SCDNR Charterboat Logbook Program Data, 1993 - 2010

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SEDAR25-DW16

Date Submitted: 22 April 2011
Date Updated: 5 May 2011
This working paper was replaced by SEDAR25-DW23 following the data workshop.

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For: SEDAR 25 Black Seabass Data Workshop, April 2011

NOTE: This working paper was replaced by SEDAR25-DW23 following the data workshop. This version is the paper that was initially available to the data workshop panelists. However SEDAR-DW23 was what was discussed and considered at the data workshop.

Abstract:
An index of abundance was developed for the South Carolina Department of Natural Resources (SCDNR) charterboat logbook program for 1993-2010. The index of abundance is standardized catch per unit effort (CPUE; catch per angler hour) of black seabass (BSB) using a delta-GLM model. Three explanatory variables were used in the delta-GLM model (year, locale, and season). The analysis is 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 charter boat logbook program is a complete census and should theoretically represent the total catch and effort of the charter boat trips in waters off of SC.

Logbook Data:
The charter 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 number 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.) 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.

Methods:

SCDNR charterboat logbook vessel trips included in this analysis represent fishing trips where at least one of a suite of bottom fishes (likely, or even possibly, to occur in association with black seabass) were caught using hook and line.

The CPUE for black seabass was standardized using a delta generalized linear model (GLM) approach. The program R was used for all modeling. This type of 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 (Li et al. 2011, Siquan et al. 2009, and Yu In press)

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

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. We used a GLM for each of these models. The models were built assuming a log normal distribution. The model of the positive catch rates used was:

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

Where β_0 is the intercept and β_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 α_0 is the intercept and α_i is the coefficient for the i^{th} explanatory variable X_i.

There were 3 explanatory variables used in this modeling approach. They were the year (1993-2010), the locale of the catch (inshore, nearshore, and offshore), and the season (winter, spring, summer, and fall). For locale, inshore was for all trips that occurred in estuaries and inland waters, nearshore from 0-3 miles, and offshore >3 miles. For the seasons, winter was considered for all trips occurring from Dec. to Feb., spring from Mar.-May, summer from June-Aug., and fall from Sept. to Nov.

Results:

The SCDNR charterboat logbook data represent 24,315 fishing trips in which 96,573 anglers caught 554,294 black seabass and harvested 250,995 black seabass. Summarized catch and effort data are presented in Table 1. The residual plot (Figure 2) and the Normal Q-Q plot (Figure 3) indicate that the model fit the data well and that the assumption of a log normal distribution was appropriate. However, the ANOVA tables (Table 2) and the Residual plot (Figure 2) show there is a lot of variation in the data. The index is presented in Table 3 and Figure 3.

Literature Cited:

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. In press. 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.

Table 1. Annual black seabass catch, harvest, and effort from SCDNR Charterboat Logbook Program, 1993-2010. Vessel trips represent trips where at least one of a suite of bottom fishes (likely, or even possibly, to occur in association with black seabass) were caught using hook and line.

Year	Vessel Trips	Black Seabass Catch (# fish)	Black Seabass Harvest (# fish)	% Vessel Trips With BSB Catch
1993	1009	15132	10257	40.44%
1994	1099	19832	13690	47.86%
1995	929	15368	10026	45.53%
1996	1073	28541	18976	54.80%
1997	1138	25217	16186	55.89%
1998	1392	23785	14945	55.89%
1999	1339	21484	12604	57.65%
2000	1559	26725	13254	56.57%
2001	1494	32211	16319	62.45%
2002	1374	30281	15537	63.61%
2003	1304	31350	17475	65.11%
2004	1328	33052	17189	78.31%
2005	1424	36030	15717	77.39%
2006	1529	40816	16887	76.65%
2007	1698	36312	10084	68.96%
2008	1645	53267	11800	71.73%
2009	1393	33057	6840	62.46%
2010	1588	51832	13209	68.51%

Table 2. Deviances for the explanatory variables used in the delta-GLM CPUE standardization.

ANOVA for the Positive Catch Rate GLM				
Variable	Df	Deviance	Resid. Df	Resid. Dev
NULL	NA	NA	15284	24098.7096
Year	1	1.289580692	15283	24097.42002
Season	3	1079.244061	15280	23018.17596
Locale	3	2241.748016	15277	20776.42794
Year:Season	3	21.92982882	15274	20754.49811
Year:Locale	2	44.07496176	15272	20710.42315
Season:Locale	6	19.05358151	15266	20691.36957

ANOVA for the Probability of a Positive Catch Rate GLM				
Variable	Df	Deviance	Resid. Df	Resid. Dev
NULL	NA	NA	24314	32080.42274
Year	1	584.2688469	24313	31496.1539
Season	3	497.9744843	24310	30998.17941

Locale	3	2855.223676	24307	28142.95574
Year:Season	3	13.12162447	24304	28129.83411
Year:Locale	3	78.30655435	24301	28051.52756
Season:Locale	7	315.0444232	24294	27736.48313

Table 3. Black seabass catch per unit effort (catch per angler hour).

Year	Nominal		Standardized	
	CPUE	Variance	CPUE	Variance
1993	1.103	19.317	1.103	0.177
1994	1.309	22.007	1.145	0.138
1995	0.916	6.241	0.835	0.035
1996	1.668	23.282	0.800	0.049
1997	1.337	8.968	0.840	0.047
1998	1.145	7.289	0.807	0.041
1999	1.033	4.915	0.791	0.058
2000	1.095	4.830	0.220	0.003
2001	1.268	5.843	0.209	0.003
2002	1.442	7.565	0.427	0.024
2003	1.414	8.295	0.472	0.018
2004	1.612	6.268	0.456	0.018
2005	1.757	7.663	0.536	0.010
2006	1.826	7.945	1.075	0.121
2007	1.433	8.162	1.025	0.144
2008	2.007	15.872	0.979	0.127
2009	1.493	9.360	1.118	0.134
2010	1.797	9.012	0.950	0.114

Figure 1. Residual plot for positive catch rate GLM.

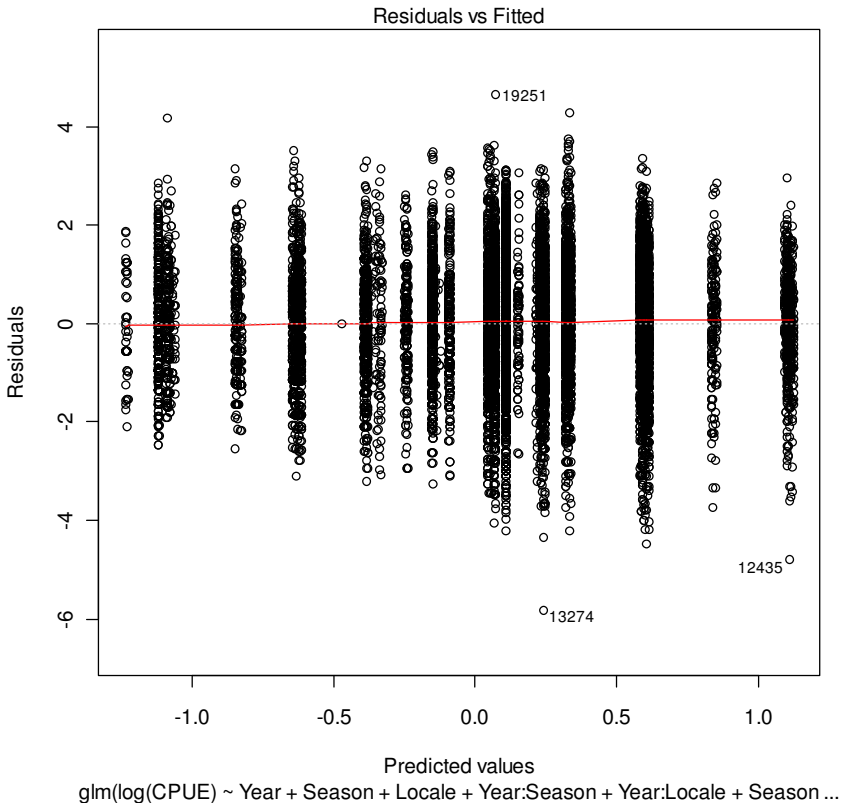
Residuals vs Fitted
19251
12435
13274
Residuals
Predicted values
glm(log(CPUE) ~ Year + Season + Locale + Year:Season + Year:Locale + Season ...

Figure 2. Normal quantile plot for the positive catch rate GLM.

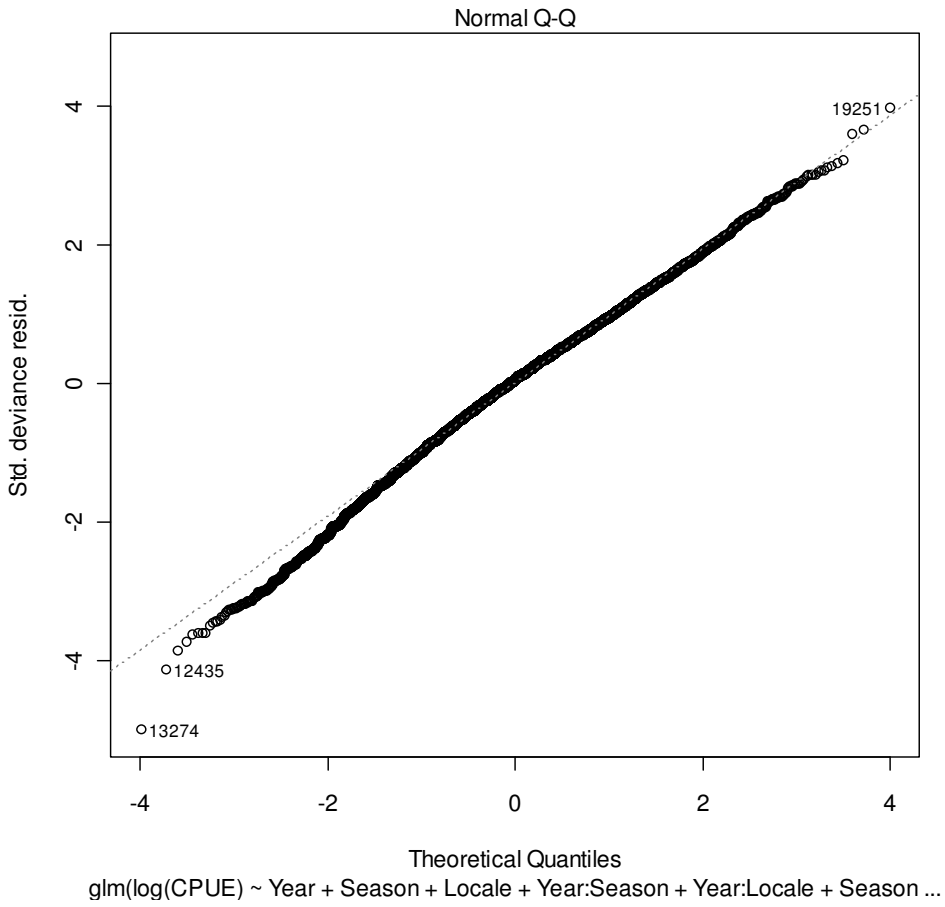

Figure 3. Black seabass CPUE (catch per angler hour).