United States Commercial Longline Vessel Standardized Catch Rates of Yellowedge Grouper (*Epinephelus flavolimbatus*) for Three Regions in the Gulf of Mexico, 1991-2009

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Introduction

The National Marine Fisheries Service (NMFS) has been monitoring commercial landings and fishing effort of federally managed coastal finfishes in the Gulf of Mexico and U.S. South Atlantic through the Southeast Fisheries Science Center's Coastal Fisheries Logbook Program (CFLP). The CFLP collects landings and effort data by fishing trip which is submitted by fishers who own or operate a federally permitted commercial fishing vessel. Most data collected by the CFLP are for fisheries managed by the Gulf of Mexico and South Atlantic Fishery Management Councils. The CFLP began in 1990 to obtain a complete census of the coastal fisheries, with the exception of Florida, where only 20 percent of vessels were selected to report. Beginning in 1993, 100 percent of federally permitted Florida vessels were required to report.

Using the CFLP's available catch per unit effort (CPUE) data, an initial index of abundance was created for yellowedge grouper in the Gulf of Mexico (Baertlein and McCarthy, 2010). However, to assess the possibility of serial depletion of yellowedge grouper in adjacent areas, indices with finer special resolution in the Gulf of Mexico were needed. To accomplish this, the Gulf of Mexico was divided into three regions (statistical areas 2-5, 6-11, and 13-21) and a separate index was constructed for each region. Data were insufficient for index construction on a finer spatial scale.

Methods

Available Data

Longline data used from the CFLP database were described in Baertlein and McCarthy (2010). A modified Stephens and MacCall (Stephens and MacCall, 2004) subsetting technique was used in trip selection (Baertlein and McCarthy, 2010) for each of the three regions. It was found, however, that yellowedge positive trips comprised 100% of the trip selection for some years in region 3 (areas 13-21). This was also the case in the earlier analysis (Baertlein and McCarthy, 2010), but no year had 100% positive trips selected because trip selection was Gulf-wide and index construction, using the delta-lognormal method of Lo, et. al. (1992), was successful. Since the delta-lognormal model fails if one or more years of data include only positive trips, a lognormal model on positive trips was used for index construction in region 3. Figures 2A and 2B provide species-specific Stephens and MacCall regression coefficients for regions 1 and 2.

Index Development

Longline catch rate was calculated in gutted pounds per hook. For each trip, catch per unit effort was calculated as:

CPUE = gutted pounds of yellowedge grouper/ (number of sets *number of hooks per set)

As in previous analyses (Baertlein and McCarthy, 2010), eight factors were considered as possible influences on longline proportion of trips that landed yellowedge grouper and the catch rate of yellowedge grouper. In order to develop a well balanced sample design, the factors were defined as:

Yellowedge grouper longline

Region 1 – Areas 2-5

Factor	Levels	Value
Year	19	1991-2009
Area(*area_cat3*)*	3	Stat areas 2-3, 4, 5 (see Fig 1.)
Days at Sea	3	1-9, 10-13, 14+ days
Distance between Hooks (*hook_cat*)*	2	1-25, 26+ feet
Number of Crew	3	1-2, 3, 4-6 crew members
Season	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Total hooks fished (*hook_cat2*)[1]	3	<18,000; 18,000-33,999; 34,000+ hooks
Longline length	2	<6, 6+ miles

Region 2 – Areas 6-11

Factor	Levels	Value
Year	19	1991-2009
Area(*area_cat3*)*	4	Stat areas 6-7, 8, 9, 10-11 (see Fig 1.)
Days at Sea	3	1-5, 6-8, 9+ days
Distance between Hooks (*hook_cat*)*	2	1-25, 26+ feet
Number of Crew	3	1-2, 3, 4-6 crew members
Season	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Total hooks fished [1]	3	<=8,000; 8,001-18,999; 19,000+ hooks
Longline length	2	<=4, >4 miles

Region 3 – Areas 13-21

Factor	Levels	Value
Year	19	1991-2009
Area(*area_cat3*)*	3	Stat areas 13-15, 16-18, 19-21 (see Fig 1.)
Days at Sea (*away_cat*)*	3	1-5, 6-9, 10+ days
Distance between Hooks (*hook_cat*)*	2	1-25, 26+ feet
Number of Crew	2	1-3, 4-6 crew members
Season	4	Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec
Total hooks fished[1]	3	<=10,000; 10,001-28,999; 29,000+ hooks
Longline length (*length_cat*)*	2	<=4, >4 miles

*Names in parentheses appear in some figures and tables.
[1]Total hooks fished was only tested in the proportion positive analysis.

Significant affects on the proportion of positive trips and on the CPUE of positive trips of the above factors were tested using general linear model (GLM) analyses. For each GLM analysis of proportion positive trips (regions 1 and 2 only), a type-3 model was fit, 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 (all regions), a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was log(CPUE). The response variable of longline data was calculated as: log(CPUE) = ln(pounds of yellowedge grouper/hook). All 2-way interactions among significant main effects were examined. Higher order interaction terms were not examined.

For regions 1 and 2, the final delta-lognormal model was fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute), as described in Baertlein and McCarthy (2010). In region 3 however, only positive trips were included and a lognormal model was used for index construction. The lognormal model was fit using a PROC MIXED SAS procedure (Version 9.2 SAS Institute).

Results and Discussion

The final models for the binomial on proportion positive trips (PPT) and the lognormal on CPUE of successful trips were:

Yellowedge grouper longline 1991-2009:

Region 1 – Areas 2-5:

PPT = Year + Area + Number of Hooks
LOG(CPUE) = Year + Area + Hook Distance + Year*Area

Region 2 – Areas 6-11:

PPT = Year + Area
LOG(CPUE) = Year + Area + Hook Distance + Year*Area + Year*Hook Distance

Region 3 – Areas 13-21:

LOG(CPUE) = Year + Days at Sea + Hook Distance + LL length + Area +
Year*Area + Year*Days at Sea + Year*LL length

The linear regression statistics and analyses of the mixed model formulations of the final models are summarized in Table 1.

Relative nominal CPUE, number of trips, proportion positive trips, and relative abundance index are provided in Table 2. The delta-lognormal (regions 1 and 2) and lognormal (region 3) abundance indices constructed, with 95% confidence intervals, are shown in Figure 3.

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. 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 these data were somewhat skewed from the expected normal distribution. Those variations from the expected fit of the data were not sufficient to violate assumptions of the analyses, although there were high proportion of positive trips in some years. The observed positive yellowedge grouper trips for region 1 ranged from approximately 75 to 96%, and 80 to 99% for region 2. Again, region 3 possessed 100% positive trips for all years.

Yellowedge grouper standardized catch rates for region 1 fell the first two years, remained relatively constant from 1993 through 1999, and generally increased over the remainder of the time series. Coefficients of variation ranged from 0.30-0.53, with higher CVs from 1991-1993, but were generally consistent over the rest of the time series. For region 2, catch rates were lowest in 1993, but had an overall increasing trend through 2008, with peaks in 1997, 2000, 2003, and 2008. However, catch rates in 2009 dropped by 50% from 2008. Coefficients of variation ranged from 0.24-0.38, with higher CVs from 1991-1993, but were generally consistent over the rest of the time series. Catch rates for region 3 were lowest in 1996 and showed an overall increasing trend after 2000. Coefficients of variation remained relative constant throughout the time series, ranging from 0.31-0.37. Results from the previous Gulf-wide analysis (Baertlein and McCarthy, 2010) were most similar to the results of regions 1 and 2. The catch rates remained relatively constant from 1993 through 2002, but rose steadily from 2003 through 2008, and dropped-off in 2009. However, the coefficients of variation from the Gulf-wide model were noticeably lower ranging from 0.15 to 0.23.

Acknowledgements

Thanks to Drs. John Walter and John Quinlan for the valuable discussions, advice, and help regarding methods for identifying yellowedge grouper trips and defining separate regions for analyses.

Literature Cited

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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.

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

Figure 1. Coastal Logbook defined fishing areas.

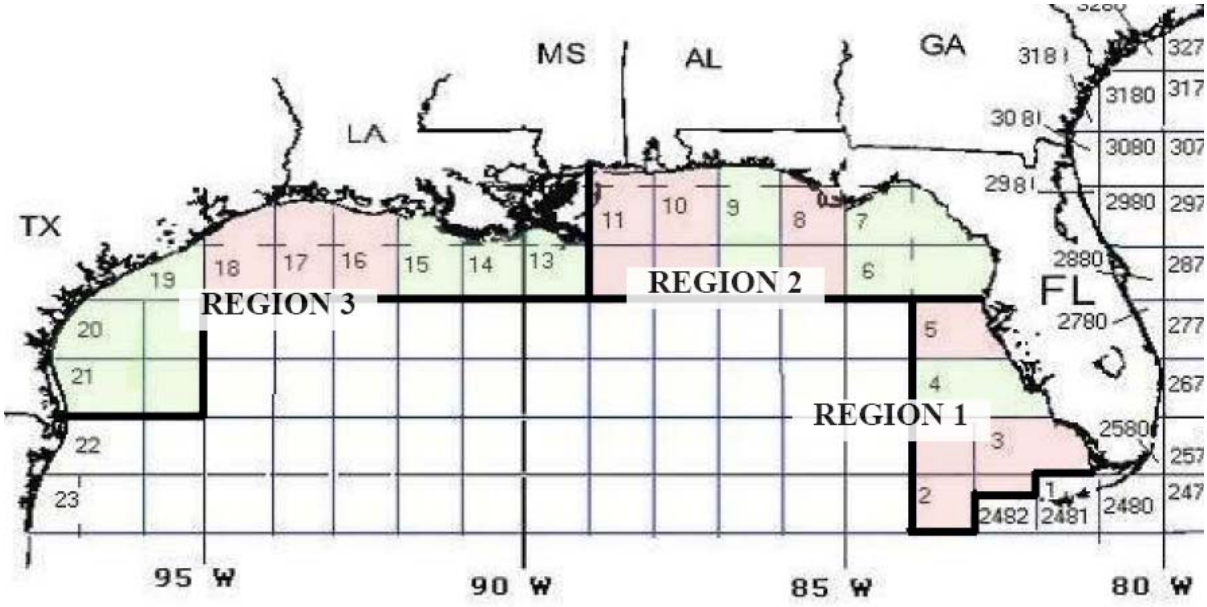


Table 1. (A) Region 1 of the Gulf of Mexico, **(B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico. Linear regression statistics for the GLM models on (**i**) proportion positive trips and (**ii**) catch rates on positive trips of yellowedge grouper in the Gulf of Mexico for vessels reporting longline gear landings 1991-2009. (**iii**) Analysis of the mixed model formulations of the positive trip model. The likelihood ratio was used to test the difference of –2 REM log likelihood between two nested models. The final model is indicated with gray shading. See text for factor (effect) definitions.

A. Region 1 – Areas 2-5

i.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
YEAR	18	145	49.89	2.77	<.0001	0.0004
AREA_CAT3	2	145	22.59	11.29	<.0001	<.0001
HOOK_CAT2	2	145	51.19	25.59	<.0001	<.0001

ii.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
AREA_CAT3	2	36	18.92	9.46	<.0001	0.0005
HOOK_CAT	1	1681	22.37	22.37	<.0001	<.0001
YEAR	18	36	58.41	3.25	<.0001	0.0013

iii.

Catch Rates on Positive Trips	*-2 REM Log likelihood*	*Akaike's Information Criterion*	*Schwartz's Bayesian Criterion*	*Likelihood Ratio Test*	*P*
Year + Area + Hook dist	6281.0	6283.0	6288.5	-	-
*Year + Area + Hook dist + Year*Area*	6273.2	6277.2	6281.3	7.8	0.0052

B. Region 2 – Areas 6-11

i.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
YEAR	18	54	27.98	1.55	0.0624	0.1074
AREA_CAT3	3	54	11.76	3.92	0.0083	0.0133

ii.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
AREA_CAT3	3	54	31.46	10.49	<.0001	<.0001
HOOK_CAT	1	18	21.78	21.78	<.0001	0.0002
YEAR	18	18	29.56	1.64	0.0420	0.1509

iii.

Catch Rates on Positive Trips	*-2 REM Log likelihood*	*Akaike's Information Criterion*	*Schwartz's Bayesian Criterion*	*Likelihood Ratio Test*	*P*
Year + Area + Hook Dist	6223.9	6225.9	6231.5	-	-
*Year + Area + Hook Dist + Year*Area*	6218.4	6222.4	6227.0	5.5	0.0190
*Year + Area + Hook Dist + Year*Area + Year*Hook Dist*	6210.7	6216.7	6223.7	7.7	0.0055

C. Region 3 – Areas 13-21

i. No binomial component for region 3.

ii.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
YEAR	18	18	1.14	0.3914
AWAY_CAT	2	34	8.33	0.0011
HOOK_CAT	1	1268	43.07	<.0001
LENGTH_CAT	1	18	9.92	0.0055
AREA_CAT3	2	36	4.39	0.0197

iii.

Catch Rates on Positive Trips	*-2 REM Log likelihood*	*Akaike's Information Criterion*	*Schwartz's Bayesian Criterion*	*Likelihood Ratio Test*	*P*
Year + Days away + Hook dist + LL length + Area	4149.1	4151.1	4156.3	-	-
*Year + Days away + Hook dist + LL length + Area + Year*Area*	4134.9	4138.9	4143.0	14.2	0.0002
*Year + Days away + Hook dist + LL length + Area + Year*Area + Year*Days away*	4120.3	4126.3	4132.4	14.6	0.0001
*Year + Days away + Hook dist + LL length + Area + Year*Area + Year*Days away + Year*LL length*	**4106.2**	**4114.2**	**4122.4**	**14.1**	**0.0002**

Table 2. Gulf of Mexico Longline relative nominal CPUE, number of trips, proportion positive trips, and relative abundance index for yellowedge grouper (1991-2009) in **(A)** region 1 of the Gulf of Mexico, (**B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico.

A. Region 1 – Areas 2-5

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1991	1.096094	25	0.920000	1.784039	0.782583	4.067043	0.430138
1992	1.669189	15	0.866667	1.335629	0.490386	3.637756	0.534124
1993	0.483380	52	0.750000	0.279304	0.127437	0.612149	0.407931
1994	0.740413	144	0.854167	0.601375	0.325853	1.109863	0.313719
1995	1.407273	97	0.793814	0.591904	0.304592	1.150230	0.341564
1996	0.404959	49	0.755102	0.461769	0.216508	0.984864	0.392714
1997	0.713916	152	0.875000	0.810498	0.448556	1.464492	0.302398
1998	0.604506	148	0.770270	0.619144	0.329421	1.163679	0.323518
1999	0.825079	132	0.787879	0.674633	0.360115	1.263847	0.321765
2000	0.926472	129	0.860465	0.805316	0.429796	1.508932	0.321860
2001	0.782262	149	0.872483	0.719347	0.395765	1.307495	0.305554
2002	1.036139	103	0.766990	0.898862	0.465021	1.737455	0.338675
2003	0.784065	128	0.882813	0.860791	0.466922	1.586905	0.313138
2004	0.947965	131	0.832061	0.805691	0.431574	1.504116	0.319889
2005	1.074405	122	0.803279	1.243503	0.669765	2.308719	0.316933
2006	1.246338	121	0.909091	1.283193	0.709524	2.320689	0.302877
2007	1.433544	121	0.966942	1.719657	0.962833	3.071376	0.296206
2008	1.472504	107	0.915888	1.812173	0.995807	3.297797	0.306198
2009	1.351496	116	0.956897	1.693172	0.946098	3.030161	0.297277

B. Region 2 – Areas 6-11

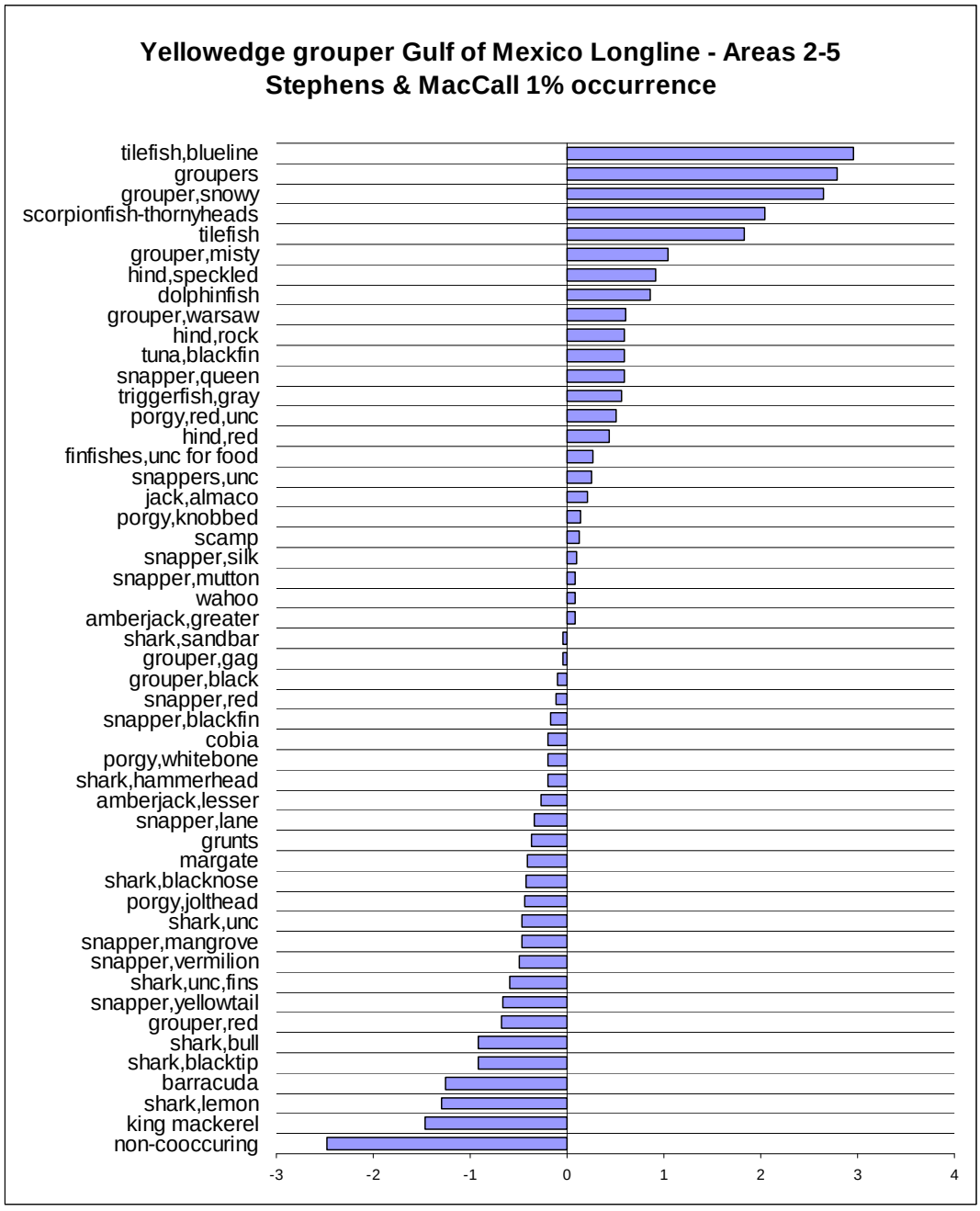
YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1991	1.320395	15	0.866667	1.571786	0.754964	3.272358	0.379324
1992	1.677019	27	0.888889	1.49062	0.800665	2.775128	0.318408
1993	0.635908	40	0.875	0.488758	0.276854	0.862852	0.290024
1994	0.785293	105	0.87619	0.942643	0.575011	1.545318	0.250971
1995	0.794935	126	0.801587	0.824279	0.503863	1.348453	0.249876
1996	0.989027	89	0.898876	0.966403	0.585145	1.596075	0.25486
1997	0.995347	161	0.944099	1.038041	0.646381	1.66702	0.240212
1998	0.680416	129	0.899225	0.634763	0.390269	1.032425	0.246849
1999	0.901865	126	0.84127	0.866008	0.529697	1.415848	0.249554
2000	1.241298	197	0.923858	1.062515	0.662747	1.703424	0.239325
2001	0.792618	187	0.898396	0.694591	0.430892	1.119669	0.242175
2002	0.880859	186	0.924731	0.818837	0.510437	1.313567	0.239646
2003	0.976715	212	0.957547	1.089059	0.682358	1.738164	0.236987
2004	0.849718	103	0.961165	0.88154	0.540763	1.437068	0.248037
2005	0.967547	88	0.954545	0.972883	0.58796	1.609807	0.255847
2006	1.097876	96	0.947917	1.173947	0.713199	1.932352	0.253102
2007	1.319979	112	0.991071	1.239692	0.760345	2.021236	0.24812
2008	1.408766	83	0.927711	1.48181	0.895826	2.451102	0.255673
2009	0.68442	81	0.901235	0.761824	0.458799	1.264989	0.257682

C. Region 3 – Areas 13-21

YEAR	Relative Nominal CPUE	Trips	Proportion Successful Trips	Standardized Index	Lower 95% CI (Index)	Upper 95% CI (Index)	CV (Index)
1991	2.793320	70	1.0	1.705792	0.886086	3.283795	0.336465
1992	1.217380	80	1.0	1.085733	0.558923	2.109082	0.341361
1993	0.941356	80	1.0	1.238205	0.643027	2.384273	0.336607
1994	1.097520	75	1.0	1.191956	0.637289	2.229382	0.320894
1995	1.351630	122	1.0	1.005514	0.544674	1.856264	0.313877
1996	0.612567	62	1.0	0.461612	0.243003	0.876886	0.329261
1997	0.737964	57	1.0	0.572668	0.301808	1.086614	0.328648
1998	0.858529	60	1.0	0.961379	0.511209	1.807965	0.323834
1999	0.857940	136	1.0	0.868225	0.469799	1.604548	0.314456
2000	0.654055	99	1.0	0.627349	0.338443	1.162876	0.316067
2001	1.195622	78	1.0	0.894121	0.479428	1.667512	0.319344
2002	0.526028	78	1.0	0.593116	0.316202	1.112536	0.322444
2003	0.543252	96	1.0	0.856225	0.449426	1.631239	0.330833
2004	0.501382	73	1.0	0.877822	0.454687	1.69473	0.338017
2005	0.703354	69	1.0	1.462568	0.740608	2.888308	0.350327
2006	0.485282	50	1.0	1.205926	0.60202	2.415631	0.358102
2007	0.706720	29	1.0	0.815495	0.397455	1.673225	0.371277
2008	1.342341	39	1.0	1.094302	0.558137	2.145526	0.3464
2009	1.873758	28	1.0	1.481993	0.729264	3.011673	0.365994

Figure 2. Regression coefficients from the Stephens & MacCall analyses. Positive coefficients signify species that had positive associations with the target species. The magnitude of the coefficients indicates the predictive impact of each species. The value for "non-cooccurring" is the regression intercept and denotes the probability a trip was fishing in the target species' habitat, but did not report any of the listed species. Species included were reported on at least one percent of longline trips in **(A)** region 1 of the Gulf of Mexico and **(B)** region 2 of the Gulf of Mexico. Stephens & MacCall selected trips for region 3 of the Gulf of Mexico were not used.

A.



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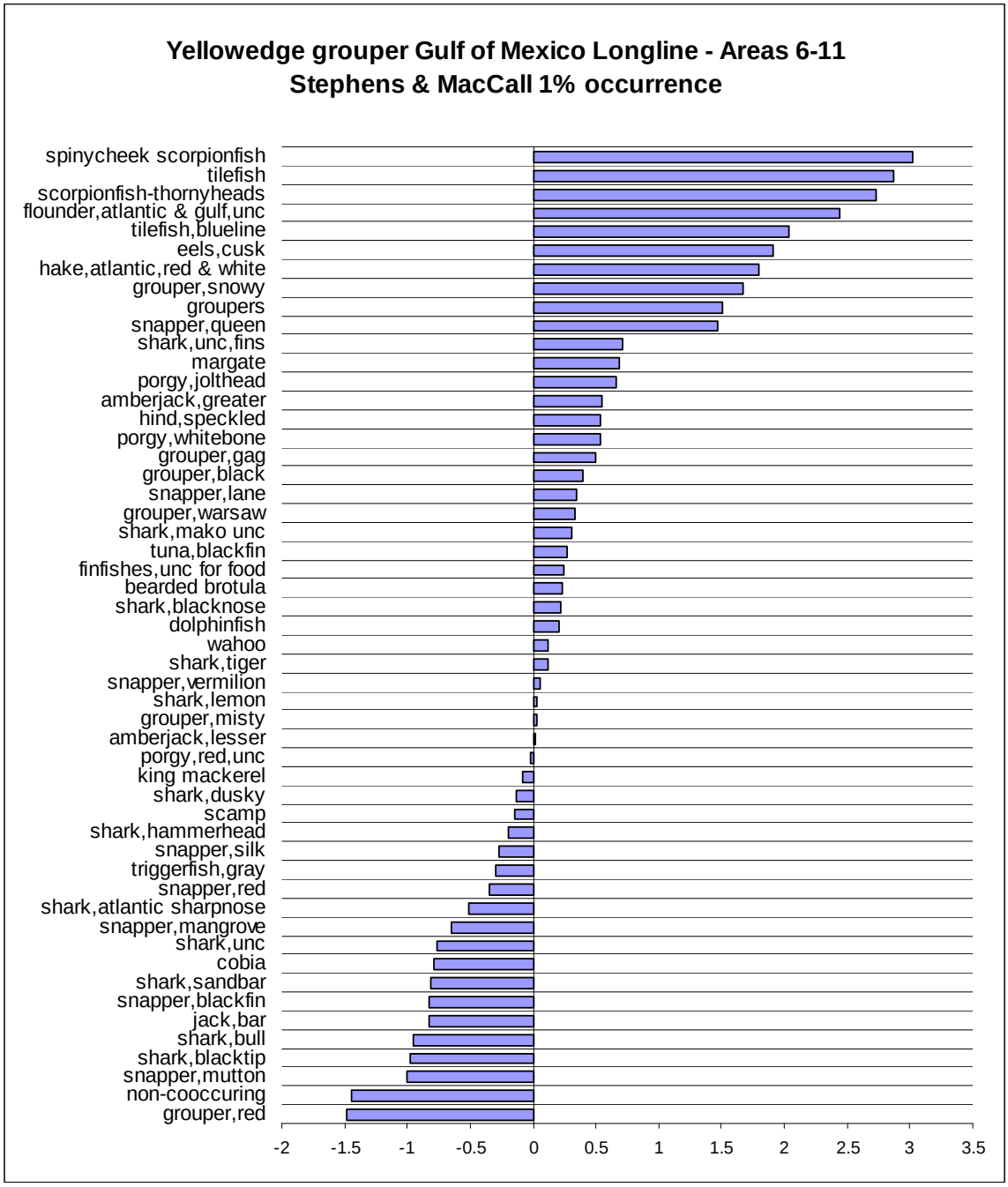
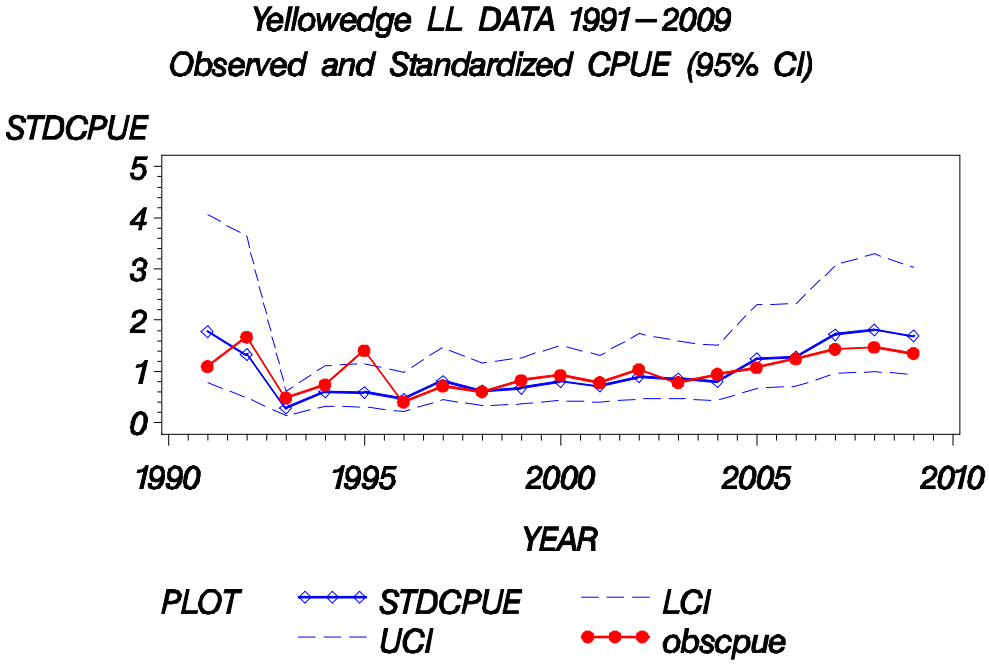
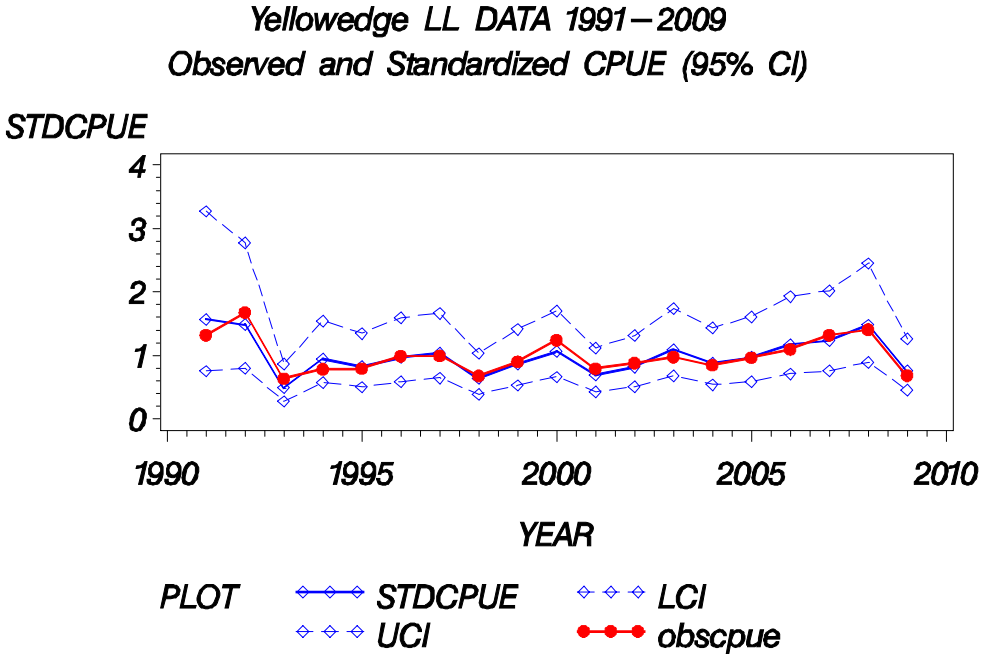

Yellowedge grouper Gulf of Mexico Longline - Areas 6-11
Stephens & MacCall 1% occurrence
spinycheek scorpionfish
tilefish
scorpionfish-thornyheads
flounder,atlantic & gulf,unc
tilefish,blueline
eels,cusk
hake,atlantic,red & white
grouper,snowy
groupers
snapper,queen
shark,unc,fins
margate
porgy,jolthead
amberjack,greater
hind,speckled
porgy,whitebone
grouper,gag
grouper,black
snapper,lane
grouper,warsaw
shark,mako unc
tuna,blackfin
finfishes,unc for food
bearded brotula
shark,blacknose
dolphinfish
wahoo
shark,tiger
snapper,vermilion
shark,lemon
grouper,misty
amberjack,lesser
porgy,red,unc
king mackerel
shark,dusky
scamp
shark,hammerhead
snapper,silk
triggerfish,gray
snapper,red
shark,atlantic sharpnose
snapper,mangrove
shark,unc
cobia
shark,sandbar
snapper,blackfin
jack,bar
shark,bull
shark,blacktip
snapper,mutton
non-cooccuring
grouper,red
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5

Figure 3. Yellowedge grouper nominal CPUE (solid circles), standardized CPUE (open diamonds) and upper and lower 95% confidence limits of the standardized CPUE estimates (dashed lines) for vessels fishing longline gear in **(A)** region 1 of the Gulf of Mexico, **(B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico.

A. Region 1 – Areas 2-5



B. Region 2 – Areas 6-11



C. Region 3 – Areas 13-21

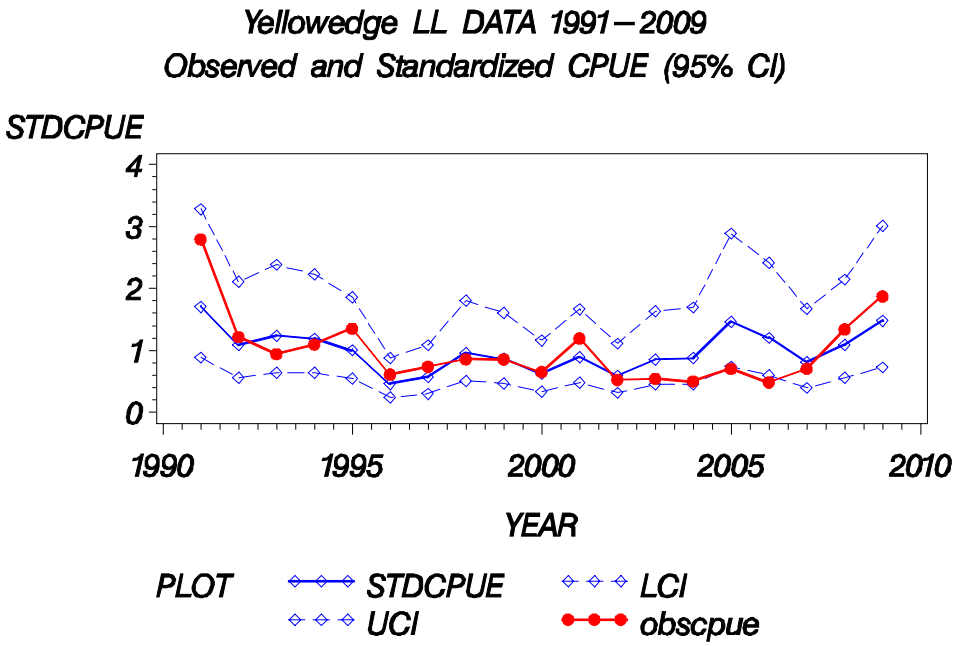
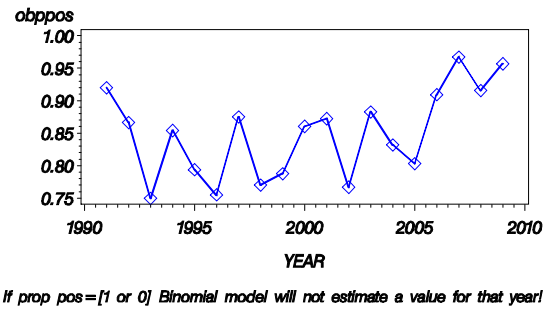


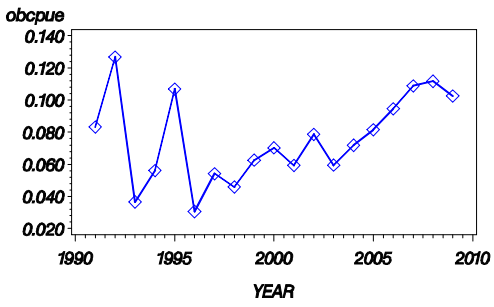
Figure 4. Annual trend in **(i)** the proportion of positive trips and **(ii)** nominal CPUE for 1991-2009 yellowedge grouper commercial longline gear model in **(A)** region 1 of the Gulf of Mexico, **(B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico.

A. Region 1 – Areas 2-5

i.

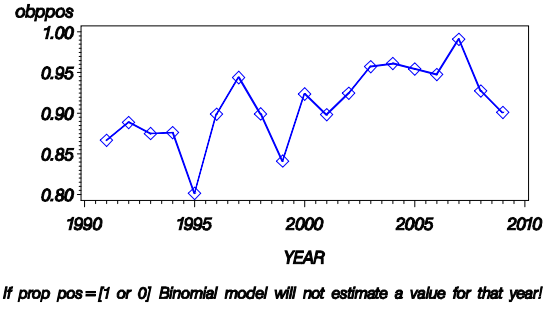


ii.

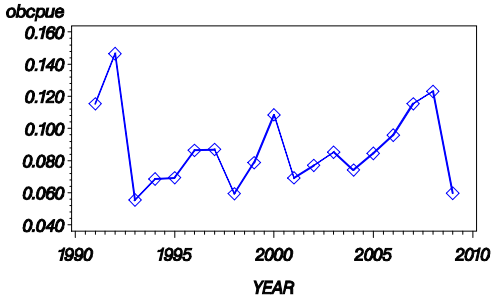


B. Region 2 – Areas 6-11

i.



ii.



C. Region 3 – Areas 13-21

i. No binomial component for region 3.

ii.

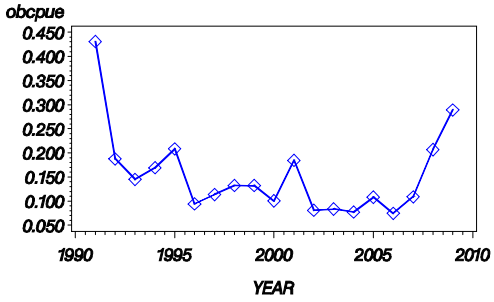
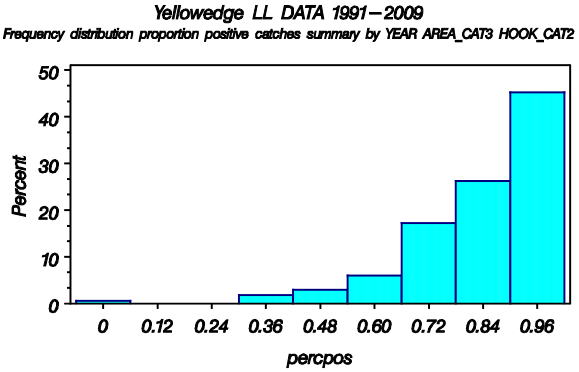


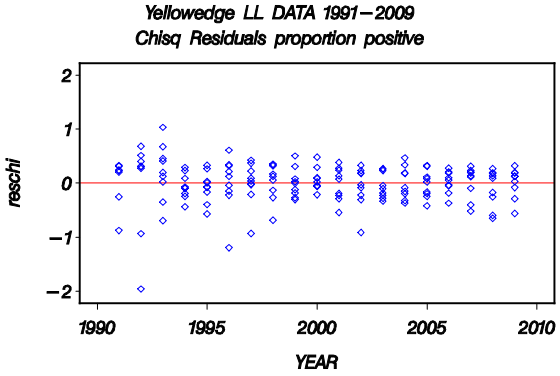
Figure 5. Diagnostic plots for the binomial component of **(A)** region 1 of the Gulf of Mexico and **(B)** region 2 of the Gulf of Mexico 1991-2009 yellowedge grouper commercial longline gear mode: **(i)** the frequency distribution of the proportion positive trips; (**ii)** the Chi-Square residuals by year; (**iii)** the Chi-Square residuals by area (area_cat3); and **(iv)** the Chi-Square residuals by total number of hooks fished (hook_cat2) (region 1 only).

A. Region 1 – Areas 2-5

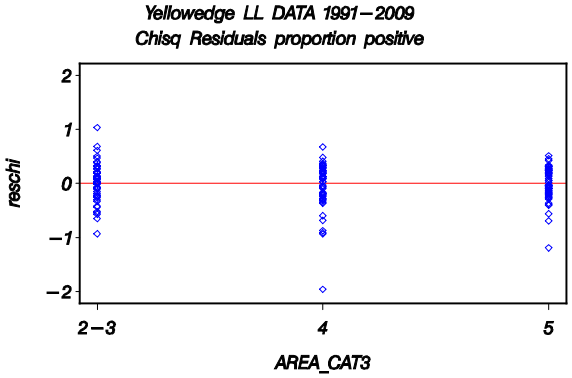
i.



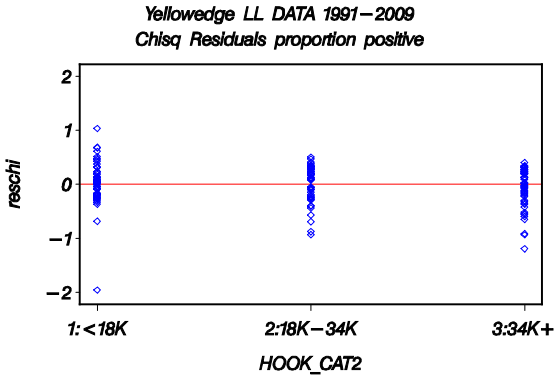
ii.



iii.

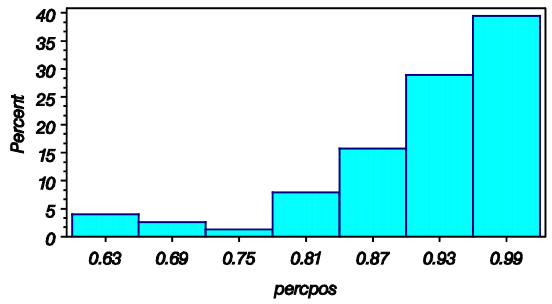


iv.

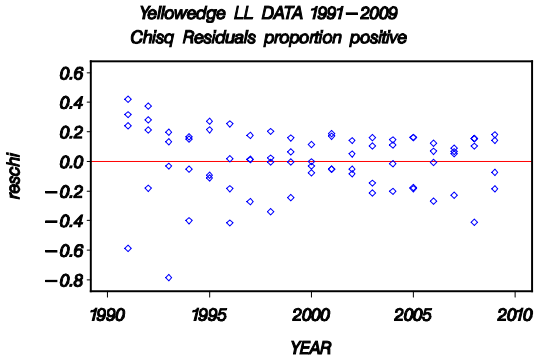


B. Region 2 – Areas 6-11

i.



ii.



iii.

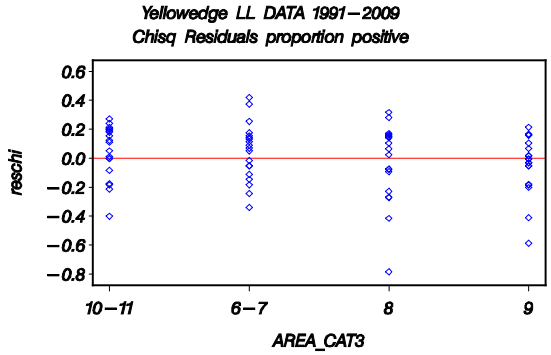
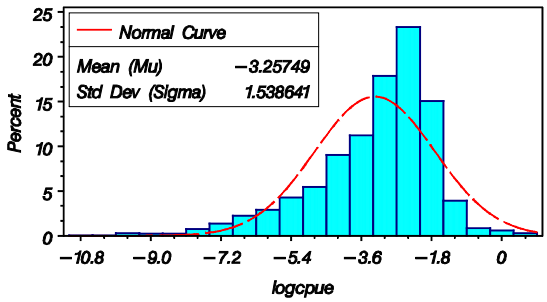


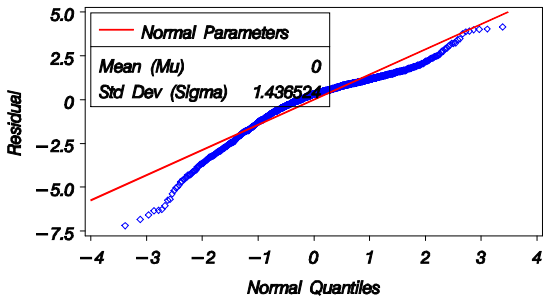
Figure 6. Diagnostic plots for the lognormal component of **(A)** region 1 of the Gulf of Mexico, **(B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico 1991-2009 yellowedge grouper commercial longline gear model: **(i)** the frequency distribution of log(CPUE) on positive trips, **(ii)** the cumulative normalized residuals (QQ-Plot) from the lognormal model. The red line is the expected normal distribution.

A. Region 1 – Areas 2-5

i.

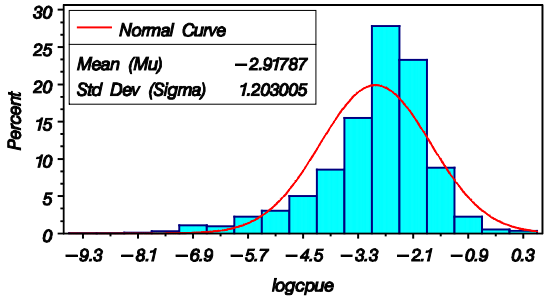


ii.

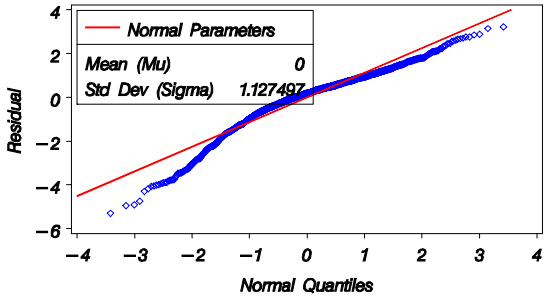


B. Region 2 – Areas 6-11

i.

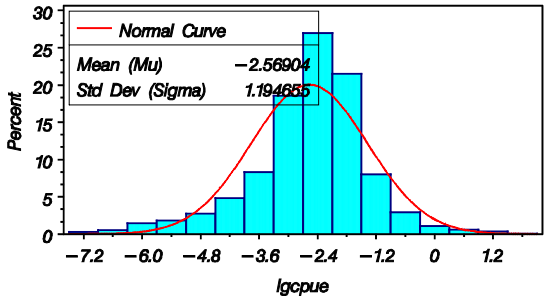


ii.



C. Region 3 – Areas 13-21

i.



ii.

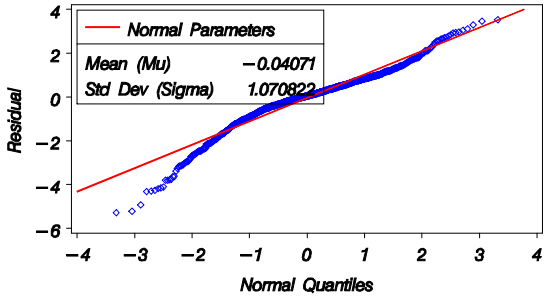
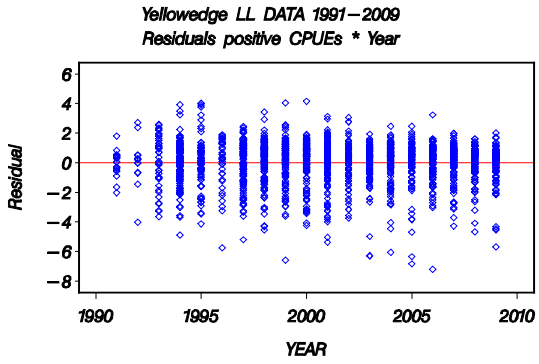


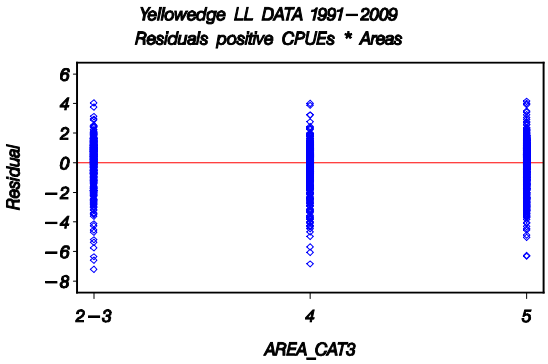
Figure 7. Diagnostic plots for the lognormal component of **(A)** region 1 of the Gulf of Mexico, **(B)** region 2 of the Gulf of Mexico, and **(C)** region 3 of the Gulf of Mexico 1991-2009 yellowedge grouper commercial longline gear model: **(i)** the Chi-Square residuals by year; **(ii)** the Chi-Square residuals by area (area_cat3); **(iii)** the Chi-Square residuals by distance between hooks (hook_cat). For region 3 only: **(iv)** the Chi-Square residuals by length of longline (length_cat) and **(v)** the Chi-Square residuals by days at sea (away_cat).

A. Region 1 – Areas 2-5

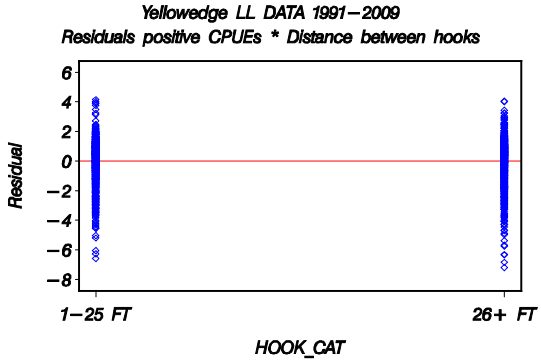
i.



ii.

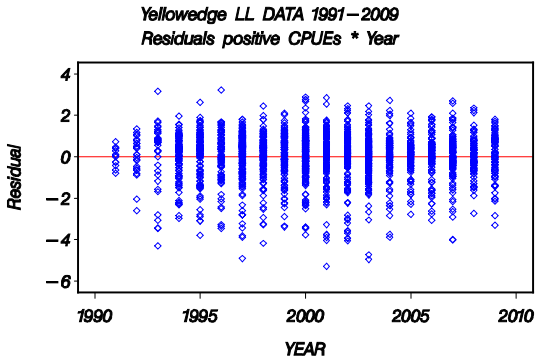


iii.

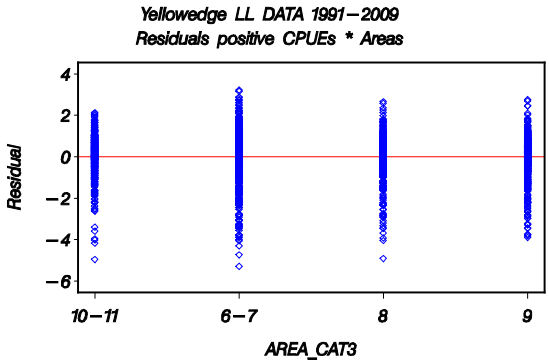


B. Region 2 – Areas 6-11

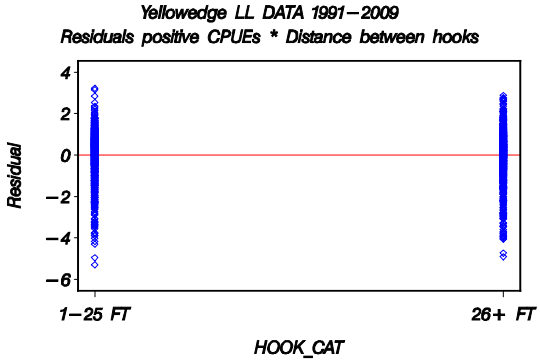
i.



ii.

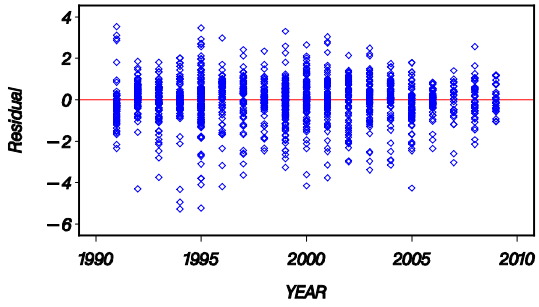


iii.

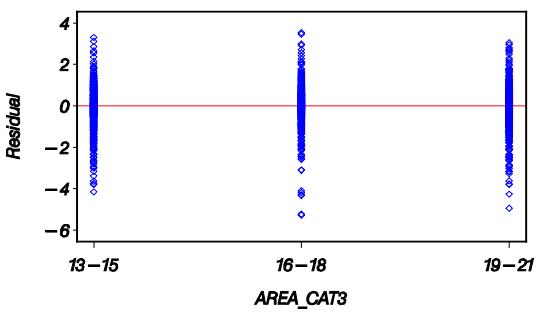


C. Region 3 – Areas 13-21

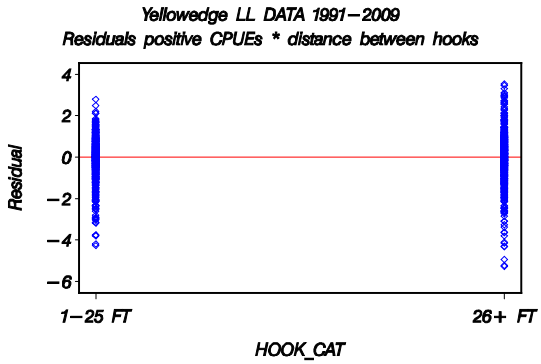
i.



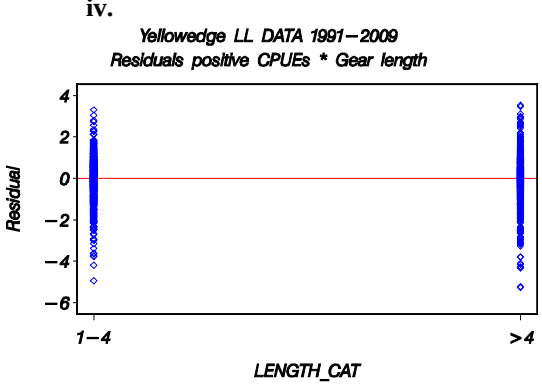
ii.



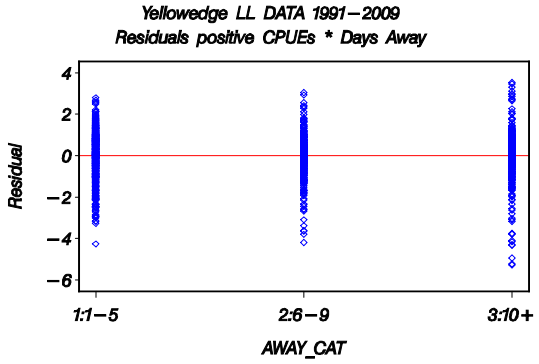
iii.



iv.



v.



5.