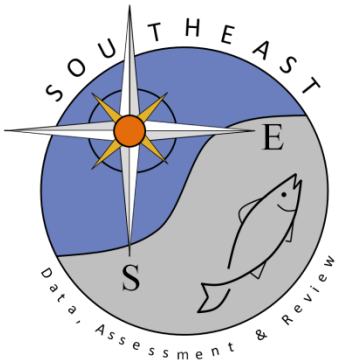
# SCDNR Charterboat Logbook Program Data, 1993-2013

Eric Hiltz

SEDAR41-DW32

Submitted: 25 July 2014




*This information is distributed solely for the purpose of pre-dissemination peer review. It does not represent and should not be construed to represent any agency determination or policy.*

Please cite this document as:

Hiltz, E. 2014. SCDNR Charterboat Logbook Program Data, 1993-2013. SEDAR41-DW32. SEDAR, North Charleston, SC. 8 pp.

**SCDNR Charterboat Logbook Program Data, 1993 - 2013**

**Date:** **7/25/2014**

**Prepared by:** **Eric Hiltz, South Carolina Department of Natural Resources**

**For:** **SEDAR 41 Data Workshop, August 2014**

**Abstract:**

The South Carolina Department of Natural Resources (SCDNR) charterboat logbook program was used to develop indices of abundance for red snapper from 1993 – 2010. The indices of abundance are standardized catch per unit effort (CPUE; catch per angler hour). A delta-gamma GLM was used to produce annual abundance estimates. The indices are meant to describe the population trends of fish caught by V1 (6-pack) charter vessels operating in or off of South Carolina.

**Background:**

The South Carolina Department of Natural Resources (SCDNR) issues three types of charter vessel licenses: V1 (vessels carrying six or fewer passengers), V2 (vessels carrying 7 to 49 passengers), and V3 (vessels carrying 50 or more passengers). In 1993, SCDNR's Marine Resources Division (MRD) initiated a mandatory logbook reporting system for all charter vessels to collect basic catch and effort data. Under state law, vessel owners/operators purchasing South Carolina Charter Vessel Licenses (V1, V2, or V3) and carrying fishermen on a for-hire basis are required to submit trip level reports of their fishing activity in waters off of SC. Logbook reports are submitted by mail or fax to the SCDNR Fisheries Statistics section monthly. Reporting compliance is tracked by staff, and charter vessel owners/operators failing to submit reports can be charged with a misdemeanor. The charterboat logbook program is a complete census and should theoretically represent the total catch and effort of the charterboat trips in waters off of SC.

**Logbook Data:**

The charterboat logbook reports include: date, number of fishermen, fishing locale (inshore, 0-3 miles, >3miles), fishing location (based on a 10x10 mile grid map), fishing method, hours fished, target species, and catch (number of landed and released fish by species) per vessel per trip. The logbook forms have remained similar throughout the program's existence with a few exceptions: in 1999 the logbook forms were altered to begin collecting the number of fish released alive and the number of fish released dead (prior to 1999 only the total numbers of fish released were recorded) and in 2008 additional fishing methods were added to the logbook forms, including 4) cast, 5) cast and bottom, and 6) gig.

After being tracked for compliance each V1 charterboat logbook report is coded and entered into an existing Access database. (V2 and V3 charterboat logbook reports are tracked for compliance but are currently not coded and entered electronically. Most of these vessels participate in the NMFS Beaufort Headboat Logbook Survey.) Since the inception of the program, a variety of staff have coded the charterboat logbook data. From ~1999 to 2006, only information that was explicitly filled out by the charterboat owners/operators on the logbook forms was coded and entered into the database. No efforts were made to fill in incomplete reports. From 2007 to the present, staff have tried to fill in incomplete trip reports through conversations with charterboat owners/operators and by making assumptions based on the submitted data (i.e. if a location description was given instead of a grid location – a grid location was determined, if fishing method was left blank – it was determined based on catch, etc.). From 1999 to 2006 each individual trip record was reviewed to look for anomalies in the data. Starting in 2007 queries were used to look for and correct anomalous data and staff began checking a component of the database records against the raw logbook reports. Coding and QA/QC measures prior to 1999 were likely similar to those used from 1999 to the present. However, details on these procedures were not available since staff members working on this project prior to 1998 are no longer with the SCDNR. Data are not validated in the field and currently no correction factors are used to account for reporting errors. Recall periods for logbook records are typically one month or less. However, in the case of delinquent reports recall periods could be up to several months.

**Data:**

SCDNR charterboat logbook vessel trips included in the analysis for red snapper represent reported fishing trips that caught red snapper or other species that were caught at least 35% of the time when red snapper were caught. These species include: black seabass, vermillion snapper, triggerfishes, gag grouper, red porgy, scamp, and white grunt. For a list of percent occurrences of species when red snapper were caught see table 1.

For all model runs for, catch per unit effort was calculated as the total number of fish caught per angler-hour. Management measures (bag and size limits) have been in place for red snapper throughout most of the dataset's time series (see management histories on red snapper provided for SEDAR 41 in RD12). To limit the possible influence of bag limits, total catch (includes harvest and discards) was used to calculate the CPUE instead of harvest.

**Methods:**

The indices were standardized using a delta generalized linear model (GLM) approach. All analyses were conducted in R, based primarily on code adapted from Dick (2004). A delta GLM model was chosen due to the significant amount of zeros in the CPUE data. A delta model has 2 components to it. First, the probability of a positive catch is modeled. Then the positive catch rates are modeled separately. Finally, the two are multiplied together to get the predicted CPUE (Dick 2004, Li et al. 2011, Siquan et al. 2009, and Yu et al. 2011)

$$\widehat{CPUE} = \hat{d}\ x\ \hat{q}$$

Where $\widehat{CPUE}$ is the standardized CPUE, $\hat{d}$ is the predicted catch rate of the positive catches, and $\hat{q}$ is the probability of a positive catch. The models for red snapper were built assuming a gamma distribution. The model of the positive catch rates used was:

$$ln(\hat{d}) = \beta_0 + \sum_{i=1} \beta_i X_i$$

Where $\beta_0$ is the intercept and $\beta_i$ is the coefficient for the $i^{th}$ explanatory variable $X_i$. The probability of a positive catch was modeled as:

$$ln\left(\frac{\hat{q}}{1-\hat{q}}\right) = \alpha_0 + \sum_{i=1} \alpha_i X_i$$

Where $\alpha_0$ is the intercept and $\alpha_i$ is the coefficient for the $i^{th}$ explanatory variable $X_i$.

The modeling approach used the year and the month as explanatory variables. A Jackknife approach was used to estimate the amount of variation in the model runs as per Dick (2004).

**Results:**

The SCDNR charterboat logbook data used to create the index represent 23,223 fishing trips in which anglers caught 12,972 red snapper and harvested 4,450 red snapper. Summarized catch and effort data are presented in Table 2. The indices are presented in Table 3 and Figure 2. Diagnostics for the monthly model run are found in Figures 3 and 4.

**Literature Cited:**


Dick, E.J. 2004. Beyond 'lognormal versus gamma': discrimination among error distributions for generalized linear models. Fisheries Research 70:351-366.

Li, Y., Jiao, Y., He, Q. 2011. Decreasing uncertainty in catch rate analyses using Delta-AdaBoost: An alternative approach in catch and bycatch analyses with high percentage of zeros. Fisheries Research 107: 261-271.

Siquan, T., Xinjun, C.,Yong, C., Liuxiong, X., Xiaojie, D. 2009. Standardizing CPUE of *Ommastrephes bartramii* for Chinese squid-jigging fishery in Northwest Pacific Ocean. Chinese Journal of Oceanology and Limnology 27 (4): 729-739.

Yu, Hao, Jiao, Y., and Winter, A. 2011. Catch rate standardization of yellow perch in Lake Erie: a comparison of the spatial generalized linear model and generalized additive model. Transactions of the American Fisheries Society 140 (4): 905-918.

Table 1. Species caught when red snapper were caught. Percent occurrence was calculated by trips when species in question was caught when red snapper was caught / total trips when red snapper was caught.

| Species | Trips | % Occurrence |
|---|---|---|
| Snapper, Red, Unclassified | 2455 | 100.00% |
| Black Sea Bass, Unclassified | 2035 | 82.89% |
| Snapper, Vermilion, Unclassified | 1456 | 59.31% |
| Triggerfishes | 1307 | 53.24% |
| Grouper, Gag | 1293 | 52.67% |
| Porgy, Red, Unclassified | 1157 | 47.13% |
| Scamp | 952 | 38.78% |
| Grunt, White | 911 | 37.11% |
| King Mackerel | 816 | 33.24% |
| Shark, Atlantic Sharpnose | 750 | 30.55% |
| Amberjack | 593 | 24.15% |
| Dolphin | 376 | 15.32% |
| Pinfish, Spottail | 317 | 12.91% |
| Shark, Unclassified | 302 | 12.30% |
| Porgy, Whitebone | 294 | 11.98% |
| Grunts | 265 | 10.79% |
| Barracuda | 244 | 9.94% |
| Grouper, Red | 218 | 8.88% |
| Cobia | 197 | 8.02% |
| Porgy, Unclassified | 159 | 6.48% |
| Tuna, Little | 151 | 6.15% |
| Flounder, Unclassified | 86 | 3.50% |
| Mackerel, Spanish | 73 | 2.97% |
| Bonito | 52 | 2.12% |
| Wahoo | 45 | 1.83% |
| Grouper, Snowy | 35 | 1.43% |
| Drum, Red | 35 | 1.43% |
| Bluefish | 35 | 1.43% |
| Shark, Black Tip | 28 | 1.14% |
| Finfish, Unclassified | 27 | 1.10% |
| Sailfishes | 23 | 0.94% |

| Species | Trips | % Occurrence |
|---|---|---|
| Spadefish | 22 | 0.90% |
| Sheepshead | 20 | 0.81% |
| Tuna, Blackfin | 19 | 0.77% |
| Grouper, Unclassified | 19 | 0.77% |
| Tuna, Yellowfin | 17 | 0.69% |
| Banded Rudderfish | 16 | 0.65% |
| Rays,Unc. | 10 | 0.41% |
| Shark, Dogfish, Smooth | 10 | 0.41% |
| Hind, Speckled | 10 | 0.41% |
| Seatrout, Gray (Weakfish) | 8 | 0.33% |
| Drum, Black | 6 | 0.24% |
| Hogfish | 6 | 0.24% |
| Shark, Dogfish,Spiny | 6 | 0.24% |
| Hind, Rock | 5 | 0.20% |
| Crevalle Jack | 5 | 0.20% |
| Bank Sea Bass | 5 | 0.20% |
| Porgy, Knobbed | 4 | 0.16% |
| Shark, Bonnethead | 4 | 0.16% |
| Shark, Bull | 4 | 0.16% |
| Grouper, Warsaw | 3 | 0.12% |
| Tomtate | 3 | 0.12% |
| Rudderfish | 3 | 0.12% |
| Jack, Almaco | 3 | 0.12% |
| Shark, Dusky | 3 | 0.12% |
| Snapper, Cubera | 3 | 0.12% |
| Shark, Lemon | 3 | 0.12% |
| Porgy, Red, Large | 3 | 0.12% |
| Tilefish, Golden, Unclassified | 2 | 0.08% |
| Shark, Tiger | 2 | 0.08% |
| Porgy, Jolthead | 2 | 0.08% |
| Toadfishes | 2 | 0.08% |

| Species | Trips | % Occurrence |
|---|---|---|
| Snapper, Silk | 2 | 0.08% |
| Shark, Nurse | 2 | 0.08% |
| Sea Catfish | 2 | 0.08% |
| Snapper, Yellowtail | 2 | 0.08% |
| Snapper, Unclassified | 2 | 0.08% |
| Ladyfish | 2 | 0.08% |
| King Whiting | 2 | 0.08% |
| Graysby | 2 | 0.08% |
| Blue Runner | 1 | 0.04% |
| Squirrelfishes | 1 | 0.04% |
| Snapper, Mutton | 1 | 0.04% |
| Eel, Pac. | 1 | 0.04% |
| Eels, Moray | 1 | 0.04% |
| Tarpon | 1 | 0.04% |
| Filefishes | 1 | 0.04% |
| Snapper, Blackfin | 1 | 0.04% |
| Scup | 1 | 0.04% |
| Pinfish | 1 | 0.04% |
| Sand Perch | 1 | 0.04% |
| Shark, Thresher | 1 | 0.04% |
| Shark, Dogfish | 1 | 0.04% |
| Seatrout, Spotted | 1 | 0.04% |
| Finfishes, General | 1 | 0.04% |
| Triggerfish, Queen | 1 | 0.04% |
| Rainbow Runner | 1 | 0.04% |
| Tuna, Skipjack | 1 | 0.04% |
| Marlin, Blue | 1 | 0.04% |
| Triggerfish, Grey | 1 | 0.04% |

Table 2. Annual red snapper catch, harvest, and effort from SCDNR Charterboat Logbook Program, 1993-2013. Vessel trips were determined from the number of trips used in the index as defined above.

| Year | Vessel Trips | % Trips With Red Snapper | Red Snapper Catch (# fish) | Red Snapper Harvest (# fish) | Red Snapper Released (# fish) | % Released |
|---|---|---|---|---|---|---|
| 1993 | 571 | 16.81% | 531 | 286 | 245 | 46.14% |
| 1994 | 694 | 15.56% | 410 | 189 | 221 | 53.90% |
| 1995 | 558 | 11.47% | 192 | 104 | 88 | 45.83% |
| 1996 | 715 | 7.97% | 174 | 155 | 19 | 10.92% |
| 1997 | 773 | 5.17% | 79 | 42 | 37 | 46.84% |
| 1998 | 946 | 11.52% | 401 | 222 | 179 | 44.64% |
| 1999 | 883 | 16.65% | 680 | 457 | 223 | 32.79% |
| 2000 | 1047 | 15.28% | 1273 | 343 | 930 | 73.06% |
| 2001 | 1036 | 18.05% | 1831 | 591 | 1240 | 67.72% |
| 2002 | 985 | 16.85% | 1238 | 575 | 663 | 53.55% |
| 2003 | 941 | 12.33% | 541 | 246 | 295 | 54.53% |
| 2004 | 1104 | 9.06% | 365 | 211 | 154 | 42.19% |
| 2005 | 1205 | 9.13% | 362 | 208 | 154 | 42.54% |
| 2006 | 1249 | 5.60% | 229 | 107 | 122 | 53.28% |
| 2007 | 1307 | 8.57% | 425 | 181 | 244 | 57.41% |
| 2008 | 1300 | 11.31% | 845 | 233 | 612 | 72.43% |
| 2009 | 982 | 12.12% | 662 | 247 | 415 | 62.69% |
| 2010 | 1164 | 11.94% | 647 | 1 | 646 | 99.85% |
| 2011 | 1423 | 9.91% | 916 | 19 | 897 | 97.93% |
| 2012 | 1989 | 5.98% | 681 | 17 | 664 | 97.50% |
| 2013 | 2351 | 4.85% | 490 | 16 | 474 | 96.73% |

Table 3. Red snapper catch per unit effort (catch per angler hour) for the standardized index model runs.

| Year | Nominal CPUE | Standardized CPUE | SE | Upper | Lower |
|---|---|---|---|---|---|
| 1993 | 0.21138535 | 0.228034666 | 0.058800474 | 0.169234193 | 0.28683514 |
| 1994 | 0.12503812 | 0.112603611 | 0.024008548 | 0.088595064 | 0.136612159 |
| 1995 | 0.07643312 | 0.068251716 | 0.01425174 | 0.053999976 | 0.082503457 |
| 1996 | 0.05335787 | 0.046288437 | 0.011625903 | 0.034662534 | 0.05791434 |
| 1997 | 0.02241135 | 0.023081839 | 0.009274894 | 0.013806945 | 0.032356734 |
| 1998 | 0.0920358 | 0.091752285 | 0.01982818 | 0.071924105 | 0.111580465 |
| 1999 | 0.17250127 | 0.174759478 | 0.037760517 | 0.136998961 | 0.212519996 |
| 2000 | 0.25665323 | 0.283302109 | 0.041945362 | 0.241356747 | 0.325247471 |
| 2001 | 0.38825276 | 0.333114983 | 0.053478258 | 0.279636725 | 0.386593242 |
| 2002 | 0.27652446 | 0.261014268 | 0.068395934 | 0.192618334 | 0.329410202 |
| 2003 | 0.12345961 | 0.182318065 | 0.067852277 | 0.114465788 | 0.250170342 |
| 2004 | 0.07224861 | 0.060941999 | 0.010441077 | 0.050500922 | 0.071383076 |
| 2005 | 0.06485131 | 0.072807797 | 0.014234379 | 0.058573417 | 0.087042176 |
| 2006 | 0.04090747 | 0.04868721 | 0.018607226 | 0.030079984 | 0.067294436 |
| 2007 | 0.06871463 | 0.070046166 | 0.018815039 | 0.051231127 | 0.088861205 |
| 2008 | 0.12733574 | 0.145831279 | 0.034917405 | 0.110913875 | 0.180748684 |
| 2009 | 0.14010582 | 0.118338725 | 0.028436763 | 0.089901961 | 0.146775488 |
| 2010 | 0.12100243 | 0.116740875 | 0.026749078 | 0.089991797 | 0.143489953 |
| 2011 | 0.14745654 | 0.146053434 | 0.037032182 | 0.109021252 | 0.183085617 |
| 2012 | 0.07858297 | 0.07629779 | 0.015503507 | 0.060794283 | 0.091801296 |
| 2013 | 0.04869323 | 0.044773705 | 0.009532571 | 0.035241134 | 0.054306276 |

Table 4. AIC values for the red snapper standardized index model run. SE is the standard error calculated from the model jack knife. % Total CPUE is sum(SE)/sum(CPUE).

| AIC | Standardized CPUE |
|---|---|
| Binomial | 100.1791019 |
| Positive | -537.157572501 |
| **Sum of SE** | 0.621491315 |
| **% Total CPUE** | 22.98% |

Figure 1. Distribution of red snapper catch from SCDNR 6-pack Charterboat Logbook data. Each square represents a 10 mile$^2$ area. Only data from 2008-2013 were used because prior to 2008 approximately 80% of the logbook trips included in the analysis did not include location information.

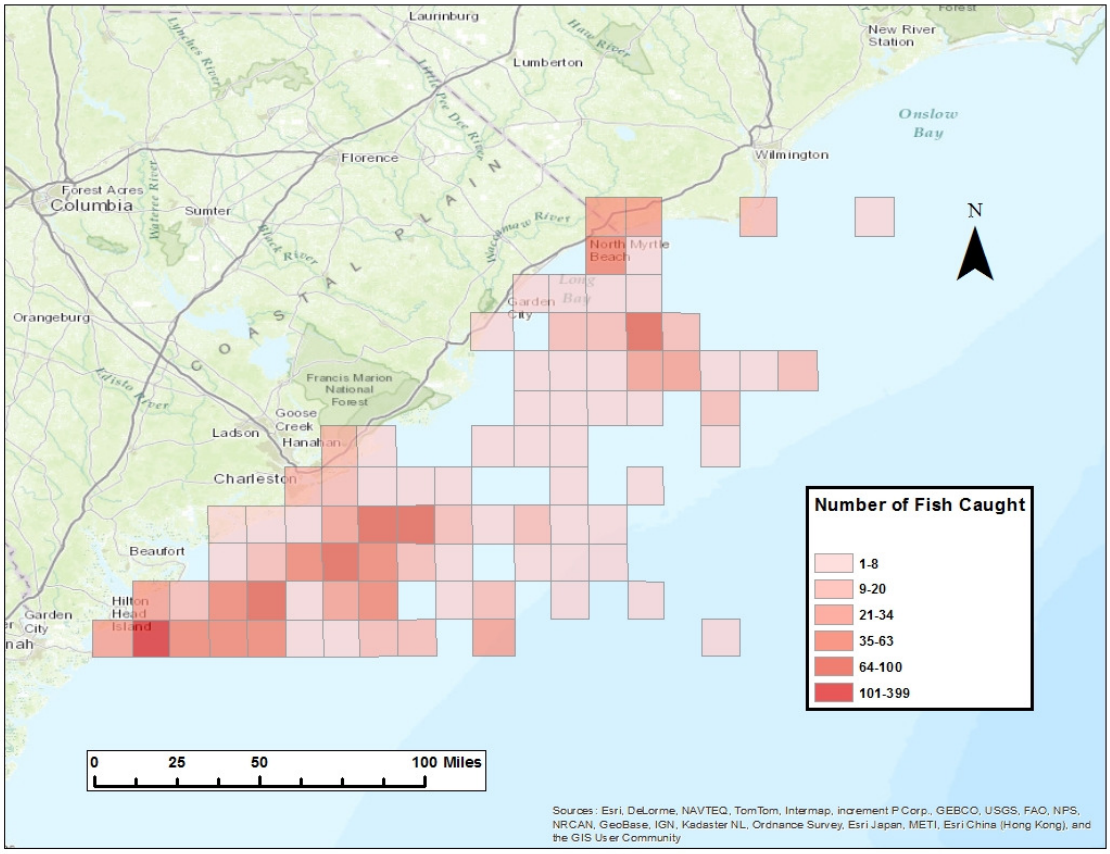



Figure 2. Red snapper CPUE from SCDNR 6-pack Charterboat Logbook data from 1993-2010. Nominal (blue) and monthly standardized (green)catch per angler-hour are shown. The dotted lines show 1 standard error from the standardized CPUE.

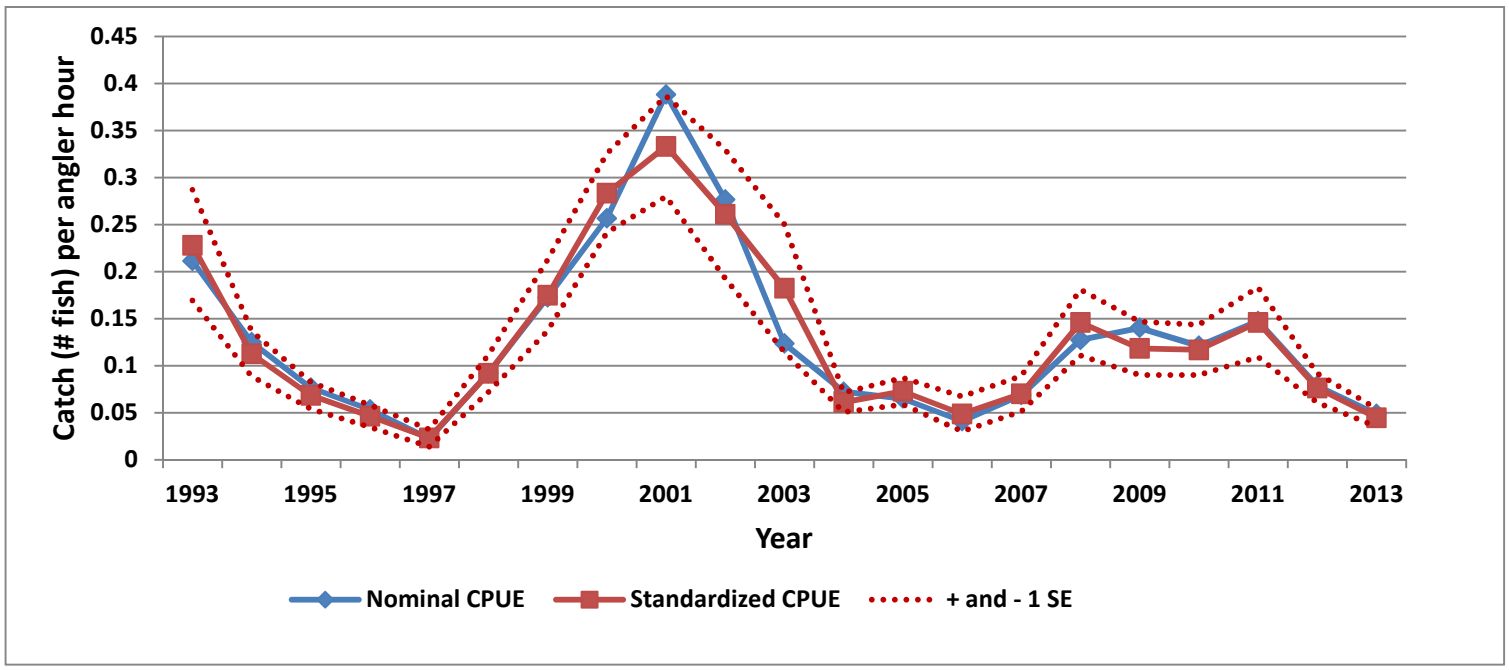
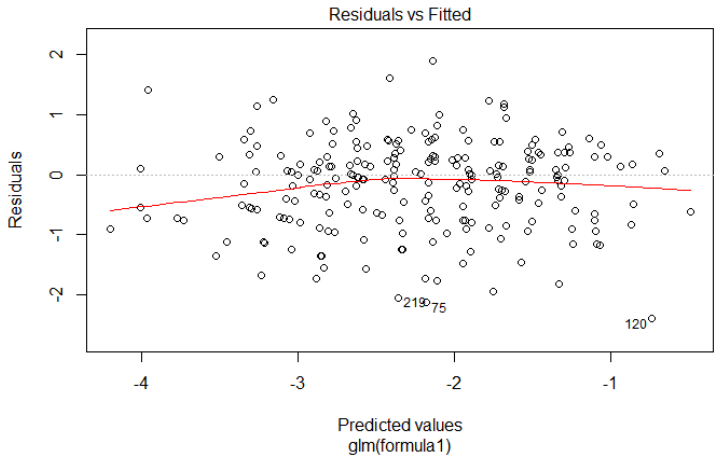
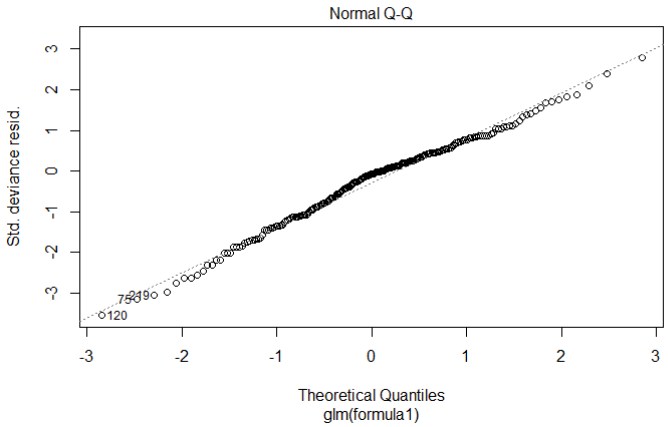


Figure 3. Diagnostic plots for gamma component of the red snapper SCDNR 6-pack Charterboat Logbook monthly model: **A.** residuals plotted against predicted values; **B.** the cumulative normalized residuals (QQ plot); **C.** the residuals by year; **D.** the residuals by month

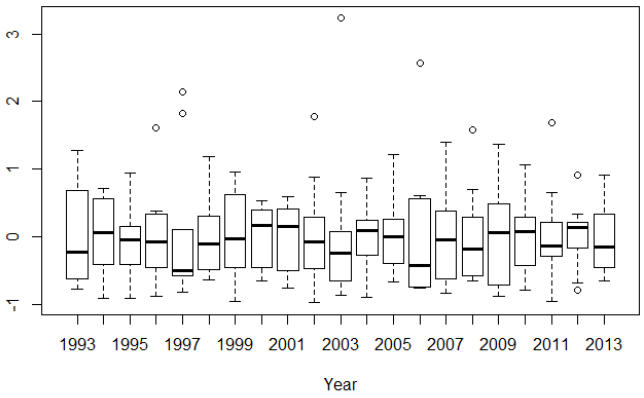
A




B




C




D

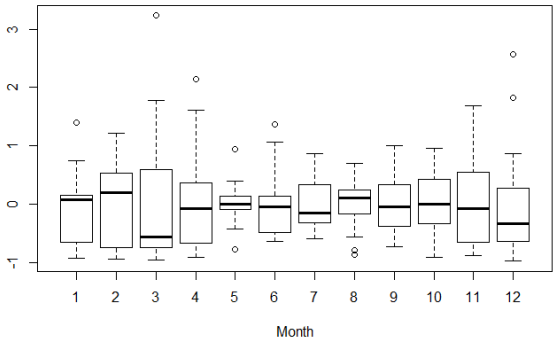
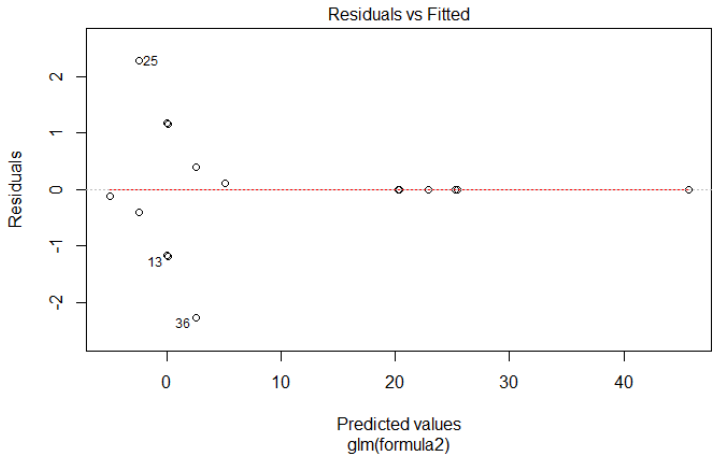
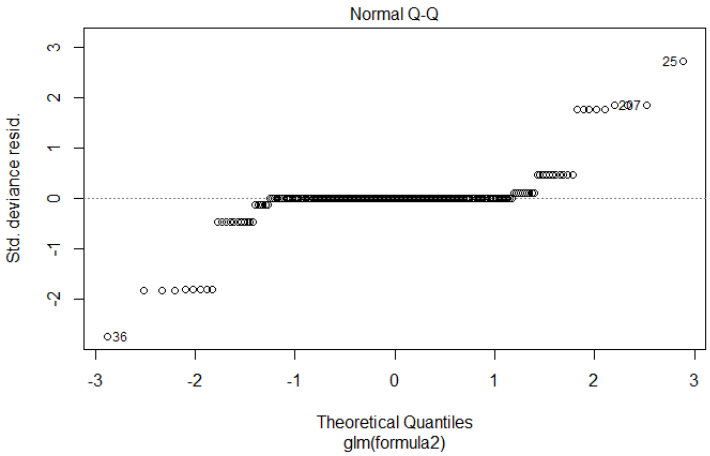


Figure 4. Diagnostic plots for binomial component of the red snapper SCDNR 6-pack Charterboat Logbook monthly model: **A.** residuals plotted against predicted values; **B.** the cumulative normalized residuals (QQ plot); **C.** the residuals by year, **D.** the residuals by month

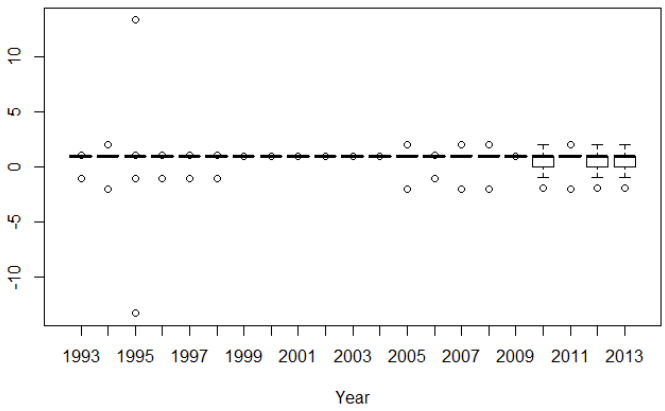
A




B




C




D