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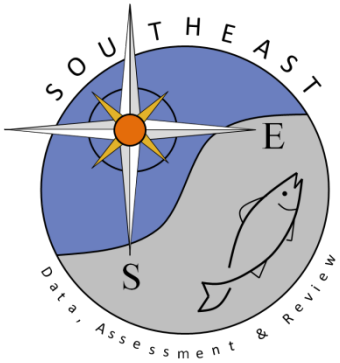

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Introduction

Handline, electric and hydraulic reel (bandit rig), and longline landings and fishing effort of commercial vessels operating in the Gulf of Mexico and U.S. South Atlantic have been reported to the National Marine Fisheries Service (NMFS) through the Coastal Fisheries Logbook Program (CFLP) conducted by the NMFS Southeast Fisheries Science Center. The program collects landings and effort data by fishing trip from vessels that are federally permitted to fish in a number of fisheries managed by the Gulf of Mexico and South Atlantic Fishery Management Councils. The coastal logbook program began in 1990 in the Gulf of Mexico and in 1992 in the US South Atlantic with the objective of a complete census of coastal fisheries permitted vessel activity, however in Florida a 20% sample of vessels was selected to report. Beginning in 1993, reporting in Florida was increased to include all vessels permitted for federally managed coastal fisheries.

The CFLP available catch per unit effort (CPUE) data were used to construct standardized abundance indices for blacktip shark. Indices were constructed using data reported from commercial bottom longline trips in the Gulf of Mexico and in the US South Atlantic. Blacktip shark data were sufficient to construct indices of abundance including the years 1996-2010. Although fishing effort and landings from 1990-1995 were reported to the coastal logbook program, species identification problems were found in those data (Brown, 2002). A large proportion of the landings were identified as unclassified shark prior to 1996 (Heinemann and Poffenberger, 2002). The proportion of unclassified sharks decreased after 1995 and the proportion of blacktip and sandbar sharks increased coincidentally (Brown, 2002). Data prior to 1996 was excluded from these analyses because of the apparent species identification problem.

Methods

Methods followed those used in the 2005 blacktip shark assessment (McCarthy and Abercrombie, 2005). Data were limited to those reported from vessels which were presumed to actively target large coastal sharks. Vessels were ranked by average yearly large coastal shark CPUE (large coastal shark landings/number of sets fished per trip). The highest 20% of vessels by CPUE rank were classified as targeting sharks and data reported for those vessels were retained for analysis.

Index Development

Two indices were constructed using coastal logbook commercial bottom longline data. The first index (Gulf of Mexico index) included effort and landings data reported from statistical areas 1-21 (Figure 1). The second index (South Atlantic index) included data reported from areas 2482-3675. Models used to standardize the indices were those used in the 2005 assessment and included the factors year (1996-2010), vessel (those vessels above the 80th percentile of large coastal shark CPUE averaged across all years), and quarter (i.e., Jan-Mar, Apr-Jun, etc.). South Atlantic models did not include the factor quarter.

Bottom longline catch rate was calculated as weight of blacktip shark per set fished:

CPUE = pounds of blacktip shark/(number of sets fished)

The delta lognormal model approach (Lo et al. 1992) was used to construct standardized indices of abundance. This method combines separate general linear model (GLM) analyses of the proportion of successful trips (trips that landed blacktip shark) and the catch rates on successful trips to construct a single standardized CPUE index. Parameterization of each model was accomplished using a GLM analysis (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA).

The final delta-lognormal models were fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). To facilitate visual comparison, a relative index and relative nominal CPUE series were calculated by dividing each value in the series by the mean CPUE of the series.

Results and Discussion

The final model of the Gulf of Mexico data set for the binomial on proportion positive trips (PPT) and the lognormal on CPUE of successful trips for blacktip sharks were:

PPT[1] = Year + Quarter

LOG(CPUE) = Year + Vessel + Quarter

[1]The binomial model failed to converge when Vessel was included as a factor in the Gulf of Mexico analysis.

Final models for the South Atlantic data set were:

PPT = Year + Vessel

LOG(CPUE) = Year + Vessel

Relative nominal CPUE, number of trips, proportion positive trips, and relative abundance indices are provided in Tables 1 and 2 for each of the blacktip shark analyses. For both indices, yearly mean CPUE varied greatly over the period 1996-2010. Gulf of Mexico yearly mean CPUE ranged from a low of 0.17 in 1996 to approximately 1.8 in 2003. The South Atlantic yearly mean CPUE was lowest in 1998 (0.1) and highest during 2008 (1.6). Coefficients of variation (CV) for the Gulf of Mexico index were highest during the beginning and end of the time series. The South Atlantic index CVs were highest during the first six years of the time series, perhaps due to low sample size, and were lowest during the final six years of the index.

The delta-lognormal abundance index constructed for Gulf of Mexico, along with 95% confidence intervals, is shown in Figure 2A. Yearly mean CPUE generally increased from 1996-2002, was fairly consistent among years during the period 2002-2006, and decreased after 2006. The Gulf of Mexico index constructed for the 2005 assessment is plotted on a common scale with the current index in Figure 2B. Both indices have the same overall trend in CPUE during the period 1996-2004, but the yearly mean CPUEs differ between the two indices. Those differences were greatest for the years 1997, 2002, and 2004. The disparity in CPUE was likely due to differences in the vessels identified as targeting large coastal sharks. Fewer vessels were included in the 2005 analysis because the universe of vessels from which "shark targeting vessels" were identified was smaller in 2005. Additional vessels reported large coastal shark landings after 2004 thereby increasing the universe of vessels for construction of the current index.

The South Atlantic index with 95% confidence intervals is provided in Figure 3A. Yearly mean CPUE initially decreased from 1996-1998. During the period 1999-2005 yearly mean CPUE increased, except for a decrease in 2003. After 2005, CPUE varied little among years. The South Atlantic index constructed for the 2005 assessment is plotted with the current index on a common scale in Figure 3B. As with the comparison of Gulf of Mexico indices, both South Atlantic indices have the same overall trend in CPUE during 1996-2004. There were differences in yearly mean CPUEs between the two indices, however. As discussed above for the Gulf of

Mexico indices, dissimilarities between the 2005 and current South Atlantic indices in yearly mean CPUE were likely due to differences in the number of vessels identified as targeting large coastal sharks.

Plots of the proportion of positive trips per year, nominal CPUE, frequency distributions of the proportion of positive trips, frequency distributions of log(CPUE) for positive catch, cumulative normalized residuals, and plots of chi-square residuals by each main effect for the binomial and lognormal models are shown in Figures 4-7 (Gulf of Mexico) and Figures 8-11 (South Atlantic). The Chi-Square residuals by vessel are not shown due to data confidentiality restrictions. For both indices, the proportion of positive trips was acceptable for the analysis. The Chi-Square residuals of quarters two and four in the Gulf of Mexico binomial model were predominantly negative suggesting the assumption of linearity may not be met (Figure 5b). No obvious patterns were apparent in the other residual plots, however, although there were a small number of outliers observed (Figures 5a-b, 7a-b, 9a, 11a). The frequency distribution of the Gulf of Mexico log(CPUE) data were somewhat skewed from a normal distribution (Figures 8a-b), however, the lack of fit is typical for fisheries dependent data. The South Atlantic log(CPUE) distribution better approximated a normal distribution.

Blacktip shark standardized catch rates for commercial bottom longline vessels have much different trends in the Gulf of Mexico and the US South Atlantic. Standardized yearly mean CPUE have decreased from 1.7 to 0.24 from 2006 to 2010 in the Gulf of Mexico. Yearly mean CPUE of blacktip sharks in the South Atlantic have remained relatively constant (range 1.35-1.59) during the period 2005-2010, although the lowest CPUEs during that period were in the final two years of the series. As with any fishery dependent index of abundance, changes in catchability may mask true trends in population abundance.

Literature Cited

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Heinemann, D. and J. Poffenberger. 2002. Summaries of Gulf of Mexico and southeastern US Atlantic shark catch and fishing effort from coastal fishery logbook reports. Sustainable Fisheries Division Contribution SFD-01/02-168. 19pp.

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

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Table 1. Gulf of Mexico bottom longline relative nominal CPUE, number of trips, proportion positive trips, and standardized abundance index for blacktip shark constructed using commercial bottom longline data.

.

YEAR	Normalized Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1996	0.318045	298	0.228	0.178186	0.069043	0.459862	0.501971
1997	0.435843	286	0.297	0.441856	0.18639	1.047463	0.452468
1998	0.584901	308	0.312	0.333326	0.145418	0.764048	0.433248
1999	1.428826	363	0.391	1.548638	0.783957	3.059199	0.350491
2000	1.269556	282	0.433	1.122844	0.537847	2.34412	0.380843
2001	0.815879	387	0.380	0.961932	0.484133	1.91128	0.353659
2002	1.121982	391	0.527	1.565006	0.897969	2.727539	0.283199
2003	1.774209	438	0.591	1.840685	1.143714	2.962386	0.241336
2004	1.567498	336	0.497	1.482115	0.789948	2.780771	0.322579
2005	1.416828	343	0.466	1.409921	0.753382	2.638604	0.32121
2006	1.841394	380	0.521	1.7042	1.004444	2.891449	0.269016
2007	1.158307	223	0.354	1.058567	0.436949	2.564517	0.464987
2008	0.489104	240	0.438	0.673053	0.335955	1.348396	0.358175
2009	0.435271	126	0.317	0.438894	0.14234	1.35329	0.610727
2010	0.342357	74	0.284	0.240777	0.053193	1.089878	0.876497

Table 2. The South Atlantic bottom longline relative nominal CPUE, number of trips, proportion positive trips, and standardized abundance index for blacktip shark constructed using commercial bottom longline data.

YEAR	Normalized Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1996	0.811826	53	0.415	0.702399	0.249395	1.97825	0.554445
1997	0.683504	41	0.341	0.293609	0.056805	1.517592	0.98141
1998	0.340199	60	0.167	0.108865	0.014477	0.818637	1.32912
1999	0.961516	47	0.426	0.322442	0.074537	1.394871	0.842407
2000	1.536075	48	0.354	1.015936	0.344741	2.993913	0.582345
2001	1.092866	80	0.300	0.823039	0.263982	2.566053	0.617759
2002	1.67892	119	0.403	1.243299	0.555564	2.782381	0.41967
2003	0.770689	149	0.248	0.710225	0.302054	1.669964	0.447782
2004	1.146257	138	0.246	0.966909	0.435204	2.148216	0.415582
2005	0.984507	131	0.374	1.47601	0.796038	2.736811	0.31623
2006	1.419663	182	0.401	1.580836	0.891955	2.80176	0.292105
2007	1.002709	81	0.370	1.436049	0.661104	3.119383	0.402925
2008	0.965279	152	0.447	1.592362	0.966258	2.624161	0.253718
2009	1.002388	240	0.467	1.373508	0.881269	2.140691	0.224639
2010	0.603601	180	0.428	1.354511	0.797336	2.301039	0.269679

Figure 1. Coastal Logbook defined fishing areas.

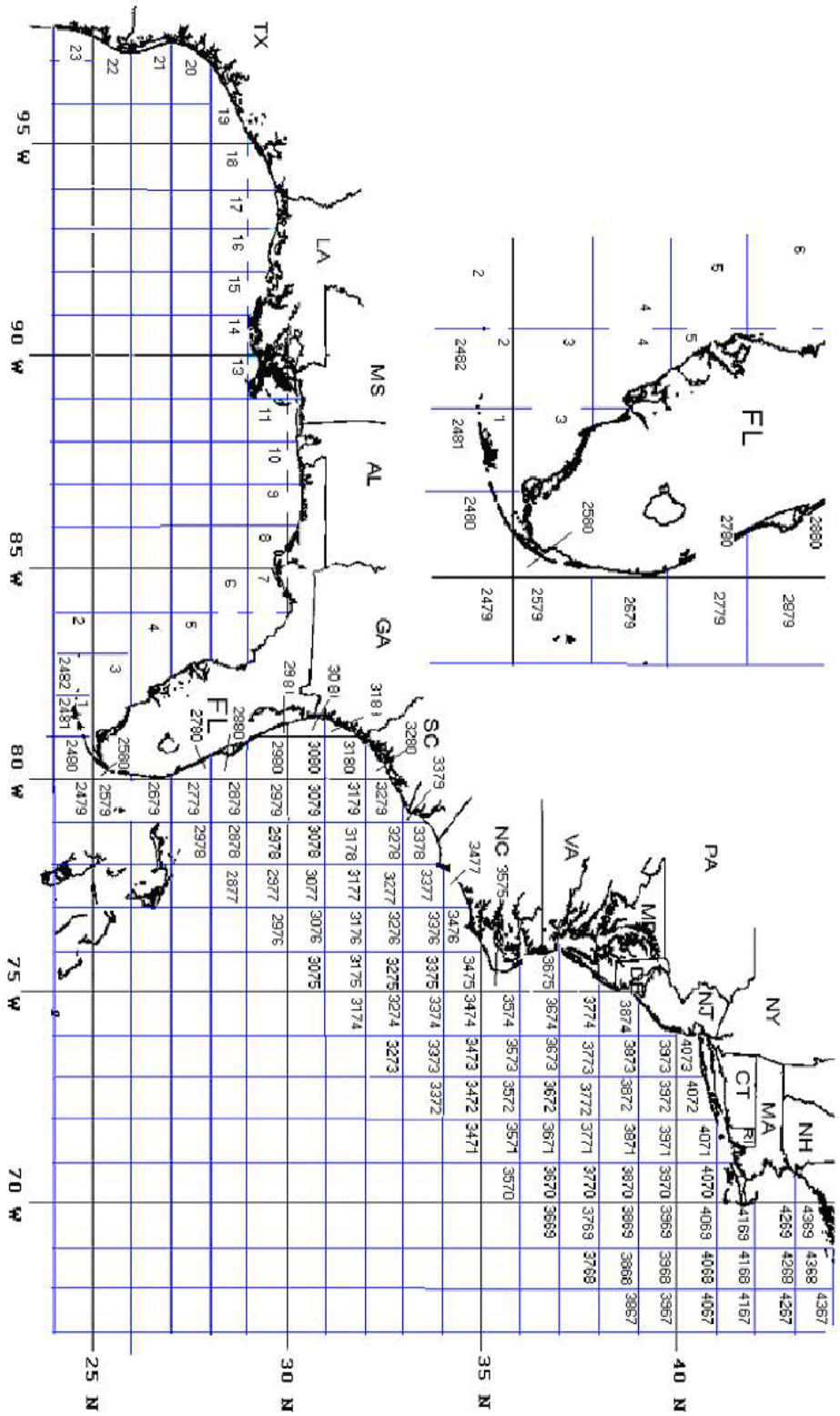


Figure 2A. Blacktip shark Gulf of Mexico nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for commercial vessels fishing bottom longline gear.

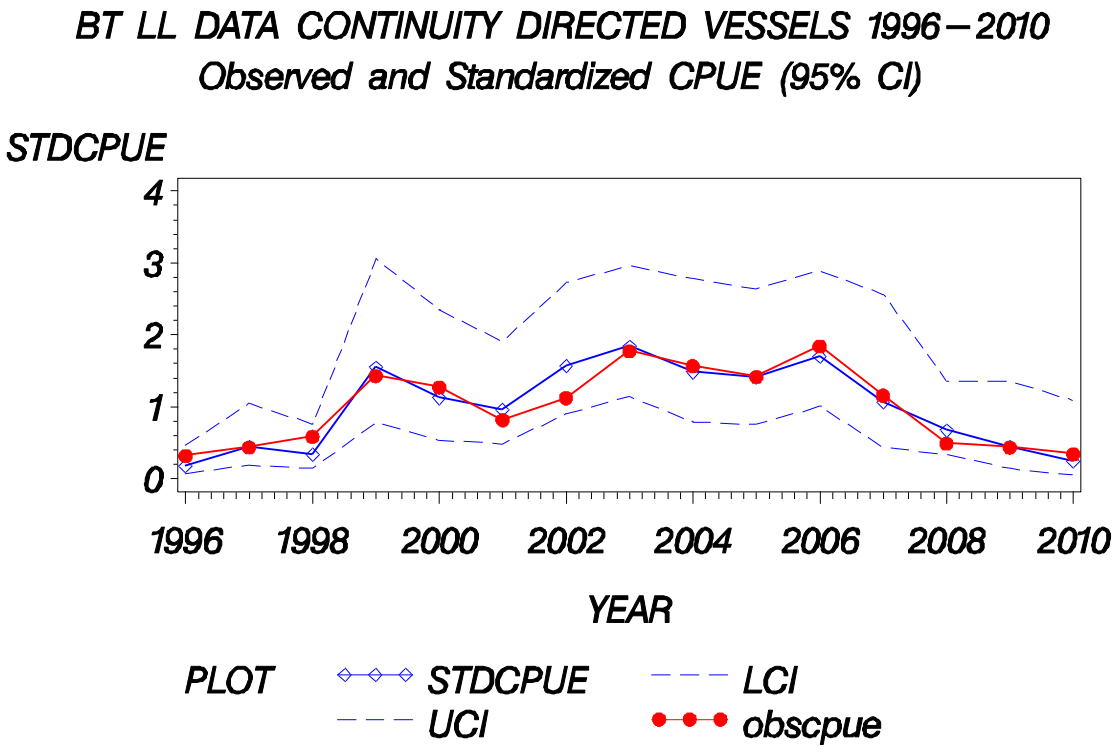


Figure 2B. The 1996-2010 blacktip shark Gulf of Mexico standardized index (blue, open diamonds) and the 1995-2004 standardized index (red, solid squares) constructed for the 2005 assessment.

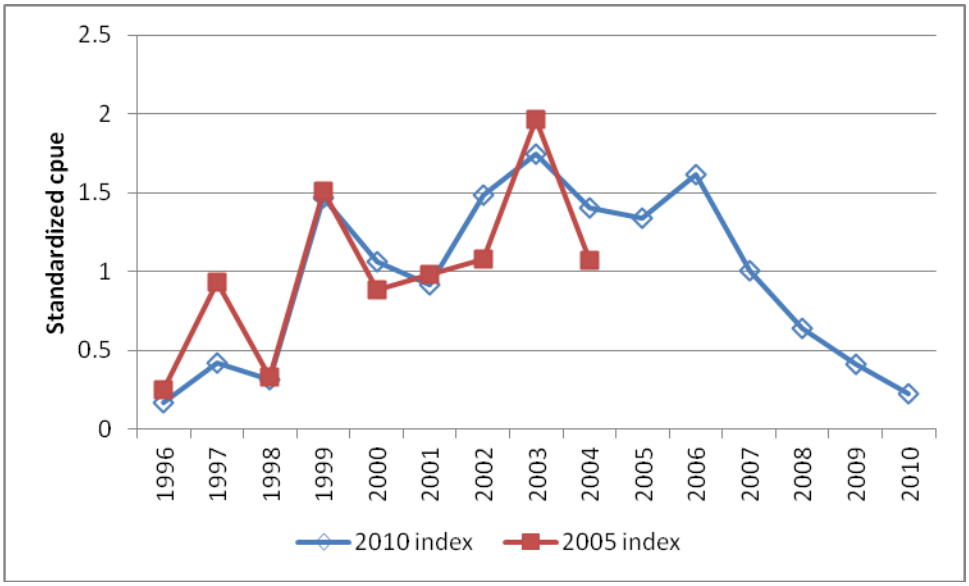


Figure 3A. Blacktip shark South Atlantic nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for commercial vessels fishing bottom longline gear.

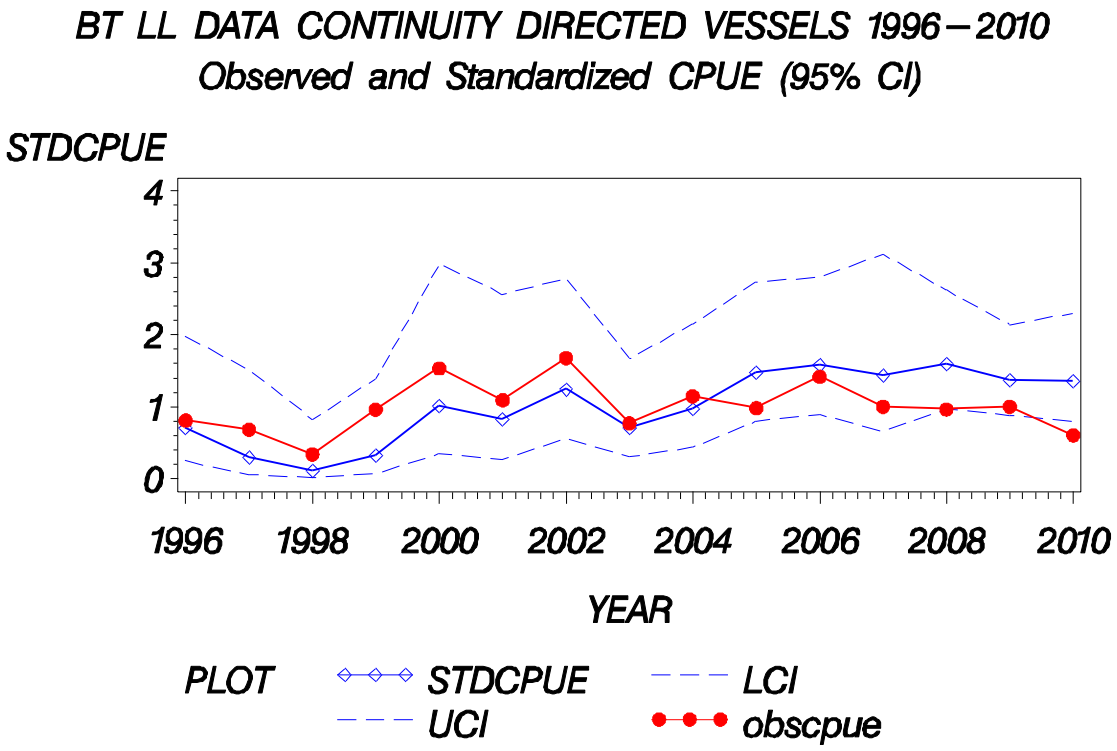


Figure 3B. The 1996-2010 blacktip shark South Atlantic standardized index (blue, open diamonds) and the 1995-2004 standardized index (red, solid squares) constructed for the 2005 assessment.

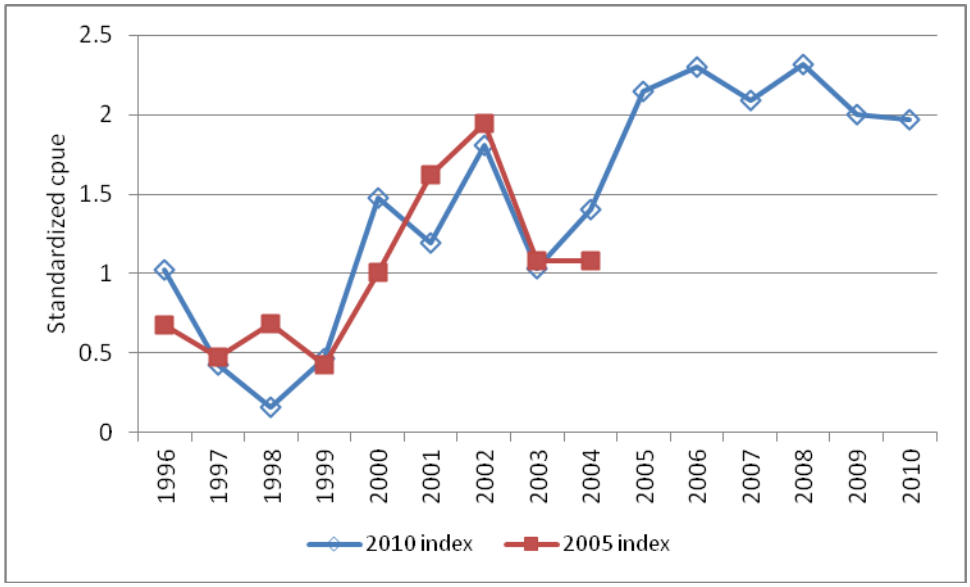


Figure 4. Gulf of Mexico blacktip shark commercial bottom longline gear data set annual trends in **A.** the proportion of positive trips and **B.** nominal CPUE.

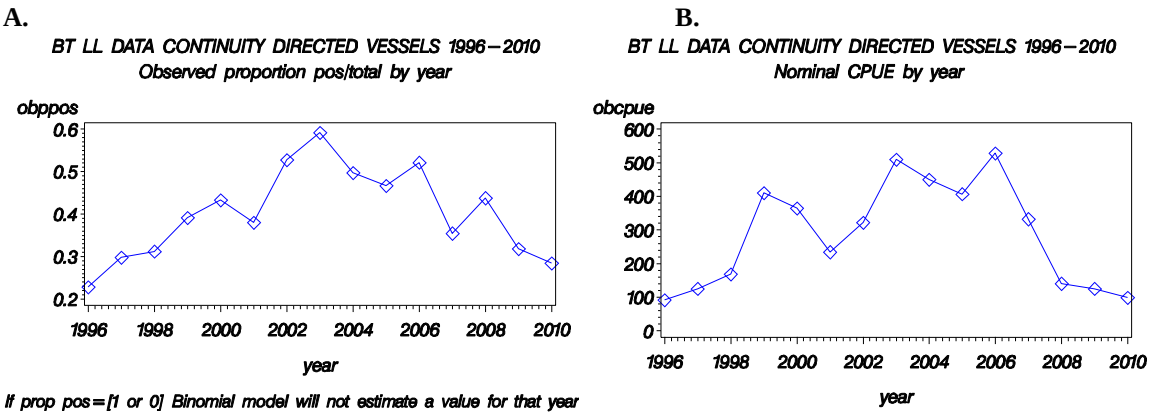


Figure 5. Diagnostic plots for the binomial component of the blacktip shark commercial bottom longline gear Gulf of Mexico model: **A**. the Chi-Square residuals by year and **B**. the Chi-Square residuals by quarter.

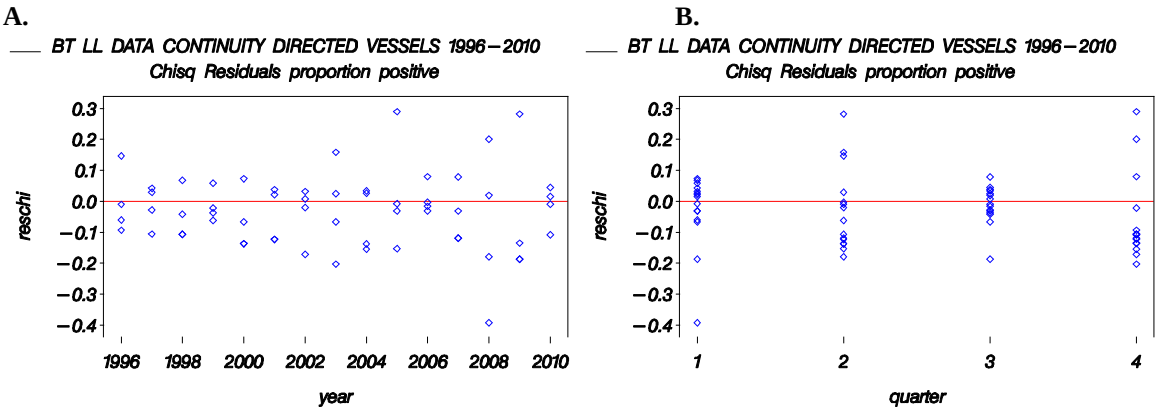


Figure 6. Diagnostic plots for the lognormal component of the Gulf of Mexico blacktip shark commercial bottom longline gear model: **A.** the frequency distribution of log(CPUE) on positive trips, **B.** the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

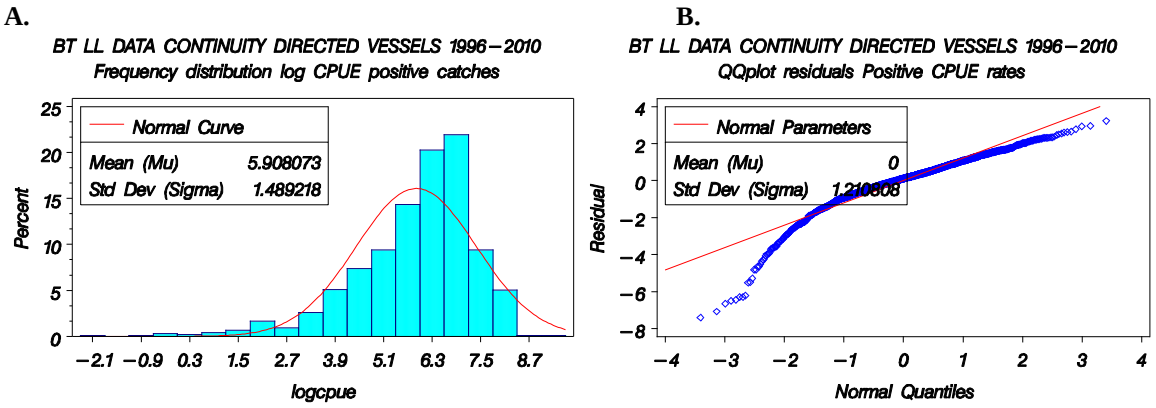


Figure 7. Diagnostic plots for the lognormal component of the Gulf of Mexico blacktip shark commercial bottom longline gear model: **A**. the Chi-Square residuals by year and **B**. the Chi-Square residuals by quarter. The Chi-Square residuals by vessel are not shown due to data confidentiality restrictions.

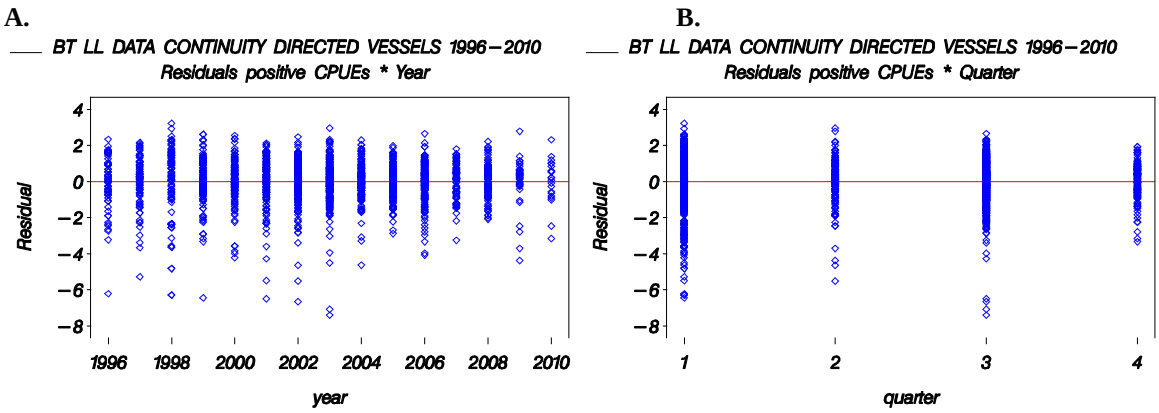
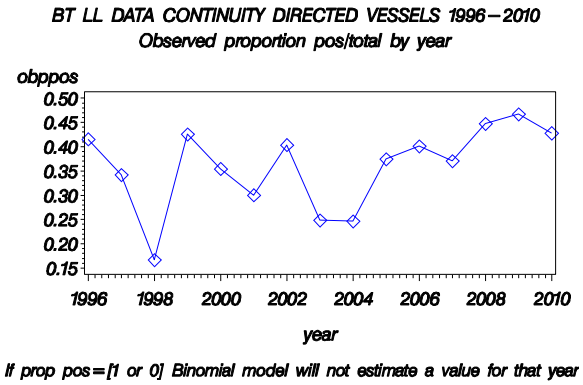


Figure 8. South Atlantic blacktip shark commercial bottom longline gear data set annual trends in **A.** the proportion of positive trips and **B.** nominal CPUE.

A.



B.

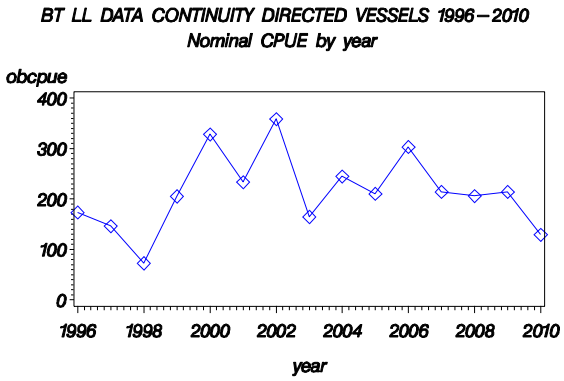


Figure 9. Diagnostic plots for the binomial component of the South Atlantic blacktip shark commercial bottom longline gear South Atlantic model: **A**. the Chi-Square residuals by year. The Chi-Square residuals by vessel are not shown due to data confidentiality restrictions.

A.

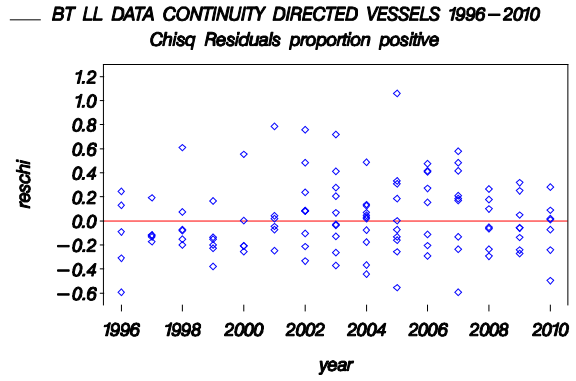
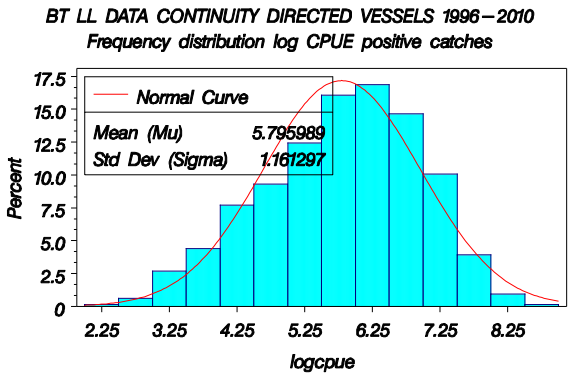


Figure 10. Diagnostic plots for the lognormal component of the South Atlantic blacktip shark commercial bottom longline gear model: **A.** the frequency distribution of log(CPUE) on positive trips, **B.** the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A.



B.

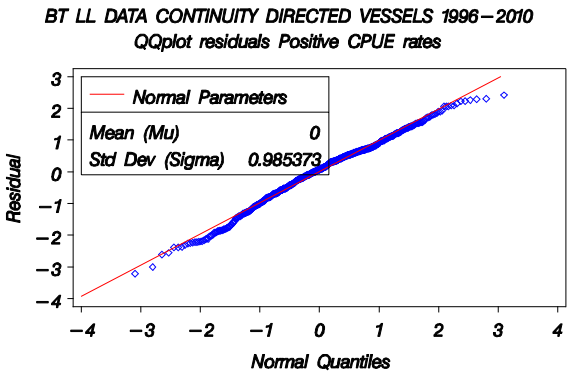


Figure 11. Diagnostic plots for the lognormal component of the South Atlantic blacktip shark commercial bottom longline gear model: **A**. the Chi-Square residuals by year. The Chi-Square residuals by vessel are not shown due to data confidentiality restrictions.

A.