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Summary of fishery-independent surveys of juvenile gag grouper in the Gulf of Mexico

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In order to develop abundance indices of age-0 gag grouper in the Gulf of Mexico, three available data bases were combined and subsequently analyzed. In the following sections, each database is briefly outlined along with the survey methodology. Next is presented the statistical approach by which the indices are developed from the combined data.

1. FSU estuarine gag survey

Gear: 5-m otter trawl towed for 5 minutes at ~2 km/h covering approximately a 150 m transect. Numbers of gag caught are standardized by tow time and estimates of area covered.

Areas covered: St. Andrew Bay, St. Joe Bay, Turkey Point, Big Bend (Keaton Beach, Cedar Key), Crystal River, Anclote Key, Sarasota Bay, Sanibel, primarily in seagrass habitat. The 35 sampling locations in this survey were lumped into 9 sampling regions (Table 1.1 and Figure 1.1) similar to those of Brown et al. (2000).

Index years: 1991-1999, 2003-2009, 2011

Index value based upon: Number of gag per 100-m tow

Noteworthy: Gag is the target species, primarily captured during summer months in the post-settlement juvenile stage. In early years 1991 and 1993, survey efforts were limited to the Turkey Point area, and no sampling was conducted in years 2000, 2001 and 2003. While this is currently one of the longer-term age-0 surveys, the hiatus in sampling during those years resulted in this survey not being recommended during the data workshop for use in the SEDAR 10 assessment (where data was included up to 2005).

Principal contacts: Chris Koenig (koenig@bio.fsu.edu), FSU Marine Lab

Pertinent references: Koenig and Coleman 1998 a & b, Brown et al. 2000.

2. NMFS PC Lab St. Andrew Bay survey

Gear: Weekly sampling, May-November, 16 (50 m) tows taken using 1 m beam trawl ("crab scrape") at 5 fixed locations pre-determined to be settlement areas. Area covered is precisely measured.

Areas covered: St. Andrew Bay, Florida, principally 1-2 meters depth in conjunction with seagrass habitat

Index years: 1998-2011.

Index value based upon: Catch per meter^2

Noteworthy: Gag, grey snapper, and lane snapper are the target species; fish are primarily sampled soon after settlement into seagrass habitats. This survey has not been used previously as an assessment index for gag.

Principal contacts: Stacey Harter, (Stacey.Harter@noaa.gov) NMFS Panama City

Pertinent references: Harter 2008, 2009, NOAA-FWC 2009

3. State of Florida FWC estuarine (FIM) survey

Gear: 183-m haul seine, a component of the Fishery Independent Monitoring Program (FIM); and 183-m haul seine and 6.1 m otter trawl, components of a polyhaline seagrass survey.

Areas covered: Apalachicola Bay, Cedar Key, Tampa Bay, Charlotte Harbor, in estuarine near-shore habitats (~0.5 m depth).

Index years: 1996-2012

Index value based upon: Catch per haul

Noteworthy: While the FIM survey includes several gear types, the 183-m haul seine catches the most gag juveniles, typically later in the year (about ¾ of a year old) and closer to period of movement to deeper water. Similar sized fish are collected in the 183-m haul seine and 6.1 m otter trawl gears of the recently initiated polyhaline seagrass survey. There was a 2008 expansion to St. Andrew Bay, Big Bend and Apalachicola Bay resulting in increased coverage of seagrass habitats likely to hold juvenile gag. During the SEDAR 10 assessment workshop, issues related to lack of model convergence resulted in this survey not being used in the final model runs.

Principal contacts: Ted Switzer (Ted.Switzer@MyFWC.com), FWC St. Petersburg

Pertinent references: Casey et al. 2005, Ingram et al. 2005, NOAA-FWC 2009

4. Combined index of abundance

4.1 Methodology

In order to develop standardized indices of annual abundance of juvenile gag from Florida estuaries and coastal waters in the Gulf of Mexico, data from the above described surveys were combined. This was accomplished by first calculating the overall mean catch rate for each data set and scaling the data in each dataset to a mean of one. Due to the presence of two gear-types in the FWRI data, each gear type was considered a separate dataset, resulting in four datasets (FWRI trawl, FWRI seine, PCNMFS trawl and FSU trawl); and a database code was assigned to each dataset in order to model for differences between datasets. Next, sampling locations in each dataset were lumped into the 9 sampling regions as described in Section 1 (Table 1.1 and Figure 1.1). Therefore, while the FSU dataset (Section 1) had nine regions sampled, the NMFS PC Lab St. Andrew Bay survey (Section 2) sampled only that region (i.e. St. Andrew Bay, SAR) and the FWC estuarine (FIM) survey (Section 3) had four regions sampled (i.e. Charlotte Harbor, CHR; Cedar Key, CKR; Mid Big Bend, MBB; and Tampa Bay, TBR).

Four different indices were developed. Two indices were developed using data from 1991 through 2012, and two were developed using data from 1994 through 2012. This was due to sampling limited to the Turkey Point Region in 1991 and 1993. While employing each of the two different time series, an index was developed that was weighted by the aerial coverage of seagrass in each sampling region (Figure 1.1), and an index was developed that was not weighted, resulting in four indices.

The weight for each region was based on the seagrass coverage area in each region, between 0 and 6 feet of water depth. This depth range was said to be that in which the majority of juvenile gag are captured (Chris Koenig, personal communication). The area between 0 and 6 feet water depth was estimated in each region using a NOAA bathy model of medium scale (http://www.ngdc.noaa.gov/mgg/coastal/model.html for more details). The seagrass aerial coverage for each region was estimated using a GIS data set based a compilation of statewide seagrass data from various source agencies and scales. The GIS seagrass data were mapped from sources ranging in date from 1987 to 2007. Not all data in this compilation are mapped from photography; some are the results of field measurements. Some used the Florida Land Use Cover and Forms Classification System (FLUCCS) codes 9113 for discontinuous seagrass and 9116 for continuous seagrass; some defined only presence and absence of seagrass, and some defined varying degrees of seagrass percent cover. In order to merge all of these data sources into one compilation data set, FWRI reclassified the various source data attribute schemes into two categories: "continuous" and "discontinuous" seagrass. In areas where studies overlap, the most recent study where a given area has been interpreted is represented in this data set. The seagrass data was cross-referenced with the bathymetry data to estimate the seagrass coverage area in each region, between 0 and 6 feet of water depth (Figure 1.1).

A delta-lognormal model, as described by Lo et al. (1992) was employed for each index. The GLMMIX and MIXED procedures in SAS were employed to provide yearly index values for both the binomial and lognormal sub-models, respectively. A backward stepwise selection procedure was employed to develop both sub-models. Type 3 analyses were used to test each parameter for inclusion or exclusion into the sub-model. Both variable inclusion and exclusion significance level was set at an $\alpha = 0.05$. The parameters tested for inclusion in each sub-model were categorical variables of year, database code, region code, and season (spring: months 4-5; early summer: months 6-7; late summer: month 8-9; and fall: months 10-11). The fit of each model was evaluated using the fit statistics provided by the GLMMIX macro.

4.2 Unweighted, 1991-2012

Table 4.2.1 summarizes the results of Type 3 analyses for those variables retained in the binomial sub-model. Table 4.2.2 summarizes the results of Type 3 analyses for those variables retained in the lognormal sub-model. Figure 4.2.1 shows the approximate normality of the residual for the lognormal sub-model. Table 4.2.3 and Figures 4.2.2 and 4.2.3 summarize the unweighted index values for gag in Gulf estuaries of Florida based on all data sets combined from 1991-2012.

4.3 Weighted, 1991-2012

Table 4.3.1 summarizes the results of Type 3 analyses for those variables retained in the binomial sub-model. Table 4.3.2 summarizes the results of Type 3 analyses for those variables retained in the lognormal sub-model. Figure 4.3.1 shows the approximate normality of the residual for the lognormal sub-model. Table 4.3.3 and Figure 4.3.2 summarize the weighted index values for gag in Gulf estuaries of Florida based on all data sets combined from 1991-2012.

4.4 Unweighted, 1994-2012

Table 4.4.1 summarizes the results of Type 3 analyses for those variables retained in the binomial sub-model. Table 4.4.2 summarizes the results of Type 3 analyses for those variables retained in the lognormal sub-model. Figure 4.4.1 shows the approximate normality of the residual for the lognormal sub-model. Table 4.4.3 and Figure 4.4.2 summarize the unweighted index values for gag in Gulf estuaries of Florida based on all data sets combined from 1994-2012.

4.5 Weighted, 1994-2012

Table 4.5.1 summarizes the results of Type 3 analyses for those variables retained in the binomial sub-model. Table 4.5.2 summarizes the results of Type 3 analyses for those variables retained in the lognormal sub-model. Figure 4.5.1 shows the approximate normality of the residual for the lognormal sub-model. Table 4.5.3 and Figure 4.5.2 summarize the weighted index values for gag in Gulf estuaries of Florida based on all data sets combined from 1994-2012.

5. Discussion of combined indices for juvenile gag

During the previous update workshop in 2009, these indices were discussed. The panel decided the most appropriate index to be one that was weighted by seagrass aerial coverage and that was based on data from 1994 to 2012. However, when region-specific abundance patterns were examined (Figure 5.1), it was decided that an index calculated excluding data from the Marco Island Region was most appropriate. This was due to the short length of the time series, limited sampling area, and the location of the region in the southern end of the juvenile gag range.

The following results are for the index that was weighted by seagrass aerial coverage and based on data from 1994 to 2012, but excluding data from the Marco Island Region. Table 5.1 summarizes the results of Type 3 analyses for those variables retained in the binomial sub-model. Table 5.2 summarizes the results of Type 3 analyses for those variables retained in the lognormal sub-model. Figure 5.2 shows the approximate normality of the residual for the lognormal sub-model. Table 5.3 and Figure 5.3 summarize the weighted index values for gag in

Gulf estuaries of Florida based on all data sets combined from 1994-2012 excluding the Marco Island data.

Acknowledgments

Many thanks to Chris Koenig, Stacey Harter, and Ted Switzer for coding and providing their respective databases. Also thanks to Gary Fitzhugh for help with summaries of the databases.

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Table 1.1. Sampling location and corresponding region codes for data used in these analyses.

Location	Site_code	Region	Region_code
Cedar Key	CED	Cedar Key region	CKR
Crystal River	CRY	Cedar Key region	CKR
Homasassa	HOM	Cedar Key region	CKR
Suwanee Sound	SUS	Cedar Key region	CKR
Waccasassa	WAC	Cedar Key region	CKR
Captiva Pass	CAP	Charlotte Harbor region	CHR
Fisherman Key	FIK	Charlotte Harbor region	CHR
Jug Creek Shoal	JUG	Charlotte Harbor region	CHR
Punta Rassa	PUN	Charlotte Harbor region	CHR
Redfish Pass	RED	Charlotte Harbor region	CHR
Sanibel	SAN	Charlotte Harbor region	CHR
Smokehouse Bay	SHB	Charlotte Harbor region	CHR
Ussepa Island	USI	Charlotte Harbor region	CHR
Wulford Pass	WUP	Charlotte Harbor region	CHR
Cape Romano	CPR	Marco Island region	MIR
Horseshoe Beach	HSB	Mid Big Bend region	MBB
Keaton Beach	KEB	Mid Big Bend region	MBB
St Marks	SMK	Mid Big Bend region	MBB
Steinhatchee	STE	Mid Big Bend region	MBB
Longboat Pass	LBP	Sarasota Bay region	SBR
New Pass	NWP	Sarasota Bay region	SBR
Sarasota Bay	SAR	Sarasota Bay region	SBR
Crooked Is Sound	CIS	St. Andrew Bay region	SAR
St Andrew Bay	SAB	St. Andrew Bay region	SAR
St Joe Bay	SJB	St. Joe Bay region	SJR
Anclote	ANC	Tampa Bay region	TBR
Aripeka	ARI	Tampa Bay region	TBR
Bunces Pass	BPN	Tampa Bay region	TBR
Egmont Key	EGM	Tampa Bay region	TBR
Mullet Key	MUL	Tampa Bay region	TBR
NE Anna Maria	NAM	Tampa Bay region	TBR
Tampa Bay	TPB	Tampa Bay region	TBR
Dog Is Shoal	DIS	Turkey Pt region	TPR
Lanark	LAN	Turkey Pt region	TPR
Turkey Point	TUP	Turkey Pt region	TPR

Figure 1.1. Nine sampling regions used in this study. The green areas indicate seagrass coverage between 0 and 6 feet of water depth. Seagrass coverage in acres for each region is listed.

Table 4.2.1. Type 3 tests of fixed effects for binomial sub-model for the unweighted index based on all data sets combined from 1991-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
year	20	16E3	775.21	38.76	<.0001	<.0001
season	3	16E3	277.03	92.34	<.0001	<.0001
region_code	8	16E3	477.47	59.68	<.0001	<.0001
database_code	3	16E3	653.44	217.81	<.0001	<.0001

Table 4.2.2. Type 3 tests of fixed effects for lognormal sub-model for the unweighted index based on all data sets combined from 1991-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
year	21	2645	25.30	<.0001
season	3	2645	6.23	0.0003
region_code	8	2645	9.02	<.0001
database_code	3	2645	418.06	<.0001

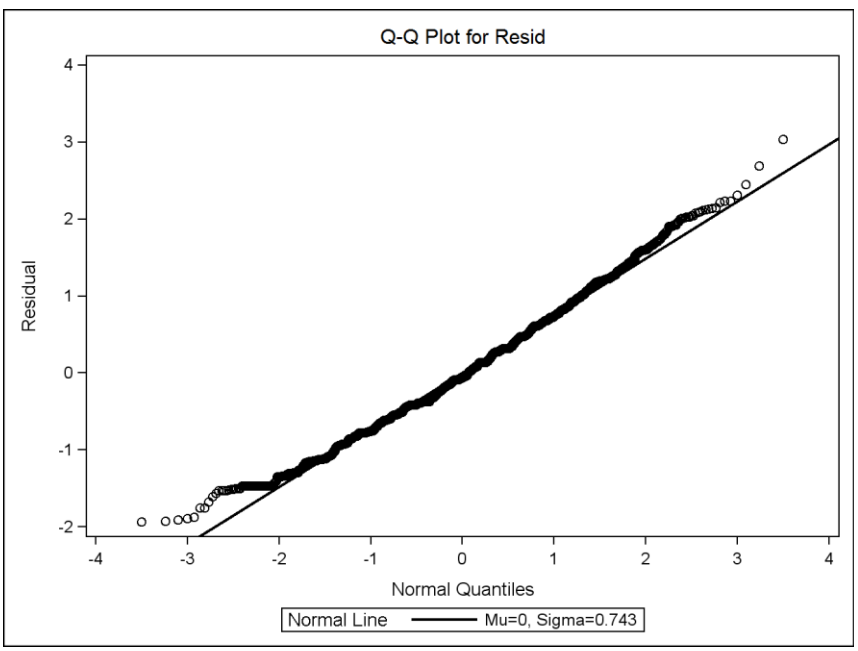

Figure 4.2.1. QQplot of residuals from the lognormal sub-model for the unweighted index based on all data sets combined from 1991-2012.

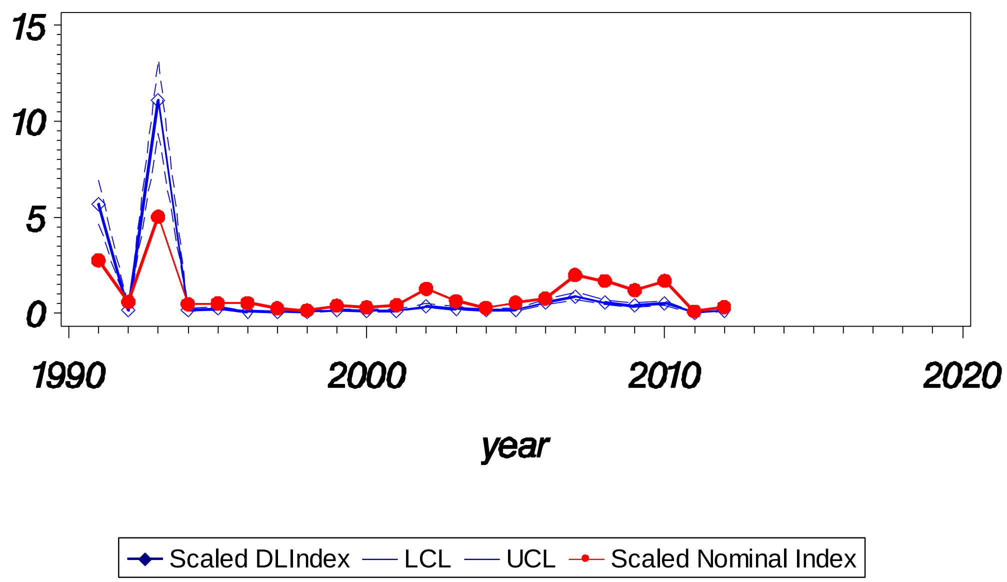

Figure 4.2.2. Unweighted abundance indices developed from all data sets combined from 1991-2012.

Table 4.2.3. Unweighted abundance indices developed from all data sets combined from 1991-2012.

Survey Year	*Nominal Frequency*	*N*	*DL Index*	*Scaled DL Index*	*CV*	*LCL*	*UCL*
1991	0.97005	434	7.2634	5.6689	0.10017	4.64206	6.9230
1992	0.38645	251	0.2163	0.1688	0.19820	0.11401	0.2500
1993	1.00000	13	14.2219	11.0999	0.08695	9.33115	13.2038
1994	0.34921	126	0.2003	0.1563	0.26571	0.09271	0.2636
1995	0.50742	337	0.3089	0.2411	0.17853	0.16915	0.3436
1996	0.16134	626	0.1094	0.0854	0.18235	0.05946	0.1226
1997	0.13803	681	0.1068	0.0833	0.18399	0.05785	0.1200
1998	0.06140	570	0.1011	0.0789	0.26151	0.04717	0.1320
1999	0.11203	723	0.1900	0.1483	0.18097	0.10355	0.2123
2000	0.08179	648	0.1623	0.1267	0.20317	0.08472	0.1894
2001	0.05317	583	0.1706	0.1332	0.26017	0.07981	0.2222
2002	0.11000	800	0.4597	0.3588	0.16340	0.25932	0.4964
2003	0.12164	855	0.3088	0.2410	0.16345	0.17417	0.3335
2004	0.10961	812	0.2096	0.1636	0.17403	0.11580	0.2311
2005	0.13563	928	0.2270	0.1771	0.14924	0.13164	0.2383
2006	0.21150	922	0.6986	0.5452	0.12025	0.42905	0.6929
2007	0.24763	844	1.1185	0.8730	0.11206	0.69818	1.0915
2008	0.19331	1376	0.7183	0.5606	0.10774	0.45221	0.6950
2009	0.14632	1237	0.5237	0.4087	0.12464	0.31885	0.5239
2010	0.14361	1142	0.6544	0.5108	0.12980	0.39442	0.6615
2011	0.02864	1327	0.0427	0.0333	0.24219	0.02067	0.0537
2012	0.07030	1138	0.1758	0.1372	0.17535	0.09685	0.1943

Table 4.3.1. Type 3 tests of fixed effects for binomial sub-model for the weighted index based on all data sets combined from 1991-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
year	20	16E3	427.35	21.37	<.0001	<.0001
season	3	16E3	182.36	60.79	<.0001	<.0001
region_code	8	16E3	968.34	121.04	<.0001	<.0001
database_code	3	16E3	881.04	293.68	<.0001	<.0001

Table 4.3.2. Type 3 tests of fixed effects for lognormal sub-model for the weighted index based on all data sets combined from 1991-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
year	21	2645	13.68	<.0001
season	3	2645	9.47	<.0001
region_code	8	2645	19.70	<.0001
database_code	3	2645	504.81	<.0001

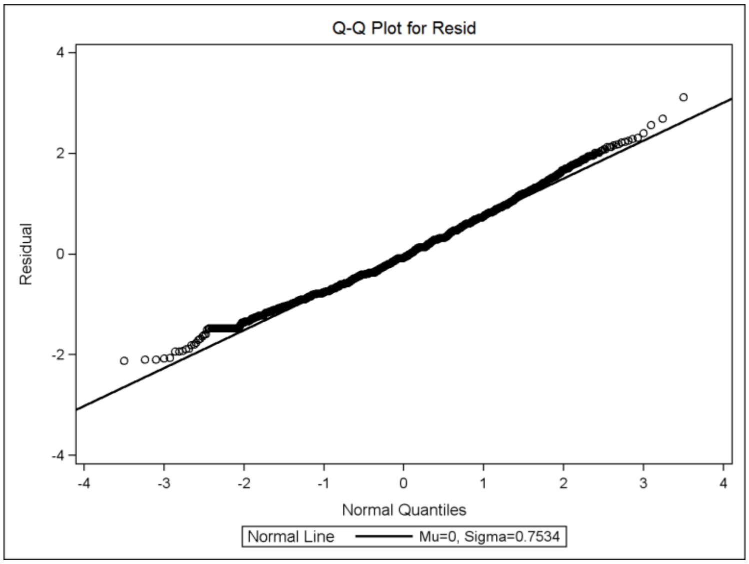

Figure 4.3.1. QQplot of residuals from the lognormal sub-model for the weighted index based on all data sets combined from 1991-2012.

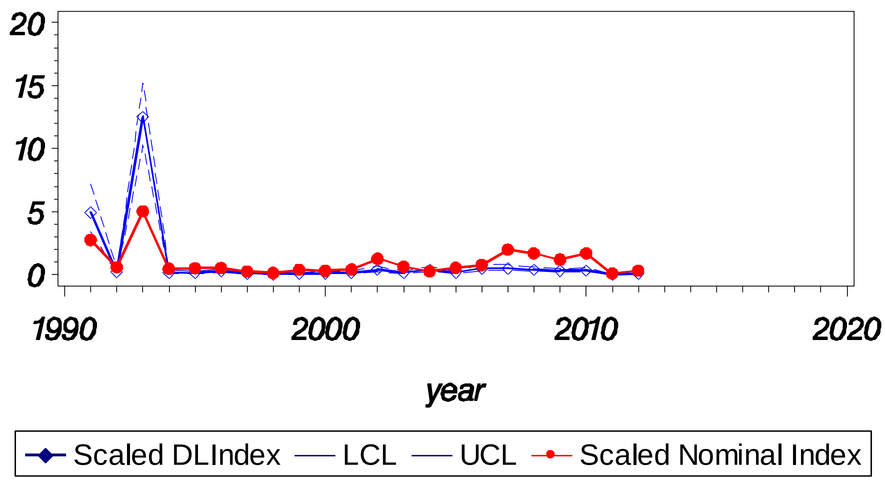

Figure 4.3.2. Weighted abundance indices developed from all data sets combined from 1991-2012.

Table 4.3.3. Weighted abundance indices developed from all data sets combined from 1991-2012.

Survey Year	*Nominal Frequency*	*N*	*DL Index*	*Scaled DL Index*	*CV*	*LCL*	*UCL*
1991	0.97005	434	5.7230	4.9464	0.18841	3.4045	7.1864
1992	0.38645	251	0.2190	0.1893	0.31324	0.1026	0.3490
1993	1.00000	13	14.4731	12.5089	0.09815	10.2842	15.2147
1994	0.34921	126	0.2046	0.1768	0.38875	0.0835	0.3744
1995	0.50742	337	0.1491	0.1289	0.32258	0.0687	0.2418
1996	0.16134	626	0.3177	0.2746	0.25442	0.1664	0.4531
1997	0.13803	681	0.1164	0.1006	0.27786	0.0583	0.1735
1998	0.06140	570	0.0534	0.0461	0.38975	0.0217	0.0979
1999	0.11203	723	0.0768	0.0663	0.33857	0.0343	0.1282
2000	0.08179	648	0.1305	0.1128	0.33649	0.0586	0.2171
2001	0.05317	583	0.1599	0.1382	0.35644	0.0692	0.2760
2002	0.11000	800	0.4559	0.3940	0.26939	0.2320	0.6689
2003	0.12164	855	0.1966	0.1699	0.29794	0.0948	0.3044
2004	0.10961	812	0.4539	0.3923	0.24637	0.2414	0.6375
2005	0.13563	928	0.1972	0.1704	0.25717	0.1027	0.2827
2006	0.21150	922	0.5816	0.5027	0.22406	0.3229	0.7826
2007	0.24763	844	0.5839	0.5047	0.21892	0.3274	0.7779
2008	0.19331	1376	0.4612	0.3986	0.21738	0.2593	0.6126
2009	0.14632	1237	0.3623	0.3131	0.23337	0.1976	0.4963
2010	0.14361	1142	0.3793	0.3278	0.24056	0.2040	0.5268
2011	0.02864	1327	0.0306	0.0265	0.34027	0.0137	0.0514
2012	0.07030	1138	0.1287	0.1113	0.28018	0.0642	0.1928

Table 4.4.1. Type 3 tests of fixed effects for binomial sub-model for the unweighted index based on all data sets combined from 1994-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
year	18	16E3	570.87	31.72	<.0001	<.0001
season	3	16E3	271.83	90.61	<.0001	<.0001
region_code	8	16E3	458.19	57.27	<.0001	<.0001
database_code	3	16E3	634.56	211.52	<.0001	<.0001

Table 4.4.2. Type 3 tests of fixed effects for lognormal sub-model for the unweighted index based on all data sets combined from 1994-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
year	18	2117	12.58	<.0001
season	3	2117	5.74	0.0007
region_code	8	2117	7.48	<.0001
database_code	3	2117	391.76	<.0001

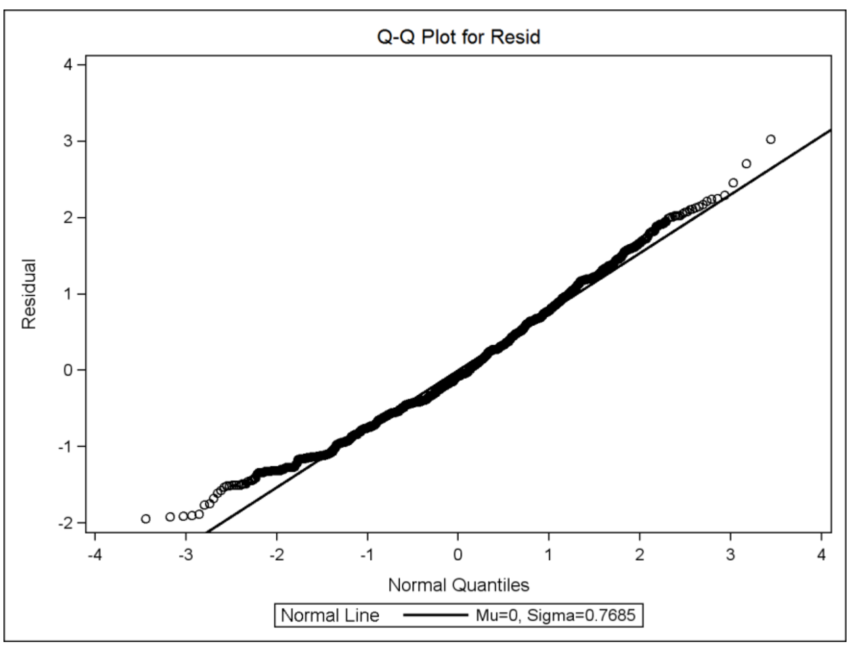

Figure 4.4.1. QQplot of residuals from the lognormal sub-model for the unweighted index based on all data sets combined from 1994-2012.

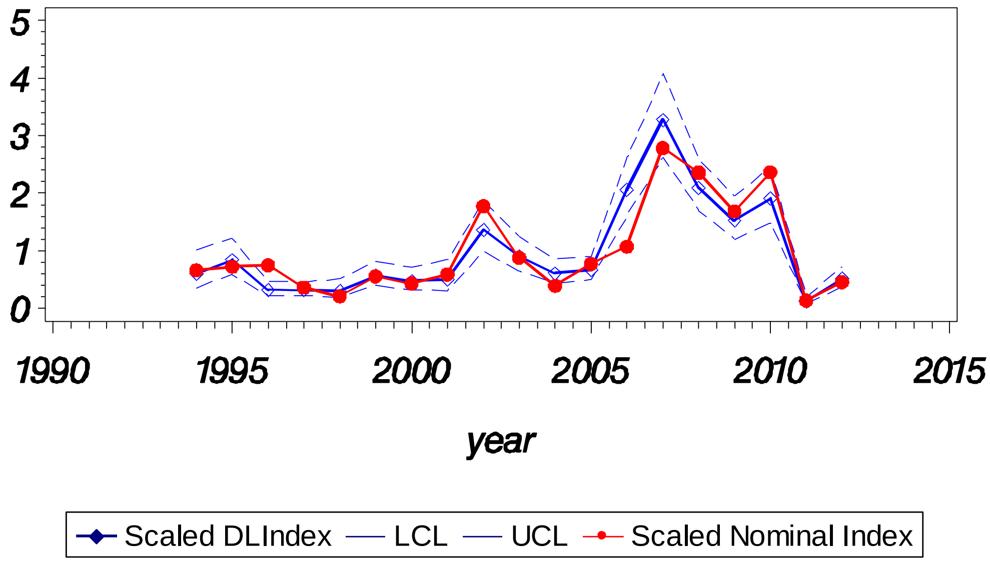

Figure 4.4.2. Unweighted abundance indices developed from all data sets combined from 1994-2012.

Table 4.4.3. Unweighted abundance indices developed from all data sets combined from 1994-2012.

Survey Year	*Nominal Frequency*	*N*	*DL Index*	*Scaled DL Index*	*CV*	*LCL*	*UCL*
1994	0.34921	126	0.26399	0.60379	0.26608	0.35786	1.01873
1995	0.50742	337	0.36874	0.84337	0.18106	0.58886	1.20787
1996	0.16134	626	0.14155	0.32376	0.18218	0.22556	0.46469
1997	0.13803	681	0.13857	0.31692	0.18416	0.21995	0.45665
1998	0.06140	570	0.13337	0.30503	0.26034	0.18277	0.50907
1999	0.11203	723	0.24787	0.56693	0.17943	0.39711	0.80937
2000	0.08179	648	0.20968	0.47958	0.20127	0.32194	0.71441
2001	0.05317	583	0.22191	0.50754	0.25810	0.30542	0.84343
2002	0.11000	800	0.59445	1.35962	0.16141	0.98655	1.87377
2003	0.12164	855	0.39279	0.89839	0.16267	0.65026	1.24119
2004	0.10961	812	0.26623	0.60892	0.17326	0.43170	0.85889
2005	0.13563	928	0.29398	0.67238	0.14915	0.49978	0.90460
2006	0.21150	922	0.90112	2.06103	0.12029	1.62173	2.61934
2007	0.24763	844	1.43242	3.27620	0.11083	2.62661	4.08643
2008	0.19331	1376	0.91714	2.09766	0.10547	1.69971	2.58877
2009	0.14632	1237	0.66887	1.52982	0.12224	1.19911	1.95175
2010	0.14361	1142	0.83378	1.90701	0.12739	1.47963	2.45784
2011	0.02864	1327	0.05518	0.12621	0.24008	0.07861	0.20263
2012	0.07030	1138	0.22554	0.51584	0.17360	0.36547	0.72809

Table 4.5.1. Type 3 tests of fixed effects for binomial sub-model for the weighted index based on all data sets combined from 1994-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
year	18	16E3	372.55	20.70	<.0001	<.0001
season	3	16E3	175.80	58.60	<.0001	<.0001
region_code	8	16E3	888.73	111.09	<.0001	<.0001
database_code	3	16E3	859.24	286.41	<.0001	<.0001

Table 4.5.2. Type 3 tests of fixed effects for lognormal sub-model for the weighted index based on all data sets combined from 1994-2012.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
year	18	2117	7.73	<.0001
season	3	2117	8.29	<.0001
region_code	8	2117	16.52	<.0001
database_code	3	2117	440.13	<.0001

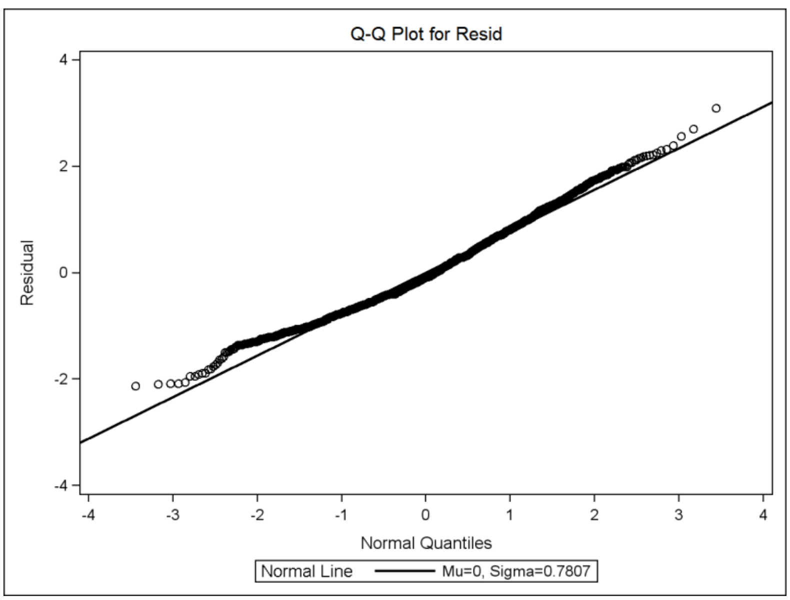

Figure 4.5.1. QQplot of residuals from the lognormal sub-model for the weighted index based on all data sets combined from 1994-2012.

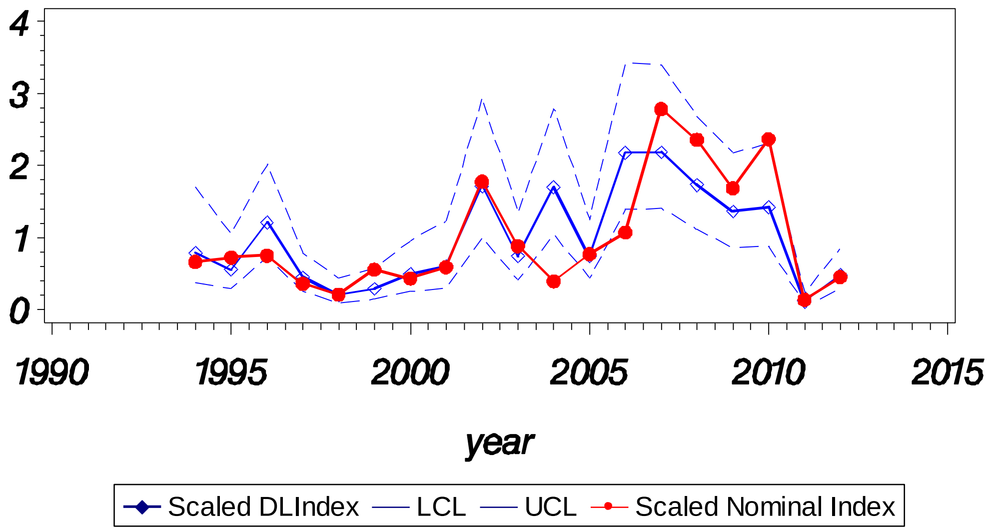

Figure 4.5.2. Weighted abundance indices developed from all data sets combined from 1994-2008.

Table 4.5.3. Weighted abundance indices developed from all data sets combined from 1994-2008.

Survey Year	*Nominal Frequency*	*N*	*DL Index*	*Scaled DL Index*	*CV*	*LCL*	*UCL*
1994	0.34921	126	0.23124	0.78941	0.39680	0.36742	1.69607
1995	0.50742	337	0.16267	0.55531	0.33062	0.29160	1.05752
1996	0.16134	626	0.35575	1.21444	0.25949	0.72887	2.02349
1997	0.13803	681	0.13126	0.44810	0.28379	0.25682	0.78182
1998	0.06140	570	0.06022	0.20558	0.39823	0.09544	0.44282
1999	0.11203	723	0.08523	0.29094	0.34564	0.14860	0.56964
2000	0.08179	648	0.14446	0.49316	0.34392	0.25268	0.96252
2001	0.05317	583	0.17761	0.60634	0.36444	0.29921	1.22872
2002	0.11000	800	0.50263	1.71589	0.27494	1.00004	2.94414
2003	0.12164	855	0.21727	0.74170	0.30397	0.40928	1.34414
2004	0.10961	812	0.49815	1.70057	0.25152	1.03627	2.79073
2005	0.13563	928	0.21834	0.74537	0.26263	0.44468	1.24939
2006	0.21150	922	0.63937	2.18268	0.22890	1.38899	3.42988
2007	0.24763	844	0.64045	2.18637	0.22325	1.40658	3.39848
2008	0.19331	1376	0.50758	1.73276	0.22086	1.11990	2.68101
2009	0.14632	1237	0.39970	1.36451	0.23730	0.85443	2.17909
2010	0.14361	1142	0.41710	1.42390	0.24471	0.87904	2.30648
2011	0.02864	1327	0.03419	0.11673	0.34756	0.05941	0.22936
2012	0.07030	1138	0.14243	0.48623	0.28575	0.27765	0.85151

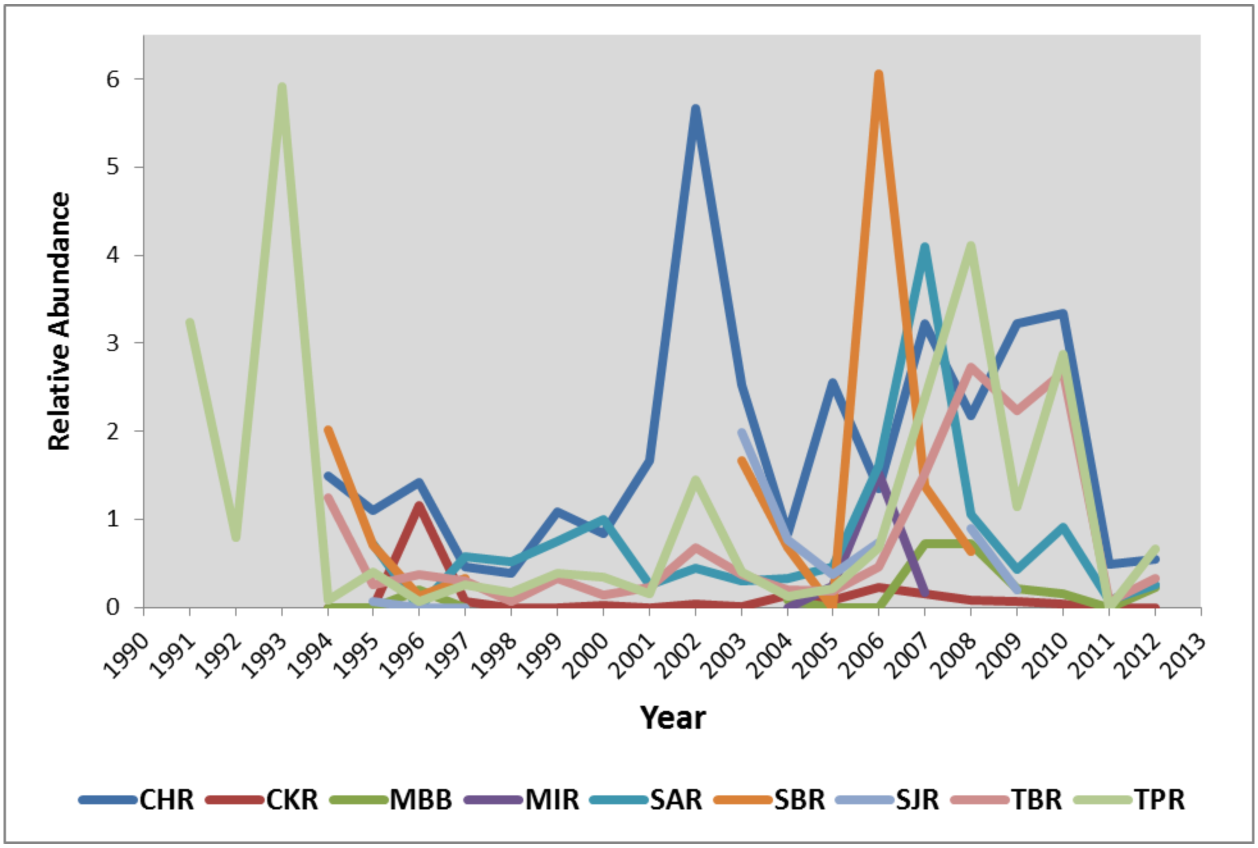

Figure 5.1. Nominal relative catch per region. Region codes described in Table 1.1.

Table 5.1. Type 3 tests of fixed effects for binomial sub-model for the weighted index based on all data sets combined from 1994-2012 excluding Marco Island Region.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*
year	18	16E3	371.81	20.66	<.0001	<.0001
season	3	16E3	175.57	58.52	<.0001	<.0001
region_code	7	16E3	886.97	126.71	<.0001	<.0001
database_code	3	16E3	857.52	285.84	<.0001	<.0001

Table 5.2. Type 3 tests of fixed effects for lognormal sub-model for the weighted index based on all data sets combined from 1994-2012 excluding Marco Island Region.

Type 3 Tests of Fixed Effects

Effect	*Num DF*	*Den DF*	*F Value*	*Pr > F*
year	18	2104	7.68	<.0001
season	3	2104	8.24	<.0001
region_code	7	2104	18.77	<.0001
database_code	3	2104	437.53	<.0001

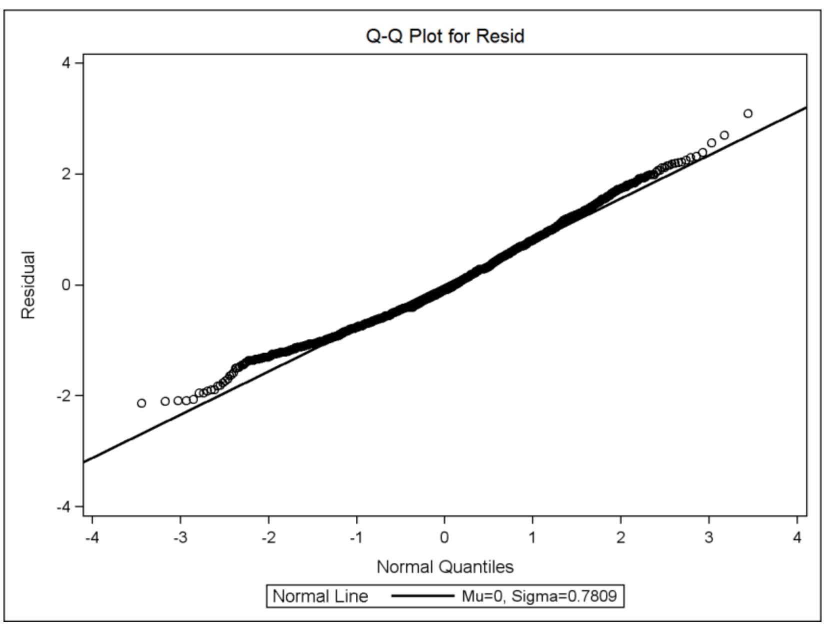

Figure 5.2. QQplot of residuals from the lognormal sub-model for the weighted index based on all data sets combined from 1994-2012 excluding Marco Island Region.

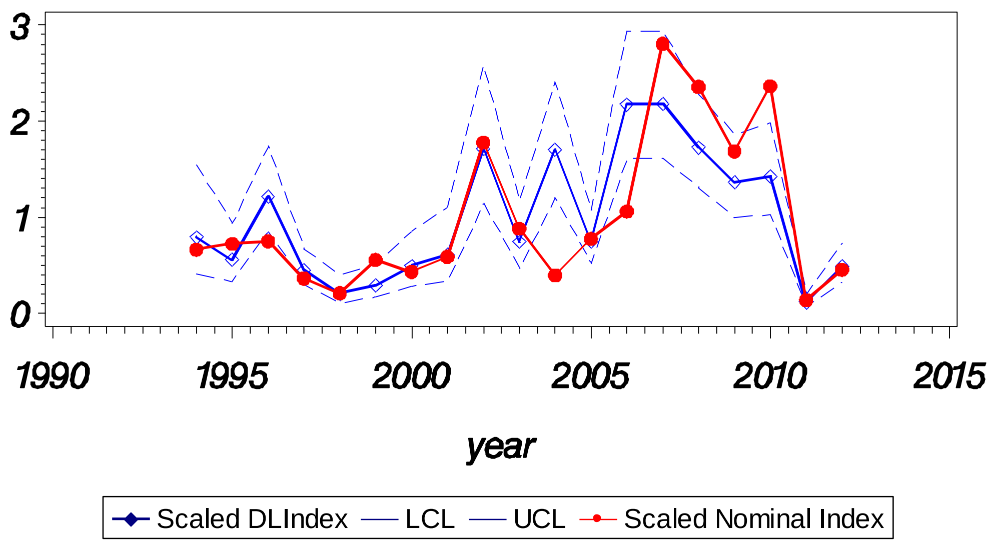

Figure 5.3. Weighted abundance indices developed from all data sets combined from 1994-2012 excluding Marco Island Region.

Table 5.3. Weighted abundance indices developed from all data sets combined from 1994-2012 excluding Marco Island Region.

Survey Year	*Nominal Frequency*	*N*	*DL Index*	*Scaled DL Index*	*CV*	*LCL*	*UCL*
1994	0.34921	126	0.24538	0.79297	0.34205	0.40770	1.54234
1995	0.50742	337	0.17262	0.55785	0.26302	0.33256	0.93577
1996	0.16134	626	0.37648	1.21665	0.17968	0.85181	1.73777
1997	0.13803	681	0.13942	0.45054	0.20178	0.30215	0.67182
1998	0.06140	570	0.06403	0.20694	0.34002	0.10679	0.40099
1999	0.11203	723	0.09054	0.29259	0.27938	0.16910	0.50628
2000	0.08179	648	0.15311	0.49479	0.28176	0.28467	0.85999
2001	0.05317	583	0.18837	0.60876	0.30481	0.33539	1.10495
2002	0.11000	800	0.53053	1.71449	0.20567	1.14114	2.57592
2003	0.12164	855	0.23038	0.74451	0.23159	0.47134	1.17600
2004	0.11029	807	0.52640	1.70112	0.17541	1.20096	2.40957
2005	0.13341	921	0.23120	0.74714	0.18245	0.52027	1.07296
2006	0.20485	908	0.67280	2.17426	0.15089	1.61060	2.93519
2007	0.24731	837	0.67393	2.17790	0.15044	1.61472	2.93751
2008	0.19331	1376	0.53457	1.72754	0.13973	1.30811	2.28145
2009	0.14632	1237	0.42180	1.36309	0.15687	0.99792	1.86190
2010	0.14361	1142	0.44040	1.42322	0.16551	1.02444	1.97724
2011	0.02864	1327	0.03637	0.11754	0.27848	0.06805	0.20304
2012	0.07030	1138	0.15103	0.48808	0.20853	0.32307	0.73738