MRFSS Index for Atlantic Spanish mackerel and cobia

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1 Introduction

The MRFSS access-point angler intercept survey is conducted at public marine fishing access points to collect data on the individual catch of fishers, including species identification, total number and disposition of each species, and length and weight measurements of retained fish, as well as information about the fishing trip and the angler's fishing behavior. For more information on the methodology and variables collected, see the MRFSS Data User's Manual (available at http://www.st.nmfs.noaa.gov/st1/recreational/pubs/data_users/index.html).

In the Atlantic, a total of 30,745 interviews were conducted from 1982 – 2010 that caught or targeted Spanish mackerel. A total of 5,942 trips were intercepted from Volusia county north that caught or targeted cobia from 1982 – 2010.

The recreational fisheries target adult fish of both species. The median fork length for Spanish mackerel was 38 cm, with individuals ranging from 15 to 178 cm (**Error! Reference source not found.**). The median fork length for cobia was 98 cm, with individuals ranging from 11 to 197 cm (**Error! Reference source not found.**).

2 Methods

Data from 1982 – 2010 were used. Wave 1 was not sampled in 1981, and wave 6 data for 2011 were not yet available.

The unit of effort used was directed angler-trip. The MRFSS intercept database was subset to trips that either targeted or caught (regardless of disposition) the species of interest. Each set of grouped anglers in the intercept database was assumed to represent a single vessel-trip; anglers with no follower records were also assumed to represent a single vessel-trip. Total available catch (Type A catch) was divided by the number of anglers that contributed to that catch to obtain Type A catch-per-angler-trip. The number of unavailable fish (Type B1 + B2 catch) was summed over all Type B records in the group trip set and divided by the number of unavailable catch records for that group trip to obtain Type B catch-per-angler-trip. The Type A and Type B catch per angler-trip estimates were added together to get total catch per angler-trip.

The MRFSS intercept survey only counts anglers who contribute to the total catch, thus estimates of total catch per angler-trip may be biased high in cases where anglers in the group fished but did not catch anything. In addition, the directed trips designation may not adequately identify zero trips. Anglers targeting other species or who do not report a target species may still have taken a trip that could have caught the species of interest, and that zero trip would not be been included in the directed trips subset.

For Spanish mackerel, Atlantic observations were defined as Miami-Dade County north; intercepts from the Florida Keys were assigned to the Gulf. The Spanish mackerel index reflects private/rental boats only, as it was the dominant mode and sample sizes in the other modes were inconsistent. For cobia, Atlantic observations were defined as Flagler County, FL north through New York. The cobia index includes the private/rental boat mode and the shore mode, as they were the dominant mode and sample sizes were low in the other modes. However, the charter and headboat modes had a higher proportion positive than the shore and private/rental modes.

In addition, for both species, the sampling methodology for the party/charter and headboat modes was not consistent over time or between regions, and may include data that are being considered in the headboat logbook index.

This reduced the sample size from 30,745 directed trips to 17,762 directed trips for Spanish mackerel, of which 59.6% caught Spanish mackerel. Sample size for cobia was reduced from 5,942 directed trips to 5,442 directed trips, of which 22.0% caught cobia. For Spanish mackerel, bag limits were established in 1987 and increased in 1992 and 2000. Since the CPUE measures both retained and discarded or released fish, the index should not be strongly affected by changes in regulations.

A delta-lognormal approach (Lo *et al.,* 1992) was used to standardize each index. A forward selection method was used to select the factors based on reductions in deviance for each component of the model. Factors considered included region, area fished, wave, and, for cobia, mode. A factor was included in the model if it reduced the deviance by 5% or more.

3 Results

For Spanish mackerel, year, area fished, and wave provided the greatest reductions in deviance for both the positive trips model and the proportion positive model (**Error! Reference source not found.**, **Error! Reference source not found.**). For cobia, year, area fished, and region provided the greatest reduction in deviance for the positive trips model, and all factors reduced the deviance by at least 5% for the proportion positive model, although region and wave reduced it less than the other factors (**Error! Reference source not found.**, **Error! Reference source not found.**).

For both species, both the nominal and standardized indices were flat, varying without trend (Figure 5, Figure 6). The standardized cobia index had a higher degree of uncertainty around the estimates.

The cobia positive trip data did not follow a log-normal distribution well, and there was some undesirable patterning in the residuals (Figure 10). Spanish mackerel positive intercepts also deviated slightly from the lognormal distribution, but the effects were not as severe (Figure 7).

4 Conclusions

Given the difficulty of selecting an appropriate subset of trips and interpreting the catch per trip from the MRFSS dataset, which was not designed to produce a CPUE index, as well as the deviations from a lognormal distribution in the cobia data, caution should be used when interpreting and applying these indices.

5 Literature Cited

Lo, N.C., L.D. Jacobson, and J. L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Canadian Journal of Fisheries and Aquatic Sciences 49: 2515-2526.

Table 1: Deviance table for Atlantic Spanish mackerel positive trips model.

	D.F.	Deviance	Resid. D.F.	Resid. Dev.	Pr(>Chi)	Percent Deviance Explained
NULL	.	.	10583	11057.6	.	.
YEAR	28	140.06	10555	10917.6	0.000	16.4
AREA_F	2	563.77	10553	10353.8	0.000	66.1
WAVE	5	147.95	10548	10205.9	0.000	17.4
REGION	2	0.59	10546	10205.3	0.736	0.1

Table 2: Deviance table for Atlantic Spanish mackerel proportion positive model.

	D.F.	Deviance	Resid. D.F.	Resid. Dev.	Pr(>Chi)	Percent Deviance Explained
NULL	.	.	17761	23966.2	.	.
YEAR	28	276.00	17733	23690.2	0.000	53.0
AREA_F	2	63.93	17731	23626.2	0.000	12.3
WAVE	5	169.01	17726	23457.2	0.000	32.4
REGION	2	12.30	17724	23444.9	0.002	2.4

Table 3: Convergence statistics for Atlantic Spanish mackerel positive trips model.

Final model	lnCPUE ~ Year + Area fished + Wave
Dispersion parameter	0.96
Null deviance	11058 on 10583 degrees of freedom
Residual deviance	10206 on 10548 degrees of freedom
AIC	29725

Table 4: Convergence statistics for Atlantic Spanish mackerel proportion positive trips model.

Final model	Success ~ Year + Area Fished + Wave
Dispersion parameter	1.32
Null deviance	23966 on 17761 degrees of freedom
Residual deviance	23457 on 17726 degrees of freedom
AIC	23529

Table 5: Deviance table for Atlantic cobia positive trips model

	D.F.	Deviance	Resid. D.F.	Resid. Dev.	Pr(>Chi)	Percent Deviance Explained
NULL	.	.	1198	301.0	.	.
YEAR	28	16.16	1170	284.8	0.000	48.0
AREA_F	2	8.49	1168	276.3	0.000	25.2
WAVE	5	3.90	1163	272.4	0.005	11.6
REGION	1	5.05	1162	267.4	0.000	15.0
MODE	1	0.07	1161	267.3	0.582	0.2

Table 6: Deviance table for Atlantic cobia proportion positive trips model.

	D.F.	Deviance	Resid. D.F.	Resid. Dev.	Pr(>Chi)	Percent Deviance Explained
NULL	.	.	5441	5739.3	.	.
YEAR	28	86.86	5413	5652.5	0.000	17.0
AREA_F	2	156.07	5411	5496.4	0.000	30.5
WAVE	5	201.72	5406	5294.7	0.000	39.4
REGION	1	31.82	5405	5262.8	0.000	6.2
MODE	1	35.03	5404	5227.8	0.000	6.8

Table 7: Convergence statistics for Atlantic cobia positive trips model.

Final model	**lnCPUE ~ Year + Wave + Region + Area fished**
Dispersion parameter	0.23
Null deviance	300.97 on 1198 degrees of freedom
Residual deviance	67.36 on 1162 degrees of freedom
AIC	1679.3

Table 8: Convergence statistics for cobia proportion positive trips model.

Final model	**Success ~ Year + Area Fished + Region + Wave + Mode**
Dispersion parameter	0.97
Null deviance	5739.3 on 5441 degrees of freedom
Residual deviance	5227.8 on 5404 degrees of freedom
AIC	5303.8

Table 9: Standardized index for Atlantic Spanish mackerel.

Year	Index	Standard Error	Sample Size
1982	1.678	0.503	93
1983	0.818	0.209	34
1984	2.547	0.436	41
1985	2.780	0.327	65
1986	2.641	0.182	144
1987	1.984	0.147	599
1988	2.507	0.186	670
1989	1.928	0.129	721
1990	2.034	0.132	875
1991	1.924	0.131	995
1992	1.872	0.144	1022
1993	1.462	0.109	788
1994	2.091	0.174	943
1995	1.711	0.144	643
1996	2.003	0.157	625
1997	2.217	0.167	624
1998	2.046	0.145	546
1999	2.333	0.151	590
2000	2.353	0.152	797
2001	2.383	0.154	746
2002	2.561	0.163	757
2003	2.269	0.158	755
2004	2.029	0.151	606
2005	2.183	0.165	528
2006	1.751	0.125	508
2007	1.878	0.134	649
2008	2.908	0.193	670
2009	2.109	0.132	720
2010	1.986	0.342	1008

Table 10: Standardized index for Atlantic cobia

Year	Index	Standard Error	Sample Size
1982	0.123	0.162	44
1983	0.673	0.566	10
1984	0.269	0.263	47
1985	0.378	0.372	131
1986	0.248	0.272	129
1987	0.261	0.277	141
1988	0.281	0.292	118
1989	0.389	0.364	136
1990	0.292	0.295	200
1991	0.390	0.367	215
1992	0.291	0.289	229
1993	0.160	0.184	122
1994	0.156	0.184	341
1995	0.222	0.246	235
1996	0.218	0.247	255
1997	0.307	0.318	203
1998	0.302	0.303	158
1999	0.449	0.433	166
2000	0.283	0.287	138
2001	0.378	0.371	188
2002	0.285	0.296	232
2003	0.356	0.343	226
2004	0.364	0.362	189
2005	0.356	0.349	198
2006	0.365	0.348	166
2007	0.254	0.267	262
2008	0.260	0.279	232
2009	0.356	0.346	272
2010	0.355	0.371	459

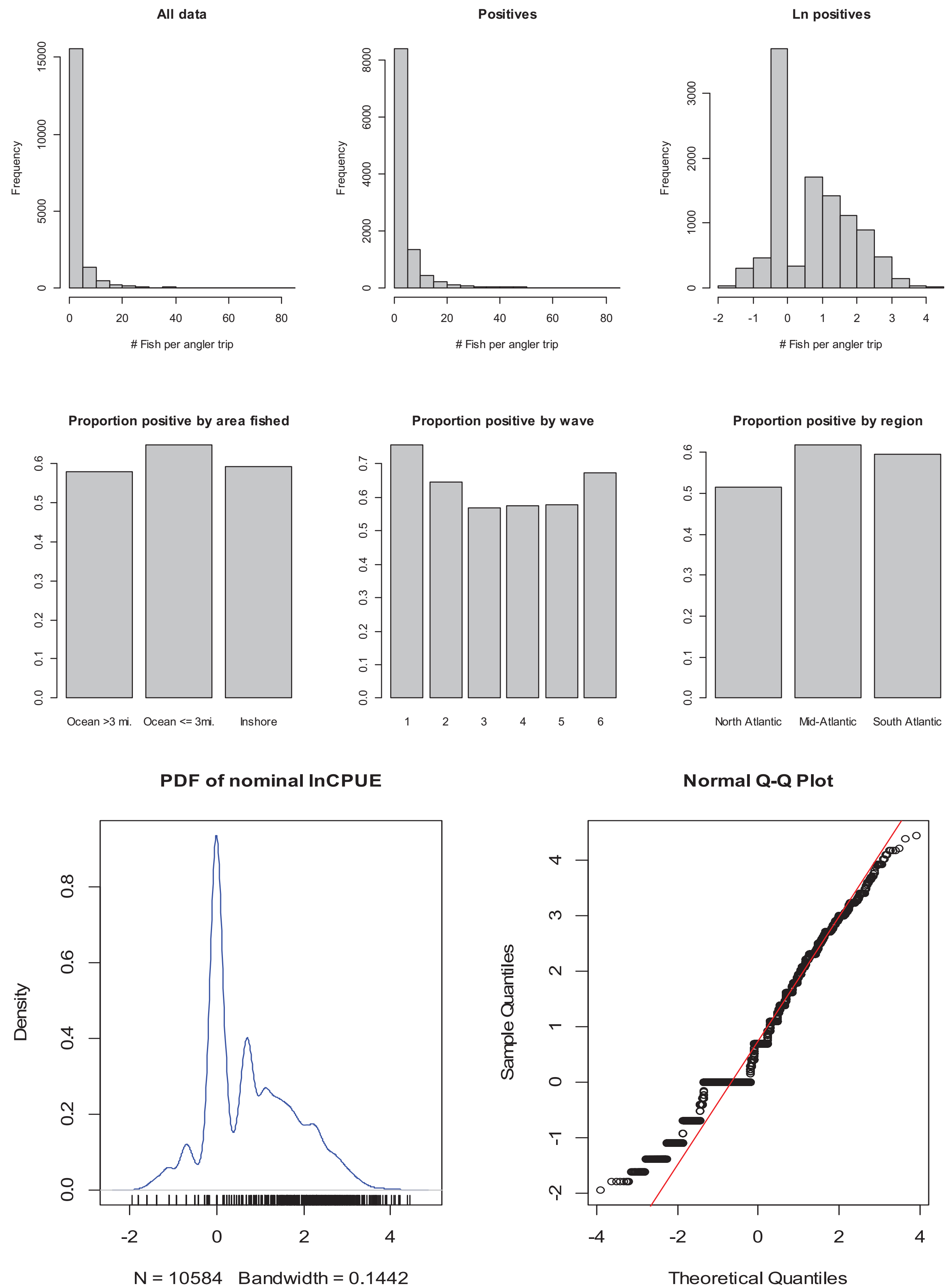

Figure 1: Summary plots for Atlantic Spanish mackerel intercept data.

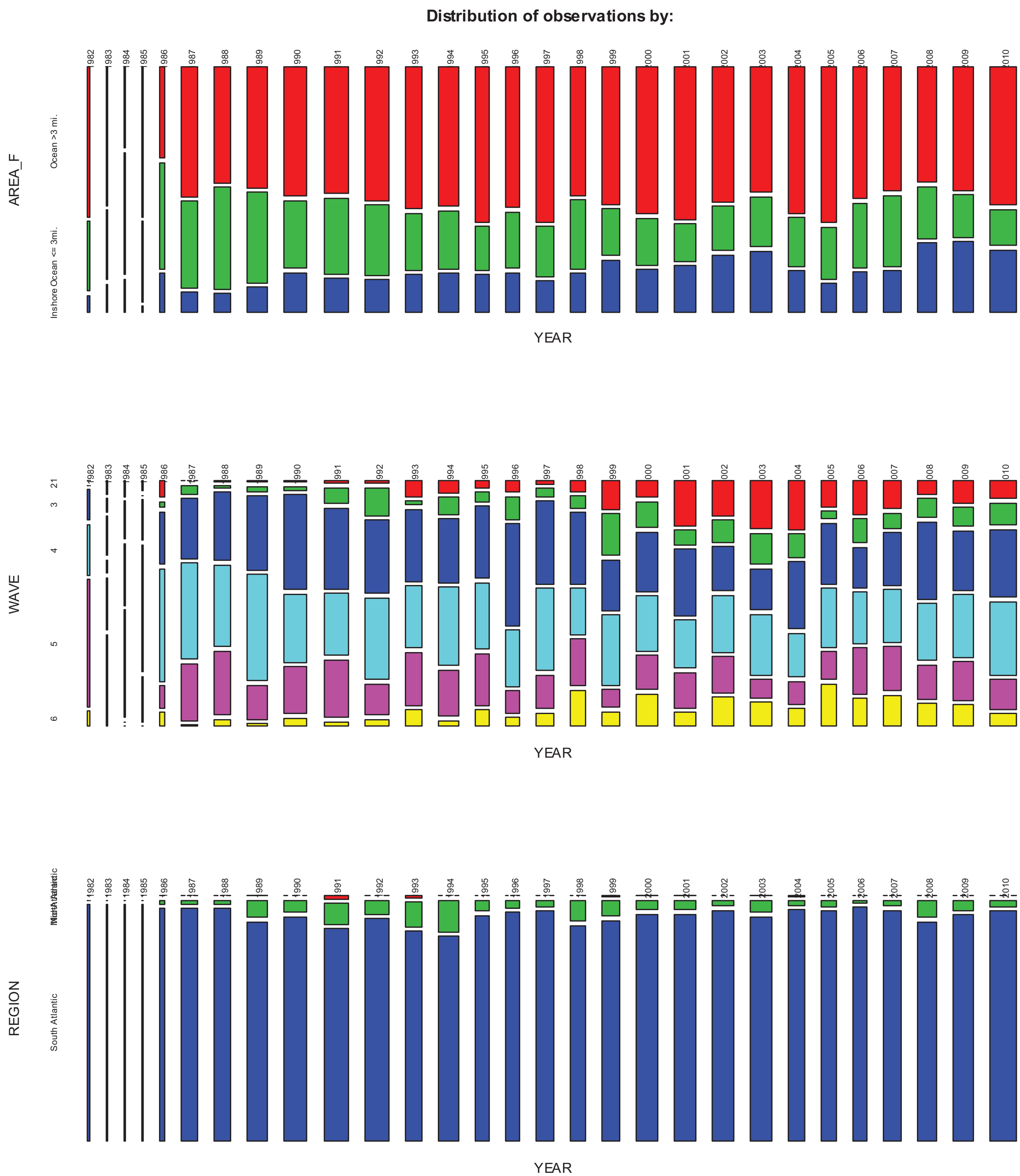

Figure 2: Distribution of positive observations for Atlantic Spanish mackerel by year and factor. Width of bars is proportional to sample size.

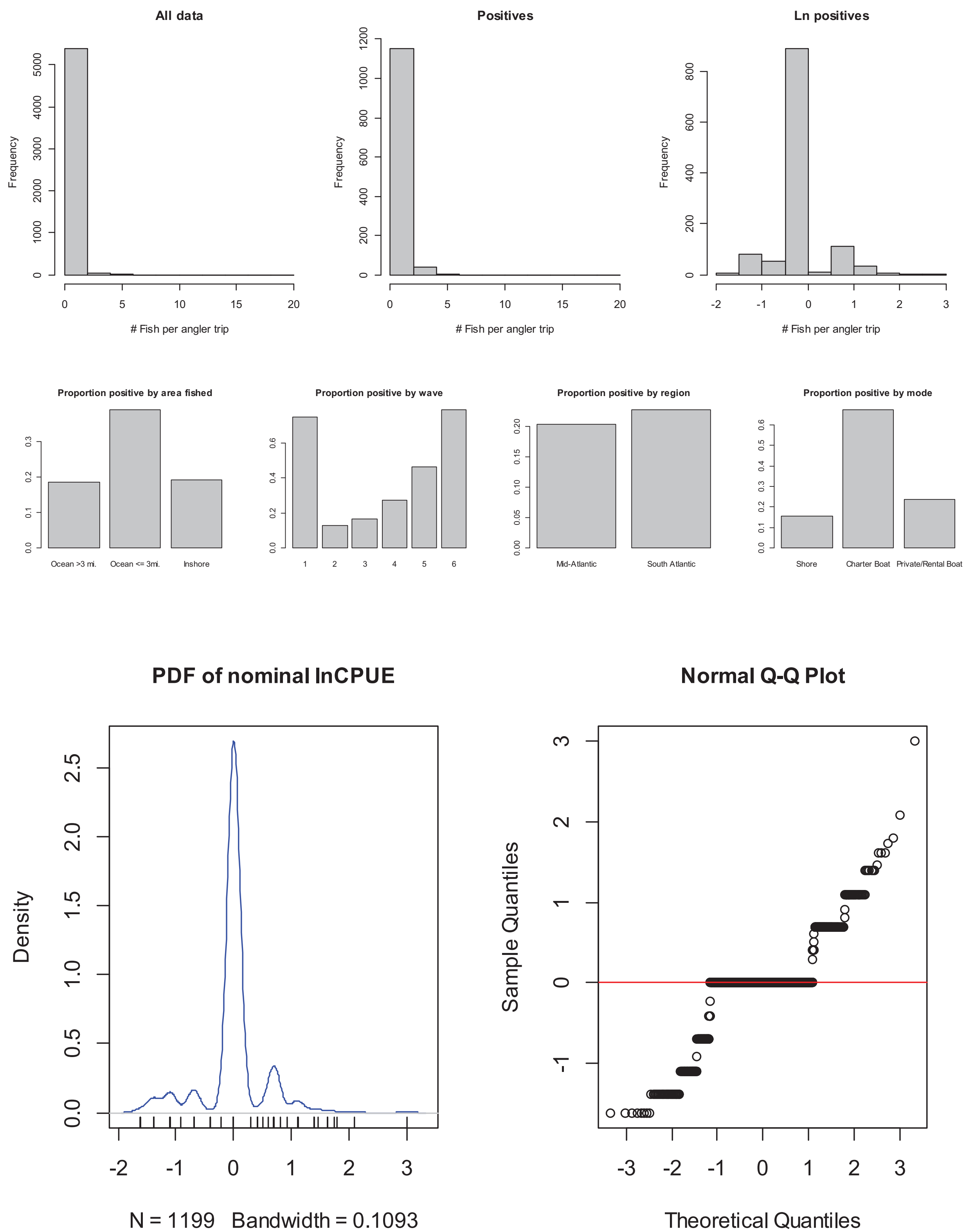

Figure 3: Summary plots of Atlantic cobia intercept data.

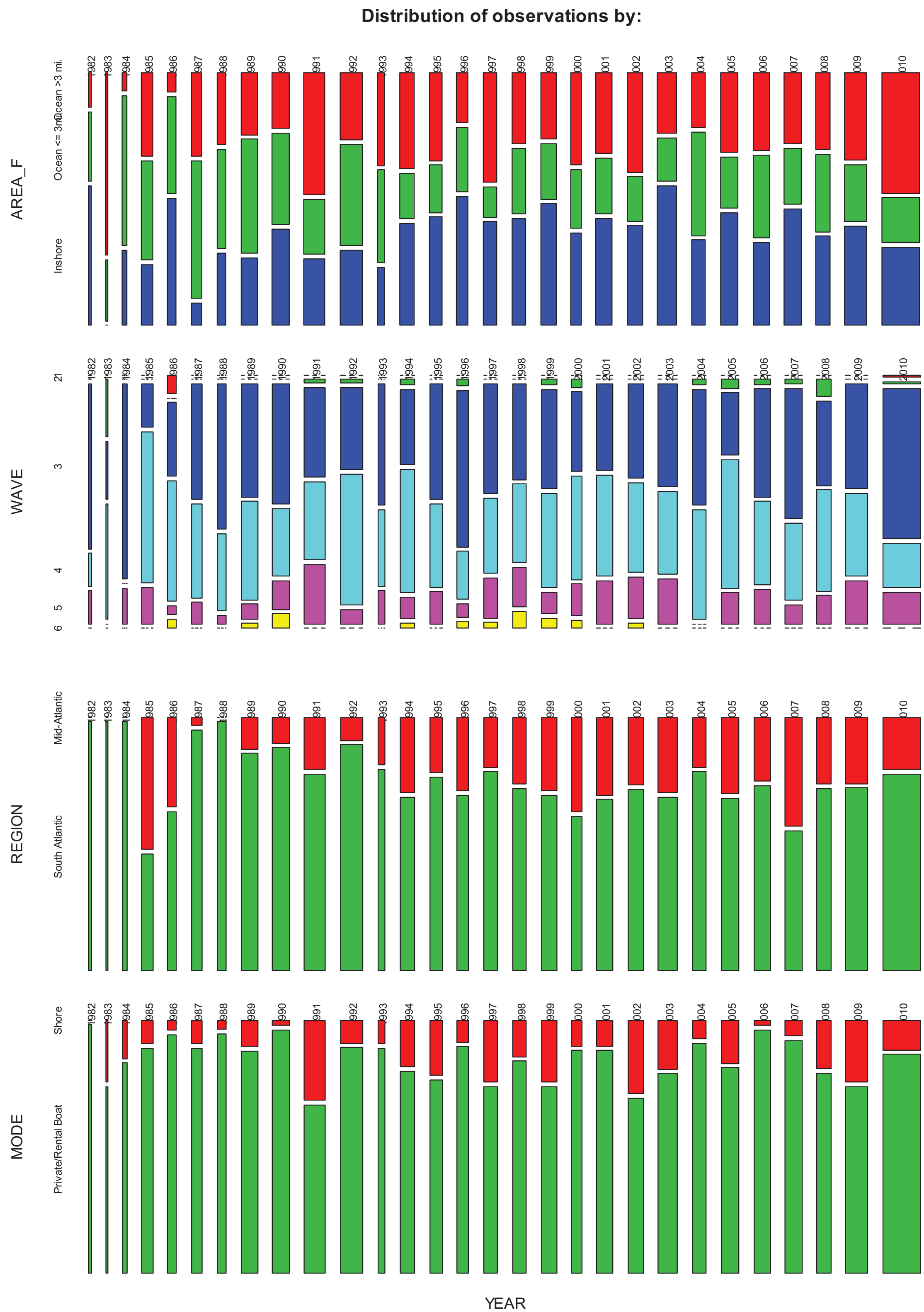

Figure 4: Distribution of positive observations by factor and year for Atlantic cobia. Width of bars is proportional to sample size in each year.

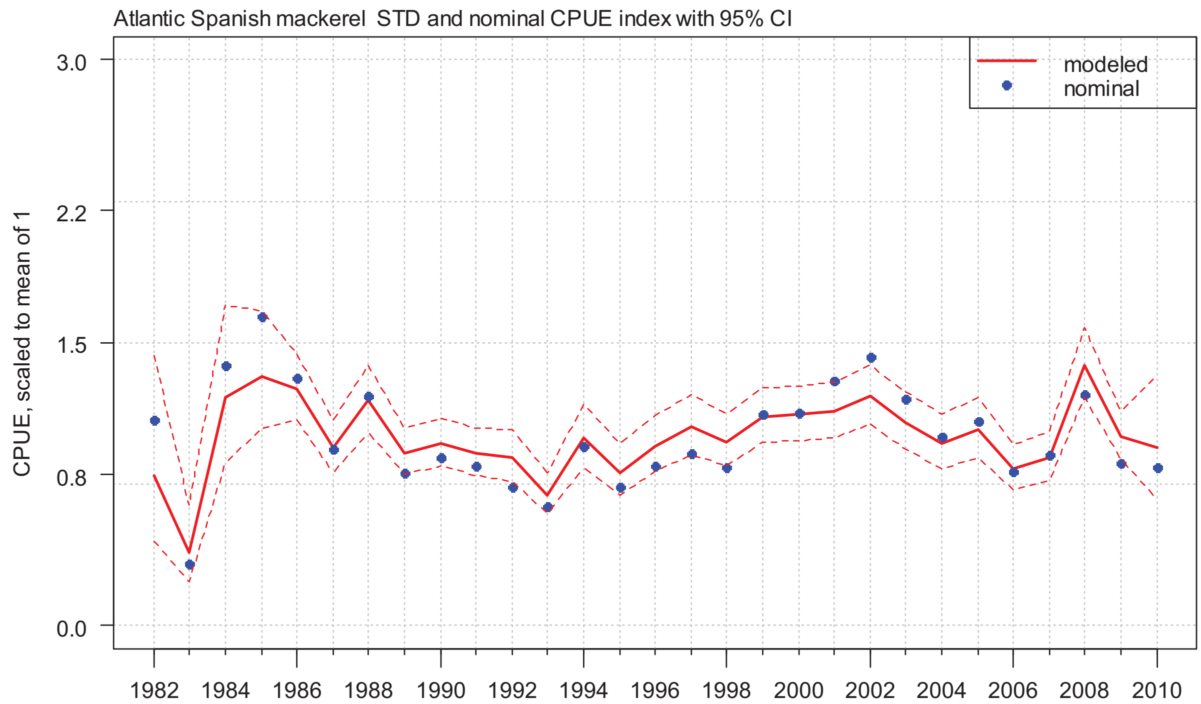

Figure 5: Nominal and standardized CPUE for Atlantic Spanish mackerel. Dashed lines represent 95% confidence intervals.

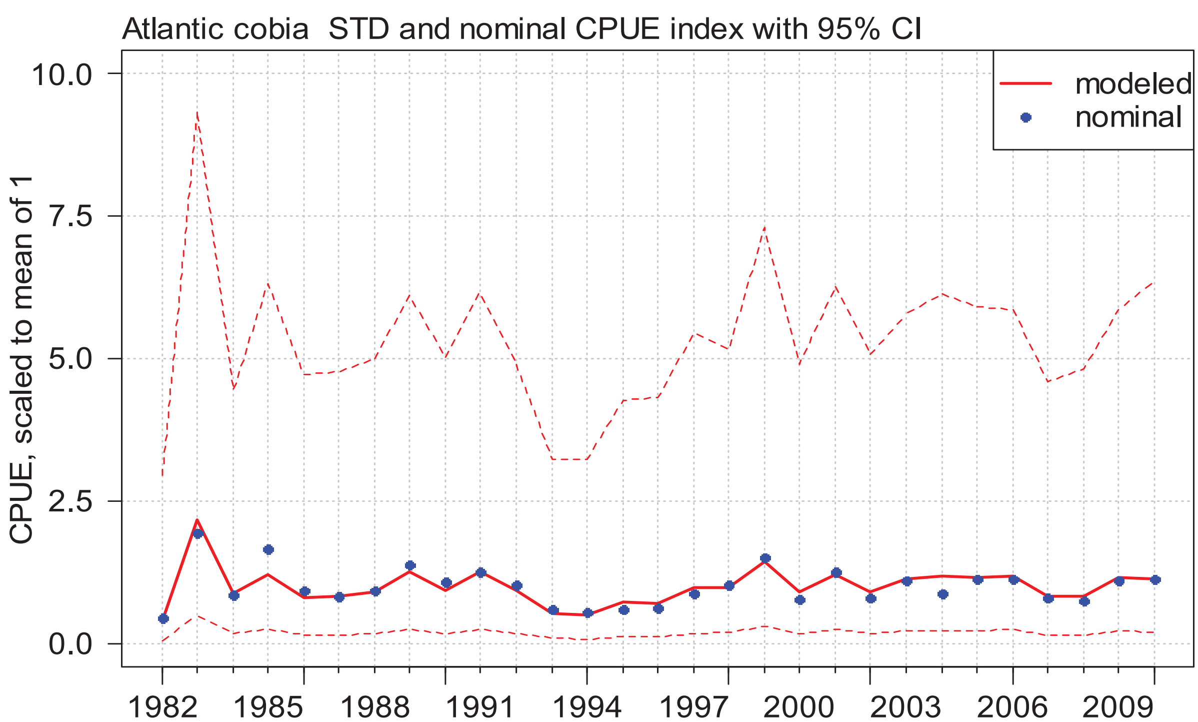

Figure 6: Nominal and standardized CPUE for Atlantic cobia. Dashed lines represent 95% confidence intervals.

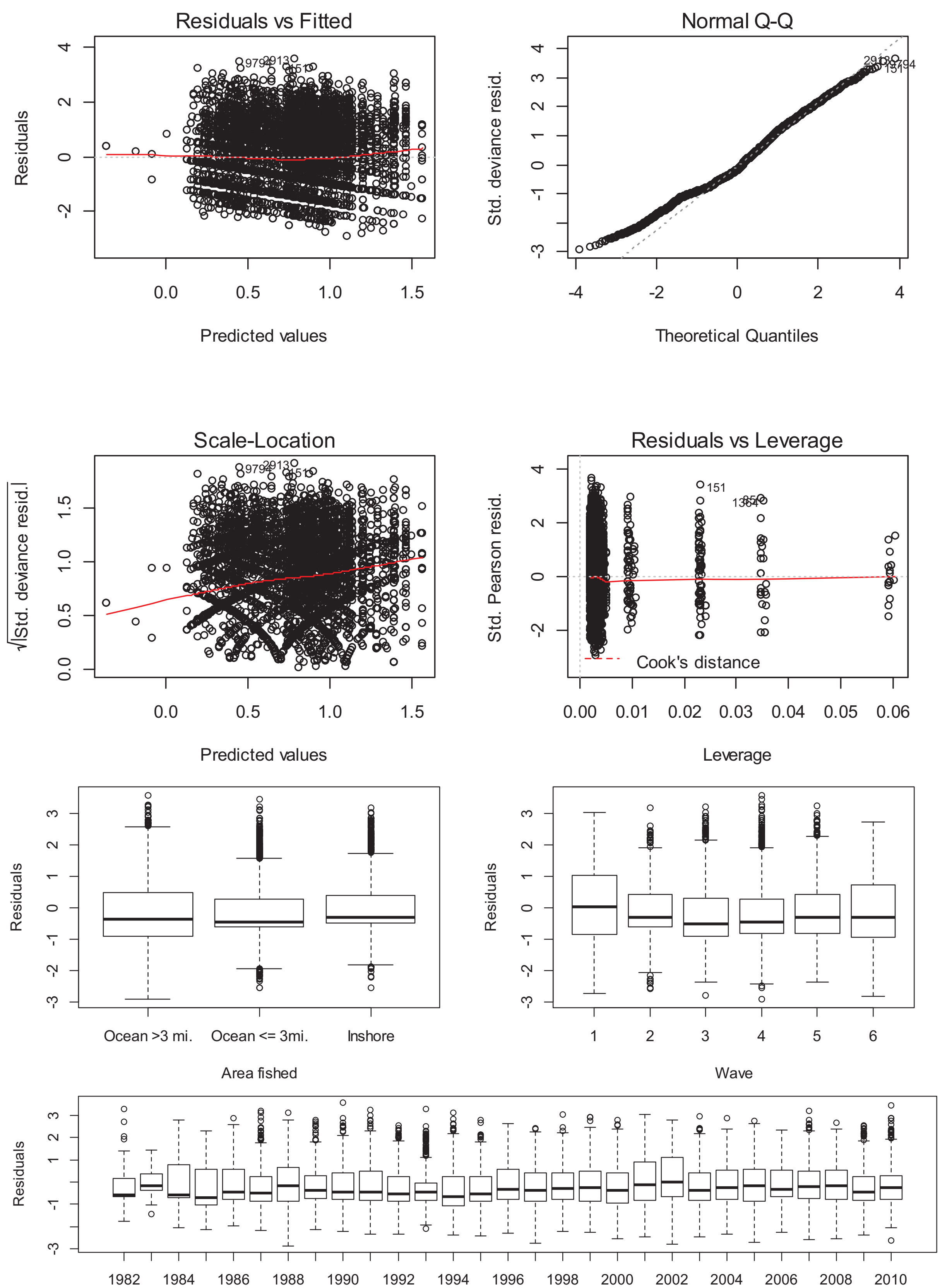

Figure 7: Residuals for postive trips model for Atlantic Spanish mackerel.

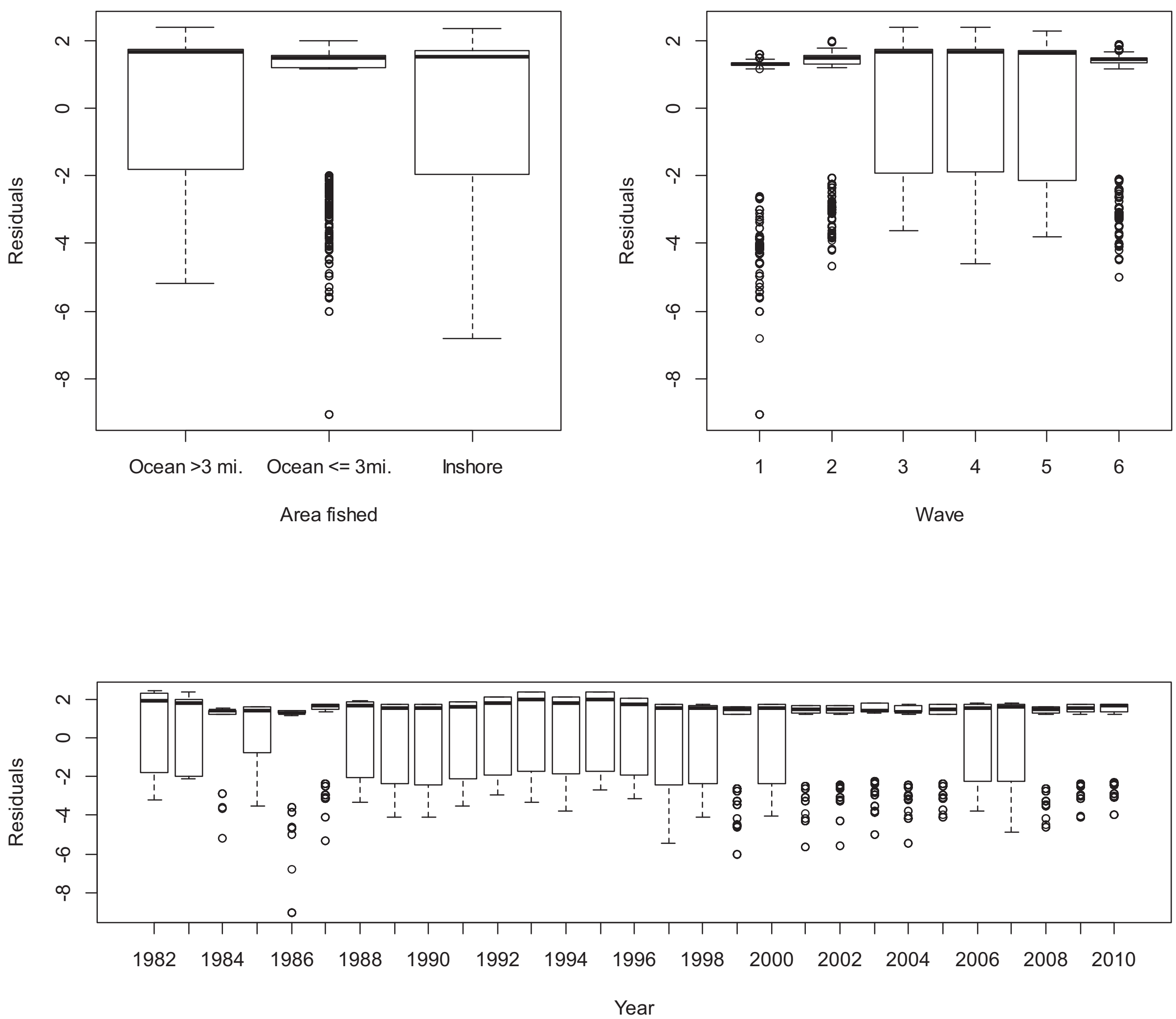

Figure 8: Residuals for proportion positive model by factor and year for Atlantic Spanish mackerel.

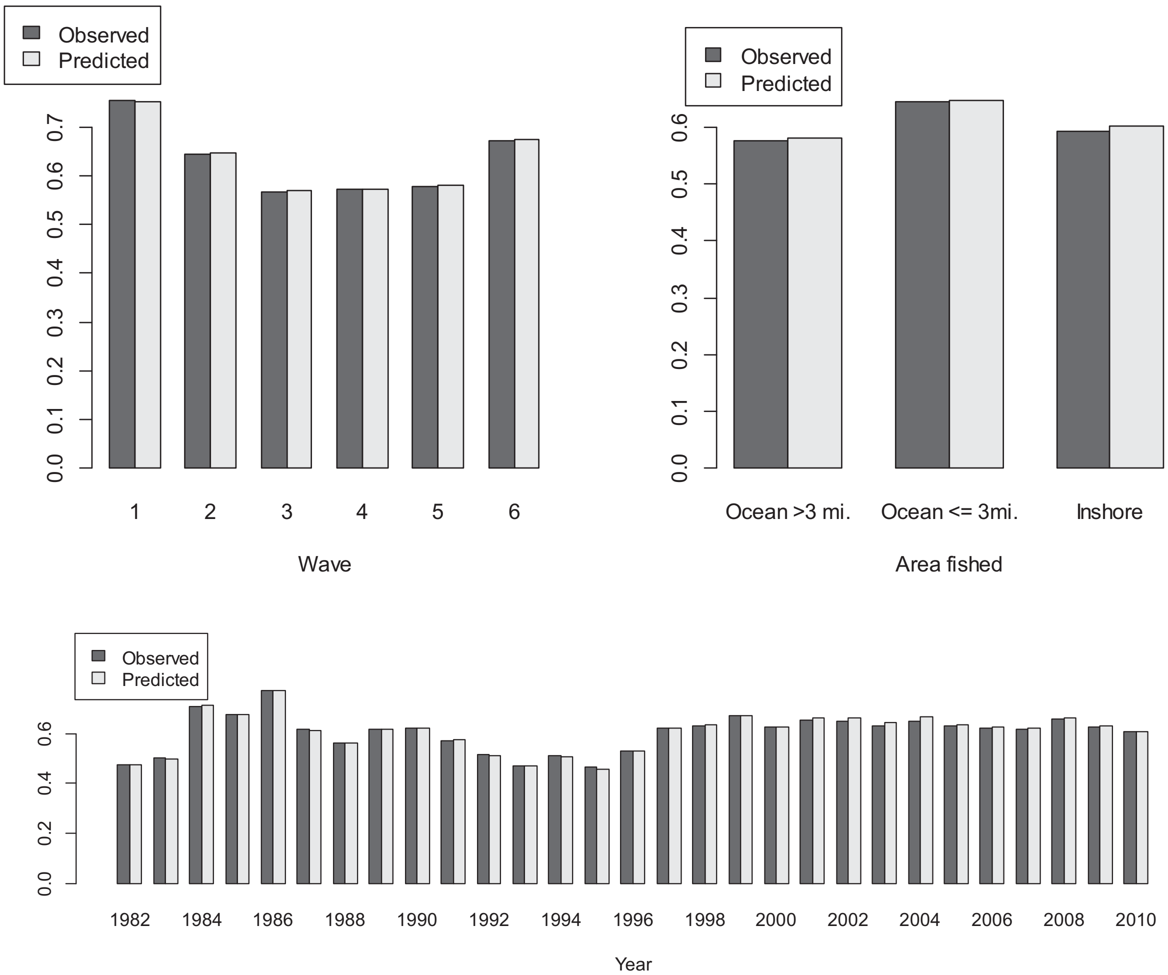

Figure 9: Observed and predicted proportion positive by factor and year for Atlantic Spanish mackerel.

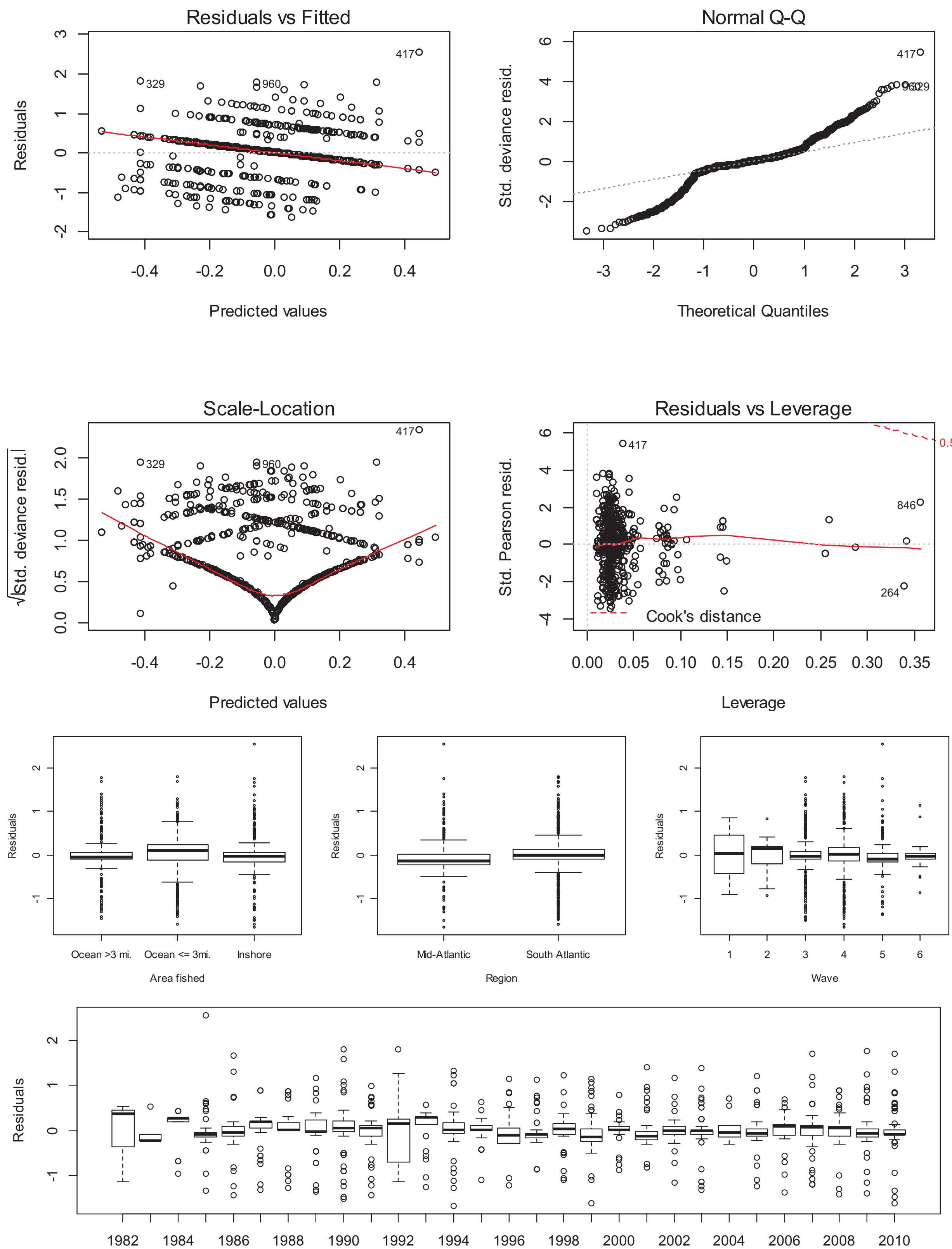

Figure 10: Residuals for positive trips model for Atlantic cobia.

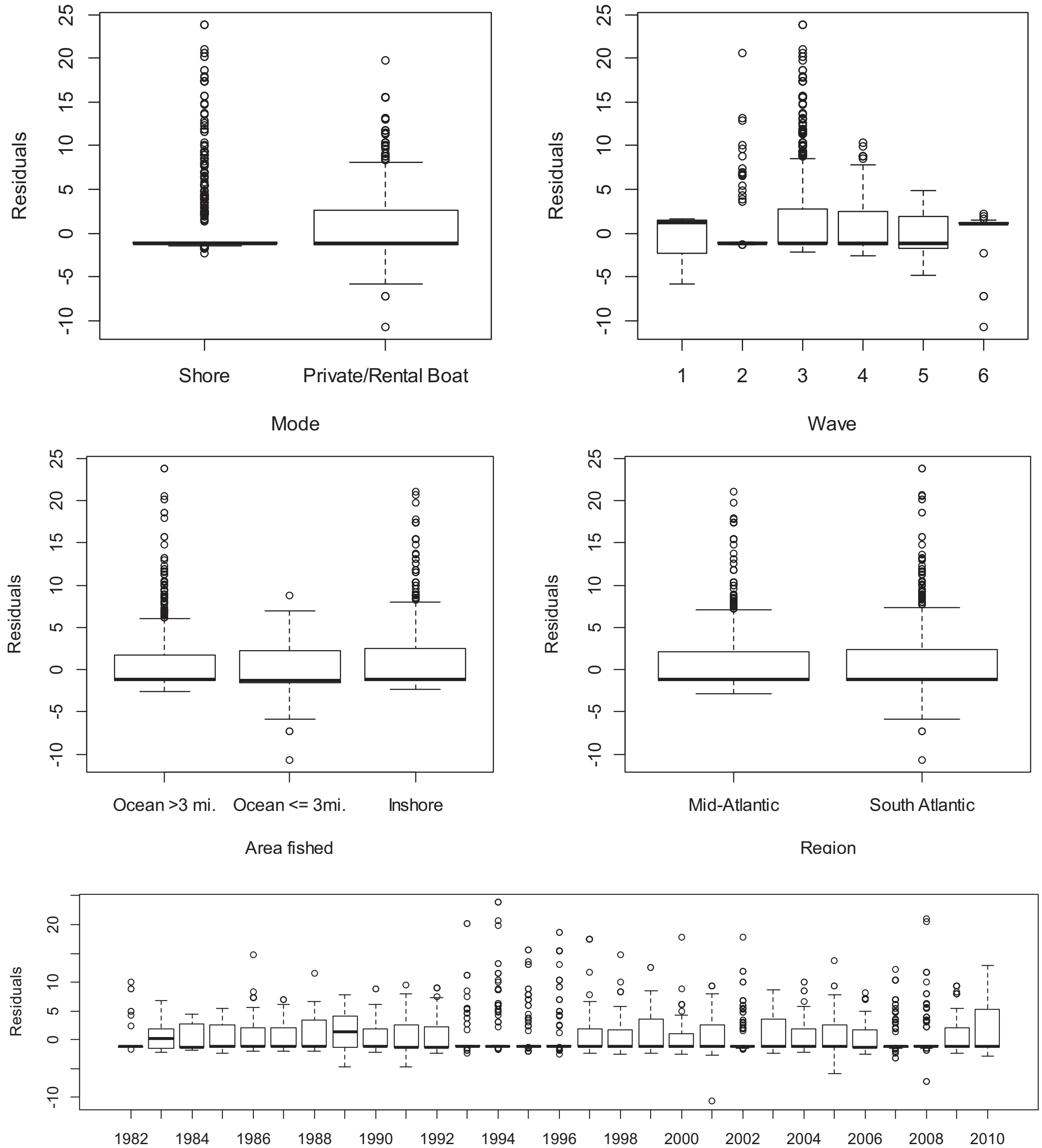

Figure 11: Residuals by year and factor for proportion positive model for Atlantic cobia.

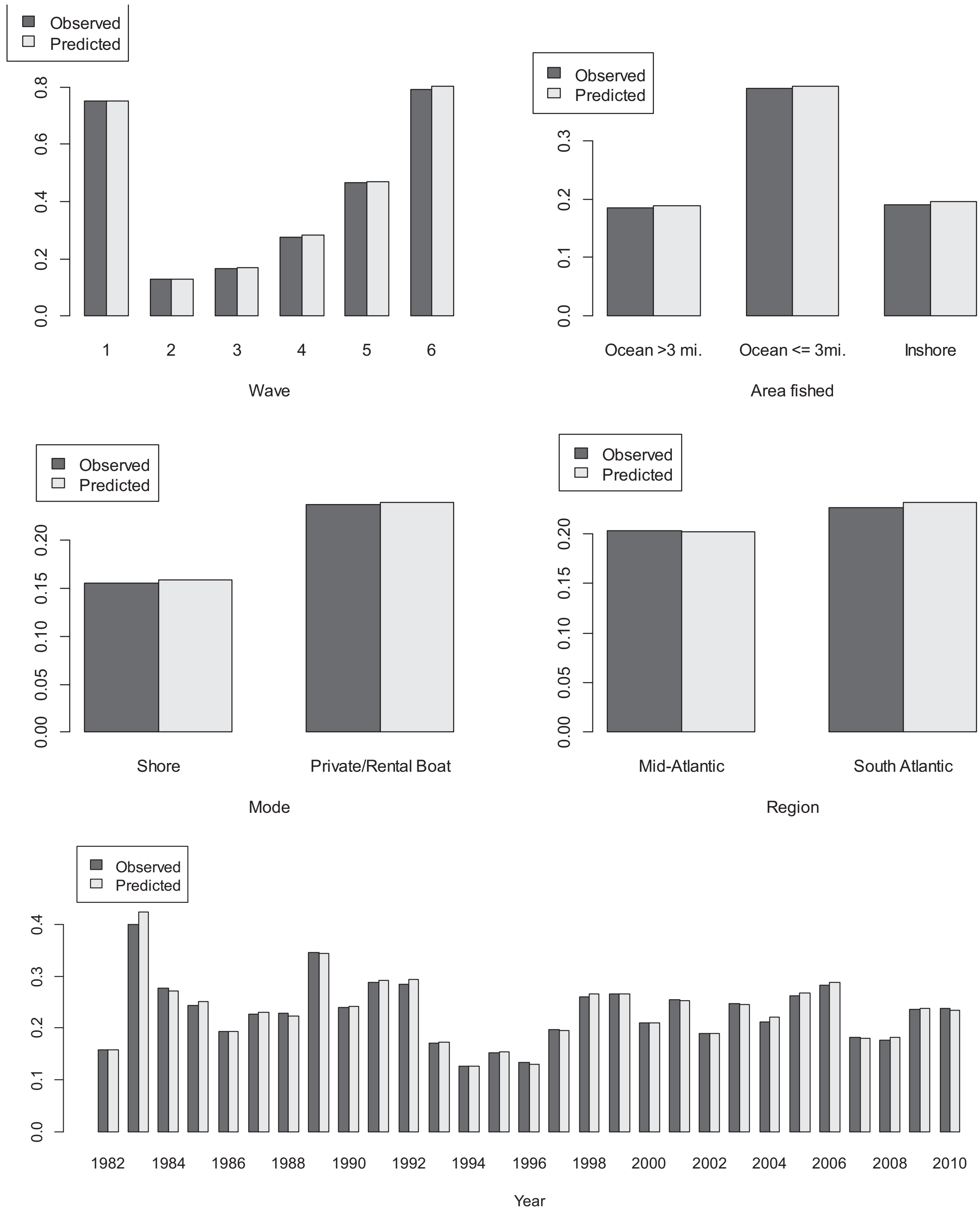

Figure 12: Observed and predicted proportion positive by factor and year for Atlantic cobia.

Evaluation of Abundance Indices of list species:
List data set (SEDAR28-DW-##)

DESCRIPTION OF THE DATA SOURCE

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
1. Fishery Independent Indices					
A. Describe the survey design (e.g. fixed sampling sites, random stratified sampling), location, seasons/months and years of sampling.					
B. Describe sampling methodology (e.g. gear, vessel, soak time etc.)					
C. Describe any changes in sampling methodology (e.g. gear, vessel, sample design etc.)					
D. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).					
E. What species or species assemblages are targeted by this survey (e.g. red snapper, reef fish, pelagic).					
F. Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.					
2. Fishery Dependent Indices					
A. Describe the data source and type of fishery (e.g. commercial handline, commercial longline, recreational hook and line etc.).				✓	
B. Describe any changes to reporting requirements, variables reported, etc.	✓				
C. Describe the variables reported in the data set (e.g. location, time, temperature, catch, effort etc.).			✓		
D Describe the size/age range that the index applies to. Include supporting figures (e.g. size comp) if available.				✓	

METHODS

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
1. Data Reduction and Exclusions					
A. Describe any data exclusions (e.g. gears, fishing modes, sampling areas etc.). Report the number of records removed and justify removal.				✓	
B. Describe data reduction techniques (if any) used to address targeting (e.g. Stephens and MacCall, 2004; gear configuration, species assemblage etc).				✓	
C. Discuss procedures used to identify outliers. How many were identified? Were they excluded?		✓			

Working Group Comments:

2. Management Regulations (for FD Indices)

	Not Applicable	Absent	Incomplete	Complete
A. Provide (or cite) history of management regulations (e.g. bag limits, size limits, trip limits, closures etc.).			✓	
B. Describe the effects (if any) of management regulations on CPUE				✓
C. Discuss methods used (if any) to minimize the effects of management measures on the CPUE series.				✓

3. Describe Analysis Dataset (after exclusions and other treatments)

	Not Applicable	Absent	Incomplete	Complete
A. Provide tables and/or figures of number of observations by factors (including year, area, etc.) and interaction terms.		✓		
B. Include tables and/or figures of number of positive observations by factors and interaction terms.			✓	
C. Include tables and/or figures of the proportion positive observations by factors and interaction terms.				✓
D. Include tables and/or figures of average (unstandardized) CPUE by factors and interaction terms.		✓		
E. Include annual maps of locations of survey sites (or fishing trips) and associated catch rates ***OR*** supply the raw data needed to construct these maps (Observation, Year, Latitude, Longitude (or statistical grid, area), Catch, Effort).		✓		
F. Describe the effort variable and the units. If more than one effort variable is present in the dataset, justify selection.				✓
G. What are the units of catch (e.g. numbers or biomass, whole weight, gutted weight, kilograms, pounds).				✓

4. Model Standardization

	Not Applicable	Absent	Incomplete	Complete
A. Describe model structure (e.g. delta-lognormal)				✓
B. Describe construction of GLM components (e.g. forward selection from null etc.)				✓
C. Describe inclusion criteria for factors and interactions terms.				✓
D. Were YEAR*FACTOR interactions included in the model? If so, how (e.g. fixed effect, random effect)? Were random effects tested for significance using a likelihood ratio test?	✓			
E. Provide a table summarizing the construction of the GLM components.				✓
F. Summarize model statistics of the mixed model formulation(s) (e.g. log likelihood, AIC, BIC etc.)				✓
G. Report convergence statistics.				✓

MODEL DIAGNOSTICS

Comment: Other model structures are possible and acceptable. Please provide appropriate diagnostics to the CPUE indices working group.

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:
1. Binomial Component					
A. Include plots of the chi-square residuals by factor.				✓	
B. Include plots of predicted and observed proportion of positive trips by year and factor (e.g. year*area)				✓	
C. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).				✓	
2. Lognormal/Gamma Component					
A. Include histogram of log(CPUE) or a histogram of the residuals of the model on CPUE. Overlay the expected distribution.		✓			
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.				✓	
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.				✓	
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.				✓	
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.				✓	
F. Include plots of the residuals by factor				✓	
3. Poisson Component					
A. Report overdispersion parameter and other fit statistics (e.g. chi-square / degrees of freedom).					
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor.					
C. Include QQ-plot – (e.g. Student deviance residuals vs. theoretical quantiles), Overlay expected distribution.					
D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.					
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.					***The feasibility of this diagnostic is still under review.***
4. Zero-inflated model					
A. Include ROC curve to quantify goodness of fit.					
B. Include plots describing error distribution (e.g. Studentized residuals vs. linear predictor).					
C. Include QQ-plot (e.g. Student dev. residuals vs. theoretical quantiles), Overlay expected distribution.					

MODEL DIAGNOSTICS (CONT.)

	Not Applicable	Absent	Incomplete	Complete	Working Group Comments:

D. Include diagnostic plot for variance function (e.g. square root of std residuals vs. fitted values). Overlay expected distribution.				
E. Include diagnostic plot for link function (e.g. linear response variable vs. linear predictor). Overlay expected distribution.				

MODEL RESULTS

A. Tables of Nominal CPUE, Standardized CPUE, Observations, Positive Observations, Proportion Positive Observations and Coefficients of Variation (CVs). Other statistics may also be appropriate to report			✓	
B. Figure of Nominal and Standardized Indices with measure of variance (i.e. CVs).				✓

IF MULTIPLE MODEL STRUCTURES WERE CONSIDERED:

(***Note: this is always recommended but required when model diagnostics are poor***.)

1. Plot of resulting indices and estimates of variance				
2. Table of model statistics (e.g. AIC criteria)				

	Date Received	*Workshop Recommendation*	*Revision Deadline ****	*Author and Rapporteur Signatures*
First Submission				
Revision				

*The revision deadline is negotiated by the author, the SEDAR coordinator and the CPUE rapporteur. The author **DOES NOT** commit to any **LEGAL OBLIGATION** by agreeing to submit a manuscript before this deadline. The maximum penalty for failure to submit a revised document prior to the submission deadline is rejection of the CPUE series.*

Justification of Working Group Recommendation
