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Adam G. Pollack[1], David S. Hanisko[2] and G. Walter Ingram, Jr.[2]

[1] Riverside Technology, Inc.
NOAA Fisheries, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, MS

[2] NOAA Fisheries, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, MS

Abstract

The 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 several sampling programs. In 1987, both groundfish surveys (summer and fall) were brought under the Southeast Area Monitoring and Assessment Program (SEAMAP). These fisheries independent data were used to develop abundance indices for gray triggerfish (Balistes capriscus). Four abundance indices were produced, two from the summer data series and two from the fall data series. The data for each season were split when the survey design was changed mid-year in 2008. These indices represented abundance estimates for age zero and one year old gray triggerfish.

Introduction

The Southeast Fisheries Science Center (SEFSC) Mississippi Laboratories (MSLABS) and state partners have conducted standardized 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. The purpose of this document is to provide abundance indices for gray triggerfish (*Balistes capriscus*).

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 fathoms), shrimp statistical zones (SSZ) (between 88° and 97° W longitude, 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 minute 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. Recently, a new modification was added to the survey design, a depth stratification of 5 - 20 fathoms and 20 – 60 fathoms.

Data

A total of 15,580 stations were sampled from 1987- 2017 with 8,089 and 7,491 stations sampled during the summer and fall survey, respectively (Tables 1 and 2). Trawl data was obtained from the MSLABS database and combined with data from the Gulf States Marine Fisheries Commission (GSMFC) database, which contains data collected by state agencies/partners from Alabama, Florida, Louisiana, Mississippi and Texas.

Data Exclusions

Data was limited by several factors:

(1) No problems with tow (i.e. net torn, doors crossed, etc.)
(2) Depths between 5 and 60 fathoms
(3) Within SSZ 2 – 21 (excluding 12 due to depths outside of sample universe)
(4) Sampled with a 40 ft. shrimp trawl (Texas uses a 20 ft. shrimp trawl and data are not used)
(5) Sampled between 1987 and 2017

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 were designated the secondary sampling areas; East Florida and Texas were not sampled. During this time, triplicate 10 minute tows were done at each station. For the purpose of this analysis, these stations were excluded, in following what had been done during previous assessments.

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 minutes. Therefore in some cases multiple tows were needed to cover a depth stratum. For purposes of this analysis, these multiple tows were collapsed into a single station. 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 gray triggerfish (Pennington, 1983; Bradu & 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

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

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

The submodels of the delta-lognormal model were built using a backward selection procedure based on type 3 analyses with an inclusion level of significance of $\alpha = 0.05$. Binomial submodel performance was evaluated using AIC, while the performance of the lognormal submodel was evaluated based on analyses of residual scatter and QQ plots in addition to AIC. Variables that could be included in the submodels were:

Submodel Variables – Summer Survey (1987-2008)

Year: 1987 – 2008
Depth Zone: 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, 50-60 fm
SSZ Combo: 10-11, 13-15, 16-17, 18-19, 20-21
Time of Day: Day, Night

Submodel Variables – Summer Survey (2009 – 2017)

Year: 2009 - 2017
Depth: 5 – 60 fathoms (continuous)
SSZ: 2 – 21
Time of Day: Day, Night

Submodel Variables – Fall Survey (1987 – 2007)

Year: 1987 – 2007
Depth: 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+ fm
SSZ Combo: 10-11, 13-15, 16-17, 18-19, 20-21
Time of Day: Day, Night

Submodel Variables – Fall Survey (2008 – 2017)

Year: 2008 - 2017
Depth: 5 – 60 fathoms (continuous)
SSZ: 2 – 21
Time of Day: Day, Night

Results and Discussion

Distribution, Size and Age

The distribution of gray triggerfish from the Summer and Fall SEAMAP Groundfish Surveys area presented in Figures 1 and 2, respectively, with seasonal/annual abundance and distribution presented in the Appendix Figures 1 and 2. The annual number of gray triggerfish captured ranged from 29 to 439 in the summer (Tables 3 and 4) and 12 to 1,752 in the fall (Tables 5 and 6). Of the 3,721 gray triggerfish captured during the summer survey, a total of 2,779 were

measured with an average fork length of 141 mm under the old survey design (1987-2008) and a total of 942 were measured with an average fork length of 177 mm under the new survey design (2009-2017). During the fall survey, 10,665 gray triggerfish were captured, with 4,185 fish and 1,687 fish measured under the old (1987-2007) and new (2008-2017) survey designs, respectively, with an average fork length of 145 mm. The length frequency distribution of gray triggerfish captured is shown in Figure 3. Based on data from previous assessments, the gray triggerfish captured most likely represent age zero and one year old fish.

Index of Abundance

For the SEAMAP Summer Groundfish Survey (1987-2008) abundance index of gray triggerfish, year, depth zone and SSZ combo were retained in the binomial submodel, while year, depth 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 1. Table 7 summarizes the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 26,544.7 and 1,589.5, respectively. The diagnostic plots for the lognormal submodel are shown in Figure 4, and indicated the distribution of the residuals is approximately normal. Annual abundance indices are presented in Table 8 and Figure 5.

For the SEAMAP Summer Groundfish Survey (2009-2017) abundance index of gray triggerfish, year, depth and SSZ were retained in the both binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 2. Table 9 summarizes the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 17,990.7 and 851.7, respectively. The diagnostic plots for the lognormal submodel are shown in Figure 6, and indicated the distribution of the residuals is approximately normal. Annual abundance indices are presented in Table 10 and Figure 7.

For the SEAMAP Fall Groundfish Survey (1987-2007) abundance index of gray triggerfish, year, depth zone and SSZ combo were retained in both the binomial and lognormal submodels. A summary of the factors used in the analysis is presented in Appendix Table 3. Table 11 summarizes the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 25,299.9 and 3,399.3, respectively. The diagnostic plots for the lognormal submodel are shown in Figure 8, and indicated the distribution of the residuals is approximately normal. Annual abundance indices are presented in Table 12 and Figure 9.

For the SEAMAP Fall Groundfish Survey (2008-2017) abundance index of gray triggerfish, 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 4. Table 13 summarizes the final set of variables used in the submodels and their significance. The AIC for the binomial and lognormal submodels were 13,632.0 and 1,452.6, respectively. The diagnostic plots for the lognormal submodel are shown in Figures 10, and indicated the distribution of the residuals is approximately normal. Annual abundance indices are presented in Table 14 and Figure 11.

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Table 1. Number of stations sampled by shrimp statistical zone during the SEAMAP Summer Groundfish Survey from 1987-2017.

	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
1987										28	61	6	20	19	25	20	16	25	28	19	267
1988										18	48	5	4	3	19	24	14	25	28	23	211
1989										23	31		3	18	25	7	15	20	29	24	195
1990											69	11	20	15	23	16	20	23	24	20	241
1991											46	12	24	13	23	22	24	18	23	26	231
1992										1	45	2	20	24	20	25	12	31	26	20	226
1993											46	10	19	17	24	19	14	29	24	22	224
1994											61	6	17	22	25	17	20	22	26	22	238
1995											45	10	16	18	22	23	13	27	26	21	221
1996											46	14	13	19	22	18	17	21	26	25	221
1997											44		12	16	22	23	10	28	26	26	207
1998											36	2	14	21	25	18	14	22	36	17	205
1999											44	7	20	19	20	23	13	25	32	20	223
2000											45	2	19	15	19	27	8	29	31	21	216
2001											36	7	18	18	13	3	10	9	17	21	152
2002											45	11	14	21	27	19	15	25	29	22	228
2003											44	9	10	8	2	17	20	22	26	23	181
2004											39	11	18	17	20	25	21	19	25	21	216
2005											32	11	9	12	16	21	5	28	22	27	183
2006											45	11	21	12	20	23	17	23	31	18	221
2007											41		7	16	24	23	7	29	32	21	200
2008				1	8	11	6	11	8	11	41	12	17	16	23	21	16	24	21	28	275
2009				36	23	29	16	16	18	25	65	25	20	36	39	46	50	33	29	23	529
2010			31	26	21	26	10	12	14	15	21	5	19	18	21	33	34	27	27	19	379
2011		11	24	22	20	29	2	15	11	8	16	7	14	17	23	29	29	18	21	13	329
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	7	14	5	13	14	22	22	22	16	17	12	297
2014		15	31	23	24	30	17	15	9	7	17	6	15	18	22	28	23	18	18	14	350
2015	1	9	32	29	22	27	22	18	10	8	16	7	15	18	21	29	27	19	20	13	363
2016		9	25	29	26	23	15	15	10	8	15	6	16	16	23	30	23	19	17	14	339
2017		10	28	19	28	14	15	14	6	10	17	7	14	13	23	26	24	19	21	14	322
Total	1	75	237	246	224	238	130	143	110	182	1187	234	475	527	678	707	580	713	778	624	8089

Table 2. Number of stations sampled by shrimp statistical zone during the SEAMAP Fall Groundfish Survey from 1987-2017.

	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
1987										13	23	15	14	16	17	15	15	15	18	3	164
1988										8	28	7	22	17	18	26	19	21	31	20	217
1989											45	12	19	17	22	20	17	22	25	26	225
1990											52	14	12	23	22	19	18	22	19	27	228
1991											46	6	24	14	20	25	24	19	25	22	225
1992											34	7	23	14	25	18	17	27	30	18	213
1993											73	10	19	17	26	18	16	25	28	18	250
1994											50	9	16	21	25	20	21	23	24	20	229
1995											40	10	17	18	24	19	14	26	30	19	217
1996											45	9	18	19	17	28	13	25	29	24	227
1997											44	10	17	20	26	19	18	23	22	24	223
1998											44	10	22	14	34	11	15	24	29	22	225
1999											42	10	17	18	29	18	12	28	29	22	225
2000											43	10	14	22	20	26	12	30	25	21	223
2001											45	10	17	19	26	20	14	27	28	23	229
2002										1	51	10	13	22	22	23	14	26	30	21	233
2003										1	76	9	16	21	24	22	20	23	25	23	260
2004											43		11	18	17	27	14	24	30	21	205
2005											45	11	20	16	33	18	14	23	24	27	231
2006										1	46	7	22	14	18	28	13	23	32	19	223
2007											33	9	20	17	18	28	17	20	18	26	206
2008					15	14	4	4	3	4	35	8	22	32	42	46	44	19	36	20	348
2009				20	21	25	11	21	13	12	50	12	23	23	30	49	47	31	36	22	446
2010				9	25	27	17	16	11	14	15	7	15	18	26	30	29	18	19	14	310
2011								9	11	7	15	6	15	16	27	31	28	21	18	15	219
2012			2	3	6	6	17	10	7	5	12	5	11	13	19	23	22	13	15	11	200
2013		4	14	11	10	11	10	10	6	5	10	5	11	12	4	12	16	12	14	9	186
2014	1	8	31	25	22	23	13	12	7	7	16	5	14	15	21	27	22	15	17	12	313
2015	1	10	28	25	25	21	13	12	9	11	15	6	13	13	19	27	21	16	17	12	314
2016	1	5	4	8	11	9	6	13	5	4	8	4	12	12	18	22	17	13	13	8	193
2017		9	19	27	19	18	8	12	7	7	15	6	9	12	22	25	22	15	18	14	284
Total	3	36	98	128	154	154	99	119	79	100	1139	259	518	543	711	740	605	669	754	583	7491

Table 3. Summary of the gray triggerfish length data collected during SEAMAP Summer Groundfish Surveys conducted between 1987 and 2008.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1987	267	59	2	135	165	150	21
1988	211	159	22	109	377	195	68
1989	195	96	46	55	401	126	70
1990	241	107	38	60	320	163	77
1991	231	135	50	42	384	180	93
1992	226	68	60	106	406	209	62
1993	224	32	20	110	374	220	76
1994	238	156	104	57	461	152	76
1995	221	135	81	42	455	188	76
1996	221	69	56	105	346	229	57
1997	207	94	46	64	415	191	78
1998	205	29	21	64	342	211	102
1999	223	177	140	30	356	114	59
2000	216	439	199	56	396	109	45
2001	152	241	130	57	360	148	54
2002	228	107	81	83	303	182	54
2003	181	33	26	79	318	170	82
2004	216	34	23	115	271	196	45
2005	183	56	44	61	339	142	74
2006	221	397	406	44	356	83	39
2007	200	59	43	59	325	176	68
2008	275	97	67	43	415	197	76

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
22	4782	2779	1705	141

Table 4. Summary of the gray triggerfish length data collected during SEAMAP Summer Groundfish Surveys conducted between 2009 and 2017.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2009	529	120	109	68	388	210	64
2010	379	75	51	66	359	201	67
2011	329	148	61	76	471	195	101
2012	399	116	83	68	455	212	90
2013	297	53	52	116	394	178	56
2014	350	100	100	107	340	174	44
2015	363	207	201	44	557	117	81
2016	339	48	48	89	531	245	91
2017	322	75	59	62	512	185	115

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
9	3307	942	764	177

Table 5. Summary of the gray triggerfish length data collected during SEAMAP Fall Groundfish Surveys conducted between 1987 and 2007.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
1987	164	176	47	93	176	136	19
1988	217	155	67	76	354	146	49
1989	225	275	139	25	372	140	37
1990	228	74	50	82	454	156	71
1991	225	1415	562	76	350	156	34
1992	213	86	69	65	367	167	70
1993	250	825	377	54	421	156	65
1994	229	619	377	66	392	147	41
1995	217	304	174	73	334	138	53
1996	227	205	103	60	452	139	69
1997	223	176	111	86	288	170	37
1998	225	12	7	115	338	182	89
1999	225	406	222	76	305	142	34
2000	223	598	399	60	369	143	36
2001	229	1752	524	73	450	125	32
2002	233	292	173	82	374	124	43
2003	260	224	98	86	395	144	43
2004	205	197	167	82	364	150	39
2005	231	382	170	84	346	144	35
2006	223	313	179	61	381	149	57
2007	206	272	170	50	340	138	47

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
21	4678	8758	4185	145

Table 6. Summary of the gray triggerfish length data collected during SEAMAP Fall Groundfish Surveys conducted between 2008 and 2017.

Survey Year	Number of Stations	Number Collected	Number Measured	Minimum Fork Length (mm)	Maximum Fork Length (mm)	Mean Fork Length (mm)	Standard Deviation (mm)
2008	348	322	604	86	404	135	44
2009	446	117	104	73	362	182	63
2010	310	195	110	79	370	150	56
2011	219	147	75	99	390	173	57
2012	200	311	225	71	407	125	38
2013	186	82	40	90	264	140	44
2014	313	366	179	72	363	151	36
2015	314	178	177	81	424	158	50
2016	193	49	49	82	403	159	73
2017	284	140	124	78	391	147	40

Total Number of Years	Total Number of Stations	Total Number Collected	Total Number Measured	Overall Mean Fork Length (mm)
10	2813	1907	1687	145

Table 7. Summary of backward selection procedure for building delta-lognormal submodels for gray triggerfish SEAMAP Summer Groundfish Survey index of relative abundance from 1987 to 2008.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 26551.7)*						*Lognormal Submodel Type 3 Tests (AIC 1594.8)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	21	4688	95.09	4.53	<.0001	<.0001	21	524	4.02	<.0001
Depth Zone	22	4688	119.95	5.45	<.0001	<.0001	22	524	9.05	<.0001
SSZ Combo	4	4688	115.80	28.95	<.0001	<.0001	4	524	0.91	0.4578
Time of Day	1	4688	1.43	1.43	0.2324	0.2324	1	524	11.56	0.0007
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 26544.7)*						*Lognormal Submodel Type 3 Tests (AIC 1589.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	21	4689	95.16	4.53	<.0001	<.0001	21	528	4.11	<.0001
Depth Zone	22	4689	119.88	5.45	<.0001	<.0001	22	528	8.97	<.0001
SSZ Combo	4	4689	115.80	28.95	<.0001	<.0001	Dropped			
Time of Day	Dropped						1	528	10.82	0.0011

Table 8. Indices of gray triggerfish abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey from 1987-2008. 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
1987	0.06742	267	0.32475	0.53611	0.33605	0.27870	1.03127
1988	0.07583	211	0.26166	0.43195	0.35920	0.21521	0.86699
1989	0.09231	195	0.52107	0.86019	0.33898	0.44476	1.66363
1990	0.10788	241	0.56782	0.93736	0.28257	0.53848	1.63172
1991	0.13853	231	0.74129	1.22372	0.25582	0.73959	2.02477
1992	0.10619	226	0.25484	0.42069	0.29375	0.23663	0.74790
1993	0.07143	224	0.23132	0.38187	0.35731	0.19091	0.76384
1994	0.15546	238	0.72465	1.19625	0.23790	0.74821	1.91257
1995	0.14027	221	0.66644	1.10017	0.25902	0.66088	1.83146
1996	0.05430	221	0.27893	0.46046	0.41073	0.20905	1.01421
1997	0.14010	207	0.53300	0.87989	0.26844	0.51917	1.49123
1998	0.06341	205	0.12744	0.21037	0.39483	0.09826	0.45039
1999	0.19283	223	1.09147	1.80180	0.22100	1.16421	2.78858
2000	0.22222	216	1.20534	1.98978	0.21066	1.31163	3.01855
2001	0.17105	152	2.10734	3.47880	0.28160	2.00210	6.04468
2002	0.17544	228	0.70426	1.16260	0.22966	0.73877	1.82958
2003	0.09392	181	0.16328	0.26955	0.34742	0.13722	0.52947
2004	0.06944	216	0.18098	0.29876	0.36864	0.14631	0.61007
2005	0.13115	183	0.33920	0.55995	0.29529	0.31405	0.99838
2006	0.19910	221	1.62964	2.69021	0.21791	1.74867	4.13872
2007	0.11500	200	0.34154	0.56382	0.30018	0.31333	1.01455
2008	0.09130	230	0.33056	0.54570	0.31609	0.29438	1.01156

Table 9. Summary of backward selection procedure for building delta-lognormal submodels for gray triggerfish SEAMAP Summer Groundfish Survey index of relative abundance from 2009 to 2017.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 18,029.3)*						*Lognormal Submodel Type 3 Tests (AIC 852.2)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	8	3277	41.85	5.23	<.0001	<.0001	8	349	0.78	0.6243
Depth	1	3277	78.31	78.31	<.0001	<.0001	1	349	11.30	0.0009
SSZ	18	3277	68.99	3.83	<.0001	<.0001	18	349	2.69	0.0003
Time of Day	1	3277	1.72	1.72	0.1891	0.1892	1	349	2.69	0.1018
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 17,990.7)*						*Lognormal Submodel Type 3 Tests (AIC 851.7)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	8	3278	42.16	5.27	<.0001	<.0001	8	350	0.84	0.5648
Depth	1	3278	78.51	78.51	<.0001	<.0001	1	350	10.77	0.0011
SSZ	18	3278	69.51	3.86	<.0001	<.0001	18	350	2.77	0.0002
Time of Day	Dropped						Dropped			

Table 10. Indices of gray triggerfish abundance developed using the delta-lognormal (DL) model for SEAMAP Summer Groundfish Survey from 2009-2017. 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	0.13043	529	0.36903	1.05047	0.16415	0.75814	1.45551
2010	0.07916	379	0.23261	0.66214	0.23773	0.41428	1.05830
2011	0.11246	329	0.38075	1.08385	0.21570	0.70753	1.66033
2012	0.11779	399	0.37605	1.07046	0.19327	0.72985	1.57003
2013	0.08754	297	0.27103	0.77150	0.25391	0.46798	1.27188
2014	0.08000	350	0.23902	0.68041	0.24495	0.41986	1.10264
2015	0.19890	362	0.72383	2.06045	0.15580	1.51163	2.80852
2016	0.08850	339	0.23961	0.68208	0.23653	0.42773	1.08766
2017	0.12112	322	0.32974	0.93865	0.20945	0.62019	1.42062

Table 11. Summary of backward selection procedure for building delta-lognormal submodels for gray triggerfish SEAMAP Fall Groundfish Survey index of relative abundance from 1987 to 2007.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 25299.9)*						*Lognormal Submodel Type 3 Tests (AIC 3402.5)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	20	4631	216.19	10.81	<.0001	<.0001	20	1122	6.11	<.0001
Depth Zone	21	4631	397.24	18.92	<.0001	<.0001	21	1122	12.48	<.0001
SSZ Combo	4	4631	271.61	67.90	<.0001	<.0001	4	1122	13.25	<.0001
Time of Day	1	4631	4.21	4.21	0.0403	0.0403	1	1122	0.61	0.4357
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 25299.9)*						*Lognormal Submodel Type 3 Tests (AIC 3399.3)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	20	4631	216.19	10.81	<.0001	<.0001	20	1123	6.11	<.0001
Depth Zone	21	4631	397.24	18.92	<.0001	<.0001	21	1123	12.48	<.0001
SSZ Combo	4	4631	271.61	67.90	<.0001	<.0001	4	1123	13.26	<.0001
Time of Day	1	4631	4.21	4.21	0.0403	0.0403	Dropped			

Table 12. Indices of gray triggerfish abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey from 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	0.25610	164	1.13621	0.63376	0.24159	0.39359	1.02046
1988	0.20737	217	0.94011	0.52438	0.23334	0.33086	0.83108
1989	0.29333	225	1.92292	1.07257	0.19085	0.73474	1.56573
1990	0.13596	228	0.32511	0.18134	0.27790	0.10510	0.31290
1991	0.46667	225	5.82862	3.25110	0.14001	2.46039	4.29591
1992	0.11268	213	0.32348	0.18043	0.31327	0.09785	0.33271
1993	0.32400	250	3.48251	1.94248	0.16814	1.39099	2.71261
1994	0.36245	229	2.96847	1.65576	0.16571	1.19134	2.30121
1995	0.24885	217	1.38472	0.77237	0.21287	0.50696	1.17672
1996	0.21145	227	1.33718	0.74586	0.22569	0.47758	1.16482
1997	0.17937	223	0.67666	0.37743	0.24601	0.23243	0.61289
1998	0.03111	225	0.06214	0.03466	0.55719	0.01225	0.09807
1999	0.27111	225	1.51870	0.84710	0.19938	0.57074	1.25727
2000	0.35874	223	3.38744	1.88945	0.17020	1.34759	2.64920
2001	0.34934	229	4.89308	2.72927	0.17100	1.94352	3.83270
2002	0.21459	233	1.31462	0.73327	0.22058	0.47418	1.13393
2003	0.16923	260	1.00950	0.56308	0.23443	0.35454	0.89429
2004	0.29756	205	1.14509	0.63871	0.19849	0.43108	0.94634
2005	0.29004	231	1.40347	0.78283	0.19041	0.53673	1.14178
2006	0.21076	223	1.17524	0.65553	0.22842	0.41755	1.02914
2007	0.25728	206	1.41388	0.78864	0.21515	0.51536	1.20682

Table 13. Summary of backward selection procedure for building delta-lognormal submodels for gray triggerfish SEAMAP Fall Groundfish Survey index of relative abundance from 2008 to 2017.

Model Run #1	*Binomial Submodel Type 3 Tests (AIC 13,634.8)*						*Lognormal Submodel Type 3 Tests (AIC 1456.3)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	9	2780	118.86	13.21	<.0001	<.0001	9	582	2.09	0.0283
Depth	1	2780	96.23	96.23	<.0001	<.0001	1	582	18.33	<.0001
SSZ	18	2780	117.65	6.54	<.0001	<.0001	18	582	2.65	0.0003
Time of Day	1	2780	0.13	0.13	0.7145	0.7145	1	582	0.01	0.9282
Model Run #2	*Binomial Submodel Type 3 Tests (AIC 13,632.0)*						*Lognormal Submodel Type 3 Tests (AIC 1452.6)*			
Effect	*Num DF*	*Den DF*	*Chi-Square*	*F Value*	*Pr > ChiSq*	*Pr > F*	*Num DF*	*Den DF*	*F Value*	*Pr > F*
Year	9	2781	118.78	13.20	<.0001	<.0001	9	583	2.10	0.0276
Depth	1	2781	96.16	96.16	<.0001	<.0001	1	583	18.36	<.0001
SSZ	18	2781	117.84	6.55	<.0001	<.0001	18	583	2.65	0.0002
Time of Day				Dropped					Dropped	

Table 14. Indices of gray triggerfish abundance developed using the delta-lognormal (DL) model for SEAMAP Fall Groundfish Survey from 2008-2017. 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	0.37644	348	2.02455	2.14359	0.10992	1.72169	2.66888
2009	0.14574	446	0.44410	0.47021	0.16304	0.34010	0.65009
2010	0.16452	310	0.80201	0.84916	0.17998	0.59416	1.21360
2011	0.22831	219	0.83946	0.88882	0.18169	0.61984	1.27453
2012	0.33000	200	1.65994	1.75754	0.15042	1.30312	2.37043
2013	0.15054	186	0.66999	0.70938	0.23761	0.44394	1.13355
2014	0.24679	312	1.11905	1.18485	0.14246	0.89238	1.57318
2015	0.21406	313	0.89066	0.94303	0.15567	0.69202	1.28507
2016	0.12500	192	0.37202	0.39390	0.25822	0.23697	0.65473
2017	0.18662	284	0.62290	0.65952	0.17463	0.46632	0.93278

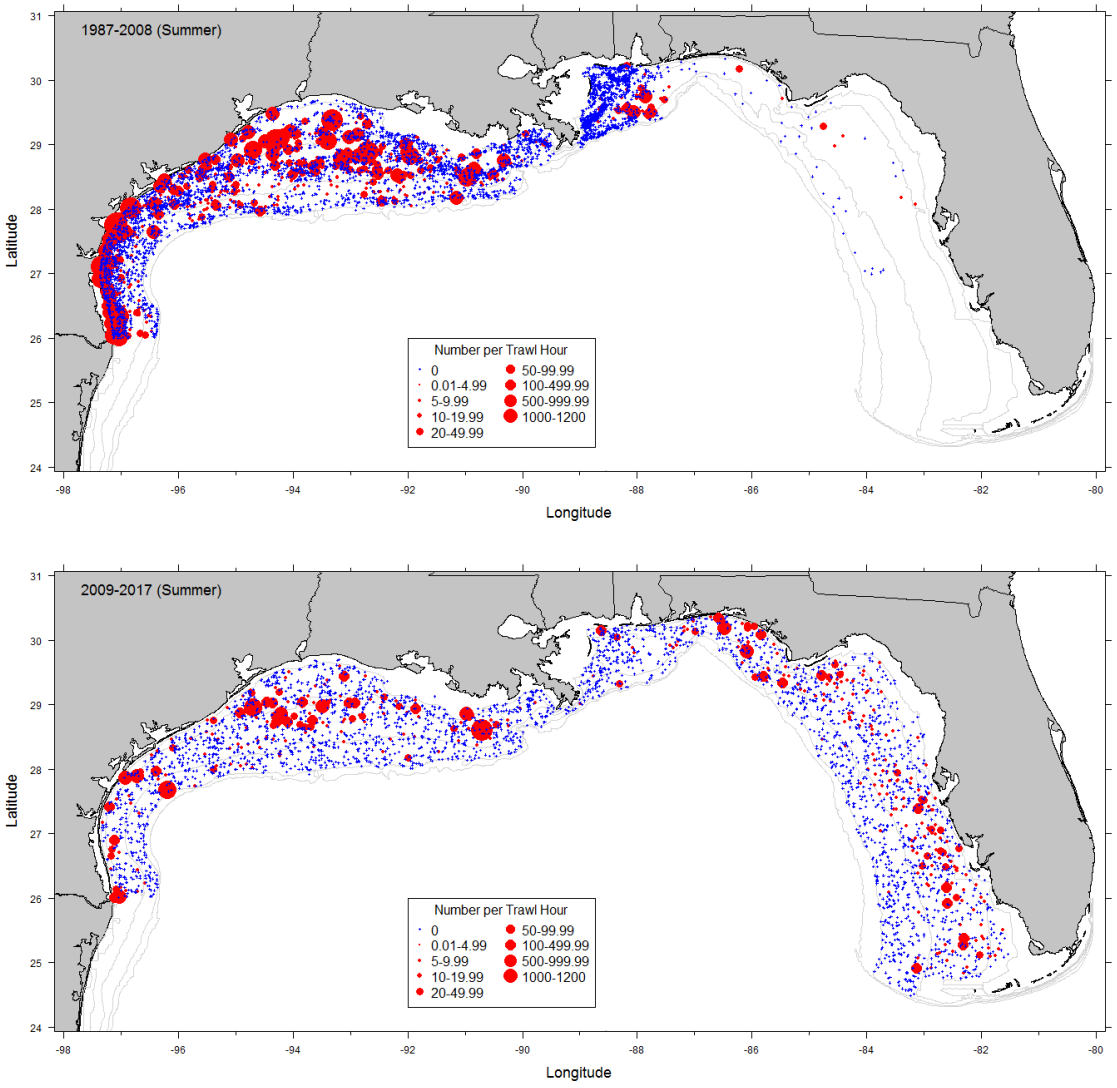


Figure 1. Stations sampled during the Summer SEAMAP Groundfish Survey with the CPUE for gray triggerfish from 1987 – 2008 (top) and 2009 – 2017 (bottom).

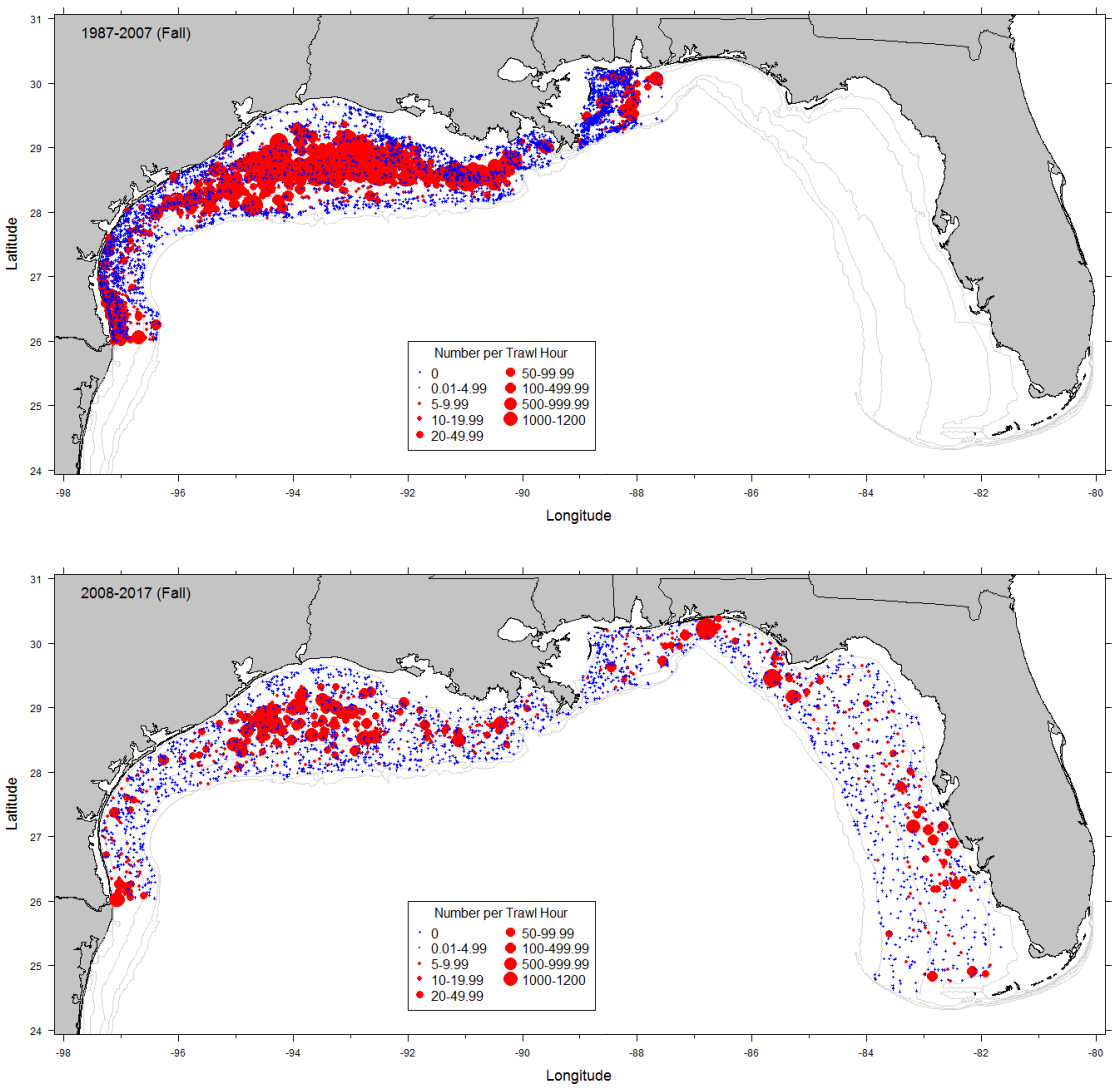


Figure 2. Stations sampled during the Fall SEAMAP Groundfish Survey with the CPUE for gray triggerfish from 1987 – 2007 (top) and 2008 – 2017 (bottom).

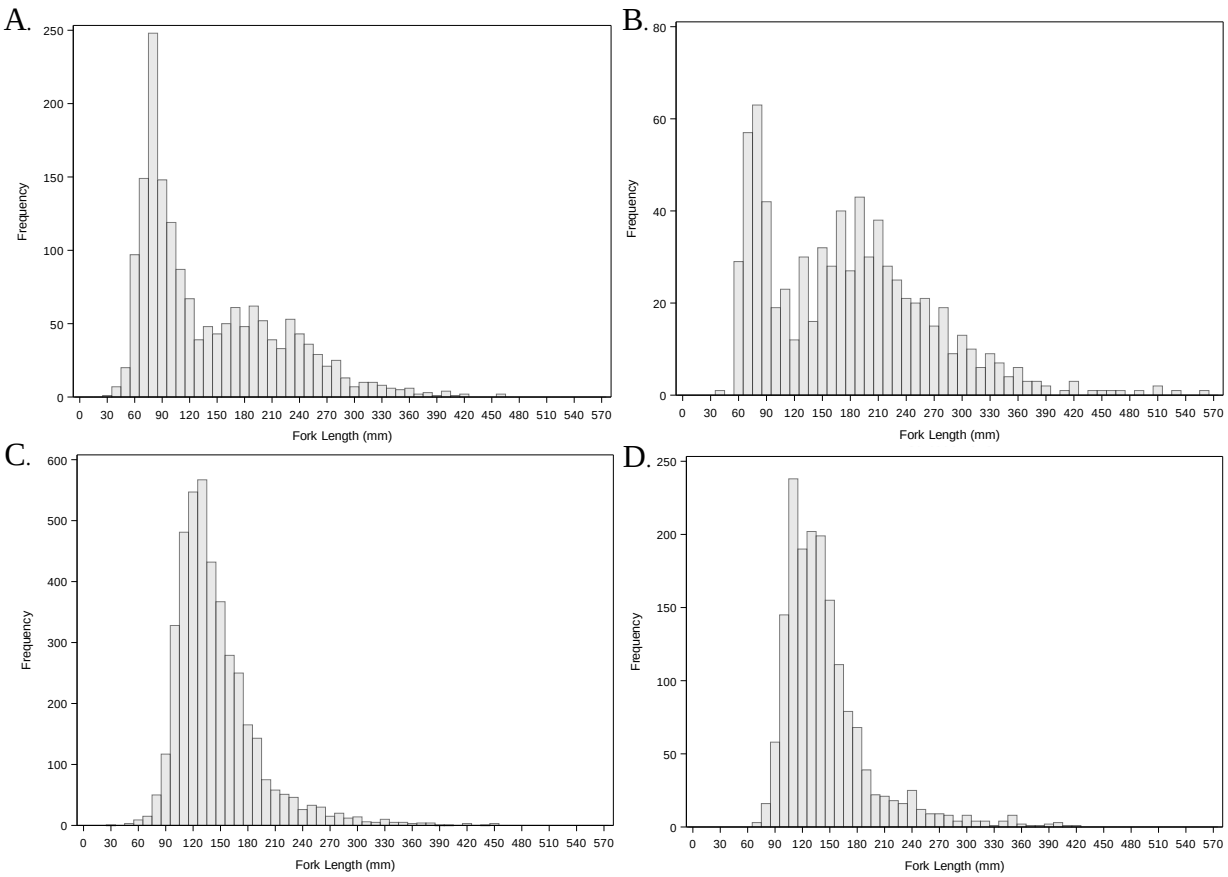


Figure 3. Length frequency histograms for gray triggerfish captured during **A.** Summer (1987-2008), **B.** Summer (2009-2017), **C.** Fall (1987-2007) and **D.** Fall (2008-2017) SEAMAP Groundfish surveys.

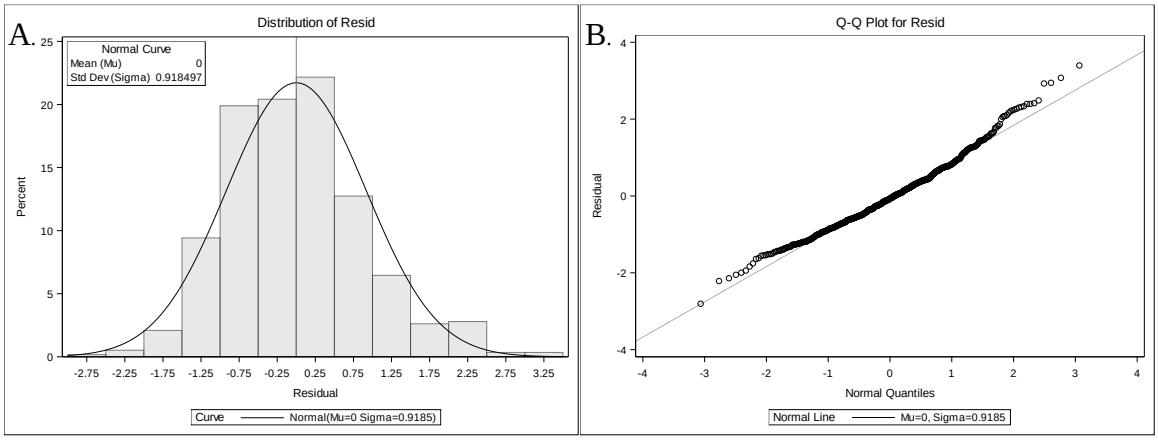


Figure 4. Diagnostic plots for lognormal component of the gray triggerfish SEAMAP Summer Groundfish Survey (1987-2008) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

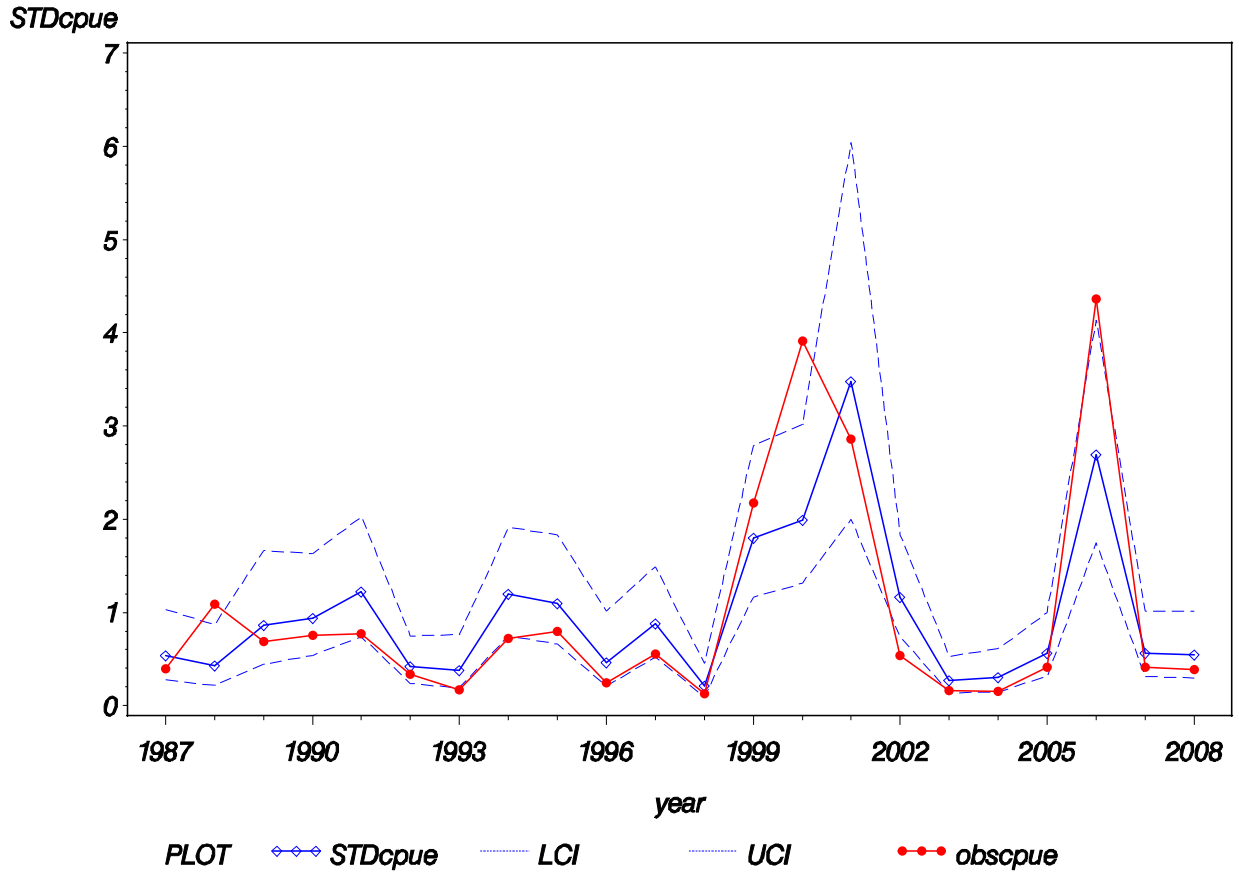


Figure 5. Annual index of abundance for gray triggerfish from the SEAMAP Summer Groundfish Survey from 1987 – 2008.

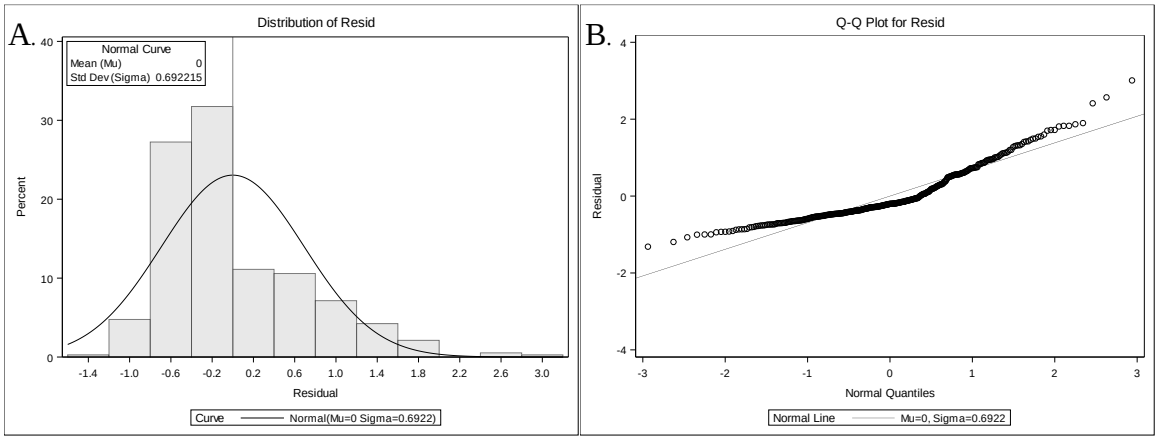


Figure 6. Diagnostic plots for lognormal component of the gray triggerfish SEAMAP Summer Groundfish Survey (2009 - 2017) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

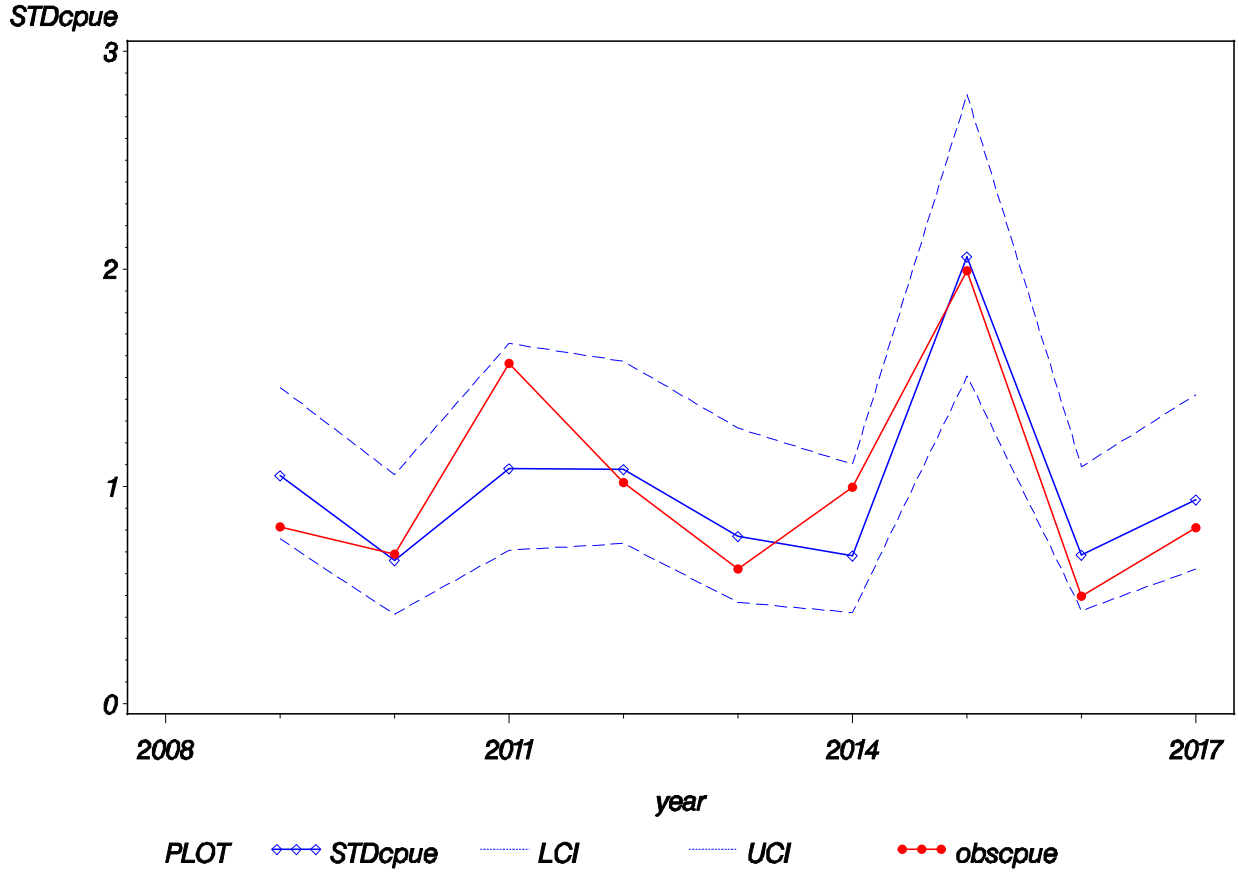


Figure 7. Annual index of abundance for gray triggerfish from the SEAMAP Summer Groundfish Survey from 2009 - 2017.

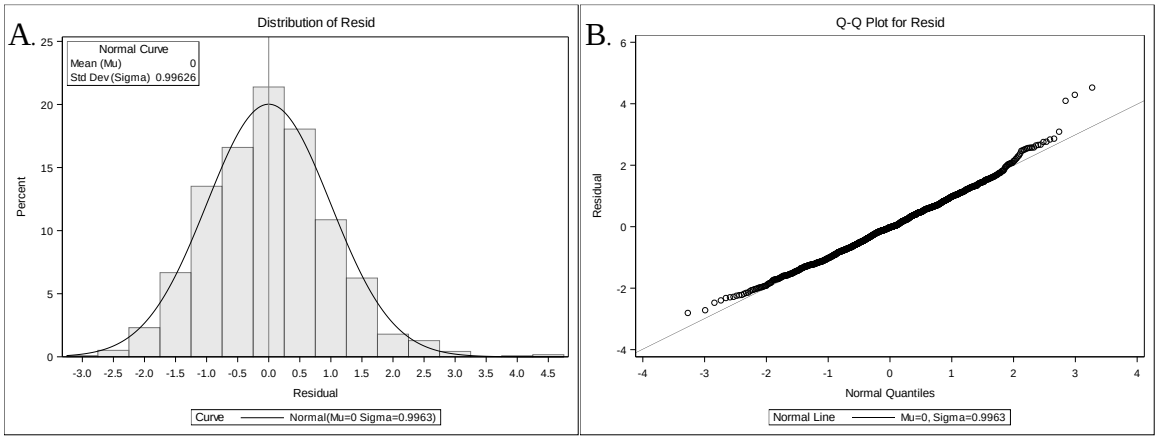


Figure 8. Diagnostic plots for lognormal component of the gray triggerfish SEAMAP Fall Groundfish Survey (1987-2007) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

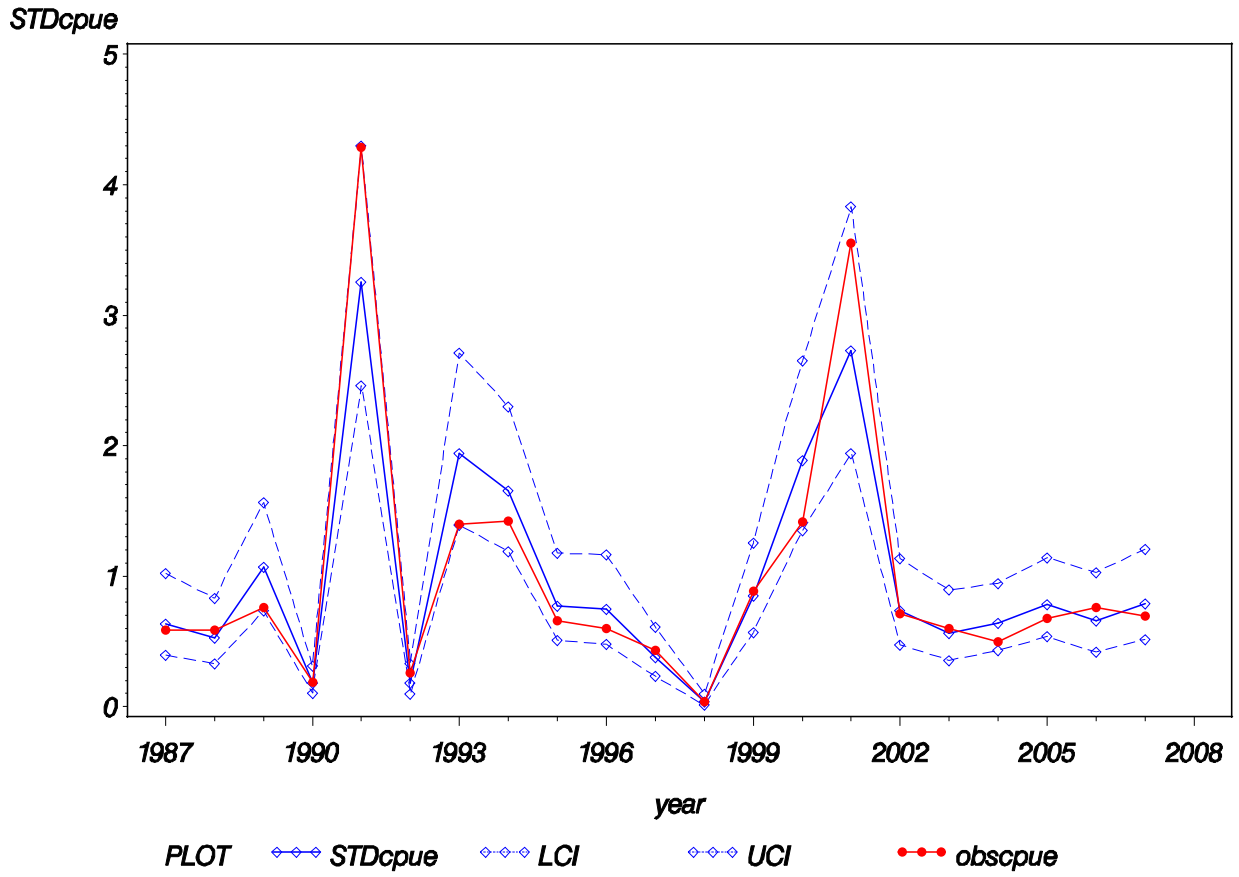


Figure 9. Annual index of abundance for gray triggerfish from the SEAMAP Fall Groundfish Survey from 1987 – 2007.

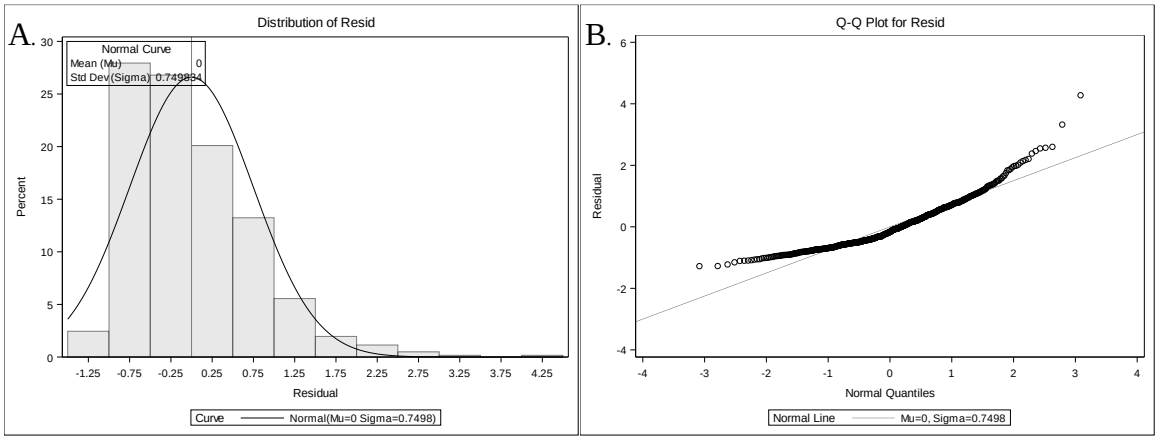


Figure 10. Diagnostic plots for lognormal component of the gray triggerfish SEAMAP Fall Groundfish Survey (2008-2017) model: **A.** the frequency distribution of log (CPUE) on positive stations and **B.** the cumulative normalized residuals (QQ plot).

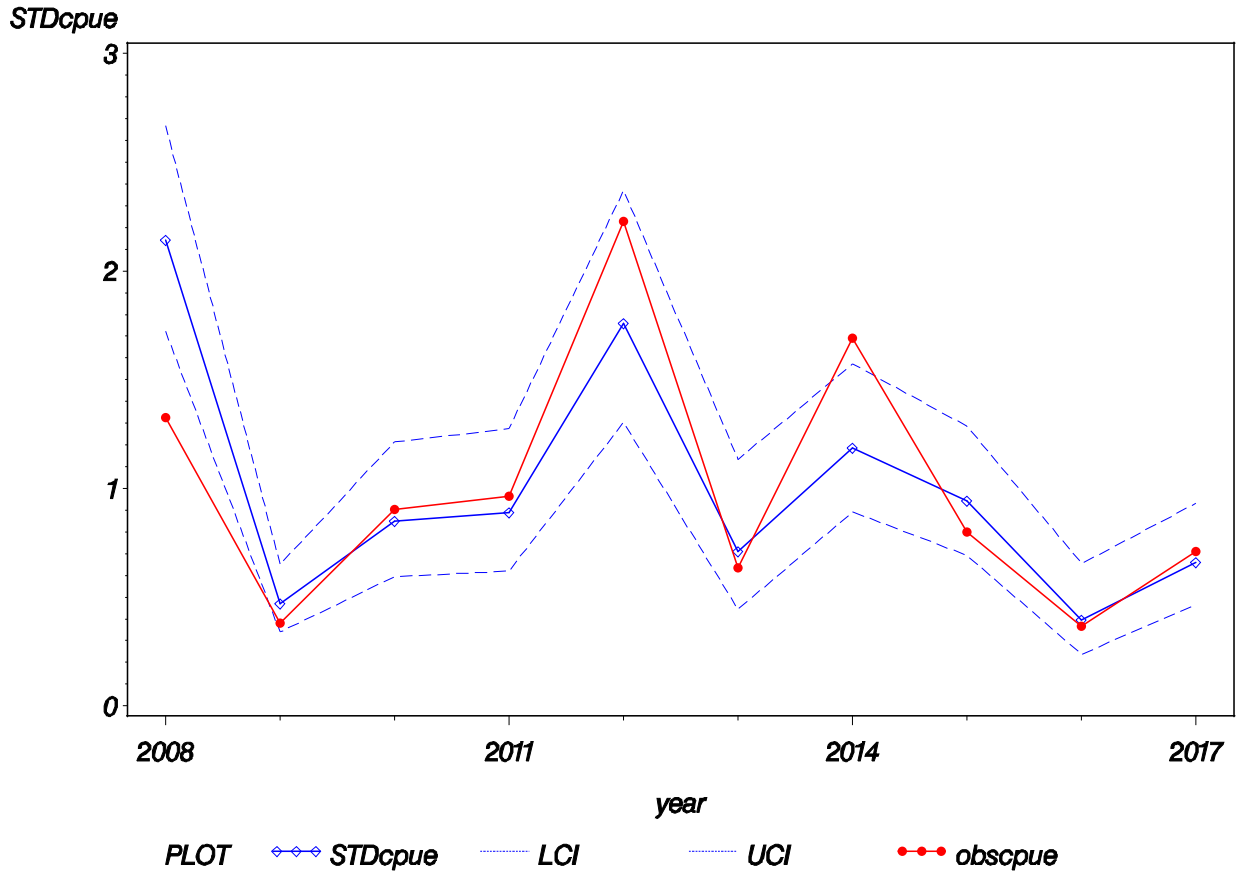


Figure 11. Annual index of abundance for gray triggerfish from the SEAMAP Fall Groundfish Survey from 2008 – 2017.

Appendix

Appendix Table 1. Summary of the factors used in constructing the gray triggerfish abundance index from the SEAMAP Summer Groundfish Survey (1987-2008) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Depth Zone	0506	225	24	0.10667	2.99745
Depth Zone	0607	250	14	0.05600	0.95619
Depth Zone	0708	206	25	0.12136	1.93997
Depth Zone	0809	175	32	0.18286	7.19473
Depth Zone	0910	216	37	0.17130	2.09305
Depth Zone	1011	255	31	0.12157	1.59193
Depth Zone	1112	213	21	0.09859	1.44224
Depth Zone	1213	174	26	0.14943	1.10660
Depth Zone	1314	253	23	0.09091	0.98565
Depth Zone	1415	211	27	0.12796	1.12751
Depth Zone	1516	184	34	0.18478	1.27718
Depth Zone	1617	213	20	0.09390	0.55154
Depth Zone	1718	243	18	0.07407	0.45285
Depth Zone	1819	205	21	0.10244	0.76196
Depth Zone	1920	186	22	0.11828	0.52701
Depth Zone	2022	218	35	0.16055	0.62855
Depth Zone	2225	210	42	0.20000	0.53548
Depth Zone	2530	181	52	0.28729	0.79299
Depth Zone	3035	213	42	0.19718	0.58805
Depth Zone	3540	189	16	0.08466	0.16683
Depth Zone	4045	183	7	0.03825	0.15619
Depth Zone	4550	187	2	0.01070	0.07889
Depth Zone	5060	147	2	0.01361	0.19168
Stat Zone Combo	1011	1071	31	0.02894	0.14657
Stat Zone Combo	1315	853	76	0.08910	0.56374
Stat Zone Combo	1617	893	163	0.18253	1.32938
Stat Zone Combo	1819	845	134	0.15858	2.01721
Stat Zone Combo	2021	1075	169	0.15721	2.07049
Time of Day	Day	2406	275	0.11430	0.82823
Time of Day	Night	2331	298	0.12784	1.61414
Year	1987	267	18	0.06742	0.49176
Year	1988	211	16	0.07583	1.34630
Year	1989	195	18	0.09231	0.85529
Year	1990	241	26	0.10788	0.93020
Year	1991	231	32	0.13853	0.95704
Year	1992	226	24	0.10619	0.41232

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Year	1993	224	16	0.07143	0.21130
Year	1994	238	37	0.15546	0.88932
Year	1995	221	31	0.14027	0.98561
Year	1996	221	12	0.05430	0.30365
Year	1997	207	29	0.14010	0.68870
Year	1998	205	13	0.06341	0.15566
Year	1999	223	43	0.19283	2.69566
Year	2000	216	48	0.22222	4.85224
Year	2001	152	26	0.17105	3.54736
Year	2002	228	40	0.17544	0.66062
Year	2003	181	17	0.09392	0.20453
Year	2004	216	15	0.06944	0.18579
Year	2005	183	24	0.13115	0.50548
Year	2006	221	44	0.19910	5.41380
Year	2007	200	23	0.11500	0.50850
Year	2008	230	21	0.09130	0.47600

Appendix Table 2. Summary of the factors used in constructing the gray triggerfish abundance index from the SEAMAP Summer Groundfish Survey (2009-2017) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Stat Zone	2	75	4	0.05333	0.34667
Stat Zone	3	237	25	0.10549	0.41045
Stat Zone	4	245	42	0.17143	0.52201
Stat Zone	5	216	39	0.18056	0.57258
Stat Zone	6	227	24	0.10573	0.24673
Stat Zone	7	124	29	0.23387	0.75780
Stat Zone	8	132	19	0.14394	0.59081
Stat Zone	9	102	17	0.16667	1.07431
Stat Zone	10	101	10	0.09901	0.23601
Stat Zone	11	197	7	0.03553	0.18377
Stat Zone	13	75	1	0.01333	0.02656
Stat Zone	14	140	12	0.08571	1.13787
Stat Zone	15	168	10	0.05952	0.29678
Stat Zone	16	219	20	0.09132	0.43698
Stat Zone	17	273	32	0.11722	0.59010
Stat Zone	18	259	43	0.16602	1.17543
Stat Zone	19	189	15	0.07937	0.23117
Stat Zone	20	190	16	0.08421	1.04552
Stat Zone	21	137	13	0.09489	0.69664
Time of Day	Day	2431	279	0.11477	0.92107
Time of Day	Night	2306	294	0.12749	1.62025
Year	2009	529	69	0.13043	0.46467
Year	2010	379	30	0.07916	0.39363
Year	2011	329	37	0.11246	0.89555
Year	2012	399	47	0.11779	0.57765
Year	2013	297	26	0.08754	0.35500
Year	2014	350	28	0.08000	0.56941
Year	2015	362	72	0.19890	1.13947
Year	2016	339	30	0.08850	0.28307
Year	2017	322	39	0.12112	0.46366

Appendix Table 3. Summary of the factors used in constructing the gray triggerfish abundance index from the SEAMAP Fall Groundfish Survey (1987-2007) data.

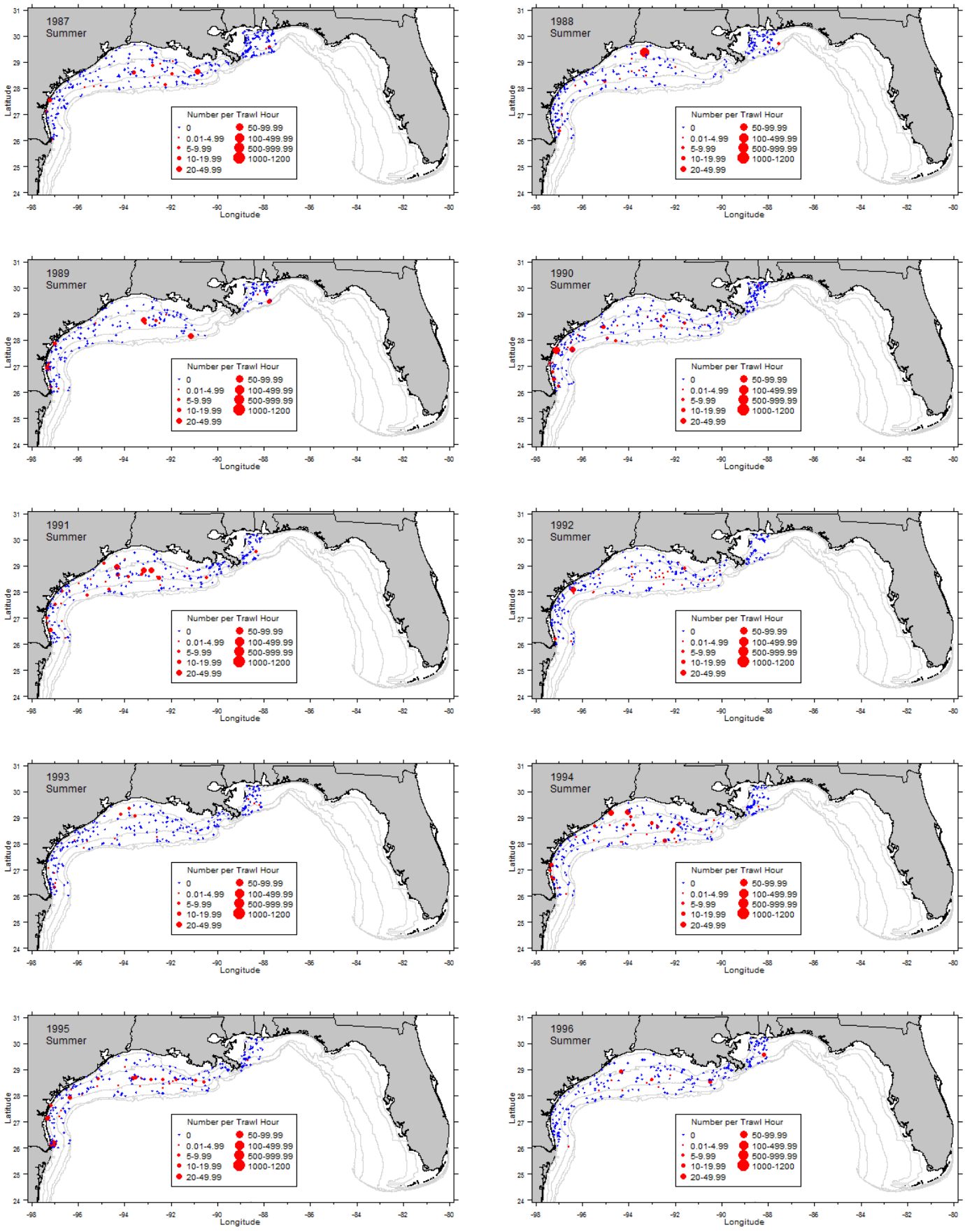
Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Depth Zone	0506	212	3	0.01415	0.1321
Depth Zone	0607	241	10	0.04149	0.2278
Depth Zone	0708	209	11	0.05263	0.4568
Depth Zone	0809	178	18	0.10112	0.9457
Depth Zone	0910	209	35	0.16746	1.2709
Depth Zone	1011	243	47	0.19342	2.1796
Depth Zone	1112	214	57	0.26636	2.7015
Depth Zone	1213	175	63	0.36000	6.4417
Depth Zone	1314	246	63	0.25610	8.1598
Depth Zone	1415	201	69	0.34328	4.9025
Depth Zone	1516	184	66	0.35870	6.3751
Depth Zone	1617	208	74	0.35577	5.9272
Depth Zone	1718	232	76	0.32759	3.9703
Depth Zone	1819	203	75	0.36946	4.1138
Depth Zone	1920	183	77	0.42077	5.0531
Depth Zone	2022	214	94	0.43925	8.8982
Depth Zone	2225	198	95	0.47980	4.1761
Depth Zone	2530	201	100	0.49751	2.9163
Depth Zone	3035	204	74	0.36275	1.0254
Depth Zone	3540	193	39	0.20207	0.6249
Depth Zone	4045	191	16	0.08377	0.1598
Depth Zone	45+	339	7	0.02065	0.0783
Stat Zone Combo	1011	972	86	0.08848	0.4804
Stat Zone Combo	1315	945	229	0.24233	2.7555
Stat Zone Combo	1617	931	374	0.40172	7.2423
Stat Zone Combo	1819	833	282	0.33854	4.4198
Stat Zone Combo	2021	997	198	0.19860	1.1393
Time of Day	Day	2328	613	0.26332	3.4822
Time of Day	Night	2350	556	0.23660	2.7764
Year	1987	164	42	0.25610	1.8132
Year	1988	217	45	0.20737	1.8046
Year	1989	225	66	0.29333	2.3490
Year	1990	228	31	0.13596	0.5825
Year	1991	225	105	0.46667	13.2396
Year	1992	213	24	0.11268	0.8057

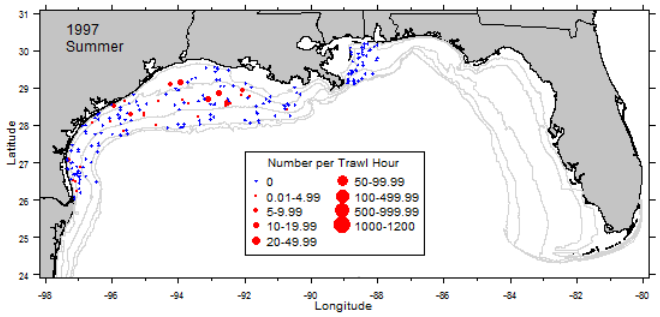
Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Year	1993	250	81	0.32400	4.3229
Year	1994	229	83	0.36245	4.3857
Year	1995	217	54	0.24885	2.0247
Year	1996	227	48	0.21145	1.8479
Year	1997	223	40	0.17937	1.3289
Year	1998	225	7	0.03111	0.1193
Year	1999	225	61	0.27111	2.7429
Year	2000	223	80	0.35874	4.3762
Year	2001	229	80	0.34934	10.9843
Year	2002	233	50	0.21459	2.2034
Year	2003	260	44	0.16923	1.8413
Year	2004	205	61	0.29756	1.5290
Year	2005	231	67	0.29004	2.0950
Year	2006	223	47	0.21076	2.3534
Year	2007	206	53	0.25728	2.1377

Appendix Table 4. Summary of the factors used in constructing the gray triggerfish abundance index from the SEAMAP Fall Groundfish Survey (2008-2017) data.

Factor	Level	Number of Observations	Number of Positive Observations	Proportion Positive	Mean CPUE
Stat Zone	2	36	5	0.13889	0.83333
Stat Zone	3	98	11	0.11224	0.32617
Stat Zone	4	128	33	0.25781	1.09166
Stat Zone	5	154	35	0.22727	0.97732
Stat Zone	6	154	28	0.18182	0.53033
Stat Zone	7	99	12	0.12121	0.36263
Stat Zone	8	119	37	0.31092	1.65823
Stat Zone	9	79	22	0.27848	5.10996
Stat Zone	10	76	17	0.22368	1.07798
Stat Zone	11	191	19	0.09948	0.26102
Stat Zone	13	64	5	0.07813	0.24940
Stat Zone	14	145	27	0.18621	0.81042
Stat Zone	15	166	35	0.21084	0.89619
Stat Zone	16	228	56	0.24561	1.51146
Stat Zone	17	292	75	0.25685	1.88788
Stat Zone	18	268	92	0.34328	3.49020
Stat Zone	19	173	29	0.16763	0.84943
Stat Zone	20	203	24	0.11823	0.39225
Stat Zone	21	137	50	0.36496	1.82431
Time of Day	Day	1357	295	0.21739	1.39472
Time of Day	Night	1453	317	0.21817	1.30759
Year	2008	348	131	0.37644	1.84092
Year	2009	446	65	0.14574	0.52544
Year	2010	310	51	0.16452	1.25290
Year	2011	219	50	0.22831	1.33530
Year	2012	200	66	0.33000	3.09078
Year	2013	186	28	0.15054	0.87923
Year	2014	312	77	0.24679	2.34431
Year	2015	313	67	0.21406	1.10829
Year	2016	192	24	0.12500	0.50905
Year	2017	284	53	0.18662	0.98242

Appendix Figure 1. Annual survey effort and catch of gray triggerfish from the SEAMAP Summer Groundfish Survey.

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50-99.99
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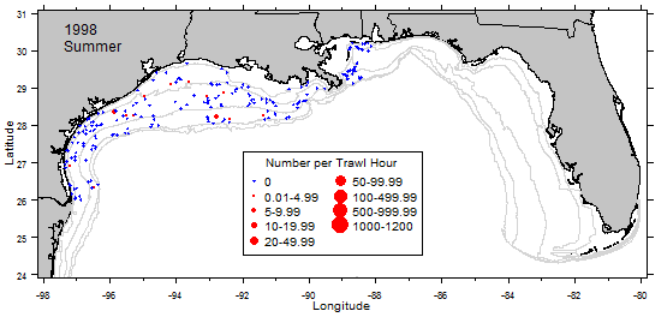
1000-1200
Latitude
Longitude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Summer
Number per Trawl Hour
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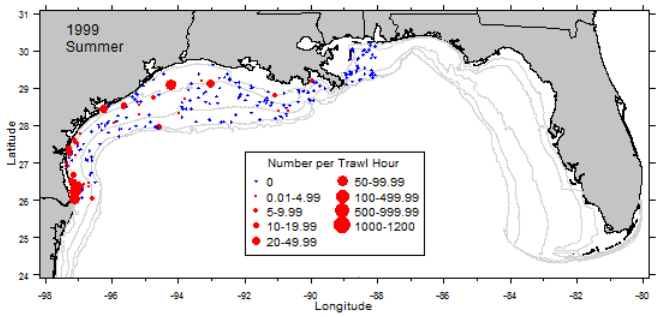
1000-1200
Latitude
Longitude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Summer
Number per Trawl Hour
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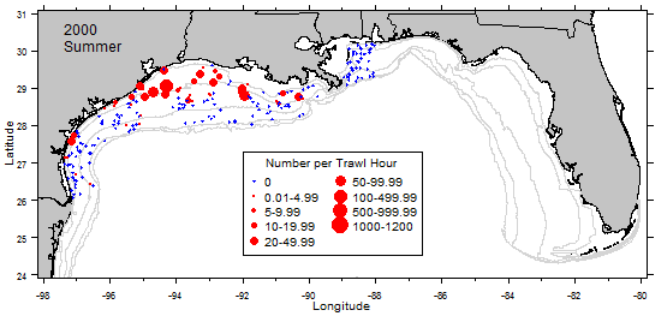
1000-1200
Latitude
Longitude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Summer
Number per Trawl Hour
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Latitude
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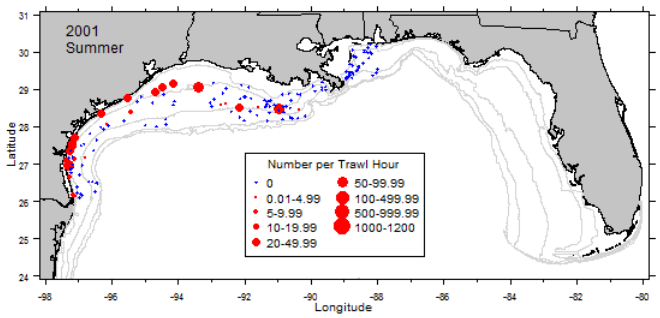
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Summer
Number per Trawl Hour
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Latitude
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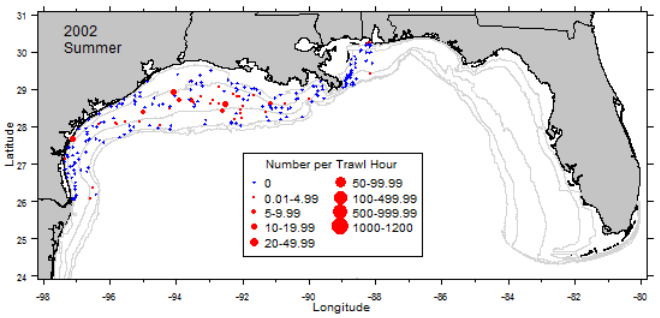
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Summer
Number per Trawl Hour
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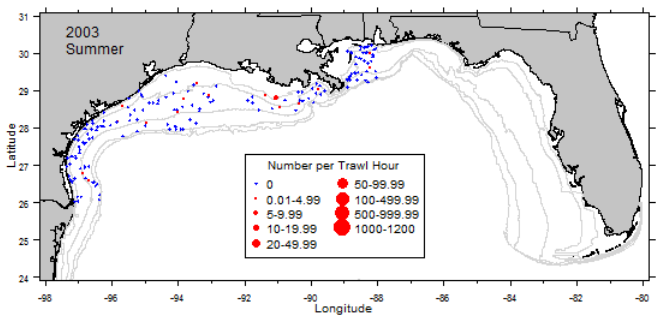
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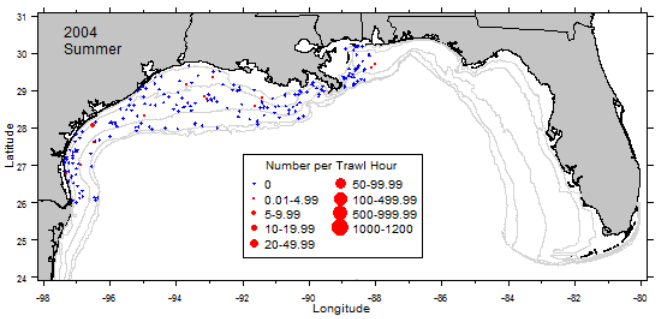
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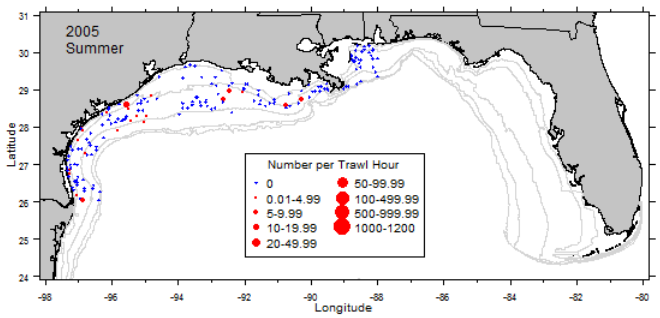
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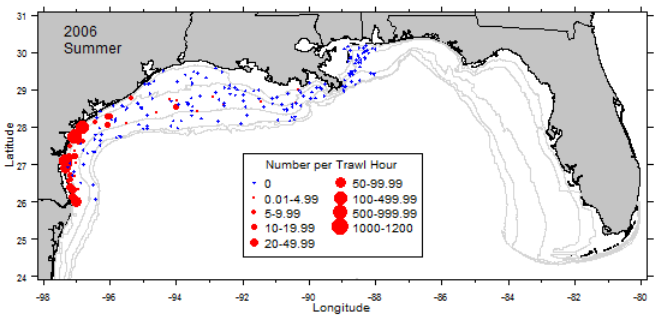
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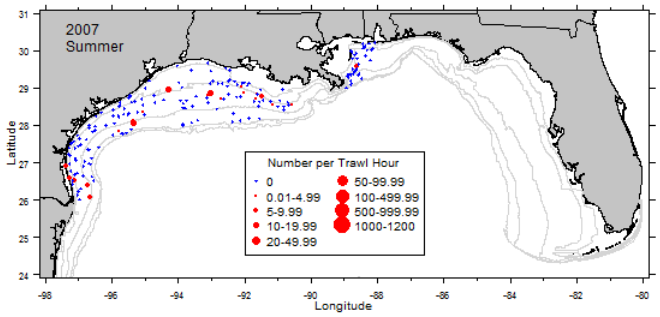
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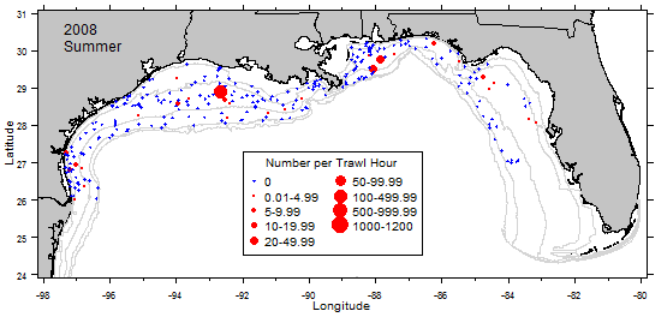
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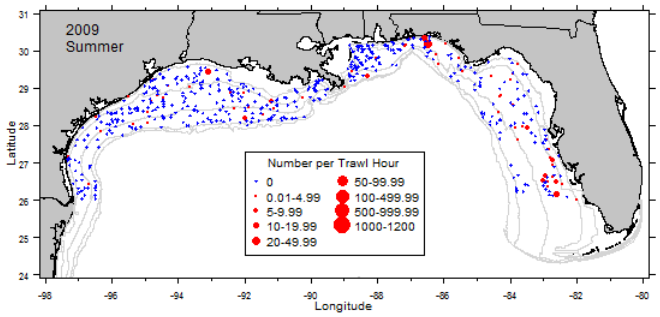
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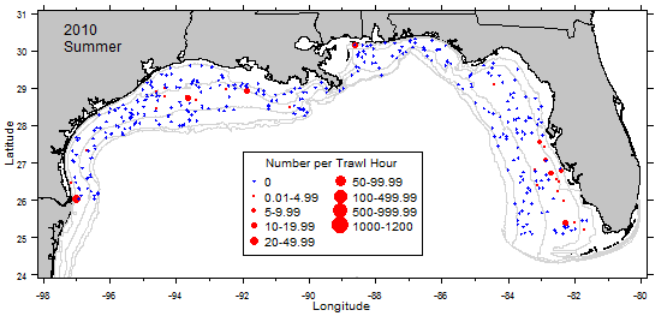
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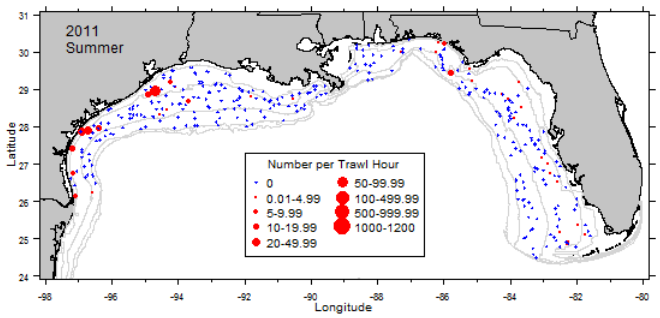
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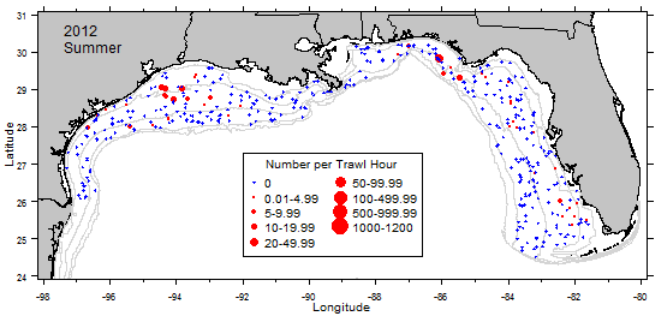
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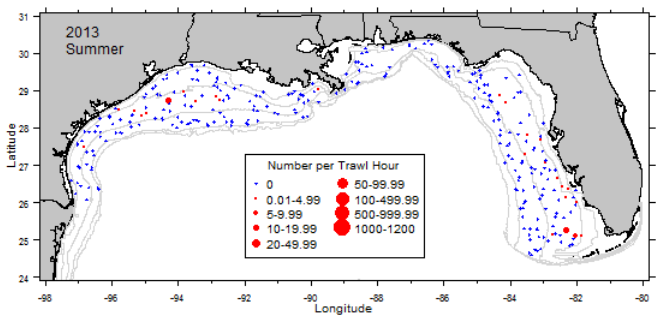
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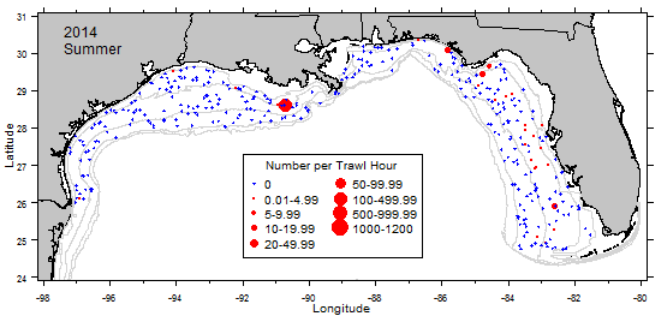
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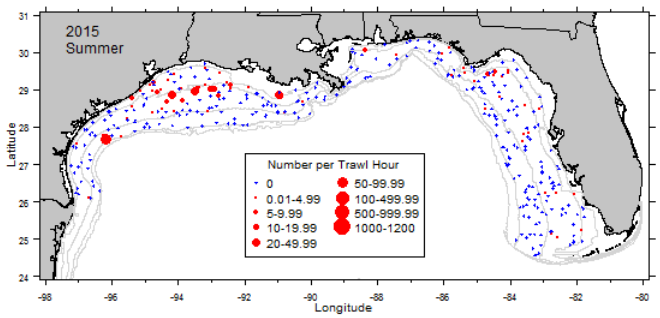
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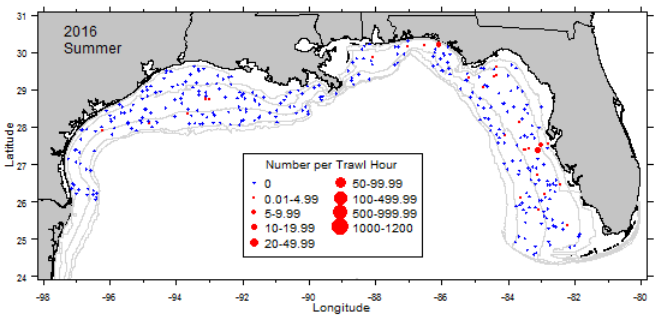
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Summer
Number per Trawl Hour
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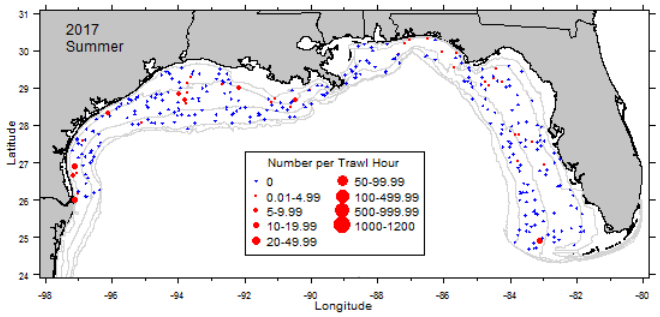
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1000-1200
Latitude
Longitude
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30
29
28
27
26
25
24
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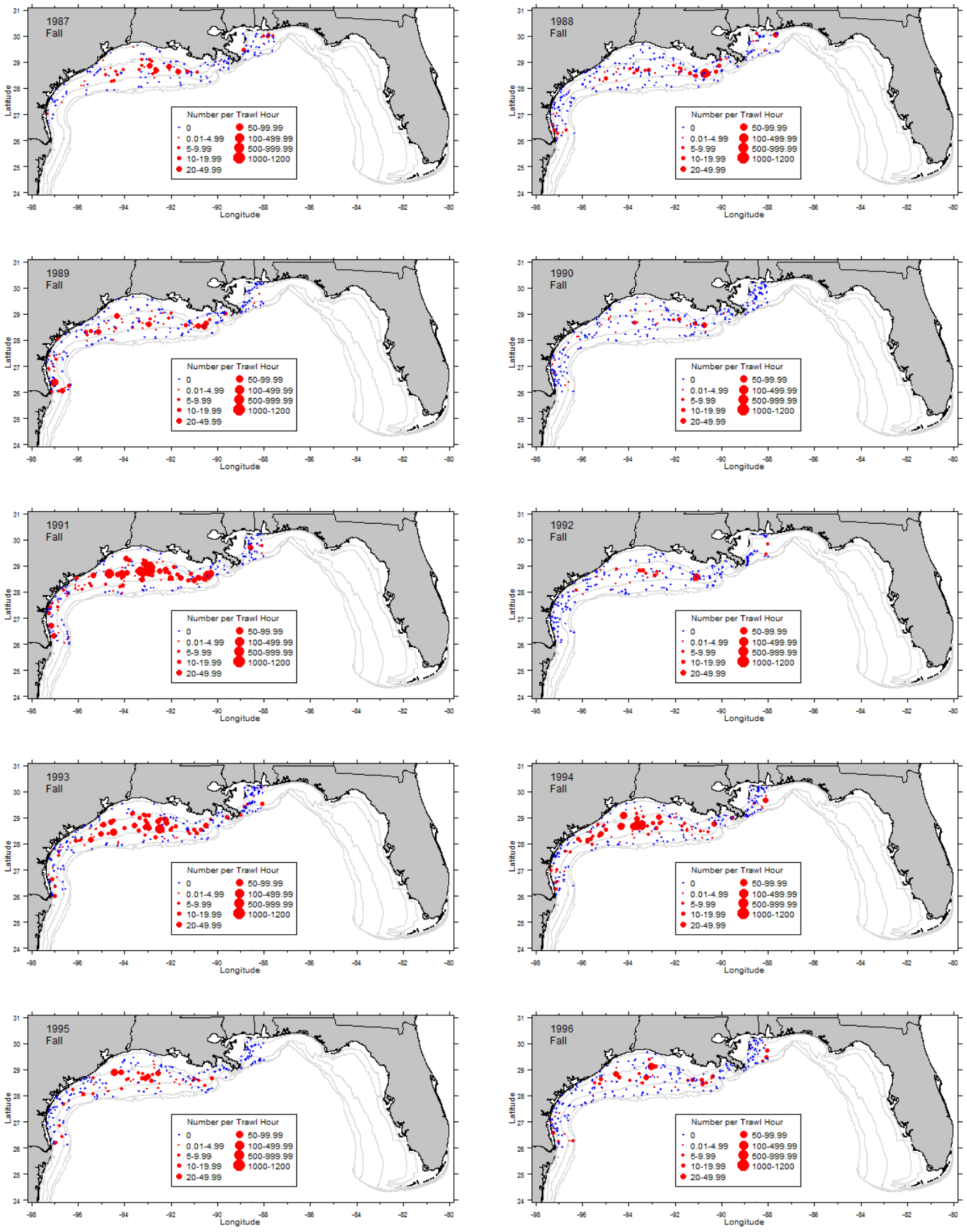
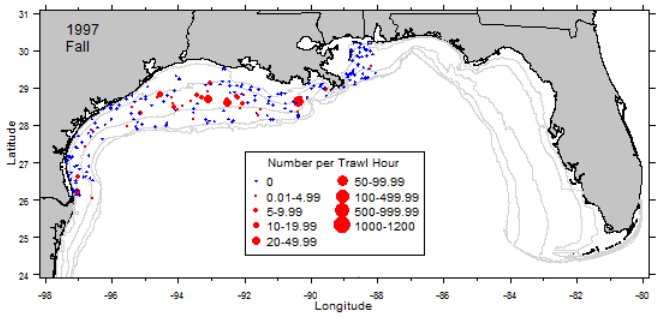
Appendix Figure 2. Annual survey effort and catch of gray triggerfish from the SEAMAP Fall Groundfish Survey.

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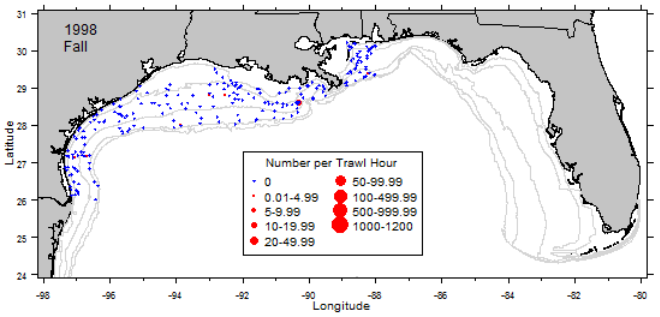
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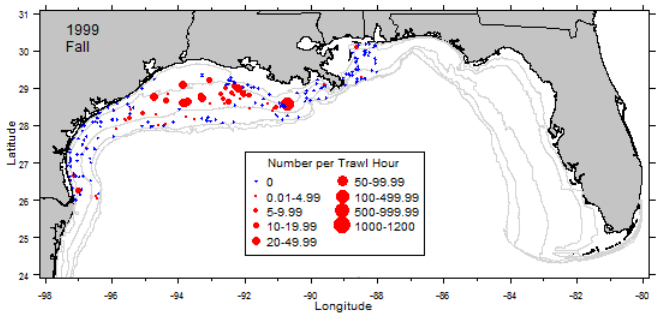
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Fall
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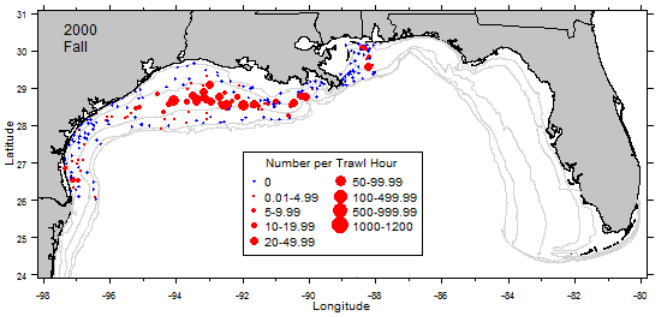
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Fall
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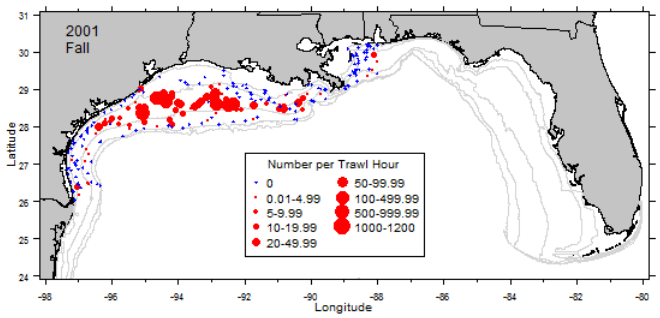
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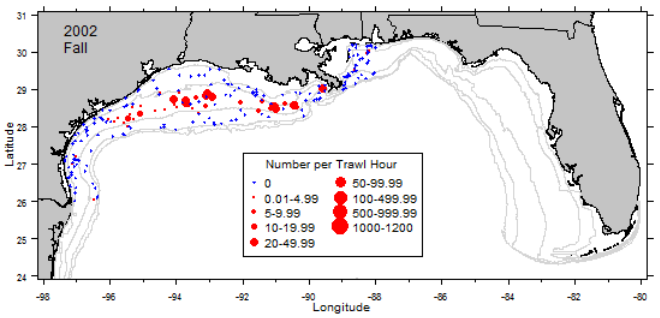
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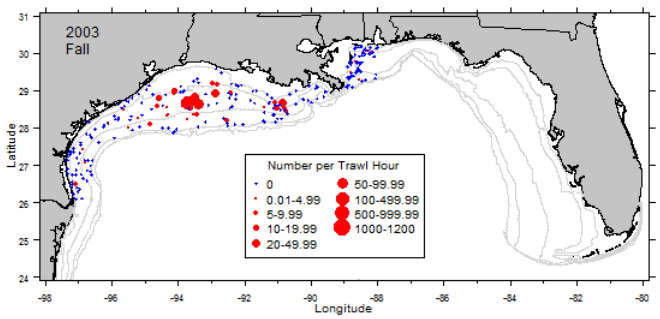
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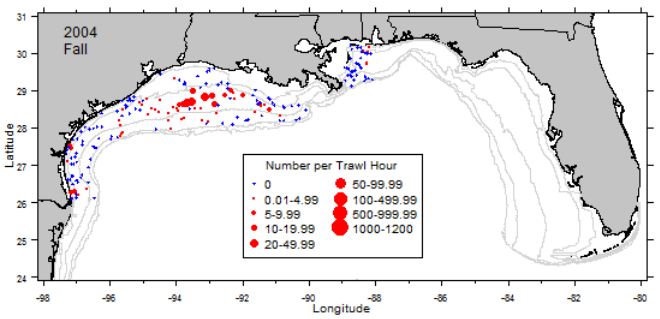
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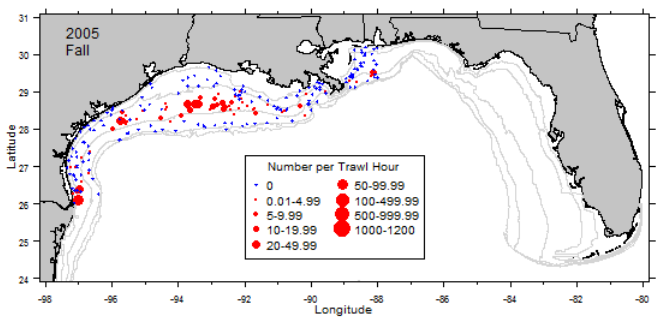
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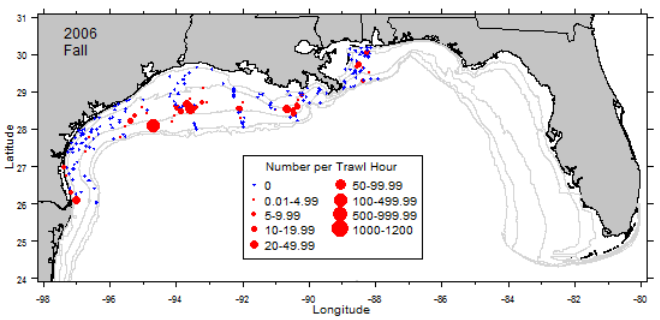
Latitude
Longitude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Fall
Number per Trawl Hour
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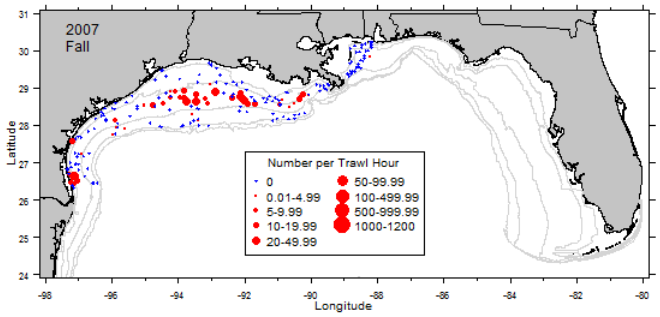
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Fall
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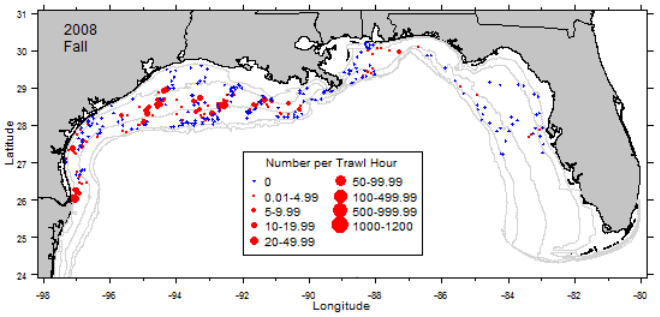
2008
Fall
Number per Trawl Hour
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Latitude
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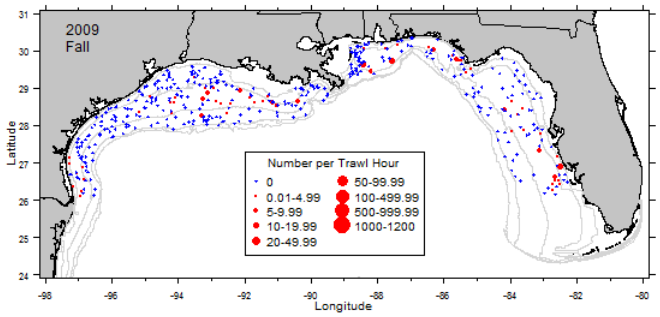
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Fall
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Latitude
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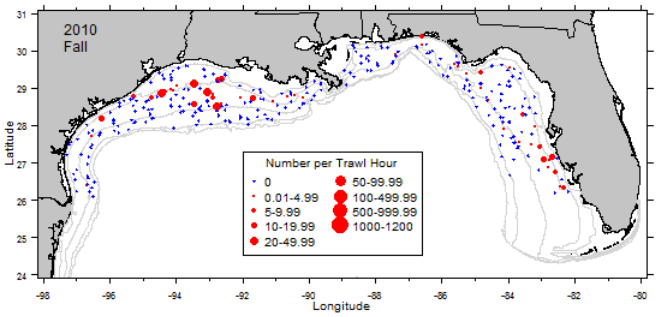
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Fall
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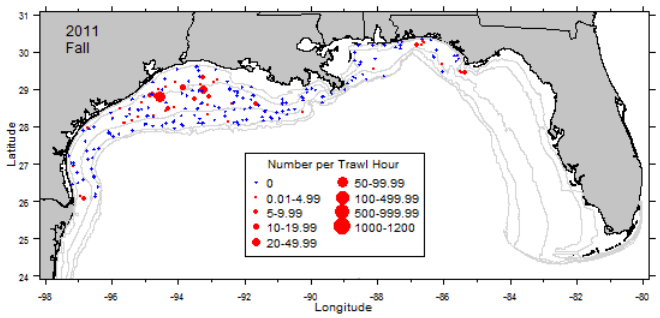
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Fall
Number per Trawl Hour
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Latitude
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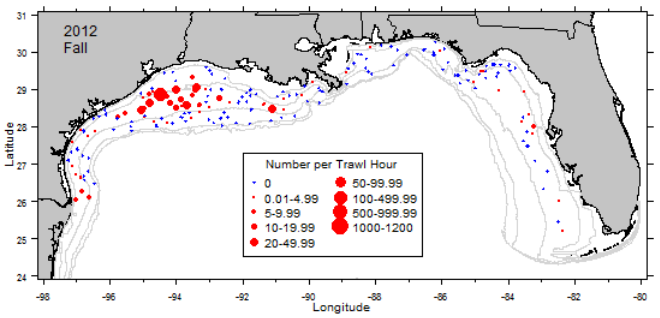
2012
Fall
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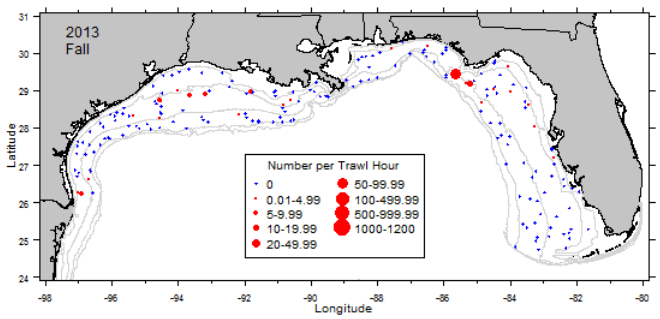
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Fall
Number per Trawl Hour
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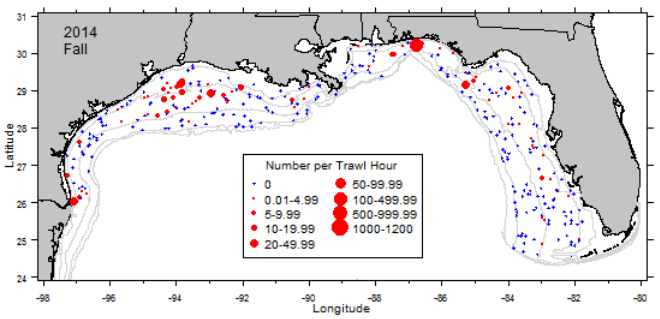
2014
Fall
Number per Trawl Hour
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1000-1200
Latitude
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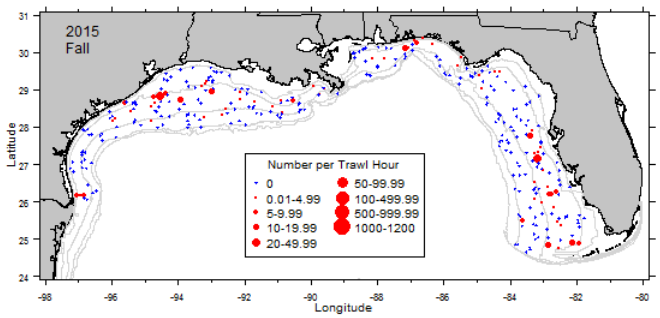
2015
Fall
Number per Trawl Hour
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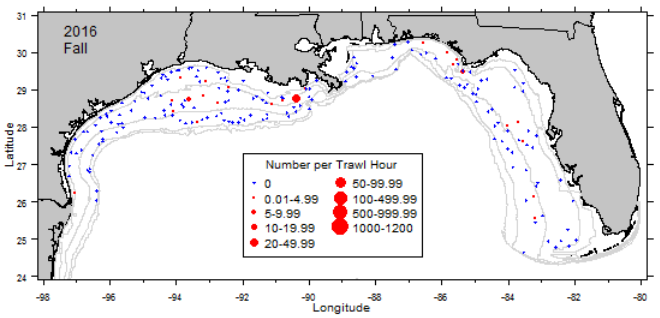
1000-1200
Latitude
Longitude


2016
Fall
Number per Trawl Hour
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20-49.99
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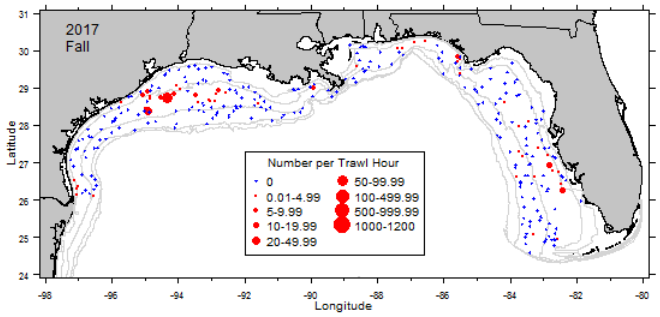
100-499.99
500-999.99
1000-1200
Latitude
Longitude


2017
Fall
Number per Trawl Hour
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10-19.99
20-49.99
50-99.99
100-499.99
500-999.99
1000-1200
Latitude
Longitude
31
30
29
28
27
26
25
24
-98
-96
-94
-92
-90
-88
-86
-84
-82
-80