Standardized catch rates of from commercial logbook data for king mackerel from the United States Gulf of Mexico, South Atlantic, and Mixing Zone, 1993-2013

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SEDAR38-DW-10

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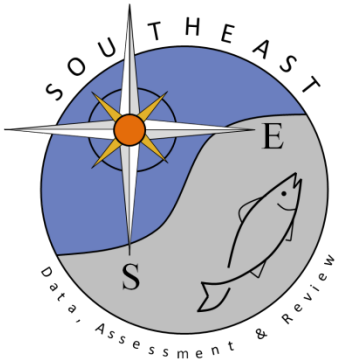

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John Walter[1] and Kevin McCarthy[1]

Summary

This paper presents five indices constructed from the NMFS coastal logbook program for king mackerel for the years 1993-2013. Three indices are basically updated (refit models) versions of indices used in SEDAR 16 for the Gulf, Mixing zone and South Atlantic, constructed by calendar year. The other indices are constructed by fishing year for the Gulf and for the Atlantic plus the summer mixing zone commensurate with data partitioning instructions for SEDAR 38. Vessel selection, trip selection, data processing and handling of regulatory impacts largely mimic those of SEDAR 16 and the indices are similar up to previous indices up until 2006. After this time period there is a substantial decrease in index values in the Atlantic while the Gulf of Mexico increases. The mixing zone shows an intermediate response with high values up until 2010 and then three years of declines. Note that index values for 2013 have incomplete data and are likely to not be included in the CPUE indices used for modeling but are shown here for informational purposes.

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Introduction

This paper presents an updated version of three indices constructed for SEDAR 16 from the National Marine Fisheries Service (NMFS) coastal logbook program. The three indices come from handline, electric reel (bandit rig), and trolling (defined here as "hook and line fisheries") landings and fishing effort of commercial vessels operating in the Gulf of Mexico and U.S. south Atlantic and were constructed for three spatial regions (Gulf, Mixing zone and South Atlantic). The indices constructed for SEDAR 16 and selected records from vessels with at least 8 years of reported landings of king mackerel and used repeated measures approach. Prior to 1998 vessel logbook reporting was not mandatory so records prior to this come from voluntary submissions from a subset of the total vessels.

The indices presented here represent revised versions (new data up to early 2013 and refit models) of indices constructed in SEDAR 16 (McCarthy, 2007a and b) and span 1993-2013. Only the index for the Gulf of Mexico was used in the base case VPA while the other indices were used for the SS model. Indices constructed for SEDAR 16 used calendar year designations

For consideration in SEDAR 38 two completely new versions of the indices were also constructed according to fishing year conventions for the Gulf of Mexico and the South Atlantic. For the South Atlantic index all observations in the Mixing zone during the months of April-October were assigned to the South Atlantic consistent with the initial data specifications for SEDAR 38.

Methods

Data

The coastal logbook program began in 1990 with the objective of a complete census ofcoastal fisheries permitted vessel activity, with the exception of Florida, where a 20% sample of vessels was targeted. Beginning in 1993, the sampling was increased to require reports from all vessels permitted in coastal fisheries. At SEDAR 16 there was substantial discussion about when to start the commercial logbook time series in either 1993 (incomplete reporting) or 1996 (full reporting). Despite the incomplete reporting the indices were started in 1993 for SEDAR 16.

For a fishing trip, the coastal logbook database includes a unique trip identifier, the landing date, fishing gear deployed, areas fished (Figure 1), number of days at sea, number of crew, gear specific fishing effort (for hook and line fisheries: number of lines fished, number of hooks per line and estimated total fishing time), species caught and whole weight of the landings. Multiple areas fished and multiple gears fished may be recorded for a single fishing trip. In such cases, assigning catch and effort to specific locations or gears was not possible; therefore, only trips which reported one area and one gear fished were included in these analyses. Data for the three hook and line fisheries were combined in these analyses. CPUE for each trip was calculated in weight of fish per hook-hour as::

CPUE = total kilograms of king mackerel/(number of lines fished*number of hooks per line*total hours

fished)

Three regions were defined (Figure 2) in the analyses. The Gulf of Mexico included all areas from southwest Florida to Mexico other than areas 1 and 2. The south Atlantic was defined as the area north of 30^{o} N to 37^{o} N. For constructing a set of new indices according to SEDAR 38 data specifications an index for the Gulf of Mexico was constructed by fishing year (July 1^{st} and ends June 30^{th}) and an index for the South Atlantic by fishing year (April 1^{st} to March 31^{st}) which includes the summer mixing zone (Figure 2) was also constructed.

Similar to decision criteria in McCarthy (2007) data used in constructing the commercial hook and line fishery indices of abundance were limited to catch and effort reported from vessels that together accounted for 80% of the reported hook and line gear landings of king mackerel over the period 1993-2006 or 1998-2006, as appropriate for the index. The selection of vessels was made for each of the three regions by ordering all vessels first by the number of years of reported king mackerel landings in the region and secondly by the vessel's total king mackerel total landings from the region. Then vessels were included until 80% of the total landings were accounted for. Vessel selection for the 1998-2013 indices was dependent upon king mackerel landings for those years, therefore, a different suite of vessels may have been selected for the 1998-2013 indices than were selected in the construction of the 1993-2006 indices. Once the vessel list for each region was defined, all hook and line gear trips within each region reported by the selected vessels were considered potential king mackerel trips and were included in the analyses.

Clear outliers in the data, i.e. values falling outside the 99.5 percentile of the data, were excluded from the analyses. These included data from trips reporting more than seven lines fished, 20 hooks per line fished, more than 10 days at sea, or more than 1,415 kilograms (3,120 pounds) of king mackerel landed.

Effects of regulations

McCarthy et al (2007) examined the potential effects of regulatory trip limits on indices for this dataset. We have not updated this examination but assumed that the same results still apply. As part of that analysis, trips were categorized by the percentage of king mackerel (by weight) in the trip landings. Based upon examination of the regulatory effects, only the 25 fish per trip limit in the Mixing Zone was observed to have a limiting effect on CPUE. Landings and effort data reported from the Mixing Zone during periods with a 25 fish per trip limit were excluded from the previous and this current analysis of this dataset. Also all regulatory closures were also assigned to the entire dataset so that records occurring during closures could be removed from the cpue estimation.

Index Development

Ten factors were evaluated as possible influences on both the proportion of trips that landed king mackerel and the catch rate of king mackerel, defined as (McCarthy 2007a):

Gulf of Mexico

Factor	Levels	Values
Year	20	1993-2013
Area	9	GOM shrimp grids 4-5, 6-7, 8, 9, 10-12, 13, 14-15, 16-17, 18-21
Days at sea (AWAY1)*	4	1, 2, 3, 4-10
Target	4	<25% of catch was king mackerel, 25-50%, 50-75%, >75%
Crew (CREW1)	4	1, 2, 3, or 4+ crew members
Vessel length (VES_LEN)	4	≤35 feet, >35 to 45, >45, unknown
Number of lines fished (NUMGEAR1)	4	1-2, 3, 4, 5-7
Number of hooks/line (EFFORT1)	5	1, 2, 3-10, 11-15, 16-20
Gear	2	Handline (includes electric reels), trolling
Hours fished (Hrs_fished)	6	≤6, >6-8, >8-12, >12-24, >24-48, >48
Season	4	Jan-Feb, Mar-May, June-Aug,

*Names in parentheses appear in some figures and tables.

Mixing Zone

Factor	Levels	Value
Year	20	1993-2013
Area*	10	Areas1-2 and 2482; 3; 2479-2480; 2481; 2575-2580; 2674-2679; 2680; 2777-2779; 2780-2781; 2842-2981
Days at sea (AWAY1)**	2	1, 2-10
Target	4	<25% of catch was king mackerel, 25-50%, 50-75%, >75%
Crew (CREW1)	2	1, 2+ crew members
Vessel length (VES_LEN)	5	≤25 feet, >25-30, >30 to 35, >35, unknown
Number of lines fished (NUMGEAR1)	4	1, 2, 3, 4-7
Number of hooks/line (EFFORT1)	2	1, 2-20
Gear	2	Handline (includes electric reels), trolling
Hours fished (Hrs_fished)	5	≤5, >5-7, >7-8, >8-10, >10
Season	4	Jan-Feb, Mar-May, June-Aug,

*Areas 1-2 and 2482 were combined.
**Names in parentheses appear in some figures and tables.

South Atlantic

Factor	Levels	Value
Year	20	1993-2013
Area	5	Areas 3075-3280; 3370-3379; 3470-3476; 3477-3478; 3570-3677
Days at sea (AWAY1)*	3	1, 2-3, 4-10
Target	4	<25% of catch was king mackerel, 25-50%, 50-75%, >75%

Crew (CREW1)	3	1, 2, 3+ crew members
Vessel length (VES_LEN)	4	≤30 feet, >30-35, >35, unknown
Number of lines fished (NUMGEAR1)	3	1-2, 3, 4-7
Number of hooks/line (EFFORT1)	3	1, 2, 3-20
Gear	2	Handline (includes electric reels), trolling
Hours fished (Hrs_fished)	6	≤6, >6-8, >8-12, >12-24, >24-48, >48
Season	4	Jan-Feb, Mar-May, June-Aug,

* Two indices were developed, one for each range of years presented under Value.
**Names in parentheses appear in some figures and tables.

For constructing Index 5 (South Atlantic and summer mixing zone index) factor levels were based upon the South Atlantic, even when samples came from the Mixing zone to maintain similar values.

Analyses were done using Glimmix and Mixed procedures from the SAS® statistical computer software (SAS Institute Inc, 1997, Littell et al 1996). Individual vessels were included as repeated measures terms using compound symmetry correlation structure. A forward step-wise regression procedure was used to determine the set of factors and interactions that significantly explained the observed variability. We used criterion which assumes that the difference in deviance between two consecutive models follows a Chi-square distribution. The deviance is a measure of the variability explained by the model. Using this statistic, with degrees of freedom equal to the number of additional parameters estimated minus one, a Chi-square test was constructed which indicates if the additional factor is or is not statistically significant (McCullagh and Nelder, 1989). Deviance analysis tables were constructed for both components of the delta model: Proportion of successful trips/sets, and mean catch rate in both numbers and weights of positive trips/sets. Each deviance table includes the deviance explained by the additional factor or interaction, the overall percent explained by each factor, and the Chi-square probability test. Final selection of explanatory factors was conditional on the relative percent of deviance explained by the added factor; factors that explained more than 5% of deviance were included. Once a set of fixed factors was specified, all possible 1^{st} level interactions with year were evaluated. These interactions were then modeled as random effects in the final model.

For each GLM analysis of proportion positive trips, a model was fit with a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion successful trips. During the analysis of catch rates on successful trips, a model assuming lognormal error distribution was examined. The linking function selected was “normal”, and the response variable was log(CPUE).

Standard indices of abundance were calculated as the product of the year effect least square means (LSmeans) from the binomial and the lognormal components of the delta lognormal model. LSmeans estimates included a weight proportional to the observed margins of the input data, to account for the unbalanced distribution of the data. Lognormal estimates also included a bias back-transformation correction factor as describe by Lo et al (1992). Variances were obtained by the delta method for the approximate variance of the product of two random variables.

To obtain variances use the Goodman (1960) exact estimator for the variance of two random variables under the assumption that the two processes (probability of capture and catch rate once captured) are independent (Christman, unpublished ms).

Results and Discussion

Deviance tables used to select the final models are shown in Tables 1-4. The same model was used for both Gulf of Mexico models as the only change was to use fishing year rather than calendar year and this change would have been unlikely to have changed the model factors. The final models for indices 1-5 are given below:

Model 1. Gulf of Mexico 1993-2013:
Final model GOM
Proportion positive ~ year + hrs_fished + gear + numgear1 + area1 + season
logCPUE ~year + crew1 + hrs_fished + gear+ target + numgear1 + effort1

Model 2. Mixing Zone 1993-2013:
prop positive ~ year +crew1 + gear + numgear1 +area1
logCPUE ~ year + effort1 +numgear1 +area1 + target

Model 3. South Atlantic 1993-2013:
Proportion positive ~ year + crew1+ gear + numgear1 + area1
logCPUE ~ year + season + crew1 + effort1 + away1+ hrs_fished+ target

Model 4. New SEDAR 38 models Gulf of Mexico fishing year
Same as model 1

Model 5. South Atlantic fishing year.
Proportion positive ~ Fyear + crew1+ gear + area1

logCPUE ~ Fyear + crew1 + area1 + target + gear + hrs_fished

Parameter estimates for all models are shown in tables 5-14. Relative nominal CPUE, number of trips, proportion positive trips, and relative abundance indices are provided in Tables 15.

Plots of the proportion and lognormal models mean values and raw residuals versus model factors are shown in Figures 3-7. These diagnostic plots indicate that most residual plots did not show substantial pattern except that gear type (trolling or handline) displayed some odd patterns. Diagnostic plots for the lognormal component of the models showing the frequency distribution of log(CPUE) on positive trips and the cumulative normalized residuals (QQ-Plot) from the lognormal model are shown in figures 8-12. Those diagnostic plots indicate that the fit of the data to the lognormal and binomial models was acceptable. There were some outliers among these data, however, and the frequency distribution of log(CPUE) from the Gulf of Mexico and South Atlantic data differed somewhat from the expected normal distribution.

The delta-lognormal abundance indices developed for each region and time series, with 95% confidence intervals, are shown in Figures 13-17. Overall the indices show substantial divergence from nominal values indicating that the standardization process has substantial impact on the estimated CPUE trends. In all indices the time period 1993-1996 has the greatest divergence from the nominal which also coincides with incomplete reporting of the logbook data. In SEDAR 16 there was considerable discussion as to the representativeness of this early time period but the final decision was to use the data to 1993.

This new treatment of the indices uses a more stringent criterion for inclusion of model factors (5% reduction in the deviance) and the resulting models had fewer significant factors or interactions. Nonetheless the models show high similarity with the previous estimates up to the end date for SEDAR 16 (2006). This indicates that, despite some different models factors and potentially different selected vessels the indices are largely the same. Since then, there have been substantially divergent trends between the Atlantic and the Gulf, with the Atlantic index showing a substantial decline since 2006. In contrast, the GOM index has seen some of the highest values of the time series (with the highest in 2010), since 2006. The mixing zone also showed the highest value in 2010 but then has seen three years of decline. Moving from calendar year to fishing year had very little impact upon the estimated indices (Figures 16 and 17). The new index for the South Atlantic and summer mixing area (Index 5) represents an unsurprising mix between the Atlantic and Mixing zone models and shows an increasing trend up until 2010, largely driven by the inclusion of samples from the Summer mixing zone.

To support evaluation of which component (% positive or CPUE of positive trips) is contributing most to the overall indices, Figure 18 shows the model estimated % positive or CPUE of positive trips and the raw arithmetic mean of each index, by year. This shows that, for many of the indices, the standardization process operated substantially on the CPUE of the positives and created substantial divergence from the nominal values. For the GOM index (1) there was a clear change in the fraction of targeted trips and in the fraction of handline to trolling trips (Figure 19) in the 1993-1996 years and then in the 2009-2013.

At the data workshop some recommendations were made to explore the vessel inclusion criteria to determine whether including vessels with 8 or more years in the fishery and 80% of the total landings was the most appropriate criteria and to explore why the model diverges so greatly from the nominal CPUE.

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Table 1. Index 1 (GOM-CY) Deviance table analysis to choose model factors and interactions. Factors and interactions were included if they reduced the deviance by 5% or more of the total explained deviance. Factors highlighted in yellow were included in the models. Note that year was always included in model even if it did not meet the 5% criterion.

Model factors prop positive rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		35960.3			
hrs_fished	5	34894.9	1065.4	7.1%	< 0.001
year	20	34605.6	289.3	1.9%	< 0.001
away1	3	34394.4	211.2	1.4%	< 0.001
effort1	3	33818.2	576.2	3.8%	< 0.001
crew1	3	33224.1	594.1	4.0%	< 0.001
gear	1	25036.7	8187.4	54.6%	< 0.001
numgear1	3	24271.9	764.8	5.1%	< 0.001
ves_len	2	24198.4	73.5	0.5%	< 0.001
area1	8	23210.6	987.8	6.6%	< 0.001
season	3	21941.9	1268.7	8.5%	< 0.001
year*gear	20	21844.0	97.9	0.7%	< 0.001
year*ves_len	40	21828.0	16.0	0.1%	< 0.001
year*numgear1	60	21678.7	149.4	1.0%	< 0.001
year*crew1	60	21575.6	103.1	0.7%	< 0.001
area1*season	19	21079.1	496.5	3.3%	< 0.001
year*area1	160	20966.1	113.0	0.8%	< 0.001

Model factors positive catch rates values	**d.f.**	**Residual deviance**	**Change in deviance**	**% of total deviance**	***p***
Intercept		70460.6			
year	20	67619.7	2840.9	5.0%	< 0.001
crew1	3	61292.4	6327.4	11.2%	< 0.001
hrs_fished	5	57512.2	3780.2	6.7%	< 0.001
away1	3	57226.2	286.0	0.5%	< 0.001
gear	1	50805.8	6420.4	11.4%	< 0.001
numgear1	3	46213.7	4592.1	8.1%	< 0.001
ves_len	2	45964.3	249.4	0.4%	< 0.001
effort1	3	42063.6	3900.6	6.9%	< 0.001
area1	8	39911.4	2152.2	3.8%	< 0.001
season	3	39338.9	572.5	1.0%	< 0.001
year*gear	20	39004.3	334.6	0.6%	< 0.001
year*ves_len	40	38773.8	230.5	0.4%	< 0.001
area1*season	19	38745.0	28.8	0.1%	< 0.001
year*numgear1	60	38485.9	259.2	0.5%	< 0.001
year*crew1	60	38395.3	90.5	0.2%	< 0.001
year*area1	160	37155.2	1240.1	2.2%	< 0.001
target	3	24220.7	12934.6	22.9%	< 0.001
target*year	21	13903	636.24	1.1%	< 0.001

Table 2. Index 2 (MIX-CY) Deviance table analysis to choose model factors and interactions. Factors and interactions were included if they reduced the deviance by 5% or more of the total explained deviance. Factors highlighted in yellow were included in the models.Note that year was always included in model even if it did not meet the 5% criterion.

Model factors prop positive rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		328048.7			
hrs_fished	4	326662.7	1386.1	1.2%	< 0.001
season	3	326500.9	161.8	0.1%	< 0.001
effort1	1	326219.7	281.2	0.2%	< 0.001
away1	1	324715.9	1503.8	1.3%	< 0.001
year	20	318020.2	6695.7	5.8%	< 0.001
crew1	1	300946.9	17073.3	14.8%	< 0.001
gear	1	250047.0	50899.9	44.1%	< 0.001
numgear1	3	241776.7	8270.3	7.2%	< 0.001
ves_len	3	240612.3	1164.4	1.0%	< 0.001
area1	9	216587.8	24024.5	20.8%	< 0.001
year*gear	20	216183.8	404.0	0.4%	< 0.001
year*crew1	20	216047.7	136.1	0.1%	< 0.001
year*numgear1	60	215824.1	223.6	0.2%	< 0.001
year*ves_len	60	215642.5	181.6	0.2%	< 0.001
year*area1	180	212739.2	2903.3	2.5%	< 0.001

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		248410.3			
away1	1	244292.9	4117.4	3.6%	< 0.001
hrs_fished	4	242227.5	2065.4	1.8%	< 0.001
season	3	241871.2	356.3	0.3%	< 0.001
year	20	234230.0	7641.2	6.6%	< 0.001
crew1	1	234130.0	99.9	0.1%	< 0.001
gear	1	233902.6	227.4	0.2%	< 0.001
effort1	1	227929.8	5972.8	5.2%	< 0.001
numgear1	3	210539.1	17390.7	15.0%	< 0.001
ves_len	3	207569.2	2969.9	2.6%	< 0.001
area1	9	198845.4	8723.8	7.5%	< 0.001
target	3	134753.4	64092.0	55.3%	< 0.001
year*gear	20	134550.9	202.5	0.2%	< 0.001
year*crew1	20	134449.9	101.0	0.1%	< 0.001
year*target	60	134180.8	269.1	0.2%	< 0.001
year*ves_len	60	133963.7	217.0	0.2%	< 0.001
year*numgear1	60	133896.8	66.9	0.1%	< 0.001
year*area1	180	132485.8	1411.1	1.2%	< 0.001

Table 3. Index 3 (SA-CY) Deviance table analysis to choose model factors and interactions. Factors and interactions were included if they reduced the deviance by 5% or more of the total explained deviance. Factors highlighted in yellow were included in the models.Note that year was always included in model even if it did not meet the 5% criterion.

Model factors prop positive rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		88045.5			
year	20	86143.4	1902.1	7.6%	< 0.001
hrs_fished	5	85954.7	188.7	0.8%	< 0.001
away1	2	85928.6	26.1	0.1%	< 0.001
season	3	85661.6	267.1	1.1%	< 0.001
effort1	2	85648.7	12.9	0.1%	< 0.001
crew1	2	84241.8	1406.9	5.6%	< 0.001
gear	1	67948.4	16293.4	65.2%	< 0.001
numgear1	2	65616.9	2331.6	9.3%	< 0.001
ves_len	2	65589.6	27.3	0.1%	< 0.001
area1	4	64171.4	1418.1	5.7%	< 0.001
year*ves_len	40	63936.8	234.7	0.9%	< 0.001
year*crew1	40	63827.1	109.6	0.4%	< 0.001
year*numgear1	40	63811.7	15.5	0.1%	< 0.001
year*gear	20	63737.4	74.3	0.3%	< 0.001
year*area1	80	63041.8	695.6	2.8%	< 0.001

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		151208.7			
year	20	142194.1	9014.6	8.5%	< 0.001
season	3	129504.6	12689.6	12.0%	< 0.001
crew1	2	104866.0	24638.5	23.3%	< 0.001
effort1	2	95330.4	9535.6	9.0%	< 0.001
away1	2	81882.7	13447.8	12.7%	< 0.001
hrs_fished	5	76062.2	5820.4	5.5%	< 0.001
gear	1	71316.0	4746.2	4.5%	< 0.001
numgear1	2	71123.0	192.9	0.2%	< 0.001
ves_len	2	71062.5	60.5	0.1%	< 0.001
area1	4	66257.7	4804.8	4.5%	< 0.001
year*numgear1	40	65885.7	372.0	0.4%	< 0.001
year*gear	20	65762.2	123.6	0.1%	< 0.001
year*crew1	40	65686.5	75.7	0.1%	< 0.001
year*ves_len	40	65550.1	136.4	0.1%	< 0.001
year*area1	80	64415.7	1134.4	1.1%	< 0.001
target	3	52533.7	11882.0	11.2%	< 0.001
target*year	21	45242.0	7291.7	6.9%	< 0.001

Table 4. Index 5 (SA+summer mix-FY) Deviance table analysis to choose model factors and interactions. Factors and interactions were included if they reduced the deviance by 5% or more of the total explained deviance. Factors highlighted in yellow were included in the models. Note that year was always included in model even if it did not meet the 5% criterion.

Model factors prop positive rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		280572.1			
effort1	2	279141.8	1430.3	1.3%	< 0.001
season	3	278413.6	728.2	0.6%	< 0.001
Fyear	21	273482.6	4931.1	4.3%	< 0.001
hrs_fished	5	273272.6	210.0	0.2%	< 0.001
away1	3	273171.6	100.9	0.1%	< 0.001
crew1	2	258855.6	14316.1	12.5%	< 0.001
gear	1	215333.2	43522.4	38.1%	< 0.001
numgear1	2	210682.4	4650.8	4.1%	< 0.001
ves_len	2	208977.1	1705.3	1.5%	< 0.001
area1	14	172837.8	36139.3	31.6%	< 0.001
Fyear*gear	21	172426.3	411.5	0.4%	< 0.001
Fyear*numgear1	42	172291.5	134.9	0.1%	< 0.001
Fyear*ves_len	42	171641.3	650.2	0.6%	< 0.001
Fyear*crew1	42	171294.8	346.5	0.3%	< 0.001
Fyear*area1	284	166287.4	5007.4	4.4%	< 0.001

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
Intercept		340646.7			
season	3	333810.5	6836.2	3.3%	< 0.001
Fyear	21	308636.2	25174.4	12.0%	< 0.001
crew1	2	260456.6	48179.6	23.1%	< 0.001
effort1	2	259055.7	1400.9	0.7%	< 0.001
gear	1	256709.8	2345.9	1.1%	< 0.001
numgear1	2	242378.7	14331.2	6.9%	< 0.001
ves_len	2	241503.5	875.2	0.4%	< 0.001
away1	3	222706.3	18797.2	9.0%	< 0.001
hrs_fished	5	216702.4	6003.9	2.9%	< 0.001
area1	14	203849.9	12852.5	6.2%	< 0.001
Fyear*ves_len	42	202414.7	1435.2	0.7%	< 0.001
Fyear*numgear1	42	202187.6	227.1	0.1%	< 0.001
Fyear*crew1	42	202016.5	171.1	0.1%	< 0.001
Fyear*gear	21	200268.2	1748.2	0.8%	< 0.001
Fyear*area1	283	198059.3	2209.0	1.1%	< 0.001
target	3	169563.8	28495.4	13.6%	< 0.001
target*Fyear	22	131697.7	37866.1	18.1%	< 0.001

Table 5. Index 1 (GOM-CY) table of fixed effects for the proportion positive model.

Solution for Fixed Effects

Effect	*gear*	*area1*	*numgear1*	*hrs_fished*	*year*	*season*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Intercept							3.9588	0.2766	2966	14.31	<.0001	0.05
year					1993		-0.6784	0.2892	2966	-2.35	0.0190	0.05
year					1994		-0.3111	0.2793	2966	-1.11	0.2654	0.05
year					1995		-0.1104	0.2808	2966	-0.39	0.6943	0.05
year					1996		-0.3156	0.2641	2966	-1.19	0.2322	0.05
year					1997		0.1893	0.2625	2966	0.72	0.4708	0.05
year					1998		-0.02831	0.2524	2966	-0.11	0.9107	0.05
year					1999		0.003036	0.2540	2966	0.01	0.9905	0.05
year					2000		0.3841	0.2521	2966	1.52	0.1277	0.05
year					2001		-0.6146	0.2497	2966	-2.46	0.0139	0.05
year					2002		-0.1276	0.2480	2966	-0.51	0.6071	0.05
year					2003		-0.2542	0.2538	2966	-1.00	0.3167	0.05
year					2004		-0.4243	0.2501	2966	-1.70	0.0899	0.05
year					2005		-0.8758	0.2586	2966	-3.39	0.0007	0.05
year					2006		-0.4562	0.2504	2966	-1.82	0.0686	0.05
year					2007		-0.1207	0.2525	2966	-0.48	0.6326	0.05
year					2008		-0.01531	0.2505	2966	-0.06	0.9513	0.05
year					2009		0.5111	0.2520	2966	2.03	0.0427	0.05
year					2010		0.02558	0.2743	2966	0.09	0.9257	0.05
year					2011		-0.07631	0.2717	2966	-0.28	0.7789	0.05
year					2012		0.4293	0.2746	2966	1.56	0.1180	0.05
year					2013		0	.	.	.	.	.
gear	H						-4.1052	0.1205	445	-34.06	<.0001	0.05
gear	TR						0	.	.	.	.	.
hrs_fished				12-24			-0.1378	0.07162	4366	-1.92	0.0545	0.05
hrs_fished				24-48			-0.2532	0.07324	4366	-3.46	0.0005	0.05
hrs_fished				6-8			-0.01891	0.07578	4366	-0.25	0.8030	0.05
hrs_fished				8-12			-0.1739	0.07305	4366	-2.38	0.0173	0.05
hrs_fished				>48			-0.4463	0.08260	4366	-5.40	<.0001	0.05
hrs_fished				le 6			0	.	.	.	.	.
numgear1			1-2				-0.2527	0.09467	1417	-2.67	0.0077	0.05
numgear1			3				0.5096	0.09453	1417	5.39	<.0001	0.05
numgear1			4				0.01560	0.08686	1417	0.18	0.8575	0.05
numgear1			5-7				0	.	.	.	.	.
area1		10-12					0.1240	0.1064	905	1.17	0.2439	0.05
area1		13					0.2451	0.1083	905	2.26	0.0239	0.05
area1		14-15					1.2940	0.1342	905	9.65	<.0001	0.05
area1		16-17					0.05820	0.1393	905	0.42	0.6762	0.05
area1		18-21					-0.3652	0.1500	905	-2.43	0.0151	0.05
area1		3-5					-0.5008	0.1232	905	-4.07	<.0001	0.05
area1		6-7					-0.4566	0.09835	905	-4.64	<.0001	0.05
area1		8					-0.04676	0.08964	905	-0.52	0.6020	0.05
area1		9					0	.	.	.	.	.
season						1	-1.8959	0.09367	2174	-20.24	<.0001	0.05
season						2	-0.7374	0.09798	2174	-7.53	<.0001	0.05
season						3	0.2295	0.05238	2174	4.38	<.0001	0.05
season						4	0	.	.	.	.	.

Table 6. Index 1 (GOM-CY) table of fixed effects for the lognormal model.

Solution for Fixed Effects

Effect	*effort1*	*hrs_fished*	*numgear1*	*crew1*	*year*	*target*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Intercept							0.9792	0.1514	2250	6.47	<.0001	0.05
year					1993		-0.2746	0.1878	2250	-1.46	0.1438	0.05
year					1994		-0.3117	0.1743	2250	-1.79	0.0738	0.05
year					1995		-0.1559	0.1689	2250	-0.92	0.3562	0.05
year					1996		-0.1481	0.1596	2250	-0.93	0.3537	0.05
year					1997		-0.09759	0.1564	2250	-0.62	0.5327	0.05
year					1998		0.1015	0.1535	2250	0.66	0.5086	0.05
year					1999		-0.1473	0.1522	2250	-0.97	0.3333	0.05
year					2000		-0.1176	0.1518	2250	-0.77	0.4387	0.05
year					2001		-0.07405	0.1520	2250	-0.49	0.6262	0.05
year					2002		-0.1126	0.1510	2250	-0.75	0.4558	0.05
year					2003		-0.1430	0.1545	2250	-0.93	0.3548	0.05
year					2004		-0.1158	0.1552	2250	-0.75	0.4559	0.05
year					2005		-0.1718	0.1594	2250	-1.08	0.2813	0.05
year					2006		-0.05399	0.1569	2250	-0.34	0.7307	0.05
year					2007		0.03073	0.1568	2250	0.20	0.8446	0.05
year					2008		-0.1344	0.1559	2250	-0.86	0.3886	0.05
year					2009		-0.01328	0.1544	2250	-0.09	0.9315	0.05
year					2010		0.2686	0.1665	2250	1.61	0.1069	0.05
year					2011		0.2012	0.1676	2250	1.20	0.2302	0.05
year					2012		0.1742	0.1670	2250	1.04	0.2970	0.05
year					2013		0	.	.	.	.	.
target						1	-3.2947	0.03157	999	-104.35	<.0001	0.05
target						2	-1.1484	0.04327	999	-26.54	<.0001	0.05
target						3	-0.5921	0.03881	999	-15.26	<.0001	0.05
target						4	0	.	.	.	.	.
effort1	1						1.3806	0.03448	575	40.04	<.0001	0.05
effort1	11-20						-1.5018	0.05257	575	-28.57	<.0001	0.05
effort1	2						0.5697	0.03834	575	14.86	<.0001	0.05
effort1	3-10						0	.	.	.	.	.
numgear1			1-2				1.0292	0.05490	737	18.75	<.0001	0.05
numgear1			3				0.8006	0.05185	737	15.44	<.0001	0.05
numgear1			4				0.2689	0.04871	737	5.52	<.0001	0.05
numgear1			5-7				0	.	.	.	.	.
crew1				1			-0.6224	0.04874	951	-12.77	<.0001	0.05
crew1				2			-0.4137	0.04392	951	-9.42	<.0001	0.05
crew1				3			-0.2988	0.04093	951	-7.30	<.0001	0.05
crew1				4+			0	.	.	.	.	.
hrs_fished		12-24					0.2196	0.02993	2422	7.34	<.0001	0.05
hrs_fished		24-48					-0.04963	0.03303	2422	-1.50	0.1331	0.05
hrs_fished		6-8					0.1356	0.02957	2422	4.59	<.0001	0.05
hrs_fished		8-12					0.2467	0.03019	2422	8.17	<.0001	0.05
hrs_fished		>48					-0.5076	0.04406	2422	-11.52	<.0001	0.05
hrs_fished		le 6					0	.	.	.	.	.

Table 7. Index 2 (MIX-CY) table of fixed effects for the proportion positive model.

Solution for Fixed Effects													
Effect	gear	area1	numgear1	crew1	year	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept						1.9429	0.1640	8163	11.85	<.0001	0.05	1.6213	2.2644
year					1993	-0.2596	0.1395	8163	-1.86	0.0628	0.05	-0.5331	0.01388
year					1994	-0.2885	0.1260	8163	-2.29	0.0221	0.05	-0.5355	-0.04149
year					1995	-0.3063	0.1235	8163	-2.48	0.0132	0.05	-0.5483	-0.06418
year					1996	0.1969	0.1138	8163	1.73	0.0836	0.05	-0.02615	0.4199
year					1997	-0.08134	0.1119	8163	-0.73	0.4675	0.05	-0.3008	0.1381
year					1998	0.4043	0.1020	8163	3.96	<.0001	0.05	0.2043	0.6042
year					1999	0.2297	0.10000	8163	2.30	0.0216	0.05	0.03371	0.4257
year					2000	0.2677	0.1008	8163	2.66	0.0079	0.05	0.07006	0.4653
year					2001	0.3173	0.1000	8163	3.17	0.0015	0.05	0.1212	0.5134
year					2002	0.3877	0.09935	8163	3.90	<.0001	0.05	0.1930	0.5824
year					2003	0.6599	0.09779	8163	6.75	<.0001	0.05	0.4682	0.8516
year					2004	0.4981	0.09886	8163	5.04	<.0001	0.05	0.3044	0.6919
year					2005	0.3977	0.1013	8163	3.93	<.0001	0.05	0.1991	0.5964
year					2006	0.7169	0.09997	8163	7.17	<.0001	0.05	0.5209	0.9128
year					2007	0.5472	0.09916	8163	5.52	<.0001	0.05	0.3528	0.7416
year					2008	0.7278	0.09909	8163	7.35	<.0001	0.05	0.5336	0.9220
year					2009	0.7277	0.09792	8163	7.43	<.0001	0.05	0.5357	0.9196
year					2010	0.7459	0.1023	8163	7.29	<.0001	0.05	0.5453	0.9464
year					2011	0.2950	0.1012	8163	2.91	0.0036	0.05	0.09653	0.4934
year					2012	0.1541	0.1040	8163	1.48	0.1383	0.05	-0.04968	0.3580
year					2013	0	.	.	.	.	.	.	.
gear	H					-1.8509	0.03240	1716	-57.13	<.0001	0.05	-1.9145	-1.7874
gear	TR					0	.	.	.	.	.	.	.
crew1				1		0.3596	0.02684	2966	13.40	<.0001	0.05	0.3070	0.4122
crew1				2+		0	.	.	.	.	.	.	.
numgear1			1			-1.0197	0.04679	6131	-21.80	<.0001	0.05	-1.1114	-0.9280
numgear1			2			-0.2660	0.03834	6131	-6.94	<.0001	0.05	-0.3412	-0.1909
numgear1			3			0.3839	0.04143	6131	9.27	<.0001	0.05	0.3027	0.4651
numgear1			4-7			0	.	.	.	.	.	.	.
area1		1-2,2482				-1.3078	0.1456	2834	-8.98	<.0001	0.05	-1.5933	-1.0223
area1		2479-2480				-2.3678	0.1502	2834	-15.76	<.0001	0.05	-2.6623	-2.0732
area1		2481				-2.2562	0.1456	2834	-15.49	<.0001	0.05	-2.5418	-1.9706
area1		2575-2580				-0.5008	0.1461	2834	-3.43	0.0006	0.05	-0.7873	-0.2144
area1		2674-2679				0.03456	0.1450	2834	0.24	0.8116	0.05	-0.2497	0.3188
area1		2680				0.2067	0.1489	2834	1.39	0.1650	0.05	-0.08515	0.4986
area1		2777-2779				-0.1392	0.1498	2834	-0.93	0.3527	0.05	-0.4330	0.1545
area1		2780-2781				-0.2094	0.1446	2834	-1.45	0.1475	0.05	-0.4928	0.07403
area1		2842-2981				-0.2529	0.1469	2834	-1.72	0.0851	0.05	-0.5409	0.03504
area1		3				0	.	.	.	.	.	.	.

Table 8. Index 2 (MIX-CY) table of fixed effects for the lognormal model.

Solution for Fixed Effects

Effect	*numgear1*	*effort1*	*area1*	*year*	*target*	*Est*	*SEr*	*DF*	*t Valu e*	*Pr > |t|*	*Alph a*	*Lower*	*U pp er*
Intercept						1.512	0.071	6935	21.34	<.0001	0.05	1.37	1.650
year				1993		-0.341	0.079	6935	-4.33	<.0001	0.05	-0.50	-0.187
year				1994		-0.295	0.071	6935	-4.13	<.0001	0.05	-0.44	-0.155
year				1995		-0.254	0.070	6935	-3.61	0.0003	0.05	-0.39	-0.116
year				1996		-0.128	0.065	6935	-1.98	0.0483	0.05	-0.26	-0.001
year				1997		-0.189	0.064	6935	-2.95	0.0032	0.05	-0.32	-0.063
year				1998		-0.131	0.058	6935	-2.27	0.0230	0.05	-0.25	-0.018
year				1999		-0.087	0.057	6935	-1.53	0.1262	0.05	-0.20	0.024
year				2000		-0.197	0.056	6935	-3.49	0.0005	0.05	-0.31	-0.086
year				2001		-0.171	0.056	6935	-3.05	0.0023	0.05	-0.28	-0.061
year				2002		-0.129	0.056	6935	-2.32	0.0204	0.05	-0.24	-0.020
year				2003		0.003	0.055	6935	0.06	0.9552	0.05	-0.11	0.111
year				2004		0.043	0.056	6935	0.77	0.4394	0.05	-0.07	0.152
year				2005		0.044	0.056	6935	0.78	0.4335	0.05	-0.07	0.154
year				2006		0.124	0.056	6935	2.21	0.0270	0.05	0.01	0.234
year				2007		0.102	0.056	6935	1.81	0.0698	0.05	-0.01	0.212
year				2008		0.171	0.056	6935	3.06	0.0022	0.05	0.06	0.281
year				2009		0.237	0.056	6935	4.21	<.0001	0.05	0.13	0.348
year				2010		0.293	0.057	6935	5.14	<.0001	0.05	0.18	0.405
year				2011		0.215	0.058	6935	3.73	0.0002	0.05	0.10	0.328
year				2012		0.142	0.059	6935	2.42	0.0157	0.05	0.03	0.257
year				2013		0.000	.	.	.	.	.	.	.
target					1	-2.539	0.010	8107	-247.81	<.0001	0.05	-2.56	-2.519
target					2	-1.319	0.010	8107	-127.89	<.0001	0.05	-1.34	-1.299
target					3	-0.695	0.008	8107	-84.96	<.0001	0.05	-0.71	-0.679
target					4	0.000	.	.	.	.	.	.	.
numgear1	1					1.312	0.019	3161	67.93	<.0001	0.05	1.27	1.349
numgear1	2					0.832	0.016	3161	52.82	<.0001	0.05	0.80	0.863
numgear1	3					0.441	0.015	3161	29.31	<.0001	0.05	0.41	0.471
numgear1	4-7					0.000	.	.	.	.	.	.	.
effort1		1				0.866	0.011	1402	82.09	<.0001	0.05	0.85	0.887

Solution for Fixed Effects

Effect	*numgear1*	*effort1*	*area1*	*year*	*target*	*Est*	*SEr*	*DF*	*t Valu e*	*Pr > |t|*	*Alph a*	*Lower*	*U pp er*
effort1		2-20				0.000	.	.	.	.	.	.	
area1			1-2,2482			-0.237	0.057	1786	-4.16	<.0001	0.05	-0.35	-0.125
area1			2479-2480			-0.743	0.062	1786	-11.90	<.0001	0.05	-0.87	-0.621
area1			2481			-0.648	0.059	1786	-11.03	<.0001	0.05	-0.76	-0.533
area1			2575-2580			-0.885	0.059	1786	-15.11	<.0001	0.05	-1.00	-0.770
area1			2674-2679			-0.709	0.057	1786	-12.47	<.0001	0.05	-0.82	-0.597
area1			2680			-0.782	0.058	1786	-13.41	<.0001	0.05	-0.90	-0.668
area1			2777-2779			-0.737	0.058	1786	-12.65	<.0001	0.05	-0.85	-0.623
area1			2780-2781			-0.731	0.056	1786	-13.01	<.0001	0.05	-0.84	-0.621

Table 9. Index 3 (SA-CY) table of fixed effects for the proportion positive model.

						Solution for Fixed Effects							
Effect	*gear*	*numgear1*	*area1*	*crew1*	*year*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*	*Lower*	*Upper*
Intercept						0.4617	0.1415	3898	3.26	0.0011	0.05	0.1843	0.7390
year					1993	2.4624	0.1622	3898	15.18	<.0001	0.05	2.1444	2.7805
year					1994	1.9242	0.1563	3898	12.31	<.0001	0.05	1.6177	2.2307
year					1995	1.6856	0.1529	3898	11.02	<.0001	0.05	1.3858	1.9853
year					1996	1.1949	0.1520	3898	7.86	<.0001	0.05	0.8969	1.4929
year					1997	1.5746	0.1492	3898	10.55	<.0001	0.05	1.2820	1.8672
year					1998	1.5815	0.1481	3898	10.68	<.0001	0.05	1.2911	1.8718
year					1999	1.4806	0.1481	3898	10.00	<.0001	0.05	1.1902	1.7710
year					2000	1.5110	0.1486	3898	10.17	<.0001	0.05	1.2197	1.8024
year					2001	1.5339	0.1470	3898	10.44	<.0001	0.05	1.2457	1.8220
year					2002	1.1482	0.1498	3898	7.67	<.0001	0.05	0.8546	1.4418
year					2003	1.0756	0.1535	3898	7.01	<.0001	0.05	0.7747	1.3766
year					2004	1.0804	0.1518	3898	7.12	<.0001	0.05	0.7827	1.3782
year					2005	1.5948	0.1505	3898	10.60	<.0001	0.05	1.2997	1.8898
year					2006	1.6401	0.1504	3898	10.91	<.0001	0.05	1.3452	1.9349
year					2007	1.5667	0.1494	3898	10.49	<.0001	0.05	1.2739	1.8596
year					2008	1.1624	0.1525	3898	7.62	<.0001	0.05	0.8635	1.4614
year					2009	0.8328	0.1553	3898	5.36	<.0001	0.05	0.5284	1.1373
year					2010	0.2465	0.1658	3898	1.49	0.1372	0.05	-0.07860	0.5716
year					2011	0.1368	0.1666	3898	0.82	0.4119	0.05	-0.1900	0.4635
year					2012	0.08696	0.1690	3898	0.51	0.6069	0.05	-0.2444	0.4183
year					2013	0	.	.	.	.	.	.	.
gear	H					-2.5664	0.04876	932	-52.64	<.0001	0.05	-2.6621	-2.4707
gear	TR					0	.	.	.	.	.	.	.
crew1				1		0.6568	0.05296	2731	12.40	<.0001	0.05	0.5529	0.7607
crew1				2		0.4439	0.03819	2731	11.62	<.0001	0.05	0.3690	0.5187
crew1				3+		0	.	.	.	.	.	.	.
area1			3075-3280			0.7256	0.06323	970	11.47	<.0001	0.05	0.6015	0.8496
area1			3370-3379			0.9138	0.05944	970	15.37	<.0001	0.05	0.7971	1.0304
area1			3470-3476			0.1060	0.06697	970	1.58	0.1138	0.05	-0.02543	0.2374
area1			3477-3478			0.3362	0.06893	970	4.88	<.0001	0.05	0.2010	0.4715
area1			3570-3677			0	.	.	.	.	.	.	.
numgear1		3				-0.4846	0.03647	2862	-13.29	<.0001	0.05	-0.5561	-0.4131
numgear1		1-2				-1.4075	0.04401	2862	-31.98	<.0001	0.05	-1.4938	-1.3212
numgear1		4-7				0	.	.	.	.	.	.	.

Table 10. Index 3 (SA-CY) table of fixed effects for the lognormal model.

Solution for Fixed Effects

Effect	*crew1*	*effort1*	*area1*	*away1*	*hrs_fished*	*year*	*target*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Intercept								0.5886	0.1074	3432	5.48	<.0001	0.05
year						1993		0.3540	0.1131	3432	3.13	0.0018	0.05
year						1994		0.2850	0.1100	3432	2.59	0.0096	0.05
year						1995		0.2879	0.1085	3432	2.65	0.0080	0.05
year						1996		0.1567	0.1080	3432	1.45	0.1469	0.05
year						1997		0.3043	0.1058	3432	2.88	0.0041	0.05
year						1998		0.1164	0.1031	3432	1.13	0.2589	0.05
year						1999		0.1320	0.1031	3432	1.28	0.2007	0.05
year						2000		0.1572	0.1029	3432	1.53	0.1266	0.05
year						2001		0.07787	0.1031	3432	0.76	0.4500	0.05
year						2002		0.08000	0.1047	3432	0.76	0.4447	0.05
year						2003		0.03738	0.1052	3432	0.36	0.7223	0.05
year						2004		0.1478	0.1055	3432	1.40	0.1613	0.05
year						2005		0.1365	0.1049	3432	1.30	0.1932	0.05
year						2006		0.08428	0.1043	3432	0.81	0.4193	0.05
year						2007		0.07099	0.1032	3432	0.69	0.4915	0.05
year						2008		0.08434	0.1045	3432	0.81	0.4197	0.05
year						2009		-0.04092	0.1059	3432	-0.39	0.6993	0.05
year						2010		-0.07316	0.1122	3432	-0.65	0.5143	0.05
year						2011		-0.00064	0.1134	3432	-0.01	0.9955	0.05
year						2012		-0.1990	0.1144	3432	-1.74	0.0820	0.05
year						2013		0	.	.	.	.	.
crew1	1							0.1714	0.02601	1725	6.59	<.0001	0.05
crew1	2							0.2520	0.01959	1725	12.86	<.0001	0.05
crew1	3+							0	.	.	.	.	.
effort1		1						1.6495	0.02868	1091	57.52	<.0001	0.05
effort1		2						0.7332	0.02542	1091	28.84	<.0001	0.05
effort1		3-20						0	.	.	.	.	.
area1			3075-3280					-0.3073	0.03838	604	-8.01	<.0001	0.05
area1			3370-3379					-0.2687	0.03161	604	-8.50	<.0001	0.05
area1			3470-3476					-0.2570	0.03783	604	-6.79	<.0001	0.05
area1			3477-3478					-0.1339	0.03947	604	-3.39	0.0007	0.05
area1			3570-3677					0	.	.	.	.	.
away1				1				-0.2092	0.04308	1465	-4.86	<.0001	0.05
away1				2-3				0.07264	0.03023	1465	2.40	0.0164	0.05
away1				4-10				0	.	.	.	.	.
hrs_fished					12-24			-0.06782	0.03558	3919	-1.91	0.0567	0.05
hrs_fished					24-48			-0.5305	0.04148	3919	-12.79	<.0001	0.05
hrs_fished					6-8			0.3048	0.01905	3919	16.00	<.0001	0.05
hrs_fished					8-12			0.4057	0.02221	3919	18.27	<.0001	0.05
hrs_fished					>48			-0.9627	0.04847	3919	-19.86	<.0001	0.05
hrs_fished					le 6			0	.	.	.	.	.
target							1	-2.7980	0.02214	2069	-126.37	<.0001	0.05
target							2	-1.1669	0.03220	2069	-36.24	<.0001	0.05
target							3	-0.6232	0.02915	2069	-21.38	<.0001	0.05
target							4	0	.	.	.	.	.

Table 11. Index 4 (GOM-FY) table of fixed effects for the proportion positive model.

Solution for Fixed Effects

Effect	*gear*	*numgear1*	*area1*	*hrs_fished*	*Fyear*	*season*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Intercept							2.9895	0.3089	2967	9.68	<.0001	0.05
Fyear					1992		-1.6588	1.6512	2967	-1.00	0.3152	0.05
Fyear					1993		-0.1412	0.3168	2967	-0.45	0.6560	0.05
Fyear					1994		0.2028	0.3089	2967	0.66	0.5117	0.05
Fyear					1995		0.3478	0.3087	2967	1.13	0.2599	0.05
Fyear					1996		0.1151	0.2967	2967	0.39	0.6980	0.05
Fyear					1997		0.5778	0.2895	2967	2.00	0.0460	0.05
Fyear					1998		0.4094	0.2873	2967	1.42	0.1543	0.05
Fyear					1999		0.5994	0.2855	2967	2.10	0.0359	0.05
Fyear					2000		0.9153	0.2897	2967	3.16	0.0016	0.05
Fyear					2001		-0.1356	0.2829	2967	-0.48	0.6317	0.05
Fyear					2002		0.3406	0.2816	2967	1.21	0.2265	0.05
Fyear					2003		0.3400	0.2852	2967	1.19	0.2332	0.05
Fyear					2004		0.03147	0.2829	2967	0.11	0.9114	0.05
Fyear					2005		-0.4459	0.2921	2967	-1.53	0.1270	0.05
Fyear					2006		0.07939	0.2824	2967	0.28	0.7786	0.05
Fyear					2007		0.3209	0.2863	2967	1.12	0.2624	0.05
Fyear					2008		0.4797	0.2834	2967	1.69	0.0907	0.05
Fyear					2009		1.0843	0.2870	2967	3.78	0.0002	0.05
Fyear					2010		0.5885	0.3016	2967	1.95	0.0511	0.05
Fyear					2011		0.4800	0.3042	2967	1.58	0.1147	0.05
Fyear					2012		0.8548	0.3040	2967	2.81	0.0050	0.05
Fyear					2013		0	.	.	.	.	.
gear	H						-4.1541	0.1201	440	-34.60	<.0001	0.05
gear	TR						0	.	.	.	.	.
hrs_fished				12-24			-0.08928	0.06863	4366	-1.30	0.1934	0.05
hrs_fished				24-48			-0.2002	0.07079	4366	-2.83	0.0047	0.05
hrs_fished				6-8			0.008462	0.07171	4366	0.12	0.9061	0.05
hrs_fished				8-12			-0.1397	0.06929	4366	-2.02	0.0439	0.05
hrs_fished				>48			-0.3499	0.07916	4366	-4.42	<.0001	0.05
hrs_fished				le 6			0	.	.	.	.	.
numgear1		3					0.4642	0.09356	1419	4.96	<.0001	0.05
numgear1		4					0.01772	0.08626	1419	0.21	0.8373	0.05
numgear1		1-2					-0.2066	0.09368	1419	-2.21	0.0276	0.05
numgear1		5-7					0	.	.	.	.	.
area1			8				0.4533	0.08078	908	5.61	<.0001	0.05
area1			9				0.5065	0.09753	908	5.19	<.0001	0.05
area1			13				0.7113	0.1031	908	6.90	<.0001	0.05
area1			10-12				0.6030	0.09958	908	6.06	<.0001	0.05
area1			14-15				1.6014	0.1246	908	12.85	<.0001	0.05
area1			16-17				0.3859	0.1306	908	2.95	0.0032	0.05
area1			18-21				0.1444	0.1443	908	1.00	0.3172	0.05
area1			3-5				-0.04537	0.1116	908	-0.41	0.6843	0.05
area1			6-7				0	.	.	.	.	.
season						1	-1.8085	0.08739	2172	-20.69	<.0001	0.05
season						2	-0.7165	0.09262	2172	-7.74	<.0001	0.05
season						3	0.2293	0.04936	2172	4.65	<.0001	0.05
season						4	0	.	.	.	.	.

Table 12. Index 4 (GOM-FY) table of fixed effects for the lognormal model.

Solution for Fixed Effects

Effect	effort1	hrs_fished	numgear1	crew1	Fyear	target	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha
Intercept							0.8873	0.1576	2257	5.63	<.0001	0.05
Fyear					1992		-1.3979	1.0711	2257	-1.31	0.1920	0.05
Fyear					1993		-0.1858	0.1935	2257	-0.96	0.3370	0.05
Fyear					1994		-0.2399	0.1798	2257	-1.33	0.1822	0.05
Fyear					1995		-0.09257	0.1742	2257	-0.53	0.5951	0.05
Fyear					1996		-0.06789	0.1655	2257	-0.41	0.6818	0.05
Fyear					1997		0.09720	0.1611	2257	0.60	0.5462	0.05
Fyear					1998		0.1172	0.1602	2257	0.73	0.4647	0.05
Fyear					1999		-0.04904	0.1585	2257	-0.31	0.7571	0.05
Fyear					2000		-0.04939	0.1583	2257	-0.31	0.7550	0.05
Fyear					2001		0.01127	0.1583	2257	0.07	0.9432	0.05
Fyear					2002		-0.03322	0.1573	2257	-0.21	0.8327	0.05
Fyear					2003		-0.05112	0.1604	2257	-0.32	0.7500	0.05
Fyear					2004		-0.03990	0.1613	2257	-0.25	0.8047	0.05
Fyear					2005		-0.1065	0.1656	2257	-0.64	0.5203	0.05
Fyear					2006		0.02759	0.1625	2257	0.17	0.8652	0.05
Fyear					2007		0.1360	0.1626	2257	0.84	0.4032	0.05
Fyear					2008		-0.06884	0.1621	2257	-0.42	0.6711	0.05
Fyear					2009		0.09645	0.1608	2257	0.60	0.5487	0.05
Fyear					2010		0.3920	0.1713	2257	2.29	0.0222	0.05
Fyear					2011		0.2943	0.1737	2257	1.69	0.0903	0.05
Fyear					2012		0.2753	0.1726	2257	1.59	0.1110	0.05
Fyear					2013		0	.	.	.	.	.
target						1	-3.2883	0.03159	996	-104.10	<.0001	0.05
target						2	-1.1330	0.04326	996	-26.19	<.0001	0.05
target						3	-0.5852	0.03878	996	-15.09	<.0001	0.05
target						4	0	.	.	.	.	.
effort1	1						1.3709	0.03452	591	39.72	<.0001	0.05
effort1	2						0.5609	0.03831	591	14.64	<.0001	0.05
effort1	11-15						-1.3251	0.06251	591	-21.20	<.0001	0.05
effort1	16-20						-1.7653	0.07141	591	-24.72	<.0001	0.05
effort1	3-10						0	.	.	.	.	.
numgear1			3				0.8081	0.05186	738	15.58	<.0001	0.05
numgear1			4				0.2855	0.04877	738	5.85	<.0001	0.05
numgear1			1-2				1.0415	0.05493	738	18.96	<.0001	0.05
numgear1			5-7				0	.	.	.	.	.
crew1				1			-0.6319	0.04869	944	-12.98	<.0001	0.05
crew1				2			-0.4120	0.04391	944	-9.38	<.0001	0.05
crew1				3			-0.2906	0.04092	944	-7.10	<.0001	0.05
crew1				4+			0	.	.	.	.	.
hrs_fished		12-24					0.2186	0.02993	2419	7.30	<.0001	0.05
hrs_fished		24-48					-0.05174	0.03300	2419	-1.57	0.1170	0.05
hrs_fished		6-8					0.1389	0.02950	2419	4.71	<.0001	0.05
hrs_fished		8-12					0.2418	0.03017	2419	8.02	<.0001	0.05
hrs_fished		>48					-0.5034	0.04399	2419	-11.44	<.0001	0.05
hrs_fished		le 6					0	.	.	.	.	.

Table 13. Index 5 (SA+summer mix -FY) table of fixed effects for the proportion positive model.

Solution for Fixed Effects

Effect	*gear*	*numgear1*	*area1*	*crew1*	*Fyear*	*Estimate*	*Standard Error*	*DF*	*t Value*	*Pr > |t|*	*Alpha*	*Lower*	*Upper*
Intercept						0.8546	0.1049	11E3	8.15	<.0001	0.05	0.6490	1.0602
Fyear					1992	0.8887	0.2649	11E3	3.36	0.0008	0.05	0.3695	1.4080
Fyear					1993	0.6568	0.1214	11E3	5.41	<.0001	0.05	0.4188	0.8948
Fyear					1994	0.4821	0.1123	11E3	4.29	<.0001	0.05	0.2620	0.7022
Fyear					1995	0.2757	0.1132	11E3	2.44	0.0149	0.05	0.05385	0.4975
Fyear					1996	0.1855	0.1098	11E3	1.69	0.0910	0.05	-0.02961	0.4007
Fyear					1997	0.4402	0.1053	11E3	4.18	<.0001	0.05	0.2338	0.6466
Fyear					1998	0.7032	0.1006	11E3	6.99	<.0001	0.05	0.5060	0.9004
Fyear					1999	0.5821	0.1004	11E3	5.80	<.0001	0.05	0.3853	0.7789
Fyear					2000	0.4790	0.1015	11E3	4.72	<.0001	0.05	0.2801	0.6779
Fyear					2001	0.5739	0.09999	11E3	5.74	<.0001	0.05	0.3779	0.7699
Fyear					2002	0.5373	0.1009	11E3	5.32	<.0001	0.05	0.3394	0.7351
Fyear					2003	0.5899	0.1001	11E3	5.90	<.0001	0.05	0.3938	0.7861
Fyear					2004	0.7542	0.1005	11E3	7.51	<.0001	0.05	0.5573	0.9512
Fyear					2005	0.6839	0.1030	11E3	6.64	<.0001	0.05	0.4819	0.8858
Fyear					2006	1.0426	0.1014	11E3	10.28	<.0001	0.05	0.8439	1.2413
Fyear					2007	0.9218	0.1010	11E3	9.13	<.0001	0.05	0.7239	1.1197
Fyear					2008	1.1117	0.1013	11E3	10.98	<.0001	0.05	0.9132	1.3103
Fyear					2009	0.8925	0.09911	11E3	9.01	<.0001	0.05	0.6983	1.0868
Fyear					2010	0.8877	0.1024	11E3	8.67	<.0001	0.05	0.6871	1.0884
Fyear					2011	0.3629	0.1035	11E3	3.51	0.0005	0.05	0.1601	0.5657
Fyear					2012	0.1787	0.1064	11E3	1.68	0.0929	0.05	-0.02978	0.3872
Fyear					2013	0	.	.	.	.	.	.	.
gear	H					-2.2160	0.03232	2080	-68.57	<.0001	0.05	-2.2794	-2.1526
gear	TR					0	.	.	.	.	.	.	.
crew1				1		0.4168	0.03755	5897	11.10	<.0001	0.05	0.3432	0.4904
crew1				2		0.4342	0.03267	5897	13.29	<.0001	0.05	0.3701	0.4982
crew1				3+		0	.	.	.	.	.	.	.
numgear1		3				-0.07534	0.03228	5523	-2.33	0.0196	0.05	-0.1386	-0.01207
numgear1		1-2				-0.8768	0.03367	5523	-26.05	<.0001	0.05	-0.9428	-0.8108
numgear1		4-7				0	.	.	.	.	.	.	.
area1			3			-0.5055	0.2075	2733	-2.44	0.0149	0.05	-0.9124	-0.09863
area1			2481			-2.5226	0.09099	2733	-27.72	<.0001	0.05	-2.7010	-2.3442
area1			2680			2.0450	0.07676	2733	26.64	<.0001	0.05	1.8945	2.1956
area1			1-2,2482			-1.1796	0.08023	2733	-14.70	<.0001	0.05	-1.3369	-1.0223
area1			2479-2480			-1.7543	0.08601	2733	-20.40	<.0001	0.05	-1.9229	-1.5856
area1			2575-2580			0.7858	0.06765	2733	11.62	<.0001	0.05	0.6531	0.9184
area1			2674-2679			1.8098	0.06599	2733	27.43	<.0001	0.05	1.6804	1.9392
area1			2777-2779			1.6046	0.07765	2733	20.66	<.0001	0.05	1.4523	1.7569
area1			2780-2781			1.8512	0.06722	2733	27.54	<.0001	0.05	1.7194	1.9830
area1			2842-2981			0.9170	0.07159	2733	12.81	<.0001	0.05	0.7766	1.0574
area1			3075-3280			0.4422	0.07043	2733	6.28	<.0001	0.05	0.3041	0.5803
area1			3370-3379			0.5092	0.06569	2733	7.75	<.0001	0.05	0.3804	0.6380
area1			3470-3476			-0.2274	0.07480	2733	-3.04	0.0024	0.05	-0.3741	-0.08075
area1			3477-3478			0.03036	0.07751	2733	0.39	0.6953	0.05	-0.1216	0.1823
area1			3570-3677			0	.	.	.	.	.	.	.

Table 14. Index 5 (SA+summer mix-FY) table of fixed effects for the lognormal model.

Solution for Fixed Effects

Effect	*effort1*	*hrs_fished*	*away1*	*crew1*	*Fyear*	*target*	*season*	*Estimate*	*SE*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Intercpt								0.6607	0.065	8685	10.22	<.0001	0.05
Fyear					1992			-0.1046	0.139	8685	-0.75	0.4508	0.05
Fyear					1993			0.1215	0.077	8685	1.58	0.1146	0.05
Fyear					1994			0.1372	0.072	8685	1.92	0.0553	0.05
Fyear					1995			0.03141	0.072	8685	0.44	0.6625	0.05
Fyear					1996			0.1141	0.069	8685	1.65	0.0984	0.05
Fyear					1997			0.1028	0.067	8685	1.53	0.1260	0.05
Fyear					1998			0.02338	0.063	8685	0.37	0.7099	0.05
Fyear					1999			0.007696	0.063	8685	0.12	0.9026	0.05
Fyear					2000			0.004193	0.063	8685	0.07	0.9469	0.05
Fyear					2001			-0.05129	0.062	8685	-0.82	0.4115	0.05
Fyear					2002			-0.06914	0.063	8685	-1.10	0.2712	0.05
Fyear					2003			0.007510	0.063	8685	0.12	0.9049	0.05
Fyear					2004			0.1127	0.063	8685	1.79	0.0729	0.05
Fyear					2005			0.05615	0.063	8685	0.89	0.3750	0.05
Fyear					2006			0.1236	0.063	8685	1.97	0.0486	0.05
Fyear					2007			0.1060	0.062	8685	1.70	0.0897	0.05
Fyear					2008			0.1134	0.062	8685	1.82	0.0695	0.05
Fyear					2009			0.1696	0.063	8685	2.70	0.0069	0.05
Fyear					2010			0.2484	0.064	8685	3.86	0.0001	0.05
Fyear					2011			0.1136	0.066	8685	1.73	0.0839	0.05

Solution for Fixed Effects

Effect	*effort1*	*hrs_fished*	*away1*	*crew1*	*Fyear*	*target*	*season*	*Estimate*	*SE*	*DF*	*t Value*	*Pr > |t|*	*Alpha*
Fyear					2012			-0.02419	0.067	8685	-0.36	0.7166	0.05
Fyear					2013			0	.	.	.	.	.
season							1	-0.09393	0.016	7745	-5.73	<.0001	0.05
season							2	-0.3154	0.013	7745	-25.23	<.0001	0.05
season							3	-0.4063	0.012	7745	-32.70	<.0001	0.05
season							4	0	.	.	.	.	.
crew1				1				0.1384	0.016	3198	8.53	<.0001	0.05
crew1				2				0.2185	0.014	3198	15.16	<.0001	0.05
crew1				3+				0	.	.	.	.	.
effort1	1							1.4340	0.017	2168	82.94	<.0001	0.05
effort1	2							0.5892	0.017	2168	34.57	<.0001	0.05
effort1	3-20							0	.	.	.	.	.
away1			1					0.1567	0.032	2081	4.84	<.0001	0.05
away1			2-10					0.3039	0.032	2081	9.45	<.0001	0.05
away1			2-3					0.1828	0.026	2081	7.10	<.0001	0.05
away1			4-10					0	.	.	.	.	.
hrs_fished		12-24						-0.1254	0.021	8500	-5.99	<.0001	0.05
hrs_fished		24-48						-0.5997	0.027	8500	-21.96	<.0001	0.05
hrs_fished		6-8						0.1182	0.008	8500	15.45	<.0001	0.05
hrs_fished		8-12						0.1654	0.010	8500	15.82	<.0001	0.05
hrs_fished		>48						-1.0539	0.034	8500	-31.46	<.0001	0.05
hrs_fished		le 6						0	.	.	.	.	.
target						1		-2.4739	0.012	7476	-212.15	<.0001	0.05
target						2		-1.1929	0.012	7476	-100.14	<.0001	0.05
target						3		-0.5983	0.009	7476	-64.76	<.0001	0.05
target						4		0	.	.	.	.	.

Table 15. Index 1, Gulf of Mexico CY CPUE and other information.

YEAR	CPUE	Lower 95% CI (Index)	Upper 95% CI (Index)	CV	SE	Trips	Relative Nominal CPUE	Obs % positive	Est % positive	Obs CPUE pos-itives	Est CPUE pos-itives
1993	0.676	0.504	0.906	0.147	0.378	573	1.151	19.9%	63.7%	5.78	4.03
1994	0.735	0.578	0.935	0.121	0.338	530	2.237	34.9%	71.7%	6.41	3.90
1995	0.906	0.728	1.129	0.110	0.380	577	4.138	43.0%	75.6%	9.63	4.56
1996	0.867	0.716	1.048	0.095	0.314	1068	4.682	48.6%	71.6%	9.64	4.60
1997	1.028	0.870	1.214	0.084	0.327	952	6.975	60.3%	80.7%	11.57	4.84
1998	1.198	1.025	1.401	0.078	0.357	1440	7.931	47.9%	77.1%	16.55	5.91
1999	0.941	0.809	1.095	0.076	0.272	1635	6.736	55.1%	77.6%	12.22	4.61
2000	1.044	0.904	1.205	0.072	0.285	1662	9.060	62.3%	83.5%	14.55	4.75
2001	0.850	0.722	1.001	0.082	0.264	1710	6.481	56.1%	65.2%	11.56	4.96
2002	0.945	0.816	1.095	0.074	0.264	1649	7.730	61.9%	75.3%	12.48	4.77
2003	0.887	0.751	1.047	0.083	0.280	1438	8.395	65.6%	72.8%	12.79	4.63
2004	0.867	0.732	1.028	0.085	0.281	1473	7.749	54.6%	69.3%	14.20	4.75
2005	0.698	0.569	0.855	0.102	0.270	1814	5.688	32.4%	59.0%	17.58	4.49
2006	0.913	0.765	1.090	0.088	0.307	1793	6.542	44.8%	68.7%	14.61	5.06
2007	1.092	0.921	1.294	0.085	0.354	1621	7.824	52.4%	75.4%	14.94	5.50
2008	0.949	0.805	1.119	0.083	0.298	1718	8.272	51.0%	77.3%	16.20	4.67
2009	1.181	1.013	1.377	0.077	0.345	1653	8.980	59.0%	85.2%	15.21	5.27
2010	1.431	1.163	1.760	0.104	0.564	756	24.435	67.5%	78.0%	36.22	6.97
2011	1.306	1.057	1.615	0.106	0.528	847	16.577	60.3%	76.2%	27.48	6.51
2012	1.404	1.147	1.719	0.101	0.541	807	16.416	78.8%	84.2%	20.83	6.34
2013	1.082	0.812	1.443	0.145	0.595	323	14.631	68.7%	77.6%	21.29	5.30

Table 16. Index 2, Mixing zone CPUE and other information.

YEAR	CPUE	Lower 95% CI (Index)	Upper 95% CI (Index)	CV	SE	Trips	Relative Nominal CPUE	Obs % positive	Est % positive	Obs CPUE pos-itives	Est CPUE pos-itives
1993	0.560	0.452	0.693	0.107	0.305	3857	0.354	26.6%	50.8%	2.43	5.61
1994	0.578	0.481	0.695	0.092	0.272	4597	0.364	28.4%	50.1%	2.49	5.88
1995	0.597	0.499	0.714	0.090	0.273	4979	0.392	28.4%	49.7%	2.69	6.13
1996	0.846	0.737	0.970	0.069	0.297	6309	0.517	34.7%	62.0%	3.54	6.95
1997	0.709	0.614	0.818	0.072	0.259	6725	0.452	33.5%	55.3%	3.10	6.54
1998	0.908	0.819	1.005	0.051	0.237	13359	0.808	64.1%	66.7%	5.54	6.93
1999	0.893	0.807	0.987	0.050	0.229	14900	0.799	56.8%	62.8%	5.48	7.25
2000	0.811	0.734	0.896	0.050	0.207	14482	0.702	59.1%	63.6%	4.81	6.49
2001	0.847	0.769	0.933	0.048	0.209	15165	0.773	59.6%	64.8%	5.30	6.66
2002	0.905	0.824	0.994	0.047	0.217	15384	0.822	59.0%	66.4%	5.63	6.95
2003	1.123	1.030	1.223	0.043	0.246	16829	1.264	64.1%	72.2%	8.66	7.93
2004	1.114	1.016	1.221	0.046	0.260	14446	1.318	58.1%	68.8%	9.03	8.25
2005	1.079	0.979	1.190	0.049	0.268	12882	1.143	56.0%	66.6%	7.83	8.26
2006	1.286	1.176	1.407	0.045	0.293	13622	1.506	63.3%	73.3%	10.33	8.94
2007	1.199	1.093	1.315	0.046	0.283	14373	1.270	62.3%	69.8%	8.70	8.75
2008	1.353	1.238	1.478	0.044	0.305	15015	1.441	64.9%	73.5%	9.88	9.38
2009	1.445	1.322	1.579	0.044	0.327	15643	1.648	66.3%	73.5%	11.30	10.02
2010	1.535	1.398	1.685	0.047	0.366	11835	1.767	67.3%	73.9%	12.11	10.59
2011	1.236	1.114	1.372	0.052	0.328	11292	1.396	58.7%	64.3%	9.57	9.80
2012	1.090	0.973	1.220	0.057	0.315	9711	1.222	58.1%	61.0%	8.38	9.11
2013	0.888	0.768	1.026	0.072	0.327	5443	1.042	54.2%	57.3%	7.14	7.90

Table 17 Index 3, South Atlantic CPUE and other information.

YEAR	CPUE	Lower 95% CI (Index)	Upper 95% CI (Index)	CV	SE	Trips	Relative Nominal CPUE	Obs % positive	Est % positive	Obs CPUE pos-itives	Est CPUE pos-itives
1993	1.705	1.485	1.958	0.069	0.143	1754	0.466	59.6%	85.7%	2.38	2.42
1994	1.445	1.268	1.647	0.065	0.115	2199	0.449	50.3%	77.8%	2.72	2.26
1995	1.368	1.204	1.553	0.064	0.106	2712	0.576	47.4%	73.4%	3.70	2.26
1996	1.027	0.899	1.172	0.066	0.083	2904	0.452	38.7%	62.9%	3.56	1.99
1997	1.349	1.199	1.517	0.059	0.097	3268	0.860	47.2%	71.2%	5.54	2.30
1998	1.120	1.006	1.247	0.054	0.073	3840	1.107	52.5%	71.3%	6.42	1.91
1999	1.104	0.991	1.230	0.054	0.073	3981	1.093	53.6%	69.2%	6.21	1.94
2000	1.143	1.027	1.272	0.054	0.074	4027	1.076	57.2%	69.9%	5.72	1.99
2001	1.063	0.955	1.183	0.053	0.069	4194	1.011	54.4%	70.4%	5.66	1.84
2002	0.935	0.829	1.054	0.060	0.068	3762	0.914	44.5%	61.8%	6.25	1.84
2003	0.871	0.768	0.987	0.063	0.067	3230	1.203	46.9%	60.0%	7.81	1.76
2004	0.974	0.859	1.105	0.063	0.074	3295	1.583	46.7%	60.1%	10.31	1.97
2005	1.147	1.023	1.286	0.057	0.080	3281	1.751	54.2%	71.6%	9.83	1.95
2006	1.103	0.986	1.233	0.056	0.075	3344	1.719	55.1%	72.5%	9.49	1.85
2007	1.066	0.957	1.188	0.054	0.070	3681	1.372	54.2%	71.0%	7.70	1.82
2008	0.944	0.836	1.066	0.061	0.070	3326	1.566	47.1%	62.1%	10.11	1.85
2009	0.725	0.633	0.831	0.068	0.060	2966	1.189	44.5%	54.1%	8.14	1.63
2010	0.514	0.428	0.617	0.092	0.057	2321	0.698	32.3%	39.6%	6.58	1.58
2011	0.516	0.427	0.624	0.095	0.060	2093	0.978	30.7%	37.0%	9.70	1.70
2012	0.410	0.336	0.500	0.099	0.049	2043	0.645	29.2%	35.8%	6.71	1.39
2013	0.472	0.368	0.606	0.125	0.072	1386	0.291	21.8%	33.9%	4.06	1.69

Table 18. Index 4, Gulf of Mexico Fishing year index.

YEAR	CPUE	Lower 95% CI (Index)	Upper 95% CI (Index)	CV	SE	Trips	Relative Nominal CPUE	Obs % positive	Est % positive	Obs CPUE pos-itives	Est CPUE pos-itives
1993	0.694	0.498	0.966	0.167	0.437	550	1.198	20.5%	65.1%	5.83	4.03
1994	0.734	0.560	0.961	0.136	0.376	507	2.339	36.5%	72.4%	6.41	3.83
1995	0.884	0.691	1.130	0.123	0.412	680	3.511	37.1%	75.2%	9.47	4.44
1996	0.852	0.684	1.061	0.110	0.354	991	5.048	52.4%	70.7%	9.64	4.56
1997	1.128	0.943	1.350	0.090	0.384	1255	8.324	50.7%	79.3%	16.43	5.38
1998	1.109	0.926	1.328	0.090	0.379	1444	5.808	46.4%	76.4%	12.52	5.49
1999	0.979	0.830	1.156	0.083	0.308	1677	8.092	56.8%	79.6%	14.24	4.65
2000	1.036	0.883	1.216	0.080	0.313	1279	9.168	73.3%	84.3%	12.51	4.65
2001	0.852	0.706	1.029	0.094	0.304	1726	6.687	56.5%	65.2%	11.84	4.94
2002	0.939	0.795	1.109	0.083	0.296	1640	7.512	61.5%	75.1%	12.21	4.72
2003	0.921	0.768	1.106	0.091	0.318	1456	8.534	66.1%	75.1%	12.92	4.64
2004	0.855	0.704	1.038	0.098	0.315	1746	6.359	45.1%	68.9%	14.09	4.69
2005	0.671	0.528	0.854	0.121	0.307	1687	6.080	34.8%	57.9%	17.47	4.38
2006	0.928	0.763	1.129	0.098	0.345	1813	7.083	46.6%	69.9%	15.20	5.02
2007	1.105	0.913	1.338	0.096	0.401	1617	7.684	52.0%	74.7%	14.77	5.59
2008	0.935	0.779	1.124	0.092	0.325	1820	7.770	47.9%	77.6%	16.22	4.56
2009	1.229	1.040	1.451	0.083	0.387	1359	10.339	69.2%	86.4%	14.93	5.38
2010	1.516	1.213	1.893	0.112	0.639	921	23.966	60.4%	79.4%	39.70	7.21
2011	1.342	1.061	1.699	0.118	0.600	754	16.662	71.2%	77.6%	23.39	6.54
2012	1.416	1.136	1.766	0.111	0.592	798	16.423	78.8%	83.5%	20.84	6.41
2013	0.874	0.601	1.273	0.189	0.626	258	10.644	60.9%	68.2%	17.49	4.84

Table 19. Index 5. South Atlantic and Summer Mixing Fishing year index.

YEAR	CPUE	Lower 95% CI (Index)	Upper 95% CI (Index)	CV	SE	Trips	Relative Nominal CPUE	Obs % positive	Est % positive	Obs CPUE pos-itives	Est CPUE pos-itives
1993	0.958	0.830	1.107	0.072	0.228	4252	0.385	39.9%	64.8%	2.00	4.87
1994	0.960	0.845	1.090	0.064	0.202	5555	0.414	36.0%	60.7%	2.15	5.21
1995	0.854	0.748	0.974	0.066	0.185	5895	0.322	34.5%	56.7%	1.67	4.96
1996	0.907	0.803	1.026	0.061	0.184	6907	0.431	32.3%	54.6%	2.24	5.47
1997	0.965	0.865	1.077	0.055	0.174	7780	0.480	37.2%	61.6%	2.49	5.17
1998	0.948	0.867	1.037	0.045	0.140	12396	0.816	59.6%	67.2%	4.24	4.65
1999	0.866	0.791	0.948	0.045	0.130	12421	0.850	56.8%	63.4%	4.41	4.50
2000	0.817	0.745	0.896	0.046	0.125	12186	0.728	57.7%	61.9%	3.78	4.35
2001	0.839	0.767	0.917	0.044	0.123	13291	0.702	57.3%	64.0%	3.65	4.31
2002	0.861	0.786	0.943	0.046	0.130	12107	0.731	56.5%	62.7%	3.80	4.53
2003	0.976	0.891	1.069	0.045	0.146	12523	1.313	58.9%	63.3%	6.82	5.08
2004	1.131	1.035	1.237	0.045	0.166	11834	1.485	58.0%	67.1%	7.72	5.55
2005	1.051	0.958	1.153	0.046	0.161	10031	1.176	57.1%	65.7%	6.11	5.27
2006	1.261	1.157	1.374	0.043	0.179	11440	1.691	62.8%	73.6%	8.79	5.64
2007	1.199	1.100	1.307	0.043	0.171	11406	1.345	63.7%	70.7%	6.99	5.59
2008	1.286	1.181	1.399	0.042	0.180	11969	1.591	64.8%	74.4%	8.27	5.70
2009	1.248	1.144	1.362	0.044	0.179	12618	1.815	64.2%	69.7%	9.43	5.90
2010	1.321	1.203	1.452	0.047	0.205	10080	2.038	63.5%	69.8%	10.59	6.24
2011	1.017	0.915	1.130	0.053	0.177	8317	1.353	54.2%	58.1%	7.03	5.76
2012	0.805	0.718	0.902	0.057	0.152	6969	1.027	50.8%	52.8%	5.33	5.03
2013	0.729	0.629	0.845	0.074	0.177	3890	0.787	42.8%	48.8%	4.09	4.92

Figure 1. Coastal Logbook defined fishing areas with king mackerel regions indicated.

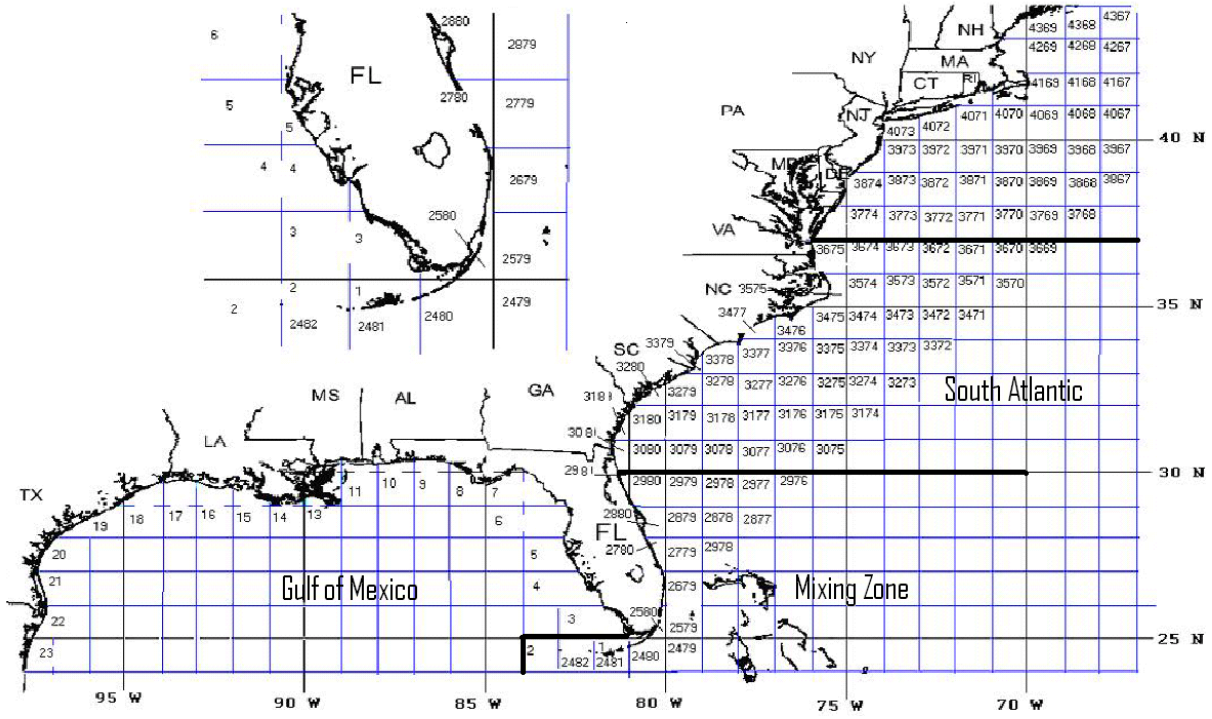


Figure 2. a. Three regional definitions for data partitioning; Gulf, Winter Mixing and Atlantic. b. For the new South Atlantic index which includes the summer mixing zone the partition in (b) applies for assigning mixed zone to Atlantic in the summer (Apr 1- Oct 31).

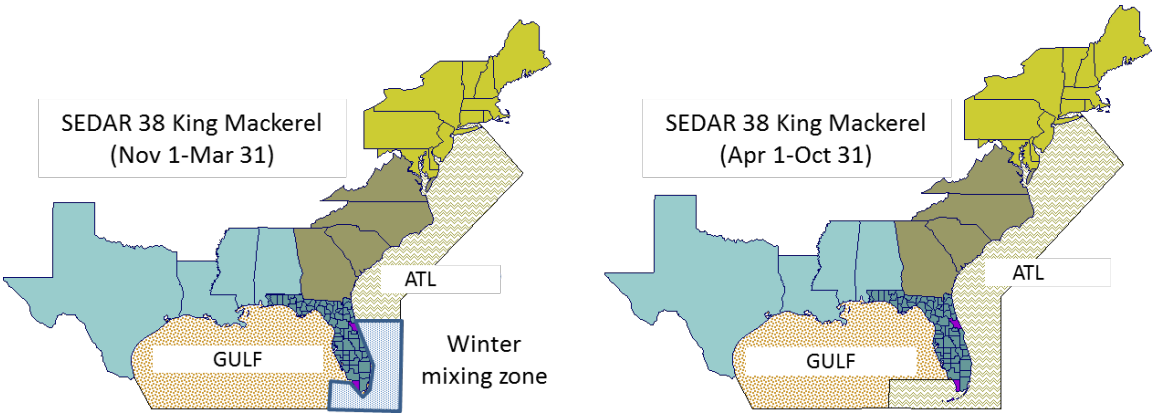


Figure 3. Index 1. Gulf of Mexico zone proportion positive and lognormal models raw residuals versus model factors.

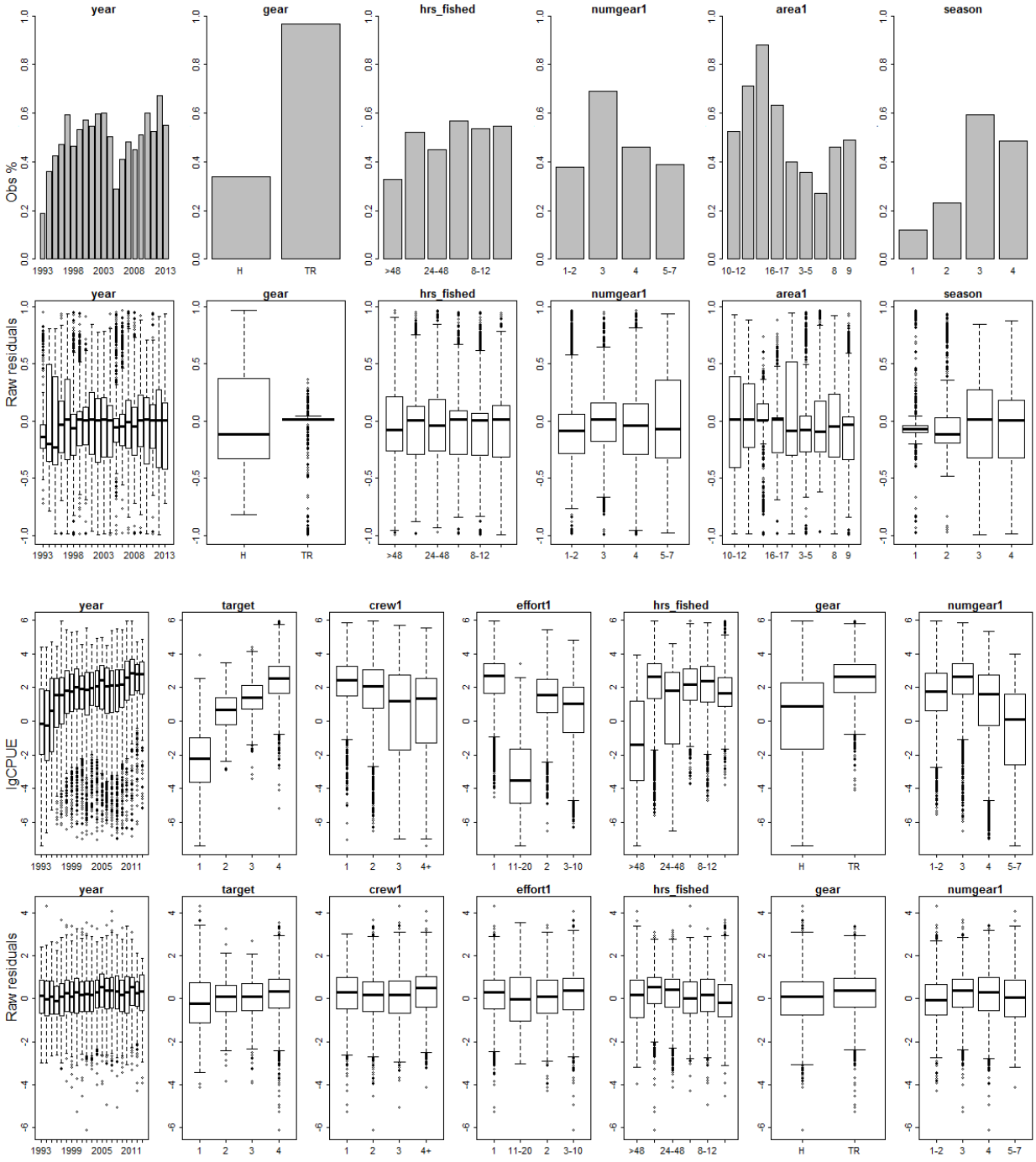


Figure 4. Index 2. Mixing zone proportion positive and lognormal models raw residuals versus model factors.

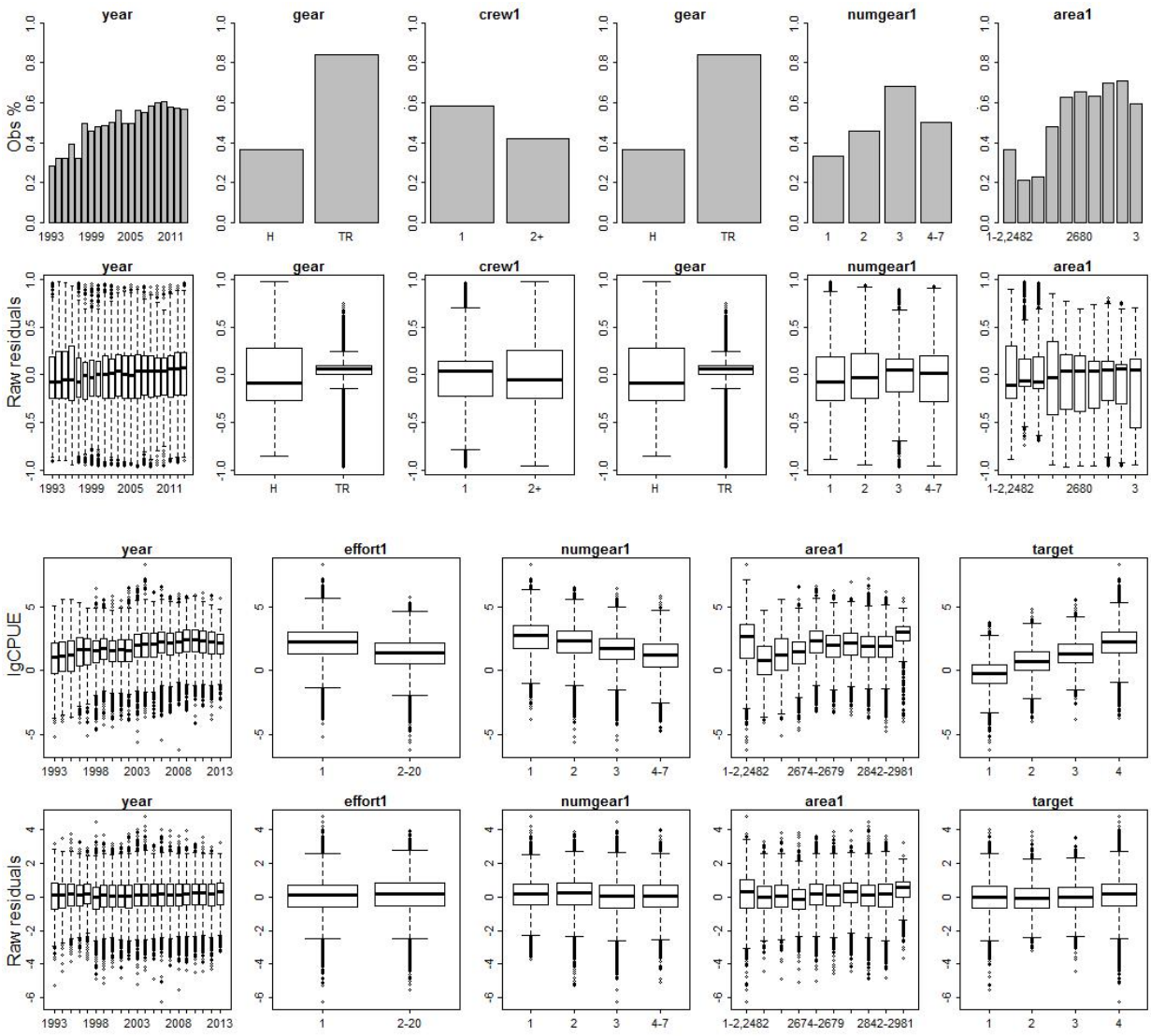


Figure 5 Index 3. South Atlantic proportion positive and lognormal models raw residuals versus model factors.

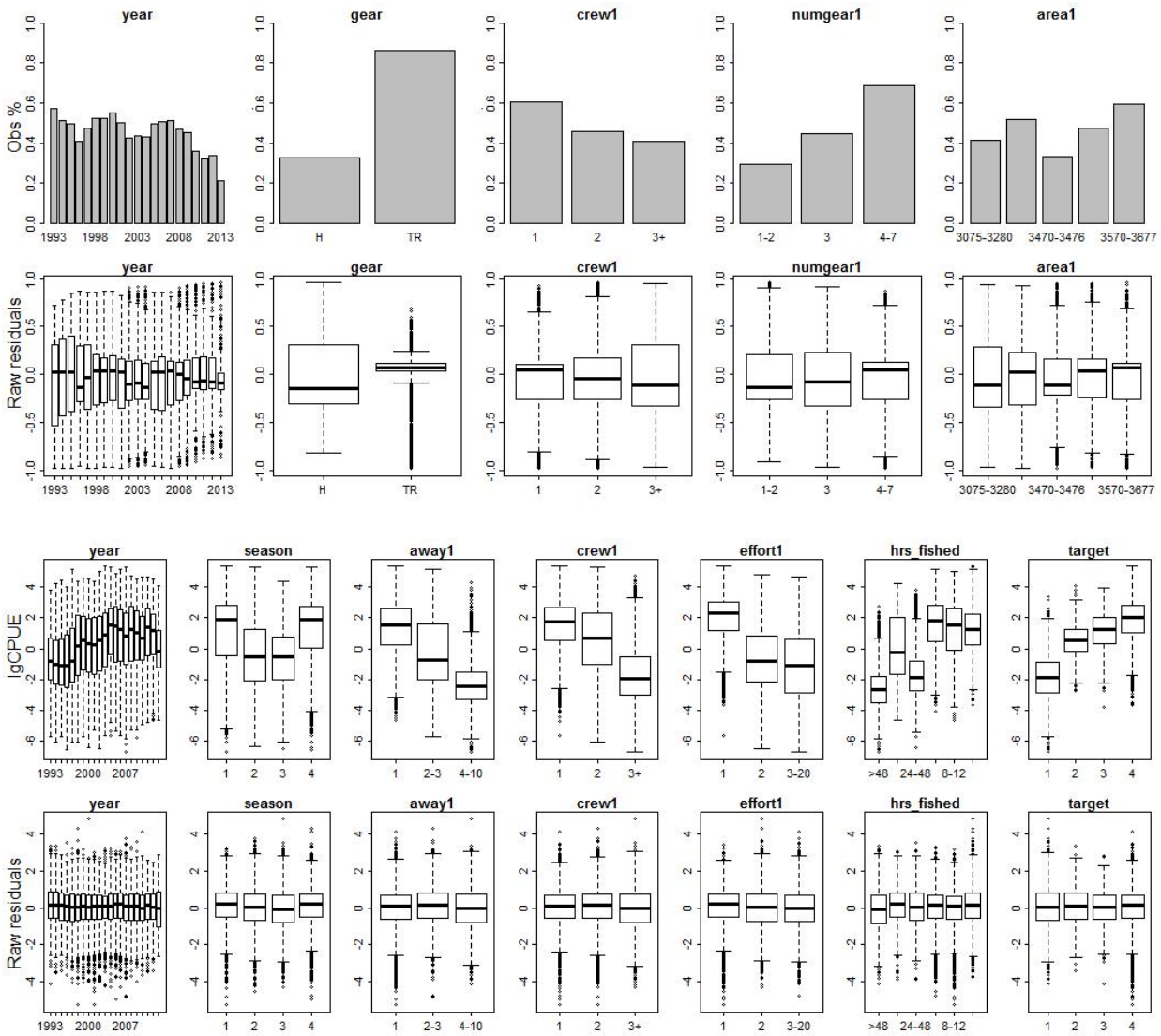


Figure 6 Index 4. Gulf of Mexico Fishing Year proportion positive and lognormal models raw residuals versus model factors.

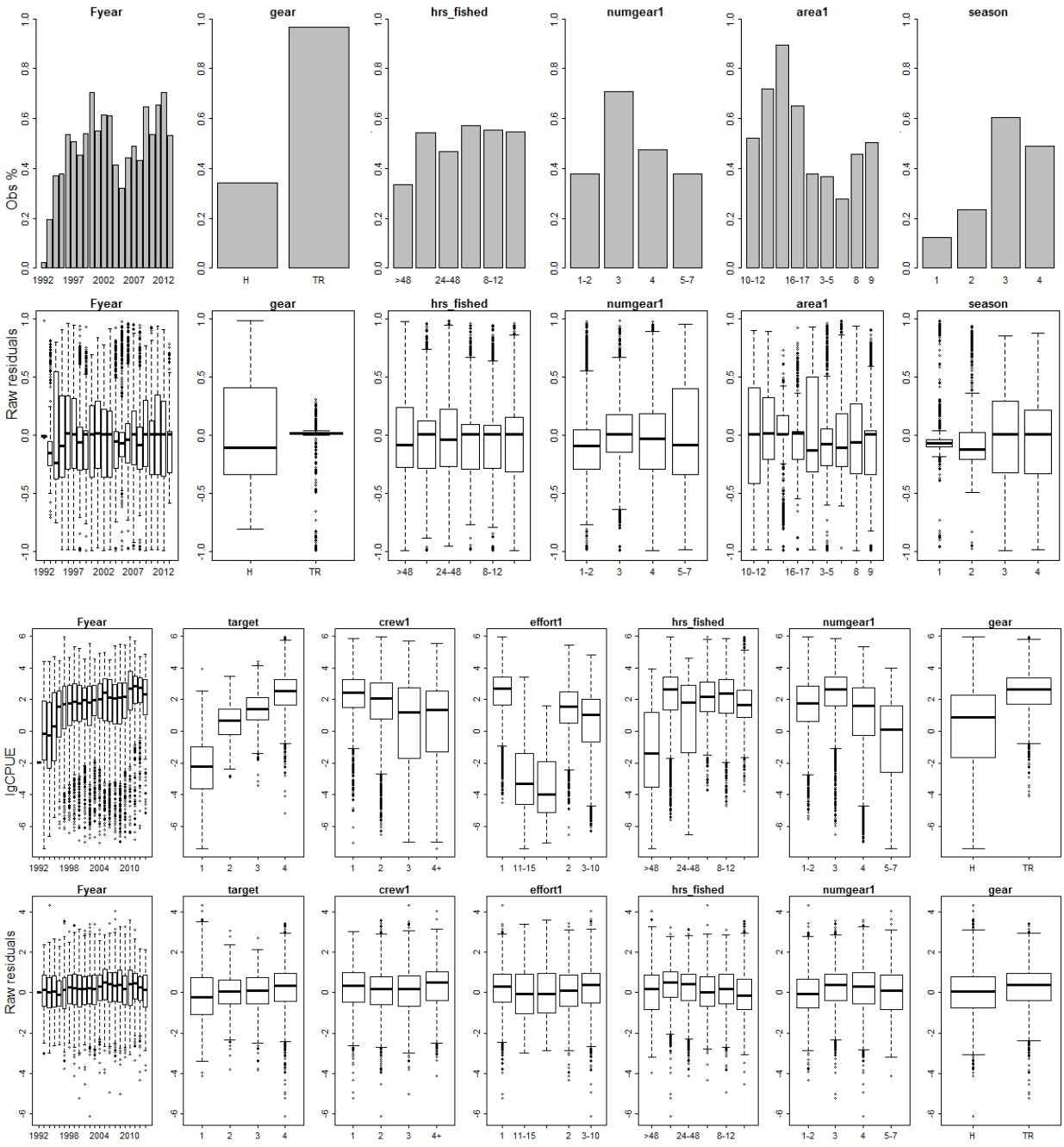


Figure 7, Index 5. South Atlantic and summer mixing zone fishing year proportion positive and lognormal models raw residuals versus model factors.

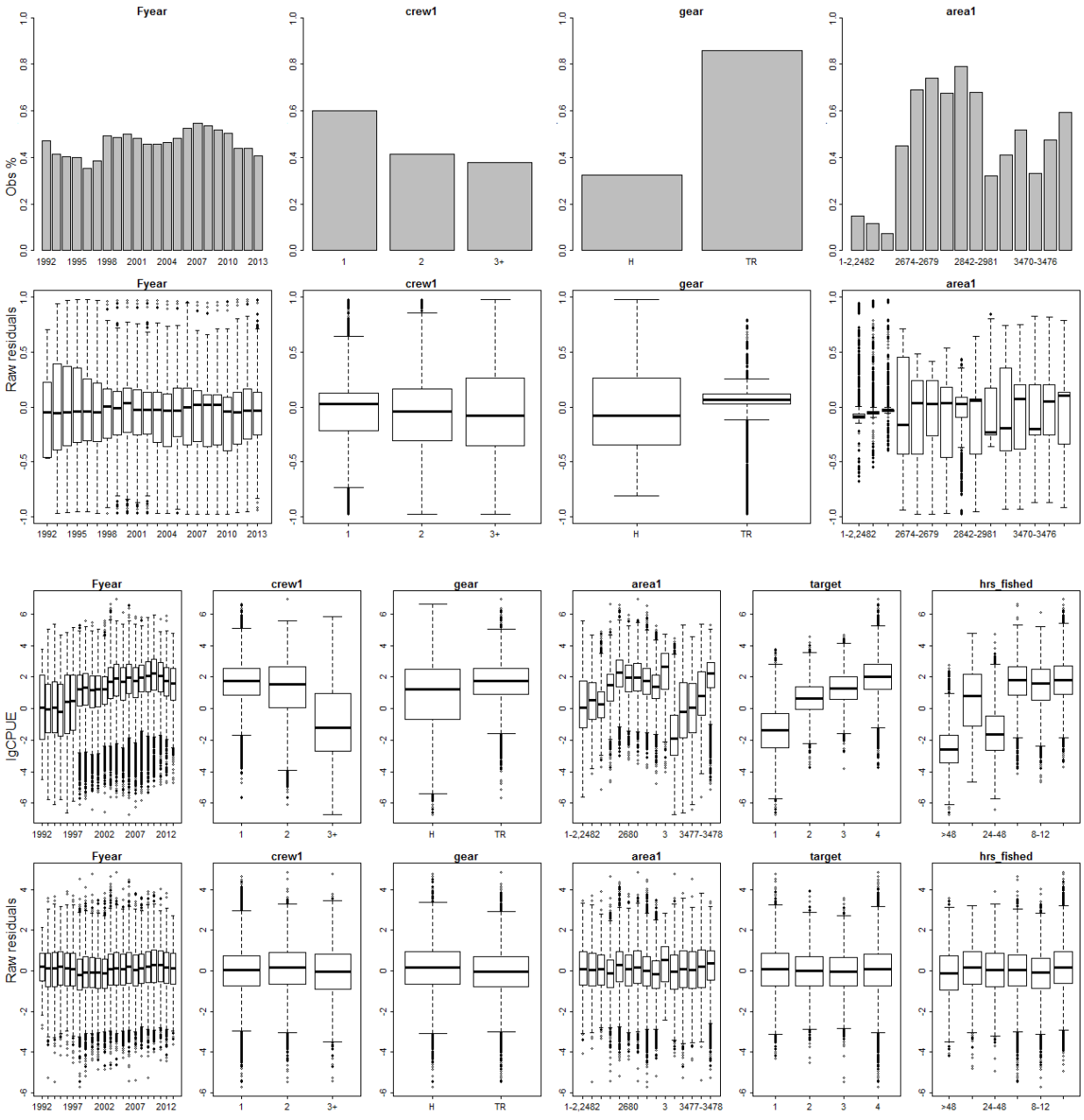
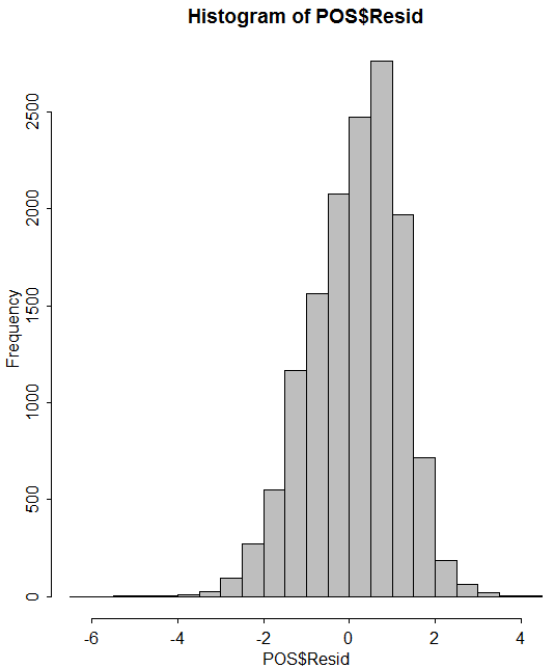


Figure 8. Diagnostic plots for the lognormal component of the Gulf of Mexico 1993-2013 king mackerel commercial hook and line gear model: **A**) the frequency distribution of log(CPUE) on positive trips, **B**) the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A.



B.

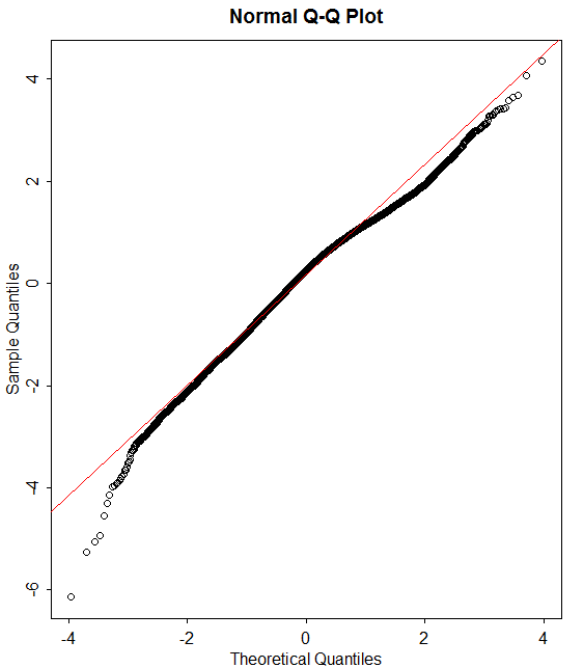
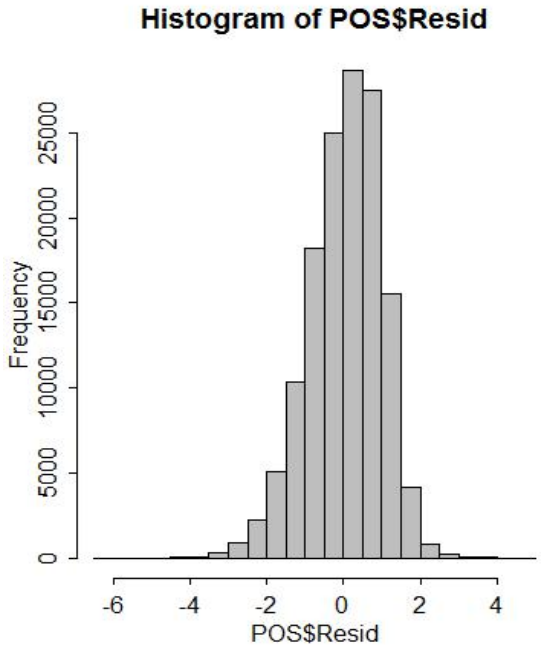


Figure 9. Diagnostic plots for the lognormal component of the Mixing 1993-2013 king mackerel commercial hook and line gear model: **A**) the frequency distribution of log(CPUE) on positive trips, **B**) the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A.



B.

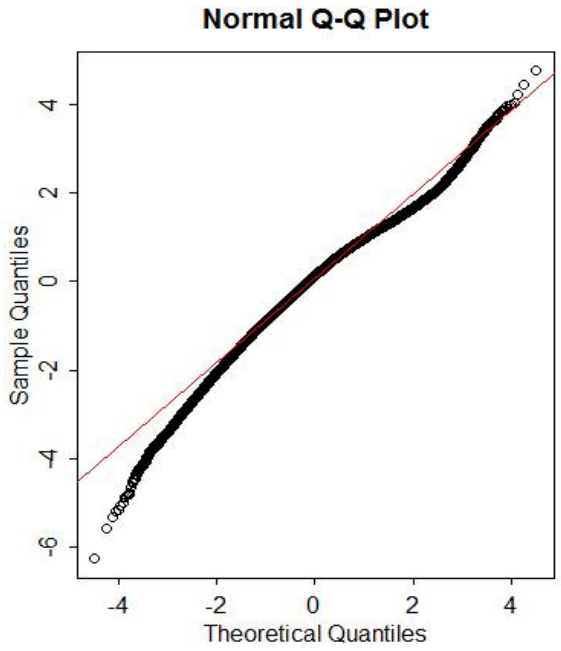


Figure 10. Diagnostic plots for the lognormal component of the SA 1993-2013 king mackerel commercial hook and line gear model: **A**) the frequency distribution of log(CPUE) on positive trips, **B**) the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A. **B.**

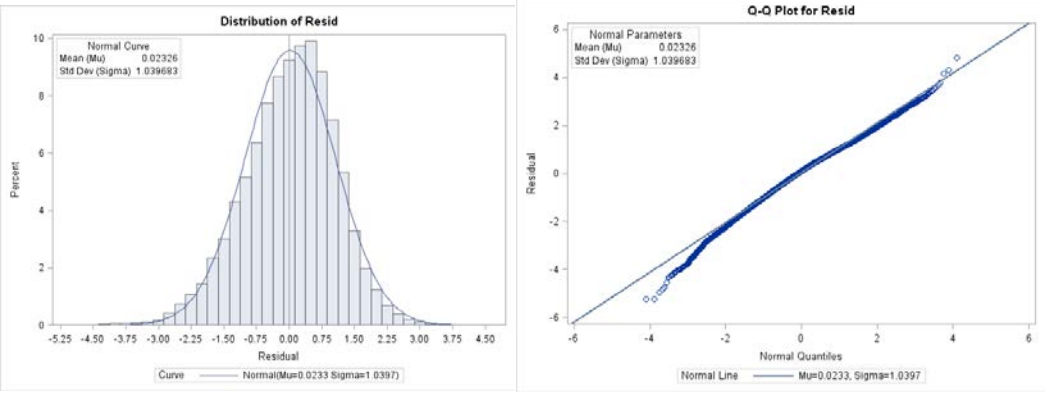


Figure 11. Diagnostic plots for the lognormal component of the Gulf of Mexico Fishing year model 1993-2013 king mackerel commercial hook and line gear model: **A**) the frequency distribution of log(CPUE) on positive trips, **B**) the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A. **B.**

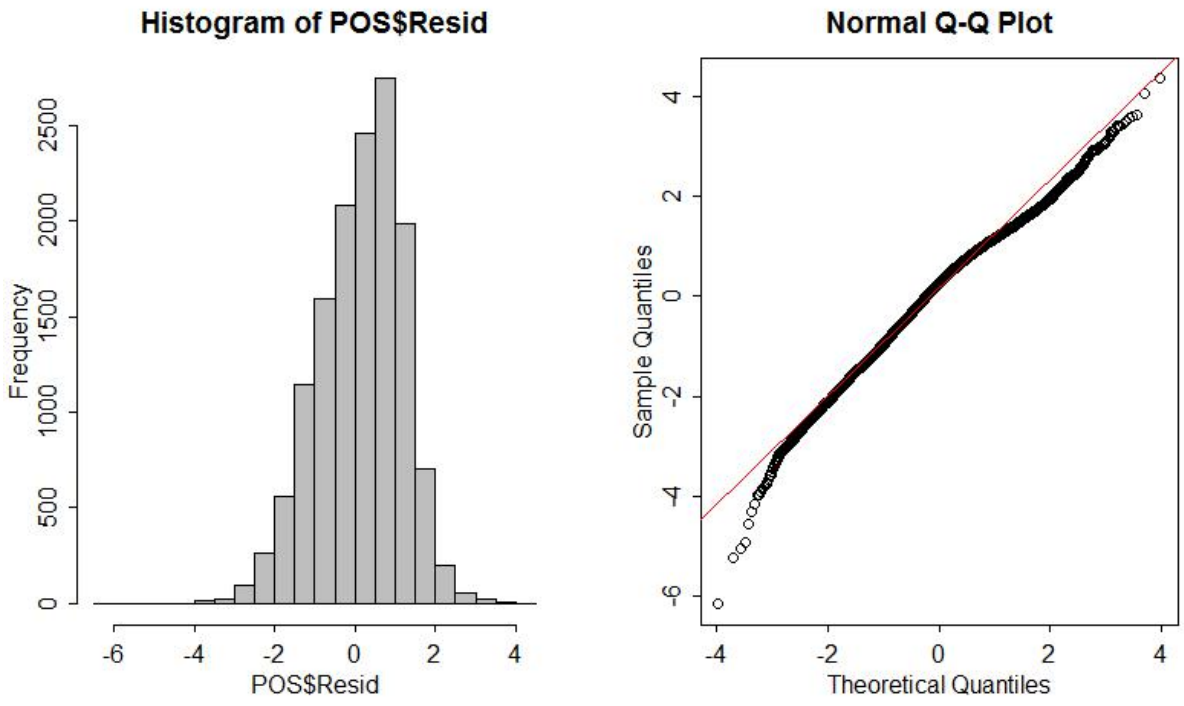
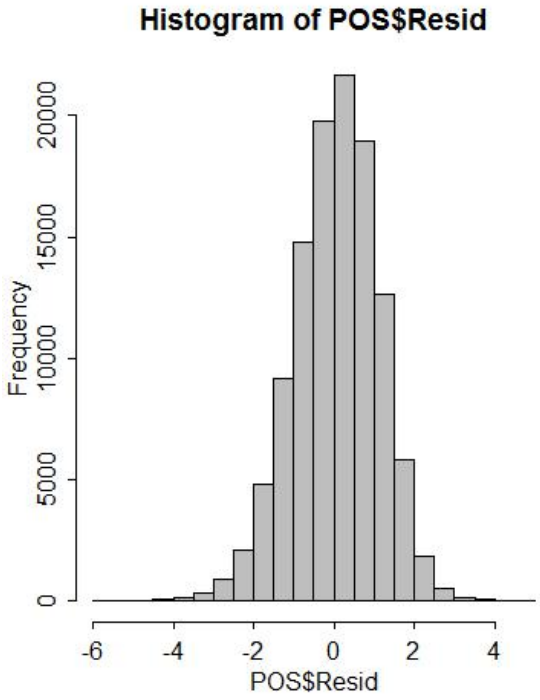


Figure 12. Diagnostic plots for the lognormal component of the South Atlantic and summer mixing zone fishing year model 1993-2013 king mackerel commercial hook and line gear model: **A**) the frequency distribution of log(CPUE) on positive trips, **B**) the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A.



B.

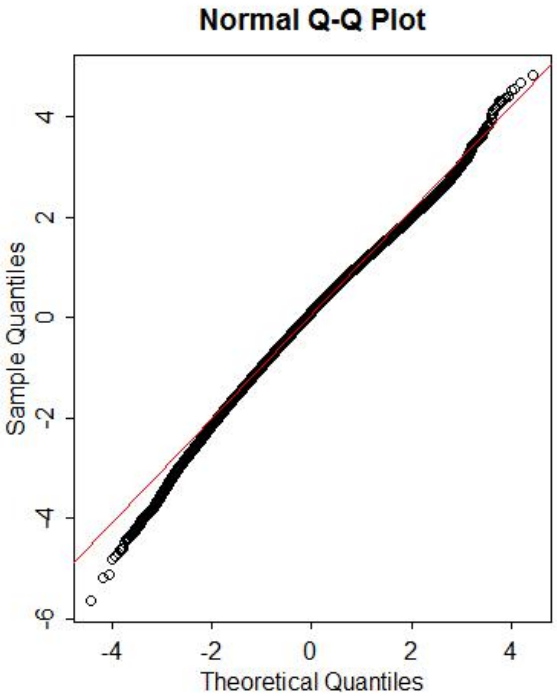


Figure 13. Index 1, king mackerel (1993-2013) nominal CPUE (solid circles), standardized CPUE (blue line) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing hook and line gear (handline, electric reel, and trolling) in the Gulf of Mexico by calendar year.

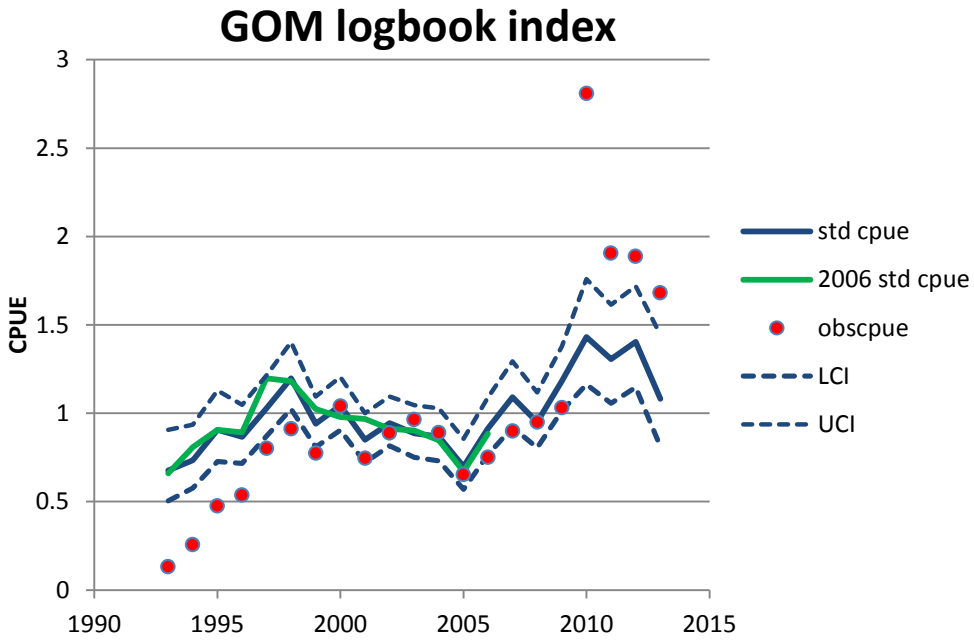


Figure 14. Index 2, king mackerel (1993-2013) nominal CPUE (solid circles), standardized CPUE (blue line) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing hook and line gear (handline, electric reel, and trolling) in the Mixing zone by calendar year.

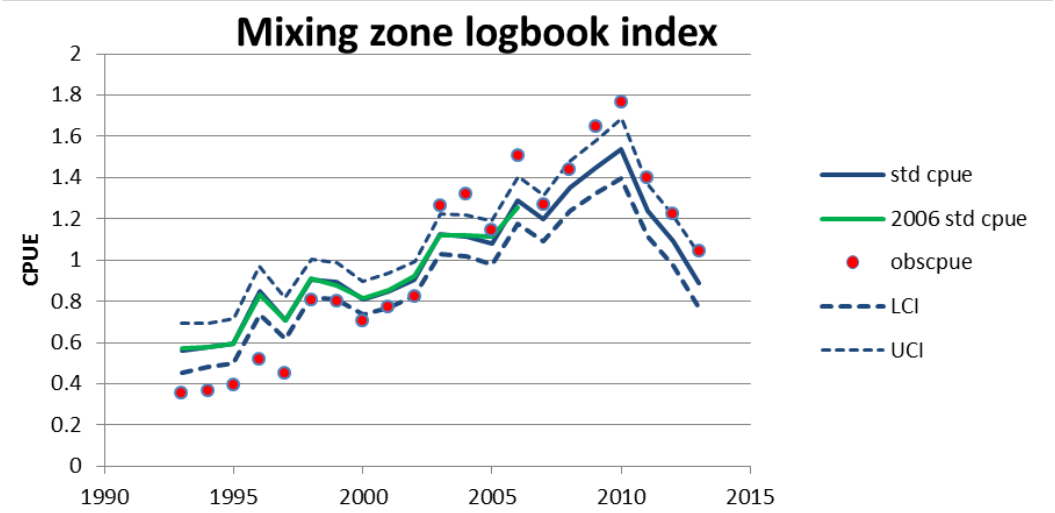


Figure 15. Index 3, king mackerel (1993-2013) nominal CPUE (solid circles), standardized CPUE (blue line) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing hook and line gear (handline, electric reel, and trolling) in the South Atlantic by calendar year.

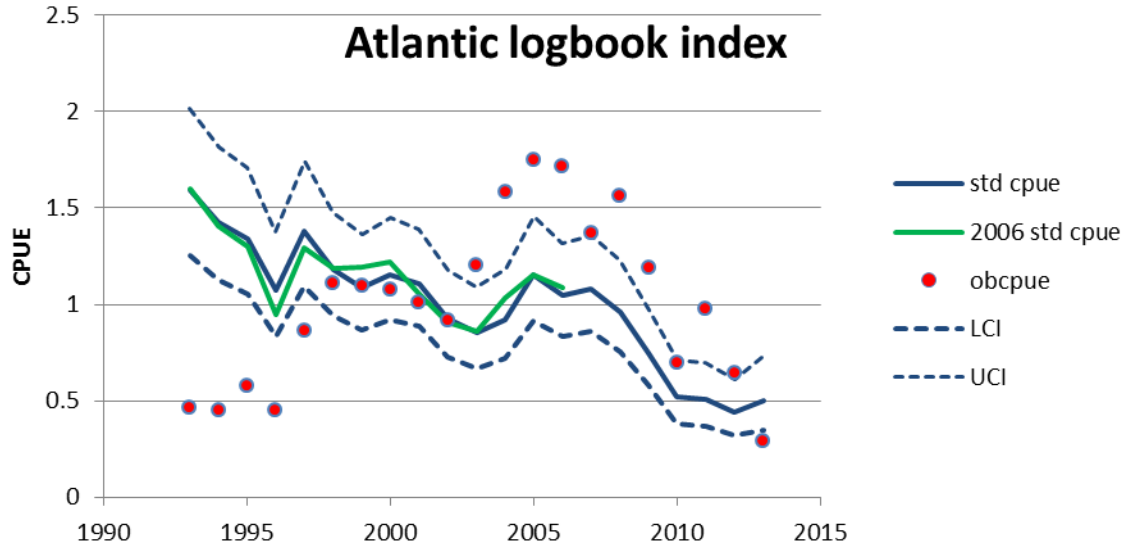


Figure 16. Index 4, king mackerel (1993-2013) nominal CPUE (solid circles), standardized CPUE (blue line) andupper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishinghook and line gear (handline, electric reel, and trolling) in the Gulf of Mexico by fishing year. The year of the index plotted below represents the first year of the two years in a fishing year, i.e. the value for 1993 represents the 1993-1994 fishing year.

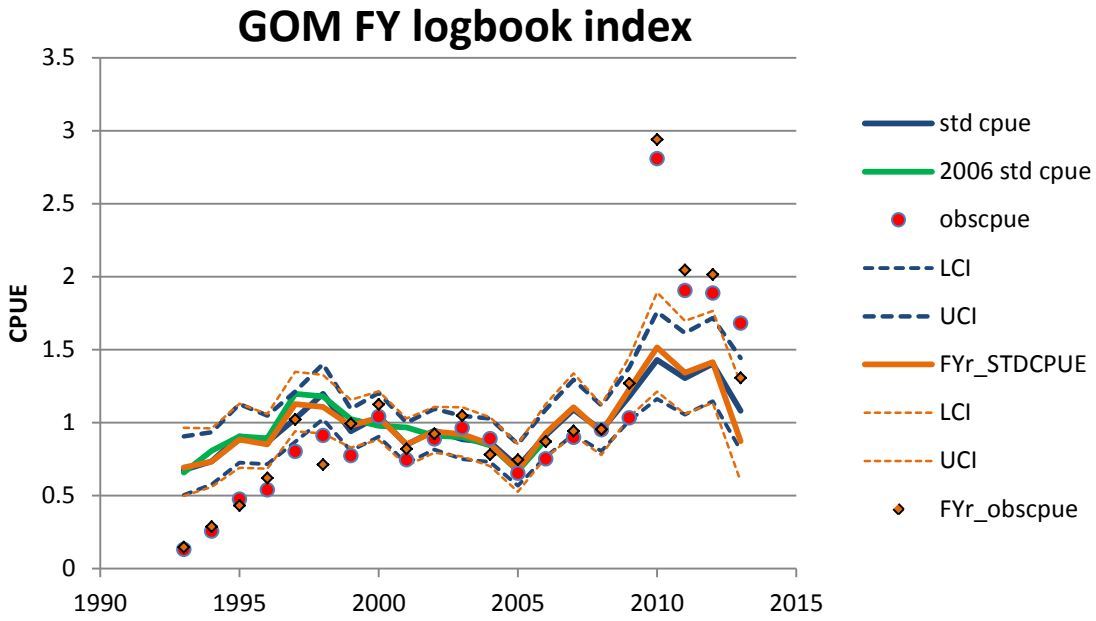


Figure 17. Index 5, king mackerel (1993-2013) nominal CPUE (solid circles), standardized CPUE (blue line) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishinghook and line gear (handline, electric reel, and trolling) in the South Atlantic and summer mixing zone CPUE index by calendar year and fishing year. The year of the index plotted below represents the first year of the two years in a fishing year, i.e. the value for 1993 represents the 1993-1994 fishing year.

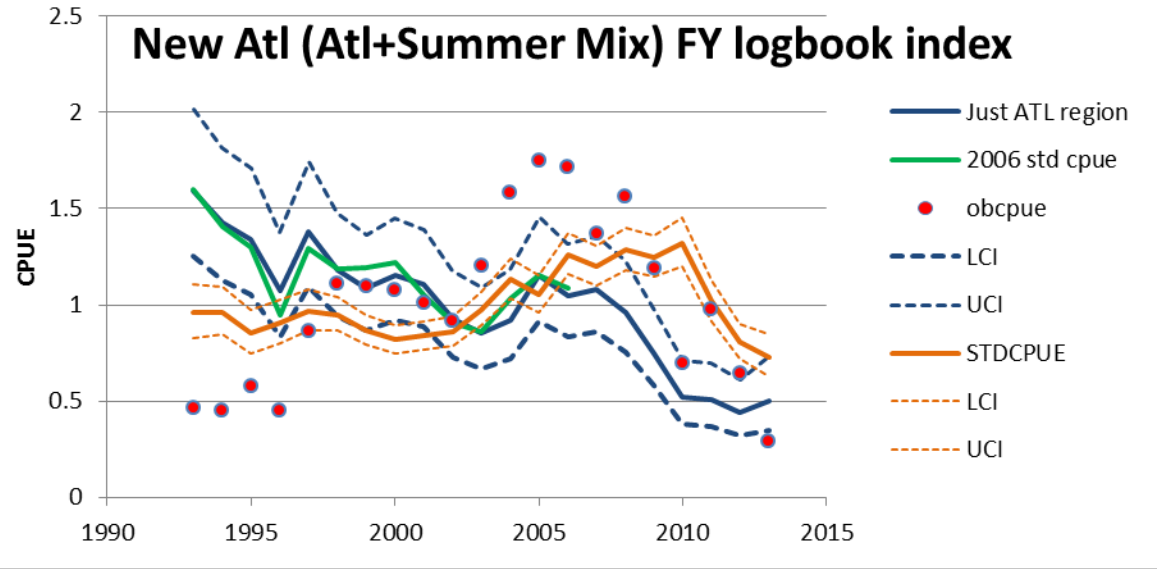


Figure 18. Nominal and estimated percentage positive and cpue for the five indices showing where divergence from the nominal values occurs.

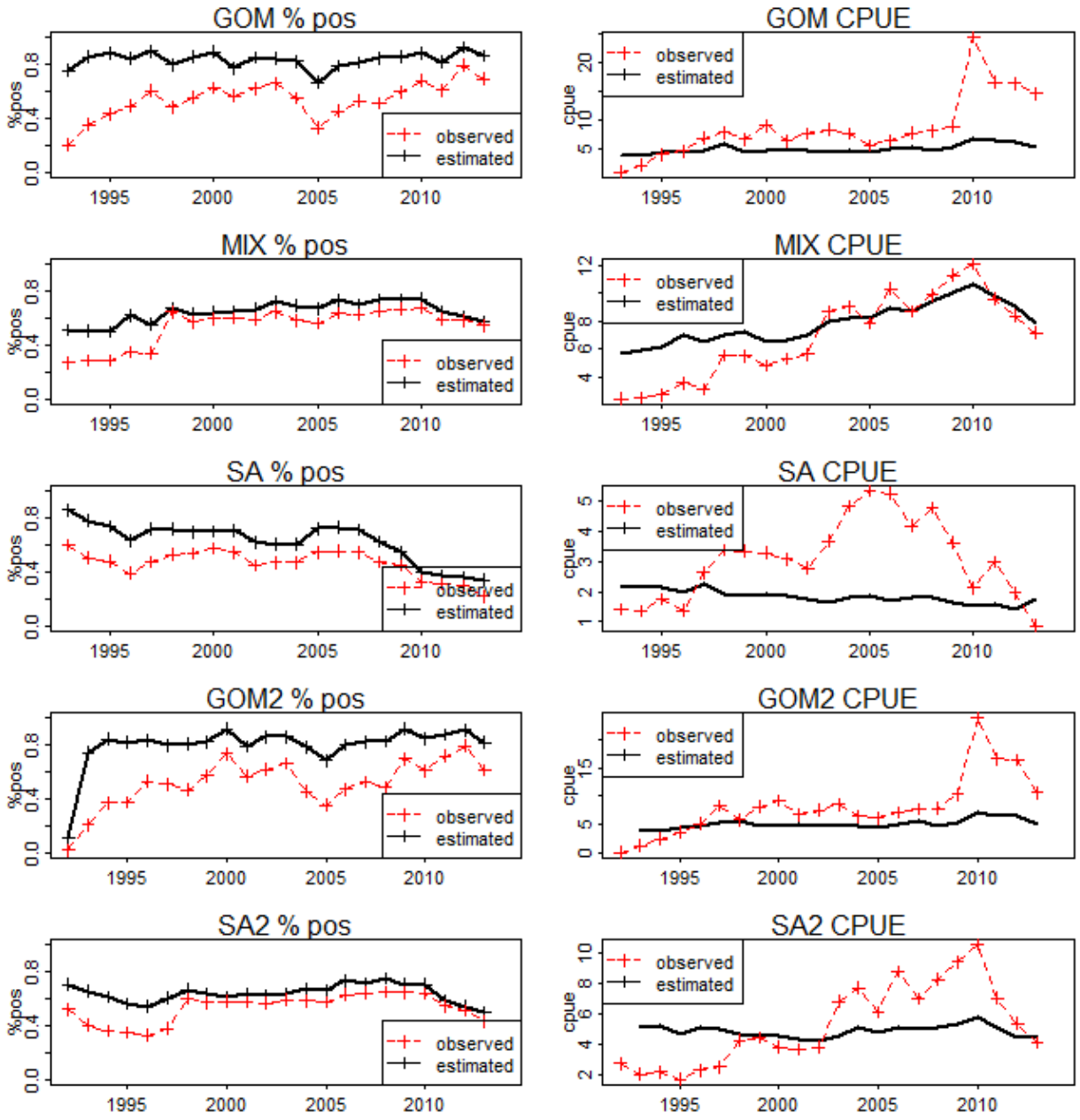


Figure 19. Explanation of the effect of the standardization by targeting level and gear for Index 1 (GOM).