Addendum 1 to SEDAR14 AW01
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Updated Commercial Catch per Unit of Effort Indices for Mutton snapper line and pot fisheries in Puerto Rico, 1983-2006

Prepared
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Background

SEDAR14AW01 described results of CPUE standardization analyses for the mutton snapper Puerto Rico fisheries. Available for analysis were observations of CPUE for 1983-2005. Based on recommendations from the SEDAR14 DW panel and after discussion with port agents and several individuals familiar with the early data collections (i.e., 1983-1989) it was recommended that analyses begin with data from 1989 forward. There were a number of issues that the panel felt may have affected the quality of the early years of data reporting thus it was agreed to restrict the time series to 1989 forward. These included that during these early years fishery agents were in the initial stages of building rapport with the fishers and that representative reporting may not have occurred during these years. Thus, CPUE models were investigated for the two main fisheries harvesting mutton snapper in Puerto Rico. SEDAR14 AW-01 provided background information on data sufficiency for model fitting and described the model fitting process. Separate CPUE models were fitted to the line fishery and to the pot (trap) fishery CPUE observations.

During the SEDAR14 Mutton snapper Assessment Workshop (AW) workshop the 2006 data was made available by the lead commercial fishery agent however insufficient time at the workshop precluded examining the data and updating the CPUE models. The SEDAR14 AW panel recommended that prior to the SEDAR14 Review Workshop (RW) that the newly received data be incorporated into the analyses. The group recommended that the final models selected for the line fishery and for the pot (trap) fishery for the AW be fitted to the updated dataset. This addendum report describes the procedures used to update the mutton snapper Puerto Rico CPUE indices and the results.

General Procedures

The procedures used to select data for inclusion into the revised analyses were as defined for the AW workshop. Briefly, information from the SEDAR14 DW was used to define the areas or spatial extent from which to include reeffish trips that may have caught or could have caught mutton snapper. These latter trips, termed zero trips, were considered to be operating in areas that contained suitable habitat for mutton snapper. The Stephens and MacCall (2004) method was used to select or identify zero trips from these areas to include in the CPUE analyses. Not unexpectedly since the reefifsh fisheries in Puerto Rico operate as a large multi-species operation, this procedure when applied to the 2006 data resulted in the selection of a large number of trips not having caught mutton snapper. For the 2006 data set 9.5% of the total selected reeffish trips were positive observations while in the pot fishery 13.8% of the total selected trips were positive observations. The range of the proportion of positives was 6.2%-14.0% (line fishery) and 3.9%-21.1% (pot fishery).

Analytical procedures used in updating the CPUE indices were as described in SEDAR14 AW01. The Lo et al. (1992) method was used to calculate standardized CPUE indices. Briefly, for the two fisheries, line and pots, a lognormal linear model was fit to the positive log (CPUE) observations (successful trips) and a second model, a binomial, was fitted to the proportion of positives. The model structure was identical to that produced for the earlier analyses, which included data only through 2005. The Lo approach combines the two analyses, the lognormal on the successes with the binomial on the proportion of positives, to yield estimates of the annual year effects, the main parameter of interest. Model error structure and model configuration were as assumed in the original analyses and are described in Table 1.

Results

The updated mutton snapper CPUE indices are provided in Tables 2 and 3. The updated indices suggest an increase in CPUE for the pot fishery and a slight decrease in CPUE in the line fishery in 2006 from the 2005 calculated values. The 2006 predicted line index is 3 % lower than the 2005 predicted value and in addition, the 2006 predicted line index is well below, by 51 %, the peak CPUE on record for the line fishery predicted for 2003. The CV of the index is similar to that of preceding years, around 20%. The observed index from the positive log (CPUE) observations was slightly larger than the 2005 index.

For the pot fishery the predicted trend in CPUE for 2006 is greater by 11% than for the 2005 predicted index. The 2006 index however is about 21% of that predicted in 2003, the peak year of CPUE in the pot fishery for mutton snapper. As for the line fishery, the CV of the index is about 20 %, relatively unchanged form the recent years before. The observed CPUE from the positive log (CPUE) pot fishery observations was lower than that of the proceeding years, by some 22 %.

As noted in SEDAR14 AW01, the mutton snapper pot fishery reflects about 25 % on average of the mutton snapper commercial yield while the line fishery reflects about 50 % of the removals. The remaining 25% of removals of mutton snapper in Puerto Rico are from a variety of fishing

gears, dive operations, beach seines, and nets however, data were insufficient spatially and temporally to consider in developing CPUE abundance indices. Detailed results of the revised indices standardizations are available from the author. Diagnostic results from the resulting fits to the log(CPUE) data and to the proportion of positives were similar in form to the earlier standardization analyses. There was no suggestion of violation of the normality assumptions for the lognormal model fits when the 2006 data were added to the fit (Figures 4and 5). Similarly, with the binomial fit to the proportion positives, the residual distributions resulting from the fits did not indicate major trends. There was some tendency of the binomial model to underestimate the observed proportion of positives and this tendency was more pronounced for the line fishery observations (see Figures 1, 2, 6 and 7). In addition, the model fit was poorer especially for years with very low proportion positives.

The updated mutton snapper commercial line and pot (trap) fishery CPUE indices provides additional information on this species since the SEDAR14 AW. As noted in the SEDAR14 AW mutton snapper Workshop report future research should concentrate on improving the information available to describe CPUE. The updated analyses carried out for this report necessarily only included very few main effects into the modeling process, namely year, month and area of catch. In addition to recording additional information on trip specific CPUE, additional analytical effort should be expended towards the best method for selection of zero trips for use in CPUE analyses.

Table 1. Information regarding model structure and final model used in the updating of the line and pot fishery mutton snapper CPUE indices for Puerto Rico.

Fishery	Years in the Analysis	Model	Main Effects – Final Model	Random Effects Final Model
Line	1989-2006	Lognormal (log CPUE)	Year, Municipality, Month	Year * Municipality
	1989-2006	Binomial-Proportion of Positives	Year, Municipality, Month	Year * Municipality
Pot	1990-2006	Lognormal: Log(CPUE)	Year, Municipality, Month	Municipality * Month
	1990-2006	Binomial: Proportion of Positives	Year, Municipality	Year * Municipality

Table 2 Updated standardized CPUE indices for the Puerto Rico Mutton Snapper Commercial Line Fishery, 1989-2006. Year = Calendar Year, STDCPUE=Index, LCI and UCI are 0.95 Upper and Lower Confidence Intervals. Obcpue=Nominal log(CPUE), obppos=proportion of positives log(CPUE), Cv_i=CV(Index).

YEAR	StdErr	Obcpue	obppos	nobs	cv_i	MEANINDEX	STDCPUE	LCI	UCI	estcpue	obscpue
1989	0.285961	1.701207	0.07767	4017	0.183437	1.762122	0.884676	0.61485	1.272914	1.558906	0.747074
1990	0.364927	1.748358	0.113977	2132	0.208528	1.762122	0.993128	0.657361	1.500398	1.750013	0.76778
1991	0.275096	1.791757	0.104353	3239	0.196462	1.762122	0.794639	0.538442	1.172739	1.400251	0.786838
1992	0.316985	1.544228	0.087267	2521	0.200392	1.762122	0.897682	0.603636	1.334967	1.581826	0.678138
1993	0.206182	1.000326	0.062299	3740	0.195765	1.762122	0.597694	0.405541	0.880891	1.053209	0.439287
1994	0.258653	2.355384	0.077848	4406	0.179929	1.762122	0.815796	0.570875	1.165796	1.437532	1.034351
1995	0.270815	2.504961	0.083678	7493	0.150037	1.762122	1.024328	0.760053	1.380495	1.804991	1.100037
1996	0.253501	2.415159	0.086458	7761	0.149224	1.762122	0.964065	0.716481	1.297201	1.698799	1.060602
1997	0.224409	2.397481	0.079815	7768	0.153603	1.762122	0.829097	0.610892	1.125243	1.460969	1.052838
1998	0.315107	2.592208	0.108903	5335	0.151488	1.762122	1.180445	0.873396	1.59544	2.080088	1.138351
1999	0.37697	3.198248	0.121817	5262	0.147173	1.762122	1.453593	1.084662	1.948012	2.561408	1.40449
2000	0.2851	2.282937	0.113495	7225	0.141998	1.762122	1.139407	0.858927	1.511478	2.007774	1.002537
2001	0.279257	2.787153	0.117682	8438	0.139753	1.762122	1.133987	0.858632	1.497645	1.998222	1.22396
2002	0.281924	2.554426	0.139519	7447	0.134542	1.762122	1.189149	0.9097	1.554443	2.095426	1.12176
2003	0.345277	4.204726	0.139967	9095	0.131633	1.762122	1.488566	1.145312	1.934694	2.623034	1.846478
2004	0.282292	2.309678	0.113321	7642	0.142471	1.762122	1.12444	0.846854	1.493015	1.9814	1.01428
2005	0.202949	1.780703	0.098087	7371	0.152342	1.762122	0.756017	0.558428	1.023519	1.332194	0.781984
2006	0.205432	1.819937	0.09468	6485	0.158985	1.762122	0.73329	0.534618	1.00579	1.292145	0.799213

Table 3. Standardized lCPUE indices for the Puerto Rico Mutton Snapper Commercial Pot fishery, 1990-2006. Year =Calendar Year, STDCPUE=Index, LCI and UCI are 0.95 Upper and Lower Confidence Intervals. Obcpue=Nominal log(CPUE), obppos=proportion of positives log(CPUE), Cv_i=CV(Index)

YEAR	StdErr	obcpue	obppos	nobs	cv_i	MEANINDEX	STDCPUE	LCI	UCI	estcpue	obscpue
1990	0.132723	0.663257	0.038693	3153	0.318086	1.038388	0.401829	0.215966	0.747647	0.417254	0.501328
1991	0.161482	0.955584	0.05612	3546	0.273631	1.038388	0.568328	0.33205	0.972735	0.590145	0.722286
1992	0.20147	0.865695	0.070398	1733	0.295837	1.038388	0.655842	0.367459	1.170549	0.681019	0.654343
1993	0.131473	0.61701	0.044124	2425	0.310272	1.038388	0.408068	0.222537	0.748279	0.423733	0.466372
1994	0.16609	0.785383	0.055712	3554	0.261029	1.038388	0.612768	0.366687	1.023993	0.636291	0.593638
1995	0.136568	0.902613	0.076156	5817	0.234288	1.038388	0.561359	0.353552	0.891308	0.582909	0.682247
1996	0.144981	0.896088	0.072747	5471	0.235983	1.038388	0.591656	0.371422	0.942477	0.614368	0.677316
1997	0.10433	0.659302	0.055003	5327	0.256603	1.038388	0.391552	0.236293	0.648825	0.406583	0.498338
1998	0.16277	0.930233	0.080573	4257	0.240729	1.038388	0.651155	0.405067	1.046746	0.676152	0.703124
1999	0.306553	1.695057	0.124463	5351	0.220071	1.038388	1.341476	0.868335	2.072423	1.392973	1.281222
2000	0.301183	2.208313	0.141402	4908	0.211895	1.038388	1.368832	0.900156	2.081528	1.421379	1.669171
2001	0.231019	1.49878	0.118068	6149	0.204685	1.038388	1.086933	0.724831	1.62993	1.128659	1.132865
2002	0.294682	1.674603	0.134021	6111	0.193339	1.038388	1.467829	1.00065	2.153124	1.524177	1.265762
2003	0.382934	2.617772	0.211824	6935	0.175724	1.038388	2.098616	1.480676	2.974444	2.179178	1.978664
2004	0.335904	2.26553	0.1991	5776	0.192767	1.038388	1.678119	1.145283	2.458856	1.74254	1.712419
2005	0.306819	1.820273	0.162796	4650	0.200487	1.038388	1.473797	0.990855	2.192125	1.530374	1.375868
2006	0.353556	1.435507	0.137612	3895	0.20738	1.038388	1.641842	1.089171	2.474952	1.70487	1.085039

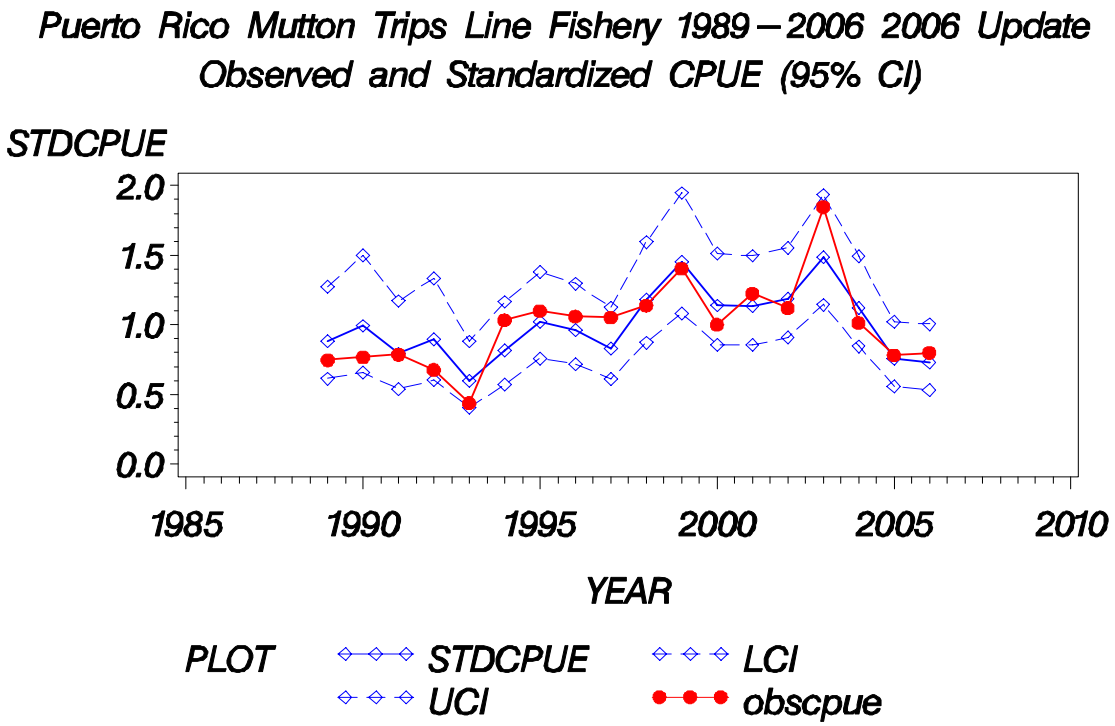

Figure 1. Updated mutton snapper commercial line fishery standardized CPUE indices in Puerto Rico, 1989-2006.

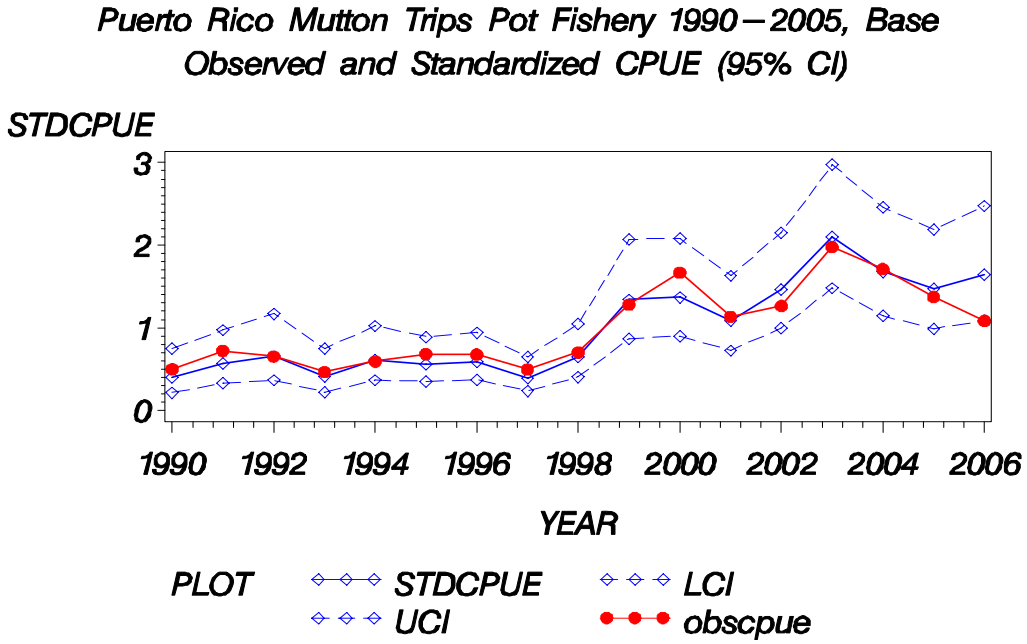

Figure 2. Updated mutton snapper commercial pot (trap) fishery standardized CPUE indices in Puerto Rico, 1990-2006.

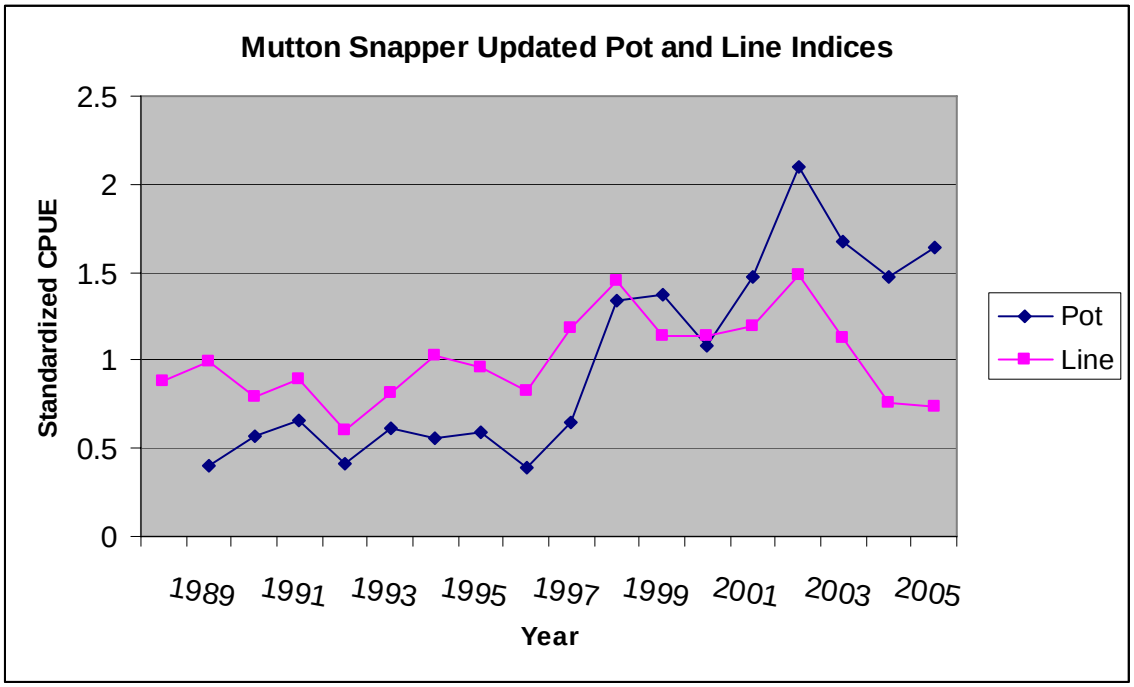

Figure 3. Revised mutton snapper standardized commercial CPUE indices for the line and pot fisheries in Puerto Rico, 1989-2003.

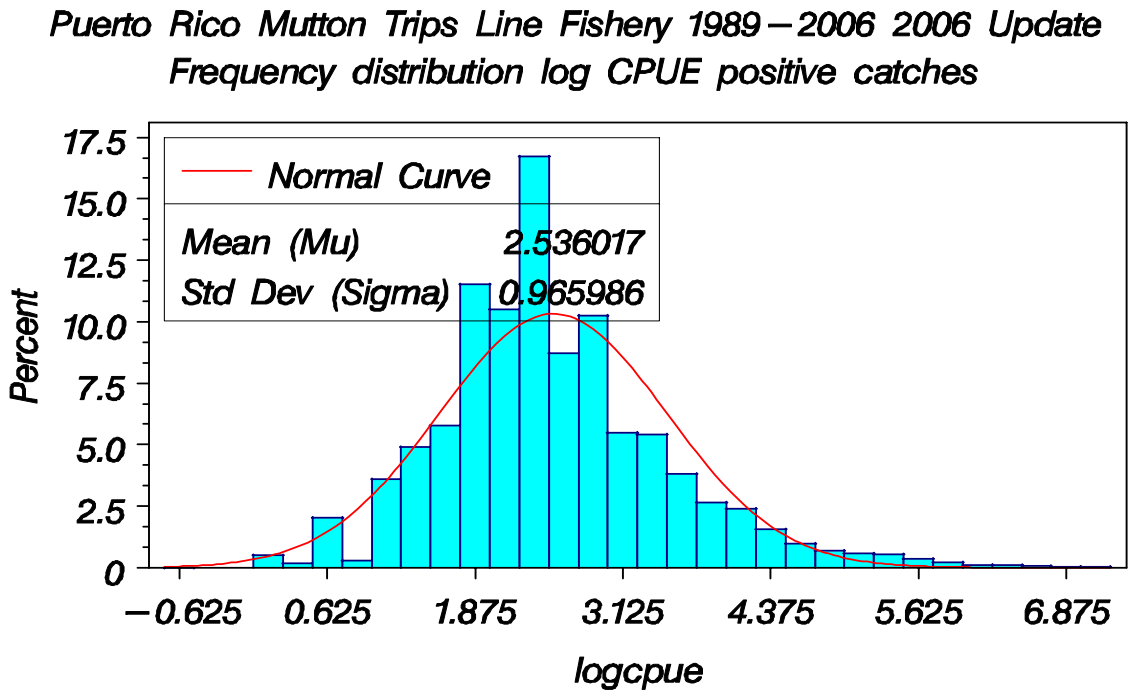

Figure 4. Frequency distribution of log(CPUE) positive catches of mutton snapper from the Puerto Rico commercial line fishery, 1989-2006, CPUE data.

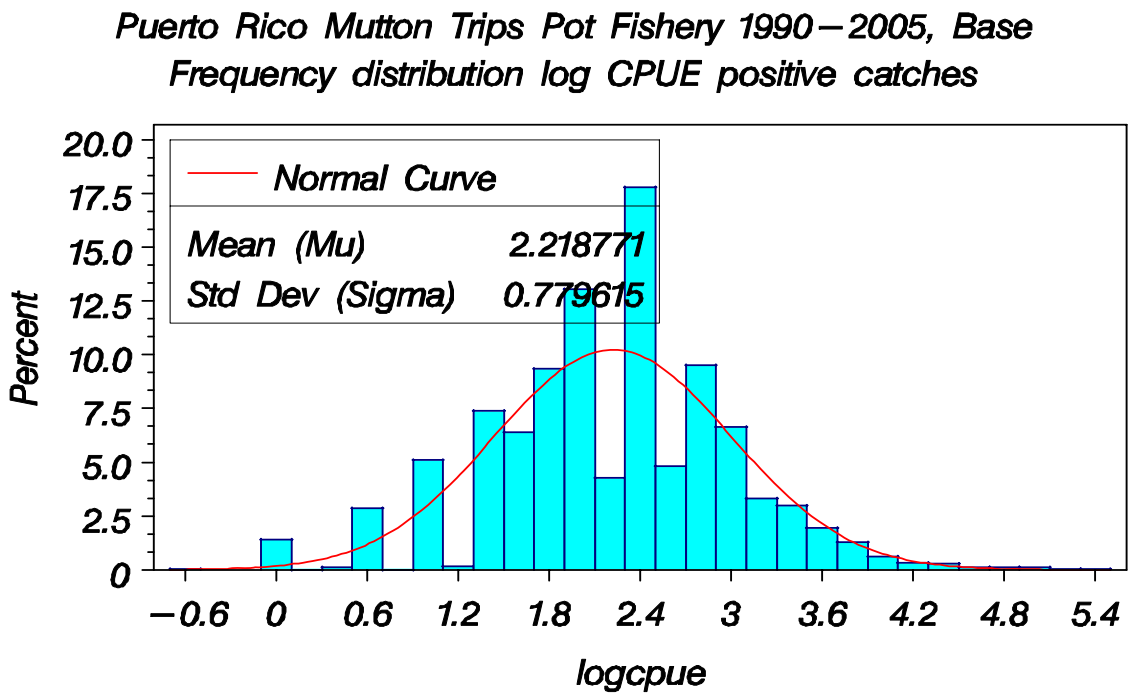

Figure 5. Frequency distribution of log(CPUE) positive CPUE catches of mutton snapper in Puerto Rico from the commercial pot fishery.

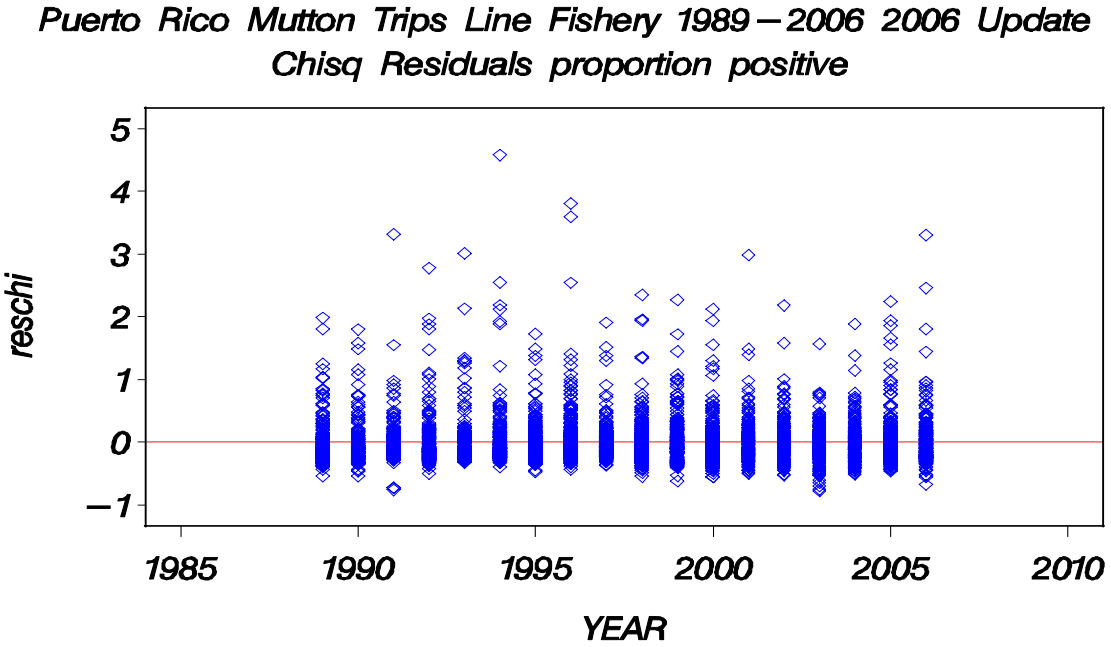

Figure 6. Distribution of residuals from the binomial fit to the proportion of positives for the mutton snapper commercial line fishery in Puerto Rico, 1989-2006.

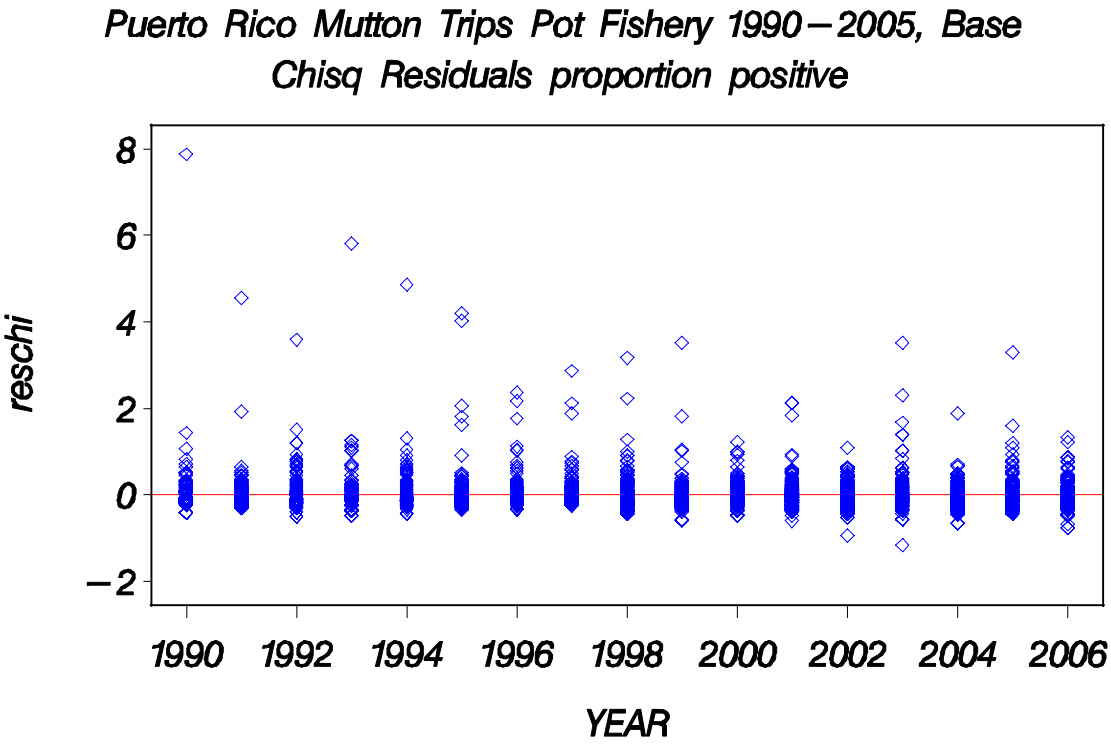

Figure 7. Distribution of residuals from the binomial fit to the proportion of positives for the mutton snapper commercial pot fishery in Puerto Rico, 1990-2006.