Preliminary standardized catch rates of Southeast US Atlantic cobia (*Rachycentron canadum*) from headboat data

NMFS Beaufort

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Appendix 1 was updated to reflect discussions at the Data workshop. The index table and figure are now included in Appendix 1.

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Abstract
Standardized catch rates were generated from the Southeast headboat survey trip records (logbooks) for 1984-2010. The analysis included areas from central North Carolina through central Florida. The index is meant to describe population trends of fish in the size/age range of fish landed by headboat vessels. Data filtering and subsetting steps were applied to the data to model trips that were likely to have directed cobia effort.

Background

The headboat fishery in the south Atlantic includes for-hire vessels. The fishery uses hook and line gear, generally targets hard bottom reefs as the fishing grounds, and generally targets multiple species in the snapper-grouper complex. One of the key characteristics defining a headboat from other recreational fishing such as charter boats is the number of anglers. Prior to 2000 headboats were defined as vessels carrying 15 or more recreational anglers. This criteria changed to 7 or more passengers in 2000 in the Atlantic (Ken Brennan, pers. comm. Dec. 2011).

Headboats in the south Atlantic are sampled from North Carolina to the Florida Keys.
Data have been collected since 1972, but logbook reporting did not start until 1973. In addition, only North Carolina and South Carolina were included in the earlier years of the data set. In 1976, data were collected from North Carolina, South Carolina, Georgia, and northern Florida, and starting in 1978, data were collected from southern Florida (Areas 1-17, Figure 1).

Variables reported in the data set include year, month, day, area, location, trip type, number of anglers, species, catch, and vessel id. Biological data and discard data were recorded for some trips in some years.

Until 1984, there was no category for cobia on the catch record form for all south Altantic states. Captains had to write in species in blanks provided on the form. The switch to new forms is not consistent across vessels. Some vessels used old forms until they depleted the supply of forms.

A 33" mimimum size limit for cobia has been in place since 1983. A bag limit of 2 cobia/person/day has been in place since 1990 in federal waters. Florida has a bag limit of 1 cobia/person/day and is the only state in the south Atlantic U.S that differs from the federal bag limit.

Exploratory Data Analysis

Headboat records were examined to determine if sufficient data exists to develop a standardized index of abundance for south Atlantic cobia.

Cobia represent a small fraction of the overall catch in the south Atlantic headboat fishery (~1%). Data filtering steps were applied to the data to identify trips that likely had directed cobia effort. Since 1984, an average 866 cobia were captured annually in the south Atlantic headboat fishery. Headboat trips including cobia represent 1.2% of all headboat trips in the south Atlantic (Table 1). Table 1 summarizes all headboat trips and positive cobia trips in the south Atlantic by year and area (North Carolina (NC), South Carolina (SC), Georgia-north Florida (GNFL).

Data Filtering Techniques

While exploring headboat data to develop a standardized index for cobia in the south Atlantic, the following methods were investigated.

Stephens & McCall
Applying methods described by Stephens & McCall (2004) to cobia resulted in a 67% reduction in positive cobia trips while identifying approximately 11,000 trips that were unsuccessful at catching cobia. A large reduction in positive cobia trips and an inflation of zero cobia trips was anticipated due to the infrequency of cobia in the headboat fishery, therefore a more appropriate method was pursued.

Positive Trips
Headboat trips that caught cobia were investigated. This method underestimates the amount of effort directed at cobia in the headboat fishery by disregarding trips that were unsuccessful at catching cobia. Due to the nature of the cobia fishery a more appropriate method was pursued.

Core Vessels
To identify headboat trips that best characterize the cobia fishery, vessels that consistently caught cobia were selected. A subset identifying data from 26 headboats representing 90% of cobia effort and landings was selected. Positive cobia trips from these core vessels increased from 1.6% (entire fleet) to 14% (Table 1). By identifying vessels that encounter cobia more frequently, the remaining vessels that infrequently encountered cobia and the associated zero trips were removed. Selecting data using a core group of vessels while removing vessels that inconsistently or never reported cobia more appropriately reflects directed cobia effort in the headboat fishery.

Spatial distributions of core vessel headboat cobia trips and catch per angler-hour in the south Atlantic by decade are presented in Figures 2 – 6. In order to present confidential information spatially, specific locations were shifted from their original position using a jitter function to randomly redistribute plot points by 3 nautical miles. Plot points located on land may be due to the jitter function or misreported location code.

Subsetting trips

The annual catch records were combined, selecting headboat trips that were in the geographical boundaries (North Carolina-Cape Canaveral, FL) *(910,496 trips).*

Area & Trip Type
Trips from area codes within the geographical boundaries were selected (Areas 1-10) (Figure 1). Multiday trips and trips with less than five anglers per trip were removed eliminating 138,353 records.

Years
Data from 1973-1983 were removed from the analysis because prior to 1984 cobia were only written on the logbook forms by the captains. In 1984, cobia was listed on all logbook forms further improving reporting rates. *(591,150 trips remained).*

Core Vessel, Month by Vessel, Area 8
Data from 26 headboats representing 90% of cobia effort and landings were selected. Trips taken by each core vessel that did not catch cobia, but were within the months that typically encountered cobia, were included in the analysis. These 'zero' trips represent additional cobia effort to be included in the binomial portion of the analysis. For each vessel, if zero cobia were caught in a specific month, trips from that month were removed (ex. exclusion of winter months for vessels in the northern range). Several vessels caught cobia from April – September, while other vessels caught cobia year around.

Headboats directly north and south of Cape Canaveral operate within 'area 8', an assigned area identifier unique to the headboat logbook form. Due to the tentative boundary decision, vessels south of Cape Canaveral were removed and vessels representing 90% of area 8 north of Cape Canaveral were included as core vessels *(54,976 trips).*

Outliers
Trips defined by the upper 0.01% of cobia catch were removed as they likely represent misreporting or data entry errors (i.e., catches greater than 12 cobia per trip). The remaining subset of data used in the analysis included 54,922 trips of which 14% were positive.

Model Input

Response and explanatory variables
CPUE – catch per unit effort (CPUE) has units of fish/angler-hour and was calculated as the number of cobia caught divided by the number of anglers times the number of trip hours.

Year- A summary of the total number of trips with cobia effort per year and trips with positive cobia catch is provided in Table 1. The number of records with positive cobia effort ranged from 1,090 in 1984 to 2,761 in 1993, and the number of records with positive cobia catch ranged from 152 in 1984 to 444 in 2007. Density plots of cobia catch by year are provided in Figure 7.

Trip Type- Trip types of half, ¾, and full day trips were included in the analysis. Multi-day trips were removed because most were in Florida and likely targeting deepwater species for some portion of the trip. The codes for first and second half-day trips designation for day and night trips were combined.

Vessel
Since each vessel targeted cobia differently (whether by state, season, mean number of anglers), vessels were included in the analysis as an explanatory variable. The number of records with positive cobia effort ranged from 31 trips for vessel 'T' and 1,255 trips for vessel 'N'. All vessel information is confidential and has been relabeled in order to present sample sizes.

Standardization

CPUE was modeled using the delta-glm approach (Lo et al. 1992; Dick 2004; Maunder and Punt 2004). In particular, fits of lognormal and gamma models were compared for positive CPUE. Also, the combination of predictor variables was examined to best explain CPUE patterns (both for positive CPUE and 0or positive CPUE). Bootstrap estimates of variance were computed. All analysis were performed in the R programming language, with much of the code adapted from Dick (2004).

BERNOULLI SUBMODEL
One component of the delta-GLM is a logistic regression model that attempts to explain the probability of either catching or not catching cobia on a particular trip. First, a model was fit with all main effects in order to determine which effects should remain in the binomial component of the delta-GLM. Stepwise AIC (Venables and Ripley1997) with a backwards selection algorithm was then used to eliminate those that did not improve model fit. In this case, the stepwise AIC procedure did not remove any predictor variables (Appendix 1). Recognizable patterns were not apparent in the randomized quantile residuals (Figures 8-13).

POSITIVE CPUE SUBMODEL
Then, to determine predictor variables important for predicting positive CPUE, the positive portion of the model was fitted with all main effects using both the lognormal and gamma distributions. Stepwise AIC (Venables and Ripley1997) with a backwards selection algorithm was then used to eliminate those that did not improve model fit. All predictor variables were modeled as fixed effects (and as factors rather than continuous variables).

Both components of the model were then fit together (with the code adapted from Dick 2004) using the lognormal and gamma distributions and compared them using AIC. With CPUE as the dependent variable, the gamma distribution outperformed the lognormal distribution with lower AIC values when all factors were included and when using only those factors that were selected in the previous step.

Thus, the gamma model with all factors was used for computing the positive component of the index, and the binomial with all factors was used for computing the Bernoulli component of the index. Standard model diagnostics (Figures 8-13) appeared reasonable for the positive component of the model using raw residuals (Dunn and Smyth 1996).

Index

The distribution of gamma CPUE for the index appeared reasonable (Figure 11), as did the QQ plot of the residuals (Figure 13). The index is presented in Table 2 and visually in Figure 14.

LITERATURE CITED

Dick, E.J. 2004. Beyond 'lognormal versus gamma': discrimination among error distributions for generalized linear models. Fish. Res. 70:351-366.

Dunn, K. P. and Smyth, G. K. 1996. Randomized quantile residuals. J Comp. Graph. Stat. 5:1-10.

Lo, N.C., Jacobson, L.D., Squire, J.L. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Can. J. Fish. Aquat. Sci. 49:2515-2526.

Maunder, M.N., Punt, A.E. 2004. Standardizing catch and effort data: a review of recent approaches. Fish. Res. 70:141-159.

Stephens, A., and A. MacCall. 2004. A multispecies approach to subsetting logbook data for purposes of estimating CPUE. Fish. Res. 70:299-310.

Venables, W. N. and B. D. Ripley. 1997. Modern Applied Statistics with S-Plus, 2nd Edition. Springer-Verlag, New York.

Table 1. Total number of headboat trips, positive cobia trips and cobia caught in the south Atlantic by year and zone (North Carolina (NC), South Carolina (SC) and Georgia-north Florida (GNFL).

	North Carolina				South Carolina				Georgia-north Florida				Total[1]				Core Vessels[2]			
Year	Total Trips	Cobia Trips	%	N.fish	Total Trips	Cobia Trips	%	N.fish	Total Trips	Cobia Trips	%	N.fish	Total Trips	Cobia Trips	%	N.fish	Total Trips	Cobia Trips	%	N.fish
1984	2,010	11	0.5%	16	8,071	18	0.2%	20	12,523	293	2.3%	526	22,604	322	1.4%	562	1,090	152	14%	343
1985	2,238	15	0.7%	14	8,717	29	0.3%	32	14,066	347	2.5%	535	25,021	391	1.6%	581	1,332	182	14%	311
1986	2,369	17	0.7%	24	9,022	45	0.5%	50	20,705	467	2.3%	645	32,096	529	1.6%	719	2,113	303	14%	426
1987	3,261	20	0.6%	24	12,612	58	0.5%	90	19,789	429	2.2%	629	35,662	507	1.4%	743	2,325	318	14%	505
1988	3,208	15	0.5%	31	13,108	54	0.4%	79	17,523	451	2.6%	728	33,839	520	1.5%	838	2,346	306	13%	544
1989	1,264	10	0.8%	10	7,625	28	0.4%	43	15,021	334	2.2%	589	23,910	372	1.6%	642	1,677	195	12%	428
1990	1,867	11	0.6%	30	8,013	27	0.3%	42	13,632	286	2.1%	529	23,512	324	1.4%	601	1,694	222	13%	473
1991	3,672	38	1.0%	77	9,680	63	0.7%	99	11,939	383	3.2%	857	25,291	484	1.9%	1,033	1,797	304	17%	756
1992	5,606	57	1.0%	166	11,843	76	0.6%	91	22,602	731	3.2%	1438	40,051	864	2.2%	1,695	2,683	402	15%	921
1993	5,107	54	1.1%	94	14,986	81	0.5%	110	18,523	633	3.4%	1600	38,616	768	2.0%	1,804	2,761	308	11%	859
1994	5,380	55	1.0%	113	13,772	74	0.5%	112	16,089	500	3.1%	882	35,241	629	1.8%	1,107	2,462	299	12%	503
1995	6,123	74	1.2%	129	13,393	73	0.5%	107	14,977	469	3.1%	701	34,493	616	1.8%	937	2,381	301	13%	494
1996	6,027	28	0.5%	38	11,904	49	0.4%	58	11,076	325	2.9%	552	29,007	402	1.4%	648	2,251	211	9%	341
1997	3,621	34	0.9%	59	9,987	61	0.6%	120	7,968	217	2.7%	317	21,576	312	1.4%	496	1,461	164	11%	319
1998	5,891	30	0.5%	48	13,822	90	0.7%	140	14,992	401	2.7%	611	34,705	521	1.5%	799	2,180	234	11%	442
1999	4,919	27	0.5%	42	11,776	56	0.5%	84	15,347	429	2.8%	658	32,042	512	1.6%	784	2,170	309	14%	500
2000	5,061	31	0.6%	56	11,494	66	0.6%	96	13,041	307	2.4%	498	29,596	404	1.4%	650	2,133	262	12%	485
2001	4,301	20	0.5%	70	10,679	75	0.7%	112	13,143	433	3.3%	859	28,123	528	1.9%	1,041	1,992	355	18%	808
2002	3,402	28	0.8%	71	11,144	103	0.9%	179	12,074	443	3.7%	737	26,620	574	2.2%	987	2,004	392	20%	768
2003	4,017	21	0.5%	46	9,522	73	0.8%	105	11,009	327	3.0%	578	24,548	421	1.7%	729	2,122	306	14%	566
2004	5,392	41	0.8%	78	11,196	87	0.8%	104	11,626	307	2.6%	545	28,214	435	1.5%	727	2,366	306	13%	550
2005	3,576	25	0.7%	44	8,052	63	0.8%	95	12,396	319	2.6%	503	24,024	407	1.7%	642	1,807	300	17%	491
2006	3,215	24	0.7%	36	10,287	55	0.5%	63	12,210	424	3.5%	746	25,712	503	2.0%	845	2,129	360	17%	602
2007	2,651	16	0.6%	20	12,328	144	1.2%	267	12,171	472	3.9%	788	27,150	632	2.3%	1,075	2,034	444	22%	826
2008	3,407	28	0.8%	31	9,140	102	1.1%	169	13,123	487	3.7%	887	25,670	617	2.4%	1,087	1,873	434	23%	803
2009	3,412	5	0.1%	5	10,203	67	0.7%	109	15,804	485	3.1%	729	29,419	557	1.9%	843	1,814	317	17%	479
2010	4,298	19	0.4%	20	10,787	67	0.6%	83	12,106	449	3.7%	728	27,191	535	2.0%	831	1,925	258	13%	407
Total	123,588	840	0.7%	1534	333,412	1,809	0.5%	2988	453,496	12264	2.7%	21531	910,496	14,913	1.6%	26,053	54,922	7,944	14%	14,950

[1] Total represents overall headboat trips, cobia trips through all of area 8. Vessels south of Cape Canaveral were not included in final analysis.

[2] Final analysis included vessels within fleet accounting for 90% of cobia caught throughout time series through Cape Canaveral, FL and participated at least three years.

Table 2. The relative nominal CPUE, number of trips with positive cobia trips, core vessel trips, % positive cobia, standardized index, and CV for the cobia headboat fishery in the south Atlantic.

Year	nominal CPUE	cobia trips	Vessel Trips	% positive cobia	Standardized index	CV (index)
1984	0.8825	152	1,127	13%	0.8465	0.1216
1985	0.7820	182	1,365	13%	0.7134	0.1181
1986	0.7531	303	2,168	14%	0.5946	0.0896
1987	0.7883	318	2,413	13%	0.6859	0.1025
1988	0.9588	306	2,465	12%	0.9033	0.0898
1989	0.9523	195	1,785	11%	0.7363	0.1102
1990	1.0307	222	1,791	12%	0.9934	0.1216
1991	1.1943	304	1,883	16%	1.6922	0.0910
1992	1.1274	402	2,806	14%	1.2004	0.0846
1993	1.0914	308	2,949	10%	1.1044	0.0966
1994	0.9736	299	2,615	11%	0.8189	0.0936
1995	0.8772	301	2,572	12%	1.0165	0.0916
1996	0.9383	211	2,473	9%	0.5235	0.1068
1997	0.8658	164	1,606	10%	0.9454	0.1049
1998	1.0515	234	2,414	10%	0.8970	0.1000
1999	0.9954	309	2,375	13%	1.0235	0.0869
2000	1.0533	262	2,336	11%	0.9279	0.0995
2001	1.2048	355	2,142	17%	1.4611	0.0850
2002	1.0645	392	2,145	18%	1.3817	0.0843
2003	1.0748	306	2,239	14%	0.8726	0.0949
2004	1.0269	306	2,484	12%	0.6605	0.0938
2005	0.9247	300	1,889	16%	0.8371	0.0928
2006	1.0928	360	2,248	16%	0.9927	0.0843
2007	1.1004	444	2,154	21%	1.7530	0.0808
2008	1.1616	434	1,980	22%	1.7891	0.0778
2009	0.9671	317	1,911	17%	0.8143	0.0957
2010	1.0664	258	2,063	13%	0.8149	0.1022

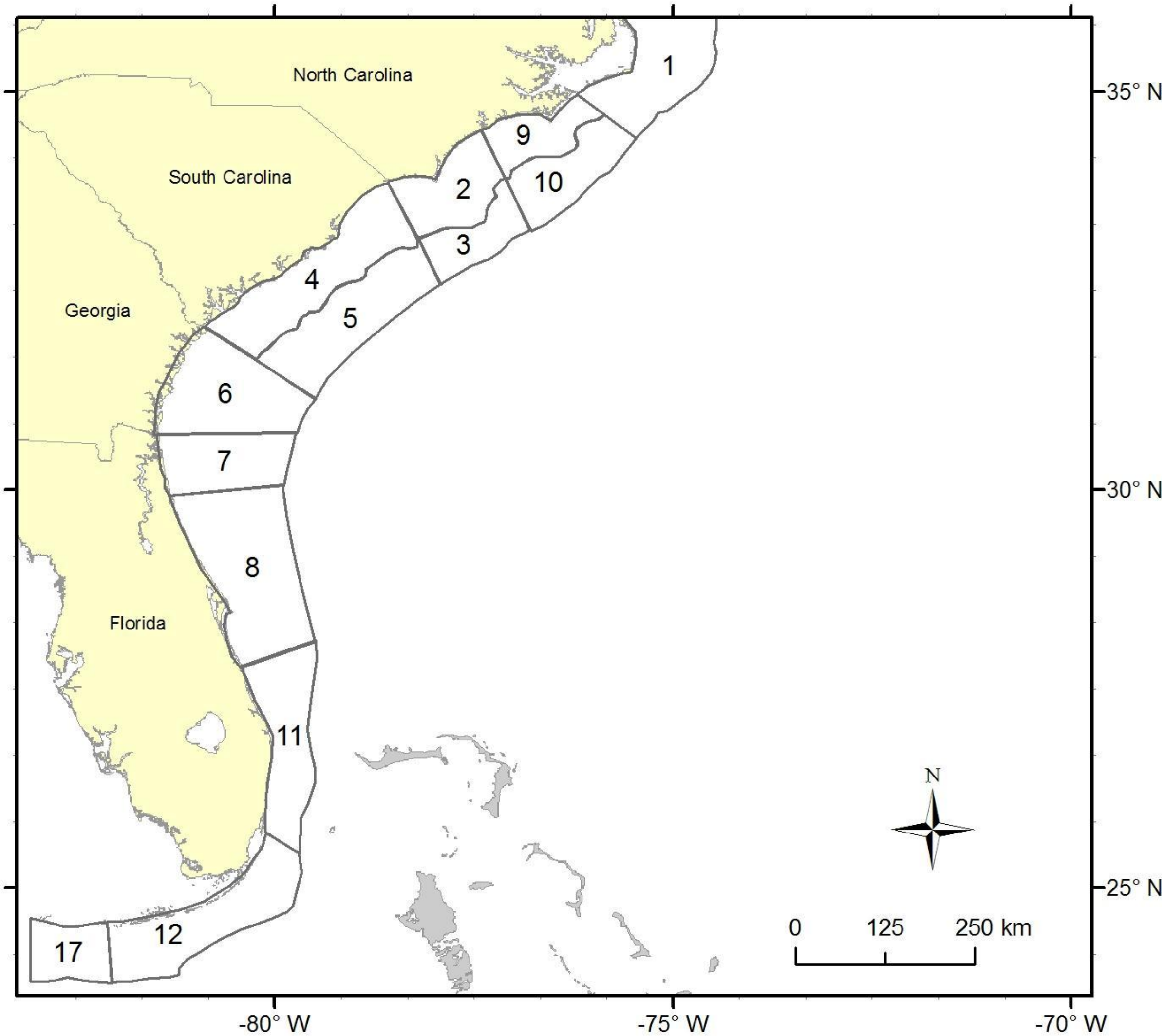


Figure 1. Map of headboat sampling area definition. These areas were pooled into regions of North Carolina (NC=1,2,3,9,10), South Carolina (SC=4,5), Georgia and North Florida (GNFL=6,7,8).

Figure 2. Cobia CPUE (Catch/angler-hr) distribution in south Atlantic headboat fishery.

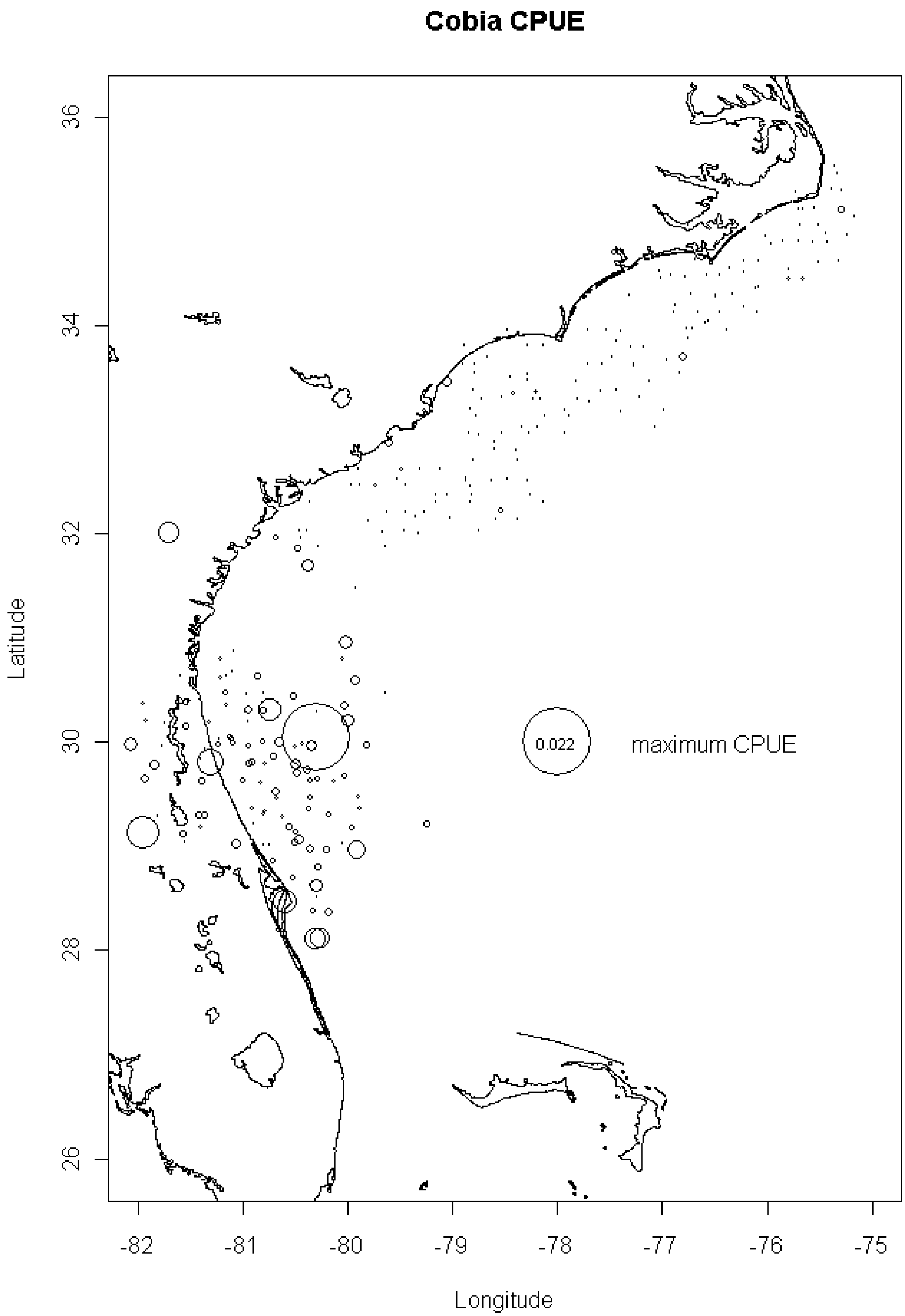


Figure 3. 1980's distribution of core vessel headboat trips in south Atlantic U.S.

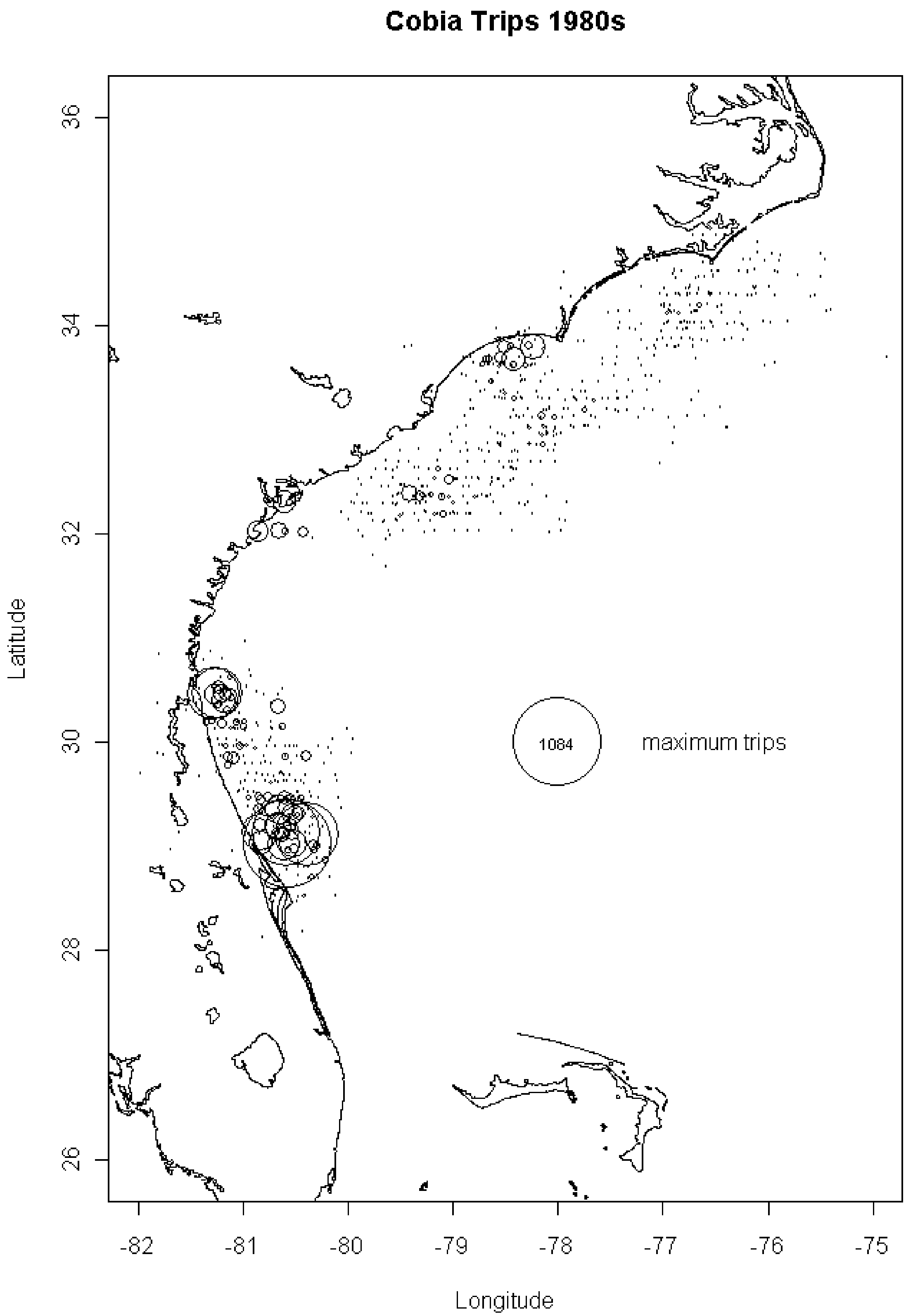


Figure 4. 1990's distribution of core vessel headboat trips in south Atlantic U.S.

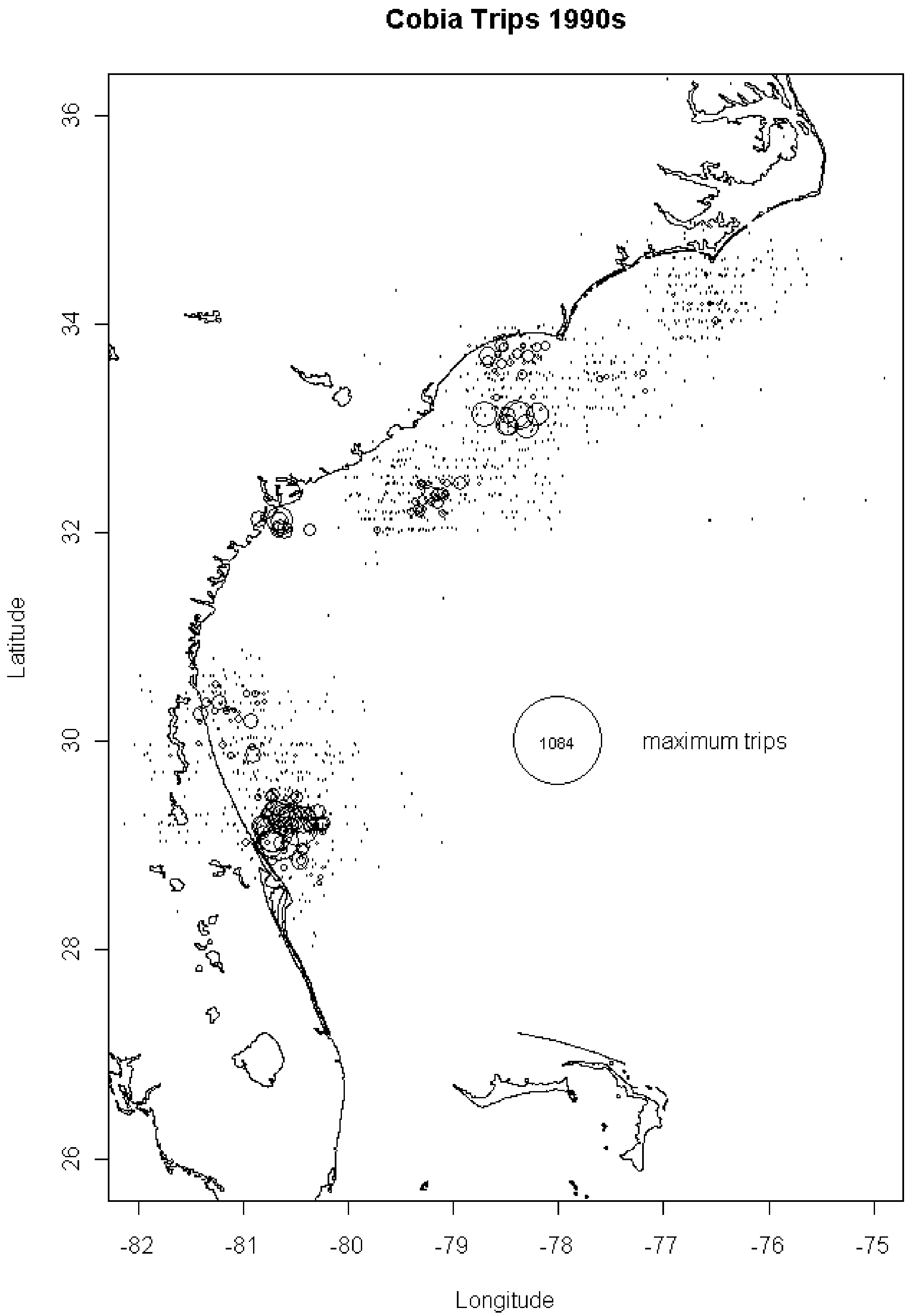


Figure 5. 2000's distribution of core vessel headboat trips in south Atlantic U.S.

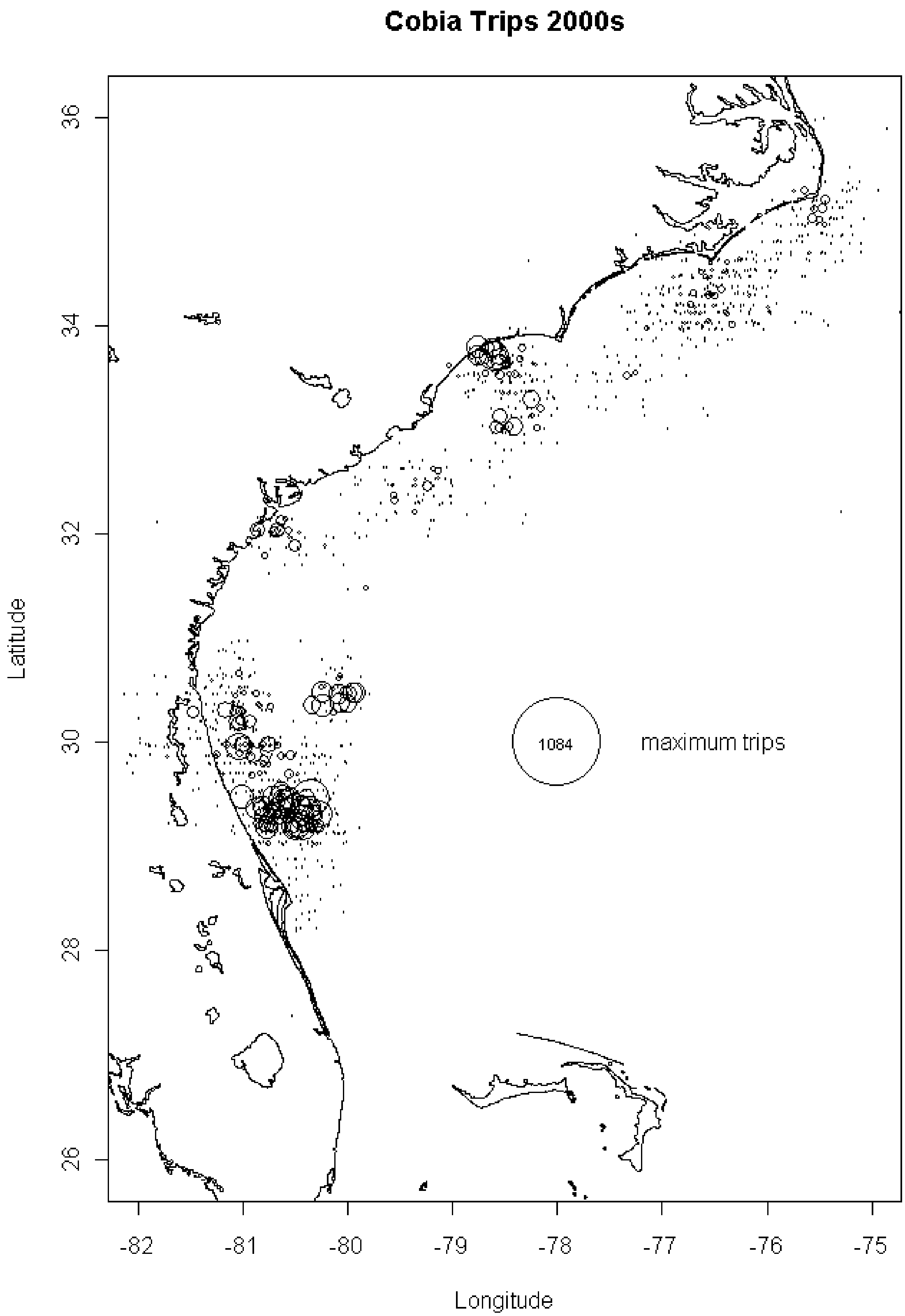


Figure 6. Distribution of core vessel headboat trips in south Atlantic U.S., 1984-2010.

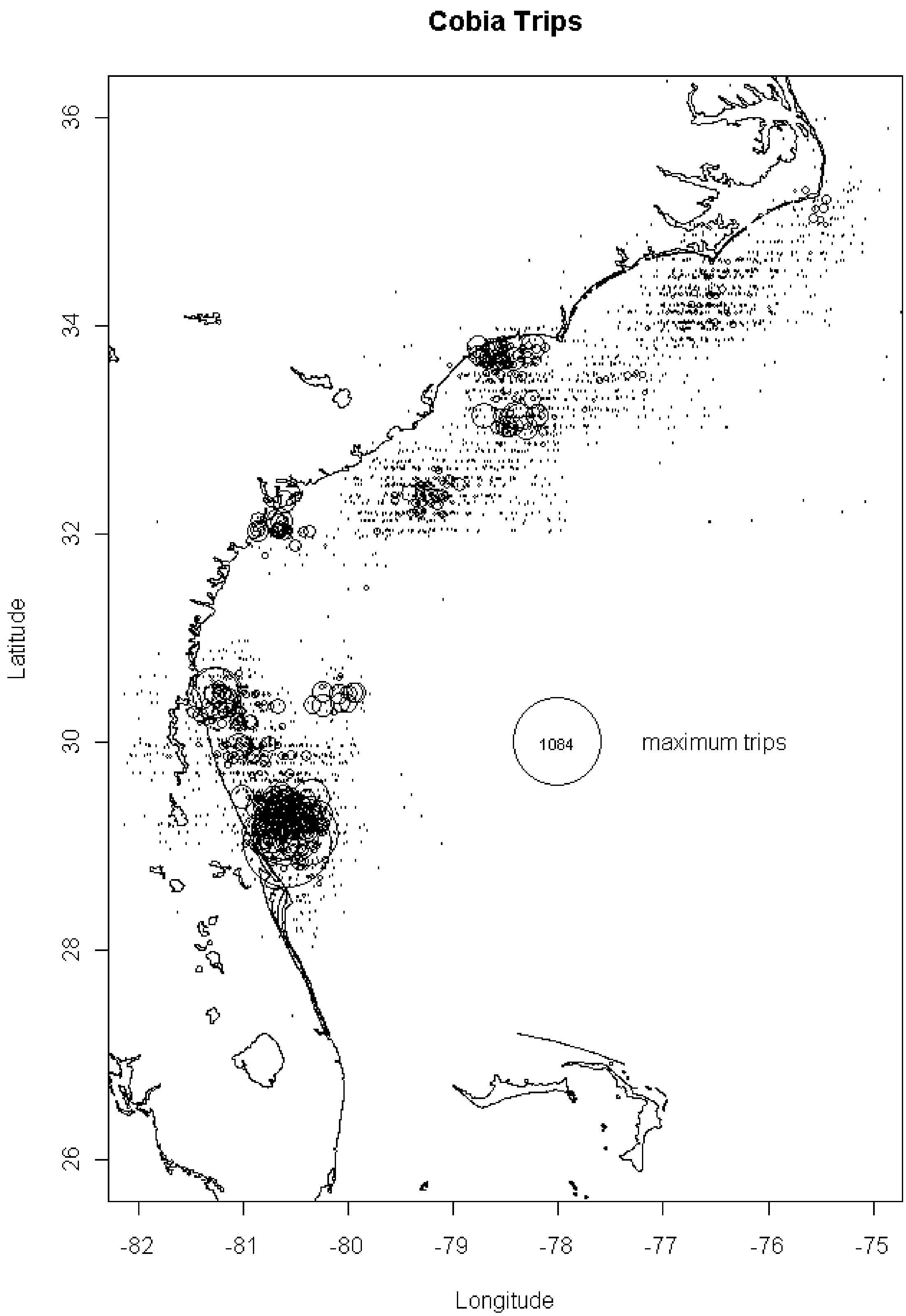


Figure 7. Density plot of non-zero cobia catch per year for the core vessels in the south Atlantic headboat fishery.

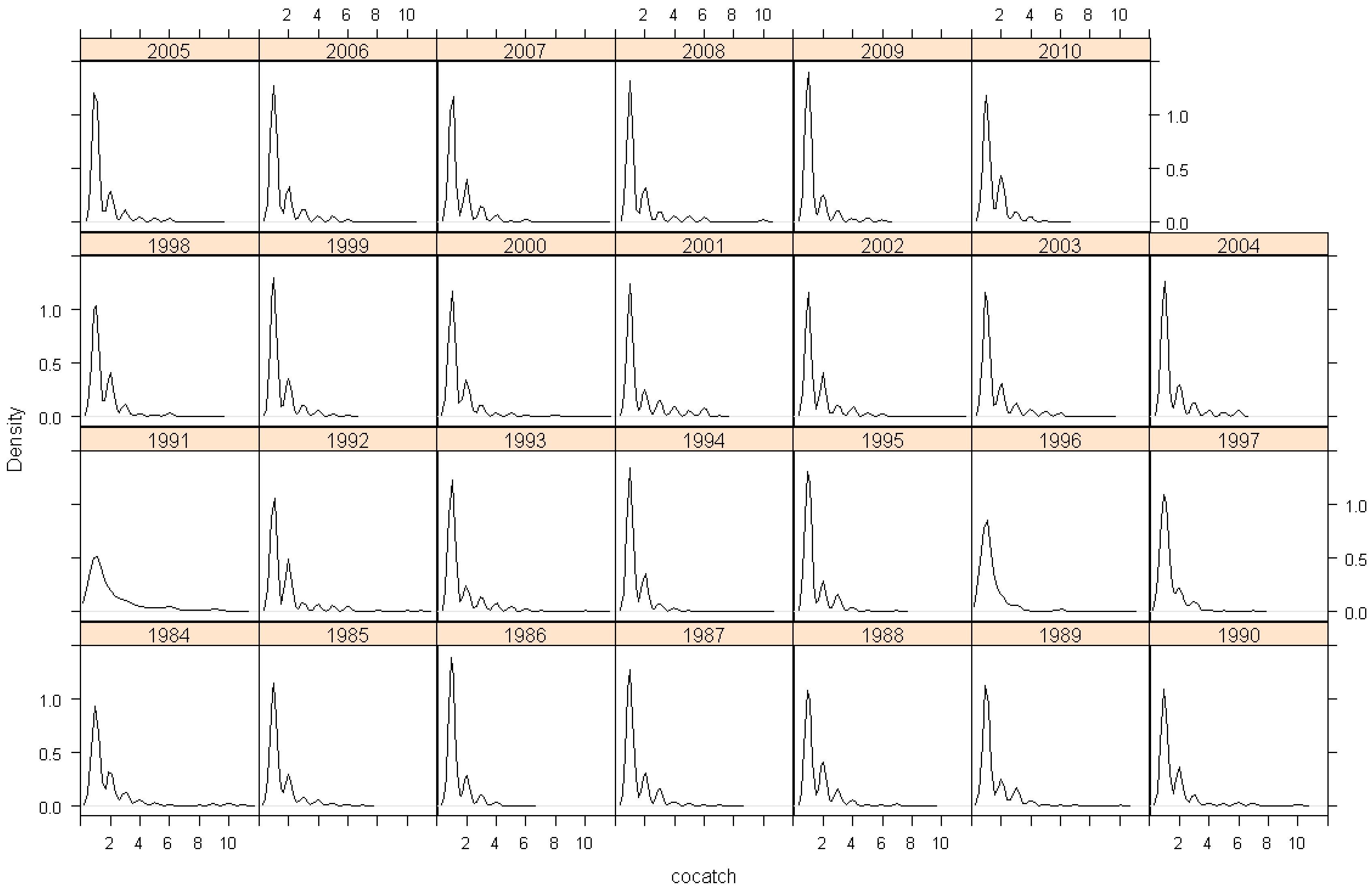


Figure 8. Observed CPUE for cobia by year from the south Atlantic headboat fishery with sample size above plot.

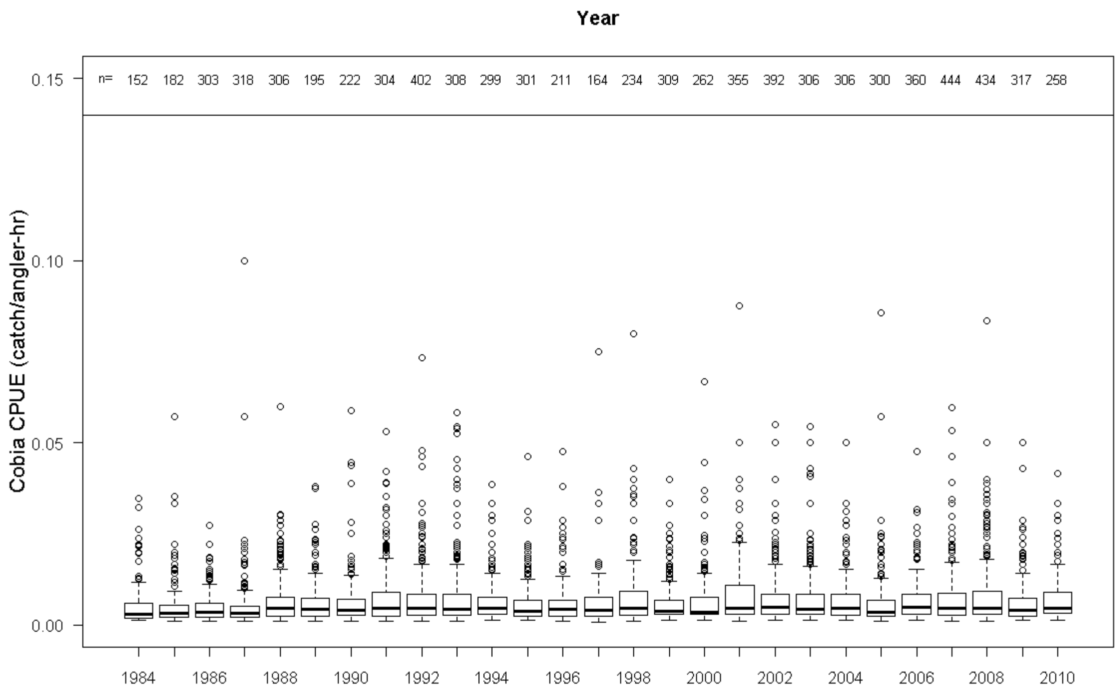


Figure 9. Observed CPUE for cobia by trip type from the south Atlantic headboat fishery with sample size above plot.

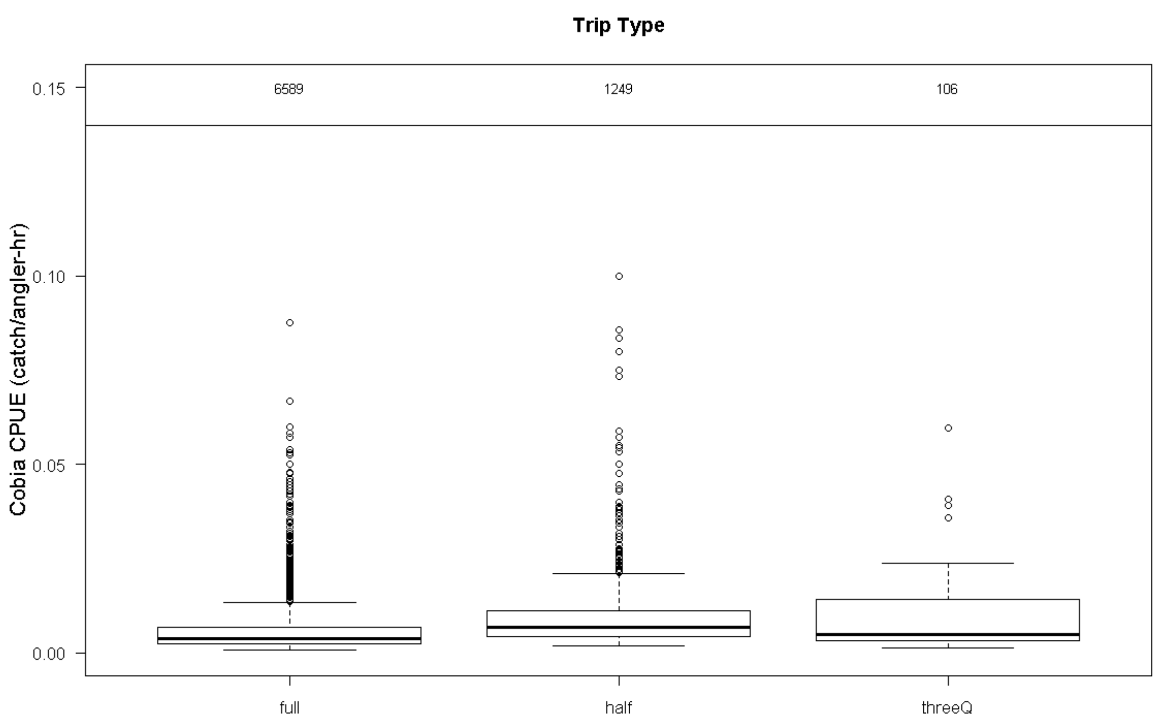


Figure 10. Observed CPUE for cobia by vessel from the south Atlantic headboat fishery with sample size above plot. Vessel not identified due to confidentiality.

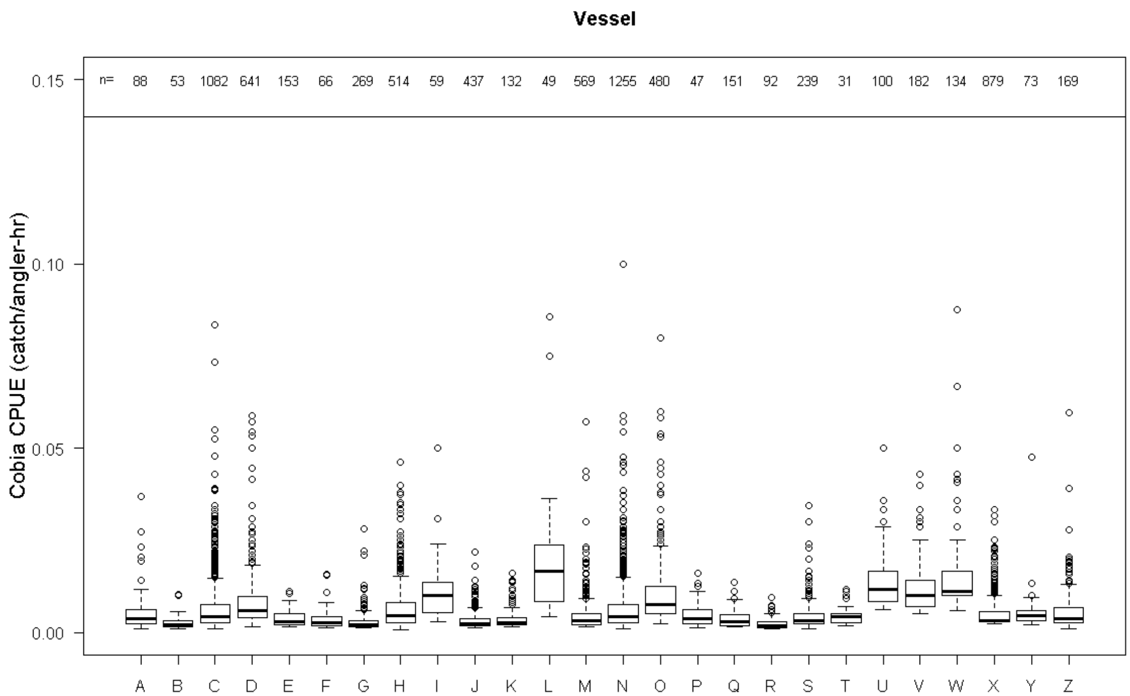


Figure 11. Gamma distribution of CPUE for cobia in the south Atlantic headboat fishery.

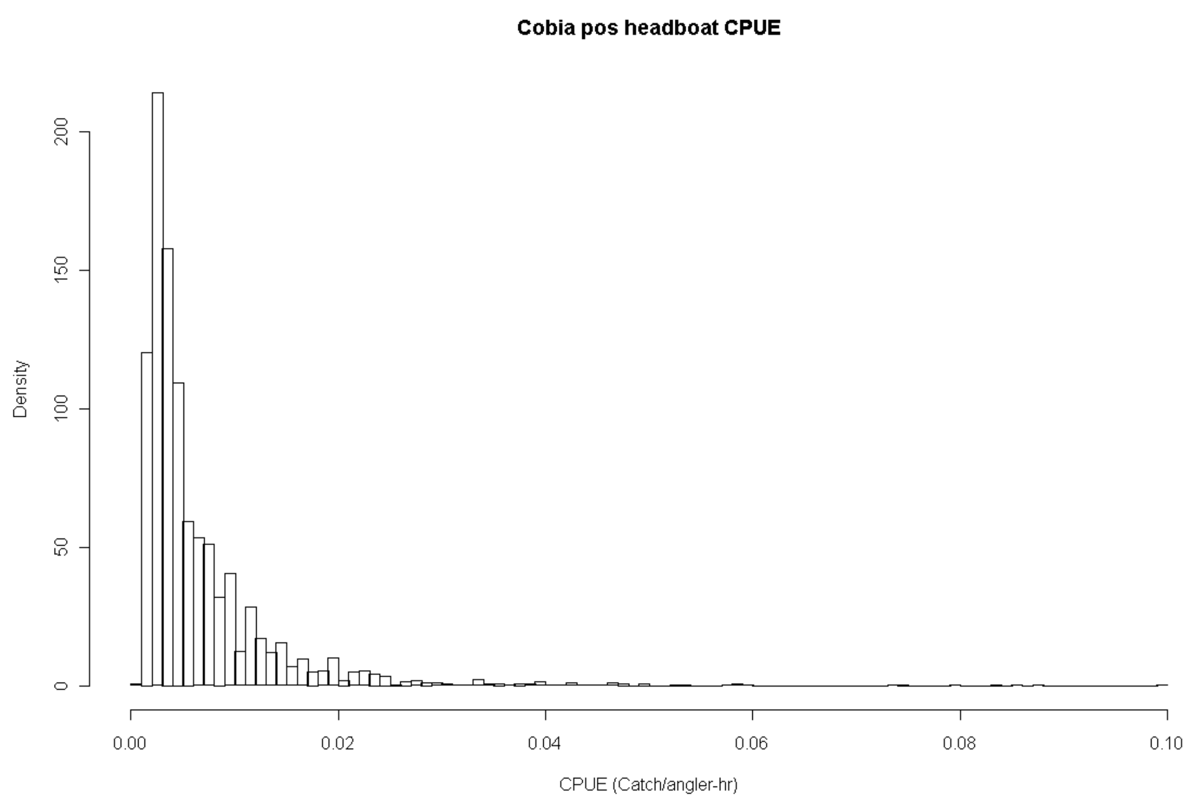
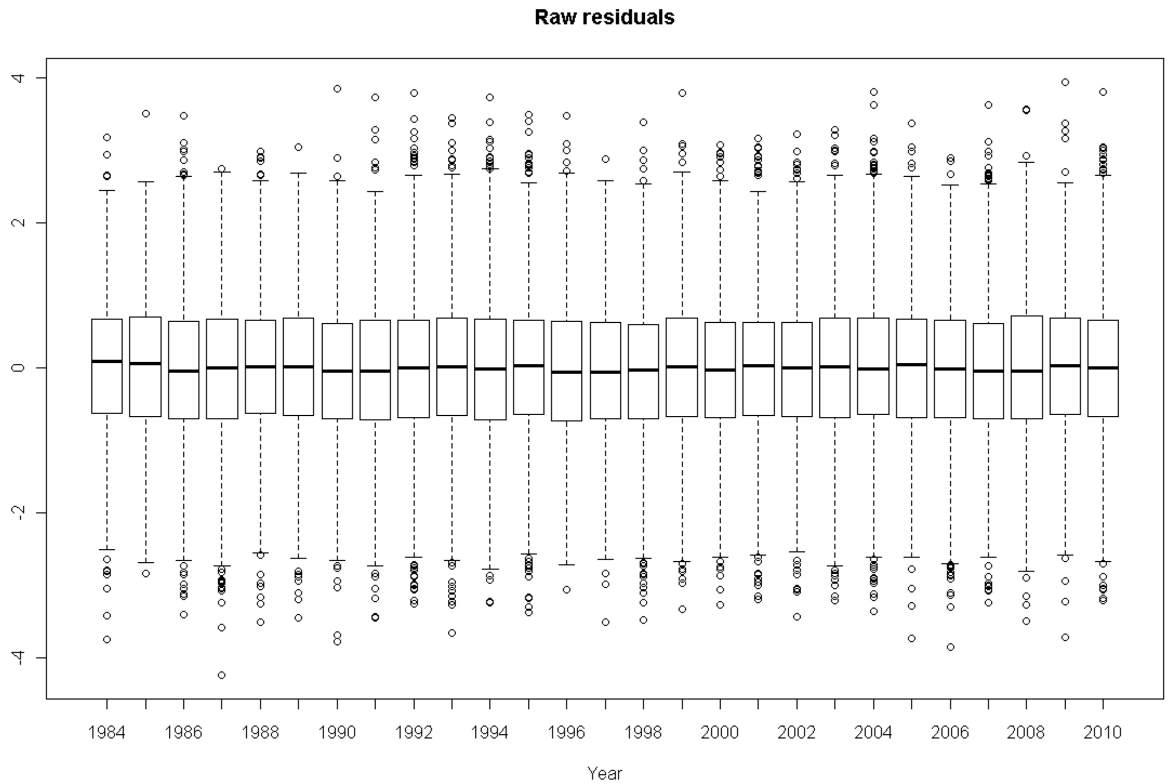
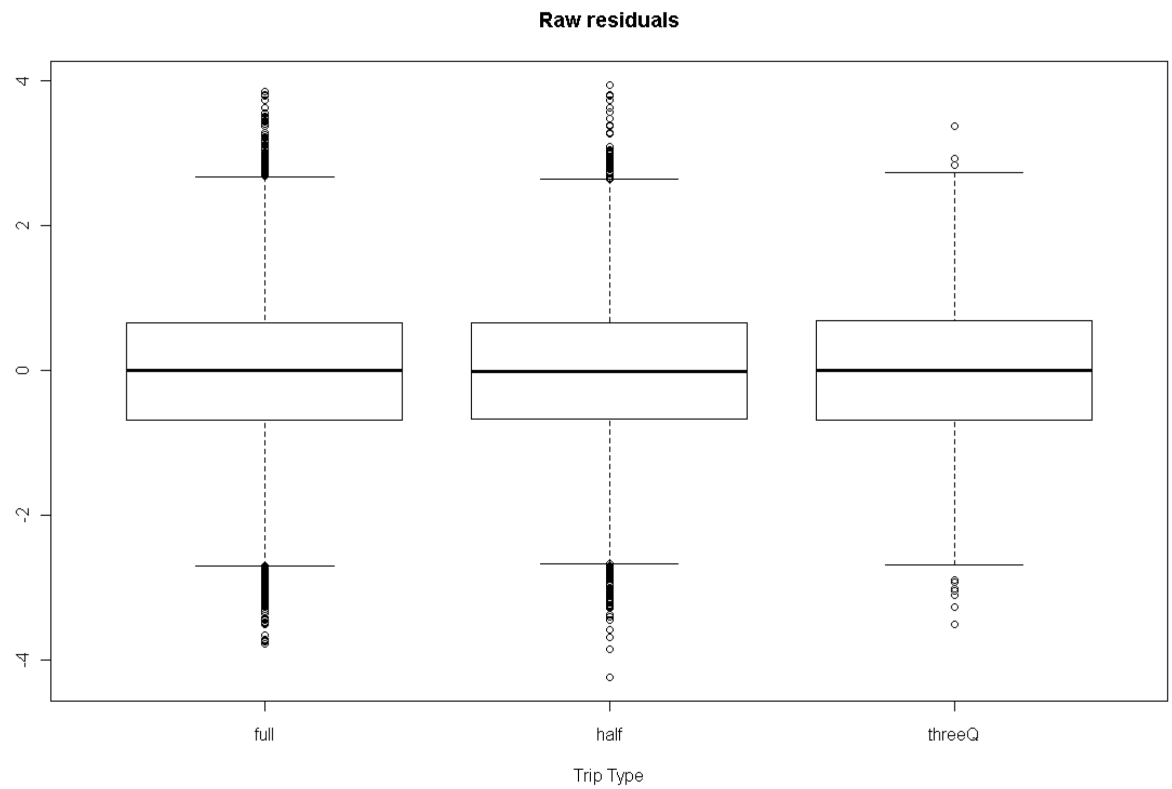


Figure 12. CPUE binomial residuals for year, trip and vessel.




Raw residuals
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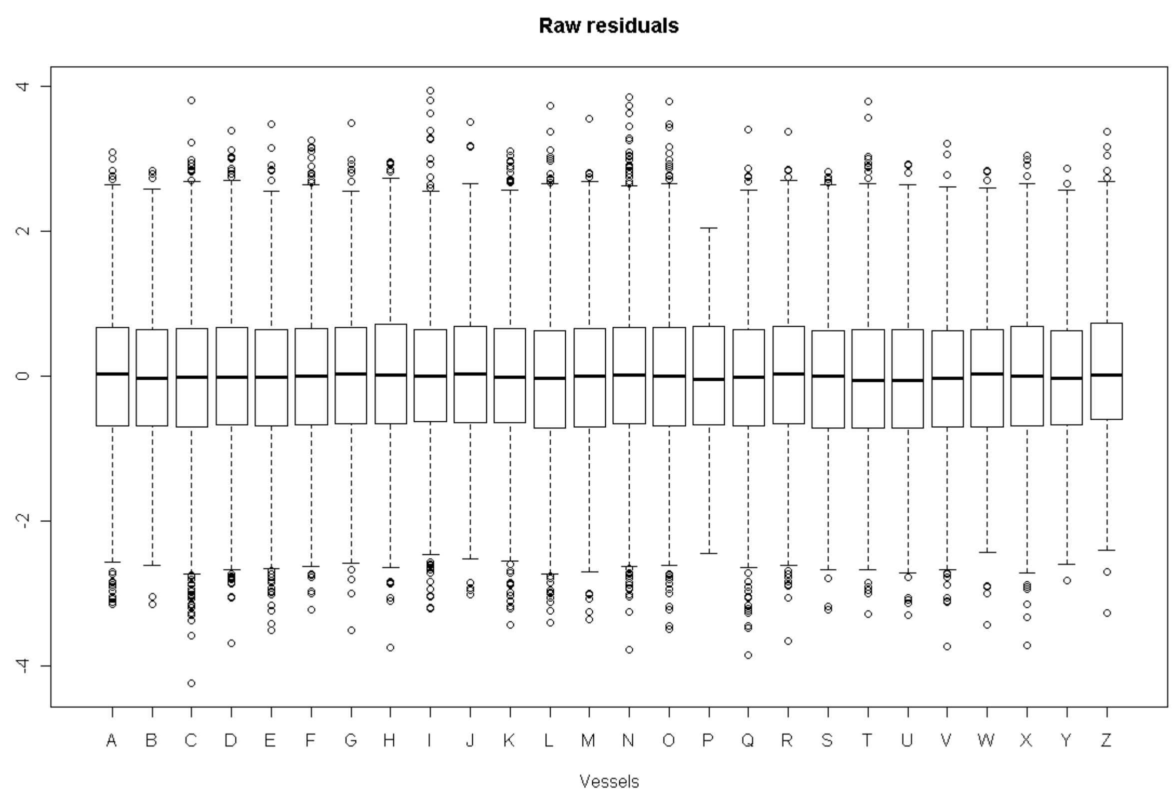
Trip Type


Raw residuals
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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Vessels

Figure 13. QQ plot of gamma residuals for cobia CPUE.

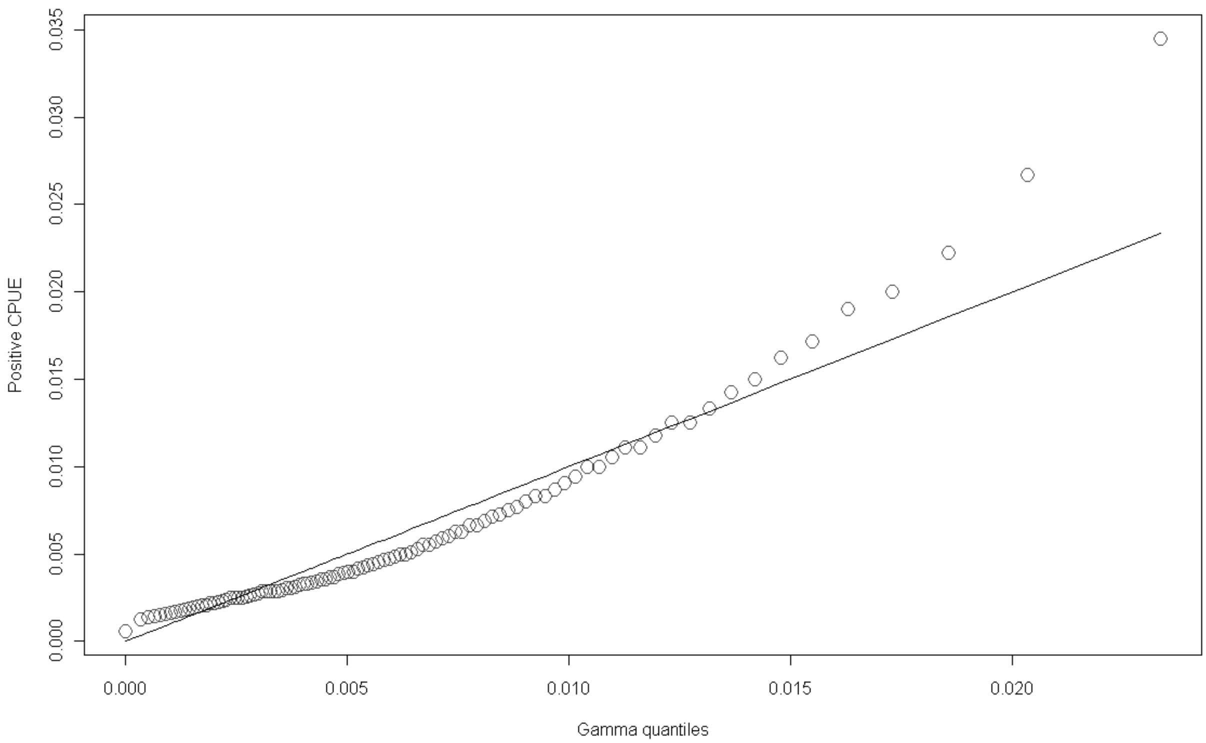
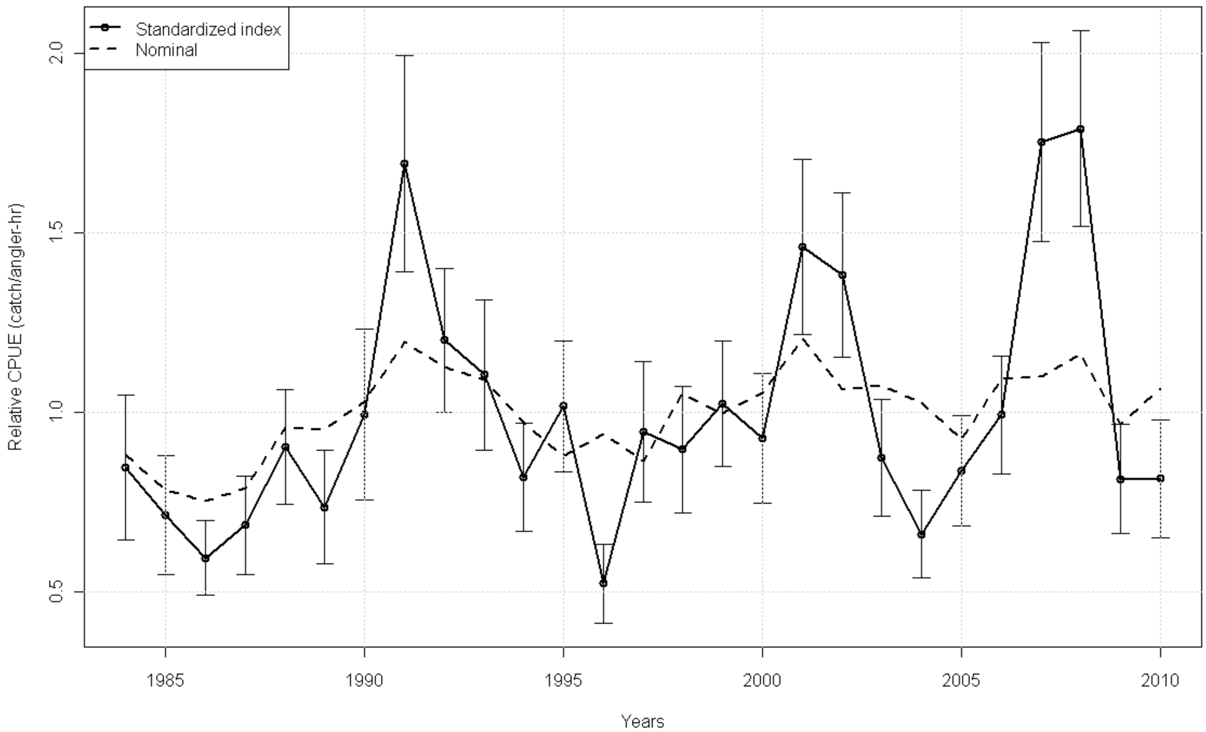


Figure 14. Relative cobia CPUE scaled to mean.



Appendix 1. The stepwise AIC output for the lognormal distribution (a), the gamma distribution (b) and the Bernoulli component using the binomial distributions.

(a) For the positive component using the lognormal distribution,

Start: AIC=15500.82
log(cpue) ~ year + trip + VESSEL

	Df	Deviance	AIC
<none>		3228.3	15501
- year	26	3283.5	15584
- trip	2	3403.9	15918
- VESSEL	25	4206.7	17554

(b) For the positive component using the gamma distribution,

Start: AIC=-68014.87
cpue ~ year + trip + VESSEL

	Df	Deviance	AIC
<none>		3739.3	-68015
- year	26	3850.1	-67924
- trip	2	3901.0	-67811
- VESSEL	25	4793.0	-66709

(c) For the Bernoulli component using the binominal distribution,

Start: AIC=38557.97
cpue ~ year + trip + VESSEL

	Df	Deviance	AIC
<none>		38450	38558
- year	26	38808	38864
- trip	2	39770	39874
- VESSEL	25	43068	43126

Appendix 1. Updated headboat index based on SEDAR 28 DW decisions.

The SEDAR 28 index working group evaluated the data and analysis of the headboat index and recommended changes to the data input to the model.

SEDAR 28 index working group decisions:

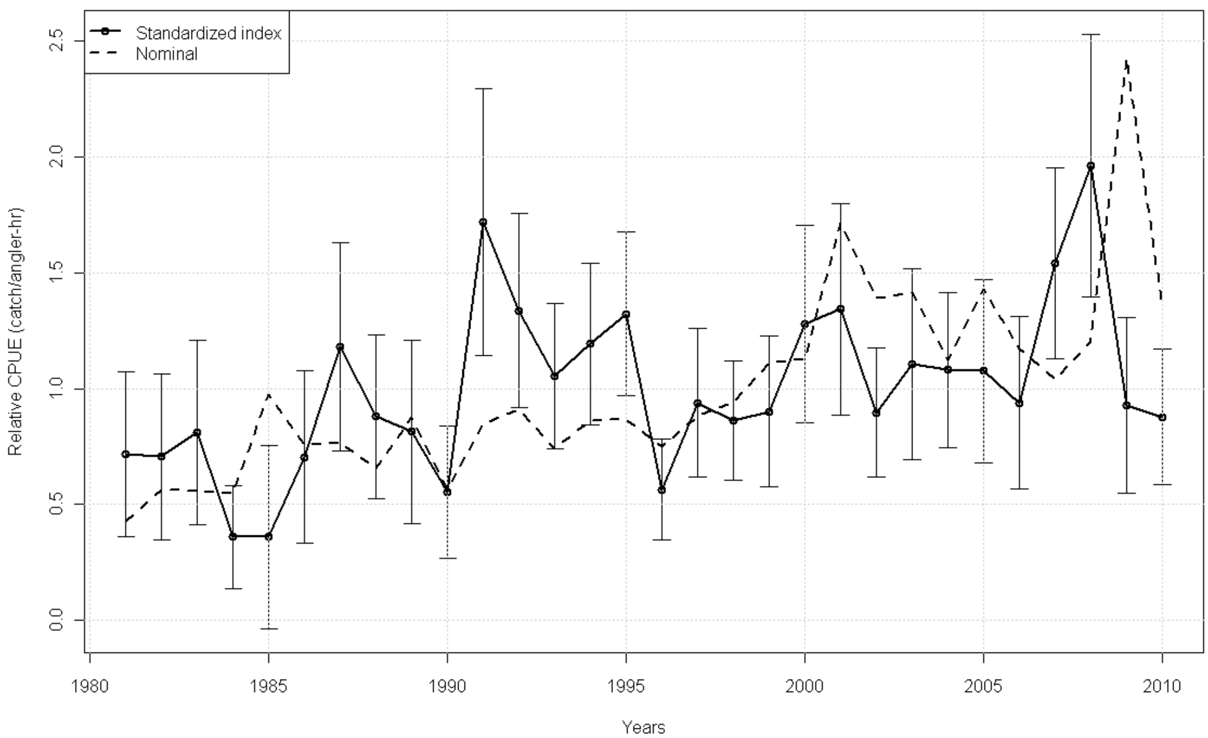
1. Begin data series in 1981 due to increased write-ins by captains. Data suggests write-in reporting of cobia prior to 1984 was similar to cobia reporting after 1984.
2. At plenary, the Georgia/Florida line was chosen as the stock boundary. This boundary change removed north Florida from the analysis.

The generalized linear model was run with the addition of 1981 to 1983 and with the removal of the Florida trips as recommended by the SEDAR 28 index working group (Table A1 and Figure A1.)

Table A1. The relative nominal CPUE, number of trips with positive cobia trips, core vessel trips, % positive cobia, standardized index, and CV for the cobia headboat fishery in the south Atlantic.

Year	nominal CPUE	cobia trips	Vessel Trips	% positive cobia	Standardized index	CV (index)
1981	0.42	23	307	7%	0.72	0.25
1982	0.56	28	459	6%	0.71	0.26
1983	0.56	27	484	6%	0.81	0.25
1984	0.55	14	500	3%	0.36	0.31
1985	0.98	7	455	2%	0.36	0.56
1986	0.76	21	508	4%	0.71	0.27
1987	0.77	42	869	5%	1.18	0.19
1988	0.66	44	995	4%	0.88	0.21
1989	0.88	22	542	4%	0.81	0.25
1990	0.56	21	562	4%	0.55	0.26
1991	0.85	70	938	7%	1.72	0.17
1992	0.91	81	1,189	7%	1.34	0.16
1993	0.74	82	1,248	7%	1.05	0.15
1994	0.86	88	1,185	7%	1.19	0.15
1995	0.87	113	1,230	9%	1.32	0.14
1996	0.75	48	1,204	4%	0.56	0.20
1997	0.88	58	816	7%	0.94	0.17
1998	0.94	76	1,281	6%	0.86	0.15
1999	1.11	58	1,152	5%	0.90	0.18
2000	1.13	84	1,339	6%	1.28	0.17
2001	1.71	74	1,047	7%	1.34	0.17
2002	1.39	70	1,007	7%	0.90	0.16
2003	1.41	57	965	6%	1.11	0.19
2004	1.12	80	1,270	6%	1.08	0.16
2005	1.43	55	902	6%	1.08	0.19
2006	1.17	55	1,093	5%	0.94	0.20
2007	1.04	100	1,063	9%	1.54	0.14
2008	1.20	87	795	11%	1.96	0.15
2009	2.43	42	822	5%	0.93	0.21
2010	1.36	58	1,016	6%	0.88	0.17

Figure A1. Relative cobia CPUE scaled to mean.



DESCRIPTION OF THE DATA SOURCE

Working Group Comments:

1. Fishery Independent Indices

	Not Applicable	Absent	Incomplete	Complete
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

	Not Applicable	Absent	Incomplete	Complete
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

1. Data Reduction and Exclusions

	Not Applicable	Absent	Incomplete	Complete
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.

Item	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

Reset Fields