# Indices of Blacktip Shark Based on NMFS Bottom Longline Surveys (1995-2011)

Walter Ingram

SEDAR29-WP-03

Date Submitted: 15 March 2012

Updated: 20 March 2012

Please site this document as follows:

Ingram, W. 2012. Indices of Blacktip Shark Based on NMFS Bottom Longline Surveys (1995-2011). SEDAR29-WP-03. SEDAR, North Charleston, SC.

# Indices of Blacktip Shark Based on NMFS Bottom Longline Surveys (1995-2011)


# Walter Ingram, NMFS Pascagoula


Relative abundance indices were developed for blacktip shark for the Gulf of Mexico (GOM) based on data collected during NMFS Bottom Longline Surveys (BLL) from 1995-2011. The survey methodologies have been detailed in numerous past SEDAR documents and will not be reiterated herein. However, there was an additional amount of data incorporated into the modeling process from an expansion of survey effort during 2011. This extra data was collected using current survey methodologies, and the only expanded survey data used was that collected in the Gulf during the time of the regular BLL, this resulted in a doubling of survey effort during the standard survey time.

To develop standardized indices of annual average CPUE (# per 100 hook-hours) for blacktip shark for the GOM, a delta-lognormal model, as described by Lo et al. (1992), was employed. This index is a mathematical combination of yearly CPUE estimates from two distinct generalized linear models: a binomial (logistic) model which describes proportion of positive CPUE values (i.e., presence/absence) and lognormal model which describes variability in only the nonzero CPUE data. A backward selection approach, while using the GLMMIX and MIXED procedures (Patetta, 2002) in SAS, was employed to provide yearly index values for both the binomial and lognormal sub-models, respectively. The parameters tested for inclusion in each sub-model were survey year, area, hook type. For this study, there were three area demarcations in the GOM: Eastern Gulf (east of $88^{o}$ west longitude); Central Gulf (between $88^{o}$ and $93^{o}$ west longitude); and Western Gulf (west of $93^{o}$ west longitude). Also, as described in previous documents (LCS05/06-DW-27, SEDAR 13-DW-22), hook-type changed over time from J to circle-hooks (C-hooks). For the binomial models, a logistic-type mixed model was employed. The fit of each model was evaluated using the fit statistics provided by the GLMMIX macro.

The following figures and tables summarize the length of individuals collected, the model building results, the abundance indices, the results of residual analyses and the distribution of effort and catch.

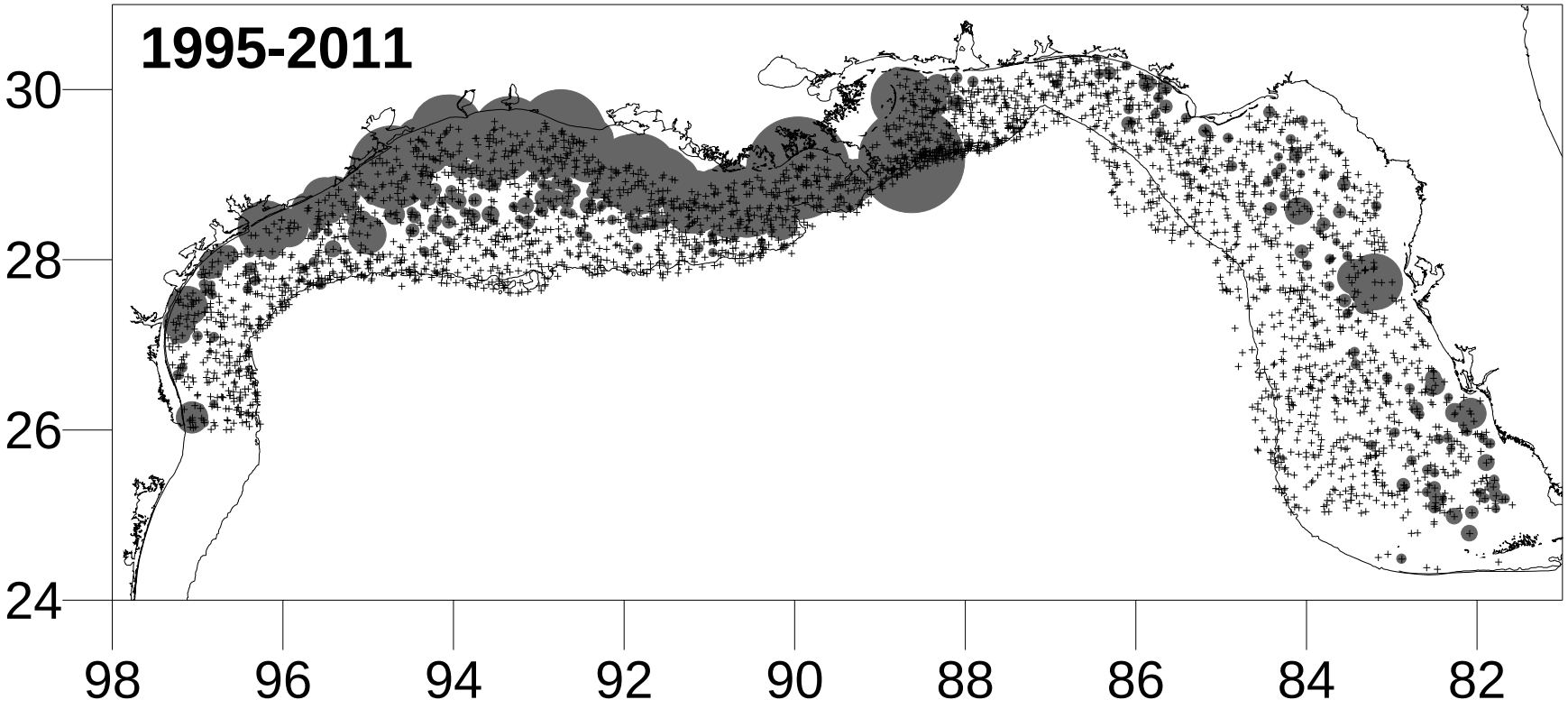

Ingram, Walter, Terry Henwood, Mark Grace, Lisa Jones, William Driggers, and Karen Mitchell. 2005. Catch rates, distribution and size composition of large coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean. LCS05/06-DW-27.

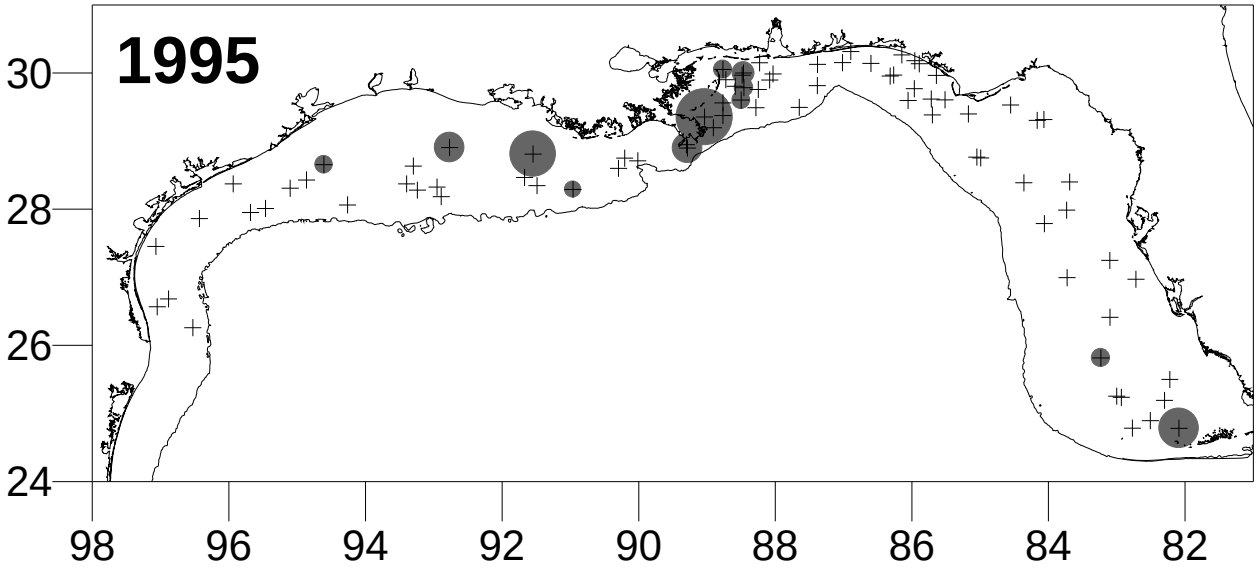
Ingram, Walter, William Driggers, Mark Grace, Terry Henwood, Lisa Jones, and Karen Mitchell. 2007. Catch rates, distribution and size composition of small coastal sharks collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico and U.S. Atlantic Ocean. SEDAR 13-DW-22.

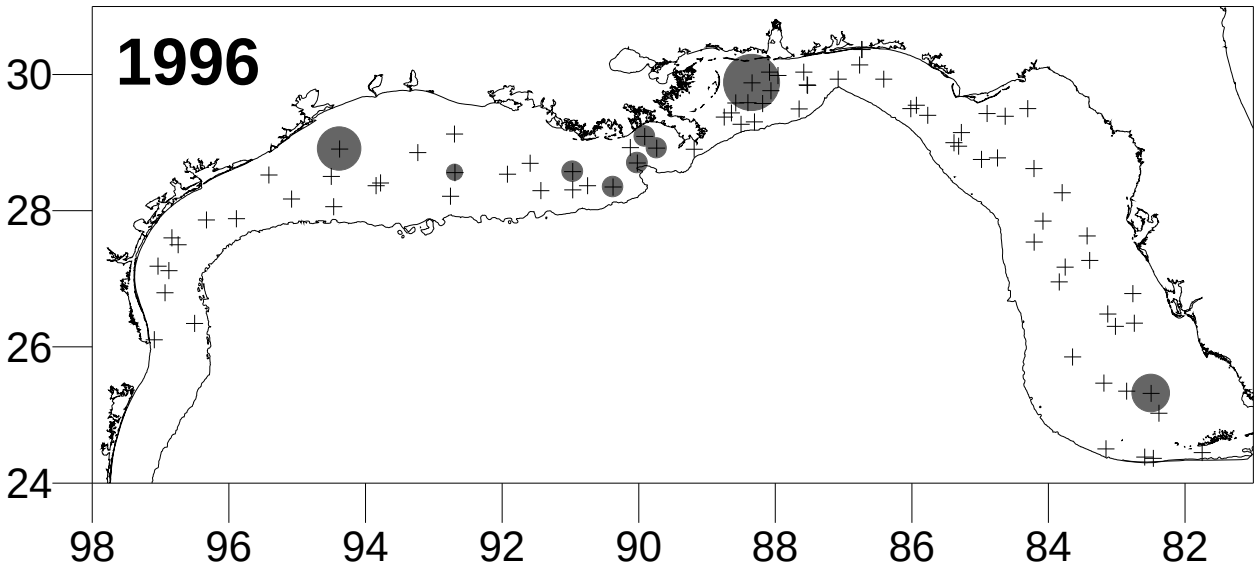
Lo, N. C. H., L.D. Jacobson, and J.L. Squire. 1992. Indices of relative abundance from fish spotter data based on delta-lognormal models. Can. J. Fish. Aquat. Sci. 49: 2515-1526.

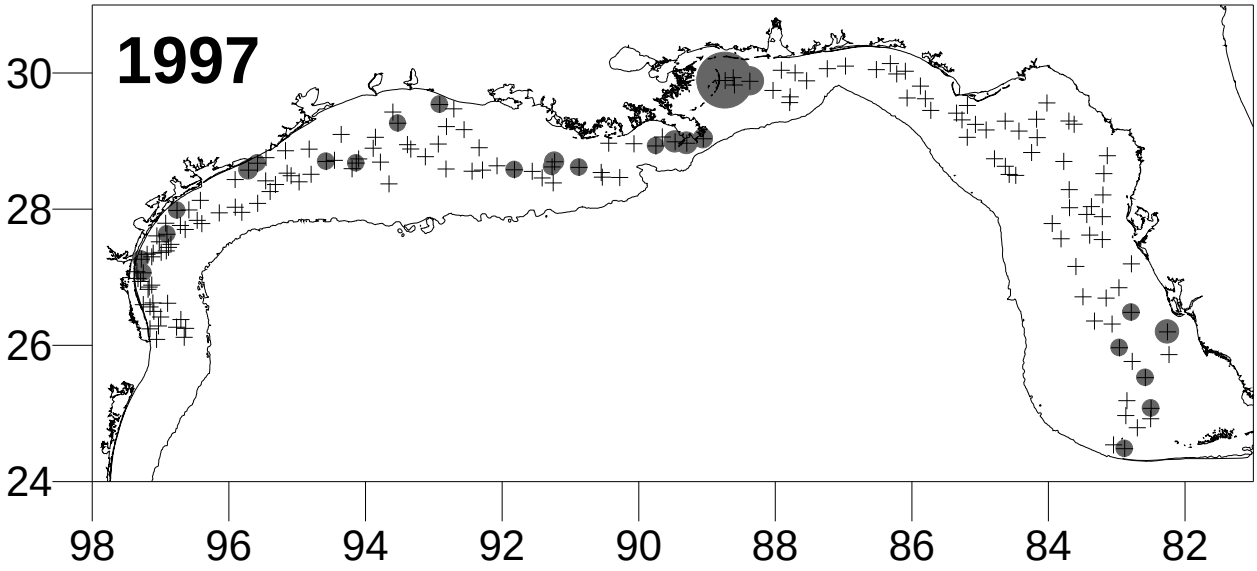
Patetta, M. 2002. *Longitudinal Data Analysis with Discrete and Continuous Responses Course Notes*. SAS Institute Inc., Cary, North Carolina. 326 p.

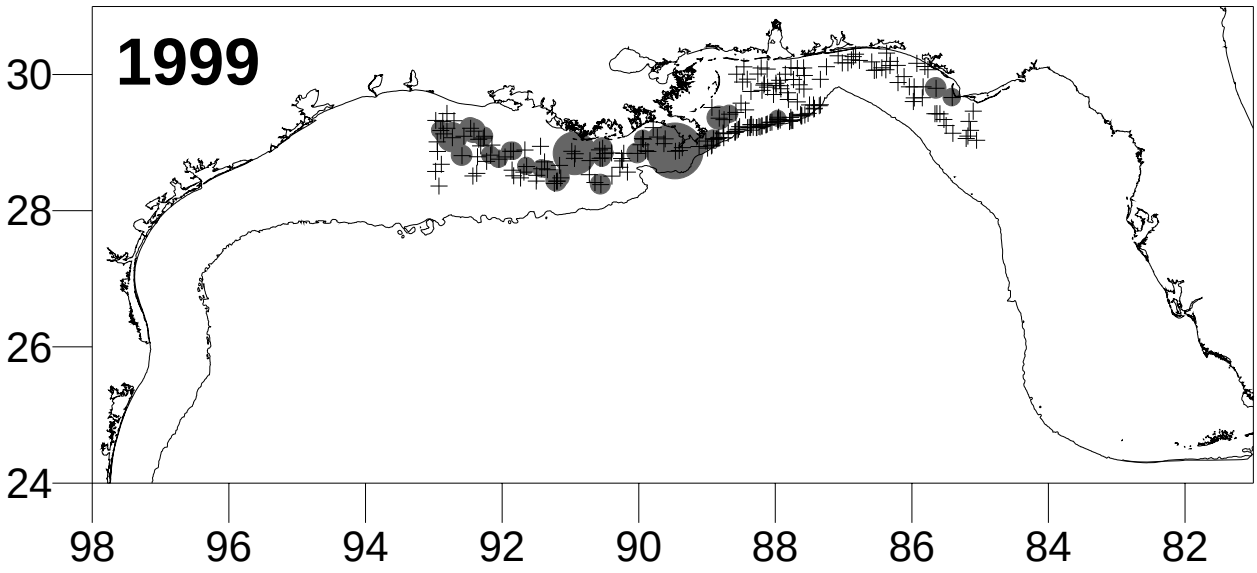
**Appendix I. Blacktip Shark Bottom Longline Distribution Maps**

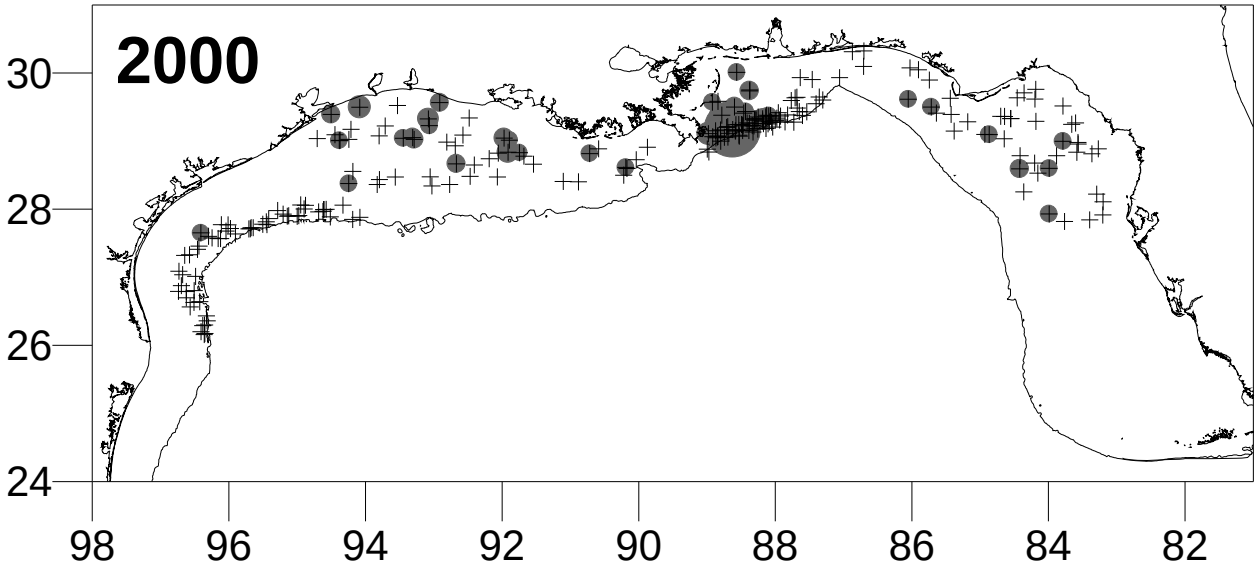


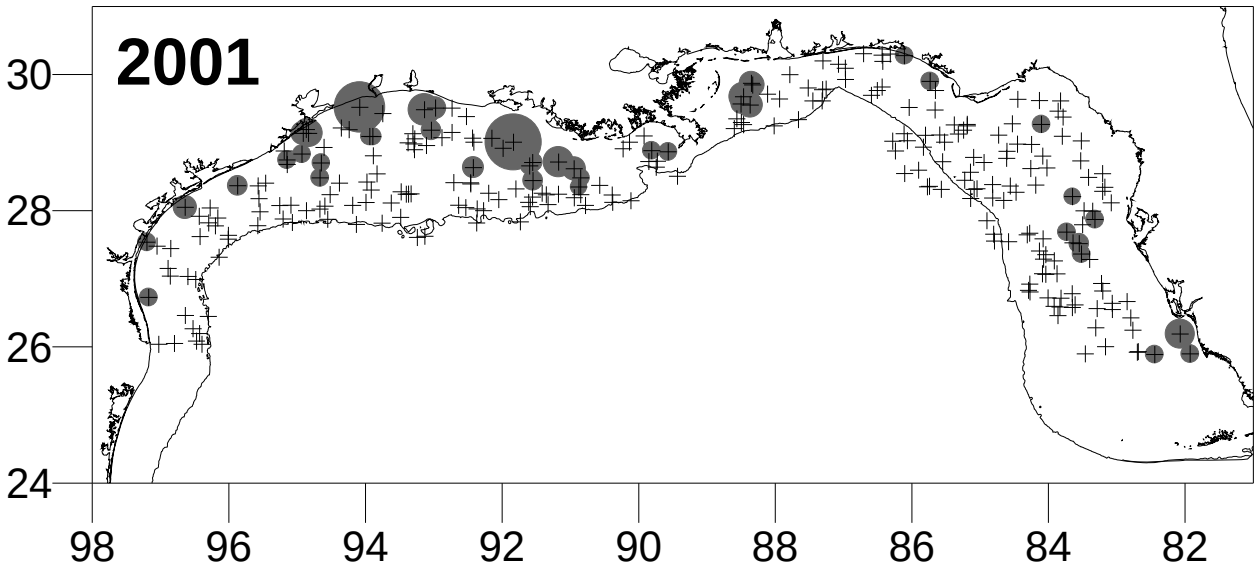

1995
30
28
26
24
98
96
94
92
90
88
86
84
82

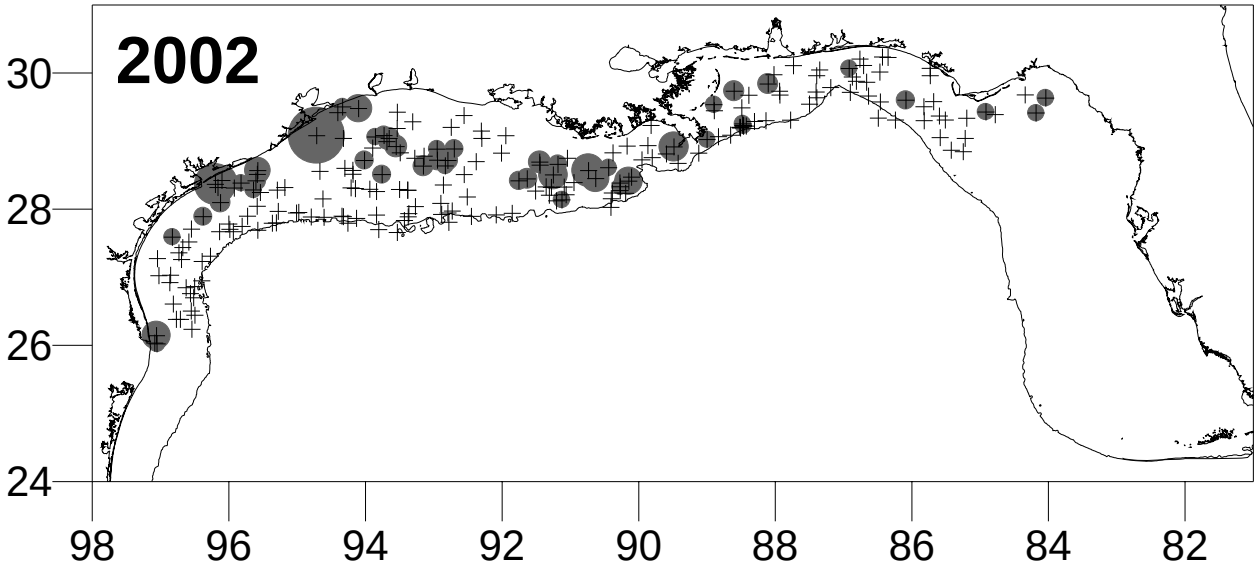

1996
30
28
26
24
98
96
94
92
90
88
86
84
82

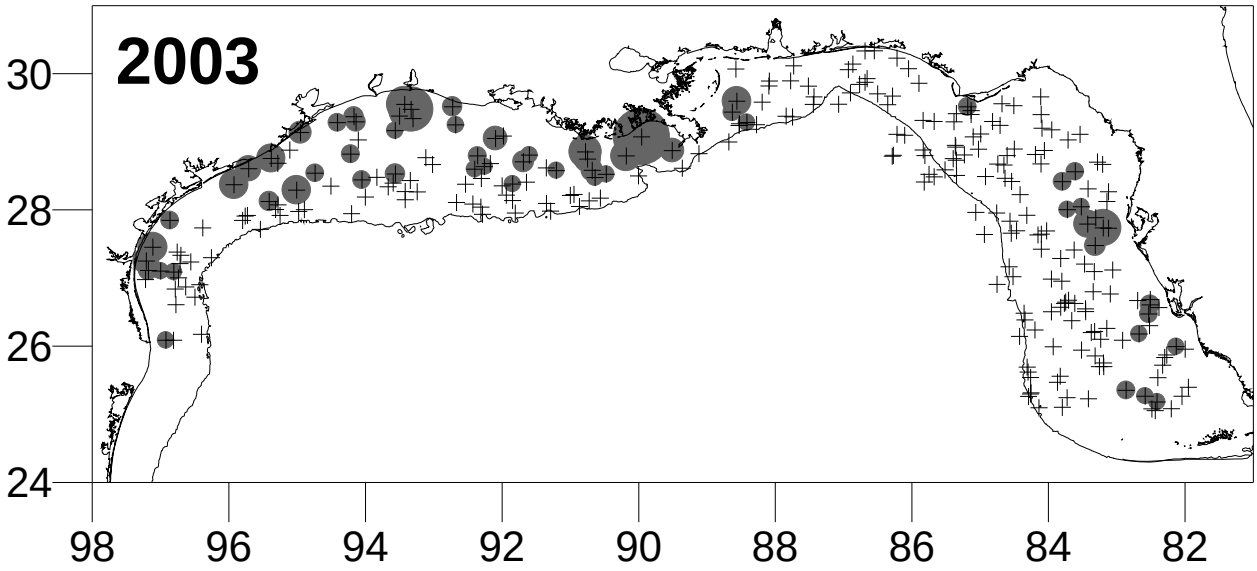

1997
30
28
26
24
98
96
94
92
90
88
86
84
82

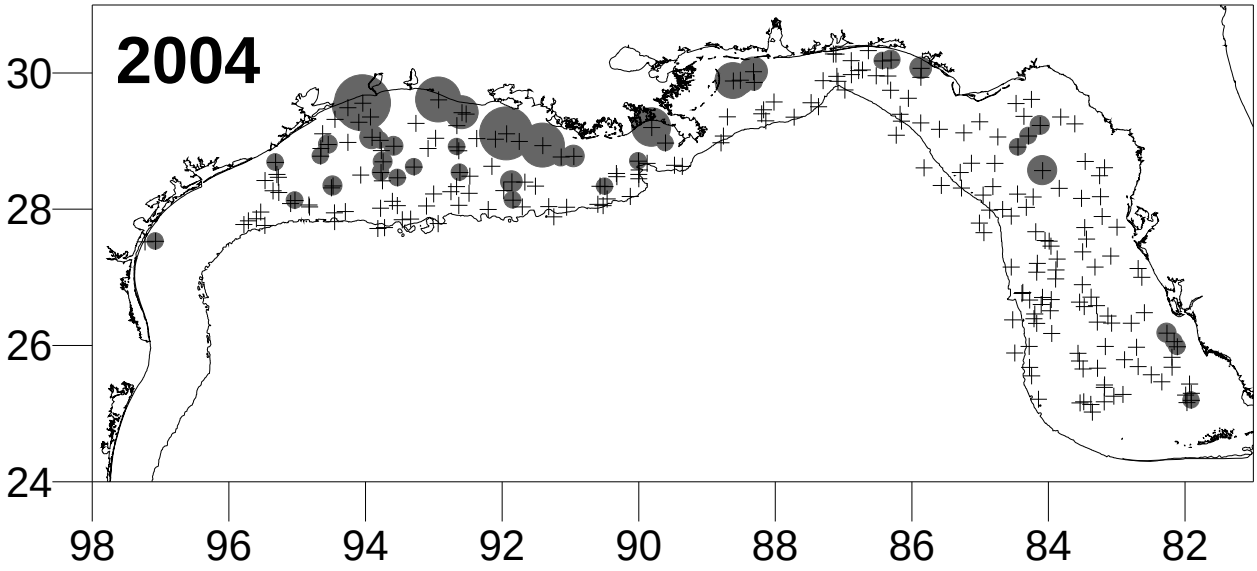

1999
30
28
26
24
98
96
94
92
90
88
86
84
82

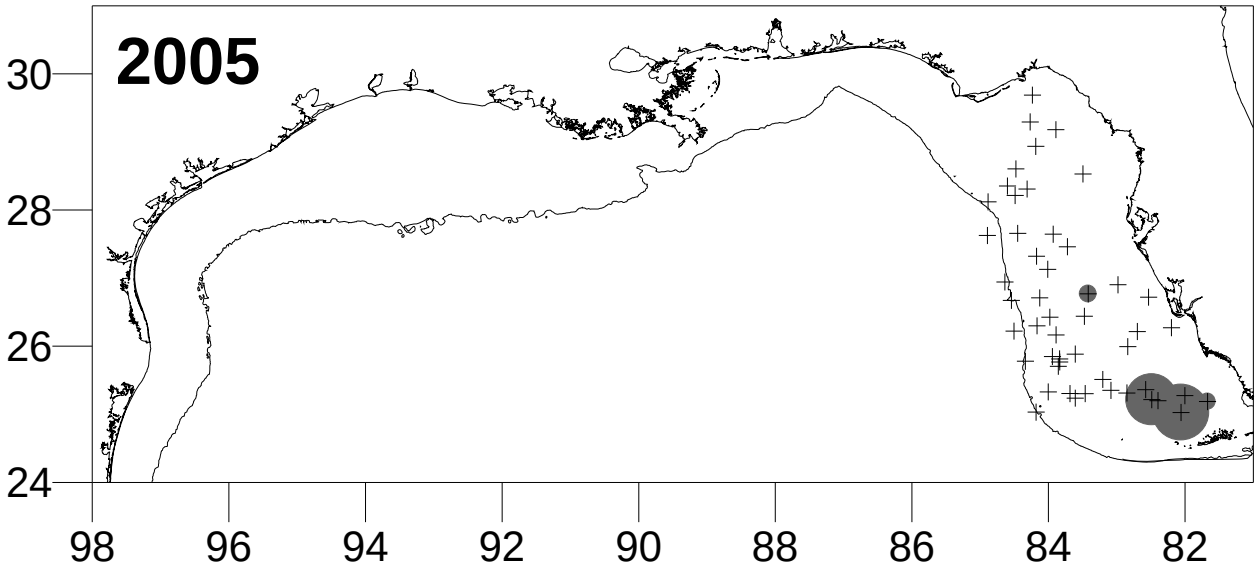

2000
30
28
26
24
98
96
94
92
90
88
86
84
82

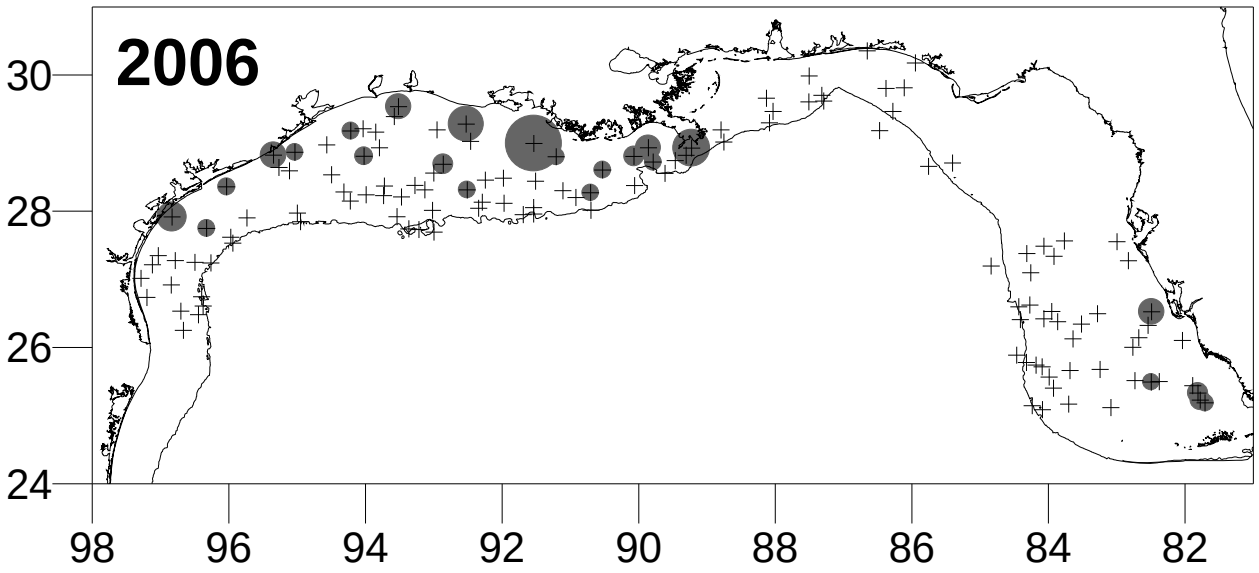

2001
30
28
26
24
98
96
94
92
90
88
86
84
82

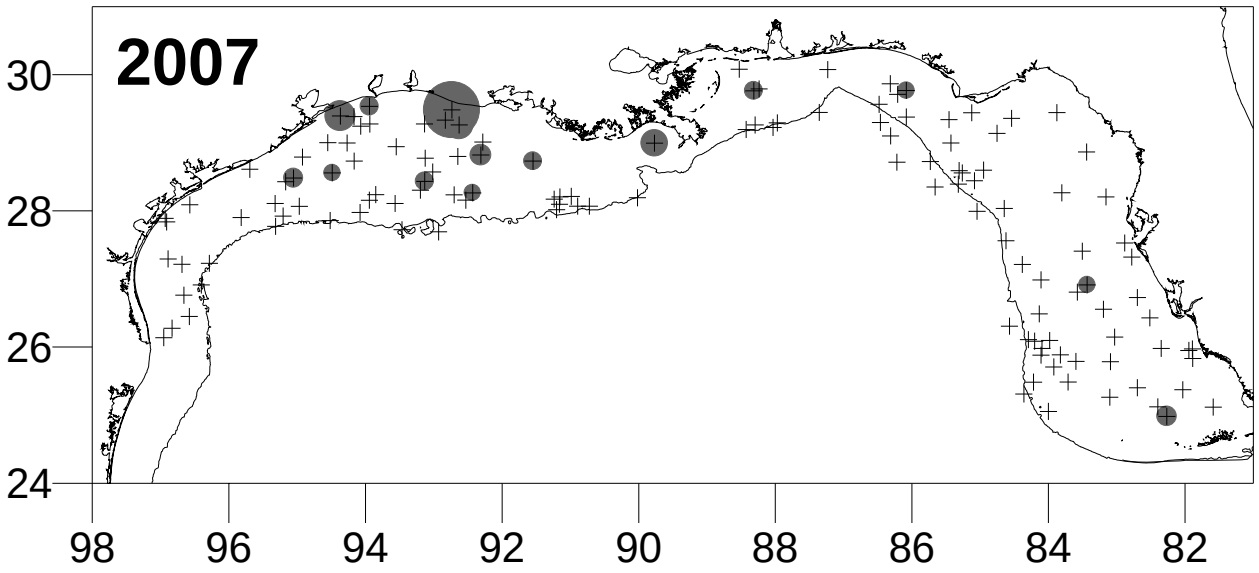

2002
30
28
26
24
98
96
94
92
90
88
86
84
82

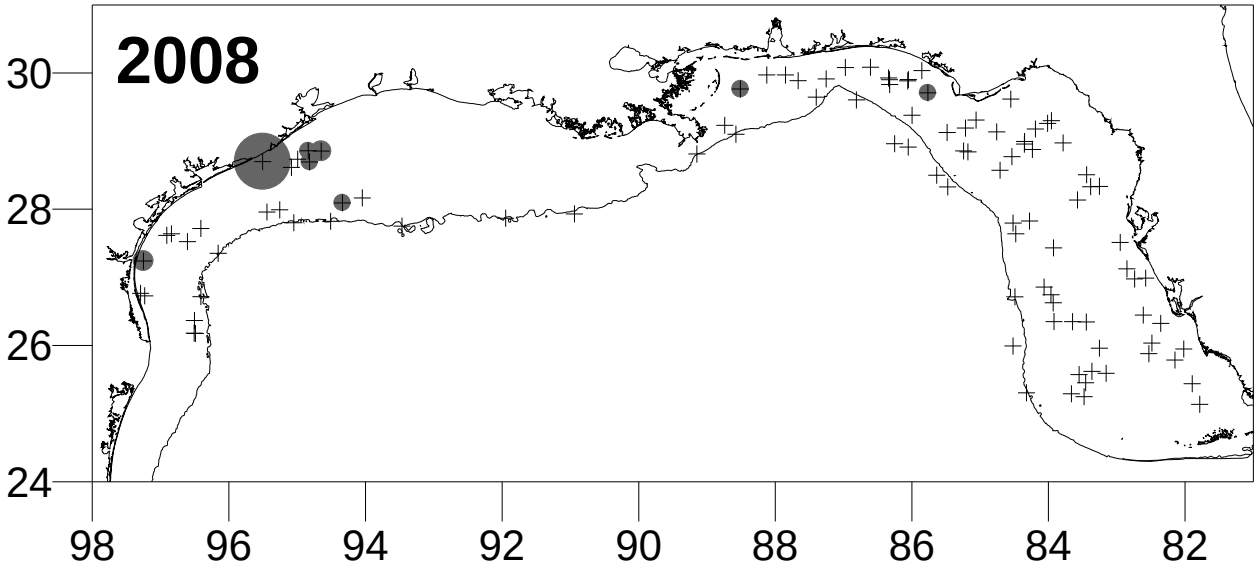

2003
30
28
26
24
98
96
94
92
90
88
86
84
82

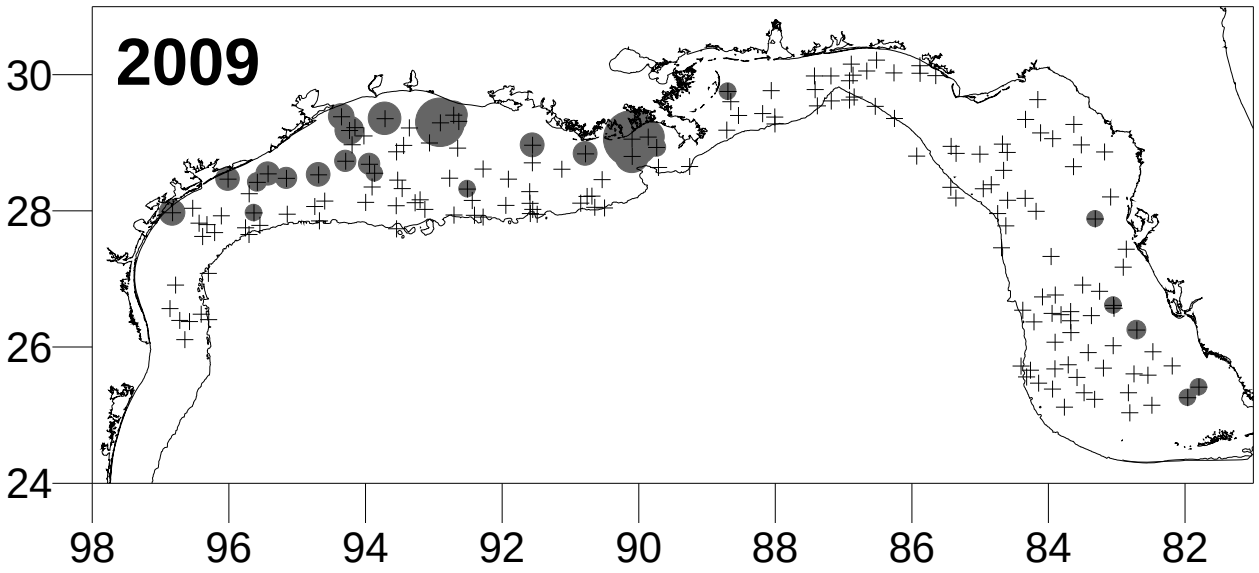

2004
30
28
26
24
98
96
94
92
90
88
86
84
82

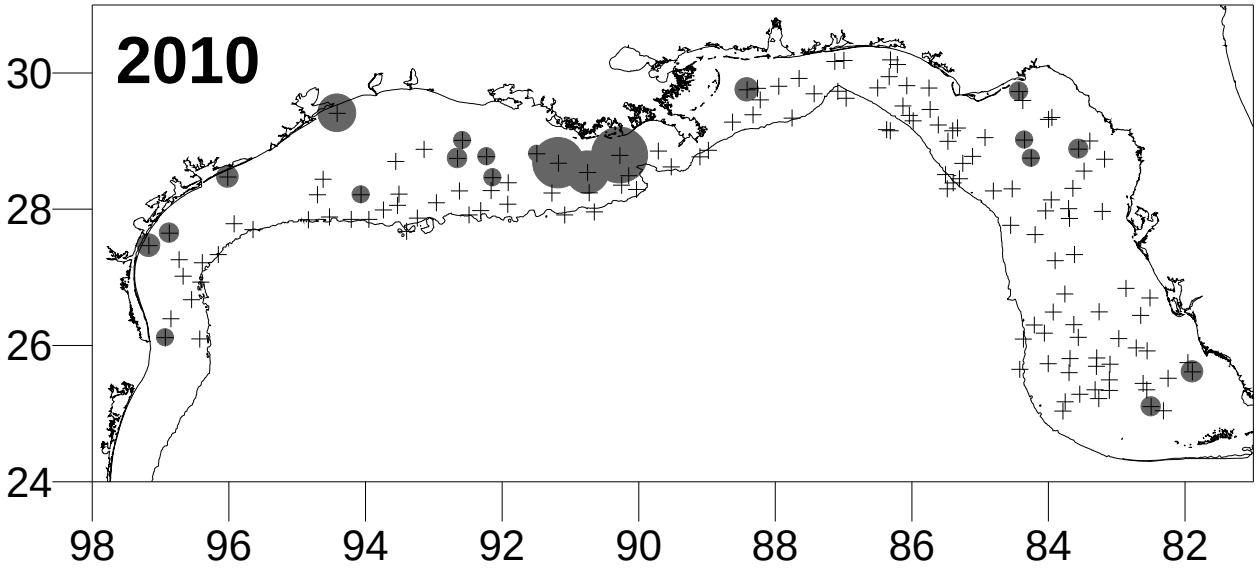

2005
30
28
26
24
98
96
94
92
90
88
86
84
82

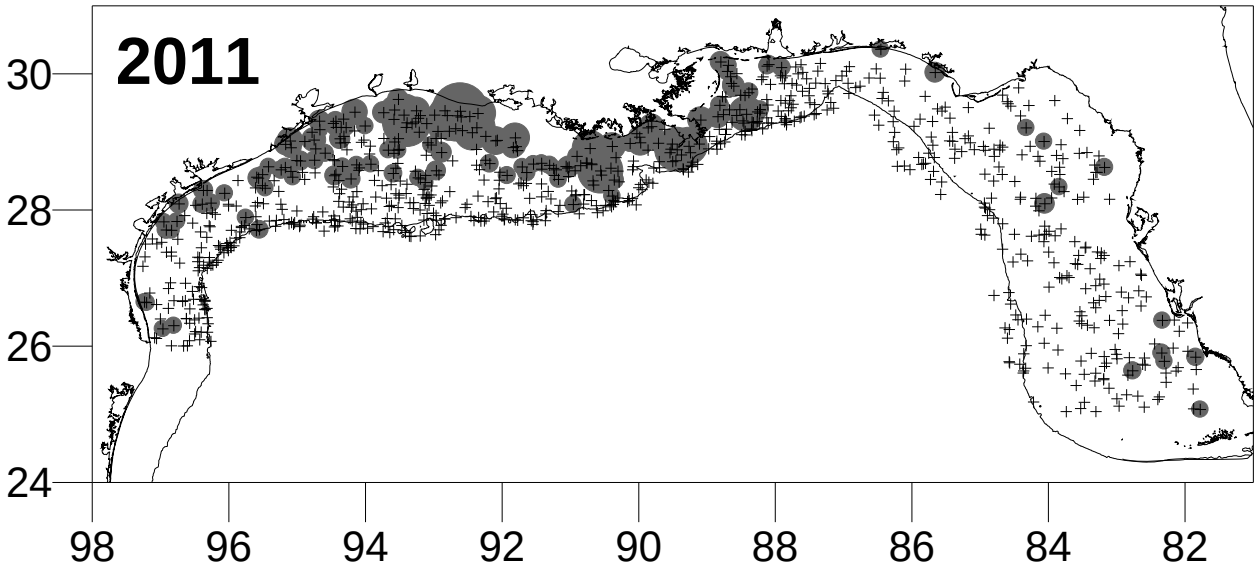

2006
30
28
26
24
98
96
94
92
90
88
86
84
82


2007
30
28
26
24
98
96
94
92
90
88
86
84
82

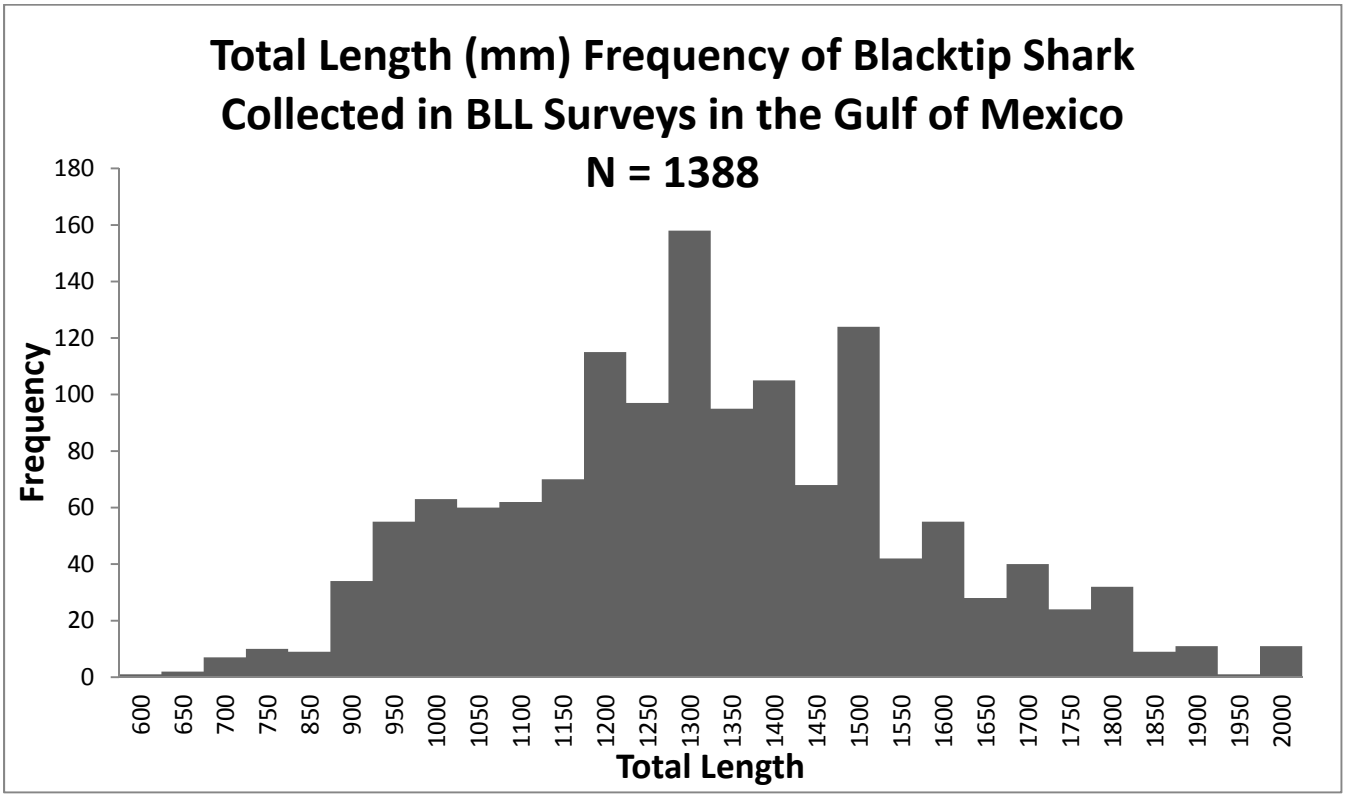

2008
30
28
26
24
98
96
94
92
90
88
86
84
82

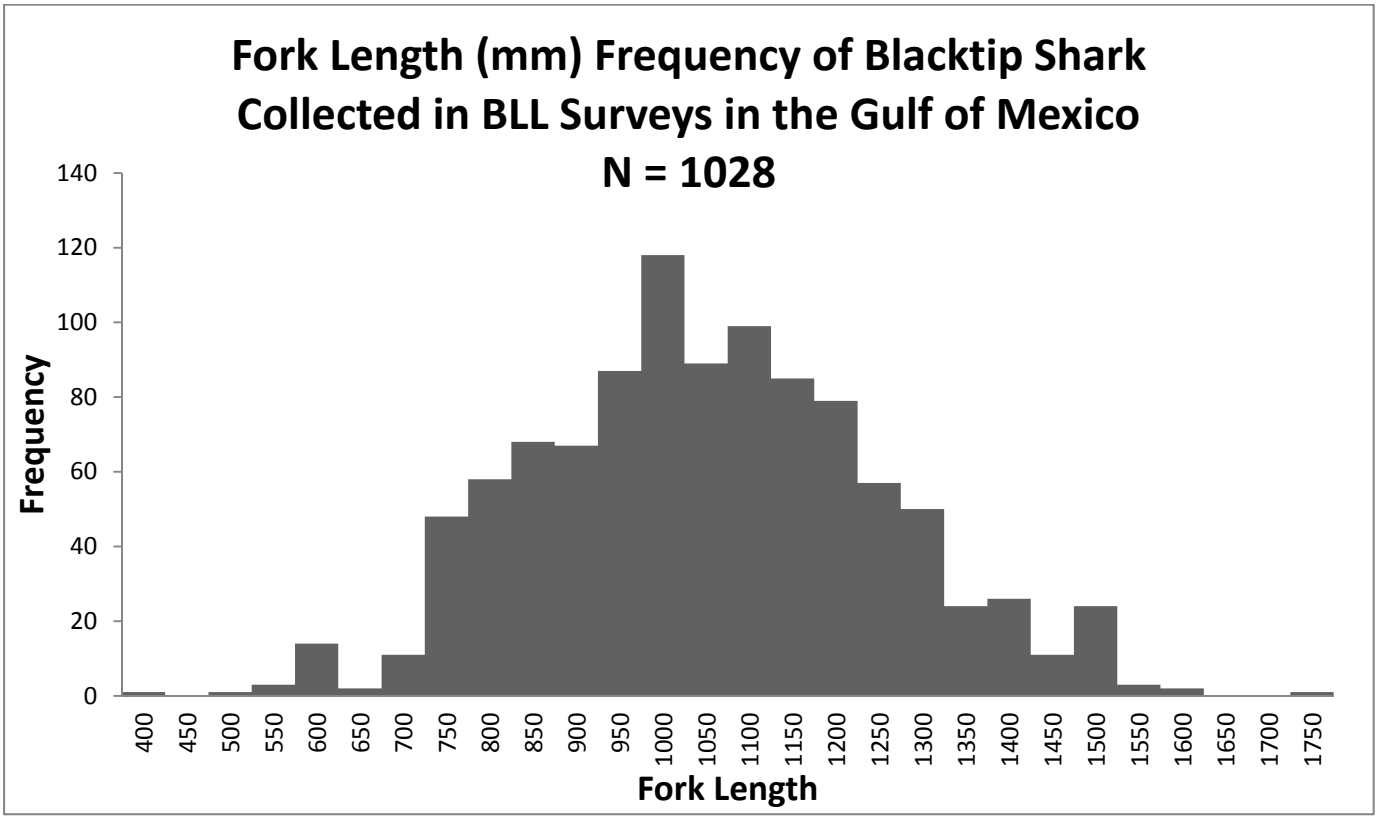

2009
30
28
26
24
98
96
94
92
90
88
86
84
82

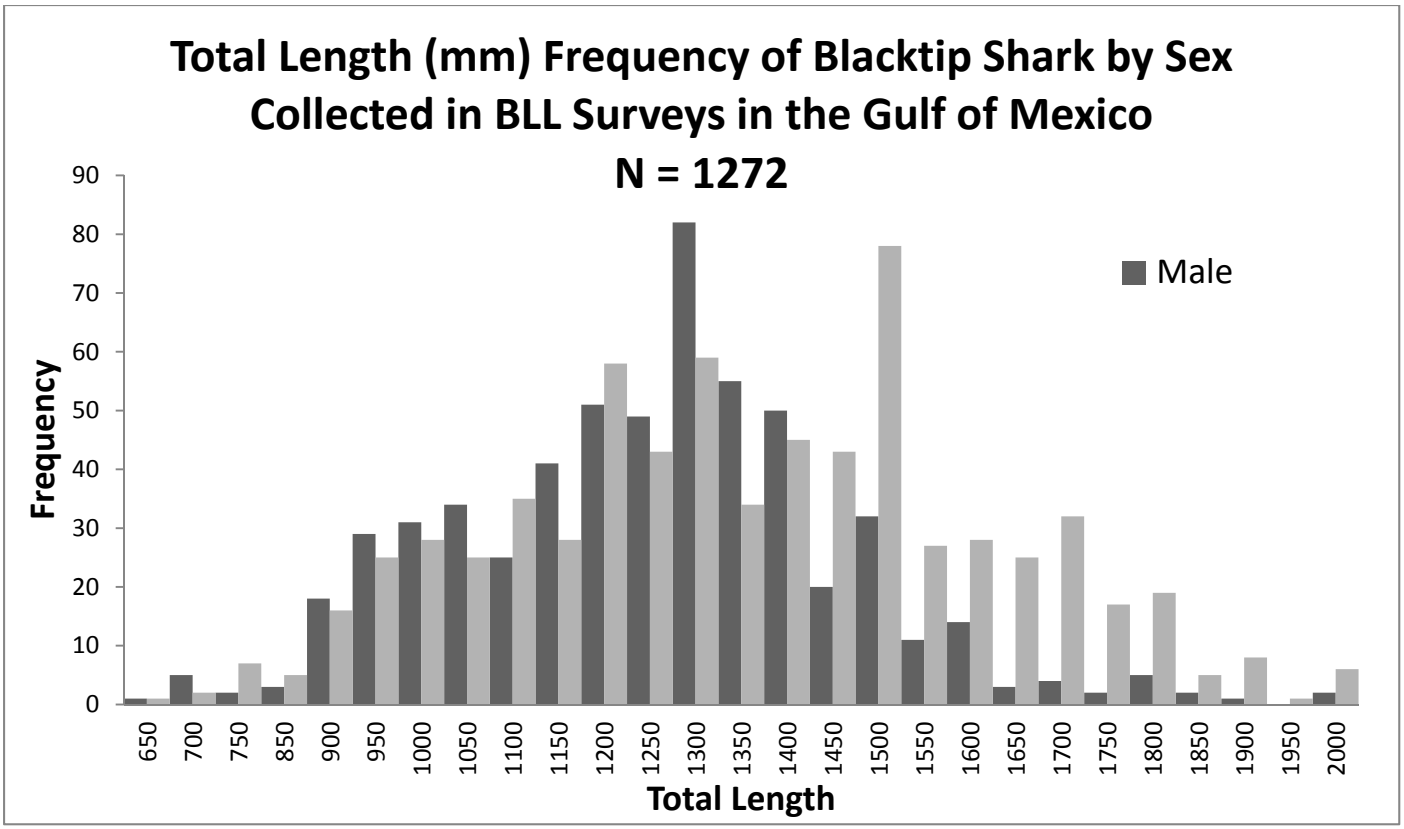

2010
30
28
26
24
98
96
94
92
90
88
86
84
82

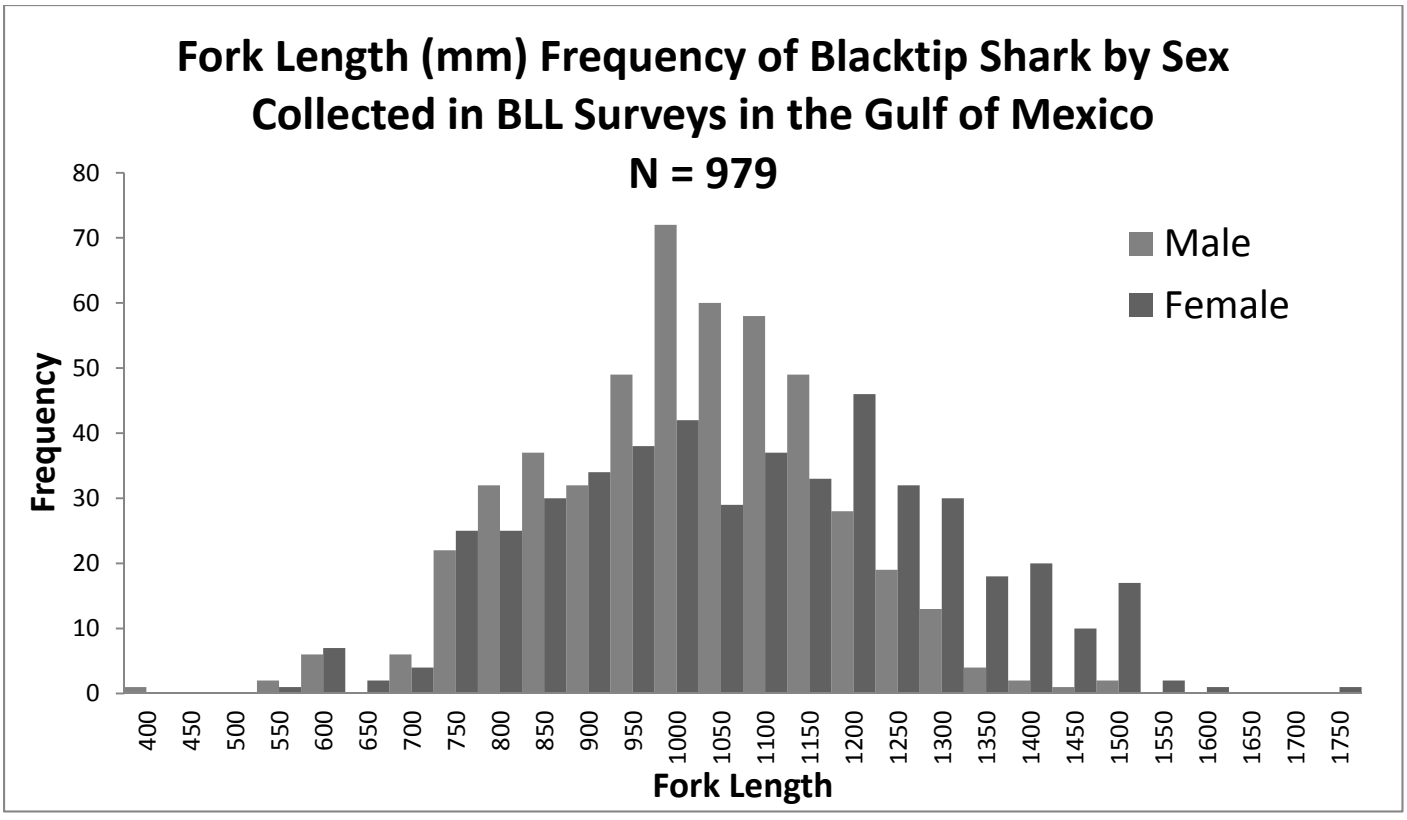

2011
30
28
26
24
98
96
94
92
90
88
86
84
82

## Appendix II. Length Frequency and Modeling Results




Total Length (mm) Frequency of Blacktip Shark by Sex
Collected in BLL Surveys in the Gulf of Mexico
N = 1272
Male
Frequency
Total Length
0
10
20
30
40
50
60
70
80
90
650
700
750
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
1850
1900
1950
2000

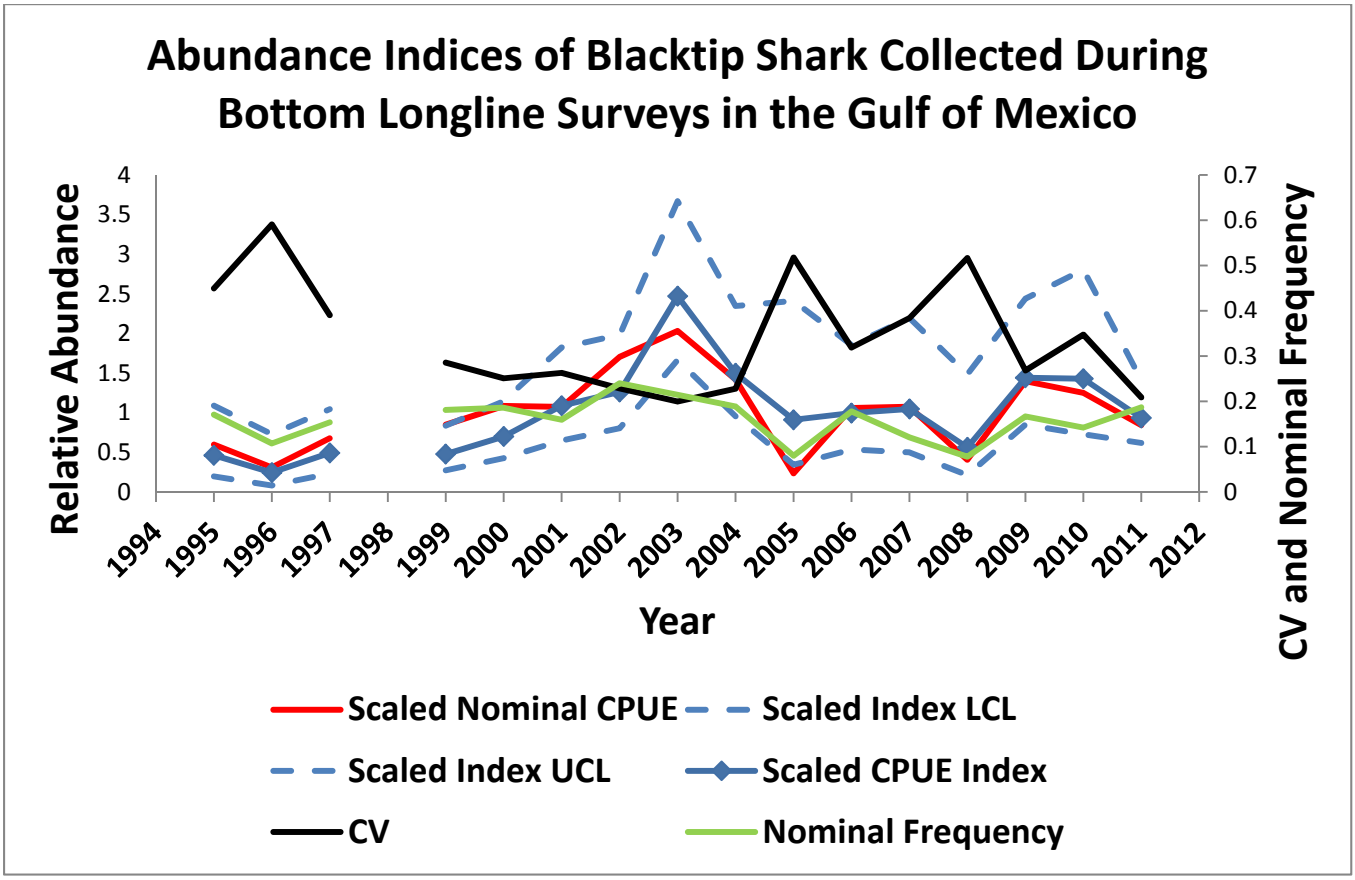

Fork Length (mm) Frequency of Blacktip Shark by Sex
Collected in BLL Surveys in the Gulf of Mexico
N = 979
Male
Female
Frequency
Fork Length
0
10
20
30
40
50
60
70
80
400
450
500
550
600
650
700
750
800
850
900
950
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
1550
1600
1650
1700
1750

*Type 3 Tests of Fixed Effects for the Binomial Submodel*

| Effect | Num DF | Den DF | Chi-Square | F Value | Pr > ChiSq | Pr > F |
|---|---|---|---|---|---|---|
| *YEAR* | 15 | 866 | 30.29 | 2.00 | 0.0109 | 0.0131 |
| *AREA* | 2 | 2679 | 170.66 | 85.33 | <.0001 | <.0001 |
| *hook* | 1 | 456 | 7.05 | 7.05 | 0.0079 | 0.0082 |

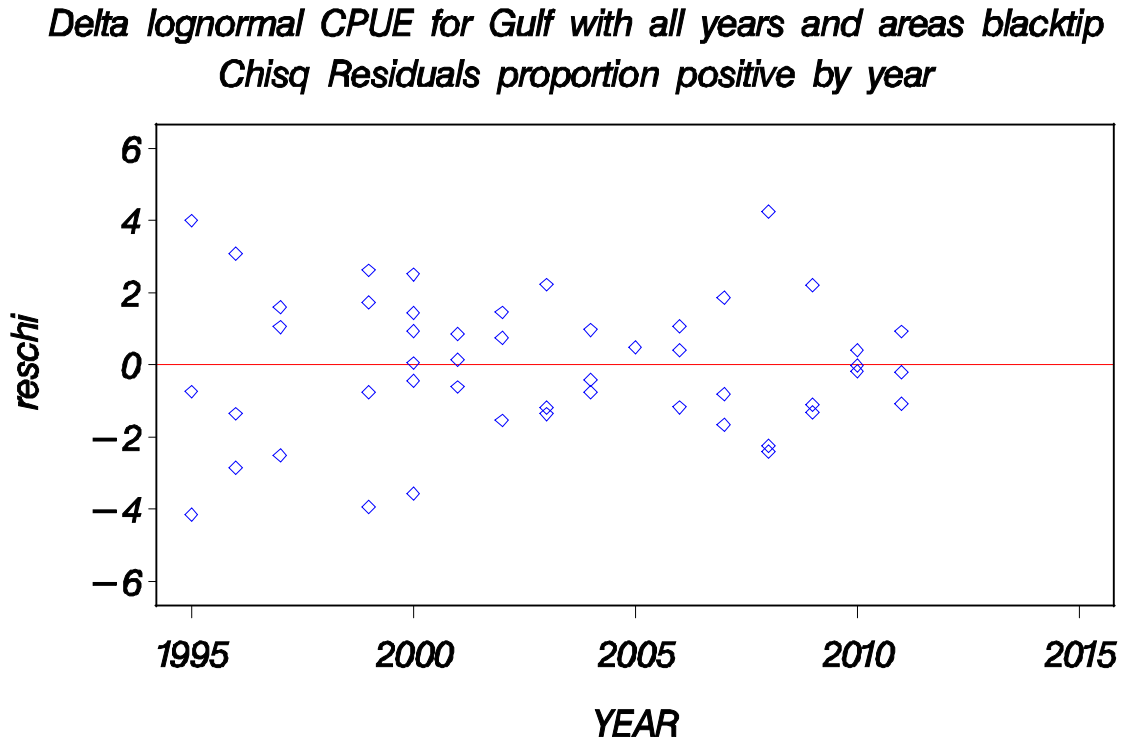
*Type 3 Tests of Fixed Effects for the Lognormal Submodel*

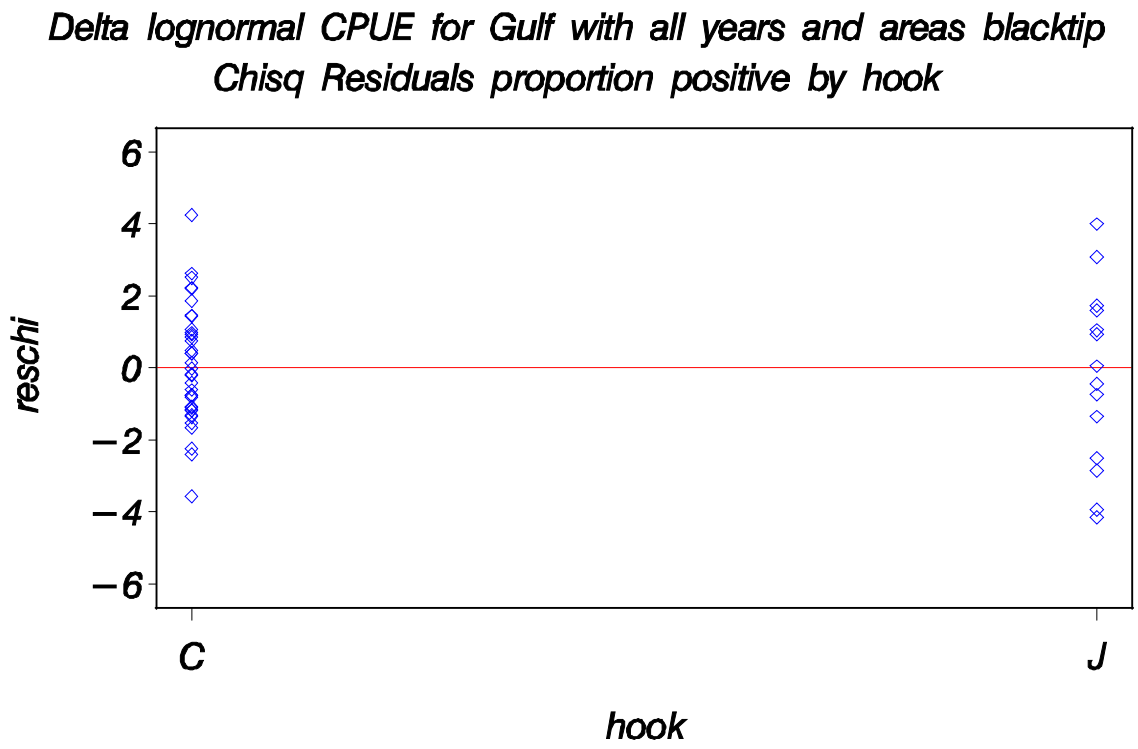
| Effect | Num DF | Den DF | F Value | Pr > F |
|---|---|---|---|---|
| *YEAR* | 15 | 500 | 1.20 | 0.2664 |
| *AREA* | 2 | 500 | 15.14 | <.0001 |
| *hook* | 1 | 500 | 6.00 | 0.0146 |



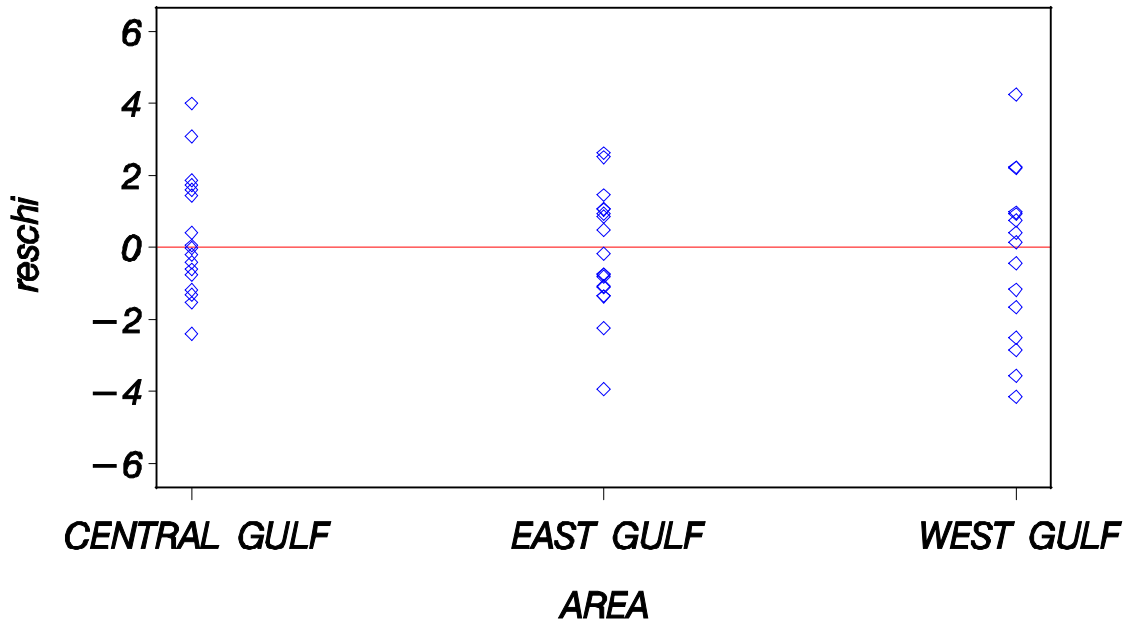
| *Survey Year* | *Nominal Frequency* | *N* | *Index (# per 100 hook-hours)* | *Scaled Nominal CPUE* | *Scaled CPUE Index* | *CV* | *Scaled Index LCL* | *Scaled Index UCL* |
|---|---|---|---|---|---|---|---|---|
| 1995 | 0.17073 | 82 | 0.26355 | 0.59745 | 0.46149 | 0.44949 | 0.19569 | 1.08834 |
| 1996 | 0.10714 | 84 | 0.13937 | 0.30971 | 0.24404 | 0.59065 | 0.08171 | 0.72883 |
| 1997 | 0.15385 | 169 | 0.28051 | 0.67588 | 0.49119 | 0.3904 | 0.23126 | 1.04326 |
| 1998 | | 0 | | | | | | |
| 1999 | 0.181 | 221 | 0.27263 | 0.84808 | 0.4774 | 0.28551 | 0.27273 | 0.83566 |
| 2000 | 0.18565 | 237 | 0.3989 | 1.08305 | 0.6985 | 0.25088 | 0.42616 | 1.14489 |
| 2001 | 0.15942 | 276 | 0.62099 | 1.07275 | 1.0874 | 0.26287 | 0.64843 | 1.82353 |
| 2002 | 0.23982 | 221 | 0.72048 | 1.70412 | 1.26162 | 0.22856 | 0.80339 | 1.98121 |
| 2003 | 0.21429 | 280 | 1.41035 | 2.03087 | 2.46962 | 0.19977 | 1.66266 | 3.66821 |
| 2004 | 0.18876 | 248 | 0.8544 | 1.41833 | 1.49611 | 0.22787 | 0.95398 | 2.34633 |
| 2005 | 0.08 | 50 | 0.51967 | 0.23452 | 0.90998 | 0.5176 | 0.34344 | 2.41107 |
| 2006 | 0.17778 | 135 | 0.56822 | 1.0575 | 0.99499 | 0.31874 | 0.53411 | 1.85356 |
| 2007 | 0.1203 | 133 | 0.59725 | 1.07321 | 1.04582 | 0.38351 | 0.49854 | 2.19388 |
| 2008 | 0.07767 | 103 | 0.32061 | 0.40492 | 0.56142 | 0.51642 | 0.2123 | 1.4846 |
| 2009 | 0.16667 | 180 | 0.82199 | 1.39701 | 1.43936 | 0.26807 | 0.84987 | 2.43772 |
| 2010 | 0.14189 | 148 | 0.8156 | 1.25035 | 1.42817 | 0.34712 | 0.72746 | 2.80382 |
| 2011 | 0.18676 | 423 | 0.53276 | 0.84224 | 0.93291 | 0.20879 | 0.61719 | 1.41013 |

# Appendix III. Residual Analysis

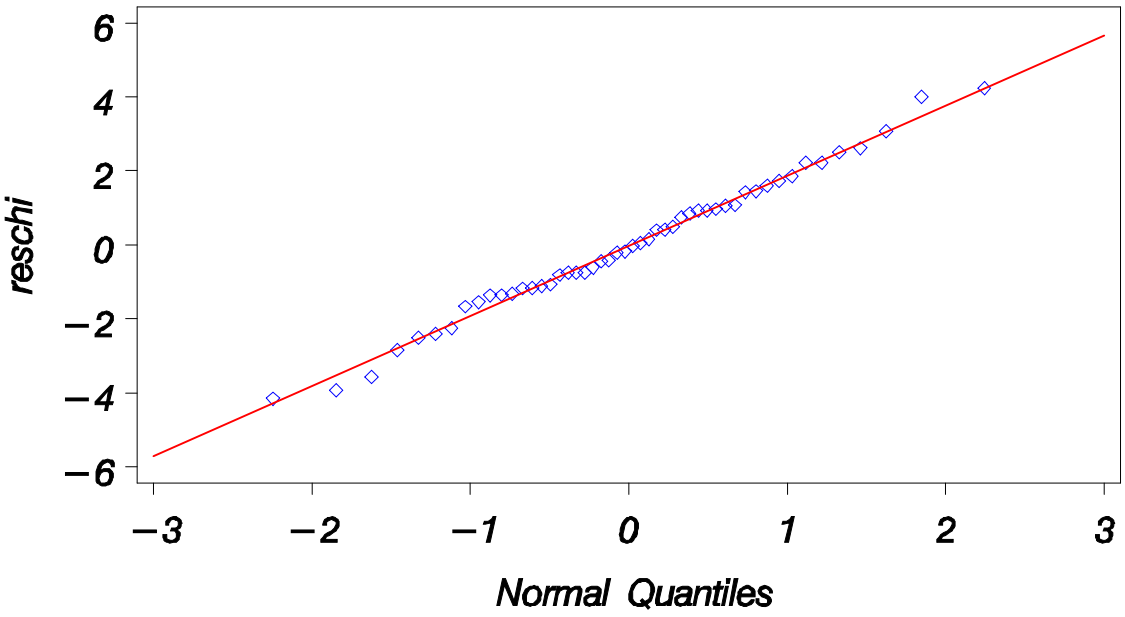


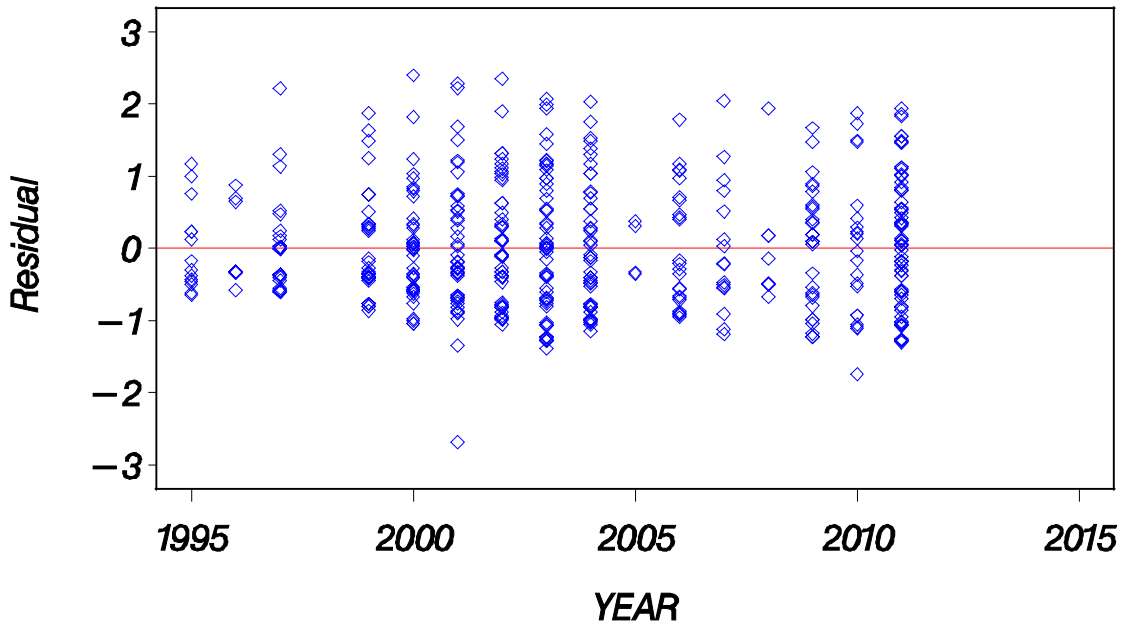
Delta lognormal CPUE for Gulf with all years and areas blacktip
Chisq Residuals proportion positive by area



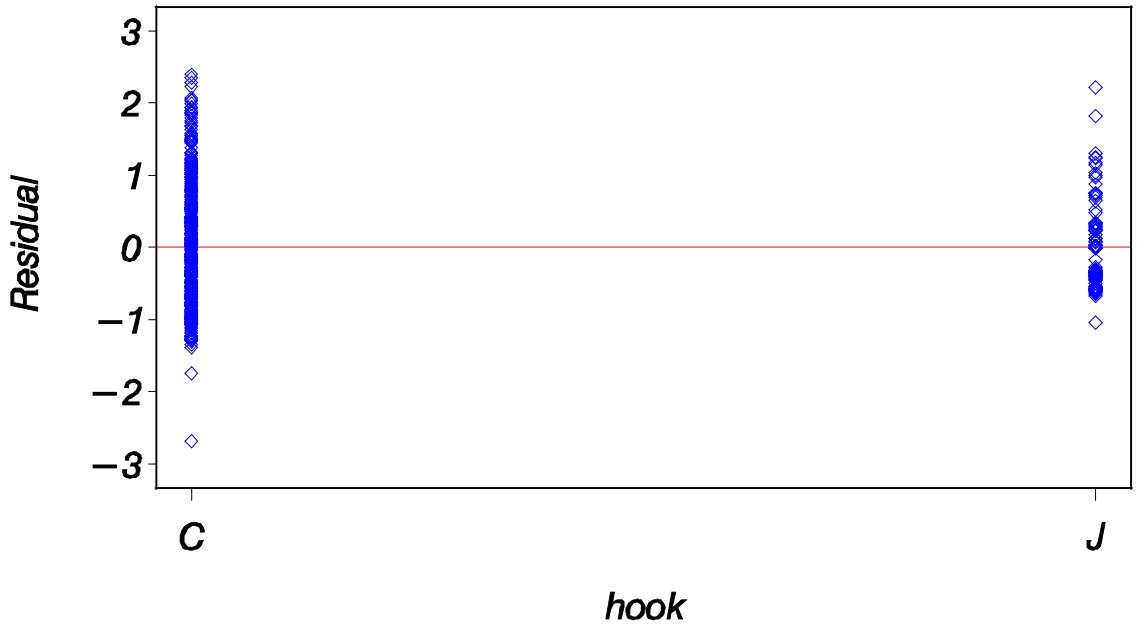

Delta lognormal CPUE for Gulf with all years and areas blacktip
QQplot Residuals proportion positive



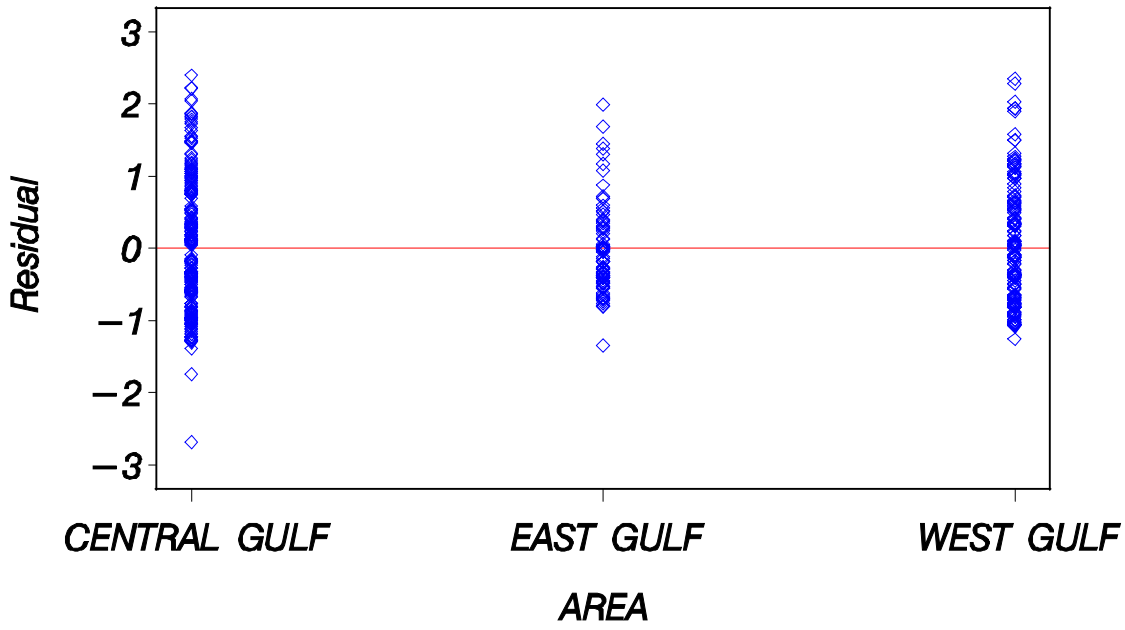
*Delta lognormal CPUE for Gulf with all years and areas blacktip*
*Residuals positive cpue * Year*




*Delta lognormal CPUE for Gulf with all years and areas blacktip*
*Residuals positive cpue * hook*



*Delta lognormal CPUE for Gulf with all years and areas blacktip*
*Residuals positive cpue * area*




*Delta lognormal CPUE for Gulf with all years and areas blacktip*
*QQplot Residuals Positive cpue rates*