrus*
0.559	Vermilion Snapper	*Rhomboplites aurorubens*
0.357	Bar Jack	*Caranx ruber*
0.331	Gray Triggerfish	*Balistes capriscus*
0.284	African Pompano	*Alectis ciliaris*
0.260	Banded Rudderfish	*Seriola zonata*
0.219	Dog Snapper	*Lutjanus jocu*
0.202	Mutton Snapper	*Lutjanus analis*
0.200	Red Snapper	*Lutjanus campechanus*
0.183	Yellowtail Snapper	*Ocyurus chrysurus*
0.106	Jolthead Porgy	*Calamus bajonado*
0.086	Gray (mangrove) Snapper	*Lutjanus griseus*
0.075	Black Snapper	*Apsilus dentatus*
-0.055	Queen Snapper	*Etelis oculatus*
-0.207	Greater Amberjack	*Seriola dumerili*
-0.300	Red Hind	*Epinephelus guttatus*
-0.700	Snowy Grouper	*Epinephelus niveatus*
-0.881	Lane Snapper	*Lutjanus synagris*
-0.935	Cubera Snapper	*Lutjanus cyanopterus*

Table A15. Total trips, positive trips (Pos), and proportion of positive trips (PPos) before (Total) and after trip selection (Stephens and MacCall, SMAC) for Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the Western U.S. GOM. The proportion of trips retained is also provided.

Year	Trips Total	Pos Total	PPos Total	Trips SMAC	Pos SMAC	PPos SMAC	Trips Retained
2010	44	13	0.295	13	11	0.846	0.295
2011	123	2	0.016	4	1	0.250	0.033
2012	248	15	0.060	14	12	0.857	0.056
2013	361	15	0.042	13	10	0.769	0.036
2014	461	11	0.024	9	6	0.667	0.020
2015	428	23	0.054	23	17	0.739	0.054
2016	99	23	0.232	23	18	0.783	0.232
2017	100	28	0.280	29	24	0.828	0.290

Table A16. Association coefficients of other species with Scamp and Yellowmouth Grouper in at least 1% of Longline trips in the Western U.S. GOM for the Post-IFQ Longline fishery. Positive numbers indicate a positive correlation.

Coefficient	Common Name	Scientific Name
17.473	Yellowedge Grouper	*Epinephelus flavolimbatus*
3.068	Speckled Hind	*Epinephelus drummondhayi*
2.849	Black Grouper	*Mycteroperca bonaci*
2.112	Yellowtail Snapper	*Ocyurus chrysurus*
1.967	Misty Grouper	*Epinephelus mystacinus*
1.606	Large Red Porgy	*Pagrus pagrus*
1.469	Bigeye	*Priacanthus arenatus*
1.296	Lane Snapper	*Lutjanus synagris*
1.144	Gag Grouper	*Mycteroperca microlepis*
0.968	Lg Atlantic Black Sea Bass	*Centropristis striata*
0.822	Mahogony Snapper	*Lutjanus mahogoni*
0.713	Warsaw Grouper	*Epinephelus nigritus*
0.689	Gray (mangrove) Snapper	*Lutjanus griseus*
0.688	Snowy Grouper	*Epinephelus niveatus*
0.570	Rock Hind	*Epinephelus adscensionis*
0.524	Red Snapper	*Lutjanus campechanus*
0.505	Vermilion Snapper	*Rhomboplites aurorubens*
0.362	Gray Triggerfish	*Balistes capriscus*
0.346	Almaco Jack	*Seriola rivoliana*
0.250	Lesser Amberjack	*Seriola fasciata*
-0.090	African Pompano	*Alectis ciliaris*
-0.134	Greater Amberjack	*Seriola dumerili*
-0.299	Red Grouper	*Epinephelus morio*
-0.476	Silk Snapper	*Lutjanus vivanus*
-1.592	Blue Runner	*Caranx crysos*
-1.593	Unc Snappers	*Lutjanidae*
-1.660	Queen Snapper	*Etelis oculatus*
-2.481	Bar Jack	*Caranx ruber*

Appendix B

Table B1. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
1993	481	109	204	212	160	282	245	319
1994	470	189	307	273	252	360	299	328
1995	575	202	330	273	322	410	325	323
1996	638	164	391	282	356	444	404	271
1997	691	218	431	536	501	509	440	426
1998	704	186	400	584	536	545	404	389
1999	708	244	519	660	624	643	454	410
2000	537	240	372	494	517	414	371	341
2001	666	269	435	448	481	540	459	338
2002	695	379	512	580	700	713	443	310
2003	708	422	580	625	766	738	499	332
2004	715	309	464	508	592	625	467	312
2005	684	325	296	324	458	541	374	256
2006	697	258	275	331	377	475	379	330
2007	349	317	356	220	158	351	370	363
2008	395	336	388	155	167	422	351	334
2009	389	395	441	179	180	430	401	393
TOTAL	10102	4562	6701	6684	7147	8442	6685	5775

Table B1 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Crew1	Crew2	Crew3	Hookhr1	Hookhr2	Hookhr3	Hookhr4
1993	513	244	249	235	278	245	248
1994	573	357	309	311	350	281	297
1995	585	440	355	335	437	340	268
1996	670	463	342	358	464	352	301
1997	783	591	502	392	531	534	419
1998	779	543	552	429	530	528	387
1999	810	636	685	450	558	655	468
2000	615	538	490	358	438	467	380
2001	684	691	443	465	490	446	417
2002	737	912	517	639	491	528	508
2003	779	1000	556	657	459	621	598
2004	775	823	398	622	417	471	486
2005	700	654	275	562	363	399	305
2006	739	543	279	471	373	396	321
2007	427	483	332	252	247	258	485
2008	459	497	318	320	242	246	466
2009	441	586	377	280	237	309	578
TOTAL	11069	10001	6979	7136	6905	7076	6932

Table B1 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	30	40	58	48	97	108	144	144	123	84	64	66
1994	24	84	77	118	149	129	148	136	115	90	77	92
1995	104	120	150	134	151	131	106	112	135	85	103	49
1996	54	81	97	104	111	100	119	181	218	104	156	150
1997	131	160	223	103	176	164	157	171	218	152	129	92
1998	102	176	214	184	146	173	148	123	115	211	142	140
1999	162	234	256	242	156	170	153	151	191	153	158	105
2000	89	209	193	152	154	152	94	95	77	155	135	138
2001	99	148	98	184	196	181	152	149	129	148	189	145
2002	157	150	142	197	146	220	179	197	115	236	221	206
2003	158	199	188	231	224	232	202	191	152	195	185	178
2004	154	154	185	213	225	250	214	161	97	235	108	0
2005	189	154	109	174	212	211	184	183	154	59	0	0
2006	137	108	115	163	83	175	143	150	130	82	114	161
2007	89	112	102	88	73	144	111	99	98	72	101	153
2008	75	108	95	119	101	110	99	102	109	102	139	115
2009	155	88	95	105	130	154	123	132	120	96	103	103
TOTAL	1909	2325	2397	2559	2530	2804	2476	2477	2296	2259	2124	1893

Table B2. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
1993	0.676	0.587	0.627	0.627	0.463	0.557	0.657	0.793
1994	0.594	0.698	0.479	0.479	0.385	0.581	0.615	0.747
1995	0.609	0.723	0.627	0.627	0.435	0.612	0.699	0.768
1996	0.660	0.762	0.506	0.506	0.427	0.606	0.666	0.771
1997	0.670	0.766	0.610	0.610	0.451	0.668	0.750	0.803
1998	0.636	0.769	0.550	0.550	0.371	0.585	0.696	0.805
1999	0.549	0.680	0.649	0.649	0.429	0.607	0.689	0.758
2000	0.557	0.438	0.573	0.573	0.379	0.563	0.671	0.739
2001	0.574	0.639	0.542	0.542	0.389	0.583	0.702	0.760
2002	0.634	0.602	0.678	0.678	0.449	0.631	0.801	0.832
2003	0.674	0.659	0.753	0.753	0.487	0.740	0.802	0.852
2004	0.654	0.728	0.709	0.709	0.519	0.754	0.814	0.814
2005	0.616	0.781	0.737	0.737	0.581	0.719	0.754	0.824
2006	0.581	0.725	0.760	0.760	0.544	0.619	0.747	0.736
2007	0.690	0.763	0.809	0.809	0.462	0.735	0.838	0.860
2008	0.595	0.812	0.863	0.863	0.497	0.737	0.869	0.838
2009	0.563	0.775	0.893	0.893	0.489	0.770	0.818	0.835
TOTAL	0.620	0.704	0.672	0.655	0.454	0.655	0.745	0.796

Table B2 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Crew1	Crew2	Crew3	Hookhr1	Hookhr2	Hookhr3	Hookhr4
1993	0.641	0.684	0.598	0.506	0.712	0.596	0.734
1994	0.522	0.658	0.650	0.434	0.620	0.605	0.717
1995	0.603	0.623	0.673	0.490	0.670	0.615	0.746
1996	0.588	0.650	0.597	0.514	0.640	0.602	0.684
1997	0.632	0.667	0.695	0.503	0.708	0.657	0.749
1998	0.596	0.611	0.573	0.466	0.630	0.587	0.692
1999	0.531	0.616	0.671	0.416	0.582	0.637	0.754
2000	0.489	0.548	0.682	0.352	0.550	0.615	0.726
2001	0.519	0.624	0.666	0.402	0.651	0.610	0.727
2002	0.582	0.664	0.661	0.463	0.697	0.646	0.783
2003	0.628	0.717	0.712	0.502	0.756	0.697	0.823
2004	0.631	0.740	0.789	0.518	0.758	0.760	0.856
2005	0.599	0.787	0.778	0.528	0.744	0.802	0.856
2006	0.586	0.753	0.656	0.490	0.686	0.707	0.804
2007	0.691	0.778	0.849	0.568	0.814	0.729	0.868
2008	0.669	0.827	0.821	0.497	0.785	0.813	0.923
2009	0.612	0.829	0.846	0.464	0.743	0.796	0.905
TOTAL	0.592	0.695	0.696	0.477	0.680	0.670	0.795

Table B2 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Vertical Line for the U.S. GOM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	0.600	0.600	0.569	0.583	0.639	0.565	0.667	0.681	0.683	0.726	0.578	0.651
1994	0.625	0.476	0.545	0.627	0.564	0.636	0.676	0.581	0.635	0.567	0.519	0.598
1995	0.606	0.500	0.580	0.575	0.623	0.687	0.632	0.643	0.741	0.506	0.709	0.816
1996	0.667	0.605	0.680	0.644	0.613	0.540	0.588	0.580	0.500	0.606	0.647	0.740
1997	0.649	0.575	0.655	0.631	0.710	0.726	0.662	0.719	0.601	0.632	0.674	0.707
1998	0.578	0.415	0.435	0.549	0.678	0.746	0.689	0.683	0.583	0.474	0.747	0.707
1999	0.667	0.483	0.590	0.570	0.712	0.671	0.601	0.649	0.508	0.516	0.627	0.781
2000	0.618	0.569	0.601	0.572	0.662	0.612	0.585	0.547	0.416	0.516	0.556	0.464
2001	0.505	0.581	0.673	0.609	0.561	0.613	0.618	0.577	0.612	0.540	0.614	0.628
2002	0.643	0.600	0.711	0.634	0.678	0.605	0.665	0.701	0.548	0.568	0.652	0.631
2003	0.741	0.694	0.755	0.706	0.728	0.724	0.708	0.686	0.737	0.585	0.535	0.629
2004	0.753	0.734	0.773	0.714	0.738	0.768	0.734	0.621	0.546	0.647	0.630	0.000
2005	0.651	0.714	0.816	0.747	0.703	0.749	0.679	0.738	0.636	0.525	0.000	0.000
2006	0.708	0.574	0.756	0.718	0.795	0.714	0.587	0.587	0.592	0.610	0.588	0.652
2007	0.730	0.768	0.873	0.795	0.808	0.708	0.748	0.808	0.735	0.722	0.752	0.778
2008	0.733	0.768	0.779	0.714	0.852	0.754	0.768	0.735	0.670	0.814	0.835	0.783
2009	0.768	0.784	0.853	0.714	0.746	0.805	0.691	0.712	0.833	0.812	0.748	0.738
TOTAL	0.672	0.605	0.670	0.651	0.688	0.691	0.667	0.661	0.618	0.596	0.650	0.677

Table B3. Number of trips for Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
2010	244	355	150	175	403	149	205	167
2011	232	442	168	127	410	167	236	156
2012	343	457	263	193	484	225	304	243
2013	342	308	174	223	380	172	257	238
2014	345	304	108	295	390	169	253	240
2015	338	244	97	293	402	177	223	170
2016	411	269	110	360	447	211	258	234
2017	345	259	95	260	391	154	234	180
TOTAL	2600	2638	1165	1926	3307	1424	1970	1628

Year	Crew1	Crew2	Crew3	Hookhr1	Hookhr2	Hookhr3	Hookhr4
2010	328	380	216	222	252	197	253
2011	327	418	224	201	260	226	282
2012	464	482	310	279	297	342	338
2013	471	359	217	247	301	279	220
2014	375	507	170	266	233	283	270
2015	380	431	161	274	221	277	200
2016	469	491	190	314	284	260	292
2017	448	357	154	281	235	220	223
TOTAL	3262	3425	1642	2084	2083	2084	2078

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	88	90	129	117	119	65	39	55	47	42	42	91
2011	72	68	74	68	88	84	87	87	86	69	55	131
2012	114	84	134	123	133	65	120	74	100	97	102	110
2013	87	68	86	99	135	99	90	93	59	73	39	119
2014	55	113	73	100	127	97	73	81	72	100	54	107
2015	101	59	106	105	79	100	74	78	58	56	61	95
2016	77	108	107	117	136	120	110	71	94	56	76	78
2017	57	114	93	84	90	98	72	69	76	46	81	79
TOTAL	651	704	802	813	907	728	665	608	592	539	510	810

Table B3 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the U.S. GOM

Year	IFQ1	IFQ2	IFQ3	IFQ4	Depth1	Depth2	Depth3	Depth4
2010	163	188	199	178	199	233	259	233
2011	202	175	184	149	127	284	320	238
2012	223	249	233	238	267	307	316	366
2013	141	176	151	224	262	301	240	244
2014	144	171	196	184	327	271	237	217
2015	172	143	124	175	315	229	214	214
2016	95	116	109	62	332	241	283	294
2017	208	131	149	137	275	231	246	207
TOTAL	1348	1349	1345	1347	2104	2097	2115	2013

Table B4. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
2010	0.738	0.673	0.660	0.660	0.578	0.758	0.883	0.874
2011	0.690	0.685	0.768	0.768	0.617	0.760	0.809	0.814
2012	0.752	0.678	0.810	0.810	0.601	0.831	0.826	0.901
2013	0.807	0.656	0.701	0.701	0.547	0.849	0.852	0.899
2014	0.736	0.674	0.759	0.759	0.580	0.805	0.798	0.896
2015	0.754	0.680	0.722	0.722	0.570	0.802	0.883	0.882
2016	0.788	0.602	0.791	0.791	0.584	0.848	0.895	0.897
2017	0.667	0.637	0.684	0.684	0.575	0.766	0.803	0.789
TOTAL	0.745	0.664	0.744	0.831	0.582	0.806	0.843	0.874

Year	Crew1	Crew2	Crew3	Hookhr1	Hookhr2	Hookhr3	Hookhr4
2010	0.649	0.740	0.829	0.531	0.754	0.731	0.874
2011	0.657	0.715	0.821	0.507	0.715	0.739	0.862
2012	0.713	0.772	0.790	0.570	0.748	0.795	0.873
2013	0.722	0.747	0.825	0.664	0.751	0.746	0.859
2014	0.709	0.765	0.735	0.587	0.743	0.830	0.796
2015	0.740	0.756	0.689	0.664	0.724	0.773	0.810
2016	0.712	0.825	0.747	0.669	0.761	0.785	0.860
2017	0.658	0.714	0.799	0.605	0.664	0.718	0.848
TOTAL	0.697	0.757	0.784	0.605	0.734	0.769	0.849

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.795	0.756	0.760	0.684	0.689	0.754	0.641	0.709	0.787	0.667	0.786	0.703
2011	0.833	0.794	0.743	0.765	0.693	0.738	0.747	0.724	0.628	0.638	0.636	0.710
2012	0.658	0.714	0.828	0.789	0.707	0.661	0.825	0.770	0.760	0.825	0.667	0.800
2013	0.747	0.897	0.767	0.828	0.711	0.768	0.700	0.645	0.848	0.740	0.667	0.740
2014	0.727	0.805	0.767	0.690	0.693	0.794	0.657	0.741	0.778	0.690	0.741	0.794
2015	0.733	0.746	0.792	0.733	0.785	0.790	0.730	0.782	0.724	0.536	0.672	0.737
2016	0.584	0.704	0.841	0.752	0.809	0.800	0.791	0.789	0.883	0.768	0.737	0.654
2017	0.667	0.798	0.731	0.655	0.722	0.694	0.694	0.565	0.658	0.652	0.679	0.810
TOTAL	0.717	0.774	0.783	0.738	0.725	0.755	0.738	0.715	0.757	0.701	0.694	0.744

Table B4 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Post-IFQ Vertical Line for the U.S. GOM

Year	IFQ1	IFQ2	IFQ3	IFQ4	Depth1	Depth2	Depth3	Depth4
2010	0.626	0.777	0.804	0.893	0.487	0.674	0.822	0.884
2011	0.644	0.783	0.815	0.886	0.378	0.644	0.834	0.840
2012	0.650	0.803	0.850	0.903	0.498	0.632	0.889	0.929
2013	0.681	0.761	0.848	0.888	0.519	0.708	0.892	0.918
2014	0.660	0.789	0.775	0.848	0.612	0.664	0.865	0.894
2015	0.733	0.776	0.798	0.840	0.616	0.668	0.855	0.878
2016	0.695	0.836	0.872	0.935	0.635	0.631	0.905	0.891
2017	0.644	0.794	0.785	0.839	0.516	0.606	0.850	0.879
TOTAL	0.663	0.789	0.817	0.877	0.552	0.654	0.864	0.892

Table B5. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
1993	105	149	48	60	69	75	103	115
1994	115	157	37	69	90	85	86	117
1995	108	125	31	97	86	79	88	108
1996	116	131	56	63	91	106	84	85
1997	160	165	83	86	106	149	110	129
1998	187	213	45	74	128	155	125	111
1999	185	230	68	69	114	154	159	125
2000	135	193	73	72	99	137	126	111
2001	151	187	92	71	96	145	147	113
2002	97	196	107	74	128	145	122	79
2003	138	258	93	85	181	158	151	84
2004	162	225	117	88	196	159	143	94
2005	168	176	110	91	239	159	98	49
2006	197	209	105	94	208	221	119	57
2007	152	148	58	60	76	145	116	81
2008	127	157	76	109	104	135	138	92
2009	65	78	27	56	30	67	75	54
TOTAL	2368	2997	1226	1318	2041	2274	1990	1604

Table B5 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Crew1	Crew2	Crew3	Length1	Length2	Length3	Length4
1993	127	160	75	209	76	54	23
1994	107	185	86	219	64	47	48
1995	98	181	82	199	60	42	60
1996	106	209	51	214	90	27	35
1997	99	283	112	275	110	60	49
1998	112	327	80	217	176	73	53
1999	110	337	105	213	196	67	76
2000	92	301	80	177	149	82	65
2001	88	296	117	178	175	53	95
2002	72	266	136	164	179	48	83
2003	85	301	188	142	206	75	151
2004	99	296	197	172	178	81	161
2005	67	297	181	125	165	96	159
2006	69	360	176	110	171	73	251
2007	30	253	135	57	97	74	190
2008	35	277	157	106	81	76	206
2009	12	128	86	76	43	39	68
TOTAL	1408	4457	2044	2853	2216	1067	1773

Table B5 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	16	23	21	19	27	39	28	38	52	29	35	35
1994	17	22	12	22	35	60	39	42	40	27	29	33
1995	28	28	32	34	37	43	23	32	45	20	31	8
1996	19	22	18	22	23	15	24	34	42	32	56	59
1997	40	35	56	40	50	36	41	36	41	36	38	45
1998	45	44	42	36	47	55	32	41	35	44	47	51
1999	27	43	52	39	66	52	49	57	32	52	43	40
2000	35	33	47	42	51	48	34	28	28	48	43	36
2001	29	26	25	43	55	49	47	51	36	58	38	44
2002	39	21	21	51	52	40	45	45	26	51	38	45
2003	40	32	29	53	52	54	48	52	56	55	52	51
2004	49	34	32	64	84	67	52	68	46	69	27	0
2005	50	52	42	73	66	79	47	59	41	36	0	0
2006	58	42	32	65	66	54	51	65	38	42	34	27
2007	32	26	28	44	39	41	31	37	35	30	35	34
2008	43	27	26	55	48	45	29	40	48	34	33	35
2009	41	20	33	32	34	24	0	0	0	4	21	33
TOTAL	608	530	548	734	832	801	620	725	641	667	600	576

Table B6. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Area1	Area2	Area3	Area4	Away1	Away2	Away3	Away4
1993	0.733	0.758	0.812	0.633	0.652	0.667	0.748	0.826
1994	0.687	0.650	0.676	0.739	0.578	0.718	0.651	0.752
1995	0.639	0.688	0.742	0.711	0.628	0.620	0.750	0.722
1996	0.716	0.725	0.857	0.794	0.659	0.736	0.774	0.859
1997	0.787	0.751	0.855	0.884	0.736	0.799	0.818	0.853
1998	0.791	0.873	0.867	0.622	0.703	0.813	0.856	0.865
1999	0.795	0.678	0.706	0.710	0.658	0.669	0.761	0.808
2000	0.637	0.679	0.685	0.694	0.525	0.693	0.754	0.676
2001	0.735	0.818	0.870	0.578	0.656	0.759	0.796	0.841
2002	0.711	0.801	0.804	0.757	0.641	0.772	0.836	0.911
2003	0.804	0.822	0.925	0.718	0.718	0.861	0.874	0.857
2004	0.796	0.831	0.889	0.716	0.719	0.855	0.881	0.851
2005	0.792	0.847	0.918	0.824	0.854	0.843	0.816	0.816
2006	0.706	0.761	0.695	0.777	0.745	0.724	0.714	0.772
2007	0.724	0.763	0.759	0.767	0.671	0.779	0.767	0.741
2008	0.748	0.860	0.855	0.780	0.769	0.815	0.812	0.848
2009	0.923	0.872	0.889	0.911	0.900	0.836	0.907	0.963
TOTAL	0.748	0.776	0.821	0.744	0.705	0.769	0.798	0.816

Table B6 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Crew1	Crew2	Crew3	Length1	Length2	Length3	Length4
1993	0.779	0.706	0.733	0.751	0.750	0.667	0.739
1994	0.738	0.649	0.674	0.685	0.781	0.638	0.562
1995	0.592	0.685	0.793	0.754	0.550	0.500	0.717
1996	0.698	0.770	0.804	0.804	0.722	0.556	0.686
1997	0.687	0.820	0.866	0.789	0.846	0.783	0.816
1998	0.786	0.816	0.800	0.811	0.807	0.808	0.792
1999	0.773	0.691	0.781	0.765	0.699	0.731	0.671
2000	0.641	0.661	0.738	0.735	0.664	0.573	0.631
2001	0.784	0.743	0.821	0.781	0.794	0.698	0.737
2002	0.639	0.797	0.809	0.738	0.793	0.729	0.843
2003	0.835	0.807	0.830	0.852	0.791	0.827	0.821
2004	0.737	0.811	0.863	0.855	0.764	0.827	0.826
2005	0.672	0.842	0.901	0.912	0.764	0.896	0.830
2006	0.522	0.719	0.847	0.727	0.684	0.767	0.761
2007	0.467	0.743	0.822	0.667	0.660	0.851	0.779
2008	0.600	0.823	0.834	0.792	0.778	0.776	0.845
2009	0.667	0.898	0.930	0.829	0.930	0.923	0.941
TOTAL	0.705	0.764	0.825	0.779	0.752	0.754	0.785

Table B6 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Pre-IFQ Longline for the U.S. GOM

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993	0.625	0.652	0.762	0.684	0.778	0.769	0.750	0.658	0.750	0.724	0.886	0.714
1994	0.765	0.864	0.750	0.682	0.657	0.733	0.744	0.762	0.475	0.630	0.517	0.667
1995	0.786	0.679	0.688	0.735	0.568	0.605	0.609	0.688	0.689	0.650	0.806	0.875
1996	0.789	0.864	0.778	0.727	0.783	0.867	0.500	0.676	0.667	0.812	0.821	0.780
1997	0.850	0.914	0.768	0.875	0.800	0.806	0.707	0.750	0.854	0.778	0.737	0.822
1998	0.822	0.841	0.833	0.861	0.681	0.709	0.844	0.829	0.829	0.818	0.830	0.843
1999	0.704	0.767	0.635	0.872	0.758	0.731	0.592	0.702	0.750	0.692	0.744	0.800
2000	0.714	0.697	0.681	0.738	0.608	0.562	0.706	0.464	0.571	0.750	0.674	0.833
2001	0.828	0.885	0.880	0.861	0.709	0.735	0.745	0.647	0.917	0.741	0.684	0.773
2002	0.846	0.857	0.714	0.863	0.731	0.825	0.778	0.644	0.538	0.765	0.842	0.844
2003	0.850	0.812	0.828	0.774	0.769	0.870	0.750	0.827	0.786	0.800	0.865	0.902
2004	0.939	0.853	0.844	0.875	0.798	0.806	0.808	0.779	0.717	0.797	0.778	0.000
2005	0.820	0.827	0.929	0.794	0.864	0.823	0.851	0.915	0.878	0.694	0.000	0.000
2006	0.879	0.857	0.812	0.815	0.712	0.778	0.647	0.554	0.632	0.643	0.588	0.778
2007	0.844	0.769	0.607	0.750	0.744	0.732	0.839	0.784	0.686	0.833	0.657	0.588
2008	0.698	0.778	0.654	0.836	0.750	0.822	0.862	0.875	0.875	0.853	0.849	0.657
2009	0.927	0.850	0.879	0.812	0.853	0.917	0.000	0.000	0.000	1.000	1.000	0.849
TOTAL	0.821	0.811	0.766	0.809	0.743	0.764	0.737	0.728	0.735	0.756	0.768	0.785

Table B7. Number of trips for Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the U.S. GOM

Year	Area1	Area2	Area3	Away1	Away2	Away3	Away4
2010	72	67	45	66	65	34	19
2011	120	118	43	90	114	44	33
2012	94	110	42	105	87	37	17
2013	97	102	56	93	88	49	25
2014	156	93	50	86	109	66	38
2015	174	111	86	77	116	95	83
2016	210	156	85	105	161	104	81
2017	183	136	96	81	111	100	123
TOTAL	1106	893	503	703	851	529	419

Year	Crew1	Crew2	Crew3	Crew4	Length1	Length2	Length3
2010	8	131	36	9	80	77	27
2011	12	200	59	10	136	107	38
2012	7	169	54	16	112	101	33
2013	12	157	58	28	82	136	37
2014	12	174	88	25	102	158	39
2015	28	219	102	22	135	185	51
2016	26	283	109	33	185	228	38
2017	33	250	110	22	210	185	20
TOTAL	138	1583	616	165	1042	1177	283

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	13	16	15	8	11	18	7	10	25	27	14	20
2011	26	22	22	18	24	14	18	21	25	23	28	40
2012	21	21	28	23	27	14	19	15	17	21	16	24
2013	15	18	19	27	28	23	13	15	17	28	24	28
2014	16	34	27	27	32	27	13	16	26	23	23	35
2015	22	22	36	32	38	31	25	21	27	23	40	54
2016	23	50	47	43	51	36	35	26	33	34	37	36
2017	29	35	46	35	41	27	22	22	34	36	34	54
TOTAL	165	218	240	213	252	190	152	146	204	215	216	291

Table B7 Continued. Number of trips for Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the U.S. GOM

Year	IFQ1	IFQ2	IFQ3	IFQ4	Depth1	Depth2	Depth3	Depth4	Open	35ftms
2010	40	30	21	64	51	38	54	41	90	94
2011	58	55	66	59	52	97	76	56	228	53
2012	33	25	69	84	48	74	53	71	198	48
2013	41	48	52	60	55	83	58	59	204	51
2014	44	66	58	49	108	73	50	68	243	56
2015	66	67	58	50	125	88	68	90	294	77
2016	54	54	34	18	105	130	112	104	354	97
2017	80	71	57	32	119	131	77	88	344	71
TOTAL	416	416	415	416	663	714	548	577	1955	547

Table B8. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the U.S. GOM

Year	Area1	Area2	Area3	Away1	Away2	Away3	Away4
2010	0.875	0.746	0.911	0.864	0.815	0.824	0.842
2011	0.808	0.822	0.744	0.833	0.772	0.750	0.909
2012	0.947	0.809	0.881	0.848	0.839	0.973	1.000
2013	0.949	0.765	0.929	0.839	0.909	0.918	0.760
2014	0.853	0.806	0.800	0.849	0.780	0.864	0.868
2015	0.891	0.901	0.895	0.896	0.888	0.895	0.904
2016	0.890	0.910	0.859	0.867	0.907	0.904	0.876
2017	0.913	0.868	0.896	0.827	0.928	0.900	0.902
TOTAL	0.889	0.839	0.871	0.852	0.859	0.885	0.888

Year	Crew1	Crew2	Crew3	Crew4	Length1	Length2	Length3
2010	1.000	0.809	0.861	1.000	0.812	0.857	0.852
2011	0.583	0.805	0.848	0.800	0.801	0.794	0.842
2012	0.429	0.876	0.926	0.875	0.804	0.951	0.879
2013	0.500	0.866	0.931	0.929	0.780	0.919	0.892
2014	0.667	0.799	0.886	0.920	0.824	0.842	0.795
2015	0.893	0.890	0.912	0.864	0.881	0.913	0.863
2016	0.962	0.897	0.872	0.849	0.881	0.899	0.895
2017	0.879	0.896	0.891	0.909	0.900	0.881	0.950
TOTAL	0.804	0.861	0.891	0.891	0.847	0.885	0.866

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.923	0.875	0.933	0.875	0.727	0.889	1.000	1.000	0.840	0.667	0.643	0.900
2011	0.885	0.864	0.727	0.889	0.833	0.929	0.889	0.905	0.640	0.565	0.786	0.825
2012	0.905	0.952	0.750	0.826	0.667	1.000	0.895	0.933	0.882	0.905	1.000	0.958
2013	0.867	0.889	0.789	0.852	0.857	1.000	1.000	1.000	0.824	0.821	0.833	0.821
2014	1.000	0.882	0.704	0.741	0.719	0.926	0.769	1.000	0.692	0.957	0.783	0.886
2015	0.818	0.909	0.833	0.844	0.868	0.968	0.960	0.952	0.852	0.739	0.950	0.963
2016	0.913	0.860	0.936	0.930	0.902	0.972	0.971	0.962	0.909	0.824	0.811	0.722
2017	0.828	0.971	0.891	0.914	0.902	1.000	1.000	0.909	0.794	0.917	0.824	0.852
TOTAL	0.885	0.899	0.833	0.864	0.829	0.963	0.941	0.952	0.804	0.805	0.838	0.866

Table B8 Continued. Proportion positive of trips with Scamp and Yellowmouth Grouper in the Post-IFQ Longline for the U.S. GOM

Year	IFQ1	IFQ2	IFQ3	IFQ4	Depth1	Depth2	Depth3	Depth4	Open	35ftms
2010	0.750	0.933	0.857	0.844	0.627	0.974	0.982	0.780	0.756	0.915
2011	0.724	0.873	0.864	0.915	0.596	0.835	0.895	0.821	0.781	0.906
2012	0.849	0.960	0.884	0.929	0.562	0.946	1.000	0.915	0.859	0.938
2013	0.976	0.979	0.846	0.917	0.600	0.916	1.000	0.932	0.838	1.000
2014	0.795	0.879	0.879	0.878	0.694	0.890	0.920	0.912	0.811	0.911
2015	0.939	0.940	0.897	0.760	0.824	0.966	1.000	0.844	0.878	0.961
2016	0.907	0.926	0.941	0.944	0.686	0.962	0.991	0.904	0.870	0.969
2017	0.950	0.901	0.895	0.875	0.740	0.954	0.987	0.932	0.878	0.972
TOTAL	0.870	0.918	0.882	0.882	0.695	0.930	0.973	0.887	0.845	0.947