Standardized indices of abundance for Smooth Dogfish, *Mustelus canis*, from the Northeast Fisheries Observer Program

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SEDAR39-DW-09

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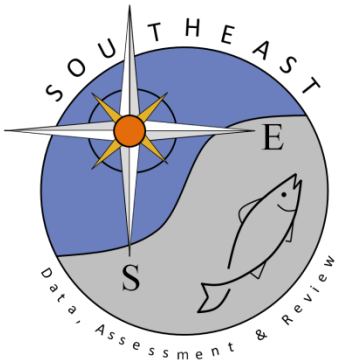

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SEDAR 39 DATA WORKSHOP DOCUMENT

Standardized indices of abundance for Smooth Dogfish, *Mustelus canis*, from the Northeast Fisheries Observer Program

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Summary

This document details the smooth dogfish, *Mustelus canis*, catch from the anchored sink gillnet fishery observed by the Northeast Fisheries Observer Program from 1995 to 2013 and fish lengths measured during observed trips in this fishery, as well as the drift sink gillnet and otter trawl fisheries. Catch per unit effort (CPUE) in pounds whole weight per (number of nets * net length * soak duration)/1000 were examined by year. The CPUE was standardized using a generalized linear model of the positive catch assuming a lognormal error distribution. Only a subset of the observer data was used to model the trend in abundance. The need to standardize effort across the observed sets required the use of several variables, some of which contained missing data and were therefore not used. The standardized relative abundance for smooth dogfish caught during the observed anchored sink gillnet trips shows an overall decreasing trend across the time series. The individual fish length data provided from the observer program may provide valuable information to help characterize the length distribution sampled by the different fisheries.

Introduction

The National Marine Fisheries Service (NMFS) Northeast Fisheries Science Center (NEFSC) Fisheries Sampling Branch (FSB) collects, maintains, and distributes data for scientific and management purposes in the northwest Atlantic Ocean. FSB manages three separate but related observer programs: the Northeast Fisheries Observer Program (NEFOP), the Industry Funded Scallop (IFS) Observer Program, and the At Sea Monitoring (ASM) Program. Observed trips are required under many of the region's fishery management plans, and for some fisheries by other federal laws and authorities such as Amendment 16 and Framework 44, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act, the Endangered Species Act, and the Sustainable Fisheries Act. In this document, NEFOP observations from the anchored sink gillnet fishery were modeled to create a standardized index of abundance for smooth dogfish, *Mustelus canis*.

Methods

Observer Data

Observers were deployed on commercial gillnet vessels from 1995-2013 in an effort to quantify bycatch and document protected species interactions. Vessels were selected based on the intended target species, mesh size used and the likelihood of protected species interactions. Sampling priorities were determined by the funding source. Trips varied in duration from single day to multi day trips on vessels that were deploying anchored sink gillnet, drift sink gillnet or bottom otter trawl gears. Deployments took place from Maine to North Carolina. Sampling priorities were determined by the funding source. Observers were tasked with collecting economic data, weather conditions, and gear characteristics as well as biological data for both the catch and bycatch. The number of hauls per trip ranged from one to seventy one. The amount of the smooth dogfish catch (lbs whole weight) was recorded for each haul, both kept and discarded status. Species lengths for all fisheries are taken based on priority. Some species are high priorities (i.e. groundfish species) and some become priorities if they are the primary target species. In the case of smooth dogfish, most of the lengths are taken opportunistically.

Available smooth dogfish lengths from the anchored sink gillnet, drift sink gillnet, and the otter trawl fisheries were converted from total length to fork length using the following formula (provided by the SEDAR 39 Life History Working Group Chair, William B. Driggers):

$$\text{Sexes combined: } TLcm = 3.43329 + 1.09539 * FLcm$$

Data Analysis

Only observed trips from the anchored sink gillnet fishery with at least one record of smooth dogfish were used for this study. Catch per unit effort (CPUE) in pounds whole weight of both kept and discarded fish

per (number of nets * net length * soak duration)/1000 were examined by year. The CPUE was standardized using a generalized linear model of the positive catch assuming a lognormal error distribution. Factors considered as potential influences on the CPUE for these analyses were: year (1995-2012), season (winter: January-March, spring: April-June, summer: July-September, fall: October-December), area (North Carolina, Mid-Atlantic, Northeast), and target (teleost, elasmobranch).

Models were fit in a stepwise forward manner adding one potential factor at a time after initially running a null model with no factors included. Each potential factor was ranked from greatest to least reduction in deviance per degree of freedom when compared to the null model. The factor resulting in the greatest reduction in deviance was then incorporated into the model providing the deviance per degree freedom was reduced by at least 1% from the less complex model. This process was continued until no additional factors met the criteria for incorporation into the final model. The factor "year" was kept in the final model to allow for calculation of indices. All models in the stepwise approach were fitted using the SAS GENMOD procedure (SAS Institute, Inc.). The standardized indices of abundance were based on the year effect least square means determined from the final model using the SAS GLIMMIX macro for the lognormal positive catch.

Results

The proportion of observed hauls with positive catch (at least one smooth dogfish was caught) from the anchored sink gillnet fishery was 54%. Smooth dogfish sampled during observed anchored sink gillnet fishery trips ranged in fork length from 17 to 129 cm (Figure 1). Only a subset of the observer data was used to model the trend in abundance for this fishery. The need to standardize effort across the observed hauls required the use of several variables, some of which contained missing data and were therefore not used. The stepwise construction of each model and the resulting statistics are detailed in Table 1. Model diagnostic plots reveal that the model fit is acceptable (Figure 2). The resulting indices of abundance based on the year effect least square means, associated statistics, and nominal indices are reported in Table 2 and are plotted by year in Figure 3. The standardized relative abundance for smooth dogfish caught during the observed anchored sink gillnet trips shows an overall decreasing trend across the time series. Smooth dogfish sampled during observed drift sink gillnet and otter trawl fishery trips ranged in fork length from 25 to 122 and 17 to 117 cm, respectively (Figure 3 and 4). The individual fish length data provided from the observer program may provide valuable information to help characterize the length distribution sampled by the different fisheries.

Table 1. Results of the stepwise procedure for development of the catch rate model for smooth dogfish. DF is the degrees of freedom. %DIF is the percent difference in deviance/DF between each model and the null model. Delta% is the difference in deviance/DF between the newly included factor and the previous entered factor in the model.

POSITIVE CATCHES-LOGNORMAL ERROR DISTRIBUTION

FACTOR	DF	DEVIANCE	DEVIANCE/DF	%DIFF	DELTA%
NULL	223	2108.0741	9.4532		
AREA	221	1701.3450	7.6984	18.5630	18.5630
TARGET	222	2010.9946	9.0585	4.1753	
SEASON	220	1998.8829	9.0858	3.8865	
YEAR	206	1924.3310	9.3414	1.1827	
AREA +					
SEASON	218	1599.3034	7.3363	22.3935	3.8304
TARGET	220	1622.8698	7.3767	21.9661	3.4031
YEAR	204	1559.3226	7.6437	19.1417	0.5786
AREA + SEASON +					
TARGET	217	1536.2392	7.0794	25.1111	3.1450
YEAR	201	1448.6725	7.2073	23.7581	1.7920
AREA + SEASON + TARGET +					
YEAR	200	1397.9134	6.9896	26.0610	0.9499

FINAL MODEL	AIC	BIC	(-2) Res Log Likelihood
AREA + SEASON + TARGET	1024.9	1028.2	1022.9
YEAR			

Type 3 Test of Fixed Effects

Significance (Pr>Chi) of Type 3 test of fixed effects for each factor	AREA	SEASON	TARGET	YEAR
DF	2	3	1	17
CHI SQUARE	48.63	13.59	7.26	19.79

Table 2. Smooth dogfish analysis lbs whole weight of both kept and discarded sharks by year (catch), number of observations per year (n obs), number of positive observations per year (obs pos), proportion of positive observations per year (obs ppos), nominal cpue as catch per (number of nets * net length * soak duration)/1000 (nom cpue), estimated cpue from the model (est cpue), the lower 95% confidence limit for the est cpue (LCL), the upper 95% confidence limit for the est cpue (UCL), and the coefficient of variation for the est cpue (CV).

year	catch	n obs	obs pos	obs ppos	nom cpue	est cpue	LCL	UCL	CV
1995	69422	561	282	0.5027	12.2666	31.9861	8.9926	113.7838	0.1857
1996	83822	585	362	0.6188	9.6340	21.1513	5.2284	85.5670	0.2322
1997	14273	618	266	0.4304	3.6848	7.0097	1.6141	30.4413	0.3824
1998	48089	455	240	0.5275	16.0775	46.9414	13.1760	167.2517	0.1674
1999	31638	462	261	0.5649	6.0015	21.7845	5.3741	88.2965	0.2304
2000	35044	476	274	0.5756	20.9173	30.8890	7.9853	119.4980	0.2000
2001	64492	263	184	0.6996	7.3133	13.8599	2.6348	72.9081	0.3202
2002	11577	152	94	0.6184	5.7682	8.5318	1.6379	44.4427	0.3904
2003	45482	117	66	0.5641	16.0494	9.1404	1.5934	52.4363	0.4004
2004	16782	166	94	0.5663	3.7253	17.2222	3.5413	83.7553	0.2818
2005	23417	211	123	0.5829	6.6857	17.2222	5.3495	178.5913	0.2818
2006	20441	148	75	0.5068	71.8302	18.3605	3.4754	96.9989	0.2900
2007	26323	189	107	0.5661	15.5915	8.9049	2.3124	34.2950	0.3127
2008	6344	119	64	0.5378	5.8876	10.0132	2.0503	48.9011	0.3491
2009	4151	92	37	0.4022	1.4201	1.6867	0.3483	8.1703	1.5304
2010	70501	267	156	0.5843	15.1692	7.0182	1.6421	29.9941	0.3780
2011	10338	157	66	0.4204	4.5516	7.0428	1.5451	32.0982	0.3941
2012	35348	207	83	0.4010	8.9200	6.9699	1.6203	29.9851	0.3811

Figure 1. Fork lengths (cm) of smooth dogfish sampled during observed anchored sink gillnet fishery trips from 1995-2012.

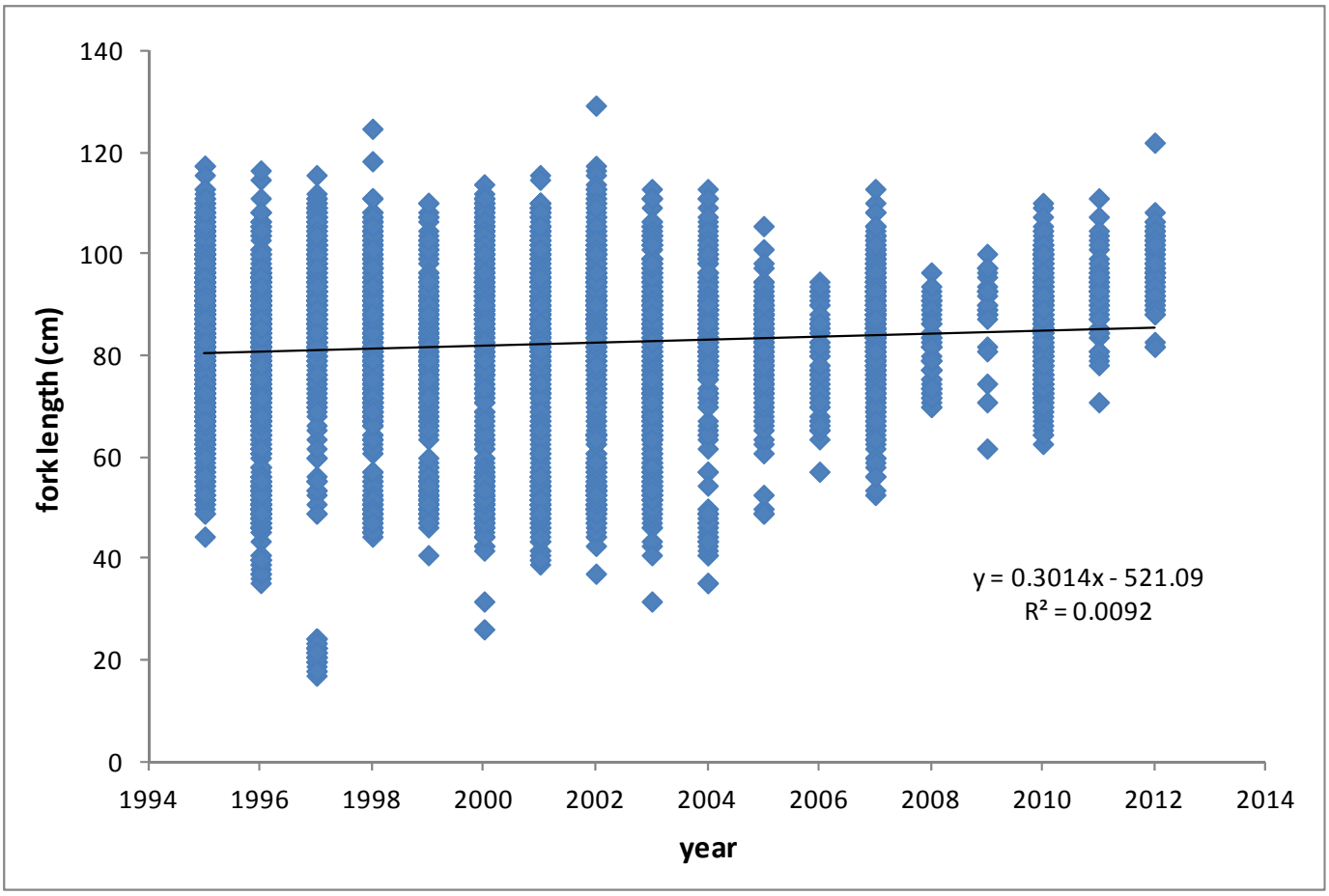
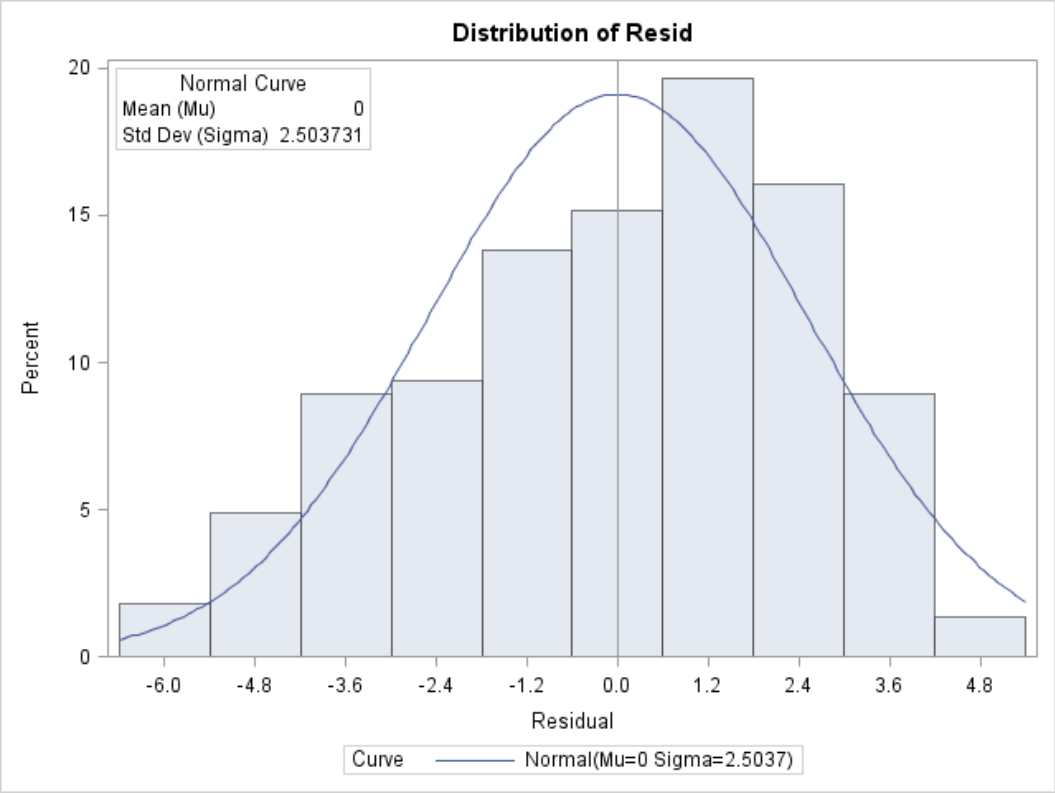


Figure 2. Smooth dogfish model diagnostic plots for the lognormal cpue of positive catch observations.



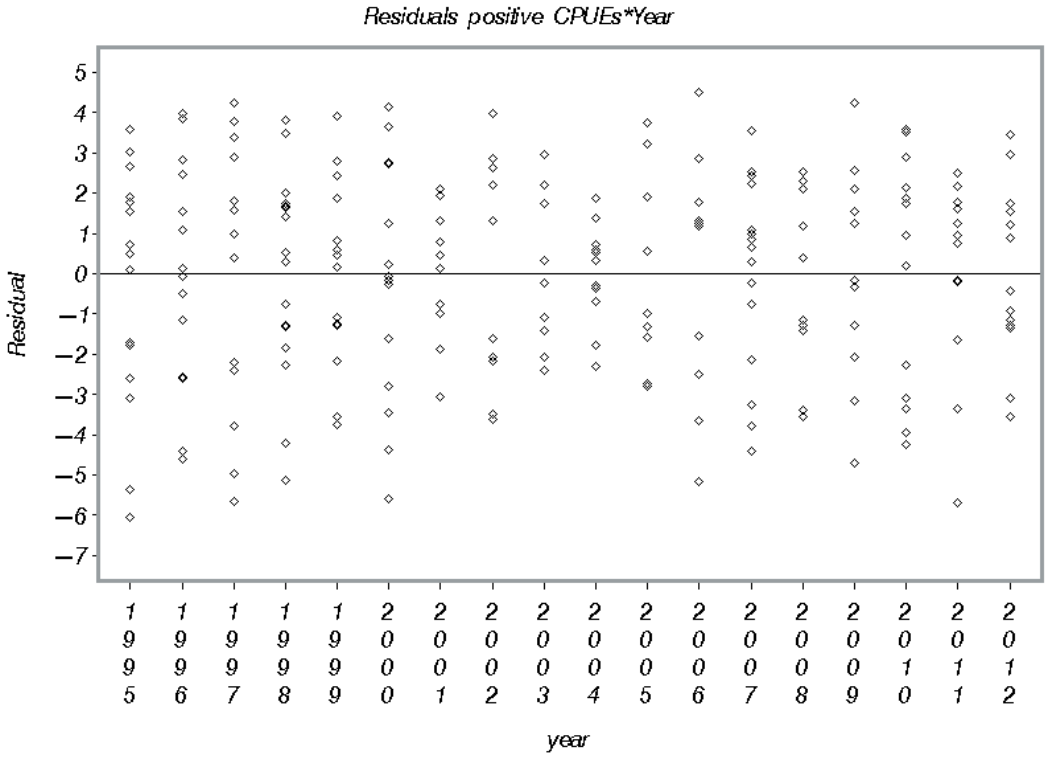
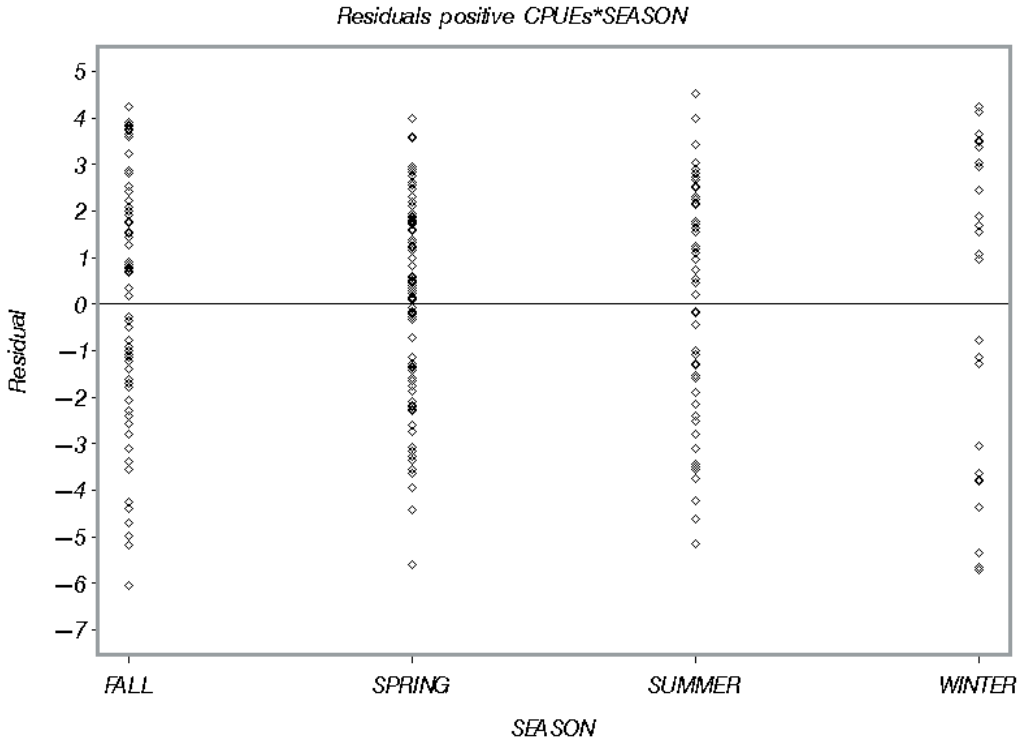


Figure 2 continued. Smooth dogfish model diagnostic plots for the lognormal cpue of positive catch observations.



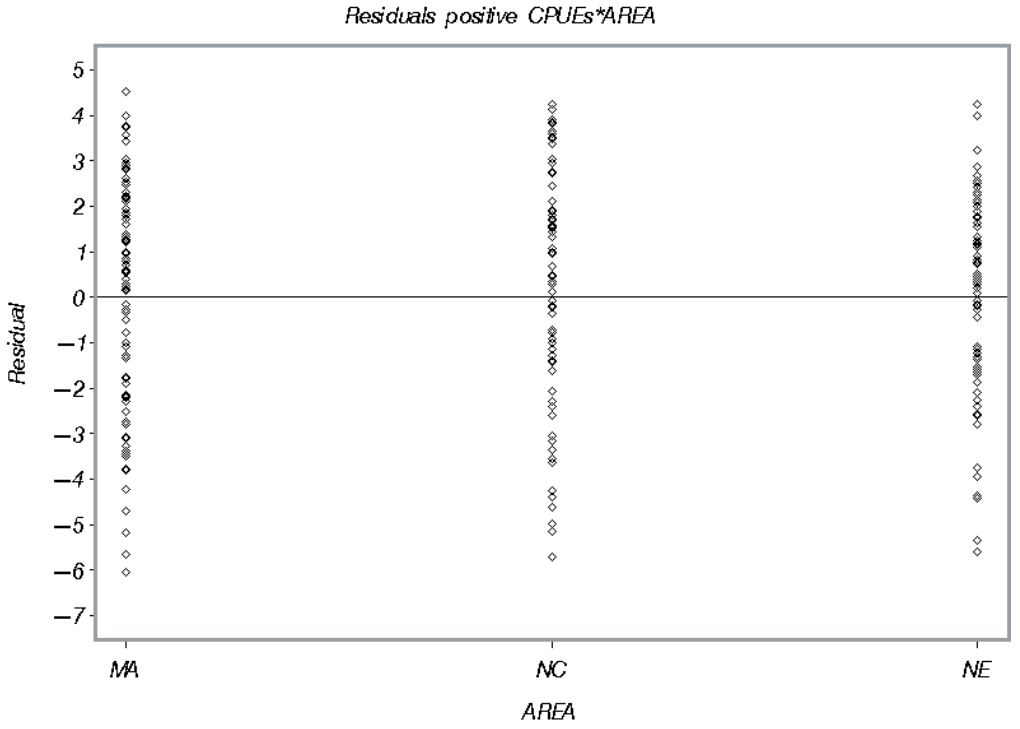
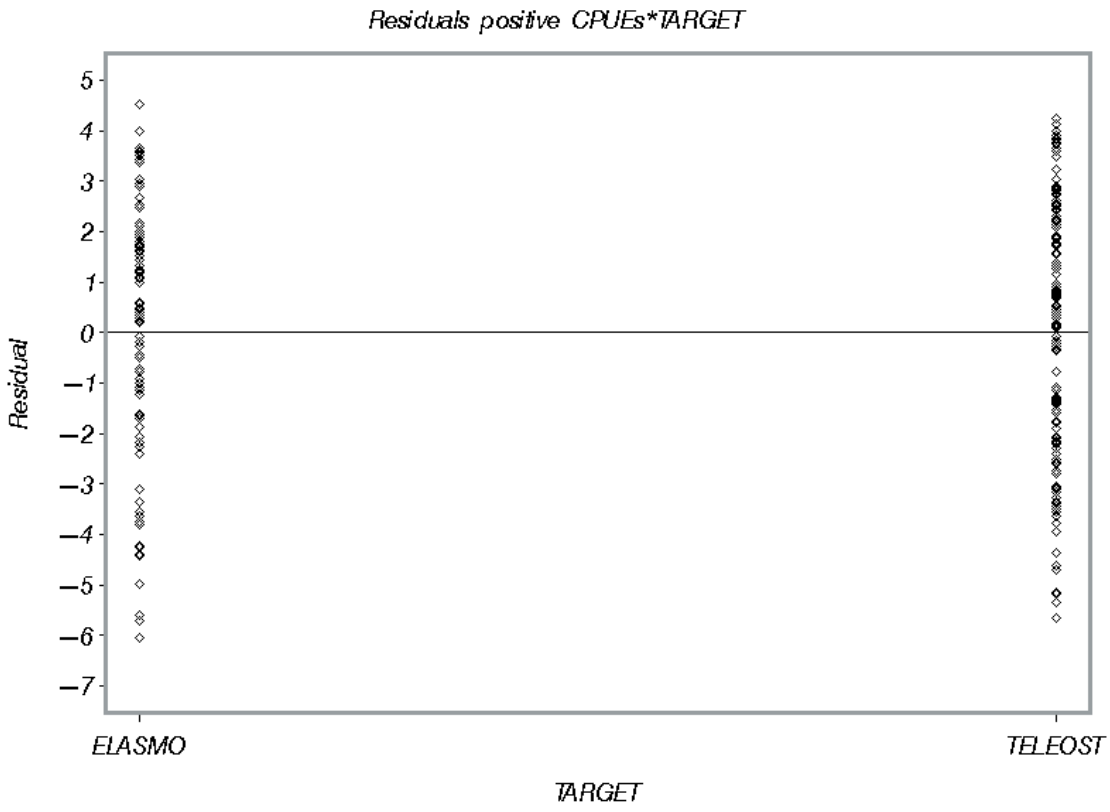


Figure 2 continued. Smooth dogfish model diagnostic plots for the lognormal cpue of positive catch observations.



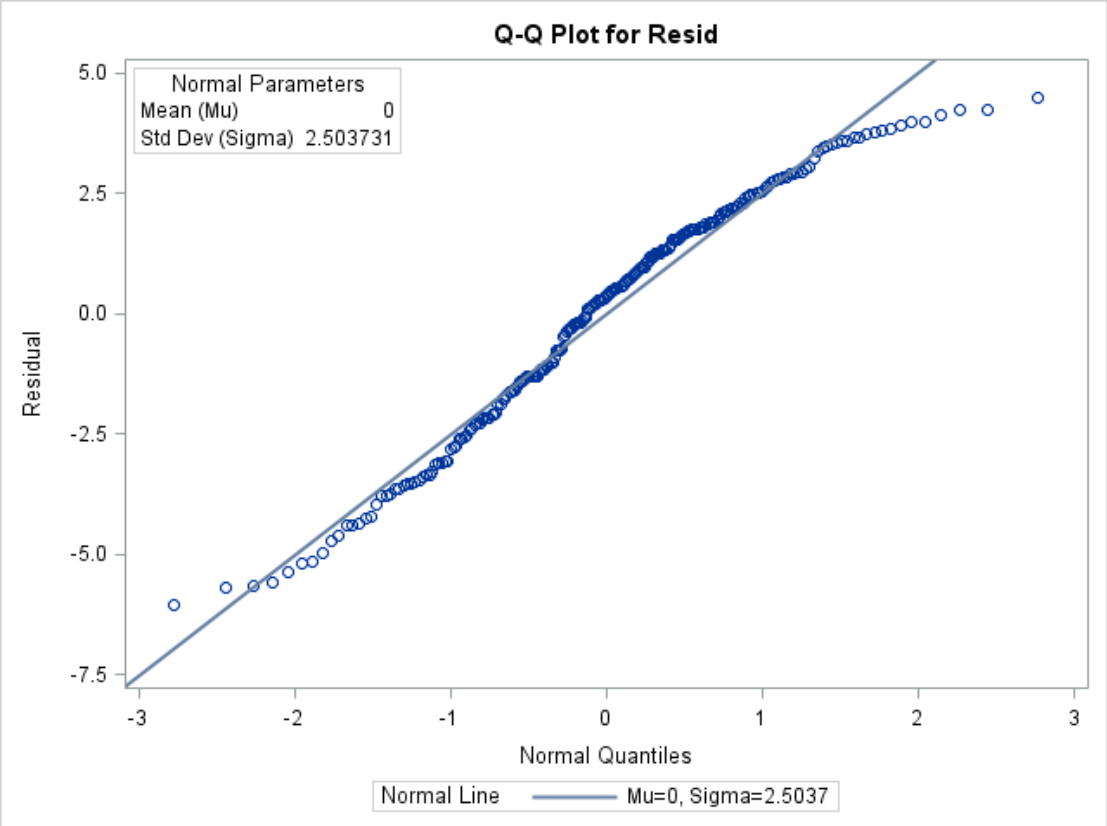


Figure 3. Smooth dogfish nominal (nom cpue) and estimated (est cpue) cpue (catch per unit effort: catch in lbs whole weight per (number of nets * net length * soak duration)/1000) with 95% confidence limits (LCL = lower confidence limit, UCL= upper confidence limit) for the estimated cpue.

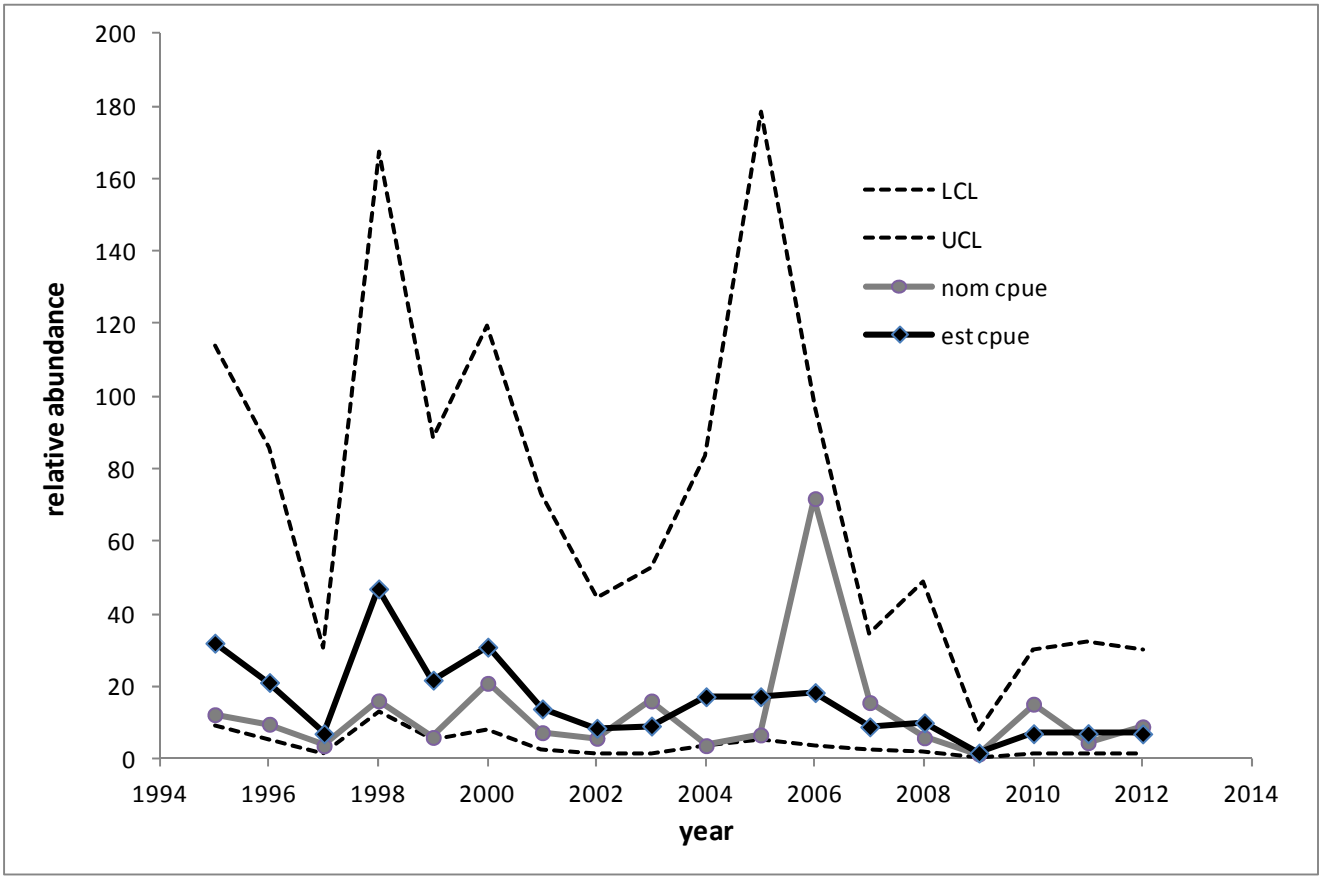


Figure 3. Fork lengths (cm) of smooth dogfish sampled during observed drift sink gillnet fishery trips from 2001-2012.

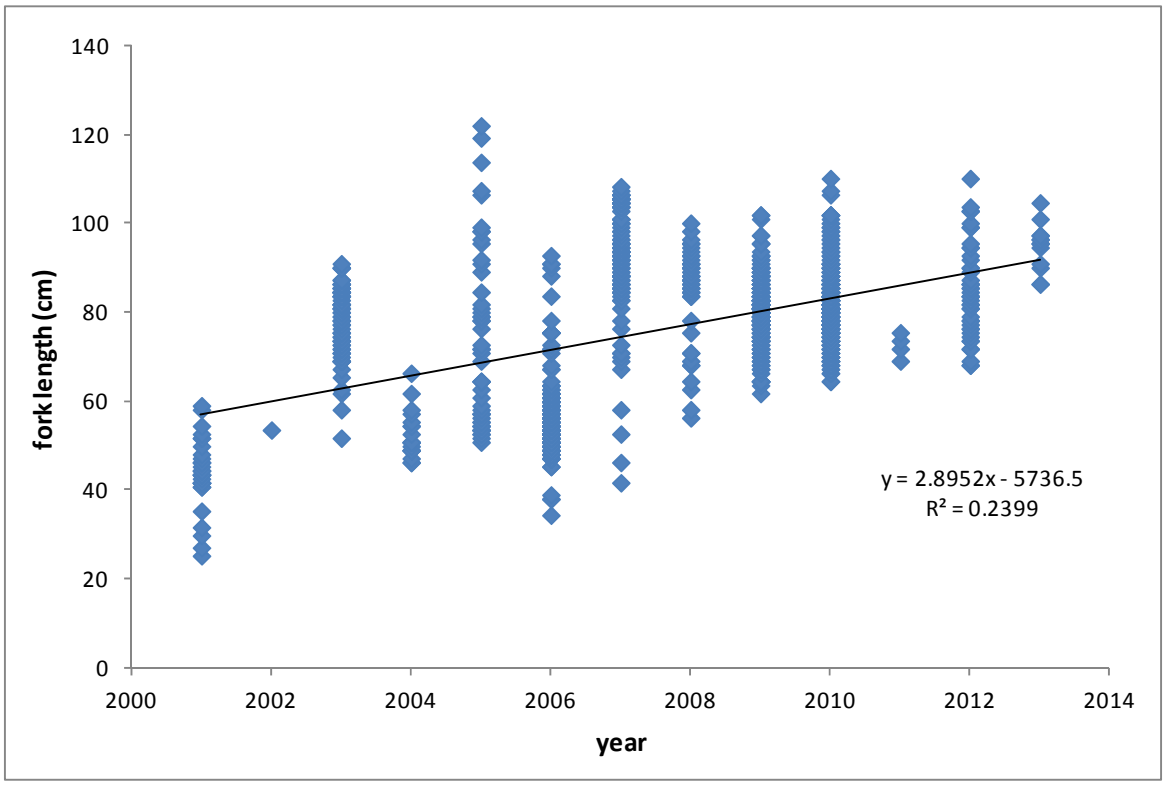


Figure 4. Fork lengths (cm) of smooth dogfish sampled during observed otter trawl fishery trips from 1996-2012.