SEAMAP Reef Fish Survey of Offshore Banks

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Introduction

The objective of the annual Southeast Area Monitoring and Assessment Program (SEAMAP) offshore reef fish survey is to provide an index of the relative abundances of fish species associated with topographic features (banks, ledges) located on the continental shelf of the Gulf of Mexico (Gulf) in the area from Brownsville, TX to the Dry Tortugas, FL (Figure 1). The total reef area surveyed is approximately 1771 km²; 1244 km² in the eastern and 527 km² in the western Gulf. The offshore reef fish survey was initiated in 1992, with sampling conducted during the months of May to August from 1992-1997, and in 2001-2002. No surveys were conduced from 1998 to 2000. The 2001 survey was abbreviated due to ship scheduling.

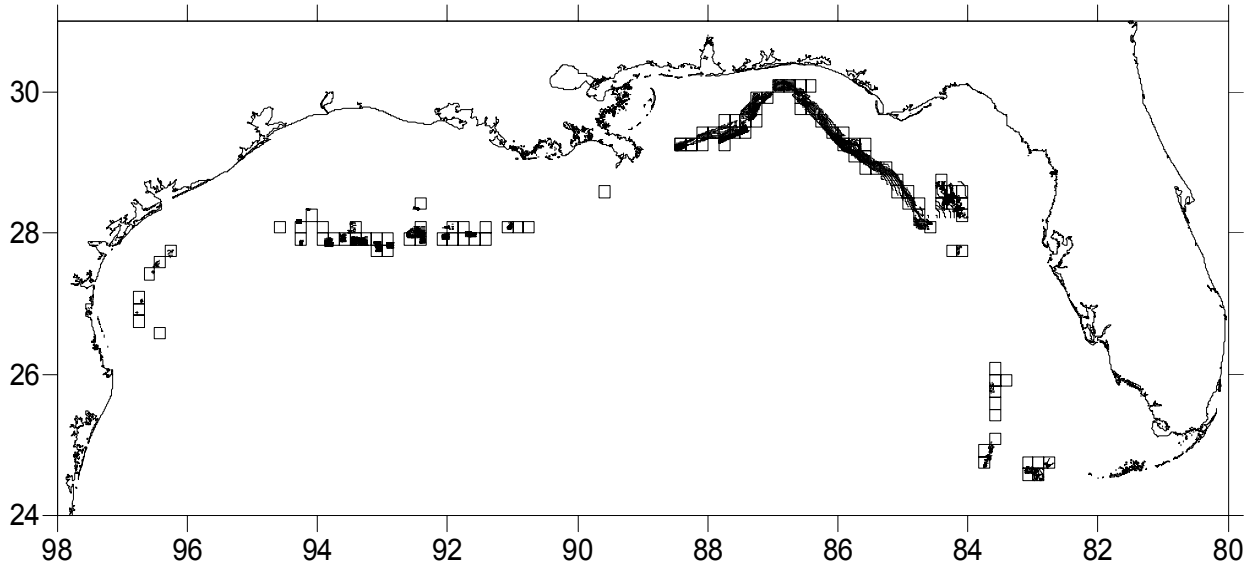

Figure 1. Gulf of Mexico shelf-edge banks sampled by SEAMAP offshore reef fish survey, and first-stage sample blocks.

Sample Design

The survey area is large, therefore a two-stage sampling design is used to minimize travel times between sample stations. The first-stage or primary sampling units (PSUs) are blocks 10 minutes of latitude by 10 minutes of longitude (Figures 2 and 3). The first-stage units are selected by stratified random sampling. The blocks were stratified, with strata defined by geographic region (4 regions: South Florida, Northeast Gulf, Louisians-Texas Shelf, and

SouthTexas), and by reef habitat area (Blocks # 20 km² reef, Block > 20 km² reef). There are a total of 7 strata. The ultimate sample sites (second stage units) within a block are selected randomly. However, stratum 1 (South Florida, small blocks) and stratum 7 (S. Texas, small blocks) were not consistently sampled. So, these were dropped from annual indices.

Gear

The SEAMAP reef fish survey currently employs four Sony VX2000 DCR digital camcorders mounted in Gates PD150M underwater housings. The housings are rated to a maximum depth of 150 meters. The four Sony VX2000 camcorders are mounted orthogonally and a height of 30 cm above the bottom of the pod. A chevron (or arrow) fish trap with 1.5-inch vinyl-clad mesh is used to capture fish for biological samples. In its greatest dimensions, the trap is 1.76 m in length, 1.52 m in width and 0.61 m in depth. A 0.4 m by 0.29 m blow out panel is placed on one side and kept closed using 7-day magnesium releases. The magnesium releases are examined after each soak and replaced as needed. The trap is deployed at a randomly selected subset of video stations. Both the camera pod and fish trap are baited with squid.

Video tape viewing procedures

One video tape from each station is selected out of the four for viewing. If all four video cameras face reef fish habitat and are in focus, the viewed tape is selected randomly. Tape viewers examine 20 minutes of the selected video tape, identify, and enumerate all species for the duration of the tape. Identifications are made to the lowest taxonomic level and the time when each fish enters and leaved the field of view is recorded. This is referred as a time in - time out procedure (TITO).

Tapes are viewed from the time when the view clears from any silt plume raised by the gear when it landed. Less than 20 minutes may be viewed if the duration when water is not clear enough to count fish is less than 20 minutes, or if the camera array is dragged. If a tape contains a large amount of fish, it is sub-sampled. There are four cases for sub-sampling: 1) when there is generally a large number of fish of a given species present throughout the tape so that following individual fish is difficult; 2) large number of fish occur in pulses periodically during the tape; 3) a single school of fish; and, 4) multiple schools of fish. Three estimators of relative abundance are available from the video data: 1) presence and absence; 2) maximum count (each fish of each taxon is counted each time it appears on the screen); and, 3) a minimum count (the greatest number of a taxon that appears on screen at one time). Presence and absence (frequency of occurrence) and minimum count estimators are advantageous because they avoid the potential of multiple counting of fish, and are reported here.

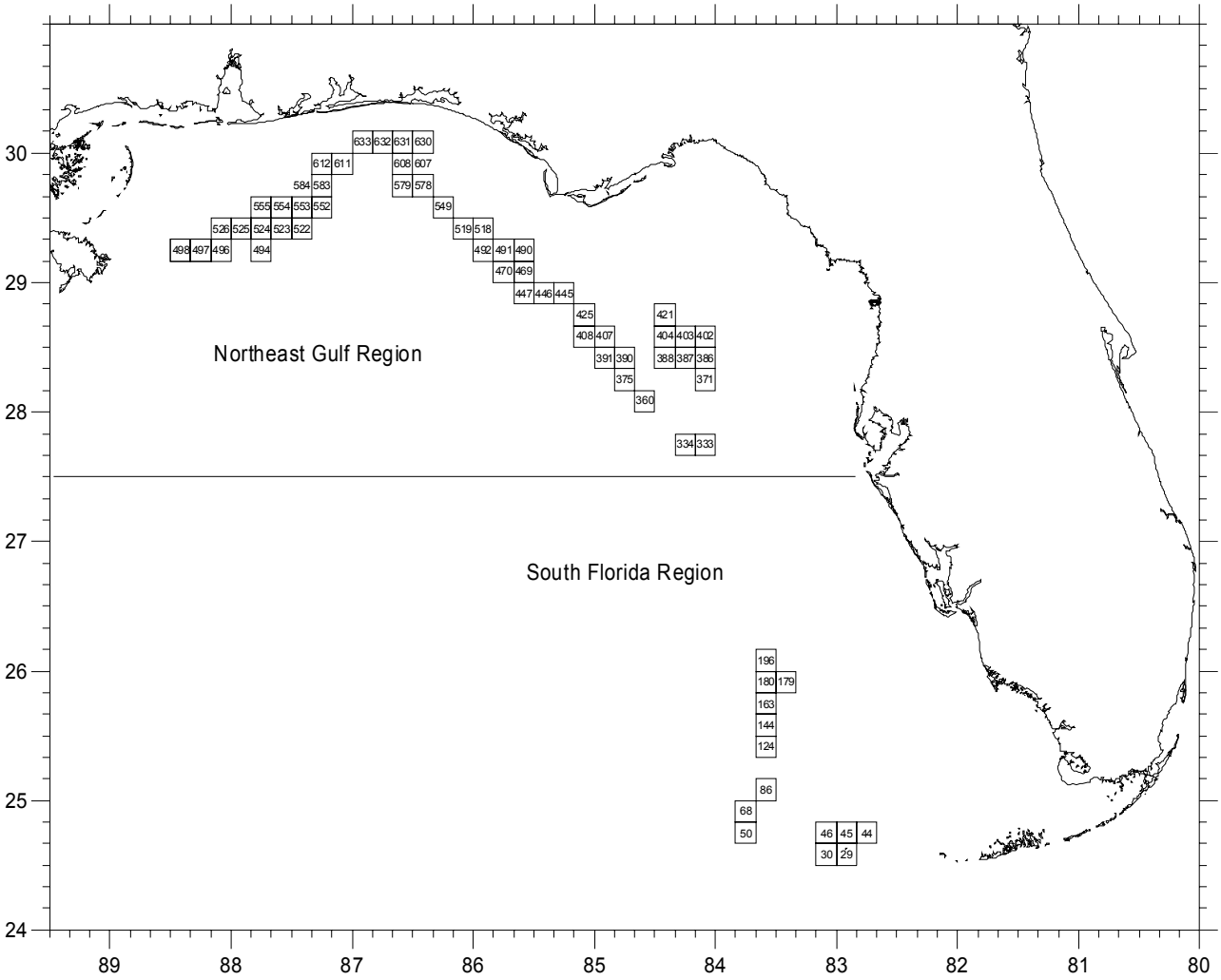

Figure 2. SEAMAP reef fish survey sample blocks in the eastern Gulf of Mexico.

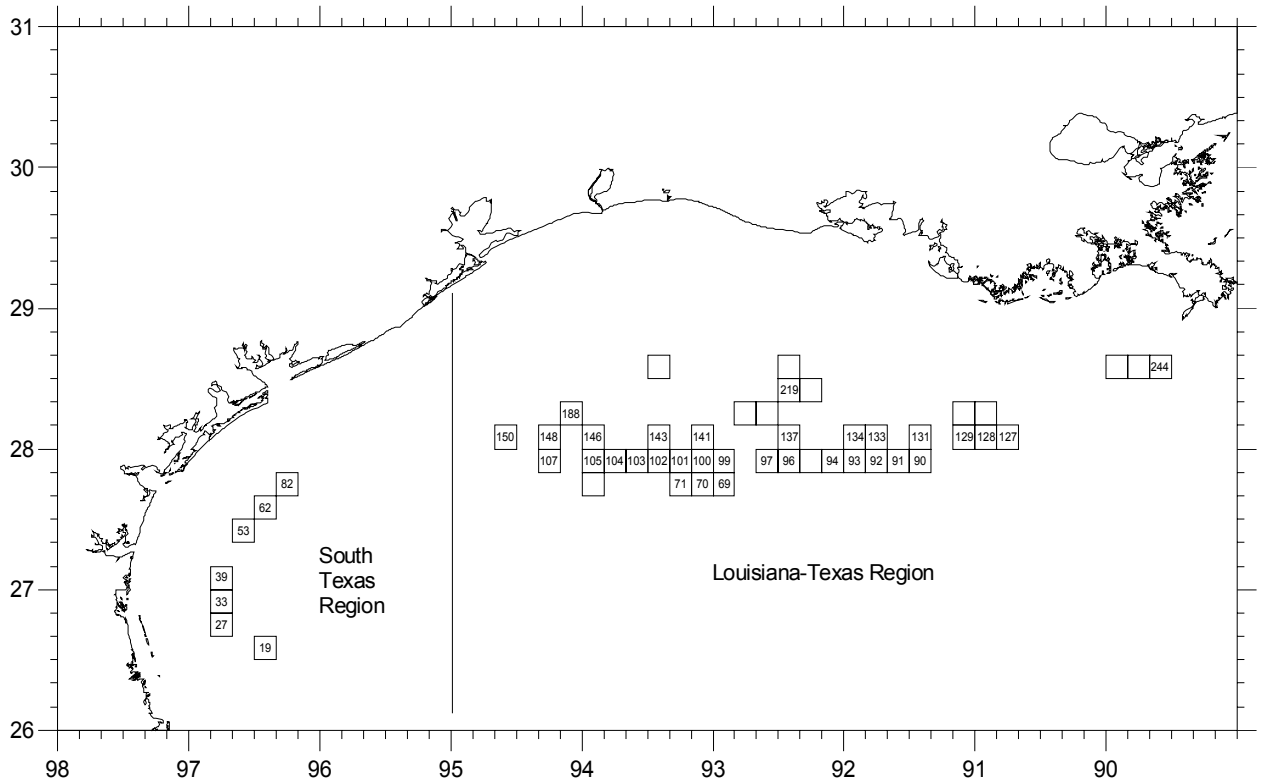

Figure 3. SEAMAP reef fish survey sample blocks in the western Gulf of Mexico.

Statistics

The design-based estimators of abundance are those for stratified, two-stage sampling (Cochran, 1977).

1. Block means

$$\overline{x_{hi}} = \frac{\sum_{j=1}^{m_{hi}} x_{hij}}{m_{hi}},$$ where x_{hij} is the number of red snapper observed at the j-th site in the i-th block within the h-th stratum, and m_{hi} in the number of sites sampled in the i-th block and h-th stratum.

2. Stratum means

$$\overline{x_h} = \frac{\sum_{j=1}^{n_h} \overline{x_{hi}}}{n_h},$$ where $\overline{x}_{hi}$ is the i-th block mean in the h-th stratum and n_h is the number of blocks sampled in the h-th stratum.

3. Stratified mean

$\overline{x}_{st} = \sum_h w_h \overline{x}_h$, where w_h is the stratum weight estimated as the area of the stratum divided by the total survey area (A_h/A).

4. Variance of the stratified mean ($V(\bar{0}_{st})$, ignoring finite population correction

$$V\overline{x}_{st} = \sum_h w_h^2 \left[\frac{s_{1h}^2}{n_h} + \frac{s_{2h}^2}{n_h m_h} \right],$$

where w_h is the stratum weight, s^2_{1h} and s^2_{2h} are the variances among the first-stage and second-stage units, n_h and m_h are the number of first stage and second-stage units sampled.

5. Variance among first-stage units, s^2_{1h}

$$s_{1h}^2 = \frac{\sum_h \left(\overline{x}_{hi} - \overline{x}_h \right)^2}{n_h - 1}.$$

6. Variance among second-stage units, s^2_{2h}

$$s_{2h}^2 = \frac{\sum_i \sum_j \left(x_{hij} - \overline{x}_{hi} \right)^2}{n_h \left(m_{hi} - 1 \right)}.$$

The estimates for the frequency of occurrence of red snapper were calculated using the same equations where x_{hij} was either 0 or 1. The final estimate is a stratified mean proportion.

Model-based estimator

In addition to the calculations of stratified means, a modeling approach was used to develop abundance indices. We used the MIXED procedure in SAS as described in (Patetta, 2002) to estimate both mean annual frequency of occurrence and mean annual minimum count. Abundance indices were developed not only for the overall US Gulf of Mexico, but separate indices were developed for red snapper sighted on reefs both east and west of the Mississippi River. A mixed logistic regression model was employed to estimate mean annual frequency of occurrence of red snapper. The parameters included in the model were year, stratum, and block

nested within stratum. The estimates were weighted using the stratum area, and separate covariance structures were developed for each survey year. The LSMEANS statement in the MIXED procedure was use estimate the mean annual frequency of occurrence. Methods and model parameters included for developing an index of mean annual minimum count were the same as those of the frequency of occurrence mixed logistic regression. However, we assumed an over-dispersed Poisson distribution for the minimum count data, and used a mixed loglinear model. Models for both occurrence and count data from east of the delta would not converge with the inclusion of the block nested within stratum parameter. Therefore, this parameter was dropped from both models. Also, the loglinear model describing minimum count data from west of the delta exhibited significant lack-of-fit until the exclusion of both the block nested within stratum parameter and year-specific separate covariance matrices. Presently, all current models have insignificant lack-of-fit ($p > 0.25$ for all models).

Results

Red snapper abundance data from seven strata were included for analysis during all years except 2001 (Table 1). No red snapper size information was collected because none were captured in the fish traps, or hit with lasers mounted on video cameras. Stratum 1 was sampled only in 1994, 1996 and 1997. This stratum was 62.847 km² in area. Stratum 7 was sampled only in 1996, 1997, and 2002, and was 13.030 km² in area. Since these strata were not sampled during all years of the survey, they were excluded from estimates of the stratified mean. However, when included for those years, the stratified means and variances changed very little since their stratum weights were small. Model-based Gulf-wide estimates of red snapper abundance range from 0.05 to 0.35 fish per site and the stratified means ranged from 0.17 to 2.30 fish per site (Table 1, Figures 4). In general, fish abundance estimates were lower in the eastern Gulf of Mexico than the western Gulf (Table 1, Figures 5 and 6). The large fish abundance mean in 1992 resulted from a single large value observed at a single site in the western Gulf (Figures 4 and 6). If the 1992 high estimated mean is ignored, red snapper abundance does not shown any trend. Frequency of occurrence has a similar pattern, although the 2002 estimates are the largest (Table 2, Figures 7-9). Gulf wide model-based estimates of occurrence range from 0.03 to 0.14, while stratified means range from 0.10 to 0.21 (Table 2).

The 2001 survey was abbreviated. Very few strata were sampled in the eastern Gulf of Mexico. We recommend that the 2001 estimates of abundance for the entire Gulf of Mexico, and for the eastern Gulf of Mexico not be used for estimating trends in fish abundance. However, the two strata in the western Gulf of Mexico were sampled, and provide useful estimates of abundance.

Literature Cited

Cochran, W.G. 1977. Sampling Techniques. John Wiley & Sons. New York, NY. 428 p.

Patetta, M. 2002. Longitudinal Data Analysis with Discrete and Continuous Responses Course Notes. SAS Institute Inc., Cary, North Carolina. 326 p.

Table 1. The number of strata and number of blocks sampled in the eastern and western Gulf of Mexico during SEAMAP reef fish survey.

	Eastern Gulf of Mexico		Western Gulf of Mexico	
Year	Number of Strata	Number of Blocks	Number of Strata	Number of Blocks
1992	3	12	2	12
1993	3	18	2	9
1994	3	14	2	9
1995	3	12	2	10
1996	3	21	2	12
1997	3	20	2	17
2001	1	5	2	9
2002	3	20	2	13

Table 2. Model-based and design-based annual estimates of the mean number of red snapper observed during SEAMAP reef fish survey from the entire Gulf of Mexico (Gulf), and by region of the Gulf (east or west).

YEAR	Mixed Model Results						Stratified Mean Results					
	$\bar{O}_{Gulf}$	SE	$\bar{O}_{East}$	SE	$\bar{O}_{West}$	SE	$\bar{O}_{st\,Gulf}$	SE	$\bar{O}_{st\,East}$	SE	$\bar{O}_{st\,West}$	SE
1992	0.3492	0.183	0.0169	0.0186	3.0581	0.8009	2.3023	2.2576	0.0444	0.0619	8.6447	7.5895
1993	0.1647	0.0802	0.0394	0.0337	0.7683	0.581	0.2336	0.2185	0.108	0.1401	0.5302	0.6558
1994	0.0539	0.0258	0.0179	0.0232	0.9105	0.6186	0.4586	0.3888	0.1786	0.167	1.12	1.2464
1995	0.0683	0.0281	0.0298	0.0235	0.4361	0.3415	0.1664	0.0956	0.0656	0.0586	0.4045	0.2902
1996	0.0785	0.0334	0.0391	0.0321	0.5104	0.2464	0.2147	0.1462	0.0827	0.0878	0.5266	0.4456
1997	0.1475	0.0644	0.0458	0.0442	1.1808	0.3952	0.4354	0.2316	0.1555	0.2505	1.0968	0.5064
2001	0.0893	0.0907	0.0617	0.0872	0.4824	0.5055	0.2063	0.1339	0.085	0.1391	0.493	0.3072
2002	0.2266	0.0981	0.1426	0.1099	0.8309	0.4034	0.4464	0.2164	0.3047	0.2184	0.7812	0.5131

Table 3 . Model-based and design-based annual estimates of the mean frequency of occurrence of red snapper during SEAMAP reef fish survey from the entire Gulf of Mexico (Gulf), and by region of the Gulf (east or west).

YEAR	Mixed Model Results						Stratified Mean Results					
	Gulf	SE	East	SE	West	SE	Gulf	SE	East	SE	West	SE
1992	0.0457	0.022	0.0178	0.0179	0.2518	0.0728	0.1121	0.1193	0.0444	0.0876	0.2721	0.1944
1993	0.0723	0.0397	0.0269	0.0194	0.244	0.0951	0.1027	0.13	0.0646	0.0994	0.1927	0.2025
1994	0.0333	0.0167	0.0117	0.0133	0.1933	0.0777	0.1456	0.166	0.1003	0.1365	0.2528	0.2356
1995	0.0686	0.0293	0.0324	0.0214	0.2709	0.0727	0.1165	0.1167	0.0656	0.0827	0.2367	0.197
1996	0.0466	0.0212	0.0355	0.0233	0.205	0.0559	0.102	0.101	0.0693	0.0866	0.1793	0.135
1997	0.0973	0.0374	0.0155	0.0123	0.5024	0.072	0.1786	0.118	0.0485	0.0801	0.4859	0.2075
2001	0.0796	0.0728	0.0331	0.036	0.2582	0.0953	0.1169	0.1096	0.0447	0.0617	0.2874	0.2226
2002	0.1411	0.0583	0.0765	0.0436	0.4303	0.081	0.214	0.161	0.14	0.1173	0.3887	0.2642

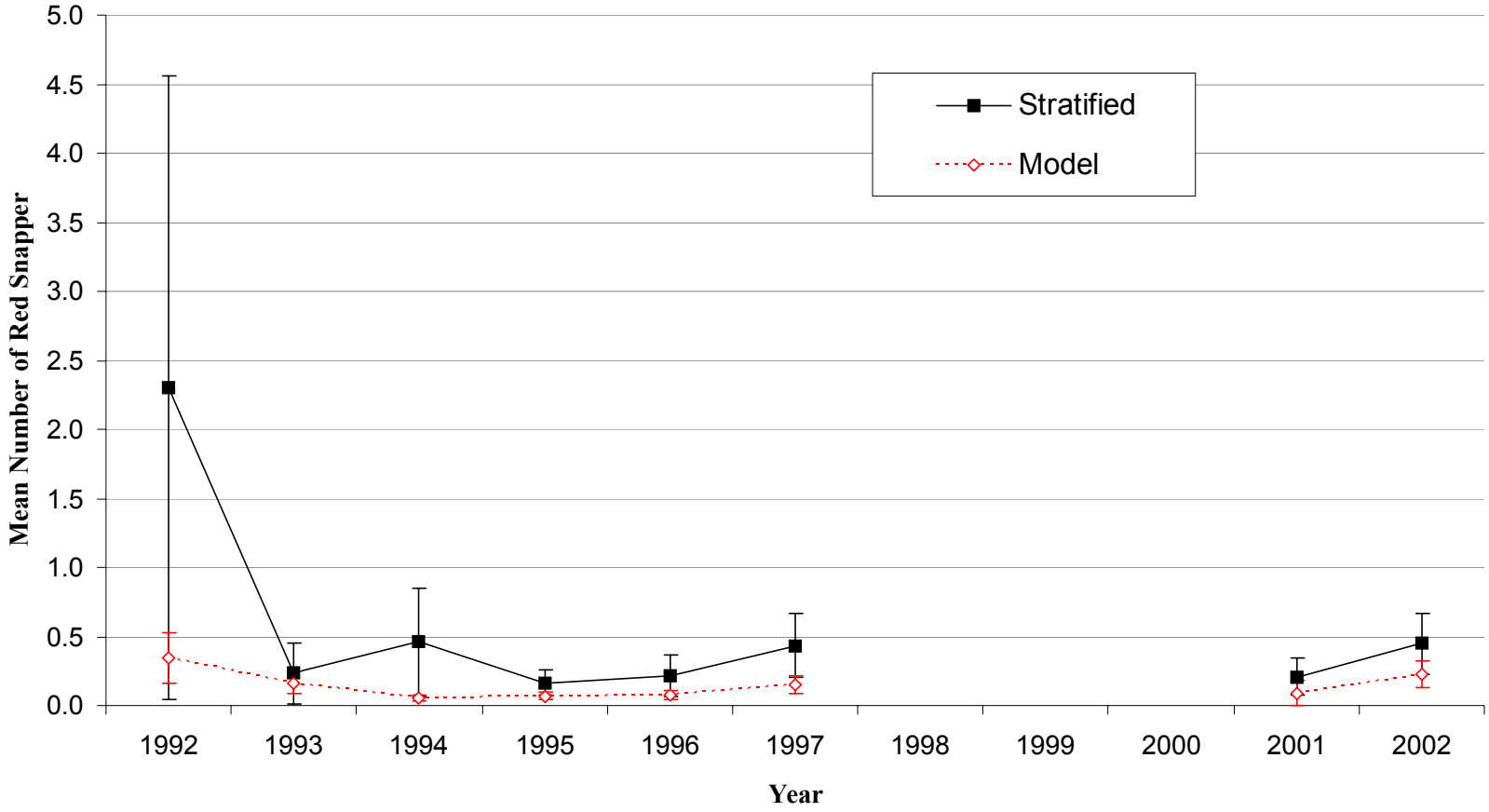

Figure 4. Model-based and design-based estimated mean number of red snapper with standard error for the entire Gulf of Mexico observed during SEAMAP reef fish survey.

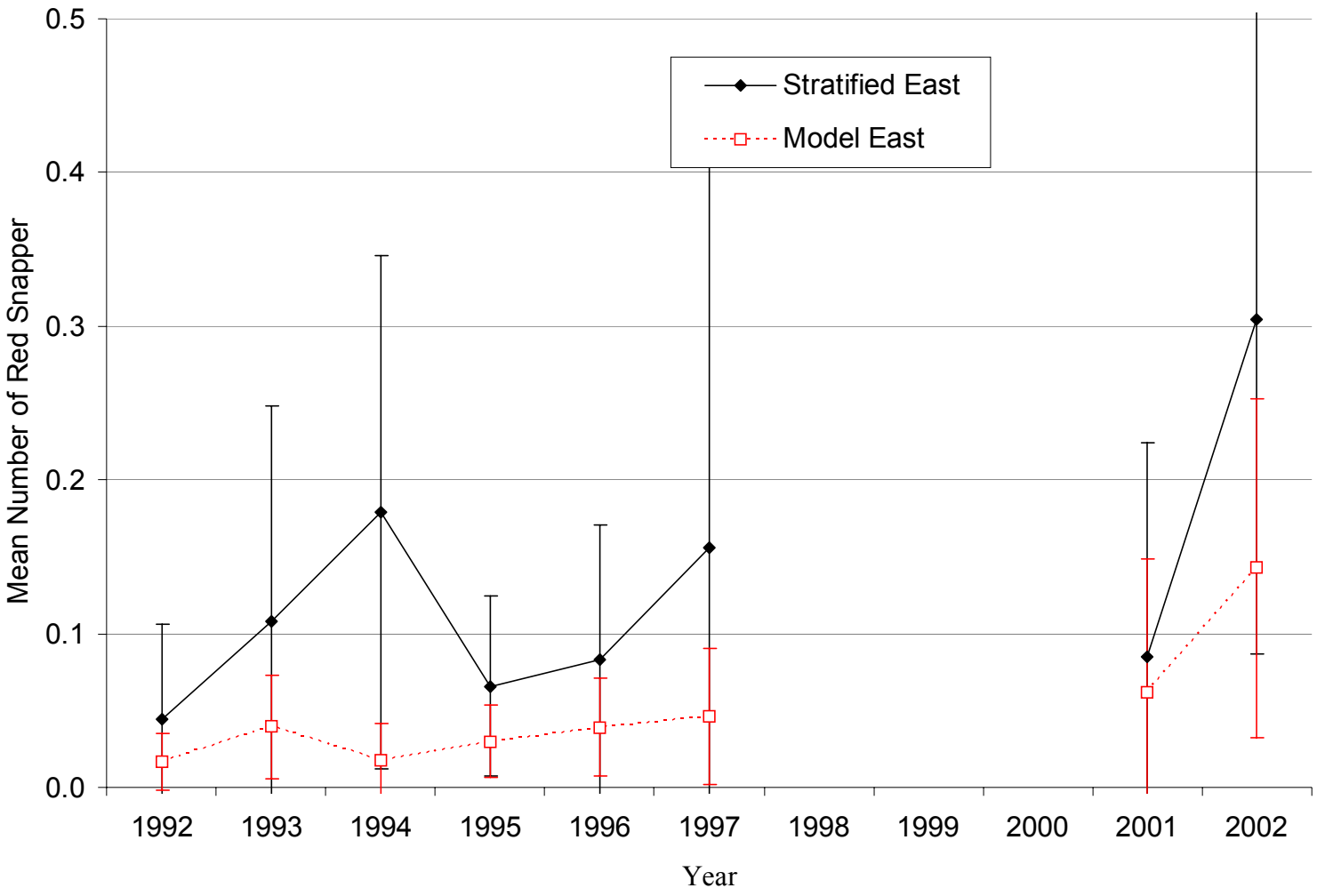

Figure 5. Model-based and design-based estimated mean number of red snapper with standard error observed in the eastern Gulf of Mexico during SEAMAP reef fish survey.

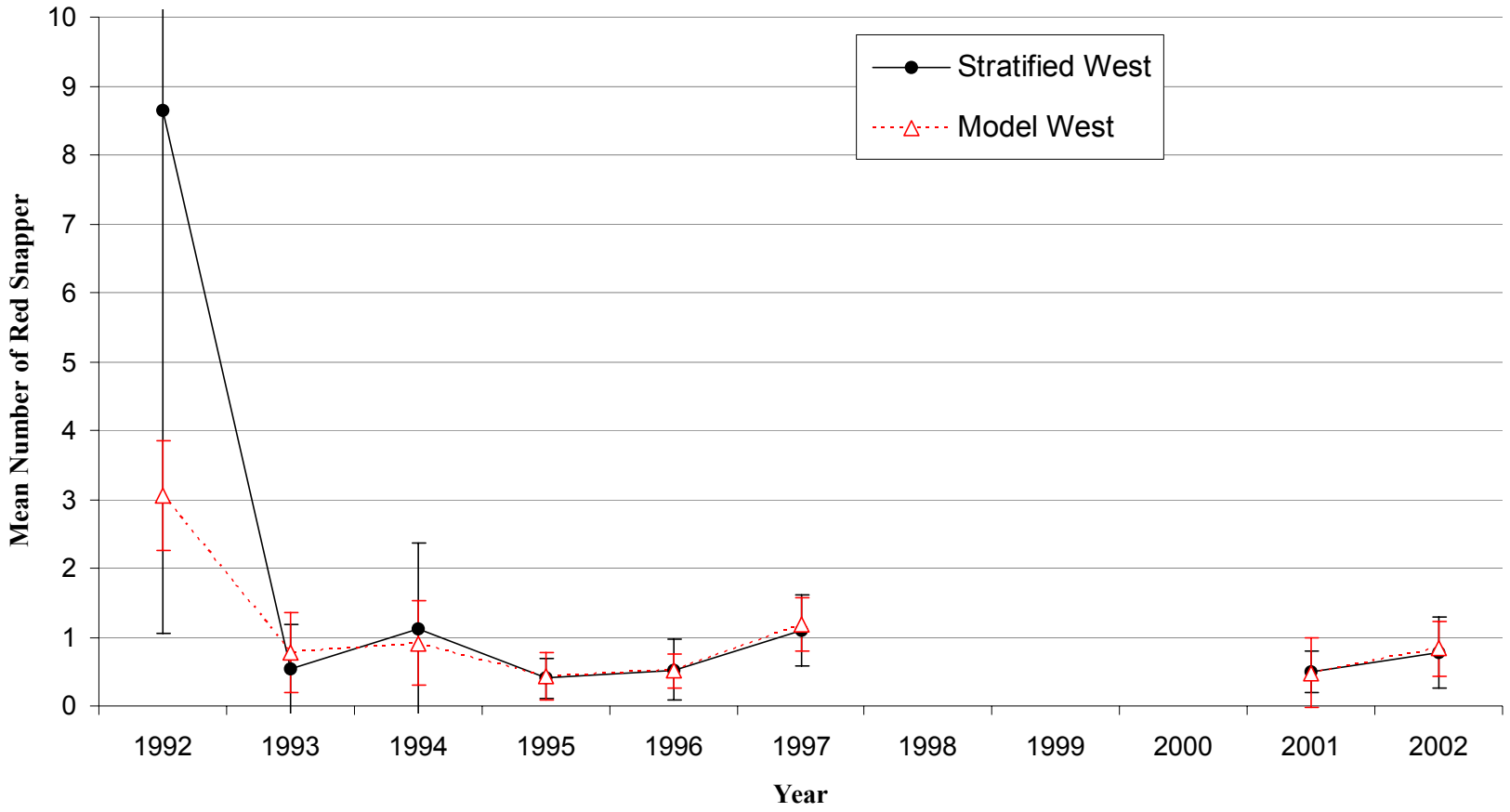

Figure 6. Model-based and design-based estimated mean number of red snapper with standard error observed during the SEAMAP reef fish survey in the western Gulf of Mexico.

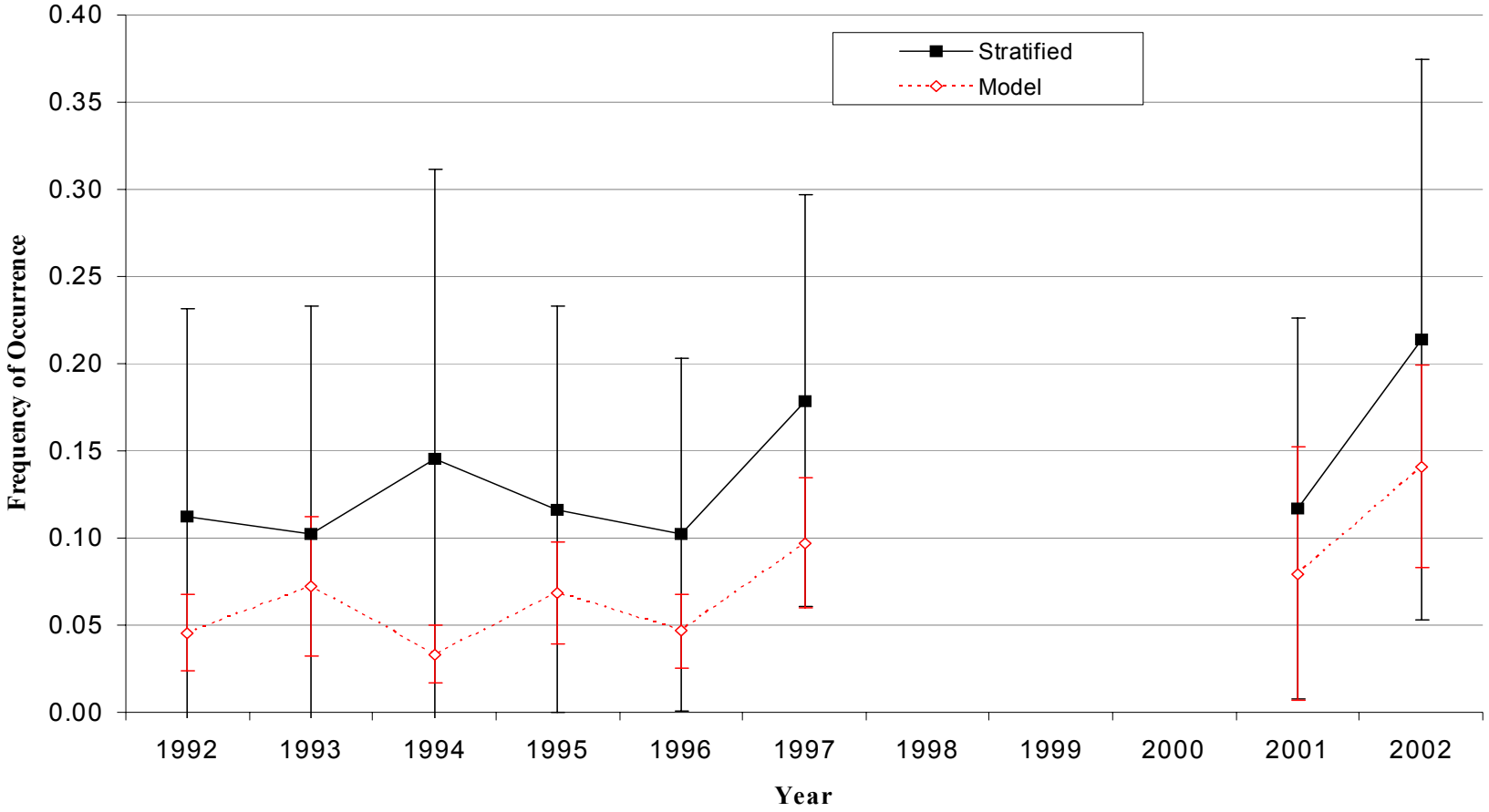

Figure 7. Model-based and design-based estimated mean frequency of occurrence of red snapper with standard errors observed in the entire Gulf of Mexico survey area during the SEAMAP reef fish survey.

Figure 8. Model-based and design based estimated mean frequency of occurrence of red snapper with standard errors observed in the eastern Gulf of Mexico survey area during the SEAMAP reef fish survey.

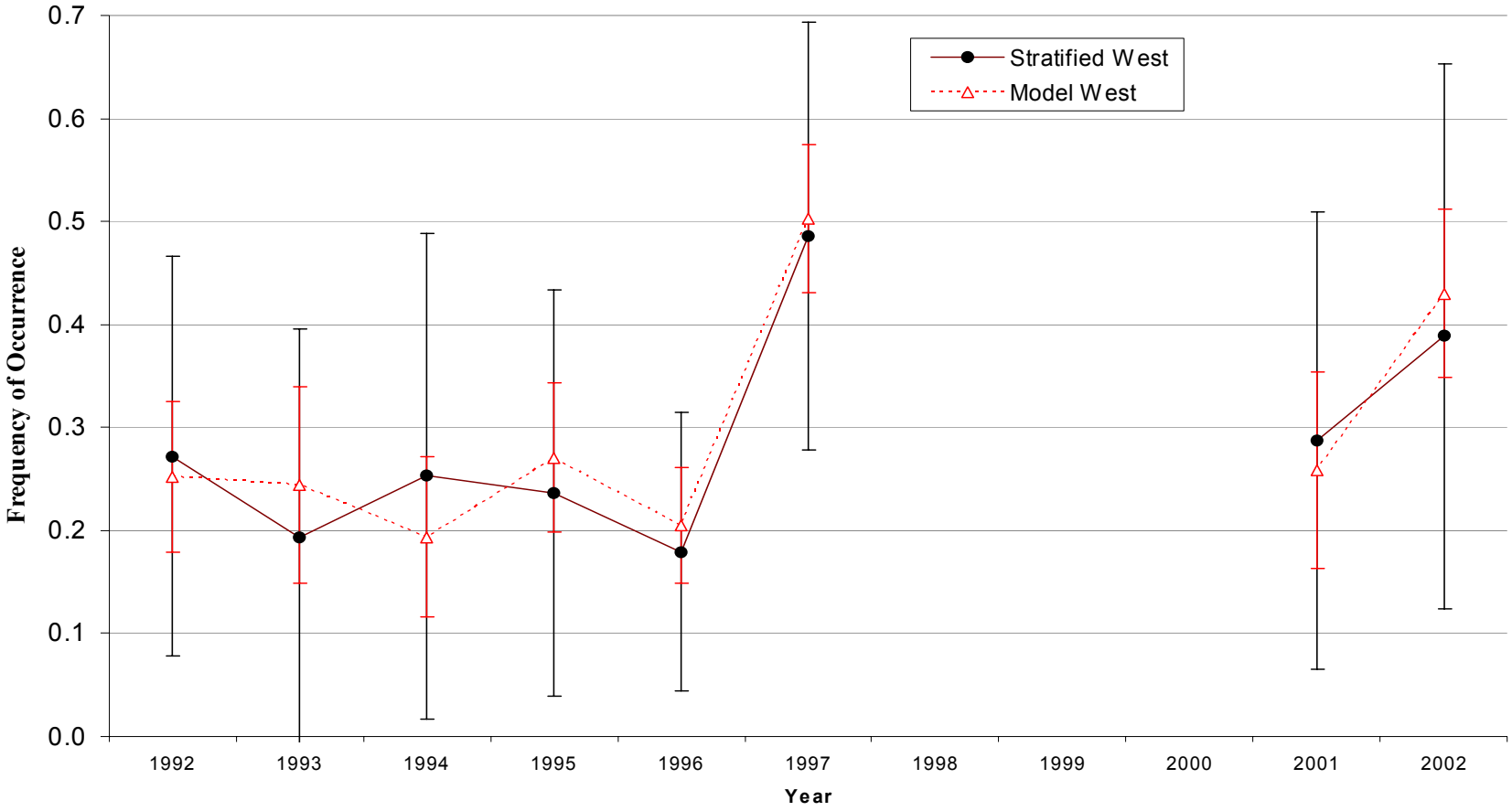

Figure 9. Model-based and design-based estimated mean frequency of occurrence of red snapper with standard errors observed in the western Gulf of Mexico survey area during the SEAMAP reef fish survey.

Appendix: Model Coding and Output

A.1. SAS code for models used in these analyses.

```
LIBNAME RSREEF 'C:\Red Snapper\RSSEDAR 2004\Reef Fish\';

data rsreef.Videoredsnapper2;set rsreef.Videoredsnapper;
if maxmincount=0 then p=0; else p=1;
if stratum=1 or stratum=7 then delete;
if stratum=2 then wgtall =331.44/1770.549;
if stratum=2 then wgtreg =331.44/1243.957;
if stratum=3 then wgtall =328.229/1770.549;
if stratum=3 then wgtreg =328.229/1243.957;
if stratum=4 then wgtall =584.288/1770.549;
if stratum=4 then wgtreg =584.288/1243.957;
if stratum=5 then wgtall =305.700/1770.549;
if stratum=5 then wgtreg =305.700/526.592;
if stratum=6 then wgtall =220.892/1770.549;
if stratum=6 then wgtreg =220.892/526.592;
run;

%include 'glimmix.sas';

/*Block nested in stratum*/
%glimmix(data=rsreef.Videoredsnapper2,
       stmts=%str(
          class year stratum blockno;
          model p=year stratum / ddfm=kr;
              random blockno(stratum)/solution;
              repeated /group=year;
              lsmeans year;
       ),
         weight=wgtall,
       error=b,
       link=logit,
        options=noitprint
    )

%glimmix(data=rsreef.Videoredsnapper,
       stmts=%str(
          class year stratum blockno;
          model maxmincount=year stratum / ddfm=kr;
              random blockno(stratum)/solution;
              repeated /group=year;
              lsmeans year;
       ),
         weight=wgtall,
         error=p,
       link=log,
        options=noitprint
    );
run;

/*West region*/
data rsreef.west; set rsreef.Videoredsnapper2;
if region='W';run;

%glimmix(data=rsreef.west,
```

```
        stmts=%str(
           class year stratum blockno;
           model p=year stratum / ddfm=kr;
               random blockno(stratum)/solution;
           repeated /group=year;
               lsmeans year;
        ),
          weight=wgtreg,
        error=b,
        link=logit,
         options=noitprint
    )

%glimmix(data=rsreef.west,
        stmts=%str(
           class year stratum blockno;
           model maxmincount=year stratum / ddfm=kr;

               lsmeans year;
        ),
          weight=wgtreg,
          error=p,
        link=log,
         options=noitprint
    );
run;

/*East region*/
data rsreef.east; set rsreef.Videoredsnapper2;
if region='E';run;

%glimmix(data=rsreef.east,
        stmts=%str(
           class year stratum blockno;
           model p=year stratum / ddfm=kr;
               repeated /group=year;
               lsmeans year;
        ),
          weight=wgtreg,
        error=b,
        link=logit,
         options=noitprint
    )

%glimmix(data=rsreef.east,
        stmts=%str(
           class year stratum blockno;
           model maxmincount=year stratum / ddfm=kr;
               repeated /group=year;
               lsmeans year;
        ),
          weight=wgtreg,
          error=p,
        link=log,
         options=noitprint
    );
run;
```

A.2. SAS output for logistic mixed model describing frequency of red snapper occurrence for the Gulf of Mexico.

Model Information

Dependent Variable	red snapper occurrence
Weight Variable	stratum area
Covariance Structure	Variance Components
Group Effect	YEAR
Estimation Method	REML
Fixed Effects SE Method	Prasad-Rao-Jeske-Kackar-Harville
Degrees of Freedom Method	Kenward-Roger

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	5	2 3 4 5 6
BLOCKNO	60	29 30 45 46 50 69 70 92 93 94 96 97 99 100 101 102 103 104 105 107 129 131 134 137 143 150 180 188 219 333 334 360 371 375 386 387 388 403 404 407 421 445 446 469 490 491 492 498 523 524 553 554 608 611 612 617 630 632 633 639

Dimensions

Covariance Parameters	9
Columns in X	14
Columns in Z	60
Subjects	1
Max Obs Per Subject	1515
Observations Used	1515
Total Observations	1515

Covariance Parameter Estimates

Cov Parm	Group	Estimate
BLOCKNO(stratum)		1.7304
Residual	YEAR 1992	0.1032
Residual	YEAR 1993	0.3014
Residual	YEAR 1994	0.07100
Residual	YEAR 1995	0.1186
Residual	YEAR 1996	0.2061
Residual	YEAR 1997	0.08948
Residual	YEAR 2001	0.6892
Residual	YEAR 2002	0.3456

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			0.2754	0.4530	76	0.61	0.5451
YEAR	1992		-1.2317	0.3472	436	-3.55	0.0004
YEAR	1993		-0.7462	0.4225	345	-1.77	0.0783
YEAR	1994		-1.5634	0.3651	376	-4.28	<.0001
YEAR	1995		-0.8016	0.3215	568	-2.49	0.0129
YEAR	1996		-1.2115	0.3223	566	-3.76	0.0002
YEAR	1997		-0.4207	0.2958	494	-1.42	0.1556
YEAR	2001		-0.6419	0.6938	103	-0.93	0.3570
YEAR	2002		0	.	.	.	.
stratum		2	-5.6841	1.5643	453	-3.63	0.0003
stratum		3	-2.3350	0.5707	51.1	-4.09	0.0002
stratum		4	-2.0533	0.5628	41.8	-3.65	0.0007
stratum		5	-0.3363	0.6155	33.5	-0.55	0.5884
stratum		6	0	.	.	.	.

Solution for Random Effects

Effect	stratum	BLOCKNO	Estimate	Std Err Pred	DF	t Value	Pr > |t|
BLOCKNO(stratum)	2	29	-0.1939	1.2398	33.7	-0.16	0.8767
BLOCKNO(stratum)	2	30	-0.1593	1.2497	32.6	-0.13	0.8993
BLOCKNO(stratum)	2	45	0.5692	1.2095	37.2	0.47	0.6407
BLOCKNO(stratum)	2	46	-0.1292	1.2593	31.6	-0.10	0.9189
BLOCKNO(stratum)	2	50	-0.05371	1.2893	28.6	-0.04	0.9671
BLOCKNO(stratum)	2	180	-0.03307	1.2985	27.5	-0.03	0.9799
BLOCKNO(stratum)	3	334	0.8800	0.6212	143	1.42	0.1588
BLOCKNO(stratum)	3	371	-1.5444	0.8848	110	-1.75	0.0837
BLOCKNO(stratum)	3	386	-0.9336	0.8317	124	-1.12	0.2638
BLOCKNO(stratum)	3	388	-1.1174	0.9555	86	-1.17	0.2454
BLOCKNO(stratum)	3	421	-0.9449	0.8464	118	-1.12	0.2665
BLOCKNO(stratum)	3	446	-0.09161	0.8347	119	-0.11	0.9128
BLOCKNO(stratum)	3	469	-0.8669	1.0107	74.6	-0.86	0.3938
BLOCKNO(stratum)	3	490	1.4323	0.9052	91.1	1.58	0.1170
BLOCKNO(stratum)	3	491	0.7619	0.5870	136	1.30	0.1964
BLOCKNO(stratum)	3	492	-0.9231	0.9969	75.1	-0.93	0.3574
BLOCKNO(stratum)	3	498	-0.4766	1.1236	49.7	-0.42	0.6733
BLOCKNO(stratum)	3	553	1.2838	0.7811	128	1.64	0.1027
BLOCKNO(stratum)	3	611	1.6406	0.7893	128	2.08	0.0397
BLOCKNO(stratum)	3	617	-0.00896	1.0145	69.3	-0.01	0.9930
BLOCKNO(stratum)	3	630	-0.2706	1.1928	40.7	-0.23	0.8217
BLOCKNO(stratum)	3	632	1.4208	0.6081	136	2.34	0.0209
BLOCKNO(stratum)	3	639	-0.2413	1.2051	37.9	-0.20	0.8424
BLOCKNO(stratum)	4	333	-1.7711	0.8524	111	-2.08	0.0400
BLOCKNO(stratum)	4	360	-1.3067	0.9220	89	-1.42	0.1599
BLOCKNO(stratum)	4	375	-0.2444	0.6367	127	-0.38	0.7018
BLOCKNO(stratum)	4	387	-1.4333	0.6573	134	-2.18	0.0310
BLOCKNO(stratum)	4	403	-1.2199	0.7037	134	-1.73	0.0853
BLOCKNO(stratum)	4	404	-1.3792	0.6511	134	-2.12	0.0360
BLOCKNO(stratum)	4	407	-0.4898	0.6963	131	-0.70	0.4830
BLOCKNO(stratum)	4	445	1.1564	0.4654	64.9	2.48	0.0155
BLOCKNO(stratum)	4	523	2.5609	0.6147	121	4.17	<.0001
BLOCKNO(stratum)	4	524	1.0417	0.8869	93.8	1.17	0.2432
BLOCKNO(stratum)	4	554	-0.2217	1.2132	37.9	-0.18	0.8560
BLOCKNO(stratum)	4	608	1.0895	0.7801	111	1.40	0.1653
BLOCKNO(stratum)	4	612	1.4200	0.5338	94.1	2.66	0.0092
BLOCKNO(stratum)	4	633	0.7975	0.5371	96.2	1.49	0.1408

BLOCKNO(stratum)	5	70	-0.9804	0.5618	51.5	-1.75	0.0869
BLOCKNO(stratum)	5	94	0.07233	0.5656	52.6	0.13	0.8987
BLOCKNO(stratum)	5	96	0.2988	0.5517	48.4	0.54	0.5907
BLOCKNO(stratum)	5	101	-0.06290	0.5428	45.9	-0.12	0.9083
BLOCKNO(stratum)	5	102	0.7254	0.5890	59.6	1.23	0.2230
BLOCKNO(stratum)	5	103	-0.3634	0.5293	42.2	-0.69	0.4961
BLOCKNO(stratum)	5	104	0.3145	0.5367	44.2	0.59	0.5609
BLOCKNO(stratum)	5	105	-0.00428	0.5523	48.6	-0.01	0.9939
BLOCKNO(stratum)	6	69	-1.9055	0.7576	140	-2.52	0.0130
BLOCKNO(stratum)	6	92	-1.1285	0.6371	146	-1.77	0.0786
BLOCKNO(stratum)	6	93	0.09605	0.6571	145	0.15	0.8840
BLOCKNO(stratum)	6	97	-0.2324	0.7707	108	-0.30	0.7636
BLOCKNO(stratum)	6	99	-0.7624	0.6817	138	-1.12	0.2653
BLOCKNO(stratum)	6	100	-2.1268	0.7584	137	-2.80	0.0058
BLOCKNO(stratum)	6	107	-0.7212	0.6681	141	-1.08	0.2822
BLOCKNO(stratum)	6	129	0.3788	0.6589	132	0.57	0.5664
BLOCKNO(stratum)	6	131	-0.4308	0.9300	86.6	-0.46	0.6443
BLOCKNO(stratum)	6	134	0.8347	0.6314	134	1.32	0.1884
BLOCKNO(stratum)	6	137	0.05086	0.5557	122	0.09	0.9272
BLOCKNO(stratum)	6	143	1.1229	0.6232	138	1.80	0.0737
BLOCKNO(stratum)	6	150	1.1971	0.7120	124	1.68	0.0952
BLOCKNO(stratum)	6	188	1.9800	0.6115	133	3.24	0.0015
BLOCKNO(stratum)	6	219	1.6473	0.6447	134	2.55	0.0117

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	540	4.62	<.0001
stratum	4	58.7	8.25	<.0001

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	-3.0381	0.4151	344	-7.32	<.0001
YEAR	1993	-2.5526	0.4826	359	-5.29	<.0001
YEAR	1994	-3.3698	0.4253	325	-7.92	<.0001
YEAR	1995	-2.6080	0.3870	298	-6.74	<.0001
YEAR	1996	-3.0179	0.3974	343	-7.59	<.0001
YEAR	1997	-2.2271	0.3675	262	-6.06	<.0001
YEAR	2001	-2.4483	0.7325	124	-3.34	0.0011
YEAR	2002	-1.8064	0.4164	339	-4.34	<.0001

GLIMMIX Model Statistics

Description	Value
Deviance	200.8589
Scaled Deviance	581.2108
Pearson Chi-Square	312.5812
Scaled Pearson Chi-Square	904.4937
Extra-Dispersion Scale	0.3456

A.3. SAS output for Poisson mixed model describing frequency of red snapper occurrence for the Gulf of Mexico.

Model Information

Dependent Variable	maxmincount
Weight Variable	stratum area
Covariance Structure	Variance Components
Group Effect	YEAR
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Prasad-Rao-Jeske-Kackar-Harville
Degrees of Freedom Method	Kenward-Roger

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	5	2 3 4 5 6
BLOCKNO	60	29 30 45 46 50 69 70 92 93 94 96 97 99 100 101 102 103 104 105 107 129 131 134 137 143 150 180 188 219 333 334 360 371 375 386 387 388 403 404 407 421 445 446 469 490 491 492 498 523 524 553 554 608 611 612 617 630 632 633 639

Dimensions

Covariance Parameters	9
Columns in X	14
Columns in Z	60
Subjects	1
Max Obs Per Subject	1515
Observations Used	1515
Total Observations	1515

Covariance Parameter Estimates

Cov Parm	Group	Estimate
BLOCKNO(stratum)		1.5067
Residual	YEAR 1992	1.9409
Residual	YEAR 1993	0.4424
Residual	YEAR 1994	0.1847
Residual	YEAR 1995	0.08767
Residual	YEAR 1996	0.2738
Residual	YEAR 1997	0.5422
Residual	YEAR 2001	1.9352
Residual	YEAR 2002	0.5876

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			0.3979	0.3946	63.4	1.01	0.3171
YEAR	1992		0.4325	0.3350	327	1.29	0.1975
YEAR	1993		-0.3190	0.2965	362	-1.08	0.2828
YEAR	1994		-1.4357	0.2960	377	-4.85	<.0001
YEAR	1995		-1.1990	0.2276	604	-5.27	<.0001
YEAR	1996		-1.0596	0.2327	607	-4.55	<.0001
YEAR	1997		-0.4291	0.2539	654	-1.69	0.0914
YEAR	2001		-0.9316	0.6500	93.4	-1.43	0.1551
YEAR	2002		0	.	.	.	.
stratum		2	-5.0530	1.4492	418	-3.49	0.0005
stratum		3	-1.9561	0.5509	58.5	-3.55	0.0008
stratum		4	-1.9215	0.5310	46.6	-3.62	0.0007
stratum		5	-0.4822	0.5790	37.5	-0.83	0.4102
stratum		6	0	.	.	.	.

Solution for Random Effects

Effect	stratum	BLOCKNO	Estimate	Std Err Pred	DF	t Value	Pr > |t|
BLOCKNO(stratum)	2	29	-0.2032	1.1534	37.6	-0.18	0.8611
BLOCKNO(stratum)	2	30	-0.2152	1.1507	37.9	-0.19	0.8526
BLOCKNO(stratum)	2	45	0.5838	1.1255	41.4	0.52	0.6067
BLOCKNO(stratum)	2	46	-0.07187	1.1946	32.4	-0.06	0.9524
BLOCKNO(stratum)	2	50	-0.05043	1.2038	31.4	-0.04	0.9668
BLOCKNO(stratum)	2	180	-0.04313	1.2068	31	-0.04	0.9717
BLOCKNO(stratum)	3	334	1.0279	0.5547	140	1.85	0.0660
BLOCKNO(stratum)	3	371	-1.3867	0.8469	109	-1.64	0.1044
BLOCKNO(stratum)	3	386	-0.4976	0.8003	124	-0.62	0.5352
BLOCKNO(stratum)	3	388	-0.7889	0.9534	76.8	-0.83	0.4105
BLOCKNO(stratum)	3	421	-0.7165	0.8764	99	-0.82	0.4156
BLOCKNO(stratum)	3	446	0.1957	0.7743	127	0.25	0.8009
BLOCKNO(stratum)	3	469	-0.5560	1.0154	61.4	-0.55	0.5860
BLOCKNO(stratum)	3	490	-0.03622	1.1447	39.3	-0.03	0.9749
BLOCKNO(stratum)	3	491	1.1380	0.5293	131	2.15	0.0334
BLOCKNO(stratum)	3	492	-0.3845	1.0655	51.5	-0.36	0.7196
BLOCKNO(stratum)	3	498	-0.4477	1.0451	55.5	-0.43	0.6700
BLOCKNO(stratum)	3	553	0.9523	0.6878	146	1.38	0.1683
BLOCKNO(stratum)	3	611	0.4535	0.8997	90	0.50	0.6154
BLOCKNO(stratum)	3	617	0.02617	0.9257	81.2	0.03	0.9775
BLOCKNO(stratum)	3	630	-0.1883	1.1413	39.7	-0.16	0.8698
BLOCKNO(stratum)	3	632	1.5517	0.6168	149	2.52	0.0129
BLOCKNO(stratum)	3	639	-0.3429	1.0814	48.7	-0.32	0.7525
BLOCKNO(stratum)	4	333	-1.3039	0.8533	105	-1.53	0.1295
BLOCKNO(stratum)	4	360	-1.3083	0.8538	99.7	-1.53	0.1286
BLOCKNO(stratum)	4	375	-0.2949	0.6423	143	-0.46	0.6468
BLOCKNO(stratum)	4	387	-1.4944	0.6991	144	-2.14	0.0342
BLOCKNO(stratum)	4	403	-0.5175	0.6758	144	-0.77	0.4451
BLOCKNO(stratum)	4	404	-1.2672	0.6760	146	-1.87	0.0629
BLOCKNO(stratum)	4	407	0.2954	0.6226	139	0.47	0.6359
BLOCKNO(stratum)	4	445	1.4195	0.4345	69.9	3.27	0.0017
BLOCKNO(stratum)	4	523	2.1054	0.4832	93.5	4.36	<.0001
BLOCKNO(stratum)	4	524	0.5850	0.8662	94.8	0.68	0.5011
BLOCKNO(stratum)	4	554	-0.1234	1.1690	35.9	-0.11	0.9165
BLOCKNO(stratum)	4	608	0.9368	0.6777	127	1.38	0.1693
BLOCKNO(stratum)	4	612	0.6693	0.5541	126	1.21	0.2294
BLOCKNO(stratum)	4	633	0.2982	0.5549	126	0.54	0.5919

BLOCKNO(stratum)	5	70	-0.9730	0.5611	69.2	-1.73	0.0873
BLOCKNO(stratum)	5	94	-0.7870	0.6214	87.8	-1.27	0.2086
BLOCKNO(stratum)	5	96	0.5333	0.4916	45.5	1.08	0.2837
BLOCKNO(stratum)	5	101	0.5339	0.4808	42.1	1.11	0.2732
BLOCKNO(stratum)	5	102	0.1362	0.6339	89	0.21	0.8303
BLOCKNO(stratum)	5	103	-0.1411	0.4986	47.8	-0.28	0.7784
BLOCKNO(stratum)	5	104	0.8712	0.4767	40.7	1.83	0.0749
BLOCKNO(stratum)	5	105	-0.1734	0.5237	56.3	-0.33	0.7417
BLOCKNO(stratum)	6	69	-1.8207	0.7225	149	-2.52	0.0128
BLOCKNO(stratum)	6	92	-1.0788	0.6347	158	-1.70	0.0912
BLOCKNO(stratum)	6	93	-0.6656	0.6316	152	-1.05	0.2936
BLOCKNO(stratum)	6	97	-0.4132	0.8381	93.2	-0.49	0.6231
BLOCKNO(stratum)	6	99	-1.0361	0.7916	122	-1.31	0.1930
BLOCKNO(stratum)	6	100	-1.5026	0.7706	132	-1.95	0.0533
BLOCKNO(stratum)	6	107	-0.2550	0.7333	134	-0.35	0.7286
BLOCKNO(stratum)	6	129	-0.1490	0.7475	124	-0.20	0.8423
BLOCKNO(stratum)	6	131	-0.6700	0.7717	119	-0.87	0.3870
BLOCKNO(stratum)	6	134	0.5166	0.5012	119	1.03	0.3047
BLOCKNO(stratum)	6	137	-0.1392	0.5736	147	-0.24	0.8086
BLOCKNO(stratum)	6	143	1.0660	0.4477	92.4	2.38	0.0193
BLOCKNO(stratum)	6	150	2.8586	0.4457	87.7	6.41	<.0001
BLOCKNO(stratum)	6	188	1.8033	0.4236	77.2	4.26	<.0001
BLOCKNO(stratum)	6	219	1.4858	0.4581	97.6	3.24	0.0016

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	557	10.02	<.0001
stratum	4	66.2	6.91	0.0001

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	-1.0521	0.4214	371	-2.50	0.0130
YEAR	1993	-1.8036	0.3966	352	-4.55	<.0001
YEAR	1994	-2.9203	0.3911	341	-7.47	<.0001
YEAR	1995	-2.6836	0.3440	261	-7.80	<.0001
YEAR	1996	-2.5442	0.3541	306	-7.18	<.0001
YEAR	1997	-1.9138	0.3622	322	-5.28	<.0001
YEAR	2001	-2.4162	0.7015	123	-3.44	0.0008
YEAR	2002	-1.4846	0.3597	300	-4.13	<.0001

GLIMMIX Model Statistics

Description	Value
Deviance	353.2092
Scaled Deviance	601.1069
Pearson Chi-Square	864.4938
Scaled Pearson Chi-Square	1471.2335
Extra-Dispersion Scale	0.5876

A.4. SAS output for logistic mixed model describing frequency of red snapper occurrence for the western Gulf of Mexico.

Model Information

Dependent Variable	red snapper occurrence
Weight Variable	stratum area
Covariance Structure	Variance Components
Group Effect	YEAR
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Prasad-Rao-Jeske-Kackar-Harville
Degrees of Freedom Method	Kenward-Roger

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	2	5 6
BLOCKNO	23	69 70 92 93 94 96 97 99 100 101 102 103 104 105 107 129 131 134 137 143 150 188 219

Dimensions

Covariance Parameters	9
Columns in X	11
Columns in Z	23
Subjects	1
Max Obs Per Subject	632
Observations Used	632
Observations Not Used	0
Total Observations	632

Covariance Parameter Estimates

Cov Parm	Group	Estimate
BLOCKNO(stratum)		0.8810
Residual	YEAR 1992	0.3938
Residual	YEAR 1993	0.6076
Residual	YEAR 1994	0.4443
Residual	YEAR 1995	0.5046
Residual	YEAR 1996	0.5342
Residual	YEAR 1997	0.4530
Residual	YEAR 2001	0.6033
Residual	YEAR 2002	0.5187

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			-0.2064	0.3764	41.9	-0.55	0.5864
YEAR	1992		-0.8082	0.3956	170	-2.04	0.0426
YEAR	1993		-0.8500	0.4778	83.4	-1.78	0.0789
YEAR	1994		-1.1480	0.4692	93.8	-2.45	0.0163
YEAR	1995		-0.7094	0.3604	171	-1.97	0.0506
YEAR	1996		-1.0748	0.3356	211	-3.20	0.0016
YEAR	1997		0.2904	0.3259	194	0.89	0.3741
YEAR	2001		-0.7744	0.4735	87.6	-1.64	0.1055
YEAR	2002		0	.	.	.	.
stratum		5	-0.1486	0.4680	14.6	-0.32	0.7554
stratum		6	0	.	.	.	.

Solution for Random Effects

Effect	stratum	BLOCKNO	Estimate	Std Err Pred	DF	t Value	Pr > |t|
BLOCKNO(stratum)	5	70	-0.6343	0.4399	22.8	-1.44	0.1629
BLOCKNO(stratum)	5	94	-0.02167	0.4678	26.5	-0.05	0.9634
BLOCKNO(stratum)	5	96	0.09507	0.4403	22.8	0.22	0.8310
BLOCKNO(stratum)	5	101	0.08465	0.4407	22.7	0.19	0.8494
BLOCKNO(stratum)	5	102	0.5362	0.5204	31.4	1.03	0.3107
BLOCKNO(stratum)	5	103	-0.2568	0.4175	19.9	-0.62	0.5455
BLOCKNO(stratum)	5	104	0.2919	0.4297	21.4	0.68	0.5042
BLOCKNO(stratum)	5	105	-0.09504	0.4506	24.2	-0.21	0.8347
BLOCKNO(stratum)	6	69	-1.2882	0.5978	44	-2.15	0.0367
BLOCKNO(stratum)	6	92	-0.8360	0.5782	47.7	-1.45	0.1548
BLOCKNO(stratum)	6	93	-0.1924	0.5575	47	-0.35	0.7316
BLOCKNO(stratum)	6	97	-0.1074	0.7773	21.4	-0.14	0.8914
BLOCKNO(stratum)	6	99	-0.9111	0.6244	39.9	-1.46	0.1523
BLOCKNO(stratum)	6	100	-1.5117	0.6258	41.3	-2.42	0.0202
BLOCKNO(stratum)	6	107	-0.6842	0.6429	39.1	-1.06	0.2938
BLOCKNO(stratum)	6	129	0.3625	0.6325	38.1	0.57	0.5700
BLOCKNO(stratum)	6	131	-0.1752	0.6798	31.2	-0.26	0.7983
BLOCKNO(stratum)	6	134	0.5534	0.5647	46.2	0.98	0.3322
BLOCKNO(stratum)	6	137	-0.04809	0.5306	51.3	-0.09	0.9281
BLOCKNO(stratum)	6	143	1.0433	0.5718	45.4	1.82	0.0747
BLOCKNO(stratum)	6	150	0.8840	0.7333	26.8	1.21	0.2385
BLOCKNO(stratum)	6	188	1.5048	0.6142	40.6	2.45	0.0187
BLOCKNO(stratum)	6	219	1.4064	0.5493	49.5	2.56	0.0136

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	225	4.17	0.0002
stratum	1	14.6	0.10	0.7573

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	-1.0889	0.3561	56.4	-3.06	0.0034
YEAR	1993	-1.1306	0.4632	56.2	-2.44	0.0178
YEAR	1994	-1.4287	0.4392	53.7	-3.25	0.0020
YEAR	1995	-0.9901	0.3430	53	-2.89	0.0056
YEAR	1996	-1.3554	0.3140	43	-4.32	<.0001
YEAR	1997	0.009704	0.2900	31.9	0.03	0.9735
YEAR	2001	-1.0551	0.4515	54.3	-2.34	0.0232
YEAR	2002	-0.2807	0.3261	42.6	-0.86	0.3942

GLIMMIX Model Statistics

Description	Value
Deviance	338.8641
Scaled Deviance	653.2431
Pearson Chi-Square	306.2164
Scaled Pearson Chi-Square	590.3068
Extra-Dispersion Scale	0.5187

A.5. SAS output for Poisson mixed model describing frequency of red snapper occurrence for the western Gulf of Mexico.

Model Information

Dependent Variable	maxmincount
Weight Variable	stratum area
Covariance Structure	Diagonal
Estimation Method	REML
Residual Variance Method	Profile
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Residual

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	2	5 6
BLOCKNO	23	69 70 92 93 94 96 97 99 100 101 102 103 104 105 107 129 131 134 137 143 150 188 219

Dimensions

Covariance Parameters	1
Columns in X	11
Columns in Z	0
Subjects	1
Max Obs Per Subject	632
Observations Used	632
Observations Not Used	0
Total Observations	632

Covariance Parameter

Estimates

Cov Parm	Estimate
Residual	5.4032

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			0.1158	0.4151	623	0.28	0.7803
YEAR	1992		1.3030	0.4585	623	2.84	0.0046
YEAR	1993		-0.07843	0.6889	623	-0.11	0.9094
YEAR	1994		0.09145	0.6521	623	0.14	0.8885
YEAR	1995		-0.6446	0.7020	623	-0.92	0.3588
YEAR	1996		-0.4874	0.5598	623	-0.87	0.3842
YEAR	1997		0.3514	0.4888	623	0.72	0.4725
YEAR	2001		-0.5438	0.8189	623	-0.66	0.5069
YEAR	2002		0	.	.	.	.
stratum		5	-0.6021	0.2776	623	-2.17	0.0304
stratum		6	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	623	3.82	0.0004
stratum	1	623	4.71	0.0304

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	1.1178	0.2326	623	4.81	<.0001
YEAR	1993	-0.2636	0.5632	623	-0.47	0.6399
YEAR	1994	-0.09376	0.5185	623	-0.18	0.8566
YEAR	1995	-0.8298	0.5782	623	-1.44	0.1517
YEAR	1996	-0.6726	0.3940	623	-1.71	0.0882
YEAR	1997	0.1662	0.2887	623	0.58	0.5651
YEAR	2001	-0.7290	0.7168	623	-1.02	0.3095
YEAR	2002	-0.1852	0.3957	623	-0.47	0.6399

GLIMMIX Model Statistics

Description	Value
Deviance	1144.5459
Scaled Deviance	211.8267
Pearson Chi-Square	3366.2042
Scaled Pearson Chi-Square	623.0000
Extra-Dispersion Scale	5.4032

A.6. SAS output for logistic mixed model describing frequency of red snapper occurrence for the eastern Gulf of Mexico.

Model Information

Dependent Variable	red snapper occurrence
Weight Variable	stratum area
Covariance Structure	Variance Components
Group Effect	YEAR
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Prasad-Rao-Jeske-Kackar-Harville
Degrees of Freedom Method	Kenward-Roger

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	3	2 3 4
BLOCKNO	37	29 30 45 46 50 180 333 334 360 371 375 386 387 388 403 404 407 421 445 446 469 490 491 492 498 523 524 553 554 608 611 612 617 630 632 633 639

Dimensions

Covariance Parameters	8
Columns in X	12
Columns in Z	0
Subjects	883
Max Obs Per Subject	1
Observations Used	883
Observations Not Used	0
Total Observations	883

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	YEAR 1992	0.3545
Residual	YEAR 1993	0.3240
Residual	YEAR 1994	0.2882
Residual	YEAR 1995	0.2779
Residual	YEAR 1996	0.3222
Residual	YEAR 1997	0.2928
Residual	YEAR 2001	0.4849
Residual	YEAR 2002	0.4679

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			-1.3849	0.2539	189	-5.45	<.0001
YEAR	1992		-1.5210	0.6082	92.3	-2.50	0.0142
YEAR	1993		-1.0967	0.4225	226	-2.60	0.0101
YEAR	1994		-1.9496	0.6842	98.4	-2.85	0.0053
YEAR	1995		-0.9053	0.3854	273	-2.35	0.0195
YEAR	1996		-0.8106	0.3758	282	-2.16	0.0318
YEAR	1997		-1.6588	0.4685	250	-3.54	0.0005
YEAR	2001		-0.8838	0.6664	42.2	-1.33	0.1919
YEAR	2002		0	.	.	.	.
stratum		2	-3.2814	1.3536	595	-2.42	0.0156
stratum		3	-0.03573	0.2924	767	-0.12	0.9028
stratum		4	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	260	2.99	0.0049
stratum	2	689	2.94	0.0536

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	-4.0116	0.7161	163	-5.60	<.0001
YEAR	1993	-3.5873	0.5628	455	-6.37	<.0001
YEAR	1994	-4.4401	0.7752	153	-5.73	<.0001
YEAR	1995	-3.3959	0.5285	403	-6.43	<.0001
YEAR	1996	-3.3012	0.5282	532	-6.25	<.0001
YEAR	1997	-4.1494	0.5944	466	-6.98	<.0001
YEAR	2001	-3.3744	0.7732	74.4	-4.36	<.0001
YEAR	2002	-2.4906	0.4991	470	-4.99	<.0001

GLIMMIX Model Statistics

Description	Value
Deviance	164.5284
Scaled Deviance	351.5984
Pearson Chi-Square	299.9424
Scaled Pearson Chi-Square	640.9791
Extra-Dispersion Scale	0.4679

A.7. SAS output for Poisson mixed model describing frequency of red snapper occurrence for the eastern Gulf of Mexico.

Model Information

Dependent Variable	maxmincount
Weight Variable	stratum area
Covariance Structure	Variance Components
Group Effect	YEAR
Estimation Method	REML
Residual Variance Method	None
Fixed Effects SE Method	Prasad-Rao-Jeske-Kackar-Harville
Degrees of Freedom Method	Kenward-Roger

Class Level Information

Class	Levels	Values
YEAR	8	1992 1993 1994 1995 1996 1997 2001 2002
stratum	3	2 3 4
BLOCKNO	37	29 30 45 46 50 180 333 334 360 371 375 386 387 388 403 404 407 421 445 446 469 490 491 492 498 523 524 553 554 608 611 612 617 630 632 633 639

Dimensions

Covariance Parameters	8
Columns in X	12
Columns in Z	0
Subjects	883
Max Obs Per Subject	1
Observations Used	883
Observations Not Used	0
Total Observations	883

Covariance Parameter Estimates

Cov Parm	Group	Estimate
Residual	YEAR 1992	0.3348
Residual	YEAR 1993	0.5218
Residual	YEAR 1994	0.5059
Residual	YEAR 1995	0.2500
Residual	YEAR 1996	0.4601
Residual	YEAR 1997	1.1537
Residual	YEAR 2001	1.3636
Residual	YEAR 2002	1.2887

Solution for Fixed Effects

Effect	YEAR	stratum	Estimate	Standard Error	DF	t Value	Pr > |t|
Intercept			-0.8361	0.2548	190	-3.28	0.0012
YEAR	1992		-2.1357	0.5812	95.5	-3.67	0.0004
YEAR	1993		-1.2865	0.4136	232	-3.11	0.0021
YEAR	1994		-2.0735	0.6945	97.7	-2.99	0.0036
YEAR	1995		-1.5642	0.3641	287	-4.30	<.0001
YEAR	1996		-1.2929	0.3825	278	-3.38	0.0008
YEAR	1997		-1.1356	0.4997	237	-2.27	0.0240
YEAR	2001		-0.8379	0.7408	39.7	-1.13	0.2648
YEAR	2002		0	.	.	.	.
stratum		2	-3.3792	1.5812	582	-2.14	0.0330
stratum		3	0.04473	0.2861	763	0.16	0.8758
stratum		4	0	.	.	.	.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
YEAR	7	258	4.27	0.0002
stratum	2	679	2.32	0.0992

Least Squares Means

Effect	YEAR	Estimate	Standard Error	DF	t Value	Pr > |t|
YEAR	1992	-4.0833	0.7439	217	-5.49	<.0001
YEAR	1993	-3.2340	0.6186	523	-5.23	<.0001
YEAR	1994	-4.0211	0.8295	181	-4.85	<.0001
YEAR	1995	-3.5117	0.5799	431	-6.06	<.0001
YEAR	1996	-3.2404	0.5982	571	-5.42	<.0001
YEAR	1997	-3.0832	0.6758	503	-4.56	<.0001
YEAR	2001	-2.7855	0.8808	76.9	-3.16	0.0022
YEAR	2002	-1.9476	0.5711	531	-3.41	0.0007

GLIMMIX Model Statistics

Description	Value
Deviance	219.2687
Scaled Deviance	170.1463
Pearson Chi-Square	642.8439
Scaled Pearson Chi-Square	498.8289
Extra-Dispersion Scale	1.2887