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Red Snapper Abundance Indices from Groundfish Surveys in the Northern Gulf of Mexico

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Abstract

The National Marine Fisheries Service Southeast Fisheries Science Center Mississippi Laboratories and state partners have conducted groundfish surveys since 1972 in the northern Gulf of Mexico during the summer and fall under two different sampling programs. In 1987, both groundfish surveys (summer and fall) were brought under the Southeast Area Monitoring and Assessment Program (SEAMAP). These fisheries independent datasets were used to develop abundance indices for Red Snapper (Lutjanus campechanus). An additional survey conducted off the coast of Alabama by the Dauphin Island Sea Lab was incorporated into the eastern Gulf of Mexico abundance indices at the request of the SEDAR31 Data Workshop Panel. Multiple abundance indices were developed with respect to changes in survey design and/or survey coverage and by season. The indices were split by season since the primary age class captured differs between the summer and fall surveys, age 0 and age 1, respectively.

Introduction

The NOAA Fisheries Southeast Fisheries Science Center (SEFSC) Population and Ecosystem Monitoring Division Trawl and Plankton Branch and state partners have conducted standardized fall groundfish surveys under the Southeast Area Monitoring and Assessment Program (SEAMAP) in the Gulf of Mexico (GOM) since 1987. Prior to 1987, the summer survey was conducted under SEAMAP protocols; however, the fall survey operated independent of SEAMAP and dates back to 1972. SEAMAP is a collaborative effort between federal, state and university programs, designed to collect, manage and distribute fishery independent data throughout the region. The primary objective of this trawl survey is to collect data on the abundance and distribution of demersal organisms in the northern GOM. This survey, which is conducted semi-annually (summer and fall), provides an important source of fisheries independent information on many commercially and recreationally important species throughout the GOM.

In addition to the NMFS Groundfish and SEAMAP surveys, the Dauphin Island Sea Lab (DISL) has conducted fishery-independent trawl surveys in the north-central GOM off Alabama. The gear used during the survey is similar to that used by the NMFS Groundfish and SEAMAP surveys, but utilizes a different sampling design and was located in an area that is not trawled under the SEAMAP survey design due to the large number of unmarked artificial reefs. Details concerning the DISL surveys can be obtained from Dr. Sean Powers[1], DISL.

[1] Dr. Sean Powers, Dauphin Island Sea Lab, 101 Bienville Blvd, Dauphin Island, AL 36528.

The purpose of this document is to provide abundance indices for Red Snapper (*Lutjanus campechanus*).

Methodology

Survey Design

The survey methodologies and descriptions of the datasets used herein have been presented in detail by Nichols (2004) and Pollack and Ingram (2010). A change to the survey design was implemented between the summer and fall surveys of 2008. Prior to the fall survey of 2008, the basic structure of the groundfish surveys (i.e. 1987- summer of 2008) follows a stratified random station location assignment with strata derived from depth zones (5-6, 6-7, 7-8, 8-9, 9-10, 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18, 18-19, 19-20, 20-22, 22-25, 25-30, 30-35, 35-40, 40-45, 45-50 and 50-60 fm), shrimp statistical zones (SSZ) (between 88° and 97° W longitude, paired SSZ from west to east: 21-20, 19-18, 17-16, 15-13 and 12-10), and time of day (i.e. day or night). Survey methodology prior to 1987 was presented in detail by Nichols (2004).

Starting in the fall of 2008 and continuing until the present, station allocation is randomized within each SSZ with a weighting by area. Other notable changes included a standardized 30 min tow and dropping the day/night stratification. The main purpose of these changes was to increase the sample size of each survey and expand the survey into the waters off of Florida.

Data

A total of 21,545 stations were sampled from 1972- 2019 with 8,607 and 12,938 stations sampled during the summer and fall surveys, respectively (Tables 1 and 2). Trawl data from SEFSC was obtained from the SEFSC Oracle database and combined with data from the Gulf States Marine Fisheries Commission (GSMFC) database, which contains data collected by state agencies/partners from Alabama, Florida, Louisiana, Mississippi and Texas. Age data was obtained from the NMFS SEFSC Panama City Laboratory (Lombardi, personal communication). Data for the DISL survey was obtained from Dr. Sean Powers. Finally, for this assessment, the GOM was broken down into three areas, western GOM (wGOM), central GOM (cGOM), and eastern GOM (eGOM) (Figure 1).

Data Exclusions

Data was limited to stations where no problems were reported (i.e. net torn, doors crossed, etc.) and were sampled with a 40 ft shrimp trawl (data from the state of Texas was not utilized because of the use of a 20 ft shrimp trawl). Data from the DISL survey was limited to stations completed within the following months to match the temporal period of the SEAMAP Groundfish survey: May, June, and July for the summer survey and October and November for the fall survey. No data from the fall of 1987 was used because of the lack of coverage off of Texas which is attributed to the direction in which sampling was undertaken (east to west, changed in subsequent years to west to east).

Data Caveats

The survey area has been expanded throughout the course of the fall time series. Prior to 1987, the areas of East Louisiana and Mississippi/Alabama were considered the primary sampling area, areas directly west and east of the primary area were designated the secondary sampling areas; East Florida and Texas were not sampled. During this time, triplicate 10 min tows were done at each station.

From 1987 – 2008 (summer), the area sampled was from Brownsville, TX to Mobile Bay, AL. Sampling rarely extended past Mobile Bay due to an increase in the number of hangs. During this time, tow length was dependent on how long it took to cover a full depth stratum (defined above). However, single tows never exceeded 55 min. Full details about this survey can be found in Nichols (2004).

Beginning in 2008, sampling was expanded to cover the eastern GOM, down to the Florida Keys. The other changes to the survey are outlined above in the survey design section and in Pollack and Ingram (2010).

Index Construction

Delta-lognormal modeling methods were used to estimate relative abundance indices for Red Snapper (Bradu and Mundlak 1970, Pennington 1983). The main advantage of using this method is allowance for the probability of zero catch (Ortiz *et al.* 2000). The index computed by this method is a mathematical combination of yearly abundance estimates from two distinct generalized linear models: a binomial (logistic) model which describes proportion of positive abundance values (i.e. presence/absence) and a lognormal model which describes variability in only the nonzero abundance data (*cf.* Lo *et al*. 1992).

The delta-lognormal index of relative abundance (I_y) was estimated as:

(1) $$I_y = c_y p_y,$$

where c_y is the estimate of mean CPUE for positive catches only for year y, and p_y is the estimate of mean probability of occurrence during year y. Both c_y and p_y were estimated using generalized linear models. Data used to estimate abundance for positive catches (c) and probability of occurrence (p) were assumed to have a lognormal distribution and a binomial distribution, respectively, and modeled using the following equations:

(2) $$\ln(c) = X\beta + \varepsilon$$

and

(3) $$p = \frac{e^{\mathbf{X\beta}+\varepsilon}}{1+e^{\mathbf{X\beta}+\varepsilon}},$$

respectively, where c is a vector of the positive catch data, p is a vector of the presence/absence data, X is the design matrix for main effects, β is the parameter vector for main effects, and ε is a vector of independent normally distributed errors with expectation zero and variance σ^2. Therefore, c_y and p_y were estimated as least-squares means for each year along with their corresponding standard errors, SE (c_y) and SE (p_y), respectively. From these estimates, I_y was calculated, as in equation (1), and its variance calculated using the delta method approximation

$$(4) \qquad V(I_y) \approx V(c_y)p_y^2 + c_y^2 V(p_y).$$

A covariance term is not included in the variance estimator since there is no correlation between the estimator of the proportion positive and the mean CPUE given presence. The two estimators are derived independently and have been shown to not covary for a given year (Christman, unpublished).

The submodels of the delta-lognormal model were built using a backward selection procedure based on type III analyses with an inclusion level of significance of $\alpha = 0.05$. Binomial submodel performance was evaluated using Akaike Information Criterion (AIC), while the performance of the lognormal submodel was evaluated based on analyses of residual scatter and quantile-quantile (QQ) plots in addition to AIC. Variables that could be included in the submodels were:

Abundance Index – Western Gulf of Mexico – Fall Groundfish

Year: 1972 – 1986
Depth: 9 – 110 m (continuous variable)
Time of Day: Day and Night

Abundance Index – Western Gulf of Mexico – SEAMAP Fall Groundfish (old design)

Year: 1988 – 2007
Depth Zone: 23 levels (see Appendix Table 2 for full listing)
Paired SSZ: 1315, 1617, 1819, 2021
Time of Day: Day and Night

Abundance Index – Western Gulf of Mexico – SEAMAP Fall Groundfish (new design)

Year: 2008 – 2019
Depth: 9 – 110 m (continuous variable)
SSZ: 13 – 21
Time of Day: Day and Night

Abundance Index – Central Gulf of Mexico –Fall Groundfish

Year: 1972 – 1986
Depth: 9 – 110 m (continuous variable)
Time of Day: Day and Night

Abundance Index – Central Gulf of Mexico – SEAMAP Fall Groundfish (old design)

Year: 1987 – 2007
Depth Zone: 23 levels (see Appendix Table 2 for full listing)
Time of Day: Day and Night

Abundance Index – Central Gulf of Mexico –SEAMAP Fall Groundfish (new design)

Year: 2008 – 2019
Depth: 9 – 110 m (continuous variable)
SSZ: 7 – 11
Time of Day: Day and Night

Abundance Index – Eastern Gulf of Mexico –SEAMAP Fall Groundfish (new design)

Year: 2008 – 2019
Depth: 9 – 110 m (continuous variable)
SSZ: 2 – 6
Time of Day: Day and Night

Abundance Index – Western Gulf of Mexico – SEAMAP Summer Groundfish (old design)

Year: 1984 – 2008
Depth Zone: 23 levels (see Appendix Table 2 for full listing)
Paired SSZ: 1315, 1617, 1819, 2021
Time of Day: Day and Night

Abundance Index – Western Gulf of Mexico – SEAMAP Summer Groundfish (new design)

Year: 2009 – 2019
Depth: 9 – 110 m (continuous variable)
SSZ: 13 – 21
Time of Day: Day and Night

Abundance Index – Central Gulf of Mexico – SEAMAP Summer Groundfish (old design)

Year: 1982 – 2008
Depth Zone: 23 levels (see Appendix Table 2 for full listing)
Time of Day: Day and Night

Abundance Index – Central Gulf of Mexico –SEAMAP Summer Groundfish (new design)

Year: 2009 – 2019
Depth: 9 – 110 m (continuous variable)
Time of Day: Day and Night

Abundance Index – Eastern Gulf of Mexico –SEAMAP Summer Groundfish (new design)

Year: 2009 – 2019
Depth: 9 – 110 m (continuous variable)
Area: 1 -6
Time of Day: Day and Night

Results and Discussion

Distribution, Size and Age

The distribution of Red Snapper is presented in Figures 2, 3, and 4, with seasonal/annual abundance and distribution presented in the Appendix Figures 1 and 2. The length frequency distribution of Red Snapper used in the relative abundance index is shown in Figures 5 and 6 for the fall and summer surveys, respectively.

Abundance Index – Western Gulf of Mexico – Fall Groundfish

For the Fall Groundfish Survey (wGOM, 1972-1986) abundance index of Red Snapper, year and depth were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 1. Table 3 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 7965.3 and 2387.8, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 7, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 4 and Figure 8.

Abundance Index – Western Gulf of Mexico – SEAMAP Fall Groundfish (old design)

For the SEAMAP Fall Groundfish Survey (wGOM, 1988-2007) abundance index of Red Snapper, year, depth zone, area and time of day were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 2. Table 5 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 17,866.0 and 7193.3, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 9, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 6 and Figure 10.

Abundance Index – Western Gulf of Mexico – SEAMAP Fall Groundfish (new design)

For the SEAMAP Fall Groundfish Survey (wGOM, 2008-2019) abundance index of Red Snapper, year and SSZ were retained in the binomial submodel, while year, depth and SSZ were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 3. Table 7 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal

submodels were 8905.8 and 4009.5, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 11, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 8 and Figure 12.

Abundance Index – Central Gulf of Mexico –Fall Groundfish

For the Fall Groundfish Survey (eGOM, 1972-1986) abundance index of Red Snapper, year, depth, and time of day were retained in the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 4. Table 9 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 6427.5 and 2139.4, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 13, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 10 and Figure 14.

Abundance Index – Central Gulf of Mexico – SEAMAP Fall Groundfish (old design)

For the SEAMAP Fall Groundfish Survey (eGOM, 1987-2007) abundance index of Red Snapper, year, depth zone, and time of day were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 5. Table 11 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 4504.2 and 1652.2, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 15, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 12 and Figure 16.

Abundance Index – Central Gulf of Mexico –SEAMAP Fall Groundfish (new design)

For the SEAMAP Fall Groundfish Survey (cGOM, 2008-2019) abundance index of Red Snapper, year, depth, and SSZ were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 6. Table 13 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 3261.8 and 963.8, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 17, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 14 and Figure 18.

Abundance Index – Eastern Gulf of Mexico –SEAMAP Fall Groundfish (new design)

For the SEAMAP Fall Groundfish Survey (eGOM, 2008-2019) abundance index of Red Snapper, year, depth, and SSZ were retained in the binomial submodel, while year and SSZ were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 7. Table 15 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 3873.6 and 282.1, respectively. Diagnostic plots for the lognormal submodels

are shown in Figure 19, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 16 and Figure 20.

Abundance Index – Western Gulf of Mexico – SEAMAP Summer Groundfish (old design)

For the SEAMAP Summer Groundfish Survey (wGOM, 1984-2008) abundance index of Red Snapper, year, depth zone, paired SSZ and time of day were retained in the binomial submodel, while year and depth zone were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 8. Table 17 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 18,630.2 and 4528.9, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 21, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 18 and Figure 22.

Abundance Index – Western Gulf of Mexico – SEAMAP Summer Groundfish (new design)

For the SEAMAP Summer Groundfish Survey (wGOM, 2009-2016) abundance index of Red Snapper, year, depth and SSZ were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 9. Table 19 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 8478.7 and 2707.8, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 23, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 20 and Figure 24.

Abundance Index – Central Gulf of Mexico – SEAMAP Summer Groundfish (old design)

For the SEAMAP Summer Groundfish Survey (eGOM, 1982-2008) abundance index of Red Snapper, year and depth zone were retained in the binomial submodel, while year and time of day were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 10. Table 21 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 5759.0 and 877.1, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 25, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 22 and Figure 26.

Abundance Index – Central Gulf of Mexico –SEAMAP Summer Groundfish (new design)

For the SEAMAP Summer Groundfish Survey (eGOM, 2009-2019) abundance index of Red Snapper, year and SSZ were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 11. Table 23 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 4308.7 and 767.1, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 27, and

indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 24 and Figure 28.

Abundance Index – Eastern Gulf of Mexico –SEAMAP Summer Groundfish (new design)

For the SEAMAP Summer Groundfish Survey (eGOM, 2009-2019) abundance index of Red Snapper, year and SSZ were retained in the binomial submodel, while year and TOD were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 12. Table 25 summarizes the backward selection process and the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 7096.0 and 250.6, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 29, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 26 and Figure 30.

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Table 1. Number of stations sampled by shrimp statistical zone during the SEAMAP Summer Groundfish Surveys from 1982-2016.

	Shrimp Statistical Zone																				
Year	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
1982										14	22	24	26	8	1	11	30	10	3	23	172
1983								5	19	8	13		6	16	19	25	24	21	5	17	178
1984										13	16	10	16	16	22	17	15	23	28	14	190
1985										10	26	5	7	8	10	7	7	12	11	10	113
1986										14	21	2	5	14	8	11	8	11	14	6	114
1987										29	59	6	20	19	25	20	16	25	28	19	266
1988										17	46	5	4	3	19	24	14	25	28	23	208
1989										21	30		3	18	25	7	15	20	29	24	192
1990											65	11	20	15	23	16	20	23	24	20	237
1991											44	12	24	13	23	22	24	18	23	26	229
1992										1	44	2	20	24	20	25	12	31	26	20	225
1993											44	10	19	17	24	19	14	29	24	22	222
1994											60	6	17	22	25	17	20	22	26	22	237
1995											42	10	16	18	22	23	13	27	26	21	218
1996											46	14	12	19	22	18	17	21	26	25	220
1997											42		12	16	22	23	10	28	26	26	205
1998											34	2	14	21	25	18	14	22	36	17	203
1999											43	7	20	19	20	23	13	25	32	20	222
2000											43	2	19	15	19	27	8	29	31	21	214
2001											34	7	18	18	13	3	10	9	17	21	150
2002											44	11	14	21	27	19	15	25	29	22	227
2003											42	9	10	8	2	17	20	22	26	23	179
2004											38	11	18	17	20	25	21	19	25	21	215
2005											31	10	9	11	16	21	5	28	22	27	180
2006											45	11	21	12	20	23	17	23	31	18	221
2007											40		6	15	22	23	7	29	32	21	195
2008				1	8	11	6	11	8	11	42	24	19	27	23	22	17	24	21	29	304
2009				20	21	25	11	21	13	12	50	12	23	23	30	49	47	31	36	22	446
2010				9	25	27	17	16	11	25	16	7	15	18	26	30	29	18	19	14	322
2011								9	11	7	15	6	15	16	27	31	28	21	18	15	219
2012			2	3	6	6	17	10	7	5	12	5	11	13	19	23	22	13	15	11	200
2013		4	14	10	10	11	10	10	6	19	12	5	11	9	3	12	16	12	14	9	197
2014	1	8	31	25	22	23	13	12	7	7	16	5	13	14	21	27	22	15	17	12	311
2015	1	10	28	25	25	21	14	12	9	11	16	6	13	13	19	27	21	16	17	12	316
2016	1	5	4	8	11	9	6	13	5	4	8	4	12	11	18	22	17	13	13	8	192
2017		9	19	27	19	18	8	12	7	25	24	6	9	12	22	25	22	15	18	14	311

	Shrimp Statistical Zone																				
Year	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
2018		9	29	21	14	10	7	13	8	13	15	5	12	15	21	25	22	13	15	14	281
2019		11	17	17	19	24	9	11	9	10	12	4	9	13	20	25	22	16	16	12	276

Table 2. Number of stations sampled by shrimp statistical zone during the SEAMAP Fall Groundfish Surveys from 1972-2016.

	Shrimp Statistical Zone																			
Year	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
1972										10	55	27	41	34	17						184
1973									11	17	98	34	71	39	2						272
1974										12	92	35	73	31							243
1975											93	33	80	35	32	7					280
1976											108	42	79	56	22						307
1977											97	31	76	38							242
1978										36	101	32	67	58	25						319
1979											109	35	72	55	2						273
1980										24	85	22	70	32							233
1981										21	85	33	66	49	25						279
1982										21	102	41	72	37							273
1983										17	82	35	63	25							222
1984											82	32	64	47	1						226
1985										30	59	17	27	51	32	10	20	20	19	19	304
1986								20	10	21	19	7	15	14	27	35	26	23	22	21	260
1987										16	26	15	14	16	17	15	15	15	18	3	170
1988										8	27	7	22	17	18	26	19	21	31	20	216
1989											43	12	19	17	22	20	17	22	25	26	223
1990											52	14	12	23	22	19	18	22	19	27	228
1991											45	6	24	14	20	25	24	19	25	22	224
1992											32	7	23	14	25	18	17	27	30	18	211
1993											70	10	19	17	26	18	16	25	28	18	247
1994											49	9	16	21	25	20	21	23	24	20	228
1995											39	10	17	18	24	19	14	26	30	19	216
1996											43	9	18	19	17	28	13	25	29	24	225
1997											43	10	17	20	26	19	18	23	22	24	222
1998											43	10	22	14	34	11	15	24	29	22	224
1999											42	9	17	18	29	18	12	28	29	22	224
2000											42	10	14	22	20	26	12	30	25	21	222
2001											43	10	17	19	26	20	14	27	28	23	227
2002										1	49	10	13	22	22	23	14	26	30	21	231
2003										1	74	9	16	21	24	22	20	23	25	23	258
2004											43		11	18	17	27	14	24	30	21	205
2005											43	11	20	16	33	18	14	23	24	27	229
2006										1	45	7	22	14	18	28	13	23	32	19	222
2007											31	9	20	17	18	28	17	20	18	26	204

	Shrimp Statistical Zone																				
Year	1	2	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	Total
2008				1	8	11	6	11	8	11	44	24	19	26	23	21	16	24	21	28	302
2009				36	23	29	15	16	18	24	67	25	20	36	39	46	50	33	29	23	529
2010			31	26	21	26	10	12	14	13	21	5	19	16	21	33	34	27	27	19	375
2011		11	24	22	20	29	2	15	11	18	18	7	14	17	23	29	29	18	21	13	341
2012		12	39	33	29	30	19	16	16	13	16	7	14	18	25	30	27	20	20	15	399
2013		9	27	28	23	19	8	11	9	23	16	5	12	14	22	21	22	16	17	12	314
2014		15	31	23	24	30	17	15	9	21	29	6	15	18	22	28	23	18	18	14	376
2015	1	9	32	29	22	27	22	18	10	24	27	7	15	18	21	28	27	19	20	13	389
2016		9	25	29	26	22	15	15	10	23	18	6	16	16	21	30	23	19	17	14	354
2017		10	28	19	28	14	15	14	6	23	30	7	14	13	23	26	24	19	21	14	348
2018		8	30	28	24	23	16	12	5	14	19	7	12	14	21	26	19	11	11	14	314
2019		11	31	23	21	15	5	15	8	24	26	3	12	13	20	27	22	16	20	12	324

Table 3. Summary of backward selection procedure for building delta-lognormal submodels for Fall Groundfish Survey (wGOM, 1972-1986) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 7969.5)*						*Lognormal Submodel Type 3 Tests (AIC 2391.0)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	14	1821	96.39	6.89	<.0001	<.0001	14	767	9.85	<.0001
Depth	1	1821	9.28	9.28	0.0023	0.0023	1	767	34.51	<.0001
Time of Day	1	1821	0.88	0.88	0.3478	0.3480	1	767	0.07	0.7884
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 7965.3)*						*Lognormal Submodel Type 3 Tests (AIC 2387.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	14	1821	96.39	6.89	<.0001	<.0001	14	767	9.85	<.0001
Depth	1	1821	9.28	9.28	0.0023	0.0023	1	767	34.51	<.0001
Time of Day	Dropped						Dropped			

Table 4. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for Fall Groundfish Survey (wGOM, 1972-1986). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1972	0.64773	88	26.2771	2.83742	0.16781	2.03320	3.95974
1973	0.53077	130	13.9507	1.50641	0.15775	1.10095	2.06120
1974	0.38129	139	5.0269	0.54281	0.18690	0.37471	0.78630
1975	0.38571	140	8.6578	0.93488	0.18525	0.64745	1.34990
1976	0.37500	160	5.8655	0.63336	0.17653	0.44616	0.89911
1977	0.42657	143	5.7754	0.62363	0.17307	0.44229	0.87933
1978	0.21233	146	4.1942	0.45289	0.25412	0.27461	0.74693
1979	0.41060	151	8.1738	0.88261	0.17183	0.62749	1.24146
1980	0.70161	124	27.7897	3.00075	0.13393	2.29834	3.91782
1981	0.42636	129	6.6530	0.71840	0.18110	0.50156	1.02897
1982	0.50340	147	6.3903	0.69003	0.15396	0.50807	0.93715
1983	0.36585	123	6.7950	0.73373	0.20345	0.49046	1.09764
1984	0.36220	127	2.5234	0.27248	0.20119	0.18294	0.40584
1985	0.35385	65	6.9645	0.75204	0.28535	0.42975	1.31600
1986	0.26923	26	3.8764	0.41858	0.51766	0.15796	1.10918

Table 5. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 1988-2007) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 17866.0)*						*Lognormal Submodel Type 3 Tests (AIC 7193.3)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	19	3527	122.02	6.42	<.0001	<.0001	19	2227	8.61	<.0001
Depth Zone	22	3527	938.57	42.66	<.0001	<.0001	22	2227	18.10	<.0001
Area	3	3527	203.21	67.74	<.0001	<.0001	3	2227	124.54	<.0001
Time of Day	1	3527	23.29	23.29	<.0001	<.0001	1	2227	18.86	<.0001

Table 6. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (wGOM, 1988-2007). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1988	0.53039	181	7.7709	0.42781	0.14968	0.31765	0.57616
1989	0.56667	180	15.5618	0.85672	0.14082	0.64733	1.13384
1990	0.65714	175	16.5030	0.90854	0.12376	0.70998	1.16261
1991	0.68156	179	18.6606	1.02731	0.11777	0.81239	1.29910
1992	0.53073	179	5.7420	0.31611	0.15075	0.23423	0.42662
1993	0.57062	177	10.4316	0.57429	0.14108	0.43370	0.76045
1994	0.65363	179	29.5175	1.62501	0.12146	1.27569	2.06999
1995	0.73446	177	31.7265	1.74663	0.11071	1.40065	2.17806
1996	0.61878	181	15.8018	0.86993	0.12869	0.67323	1.12410
1997	0.64045	178	23.4327	1.29003	0.12559	1.00448	1.65676
1998	0.55249	181	10.8088	0.59505	0.14396	0.44684	0.79243
1999	0.68132	182	24.9668	1.37449	0.11653	1.08959	1.73387
2000	0.68156	179	16.4783	0.90717	0.11810	0.71691	1.14793
2001	0.58696	184	12.3638	0.68066	0.13467	0.52057	0.88998
2002	0.59669	181	11.8046	0.64987	0.13396	0.49773	0.84853
2003	0.65574	183	20.9245	1.15195	0.12107	0.90501	1.46626
2004	0.78395	162	32.6641	1.79825	0.10940	1.44579	2.23662
2005	0.77957	186	23.0971	1.27156	0.10272	1.03597	1.56071
2006	0.66477	176	19.6872	1.08383	0.12343	0.84754	1.38600
2007	0.56647	173	15.3452	0.84479	0.14374	0.63465	1.12452

Table 7. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 2008-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 8933.5)*						*Lognormal Submodel Type 3 Tests (AIC 4100.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	11	1943	42.74	3.89	<.0001	<.0001	11	1291	10.91	<.0001
Depth	1	1943	0.81	0.81	0.3695	0.3696	1	1291	29.75	<.0001
Statistical Zone	8	1943	159.12	19.89	<.0001	<.0001	8	1291	41.42	<.0001
Time of Day	1	1943	0.78	0.78	0.3779	0.3780	1	1291	2.43	0.1194
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 8929.2)*						*Lognormal Submodel Type 3 Tests (AIC 4099.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	11	1944	42.68	3.88	<.0001	<.0001	11	1292	10.86	<.0001
Depth	1	1944	0.79	0.79	0.3742	0.3744	1	1292	29.62	<.0001
Statistical Zone	8	1944	159.55	19.94	<.0001	<.0001	8	1292	41.25	<.0001
Time of Day				Dropped				Dropped		
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 8905.8)*						*Lognormal Submodel Type 3 Tests (AIC 4099.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	11	1945	42.45	3.86	<.0001	<.0001	11	1292	10.86	<.0001
Depth				Dropped			1	1292	29.62	<.0001
Statistical Zone	8	1945	160.30	20.04	<.0001	<.0001	8	1292	41.25	<.0001
Time of Day				Dropped				Dropped		

Table 8. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (wGOM, 2008-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2008	0.61888	286	9.7944	0.44531	0.10027	0.36457	0.54391
2009	0.73260	273	32.3725	1.47183	0.09172	1.22562	1.76751
2010	0.59659	176	15.2527	0.69347	0.12964	0.53566	0.89777
2011	0.64972	177	17.9492	0.81607	0.12176	0.64026	1.04015
2012	0.78030	132	34.6477	1.57527	0.12207	1.23515	2.00906
2013	0.61538	91	14.5945	0.66354	0.18001	0.46425	0.94838
2014	0.69863	146	19.7965	0.90006	0.12683	0.69910	1.15877
2015	0.78472	144	36.2801	1.64949	0.11665	1.30729	2.08127
2016	0.62712	118	24.3311	1.10622	0.15101	0.81925	1.49371
2017	0.58741	143	16.8260	0.76500	0.14591	0.57226	1.02266
2018	0.71831	142	23.6877	1.07697	0.12548	0.83877	1.38282
2019	0.59854	137	18.4043	0.83676	0.14676	0.62489	1.12047

Table 9. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper Fall Groundfish Survey (cGOM, 1972-1986) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 6427.5)*						*Lognormal Submodel Type 3 Tests (AIC 2139.4)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	14	1459	92.27	6.59	<.0001	<.0001	14	673	8.66	<.0001
Depth	1	1459	31.32	31.32	<.0001	<.0001	1	673	12.14	0.0005
Time of Day	1	1459	4.08	4.08	0.0435	0.0437	1	673	15.65	<.0001

Table 10. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for Fall Groundfish Survey (cGOM, 1972-1986). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1972	0.67692	65	45.3659	3.12798	0.18956	2.14815	4.55474
1973	0.51304	115	10.1263	0.69821	0.17640	0.49197	0.99090
1974	0.40385	104	12.4658	0.85952	0.21374	0.56322	1.31171
1975	0.44086	93	10.8946	0.75118	0.21345	0.49250	1.14574
1976	0.45370	108	12.4716	0.85992	0.19581	0.58341	1.26747
1977	0.43299	97	14.0453	0.96842	0.21177	0.63699	1.47230
1978	0.45985	137	8.2626	0.56971	0.17333	0.40385	0.80369
1979	0.39450	109	6.1797	0.42609	0.21259	0.27982	0.64881
1980	0.49541	109	13.1767	0.90853	0.18477	0.62979	1.31065
1981	0.59434	106	32.2700	2.22502	0.16703	1.59680	3.10040
1982	0.71545	123	32.7089	2.25528	0.13666	1.71811	2.96041
1983	0.50505	99	6.9061	0.47618	0.19114	0.32602	0.69551
1984	0.34146	82	5.1413	0.35449	0.26455	0.21072	0.59637
1985	0.21348	89	3.4490	0.23781	0.32832	0.12541	0.45097
1986	0.12500	40	4.0847	0.28164	0.63034	0.08857	0.89557

Table 11. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (cGOM, 1987-2007) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 4504.2)*						*Lognormal Submodel Type 3 Tests (AIC 1652.2)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	20	907	86.98	4.35	<.0001	<.0001	20	504	4.16	<.0001
Depth Zone	22	907	142.39	6.47	<.0001	<.0001	22	504	4.66	<.0001
Time of Day	1	907	17.30	17.30	<.0001	<.0001	1	504	8.91	0.0030

Table 12. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (cGOM, 1987-2007). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1987	0.23810	42	3.3368	0.22080	0.48049	0.08874	0.54938
1988	0.37143	35	5.0331	0.33305	0.41024	0.15134	0.73295
1989	0.67442	43	40.3049	2.66703	0.23640	1.67293	4.25183
1990	0.73077	52	20.7581	1.37359	0.20325	0.91854	2.05407
1991	0.77778	45	32.6181	2.15838	0.20305	1.44391	3.22638
1992	0.43750	32	4.7145	0.31197	0.37986	0.14970	0.65013
1993	0.50000	70	12.8449	0.84996	0.24640	0.52303	1.38126
1994	0.53061	49	7.6463	0.50597	0.27306	0.29593	0.86507
1995	0.64103	39	14.3067	0.94669	0.26411	0.56320	1.59132
1996	0.55814	43	9.5351	0.63095	0.28683	0.35955	1.10720
1997	0.51163	43	16.2571	1.07575	0.30172	0.59612	1.94130
1998	0.46512	43	4.5565	0.30151	0.32749	0.15924	0.57088
1999	0.54762	42	10.4714	0.69291	0.29464	0.38910	1.23393
2000	0.69048	42	28.6356	1.89485	0.24124	1.17758	3.04901
2001	0.44186	43	5.0810	0.33621	0.33655	0.17462	0.64735
2002	0.46000	50	5.9462	0.39347	0.30637	0.21615	0.71626
2003	0.65333	75	14.2130	0.94049	0.19591	0.63796	1.38650
2004	0.41860	43	5.8099	0.38445	0.34622	0.19615	0.75352
2005	0.69767	43	11.0976	0.73434	0.23816	0.45907	1.17466
2006	0.91304	46	37.2198	2.46288	0.17702	1.73329	3.49958
2007	0.77419	31	26.9718	1.78475	0.25925	1.07165	2.97238

Table 13. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (cGOM, 2008-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 3270.3)*						*Lognormal Submodel Type 3 Tests (AIC 965.7)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	11	710	13.30	1.21	0.2741	0.2766	11	294	2.34	0.0089
Depth	1	710	8.07	8.07	0.0045	0.0046	1	294	7.84	0.0054
Statistical Zone	4	710	89.42	22.35	<.0001	<.0001	4	294	9.79	<.0001
Time of Day	1	710	3.57	3.57	0.0588	0.0592	1	294	0.34	0.5591
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 3261.8)*						*Lognormal Submodel Type 3 Tests (AIC 963.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	11	711	14.22	1.29	0.2210	0.2238	11	295	2.32	0.0096
Depth	1	711	6.99	6.99	0.0082	0.0084	1	295	8.10	0.0047
Statistical Zone	4	711	88.05	22.01	<.0001	<.0001	4	295	9.88	<.0001
Time of Day				Dropped					Dropped	

Table 14. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (cGOM, 2008-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2008	0.46000	50	3.4629	0.60397	0.33950	0.31198	1.16923
2009	0.58879	107	13.0761	2.28064	0.18760	1.57224	3.30823
2010	0.31765	85	3.9736	0.69305	0.28053	0.39967	1.20180
2011	0.42857	42	3.2702	0.57036	0.34558	0.29135	1.11657
2012	0.45098	51	7.8448	1.36823	0.29081	0.77387	2.41906
2013	0.33333	57	4.0171	0.70064	0.33441	0.36533	1.34368
2014	0.43636	55	5.6090	0.97828	0.29420	0.54980	1.74067
2015	0.43548	62	7.4072	1.29191	0.27548	0.75216	2.21896
2016	0.33333	36	5.6465	0.98483	0.41426	0.44431	2.18290
2017	0.39474	76	3.2254	0.56256	0.27826	0.32581	0.97133
2018	0.48214	56	7.2872	1.27098	0.27251	0.74416	2.17077
2019	0.37255	51	3.9823	0.69456	0.32661	0.36743	1.31292

Table 15. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (eGOM, 2008-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 3876.6)*						*Lognormal Submodel Type 3 Tests (AIC 290.0)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	723	14.55	1.46	0.1493	0.1519	10	90	2.67	0.0067
Depth	1	723	12.00	12.00	0.0005	0.0006	1	90	0.04	0.8518
Statistical Zone	4	723	24.49	6.12	<.0001	<.0001	4	90	2.74	0.0337
Time of Day	1	723	0.03	0.03	0.8568	0.8568	1	90	0.88	0.3511
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 3873.6)*						*Lognormal Submodel Type 3 Tests (AIC 282.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	724	14.77	1.48	0.1408	0.1435	10	91	2.72	0.0057
Depth	1	724	12.09	12.09	0.0005	0.0005		Dropped		
Statistical Zone	4	724	24.55	6.14	<.0001	<.0001	4	91	2.87	0.0273
Time of Day				Dropped			1	91	0.92	0.3412
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 3873.6)*						*Lognormal Submodel Type 3 Tests (AIC 282.1)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	724	14.77	1.48	0.1408	0.1435	10	92	2.80	0.0045
Depth	1	724	12.09	12.09	0.0005	0.0005		Dropped		
Statistical Zone	4	724	24.55	6.14	<.0001	<.0001	4	92	2.82	0.0295
Time of Day				Dropped				Dropped		

Table 16. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (eGOM, 2008-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2008	0.10345	29	0.64478	0.66509	0.78822	0.16561	2.67099
2009	0.10606	66	0.39637	0.40885	0.53266	0.15048	1.11085
2010	0.18033	61	0.69938	0.72140	0.43027	0.31637	1.64495
2011							
2012	0.17647	17	0.90457	0.93305	0.77485	0.23674	3.67738
2013	0.06122	49	0.16895	0.17427	0.77531	0.04419	0.68730
2014	0.14679	109	3.16227	3.26184	0.34433	1.67002	6.37094
2015	0.19266	109	1.21448	1.25273	0.29908	0.69762	2.24953
2016	0.27027	37	1.55336	1.60227	0.42693	0.70683	3.63209
2017	0.16304	92	0.83406	0.86033	0.36111	0.42714	1.73286
2018	0.07229	83	0.33236	0.34283	0.55536	0.12154	0.96700
2019	0.13636	88	0.75360	0.77733	0.39848	0.36071	1.67515

Table 17. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 1984-2008) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 18630.2)*						*Lognormal Submodel Type 3 Tests (AIC 4534.2)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	24	3952	175.60	7.32	<.0001	<.0001	24	1413	2.81	<.0001
Depth Zone	22	3952	340.27	15.47	<.0001	<.0001	22	1413	10.30	<.0001
Area	3	3952	211.47	70.49	<.0001	<.0001	3	1413	1.68	0.1692
Time of Day	1	3952	4.88	4.88	0.0272	0.0272	1	1413	3.19	0.0744
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 18630.2)*						*Lognormal Submodel Type 3 Tests (AIC 4529.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	24	3952	175.60	7.32	<.0001	<.0001	24	1416	2.76	<.0001
Depth Zone	22	3952	340.27	15.47	<.0001	<.0001	22	1416	10.82	<.0001
Area	3	3952	211.47	70.49	<.0001	<.0001		Dropped		
Time of Day	1	3952	4.88	4.88	0.0272	0.0272	1	1416	3.03	0.0819
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 18630.2*						*Lognormal Submodel Type 3 Tests (AIC 4528.9)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	24	3952	175.60	7.32	<.0001	<.0001	24	1417	2.81	<.0001
Depth Zone	22	3952	340.27	15.47	<.0001	<.0001	22	1417	11.07	<.0001
Area	3	3952	211.47	70.49	<.0001	<.0001		Dropped		
Time of Day	1	3952	4.88	4.88	0.0272	0.0272		Dropped		

Table 18. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (wGOM, 1984-2008). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1984	0.18012	161	2.90020	0.74713	0.28624	0.42624	1.30961
1985	0.31169	77	4.30939	1.11016	0.30860	0.60731	2.02936
1986	0.15190	79	1.13953	0.29356	0.43855	0.12688	0.67919
1987	0.26404	178	2.75630	0.71006	0.22079	0.45898	1.09849
1988	0.26207	145	1.34507	0.34651	0.24776	0.21267	0.56457
1989	0.17730	141	0.99448	0.25619	0.30539	0.14099	0.46552
1990	0.46512	172	8.78092	2.26208	0.16018	1.64535	3.10998
1991	0.33514	185	3.96280	1.02087	0.18827	0.70286	1.48278
1992	0.31667	180	2.50149	0.64442	0.19770	0.43560	0.95333
1993	0.33146	178	2.73257	0.70395	0.19391	0.47936	1.03375
1994	0.37853	177	5.22289	1.34549	0.17943	0.94246	1.92086
1995	0.41477	176	4.56545	1.17612	0.17020	0.83882	1.64906
1996	0.41379	174	5.07947	1.30854	0.17055	0.93263	1.83596
1997	0.43558	163	3.85837	0.99397	0.17211	0.70626	1.39888
1998	0.34911	169	3.43875	0.88587	0.19190	0.60561	1.29582
1999	0.32961	179	2.94463	0.75858	0.19287	0.51760	1.11173
2000	0.49123	171	5.39991	1.39109	0.15399	1.02419	1.88942
2001	0.27586	116	3.05334	0.78658	0.26337	0.46861	1.32031
2002	0.39891	183	4.24748	1.09421	0.17058	0.77983	1.53532
2003	0.36496	137	2.38168	0.61355	0.21065	0.40445	0.93076
2004	0.44068	177	5.16680	1.33104	0.16223	0.96425	1.83734
2005	0.49324	148	5.83019	1.50193	0.16631	1.07940	2.08987
2006	0.51136	176	5.50751	1.41881	0.14692	1.05923	1.90046
2007	0.41935	155	4.52529	1.16578	0.18240	0.81185	1.67399
2008	0.41262	206	4.40014	1.13354	0.15471	0.83340	1.54176

Table 19. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 2009-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 8481.9)*						*Lognormal Submodel Type 3 Tests (AIC 2710.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	1902	55.72	5.57	<.0001	<.0001	10	873	3.38	0.0002
Depth	1	1902	21.24	21.24	<.0001	<.0001	1	873	3.93	0.0477
Statistical Zone	8	1902	173.92	21.74	<.0001	<.0001	8	873	6.09	<.0001
Time of Day	1	1902	0.37	0.37	0.5447	0.5448	1	873	0.64	0.4245
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 8478.7)*						*Lognormal Submodel Type 3 Tests (AIC 2707.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	1903	55.53	5.55	<.0001	<.0001	10	874	3.38	0.0002
Depth	1	1903	21.25	21.25	<.0001	<.0001	1	874	4.00	0.0458
Statistical Zone	8	1903	173.92	21.74	<.0001	<.0001	8	874	6.05	<.0001
Time of Day				Dropped					Dropped	

Table 20. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (wGOM, 2009-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2009	0.29568	301	2.3321	0.36643	0.15392	0.26983	0.49762
2010	0.44776	201	5.5356	0.86976	0.14973	0.64575	1.17149
2011	0.49708	171	7.7015	1.21008	0.14826	0.90102	1.62514
2012	0.52273	176	5.3168	0.83538	0.14179	0.62999	1.10772
2013	0.48227	141	8.3262	1.30822	0.16676	0.93936	1.82193
2014	0.44444	162	5.0447	0.79263	0.16255	0.57386	1.09481
2015	0.49405	168	6.9088	1.08551	0.15037	0.80493	1.46390
2016	0.50000	162	5.6918	0.89431	0.15118	0.66208	1.20799
2017	0.45963	161	5.4368	0.85424	0.16141	0.61985	1.17727
2018	0.62222	135	10.4300	1.63878	0.13971	1.24096	2.16414
2019	0.52414	145	7.2852	1.14466	0.15603	0.83938	1.56096

Table 21. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (cGOM, 1982-2008) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 5783.0)*						*Lognormal Submodel Type 3 Tests (AIC 854.3)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	26	1144	74.50	2.87	<.0001	<.0001	26	252	2.29	0.0006
Depth Zone	22	1144	71.64	3.26	<.0001	<.0001	22	252	1.06	0.3898
Time of Day	1	1144	3.64	3.64	0.0565	0.0568	1	252	4.72	0.0307
Model Run #1	*Binomial Submodel Type 3 Tests (AIC 5759.0)*						*Lognormal Submodel Type 3 Tests (AIC 877.1)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	26	1145	73.93	2.84	<.0001	<.0001	26	274	2.16	0.0012
Depth Zone	22	1145	72.82	3.31	<.0001	<.0001		Dropped		
Time of Day				Dropped			1	274	4.61	0.0327

Table 22. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (cGOM, 1982-2008). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
1982	0.19444	36	3.1928	1.18359	0.54745	0.42511	3.29541
1983	0.28571	21	2.2693	0.84124	0.58285	0.28523	2.48113
1984	0.06897	29	0.2286	0.08473	0.98554	0.01631	0.44014
1985	0.27778	36	1.7375	0.64411	0.45835	0.26894	1.54262
1986	0.05714	35	0.1626	0.06027	0.98730	0.01158	0.31376
1987	0.22727	88	2.1529	0.79812	0.33455	0.41606	1.53103
1988	0.15873	63	1.3114	0.48615	0.46818	0.19957	1.18428
1989	0.27451	51	3.9486	1.46378	0.39322	0.68570	3.12477
1990	0.36923	65	3.5348	1.31039	0.28738	0.74598	2.30186
1991	0.36364	44	3.6572	1.35575	0.35457	0.68120	2.69827
1992	0.28889	45	7.1736	2.65932	0.40116	1.22812	5.75837
1993	0.20455	44	1.0942	0.40565	0.48578	0.16156	1.01848
1994	0.33333	60	2.7587	1.02269	0.32473	0.54291	1.92649
1995	0.19048	42	0.8856	0.32830	0.51951	0.12351	0.87265
1996	0.26087	46	1.9924	0.73861	0.42203	0.32867	1.65985
1997	0.35714	42	2.2680	0.84075	0.36850	0.41184	1.71636
1998	0.08824	34	0.5748	0.21309	0.81956	0.05081	0.89370
1999	0.11628	43	0.4758	0.17638	0.64828	0.05395	0.57669
2000	0.32558	43	2.0798	0.77099	0.38445	0.36691	1.62008
2001	0.14706	34	0.8020	0.29730	0.64876	0.09086	0.97273
2002	0.11364	44	0.8082	0.29961	0.64950	0.09147	0.98141
2003	0.21429	42	1.8381	0.68141	0.48758	0.27057	1.71610
2004	0.23684	38	1.7149	0.63573	0.49243	0.25035	1.61435
2005	0.25806	31	4.2443	1.57339	0.49903	0.61269	4.04042
2006	0.22222	45	1.2713	0.47129	0.45886	0.19661	1.12971
2007	0.57500	40	7.8164	2.89761	0.27238	1.69697	4.94773
2008	0.43396	53	12.8396	4.75976	0.28979	2.69731	8.39924

Table 23. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (cGOM, 2009-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 4314.6)*						*Lognormal Submodel Type 3 Tests (AIC 767.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	909	26.75	2.68	0.0028	0.0031	10	238	0.99	0.4511
Depth	1	909	0.04	0.04	0.8473	0.8473	1	238	4.72	0.0309
Statistical Zone	4	909	79.60	19.90	<.0001	<.0001	5	238	6.44	<.0001
Time of Day	1	909	2.23	2.23	0.1350	0.1354	1	238	3.00	0.0845
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 4305.4)*						*Lognormal Submodel Type 3 Tests (AIC 768.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	910	26.89	2.69	0.0027	0.0030	10	239	0.91	0.5206
Depth				Dropped			1	239	3.83	0.0514
Statistical Zone	4	910	79.66	19.92	<.0001	<.0001	5	239	5.90	<.0001
Time of Day	1	910	2.32	2.32	0.1280	0.1283		Dropped		
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 4308.7)*						*Lognormal Submodel Type 3 Tests (AIC 767.1)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	911	25.45	2.55	0.0046	0.0050	10	240	0.92	0.5150
Depth				Dropped				Dropped		
Statistical Zone	4	911	78.68	19.67	<.0001	<.0001	5	240	5.95	<.0001
Time of Day				Dropped				Dropped		

Table 24. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (cGOM, 2009-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2009	0.23571	140	1.09614	0.44691	0.27059	0.26262	0.76052
2010	0.29577	71	2.48777	1.01429	0.31763	0.54560	1.88559
2011	0.23438	64	1.39249	0.56773	0.37691	0.27389	1.17682
2012	0.26250	80	2.64051	1.07656	0.31270	0.58444	1.98306
2013	0.25373	67	3.36595	1.37233	0.34904	0.69655	2.70373
2014	0.24176	91	1.67691	0.68369	0.31524	0.36941	1.26536
2015	0.17822	101	1.60266	0.65342	0.34799	0.33230	1.28486
2016	0.28395	81	2.33592	0.95237	0.29861	0.53084	1.70866
2017	0.45455	88	4.10077	1.67192	0.22371	1.07466	2.60112
2018	0.31818	66	2.80711	1.14448	0.31295	0.62102	2.10918
2019	0.32051	78	3.47379	1.41630	0.29393	0.79638	2.51875

Table 25. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 2009-2019) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 7126.0)*						*Lognormal Submodel Type 3 Tests (AIC 255.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	1196	35.01	3.50	0.0001	0.0001	10	82	2.35	0.0173
Depth	1	1196	1.72	1.72	0.1902	0.1905	1	82	1.75	0.1898
Statistical Zone	4	1196	19.21	4.80	0.0007	0.0008	4	82	1.07	0.3783
Time of Day	1	1196	1.17	1.17	0.2803	0.2805	1	82	2.39	0.1259
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 7125.6)*						*Lognormal Submodel Type 3 Tests (AIC 256.7)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	1197	34.70	3.47	0.0001	0.0002	10	86	2.15	0.0291
Depth	1	1197	1.51	1.51	0.2190	0.2192	1	86	1.55	0.2169
Statistical Zone	4	1197	18.83	4.71	0.0008	0.0009		Dropped		
Time of Day				Dropped			1	86	1.57	0.2141
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 7096.0)*						*Lognormal Submodel Type 3 Tests (AIC 250.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	10	1198	34.13	3.41	0.0002	0.0002	10	87	2.69	0.0064
Depth				Dropped				Dropped		
Statistical Zone	4	1198	19.64	4.91	0.0006	0.0006		Dropped		
Time of Day				Dropped			1	87	1.95	0.1664

Table 26. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (eGOM, 2009-2019). The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per trawl-hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2009	0.02273	88	0.05095	0.09735	0.91896	0.02036	0.46553
2010	0.00962	104	0.01753	0.03350	1.26022	0.00476	0.23553
2011	0.06604	106	0.61245	1.17019	0.50238	0.45311	3.02214
2012	0.06294	143	0.29114	0.55628	0.44159	0.23915	1.29390
2013	0.01887	106	0.09085	0.17358	0.91565	0.03645	0.82659
2014	0.07317	123	0.19828	0.37885	0.44236	0.16266	0.88239
2015	0.12605	119	1.75632	3.35578	0.33977	1.73258	6.49970
2016	0.18018	111	1.06205	2.02925	0.29053	1.14837	3.58581
2017	0.13131	99	0.78192	1.49400	0.36124	0.74158	3.00987
2018	0.13274	113	0.61695	1.17880	0.33840	0.61015	2.27741
2019	0.05941	101	0.27865	0.53242	0.53561	0.19500	1.45369

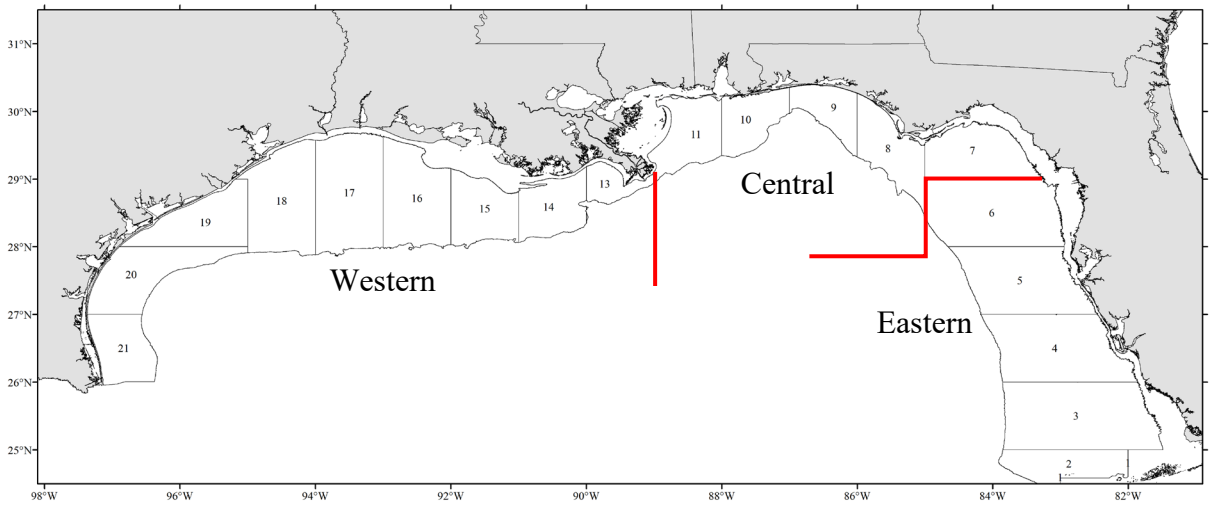

Figure 1. Breakdown of Gulf of Mexico for the SEAMAP Groundfish Survey by shrimp statistical zone. Red lines represent the boundaries for the three areas for which indices were produced according to the SEDAR 74 Stock ID Workshop (SEDAR 74 Stock ID 2021).

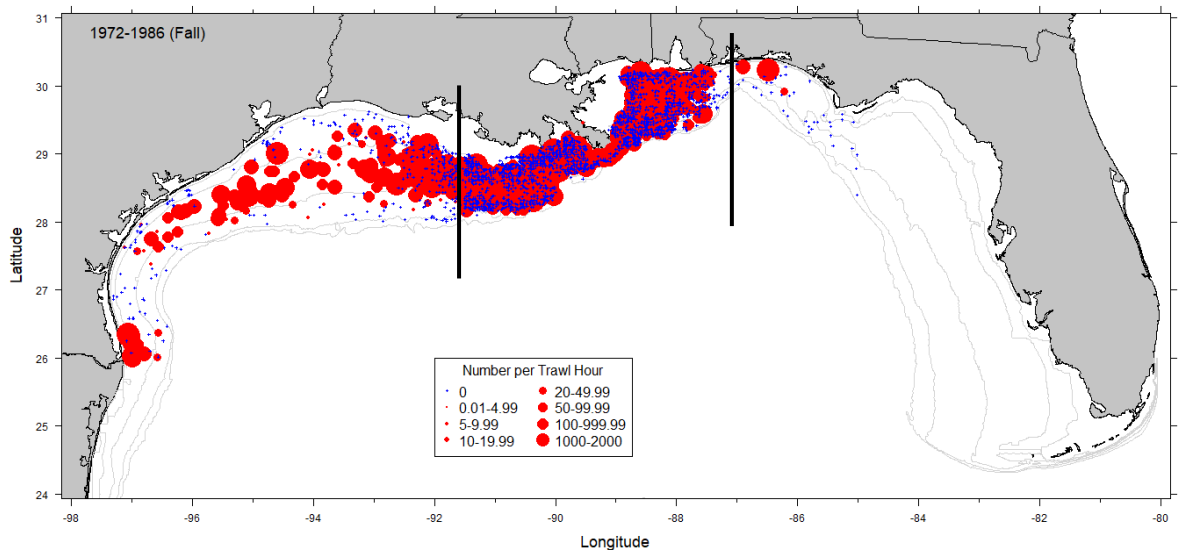

Figure 2. Stations sampled during the Fall Groundfish Survey conducted from 1972- 1986, stations within black lines were used in the index as it represents the primary sampling area.

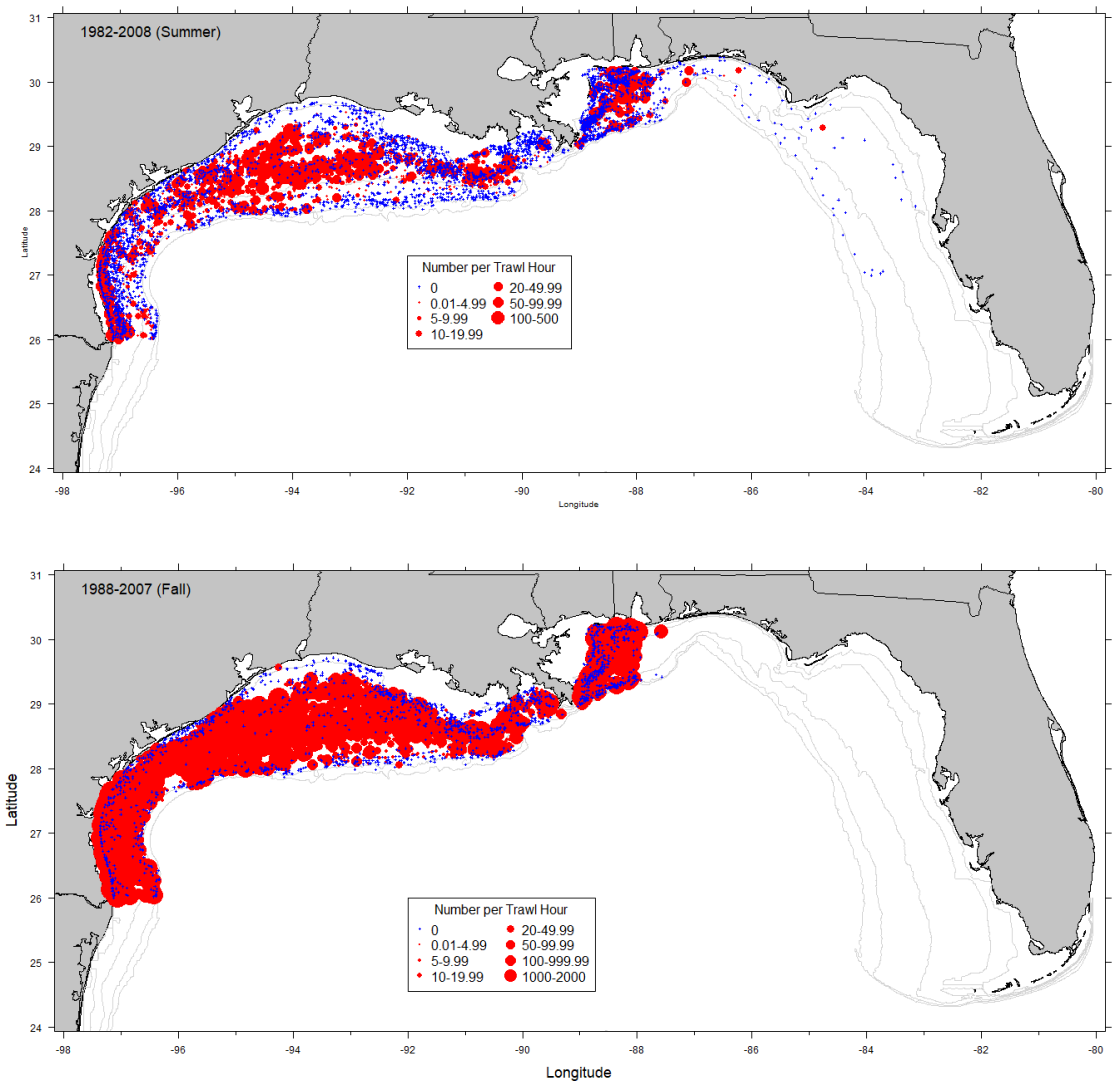

Figure 3. Stations sampled from 1982 to 2008 during the Summer (top) SEAMAP Groundfish Survey and from 1972 to 2007 during the Fall (bottom) SEAMAP Groundfish Survey with the CPUE for Red Snapper.

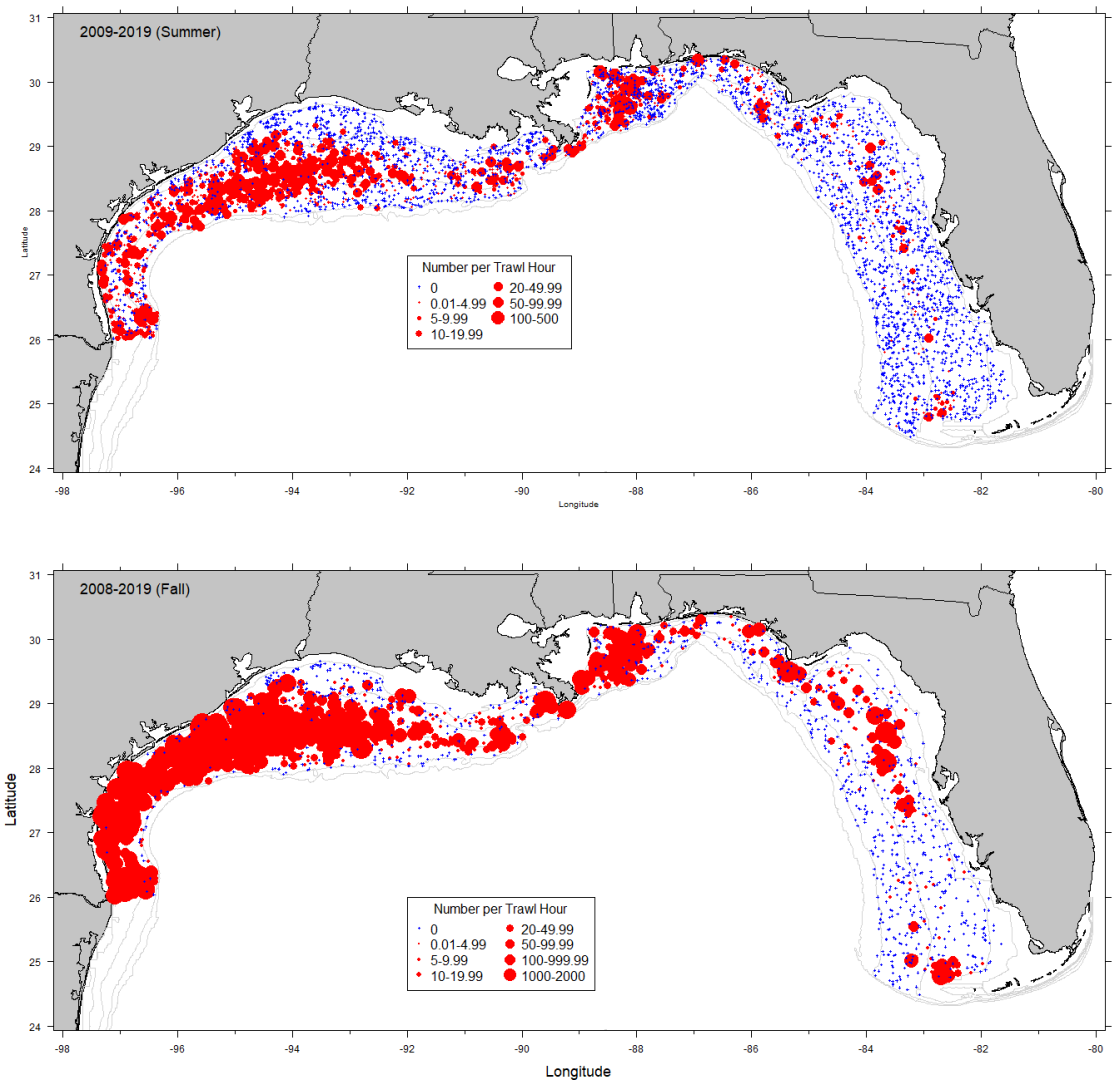

Figure 4. Stations sampled from 2009 to 2019 during the Summer (top) SEAMAP Groundfish Survey and from 2008 to 2019 during the Fall (bottom) SEAMAP Groundfish Surveys with the CPUE for Red Snapper, with additional data from the DISL trawl survey.

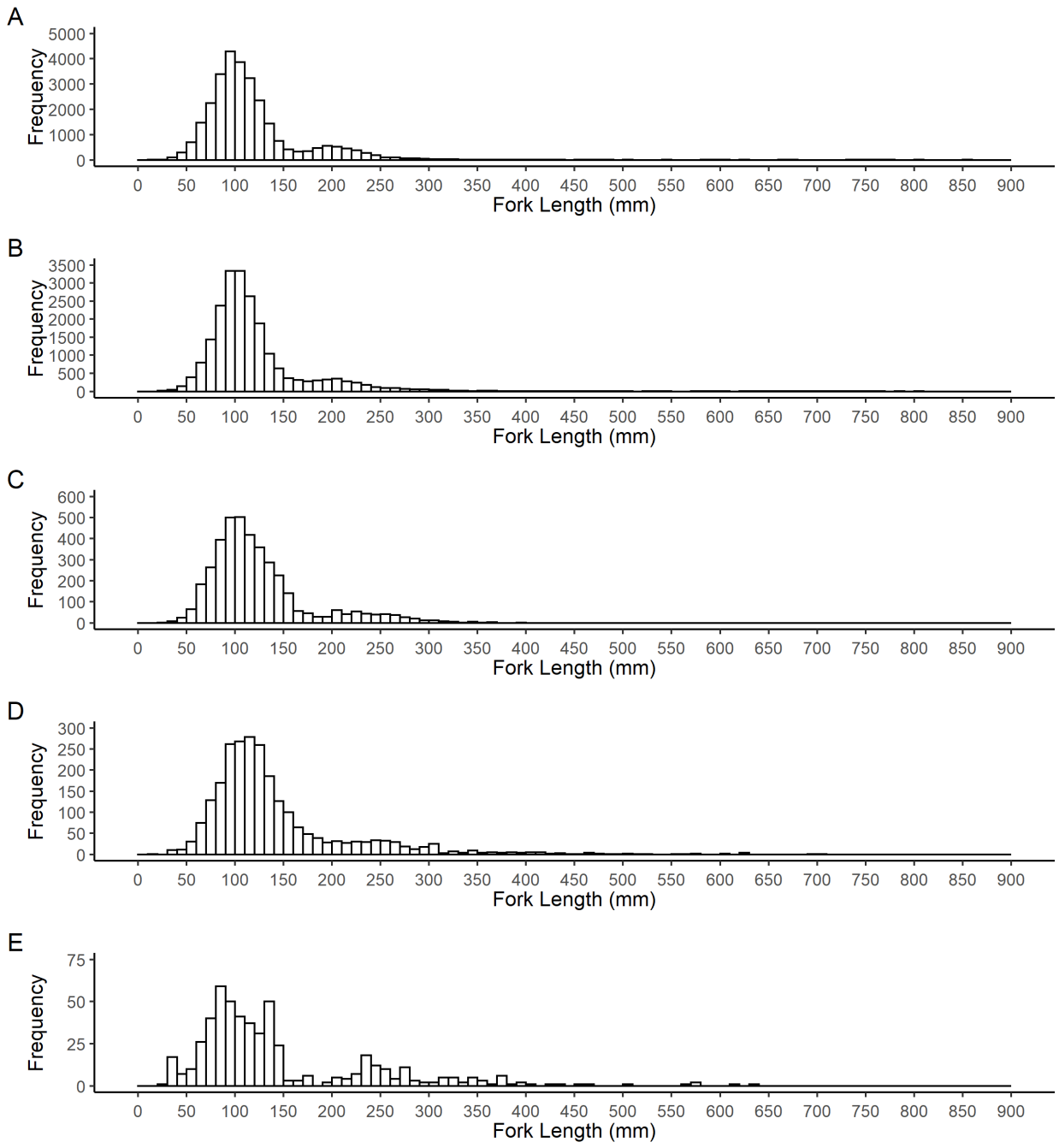

Figure 5. Length frequency histogram for Red Snapper captured during SEAMAP Fall Groundfish Survey **A.** wGOM (1987- 2007), **B.** wGOM (2008-2019), **C.** cGOM (1987-2007), **D.** cGOM (2008-2019), and **E.** eGOM (2008-2019). Note that no lengths was available prior to 1987.

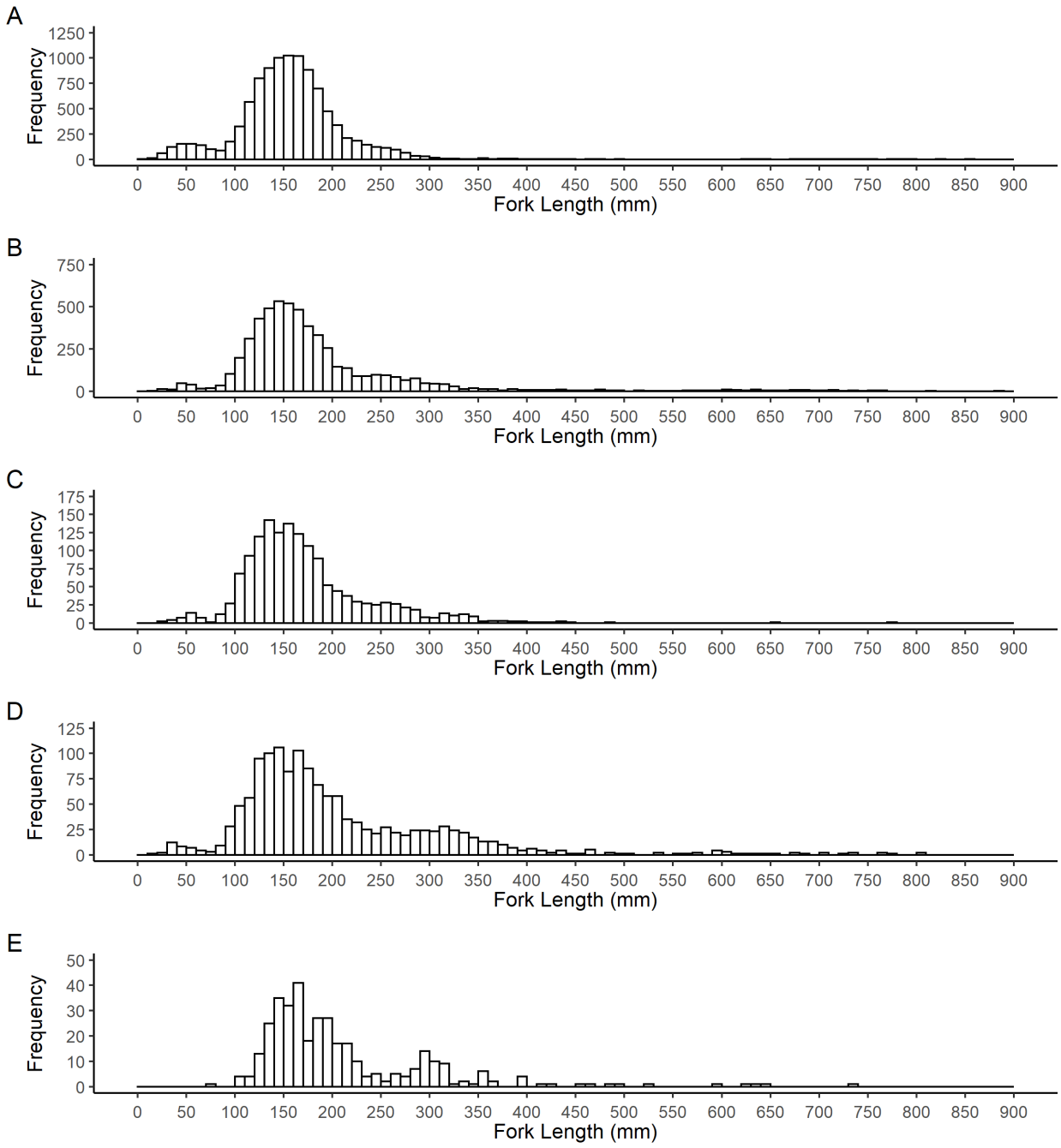

Figure 6. Length frequency histogram for Red Snapper captured during SEAMAP Summer Groundfish Survey **A.** wGOM (1987- 2008), **B.** wGOM (2009-2016), **C.** eGOM (1987-2008) and **D.** eGOM (2009-2016). Note that no lengths was available prior to 1987.

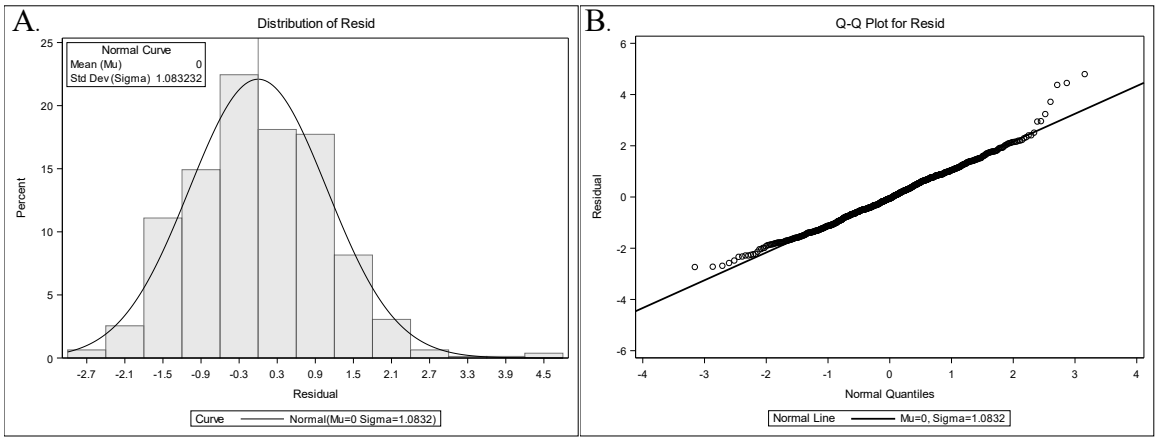

Figure 7. Diagnostic plots for lognormal component of the Red Snapper Fall Groundfish Survey (wGOM, 1972-1986) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

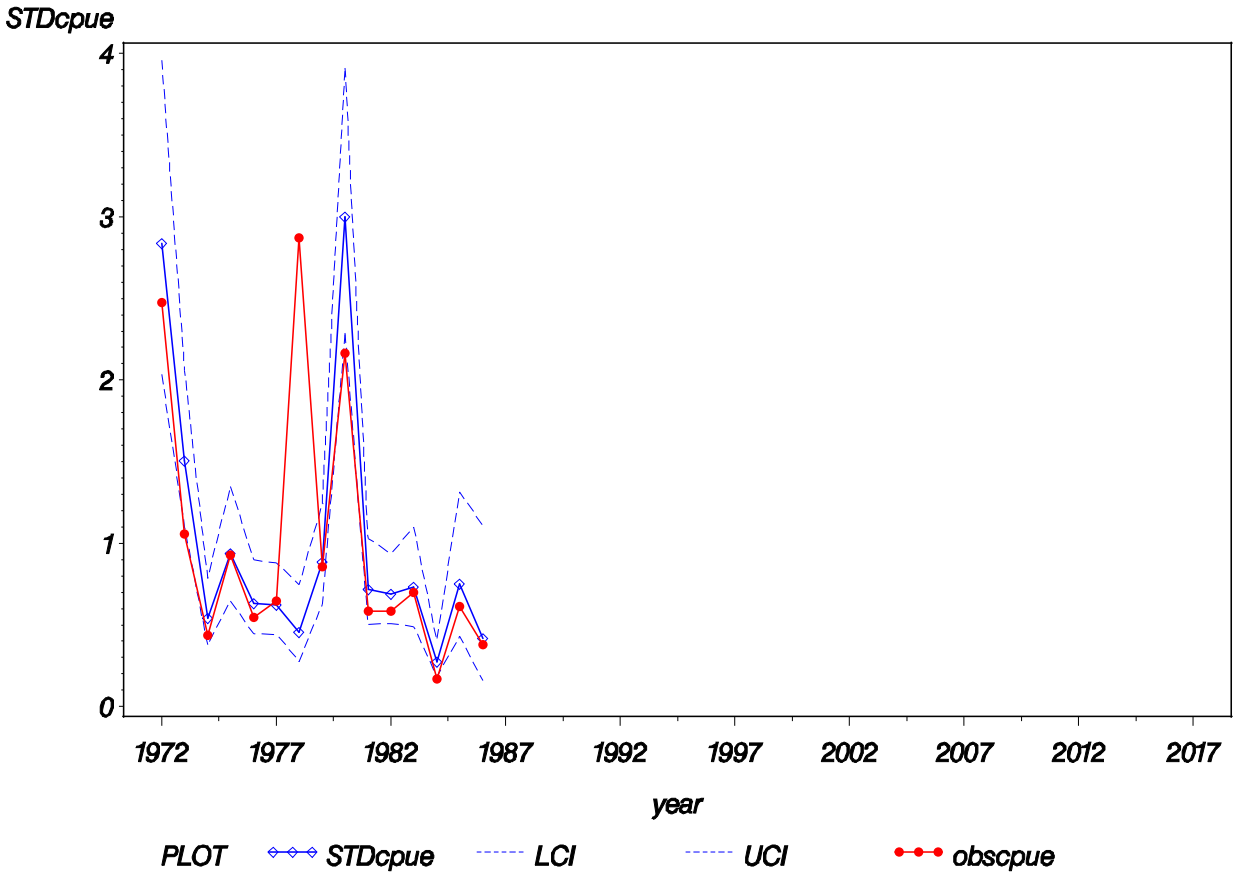

Figure 8. Annual index of abundance for Red Snapper from the Fall Groundfish Survey (wGOM, 1972-1986).

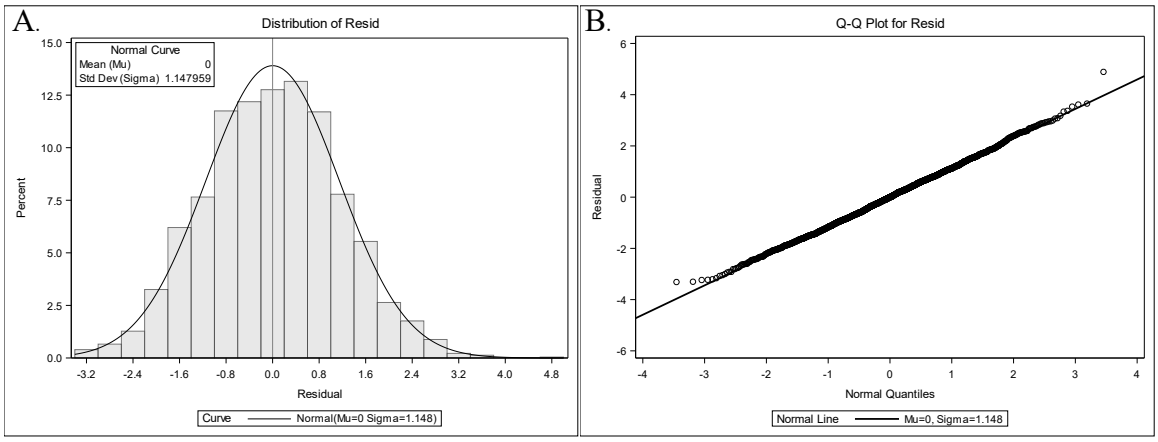

Figure 9. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 1988-2007) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

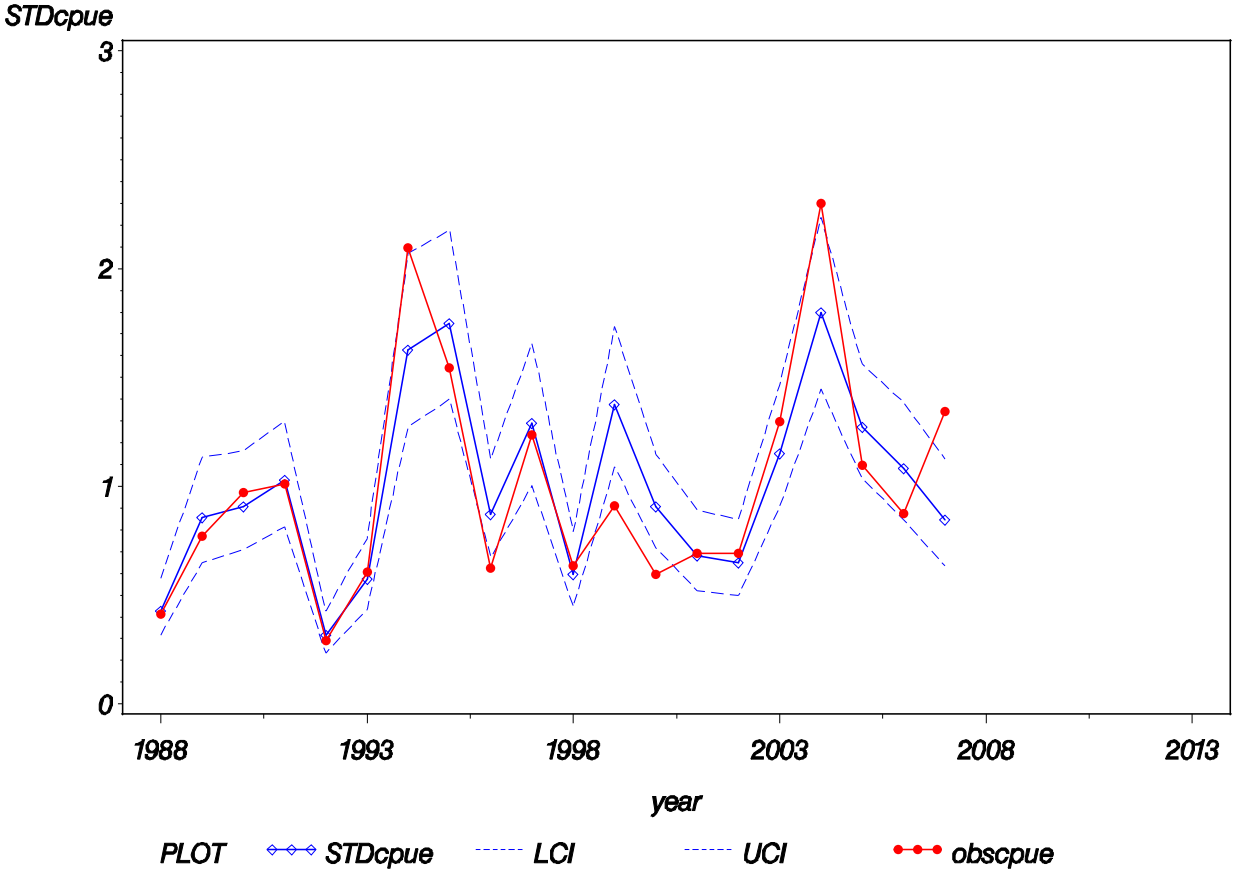

Figure 10. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (wGOM, 1988-2007).

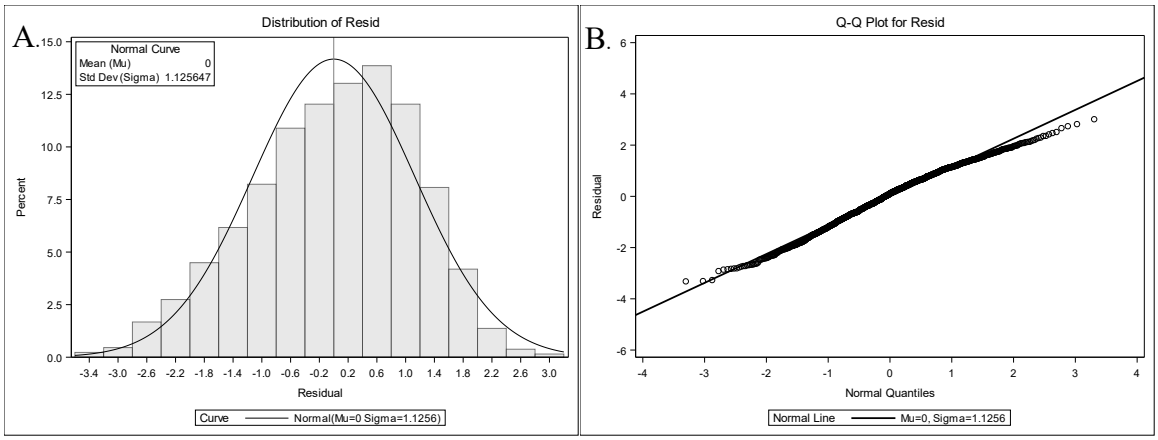

Figure 11. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 2008-2016) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

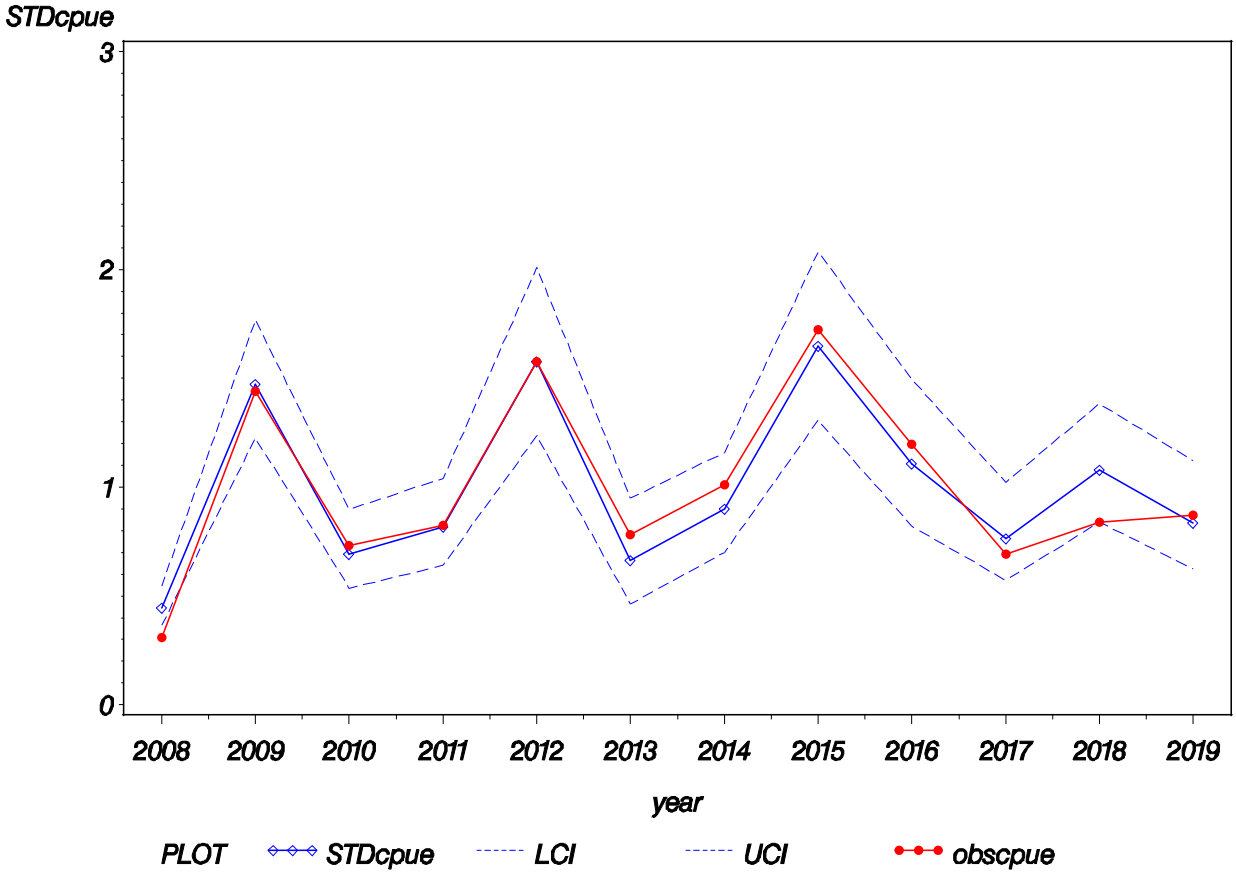

Figure 12. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (wGOM, 2008-2019)

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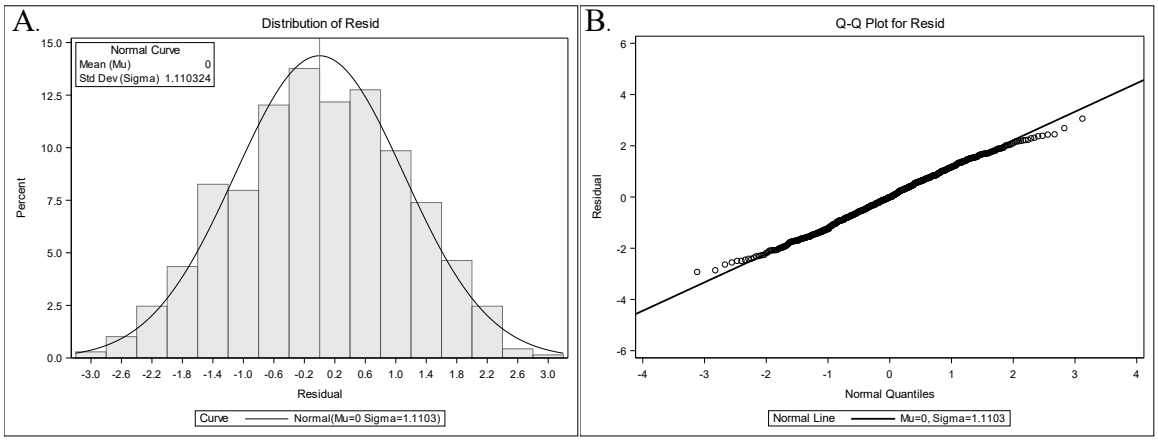


Figure 13. Diagnostic plots for lognormal component of the Red Snapper Fall Groundfish Survey (cGOM, 1972-1986) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

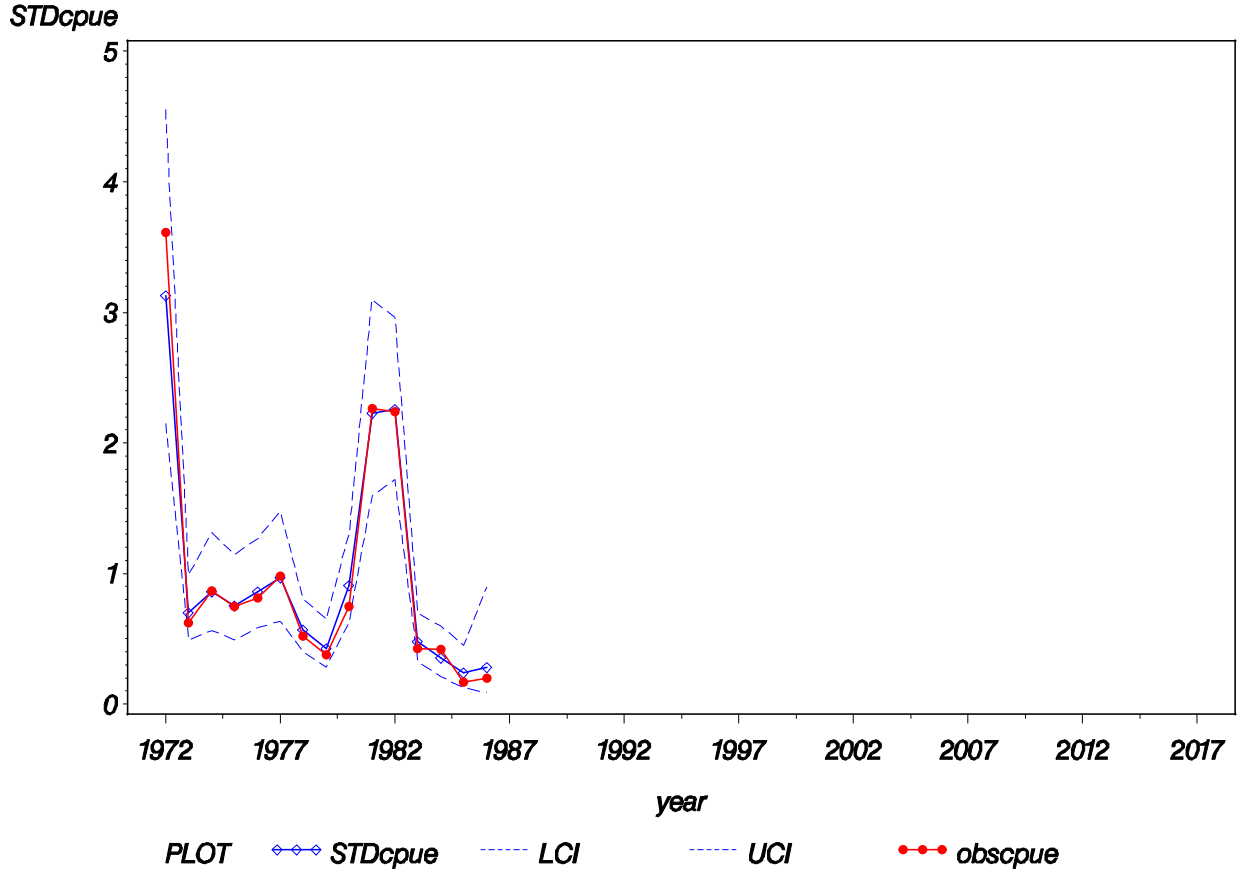


Figure 14. Annual index of abundance for Red Snapper from the Fall Groundfish Survey (cGOM, 1972-1986).

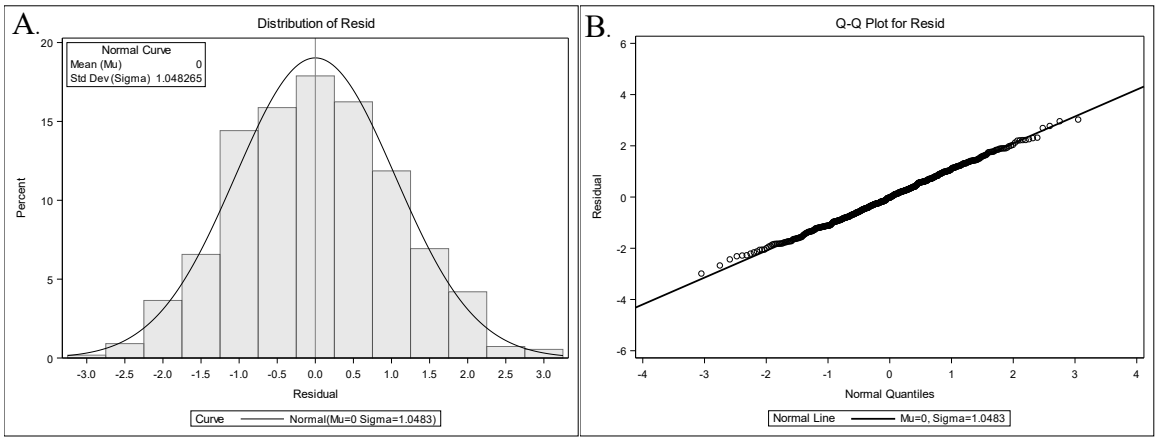


Figure 15. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (cGOM, 1987-2007) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

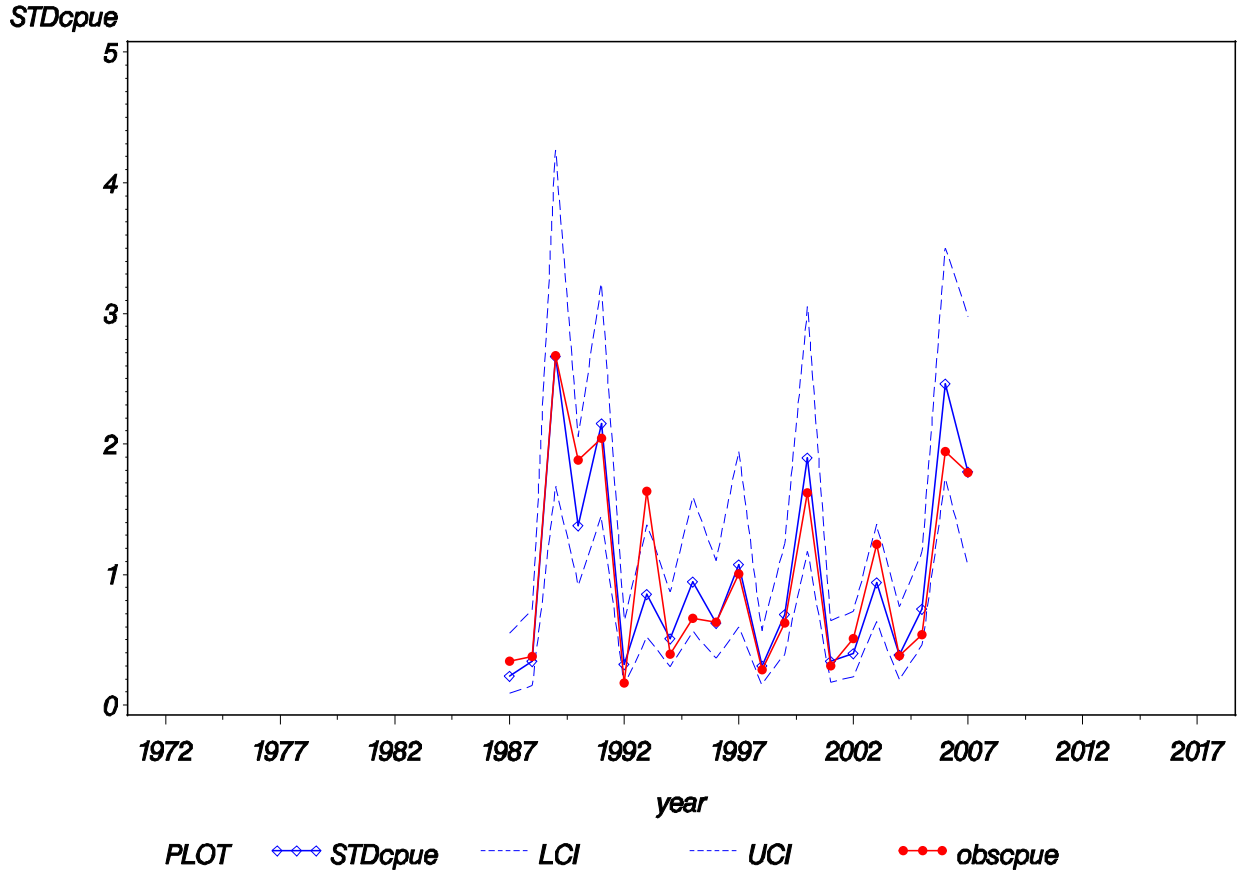


Figure 16. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (cGOM, 1987-2007).

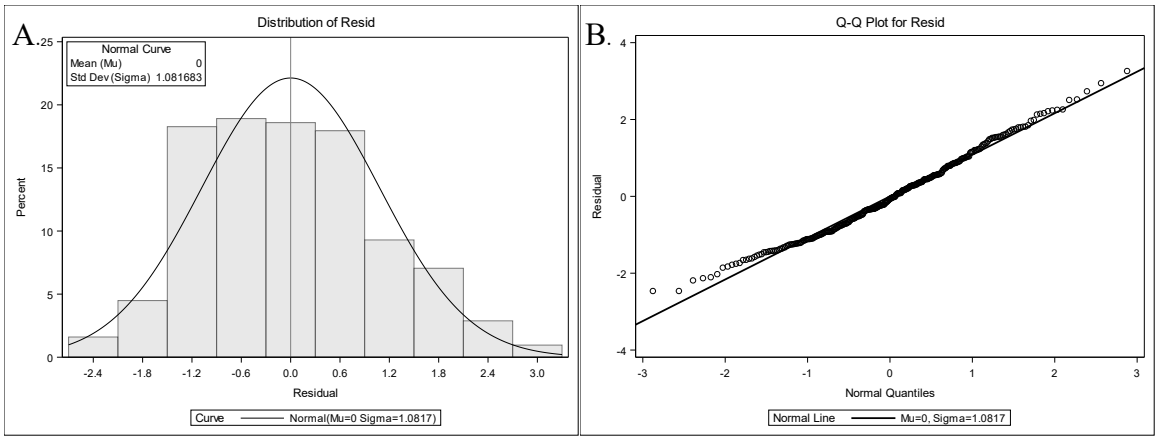


Figure 17. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (cGOM, 2008-2019) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

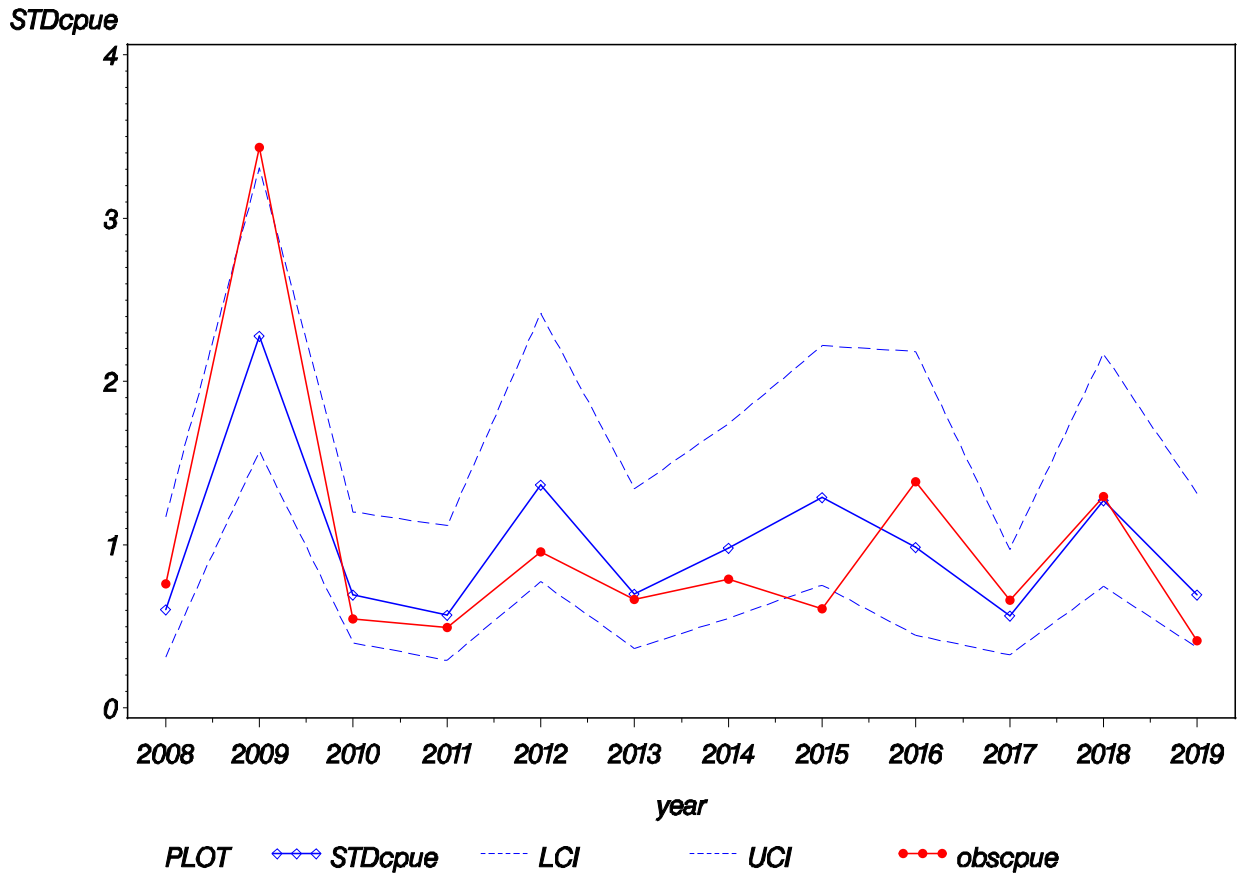


Figure 18. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (cGOM, 2008-2019).

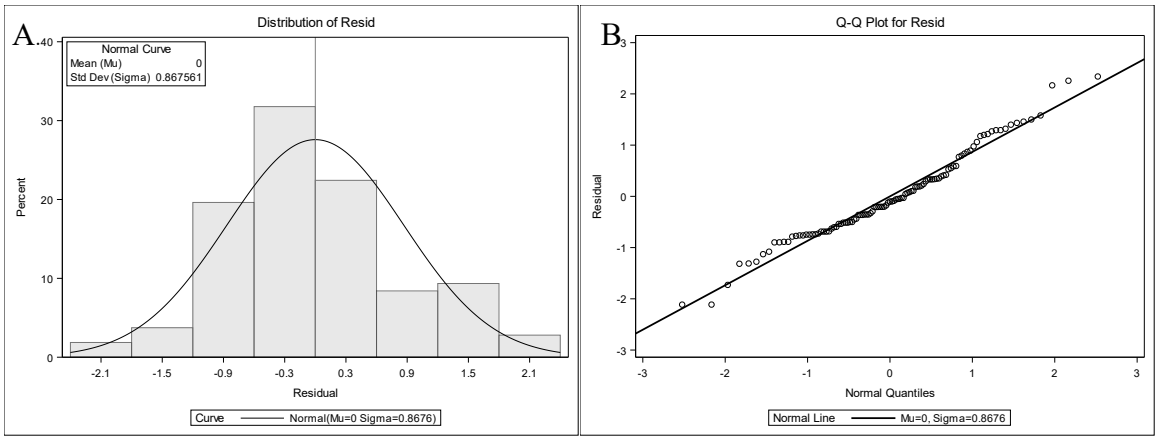


Figure 19. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 2008-2019) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

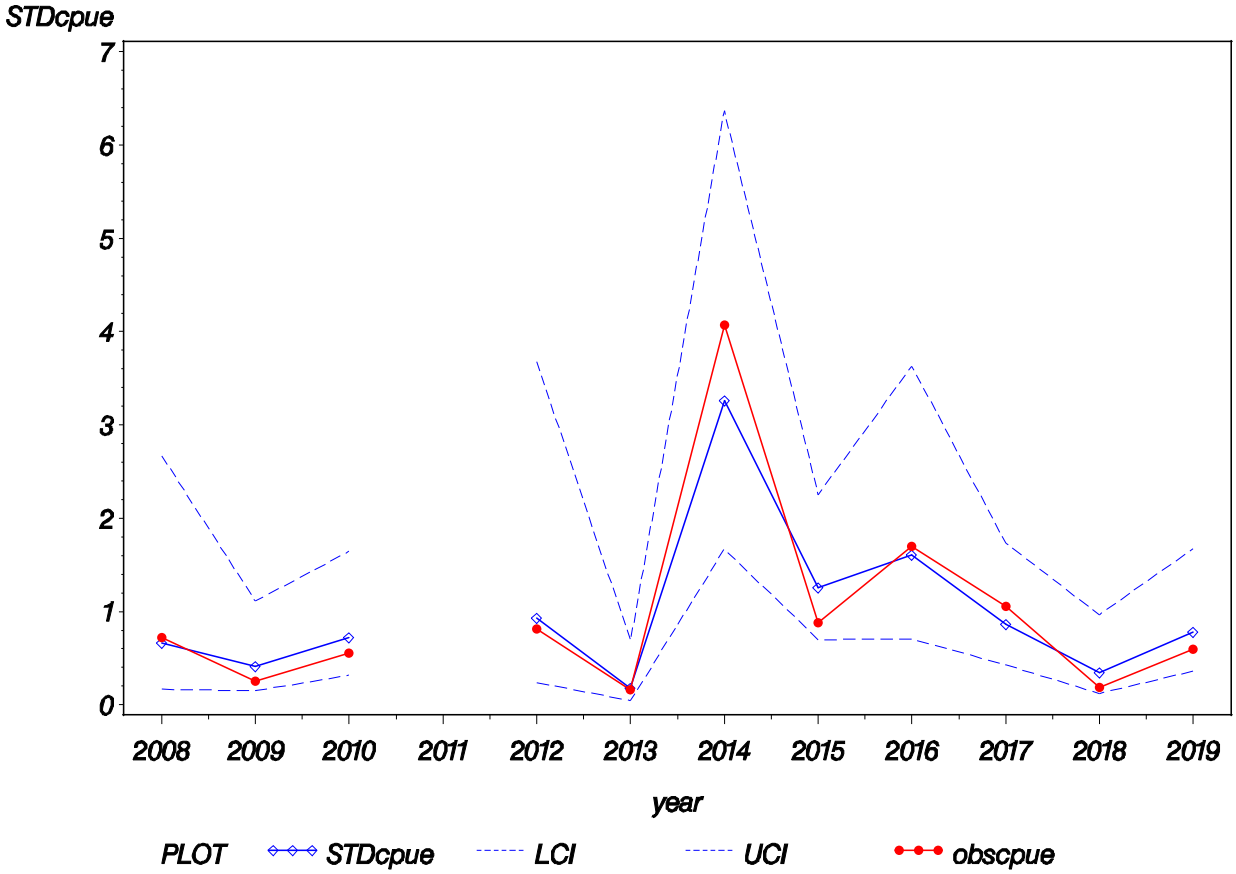


Figure 20. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (eGOM, 2008-2019).

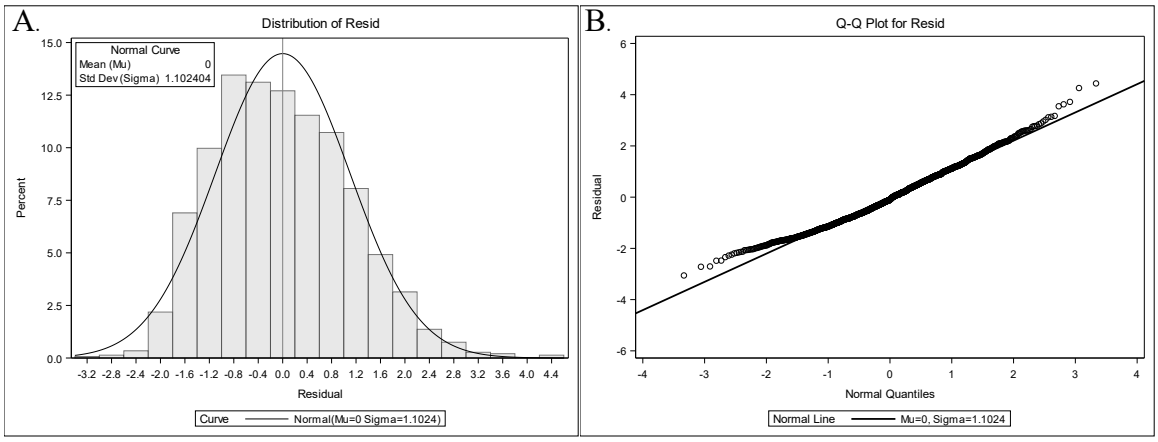


Figure 21. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 1984-2008) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

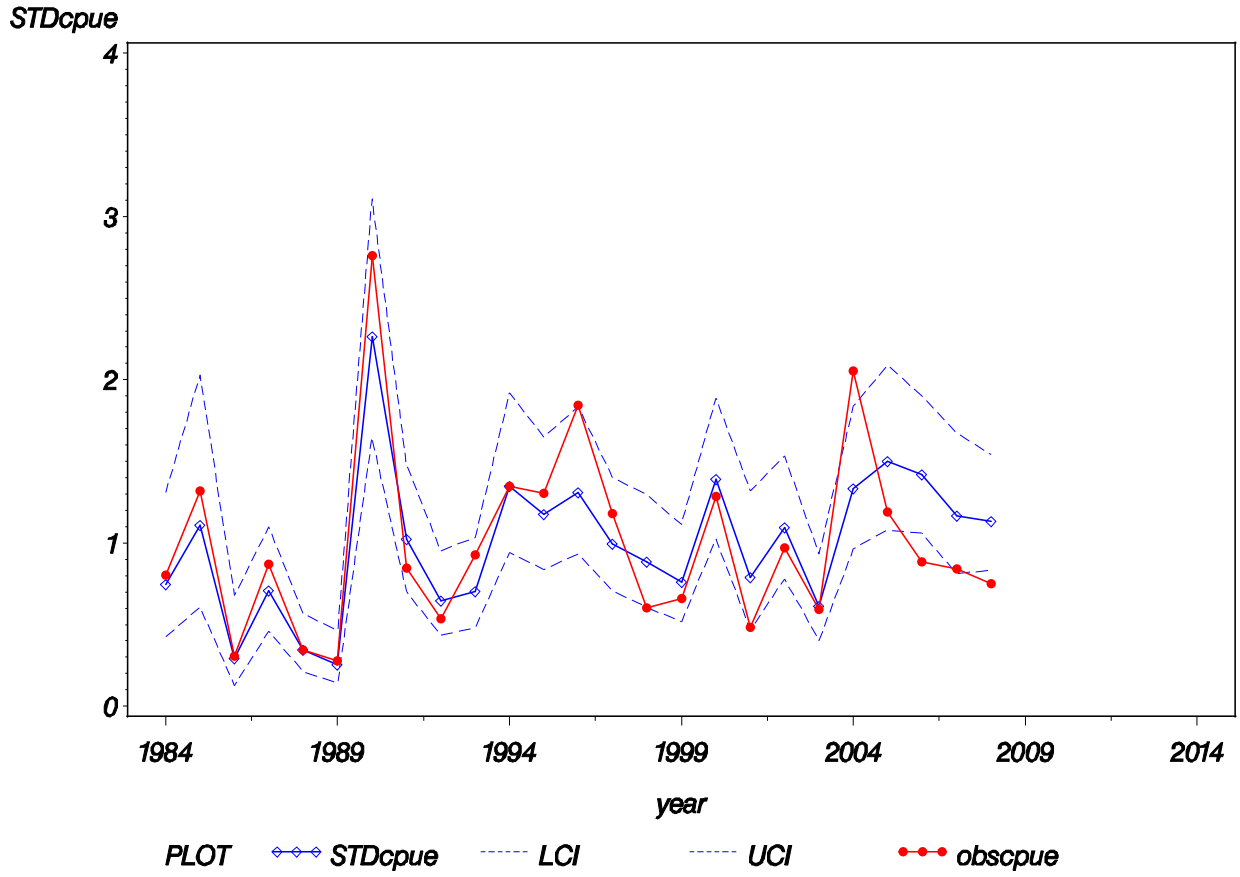


Figure 22. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (wGOM, 1984-2008).

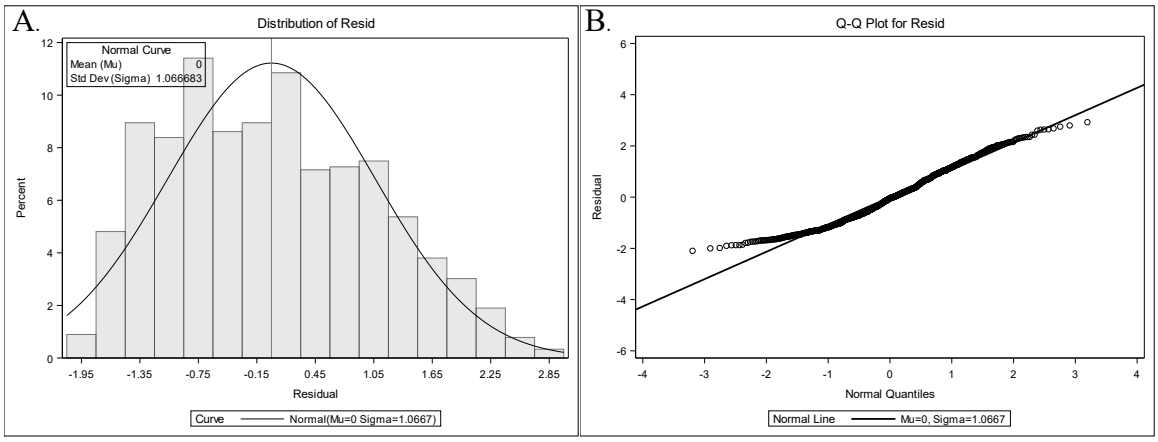


Figure 23. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 2009-2019) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

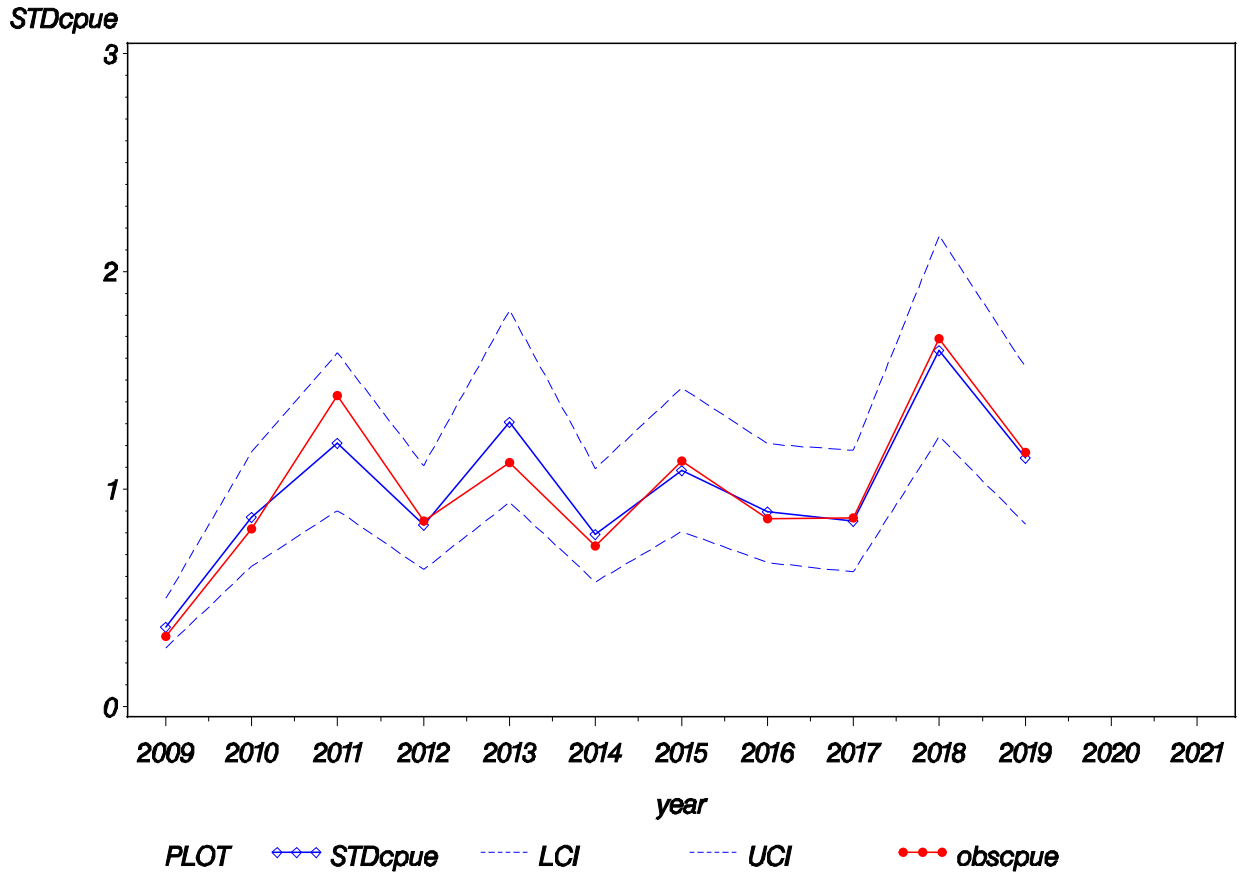


Figure 24. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (wGOM, 2009-2019).

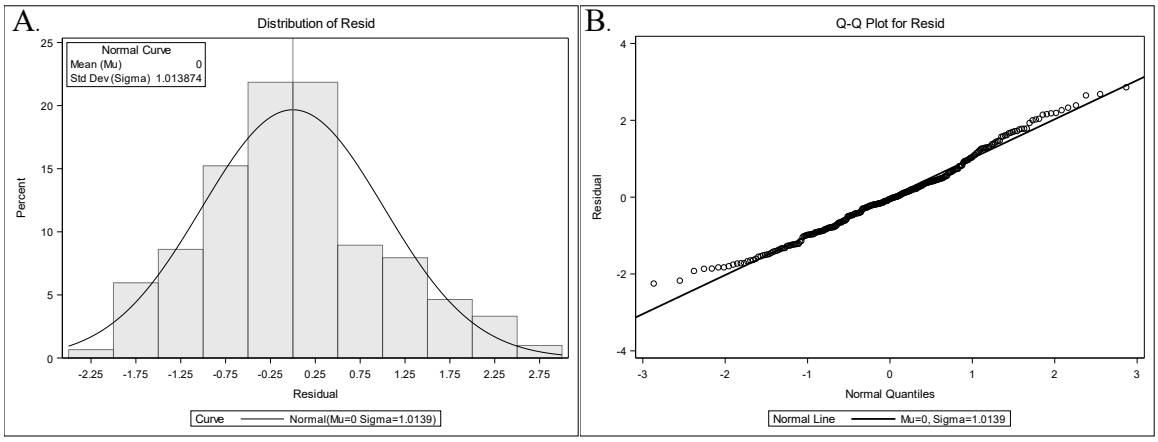


Figure 25. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (cGOM, 1982-2008) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

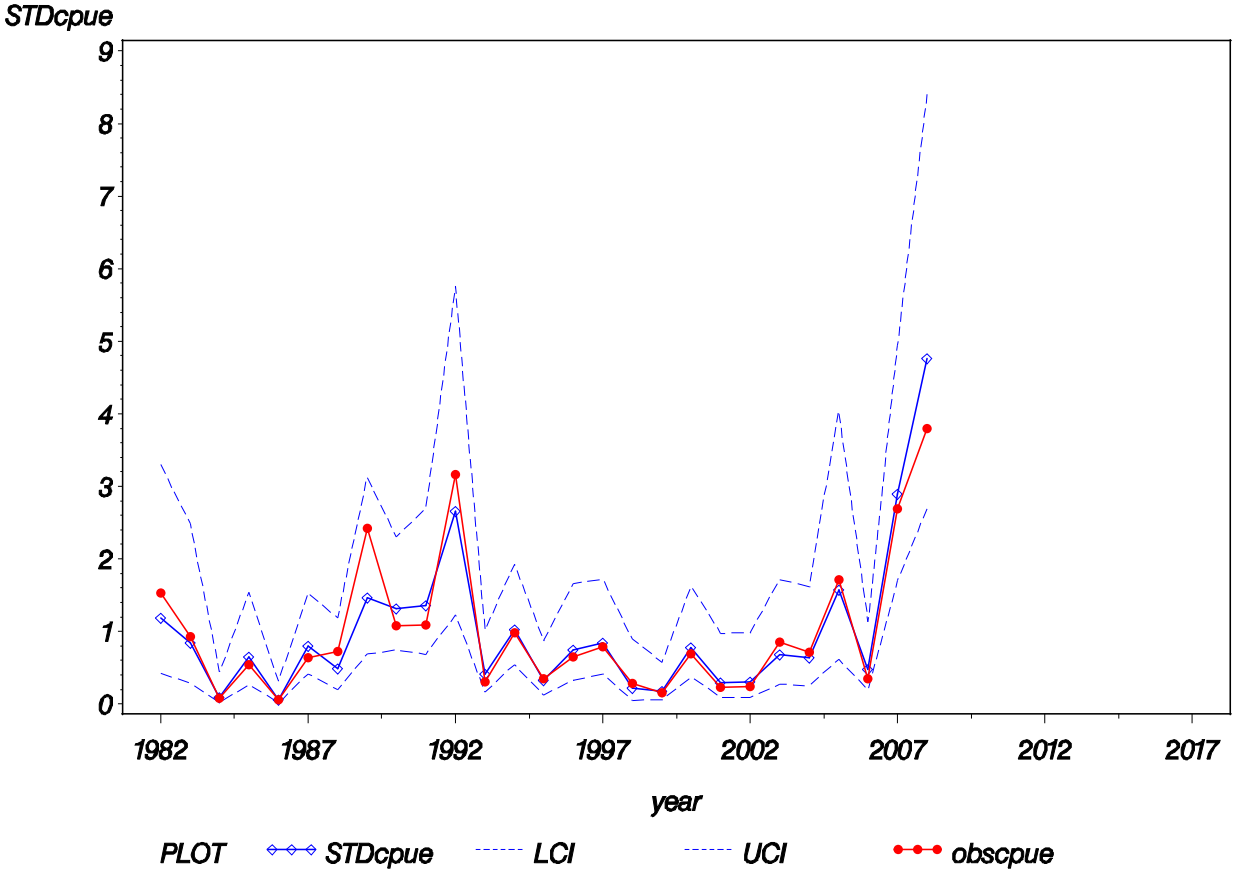


Figure 26. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (cGOM, 1982-2008).

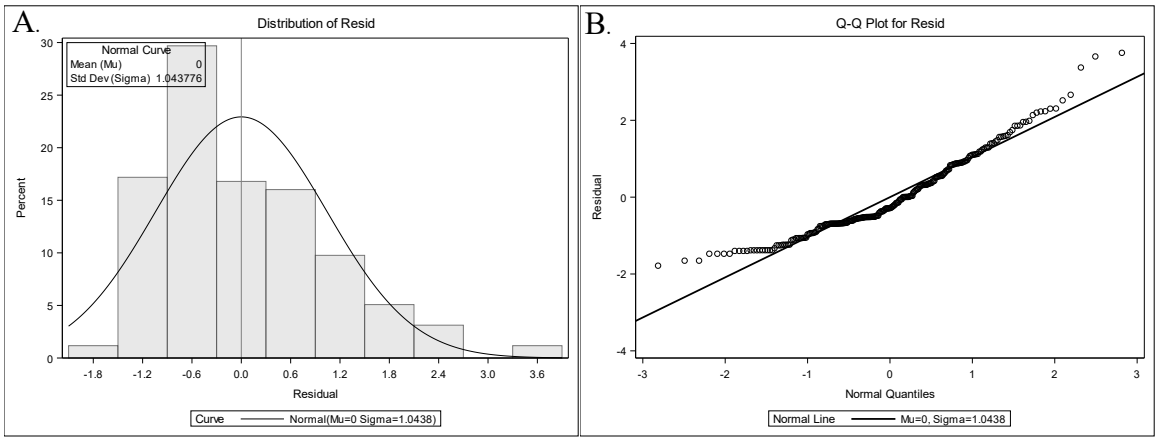


Figure 27. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (cGOM, 2009-2019) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

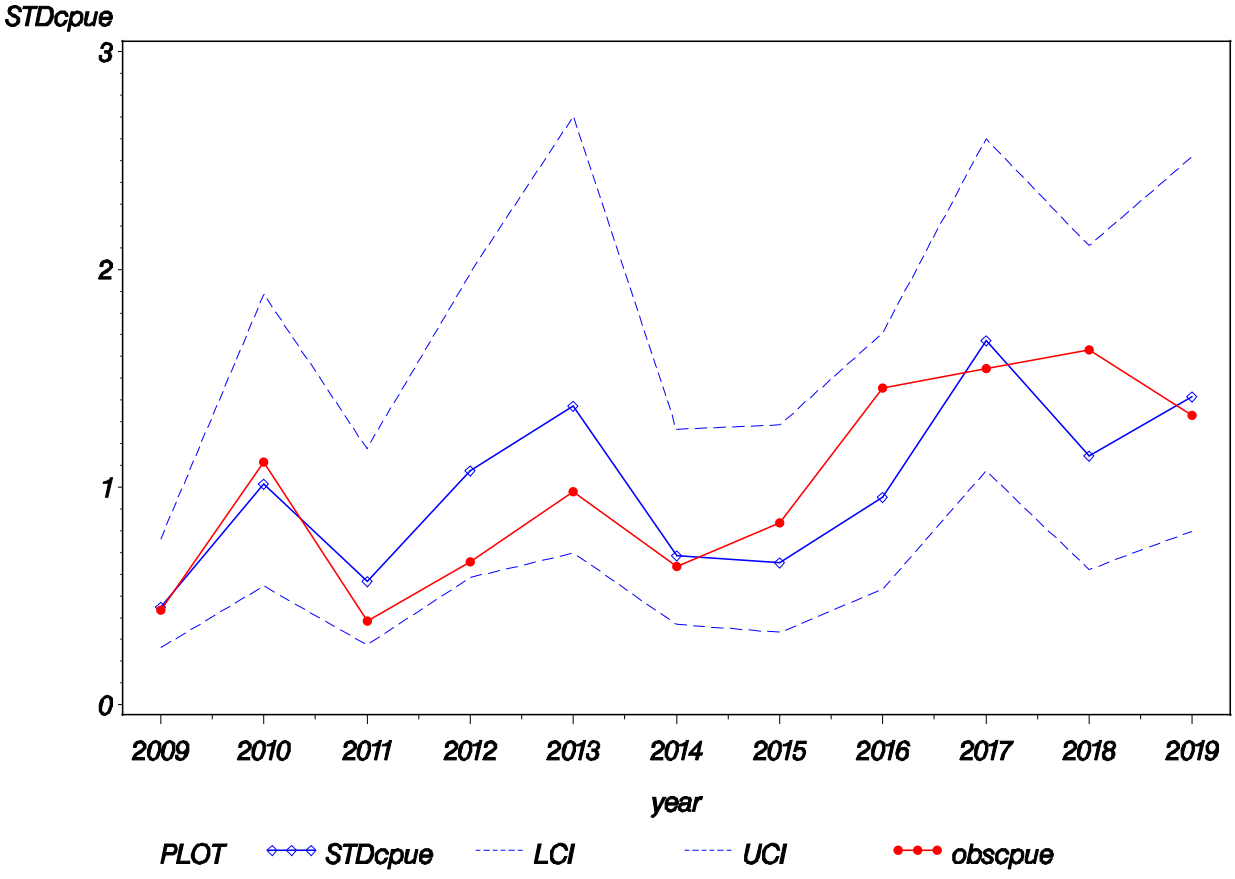


Figure 28. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (cGOM, 2009-2019).

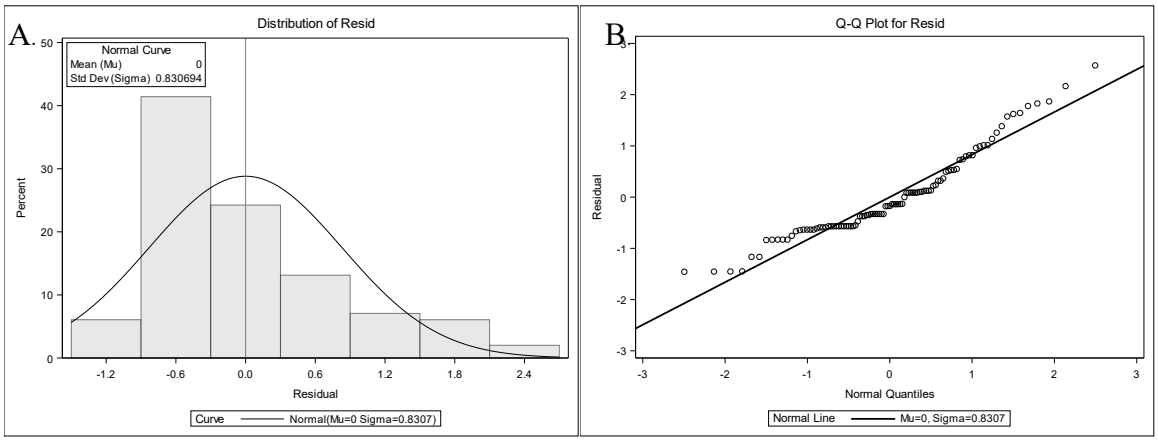


Figure 29. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 2009-2019) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

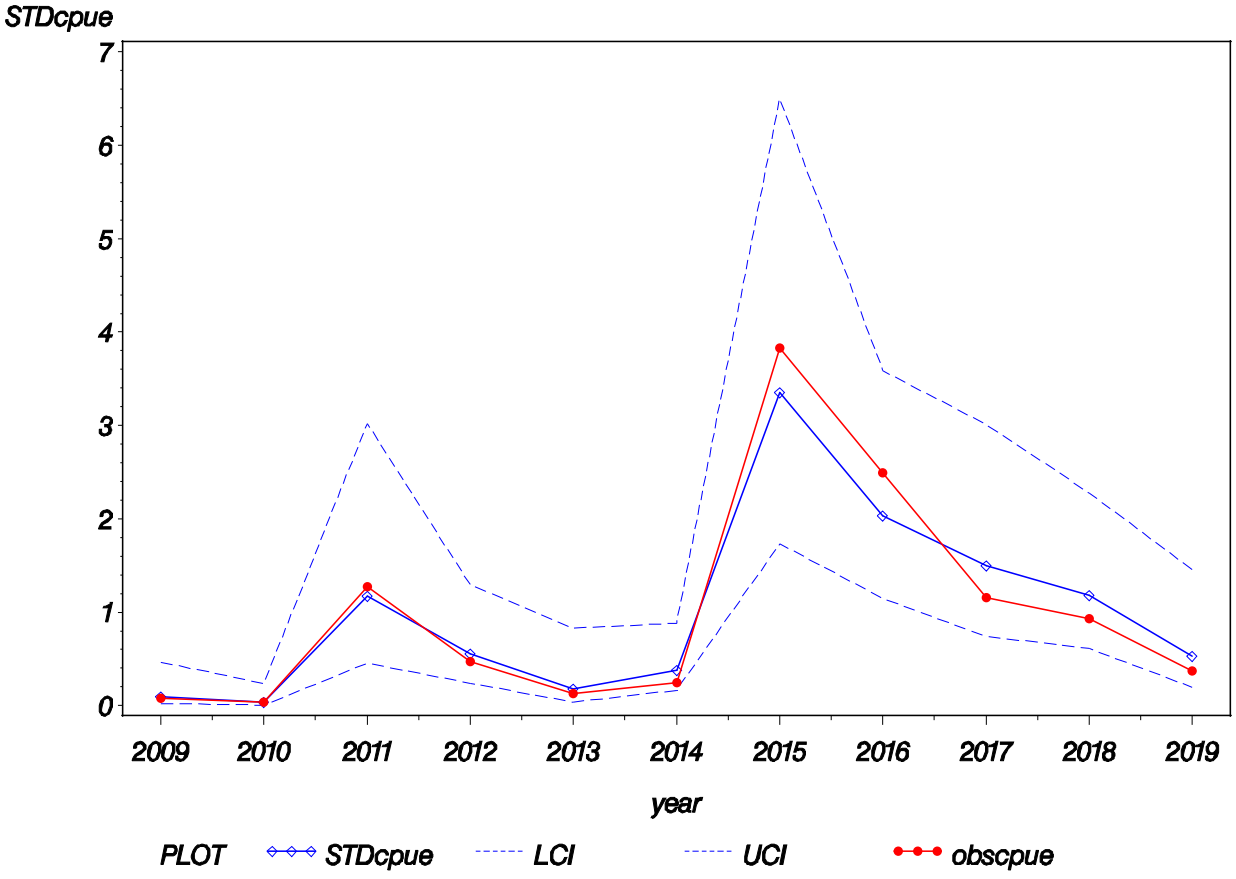


Figure 30. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (eGOM, 2009-2019).

Appendix

Appendix Table 1. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys wGOM (72-86) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	883	388	0.43941	11.2483
TIME OF DAY	Night	955	396	0.41466	10.9830
YEAR	1972	88	57	0.64773	27.1477
YEAR	1973	130	69	0.53077	11.6077
YEAR	1974	139	53	0.38129	4.7986
YEAR	1975	140	54	0.38571	10.2000
YEAR	1976	160	60	0.37500	5.9781
YEAR	1977	143	61	0.42657	7.1154
YEAR	1978	146	31	0.21233	31.5068
YEAR	1979	151	62	0.41060	9.3775
YEAR	1980	124	87	0.70161	23.7644
YEAR	1981	129	55	0.42636	6.3853
YEAR	1982	147	74	0.50340	6.4184
YEAR	1983	123	45	0.36585	7.6829
YEAR	1984	127	46	0.36220	1.8504
YEAR	1985	65	23	0.35385	6.7077
YEAR	1986	26	7	0.26923	4.1538

Appendix Table 2. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys wGOM (88-08) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
DEPTH ZONE	0506	161	16	0.09938	1.8783
DEPTH ZONE	0607	163	25	0.15337	2.5255
DEPTH ZONE	0708	158	48	0.30380	10.2114
DEPTH ZONE	0809	155	53	0.34194	13.4098
DEPTH ZONE	0910	161	73	0.45342	23.6063
DEPTH ZONE	1011	164	103	0.62805	26.5755
DEPTH ZONE	1112	161	112	0.69565	17.0849
DEPTH ZONE	1213	158	122	0.77215	34.4651
DEPTH ZONE	1314	158	129	0.81646	34.4801
DEPTH ZONE	1415	155	128	0.82581	29.3994
DEPTH ZONE	1516	160	133	0.83125	36.7411
DEPTH ZONE	1617	162	139	0.85802	36.9869
DEPTH ZONE	1718	155	136	0.87742	34.5009
DEPTH ZONE	1819	156	131	0.83974	30.6556
DEPTH ZONE	1920	155	127	0.81935	28.4648
DEPTH ZONE	2022	152	144	0.94737	23.7190
DEPTH ZONE	2225	152	144	0.94737	21.5295
DEPTH ZONE	2530	160	151	0.94375	21.7944
DEPTH ZONE	3035	155	136	0.87742	15.9455
DEPTH ZONE	3540	154	103	0.66883	7.5806
DEPTH ZONE	4045	149	64	0.42953	5.3923
DEPTH ZONE	4550	142	36	0.25352	1.4561
DEPTH ZONE	5060	127	20	0.15748	0.3350
TIME OF DAY	Day	1793	1089	0.60736	18.0807
TIME OF DAY	Night	1780	1184	0.66517	22.3687
YEAR	1988	181	96	0.53039	8.4383
YEAR	1989	180	102	0.56667	15.7186
YEAR	1990	175	115	0.65714	19.8232
YEAR	1991	179	122	0.68156	20.5562
YEAR	1992	179	95	0.53073	5.9080
YEAR	1993	177	101	0.57062	12.3303
YEAR	1994	179	117	0.65363	42.7229
YEAR	1995	177	130	0.73446	31.4883
YEAR	1996	181	112	0.61878	12.7182

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
YEAR	1997	178	114	0.64045	25.1660
YEAR	1998	181	100	0.55249	12.9048
YEAR	1999	182	124	0.68132	18.5248
YEAR	2000	179	122	0.68156	12.1476
YEAR	2001	184	108	0.58696	14.1352
YEAR	2002	181	108	0.59669	14.1153
YEAR	2003	183	120	0.65574	26.4264
YEAR	2004	162	127	0.78395	46.8837
YEAR	2005	186	145	0.77957	22.3231
YEAR	2006	176	117	0.66477	17.7875
YEAR	2007	173	98	0.56647	27.3755
ZONE	1315	895	433	0.48380	8.2667
ZONE	1716	899	578	0.64294	10.6579
ZONE	1918	803	547	0.68120	30.9979
ZONE	2021	976	715	0.73258	31.1101

Appendix Table 3. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys wGOM (08-19) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	934	635	0.67987	23.0990
TIME OF DAY	Night	1031	678	0.65761	23.7287
YEAR	2008	286	177	0.61888	7.4749
YEAR	2009	273	200	0.73260	34.7313
YEAR	2010	176	105	0.59659	17.5942
YEAR	2011	177	115	0.64972	19.9068
YEAR	2012	132	103	0.78030	37.9759
YEAR	2013	91	56	0.61538	18.8252
YEAR	2014	146	102	0.69863	24.3856
YEAR	2015	144	113	0.78472	41.5058
YEAR	2016	118	74	0.62712	28.8772
YEAR	2017	143	84	0.58741	16.6520
YEAR	2018	142	102	0.71831	20.2458
YEAR	2019	137	82	0.59854	20.9670
STATZONE	13	82	44	0.53659	11.8192
STATZONE	14	171	104	0.60819	5.6515
STATZONE	15	191	105	0.54974	5.9328
STATZONE	16	268	131	0.48881	6.6025
STATZONE	17	342	190	0.55556	13.9965
STATZONE	18	312	235	0.75321	33.0798
STATZONE	19	202	161	0.79703	51.8840
STATZONE	20	234	202	0.86325	44.8249
STATZONE	21	163	141	0.86503	31.4307

Appendix Table 4. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys cGOM (72-86) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	687	298	0.43377	11.0530
TIME OF DAY	Night	789	392	0.49683	18.1374
YEAR	1972	65	44	0.67692	54.3067
YEAR	1973	115	59	0.51304	9.3739
YEAR	1974	104	42	0.40385	13.0385
YEAR	1975	93	41	0.44086	11.2043
YEAR	1976	108	49	0.45370	12.2222
YEAR	1977	97	42	0.43299	14.7423
YEAR	1978	137	63	0.45985	7.8109
YEAR	1979	109	43	0.39450	5.7064
YEAR	1980	109	54	0.49541	11.2018
YEAR	1981	106	63	0.59434	33.9887
YEAR	1982	123	88	0.71545	33.6585
YEAR	1983	99	50	0.50505	6.4040
YEAR	1984	82	28	0.34146	6.2683
YEAR	1985	89	19	0.21348	2.5169
YEAR	1986	40	5	0.12500	3.0000

Appendix Table 5. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys cGOM (88-08) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
DEPTH ZONE	0506	14	3	0.21429	3.6593
DEPTH ZONE	0607	73	21	0.28767	10.6841
DEPTH ZONE	0708	48	20	0.41667	11.4881
DEPTH ZONE	0809	17	8	0.47059	10.9373
DEPTH ZONE	0910	44	30	0.68182	17.4958
DEPTH ZONE	1011	75	43	0.57333	13.6848
DEPTH ZONE	1112	48	33	0.68750	34.1770
DEPTH ZONE	1213	12	6	0.50000	20.4977
DEPTH ZONE	1314	82	57	0.69512	33.0077
DEPTH ZONE	1415	39	31	0.79487	27.2191
DEPTH ZONE	1516	18	16	0.88889	18.9029
DEPTH ZONE	1617	40	31	0.77500	26.8895
DEPTH ZONE	1718	71	49	0.69014	26.8143
DEPTH ZONE	1819	41	30	0.73171	26.5632
DEPTH ZONE	1920	21	16	0.76190	16.4877
DEPTH ZONE	2022	57	43	0.75439	21.7976
DEPTH ZONE	2225	38	31	0.81579	9.0003
DEPTH ZONE	2530	35	25	0.71429	5.3320
DEPTH ZONE	3035	42	25	0.59524	7.7765
DEPTH ZONE	3540	36	13	0.36111	3.5529
DEPTH ZONE	4045	38	10	0.26316	1.9589
DEPTH ZONE	4550	35	5	0.14286	3.4679
DEPTH ZONE	5060	27	2	0.07407	0.3821
TIME OF DAY	Day	473	244	0.51586	12.6309
TIME OF DAY	Night	478	304	0.63598	21.4051
YEAR	1987	42	10	0.23810	5.5479
YEAR	1988	35	13	0.37143	6.0808
YEAR	1989	43	29	0.67442	43.8508
YEAR	1990	52	38	0.73077	30.7486
YEAR	1991	45	35	0.77778	33.5361
YEAR	1992	32	14	0.43750	2.7666
YEAR	1993	70	35	0.50000	26.8419
YEAR	1994	49	26	0.53061	6.4202
YEAR	1995	39	25	0.64103	10.8987

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
YEAR	1996	43	24	0.55814	10.3958
YEAR	1997	43	22	0.51163	16.4818
YEAR	1998	43	20	0.46512	4.4773
YEAR	1999	42	23	0.54762	10.2951
YEAR	2000	42	29	0.69048	26.6059
YEAR	2001	43	19	0.44186	4.9180
YEAR	2002	50	23	0.46000	8.3927
YEAR	2003	75	49	0.65333	20.2299
YEAR	2004	43	18	0.41860	6.1496
YEAR	2005	43	30	0.69767	8.8595
YEAR	2006	46	42	0.91304	31.8014
YEAR	2007	31	24	0.77419	29.1862

Appendix Table 6. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys cGOM (08-19) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
STATZONE	7	116	33	0.28448	1.4980
STATZONE	8	143	40	0.27972	6.2196
STATZONE	9	96	24	0.25000	2.0765
STATZONE	10	142	54	0.38028	4.4938
STATZONE	11	231	161	0.69697	20.1455
TOD	D	388	160	0.41237	8.1815
TOD	N	340	152	0.44706	9.9406
YEAR	2008	50	23	0.46000	5.9704
YEAR	2009	107	63	0.58879	27.0055
YEAR	2010	85	27	0.31765	4.2792
YEAR	2011	42	18	0.42857	3.8910
YEAR	2012	51	23	0.45098	7.5211
YEAR	2013	57	19	0.33333	5.2274
YEAR	2014	55	24	0.43636	6.2190
YEAR	2015	62	27	0.43548	4.7623
YEAR	2016	36	12	0.33333	10.8865
YEAR	2017	76	30	0.39474	5.1761
YEAR	2018	56	27	0.48214	10.1642
YEAR	2019	51	19	0.37255	3.2479

Appendix Table 7. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys eGOM (08-19) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
STATZONE	2	56	15	0.26786	2.99364
STATZONE	3	144	11	0.07639	0.55632
STATZONE	4	165	10	0.06061	0.14459
STATZONE	5	187	34	0.18182	1.02597
STATZONE	6	188	37	0.19681	3.46486
TOD	D	362	51	0.14088	0.92352
TOD	N	378	56	0.14815	2.06494
YEAR	2008	29	3	0.10345	0.93103
YEAR	2009	66	7	0.10606	0.33138
YEAR	2010	61	11	0.18033	0.72041
YEAR	2012	17	3	0.17647	1.05272
YEAR	2013	49	3	0.06122	0.20830
YEAR	2014	109	16	0.14679	5.27341
YEAR	2015	109	21	0.19266	1.13536
YEAR	2016	37	10	0.27027	2.20285
YEAR	2017	92	15	0.16304	1.36851
YEAR	2018	83	6	0.07229	0.24086
YEAR	2019	88	12	0.13636	0.77259

Appendix Table 8. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys wGOM (84-08) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
DEPTH ZONE	0506	183	17	0.09290	1.0470
DEPTH ZONE	0607	166	22	0.13253	1.5340
DEPTH ZONE	0708	174	38	0.21839	6.3573
DEPTH ZONE	0809	164	44	0.26829	5.0395
DEPTH ZONE	0910	180	72	0.40000	9.7721
DEPTH ZONE	1011	186	72	0.38710	5.9186
DEPTH ZONE	1112	181	71	0.39227	8.3461
DEPTH ZONE	1213	178	62	0.34831	7.1401
DEPTH ZONE	1314	188	80	0.42553	6.3223
DEPTH ZONE	1415	178	68	0.38202	7.3836
DEPTH ZONE	1516	181	74	0.40884	7.7856
DEPTH ZONE	1617	183	80	0.43716	9.1045
DEPTH ZONE	1718	186	82	0.44086	6.9770
DEPTH ZONE	1819	181	67	0.37017	6.4179
DEPTH ZONE	1920	181	77	0.42541	9.0913
DEPTH ZONE	2022	172	92	0.53488	6.9438
DEPTH ZONE	2225	180	109	0.60556	5.2261
DEPTH ZONE	2530	175	115	0.65714	3.6510
DEPTH ZONE	3035	177	87	0.49153	3.0491
DEPTH ZONE	3540	173	62	0.35838	1.3438
DEPTH ZONE	4045	158	45	0.28481	1.7031
DEPTH ZONE	4550	158	16	0.10127	0.1993
DEPTH ZONE	5060	120	12	0.10000	0.5295
TIME OF DAY	Day	1924	689	0.35811	4.3550
TIME OF DAY	Night	2079	775	0.37278	6.3659
YEAR	1984	161	29	0.18012	4.2183
YEAR	1985	77	24	0.31169	6.9346
YEAR	1986	79	12	0.15190	1.6210
YEAR	1987	178	47	0.26404	4.5749
YEAR	1988	145	38	0.26207	1.8053
YEAR	1989	141	25	0.17730	1.4740
YEAR	1990	172	80	0.46512	14.5175
YEAR	1991	185	62	0.33514	4.4425
YEAR	1992	180	57	0.31667	2.8096

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
YEAR	1993	178	59	0.33146	4.8806
YEAR	1994	177	67	0.37853	7.0946
YEAR	1995	176	73	0.41477	6.8711
YEAR	1996	174	72	0.41379	9.6862
YEAR	1997	163	71	0.43558	6.2003
YEAR	1998	169	59	0.34911	3.1797
YEAR	1999	179	59	0.32961	3.4758
YEAR	2000	171	84	0.49123	6.7674
YEAR	2001	116	32	0.27586	2.5540
YEAR	2002	183	73	0.39891	5.1127
YEAR	2003	137	50	0.36496	3.1195
YEAR	2004	177	78	0.44068	10.8040
YEAR	2005	148	73	0.49324	6.2688
YEAR	2006	176	90	0.51136	4.6414
YEAR	2007	155	65	0.41935	4.4326
YEAR	2008	206	85	0.41262	3.9516
ZONE	1315	955	186	0.19476	3.3041
ZONE	1716	967	428	0.44261	7.0681
ZONE	1918	922	451	0.48915	7.8894
ZONE	2021	1159	399	0.34426	3.7526

Appendix Table 9. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys wGOM (09-16) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	1112	514	0.46223	6.7314
TIME OF DAY	Night	811	380	0.46856	6.7760
YEAR	2009	301	89	0.29568	2.3338
YEAR	2010	201	90	0.44776	5.8817
YEAR	2011	171	85	0.49708	10.3026
YEAR	2012	176	92	0.52273	6.1589
YEAR	2013	141	68	0.48227	8.0841
YEAR	2014	162	72	0.44444	5.3130
YEAR	2015	168	83	0.49405	8.1408
YEAR	2016	162	81	0.50000	6.2242
YEAR	2017	161	74	0.45963	6.2662
YEAR	2018	135	84	0.62222	12.1804
YEAR	2019	145	76	0.52414	8.4175
STATZONE	13	85	19	0.22353	3.2835
STATZONE	14	163	56	0.34356	4.2320
STATZONE	15	193	46	0.23834	1.4036
STATZONE	16	258	80	0.31008	3.7914
STATZONE	17	324	141	0.43519	7.4136
STATZONE	18	300	174	0.58000	11.1576
STATZONE	19	216	127	0.58796	8.7512
STATZONE	20	221	151	0.68326	8.4504
STATZONE	21	163	100	0.61350	7.7032

Appendix Table 10. Summary of the factors used in constructing the Red Snapper abundance index from the Summer Groundfish Surveys cGOM (82-08) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
DEPTH ZONE	0506	17	2	0.11765	0.4482
DEPTH ZONE	0607	95	16	0.16842	2.2380
DEPTH ZONE	0708	57	10	0.17544	1.9388
DEPTH ZONE	0809	14	2	0.14286	3.3429
DEPTH ZONE	0910	63	11	0.17460	1.8709
DEPTH ZONE	1011	97	22	0.22680	2.1355
DEPTH ZONE	1112	59	10	0.16949	2.4799
DEPTH ZONE	1213	24	5	0.20833	2.2891
DEPTH ZONE	1314	92	30	0.32609	7.7271
DEPTH ZONE	1415	59	13	0.22034	3.9981
DEPTH ZONE	1516	28	4	0.14286	1.4666
DEPTH ZONE	1617	52	18	0.34615	4.1827
DEPTH ZONE	1718	84	29	0.34524	6.7997
DEPTH ZONE	1819	50	14	0.28000	6.9350
DEPTH ZONE	1920	28	12	0.42857	6.6031
DEPTH ZONE	2022	70	33	0.47143	6.6296
DEPTH ZONE	2225	56	22	0.39286	2.9341
DEPTH ZONE	2530	29	6	0.20690	1.6305
DEPTH ZONE	3035	60	22	0.36667	2.3212
DEPTH ZONE	3540	37	12	0.32432	5.1382
DEPTH ZONE	4045	45	5	0.11111	0.7201
DEPTH ZONE	4550	50	3	0.06000	0.1798
DEPTH ZONE	5060	28	1	0.03571	0.1648
TIME OF DAY	Day	560	132	0.23571	3.1245
TIME OF DAY	Night	634	170	0.26814	3.9642
YEAR	1982	36	7	0.19444	5.2539
YEAR	1983	21	6	0.28571	3.1921
YEAR	1984	29	2	0.06897	0.2743
YEAR	1985	36	10	0.27778	1.8751
YEAR	1986	35	2	0.05714	0.2041
YEAR	1987	88	20	0.22727	2.1906
YEAR	1988	63	10	0.15873	2.4740
YEAR	1989	51	14	0.27451	8.3514
YEAR	1990	65	24	0.36923	3.6951

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
YEAR	1991	44	16	0.36364	3.7451
YEAR	1992	45	13	0.28889	10.9081
YEAR	1993	44	9	0.20455	1.0514
YEAR	1994	60	20	0.33333	3.3780
YEAR	1995	42	8	0.19048	1.2079
YEAR	1996	46	12	0.26087	2.2275
YEAR	1997	42	15	0.35714	2.6974
YEAR	1998	34	3	0.08824	0.9706
YEAR	1999	43	5	0.11628	0.5231
YEAR	2000	43	14	0.32558	2.3821
YEAR	2001	34	5	0.14706	0.7742
YEAR	2002	44	5	0.11364	0.8123
YEAR	2003	42	9	0.21429	2.9324
YEAR	2004	38	9	0.23684	2.4702
YEAR	2005	31	8	0.25806	5.9110
YEAR	2006	45	10	0.22222	1.2063
YEAR	2007	40	23	0.57500	9.2535
YEAR	2008	53	23	0.43396	13.0897

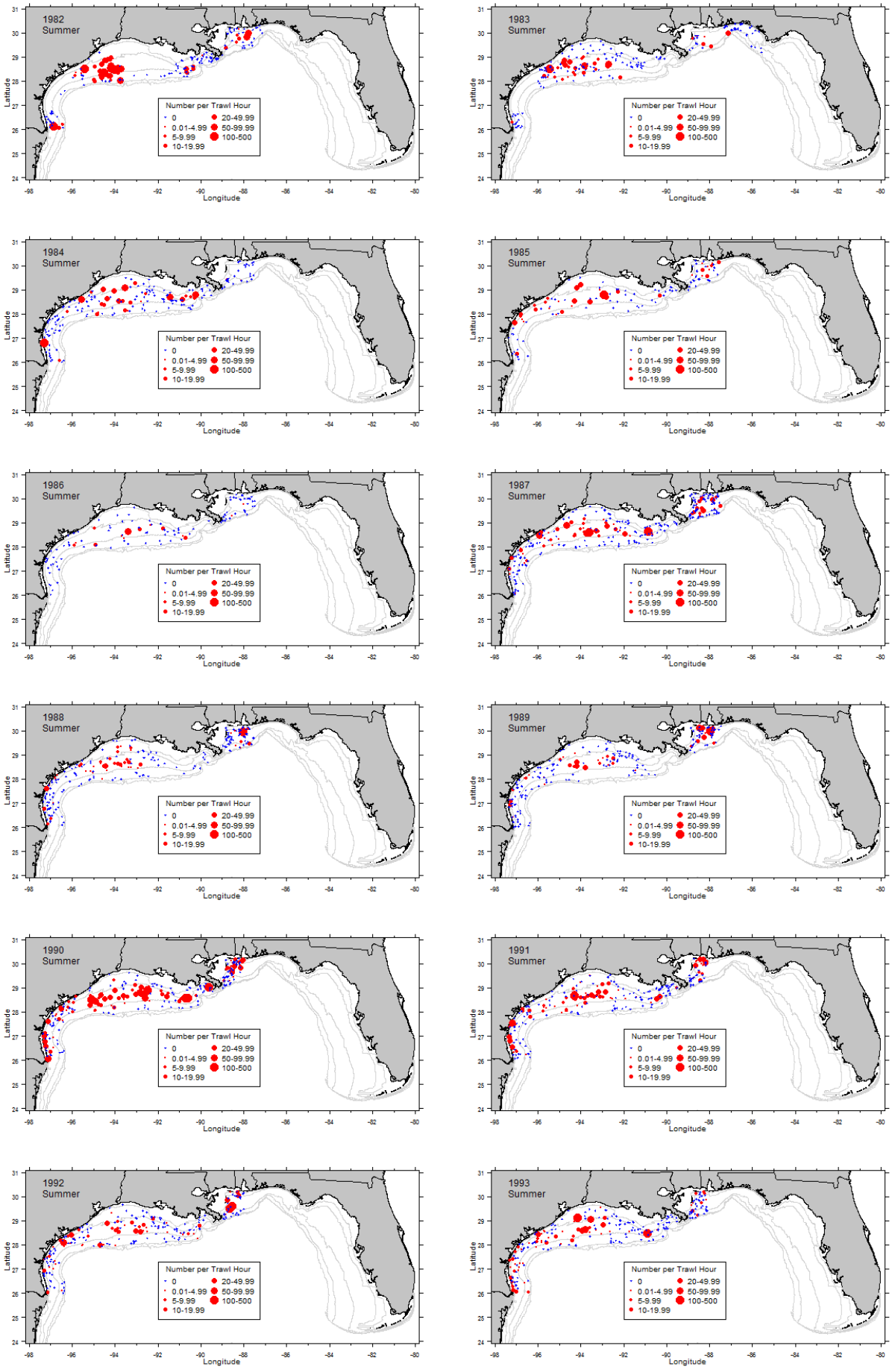
Appendix Table 11. Summary of the factors used in constructing the Red Snapper abundance index from the Summer Groundfish Surveys cGOM (0916) data.

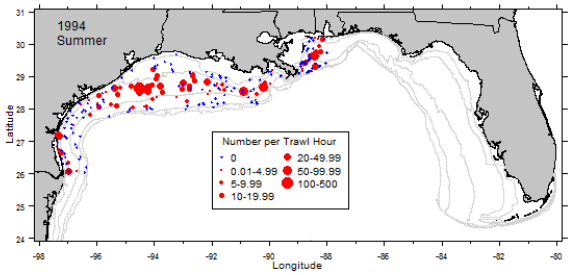
Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	628	168	0.26752	2.99002
TIME OF DAY	Night	299	88	0.29431	4.42347
YEAR	2009	140	33	0.23571	1.56541
YEAR	2010	71	21	0.29577	4.00565
YEAR	2011	64	15	0.23438	1.37500
YEAR	2012	80	21	0.26250	2.36514
YEAR	2013	67	17	0.25373	3.52239
YEAR	2014	91	22	0.24176	2.27984
YEAR	2015	101	18	0.17822	3.00221
YEAR	2016	81	23	0.28395	5.23251
YEAR	2017	88	40	0.45455	5.55575
YEAR	2018	66	21	0.31818	5.86776
YEAR	2019	78	25	0.32051	4.78049
STATZONE	7	144	25	0.17361	0.77568
STATZONE	8	159	29	0.18239	1.69383
STATZONE	9	116	24	0.20690	2.18334
STATZONE	10	220	41	0.18636	1.54952
STATZONE	11	288	137	0.47569	7.72628

Appendix Table 12. Summary of the factors used in constructing the Red Snapper abundance index from the Summer Groundfish Surveys eGOM (0916) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	696	61	0.08764	0.53408
TIME OF DAY	Night	517	38	0.07350	0.70742
YEAR	2009	88	2	0.02273	0.04545
YEAR	2010	104	1	0.00962	0.01923
YEAR	2011	106	7	0.06604	0.75472
YEAR	2012	143	9	0.06294	0.27927
YEAR	2013	106	2	0.01887	0.07547
YEAR	2014	123	9	0.07317	0.14616
YEAR	2015	119	15	0.12605	2.26731
YEAR	2016	111	20	0.18018	1.47714
YEAR	2017	99	13	0.13131	0.68478
YEAR	2018	113	15	0.13274	0.54867
YEAR	2019	101	6	0.05941	0.21759
STATZONE	2	94	15	0.15957	0.99989
STATZONE	3	298	15	0.05034	0.21407
STATZONE	4	296	16	0.05405	0.29054
STATZONE	5	261	20	0.07663	0.61303
STATZONE	6	264	33	0.12500	1.26391

Appendix Figure 1. Annual survey effort and catch of Red Snapper from the SEAMAP Summer Groundfish Surveys including stations from DISL trawl survey between 2010 and 2019.

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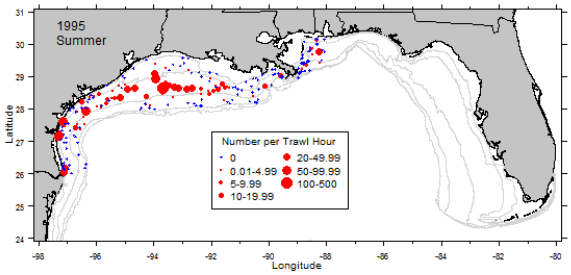
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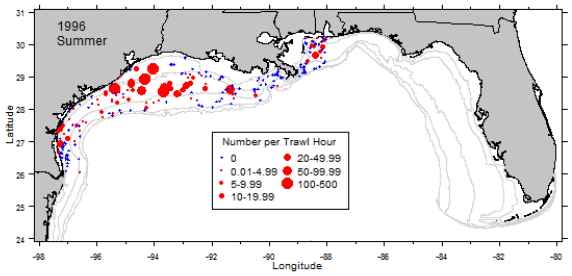
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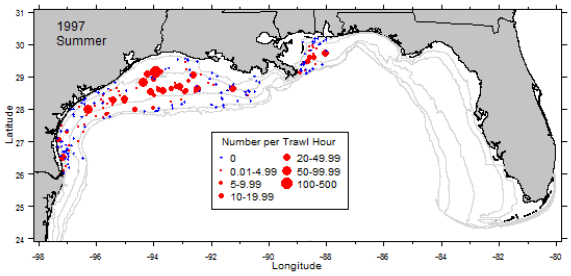
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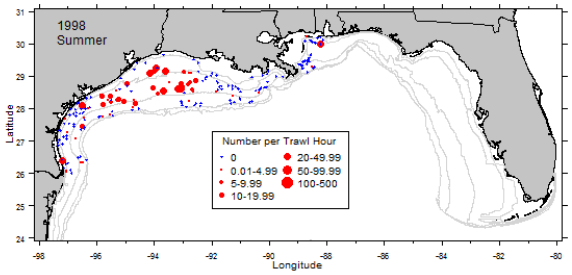
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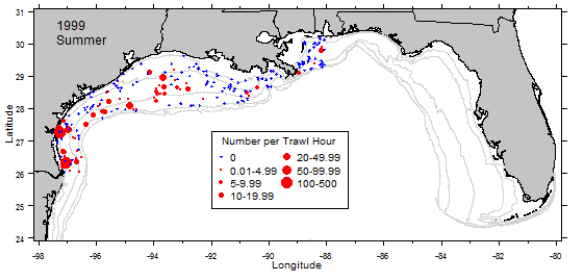
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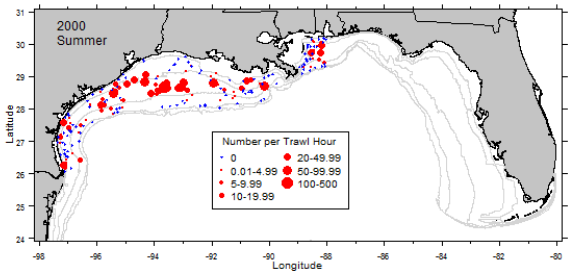
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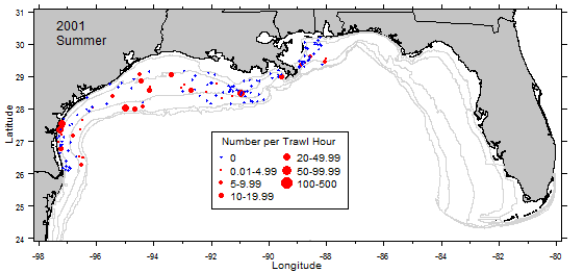
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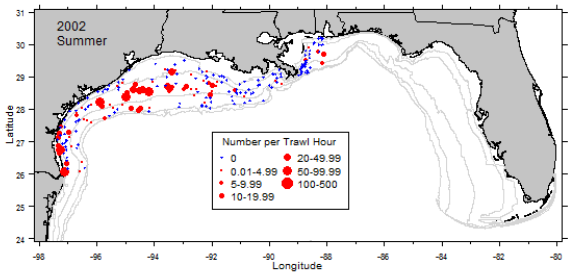
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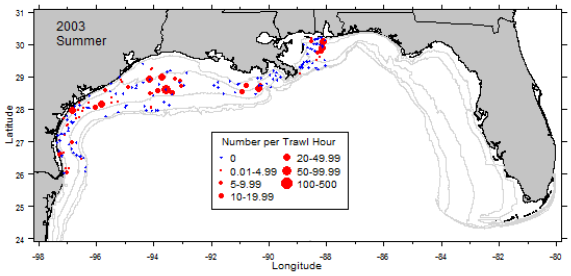
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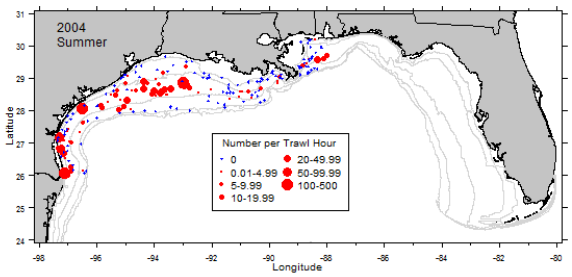
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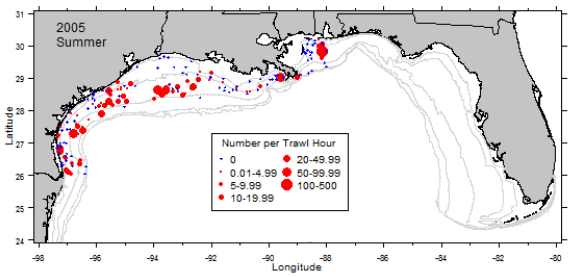
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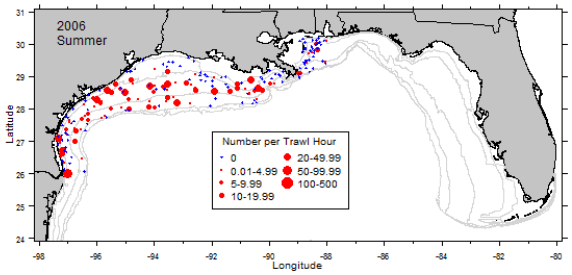
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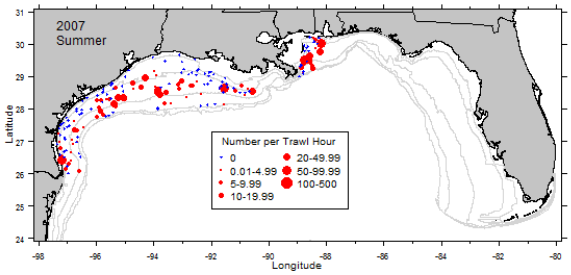
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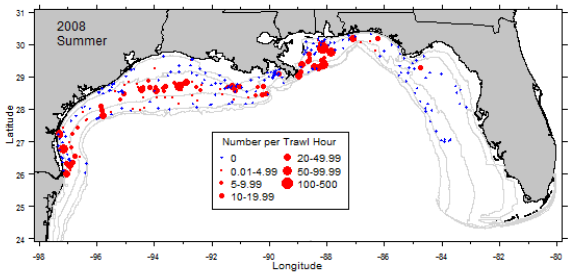
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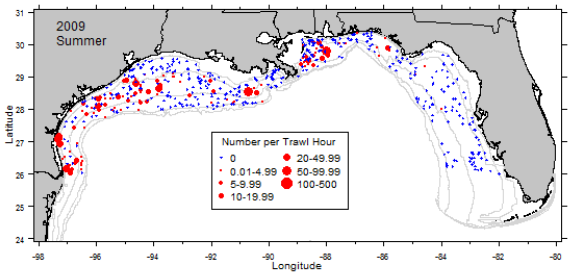
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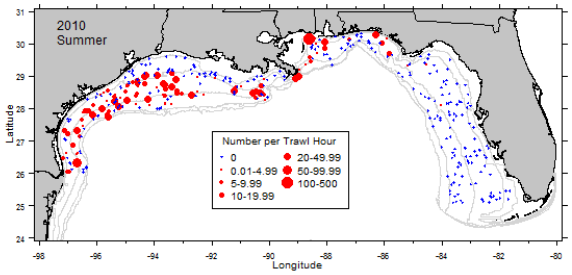
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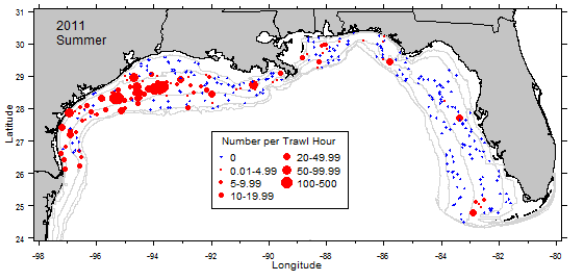
Longitude


2011
Summer
Number per Trawl Hour
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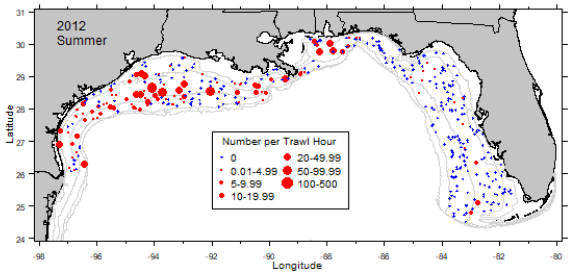
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2012
Summer
Number per Trawl Hour
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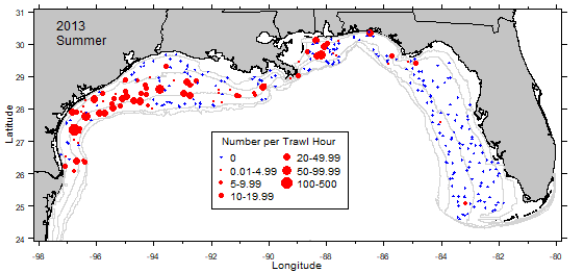
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2013
Summer
Number per Trawl Hour
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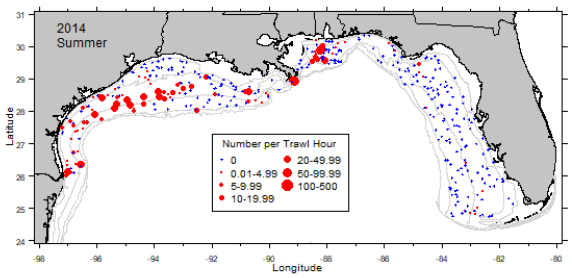
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2014
Summer
Number per Trawl Hour
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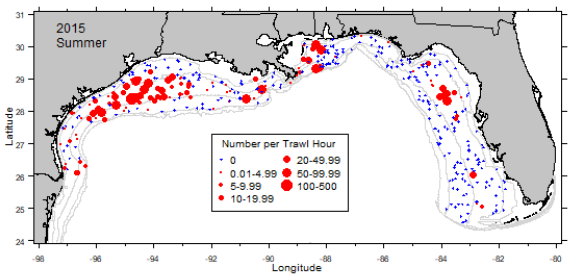
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2015
Summer
Number per Trawl Hour
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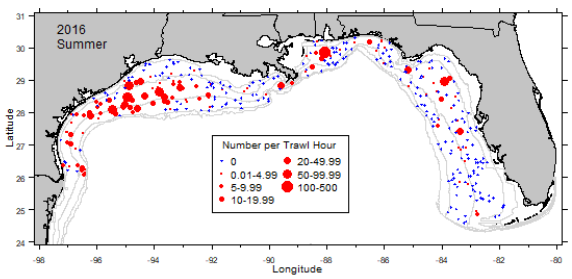
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2016
Summer
Number per Trawl Hour
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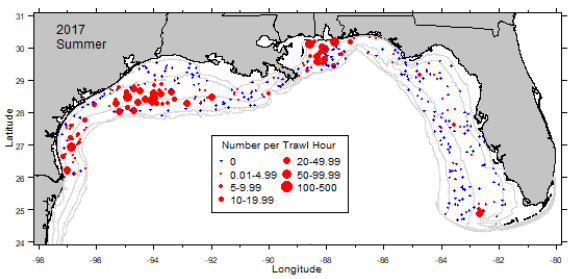
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2017
Summer
Number per Trawl Hour
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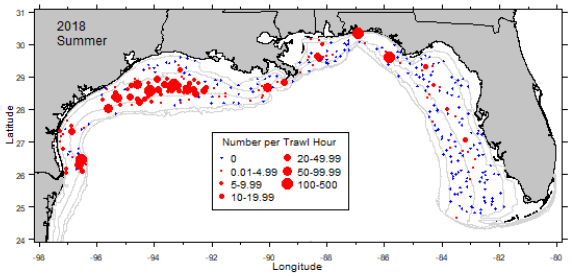
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2018
Summer
Number per Trawl Hour
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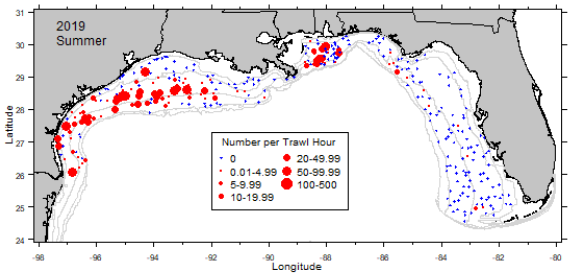
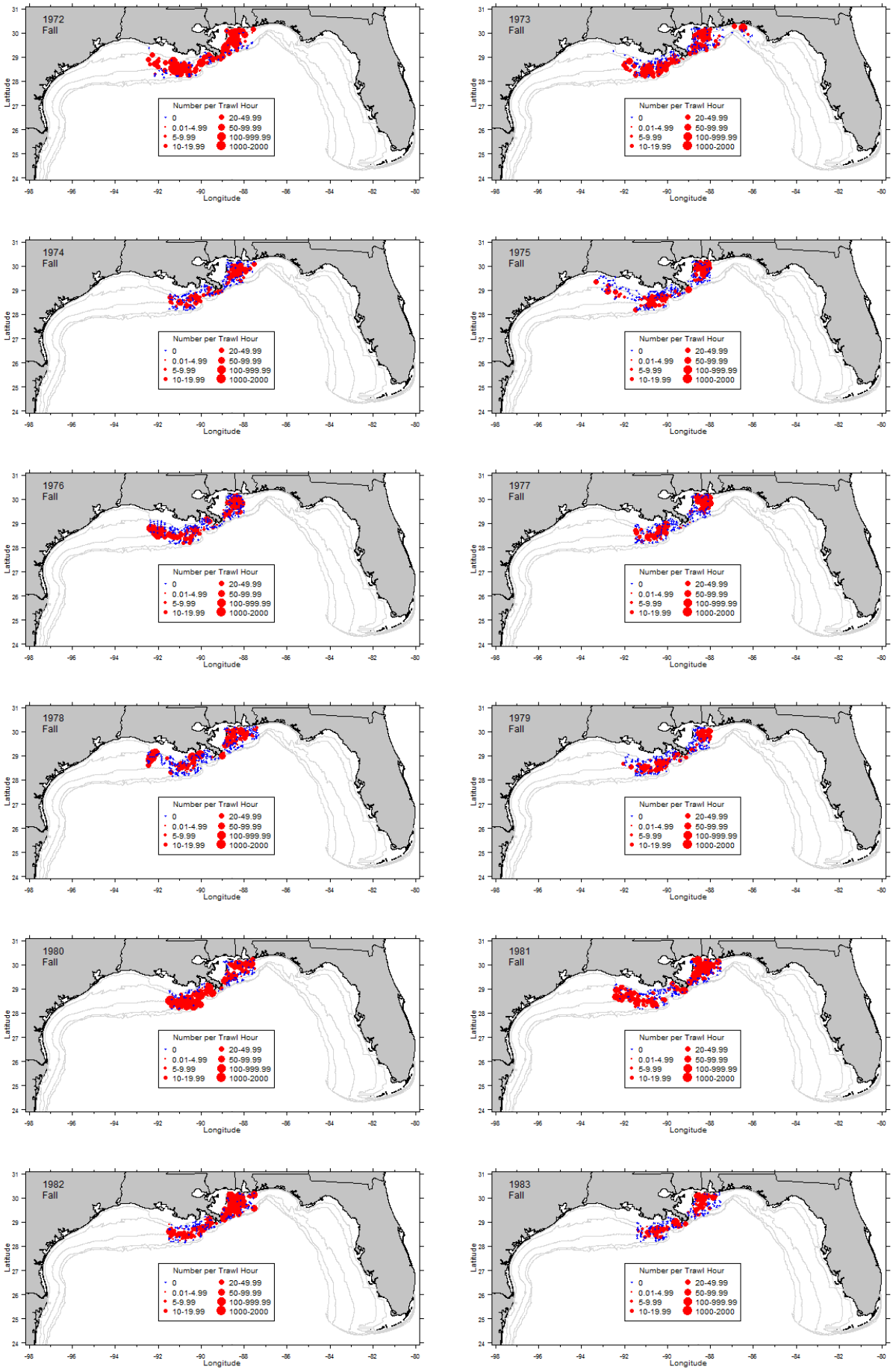
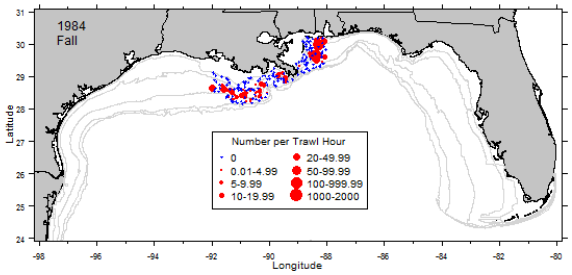
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2019
Summer
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude

Appendix Figure 2. Annual survey effort and catch of Red Snapper from the SEAMAP Fall Groundfish Surveys including stations from DISL trawl survey between 2010 and 2019.




1984
Fall
Number per Trawl Hour
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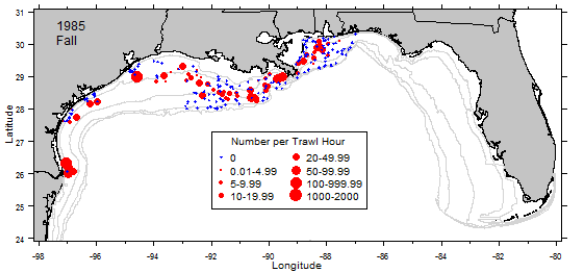
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1985
Fall
Number per Trawl Hour
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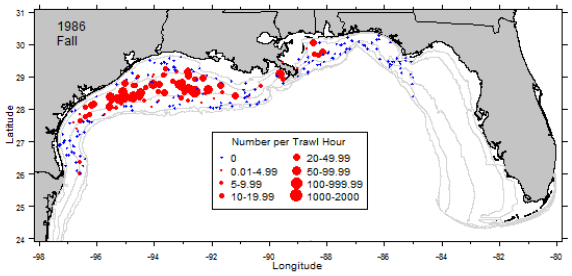
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1986
Fall
Number per Trawl Hour
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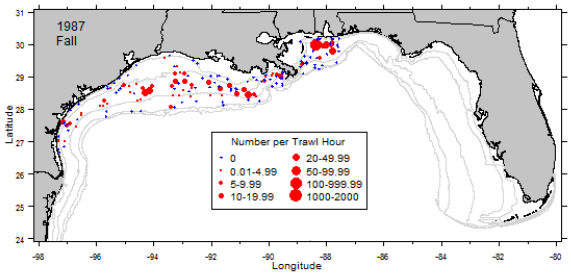
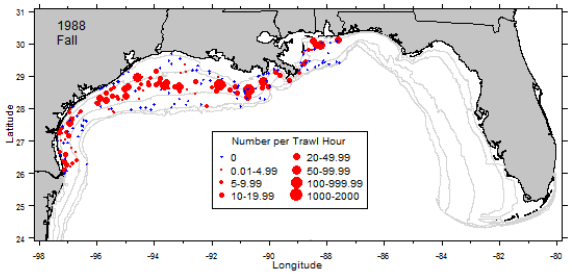
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1987
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1988
Fall
Number per Trawl Hour
0
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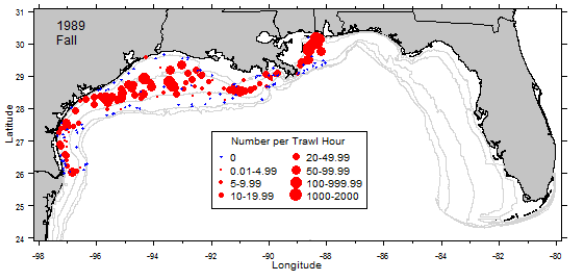
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1989
Fall
Number per Trawl Hour
0
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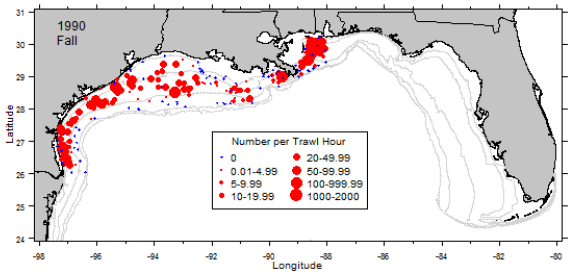
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1990
Fall
Number per Trawl Hour
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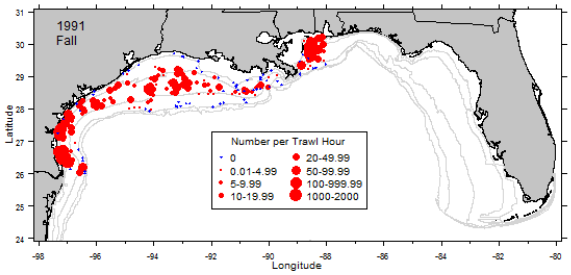
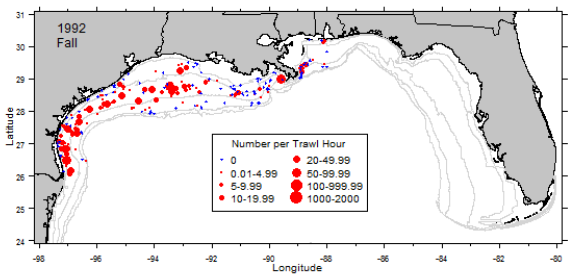
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1991
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1992
Fall
Number per Trawl Hour
0
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5-9.99
10-19.99
20-49.99
50-99.99
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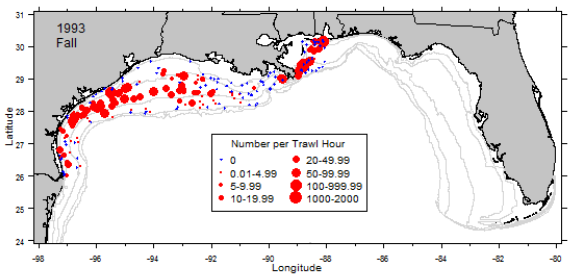
1000-2000
Latitude
Longitude


1993
Fall
Number per Trawl Hour
0
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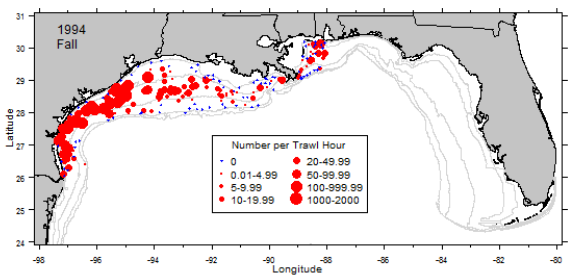
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1994
Fall
Number per Trawl Hour
0
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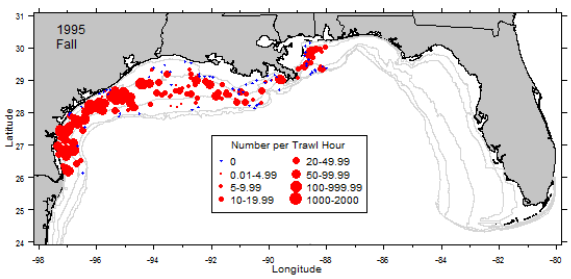
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1995
Fall
Number per Trawl Hour
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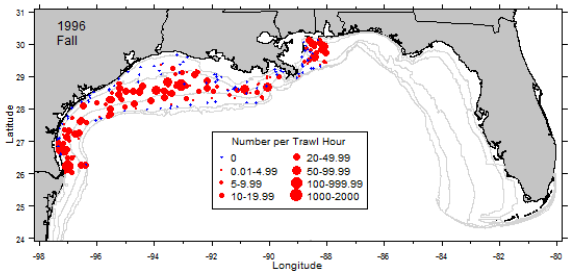
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1996
Fall
Number per Trawl Hour
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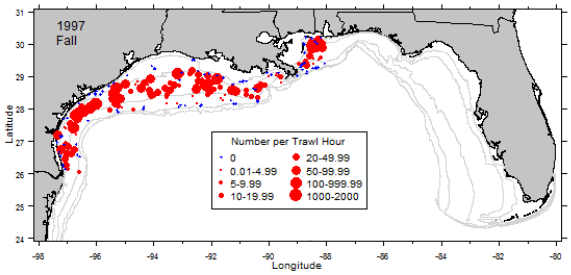
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1997
Fall
Number per Trawl Hour
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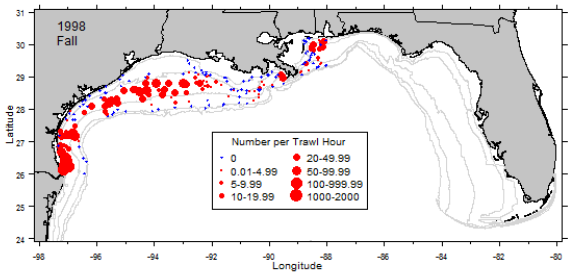
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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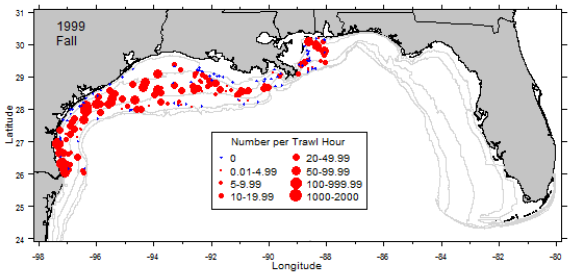
1000-2000
Latitude
Longitude


1999
Fall
Number per Trawl Hour
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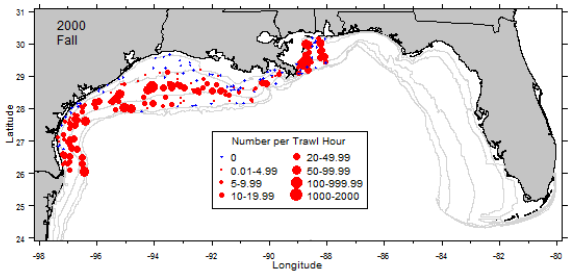
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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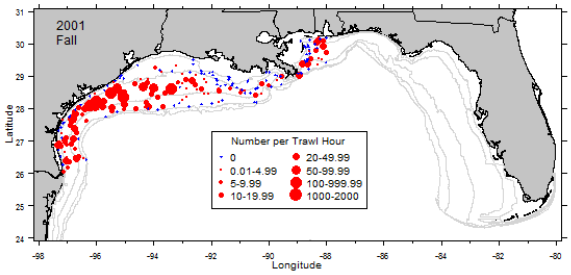
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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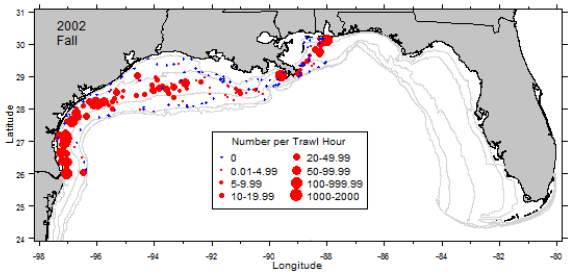
100-999.99
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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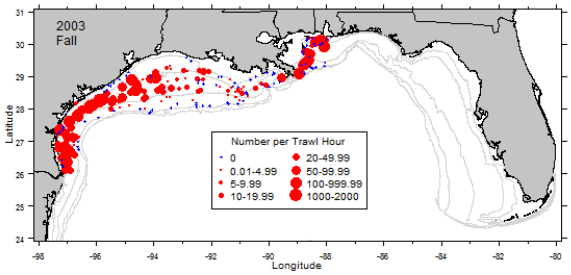
Latitude
Longitude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Fall
Number per Trawl Hour
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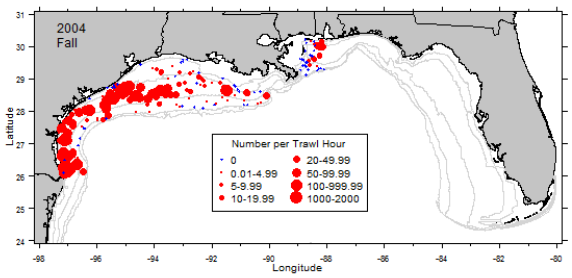
1000-2000
Latitude
Longitude


2004
Fall
Number per Trawl Hour
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10-19.99
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50-99.99
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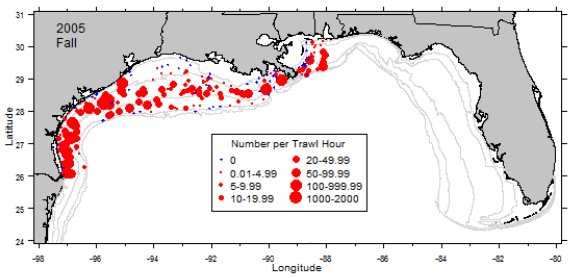
1000-2000
Latitude
Longitude


2005
Fall
Number per Trawl Hour
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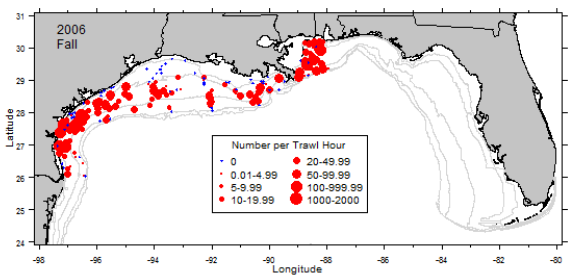
1000-2000
Latitude
Longitude


2006
Fall
Number per Trawl Hour
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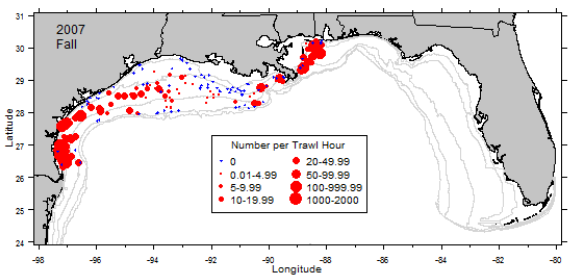
Longitude


2007
Fall
Number per Trawl Hour
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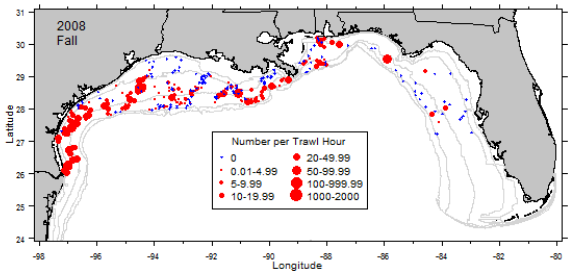
Latitude
Longitude


2008
Fall
Number per Trawl Hour
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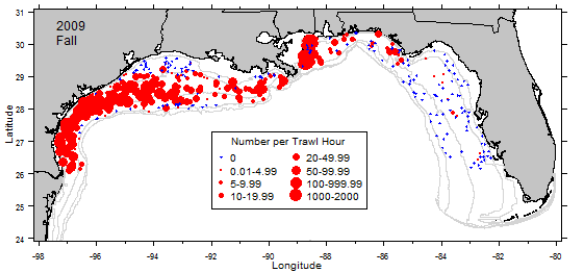
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2009
Fall
Number per Trawl Hour
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5-9.99
10-19.99
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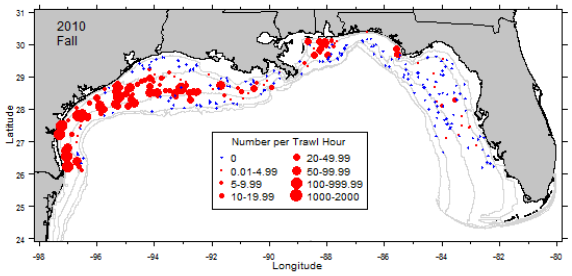
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2010
Fall
Number per Trawl Hour
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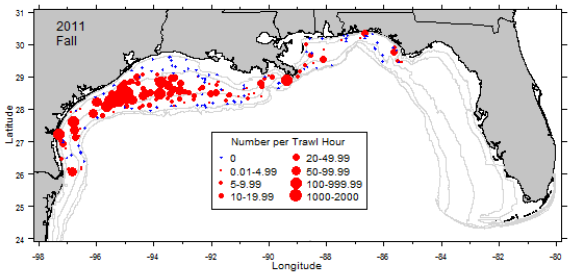
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2011
Fall
Number per Trawl Hour
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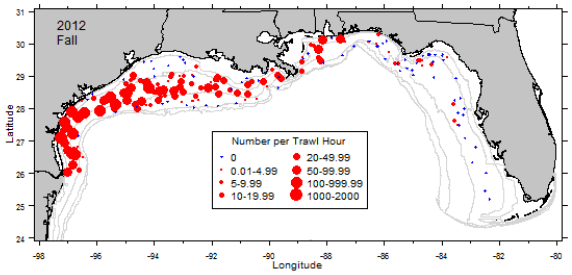
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2012
Fall
Number per Trawl Hour
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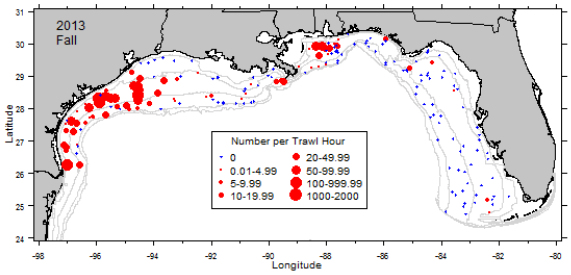
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2013
Fall
Number per Trawl Hour
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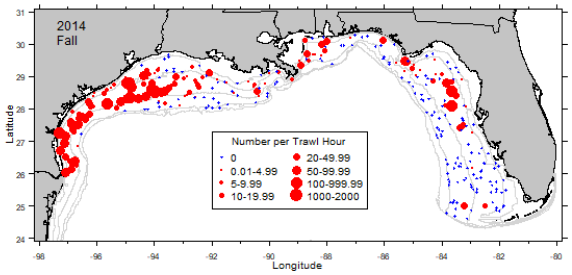
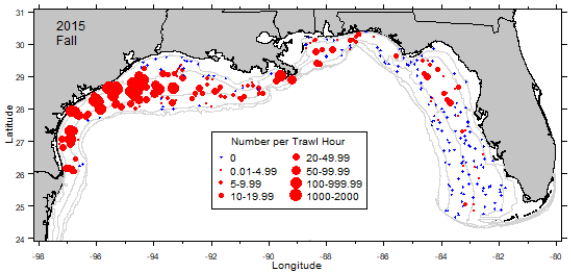
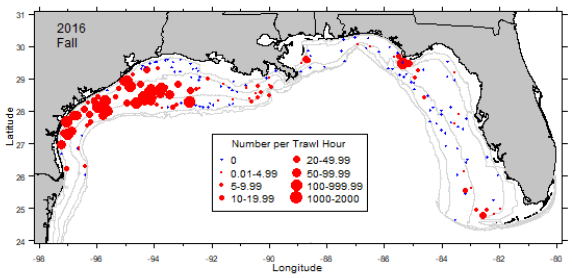
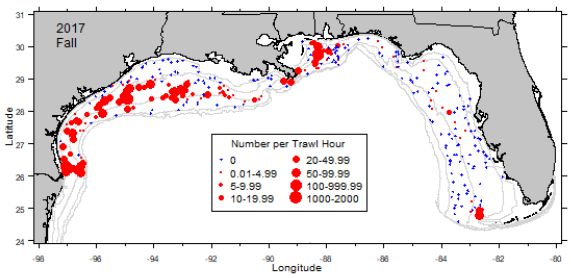
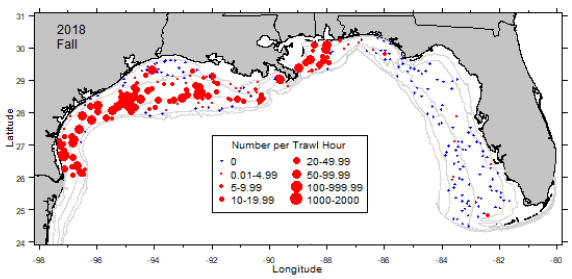
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude

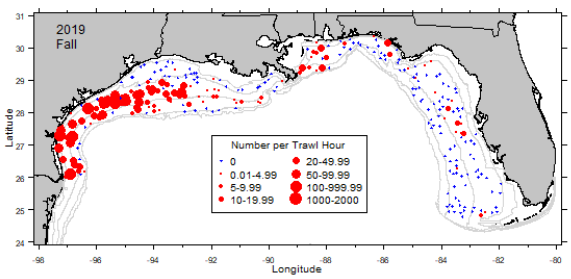

2014
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2015
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2016
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2017
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2018
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


2019
Fall
Number per Trawl Hour
0
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude