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UPDATE OF STANDARDIZED CATCH RATES BY SEX AND AGE FOR SWORDFISH (*XIPHIAS GLADIUS*) FROM THE U.S. LONGLINE FLEET 1981-2008

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SUMMARY

Swordfish (Xiphias gladius) catch and effort data from the U.S. 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 2006 by including the latest available year catches of swordfish by the U.S. 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 U.S. size restrictions implemented in 1991. Indices of abundance in numbers of fish for ages 3-10+ by sex and 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 de l'Atlantique Nord. Le présent document actualise l'analyse présentée en 2006 en incluant les dernières captures disponibles d'espadon réalisées par la flottille palangrière des Etats-Unis. Les taux de capture standardisés ont été estimés en utilisant une approche de modèle linéaire généralisé mixte postulant une distribution d'erreur lognormale. Des indices d'abondance en unités de biomasse (poids manipulé) ont été estimés pour des poissons pesant plus de 33 livres en raison des restrictions de tailles mises en œuvre en 1991 par les Etats-Unis. Les indices d'abondance en nombres de poissons pour les âges 3-10+ par sexe et sexes combinés ont également été actualisés.

RESUMEN

Se utilizaron datos de captura y esfuerzo del pez espada (Xiphias gladius) de la flota de palangre pelágico estadounidense que opera en el Atlántico norte occidental para actualizar índices de abundancia del stock de pez espada del Atlántico norte. Este documento actualiza los análisis presentados en 2006 incluyendo las últimas capturas anuales disponibles de pez espada de la flota de palangre de Estados Unidos. Las tasas de captura estandarizadas se estimaron utilizando un enfoque de modelación mixto lineal generalizado asumiendo una distribución de error delta-lognormal. Se estimaron los índices de abundancia en unidades de biomasa (peso canal) para peces de más de 30 libras debido a restricciones de talla estadounidenses implementadas en 1991. También se actualizaron los índices de abundancia en número de peces de edades 3-10+ por sexo y sexos combinados.

KEY WORDS

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 (Anon. 2006). Data collected from the US pelagic longline fishery were used to develop standardized catch per unit effort (CPUE) indices for the North Atlantic swordfish stock. This report updates the model applied to the available US longline fleet data through 2008 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 commercial fishers that fish for and land swordfish in the 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 Logbook data program). 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 program). 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 U.S. regulations, in conformity with the ICCAT recommendations, limit the allowable landings of swordfish by U.S. 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 1st 2000) and the Florida east coast (effective since March 1st 2001) **(Figure 1)**. There are also three time-area closures for longline in the U.S. Atlantic coast: the Charleston Bump that is closed from February 1st to April 30th, 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).

The swordfish weight-out data set extends from 1981 through 2008. 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 US longline pelagic 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 U.S. 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 (Fig 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). Trimesters 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 U.S. pelagic longline fleet; however this fleet also targets tunas (yellowfin, and bigeye tuna) and to a lesser extends 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 2006, 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 ≥ 13 kg (due to size-weight 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 U.S. 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 2006 (Ortiz 2006). 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 ≥ 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 specific 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 unisex (Age 0 to 5+), and **Table 9** for combined sex and age groups (males and females, ages 3-10+), 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 on.

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 **6** present the evaluation of random interactions in the mixed model formulations. 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 10**).

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 a general decline trends from higher values in the early period (1981/82) to lower values in the early 1990's, follow by a rather constant low catch rates through the 1990's with some slight indication of recovery by 2000-02 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 1991-97, with higher catch rates for males. Cathc rates then decline in 1998-2000, stabilized for a while and in the latest years have decline again.

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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 Females by Age (0-3 1981-1990 / 3-10+ 1981-2008)

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	117880			
Year	27	98784	19096	25.8%	< 0.001
Year Age	10	72905	25879	34.9%	< 0.001
Year Age Op	7	61273	11632	15.7%	< 0.001
Year Age Op Area	6	59777	1497	2.0%	< 0.001
Year Age Op Area Qtr	3	59127	650	0.9%	< 0.001
Year Age Op Area Qtr Szst	2	52818	6309	8.5%	< 0.001
Year Age Op Area Qtr Szst Targ	3	48643	4175	5.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	216	48199	444	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Area	154	46598	1601	2.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Op	176	45923	675	0.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Area	34	45657	266	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Qtr	81	45291	366	0.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Qtr	18	45018	273	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Qtr	21	44974	44	0.1%	0.002
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Szst	52	44508	466	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Szst	12	44400	108	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Szst	14	44332	68	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Szst	6	44300	32	0.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Targ	79	44099	201	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Targ	18	43970	129	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Targ	21	43886	84	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Targ	9	43835	52	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Szst*Targ	6	43817	18	0.0%	0.007

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	162380			
Year	27	155354	7026	8%	< 0.001
Year Age	10	129775	25579	31%	< 0.001
Year Age Op	7	101811	27964	34%	< 0.001
Year Age Op Area	6	95233	6578	8%	< 0.001
Year Age Op Area Qtr	3	93364	1868	2%	< 0.001
Year Age Op Area Qtr Szst	2	92880	484	1%	< 0.001
Year Age Op Area Qtr Szst Targ	3	82119	10761	13%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	216	81672	447	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Szst	52	81201	471	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Targ	81	81061	611	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Qtr	81	80829	842	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Area*Qtr	18	80647	1025	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Op*Area	36	80614	1058	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Op	176	79963	1709	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Area	154	79318	2354	3%	< 0.001

Table 2. Analysis of mixed model formulations for swordfish catch rates by age-sex from the U.S. pelagic longline fishery. Likelihood ratio tests the difference of –2 REM loglikelihood between two nested models.

	Swordfish Females by Age [0-3 1981-1990 / 3-10+ 1981-2005] GLMixed Model	-2 REM Log likelihood	Akaike's Information Criterion	Schwartz's Bayesian Criterion	Likelihood Ratio Test	
	Proportion Positives					
	Year Age Year*Age Area Target OP	202281.1	202283.1	202292.2		
*	Year Age Year*Age Area Target OP *Year*OP*	202022.6	203026.6	203033.3	258.5	0.0000
	Year Age Year*Age Area Target OP *Year*OP Year*Area*	202682.5	202688.5	202698.5	-659.9	N/A
	Positives catch rates					
	Year Age Year*Age OP Area Szst Target	183971.6	183973.6	183982.8		
	Year Age Year*Age OP Area Szst Target *Year*Area*	182063.5	182067.5	182074	1908.1	0.0000
	Year Age Year*Age OP Area Szst Target *Year*Area Year*Szst*	181308.4	181314.4	181324.1	755.1	0.0000
*	Year Age Year*Age OP Area Szst Target *Year*Area Year*Szst Year*OP*	180850.1	180858.1	180871.1	458.3	0.0000

Table 3. 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+ 1981-2008)

Model factors positive catch rates values	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	52781.614			
Year	27	46021.35	6760.26	24.5%	< 0.001
Year Age	5	43950.957	2070.39	7.5%	< 0.001
Year Age Op	7	35846.291	8104.67	29.3%	< 0.001
Year Age Op Area	6	35089.38	756.91	2.7%	< 0.001
Year Age Op Area Qtr	3	34763.779	325.60	1.2%	< 0.001
Year Age Op Area Qtr Szst	2	31555.191	3208.59	11.6%	< 0.001
Year Age Op Area Qtr Szst Targ	3	28253.695	3301.50	11.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	81	28054.433	199.26	0.7%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Year*Area	153	27306.234	748.20	2.7%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Year*Op	172	26769.539	536.70	1.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Op*Area	35	26608.863	160.68	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Year*Qtr	80	26220.451	388.41	1.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Area*Qtr	18	26104.217	116.23	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Op*Qtr	21	26057.816	46.40	0.2%	0.001
Year Age Op Area Qtr Szst Targ Year*Age … Year*Szst	50	25783.004	274.81	1.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Area*Szst	12	25660.247	122.76	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Op*Szst	14	25607.863	52.38	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Qtr*Szst	6	25598.414	9.45	0.0%	0.150
Year Age Op Area Qtr Szst Targ Year*Age … Year*Targ	78	25460.963	137.45	0.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Area*Targ	18	25273.531	187.43	0.7%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Op*Targ	21	25174.299	99.23	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age … Qtr*Targ	9	25161.3	13.00	0.0%	0.163
Year Age Op Area Qtr Szst Targ Year*Age … Szst*Targ	6	25150.248	11.05	0.0%	0.087

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	58302.081			
Year	27	56835.888	1466.19	7%	< 0.001
Year Age	5	55829.992	1005.90	5%	< 0.001
Year Age Op	7	47891.225	7938.77	36%	< 0.001
Year Age Op Area	6	43204.459	4686.77	22%	< 0.001
Year Age Op Area Qtr	3	43084.136	120.32	1%	< 0.001
Year Age Op Area Qtr Szst	2	43070.674	13.46	0%	0.001
Year Age Op Area Qtr Szst Targ	3	37975.046	5095.63	23%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	81	37861.290	113.76	1%	0.010
Year Age Op Area Qtr Szst Targ Year*Age Year*Szst	52	37650.791	210.50	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Op*Area	36	37504.534	356.76	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Area*Qtr	18	37487.146	374.14	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Targ	81	37395.477	465.81	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Qtr	81	37198.309	662.98	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Op	176	36868.947	992.34	5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Area	154	36535.871	1325.42	6%	< 0.001

Table 4. Analyses of mixed model formulations for swordfish catch rates by age-sex 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	94361.9	94363.9	94372.4		
	Year Age Year*Age Area OP Szst Targ *Year*Area*	93811.9	93815.9	93822.3	550	0.0000
	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP*	93534.7	93540.7	93550.4	277.2	0.0000
*	Year Age Year*Age Area OP Szst Targ *Year*Area Year*OP Year*Qtr*	93112.2	93120.2	93133.1	422.5	0.0000
	Proportion Positives					
	Year Age Year*Age OP Area Targ	109720.6	109722.6	109730.9		
	Year Age Year*Age OP Area Targ *Year*Area*	109543.2	109543.2	109549.7	177.4	0.0000
	Year Age Year*Age OP Area Targ *Year*Area Year*OP*	109834.3	109840.3	109850	-291.1	N/A
*	Year Age Year*Age OP Area Targ *Year*Area Year*Qtr*	109401.2	109407.2	109416.9	142	0.0000

Table 5. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates by age groups (no sex differentiation) (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	115966.67			
Year	27	96421.655	19545.02	26.4%	< 0.001
Year Age	5	92229.984	4191.67	5.7%	< 0.001
Year Age Op	7	70759.45	21470.53	29.0%	< 0.001
Year Age Op Area	6	66019.835	4739.61	6.4%	< 0.001
Year Age Op Area Qtr	3	64880.836	1139.00	1.5%	< 0.001
Year Age Op Area Qtr Szst	2	58205.852	6674.98	9.0%	< 0.001
Year Age Op Area Qtr Szst Targ	3	47601.486	10604.37	14.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	81	47215.89	385.60	0.5%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Area	154	45624.885	1591.01	2.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Op	176	44902.986	721.90	1.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Area	36	44588.921	314.06	0.4%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Qtr	81	43918.387	670.53	0.9%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Qtr	18	43780.971	137.42	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Qtr	21	43681.871	99.10	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Szst	52	43226.601	455.27	0.6%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Szst	12	43047.759	178.84	0.2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Szst	14	42980.438	67.32	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Szst	6	42936.549	43.89	0.1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Year*Targ	80	42713.362	223.19	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Area*Targ	18	42209.665	503.70	0.7%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Op*Targ	21	42006.441	203.22	0.3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Qtr*Targ	9	41977.75	28.69	0.0%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age ... Szst*Targ	6	41955.072	22.68	0.0%	< 0.001

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	71552.211			
Year	27	68786.794	2765.42	7%	< 0.001
Year Age	5	66698.672	2088.12	5%	< 0.001
Year Age Op	7	52139.582	14559.09	38%	< 0.001
Year Age Op Area	6	48895.892	3243.69	8%	< 0.001
Year Age Op Area Qtr	3	47743.447	1152.44	3%	< 0.001
Year Age Op Area Qtr Szst	2	47531.895	211.55	1%	< 0.001
Year Age Op Area Qtr Szst Targ	3	35411.905	12119.99	31%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age	81	35135.515	276.39	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Targ	81	34684.687	450.83	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Szst	52	34632.933	502.58	1%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Area*Qtr	18	34433.090	702.43	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Op*Area	36	34281.127	854.39	2%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Qtr	81	34099.298	1036.22	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Op	176	33930.751	1204.76	3%	< 0.001
Year Age Op Area Qtr Szst Targ Year*Age Year*Area	154	32851.392	2284.12	6%	< 0.001

Table 6. Analysis of mixed model formulations for swordfish catch rates by age groups (no sex differentiation) 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 Unisex 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 OP Area Szst Targ	179903.9	179905.9	179915.2		
	Year Age Year*Age OP Area Szst Targ *Year*Area*	177957.5	177961.5	177968	1946.4	0.0000
	Year Age Year*Age OP Area Szst Targ *Year*Area Year*OP*	177320.3	177326.3	177336	637.2	0.0000
*	Year Age Year*Age OP Area Szst Targ *Year*Area Year*OP Year*Qtr*	175682.1	175690.1	175703.1	1638.2	0.0000
	Proportion Positives					
*	Year Age Year*Age OP Area Targ	125816.4	125818.4	125826.7		
	Year Age Year*Age OP Area Targ *Year*Area*	127637.8	127641.8	127648.2	-1821.4	N/A
	Year Age Year*Age OP Area Targ *Year*OP*	126345.7	126349.7	126356.4	-529.3	N/A

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	59441.861			
Year	26	53451.043	5990.82	14.7%	< 0.001
Year Area	7	38939.138	14511.91	35.6%	< 0.001
Year Area Qtr	3	37901.457	1037.68	2.5%	< 0.001
Year Area Qtr Op	7	33942.63	3958.83	9.7%	< 0.001
Year Area Qtr Op Targ	3	19469.141	14473.49	35.5%	< 0.001
Year Area Qtr Op Targ Area*Qtr	21	19350.592	118.55	0.3%	< 0.001
Year Area Qtr Op Targ Qtr*Op	21	19324.865	144.28	0.4%	< 0.001
Year Area Qtr Op Targ Year*Qtr	78	19189.642	279.50	0.7%	< 0.001
Year Area Qtr Op Targ Op*Targ	21	19188.511	280.63	0.7%	< 0.001
Year Area Qtr Op Targ Year*Targ	78	19181.306	287.83	0.7%	< 0.001
Year Area Qtr Op Targ Area*Op	41	19119.407	349.73	0.9%	< 0.001
Year Area Qtr Op Targ Area*Targ	21	18954.582	514.56	1.3%	< 0.001
Year Area Qtr Op Targ Year*Op	174	18794.221	674.92	1.7%	< 0.001
Year Area Qtr Op Targ Year*Area	164	18649.245	819.90	2.0%	< 0.001

Model factors proportion positives	**d.f.**	**Residual deviance**	**Change in deviance**	**% of total deviance**	***p***
1	1	12132.954			
Year	26	11483.613	649.34	7%	< 0.001
Year Area	7	8636.325	2847.29	29%	< 0.001
Year Area Qtr	3	8192.056	444.27	4%	< 0.001
Year Area Qtr Op	7	7168.703	1023.35	10%	< 0.001
Year Area Qtr Op Targ	3	2803.223	4365.48	44%	< 0.001
Year Area Qtr Op Targ Op*Targ	21	2766.543	36.68	0%	0.018
Year Area Qtr Op Targ Area*Targ	21	2755.409	47.81	0%	< 0.001
Year Area Qtr Op Targ Year*Targ	78	2680.842	122.38	1%	< 0.001
Year Area Qtr Op Targ Year*Qtr	78	2605.686	197.54	2%	< 0.001
Year Area Qtr Op Targ Qtr*Op	21	2564.591	238.63	2%	< 0.001
Year Area Qtr Op Targ Area*Op	41	2552.326	250.90	3%	< 0.001
Year Area Qtr Op Targ Area*Qtr	21	2529.967	273.26	3%	< 0.001
Year Area Qtr Op Targ Year*Op	174	2291.898	511.32	5%	< 0.001
Year Area Qtr Op Targ Year*Area	164	2239.218	564.00	6%	< 0.001

Table 8. 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	42485.6	42487.6	42494.2		
	Year Target OP Qtr *Year*Area*	42069.3	42073.3	42079.9	416.3	0.0000
	Year Target OP Qtr *Year*Area Area*Qtr*	42044.7	42050.7	42060.6	24.6	0.0000
*	Year Target OP Qtr *Year*Area Area*Qtr Year*OP*	41761.3	41769.3	41782.4	283.4	0.0000
	Positives catch rates					
	Year OP Area Target	68721.4	68723.4	68731.6		
	Year OP Area Target *Year*Area*	68010.5	68014.5	68021.1	710.9	0.0000
	Year OP Area Target *Year*Area Year*OP*	67796	67802	67811.9	214.5	0.0000
*	Year OP Area Target *Year*Area Year*OP Area*Target*	67166.6	67174.6	67187.7	629.4	0.0000

Table 9. Deviance analysis table of explanatory variables in the delta lognormal model for swordfish catch rates by aggreagated age and sex (males & females, ages 3 to 10+) (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

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	39376.648			
Year	27	35960.587	3416.06	13.1%	< 0.001
Year Op	7	26395.261	9565.33	36.8%	< 0.001
Year Op Area	6	23847.799	2547.46	9.8%	< 0.001
Year Op Area Qtr	3	22817.323	1030.48	4.0%	< 0.001
Year Op Area Qtr Szst	2	20518.983	2298.34	8.8%	< 0.001
Year Op Area Qtr Szst Targ	3	15718.075	4800.91	18.5%	< 0.001
Year Op Area Qtr Szst Targ … Year*Area	154	15036.188	681.89	2.6%	< 0.001
Year Op Area Qtr Szst Targ … Year*Op	176	14692.767	343.42	1.3%	< 0.001
Year Op Area Qtr Szst Targ … Op*Area	36	14560.111	132.66	0.5%	< 0.001
Year Op Area Qtr Szst Targ … Year*Qtr	81	14413.97	146.14	0.6%	< 0.001
Year Op Area Qtr Szst Targ … Area*Qtr	18	14238.221	175.75	0.7%	< 0.001
Year Op Area Qtr Szst Targ … Op*Qtr	21	14187.412	50.81	0.2%	< 0.001
Year Op Area Qtr Szst Targ … Year*Szst	52	14035.175	152.24	0.6%	< 0.001
Year Op Area Qtr Szst Targ … Area*Szst	12	13958.867	76.31	0.3%	< 0.001
Year Op Area Qtr Szst Targ … Op*Szst	14	13921.496	37.37	0.1%	< 0.001
Year Op Area Qtr Szst Targ … Qtr*Szst	6	13895.482	26.01	0.1%	< 0.001
Year Op Area Qtr Szst Targ … Year*Targ	78	13793.821	101.66	0.4%	0.037
Year Op Area Qtr Szst Targ … Area*Targ	18	13491.185	302.64	1.2%	< 0.001
Year Op Area Qtr Szst Targ … Op*Targ	21	13385.564	105.62	0.4%	< 0.001
Year Op Area Qtr Szst Targ … Qtr*Targ	9	13366.96	18.60	0.1%	0.029
Year Op Area Qtr Szst Targ … Szst*Targ	6	13364.969	1.99	0.0%	0.920

Model factors proportion positives	d.f.	Residual deviance	Change in deviance	% of total deviance	*p*
1	1	16558.907			
Year	27	16133.167	425.74	5%	< 0.001
Year Op	7	12642.916	3490.25	37%	< 0.001
Year Op Area	6	11761.149	881.77	9%	< 0.001
Year Op Area Qtr	3	11299.804	461.35	5%	< 0.001
Year Op Area Qtr Szst	2	11254.416	45.39	0%	< 0.001
Year Op Area Qtr Szst Targ	3	7954.266	3300.15	35%	< 0.001
Year Op Area Qtr Szst Targ Year*Targ	81	7806.085	148.18	2%	< 0.001
Year Op Area Qtr Szst Targ Year*Szst	52	7794.506	159.76	2%	< 0.001
Year Op Area Qtr Szst Targ Area*Qtr	18	7693.065	261.20	3%	< 0.001
Year Op Area Qtr Szst Targ Year*Qtr	81	7686.329	267.94	3%	< 0.001
Year Op Area Qtr Szst Targ Op*Area	36	7610.173	344.09	4%	< 0.001
Year Op Area Qtr Szst Targ Year*Op	176	7515.541	438.72	5%	< 0.001
Year Op Area Qtr Szst Targ Year*Area	154	7244.259	710.01	8%	< 0.001

consecutive models (alpha = 0.05).

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 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	37702.9	37704.9	37711.9		
	Year OP Qtr Target *Year*Area*	38334	38338	38344.5	-631.1	N/A
	Year OP Qtr Target *Year*Area Year*OP*	38223.1	28229.1	28238.8	-520.2	N/A
	Positives catch rates					
	Year Area OP Szst Targ	61187	61189	61197.2		
	Year Area OP Szst Targ *Year*Area*	60535.5	60539.5	60545.9	651.5	0.0000
	Year Area OP Szst Targ *Year*Area Year*OP*	60345.4	60351.4	60361.1	190.1	0.0000
*	Year Area OP Szst Targ *Year*Area Year*OP Area*Targ*	59601.8	59609.8	59622.7	743.6	0.0000

Table 11. Nominal and standard swordfish CPUE by age-sex (females, fish/1000 hooks).

Age	Year	N obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
0	1981	70	1.368	1.448	0.699	3.000	37.7%	0.628
0	1982	93	1.960	0.948	0.531	1.694	29.6%	0.324
0	1983	142	1.142	1.048	0.632	1.740	25.7%	0.311
0	1984	164	0.804	0.717	0.426	1.204	26.4%	0.218
0	1985	185	0.700	0.661	0.403	1.086	25.2%	0.192
0	1986	347	1.225	1.683	1.170	2.420	18.3%	0.355
0	1987	833	0.763	0.966	0.669	1.396	18.5%	0.206
0	1988	1138	0.770	0.936	0.647	1.354	18.6%	0.201
0	1989	879	0.562	0.736	0.506	1.072	19.0%	0.161
0	1990	911	0.708	0.857	0.588	1.248	19.0%	0.187
1	1981	70	1.141	1.033	0.566	1.883	30.7%	0.770
1	1982	93	1.439	0.645	0.390	1.067	25.6%	0.400
1	1983	142	1.124	0.908	0.601	1.372	20.8%	0.459
1	1984	164	0.926	0.881	0.594	1.306	19.9%	0.425
1	1985	185	0.674	0.644	0.435	0.952	19.8%	0.309
1	1986	347	1.016	1.291	0.923	1.805	16.9%	0.529
1	1987	833	0.988	1.155	0.841	1.586	16.0%	0.447
1	1988	1138	0.948	1.217	0.890	1.663	15.7%	0.464
1	1989	879	0.943	1.147	0.837	1.571	15.8%	0.441
1	1990	911	0.801	1.081	0.788	1.484	15.9%	0.418
2	1981	70	2.037	1.580	0.875	2.851	30.2%	1.038
2	1982	93	1.175	0.533	0.324	0.879	25.4%	0.294
2	1983	142	0.915	0.802	0.529	1.216	21.0%	0.367
2	1984	164	0.852	0.922	0.622	1.367	19.9%	0.399
2	1985	185	0.887	0.771	0.525	1.134	19.5%	0.327
2	1986	347	0.834	1.078	0.770	1.508	16.9%	0.397
2	1987	833	0.851	1.104	0.804	1.518	16.0%	0.385
2	1988	1138	0.921	1.171	0.855	1.603	15.8%	0.403
2	1989	879	0.750	0.949	0.690	1.305	16.1%	0.332
2	1990	911	0.778	1.089	0.793	1.497	16.0%	0.380
3	1981	70	3.808	1.756	0.977	3.157	30.0%	0.747
3	1982	93	2.751	0.735	0.443	1.220	25.7%	0.269
3	1983	142	1.281	0.656	0.406	1.059	24.3%	0.227
3	1984	164	1.488	0.937	0.616	1.426	21.2%	0.283
3	1985	185	1.786	0.870	0.573	1.321	21.1%	0.261
3	1986	347	1.419	1.018	0.711	1.458	18.1%	0.262
3	1987	833	1.211	0.969	0.693	1.355	16.9%	0.232
3	1988	1138	1.285	1.060	0.762	1.476	16.6%	0.251
3	1989	879	1.140	0.930	0.666	1.298	16.8%	0.222
3	1990	911	0.955	0.842	0.596	1.188	17.3%	0.207
3	1991	1367	0.890	1.024	0.735	1.425	16.7%	0.242
3	1992	1885	0.683	0.813	0.585	1.130	16.5%	0.191
3	1993	2185	0.596	0.796	0.574	1.106	16.5%	0.187
3	1994	2279	0.629	0.772	0.554	1.076	16.7%	0.183
3	1995	2379	0.572	0.836	0.601	1.162	16.6%	0.197
3	1996	1922	0.610	0.855	0.612	1.195	16.9%	0.205
3	1997	1961	0.677	0.952	0.684	1.324	16.6%	0.225
3	1998	1682	0.652	0.896	0.642	1.250	16.8%	0.213
3	1999	1584	0.740	1.094	0.789	1.517	16.4%	0.256
3	2000	1684	0.611	0.958	0.690	1.331	16.5%	0.225
3	2001	1492	0.478	1.104	0.796	1.530	16.4%	0.258
3	2002	1430	0.566	1.260	0.911	1.743	16.3%	0.292
3	2003	1376	0.620	1.278	0.926	1.764	16.2%	0.295
3	2004	1486	0.557	1.249	0.902	1.729	16.4%	0.290
3	2005	1165	0.582	1.342	0.967	1.862	16.5%	0.314
3	2006	1110	0.451	1.127	0.796	1.596	17.5%	0.280
3	2007	1369	0.528	1.016	0.726	1.420	16.9%	0.243
3	2008	1168	0.433	0.856	0.591	1.241	18.7%	0.228
4	1981	70	3.474	1.709	0.892	3.274	33.4%	0.465
4	1982	93	3.604	0.973	0.559	1.696	28.3%	0.224
4	1983	142	1.294	0.666	0.375	1.180	29.2%	0.159
4	1984	164	1.689	0.958	0.590	1.555	24.6%	0.192
4	1985	185	1.920	0.916	0.572	1.469	23.9%	0.179
4	1986	347	1.761	1.128	0.764	1.666	19.7%	0.181
4	1987	833	1.142	0.905	0.626	1.310	18.6%	0.138
4	1988	1138	1.169	0.968	0.677	1.383	18.0%	0.142
4	1989	879	1.034	0.828	0.571	1.203	18.8%	0.127
4	1990	911	0.881	0.795	0.541	1.168	19.4%	0.126
4	1991	1367	0.787	0.961	0.671	1.377	18.1%	0.142
4	1992	1885	0.654	0.829	0.580	1.185	18.0%	0.122
4	1993	2185	0.566	0.763	0.533	1.093	18.1%	0.113
4	1994	2279	0.554	0.735	0.507	1.064	18.7%	0.112
4	1995	2379	0.504	0.791	0.551	1.134	18.2%	0.117
4	1996	1922	0.520	0.794	0.550	1.146	18.5%	0.120
4	1997	1961	0.648	0.932	0.653	1.331	17.9%	0.136
4	1998	1682	0.539	0.816	0.563	1.183	18.7%	0.125
4	1999	1584	0.652	1.116	0.789	1.579	17.5%	0.159
4	2000	1684	0.520	0.912	0.638	1.304	18.0%	0.134
4	2001	1492	0.476	1.109	0.784	1.570	17.5%	0.158
4	2002	1430	0.585	1.440	1.025	2.023	17.1%	0.201
4	2003	1376	0.541	1.167	0.826	1.649	17.4%	0.166
4	2004	1486	0.526	1.338	0.951	1.884	17.2%	0.188
4	2005	1165	0.588	1.335	0.944	1.888	17.5%	0.190
4	2006	1110	0.392	1.101	0.758	1.599	18.8%	0.169
4	2007	1369	0.519	1.092	0.767	1.554	17.8%	0.158
4	2008	1168	0.460	0.921	0.621	1.366	19.9%	0.149
5	1981	70	4.129	2.203	1.117	4.346	35.0%	0.398
5	1982	93	4.806	1.310	0.746	2.302	28.7%	0.195
5	1983	142	1.489	0.817	0.443	1.509	31.4%	0.133
5	1984	164	1.711	1.043	0.611	1.781	27.2%	0.147
5	1985	185	1.946	1.019	0.595	1.746	27.4%	0.144
5	1986	347	1.499	1.084	0.701	1.676	22.1%	0.124
5	1987	833	0.966	0.764	0.491	1.190	22.4%	0.089
5	1988	1138	0.958	0.763	0.501	1.160	21.2%	0.084
5	1989	879	0.943	0.767	0.501	1.172	21.5%	0.085
5	1990	911	0.771	0.716	0.458	1.120	22.7%	0.084
5	1991	1367	0.807	1.038	0.700	1.539	19.9%	0.107
5	1992	1885	0.584	0.824	0.550	1.232	20.4%	0.087
5	1993	2185	0.537	0.783	0.522	1.174	20.5%	0.083
5	1994	2279	0.440	0.657	0.427	1.009	21.7%	0.074
5	1995	2379	0.380	0.683	0.446	1.046	21.5%	0.076
5	1996	1922	0.419	0.611	0.390	0.957	22.7%	0.072
5	1997	1961	0.493	0.811	0.536	1.227	20.9%	0.088
5	1998	1682	0.484	0.791	0.517	1.210	21.5%	0.088
5	1999	1584	0.626	1.082	0.738	1.587	19.3%	0.108
5	2000	1684	0.503	0.958	0.648	1.416	19.7%	0.098
5	2001	1492	0.439	1.134	0.773	1.663	19.3%	0.113
5	2002	1430	0.506	1.478	1.029	2.123	18.3%	0.140
5	2003	1376	0.398	1.059	0.715	1.567	19.8%	0.108
5	2004	1486	0.439	1.284	0.882	1.869	18.9%	0.126
5	2005	1165	0.505	1.273	0.873	1.857	19.0%	0.125
5	2006	1110	0.356	1.095	0.725	1.654	20.9%	0.118
5	2007	1369	0.444	1.046	0.709	1.543	19.6%	0.106
5	2008	1168	0.423	0.906	0.583	1.407	22.3%	0.104
6	1981	70	4.928	2.633	1.264	5.487	38.0%	0.350
6	1982	93	3.723	0.993	0.482	2.048	37.4%	0.130
6	1983	142	2.150	1.159	0.612	2.198	32.8%	0.133
6	1984	164	1.861	1.116	0.622	2.002	29.9%	0.117
6	1985	185	1.774	0.915	0.500	1.673	30.9%	0.099
6	1986	347	1.240	0.929	0.545	1.585	27.2%	0.088
6	1987	833	1.076	0.844	0.520	1.371	24.6%	0.073
6	1988	1138	0.970	0.751	0.462	1.220	24.6%	0.065
6	1989	879	0.964	0.742	0.453	1.214	25.0%	0.065
6	1990	911	0.869	0.746	0.451	1.233	25.5%	0.067
6	1991	1367	0.694	0.911	0.576	1.442	23.2%	0.074
6	1992	1885	0.566	0.824	0.523	1.300	23.1%	0.067
6	1993	2185	0.513	0.718	0.444	1.160	24.3%	0.061
6	1994	2279	0.404	0.635	0.383	1.052	25.7%	0.057
6	1995	2379	0.432	0.694	0.427	1.128	24.6%	0.060
6	1996	1922	0.364	0.563	0.325	0.973	27.9%	0.055
6	1997	1961	0.426	0.720	0.441	1.178	25.0%	0.063
6	1998	1682	0.430	0.698	0.418	1.164	26.0%	0.064
6	1999	1584	0.636	1.013	0.652	1.572	22.3%	0.079
6	2000	1684	0.523	1.016	0.659	1.568	21.9%	0.078
6	2001	1492	0.355	1.031	0.662	1.605	22.4%	0.081
6	2002	1430	0.568	1.559	1.054	2.306	19.8%	0.108
6	2003	1376	0.448	1.190	0.776	1.825	21.6%	0.090
6	2004	1486	0.383	1.150	0.745	1.777	22.0%	0.089
6	2005	1165	0.517	1.310	0.863	1.989	21.1%	0.097
6	2006	1110	0.361	1.165	0.741	1.834	23.0%	0.094
6	2007	1369	0.400	1.003	0.643	1.563	22.5%	0.079
6	2008	1168	0.428	0.971	0.601	1.569	24.3%	0.083
7	1981	70	6.873	3.672	1.712	7.876	39.6%	0.326
7	1982	93	4.330	1.349	0.626	2.906	39.8%	0.120
7	1983	142	2.391	1.389	0.697	2.765	35.5%	0.110
7	1984	164	1.858	1.232	0.627	2.421	34.8%	0.096
7	1985	185	1.518	0.849	0.390	1.849	40.5%	0.077
7	1986	347	0.856	0.686	0.332	1.417	37.5%	0.058
7	1987	833	0.798	0.657	0.338	1.277	34.2%	0.050
7	1988	1138	0.731	0.622	0.328	1.180	32.9%	0.046
7	1989	879	0.856	0.694	0.375	1.285	31.5%	0.049
7	1990	911	0.682	0.633	0.328	1.218	33.7%	0.048
7	1991	1367	0.535	0.751	0.415	1.361	30.4%	0.051
7	1992	1885	0.464	0.720	0.400	1.296	30.0%	0.048
7	1993	2185	0.446	0.638	0.346	1.175	31.3%	0.045
7	1994	2279	0.347	0.620	0.333	1.154	31.8%	0.044
7	1995	2379	0.420	0.750	0.423	1.327	29.2%	0.049
7	1996	1922	0.296	0.455	0.216	0.960	38.6%	0.039
7	1997	1961	0.339	0.579	0.298	1.126	34.2%	0.044
7	1998	1682	0.384	0.631	0.329	1.211	33.4%	0.047
7	1999	1584	0.524	1.074	0.645	1.790	25.9%	0.062
7	2000	1684	0.460	0.975	0.578	1.643	26.6%	0.058
7	2001	1492	0.309	1.053	0.621	1.787	26.9%	0.063
7	2002	1430	0.428	1.445	0.911	2.293	23.4%	0.076
7	2003	1376	0.396	1.147	0.689	1.908	25.9%	0.066
7	2004	1486	0.307	1.126	0.662	1.915	27.0%	0.068
7	2005	1165	0.397	1.132	0.671	1.908	26.6%	0.067
7	2006	1110	0.288	1.066	0.605	1.880	28.9%	0.069
7	2007	1369	0.389	1.132	0.687	1.866	25.4%	0.064
7	2008	1168	0.377	0.924	0.520	1.642	29.4%	0.061
8	1981	70	6.739	3.974	1.532	10.307	50.5%	0.257
8	1982	93	5.471	1.592	0.597	4.245	52.1%	0.106
8	1983	142	2.221	1.188	0.437	3.233	53.4%	0.081
8	1984	164	1.603	1.109	0.425	2.893	50.8%	0.072
8	1985	185	1.697	0.893	0.340	2.349	51.3%	0.059
8	1986	347	0.922	0.747	0.288	1.939	50.5%	0.048
8	1987	833	0.739	0.634	0.256	1.570	47.8%	0.039
8	1988	1138	0.827	0.632	0.267	1.497	45.2%	0.037
8	1989	879	0.699	0.582	0.236	1.437	47.5%	0.035

8	1990	911	0.689	0.621	0.253	1.523	47.2%	0.038
8	1991	1367	0.501	0.696	0.311	1.556	41.9%	0.037
8	1992	1885	0.407	0.785	0.371	1.659	38.8%	0.039
8	1993	2185	0.392	0.622	0.273	1.416	42.9%	0.034
8	1994	2279	0.332	0.612	0.266	1.410	43.6%	0.034
8	1995	2379	0.400	0.699	0.319	1.530	40.8%	0.036
8	1996	1922	0.311	0.411	0.142	1.191	57.2%	0.030
8	1997	1961	0.307	0.512	0.198	1.328	50.4%	0.033
8	1998	1682	0.273	0.512	0.194	1.348	51.4%	0.034
8	1999	1584	0.526	1.070	0.547	2.095	34.6%	0.047
8	2000	1684	0.408	0.910	0.451	1.835	36.2%	0.042
8	2001	1492	0.315	1.139	0.586	2.212	34.1%	0.050
8	2002	1430	0.380	1.510	0.842	2.709	29.8%	0.058
8	2003	1376	0.311	0.995	0.493	2.007	36.2%	0.046
8	2004	1486	0.273	1.184	0.607	2.308	34.3%	0.052
8	2005	1165	0.401	1.368	0.739	2.532	31.5%	0.055
8	2006	1110	0.252	1.150	0.570	2.320	36.2%	0.053
8	2007	1369	0.308	1.002	0.500	2.008	35.8%	0.046
8	2008	1168	0.297	0.851	0.387	1.872	41.0%	0.045
9	1981	70	4.415	3.096	0.674	14.224	88.8%	0.207
9	1982	93	5.224	1.684	0.503	5.641	66.4%	0.084
9	1983	142	2.919	1.577	0.507	4.905	61.6%	0.073
9	1984	164	1.942	1.267	0.392	4.103	64.2%	0.061
9	1985	185	1.369	0.612	0.125	2.996	93.8%	0.043
9	1986	347	1.054	0.733	0.211	2.547	68.9%	0.038
9	1987	833	1.011	0.734	0.245	2.201	59.3%	0.033
9	1988	1138	0.980	0.717	0.252	2.041	56.1%	0.030
9	1989	879	0.955	0.647	0.211	1.990	60.9%	0.030
9	1990	911	0.709	0.578	0.168	1.981	68.0%	0.030
9	1991	1367	0.586	0.706	0.245	2.035	56.8%	0.030
9	1992	1885	0.564	0.690	0.238	2.000	57.2%	0.030
9	1993	2185	0.421	0.551	0.171	1.778	64.0%	0.027
9	1994	2279	0.346	0.675	0.236	1.933	56.5%	0.029
9	1995	2379	0.349	0.564	0.176	1.814	63.7%	0.027
9	1996	1922	0.298	0.452	0.121	1.689	73.8%	0.025
9	1997	1961	0.459	0.602	0.186	1.942	64.0%	0.029
9	1998	1682	0.369	0.463	0.121	1.773	75.5%	0.026
9	1999	1584	0.401	0.866	0.317	2.365	53.6%	0.035
9	2000	1684	0.548	1.060	0.446	2.519	45.4%	0.036
9	2001	1492	0.363	1.134	0.468	2.747	46.5%	0.040
9	2002	1430	0.447	1.571	0.745	3.313	38.6%	0.046
9	2003	1376	0.418	1.248	0.547	2.845	43.0%	0.041
9	2004	1486	0.397	1.374	0.604	3.124	42.9%	0.044
9	2005	1165	0.467	1.161	0.475	2.841	47.1%	0.041
9	2006	1110	0.351	1.472	0.630	3.439	44.4%	0.049
9	2007	1369	0.305	0.937	0.353	2.492	52.0%	0.037
9	2008	1168	0.330	0.827	0.285	2.402	57.4%	0.036
10	1981	70	6.838	4.211	1.641	10.805	49.9%	0.271
10	1982	93	4.638	1.649	0.626	4.343	51.4%	0.109
10	1983	142	3.153	1.734	0.737	4.083	44.9%	0.100
10	1984	164	1.785	1.270	0.515	3.136	47.6%	0.078
10	1985	185	1.828	1.121	0.450	2.791	48.1%	0.070
10	1986	347	0.904	0.782	0.305	2.004	49.8%	0.050
10	1987	833	0.970	0.827	0.374	1.828	41.2%	0.044
10	1988	1138	0.846	0.784	0.361	1.704	40.3%	0.041
10	1989	879	0.938	0.731	0.329	1.623	41.5%	0.039
10	1990	911	0.669	0.665	0.279	1.586	45.6%	0.039
10	1991	1367	0.608	0.850	0.402	1.799	38.8%	0.043
10	1992	1885	0.419	0.725	0.332	1.581	40.5%	0.038
10	1993	2185	0.316	0.569	0.241	1.345	45.1%	0.033
10	1994	2279	0.354	0.679	0.302	1.527	42.2%	0.037
10	1995	2379	0.284	0.689	0.310	1.529	41.5%	0.037
10	1996	1922	0.270	0.418	0.148	1.180	55.6%	0.030
10	1997	1961	0.248	0.381	0.127	1.143	59.3%	0.029
10	1998	1682	0.234	0.459	0.165	1.280	54.8%	0.032
10	1999	1584	0.304	0.763	0.343	1.698	41.7%	0.041
10	2000	1684	0.298	0.901	0.442	1.837	36.8%	0.043
10	2001	1492	0.209	0.814	0.371	1.787	40.9%	0.043
10	2002	1430	0.295	1.154	0.590	2.258	34.5%	0.051
10	2003	1376	0.261	0.969	0.473	1.987	37.1%	0.046
10	2004	1486	0.238	0.961	0.460	2.010	38.2%	0.047
10	2005	1165	0.323	1.189	0.606	2.331	34.6%	0.053
10	2006	1110	0.291	1.280	0.652	2.511	34.7%	0.057
10	2007	1369	0.196	0.663	0.274	1.607	46.5%	0.040
10	2008	1168	0.282	0.760	0.327	1.763	44.0%	0.043

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	70	0.467	0.833	0.326	2.129	49.6%	0.407
0	1982	93	1.349	0.827	0.398	1.717	37.8%	0.307
0	1983	142	1.290	1.006	0.575	1.762	28.6%	0.283
0	1984	164	0.664	0.626	0.344	1.138	30.6%	0.188
0	1985	185	1.046	0.906	0.577	1.422	22.8%	0.203
0	1986	347	1.558	1.406	0.975	2.028	18.5%	0.255
0	1987	833	1.057	1.177	0.828	1.674	17.8%	0.206
0	1988	1138	0.934	1.182	0.838	1.668	17.3%	0.202
0	1989	879	0.829	1.168	0.848	1.610	16.1%	0.185
0	1990	911	0.806	0.868	0.604	1.247	18.3%	0.156
1	1981	70	0.832	0.933	0.426	2.042	40.7%	0.516
1	1982	93	0.825	0.521	0.254	1.070	37.2%	0.263
1	1983	142	1.175	0.732	0.426	1.257	27.6%	0.274
1	1984	164	0.957	0.839	0.532	1.324	23.1%	0.263
1	1985	185	0.731	0.682	0.451	1.032	20.9%	0.194
1	1986	347	1.152	1.126	0.779	1.626	18.5%	0.284
1	1987	833	1.099	1.123	0.817	1.543	16.0%	0.244
1	1988	1138	1.163	1.439	1.068	1.940	15.0%	0.294
1	1989	879	1.171	1.467	1.102	1.952	14.4%	0.287
1	1990	911	0.896	1.138	0.830	1.561	15.9%	0.246
2	1981	70	0.986	0.895	0.383	2.088	44.3%	0.384
2	1982	93	1.012	0.699	0.343	1.425	36.8%	0.249
2	1983	142	1.061	0.717	0.414	1.241	28.0%	0.194
2	1984	164	0.927	0.896	0.558	1.438	24.0%	0.208
2	1985	185	1.013	0.890	0.598	1.325	20.1%	0.173
2	1986	347	1.049	0.980	0.674	1.425	18.9%	0.179
2	1987	833	1.021	1.133	0.814	1.578	16.7%	0.183
2	1988	1138	1.149	1.358	0.990	1.864	15.9%	0.209
2	1989	879	0.927	1.302	0.953	1.779	15.7%	0.198
2	1990	911	0.854	1.130	0.813	1.571	16.6%	0.181
3	1981	70	2.427	1.449	0.659	3.187	41.0%	0.433
3	1982	93	1.390	0.549	0.249	1.213	41.2%	0.165
3	1983	142	0.853	0.296	0.140	0.624	38.7%	0.083
3	1984	164	1.399	0.783	0.466	1.315	26.4%	0.151
3	1985	185	1.838	0.907	0.577	1.424	22.9%	0.151
3	1986	347	1.194	0.599	0.366	0.981	25.1%	0.110
3	1987	833	1.066	0.727	0.484	1.093	20.6%	0.109
3	1988	1138	1.246	0.832	0.565	1.227	19.6%	0.119
3	1989	879	1.145	0.867	0.596	1.261	18.9%	0.120
3	1990	911	1.000	0.723	0.480	1.087	20.6%	0.109
3	1991	1367	0.931	0.997	0.687	1.446	18.8%	0.136
3	1992	1885	0.836	0.949	0.664	1.357	18.0%	0.125
3	1993	2185	0.791	0.889	0.620	1.274	18.1%	0.118
3	1994	2279	0.798	0.854	0.595	1.225	18.2%	0.113
3	1995	2379	0.895	1.086	0.768	1.534	17.4%	0.138
3	1996	1922	0.913	1.001	0.708	1.416	17.5%	0.128
3	1997	1961	1.057	1.292	0.925	1.804	16.8%	0.158
3	1998	1682	1.064	1.273	0.920	1.761	16.3%	0.152
3	1999	1584	1.105	1.581	1.151	2.172	16.0%	0.184
3	2000	1684	0.849	1.575	1.145	2.167	16.1%	0.184
3	2001	1492	0.611	1.182	0.851	1.641	16.5%	0.142
3	2002	1430	0.546	1.046	0.739	1.481	17.5%	0.134
3	2003	1376	0.848	1.219	0.878	1.692	16.5%	0.147
3	2004	1486	1.043	1.324	0.950	1.845	16.7%	0.161
3	2005	1165	0.612	1.017	0.713	1.450	17.9%	0.133
3	2006	1110	0.474	1.005	0.697	1.448	18.4%	0.135
3	2007	1369	0.571	1.158	0.812	1.649	17.8%	0.151
3	2008	1168	0.500	0.820	0.563	1.194	19.0%	0.113
4	1981	70	2.141	1.306	0.477	3.570	53.7%	0.309
4	1982	93	1.518	0.572	0.214	1.531	52.4%	0.132
4	1983	142	1.267	0.491	0.227	1.063	40.1%	0.087
4	1984	164	1.663	0.922	0.514	1.655	29.9%	0.122
4	1985	185	2.214	1.188	0.747	1.890	23.5%	0.123
4	1986	347	1.505	0.799	0.474	1.346	26.5%	0.094
4	1987	833	1.170	0.768	0.490	1.203	22.8%	0.077
4	1988	1138	1.288	0.853	0.556	1.310	21.7%	0.082
4	1989	879	1.066	0.856	0.561	1.307	21.4%	0.081
4	1990	911	0.834	0.613	0.381	0.984	24.0%	0.065
4	1991	1367	0.880	0.925	0.605	1.414	21.5%	0.088
4	1992	1885	0.758	0.883	0.585	1.331	20.8%	0.081
4	1993	2185	0.720	0.799	0.532	1.200	20.6%	0.073
4	1994	2279	0.747	0.801	0.529	1.213	20.9%	0.074
4	1995	2379	0.743	0.994	0.671	1.474	19.9%	0.087
4	1996	1922	0.912	0.952	0.646	1.403	19.6%	0.082
4	1997	1961	0.977	1.228	0.841	1.792	19.1%	0.103
4	1998	1682	0.940	1.237	0.855	1.790	18.6%	0.102
4	1999	1584	0.911	1.410	0.974	2.041	18.7%	0.116
4	2000	1684	0.778	1.468	1.024	2.106	18.2%	0.118
4	2001	1492	0.681	1.320	0.919	1.895	18.2%	0.106
4	2002	1430	0.543	1.034	0.697	1.532	19.9%	0.091
4	2003	1376	0.782	1.201	0.832	1.735	18.5%	0.098
4	2004	1486	0.880	1.281	0.884	1.856	18.7%	0.106
4	2005	1165	0.626	1.109	0.754	1.630	19.5%	0.095
4	2006	1110	0.432	1.045	0.696	1.570	20.6%	0.095

4	2007	1369	0.506	1.101	0.735	1.648	20.4%	0.099
4	2008	1168	0.517	0.844	0.555	1.284	21.2%	0.079
5	1981	70	2.910	1.742	0.840	3.613	37.7%	0.767
5	1982	93	2.824	1.123	0.579	2.176	34.0%	0.446
5	1983	142	2.168	0.882	0.511	1.521	27.8%	0.286
5	1984	164	1.954	1.156	0.721	1.854	23.9%	0.323
5	1985	185	2.625	1.473	0.993	2.185	19.9%	0.342
5	1986	347	1.264	0.594	0.373	0.944	23.5%	0.163
5	1987	833	0.970	0.695	0.469	1.029	19.9%	0.161
5	1988	1138	0.979	0.668	0.459	0.973	18.9%	0.148
5	1989	879	1.020	0.795	0.556	1.136	18.0%	0.167
5	1990	911	0.783	0.628	0.424	0.932	19.9%	0.146
5	1991	1367	0.760	0.860	0.604	1.224	17.8%	0.179
5	1992	1885	0.632	0.851	0.606	1.196	17.1%	0.170
5	1993	2185	0.637	0.802	0.571	1.127	17.1%	0.160
5	1994	2279	0.547	0.715	0.507	1.007	17.3%	0.144
5	1995	2379	0.557	0.837	0.597	1.173	17.0%	0.166
5	1996	1922	0.601	0.715	0.510	1.003	17.0%	0.142
5	1997	1961	0.693	1.047	0.759	1.443	16.2%	0.197
5	1998	1682	0.634	1.009	0.732	1.390	16.1%	0.190
5	1999	1584	0.770	1.331	0.980	1.808	15.4%	0.239
5	2000	1684	0.599	1.369	1.004	1.865	15.6%	0.249
5	2001	1492	0.542	1.256	0.919	1.715	15.7%	0.230
5	2002	1430	0.492	1.093	0.790	1.513	16.4%	0.209
5	2003	1376	0.563	1.040	0.760	1.425	15.8%	0.192
5	2004	1486	0.632	1.123	0.815	1.549	16.2%	0.212
5	2005	1165	0.492	1.115	0.797	1.559	16.9%	0.220
5	2006	1110	0.369	0.995	0.704	1.405	17.4%	0.202
5	2007	1369	0.463	1.143	0.817	1.598	16.9%	0.225
5	2008	1168	0.522	0.944	0.670	1.332	17.3%	0.191

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	70	0.970	1.265	0.777	2.062	24.8%	0.647
0	1982	93	1.690	1.193	0.789	1.803	20.9%	0.515
0	1983	142	1.207	0.976	0.695	1.370	17.1%	0.344
0	1984	164	0.742	0.561	0.386	0.816	18.9%	0.219
0	1985	185	0.852	0.668	0.487	0.916	15.9%	0.219
0	1986	347	1.372	1.595	1.234	2.062	12.9%	0.424
0	1987	833	0.893	1.035	0.805	1.330	12.6%	0.269
0	1988	1138	0.842	0.969	0.756	1.241	12.4%	0.249
0	1989	879	0.680	0.886	0.693	1.132	12.3%	0.226
0	1990	911	0.751	0.853	0.664	1.096	12.6%	0.221
1	1981	70	1.034	1.084	0.719	1.632	20.7%	0.850
1	1982	93	1.226	0.828	0.571	1.203	18.8%	0.590
1	1983	142	1.142	0.811	0.601	1.094	15.1%	0.463
1	1984	164	0.937	0.825	0.621	1.095	14.3%	0.446
1	1985	185	0.694	0.609	0.464	0.801	13.8%	0.318
1	1986	347	1.063	1.224	0.950	1.576	12.7%	0.589
1	1987	833	1.027	1.098	0.865	1.395	12.0%	0.500
1	1988	1138	1.022	1.238	0.978	1.567	11.8%	0.555
1	1989	879	1.022	1.199	0.946	1.518	11.8%	0.538
1	1990	911	0.834	1.084	0.855	1.375	11.9%	0.489
2	1981	70	1.728	1.561	1.040	2.343	20.5%	0.978
2	1982	93	1.127	0.780	0.544	1.119	18.2%	0.433
2	1983	142	0.958	0.741	0.550	0.999	15.0%	0.340
2	1984	164	0.874	0.857	0.641	1.145	14.6%	0.381
2	1985	185	0.924	0.786	0.598	1.032	13.7%	0.329
2	1986	347	0.897	1.009	0.782	1.300	12.8%	0.393
2	1987	833	0.901	1.071	0.843	1.362	12.1%	0.395
2	1988	1138	0.988	1.170	0.923	1.483	11.9%	0.425
2	1989	879	0.802	0.968	0.763	1.228	11.9%	0.353
2	1990	911	0.800	1.058	0.834	1.342	11.9%	0.386
3	1981	70	3.397	1.849	1.252	2.731	19.7%	0.723
3	1982	93	2.345	1.010	0.702	1.454	18.3%	0.368
3	1983	142	1.154	0.518	0.369	0.727	17.1%	0.176
3	1984	164	1.461	0.878	0.650	1.186	15.1%	0.264
3	1985	185	1.801	0.825	0.615	1.108	14.8%	0.243
3	1986	347	1.352	0.823	0.628	1.078	13.6%	0.222
3	1987	833	1.168	0.879	0.688	1.125	12.4%	0.216
3	1988	1138	1.274	0.986	0.774	1.255	12.1%	0.238
3	1989	879	1.142	0.874	0.686	1.114	12.2%	0.211
3	1990	911	0.968	0.835	0.653	1.067	12.3%	0.205
3	1991	1367	0.902	1.083	0.851	1.378	12.1%	0.260
3	1992	1885	0.729	0.921	0.728	1.166	11.8%	0.217
3	1993	2185	0.654	0.861	0.681	1.089	11.8%	0.202
3	1994	2279	0.679	0.827	0.653	1.047	11.9%	0.195
3	1995	2379	0.668	0.919	0.726	1.162	11.8%	0.215
3	1996	1922	0.700	0.838	0.662	1.062	11.9%	0.197
3	1997	1961	0.790	1.001	0.791	1.267	11.8%	0.235
3	1998	1682	0.775	0.955	0.754	1.209	11.8%	0.225
3	1999	1584	0.849	1.180	0.932	1.494	11.9%	0.278
3	2000	1684	0.682	1.173	0.927	1.485	11.8%	0.276
3	2001	1492	0.518	1.071	0.846	1.356	11.8%	0.252
3	2002	1430	0.560	1.091	0.861	1.382	11.9%	0.257
3	2003	1376	0.688	1.156	0.912	1.465	11.9%	0.273
3	2004	1486	0.702	1.181	0.931	1.499	11.9%	0.280
3	2005	1165	0.591	1.168	0.919	1.484	12.0%	0.279
3	2006	1110	0.458	1.055	0.829	1.341	12.1%	0.253
3	2007	1369	0.541	1.207	0.949	1.535	12.1%	0.289
3	2008	1168	0.453	0.836	0.657	1.063	12.1%	0.201
4	1981	70	3.051	1.891	1.223	2.926	22.1%	0.489
4	1982	93	2.941	1.212	0.803	1.829	20.8%	0.295
4	1983	142	1.285	0.591	0.401	0.870	19.5%	0.135
4	1984	164	1.681	0.876	0.622	1.235	17.3%	0.177
4	1985	185	2.013	0.902	0.663	1.227	15.5%	0.164
4	1986	347	1.680	0.898	0.673	1.200	14.5%	0.153
4	1987	833	1.151	0.823	0.635	1.065	13.0%	0.125
4	1988	1138	1.207	0.896	0.697	1.150	12.6%	0.132
4	1989	879	1.044	0.791	0.613	1.022	12.8%	0.119
4	1990	911	0.866	0.728	0.561	0.946	13.1%	0.112
4	1991	1367	0.816	0.987	0.769	1.267	12.5%	0.145
4	1992	1885	0.687	0.888	0.696	1.133	12.2%	0.127
4	1993	2185	0.615	0.795	0.624	1.014	12.2%	0.113
4	1994	2279	0.615	0.772	0.604	0.986	12.3%	0.111
4	1995	2379	0.580	0.862	0.677	1.098	12.1%	0.122
4	1996	1922	0.645	0.795	0.623	1.014	12.2%	0.114
4	1997	1961	0.753	0.979	0.769	1.247	12.1%	0.139
4	1998	1682	0.666	0.888	0.695	1.135	12.3%	0.128
4	1999	1584	0.734	1.184	0.930	1.507	12.1%	0.168
4	2000	1684	0.602	1.129	0.887	1.438	12.1%	0.160
4	2001	1492	0.541	1.140	0.896	1.449	12.1%	0.161
4	2002	1430	0.572	1.193	0.937	1.518	12.1%	0.169
4	2003	1376	0.618	1.068	0.838	1.362	12.2%	0.152
4	2004	1486	0.638	1.231	0.967	1.567	12.1%	0.175
4	2005	1165	0.600	1.216	0.954	1.551	12.2%	0.174
4	2006	1110	0.405	1.085	0.848	1.388	12.4%	0.157
4	2007	1369	0.515	1.286	1.009	1.641	12.2%	0.184
4	2008	1168	0.478	0.893	0.697	1.143	12.4%	0.130
5	1981	70	4.347	2.581	1.770	3.762	19.0%	1.132
5	1982	93	3.848	1.785	1.274	2.500	17.0%	0.698
5	1983	142	2.140	1.113	0.821	1.509	15.3%	0.393
5	1984	164	1.851	1.181	0.878	1.589	14.9%	0.406
5	1985	185	2.116	1.219	0.925	1.606	13.8%	0.389
5	1986	347	1.218	0.750	0.573	0.982	13.6%	0.235
5	1987	833	0.954	0.746	0.582	0.957	12.5%	0.215
5	1988	1138	0.932	0.773	0.607	0.983	12.1%	0.215
5	1989	879	0.954	0.801	0.629	1.020	12.1%	0.224
5	1990	911	0.767	0.728	0.570	0.929	12.2%	0.206
5	1991	1367	0.707	0.963	0.758	1.224	12.0%	0.267
5	1992	1885	0.568	0.833	0.658	1.053	11.8%	0.227
5	1993	2185	0.539	0.747	0.590	0.944	11.8%	0.203
5	1994	2279	0.455	0.683	0.539	0.864	11.8%	0.186
5	1995	2379	0.457	0.730	0.577	0.922	11.8%	0.198
5	1996	1922	0.454	0.610	0.481	0.773	11.9%	0.168
5	1997	1961	0.523	0.775	0.612	0.981	11.8%	0.211
5	1998	1682	0.496	0.774	0.610	0.980	11.9%	0.212
5	1999	1584	0.642	1.056	0.835	1.336	11.8%	0.288
5	2000	1684	0.523	1.094	0.865	1.383	11.8%	0.297
5	2001	1492	0.432	0.991	0.783	1.253	11.8%	0.270
5	2002	1430	0.478	1.123	0.887	1.421	11.8%	0.306
5	2003	1376	0.458	0.919	0.725	1.165	11.9%	0.252
5	2004	1486	0.473	0.998	0.787	1.265	11.9%	0.274
5	2005	1165	0.472	1.093	0.861	1.387	12.0%	0.302
5	2006	1110	0.345	0.970	0.762	1.233	12.1%	0.270
5	2007	1369	0.412	1.099	0.865	1.397	12.0%	0.305
5	2008	1168	0.440	0.868	0.683	1.102	12.0%	0.240

Table 14. Nominal and standard swordfish CPUE combined sex and age groups (Age0-2).

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 (Age 3-10+).

Year	Numb obs	Nominal CPUE	Standard CPUE	Low CI 95%	Upp CI 95%	Coeff Var	Std Error
1981	70	18.1	7.4	5.1	10.8	0.19	1.38
1982	93	16.4	6.2	4.5	8.7	0.17	1.04
1983	142	8.6	3.4	2.5	4.5	0.15	0.51
1984	164	8.3	3.3	2.5	4.4	0.15	0.48
1985	185	9.6	3.5	2.7	4.6	0.13	0.47
1986	347	6.3	2.3	1.8	3.0	0.13	0.30
1987	833	4.7	2.2	1.8	2.8	0.12	0.26
1988	1138	4.7	2.4	1.9	3.1	0.12	0.28
1989	879	4.5	2.2	1.8	2.8	0.12	0.26
1990	911	3.7	2.2	1.7	2.8	0.12	0.26
1991	1367	3.4	2.7	2.2	3.5	0.11	0.31
1992	1885	2.8	2.4	1.9	3.0	0.11	0.27
1993	2185	2.6	2.2	1.7	2.7	0.11	0.24
1994	2279	2.3	1.9	1.5	2.4	0.11	0.21
1995	2379	2.3	2.1	1.7	2.6	0.11	0.23
1996	1922	2.4	1.8	1.5	2.3	0.11	0.20
1997	1961	2.7	2.3	1.8	2.8	0.11	0.25
1998	1682	2.5	2.2	1.8	2.8	0.11	0.25
1999	1584	3.1	2.9	2.4	3.7	0.11	0.33
2000	1684	2.5	2.9	2.3	3.6	0.11	0.32
2001	1492	2.1	2.6	2.1	3.3	0.11	0.30
2002	1430	2.3	3.0	2.4	3.7	0.11	0.34
2003	1376	2.3	2.6	2.1	3.3	0.11	0.30
2004	1486	2.4	2.9	2.3	3.7	0.11	0.33
2005	1165	2.4	2.9	2.3	3.7	0.11	0.34
2006	1110	1.7	2.5	2.0	3.2	0.12	0.29
2007	1369	2.0	3.0	2.4	3.7	0.11	0.34
2008	1168	2.1	2.3	1.8	2.9	0.11	0.26

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	94	3647.4	1392.2	1992.5	1992.5	18.1%	251.6
1983	142	2108.0	981.2	1336.3	1336.3	15.5%	152.5
1984	164	1833.9	893.5	1205.0	1205.0	15.0%	134.4
1985	185	1997.4	861.2	1130.7	1130.7	13.7%	117.8
1986	347	1499.4	805.9	1038.8	1038.8	12.7%	102.7
1987	833	1217.4	651.5	829.8	829.8	12.1%	79.1
1988	1139	1217.2	675.4	858.6	858.6	12.0%	81.3
1989	883	1112.1	604.6	768.2	768.2	12.0%	72.7
1990	914	1007.2	628.0	797.9	797.9	12.0%	75.5
1991	1370	829.5	601.9	762.9	762.9	11.9%	71.6
1992	1893	692.1	548.4	692.0	692.0	11.7%	64.0
1993	2193	635.1	488.2	615.2	615.2	11.6%	56.7
1994	2303	597.6	448.1	565.2	565.2	11.6%	52.2
1995	2475	571.5	486.6	613.2	613.2	11.6%	56.5
1996	1584	475.6	396.8	499.8	499.8	11.6%	45.9
1997	1720	546.4	438.9	552.3	552.3	11.5%	50.6
1998	1344	521.2	470.2	593.1	593.1	11.6%	54.8
1999	1266	531.5	582.1	736.6	736.6	11.8%	68.8
2000	1331	430.1	500.5	634.1	634.1	11.9%	59.4
2001	1412	412.4	464.3	587.2	587.2	11.8%	54.7
2002	1397	504.2	517.4	654.0	654.0	11.8%	60.8
2003	1343	542.5	510.1	646.5	646.5	11.9%	60.7
2004	1441	517.4	455.6	577.8	577.8	11.9%	54.3
2005	1115	475.0	492.9	627.3	627.3	12.1%	59.6
2006	1064	403.4	451.9	575.9	575.9	12.2%	55.0
2007	1285	432.4	525.7	672.0	672.0	12.3%	64.8
2008	1078	386.5	358.5	456.7	456.7	12.1%	43.5

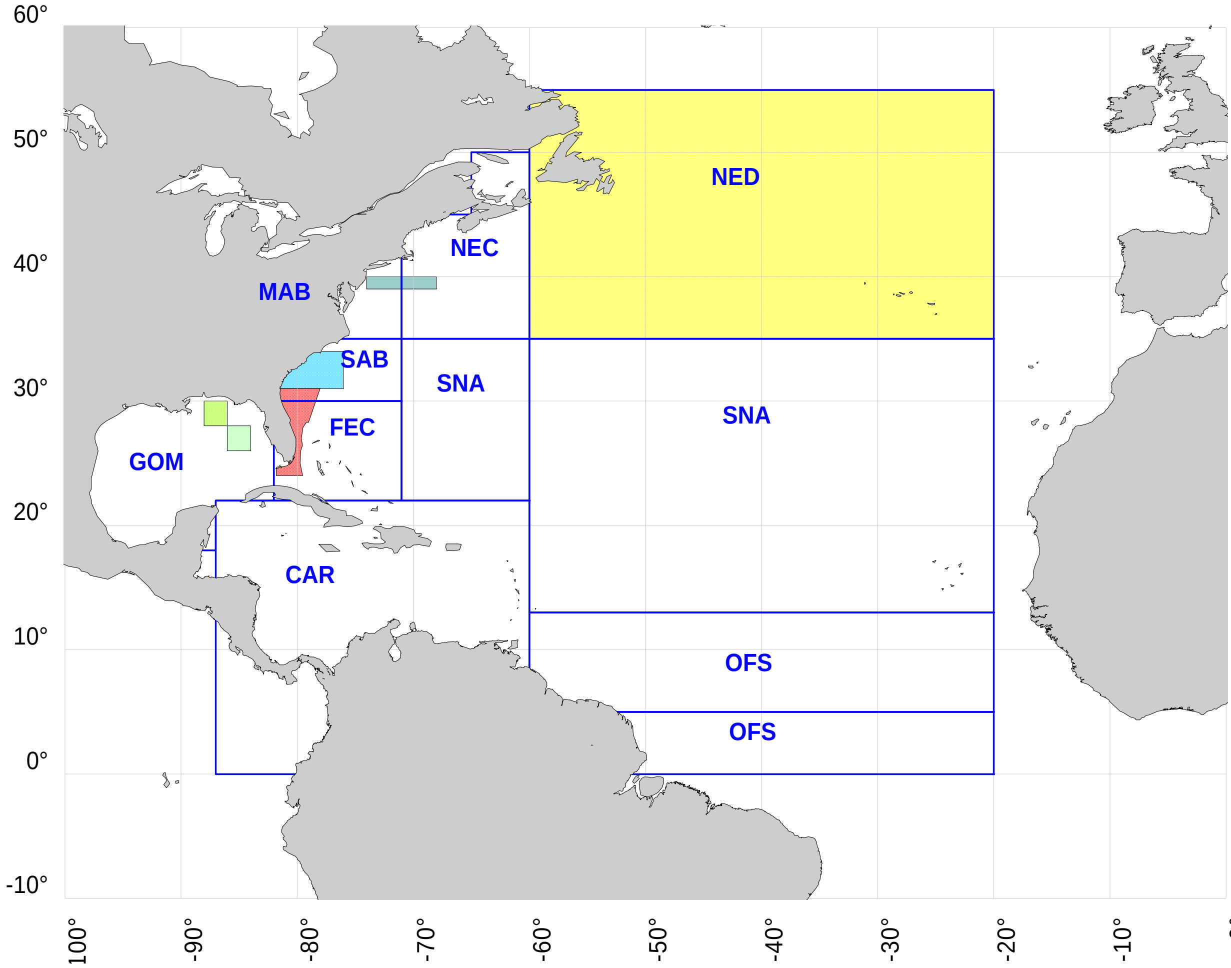


Figure 1. Geographic area classification for the US Pelagic longline fishery: CAR Caribbean, GOM Gulf of Mexico, FEC Florida east coast, SAB south Atlantic bight, MAB mid Atlantic bight, NEC north east coastal, NED north east distant waters, SNA Sargasso area, and OFS offshore waters. Shaded areas represent 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.

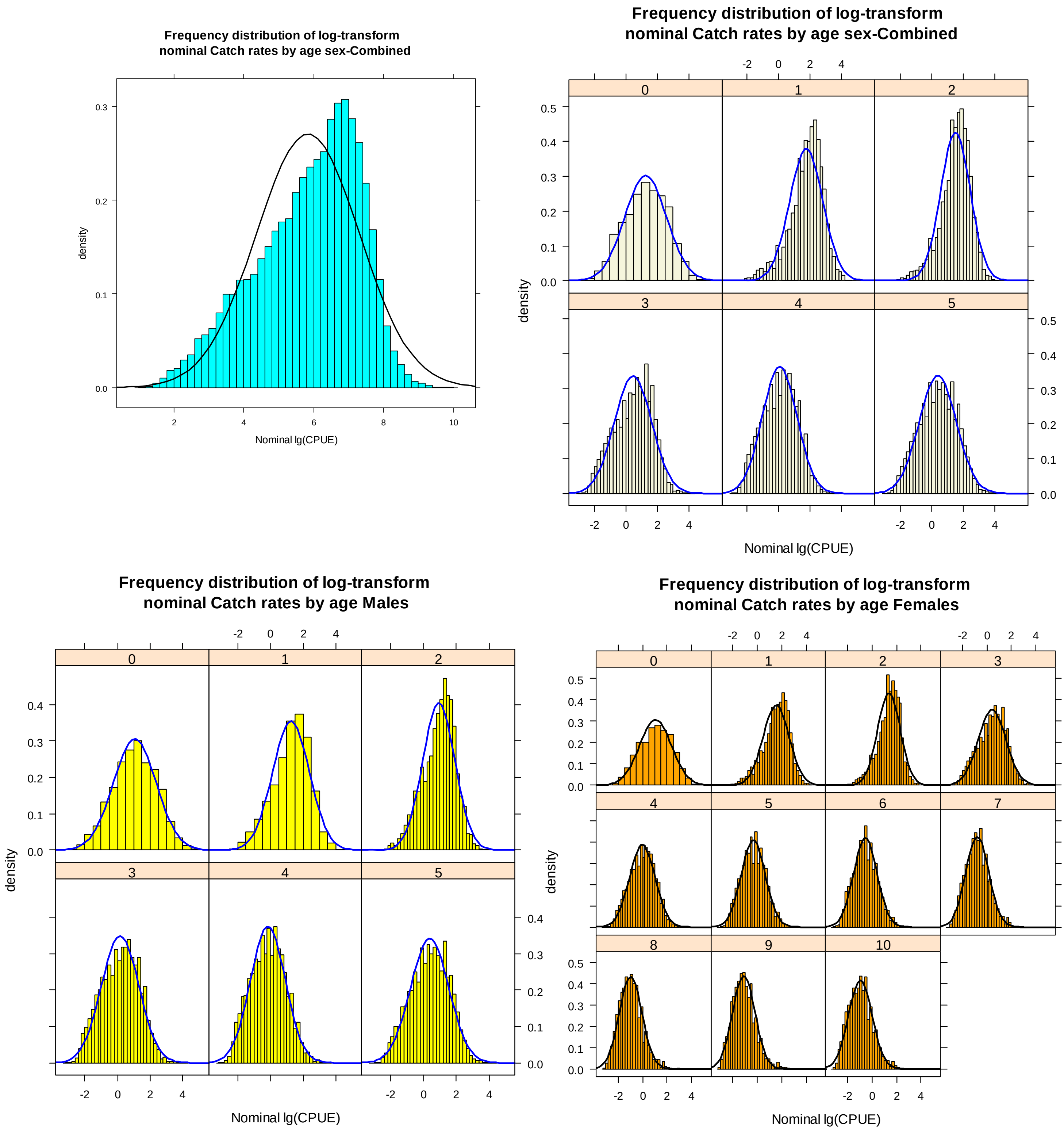


Figure 2. Swordfish density frequency distributions of positive catch trips (log CPUE) by sex and age (top), combined sex combined sex age 3-10+ (bottom left), and swordfish biomass [fish >= 33 lbs right].

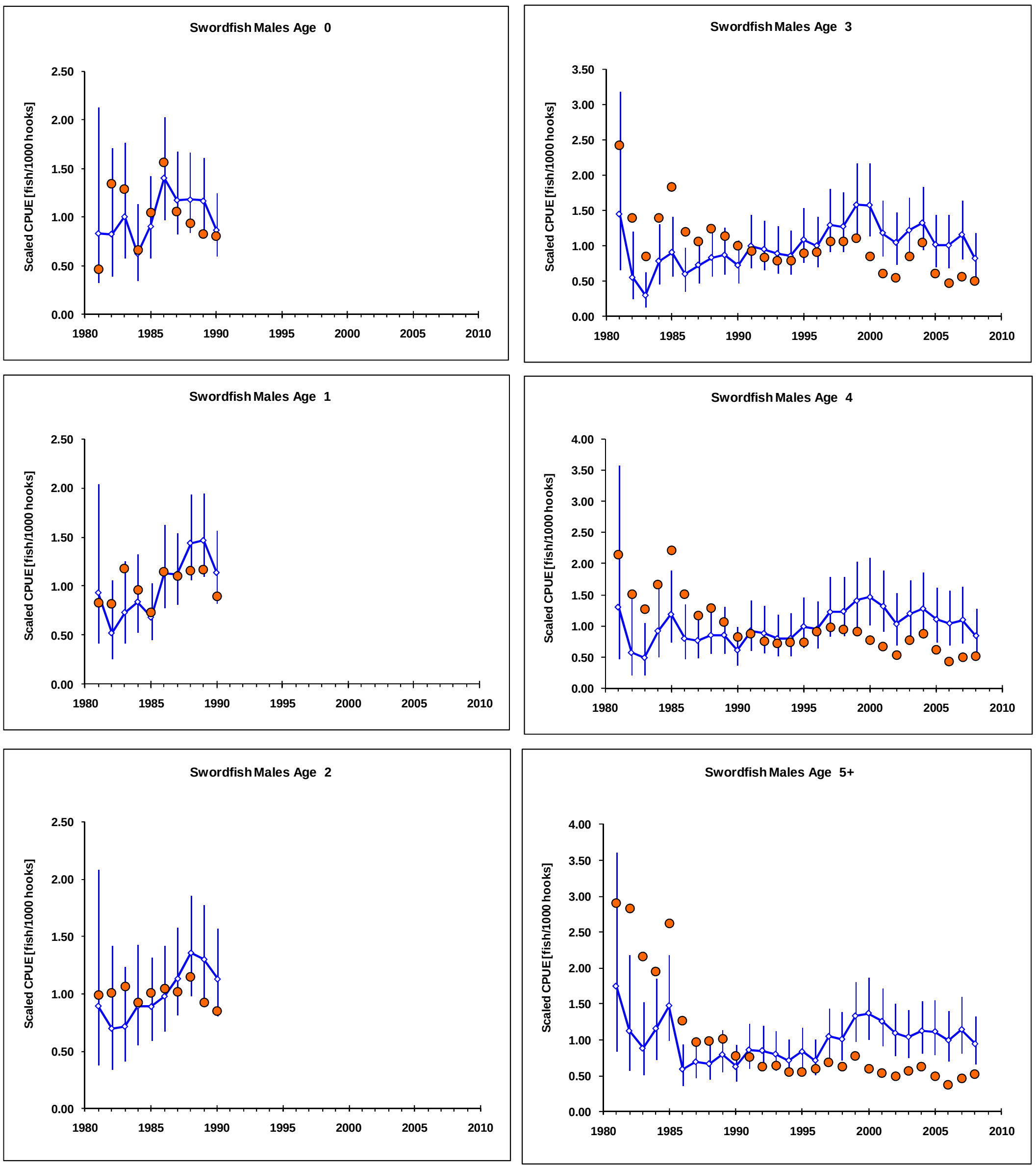
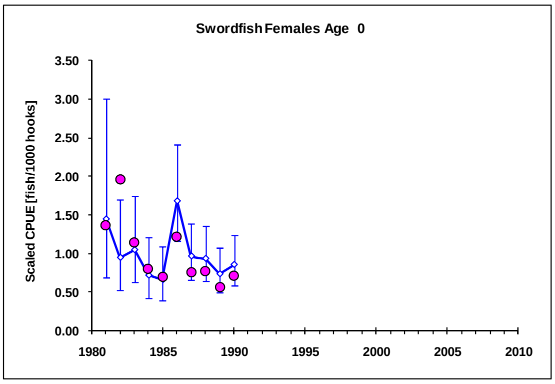
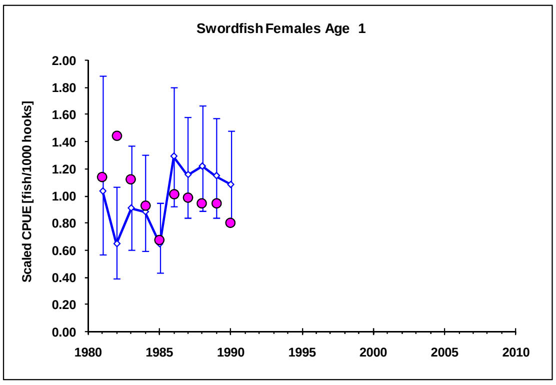
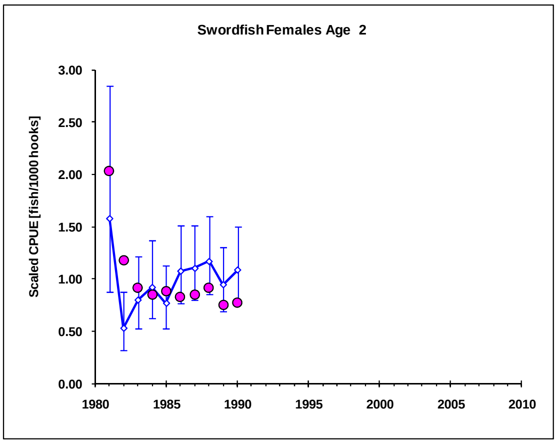
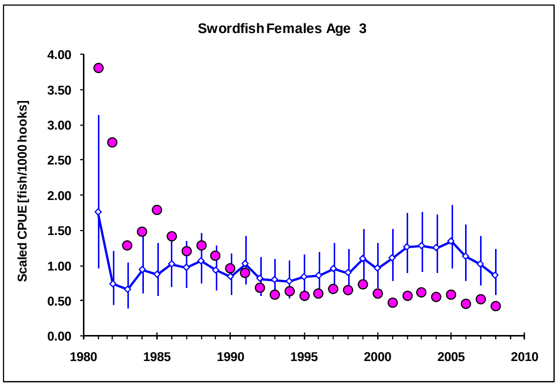


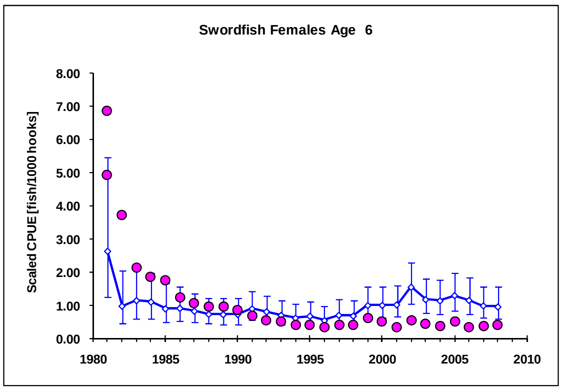
Figure 3. Nominal (solid circles) and standard CPUE for swordfish by age-sex (males) from the U.S. pelagic longline fishery 1981-2008. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value**.** Series are scaled to their corresponding mean for each age class.

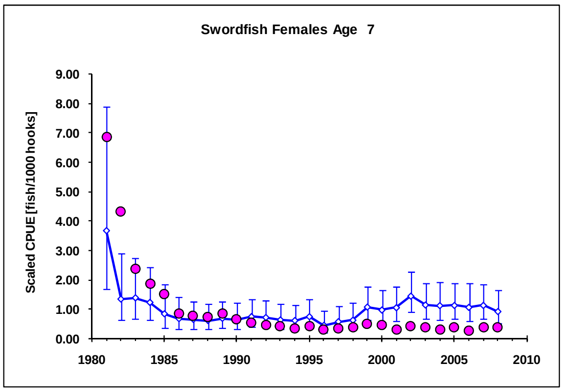

Swordfish Females Age 0
Scaled CPUE [fish/1000 hooks]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1985
1990
1995
2000
2005
2010

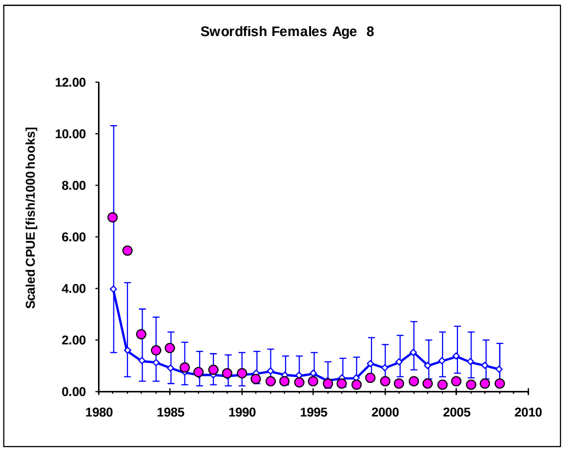

Swordfish Females Age 1
Scaled CPUE [fish/1000 hooks]
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1980
1985
1990
1995
2000
2005
2010

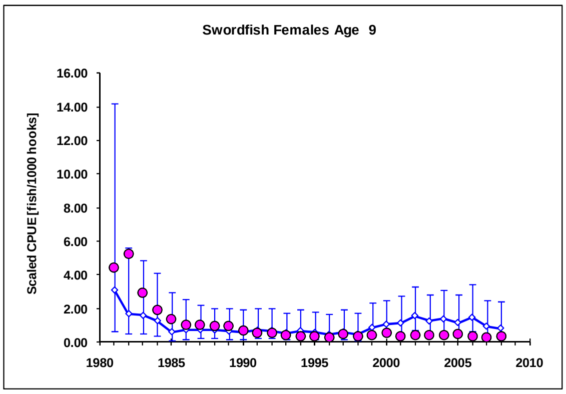

Swordfish Females Age 2
Scaled CPUE [fish/1000 hooks]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1980
1985
1990
1995
2000
2005
2010


Swordfish Females Age 3
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
2010


Swordfish Females Age 6
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
2010


Swordfish Females Age 7
Scaled CPUE [fish/1000 hooks]
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
2010


Swordfish Females Age 8
Scaled CPUE [fish/1000 hooks]
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1980
1985
1990
1995
2000
2005
2010


Swordfish Females Age 9
Scaled CPUE [fish/1000 hooks]
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1980
1985
1990
1995
2000
2005
2010

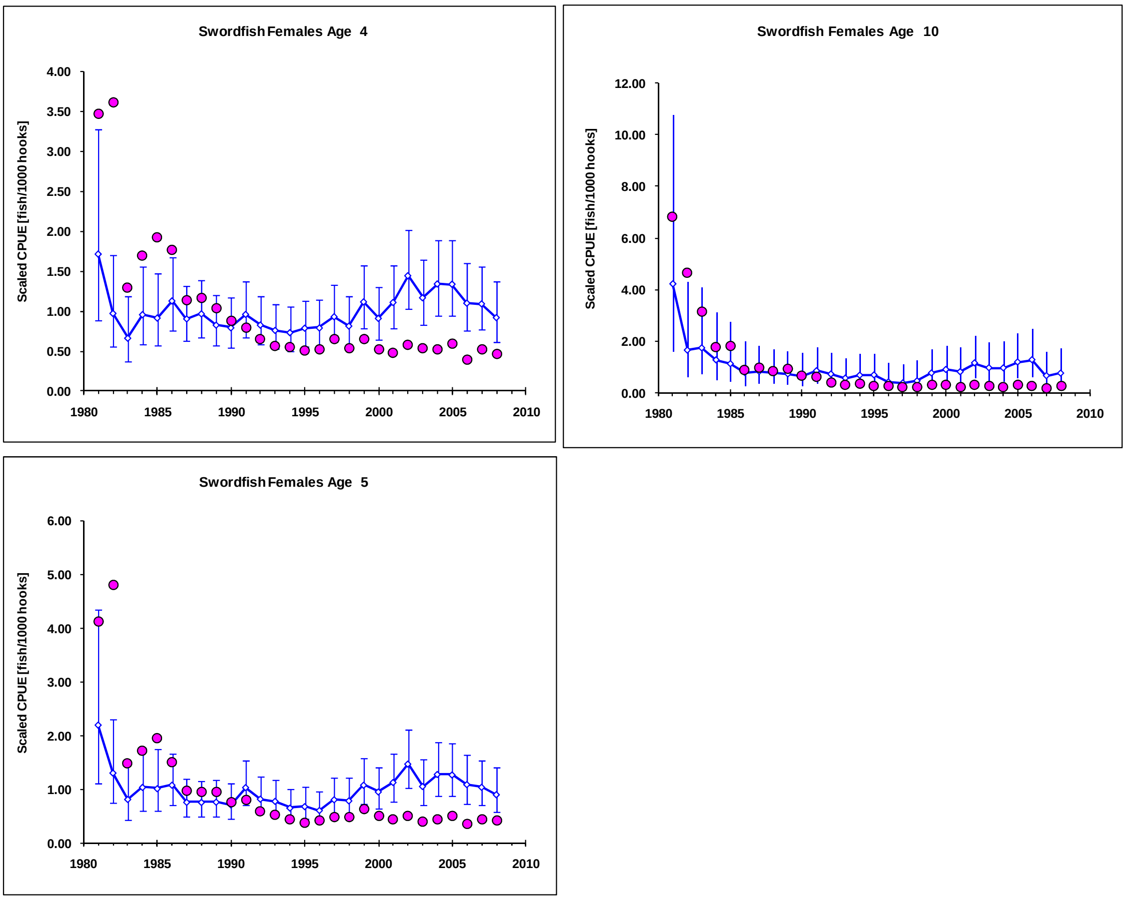


Figure 4. Nominal (solid-circles) and standard CPUE for swordfish by age-sex (Females) from the U.S. pelagic longline fishery 1981-2008. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value. Series are scaled to their corresponding mean for each age class.

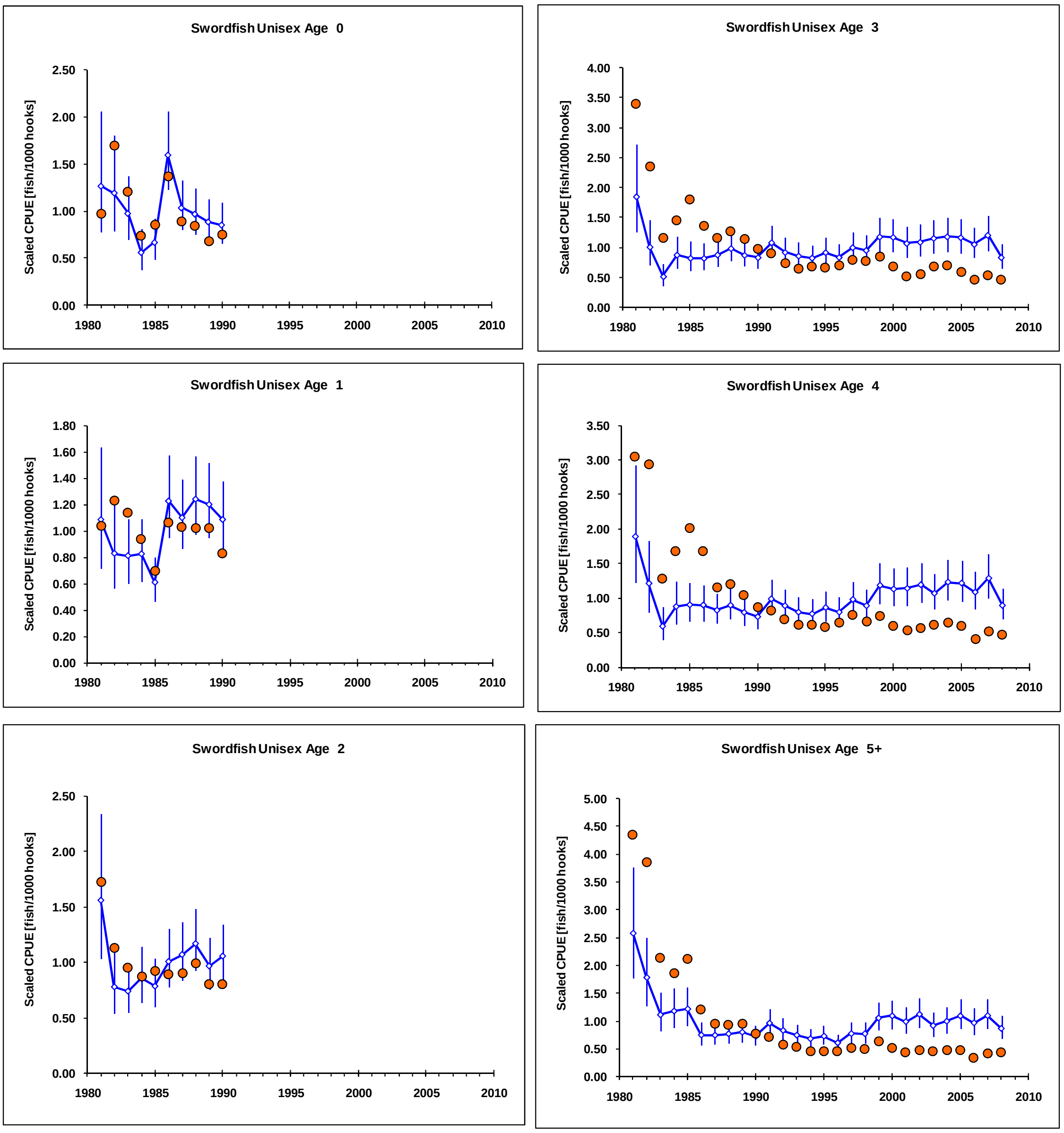
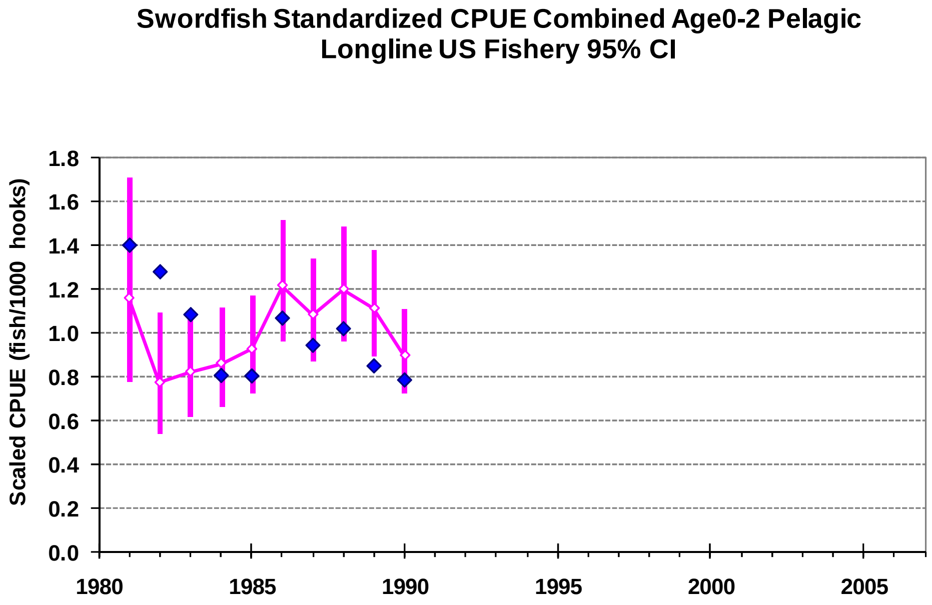


Figure 5. Nominal (solid circles) and standard CPUE for swordfish by age (unisex) from the U.S. pelagic longline fishery 1981-2005. Bars represent upper and lower estimated 95% confidence intervals for the scaled CPUE value**.** Series are scaled to their corresponding mean for each age class.



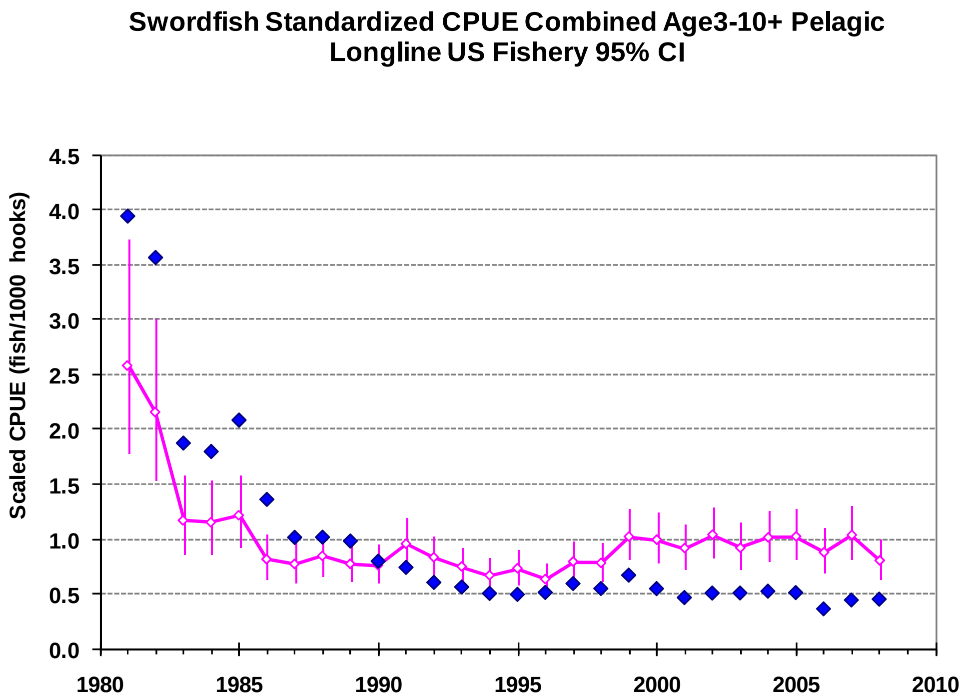


Figure 6. Nominal and standard swordfish CPUE for combined sex and age groups (0-2 top panel, 3-10+ bottom panel) from the U.S. pelagic longline fishery. Series are scaled to their corresponding mean for each age group.

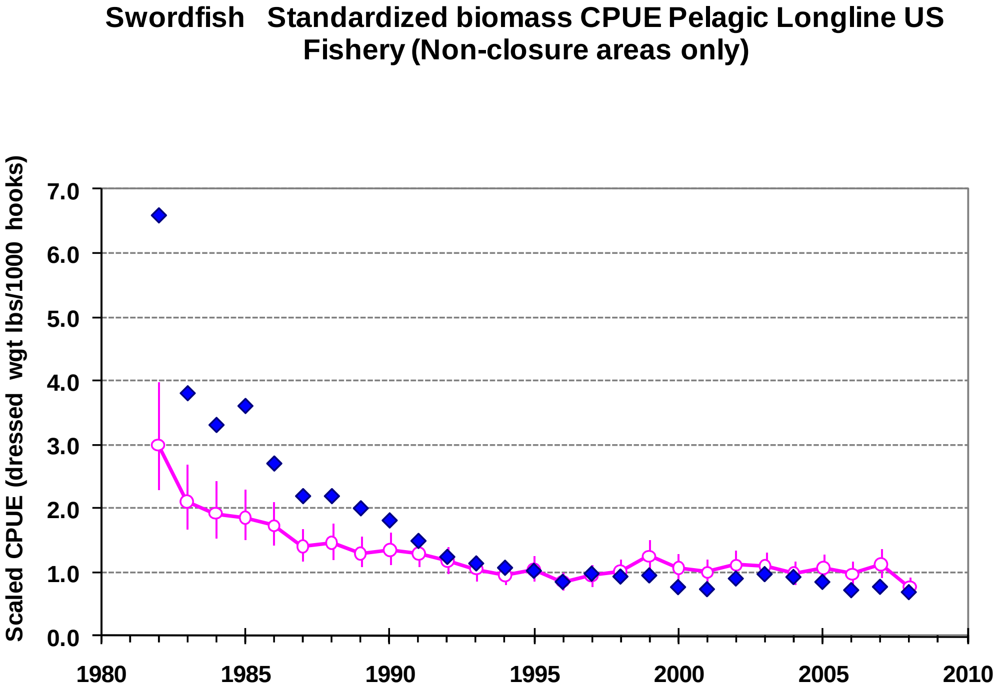


Figure 7. Nominal and standard biomass CPUE for swordfish (≥ 33 lbs) from the U.S. pelagic longline fishery. Bars represent upper and lower 95% confidence intervals

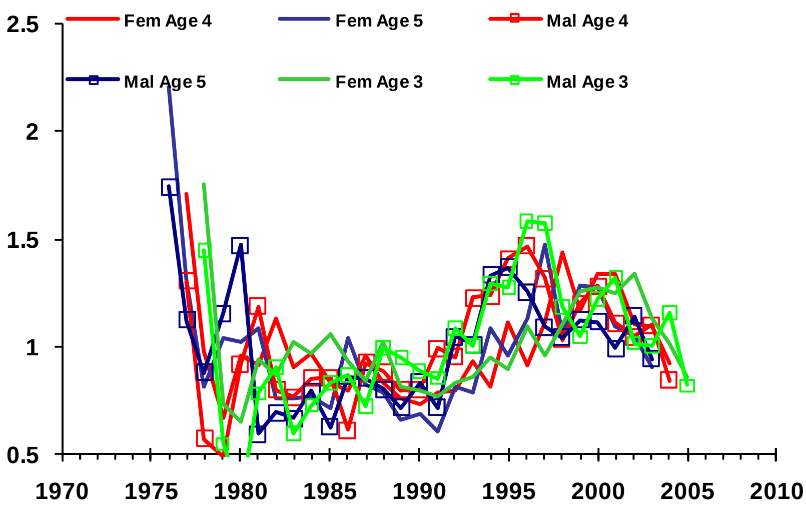


Figure 8. Comparison of ages 3, 4 and 5 for females (solid lines) and males (square-marker lines) index trends adjusted to their correspondent cohort-year group.