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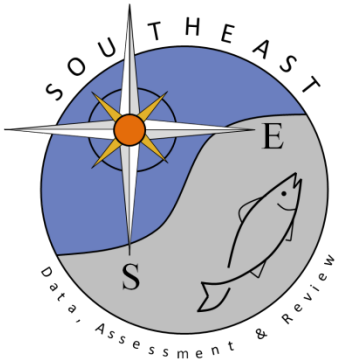

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Abstract

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 National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories (MSLABS) 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 19,720 stations were sampled from 1972- 2016 with 8,604 and 11,116 stations sampled during the summer and fall surveys, respectively (Tables 1 and 2). Trawl data from MSLABS was obtained from the MSLABS trawl unit leader (Gilmore Pellegrin) 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 and Dr. Marcus Drymon. Finally for this assessment, the GOM was broken down into two areas, western GOM (wGOM) and eastern GOM (eGOM) at 89.15°W.

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, July, October and November. 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. For the purpose of this analysis, these stations were excluded from analysis.

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 (Pennington, 1983; Bradu and Mundlak, 1970). 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

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

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 – 2016
Depth: 9 – 110 m (continuous variable)
SSZ: 13 – 21
Time of Day: Day and Night

Abundance Index – Eastern Gulf of Mexico –Fall Groundfish

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

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

No model produced

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 – 2016
Depth: 9 – 110 m (continuous variable)
SSZ: 13 – 21
Time of Day: Day and Night

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

Year: 2009 – 2016
Depth: 9 – 110 m (continuous variable)
Area: MS/AL (SSZ 10-13), NWFL (SSZ 8-9), NFL (SSZ 5-7), SFL (SSZ 1-4)
Time of Day: Day and Night

Results and Discussion

Distribution, Size and Age

The distribution of Red Snapper is presented in Figure 1, with seasonal/annual abundance and distribution presented in the Appendix Figures 1 and 2. Tables 3, 4, 5 and 6 summarize the length information collected for Red Snapper. The length frequency distribution of Red Snapper used in the relative abundance index is shown in Figure 2a and 2b for the fall and summer surveys, respectively. Ages were successfully determined for 1142 otoliths, with ages ranging

from 0 to 13 years. Analysis of age data collected from Red Snapper indicated that 55% were one year old (Figure 3).

Continuity Runs

As part of the SEDAR process, we were asked to provide updated indices with the new terminal year to be used in sensitivity runs of the assessment model. The continuity runs that follow the methods outlined in Pollack et al (2012) and Pollack et al (2013) are presented in Tables 7, 8, 9 and 10 and in Figure 3. It is important to note that in the eGOM summer and fall indices, only data from SSZ 10 and 11 are included in the model, due to the lack of sampling in SSZ 1 – 9 prior to 2008, as was approved during SEDAR31.

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 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 7965.3 and 2387.8, respectively. Diagnostic plots for the lognormal submodels are shown in Figure 5, and indicate the distribution of the residuals is normal. Annual abundance indices are presented in Table 12 and Figure 6.

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 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 17,866.0 and 7193.3, 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 14 and Figure 8.

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

For the SEAMAP Fall Groundfish Survey (wGOM, 2008-2016) 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 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 7030.7 and 3266.6, 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 16 and Figure 10.

Abundance Index – Eastern 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 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 6427.5 and 2139.4, 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 18 and Figure 12.

Abundance Index – Eastern 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 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 4504.2 and 1652.2, 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 20 and Figure 14.

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

Due to the inconsistency of survey coverage in the eGOM, from 2008 through 2016, no abundance index was modeled.

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 6. 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 18,630.2 and 4528.9, 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 22 and Figure 16.

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 7. 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 6552.5 and

1971.0, 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 24 and Figure 18.

Abundance Index – Eastern 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 8. 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 5759.0 and 877.1, 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 26 and Figure 20.

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

For the SEAMAP Summer Groundfish Survey (eGOM, 2009-2016) abundance index of Red Snapper, year and zone were retained in the binomial submodel, while year, zone and time of day were retained in the lognormal submodel. A summary of the factors used in the analysis is presented in Appendix Table 9. Table 27 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 8131.1 and 699.8, 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 28 and Figure 22.

Final Recommendation

Based on discussions during the Data/Assessment Workshop, the recommendation is to use the continuity runs (wGOM – Summer, wGOM – Fall, eGOM – Summer, eGOM – Fall) in the assessment model. A research recommendation would be to continue to explore how to incorporate the full data from the eGOM (2008 – 2016) into the models.

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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				35	18	29	14	16	18	23	67	25	20	36	39	46	53	33	29	23	524
2010			31	26	20	24	10	12	14	14	21	5	19	16	21	33	34	27	27	19	373
2011		11	24	22	20	28	2	14	11	18	18	7	14	17	23	29	29	18	21	13	339
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	8	23	16	5	12	14	22	21	22	16	17	12	313
2014		15	31	23	24	30	17	14	9	21	27	6	15	18	22	28	23	18	18	14	373
2015	1	9	32	29	22	28	26	18	10	24	27	7	15	18	21	28	27	19	20	13	394
2016		9	25	29	25	22	15	15	10	23	17	6	16	16	22	30	23	19	17	14	353

	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
Total	***1***	***65***	***209***	***226***	***189***	***221***	***117***	***132***	***123***	***297***	***1265***	***279***	***520***	***583***	***712***	***751***	***644***	***771***	***818***	***681***	***8604***

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

	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
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
2008					11	10	3	4	2	3	34	16	28	34	42	46	44	19	36	20	352
2009				20	21	25	10	21	13	12	46	12	23	23	30	49	47	31	36	22	441
2010				9	25	27	17	16	11	25	16	7	15	18	26	30	29	18	19	14	322
2011								9	11	6	15	6	15	16	27	31	28	21	18	15	218
2012			2	3	6	6	17	10	7	5	12	5	11	13	19	23	22	13	15	11	200
2013		4	14	9	9	11	10	10	6	19	12	5	11	9	3	12	16	12	14	9	195
2014	1	7	30	24	22	23	13	12	7	7	16	5	13	14	22	27	22	15	17	12	309
2015	1	10	28	25	25	21	13	11	10	11	16	6	13	13	19	27	21	16	17	12	315
2016	1	5	4	8	11	9	6	13	5	4	8	4	12	10	18	22	17	13	13	8	191
Total	***3***	***26***	***78***	***98***	***130***	***132***	***89***	***126***	***93***	***328***	***2366***	***716***	***1450***	***1128***	***874***	***767***	***629***	***697***	***777***	***609***	***11,116***

Table 3. Summary of the Red Snapper length data collected during SEAMAP Summer Groundfish Surveys conducted in the western Gulf of Mexico between 1982 and 2016.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1982	136	608					
1983	133	133					
1984	161	240					
1985	77	212					
1986	79	53					
1987	178	365	199	100	304	170	48
1988	145	158	137	87	252	163	31
1989	141	119	88	40	259	150	38
1990	172	1202	686	79	760	161	38
1991	185	430	365	22	357	179	52
1992	180	334	250	31	774	159	60
1993	178	519	352	32	271	148	34
1994	177	756	507	39	378	151	36
1995	176	692	535	14	739	156	66
1996	174	1312	599	30	860	153	66
1997	163	736	470	29	636	163	45
1998	169	398	376	51	785	156	59
1999	179	361	338	25	776	168	89
2000	171	657	584	18	691	142	71
2001	116	163	161	31	301	143	61
2002	183	612	468	4	675	168	67
2003	137	270	244	13	830	162	73
2004	177	1211	531	88	752	157	44
2005	148	722	557	18	796	165	63
2006	176	578	556	20	324	151	56
2007	155	610	610	32	432	172	44
2008	206	580	578	23	648	160	68
2009	304	402	392	19	650	141	66
2010	200	582	546	102	811	187	79
2011	171	888	805	46	719	162	63

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2012	176	548	493	24	770	191	97
2013	141	573	573	22	698	162	77
2014	160	401	401	73	760	181	94
2015	167	685	675	24	760	180	100
2016	163	507	507	31	760	197	92

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
35	5754	18,617	13,583	164

Table 4. Summary of the Red Snapper length data collected during SEAMAP Summer Groundfish Surveys conducted in the eastern Gulf of Mexico between 1982 and 2016.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1982	36	45					
1983	45	16					
1984	29	2					
1985	36	22					
1986	35	3					
1987	88	98	23	111	213	172	26
1988	63	53	44	117	365	217	75
1989	51	121	96	31	423	140	68
1990	65	106	85	42	212	147	33
1991	44	98	98	81	328	167	52
1992	45	131	77	103	231	148	29
1993	44	23	20	84	279	141	53
1994	60	148	48	85	316	170	55
1995	42	41	40	91	300	213	51
1996	46	85	59	89	377	159	55
1997	42	32	32	92	280	158	31
1998	34	10	10	106	210	141	39
1999	43	14	14	28	274	202	68
2000	43	85	82	38	778	157	77
2001	34	11	11	128	339	210	63
2002	44	29	29	87	371	217	88
2003	42	42	42	39	296	158	53
2004	38	37	37	30	346	163	58
2005	32	64	58	70	345	170	54
2006	45	20	20	93	310	168	61
2007	40	167	167	61	651	155	56
2008	98	374	374	84	481	199	70
2009	220	104	98	18	710	219	100
2010	173	156	136	35	609	217	133
2011	168	84	84	88	706	210	114

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2012	223	115	115	65	726	223	130
2013	172	122	122	38	650	193	116
2014	213	145	137	76	881	222	137
2015	227	277	277	78	673	196	89
2016	190	294	294	68	805	250	88

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
35	2850	3174	2729	194

Table 5. Summary of the Red Snapper length data collected during Fall Groundfish and SEAMAP Fall Groundfish Surveys conducted in the western Gulf of Mexico between 1972 and 2016.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1972	119	1389					
1973	146	796					
1974	139	331					
1975	187	637					
1976	199	653					
1977	145	487					
1978	182	2402					
1979	164	684					
1980	124	1255					
1981	173	556					
1982	150	469					
1983	123	277					
1984	144	130					
1985	215	486					
1986	190	544					
1987	128	229	150	50	606	146	83
1988	181	747	460	42	777	132	62
1989	180	1513	821	40	852	111	48
1990	175	1474	1044	25	670	125	56
1991	179	2068	1369	36	407	116	41
1992	179	755	607	50	374	138	58
1993	177	1441	1027	20	680	134	63
1994	179	4603	1503	33	625	115	58
1995	177	3893	1713	32	630	114	50
1996	181	1680	1271	30	605	125	51
1997	178	2957	1433	40	549	116	45
1998	181	1533	969	30	806	109	44
1999	182	2382	1722	37	453	111	39
2000	179	1641	1258	31	742	124	48
2001	184	1997	1173	40	780	125	61
2002	181	1413	1089	38	767	102	47
2003	183	2779	1480	31	750	103	38
2004	162	4744	1886	32	740	121	44
2005	186	3515	2027	33	754	126	52

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2006	176	2078	1327	31	403	112	46
2007	173	2572	2572	31	365	101	38
2008	285	1063	1037	28	760	135	67
2009	273	4758	4653	26	692	112	35
2010	176	1555	1419	39	700	121	50
2011	177	1773	1722	30	805	121	62
2012	132	2526	2526	30	761	108	42
2013	91	861	860	39	790	117	66
2014	147	1793	1793	25	661	109	51
2015	144	3002	2996	25	699	121	57
2016	117	1710	1710	27	781	128	79

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
45	7643	76,151	45,617	117

Table 6. Summary of the Red Snapper length data collected during Fall Groundfish and SEAMAP Fall Groundfish Surveys conducted in the eastern Gulf of Mexico between 1972 and 2016.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1972	65	1880					
1973	126	601					
1974	104	660					
1975	93	478					
1976	108	536					
1977	97	629					
1978	137	512					
1979	109	311					
1980	109	486					
1981	106	1738					
1982	123	1963					
1983	99	280					
1984	82	257					
1985	89	56					
1986	70	30					
1987	42	97	14	135	271	238	33
1988	35	71	47	48	260	109	34
1989	43	605	255	41	305	102	34
1990	53	616	287	50	322	125	49
1991	45	714	412	60	341	126	40
1992	32	29	25	65	236	126	45
1993	70	450	255	38	328	106	58
1994	49	204	167	74	347	165	72
1995	39	187	173	57	168	117	22
1996	44	255	200	51	366	143	72
1997	44	265	183	58	333	117	53
1998	43	81	58	38	271	121	58
1999	42	150	144	52	305	123	44
2000	43	406	304	29	347	134	59
2001	43	98	89	25	308	127	60
2002	50	196	67	48	146	85	23
2003	75	460	386	32	295	105	39
2004	43	220	202	60	265	114	42
2005	43	227	212	69	332	148	54

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2006	46	819	500	54	393	127	44
2007	31	309	234	31	230	102	26
2008	67	167	167	62	572	204	111
2009	168	1044	682	32	400	135	50
2010	146	208	202	33	640	130	91
2011	41	79	79	77	630	201	128
2012	68	201	201	13	700	156	121
2013	104	154	152	36	306	114	45
2014	162	462	462	29	475	119	62
2015	171	214	214	59	433	190	76
2016	74	240	240	55	397	127	62

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
45	3473	19,645	52,230	130

Table 7. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for Fall Groundfish and SEAMAP Fall Groundfish Surveys (Continuity, wGOM, 1972-2016). 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	0.61345	119	49.4914	3.40575	0.15608	2.49721	4.64483
1973	0.52740	146	26.3237	1.81147	0.16065	1.31638	2.49275
1974	0.38129	139	8.3841	0.57695	0.20298	0.38602	0.86232
1975	0.33690	187	12.0414	0.82863	0.18973	0.56888	1.20698
1976	0.37186	199	11.4869	0.79047	0.17527	0.55821	1.11937
1977	0.42069	145	12.1533	0.83633	0.18228	0.58256	1.20064
1978	0.25275	182	9.3225	0.64153	0.22520	0.41117	1.00094
1979	0.39024	164	13.9730	0.96155	0.18397	0.66759	1.38496
1980	0.70161	124	52.8714	3.63834	0.14172	2.74421	4.82381
1981	0.50289	173	19.1532	1.31803	0.15463	0.96918	1.79244
1982	0.50000	150	12.7302	0.87603	0.16364	0.63288	1.21259
1983	0.36585	123	10.8469	0.74643	0.22267	0.48074	1.15894
1984	0.34028	144	4.2443	0.29207	0.21373	0.19139	0.44572
1985	0.33023	215	6.3012	0.43361	0.18818	0.29859	0.62970
1986	0.45789	190	5.8253	0.40087	0.17353	0.28405	0.56574
1987	0.45313	128	2.1412	0.14734	0.20654	0.09790	0.22175
1988	0.53039	181	4.8470	0.33355	0.15959	0.24289	0.45805
1989	0.56667	180	10.2118	0.70273	0.15098	0.52046	0.94882
1990	0.65714	175	11.3665	0.78218	0.13520	0.59759	1.02379
1991	0.68156	179	12.6965	0.87371	0.13008	0.67430	1.13209
1992	0.53073	179	3.6947	0.25425	0.15981	0.18506	0.34929
1993	0.57062	177	6.8323	0.47016	0.15118	0.34808	0.63507
1994	0.65363	179	19.7279	1.35757	0.13381	1.04005	1.77203
1995	0.73446	177	23.5624	1.62145	0.12053	1.27523	2.06167
1996	0.61878	181	9.9512	0.68479	0.14123	0.51700	0.90703
1997	0.64045	178	16.6476	1.14560	0.13681	0.87248	1.50422
1998	0.55249	181	7.8497	0.54018	0.15235	0.39899	0.73132
1999	0.68132	182	16.9297	1.16502	0.12793	0.90296	1.50314
2000	0.68156	179	10.5863	0.72849	0.13029	0.56200	0.94432
2001	0.58696	184	8.2043	0.56458	0.14521	0.42292	0.75369
2002	0.59669	181	7.7407	0.53267	0.14546	0.39882	0.71145
2003	0.65574	183	13.8912	0.95592	0.13277	0.73384	1.24520
2004	0.78395	162	22.2307	1.52980	0.11985	1.20477	1.94252

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2005	0.77957	186	16.7797	1.15470	0.10964	0.92793	1.43687
2006	0.66477	176	13.1407	0.90427	0.13527	0.69078	1.18376
2007	0.56647	173	9.5407	0.65654	0.15545	0.48200	0.89429
2008	0.62105	285	6.0593	0.41697	0.11548	0.33123	0.52490
2009	0.73260	273	26.4988	1.82352	0.10011	1.49339	2.22662
2010	0.59659	176	9.6922	0.66697	0.14962	0.49529	0.89815
2011	0.64972	177	11.7340	0.80747	0.14018	0.61089	1.06732
2012	0.78030	132	26.2132	1.80386	0.13567	1.37689	2.36324
2013	0.61538	91	11.8128	0.81290	0.20372	0.54310	1.21671
2014	0.70068	147	15.0056	1.03261	0.14229	0.77798	1.37059
2015	0.78472	144	26.3184	1.81110	0.13534	1.38332	2.37117
2016	0.63248	117	16.8718	1.16103	0.17235	0.82458	1.63476

Table 8. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for Fall Groundfish and SEAMAP Fall Groundfish Surveys (Continuity, eGOM, 1972-2016). 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	36.8563	3.02803	0.20923	2.00154	4.58095
1973	0.51304	115	7.8419	0.64427	0.19223	0.44016	0.94303
1974	0.40385	104	8.0699	0.66300	0.23504	0.41696	1.05422
1975	0.44086	93	8.1690	0.67115	0.23444	0.42258	1.06593
1976	0.45370	108	9.4642	0.77755	0.21392	0.50933	1.18703
1977	0.43299	97	10.5791	0.86915	0.23007	0.55187	1.36886
1978	0.45985	137	5.9389	0.48792	0.19137	0.33391	0.71299
1979	0.39450	109	4.9189	0.40412	0.22751	0.25786	0.63335
1980	0.49541	109	8.5036	0.69864	0.20333	0.46712	1.04491
1981	0.59434	106	25.1795	2.06869	0.18393	1.43636	2.97940
1982	0.71545	123	28.6372	2.35276	0.14673	1.75716	3.15026
1983	0.50505	99	5.2478	0.43115	0.21135	0.28382	0.65494
1984	0.34146	82	3.3965	0.27905	0.28540	0.15945	0.48836
1985	0.21348	89	2.2989	0.18887	0.34601	0.09640	0.37004
1986	0.12500	40	1.7376	0.14275	0.66083	0.04283	0.47581
1987	0.23810	42	3.0317	0.24908	0.47593	0.10089	0.61492
1988	0.37143	35	4.4144	0.36268	0.41467	0.16351	0.80446
1989	0.67442	43	37.3716	3.07036	0.24541	1.89296	4.98009
1990	0.71698	53	18.6588	1.53297	0.21623	0.99967	2.35075
1991	0.77778	45	29.9820	2.46325	0.21496	1.61028	3.76805
1992	0.43750	32	3.5994	0.29572	0.38701	0.14008	0.62428
1993	0.50000	70	11.6201	0.95468	0.25067	0.58269	1.56414
1994	0.53061	49	6.3221	0.51941	0.28229	0.29854	0.90368
1995	0.64103	39	12.8704	1.05741	0.27811	0.61258	1.82525
1996	0.55814	43	8.6346	0.70940	0.29263	0.39987	1.25853
1997	0.50000	44	13.1466	1.08009	0.30853	0.59095	1.97413
1998	0.46512	43	3.8690	0.31787	0.33064	0.16691	0.60537
1999	0.54762	42	9.2076	0.75647	0.30072	0.41997	1.36259
2000	0.67442	43	26.2640	2.15779	0.25138	1.31522	3.54013
2001	0.44186	43	4.2150	0.34629	0.33982	0.17878	0.67077
2002	0.46000	50	6.2864	0.51647	0.30685	0.28346	0.94103
2003	0.65333	75	13.4565	1.10555	0.20060	0.74312	1.64475
2004	0.41860	43	5.6121	0.46108	0.34877	0.23415	0.90796

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2005	0.69767	43	10.0543	0.82604	0.24523	0.50944	1.33939
2006	0.91304	46	37.3980	3.07253	0.18185	2.14203	4.40723
2007	0.77419	31	28.1708	2.31444	0.27004	1.36146	3.93449
2008	0.54054	37	7.2608	0.59653	0.30735	0.32710	1.08790
2009	0.82759	58	28.1269	2.31084	0.19187	1.57985	3.38004
2010	0.46341	41	4.2701	0.35082	0.34670	0.17884	0.68822
2011	0.45000	20	4.5809	0.37635	0.46456	0.15546	0.91109
2012	0.64706	17	15.7234	1.29180	0.40760	0.58975	2.82958
2013	0.51613	31	9.4013	0.77239	0.33594	0.40161	1.48548
2014	0.52174	23	6.5509	0.53821	0.41728	0.24151	1.19937
2015	0.55556	27	7.3002	0.59977	0.35935	0.29873	1.20416
2016	0.25000	12	3.4883	0.28659	0.80296	0.06991	1.17480

Table 9. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Surveys (Continuity, wGOM, 1982-2016). 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	0.34559	136	9.05026	2.41162	0.22141	1.55701	3.73530
1983	0.21805	133	2.45745	0.65484	0.28513	0.37436	1.14544
1984	0.18012	161	2.44843	0.65243	0.28268	0.37472	1.13596
1985	0.31169	77	3.37081	0.89822	0.30798	0.49193	1.64004
1986	0.15190	79	0.90737	0.24179	0.43342	0.10545	0.55439
1987	0.26404	178	2.21908	0.59132	0.22068	0.38231	0.91459
1988	0.26207	145	1.05449	0.28099	0.24750	0.17255	0.45759
1989	0.17730	141	0.90098	0.24008	0.30265	0.13281	0.43401
1990	0.46512	172	7.82600	2.08539	0.16346	1.50709	2.88558
1991	0.33514	185	3.06631	0.81708	0.19087	0.55971	1.19280
1992	0.31667	180	1.89884	0.50598	0.19966	0.34073	0.75139
1993	0.33146	178	2.16779	0.57765	0.19567	0.39201	0.85119
1994	0.37853	177	4.37045	1.16459	0.18116	0.81300	1.66824
1995	0.41477	176	3.64722	0.97187	0.17357	0.68860	1.37168
1996	0.41379	174	3.89918	1.03901	0.17425	0.73519	1.46839
1997	0.43558	163	3.03243	0.80805	0.17607	0.56973	1.14606
1998	0.34911	169	2.66058	0.70896	0.19453	0.48219	1.04238
1999	0.32961	179	2.04466	0.54484	0.19631	0.36929	0.80384
2000	0.49123	171	4.37014	1.16451	0.15988	0.84751	1.60006
2001	0.27586	116	2.39814	0.63903	0.26369	0.38047	1.07331
2002	0.39891	183	3.35599	0.89427	0.17319	0.63409	1.26121
2003	0.36496	137	1.71605	0.45727	0.21523	0.29878	0.69985
2004	0.44068	177	4.20249	1.11983	0.16646	0.80455	1.55868
2005	0.49324	148	4.73479	1.26168	0.17236	0.89606	1.77648
2006	0.51136	176	4.38703	1.16901	0.15191	0.86422	1.58129
2007	0.41935	155	3.38154	0.90107	0.18593	0.62321	1.30282
2008	0.41262	206	3.35372	0.89366	0.15916	0.65132	1.22617
2009	0.29605	304	1.95025	0.51968	0.16033	0.37788	0.71468
2010	0.44500	200	5.10953	1.36153	0.15898	0.99267	1.86746
2011	0.49708	171	6.76173	1.80179	0.15801	1.31614	2.46665
2012	0.52273	176	5.28886	1.40932	0.14964	1.04654	1.89785
2013	0.48227	141	7.32352	1.95149	0.17713	1.37311	2.77351
2014	0.44375	160	4.51905	1.20419	0.17366	0.85304	1.69988

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2015	0.49102	167	5.83873	1.55584	0.16487	1.12130	2.15879
2016	0.49693	163	5.63340	1.50113	0.16129	1.08949	2.06829

Table 10. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Surveys (Continuity, eGOM, 1982-2016). 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	3.0313	0.98808	0.53515	0.36217	2.69574
1983	0.28571	21	2.2572	0.73574	0.56930	0.25498	2.12296
1984	0.06897	29	0.2303	0.07506	0.97292	0.01467	0.38397
1985	0.27778	36	1.5931	0.51929	0.44930	0.22027	1.22424
1986	0.05714	35	0.1848	0.06025	0.97367	0.01177	0.30849
1987	0.22727	88	2.2354	0.72865	0.32002	0.39021	1.36064
1988	0.15873	63	1.5384	0.50145	0.45280	0.21141	1.18941
1989	0.27451	51	4.4477	1.44978	0.37645	0.70000	3.00266
1990	0.36923	65	3.2225	1.05040	0.28309	0.60282	1.83029
1991	0.36364	44	3.6035	1.17458	0.34429	0.60140	2.29402
1992	0.28889	45	7.4466	2.42727	0.38615	1.15158	5.11613
1993	0.20455	44	1.2268	0.39988	0.47069	0.16344	0.97834
1994	0.33333	60	2.7783	0.90561	0.31213	0.49216	1.66639
1995	0.19048	42	1.0932	0.35634	0.50070	0.13837	0.91766
1996	0.26087	46	2.0525	0.66903	0.40421	0.30729	1.45659
1997	0.35714	42	2.2420	0.73080	0.35572	0.36642	1.45753
1998	0.08824	34	0.7260	0.23666	0.80204	0.05781	0.96887
1999	0.11628	43	0.5293	0.17252	0.63195	0.05412	0.54995
2000	0.32558	43	2.1746	0.70884	0.36987	0.34636	1.45067
2001	0.14706	34	0.9252	0.30158	0.62990	0.09491	0.95832
2002	0.11364	44	0.8603	0.28043	0.63222	0.08793	0.89435
2003	0.21429	42	1.9630	0.63986	0.47091	0.26143	1.56606
2004	0.23684	38	2.0425	0.66578	0.46666	0.27402	1.61760
2005	0.28125	32	4.6128	1.50356	0.46074	0.62521	3.61592
2006	0.22222	45	1.2932	0.42154	0.44660	0.17965	0.98913
2007	0.57500	40	7.7184	2.51586	0.26942	1.48170	4.27182
2008	0.43396	53	12.3424	4.02310	0.28484	2.30121	7.03339
2009	0.27778	90	1.9562	0.63765	0.28460	0.36491	1.11425
2010	0.35000	40	4.1148	1.34126	0.36716	0.65862	2.73147
2011	0.28571	35	2.2928	0.74737	0.43436	0.32541	1.71647
2012	0.43902	41	6.4926	2.11630	0.31404	1.14602	3.90806
2013	0.29730	37	5.5116	1.79656	0.41089	0.81540	3.95834
2014	0.33333	60	3.5997	1.17334	0.30941	0.64090	2.14811

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2015	0.29851	67	5.8626	1.91096	0.30970	1.04323	3.50042
2016	0.30000	40	3.1741	1.03463	0.39054	0.48700	2.19806

Table 11. 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 12. 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 13. 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
DepthZone	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 14. 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 15. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 2008-2016) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 7043.4)*						*Lognormal Submodel Type 3 Tests (AIC 3266.3)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	8	1523	31.49	3.94	0.0001	0.0001	8	1027	15.67	<.0001
Depth	1	1523	0.02	0.02	0.8848	0.8848	1	1027	29.97	<.0001
Statistical Zone	8	1523	132.52	16.57	<.0001	<.0001	8	1027	33.18	<.0001
Time of Day	1	1523	0.01	0.01	0.9253	0.9253	1	1027	3.76	0.0527
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 7040.8)*						*Lognormal Submodel Type 3 Tests (AIC 3266.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	8	1524	31.52	3.94	0.0001	0.0001	8	1027	15.67	<.0001
Depth	1	1524	0.02	0.02	0.8857	0.8857	1	1027	29.97	<.0001
Statistical Zone	8	1524	132.69	16.59	<.0001	<.0001	8	1027	33.18	<.0001
Time of Day				Dropped				Dropped		
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 7030.7)*						*Lognormal Submodel Type 3 Tests (AIC 3266.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	8	1525	31.57	3.95	0.0001	0.0001	8	1028	15.53	<.0001
Depth				Dropped			1	1028	29.51	<.0001
Statistical Zone	8	1525	133.06	16.63	<.0001	<.0001	8	1028	32.91	<.0001
Time of Day				Dropped				Dropped		

Table 16. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (wGOM, 2008-2016). 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	0.62105	285	9.7401	0.42228	0.10122	0.34507	0.51676
2009	0.73260	273	32.2992	1.40032	0.09280	1.16358	1.68522
2010	0.59659	176	15.3080	0.66367	0.13055	0.51173	0.86073
2011	0.64972	177	18.0412	0.78217	0.12268	0.61255	0.99876
2012	0.78030	132	34.7949	1.50852	0.12280	1.18110	1.92670
2013	0.61538	91	14.6593	0.63555	0.18120	0.44364	0.91047
2014	0.70068	147	20.1709	0.87450	0.12701	0.67902	1.12626
2015	0.78472	144	37.9915	1.64710	0.11739	1.30348	2.08130
2016	0.63248	117	24.5857	1.06590	0.15163	0.78842	1.44104

Table 17. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper Fall Groundfish Survey (eGOM, 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 18. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for Fall Groundfish Survey (eGOM, 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 19. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Fall Groundfish Survey (eGOM, 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 20. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey (eGOM, 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 21. 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 22. 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 23. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 2009-2016) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 6555.6)*						*Lognormal Submodel Type 3 Tests (AIC 1974.1)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	7	1464	34.90	4.99	<.0001	<.0001	7	640	4.08	0.0002
Depth	1	1464	14.34	14.34	0.0002	0.0002	1	640	10.33	0.0014
Statistical Zone	8	1464	147.91	18.49	<.0001	<.0001	8	640	3.16	0.0016
Time of Day	1	1464	0.28	0.28	0.5979	0.5980	1	640	0.02	0.9017
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 6552.5)*						*Lognormal Submodel Type 3 Tests (AIC 1971.0)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	7	1465	34.79	4.97	<.0001	<.0001	7	641	4.08	0.0002
Depth	1	1465	14.26	14.26	0.0002	0.0002	1	641	10.39	0.0013
Statistical Zone	8	1465	147.92	18.49	<.0001	<.0001	8	641	3.17	0.0016
Time of Day	Dropped						Dropped			

Table 24. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (wGOM, 2009-2016). 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	0.29605	304	2.35236	0.41220	0.15316	0.30398	0.55895
2010	0.44500	200	5.25038	0.92002	0.15118	0.68112	1.24271
2011	0.49708	171	7.51251	1.31641	0.14797	0.98075	1.76695
2012	0.52273	176	5.22049	0.91478	0.14127	0.69058	1.21177
2013	0.48227	141	8.12094	1.42303	0.16609	1.02313	1.97923
2014	0.44375	160	4.71323	0.82589	0.16357	0.59675	1.14304
2015	0.49102	167	6.85875	1.20185	0.15117	0.88980	1.62335
2016	0.49693	163	5.62586	0.98581	0.15109	0.72997	1.33133

Table 25. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 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 26. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (eGOM, 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 27. Summary of backward selection procedure for building delta-lognormal submodels for Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 2009-2016) index of relative abundance.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 8158.0)*						*Lognormal Submodel Type 3 Tests (AIC 707.7)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	7	1573	15.88	2.27	0.0262	0.0267	7	224	1.77	0.0938
Depth	1	1573	0.13	0.13	0.7164	0.7165	1	224	0.02	0.8909
Zone	3	1573	100.18	33.39	<.0001	<.0001	3	224	5.94	0.0007
Time of Day	1	1573	1.49	1.49	0.2223	0.2225	1	224	4.72	0.0308
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 8151.3)*						*Lognormal Submodel Type 3 Tests (AIC 699.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	7	1574	15.81	2.26	0.0269	0.0274	7	225	1.80	0.0879
Depth				Dropped				Dropped		
Zone	3	1574	109.90	36.63	<.0001	<.0001	3	225	6.28	0.0004
Time of Day	1	1574	1.47	1.47	0.2260	0.2262	1	225	4.76	0.0302
Model Run #3	*Binomial Submodel Type 3 Tests (AIC 8131.1)*						*Lognormal Submodel Type 3 Tests (AIC 699.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	7	1575	15.65	2.24	0.0285	0.0290	7	225	1.80	0.0879
Depth				Dropped				Dropped		
Zone	3	1575	110.27	36.76	<.0001	<.0001	3	225	6.28	0.0004
Time of Day				Dropped			1	225	4.76	0.0302

Table 28. Index of Red Snapper abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey (eGOM, 2009-2016). 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	0.15909	220	0.65883	0.52103	0.25601	0.31479	0.86240
2010	0.13295	173	1.20492	0.95291	0.30123	0.52852	1.71806
2011	0.13095	168	1.08553	0.85849	0.30653	0.47145	1.56324
2012	0.13453	223	1.19691	0.94657	0.25894	0.56870	1.57553
2013	0.11047	172	1.25417	0.99186	0.32993	0.52149	1.88647
2014	0.14554	213	1.00830	0.79741	0.26189	0.47640	1.33474
2015	0.14978	227	1.85607	1.46787	0.25117	0.89506	2.40725
2016	0.22632	190	1.85101	1.46386	0.21874	0.94999	2.25571

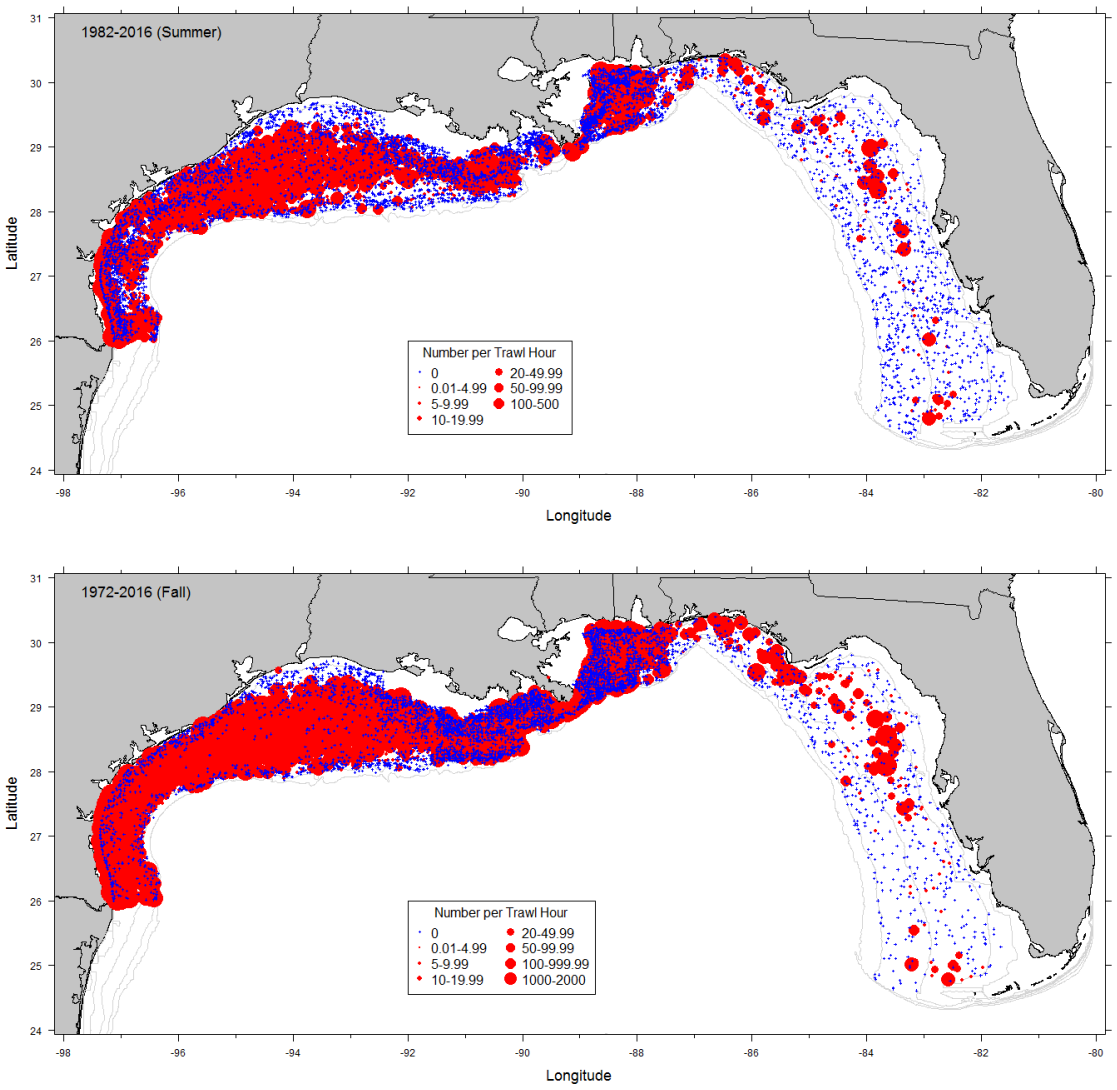

Figure 1. Stations sampled from 1982 to 2016 during the Summer (top) and from 1972 to 2016 during the Fall (bottom) Groundfish and SEAMAP Groundfish Surveys with the CPUE for Red Snapper, with data from 128 stations included from DISL trawl survey.

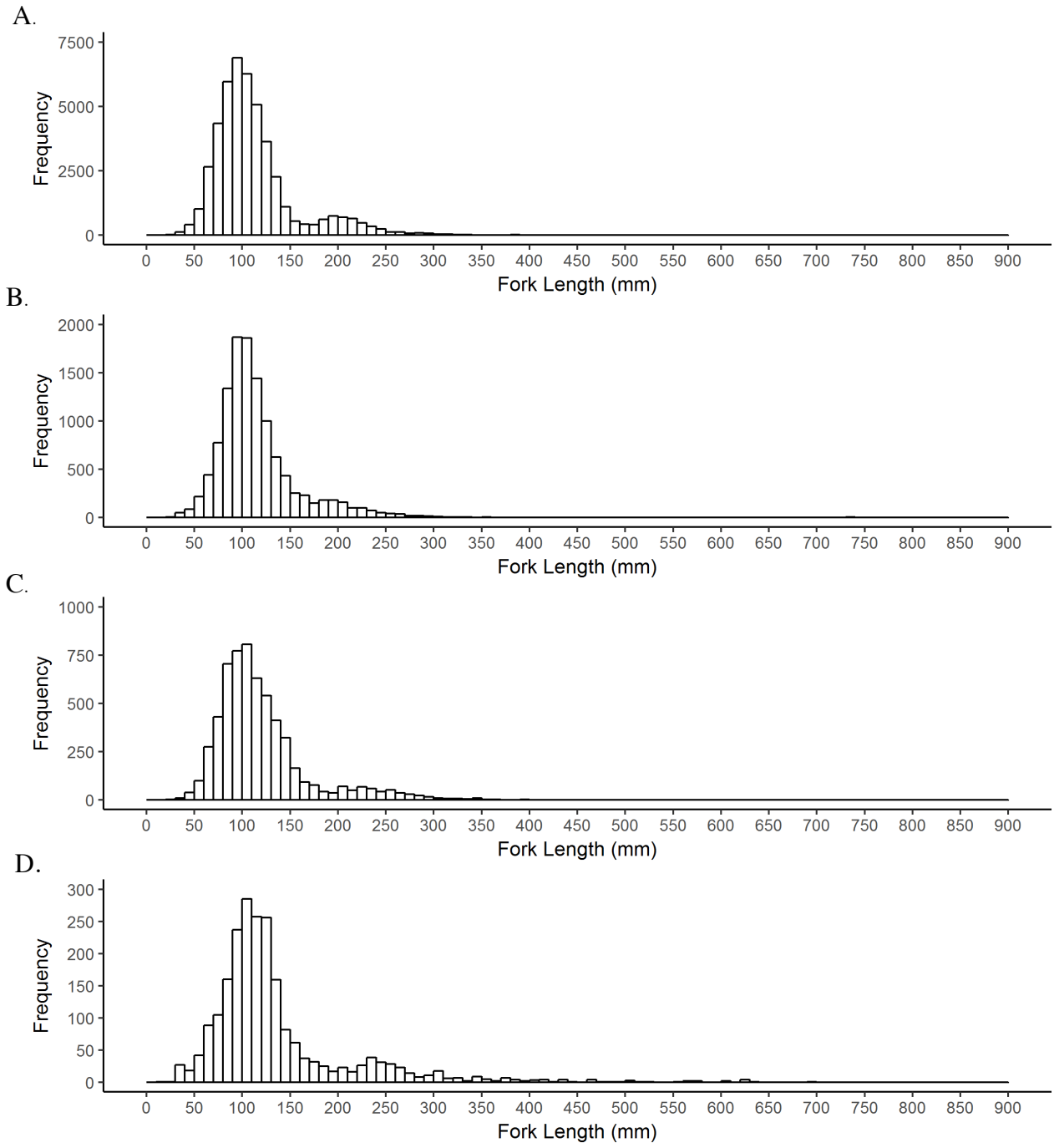

Figure 2a. Length frequency histogram for Red Snapper captured during SEAMAP Fall Groundfish Survey **A.** wGOM (1987- 2007), **B.** wGOM (2008-2016), **C.** eGOM (1987-2007) and **D.** eGOM (2008-2016). Note that no lengths was available prior to 1987.

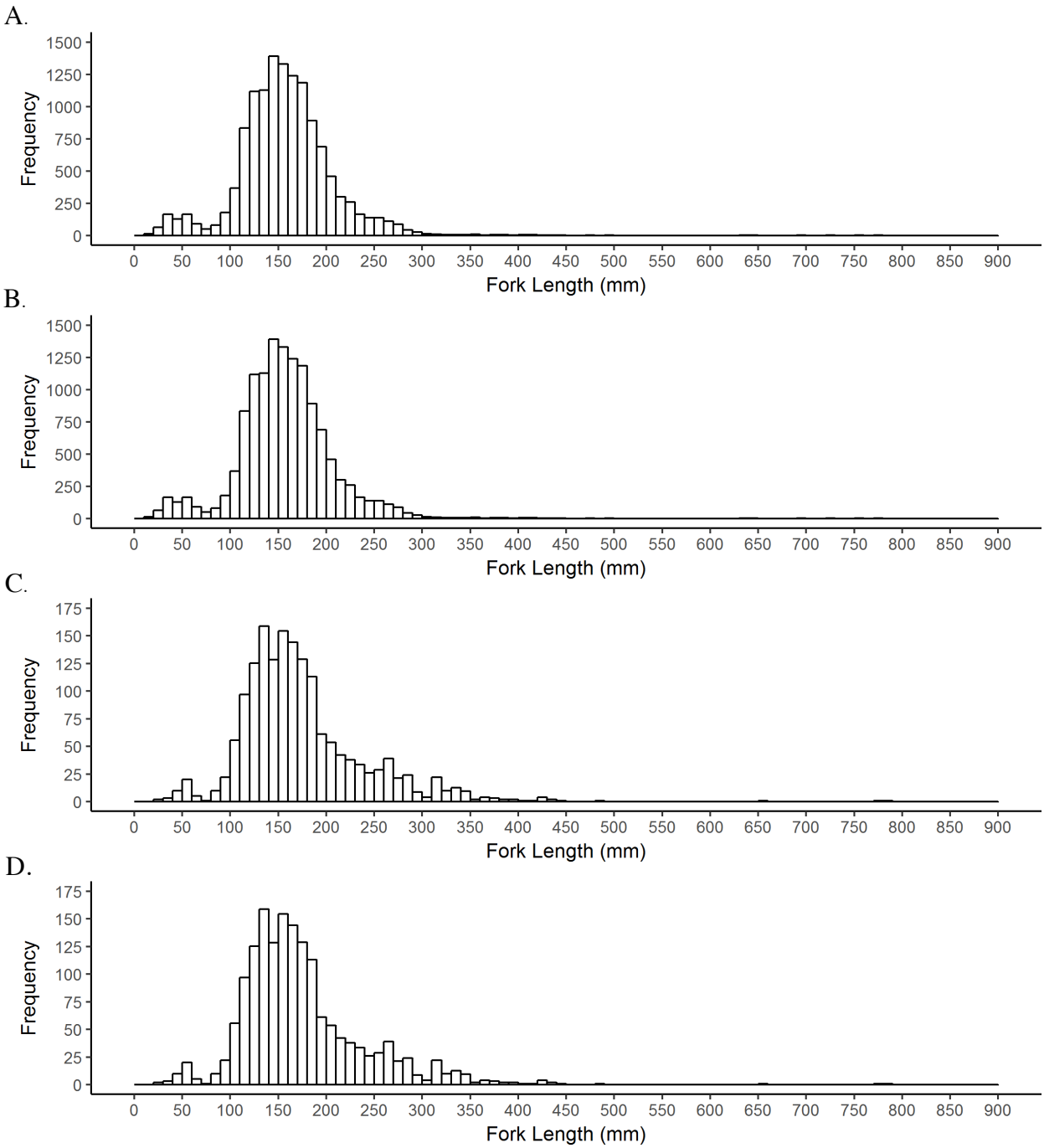

Figure 2b. Length frequency histogram for Red Snapper captured during SEAMAP Summer Groundfish Survey **A.** wGOM (1987- 2008), **B.** wGOM (2009-2016), **C.** eGOM (1987-2008) and **D.** eGOM (2009-2016). Note that no lengths was available prior to 1987.

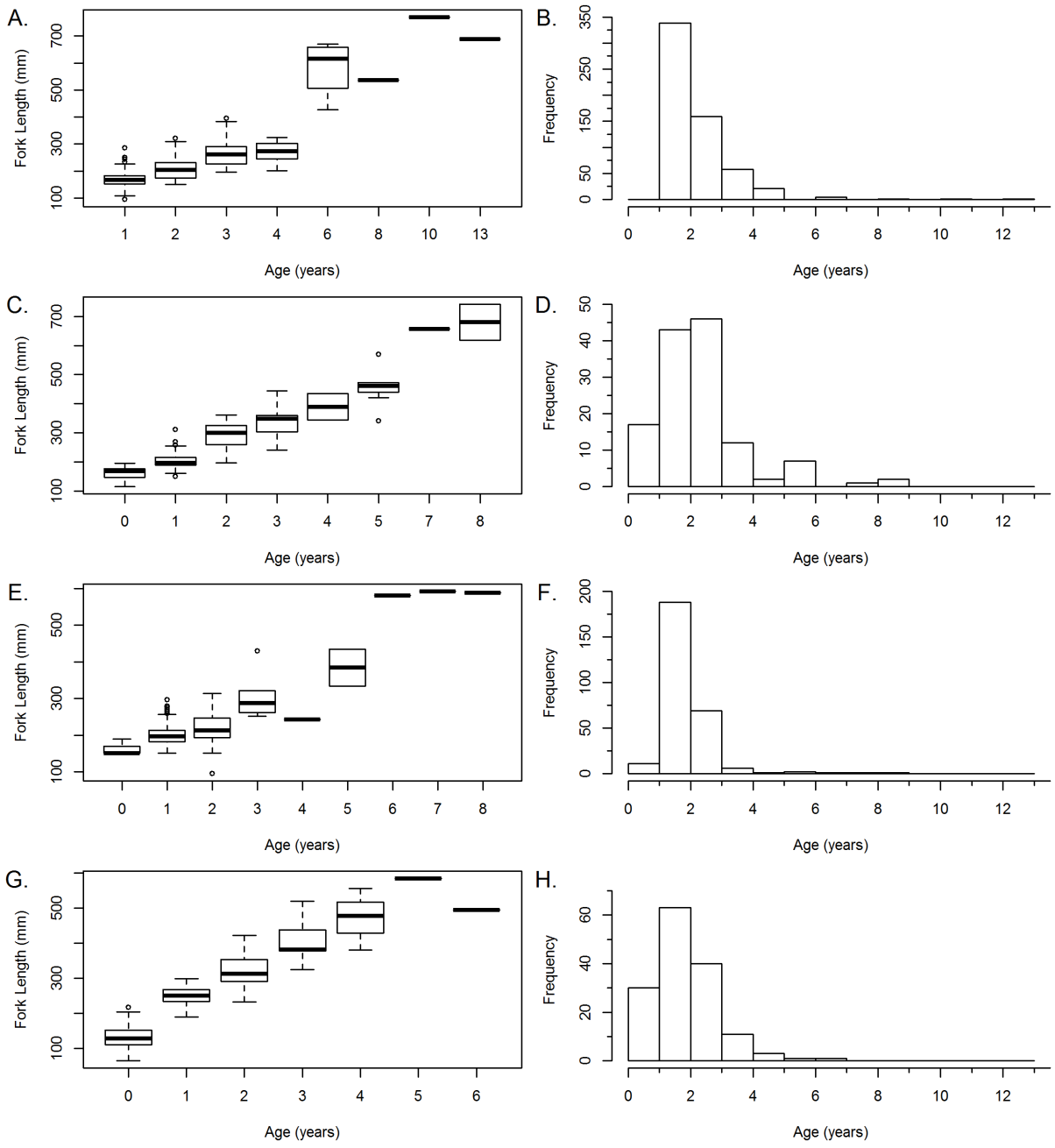

Figure 3. Breakdown of Red Snapper ages for fish caught in the: SEAMAP Summer Groundfish Survey (wGOM, 2008 – 2016) (**A.** and **B.**), SEAMAP Summer Groundfish Survey (eGOM, 2008 – 2016) (**C.** and **D.**), SEAMAP Fall Groundfish Survey (wGOM, 2008 – 2016) (**E.** and **F.**) and SEAMAP Fall Groundfish Survey (eGOM, 2008 – 2016) (**G.** and **H.**). Note that no ages were available prior to 2008.

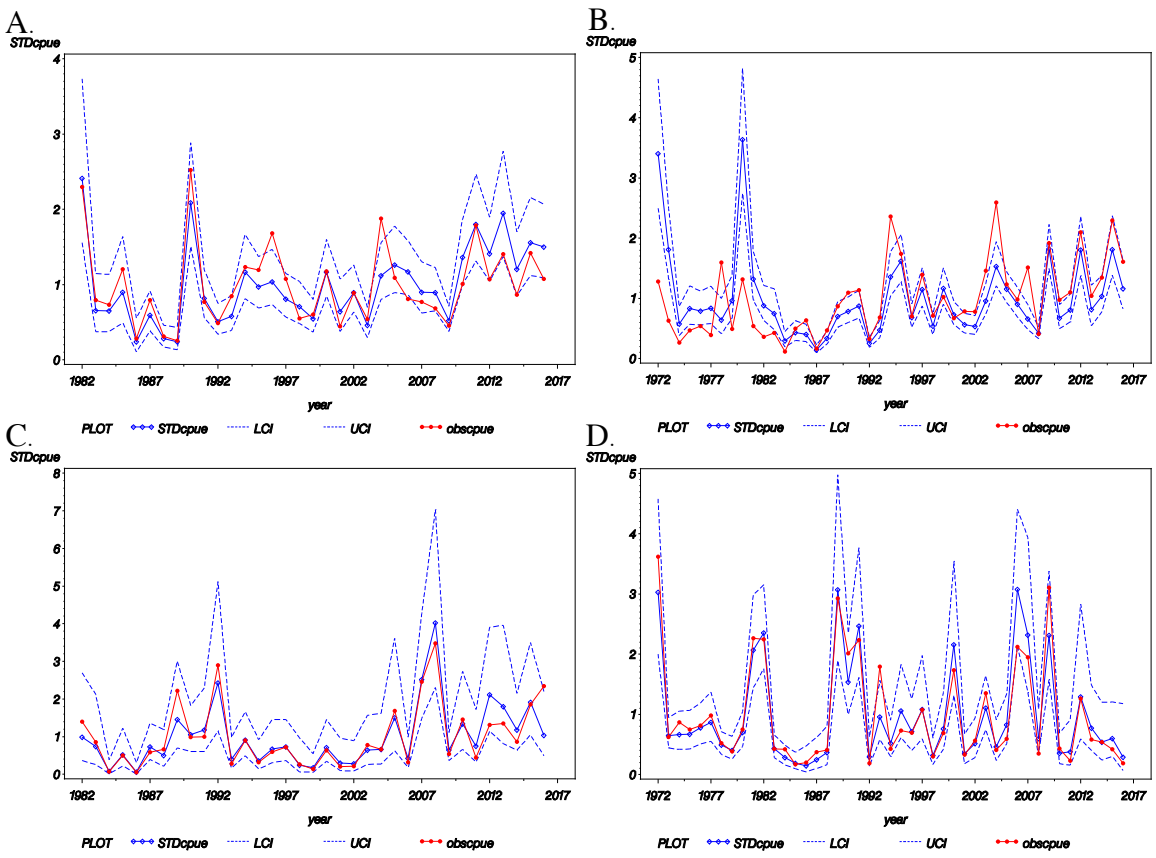

Figure 4. Continuity runs for Red Snapper abundance indices from: **A.** SEAMAP Summer Groundfish Survey (wGOM), **B.** SEAMAP Fall Groundfish Survey (wGOM), **C.** SEAMAP Summer Groundfish Survey (eGOM), and **D.** SEAMAP Fall Groundfish Survey (eGOM).

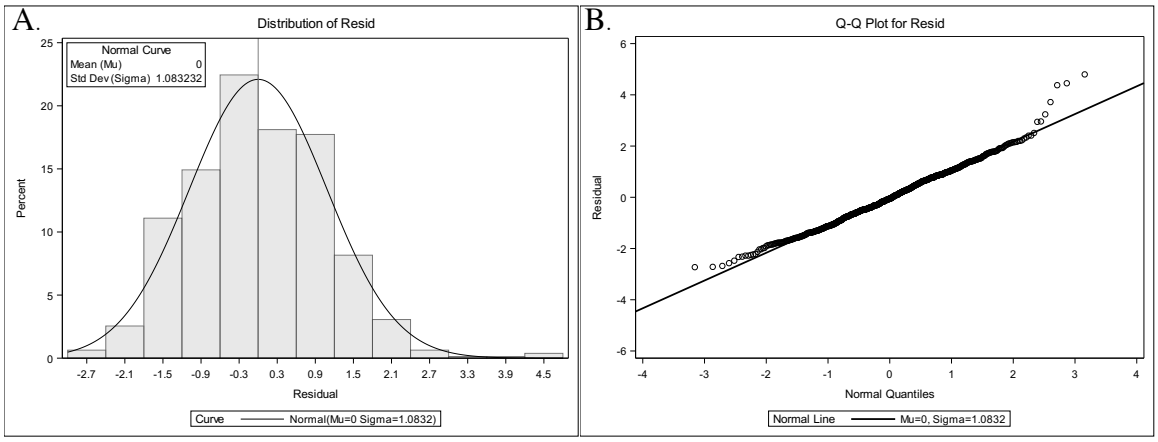

Figure 5. Diagnostic plots for lognormal component of the Red Snapper Fall Groundfish Survey (wGOM, 1972-1986) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

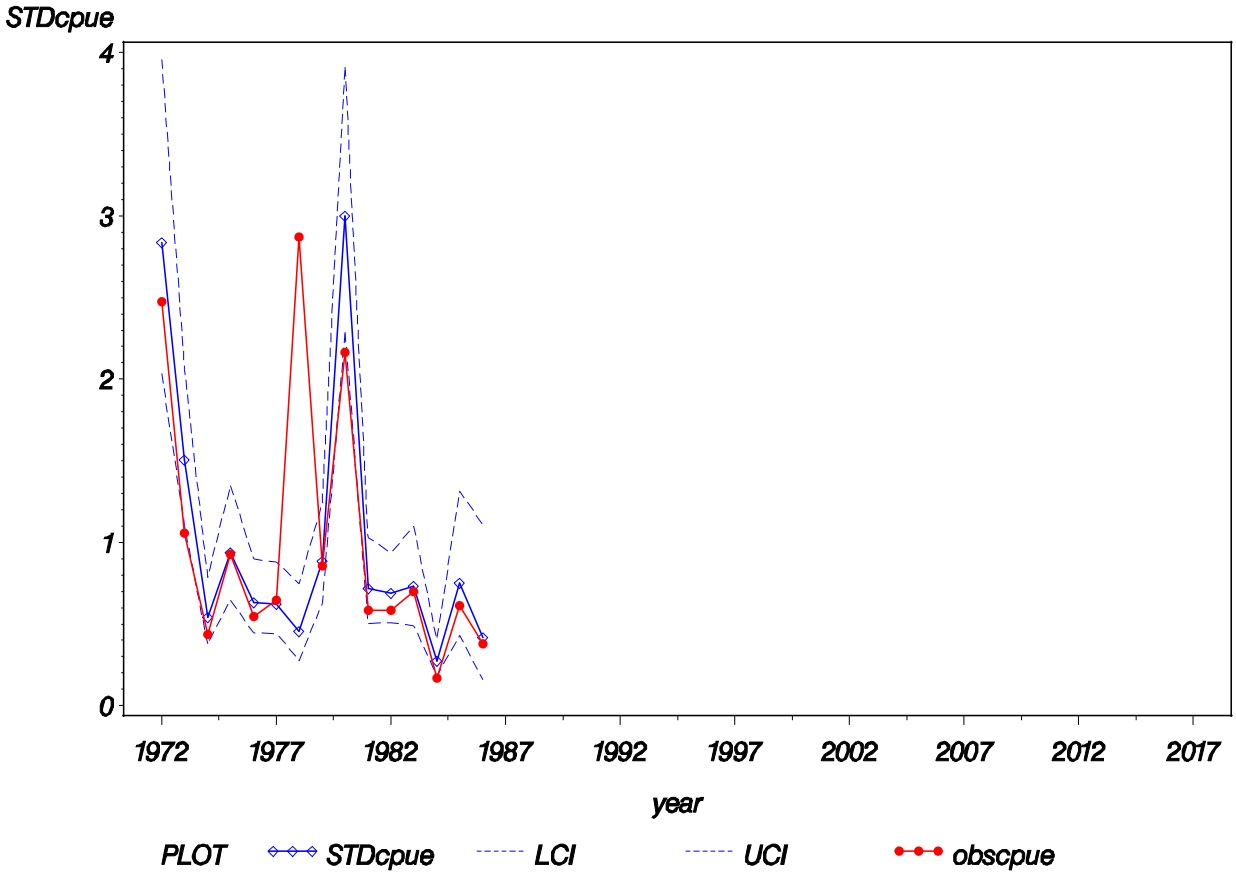

Figure 6. Annual index of abundance for Red Snapper from the Fall Groundfish Survey (wGOM, 1972-1986).

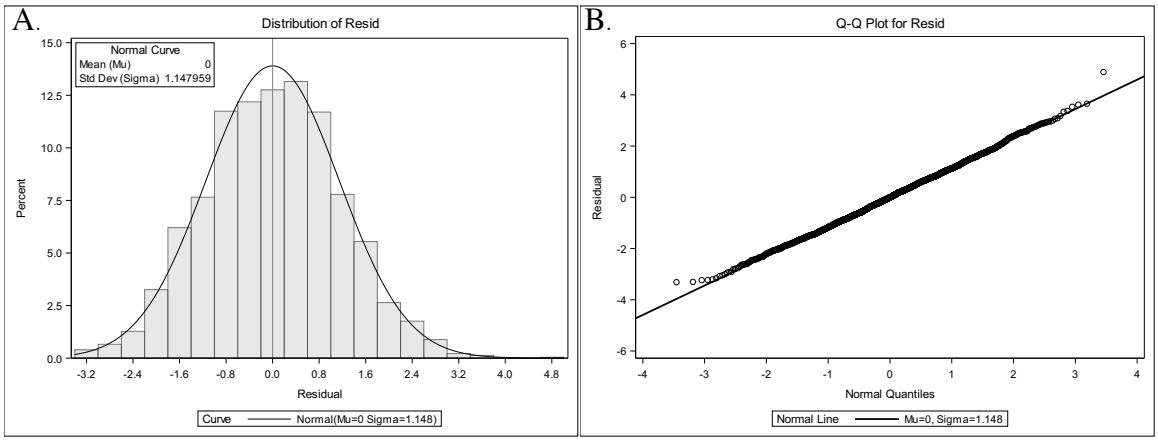

Figure 7. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 1988-2007) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

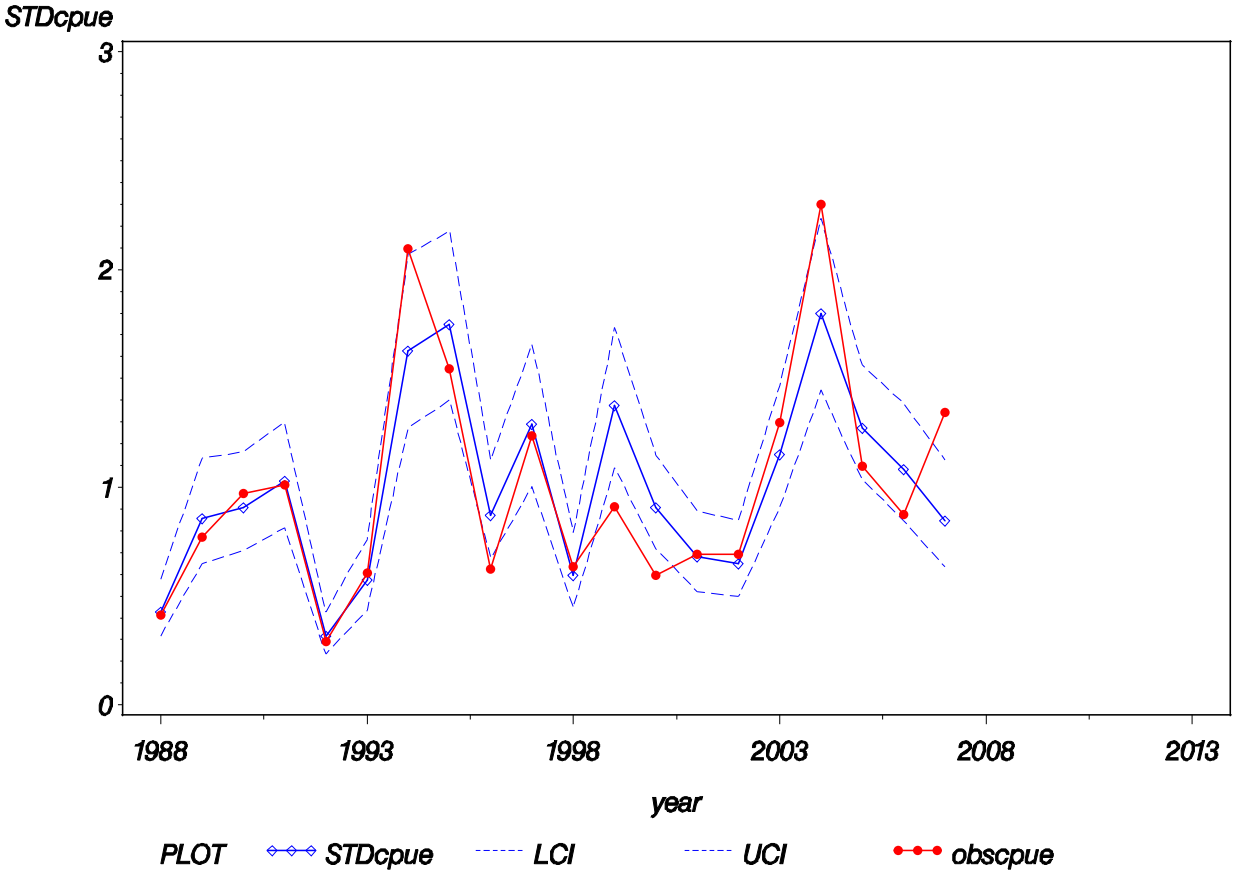

Figure 8. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (wGOM, 1988-2007).

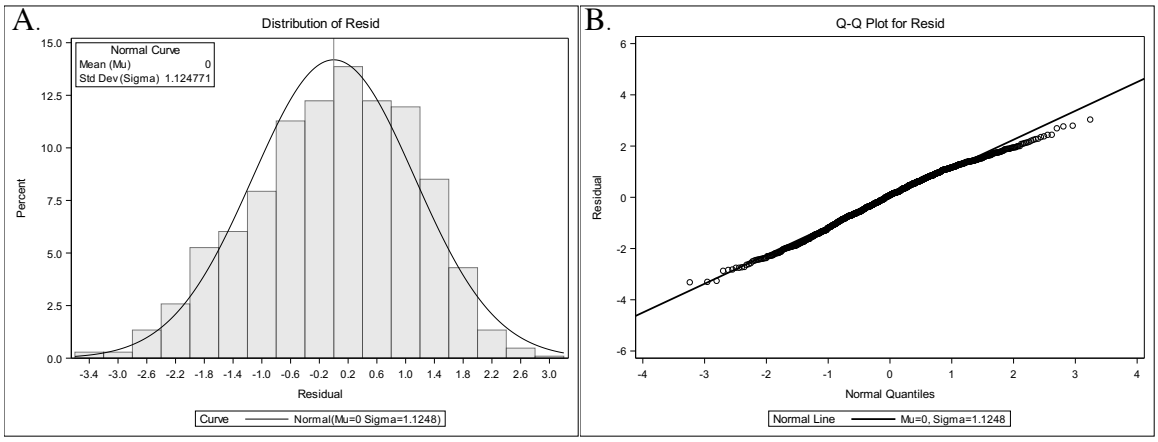

Figure 9. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (wGOM, 2008-2016) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

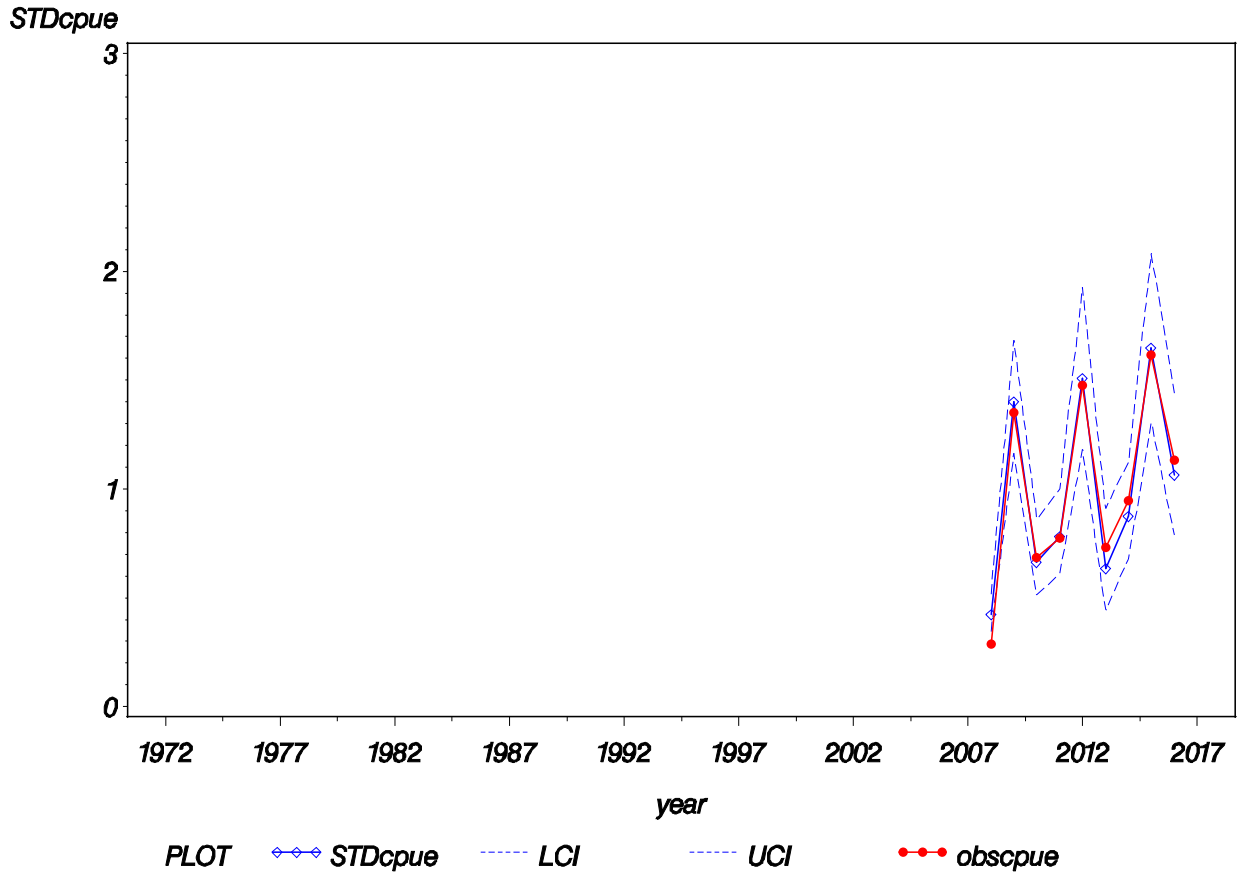

Figure 10. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (wGOM, 2008-2016)

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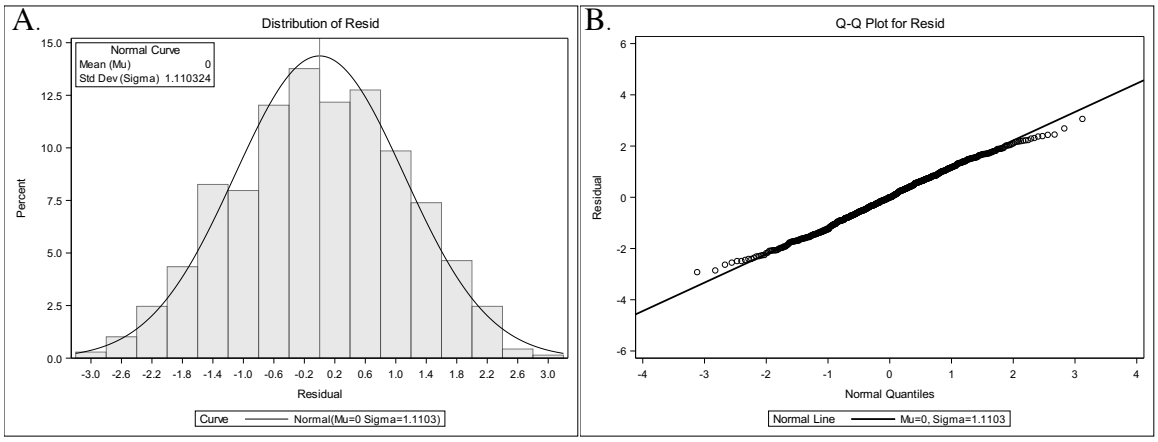


Figure 11. Diagnostic plots for lognormal component of the Red Snapper Fall Groundfish Survey (eGOM, 1972-1986) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

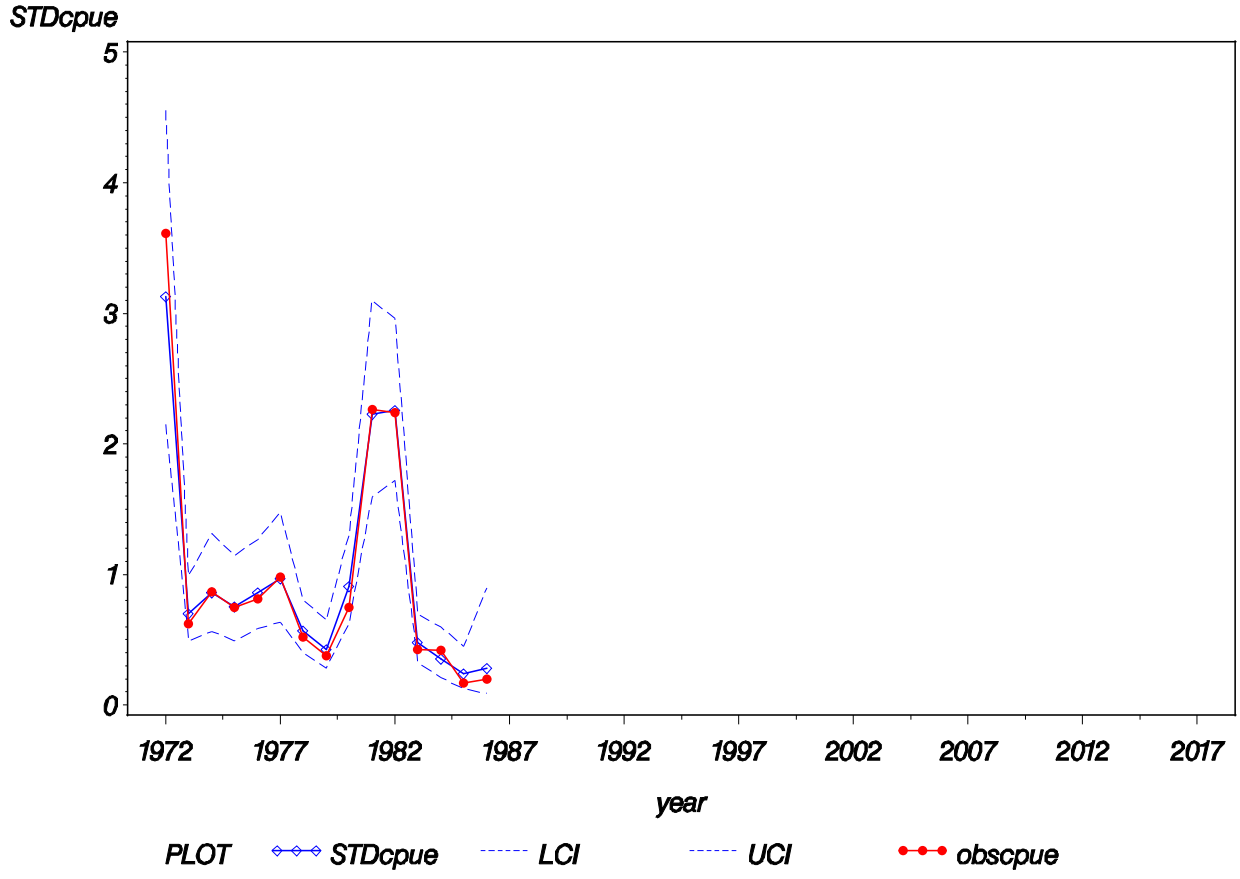


Figure 12. Annual index of abundance for Red Snapper from the Fall Groundfish Survey (eGOM, 1972-1986).

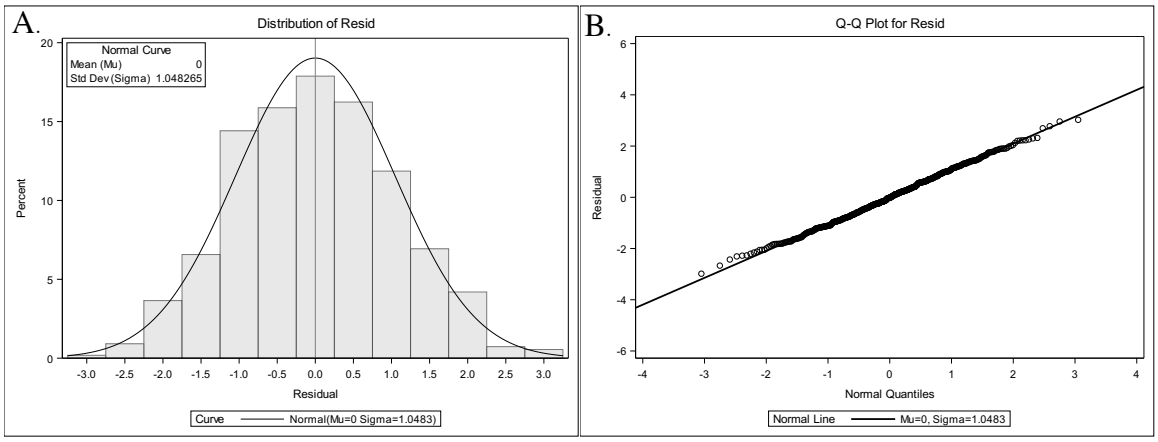


Figure 13. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Fall Groundfish Survey (eGOM, 1987-2007) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

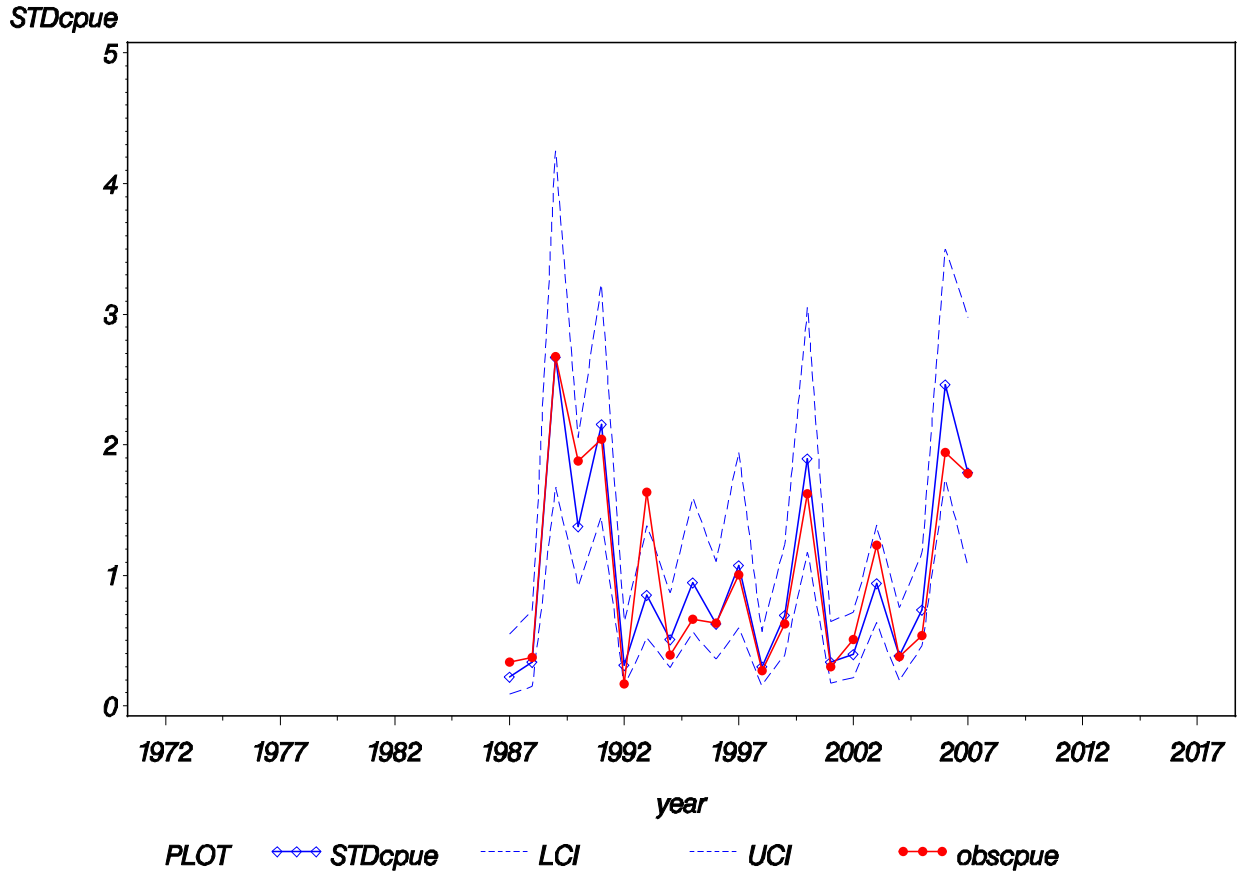


Figure 14. Annual index of abundance for Red Snapper from the SEAMAP Fall Groundfish Survey (eGOM, 1987-2007).

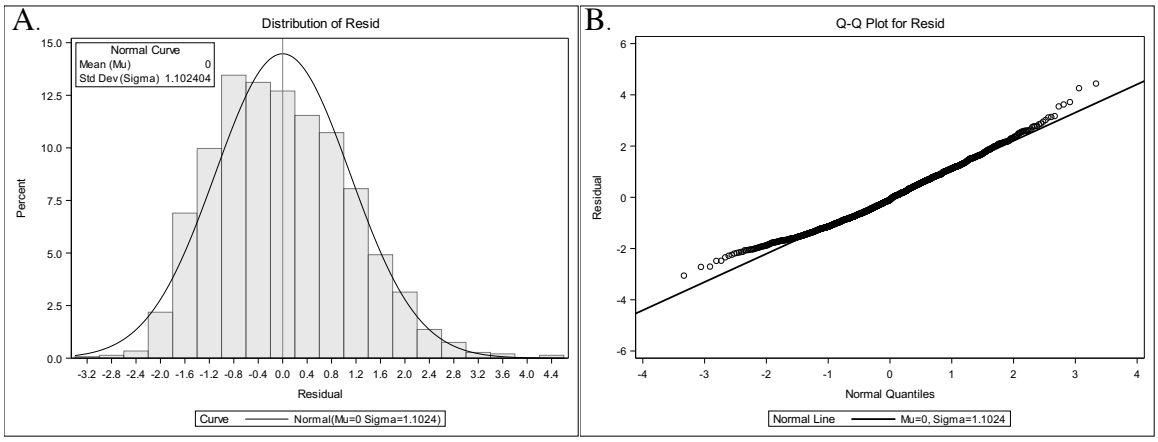


Figure 15. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 1984-2008) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

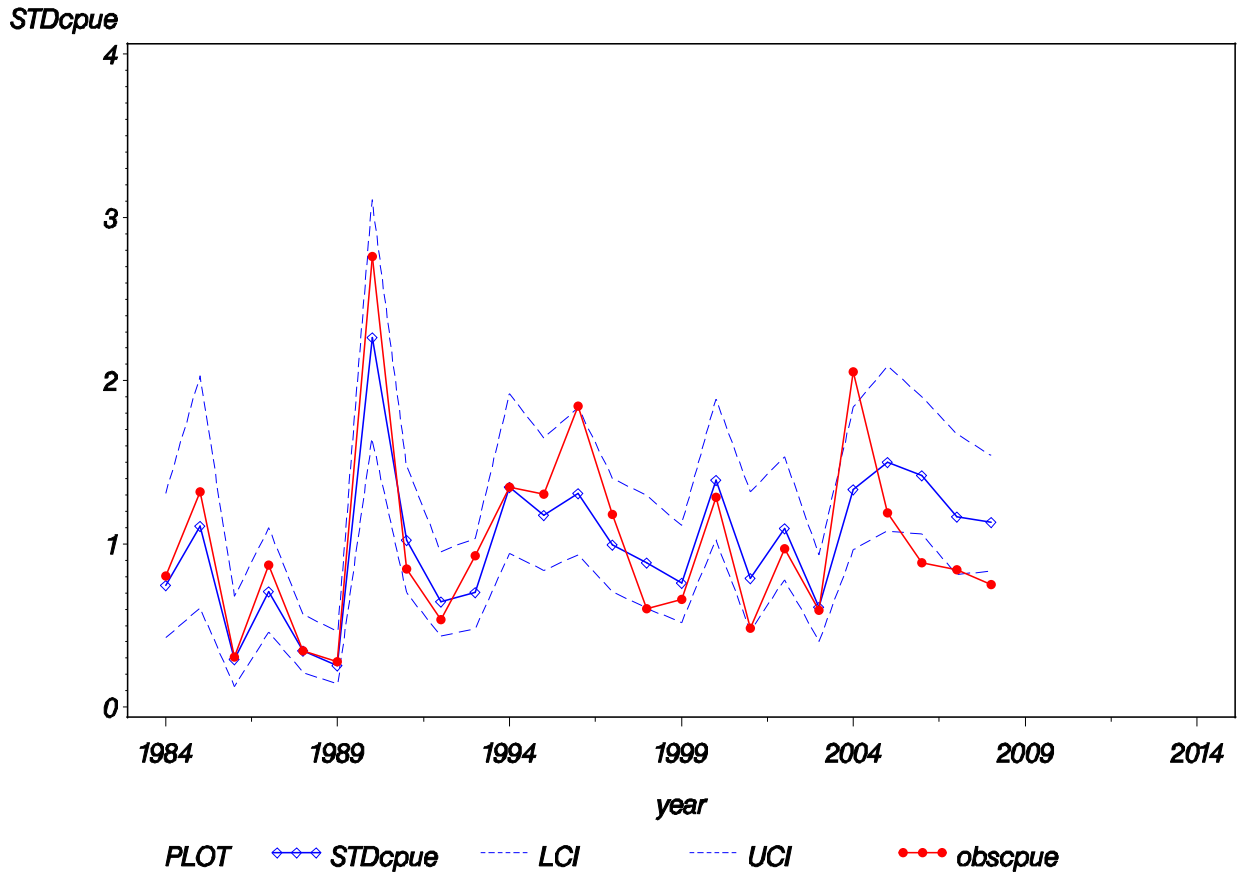


Figure 16. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (wGOM, 1984-2008).

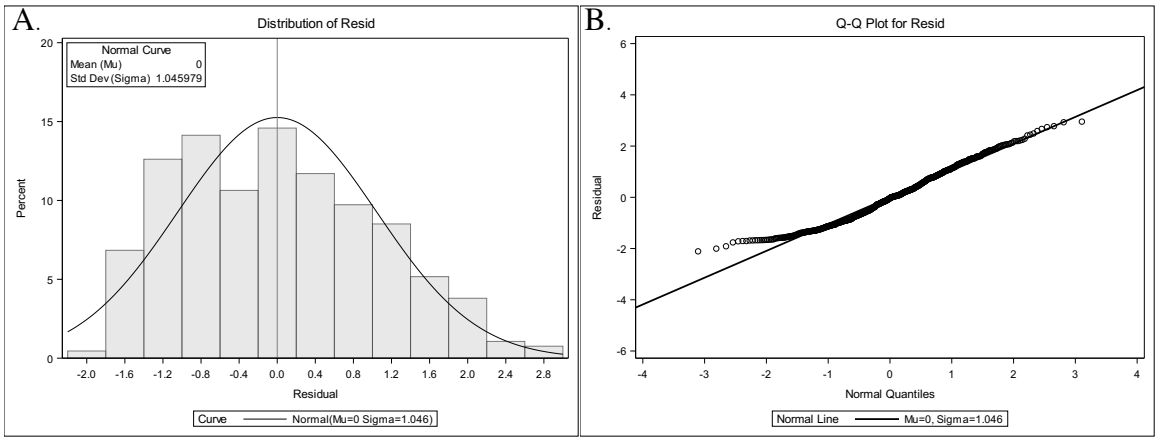


Figure 17. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (wGOM, 2009-2016) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

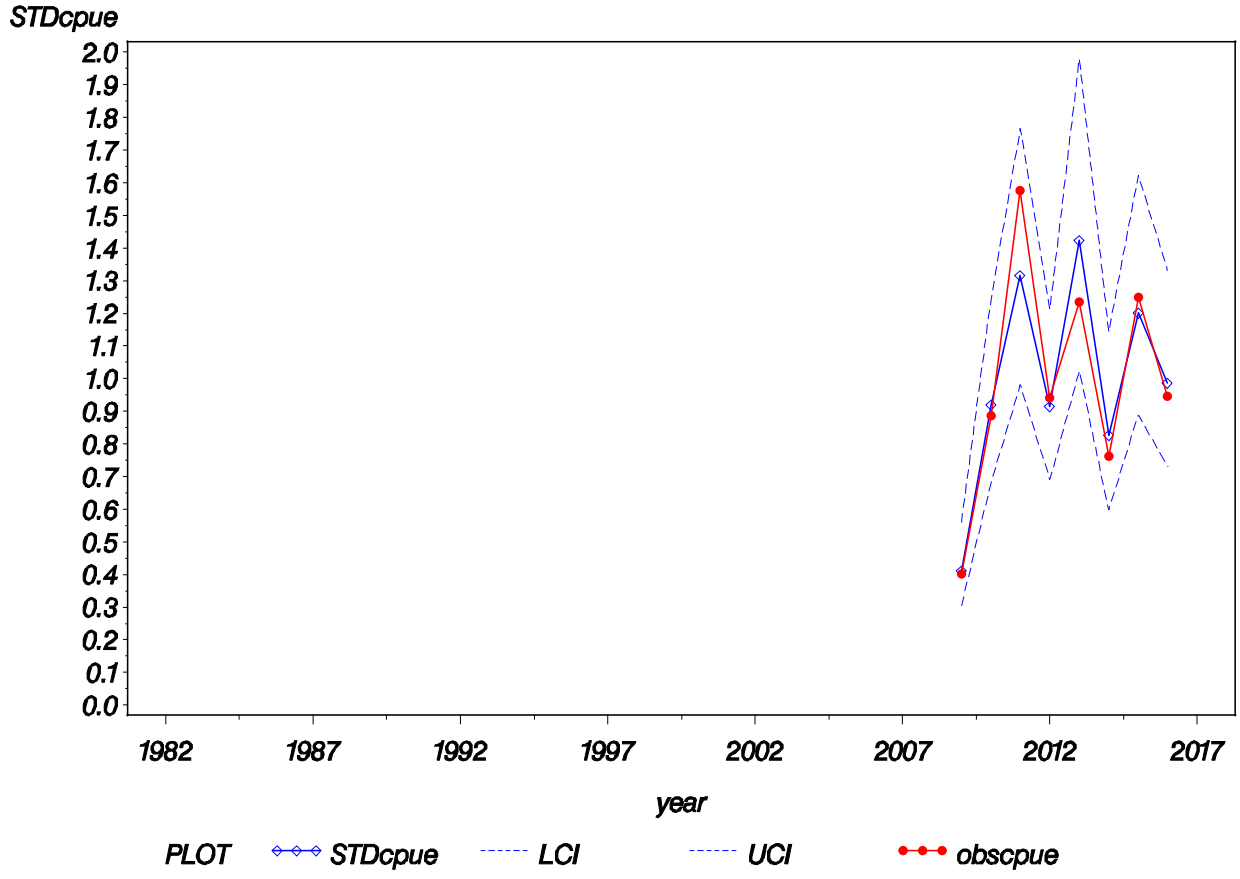


Figure 18. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (wGOM, 2009-2016).

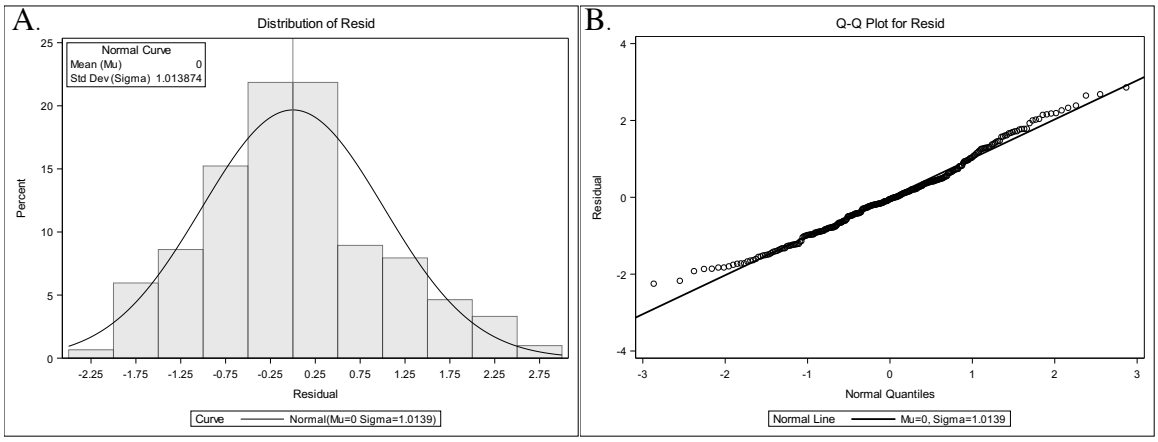


Figure 19. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 1982-2008) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

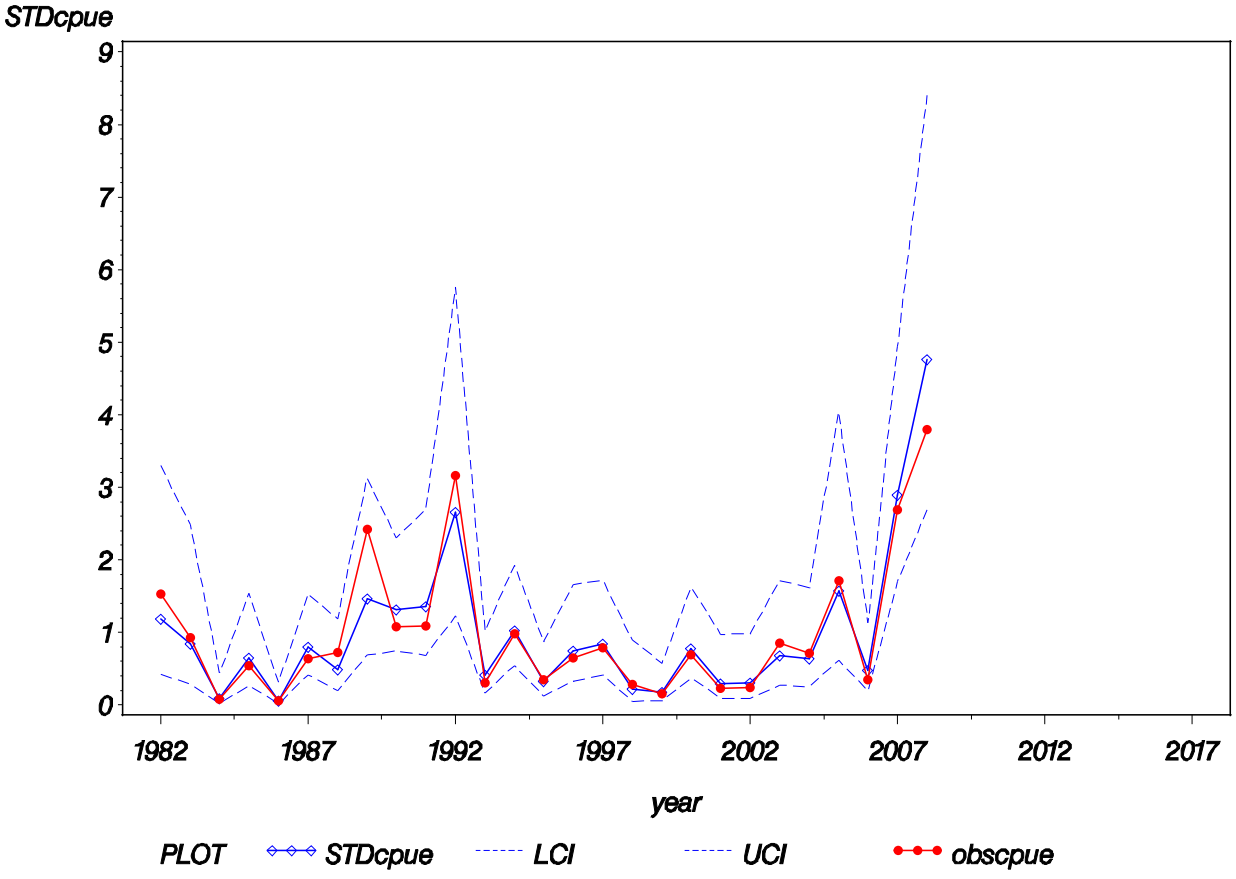


Figure 20. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (eGOM, 1982-2008).

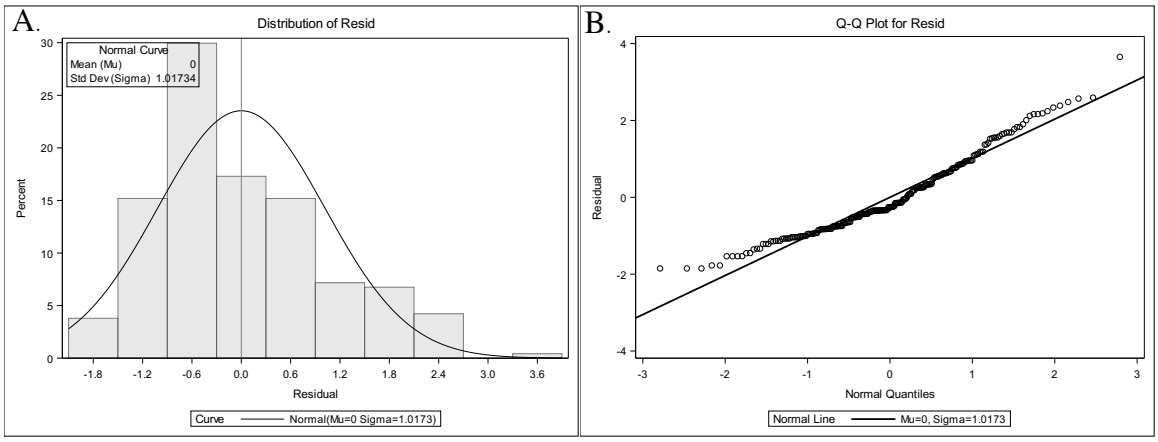


Figure 21. Diagnostic plots for lognormal component of the Red Snapper SEAMAP Summer Groundfish Survey (eGOM, 2009-2016) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

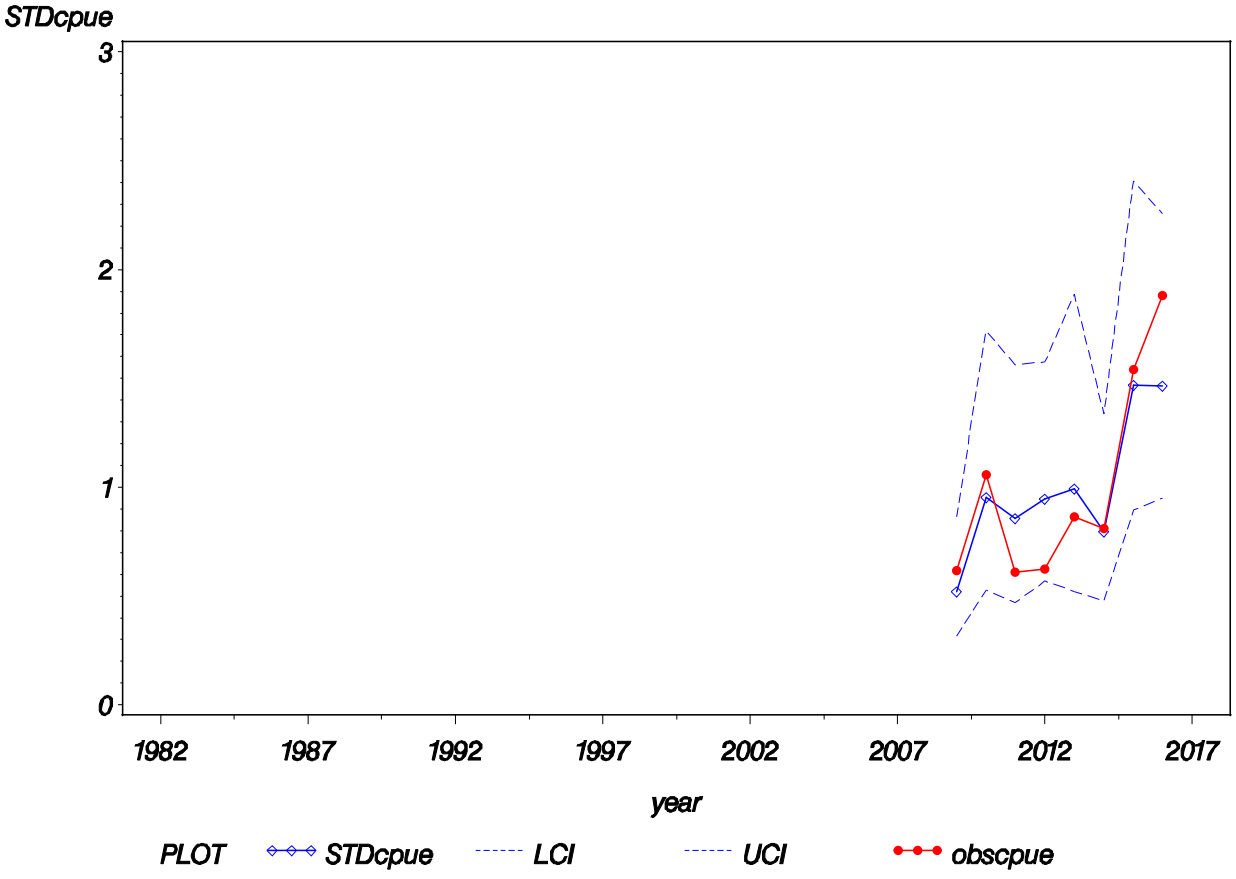


Figure 22. Annual index of abundance for Red Snapper from the SEAMAP Summer Groundfish Survey (eGOM, 2009-2016).

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 FWGOM (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 FWGOM (08-16) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	729	498	0.68313	23.7620
TIME OF DAY	Night	813	548	0.67405	25.3185
YEAR	2008	285	177	0.62105	7.4181
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	147	103	0.70068	24.3554
YEAR	2015	144	113	0.78472	41.5058
YEAR	2016	117	74	0.63248	29.1240
STATZONE	13	66	37	0.56061	12.1797
STATZONE	14	141	86	0.60993	5.9217
STATZONE	15	150	79	0.52667	6.1069
STATZONE	16	206	102	0.49515	6.0829
STATZONE	17	267	153	0.57303	14.8997
STATZONE	18	246	191	0.77642	34.3705
STATZONE	19	158	133	0.84177	56.8992
STATZONE	20	185	160	0.86486	48.1823
STATZONE	21	123	105	0.85366	30.5798

Appendix Table 4. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys EGOM (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 FEGOM (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 SWGOM (8408) 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 7. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys SWGOM (0916) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	845	374	0.44260	6.3150
TIME OF DAY	Night	637	284	0.44584	5.9348
YEAR	2009	304	90	0.29605	2.6256
YEAR	2010	200	89	0.44500	5.8011
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	160	71	0.44375	4.9921
YEAR	2015	167	82	0.49102	8.1776
YEAR	2016	163	81	0.49693	6.1860
STATZONE	13	64	11	0.17188	2.1173
STATZONE	14	125	47	0.37600	5.3088
STATZONE	15	153	33	0.21569	1.2782
STATZONE	16	195	50	0.25641	3.0375
STATZONE	17	245	97	0.39592	6.3820
STATZONE	18	238	132	0.55462	9.8422
STATZONE	19	170	101	0.59412	8.4173
STATZONE	20	169	114	0.67456	8.7083
STATZONE	21	123	73	0.59350	5.8618

Appendix Table 8. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys EGOM (82-08) data.

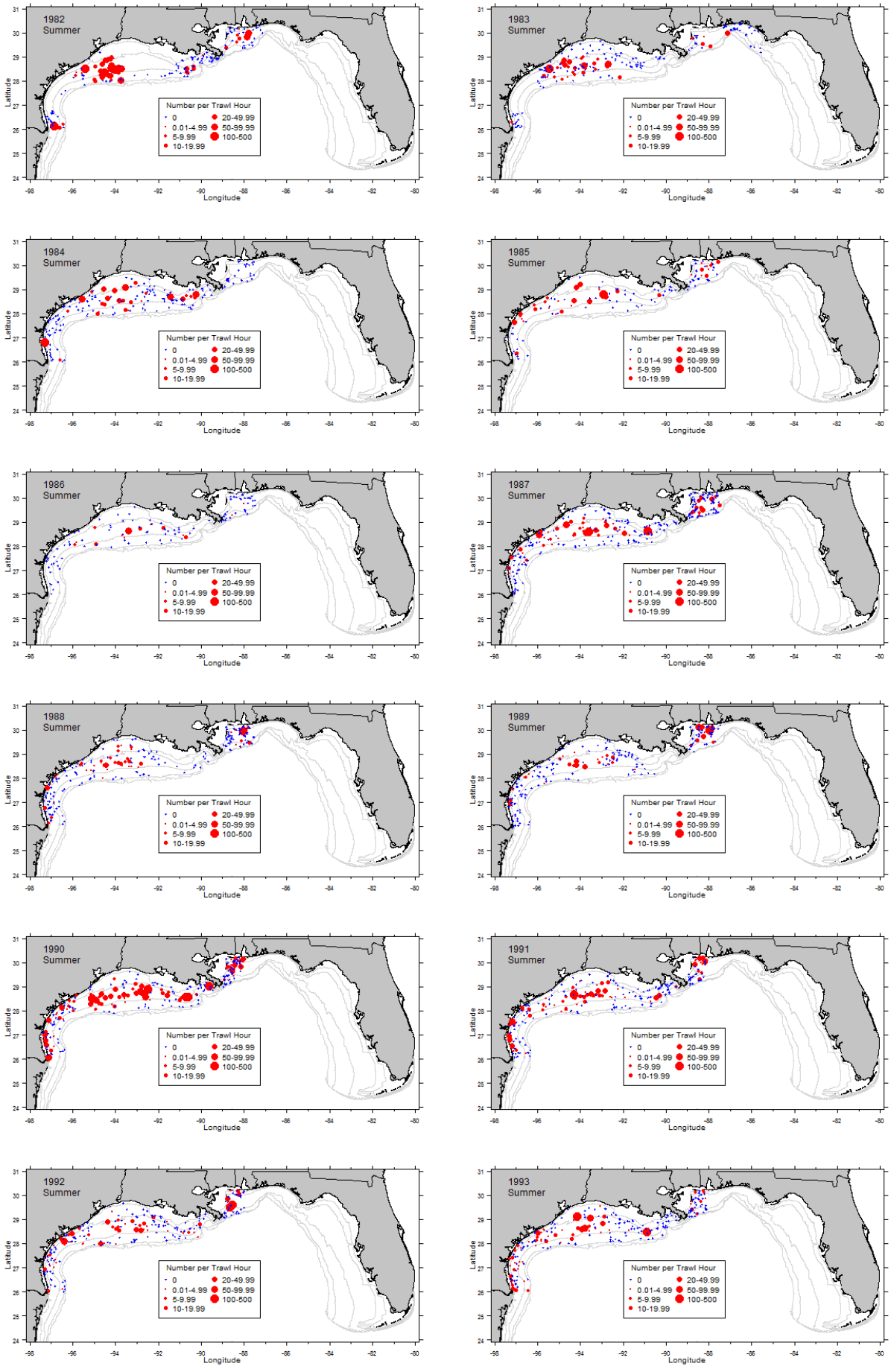
Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
DEPTH ZONE	0506	17	2	0.11765	0.4482
DEPTH ZONE	0607	95	16	0.16842	2.2380
DEPTH ZONE	0708	57	10	0.17544	1.9388
DEPTH ZONE	0809	14	2	0.14286	3.3429
DEPTH ZONE	0910	63	11	0.17460	1.8709
DEPTH ZONE	1011	97	22	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

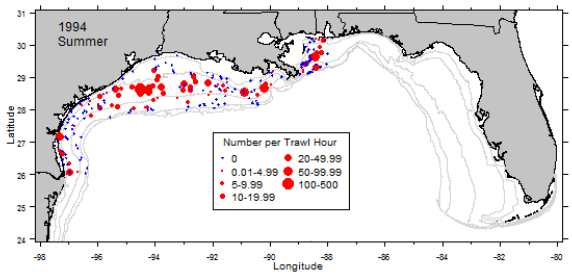
Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
YEAR	1991	44	16	0.36364	3.7451
YEAR	1992	45	13	0.28889	10.9081
YEAR	1993	44	9	0.20455	1.0514
YEAR	1994	60	20	0.33333	3.3780
YEAR	1995	42	8	0.19048	1.2079
YEAR	1996	46	12	0.26087	2.2275
YEAR	1997	42	15	0.35714	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 9. Summary of the factors used in constructing the Red Snapper abundance index from the Fall Groundfish Surveys SEGOM (0916) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
TIME OF DAY	Day	970	147	0.15155	1.31584
TIME OF DAY	Night	616	90	0.14610	2.16772
YEAR	2009	220	35	0.15909	1.01435
YEAR	2010	173	23	0.13295	1.74072
YEAR	2011	168	22	0.13095	1.00000
YEAR	2012	223	30	0.13453	1.02756
YEAR	2013	172	19	0.11047	1.41860
YEAR	2014	213	31	0.14554	1.33056
YEAR	2015	227	34	0.14978	2.53318
YEAR	2016	190	43	0.22632	3.09366
AREA	MS/AL	372	117	0.31452	4.62965
AREA	NFL	502	52	0.10359	0.99103
AREA	NWFL	212	38	0.17925	1.06597
AREA	SFL	500	30	0.06000	0.33196

Appendix Figure 1. Annual survey effort and catch of Red Snapper from the SEAMAP Summer Groundfish Surveys including 100 stations from DISL trawl survey between 2010 and 2016.

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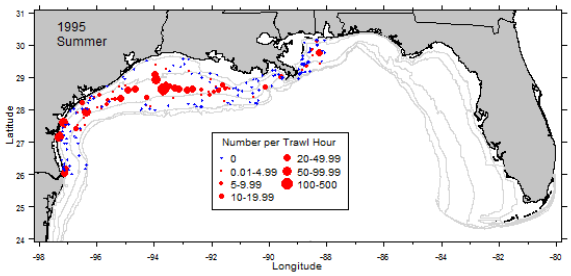
Latitude
Longitude


1995
Summer
Number per Trawl Hour
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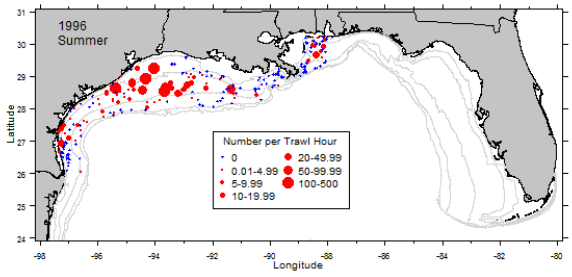
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


1996
Summer
Number per Trawl Hour
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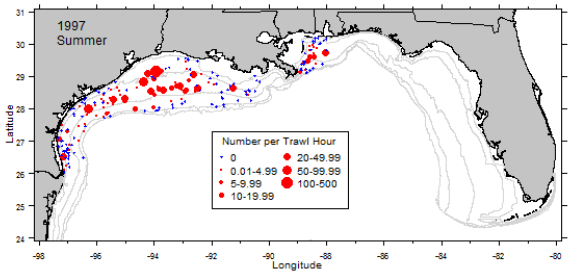
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


1997
Summer
Number per Trawl Hour
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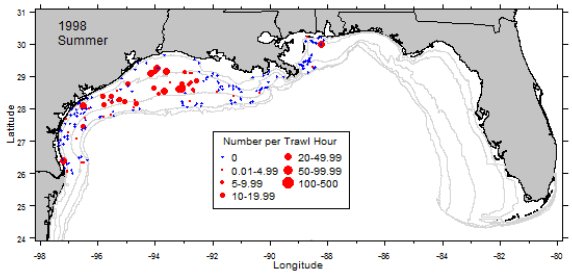
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude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Summer
Number per Trawl Hour
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5-9.99
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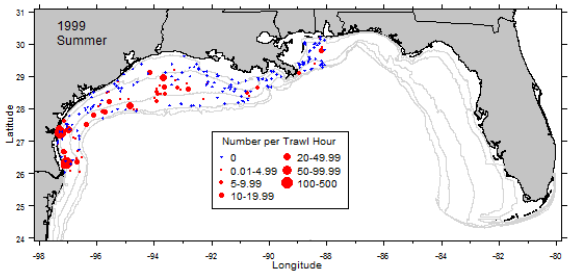
100-500
Latitude
Longitude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Summer
Number per Trawl Hour
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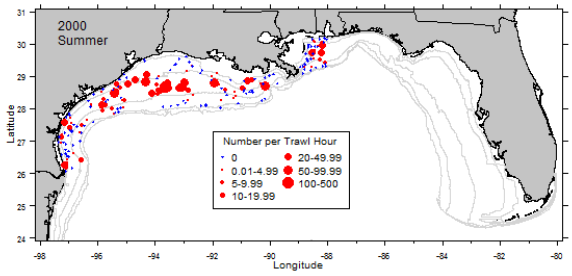
Latitude
Longitude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Latitude
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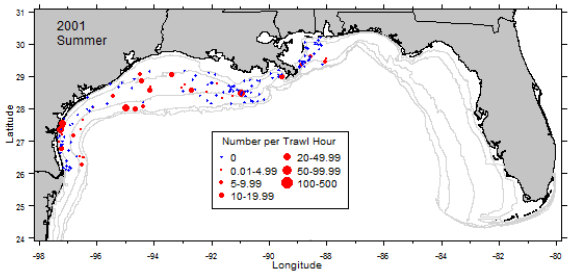
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Summer
Number per Trawl Hour
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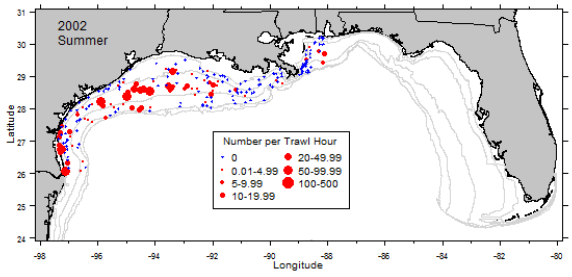
Latitude
Longitude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Summer
Number per Trawl Hour
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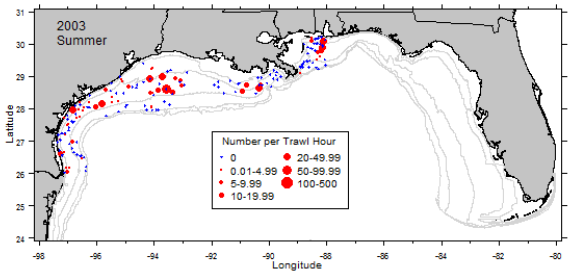
100-500
Latitude
Longitude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Summer
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Latitude
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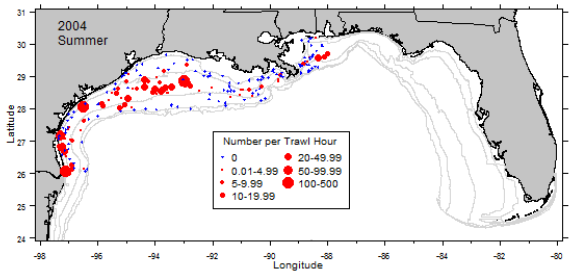
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Summer
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50-99.99
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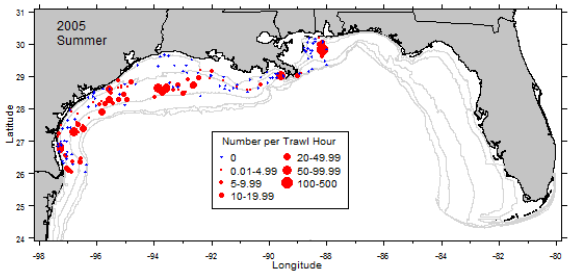
Latitude
Longitude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Summer
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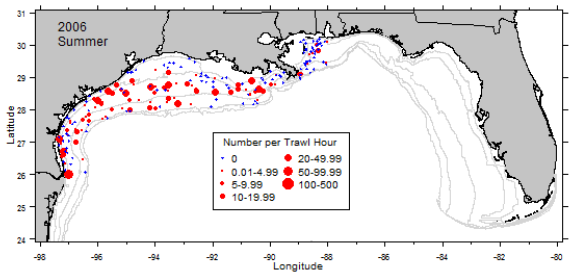
Latitude
Longitude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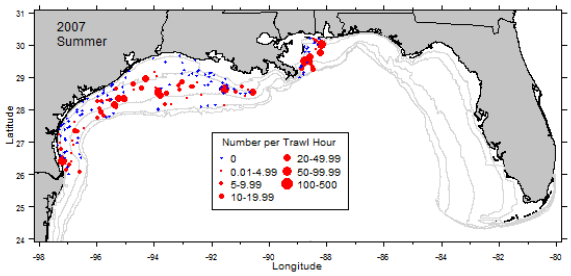
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Summer
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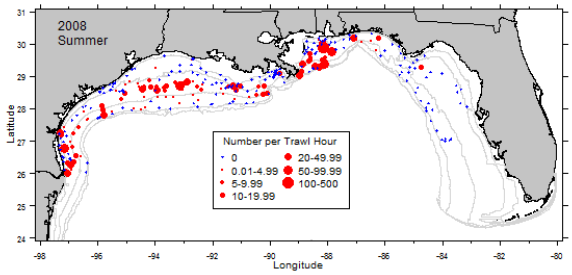
50-99.99
100-500
Latitude
Longitude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Summer
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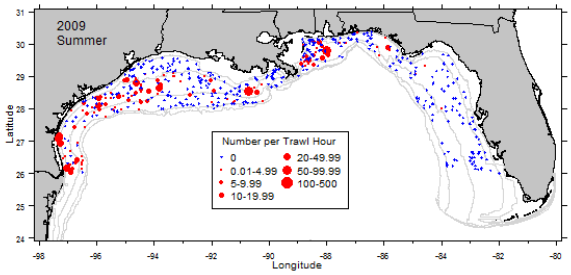
20-49.99
50-99.99
100-500
Latitude
Longitude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Summer
Number per Trawl Hour
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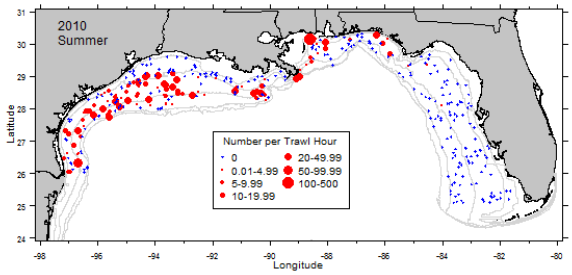
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude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Summer
Number per Trawl Hour
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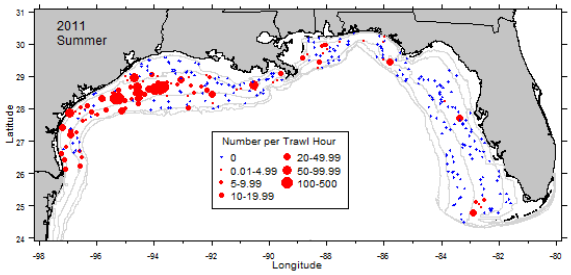
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


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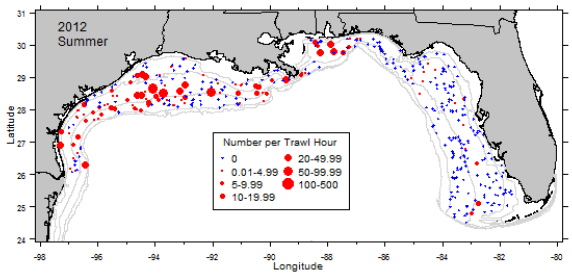
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


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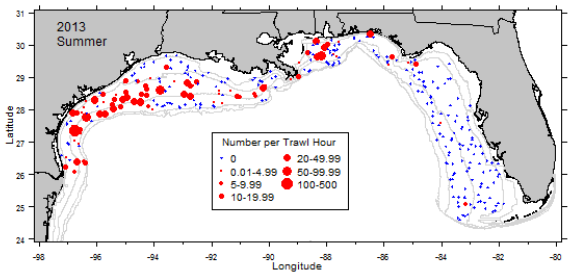
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2013
Summer
Number per Trawl Hour
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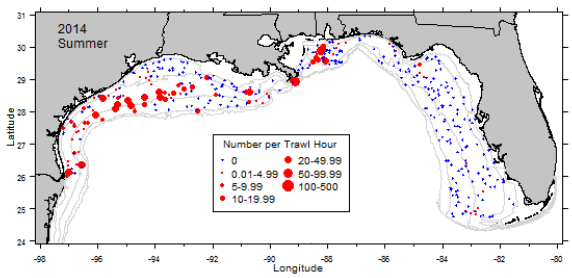
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2014
Summer
Number per Trawl Hour
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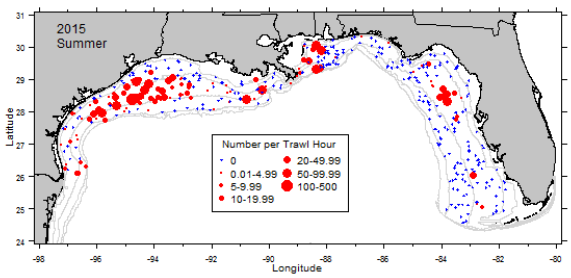
0.01-4.99
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


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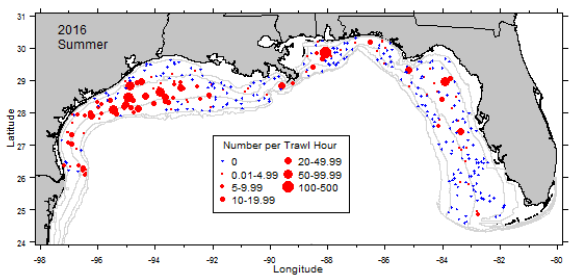
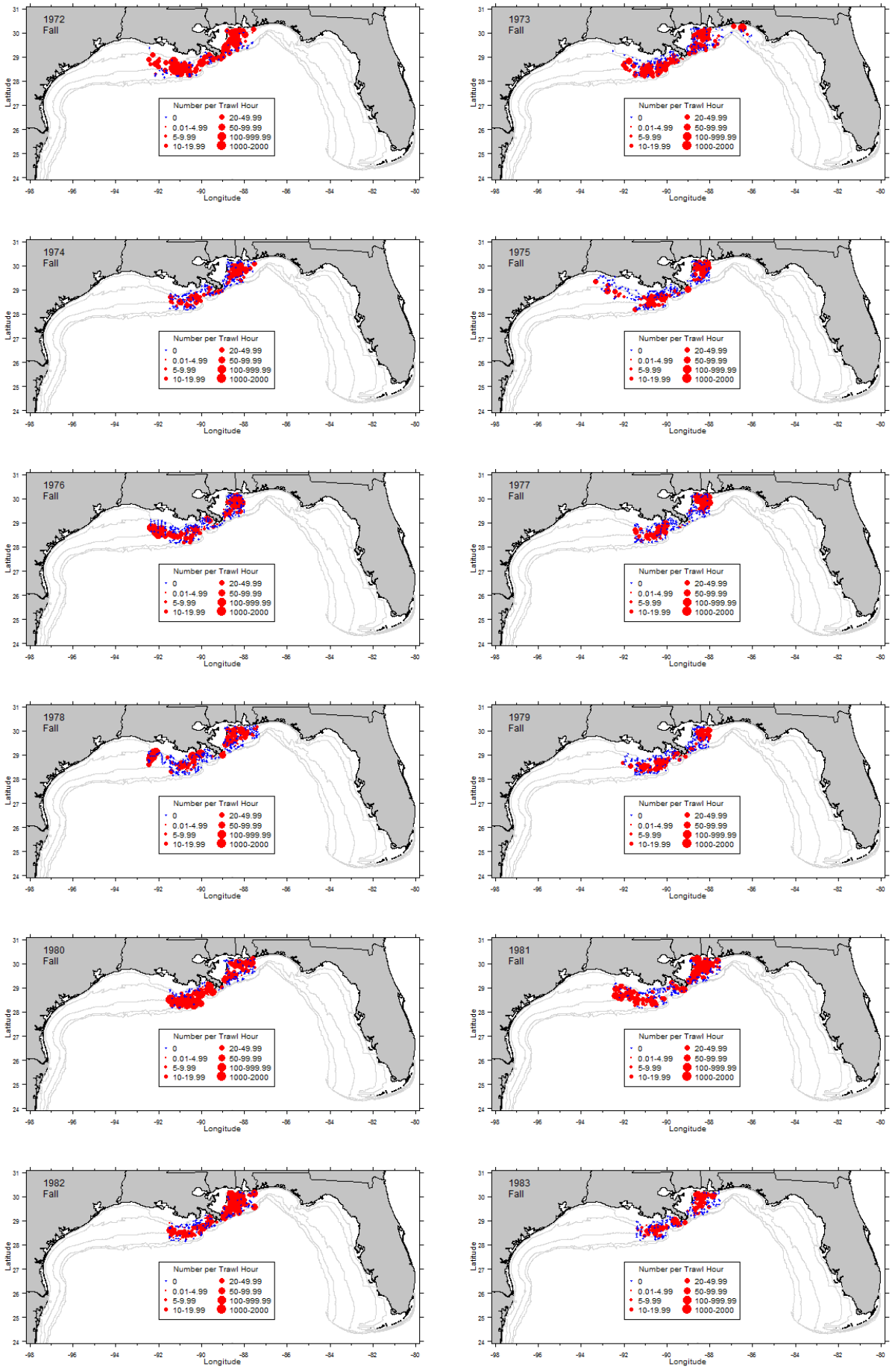
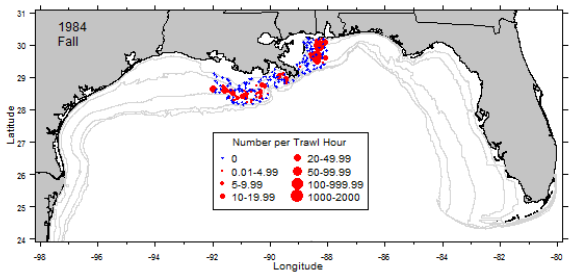
5-9.99
10-19.99
20-49.99
50-99.99
100-500
Latitude
Longitude


2016
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 28 stations from DISL trawl survey between 2010 and 2016.




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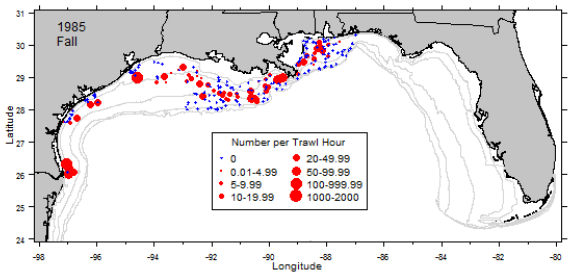
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1985
Fall
Number per Trawl Hour
0
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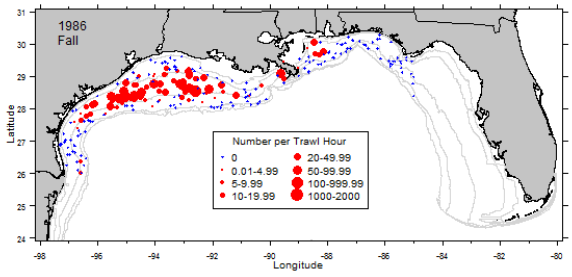
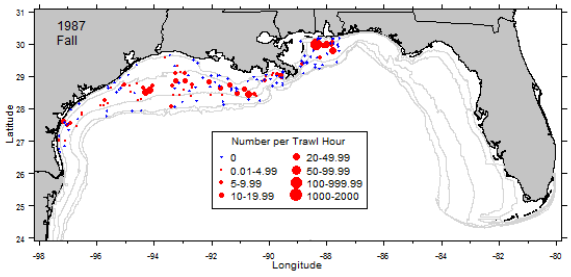
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1986
Fall
Number per Trawl Hour
0
0.01-4.99
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
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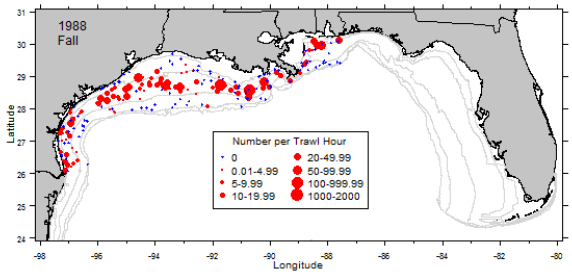
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


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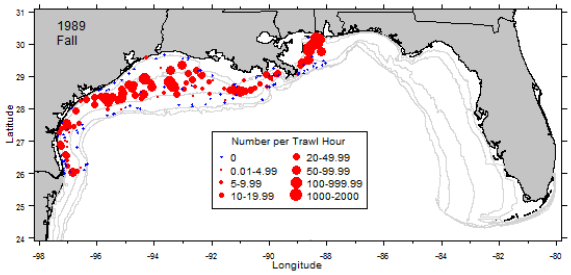
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


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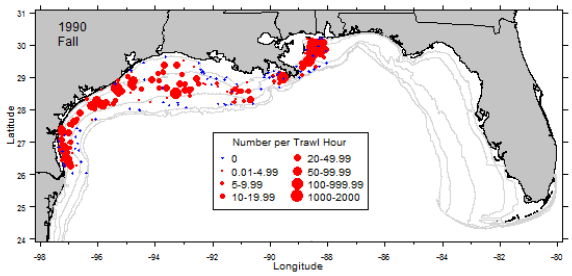
5-9.99
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1990
Fall
Number per Trawl Hour
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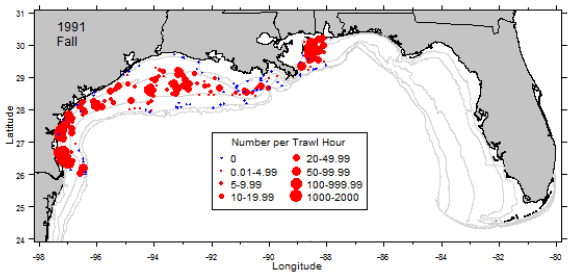
1000-2000
Latitude
Longitude


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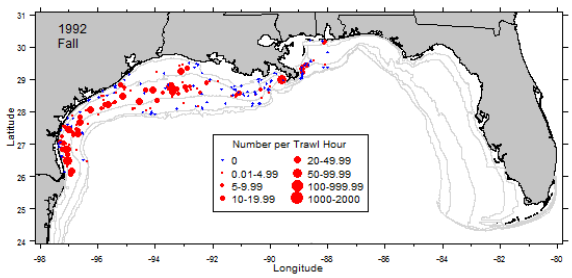
10-19.99
20-49.99
50-99.99
100-999.99
1000-2000
Latitude
Longitude


1992
Fall
Number per Trawl Hour
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5-9.99
10-19.99
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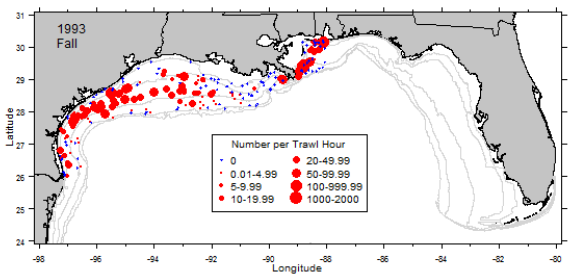
Latitude
Longitude


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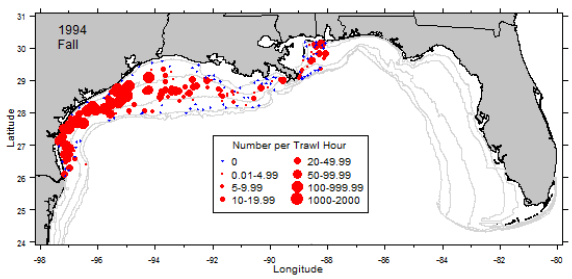
1000-2000
Latitude
Longitude


1994
Fall
Number per Trawl Hour
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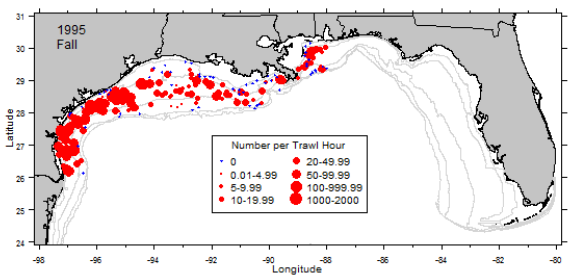
Latitude
Longitude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Fall
Number per Trawl Hour
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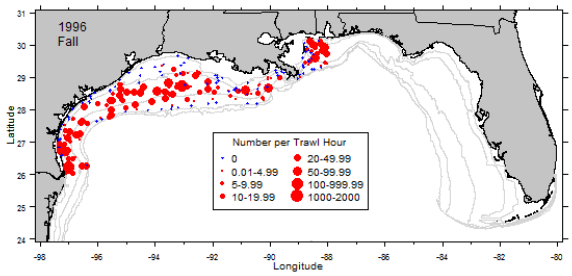
Latitude
Longitude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Fall
Number per Trawl Hour
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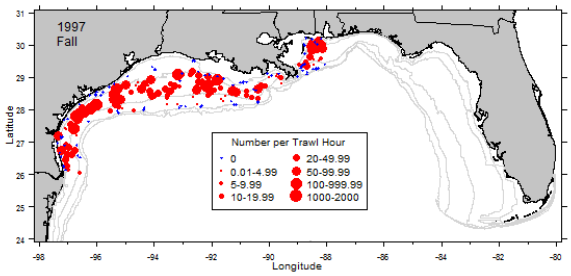
Latitude
Longitude


1997
Fall
Number per Trawl Hour
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1000-2000
Latitude
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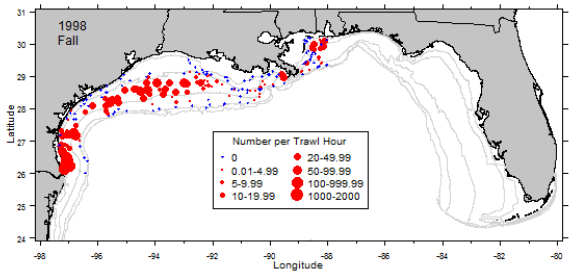
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Fall
Number per Trawl Hour
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1000-2000
Latitude
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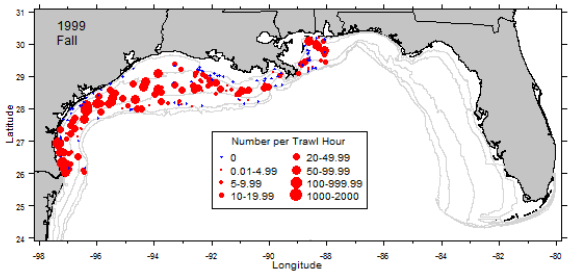
1999
Fall
Number per Trawl Hour
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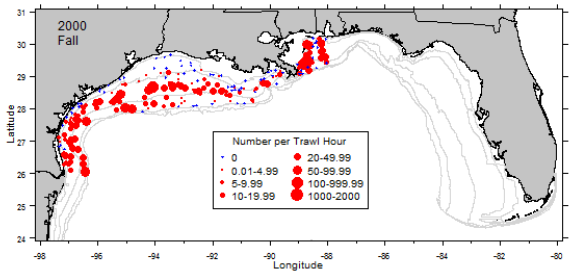
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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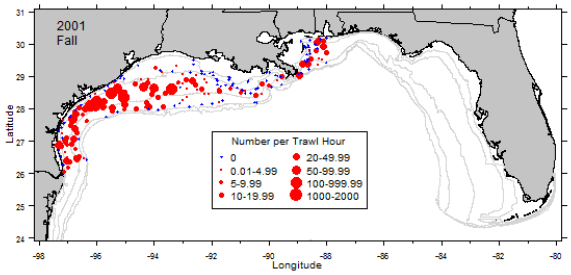
Latitude
Longitude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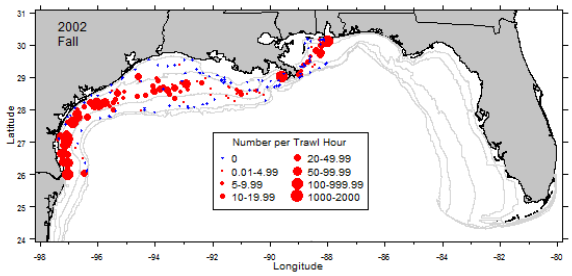
Latitude
Longitude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Number per Trawl Hour
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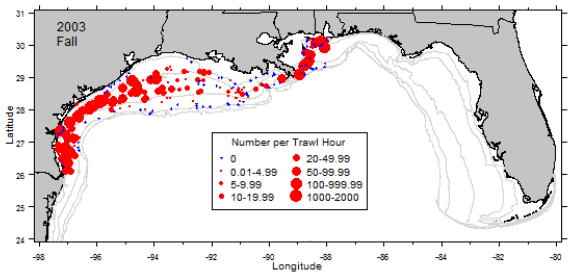
Latitude
Longitude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Fall
Number per Trawl Hour
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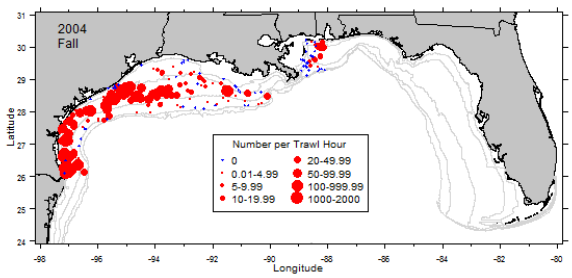
50-99.99
100-999.99
1000-2000
Latitude
Longitude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Fall
Number per Trawl Hour
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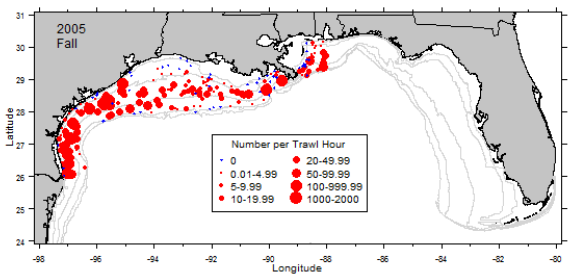
Longitude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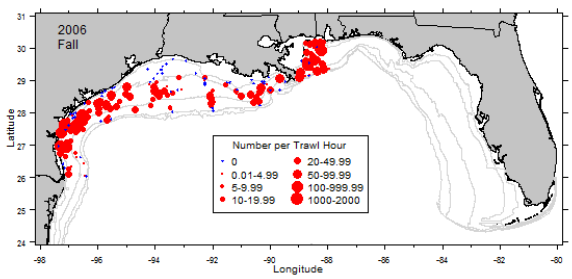
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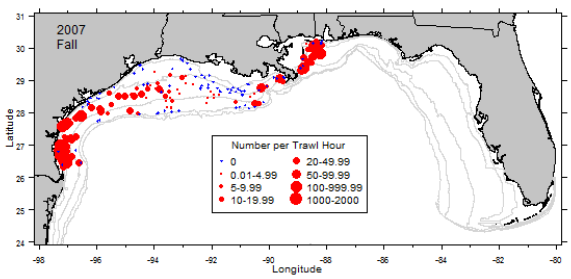
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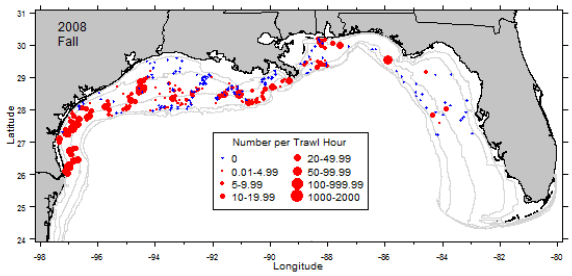
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Fall
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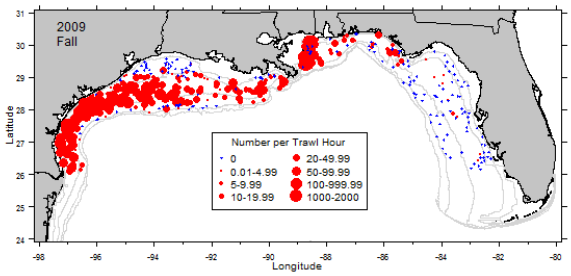
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Fall
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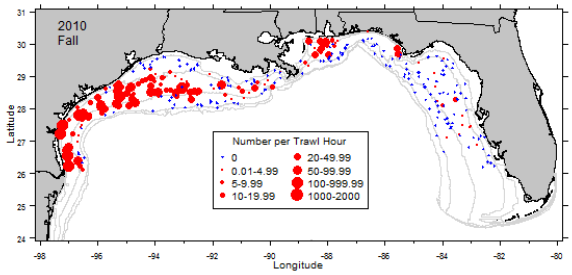
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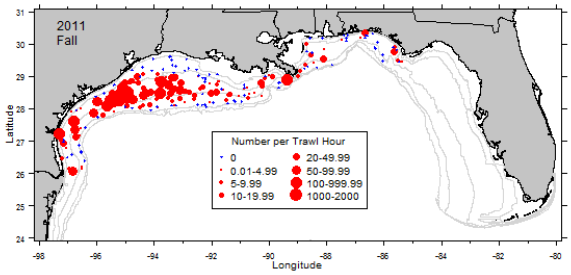
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Fall
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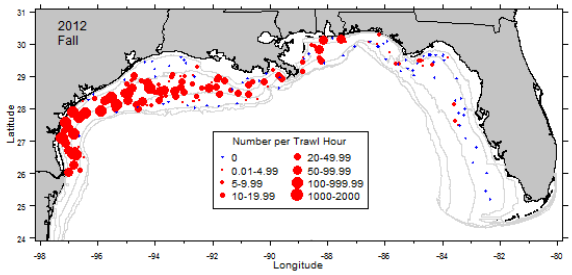
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Fall
Number per Trawl Hour
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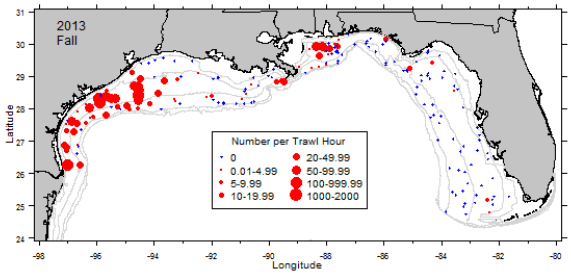
1000-2000
Latitude
Longitude


2013
Fall
Number per Trawl Hour
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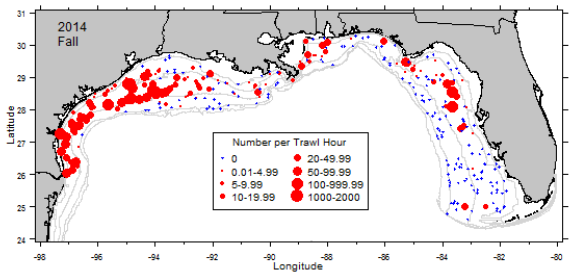
1000-2000
Latitude
Longitude


2014
Fall
Number per Trawl Hour
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1000-2000
Latitude
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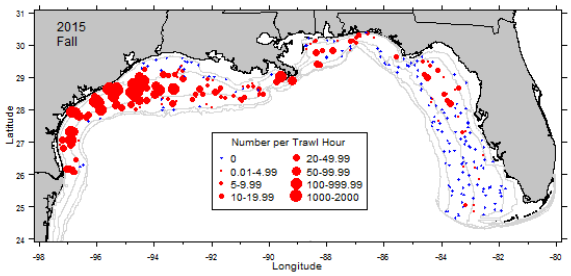
2015
Fall
Number per Trawl Hour
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0.01-4.99
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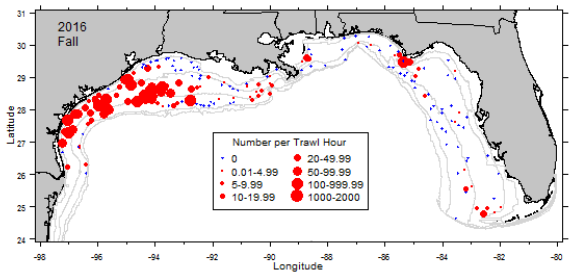
1000-2000
Latitude
Longitude


2016
Fall
Number per Trawl Hour
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5-9.99
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50-99.99
100-999.99
1000-2000
Latitude
Longitude