UPDATE OF STANDARDIZED CATCH RATES BY SEX AND AGE FOR SWORDFISH (*XIPHIAS GLADIUS*) FROM THE U.S. LONGLINE FLEET 1981-2005

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SUMMARY

*Swordfish (*Xiphias gladius*) catch and effort data from the United States Pelagic longline fleet operating in the western North Atlantic were used to update indices of abundance for the North Atlantic swordfish stock. This document updates analysis presented in 2005 by including the latest available year catches of swordfish (SCRS/2005/085) by the United States longline fleet. Standardized catch rates were estimated using a Generalized Linear Mixed modeling approach assuming a delta-lognormal error distribution. Indices of abundance in units of biomass (dressed weight) were estimated for fish greater than 33 lbs due to United States size restrictions implemented in 1991. Indices of abundance in numbers of fish for ages 3-10+ combined sexes were also updated.*

RÉSUMÉ

Les données de prise et d'effort de l'espadon (Xiphias gladius) *de la flottille palangrière pélagique des Etats-Unis qui opère dans l'Atlantique Nord-Ouest ont été utilisées pour actualiser les indices d'abondance pour le stock d'espadon nord-atlantique. Le présent document actualise l'analyse présentée en 2005 en incluant les dernières prises annuelles disponibles d'espadon (SCRS/2005/085) réalisées par la flottille palangrière des Etats-Unis. Les taux de capture standardisés ont été estimés à l'aide d'une méthode de modélisation mixte linéaire généralisé postulant une distribution d'erreur delta-lognormale. Les indices d'abondance dans les unités de biomasse (poids manipulé) ont été estimés pour les poissons d'un poids supérieur à 33 livres en raison des restrictions de taille mises en œuvre aux Etats-Unis en 1991. Les indices d'abondance en nombres de poissons pour les sexes combinés d'âges 3-10+ ont également été actualisés.*

RESUMEN

*Se utilizaron los datos de captura y esfuerzo del pez spada (*Xiphias gladius*) capturado por la flota palangrera pelágica estadounidense que opera en el Atlántico noroccidental para actualizar los índices de abundancia del stock de pez espada del Atlántico norte. Este documento actualiza los análisis presentados en 2005 mediante la inclusión de las capturas del último año disponible para el pez espada (SCRS/2005/085) realizadas por la flota de palangre estadounidense. Se estimaron las tasas de captura estandarizadas utilizando un enfoque de modelación mixta lineal generalizada asumiendo una distribución de error delta-lognormal. Se estimaron los índices de abundancia en unidades de biomasa (peso canal) para ejemplares de más de 33 lbs debido a las restricciones de talla estadounidenses implementadas en 1991. También se actualizaron los índices de abundancia en número de ejemplares para las edades 3-10+ y ambos sexos combinados.*

KEYWORDS

Catch/effort, abundance, longline, pelagic fisheries, swordfish

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1. Introduction

Indices of abundance of swordfish from commercial fisheries have been used to tune stock assessment models (Anonymous 2000). Data collected from the United States pelagic longline fishery were used to develop standardized catch per unit effort (CPUE) indices for the North Atlantic swordfish stock. This report simply updates the model applied to the available United States longline fleet data through 2005 and presents biomass and age-sex specific standardized indices for the north Atlantic swordfish stock. Standardized catch rates were estimated using the Generalized Linear Mixed Model (GLMM) approach.

2. Materials and methods

All fishers that fish for and land swordfish in United States are required to report their catch through logbooks. Each report includes the catch in numbers of all caught species and general fishery settings for each longline set (Pelagic Longline Logbook data). They are also required to submit weight-out sheets for each trip, which include individual carcass weights for swordfish and other large pelagic species landed and marketed in the United States (Weight-out data). The Pelagic longline fleet has also an observer program, established in 1992 that monitored the fishing activities of the fleet, recording detailed information on fishing operations, gear characteristics and deployment, environmental related conditions and biological information from all longline catch (Lee and Brown 1998).

Implementation of United States regulations, in conformity with the ICCAT recommendations, limit the allowable landings of swordfish by United States fishers, resulting in changes in both the type of data obtained and in the protocols in which the data are used for analysis. Regulatory norms that affect the present analysis include: a) the implementation(s) of the minimum size of 125 cm LJFL with a 15% tolerance in mid 1991, subsequently modified to 119 cm LJFL with 0% tolerance in mid 1996; b) the implementation of a total annual allowable catch (TAC) since 1995; and c) time-area closures that were in effect since late 1999 due to management regulations related to swordfish and or other species. These time-area restrictions include two permanent closures to pelagic longline; the Desoto Canyon in the Gulf of Mexico (effective since November 1, 2000) and the Florida east coast (effective since March 1, 2001) **(Figure 1)**. There are also three time-area closures for longline in the United States Atlantic coast: the Charleston Bump that is closed from February 1 to April 30, effective in 2001, the Bluefin tuna protection area that is closed from June 1 to June 30, effective in 1999, and the Grand Banks that was closed from July 17, 2001 to January 9, 2002, as a result of an emergency rule implementation (Cramer 2002).

Age-sex specific indices were developed after ageing the swordfish catch at size data. The age slicing method used the Ehrhardt's size at age growth models for males and females (Ehrhardt *et al.* 1995). Since swordfish sex ratio differs in a spatio-temporal scale (Mejuto *et al.* 1998) estimated sex ratios at size by area and time variation were incorporated into the age-slicing procedures (Ortiz *et al.* 2000). This procedure was adopted and used in the last stock assessment of North Atlantic swordfish (Anonymous 2000).

The swordfish weight-out data set extends from 1981 through 2005. Each record contains information of catch by vessel-trip, including date, geographical area of the catch, catch in numbers and weight for swordfish, tunas and other market species, and fishing effort estimated as number of sets per trip times the average number of hooks per set. Prior to 1991, reporting of fish sizes and fishing effort was voluntary and incomplete for many longline vessels. The United States longline pelagic fleet includes at least 1,714 different registered vessels from 1981 to 2003. This fleet has changed in terms of gear technology and fishery operations, Hoey *et al.* (1988) characterized the swordfish fleet into nine different vessel-groups based on boat size-power and fishing operations. This classificatory factor has shown to be an important explanatory variable of several species catch rates including swordfish (Ortiz and Cramer 2000).

The longline fishing grounds of the United States fleet extend from the Grand Banks in the North Atlantic to 5°-10° latitude south, off the South America coast, including the Caribbean and the Gulf of Mexico. Eight geographical areas have been defined for spatial classification of this fishery **(Figure 1)**. These include: the Caribbean (CAR, area 1), Gulf of Mexico (GOM, area 2), Florida East coast (FEC, area 3), South-Atlantic Bight (SAB, area 4), Mid-Atlantic Bight (MAB, area 5), New England coastal (NEC, area 6), Northeast Distant waters (NED, area 7) and the Southern offshore (OFS, area 8). Quarters were used to account for seasonal fishery distribution through the year (Jan-Mar, Apr-Jun, Jul-Sep, and Oct-Dec).

Fishing effort is reported as total number of hooks per set times the number of sets per trip, therefore nominal catch rates were calculated as numbers of swordfish caught per 1000 hooks. In addition, a classificatory variable size-set was defined as the mean number of hooks per set, grouping observations into 3 levels: (a) trips with an average of 100 to 300 hooks/set, (b) trips with 300 to 500 hooks/set, and (c) trips with 500 or more hooks/set. Set size was assumed to control for changes in gear deployment hypothesized to affect catch rates.

Swordfish is a main target species of the United States pelagic longline fleet; however this fleet also targets tunas (yellowfin, bigeye and bluefin tuna) and to a lesser extent other pelagic species including sharks. A proxy for targeted species was defined based on the proportion of swordfish catch to total catch per trip and grouped into categories, corresponding to the quartiles 0-25%, 25-50%, 50-75%, and 75-100%. This target variable was assumed to control for effects on swordfish catch rates associated with the diverse species targeted by the fleet.

Standardized indices of abundance were estimated for age-sex classes and as combined sex age groups. Catch at age by sex (CAAS) were generated using sex-ratios at size and size-at-age slicing methods used in the 1999 swordfish stock assessment (Anonymous 2000, Ortiz *et al.* 2000). For females, CAAS was estimated for ages 0 to 10+, while for males CAAS was estimated for ages 0 to 5+. Due to size restrictions implemented in 1991, standardized CPUE were restricted for ages 0, 1 and 2 from 1981 to 1990. For ages 3 and older, standardized CPUE were estimated from 1981 to 2004. Combined sex standardized CPUE was estimated for ages 0, 1, and 2 also from 1981 to 1990, and for ages 3 and older from 1981 to 2004.

As per recommendation of the SCRS, a swordfish biomass index was estimated using the Weight-Out data. This biomass index was restricted to fish $\geq$ 13 kg (due to size restrictions implemented in 1991) and estimated as total pounds landed per thousand hooks. Due to implementation of time-area closures on pelagic longline fishing within United States EEZ waters, it has been recommended to exclude observations from the time-area closure areas for 1996 forward.

Relative indices of abundance were estimated by Generalized Linear Modeling approach assuming a delta lognormal model distribution. The standardization protocols assumed a delta model with a binomial error distribution for modeling the proportion of positive sets, and a lognormal error distribution for modeling the mean catch rate of successful (i.e. positive swordfish catch) sets. The lognormal frequency distributions age aggregated by sex and data source are shown in **Figure 2.** Parameterization of the models used the GLM structure; for the proportion of successful sets per stratum is assume to follow a binomial distribution where the estimated probability is a linear function of fixed factors and interactions. The logit function was used as a link between the linear factor component and the binomial error. For successful sets, estimated CPUE rates assumed a lognormal distribution of a linear function of fixed and random effect interactions when the *year* term was within the interaction.

A step-wise regression procedure was used to determine the set of systematic factors and interactions that significantly explained the observed variability starting from the final models presented in 2005 (Ortiz 2005). As the deviance difference between two consecutive nested models follows a chi-square (χ^2) distribution, this statistic was used to test for the significance of an additional factor(s) in the model. Deviance analysis tables are presented for each data set analysis. Each table includes the deviance for the proportion of positive observations, and the deviance for the positive catch rates. Final selection of the explanatory factors was conditional to: a) the relative percent of deviance explained by adding the factor in consideration, normally factors that explained more than 5% were included in the final model, b) the χ^2 test significance, and c) type III test significance within the final specified model. Once a set of fixed factors was specified, possible first level interactions were evaluated in particular random interactions between the *year* effect and other factors. The significance of random interactions was evaluated between nested models by using the likelihood ratio test (Pinheiro and Bates 2000), the Akaike information criteria (AIC), and the Bayesian information criteria (BIC) (Littell *et al.* 1996). Analyses were done using GLIMMIX and MIXED procedures from the SAS® statistical computer software (SAS Institute Inc. 1997).

Relative indices of abundance were estimated by age-sex, age or age groups, and for biomass of fish $\geq$ 15 kg. Within age-sex analyses, the age component was included as fixed factor in the model. Relative indices were calculated as the product of the year (year*age in age-sex indices) effect least square means (LSmeans) from the binomial and the lognormal components. LSmeans estimates were weighted proportional to observed margins in the input data, and for the lognormal estimates, a log-back transformed bias corrections was applied (Lo *et al.* 1992).

3. Results and discussion

The deviance analyses tables for the swordfish CPUE standardization by age-sex results are shown in **Table 1** for females (Age 0 to 10+), **Table 3** for males (Age 0 to 5+), **Table 5** for combined sex, age groups 3-10+, and **Table 9** for unisex (Age 0 to 5+), respectively. **Table 7** shows the deviance table for the swordfish biomass index derived from the weight-out data. In this case analysis excluded those trips that were within an area designated as management area from 1996 onwards.

The age-sex index standardization analyses indicated that area, OP and target where the main explanatory factors for the proportion of positive sets models, both for males and females. While for the positive catch sets models, the main explanatory factors were OP, size set (Szst), target and area. Of the interactions evaluated, the year*Area, and year*OP were also important explanatory factors primarily for the positive catch sets models. **Tables 2, 4 and 10** present the evaluation of these interactions as random components in the mixed models. For combined sex and age aggregated indices, also area, OP and target as well quarter were the main explanatory factors for the proportion of positive sets, while for the positive catch sets, the factors area, OP, target and size set did explain most of the observed variability **(Table 6)**.

The biomass index analyses also reiterated area, OP, target and quarter and the random interactions year*Op and area*quarter as main explanatory factors for the proportion of positive trips **(Table 7)**. While area, OP and target and random interactions year*area and year*OP were the main explanatory factors of catch rates for trips with catches of swordfish **(Table 8)**.

Table 11 and **Figure 4** show the nominal and standardized CPUE by age for female swordfish, while **Table 12** and **Figure 3** present correspondent results for males, **Table 13 and Figure 5** show standardized catch rates by age for unisex groups. **Figure 6 and Tables 14 and 15** show the nominal and standardized CPUE for combined sex-age groups 0-2 and 3-10+, respectively. Reviewing catch trends by sex and age, for males ages 0-1 and females 0-1 the catch trends were different for the early years (1981-1987) **(Figures 3 and 4)**. For older fish, ages 3 and above, both males and females show general decline trends from higher values in the early period (1981-1982) to lower values in the early 1990's, followed by rather constant low catch rates through the 1990's with some slight indication of recovery by 2000-2002 particularly for fish age 3.

Figure 8 shows the trends for ages 3, 4 and 5 (the main component of the catch) for males and females swordfish adjusted to the cohort-group year. In general cohorts follow similar trends comparing by contiguous ages. For ages 3 both males and females showed an increase in catch rates in the latest year, while ages 4 and 5 showed lower catch rates compared to 2002, but overall there is a continuous increasing trend from the lower values in the mid-1990's.

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Table 1. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates by Age and sex (number of fish per thousand hooks) from the U.S. pelagic longline fishery. Percent of total deviance refers to the deviance explained by the full model; p value refers to the Chi-square probability between consecutive models (alpha = 0.05).

Swordfish Males by Age (0-2 1981-1990 / 3-5+ 1981-2005)

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	38230.6625			
Year	24	32376.0735	5854.59	27.5%	< 0.001
Year Age	5	29432.5313	2943.54	13.8%	< 0.001
Year Age Op	6	23337.9743	6094.56	28.7%	< 0.001
Year Age Op Area	6	22730.0897	607.88	2.9%	< 0.001
Year Age Op Area Qtr	3	22608.9425	121.15	0.6%	< 0.001
Year Age Op Area Qtr Szst	2	21066.3566	1542.59	7.3%	< 0.001
Year Age Op Area Qtr Szst Targ	3	19266.83	1799.53	8.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	75	19147.0518	119.78	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Area	135	18494.8119	652.24	3.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Op	128	18138.043	356.77	1.7%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Area	29	18075.0451	63.00	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Qtr	70	17680.0514	394.99	1.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Qtr	18	17548.0534	132.00	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Qtr	18	17493.5834	54.47	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Szst	43	17365.2096	128.37	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Szst	12	17281.4209	83.79	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Szst	12	17256.1377	25.28	0.1%	0.014
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Szst	6	17248.359	7.78	0.0%	0.255
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Targ	69	17131.4672	116.89	0.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Targ	18	17038.0915	93.38	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Targ	18	16996.6728	41.42	0.2%	0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Targ	9	16968.2013	28.47	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Szst*Targ	6	16958.9771	9.22	0.0%	0.161

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	47095.800			
Year	24	45305.818	1789.98	9%	< 0.001
Year Age	5	43768.574	1537.24	8%	< 0.001
Year Age Op	6	36695.481	7073.09	36%	< 0.001
Year Age Op Area	6	32097.162	4598.32	23%	< 0.001
Year Age Op Area Qtr	3	32008.133	89.03	0%	< 0.001
Year Age Op Area Qtr Szst	2	31955.616	52.52	0%	< 0.001
Year Age Op Area Qtr Szst Targ	3	28286.410	3669.21	19%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	75	28175.456	110.95	1%	0.004
Year Age Op Area Qtr Szst Targ Year*Age Year*Szst	45	28009.911	165.54	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Op*Area	30	27973.222	202.23	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Targ	72	27889.319	286.14	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Area*Qtr	18	27871.386	304.07	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Qtr	71	27744.832	430.62	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Op	131	27545.539	629.92	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Area	136	27305.282	870.17	4%	< 0.001

Table 2. Analyses of mixed model formulations for swordfish catch rates by age-sex from the US Pelagic Longline fishery. Likelihood ratio tests the difference of –2 REM loglikelihood between two nested models. * indicates the final delta mixed model.

	Swordfish Males by Age [0-5+ 1981-1990 / 3-5+ 1981-2005] GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Positives catch rates					
	Year Age Year*Age Area OP Szst Targ	67670.8	67672.8	67681		
	Year Age Year*Age Area OP Szst Targ *Year*Area*	67141.5	67145.5	67151.7	529.3	0.0000
	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP*	66949.6	66955.6	66965	191.9	0.0000
*	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP Year*Qtr*	66510.8	66518.8	66531.2	438.8	0.0000
	Proportion Positives					
	Year Age Year*Age OP Area Targ	88047.3	88049.3	88057.3		
	Year Age Year*Age OP Area Targ *Year*Area*	87929.1	87933.1	87933.1	118.2	0.0000
	Year Age Year*Age OP Area Targ *Year*Area Year*OP*	87890.3	87869.3	87905.6	38.8	0.0000
*	Year Age Year*Age OP Area Targ *Year*Area Year*OP Year*Qtr*	87784.5	87792.5	87805	105.8	0.0000

Table 3. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates combined sex and age groups (number of fish per thousand hooks) from the U.S. pelagic longline fishery. Percent of total deviance refers to the deviance explained by the full model; p value refers to the Chi-square probability between consecutive models (alpha = 0.05).

Swordfish Combined Age 3-10+ 1981-2005

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	31364.7602			
Year	24	28773.4175	2591.34	12.4%	< 0.001
Year Op	6	20489.2587	8284.16	39.6%	< 0.001
Year Op Area	6	17977.704	2511.55	12.0%	< 0.001
Year Op Area Qtr	3	17236.155	741.55	3.5%	< 0.001
Year Op Area Qtr Szst	2	15828.3137	1407.84	6.7%	< 0.001
Year Op Area Qtr Szst Targ	3	12314.276	3514.04	16.8%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Area	136	11841.8248	472.45	2.3%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Op	131	11556.9854	284.84	1.4%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Area	30	11497.749	59.24	0.3%	0.001
Year Op Area Qtr Szst Targ ... Year*Qtr	71	11376.5322	121.22	0.6%	< 0.001
Year Op Area Qtr Szst Targ ... Area*Qtr	18	11219.6185	156.91	0.8%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Qtr	18	11160.8381	58.78	0.3%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Szst	44	11045.3918	115.45	0.6%	< 0.001
Year Op Area Qtr Szst Targ ... Area*Szst	12	10982.1074	63.28	0.3%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Szst	12	10956.8977	25.21	0.1%	0.014
Year Op Area Qtr Szst Targ ... Qtr*Szst	6	10928.7023	28.20	0.1%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Targ	69	10836.397	92.31	0.4%	0.032
Year Op Area Qtr Szst Targ ... Area*Targ	18	10535.8062	300.59	1.4%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Targ	18	10469.7528	66.05	0.3%	< 0.001
Year Op Area Qtr Szst Targ ... Qtr*Targ	9	10454.0598	15.69	0.1%	0.074
Year Op Area Qtr Szst Targ ... Szst*Targ	6	10449.9705	4.09	0.0%	0.665

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	11784.273			
Year	24	11357.922	426.35	7%	< 0.001
Year Op	6	9141.061	2216.86	34%	< 0.001
Year Op Area	6	8268.137	872.92	13%	< 0.001
Year Op Area Qtr	3	7958.625	309.51	5%	< 0.001
Year Op Area Qtr Szst	2	7877.052	81.57	1%	< 0.001
Year Op Area Qtr Szst Targ	3	5662.286	2214.77	34%	< 0.001
Year Op Area Qtr Szst Targ Year*Szst	45	5576.764	85.52	1%	< 0.001
Year Op Area Qtr Szst Targ Op*Area	30	5540.830	121.46	2%	< 0.001
Year Op Area Qtr Szst Targ Year*Targ	72	5529.714	132.57	2%	< 0.001
Year Op Area Qtr Szst Targ Year*Qtr	71	5475.549	186.74	3%	< 0.001
Year Op Area Qtr Szst Targ Area*Qtr	18	5388.604	273.68	4%	< 0.001
Year Op Area Qtr Szst Targ Year*Op	131	5339.274	323.01	5%	< 0.001
Year Op Area Qtr Szst Targ Year*Area	136	5306.908	355.38	5%	< 0.001

Table 4. Analysis of mixed model formulations for swordfish catch rates combined-sex and age groups from the U.S. pelagic longline fishery. Likelihood ratio tests the difference of –2 REM log likelihood between two nested models. * indicates the final delta mixed model

	Swordfish Combined Age3-10+ GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Proportion Positives					
*	Year OP Qtr Target	29454	29456	29462.7		
	Year OP Qtr Target *Year*Area*	29773.2	29777.2	29783.4	-319.2	N/A
	Year OP Qtr Target *Year*Area Year*OP*	29649.7	29655.7	29665.1	123.5	0.0000
	Year OP Qtr Target *Year*Area Year*OP Area*Qtr*	29557.6	29565.6	29578.1	92.1	0.0000
	Positives catch rates					
	Year Area OP Szst Targ	48864.3	48866.3	48874.2		
	Year Area OP Szst Targ *Year*Area*	48467.9	48471.9	47478.2	396.4	0.0000
	Year Area OP Szst Targ *Year*Area Year*OP*	48260.1	48266.1	48275.4	207.8	0.0000
*	Year Area OP Szst Targ *Year*Area Year*OP Area*Targ*	47555	47563	47575.4	705.1	0.0000

Table 5. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates combined sex and age groups (number of fish per thousand hooks) from the U.S. pelagic longline fishery. Percent of total deviance refers to the deviance explained by the full model; p value refers to the Chi-square probability between consecutive models (alpha = 0.05).

Swordfish Combined Age 3-10+ 1981-2005

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	**1**	**31364.7602**			
Year	24	28773.4175	2591.34	12.4%	< 0.001
Year Op	6	20489.2587	8284.16	39.6%	< 0.001
Year Op Area	6	17977.704	2511.55	12.0%	< 0.001
Year Op Area Qtr	3	17236.155	741.55	3.5%	< 0.001
Year Op Area Qtr Szst	2	15828.3137	1407.84	6.7%	< 0.001
Year Op Area Qtr Szst Targ	3	12314.276	3514.04	16.8%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Area	136	11841.8248	472.45	2.3%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Op	131	11556.9854	284.84	1.4%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Area	30	11497.749	59.24	0.3%	0.001
Year Op Area Qtr Szst Targ ... Year*Qtr	71	11376.5322	121.22	0.6%	< 0.001
Year Op Area Qtr Szst Targ ... Area*Qtr	18	11219.6185	156.91	0.8%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Qtr	**18**	**11160.8381**	**58.78**	**0.3%**	**< 0.001**
Year Op Area Qtr Szst Targ ... Year*Szst	**44**	**11045.3918**	**115.45**	**0.6%**	**< 0.001**
Year Op Area Qtr Szst Targ ... Area*Szst	**12**	**10982.1074**	**63.28**	**0.3%**	**< 0.001**
Year Op Area Qtr Szst Targ ... Op*Szst	**12**	**10956.8977**	**25.21**	**0.1%**	**0.014**
Year Op Area Qtr Szst Targ ... Qtr*Szst	6	10928.7023	28.20	0.1%	< 0.001
Year Op Area Qtr Szst Targ ... Year*Targ	69	10836.397	92.31	0.4%	0.032
Year Op Area Qtr Szst Targ ... Area*Targ	18	10535.8062	300.59	1.4%	< 0.001
Year Op Area Qtr Szst Targ ... Op*Targ	18	10469.7528	66.05	0.3%	< 0.001
Year Op Area Qtr Szst Targ ... Qtr*Targ	9	10454.0598	15.69	0.1%	0.074
Year Op Area Qtr Szst Targ ... Szst*Targ	6	10449.9705	4.09	0.0%	0.665

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	11784.273			
Year	24	11357.922	426.35	7%	< 0.001
Year Op	6	9141.061	2216.86	34%	< 0.001
Year Op Area	6	8268.137	872.92	13%	< 0.001
Year Op Area Qtr	3	7958.625	309.51	5%	< 0.001
Year Op Area Qtr Szst	**2**	**7877.052**	**81.57**	**1%**	**< 0.001**
Year Op Area Qtr Szst Targ	3	5662.286	2214.77	34%	< 0.001
Year Op Area Qtr Szst Targ Year*Szst	45	5576.764	85.52	1%	< 0.001
Year Op Area Qtr Szst Targ Op*Area	30	5540.830	121.46	2%	< 0.001
Year Op Area Qtr Szst Targ Year*Targ	72	5529.714	132.57	2%	< 0.001
Year Op Area Qtr Szst Targ Year*Qtr	71	5475.549	186.74	3%	< 0.001
Year Op Area Qtr Szst Targ Area*Qtr	18	5388.604	273.68	4%	< 0.001
Year Op Area Qtr Szst Targ Year*Op	131	5339.274	323.01	5%	< 0.001
Year Op Area Qtr Szst Targ Year*Area	136	5306.908	355.38	5%	< 0.001

Table 6. Analysis of mixed model formulations for biomass swordfish catch rates (> 33 lbs dressed wgt/ thousand hooks) from the U.S. pelagic longline fishery. Likelihood ratio tests the difference of –2 REM log likelihood between two nested models. * indicates the final delta mixed model.

	Swordfish (> 33 lbs dressed wgt) GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Proportion Positives					
	Year Target OP Qtr	33132.4	33134.4	33140.7		
	Year Target OP Qtr *Year*Area*	32176.7	32180.7	32187	955.7	0.0000
*	Year Target OP Qtr *Year*Area Area*Qtr*	32134.6	32140.6	32150.1	42.1	0.0000
	Year Target OP Qtr *Year*Area Area*Qtr Year*OP*	32186.2	32194.2	32206.7	-51.6	N/A
	Positives catch rates					
	Year OP Area Target	52436.7	52438.7	52446.7		
	Year OP Area Target *Year*Area*	51893.6	51897.6	51903.9	543.1	0.0000
	Year OP Area Target *Year*Area Year*OP*	51740.9	51746.9	51756.3	152.7	0.0000
*	Year OP Area Target *Year*Area Year*OP Area*Target*	51304.6	51312.6	51325.1	436.3	0.0000

Table 7. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish biomass (pounds dressed weight/ thousand hooks) from the U.S. pelagic longline fishery.

Swordfish (> 33 lbs dressed weigth) biomass CPUE Index

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	45762.3902			
Year	23	40514.5859	5247.80	15.8%	< 0.001
Year Area	7	29203.2968	11311.29	34.0%	< 0.001
Year Area Op	6	25223.7178	3979.58	11.9%	< 0.001
Year Area Op Targ	3	14452.3846	10771.33	32.3%	< 0.001
Year Area Op Targ Qtr	3	14356.8685	95.52	0.3%	< 0.001
Year Area Op Targ Qtr Year*Area	139	13728.4962	628.37	1.9%	< 0.001
Year Area Op Targ Qtr Year*Area ... Year*Qtr	69	13545.3524	811.52	2.4%	< 0.001
Year Area Op Targ Qtr Year*Area ... Area*Qtr	21	13498.092	858.78	2.6%	< 0.001
Year Area Op Targ Qtr Year*Area ... Year*Op	130	13224.2273	1132.64	3.4%	< 0.001
Year Area Op Targ Qtr Year*Area ... Area*Op	34	13133.3675	1223.50	3.7%	< 0.001
Year Area Op Targ Qtr Year*Area ... Op*Qtr	18	13085.4214	1271.45	3.8%	< 0.001
Year Area Op Targ Qtr Year*Area ... Year*Targ	68	12891.9381	1464.93	4.4%	< 0.001
Year Area Op Targ Qtr Year*Area ... Area*Targ	21	12638.6568	1718.21	5.2%	< 0.001
Year Area Op Targ Qtr Year*Area ... Targ*Qtr	9	12599.5995	1757.27	5.3%	< 0.001
Year Area Op Targ Qtr Year*Area ... Op*Targ	18	12455.5609	1901.31	5.7%	< 0.001

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	8238.081			
Year	23	7578.847	659.23	10%	< 0.001
Year Area	7	5314.792	2264.05	33%	< 0.001
Year Area Op	6	5047.489	267.30	4%	< 0.001
Year Area Op Targ	3	1925.838	3121.65	46%	< 0.001
Year Area Op Targ Qtr	3	1810.718	115.12	2%	< 0.001
Year Area Op Targ Qtr Op*Targ	18	1784.601	26.12	0%	0.097
Year Area Op Targ Qtr Area*Targ	21	1772.274	38.44	1%	0.011
Year Area Op Targ Qtr Area*Op	34	1748.684	62.03	1%	0.002
Year Area Op Targ Qtr Year*Targ	69	1715.957	94.76	1%	0.022
Year Area Op Targ Qtr Year*Qtr	69	1678.538	132.18	2%	< 0.001
Year Area Op Targ Qtr Area*Qtr	21	1529.274	281.44	4%	< 0.001
Year Area Op Targ Qtr Year*Op	130	1483.508	327.21	5%	< 0.001
Year Area Op Targ Qtr Year*Area	139	1423.986	386.73	6%	< 0.001

Table 8. Analyses of mixed model formulations for swordfish catch rates by age from the U.S. pelagic longline fishery. Likelihood ratio tests the difference of –2 REM loglikelihood between two nested models. * indicates the final delta mixed model.

	Swordfish Males by Age [0-5+ 1981-1990 / 3-5+ 1981-2005] GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Positives catch rates					
	Year Age Year*Age Area OP Szst Targ	148985.7	148987.7	148996.8		
	Year Age Year*Age Area OP Szst Targ *Year*Area*	147714.1	147718.1	147724.4	1271.6	0.0000
	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP*	147177.8	147183.8	147193.1	536.3	0.0000
*	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP Year*Qtr*	145831.9	145839.9	145852.4	1345.9	0.0000
	Proportion Positives					
*	Year Age Year*Age OP Area Targ	101173.6	101175.6	101183.6		
	Year Age Year*Age OP Area Targ *Year*Area Year*OP Year*Qtr*	102243	102249	102258.3	-1069.4	N/A

Table 9. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates by age unisex (number of fish per thousand hooks) from the U.S. pelagic longline fishery. Percent of total deviance refers to the deviance explained by the full model; p value refers to the Chi-square probability between consecutive models (alpha = 0.05).

Swordfish Unisex by Age (0-2 1981-1990 / 3-5+ 1981-2005)

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	94724.3736			
Year	24	79682.8776	15041.50	25.2%	< 0.001
Year Age	5	75773.7437	3909.13	6.5%	< 0.001
Year Age Op	6	56439.2037	19334.54	32.4%	< 0.001
Year Age Op Area	6	52049.3911	4389.81	7.4%	< 0.001
Year Age Op Area Qtr	3	51349.6786	699.71	1.2%	< 0.001
Year Age Op Area Qtr Szst	2	47357.8486	3991.83	6.7%	< 0.001
Year Age Op Area Qtr Szst Targ	3	39363.4572	7994.39	13.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	75	39016.9028	346.55	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Area	136	37898.7984	1118.10	1.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Op	131	37327.8212	570.98	1.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Area	30	37242.8035	85.02	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Qtr	71	36651.7644	591.04	1.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Qtr	18	36518.5903	133.17	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Qtr	18	36409.149	109.44	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Szst	44	36086.8167	322.33	0.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Szst	12	35955.6387	131.18	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Szst	12	35890.1758	65.46	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Szst	6	35846.6876	43.49	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Targ	71	35672.8819	173.81	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Targ	18	35223.2975	449.58	0.8%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Targ	18	35071.1668	152.13	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Targ	9	35038.8717	32.30	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Szst*Targ	6	35013.4914	25.38	0.0%	< 0.001

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	53260.234			
Year	24	50217.527	3042.71	11%	< 0.001
Year Age	5	48264.161	1953.37	7%	< 0.001
Year Age Op	6	39158.373	9105.79	32%	< 0.001
Year Age Op Area	6	35862.078	3296.30	12%	< 0.001
Year Age Op Area Qtr	3	35067.039	795.04	3%	< 0.001
Year Age Op Area Qtr Szst	2	34724.365	342.67	1%	< 0.001
Year Age Op Area Qtr Szst Targ	3	26589.536	8134.83	29%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	75	26368.035	221.50	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Op*Area	30	26056.357	311.68	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Szst	45	26027.640	340.40	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Targ	72	25996.416	371.62	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Area*Qtr	18	25758.354	609.68	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Qtr	71	25570.847	797.19	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Op	131	25436.528	931.51	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Area	136	24983.097	1384.94	5%	< 0.001

Table 10. Analyses of mixed model formulations for swordfish catch rates by age from the U.S. pelagic longline fishery. Likelihood ratio tests the difference of –2 REM loglikelihood between two nested models.
* indicates the final delta mixed model.

	Swordfish Males by Age [0-5+ 1981-1990 / 3-5+ 1981-2005] GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Positives catch rates					
	Year Age Year*Age Area OP Szst Targ	148985.7	148987.7	148996.8		
	Year Age Year*Age Area OP Szst Targ *Year*Area*	147714.1	147718.1	147724.4	1271.6	0.0000
	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP*	147177.8	147183.8	147193.1	536.3	0.0000
*	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP Year*Qtr*	145831.9	145839.9	145852.4	1345.9	0.0000
	Proportion Positives					
*	Year Age Year*Age OP Area Targ	101173.6	101175.6	101183.6		
	Year Age Year*Age OP Area Targ *Year*Area Year*OP Year*Qtr*	102243	102249	102258.3	-1069.4	N/A

Table 11. Nominal and standard swordfish CPUE by Age-Sex (females) from the weight-out data (fish/1000 hooks).

Age	Year	N obs	Nominal CPUE	Stdard	Low	Upp	coeff var	std error
0	1981	36	1.656	1.709	0.867	3.367	34.9%	0.887
0	1982	89	1.746	1.415	0.816	2.454	28.0%	0.590
0	1983	128	1.280	1.028	0.650	1.628	23.3%	0.356
0	1984	162	0.602	0.614	0.369	1.020	25.8%	0.236
0	1985	168	0.789	0.634	0.391	1.028	24.5%	0.231
0	1986	320	1.242	1.471	1.032	2.096	17.9%	0.391
0	1987	729	0.730	0.830	0.583	1.183	17.9%	0.220
0	1988	930	0.767	0.816	0.570	1.167	18.0%	0.219
0	1989	728	0.544	0.698	0.489	0.996	18.0%	0.186
0	1990	793	0.643	0.786	0.547	1.128	18.2%	0.213
1	1981	36	1.339	1.032	0.568	1.875	30.5%	0.933
1	1982	89	1.292	0.946	0.575	1.559	25.3%	0.710
1	1983	128	1.269	0.897	0.608	1.324	19.6%	0.522
1	1984	162	0.845	0.879	0.607	1.272	18.6%	0.486
1	1985	168	0.607	0.607	0.407	0.905	20.2%	0.363
1	1986	320	1.021	1.297	0.942	1.785	16.1%	0.618
1	1987	729	1.030	1.119	0.824	1.518	15.4%	0.509
1	1988	930	0.979	1.201	0.890	1.621	15.1%	0.536
1	1989	728	0.885	1.053	0.776	1.428	15.3%	0.478
1	1990	793	0.732	0.968	0.713	1.316	15.4%	0.442
2	1981	36	2.119	1.500	0.816	2.759	31.2%	1.238
2	1982	89	1.086	0.764	0.469	1.246	24.8%	0.501
2	1983	128	0.941	0.782	0.526	1.162	20.0%	0.414
2	1984	162	0.818	0.889	0.612	1.292	18.8%	0.443
2	1985	168	0.812	0.805	0.554	1.170	18.9%	0.402
2	1986	320	0.866	1.081	0.784	1.492	16.2%	0.464
2	1987	729	0.879	1.094	0.808	1.482	15.3%	0.442
2	1988	930	0.985	1.165	0.863	1.571	15.1%	0.464
2	1989	728	0.751	0.912	0.671	1.239	15.4%	0.372
2	1990	793	0.742	1.007	0.741	1.369	15.4%	0.411
3	1981	36	3.137	1.578	0.841	2.960	32.3%	0.845
3	1982	89	2.561	1.156	0.706	1.893	25.0%	0.481
3	1983	128	1.215	0.647	0.414	1.010	22.6%	0.243
3	1984	162	1.360	0.936	0.627	1.396	20.2%	0.314
3	1985	168	1.545	0.905	0.605	1.354	20.3%	0.306
3	1986	320	1.382	1.041	0.735	1.474	17.5%	0.303
3	1987	729	1.176	1.000	0.727	1.374	16.0%	0.266
3	1988	930	1.353	1.118	0.818	1.529	15.7%	0.292
3	1989	728	1.064	0.892	0.646	1.233	16.3%	0.241
3	1990	793	0.897	0.814	0.583	1.136	16.8%	0.227
3	1991	1219	0.836	0.991	0.722	1.361	15.9%	0.263
3	1992	1760	0.648	0.843	0.617	1.152	15.7%	0.220
3	1993	2006	0.572	0.781	0.570	1.070	15.8%	0.205
3	1994	2117	0.585	0.756	0.551	1.037	15.9%	0.200
3	1995	2195	0.572	0.849	0.621	1.159	15.7%	0.221
3	1996	1789	0.570	0.805	0.585	1.107	16.0%	0.215
3	1997	1843	0.608	0.875	0.636	1.202	16.0%	0.233
3	1998	1555	0.577	0.820	0.595	1.129	16.1%	0.220
3	1999	1446	0.630	1.074	0.787	1.467	15.7%	0.280
3	2000	1512	0.601	1.010	0.739	1.381	15.7%	0.264
3	2001	1227	0.471	1.038	0.758	1.421	15.8%	0.273
3	2002	1113	0.590	1.199	0.874	1.647	15.9%	0.318
3	2003	1022	0.636	1.185	0.866	1.622	15.8%	0.311
3	2004	1017	0.715	1.221	0.891	1.674	15.9%	0.322
3	2005	779	0.700	1.467	1.066	2.019	16.1%	0.392
4	1981	36	3.072	1.651	0.806	3.381	37.0%	0.572
4	1982	89	2.784	1.299	0.744	2.268	28.4%	0.345
4	1983	128	1.416	0.771	0.464	1.281	25.8%	0.186
4	1984	162	1.436	0.929	0.589	1.463	23.0%	0.200
4	1985	168	1.751	0.943	0.605	1.470	22.4%	0.198
4	1986	320	1.621	1.147	0.791	1.664	18.8%	0.201
4	1987	729	1.140	0.945	0.666	1.340	17.6%	0.156
4	1988	930	1.175	0.953	0.678	1.341	17.2%	0.153
4	1989	728	1.060	0.848	0.594	1.212	18.0%	0.143
4	1990	793	0.868	0.794	0.551	1.145	18.5%	0.137
4	1991	1219	0.744	0.920	0.651	1.299	17.4%	0.150
4	1992	1760	0.618	0.832	0.591	1.171	17.2%	0.134
4	1993	2006	0.564	0.766	0.543	1.080	17.3%	0.124
4	1994	2117	0.528	0.738	0.520	1.048	17.7%	0.122
4	1995	2195	0.474	0.773	0.548	1.091	17.3%	0.125
4	1996	1789	0.498	0.742	0.523	1.053	17.6%	0.122
4	1997	1843	0.594	0.875	0.621	1.234	17.3%	0.142
4	1998	1555	0.515	0.817	0.574	1.162	17.8%	0.136
4	1999	1446	0.633	1.107	0.795	1.540	16.6%	0.172
4	2000	1512	0.525	0.948	0.675	1.330	17.1%	0.152
4	2001	1227	0.467	1.100	0.787	1.538	16.9%	0.174
4	2002	1113	0.608	1.305	0.932	1.827	16.9%	0.207
4	2003	1022	0.562	1.065	0.757	1.498	17.2%	0.171
4	2004	1017	0.634	1.221	0.874	1.707	16.8%	0.193
4	2005	779	0.715	1.511	1.082	2.110	16.8%	0.238
5	1981	36	3.468	1.938	0.898	4.182	39.9%	0.464
5	1982	89	4.155	1.920	1.115	3.305	27.7%	0.319
5	1983	128	1.740	0.937	0.551	1.596	27.1%	0.152
5	1984	162	1.412	0.990	0.591	1.657	26.2%	0.156
5	1985	168	1.676	1.003	0.592	1.698	26.8%	0.161
5	1986	320	1.308	1.010	0.654	1.559	22.0%	0.133
5	1987	729	0.981	0.822	0.549	1.232	20.4%	0.101
5	1988	930	0.978	0.771	0.517	1.150	20.2%	0.093
5	1989	728	0.962	0.773	0.514	1.162	20.6%	0.096
5	1990	793	0.768	0.738	0.485	1.122	21.2%	0.094
5	1991	1219	0.791	1.046	0.721	1.517	18.8%	0.118
5	1992	1760	0.550	0.828	0.566	1.213	19.3%	0.096
5	1993	2006	0.508	0.738	0.499	1.091	19.8%	0.087
5	1994	2117	0.421	0.660	0.440	0.990	20.5%	0.081
5	1995	2195	0.398	0.706	0.474	1.052	20.1%	0.085
5	1996	1789	0.421	0.595	0.391	0.907	21.3%	0.076
5	1997	1843	0.408	0.724	0.482	1.087	20.6%	0.089
5	1998	1555	0.434	0.756	0.503	1.135	20.5%	0.093
5	1999	1446	0.565	1.101	0.767	1.581	18.2%	0.120
5	2000	1512	0.481	0.958	0.659	1.391	18.8%	0.108
5	2001	1227	0.429	1.091	0.754	1.579	18.6%	0.122
5	2002	1113	0.504	1.300	0.904	1.869	18.3%	0.143
5	2003	1022	0.457	1.004	0.688	1.466	19.1%	0.115
5	2004	1017	0.547	1.184	0.820	1.709	18.5%	0.131
5	2005	779	0.639	1.408	0.978	2.028	18.4%	0.155
6	1981	36	4.105	2.189	0.946	5.066	43.9%	0.383
6	1982	89	2.913	1.405	0.699	2.825	36.0%	0.202
6	1983	128	2.195	1.237	0.693	2.210	29.6%	0.146
6	1984	162	1.866	1.280	0.764	2.146	26.3%	0.134
6	1985	168	1.607	0.931	0.511	1.696	30.7%	0.114
6	1986	320	1.187	0.973	0.586	1.617	25.8%	0.100
6	1987	729	1.087	0.891	0.564	1.408	23.2%	0.082
6	1988	930	0.996	0.744	0.465	1.188	23.8%	0.070
6	1989	728	0.945	0.762	0.475	1.221	23.9%	0.073
6	1990	793	0.828	0.735	0.454	1.189	24.4%	0.071
6	1991	1219	0.717	0.929	0.601	1.436	22.0%	0.081
6	1992	1760	0.548	0.855	0.558	1.311	21.6%	0.074
6	1993	2006	0.507	0.748	0.477	1.175	22.8%	0.068
6	1994	2117	0.378	0.643	0.401	1.030	23.9%	0.061
6	1995	2195	0.397	0.697	0.440	1.103	23.3%	0.065
6	1996	1789	0.371	0.554	0.332	0.924	26.0%	0.057
6	1997	1843	0.379	0.655	0.401	1.068	24.8%	0.065
6	1998	1555	0.394	0.691	0.425	1.123	24.6%	0.068
6	1999	1446	0.620	1.077	0.715	1.621	20.7%	0.089
6	2000	1512	0.510	1.057	0.699	1.598	20.9%	0.088
6	2001	1227	0.339	1.004	0.657	1.534	21.4%	0.086
6	2002	1113	0.592	1.439	0.976	2.124	19.6%	0.113
6	2003	1022	0.457	1.050	0.684	1.613	21.7%	0.091
6	2004	1017	0.447	1.015	0.657	1.567	22.0%	0.089
6	2005	779	0.615	1.438	0.963	2.147	20.2%	0.116
7	1981	36	4.557	2.828	1.130	7.075	48.4%	0.336
7	1982	89	3.823	1.958	0.946	4.053	37.6%	0.181
7	1983	128	2.799	1.564	0.824	2.969	32.9%	0.126
7	1984	162	1.821	1.308	0.697	2.452	32.2%	0.104
7	1985	168	1.511	0.892	0.419	1.903	39.2%	0.086
7	1986	320	0.871	0.718	0.354	1.456	36.5%	0.064
7	1987	729	0.870	0.750	0.408	1.379	31.2%	0.057
7	1988	930	0.761	0.626	0.336	1.169	31.9%	0.049
7	1989	728	0.916	0.723	0.399	1.309	30.4%	0.054
7	1990	793	0.676	0.609	0.316	1.176	33.8%	0.051
7	1991	1219	0.540	0.745	0.418	1.330	29.6%	0.054
7	1992	1760	0.489	0.798	0.461	1.380	27.9%	0.055
7	1993	2006	0.468	0.666	0.373	1.188	29.5%	0.048
7	1994	2117	0.355	0.653	0.365	1.170	29.8%	0.048
7	1995	2195	0.411	0.787	0.458	1.352	27.6%	0.053
7	1996	1789	0.327	0.496	0.250	0.985	35.3%	0.043
7	1997	1843	0.329	0.581	0.307	1.099	32.7%	0.047
7	1998	1555	0.368	0.596	0.312	1.137	33.2%	0.049
7	1999	1446	0.503	1.012	0.608	1.683	25.9%	0.064
7	2000	1512	0.479	1.046	0.637	1.717	25.2%	0.065
7	2001	1227	0.317	1.080	0.648	1.800	26.0%	0.069
7	2002	1113	0.477	1.363	0.851	2.182	23.9%	0.080
7	2003	1022	0.430	1.022	0.600	1.739	27.1%	0.068
7	2004	1017	0.388	1.009	0.586	1.738	27.7%	0.069
7	2005	779	0.515	1.170	0.694	1.974	26.6%	0.076
8	1981	36	4.585	2.969	1.024	8.613	57.3%	0.251
8	1982	89	4.994	2.463	1.027	5.908	45.9%	0.167
8	1983	128	2.647	1.413	0.590	3.384	45.8%	0.095
8	1984	162	1.733	1.181	0.486	2.872	46.7%	0.081
8	1985	168	1.409	0.871	0.330	2.299	51.5%	0.066
8	1986	320	0.902	0.800	0.330	1.940	46.6%	0.055
8	1987	729	0.790	0.710	0.314	1.607	42.6%	0.045
8	1988	930	0.869	0.619	0.269	1.424	43.5%	0.040
8	1989	728	0.744	0.594	0.253	1.397	44.7%	0.039
8	1990	793	0.569	0.508	0.195	1.320	50.6%	0.038
8	1991	1219	0.538	0.734	0.348	1.545	38.6%	0.042
8	1992	1760	0.407	0.797	0.395	1.610	36.2%	0.043
8	1993	2006	0.390	0.653	0.306	1.390	39.2%	0.038
8	1994	2117	0.368	0.670	0.315	1.427	39.2%	0.039
8	1995	2195	0.416	0.765	0.376	1.553	36.6%	0.041
8	1996	1789	0.350	0.418	0.157	1.111	51.9%	0.032
8	1997	1843	0.280	0.465	0.181	1.197	50.1%	0.034
8	1998	1555	0.278	0.571	0.240	1.358	45.4%	0.038
8	1999	1446	0.525	1.104	0.592	2.061	32.0%	0.052
8	2000	1512	0.377	0.945	0.489	1.826	33.9%	0.047
8	2001	1227	0.310	1.104	0.578	2.110	33.2%	0.054
8	2002	1113	0.383	1.352	0.740	2.472	30.9%	0.062
8	2003	1022	0.349	0.926	0.457	1.876	36.4%	0.050
8	2004	1017	0.332	1.012	0.501	2.043	36.3%	0.054

8	2005	779	0.455	1.355	0.734	2.503	31.4%	0.063
9	1981	36	5.409	3.984	0.956	16.612	81.5%	0.303
9	1982	89	4.080	2.513	0.841	7.510	59.1%	0.139
9	1983	128	3.309	1.955	0.772	4.951	49.1%	0.090
9	1984	162	1.545	1.122	0.352	3.575	63.2%	0.066
9	1985	168	1.110	0.629	0.140	2.822	87.0%	0.051
9	1986	320	0.836	0.690	0.207	2.305	66.2%	0.043
9	1987	729	0.874	0.743	0.269	2.055	54.3%	0.038
9	1988	930	0.824	0.630	0.224	1.773	55.4%	0.033
9	1989	728	0.851	0.614	0.211	1.785	57.4%	0.033
9	1990	793	0.552	0.502	0.148	1.703	67.3%	0.032
9	1991	1219	0.492	0.687	0.258	1.834	52.2%	0.034
9	1992	1760	0.527	0.755	0.295	1.932	49.7%	0.035
9	1993	2006	0.332	0.509	0.167	1.553	60.3%	0.029
9	1994	2117	0.288	0.658	0.249	1.743	51.7%	0.032
9	1995	2195	0.305	0.606	0.215	1.706	55.4%	0.031
9	1996	1789	0.276	0.442	0.130	1.499	67.3%	0.028
9	1997	1843	0.375	0.499	0.155	1.600	63.6%	0.030
9	1998	1555	0.240	0.419	0.113	1.544	72.9%	0.029
9	1999	1446	0.389	1.002	0.427	2.353	44.7%	0.042
9	2000	1512	0.442	1.004	0.443	2.276	42.7%	0.040
9	2001	1227	0.271	0.902	0.358	2.271	48.7%	0.041
9	2002	1113	0.383	1.121	0.485	2.590	43.8%	0.046
9	2003	1022	0.402	1.061	0.457	2.463	44.0%	0.044
9	2004	1017	0.396	0.951	0.382	2.365	48.0%	0.043
9	2005	779	0.490	1.002	0.396	2.534	49.0%	0.046
10	1981	36	7.598	5.184	2.126	12.641	46.9%	0.392
10	1982	89	3.128	2.091	0.847	5.164	47.6%	0.161
10	1983	128	3.170	1.834	0.872	3.858	38.5%	0.114
10	1984	162	1.482	1.195	0.525	2.718	42.9%	0.083
10	1985	168	1.601	1.127	0.479	2.654	44.8%	0.082
10	1986	320	0.829	0.802	0.343	1.874	44.4%	0.057
10	1987	729	0.890	0.806	0.384	1.690	38.4%	0.050
10	1988	930	0.763	0.680	0.317	1.462	39.7%	0.044
10	1989	728	0.824	0.677	0.313	1.465	40.1%	0.044
10	1990	793	0.622	0.652	0.294	1.450	41.6%	0.044
10	1991	1219	0.501	0.739	0.358	1.525	37.4%	0.045
10	1992	1760	0.346	0.697	0.336	1.444	37.7%	0.042
10	1993	2006	0.267	0.518	0.229	1.172	42.5%	0.036
10	1994	2117	0.289	0.580	0.263	1.280	41.2%	0.039
10	1995	2195	0.267	0.649	0.309	1.362	38.4%	0.040
10	1996	1789	0.241	0.365	0.132	1.006	54.1%	0.032
10	1997	1843	0.186	0.329	0.113	0.961	57.7%	0.031
10	1998	1555	0.183	0.386	0.142	1.050	53.4%	0.033
10	1999	1446	0.245	0.697	0.323	1.504	39.9%	0.045
10	2000	1512	0.249	0.732	0.356	1.504	37.2%	0.044
10	2001	1227	0.194	0.766	0.366	1.606	38.3%	0.047
10	2002	1113	0.282	1.010	0.517	1.973	34.5%	0.056
10	2003	1022	0.243	0.737	0.344	1.575	39.4%	0.047
10	2004	1017	0.235	0.647	0.283	1.479	43.1%	0.045
10	2005	779	0.365	1.100	0.566	2.138	34.2%	0.061

Table 12. Nominal and standard swordfish CPUE by age-sex (males) from the weight-out data (fish/1000 hooks).

Age	Year	N obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
0	1981	36	0.488	0.680	0.276	1.674	47.4%	0.374
0	1982	89	1.401	1.209	0.593	2.462	36.7%	0.514
0	1983	128	0.983	0.965	0.505	1.842	33.2%	0.371
0	1984	162	0.819	0.666	0.370	1.199	30.0%	0.232
0	1985	168	0.948	0.752	0.471	1.202	23.8%	0.207
0	1986	320	1.342	1.447	1.022	2.049	17.5%	0.294
0	1987	729	1.159	1.349	0.968	1.879	16.7%	0.261
0	1988	930	1.044	1.059	0.749	1.497	17.4%	0.214
0	1989	728	0.893	1.092	0.788	1.512	16.4%	0.207
0	1990	793	0.923	0.782	0.549	1.114	17.8%	0.162
1	1981	36	1.135	1.141	0.536	2.427	39.1%	0.734
1	1982	89	0.962	0.810	0.414	1.586	34.6%	0.461
1	1983	128	0.754	0.544	0.286	1.033	32.9%	0.295
1	1984	162	0.889	0.785	0.491	1.256	23.8%	0.308
1	1985	168	0.822	0.688	0.467	1.014	19.6%	0.222
1	1986	320	1.084	1.187	0.841	1.676	17.4%	0.339
1	1987	729	0.928	1.042	0.767	1.415	15.4%	0.264
1	1988	930	1.264	1.359	1.007	1.834	15.1%	0.337
1	1989	728	1.235	1.412	1.054	1.891	14.7%	0.341
1	1990	793	0.927	1.032	0.761	1.400	15.3%	0.260
2	1981	36	0.984	0.877	0.362	2.123	46.5%	0.442
2	1982	89	1.004	0.744	0.360	1.540	37.6%	0.303
2	1983	128	0.944	0.668	0.366	1.219	30.7%	0.223
2	1984	162	0.917	0.945	0.591	1.511	23.8%	0.244
2	1985	168	1.131	0.939	0.630	1.398	20.1%	0.205
2	1986	320	0.929	1.069	0.749	1.526	17.9%	0.208
2	1987	729	0.941	1.061	0.766	1.468	16.4%	0.188
2	1988	930	1.260	1.325	0.971	1.808	15.6%	0.225
2	1989	728	0.940	1.257	0.916	1.725	15.9%	0.217
2	1990	793	0.949	1.116	0.810	1.537	16.1%	0.195
3	1981	36	1.480	0.926	0.357	2.399	50.5%	0.359
3	1982	89	1.167	0.643	0.296	1.397	40.3%	0.199
3	1983	128	0.776	0.380	0.177	0.815	39.6%	0.116
3	1984	162	1.107	0.720	0.421	1.233	27.4%	0.152
3	1985	168	2.100	1.059	0.683	1.642	22.2%	0.181
3	1986	320	1.015	0.687	0.427	1.107	24.2%	0.128
3	1987	729	1.065	0.774	0.519	1.155	20.2%	0.120
3	1988	930	1.280	0.810	0.550	1.195	19.6%	0.122
3	1989	728	1.080	0.844	0.578	1.232	19.1%	0.124
3	1990	793	1.012	0.775	0.523	1.148	19.9%	0.118
3	1991	1219	1.011	1.103	0.776	1.566	17.7%	0.150
3	1992	1760	0.774	0.936	0.662	1.324	17.5%	0.126
3	1993	2006	0.721	0.879	0.620	1.246	17.6%	0.119
3	1994	2117	0.778	0.815	0.572	1.161	17.8%	0.112
3	1995	2195	0.826	1.006	0.714	1.417	17.3%	0.134
3	1996	1789	0.922	1.000	0.713	1.402	17.0%	0.131
3	1997	1843	0.991	1.297	0.946	1.779	15.9%	0.159
3	1998	1555	1.096	1.288	0.937	1.771	16.0%	0.159
3	1999	1446	0.937	1.308	0.942	1.817	16.5%	0.166
3	2000	1512	0.778	1.365	0.987	1.886	16.3%	0.171
3	2001	1227	0.651	1.296	0.938	1.790	16.3%	0.162
3	2002	1113	0.688	1.162	0.830	1.627	17.0%	0.152
3	2003	1022	1.080	1.524	1.114	2.084	15.8%	0.185
3	2004	1017	0.950	1.257	0.902	1.753	16.7%	0.162
3	2005	779	0.715	1.148	0.818	1.610	17.1%	0.151
4	1981	36	3.238	2.065	0.812	5.253	49.3%	0.500
4	1982	89	1.466	0.701	0.295	1.667	45.5%	0.156
4	1983	128	1.015	0.529	0.237	1.179	41.8%	0.108
4	1984	162	1.327	0.899	0.509	1.589	29.1%	0.128
4	1985	168	2.087	1.154	0.717	1.857	24.1%	0.137
4	1986	320	1.213	0.848	0.510	1.412	25.9%	0.108
4	1987	729	0.976	0.710	0.456	1.107	22.4%	0.078
4	1988	930	1.151	0.789	0.513	1.213	21.8%	0.084
4	1989	728	0.964	0.843	0.555	1.282	21.2%	0.087
4	1990	793	0.767	0.625	0.396	0.986	23.1%	0.071
4	1991	1219	0.878	1.010	0.674	1.515	20.5%	0.101
4	1992	1760	0.675	0.858	0.580	1.271	19.8%	0.083
4	1993	2006	0.645	0.818	0.555	1.206	19.6%	0.079
4	1994	2117	0.703	0.782	0.526	1.161	20.0%	0.077
4	1995	2195	0.642	0.876	0.592	1.296	19.8%	0.085
4	1996	1789	0.762	0.870	0.590	1.283	19.6%	0.084
4	1997	1843	0.910	1.242	0.871	1.772	17.9%	0.109
4	1998	1555	0.860	1.167	0.814	1.674	18.2%	0.104
4	1999	1446	0.758	1.138	0.786	1.647	18.7%	0.104
4	2000	1512	0.644	1.197	0.833	1.719	18.3%	0.107
4	2001	1227	0.658	1.323	0.924	1.896	18.1%	0.118
4	2002	1113	0.571	1.016	0.694	1.487	19.2%	0.096
4	2003	1022	0.825	1.300	0.918	1.842	17.5%	0.112
4	2004	1017	0.658	1.125	0.778	1.629	18.7%	0.103
4	2005	779	0.610	1.113	0.762	1.626	19.1%	0.104
5	1981	36	3.366	2.154	0.990	4.687	40.4%	1.147
5	1982	89	3.456	2.065	1.085	3.931	33.0%	0.900
5	1983	128	1.294	0.729	0.407	1.308	29.8%	0.287
5	1984	162	1.626	1.024	0.636	1.650	24.2%	0.327
5	1985	168	2.533	1.523	1.017	2.279	20.4%	0.409
5	1986	320	1.206	0.835	0.536	1.300	22.4%	0.247
5	1987	729	0.793	0.630	0.427	0.929	19.6%	0.163
5	1988	930	0.914	0.622	0.428	0.904	18.8%	0.155
5	1989	728	0.894	0.781	0.547	1.115	18.0%	0.185
5	1990	793	0.670	0.589	0.402	0.863	19.3%	0.150
5	1991	1219	0.707	0.918	0.653	1.290	17.2%	0.208
5	1992	1760	0.535	0.821	0.592	1.139	16.5%	0.178
5	1993	2006	0.556	0.800	0.574	1.113	16.7%	0.176
5	1994	2117	0.487	0.658	0.469	0.923	17.1%	0.148
5	1995	2195	0.478	0.729	0.524	1.014	16.6%	0.160
5	1996	1789	0.499	0.653	0.467	0.913	16.9%	0.146
5	1997	1843	0.634	1.014	0.747	1.377	15.4%	0.206
5	1998	1555	0.553	0.883	0.646	1.207	15.7%	0.183
5	1999	1446	0.597	1.018	0.745	1.390	15.7%	0.211
5	2000	1512	0.502	1.142	0.838	1.555	15.5%	0.234
5	2001	1227	0.556	1.218	0.894	1.658	15.5%	0.250
5	2002	1113	0.528	1.078	0.782	1.485	16.1%	0.229
5	2003	1022	0.612	1.109	0.817	1.506	15.4%	0.225
5	2004	1017	0.533	0.998	0.723	1.378	16.2%	0.213
5	2005	779	0.473	1.008	0.725	1.403	16.6%	0.221

Table 13. Nominal and standard swordfish CPUE by age (unisex) from the weight-out data (fish/1000 hooks).

Age	Year	N obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
0	1981	36	1.188	1.410	0.883	2.253	23.8%	0.887
0	1982	89	1.608	1.393	0.932	2.083	20.3%	0.750
0	1983	128	1.161	0.985	0.704	1.377	16.9%	0.440
0	1984	162	0.689	0.589	0.415	0.838	17.7%	0.277
0	1985	168	0.853	0.644	0.474	0.874	15.4%	0.262
0	1986	320	1.282	1.441	1.116	1.860	12.8%	0.489
0	1987	729	0.902	1.006	0.785	1.290	12.5%	0.332
0	1988	930	0.878	0.902	0.705	1.154	12.4%	0.295
0	1989	728	0.684	0.840	0.658	1.073	12.3%	0.273
0	1990	793	0.755	0.789	0.616	1.012	12.4%	0.260
1	1981	36	1.273	1.214	0.782	1.885	22.3%	1.250
1	1982	89	1.184	0.977	0.676	1.410	18.5%	0.836
1	1983	128	1.102	0.788	0.584	1.062	15.1%	0.548
1	1984	162	0.860	0.756	0.571	1.002	14.1%	0.494
1	1985	168	0.677	0.621	0.473	0.815	13.6%	0.391
1	1986	320	1.042	1.229	0.956	1.581	12.6%	0.718
1	1987	729	0.997	1.051	0.828	1.335	12.0%	0.583
1	1988	930	1.072	1.245	0.984	1.575	11.8%	0.678
1	1989	728	0.999	1.134	0.895	1.435	11.8%	0.621
1	1990	793	0.795	0.985	0.778	1.247	11.9%	0.540
2	1981	36	1.809	1.563	0.990	2.467	23.1%	1.328
2	1982	89	1.063	0.864	0.605	1.235	18.0%	0.571
2	1983	128	0.942	0.755	0.560	1.018	15.0%	0.417
2	1984	162	0.845	0.831	0.626	1.103	14.2%	0.435
2	1985	168	0.899	0.805	0.615	1.054	13.5%	0.401
2	1986	320	0.884	1.004	0.780	1.293	12.7%	0.468
2	1987	729	0.896	1.061	0.834	1.348	12.0%	0.469
2	1988	930	1.060	1.176	0.929	1.489	11.8%	0.512
2	1989	728	0.803	0.941	0.742	1.193	11.9%	0.412
2	1990	793	0.799	0.999	0.788	1.266	11.9%	0.437
3	1981	36	2.681	1.595	1.000	2.541	23.6%	0.850
3	1982	89	2.177	1.218	0.853	1.741	18.0%	0.494
3	1983	128	1.094	0.606	0.438	0.838	16.3%	0.223
3	1984	162	1.291	0.847	0.631	1.139	14.9%	0.284
3	1985	168	1.698	0.975	0.735	1.292	14.2%	0.311
3	1986	320	1.281	0.871	0.668	1.136	13.3%	0.262
3	1987	729	1.145	0.949	0.744	1.211	12.2%	0.262
3	1988	930	1.333	1.054	0.829	1.339	12.0%	0.286
3	1989	728	1.068	0.871	0.684	1.109	12.1%	0.238
3	1990	793	0.929	0.846	0.663	1.079	12.2%	0.233
3	1991	1219	0.884	1.125	0.887	1.428	11.9%	0.303
3	1992	1760	0.683	0.949	0.751	1.198	11.7%	0.251
3	1993	2006	0.613	0.853	0.676	1.077	11.7%	0.225
3	1994	2117	0.638	0.823	0.651	1.040	11.7%	0.218
3	1995	2195	0.642	0.893	0.708	1.127	11.7%	0.235
3	1996	1789	0.667	0.825	0.653	1.042	11.7%	0.218
3	1997	1843	0.713	0.971	0.769	1.226	11.7%	0.256
3	1998	1555	0.720	0.913	0.723	1.154	11.7%	0.242
3	1999	1446	0.714	1.120	0.886	1.415	11.8%	0.297
3	2000	1512	0.650	1.149	0.909	1.452	11.8%	0.305
3	2001	1227	0.521	1.030	0.814	1.304	11.8%	0.275
3	2002	1113	0.617	1.059	0.836	1.341	11.9%	0.283
3	2003	1022	0.758	1.167	0.921	1.478	11.9%	0.313
3	2004	1017	0.779	1.172	0.923	1.488	12.0%	0.317
3	2005	779	0.704	1.120	0.881	1.424	12.1%	0.305
4	1981	36	3.126	2.111	1.279	3.486	25.5%	0.727
4	1982	89	2.359	1.321	0.892	1.955	19.8%	0.354
4	1983	128	1.286	0.731	0.512	1.042	17.9%	0.177
4	1984	162	1.401	0.905	0.654	1.251	16.3%	0.200
4	1985	168	1.859	0.980	0.730	1.316	14.8%	0.196
4	1986	320	1.489	0.966	0.732	1.276	14.0%	0.183
4	1987	729	1.087	0.865	0.671	1.115	12.8%	0.149
4	1988	930	1.167	0.903	0.705	1.158	12.5%	0.152
4	1989	728	1.029	0.825	0.642	1.061	12.6%	0.141
4	1990	793	0.835	0.770	0.597	0.994	12.8%	0.133
4	1991	1219	0.787	1.020	0.798	1.304	12.3%	0.170
4	1992	1760	0.636	0.903	0.711	1.148	12.0%	0.147
4	1993	2006	0.590	0.828	0.652	1.051	12.0%	0.134
4	1994	2117	0.585	0.801	0.630	1.020	12.1%	0.131
4	1995	2195	0.528	0.816	0.643	1.037	12.0%	0.133
4	1996	1789	0.583	0.767	0.603	0.976	12.1%	0.125
4	1997	1843	0.696	0.963	0.759	1.222	12.0%	0.156
4	1998	1555	0.626	0.888	0.698	1.130	12.1%	0.145
4	1999	1446	0.673	1.128	0.888	1.432	12.0%	0.183
4	2000	1512	0.564	1.086	0.854	1.380	12.0%	0.177
4	2001	1227	0.529	1.091	0.859	1.387	12.0%	0.178
4	2002	1113	0.596	1.068	0.840	1.360	12.1%	0.175
4	2003	1022	0.647	1.014	0.795	1.292	12.2%	0.167
4	2004	1017	0.642	1.122	0.880	1.431	12.2%	0.185
4	2005	779	0.681	1.127	0.882	1.439	12.3%	0.187
5	1981	36	4.021	2.818	1.804	4.401	22.6%	1.689
5	1982	89	3.645	2.114	1.506	2.969	17.1%	0.960
5	1983	128	1.914	1.117	0.829	1.504	15.0%	0.444
5	1984	162	1.626	1.138	0.853	1.519	14.5%	0.439
5	1985	168	1.968	1.247	0.949	1.639	13.7%	0.455
5	1986	320	1.138	0.826	0.633	1.078	13.4%	0.293
5	1987	729	0.886	0.765	0.598	0.979	12.4%	0.251
5	1988	930	0.908	0.761	0.599	0.968	12.1%	0.244
5	1989	728	0.901	0.823	0.646	1.047	12.1%	0.265
5	1990	793	0.697	0.719	0.564	0.916	12.2%	0.232
5	1991	1219	0.679	0.976	0.770	1.237	11.9%	0.308
5	1992	1760	0.515	0.823	0.652	1.039	11.7%	0.255
5	1993	2006	0.495	0.745	0.591	0.941	11.7%	0.231
5	1994	2117	0.420	0.671	0.531	0.847	11.7%	0.209
5	1995	2195	0.421	0.683	0.542	0.862	11.7%	0.212
5	1996	1789	0.417	0.581	0.459	0.735	11.8%	0.182
5	1997	1843	0.468	0.754	0.597	0.953	11.7%	0.235
5	1998	1555	0.439	0.724	0.572	0.915	11.8%	0.226
5	1999	1446	0.550	0.974	0.771	1.231	11.7%	0.304
5	2000	1512	0.470	1.023	0.810	1.292	11.7%	0.319
5	2001	1227	0.432	0.929	0.735	1.176	11.8%	0.291
5	2002	1113	0.497	1.021	0.806	1.291	11.8%	0.320
5	2003	1022	0.496	0.877	0.692	1.111	11.9%	0.277
5	2004	1017	0.475	0.904	0.712	1.147	12.0%	0.287
5	2005	779	0.521	0.986	0.775	1.253	12.0%	0.315

Table 14. Nominal and standard swordfish CPUE combined sex and age groups (Age 0-2) from the weight-out data (fish/1000 hooks).

Year	Numb obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
1981	36	29.92	17.53	11.81	26.03	20.0%	3.500
1982	89	27.33	11.71	8.24	16.65	17.7%	2.077
1983	128	23.16	12.46	9.34	16.62	14.5%	1.805
1984	162	17.22	13.04	10.03	16.94	13.2%	1.715
1985	168	17.18	14.01	11.02	17.82	12.1%	1.690
1986	320	22.81	18.41	14.69	23.08	11.3%	2.089
1987	729	20.16	16.40	13.21	20.37	10.9%	1.782
1988	930	21.78	18.15	14.60	22.57	10.9%	1.983
1989	728	18.16	16.83	13.55	20.89	10.8%	1.825
1990	793	16.78	13.58	10.96	16.83	10.8%	1.462

Table 15. Nominal and standard swordfish CPUE combined sex and age groups (Age3-10+) from the weight-out data (fish/1000 hooks).

Year	Numb obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
1981	36	19.47	9.73	6.39	14.82	0.212	2.067
1982	89	16.88	7.63	5.42	10.75	0.173	1.318
1983	128	8.94	4.04	2.98	5.47	0.152	0.616
1984	162	8.09	3.59	2.68	4.81	0.147	0.527
1985	168	10.06	3.90	2.97	5.11	0.137	0.532
1986	320	6.48	2.69	2.07	3.48	0.130	0.350
1987	729	4.93	2.60	2.04	3.31	0.121	0.315
1988	930	5.14	2.59	2.04	3.28	0.119	0.307
1989	728	4.89	2.55	2.01	3.24	0.120	0.305
1990	793	3.85	2.45	1.93	3.11	0.120	0.294
1991	1219	3.70	3.05	2.42	3.84	0.116	0.354
1992	1760	2.87	2.68	2.14	3.36	0.114	0.304
1993	2006	2.73	2.45	1.96	3.07	0.113	0.278
1994	2117	2.45	2.14	1.71	2.69	0.114	0.244
1995	2195	2.36	2.27	1.81	2.85	0.113	0.258
1996	1789	2.43	1.99	1.59	2.50	0.114	0.227
1997	1843	2.80	2.53	2.01	3.17	0.114	0.287
1998	1555	2.58	2.44	1.94	3.07	0.114	0.279
1999	1446	3.06	3.12	2.48	3.92	0.114	0.357
2000	1512	2.60	3.07	2.44	3.87	0.115	0.353
2001	1227	2.40	2.88	2.29	3.63	0.115	0.332
2002	1113	2.74	3.24	2.57	4.08	0.116	0.375
2003	1022	2.82	2.86	2.27	3.61	0.116	0.333
2004	1017	2.74	3.09	2.44	3.90	0.117	0.362
2005	779	2.97	3.17	2.50	4.01	0.118	0.374

Table 16. Nominal and standard swordfish biomass CPUE (pounds dressed weight/ thousand hooks) from the weight-out data.

Year	N Obs	Nominal CPUE	Standard	Low	Upp	coeff var	std error
1982	90	3762.2	1730.1	1209.2	2475.4	18.0%	312.3
1983	128	2197.2	1150.1	842.4	1570.2	15.7%	180.1
1984	162	1816.2	993.6	738.2	1337.5	14.9%	148.5
1985	168	2091.6	1043.0	793.6	1372.7	13.8%	143.7
1986	320	1569.2	917.5	711.2	1183.8	12.8%	117.4
1987	729	1305.8	771.2	604.4	984.0	12.2%	94.3
1988	930	1374.2	753.3	591.7	959.1	12.1%	91.3
1989	731	1191.5	682.8	536.0	869.8	12.1%	82.9
1990	796	1066.4	680.8	535.3	865.8	12.1%	82.1
1991	1221	897.6	659.8	520.7	835.9	11.9%	78.3
1992	1768	719.9	607.9	481.8	766.9	11.7%	70.9
1993	2014	669.8	534.3	423.8	673.6	11.6%	62.1
1994	2126	637.6	498.9	395.5	629.2	11.6%	58.1
1995	2252	612.1	519.3	411.9	654.7	11.6%	60.4
1996	1382	473.7	388.3	307.0	491.2	11.8%	45.8
1997	1543	527.8	465.7	368.3	588.7	11.8%	54.8
1998	1198	500.7	458.6	362.1	580.8	11.9%	54.4
1999	1077	464.9	536.5	421.5	683.0	12.1%	65.0
2000	1113	408.2	533.3	418.0	680.4	12.2%	65.2
2001	1113	445.1	462.8	364.5	587.6	12.0%	55.5
2002	1059	560.0	528.3	416.4	670.3	11.9%	63.1
2003	945	633.0	531.1	417.1	676.2	12.1%	64.4
2004	952	589.1	460.4	361.6	586.1	12.1%	55.8
2005	702	595.7	523.4	409.0	669.7	12.4%	64.8

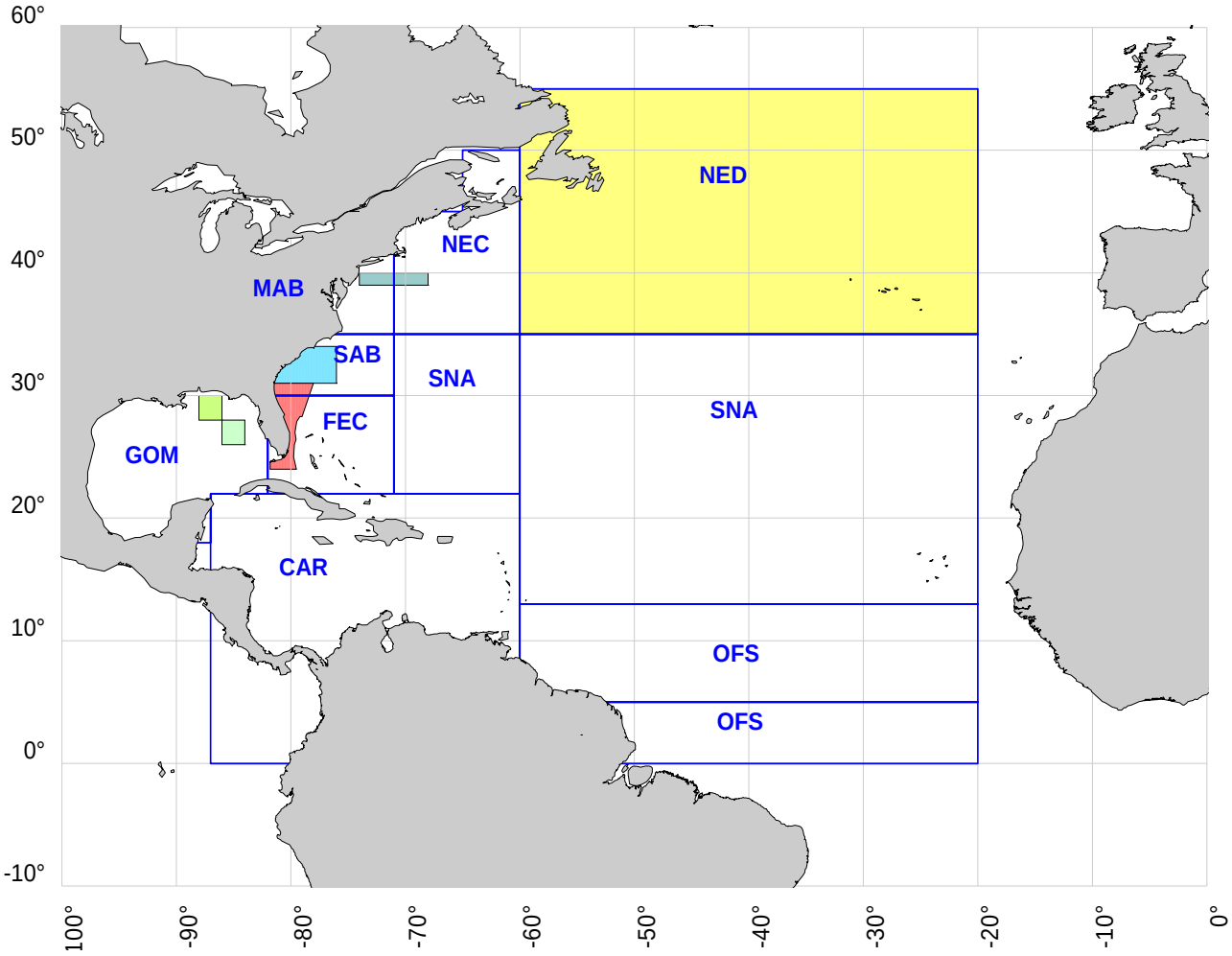


Figure 1. Geographic area classification for the US Pelagic longline fishery: CAR Caribbean, GOM Gulf of Mexico, FEC Florida east coast, SAB south Atlantic bight, MAB mid Atlantic bight, NEC north east coastal, NED north east distant waters, SNA Sargasso area, and OFS offshore waters. Shaded areas represent the current time-area closures affecting the pelagic longline fisheries. Permanent closures: the DeSoto area in the Gulf of Mexico, and the Florida east coast area. Time-area closures: the Charleston Bump in the SAB area closed Feb-Apr, the Bluefin tuna protected area in the MAB and NEC areas closed Jun, and the Grand Banks in the NED area closed from Oct 10/00 to Apr 9/01.

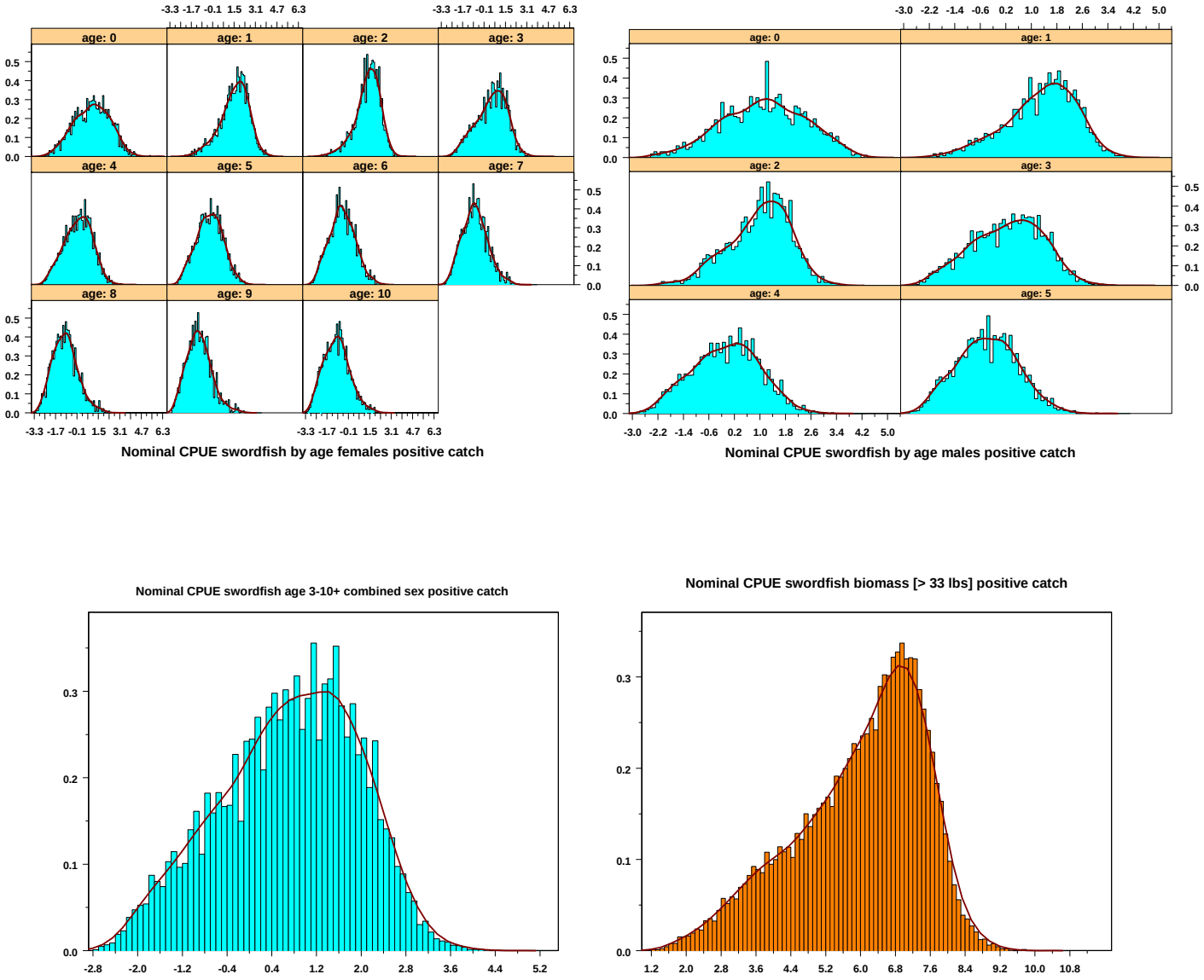


Figure 2. Swordfish density frequency distributions of positive catch trips (log CPUE) by sex and age (top), combined sex combined sex age 3-10+ (bottom left), and swordfish biomass [fish >= 33 lbs right].

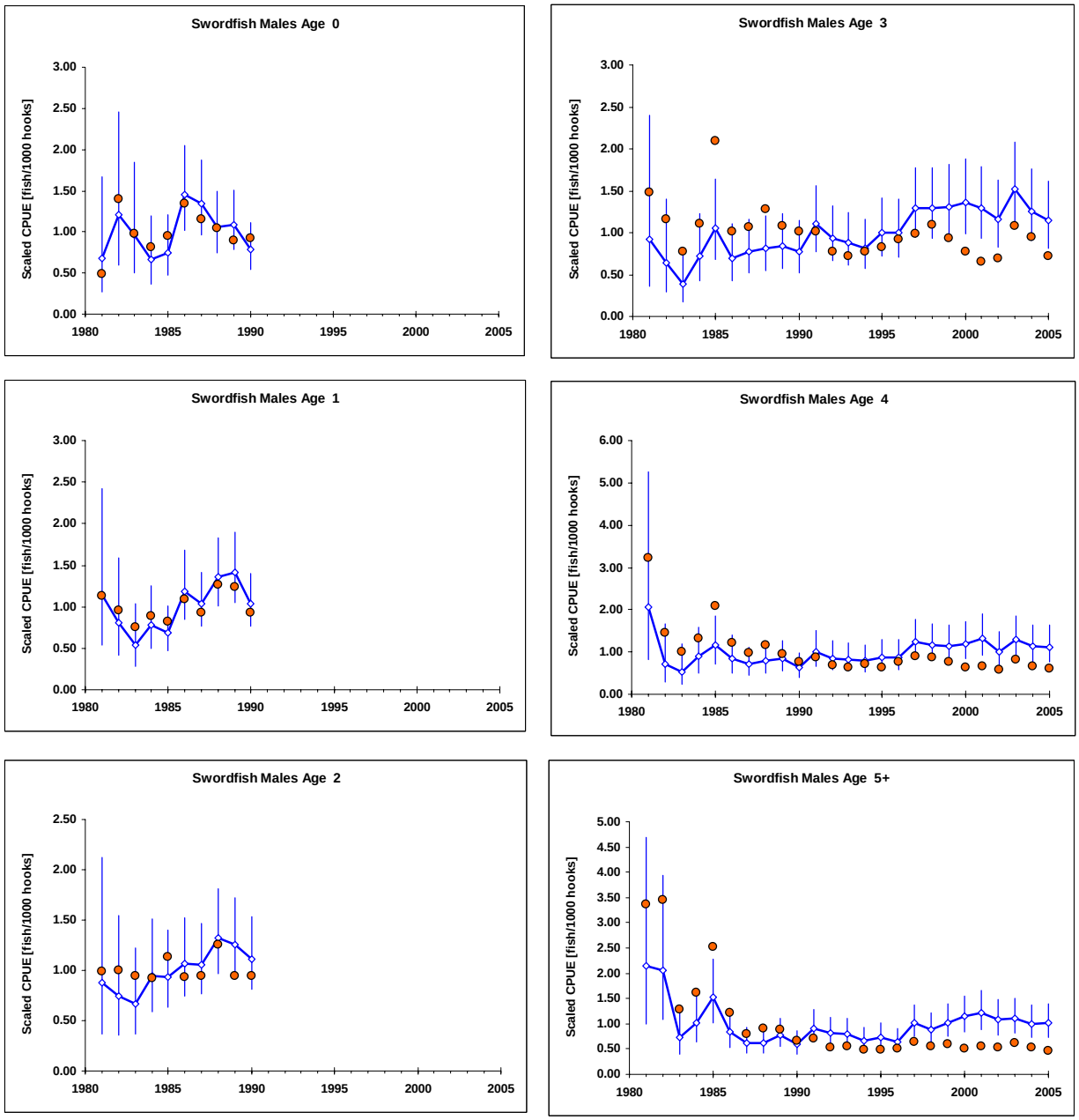
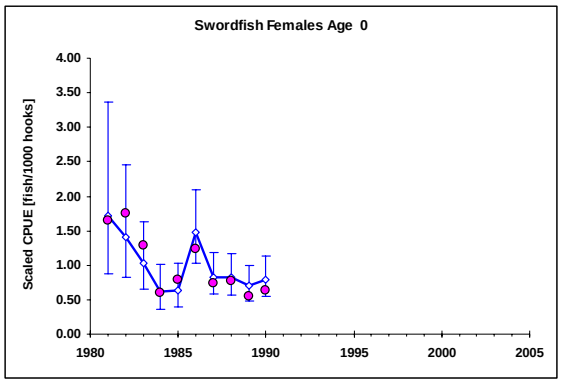
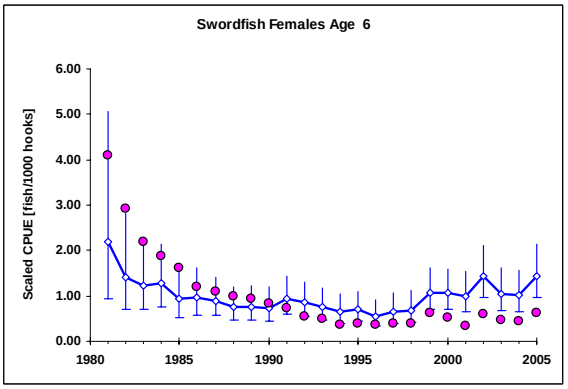
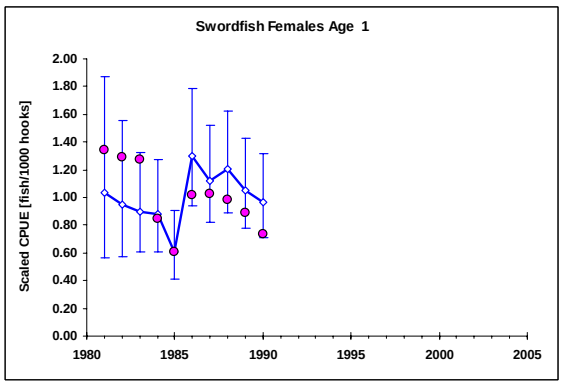
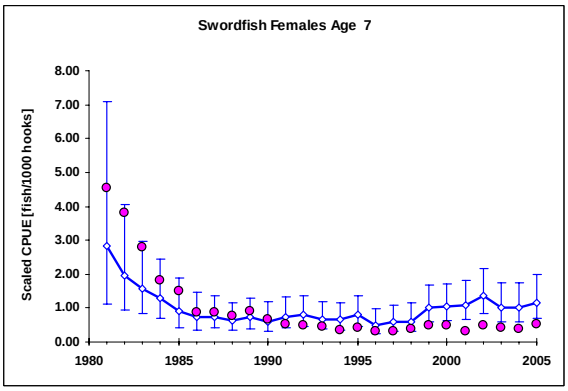


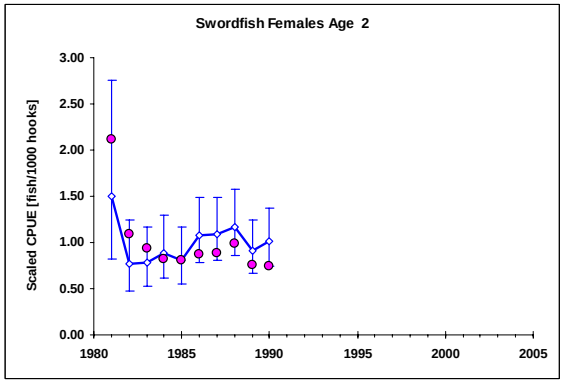
Figure 3. Nominal (solid circles) and standard CPUE for swordfish by age-sex (males) from the U.S. pelagic longline fishery 1981-2005. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value**.** Series are scaled to their corresponding mean for each age class.

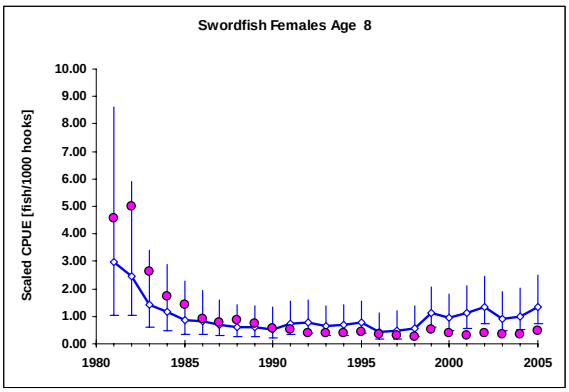

Swordfish Females Age 0
Scaled CPUE [fish/1000 hooks]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1985
1990
1995
2000
2005

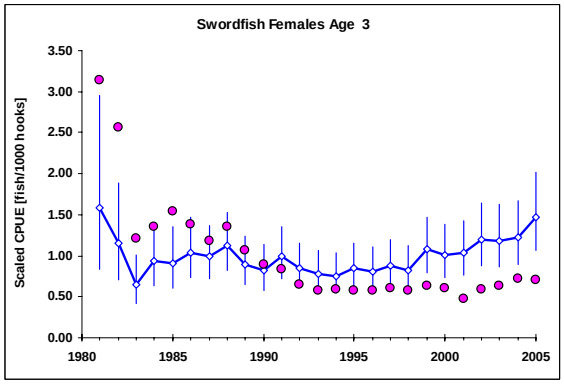

Swordfish Females Age 6
Scaled CPUE [fish/1000 hooks]
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1980
1985
1990
1995
2000
2005

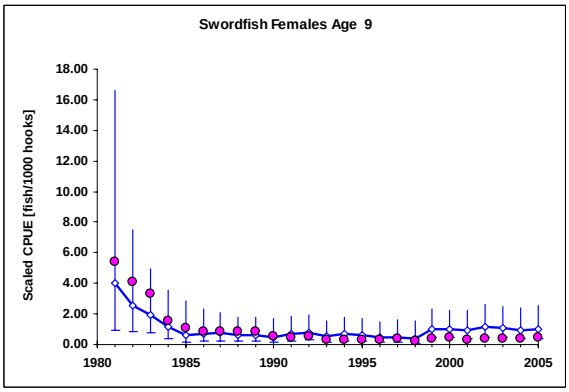

Swordfish Females Age 1
Scaled CPUE [fish/1000 hooks]
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1980
1985
1990
1995
2000
2005


Swordfish Females Age 7
Scaled CPUE [fish/1000 hooks]
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1980
1985
1990
1995
2000
2005


Swordfish Females Age 2
Scaled CPUE [fish/1000 hooks]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1985
1990
1995
2000
2005


Swordfish Females Age 8
Scaled CPUE [fish/1000 hooks]
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1980
1985
1990
1995
2000
2005


Swordfish Females Age 3
Scaled CPUE [fish/1000 hooks]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1985
1990
1995
2000
2005


Swordfish Females Age 9
Scaled CPUE [fish/1000 hooks]
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1980
1985
1990
1995
2000
2005

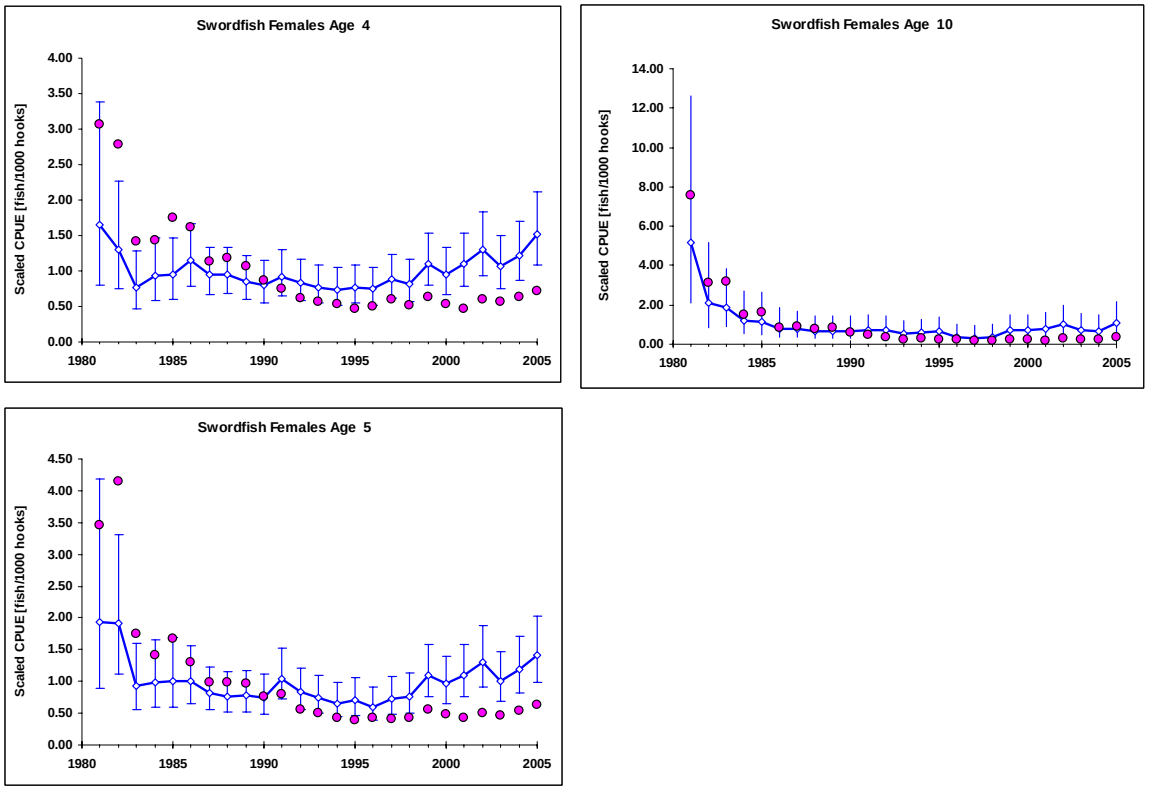


Figure 4. Nominal (solid-circles) and standard CPUE for swordfish by age-sex (Females) from the U.S. pelagic longline fishery 1981-2005. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value. Series are scaled to their corresponding mean for each age class.

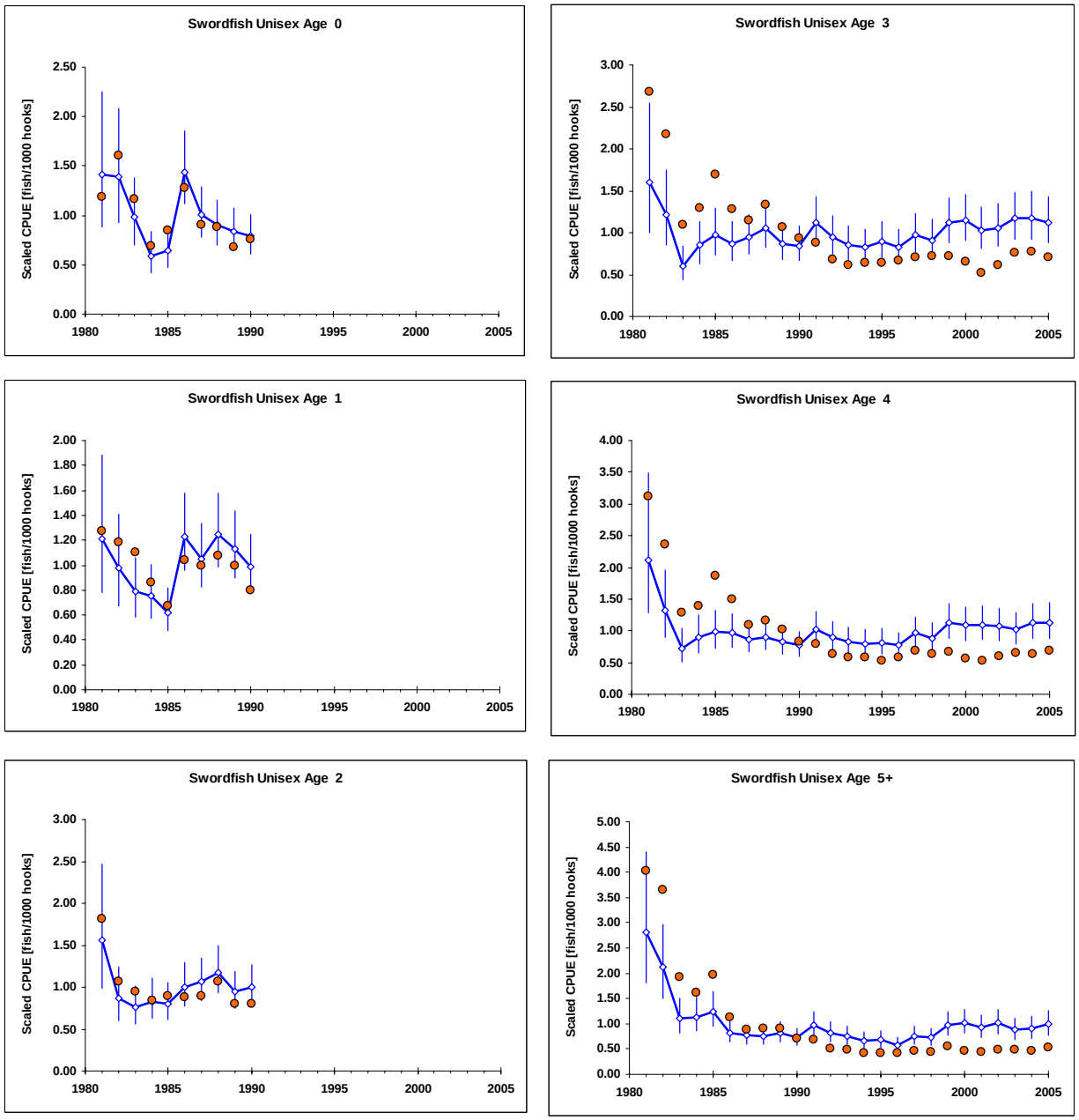
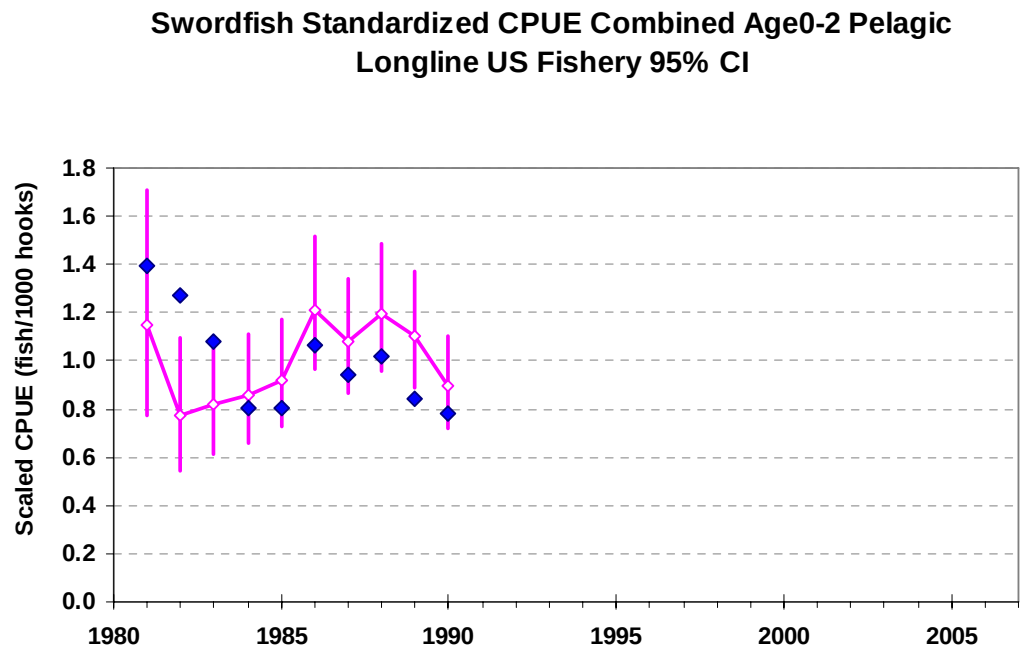


Figure 5. Nominal (solid circles) and standard CPUE for swordfish by age (unisex) from the U.S. pelagic longline fishery 1981-2005. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value**.** Series are scaled to their corresponding mean for each age class.



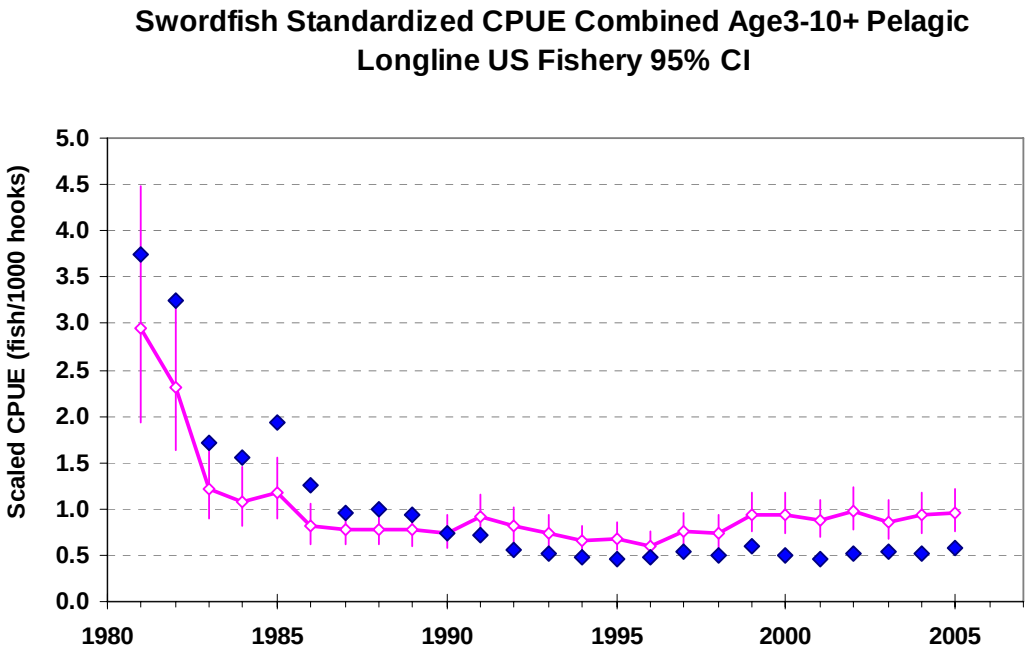


Figure 6. Nominal and standard swordfish CPUE for combined sex and age groups (0-2 top panel, 3-10+ bottom panel) from the U.S. pelagic longline fishery. Series are scaled to their corresponding mean for each age group.

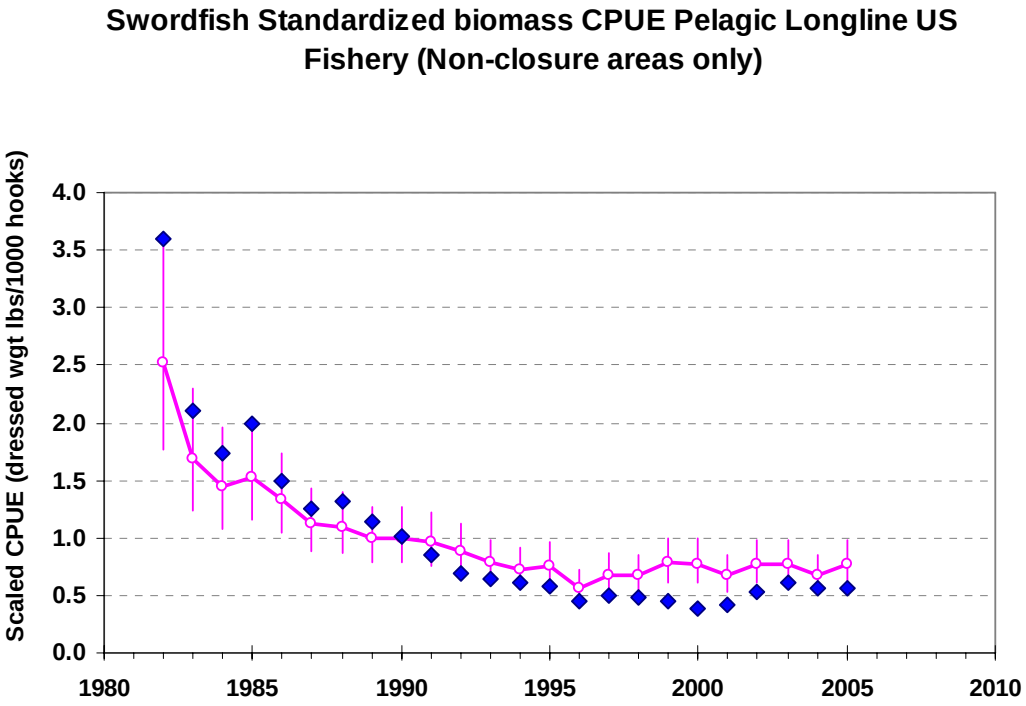


Figure 7. Nominal and standard biomass CPUE for swordfish (≥ 33 lbs) from the U.S. pelagic longline fishery. Bars represent upper and lower 95% confidence intervals.

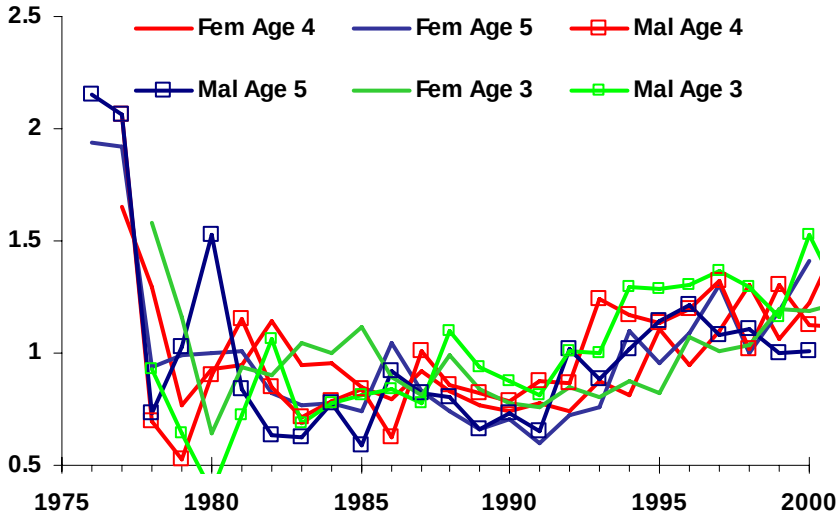


Figure 8. Comparison of ages 3, 4 and 5 for females (solid lines) and males (square-marker lines) index trends adjusted to their correspondent cohort-year group.