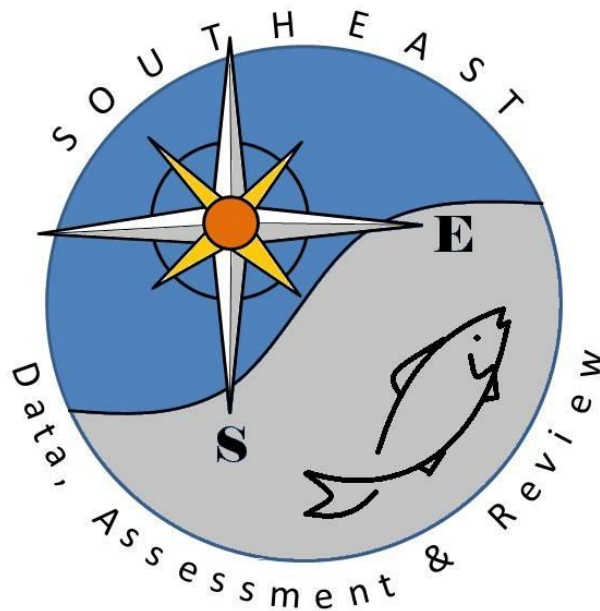Standardized Catch Rates of Greater Amberjack from the Gulf of
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1986 to 2012

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SEDAR33-AW20

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Standardized Catch Rates of Greater Amberjack from the Gulf of Mexico Recreational Charterboat and Private Boat Fisheries (MRFSS) 1986 to 2012

Adyan Rios
National Marine Fisheries Service, Southeast Fisheries Science Center
Sustainable Fisheries Division, 75 Virginia Beach Drive, Miami, FL 33149
Adyan.Rios@noaa.gov

Introduction

The recreational fishery in the Gulf of Mexico is surveyed by the Marine Recreational Fishery Statistics Survey (MRFSS) conducted by NOAA Fisheries, the Texas Marine Sport-Harvest Monitoring Program conducted by the Texas Parks and Wildlife Department (TPWD), and the Headboat Survey (HBS) conducted by NOAA Fisheries. MRFSS has monitored shore based, charterboat and private/rental boat angler fishing in the Gulf of Mexico since 1981. The purpose of this report is to outline the development of a standardized index of abundance for Gulf of Mexico greater amberjack using MRFSS data.

Methods

Marine Recreational Fishery Statistics Survey

MRFSS collects information on participation, effort, and species-specific catch. Data are collected to provide catch and effort estimates in two-month periods ("waves") for each recreational fishing mode (shore fishing, private/rental boat, charterboat, or headboat/charterboat combined) and for each area of fishing (inshore, state Territorial Seas, U.S. Exclusive Economic Zone), in each Gulf of Mexico state (except Texas). Total catch information is collected by MRFSS on fish landed whole and observed by interviewers ("Type A"), fish reported as killed by the fishers ("Type B1") and fish reported as released alive by the fishers ("Type B2").

MRFSS data were used to characterize abundance trends of greater amberjack in the Gulf of Mexico. Information on effort included hours fished and number of anglers as reported to the interviewer. Catch that was not observed by the interviewer (B1 and B2) was adjusted upwards by the ratio of non-interviewed to interviewed anglers in each group of anglers. The catch per unit effort was calculated on an individual group basis and was equal to the number of fish caught divided by the effort, where effort was the product of the number of anglers and the total hours fished.

Data preparation and filtering

The following data preparation and filtering techniques were applied to the MRFSS dataset:
1. Data from TX were excluded (not available in dataset after 1985).
2. HB mode was excluded (not available in dataset after 1985).
3. Data prior to 1986 were excluded.
4. Interviews that reported shore-based fishing or fishing in inshore waters were excluded.
5. The index was limited to interviews that reported using hook and line gear.
6. Data from Monroe County were excluded.
7. Observations were classified into five regions of the Gulf of Mexico.
8. Closed seasons for Greater Amberjack were used to define a factor called "GAJ_season".
9. Data from 2010 were excluded.
10. The Stephens and MacCall (2004) approach was not used to restrict the dataset to those interviews that targeted greater amberjack.
11. MRFSS data were weighted to account for changes in sampling effort that were implemented in 2000.

The MRFSS dataset was looked at across different strata to assess the sample size of total interviews and successful interviews (interviews that reported having caught greater amberjack) within each of the strata. Data from Texas, present in the years 1981 through 1985, were removed from the MRFSS data because the State of Texas conducts its own survey. In addition, data from the headboat mode in MRFSS, also present in the years 1981 through 1985, were removed because this information is covered by the Headboat Survey program conducted by NOAA Fisheries. Interviews that reported the shore mode and/or the inshore area were removed from the MRFSS data, because less than 0.1 percent of such interviews encountered greater amberjack. Data were limited to interviews that reported using hook and line since these represented over 98% of all private and charter interviews in the Gulf of Mexico. Data prior to 1986 were excluded due to extremely low number of interviews resulting in missing data for multiple strata.

The dataset was further partitioned according to decisions that were made during the SEDAR 33 data workshop plenary sessions. During the data workshop the majority of charterboat and private boat fishing occurring in the Dry Tortugas and Florida Keys (Monroe County, Florida) were determined to occur in South Atlantic jurisdiction waters. As such, data from Monroe County were excluded. Additionally, a single MRFSS record that was identified as erroneous was corrected. The record was associated with a private mode interview in Alabama on March 21, 2001. The number of fish released alive associated with this interview was adjusted from a total of 400 B2 fish to a total of 100 B2 fish.

Following the SEDAR9 benchmark and update assessments, observations were classified into five regions of the Gulf of Mexico using the county and state of intercept. The five regions were: 1) SW FL (Collier – Pinellas), 2) NW FL (Pasco – Franklin), 3) FL Panhandle (Gulf – Escambia) and AL, and 4) LA and MS.

The management of greater amberjack is done by size limits, bag limits, and fishing seasons. Since MRFSS routinely collects information on releases (i.e., discards, coded as B2s in the survey), possible effects from bag limits and/or minimum size change regulations were not investigated. Although the accuracy of discarded values cannot be verified, discard data were retained since over 50% of greater amberjack landings were reported as either B1 or B2 catch. Because discard data were available during fishing closed season, observations during the closed seasons were retained.

In 2009, the recreational fishery for greater amberjack in the Gulf of Mexico exceeded its quota for the first time and was closed from Oct. 25th to Dec. 31st. After reopening at the start of the 2010 fishing year, MRFSS data for the private and charterboat fisheries had unusually high catch rates in January, as compared to the catch rates in January from the previous 5 years. Later in 2010, there were significant area closures from May to November that were related to the Deepwater Horizon/BP Oil Spill (SERO 2013). Catch rates reported immediately after the 2009 quota closure and those reported during and after the 2010 area closures may reflect temporary shifts in targeting and catchability. Since changes in fisher behavior in response to regulations are not accounted for in the standardization procedure, data from 2010 were excluded from the analysis.

The Stephens and MacCall approach (2004) was explored to try and identify greater amberjack directed effort. This approach uses the species composition of each trip in a logistic regression of species presence/absence to infer if effort on that trip occurred in similar habitat to greater amberjack habitat. This approach did not work well for greater amberjack (see results section for further discussion about this), and as a result, an index was developed using a delta lognormal model on all interviews.

MRFSS data were weighted to account for changes in sampling effort that were implemented in 2000. Starting in 2000, data from FL were down-weighted by 1/6 and data from AL, MS and LA were down-weighted by 1/2.

Standardization

Delta-lognormal modeling methods were used to estimate a standardized abundance index for greater amberjack (Lo et al. 1992). The main advantage of using this method is allowance for the probability of zero catch (Ortiz et al. 2000). The delta-lognormal modeling approach combines separate generalized linear model (GLM) analyses of the proportion of successful trips (trips that landed greater amberjack) and of the catch rates on successful trips to construct a single standardized CPUE index (Lo et al. 1992, Hinton and Maunder 2003, Maunder and Punt 2004).

For each GLM procedure of proportion positive interviews, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was the proportion of successful interviews across strata. During the analysis of catch rates on successful interviews, a type-3 model assuming lognormal error distribution was examined. The linking function selected was "normal", and the response variable was calculated as the natural log of CPUE.

A stepwise approach was used to quantify the relative importance of the explanatory factors. First a weighted GLM model was fit to the null model (only the intercept) and the AIC, deviance and degrees of freedom were calculated. Next, a suite of models was tested where each potential explanatory factor was added to the null model. Again, the AIC, deviance, and degrees of freedom were calculated. The model with the factor that had the lowest AIC became the new base model and the process was repeated adding factors individually until either the AIC was no longer further reduced or the all the factors were added to the model. In addition to screening using AIC, factors were also screened and not added to the model if the reduction in deviance per degree of freedom was less than one percent. This screening was implemented in order to fit a more parsimonious model, given the fact that factors which reduce the deviance by so little exert little influence on the index trend. If at the end of this process YEAR was not identified as a significant explanatory variable it was still included as a main effect in the model.

Two-way interactions among significant main effects were examined. YEAR*FACTOR interaction terms were included in the model as random effects. The final weighted delta lognormal model was fit using a SAS macro, GLIMMIX (Russ Wolfinger, SAS Institute). To facilitate visual comparison, a relative standardized index and relative nominal CPUE series were calculated by dividing each value in the series by the mean value of the entire time-series.

The following factors were examined as possible influences on the proportion of positive interviews, and on the catch rates of anglers that observed greater amberjack.

FACTOR	LEVELS	DESCRIPTION
YEAR	26	1981-2009 and 2011-2012
MODE	2	Private, Charter
REGION	4	Southwest FL (Collier – Pinellas), Northwest FL (Pasco – Franklin), FL Panhandle (Gulf – Escambia) and AL, MS and LA
AREA	2	State, EEZ
MONTH	6	Dec-Jan, Feb-Mar, Apr-May, Jun-Jul, Aug-Sep, Oct-Nov
GAJ SEASON	2	Open, Closed (Closures were Oct. 25 - Dec. 31 in 2009 and Jun. 1 - Jul. 31 in 2011 and 2012)
HOURS FISHED (Binomial component only)	9	Bins for number of hours fished: 1, 2, 3, 4, 5, 6, 7, 8, 9+

Notes:

(1) Across all interviews, fishing mode was confounded with fishing region. In the NW_FL region, 96.7% of all interviews reported having fished from private boats. Therefore, both factors were tested, but after one was entered in the model for the proportion of positive interviews, the other was excluded from further analysis.

(2) Across positive interviews, fishing area was confounded with fishing region. In the MS and LA region, 97.8% of positive interviews reported fishing in the EEZ. Therefore, both

factors were tested, but after one was entered in the model for CPUE, the other was excluded from further analysis.
(3) Since hours fished is a component of angler hours, and thereby of CPUE, this factor was only explored in the model for the proportion of positive interviews
(4) Months were combined to avoid missing data across months in individual years. A length of two months was selected to match up with the length and timing of the 2011 and 2012 closed seasons for greater amberjack.

Results

Efforts were made to apply the Stephens and MacCall approach to the dataset. However, these efforts were met with limited success since the results were not informative and because the approach ended up eliminating most of the interviews. Due to the inability to use this approach, a model for the proportion of successful interviews was constructed using of all interviews, and a model for the catch rates was constructed using all positive interviews.

Various factors and first level interactions were tested for significance using the stepwise approach and accordingly included or excluded from the model. The following models resulted from the standardization procedures where *Success* is a binomial indicating whether or not a group of anglers caught the species of interest, α represents the parameter estimate of each factor, μ represents the mean, and ε represents the error term.

$$Success = \mu + (Year)\alpha_1 + (Region)\alpha_2 + (Area)\alpha_3 + (HRS)\alpha_4 + (Year * HRS)\alpha_5 + \varepsilon$$

$$\ln(CPUE) = \mu + (Year)\alpha_1 + (Mode)\alpha_2 + (Region)\alpha_3 + (Mode * Region)\alpha_4 + \varepsilon$$

Table 1 summarizes the standardized index and corresponding coefficients of variation, upper confidence limits, lower confidence limits, and nominal CPUE. Final deviance tables are included in Table 2.

Results for the greater amberjack MRFSS index standardization show very variable values from the start of the series through 1991, followed by a decline until 1996. After a period of relative stability between 1996 and 1999 the index increases until 2002 and then decreases again until 2006. After 2006 the index moderately increases through 2011 and ends with a decrease in the most recent year (Figure 1).

Compared to MRFSS indices developed for the SEDAR 9 benchmark and update assessments, the index developed here for SEDAR 33 shows a similar lack of trend during the start of the time series (Figure 2). After 1990, the SEDAR 33 MRFSS index exhibits higher peaks and is more variable than the MRFSS indices from previous assessments. After 1999 the general directional trends are comparable between the SEDAR 33 index and the index developed for the SEDAR 9 update assessment.

Acknowledgements

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

Tables

Table 1: Gulf of Mexico greater amberjack standardized index values, coefficients of variation, upper confidence limits, lower confidence limits, and nominal CPUE values from the MRFSS charterboat and private boat fisheries.

Year	Standardized Index	CV	Lower 95% CI	Upper 95% CI	Nominal CPUE
1986	2.002	0.131	1.543	2.597	2.530
1987	1.132	0.136	0.864	1.485	1.563
1988	0.600	0.171	0.427	0.844	0.991
1989	1.722	0.165	1.240	2.391	1.498
1990	0.168	0.300	0.094	0.303	0.277
1991	1.553	0.169	1.110	2.171	2.051
1992	1.628	0.123	1.275	2.080	1.657
1993	0.759	0.168	0.544	1.059	1.021
1994	0.632	0.186	0.437	0.914	0.521
1995	0.361	0.261	0.216	0.603	0.364
1996	0.279	0.215	0.183	0.427	0.245
1997	0.262	0.215	0.171	0.401	0.298
1998	0.296	0.173	0.210	0.418	0.325
1999	0.432	0.129	0.335	0.559	0.400
2000	0.912	0.130	0.703	1.182	0.765
2001	1.231	0.121	0.967	1.566	1.201
2002	1.946	0.105	1.579	2.399	1.638
2003	1.793	0.107	1.449	2.218	1.615
2004	0.911	0.115	0.725	1.145	0.837
2005	0.778	0.135	0.594	1.018	0.754
2006	0.720	0.142	0.543	0.956	0.660
2007	0.847	0.145	0.635	1.129	0.697
2008	1.102	0.138	0.837	1.450	0.737
2009	1.019	0.143	0.767	1.356	0.732
2010					
2011	1.547	0.130	1.194	2.003	1.281
2012	1.366	0.125	1.065	1.753	1.341

Table 2: Final deviance tables for the Gulf of Mexico greater amberjack regressions from the MRFSS charterboat and private fisheries. The table shows the order of the factors as they were added sequentially to each model. Fit diagnostics listed for each factor were the diagnostics from a model that included that factor and all of the factors listed above it in the tables below.

Binomial								
Factor	Df	Deviance	Residual Df	Residual Deviance	AIC	% Deviance Reduced	log likelihood	Likelihood Ratio Test
Null	1	25300.90	135587	25300.90	25301.00	-	-12650.50	-
Region	3	21434.30	135584	3866.60	21434.40	15.28	-10717.20	3866.60
Area	1	19160.30	135583	2274.00	19160.40	10.61	-9580.20	2274.00
Year	25	18654.80	135558	505.50	18654.80	2.64	-9327.40	505.60
HRS	8	18305.20	135550	349.60	18305.20	1.87	-9152.60	349.60
Year*HRS	200	17927.20	135350	378.00	17927.20	2.06	-8963.60	378.00
Lognormal								
Factor	Df	Deviance	Residual Df	Residual Deviance	AIC	% Deviance Reduced	log likelihood	Likelihood Ratio Test
Null	1	7797.10	135587	7797.10	-2439.80	-	1219.90	-
Mode	1	7579.70	135586	217.40	-6274.20	2.79	3137.10	3834.40
Region	3	7500.00	135583	79.70	-7707.40	1.05	3853.70	1433.20
Year	25	7488.00	135558	12.00	-7924.80	0.16	3962.40	217.40
Mode*Region	3	7391.00	135555	97.00	-9691.80	1.30	4845.90	1767.00

Figures
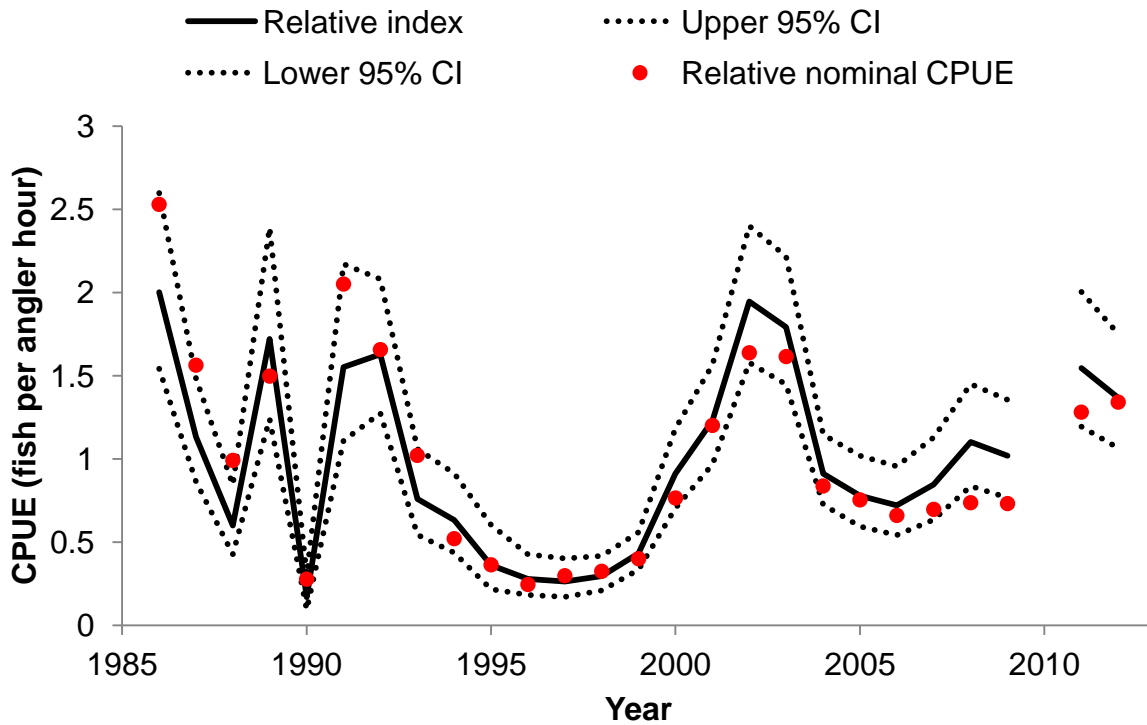
Figure 1. Nominal CPUE, standardized index, and the 95% confidence intervals for Gulf of Mexico greater amberjack from MRFSS charterboat and private boat fisheries. The standardized index and nominal CPUE values were normalized by their respective means overt the time series.
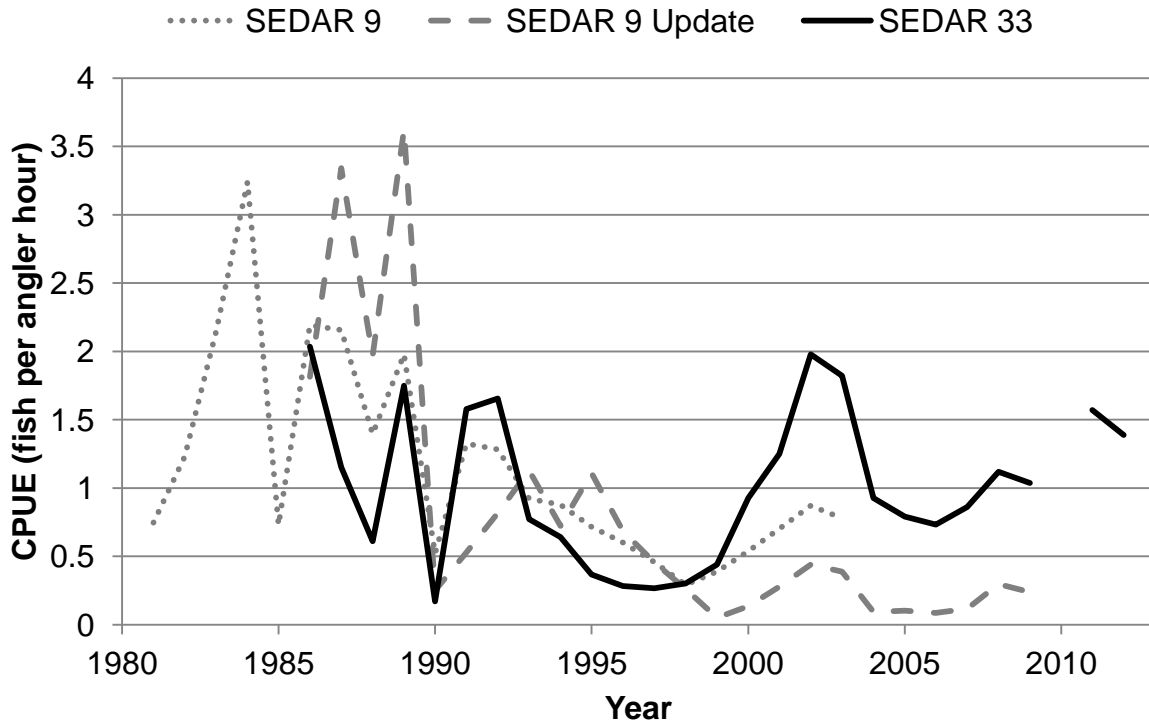
Figure 2. Standardized MRFSS indices for Gulf of Mexico greater amberjack from the current assessment (SEDAR 33) and from previous assessments (SEDAR 9 and the SEDAR 9 update). Indices were normalized by their respective means during the overlapping period.

Appendix A: Diagnostic plots for the MRFSS charterboat and private boat index of Gulf of Mexico greater amberjack
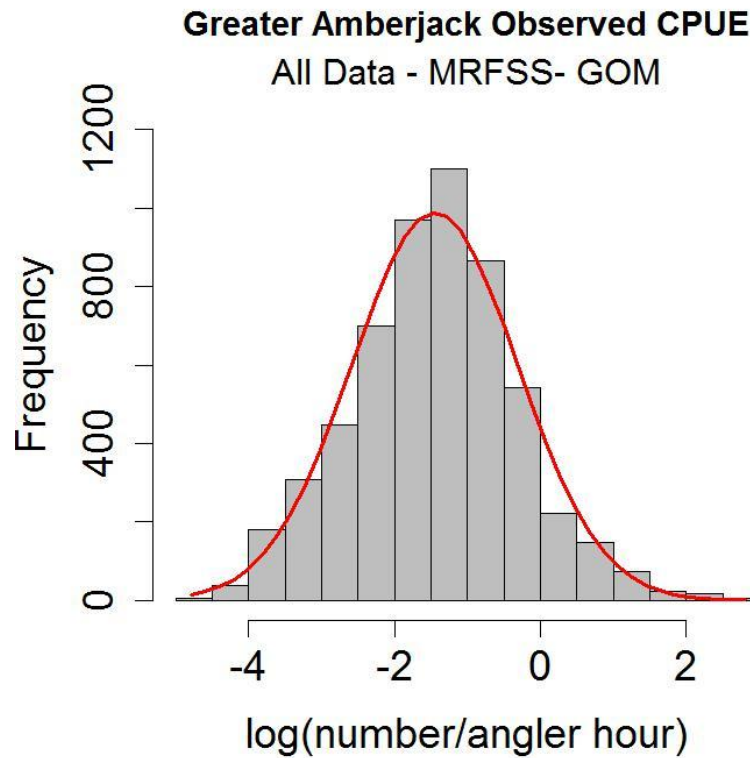
Figure 3**.** Frequency distribution of catch rates on positive interviews. The red line is the expected normal distribution.
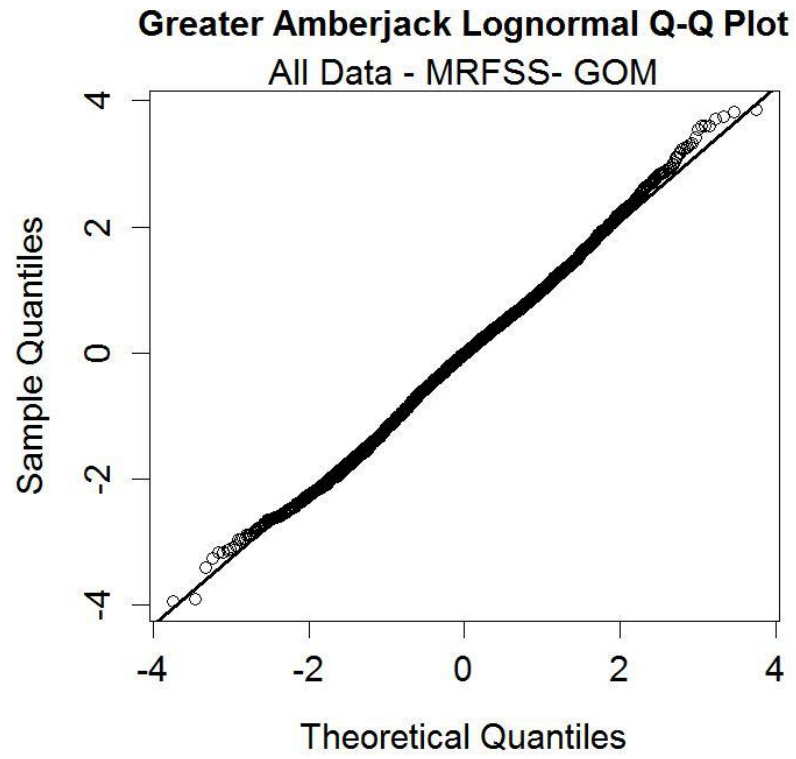
Figure 4. Q-Q plot of CPUE.
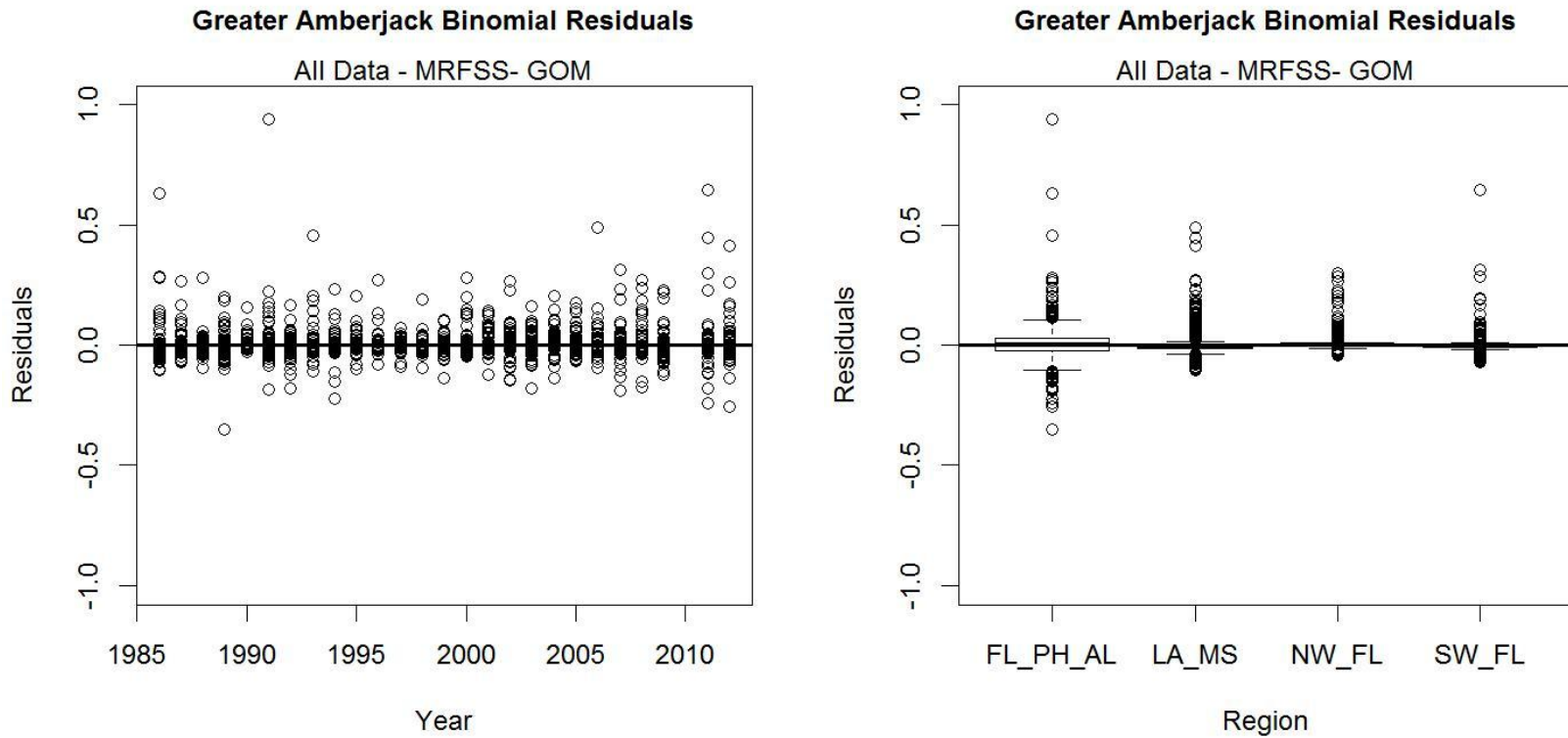
Figure 5a. Residuals from the binomial model on proportion positive interviews, by year (left panel) and by region (right panel).
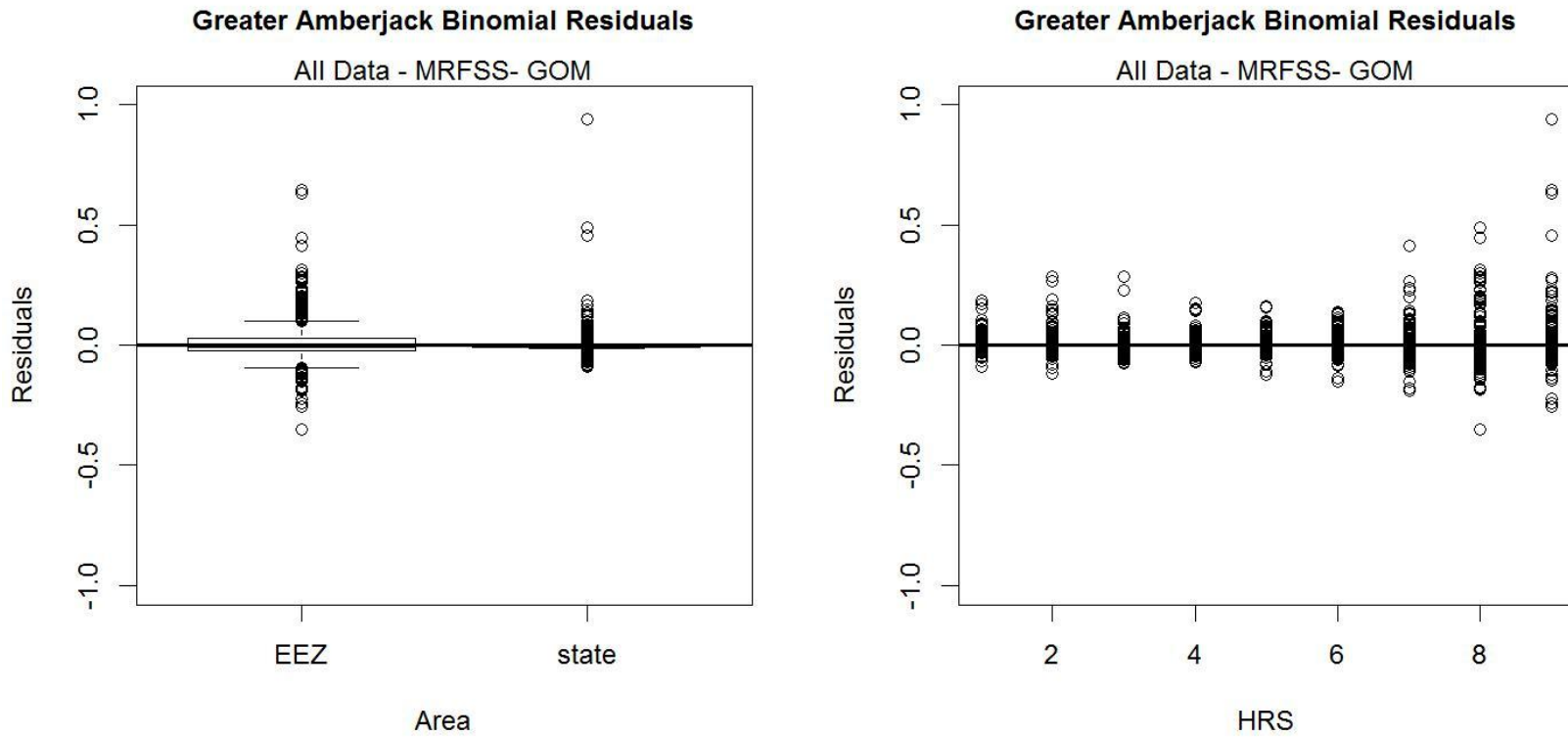
Figure 5b. Residuals from the binomial model on proportion positive interviews, by area (left panel) and by hours fished (right panel).

Appendix B: Number of total interviews and interviews that reported having caught greater amberjack across strata

Table 3. The total number of interviews, number of positive interviews, and percentage of positive interviews by year from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Total Interviews	Positive Interviews	Percent of Positive Interviews
1981	1086	18	1.66
1982	2237	35	1.56
1983	1250	35	2.80
1984	1567	20	1.28
1985	1704	13	0.76
1986	5791	207	3.57
1987	6044	190	3.14
1988	4976	109	2.19
1989	3229	123	3.81
1990	2827	32	1.13
1991	2892	118	4.08
1992	5398	243	4.50
1993	3912	117	2.99
1994	4577	91	1.99
1995	4126	43	1.04
1996	4955	65	1.31
1997	5580	65	1.16
1998	6063	106	1.75
1999	8980	216	2.41
2000	7921	321	4.05
2001	7863	309	3.93
2002	8415	507	6.02
2003	7732	484	6.26
2004	8749	414	4.73
2005	7434	260	3.50
2006	7794	248	3.18
2007	7050	227	3.22
2008	6612	245	3.71
2009	5951	225	3.78
2010	5149	295	5.73
2011	5935	331	5.58
2012	5424	348	6.42

Table 4. Total interviews, number of positive interviews, and percentage of positive interviews by year and mode from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Interviews by Mode		Positive Interviews by Mode		Percent of Positive Interviews by Mode	
	Charterboat	Private	Charterboat	Private	Charterboat	Private
1981	171	915	9	9	5.26	0.98
1982	158	2079	16	19	10.13	0.91
1983	290	960	31	4	10.69	0.42
1984	318	1249	19	1	5.97	0.08
1985	267	1437	9	4	3.37	0.28
1986	1119	4672	188	19	16.80	0.41
1987	843	5201	125	65	14.83	1.25
1988	736	4240	86	23	11.68	0.54
1989	523	2706	84	39	16.06	1.44
1990	465	2362	27	5	5.81	0.21
1991	503	2389	104	14	20.68	0.59
1992	745	4653	192	51	25.77	1.10
1993	497	3415	85	32	17.10	0.94
1994	560	4017	71	20	12.68	0.50
1995	348	3778	22	21	6.32	0.56
1996	436	4519	39	26	8.94	0.58
1997	816	4764	47	18	5.76	0.38
1998	1234	4829	89	17	7.21	0.35
1999	1957	7023	187	29	9.56	0.41
2000	2377	5544	284	37	11.95	0.67
2001	1612	6251	194	115	12.03	1.84
2002	1729	6686	407	100	23.54	1.50
2003	2082	5650	393	91	18.88	1.61
2004	2489	6260	343	71	13.78	1.13
2005	1894	5540	197	63	10.40	1.14
2006	1518	6276	213	35	14.03	0.56
2007	1529	5521	182	45	11.90	0.82
2008	1128	5484	182	63	16.13	1.15
2009	1171	4780	157	68	13.41	1.42
2010	1155	3994	210	85	18.18	2.13
2011	1480	4455	271	60	18.31	1.35
2012	1633	3791	273	75	16.72	1.98

Table 5a. Total interviews by year and region from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Interviews by Region			
	FL_PH_AL	LA_MS	NW_FL	SW_FL
1981	269	293	118	406
1982	684	629	372	552
1983	291	447	219	293
1984	402	628	162	375
1985	504	467	240	493
1986	1515	1932	782	1562
1987	2237	1120	812	1875
1988	1280	941	1355	1400
1989	806	708	829	886
1990	563	839	692	733
1991	771	917	735	469
1992	980	1381	1570	1467
1993	838	688	1292	1094
1994	903	524	2103	1047
1995	574	470	2106	976
1996	1019	504	2036	1396
1997	1123	968	2047	1442
1998	1262	660	2225	1916
1999	2194	963	3323	2500
2000	2492	748	3095	1586
2001	2109	512	3322	1920
2002	1941	619	3802	2053
2003	2045	445	3015	2227
2004	2469	532	3127	2621
2005	2075	383	2623	2353
2006	2043	577	2739	2435
2007	2128	462	3058	1402
2008	1410	363	3062	1777
2009	1416	335	2834	1366
2010	1415	146	2249	1339
2011	1798	215	2562	1360
2012	1973	294	1993	1164

Table 5b. Number of positive interviews by year and region from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Positive Interviews by Region			
	FL_PH_AL	LA_MS	NW_FL	SW_FL
1981	12	4	2	0
1982	20	8	3	4
1983	9	22	1	3
1984	1	18	0	1
1985	6	2	0	5
1986	148	24	11	24
1987	154	16	7	13
1988	94	3	2	10
1989	105	6	2	10
1990	28	2	1	1
1991	79	30	6	3
1992	169	36	5	33
1993	102	7	2	6
1994	71	13	4	3
1995	27	6	6	4
1996	53	9	1	2
1997	40	11	1	13
1998	85	4	5	12
1999	197	4	1	14
2000	284	17	1	19
2001	248	25	12	24
2002	403	55	11	38
2003	387	32	31	34
2004	324	33	24	33
2005	194	22	23	21
2006	188	45	2	13
2007	166	22	6	33
2008	199	23	8	15
2009	174	14	13	24
2010	237	7	13	38
2011	292	10	7	22
2012	313	24	4	7

Table 5c. The percentage of positive interviews by year and region from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Percent of Positive Interviews by Region			
	FL_PH_AL	LA_MS	NW_FL	SW_FL
1981	4.46	1.37	1.69	0.00
1982	2.92	1.27	0.81	0.72
1983	3.09	4.92	0.46	1.02
1984	0.25	2.87	0.00	0.27
1985	1.19	0.43	0.00	1.01
1986	9.77	1.24	1.41	1.54
1987	6.88	1.43	0.86	0.69
1988	7.34	0.32	0.15	0.71
1989	13.03	0.85	0.24	1.13
1990	4.97	0.24	0.14	0.14
1991	10.25	3.27	0.82	0.64
1992	17.24	2.61	0.32	2.25
1993	12.17	1.02	0.15	0.55
1994	7.86	2.48	0.19	0.29
1995	4.70	1.28	0.28	0.41
1996	5.20	1.79	0.05	0.14
1997	3.56	1.14	0.05	0.90
1998	6.74	0.61	0.22	0.63
1999	8.98	0.42	0.03	0.56
2000	11.40	2.27	0.03	1.20
2001	11.76	4.88	0.36	1.25
2002	20.76	8.89	0.29	1.85
2003	18.92	7.19	1.03	1.53
2004	13.12	6.20	0.77	1.26
2005	9.35	5.74	0.88	0.89
2006	9.20	7.80	0.07	0.53
2007	7.80	4.76	0.20	2.35
2008	14.11	6.34	0.26	0.84
2009	12.29	4.18	0.46	1.76
2010	16.75	4.79	0.58	2.84
2011	16.24	4.65	0.27	1.62
2012	15.86	8.16	0.20	0.60

Table 6. The percentage of positive interviews by year and area from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Interviews by Area		Positive Interviews by Area		Percent of Positive Interviews by Area	
	EEZ	state	EEZ	state	EEZ	state
1981	319	767	8	10	2.51%	1.30%
1982	486	1751	24	11	4.94%	0.63%
1983	525	725	32	3	6.10%	0.41%
1984	504	1063	14	6	2.78%	0.56%
1985	410	1294	11	2	2.68%	0.15%
1986	1302	4489	185	22	14.21%	0.49%
1987	1502	4542	151	39	10.05%	0.86%
1988	1437	3539	85	24	5.92%	0.68%
1989	870	2359	85	38	9.77%	1.61%
1990	909	1918	31	1	3.41%	0.05%
1991	793	2099	103	15	12.99%	0.71%
1992	1815	3583	220	23	12.12%	0.64%
1993	1507	2405	89	28	5.91%	1.16%
1994	1405	3172	81	10	5.77%	0.32%
1995	1238	2888	34	9	2.75%	0.31%
1996	1567	3388	62	3	3.96%	0.09%
1997	1636	3944	58	7	3.55%	0.18%
1998	2038	4025	96	10	4.71%	0.25%
1999	2814	6166	166	50	5.90%	0.81%
2000	2496	5425	286	35	11.46%	0.65%
2001	2462	5401	281	28	11.41%	0.52%
2002	2750	5665	440	67	16.00%	1.18%
2003	2643	5089	432	52	16.35%	1.02%
2004	3226	5523	362	52	11.22%	0.94%
2005	2473	4961	233	27	9.42%	0.54%
2006	2174	5620	233	15	10.72%	0.27%
2007	1876	5174	182	45	9.70%	0.87%
2008	1389	5223	180	65	12.96%	1.24%
2009	1335	4616	175	50	13.11%	1.08%
2010	1065	4084	194	101	18.22%	2.47%
2011	1440	4495	257	74	17.85%	1.65%
2012	1590	3834	265	83	16.67%	2.16%

Table 7a. The number of interviews by year and hours fished from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Interviews by HRS								
	1	2	3	4	5	6	7	8	9+
1981	47	60	141	185	161	176	75	98	143
1982	48	146	261	488	406	333	178	149	228
1983	43	98	180	240	224	183	104	108	70
1984	60	173	267	290	298	224	127	91	37
1985	113	208	283	337	244	203	87	121	108
1986	286	730	969	1393	928	762	312	227	184
1987	342	786	1088	1286	1053	717	316	298	158
1988	311	562	942	1156	775	604	231	247	148
1989	149	400	609	707	584	384	148	176	72
1990	114	290	435	598	530	353	181	236	90
1991	163	276	517	663	551	368	144	136	74
1992	214	607	861	1056	1036	716	349	358	201
1993	218	413	596	803	622	636	241	236	147
1994	307	490	684	1020	851	595	242	275	113
1995	203	427	633	944	728	579	260	221	131
1996	280	523	820	1046	913	718	281	252	122
1997	232	600	1017	1248	1046	746	315	257	119
1998	205	611	1022	1378	1085	949	380	253	180
1999	437	926	1578	2146	1519	1279	513	354	228
2000	391	723	1408	1929	1282	1208	480	359	141
2001	300	721	1393	1853	1427	1158	502	340	169
2002	402	768	1536	2105	1452	1131	555	271	195
2003	389	794	1402	1880	1275	1050	438	350	154
2004	370	911	1599	2038	1548	1205	479	382	217
2005	412	758	1394	1860	1254	924	422	251	159
2006	374	778	1332	1967	1373	1060	399	320	191
2007	356	774	1300	1740	1235	933	318	256	138
2008	301	679	1138	1716	1180	950	298	235	115
2009	264	582	1153	1640	978	756	300	217	61
2010	199	489	1038	1342	848	695	296	174	68
2011	220	587	1151	1545	1071	779	299	200	83
2012	278	597	1123	1473	868	703	202	107	73

Table 7b. The number of positive interviews by year and hours fished from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Positive Interviews by HRS								
	1	2	3	4	5	6	7	8	9+
1981	1	0	0	1	2	2	2	0	10
1982	0	0	1	3	5	1	3	7	15
1983	3	0	2	8	2	9	2	4	5
1984	0	1	4	4	3	5	2	0	1
1985	0	0	0	0	0	5	1	0	7
1986	5	17	28	48	31	43	6	14	15
1987	3	14	25	24	32	40	9	28	15
1988	1	2	11	27	21	17	4	15	11
1989	2	6	15	38	28	16	9	3	6
1990	0	1	2	9	7	5	2	4	2
1991	2	5	13	29	31	18	8	5	7
1992	6	23	41	48	45	50	11	13	6
1993	3	3	14	30	11	23	9	12	12
1994	1	10	13	24	12	18	4	6	3
1995	0	1	11	11	4	6	3	3	4
1996	1	4	12	15	14	5	2	11	1
1997	2	5	11	7	20	13	4	2	1
1998	3	5	16	29	26	10	5	8	4
1999	3	12	25	58	43	46	13	7	9
2000	11	16	37	93	55	55	17	19	18
2001	4	28	46	74	59	52	13	13	20
2002	11	36	90	150	99	65	23	18	15
2003	15	36	62	142	86	89	19	19	16
2004	1	25	61	121	86	64	22	24	10
2005	7	13	32	79	54	44	11	15	5
2006	4	14	32	60	55	39	15	15	14
2007	4	28	37	54	38	32	6	20	8
2008	4	21	40	51	53	29	16	14	17
2009	4	18	40	59	29	34	8	24	9
2010	8	24	62	69	38	43	19	17	15
2011	4	19	52	98	71	44	8	23	12
2012	7	29	63	95	76	45	15	13	5

Table 7c. The percentage of positive interviews by year and hours fished from the charterboat and private boat fisheries in the Gulf of Mexico. Data highlighted in gray were not included in the analyses.

Year	Percent of Positive Interviews by HRS								
	1	2	3	4	5	6	7	8	9+
1981	2.13	0.00	0.00	0.54	1.24	1.14	2.67	0.00	6.99
1982	0.00	0.00	0.38	0.61	1.23	0.30	1.69	4.70	6.58
1983	6.98	0.00	1.11	3.33	0.89	4.92	1.92	3.70	7.14
1984	0.00	0.58	1.50	1.38	1.01	2.23	1.57	0.00	2.70
1985	0.00	0.00	0.00	0.00	0.00	2.46	1.15	0.00	6.48
1986	1.75	2.33	2.89	3.45	3.34	5.64	1.92	6.17	8.15
1987	0.88	1.78	2.30	1.87	3.04	5.58	2.85	9.40	9.49
1988	0.32	0.36	1.17	2.34	2.71	2.81	1.73	6.07	7.43
1989	1.34	1.50	2.46	5.37	4.79	4.17	6.08	1.70	8.33
1990	0.00	0.34	0.46	1.51	1.32	1.42	1.10	1.69	2.22
1991	1.23	1.81	2.51	4.37	5.63	4.89	5.56	3.68	9.46
1992	2.80	3.79	4.76	4.55	4.34	6.98	3.15	3.63	2.99
1993	1.38	0.73	2.35	3.74	1.77	3.62	3.73	5.08	8.16
1994	0.33	2.04	1.90	2.35	1.41	3.03	1.65	2.18	2.65
1995	0.00	0.23	1.74	1.17	0.55	1.04	1.15	1.36	3.05
1996	0.36	0.76	1.46	1.43	1.53	0.70	0.71	4.37	0.82
1997	0.86	0.83	1.08	0.56	1.91	1.74	1.27	0.78	0.84
1998	1.46	0.82	1.57	2.10	2.40	1.05	1.32	3.16	2.22
1999	0.69	1.30	1.58	2.70	2.83	3.60	2.53	1.98	3.95
2000	2.81	2.21	2.63	4.82	4.29	4.55	3.54	5.29	12.77
2001	1.33	3.88	3.30	3.99	4.13	4.49	2.59	3.82	11.83
2002	2.74	4.69	5.86	7.13	6.82	5.75	4.14	6.64	7.69
2003	3.86	4.53	4.42	7.55	6.75	8.48	4.34	5.43	10.39
2004	0.27	2.74	3.81	5.94	5.56	5.31	4.59	6.28	4.61
2005	1.70	1.72	2.30	4.25	4.31	4.76	2.61	5.98	3.14
2006	1.07	1.80	2.40	3.05	4.01	3.68	3.76	4.69	7.33
2007	1.12	3.62	2.85	3.10	3.08	3.43	1.89	7.81	5.80
2008	1.33	3.09	3.51	2.97	4.49	3.05	5.37	5.96	14.78
2009	1.52	3.09	3.47	3.60	2.97	4.50	2.67	11.06	14.75
2010	4.02	4.91	5.97	5.14	4.48	6.19	6.42	9.77	22.06
2011	1.82	3.24	4.52	6.34	6.63	5.65	2.68	11.50	14.46
2012	2.52	4.86	5.61	6.45	8.76	6.40	7.43	12.15	6.85