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Standardized discard rates of U.S. Black Sea Bass (*Centropristis striata*) from headboat at-sea observer data

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Abstract

Standardized discard rates were generated from the Southeast headboat at-sea observer data for 2005-2010. The analysis included areas from North Carolina through central Florida. The index describes trends in black sea bass discard rates on board headboat vessels.

Background and Data Description

See SEDAR25-DW01 report for background information on the data provided for this index. The data used for this index were all trips in the headboat at-sea observer database which discarded black sea bass during 2005-2010. The at-sea observer program occurred during 2004-2010 in North and South Carolina, but did not occur in Florida and Georgia in 2004. In addition, after 2007 the Florida Keys were no longer included in the at-sea observer program. Trip-level information included state, county, Florida region, year, month, day, dock to dock hours (total trip hours), the number of hours fished (to the nearest half hour), the total number of anglers on the boat, the number of anglers observed on a trip, the number of black sea bass discarded, minimum depth of the fishing trip, and maximum depth of the fishing trip. Depth information was not collected for South Carolina, North Carolina, and Georgia; therefore, it was not used in this analysis.

Methods

Data treatment

Data from 2004 were dropped from the analysis because the data collected did not include Georgia and Florida. Outliers are currently being investigated and will either be corrected or excluded from the indices following the data workshop.

Subsetting trips

Trips to be included in the computation of the index were based on effort directed at black sea bass, assumed here to be all trips with black sea bass discards. The resulting data set, given the methods described above, contained 871 trips with black sea bass discards.

Response and explanatory variables

DPUE – Discards per unit effort (DPUE) has units of fish/ angler-hour and was calculated as the number black sea bass discarded divided by the product of the number of observed anglers and the number of hours fished. DPUE relative to each explanatory variable is provided in Figure 1. Changes in the minimum size or bag limit did not result in changes in the computation of the discard index. Changes in these limits can be accounted for with selectivity estimation within the assessment model.

YEAR – A summary of the total number of trips with black sea bass effort per year is provided in Table 1.

STATE – State was defined as Florida/Georgia, North Carolina and South Carolina. Total effort (hours) and observed trips by year and state for black sea bass discards are provided in Figure 2 and 3.

SEASON – The seasons were defined as winter (January, February, March), spring (April, May, June), summer (July, August, September) and fall (October, November, December). The total number of trips with black sea bass effort was greatest in spring and summer (Figure 4).

PARTY – Four categories for the number of anglers on a boat were considered in the standardization process. The categories included: ≤ 20 anglers, 21-30 anglers, 31-50 anglers, and > 50 anglers. The total number of observed trips reporting black sea bass discards by party size is provided in Figure 5.

DTD – The number of dock to dock hours was included as a factor with ≤ 8.75 hours representing few hours and > 8.75 hours representing many hours. This factor indicates hours fished.

Standardization

A generalized linear model (GLM) approach was used to model DPUE (cf., Lo et al. 1992; Dick 2004; Maunder and Punt 2004). Fits of lognormal and gamma models for positive DPUE including all main factors were compared using AIC values. The positive portion of the model was fitted with all main effects using both the lognormal and gamma distributions. Stepwise AIC (Venables and Ripley 1997) with a backwards selection algorithm was then used to eliminate those that did not improve model fit for the chosen model. All predictor variables were modeled as fixed effects (and as factors rather than continuous variables). Jackknife estimates of variance were computed using the ‘leave one out’ estimator (Dick 2004). All analyses were performed in the R programming language, with much of the code adapted from Dick (2004).

POSITIVE DPUE MODEL RESULTS

With DPUE as the dependent variable, the gamma distribution (AIC: 1739.01) outperformed the lognormal distribution (AIC: 1789.23). Thus, the gamma model with all factors was used for computing the index. Standard model diagnostics (Figure 6) appeared reasonable for the model using raw residuals. Distribution of total effort (hours), and the number of black sea bass discards by factor in the headboat at sea observer data set used to construct the standardized index are presented in Table 2. Backwards model selection eliminated no variables for both the lognormal and the gamma distributions (Appendix 1).

Index

The distribution of gamma DPUE for the index appeared reasonable (Figure 7). The index is presented in Table 3 and Figure 8.

LITERATURE CITED

- Dick, E.J. 2004. Beyond 'lognormal versus gamma': discrimination among error distributions for generalized linear models. *Fish. Res.* 70:351-366.
- 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.
- Venables, W. N. and B. D. Ripley. 1997. *Modern Applied Statistics with S-Plus*, 2nd Edition. Springer-Verlag, New York.

Table 1. The number of trips by state across years that were observed at sea. Florida and Georgia (FL/GA) were combined due to low sample sizes for GA.

Year	FL/GA	NC	SC	Total
2005	39	70	42	151
2006	33	66	34	133
2007	39	72	41	152
2008	58	64	31	153
2009	47	57	32	136
2010	52	69	25	146
Total	268	398	205	871

Table 2. Distribution of total effort (angler-hr) and discards by factor in the headboat at sea observer data set used to construct the standardized index.

Factor	Effort (angler-hr)	Discards
Year		
2005	7968.5	3465
2006	6250.5	4230
2007	8048.5	5806
2008	9091	5195
2009	7006	6599
2010	8740.5	11749
Season		
fall	9009.5	7973
spring	15452	10629
summer	16448.5	12795
winter	6195	5647
State		
FL/GA	21867.5	13676
NC	16949.5	16142
SC	8288	7226
Party size		
<20	8377	8455
20-30	10209	12423
31-50	14803.5	8665
>50	13715.5	7501
Dock to Dock		
few	30899.5	31657
many	16205.5	5387

Table 3. The relative nominal DPUE, number of trips with positive discards, standardized index, and CV for the black sea bass headboat at sea observer data in the south Atlantic.

Year	Relative nominal DPUE	N	Standardized index	CV (index)
2005	0.556234	151	0.5577	0.111418
2006	0.865678	133	0.808044	0.108747
2007	0.922769	152	0.992652	0.123286
2008	0.730979	153	0.886894	0.118531
2009	1.204866	136	1.061863	0.117956
2010	1.719474	146	1.692846	0.101116

Figure 1. Boxplot of cpue for the explanatory variables year, state, season, party size and dock to dock hours.

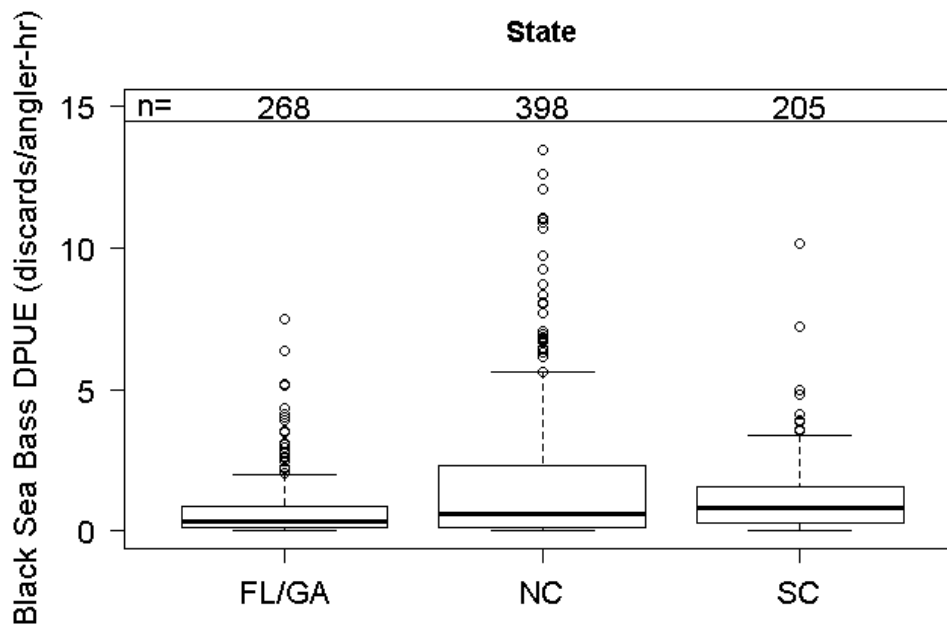
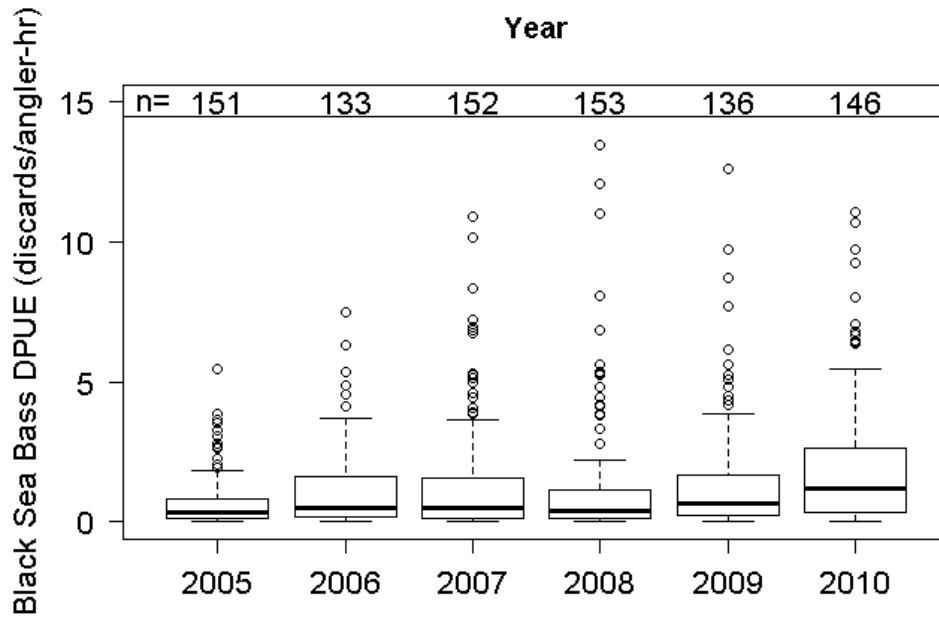


Figure 1. Continued.

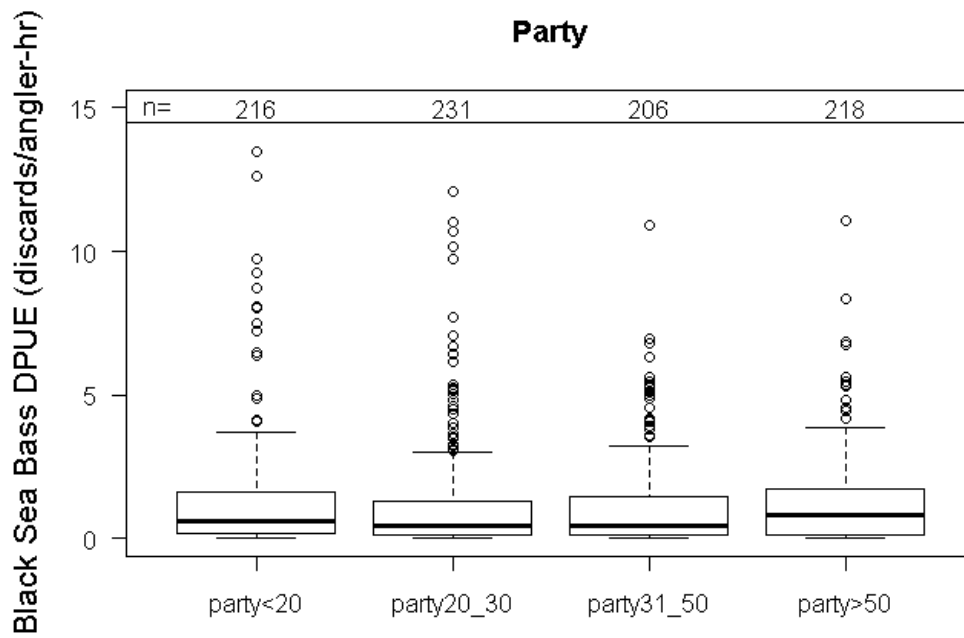
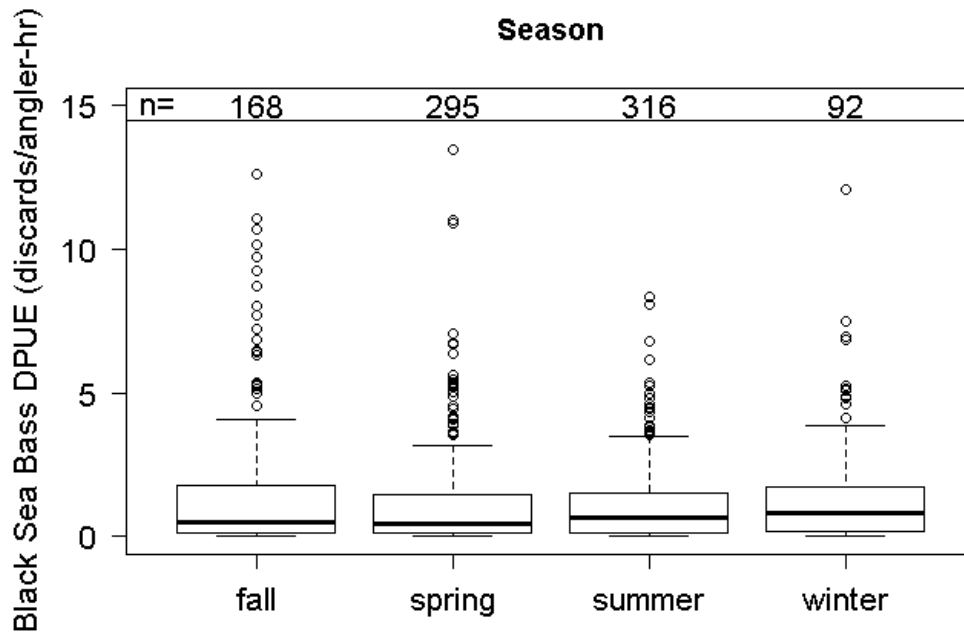


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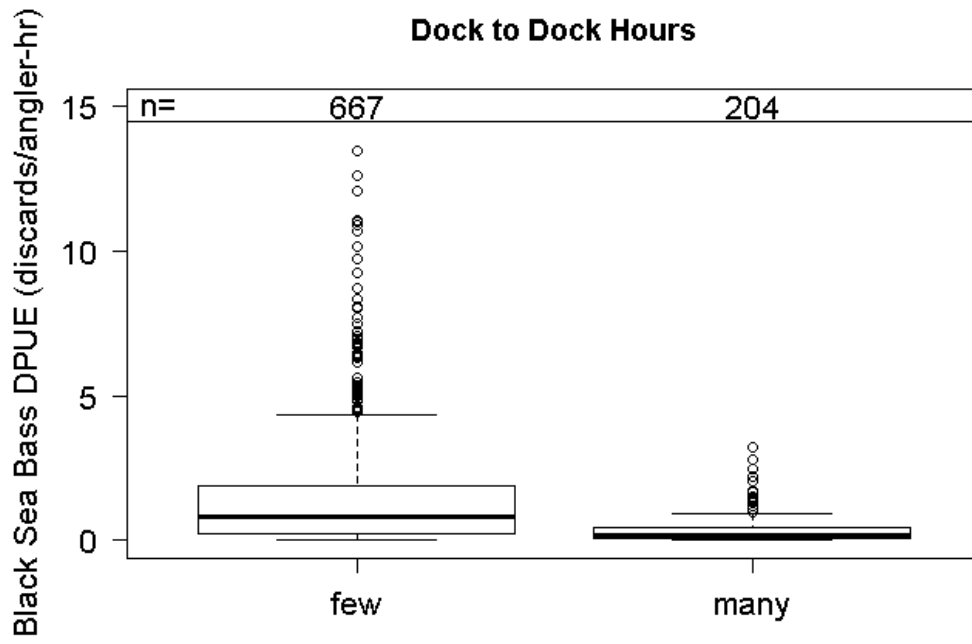


Figure 2. Total effort with black sea bass discards by state.

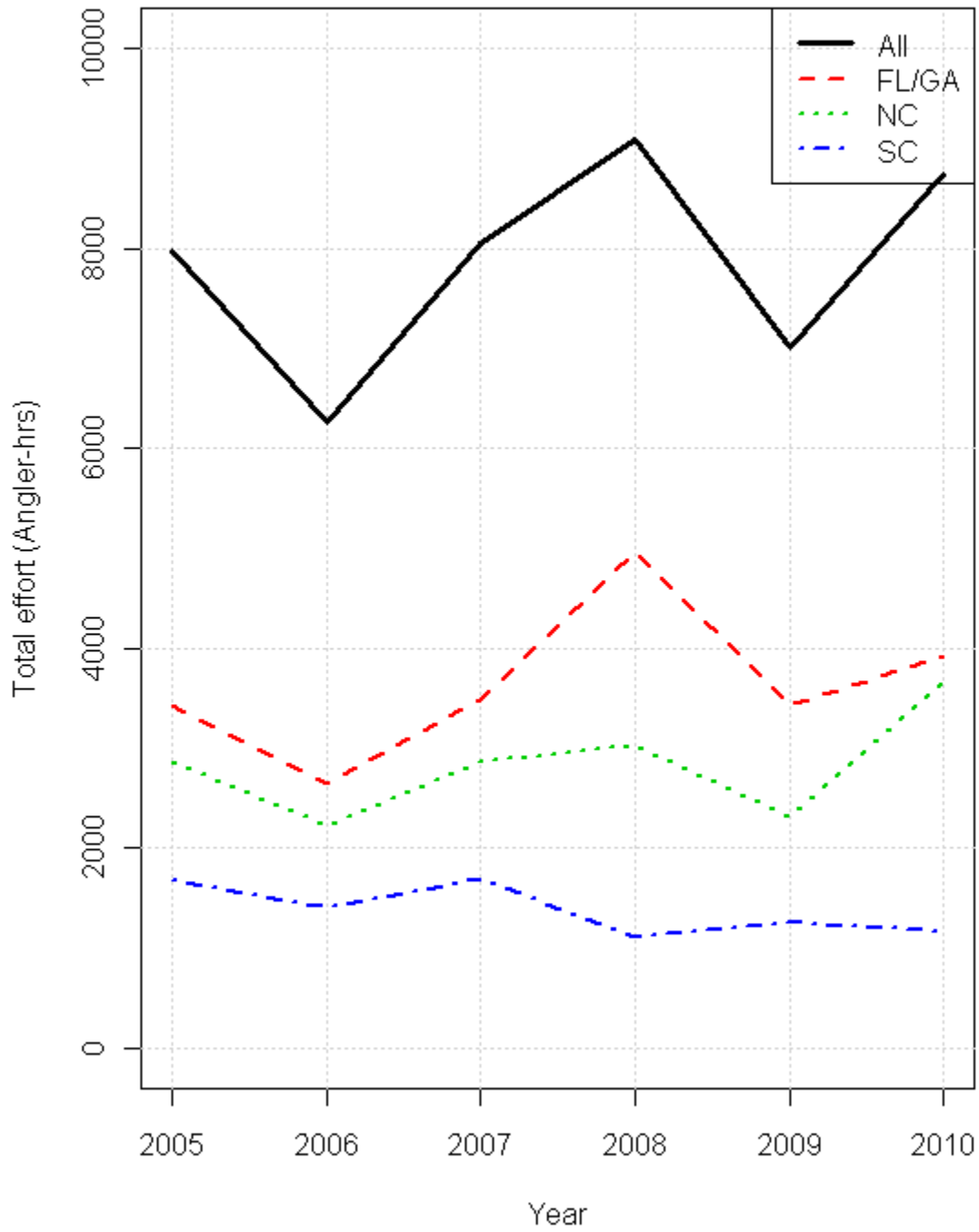


Figure 3. The total number of trips by state that were positive for black sea bass discards.

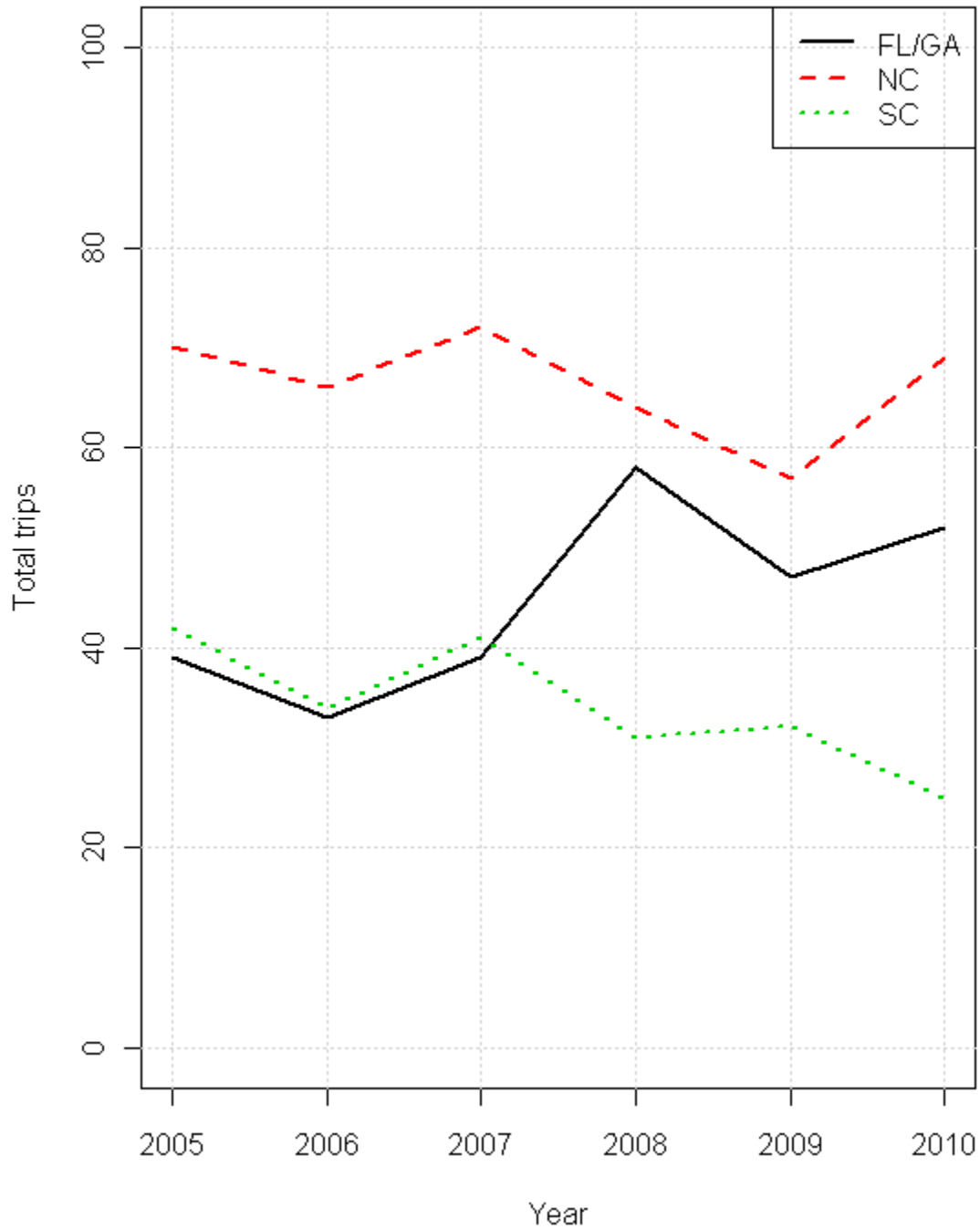


Figure 4. The total number of trips by season which had positive black sea bass discards.

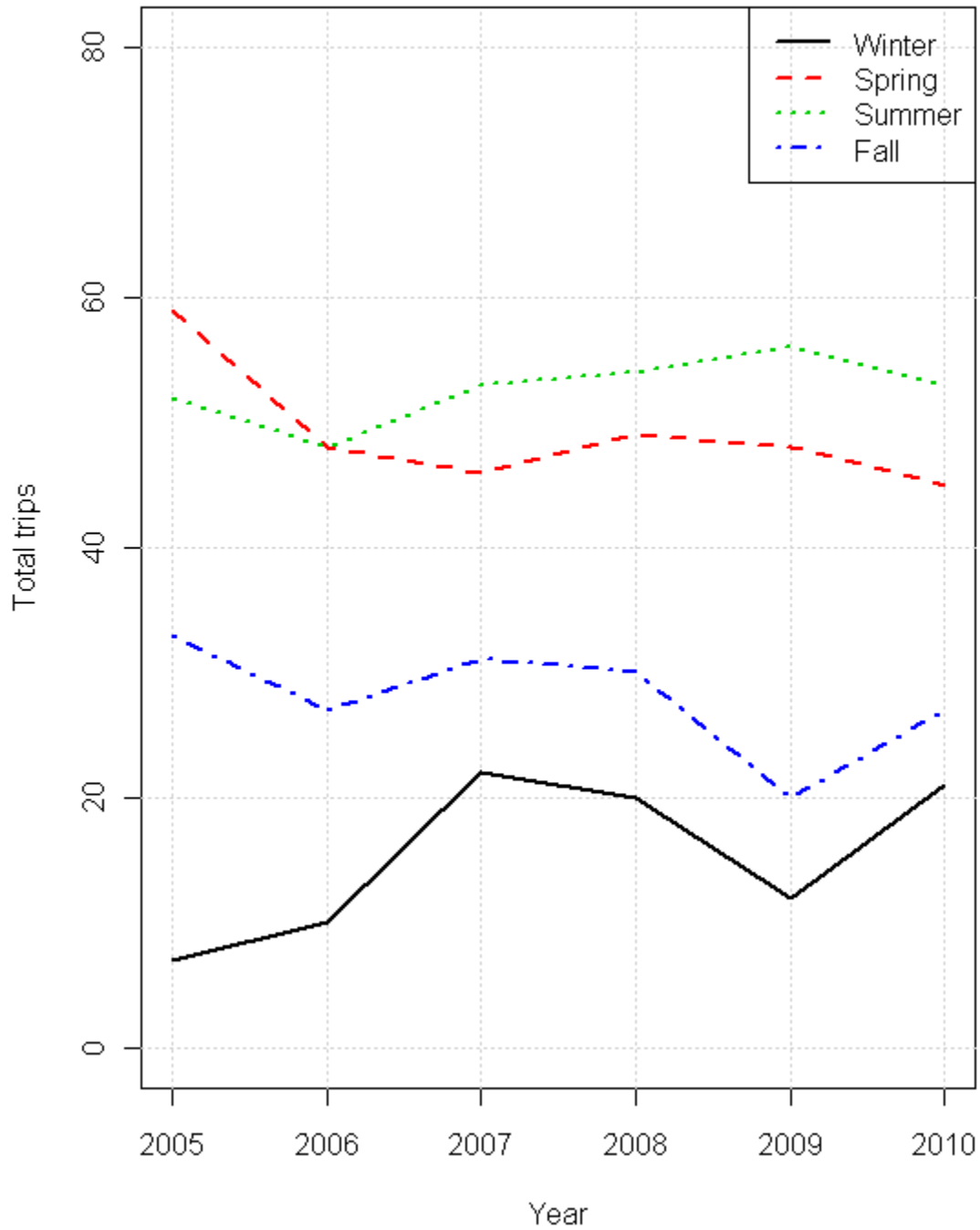


Figure 5. The total number of trips with positive black sea bass discards by party size (≤ 20 anglers, 21-30 anglers, 31-50 anglers and >50 anglers).

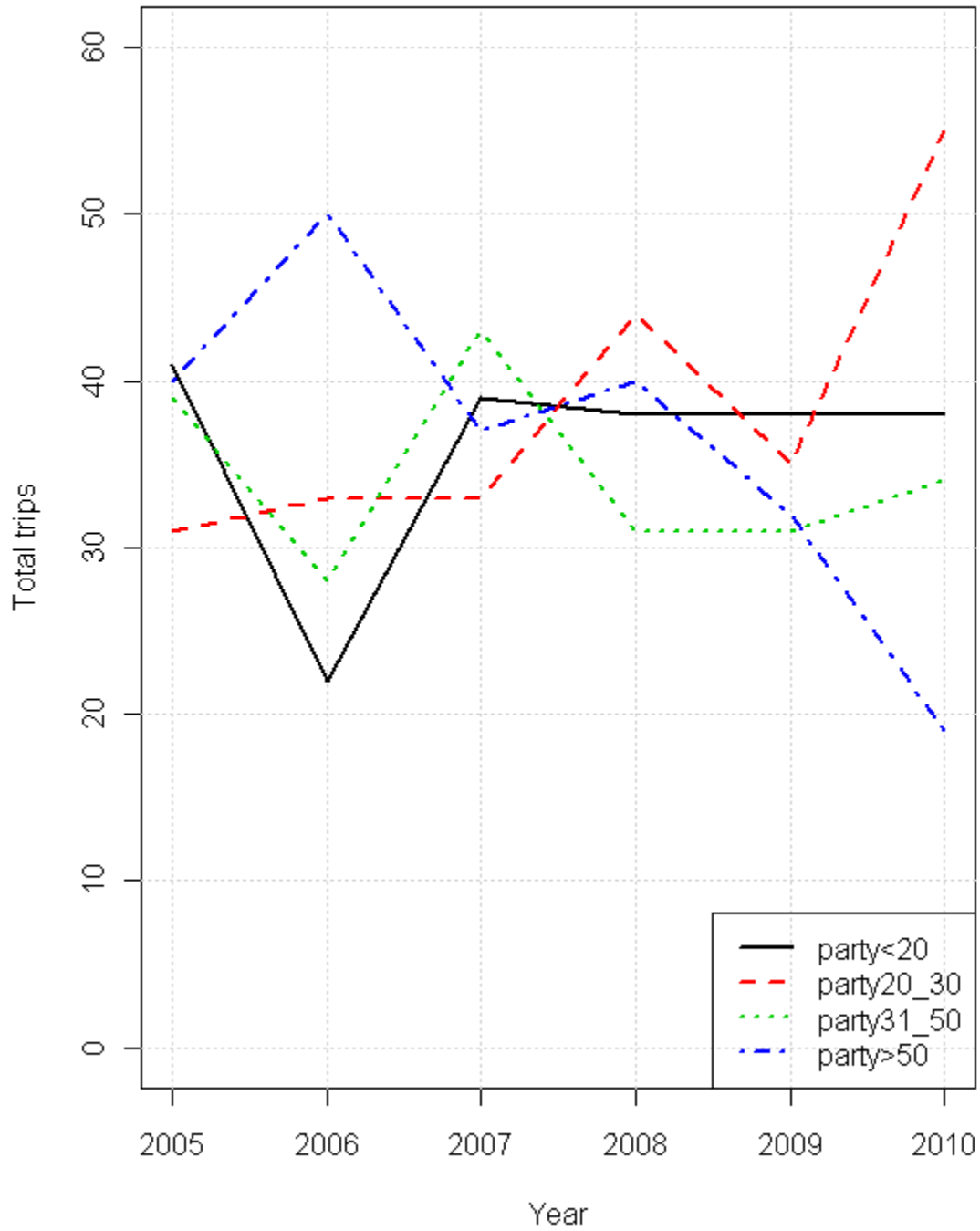


Figure 6. Raw residuals from the positive portion of the index, estimated using a lognormal distribution, across the explanatory variables year, state, season, party, and dock to dock.

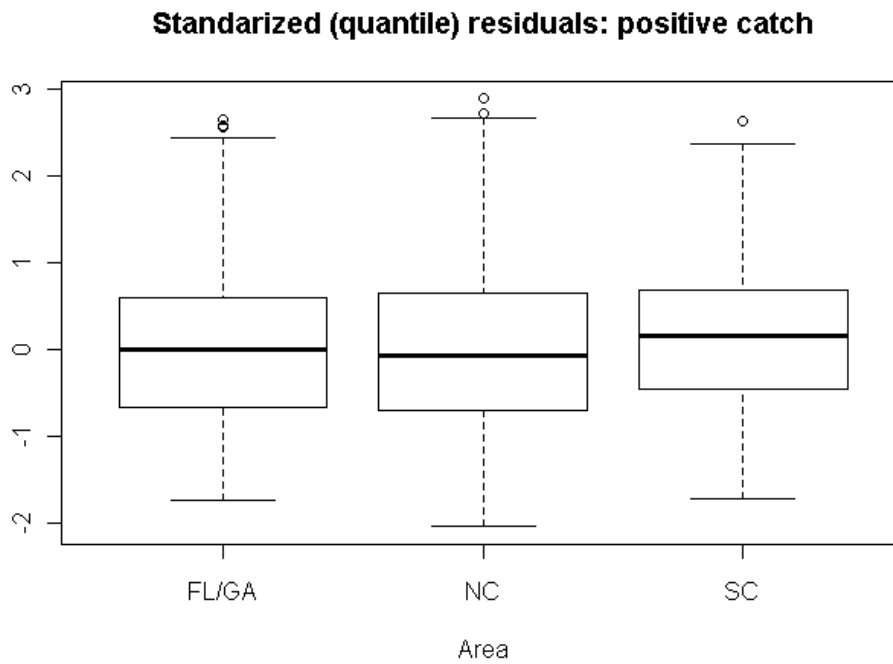
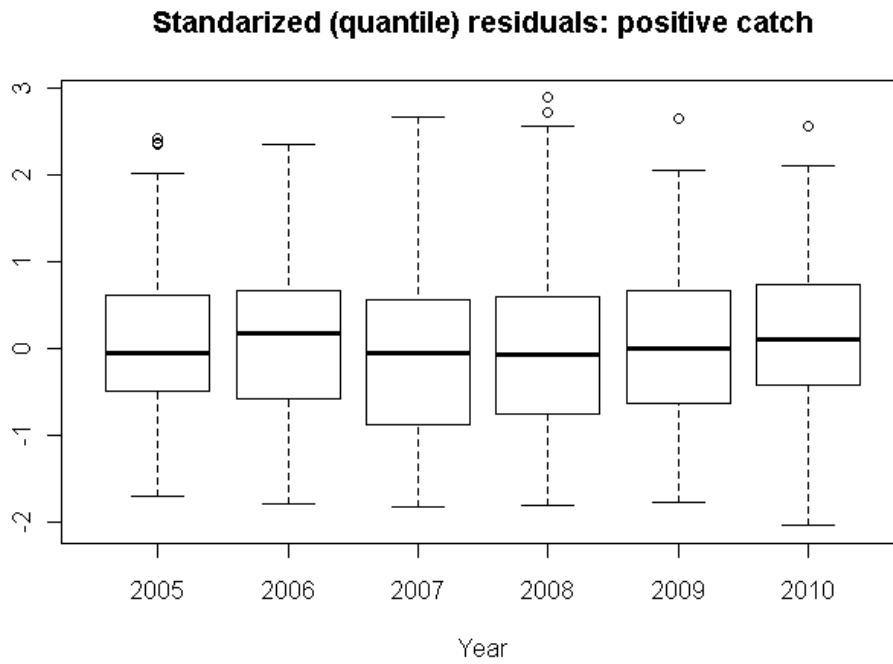


Figure 6. Continued.

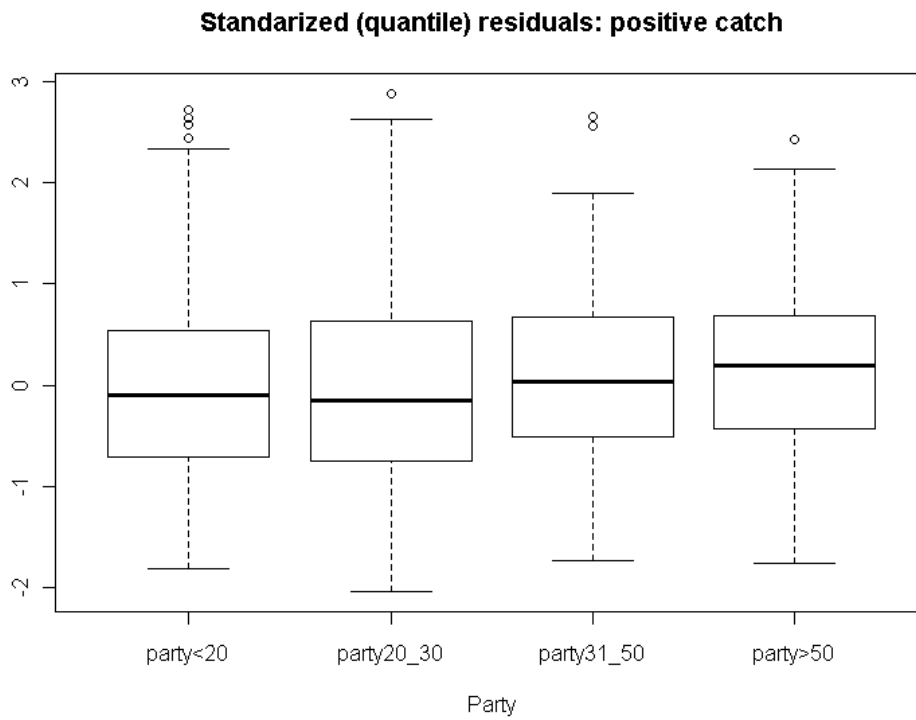
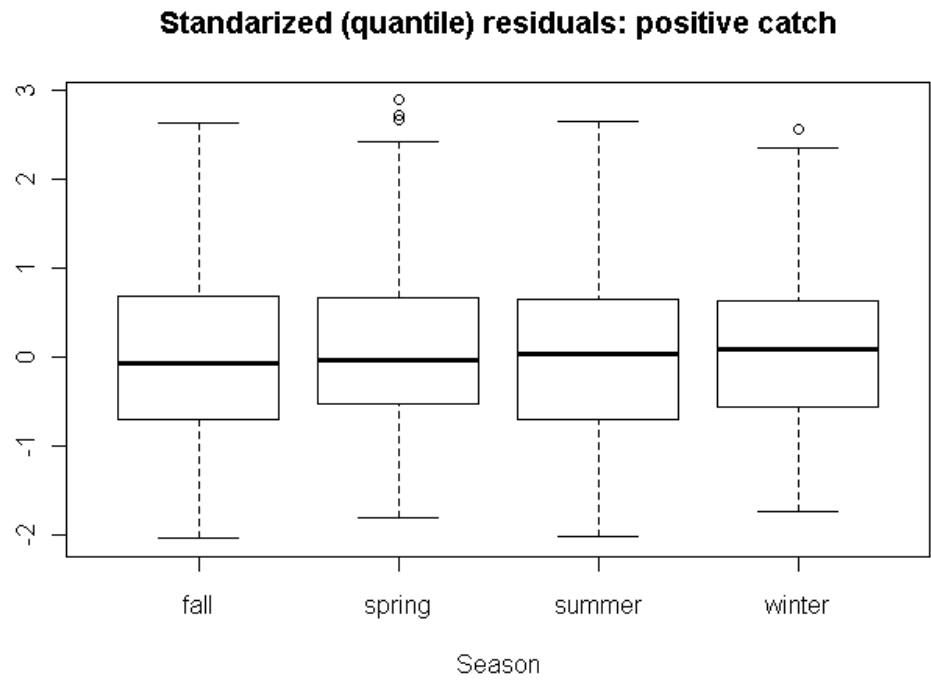


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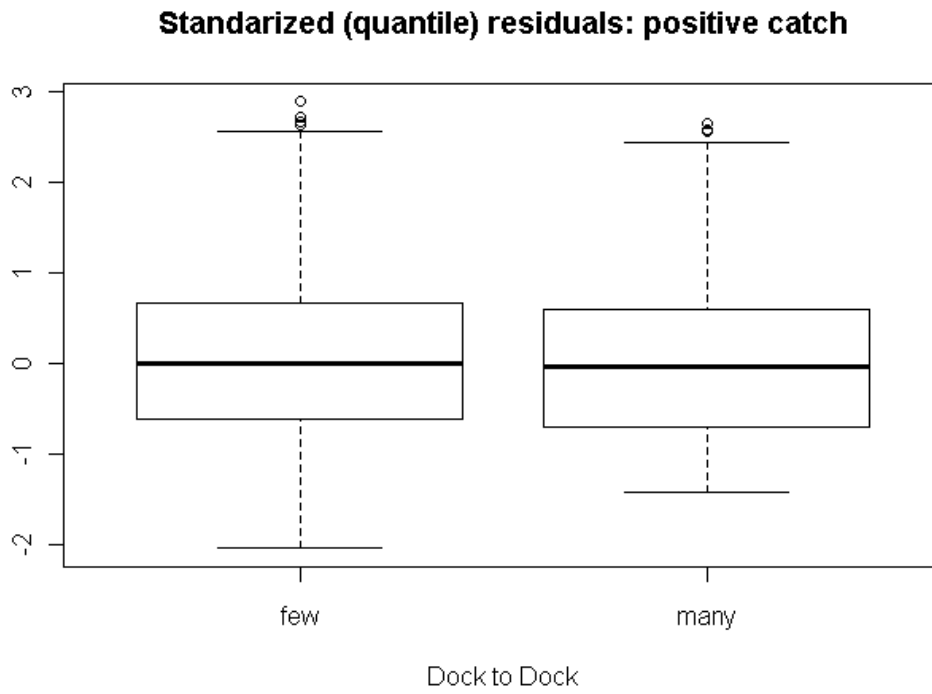


Figure 7. The distribution of gamma DPUE for the south Atlantic black sea bass headboat at sea observer program during 2005-2010.

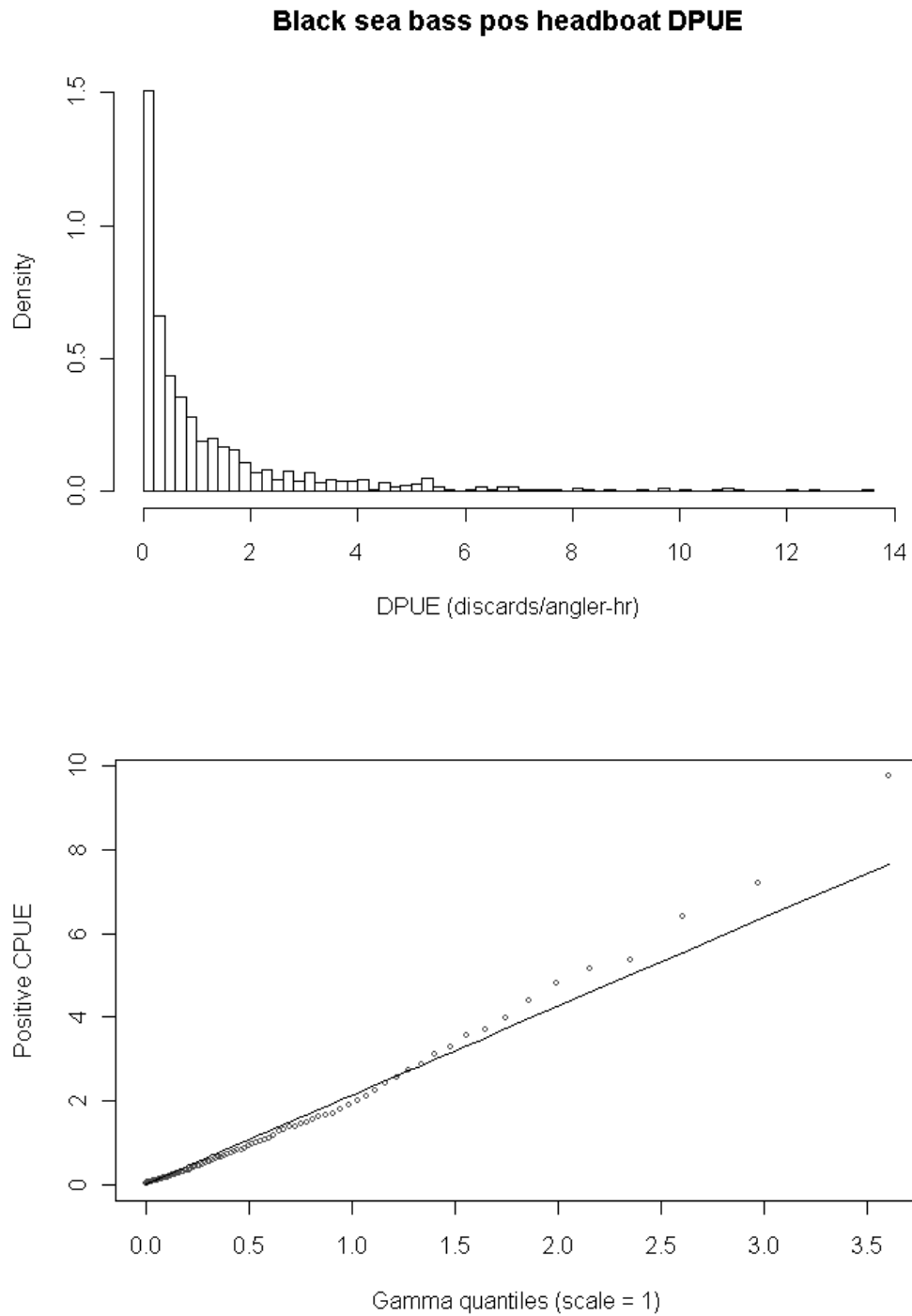
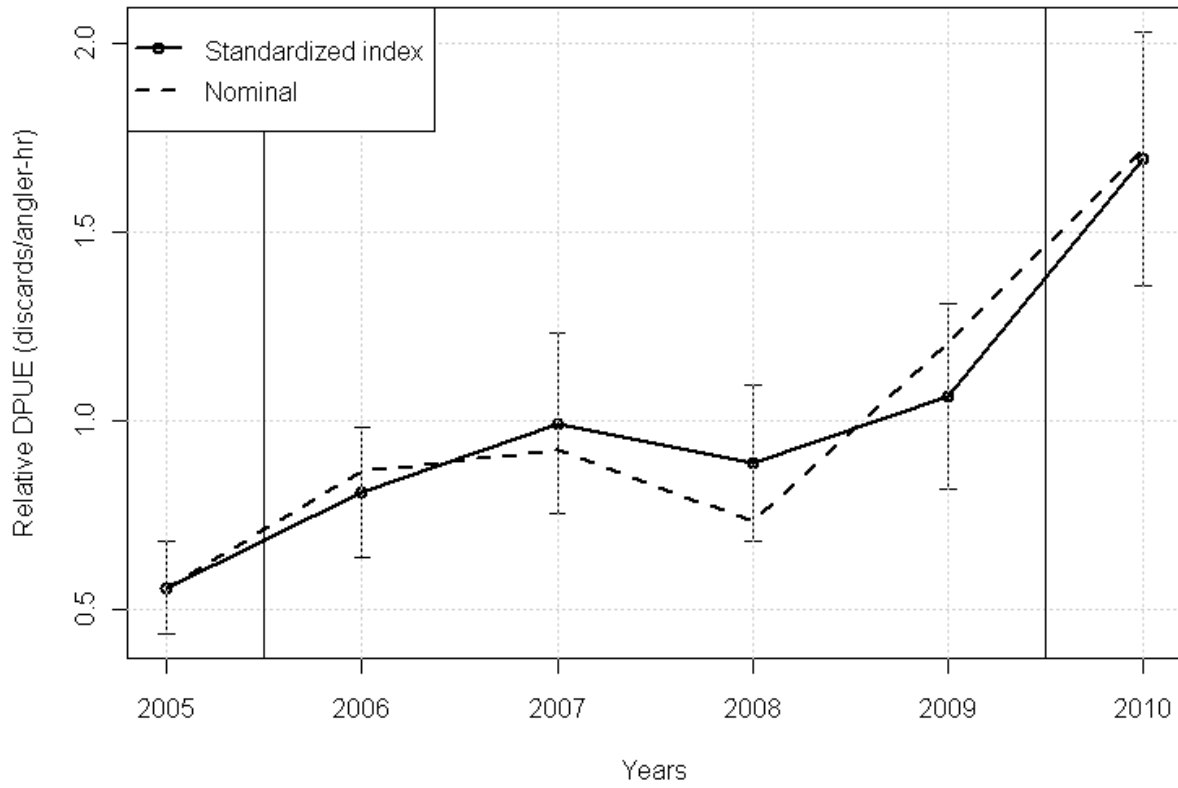


Figure 8. The standardized and nominal DPUE index computed for black sea bass in the south Atlantic using the headboat at sea observer data during 2005-2010. Vertical lines represent management changes that may have affected black sea bass discard. In 2006 bag limit went from 20 to 15 and in 2010 a 240' prohibition of harvest and retention of deepwater fishes was implemented.



Appendix 1. The stepwise AIC output for the lognormal (a), and the gamma (b) distributions

(a) Start: AIC=3170.6

$\log(\text{cpue}) \sim \text{YEAR} + \text{ST} + \text{season} + \text{party} + \text{dtd}$

	Df	Deviance	AIC
<none>		1872.8	3170.6
- season	3	1890.0	3172.6
- party	3	1893.3	3174.1
- ST	2	1902.3	3180.2
- YEAR	5	1975.9	3207.3
- dtd	1	2113.6	3273.9

(b) Start: AIC=1757.55

$\text{cpue} \sim \text{YEAR} + \text{ST} + \text{season} + \text{party} + \text{dtd}$

	Df	Deviance	AIC
<none>		1402.6	1757.5
- season	3	1411.8	1757.7
- party	3	1414.6	1759.5
- ST	2	1435.0	1774.9
- YEAR	5	1492.8	1807.0
- dtd	1	1570.3	1866.1