

## CPUE INDICES DERIVED FROM COMBINED SPANISH AND U.S. CATCH AND EFFORT DATA

by

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## SUMMARY

Trip-specific catch and effort data from the U.S. swordfish fishery from 1981 to 1987 and from the Spanish swordfish fishery from 1982 to 1987 are used to develop swordfish indices of abundance. Standardized size-specific indices are developed using General Linear Modeling (GLM) procedures. Gear and operating practices are considered and incorporated into the model along with year, area, quarter, and area-quarter interaction terms. Indices are developed for size categories which relate to the lengths at which 50 percent and 100 percent of males and females mature. These categories include swordfish less than 110 cm LJFL, from 110 to 169 cm LJFL, from 170 to 234 cm LJFL, and for those greater than 235 cm LJFL.

## RESUME

Des données de capture et d'effort spécifique des marées, provenant de la pêcherie américaine d'espadon pour les années 1981-87 et de la pêcherie espagnole de cette espèce pour 1982-87, sont utilisées pour élaborer des indices de l'abondance de l'espadon. Des indices standardisés spécifiques de la taille sont élaborés au moyen de la méthode du modèle linéaire généralisé. Les modifications des engins et des méthodes de pêche ont été prises en compte et incorporées au modèle, ainsi que les facteurs d'interaction année, zone, trimestre et zone-trimestre. Des indices sont élaborés pour les catégories de taille qui concernent la taille à laquelle 50 % et 100 % des mâles et des femelles sont matures. Ces catégories comprennent l'espadon de moins de 110 cm de longueur maxillaire-fourche, ceux de 110 à 169 cm, ceux de 170 à 234 cm, et ceux de plus de 235 cm.

## RESUMEN

Con el fin de desarrollar índices de abundancia de pez espada se emplean datos de captura y esfuerzo de viajes de la pesquería de pez espada norteamericana (periodo 1981-1987) y de la pesquería española de pez espada (periodo 1982-1987). Por medio del Modelo Lineal Generalizado se desarrollan índices estandarizados específicos de talla. Se examinan los tipos de operación y se incorporan al modelo junto con el año, zona, trimestre e interacciones zona-trimestre. Se desarrollan índices para las categorías de talla que están en relación con la talla a la cual madura el 50% por ciento de machos y hembras. Estas categorías incluyen pez espada de menos de 110 cm de longitud mandíbula inferior-longitud horquilla (MILH), de 110 a 169 cm MILH, de 170 a 234 cm MILH y los que presentan una longitud superior a 235 cm MILH.

## INTRODUCTION

Commercial catch and effort data have been used to develop indices of relative abundance based on standardized catch per unit effort (CPUE). Robson's (1966) analysis of variance or least squares regression procedure for estimating fishing power is now the standard method for exploring abundance trends over time (Conser 1984, Kimura 1981, SEFC 1984). The basic assumption is that CPUE is related to abundance (Richards and Schnute 1986) and that once factors which influence CPUE (gear, area, time, etc.) are standardized, the remaining year terms reflect trends in relative abundance. Implicit in this approach is the assumption that the catch and effort data adequately cover the range of both the fishery and the exploited stock so that the index will not be biased. Current stock assessment techniques, quantitatively compare standardized abundance indices with estimates of population abundance trends from Virtual Population Analyses (VPA's) to select the most likely among many alternatives. This process is considered to be a tuning (calibration) procedure which provides reliable estimates of absolute abundance. The basic assumption is that abundance estimates developed from the catch matrix represent the most comprehensive summarization of age specific abundance trends, and that an abundance index (CPUE) with reasonable variance should correlate well with VPA stock size estimates. This application is generally more robust if age or size specific abundance indices are used so that variability introduced by differences in distributions and abundances of age classes can be minimized.

Definitive genetic information on the stock structure of North Atlantic swordfish is currently not available. Participants at the 1987 ICCAT swordfish workshop (Anon. 1988) favored a single North Atlantic stock hypothesis for management purposes. Although the two stock hypothesis was not discarded, the participants recommended that the mixing of east and west fish in the central North Atlantic should be incorporated into any assessment of separate stocks. It was also recognized that biological stocks could be different from management units, and that the mixing of fish and fleets in the central North Atlantic represented a practical problem of correctly assigning numbers caught to the proper stock. In light of the workshop preference for the single stock hypothesis, the purpose of this analysis was to develop standardized indices of abundance that incorporate data from all areas of the North Atlantic exploited by the U.S. and Spanish fisheries. Previous cooperative work between U.S. and Spanish scientists had established a data base of size frequency and catch and effort information that formed the foundation for this project (Hoey, Mejuto, Iglesias, and Conser 1988). Although indices have been developed with U.S. catch and effort information (Hoey, Conser, Duffie 1988), a combined index might be more appropriate for tuning a North Atlantic VPA.

## DATA

Despite differences in measurement units and processing of catch, effort, and size composition, the U.S. and Spanish data are collected similarly. In both countries size composition data are collected as the fish are offloaded from a trip. In the U.S. the individual weights of the dressed carcasses (headed, gilled, gutted, and tailed) are recorded with vessel, gear, port, date, and fishing area information. In Spain, lower jaw fork length (LJFL) measurements are normally taken of each fish. Occasionally round weights are measured and then converted to LJFL using the following equation:

$$WT(KG)=3.800 \times 10^{-6} * LJFL^{**3.242775}$$

where WT is round weight and the equation was based on 2,306 measurements of LJFL and round weight over a length range of 74 to 279 cm and a weight range of 4 to 331 kg (Garces and Rey 1984). Numbers of swordfish are then compiled by 5cm intervals with the appropriate sample number (distinguishes trips), month, and five degree square of Latitude and Longitude. Because Spanish size frequency data are summarized by 5cm intervals of LJFL, U.S. individual carcass weights were converted to LJFL using the following equation:

$$LJFL=44.2237 * (DWT)^{**.29257}$$

where DWT is the dressed weight and the equation was based on 551 measurements of LJFL and dressed weight over the dressed weight range of 4 to 473 pounds (Turner 1986).

Trip effort information in the Spanish data are recorded as the number of sets fished on the trip and the average number of hooks fished on each set. This information was obtained by interviews conducted during the sampling of the catch. For the U.S. data the number of sets and total number of hooks fished on a trip are recorded. U.S. effort information was either voluntarily submitted by Captains, collected through interviews by NMFS port samplers, or developed by cross referencing logbooks with the tally sheets that record the individual weights at offloading. Voluntarily submitted logbooks were used in the early years and the mandatory logbooks, which have been required by law since October of 1986, have been used for recent information. In both the U.S. and Spanish data, trips sampled for size frequency do not always record the associated effort information. In subsequent analyses we have used only those trips for which both the set and hook effort was recorded. We did not estimate the hooks fished for trips that only recorded numbers of sets. Trips which sampled less than 90% of the fish caught were also eliminated from the analysis.

Estimates of the proportion of mature males and females at

different lengths were developed from gonads sampled off the coast of Florida between 1977 and 1980 (Ron Taylor, personal communication). Males started maturing at 90 cm LJFL, 50% were mature at 113 cm and 100% were mature at 165 cm. Females started maturing at 150 cm LJFL, 50% were mature at 171 cm and 100% were mature at 235 cm. To examine changes over time with respect to size categories that relate to these maturity values and can be aggregated from size frequency samples of numbers at 5 cm intervals, the following LJFL categories were established: fish less than 110 cm, fish from 110 cm to 169 cm, fish from 170 cm to 234 cm, and fish 235 cm or more nominal. Nominal CPUE values were calculated by dividing the number in a category caught on a trip, by the numbers of hooks fished and multiplying by 1,000. U.S. gear and operational information can be found in Hoey and Bertolino (1988) and in Berkeley, Irby, and Jolley (1981). Information on the Spanish fishery is provided by Rey, Mejuto, and Iglesias (1988) and a comparison of U.S. and Spanish operations in the central North Atlantic is provided by Hoey et al (1988).

#### MODEL DEVELOPMENT

In previous work on swordfish CPUE's from the U.S. data base, year, area, month, and month-area interaction terms were significant (Hoey 1986, Parrack 1986). In the recent analysis of U.S. catch and effort information (Hoey et al. 1988), models were developed which included terms for year, quarter, area, set size, percent swordfish, operation type, and quarter-area and operation-area interaction terms. Quarter of the year is substituted for month as a seasonal variable (Quarter 1-January-March, Quarter 2-April-June, etc.) to avoid problems caused by small monthly samples or empty (no observations) month strata. Figure 1 illustrates the nine geographical areas that are used in this analysis. The set size variable was developed to introduce a term that would track gear differences that exist within the U.S. fishery. The rationale for that variable is described in Hoey et al (1988). The set size is the average number of hooks fished on a set during a trip, categorized as follows: less than 100 hooks per set (set size 1), 100 to 299 (set size 2), 300 to 499 (set size 3), 500 to 899 (set size 4), 900 to 1499 (set size 5), and 1,500 or more (set size 6).

The percent swordfish variable was developed to address diversification in the U.S. longline fishery as operators have directed more effort towards tunas and therefore changed the effectiveness of their effort with respect to harvesting swordfish. Information on the incidental species harvested on specific Spanish swordfish trips was not available for this analysis. Therefore, the percent swordfish variable was not included in the combined CPUE analyses.

The operation type variable was a categorization of a subsample of U.S. vessels. In the U.S. trip effort file 57% of the vessels were represented by observations in only one year and many were represented by a small number of observations (less than 5) in 1986 or 1987. It was thought that the inclusion of vessels for which little data was available might bias CPUE trends and increase the variability considerably. Therefore the data was restricted to vessels represented by data in 2 or more years. The 97 vessels selected (43%) accounted for 1,408 trip observations (76%). These vessels were then grouped into 7 operation categories based primarily on gear, port, and operational information, and secondarily on the vessels history in the fishery and corporate affiliation. We believe this grouping partly defines vessels which may fish together or may fish in similar ways. The operations are characterized as follows: operation 1 - traditional northeast, operation 2 - New Distant water, operation 3 - intermittent Gulf, Operation 4 - Mid Atlantic mixed species, operation 5 - new coastal vessels FL-NY, operation 6 - new coastal vessels southeast, and operation 7 - new Gulf of Mexico. Although this subsampling did not significantly alter the pattern in the index trends, the resulting models had higher r-square values and lower mean square error terms than the models which included data from all vessels.

In the subsequent analysis of combined CPUE data, the subsample of U.S. vessels was used with the available Spanish trip information. Rather than introducing a nation variable to attempt to standardize between U.S. and Spanish fleets, the Spanish data was categorized as a separate operation type (operation 8). This is a more reliable (efficient) approach in light of the relatively constant gear and operating style of the Spanish fleet and the diversity of U.S. operations. The number of trips, total numbers of swordfish caught, and the mean nominal CPUE's for the subsample of U.S vessels and Spanish trips (2,475 observations) are provided by geographical area and year in Table 1.

In the analysis of the combined CPUE data, models include terms for 7 years (81-87), 4 quarters, 9 areas, 6 set size variables, 8 operation types, and quarter-area and operation-area interaction terms. The areas used in this analysis are different from those used in the analysis of U.S. catch rates (Hoey et al 1988). As in the analysis of the U.S data, operation-area interaction terms were only specified for those operations which recorded similar numbers of observations in several areas. Those operations which were primarily restricted to a single area with only small numbers of observations outside of that area were not considered for operation-area interaction terms. With respect to the treatment of zero catches, results obtained after deleting the zero values or after adding 0.1 or 1.0, were similar to those described in the analysis of U.S. catch rates. As in that analysis, using the zero values did not appear to improve the

model or significantly affect the trend that was detected, but it substantially increased the mean square error term and reduced the proportion of variability explained. Zero values were therefore eliminated from the final models which are presented.

## RESULTS

In the length class analyses of the combined U.S. and Spanish trip data, the standard cell was defined as 1984, quarter 3, area 5 (Grand Banks), set size 4 (500-899 hooks/set), and operation 5 (new coastal FL-NY). Area-quarter and operation-area interaction terms were incorporated into the models. In each of the analyses, different interaction terms were eliminated because observations were not recorded in those cells, or, as mentioned in the case of the operation-area interactions, the sample was extremely limited. Operation 8 (Spanish fleet) and set size 6 (greater than 1,500 hooks/set) were found to be highly correlated because the vast majority of the set size 6 observations were from the Spanish fishery. In the final analyses set size 6 was eliminated. Table 2 lists the number of observations, number of terms, R square, mean square error, and F statistic for each length analysis. The GLM model terms and their estimated coefficients and 90% confidence intervals are provided in the Appendix for each analysis.

### LESS THAN 110 CM LJFL INDEX (<50% Males Mature-Female Immature)

The analysis of catch rates of swordfish less than 110 cm LJFL evaluated 1,828 observations. The regression included terms for 52 parameters and explained 66.9% of the variation. Estimated yearly index values and 90% confidence intervals are presented in Figure 2 with a histogram plot of the standardized residuals. The residuals are acceptable because they do not indicate significant kurtosis or skewness and are similar to a normal distribution. The proportion of variability explained is higher than previous bluefin and swordfish CPUE analyses. The annual index increased between 1981 (.29) and 1983 (.33) and then declined slightly in 1984 (2.8). A slight increase in 1985 (.32) was followed by a 50% increase in 1986 (4.8) and then an additional increase in 1987 (.52). Overall the index increased 88% between 1981 and 1987.

### 110 TO 169 CM LJFL INDEX (>50% Males Mature-<50% Females Mature)

The analysis of catch rates of swordfish greater than 109 cm LJFL but less than 170 cm LJFL evaluated 2,449 observations. The regression included terms for 53 parameters and explained 74.2% of the variation. Estimated yearly index values and 90% confidence intervals are presented in Figure 3 with a histogram plot of the standardized residuals. The residuals are acceptable

and the proportion of variability explained is very high for an analysis of large pelagic catch rates. The annual index increased between 1981 (12.5) and 1982 (14.7) and then declined and fluctuated between 12.0 and 13.7 between 1983 and 1987. Overall the index in 1987 was approximately 10% greater than in 1981 and 7% below the peak value in 1982.

#### 170 TO 234 CM LJFL INDEX (Males Mature - 50-100% Females Mature)

The analysis of catch rates of swordfish greater than 169 cm LJFL but less than 235 cm LJFL evaluated 2,272 observations. The regression included terms for 53 parameters and explained 61.0% of the variation. Estimated yearly index values and 90% confidence intervals are presented in Figure 4 with a histogram plot of the standardized residuals. The residuals are acceptable and the proportion of variability explained is high. The annual index declined 58% from 1981 (31.5) to 1983 (13.2). After 1983 the index continued to decline at a slower rate with the 1987 value (8.1) reflecting an overall decline of 74% from 1981-1987.

#### GREATER THAN 234 CM LJFL INDEX (All Mature)

The analysis of catch rates of swordfish greater than 234 cm LJFL evaluated 969 observations. The regression included terms for 53 parameters and explained 80.4% of the variation. Estimated yearly index values and 90% confidence intervals are presented in Figure 5 with a histogram plot of the standardized residuals. The residuals are slightly skewed in comparison to the residuals of the previous runs, but they are not unacceptable. The proportion of variability explained is the highest recorded for recent swordfish CPUE analyses. The annual index declined 46% from 1981 (.92) to 1982 (.49). The index increased slightly in 1983 (.55) and then declined steadily. The 1987 value (.37) indicates an overall decline of 60% from 1981-1987.

### DISCUSSION

The indices developed in this report are consistent with recent analysis of U.S. CPUE data. The proportion of variability explained by these analyses (61% to 80%) is high for an analyses of catch rates of large oceanic predators. The residuals are acceptable and the 90% confidence intervals indicate that significant trends have been detected. Estimates of the mean square error indicate that there is a good probability that VPA's tuned to these indices of abundance will be reliable.

This report represents an expansion of similar analyses which considered only U.S. data. Conclusions with respect to the

importance of year, area, quarter, and area-quarter interaction terms accounting for the largest proportion of overall variability are supported by this analyses. Although a variable that accounted for incidental species caught on the trip was not included, the use of set size, operation type, and operation-area interactions represented an improvement over models which did not include these terms. Refinement of these variables is not likely to produce dramatically improved results. However, the incorporation of temperature and water mass information would seem to offer the greatest possibility of additional insight. The addition of data from the Japanese high seas tuna fishery combined with more specific gear and operation information from the U.S. and Spanish fisheries would allow gear efficiency and selectivity questions to be addressed in a more rigorous fashion.

The coefficients for the model terms in each analysis are listed in the appendix. The range of coefficient values indicates the importance of standardizing catch rates when you are attempting to investigate abundance trends. Coefficient values provide a measure of relative fishing power. General patterns between terms which are combined as interactions (area, quarter, area-quarter) need to be compared. In particular the coefficients for the distant areas (1,5,6 and 8), which have recently been exploited by the expanding U.S. and Spanish fleets, are larger than other terms for the analysis of the 170 to 234 cm LJFL catch rates. Generally, the relative importance of specific terms in each model agree with qualitative information from the fisheries relating to area-time distributions, and the effectiveness of different operation types.

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Table 1. The number of trips, number of swordfish, and mean CPUE's (number per 1,000 hooks) by area and year for the U.S. vessel subsample and Spanish trips with effort data.

NUMBER OF TRIPS

<u>AREA</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>TOTAL</u>
1	0	0	0	0	10	39	72	121
2	0	0	6	4	28	32	41	111
3	29	39	44	82	68	118	260	640
4	11	56	75	67	41	80	116	446
5	3	6	12	18	44	56	68	207
6	0	1	18	81	60	64	15	239
7	0	20	88	45	47	52	14	266
8	0	4	1	4	6	1	0	16
9	0	1	33	43	81	189	82	429
<u>TOTAL</u>	<u>43</u>	<u>127</u>	<u>277</u>	<u>344</u>	<u>385</u>	<u>631</u>	<u>668</u>	<u>2,475</u>

NUMBER OF SWORDFISH CAUGHT

<u>AREA</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>TOTAL</u>
1	-	-	-	-	735	5268	8554	14,557
2	-	-	132	308	1023	601	612	2,676
3	514	1038	1191	2343	2365	4964	9025	21,440
4	541	2419	2451	3477	2255	4366	5674	21,183
5	677	1942	2460	4819	11971	13292	16887	52,048
6	-	97	3105	11563	7853	9869	2483	34,970
7	-	1296	7351	3755	3125	4545	1480	21,552
8	-	394	30	406	542	58	0	1,430
9	-	137	2895	3738	8920	26691	15133	57,514
<u>TOTAL</u>	<u>1732</u>	<u>7323</u>	<u>19615</u>	<u>30409</u>	<u>38789</u>	<u>69654</u>	<u>59848</u>	<u>227,370</u>

MEAN CPUE's (Numbers per 1,000 hooks)

<u>AREA</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1	-	-	-	-	34.5	51.2	35.7
2	-	-	46.1	50.6	21.3	12.8	8.3
3	46.9	43.6	37.7	27.4	26.0	35.6	35.2
4	55.5	46.9	28.8	25.6	34.1	28.8	20.4
5	10.8	20.5	20.1	33.5	40.7	21.3	18.6
6	-	5.8	9.5	5.8	5.2	5.5	4.6
7	-	5.2	4.9	3.9	4.7	4.5	7.3
8	-	5.4	2.4	5.6	3.8	2.1	-
9	-	8.1	3.6	4.5	5.6	6.9	-

Table 2. The number of observations, number of terms, R square, mean square error, and F statistic for each length category analysis.

LENGTH CLASS	NUMBER OF OBSERVATIONS	NUMBER OF TERMS	R SQUARE	MEAN SQUARE ERROR	F STATISTIC
<110 cm	1,828	52	.67	.87	70.4
110-169 cm	2,449	53	.74	.41	132.5
170-234 cm	2,272	53	.61	.43	66.8
>234 cm	969	53	.80	.47	72.2

Figure 1. Geographical areas used in the analysis of combined U.S. and Spanish catch and effort data for Atlantic swordfish.

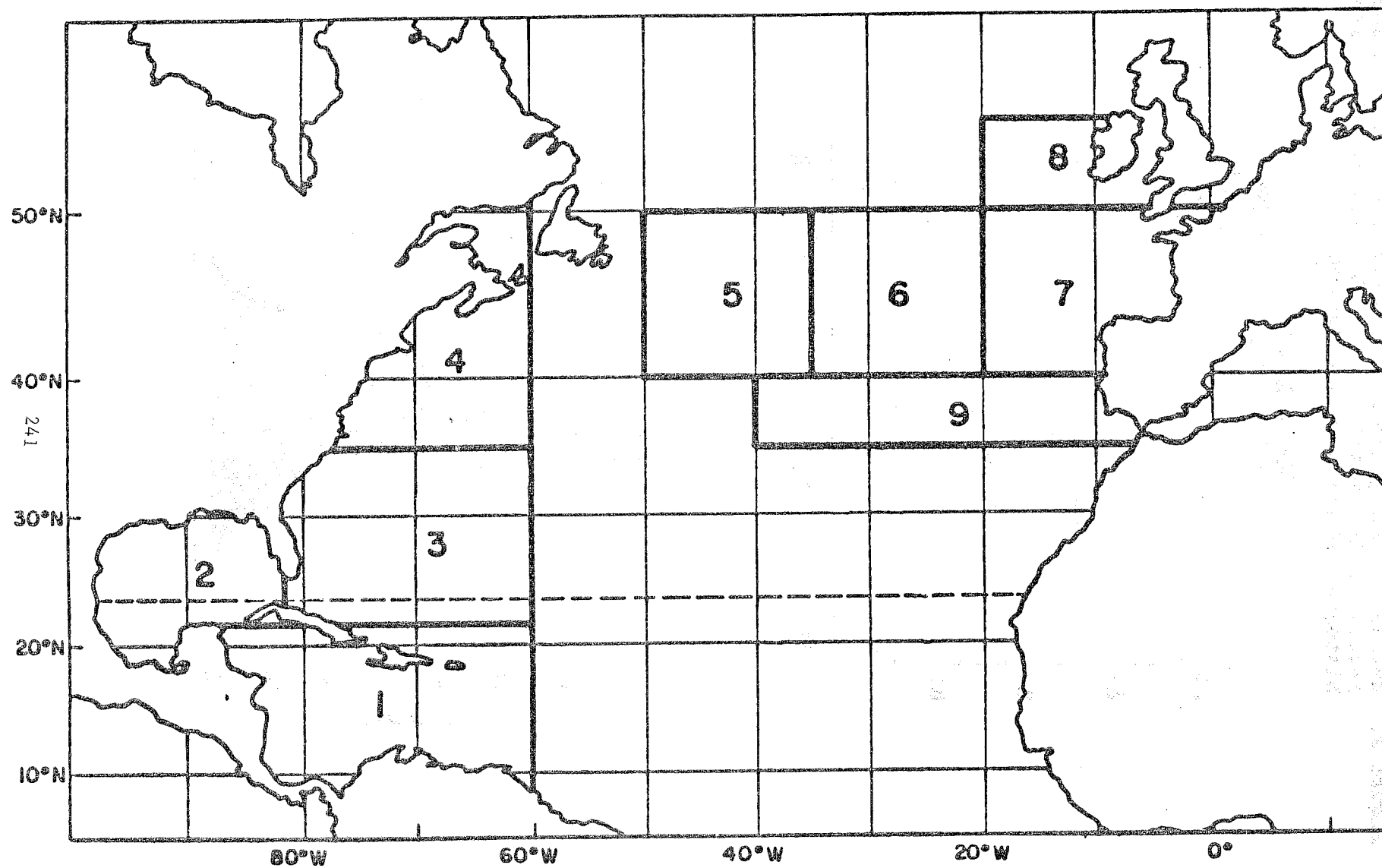


Figure 2. Estimated yearly index of abundance and 90% confidence intervals for swordfish less than 110 cm LJFL, with a histogram of standardized residuals.

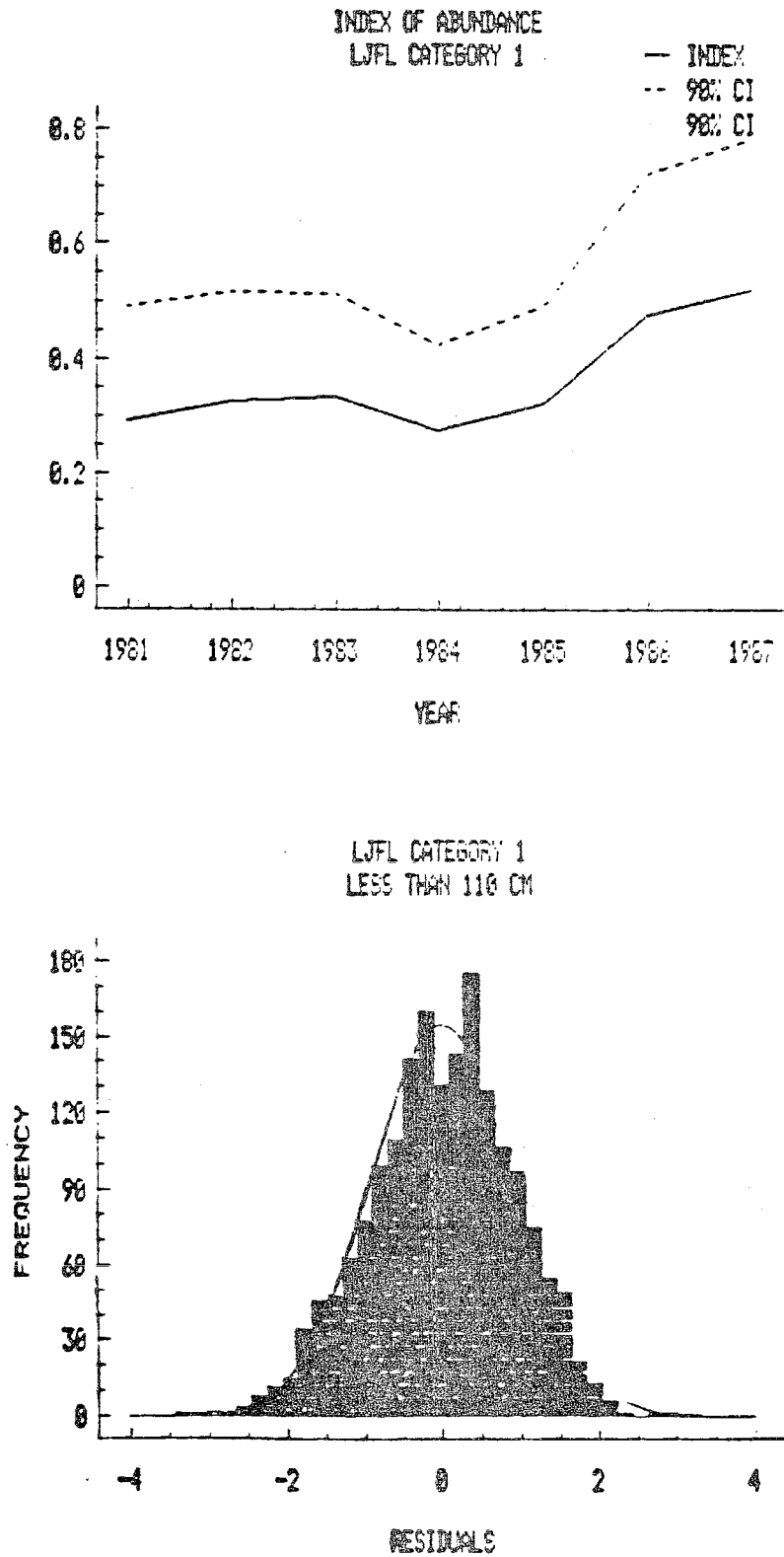


Figure 3. Estimated yearly index of abundance and 90% confidence intervals for swordfish greater than 109 cm but less than 170 cm LJFL, with a histogram of standardized residuals.

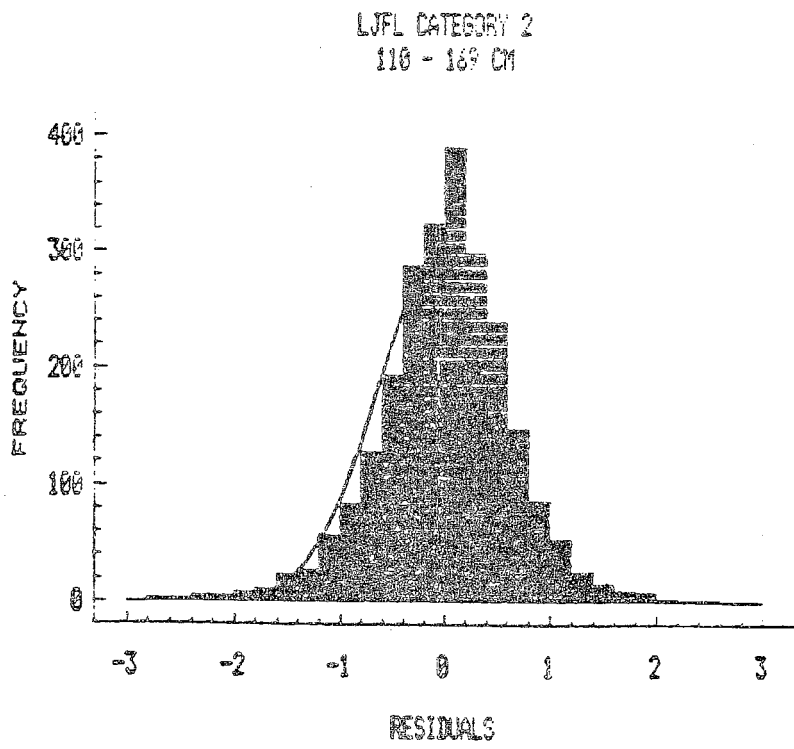
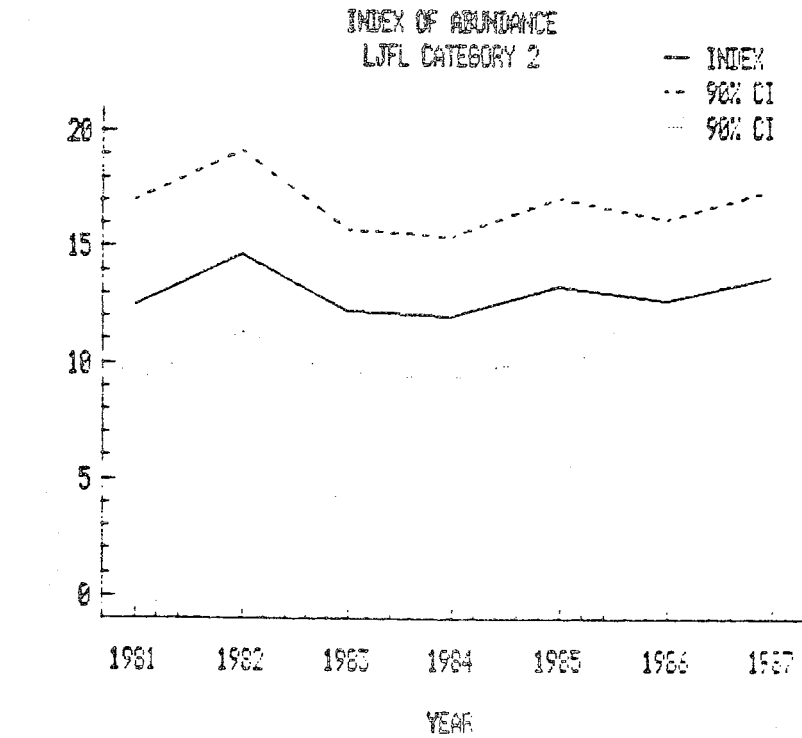


Figure 4. Estimated yearly index of abundance and 90% confidence intervals for swordfish greater than 169 cm but less than 235 cm LJFL, with a histogram of standardized residuals.

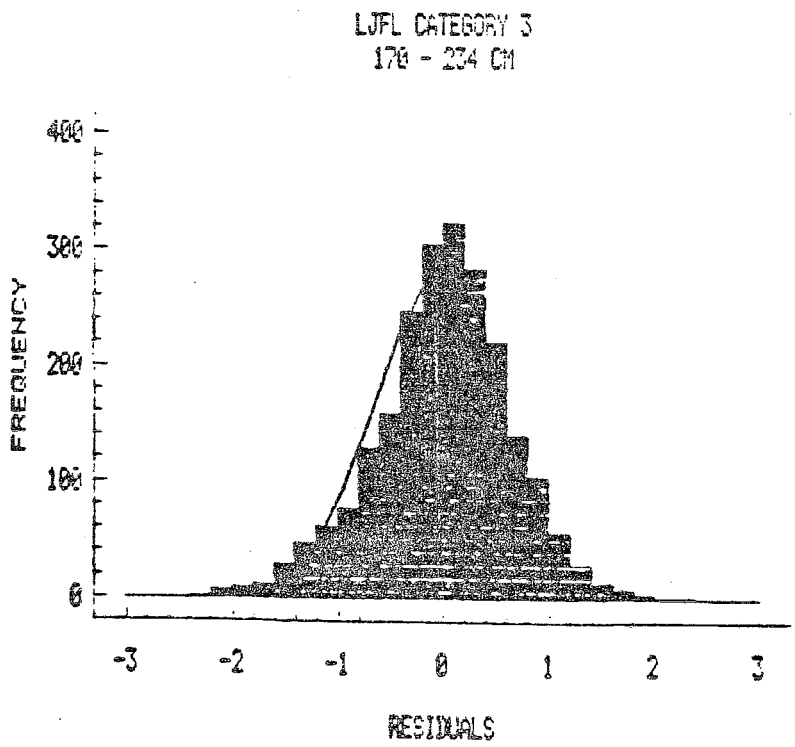
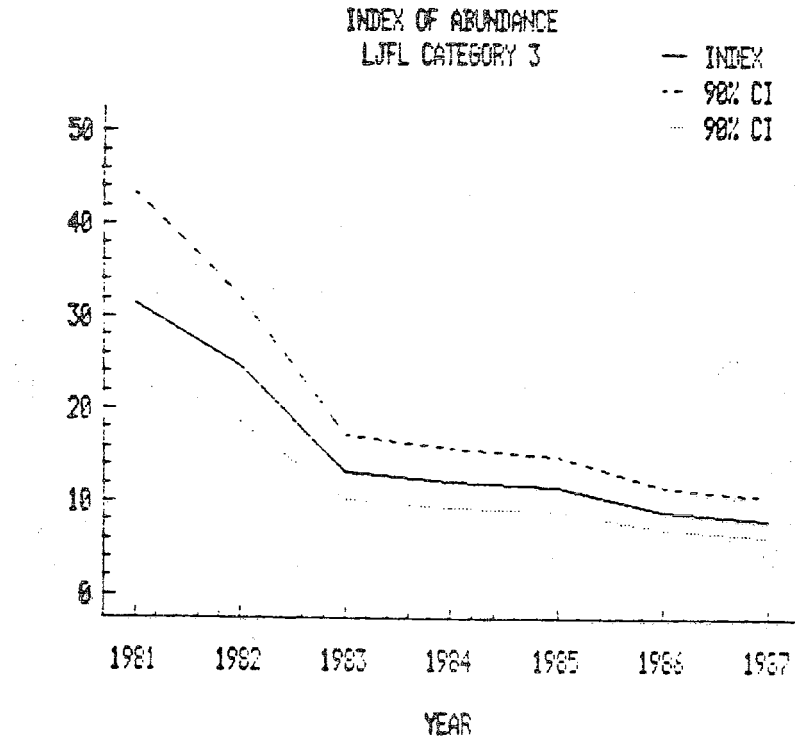
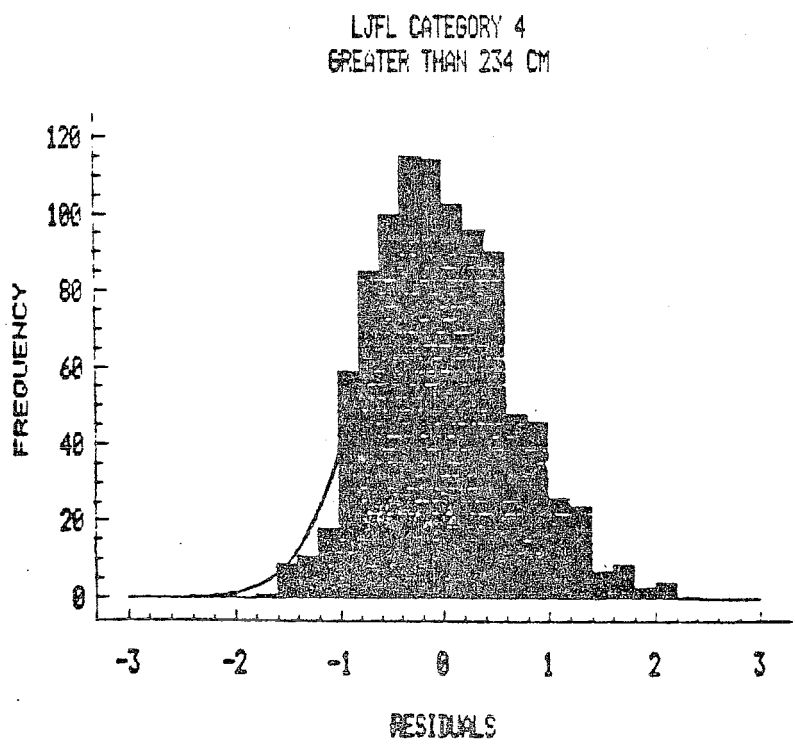
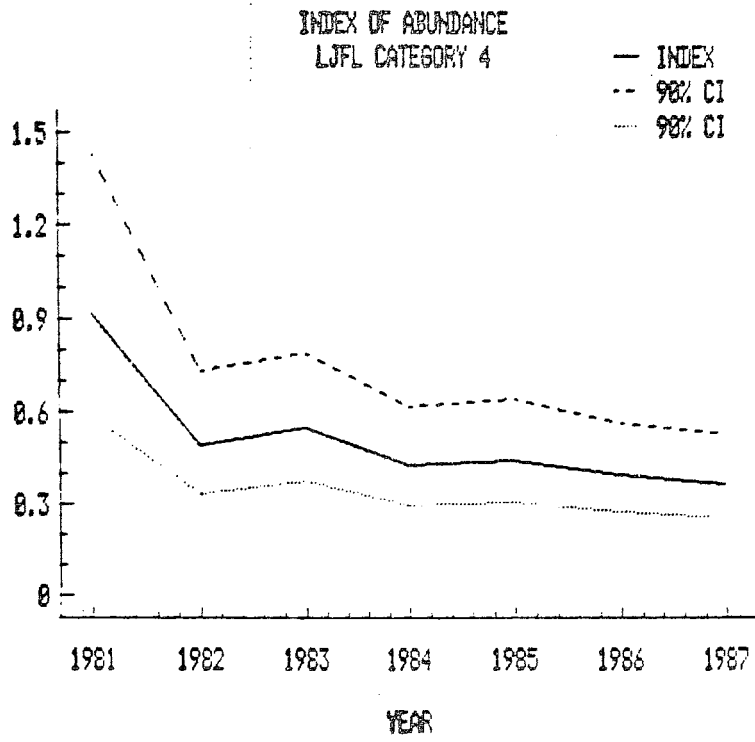


Figure 5. Estimated yearly index of abundance and 90% confidence intervals for swordfish greater than or equal to 235 cm LJFL, with a histogram of standardized residuals.



1. Parameter estimates and 90% confidence intervals for model terms in the GLM analyses of U.S. and Spanish catch rates of swordfish less than 110 cm LJFL.

	CODE	ESTIMATE	LOWER 90% CI	UPPER 90% CI
1	CONST	0.27500	0.17816	0.42448
2	YB1	0.29054	0.17151	0.49218
3	YB2	0.32502	0.20466	0.51616
4	YB3	0.33263	0.21563	0.51312
5	YB5	0.32166	0.21078	0.49087
6	YB6	0.47587	0.31382	0.72159
7	YB7	0.51811	0.34203	0.78484
8	Q1	0.11205	0.05371	0.23374
9	Q2	0.15948	0.09257	0.27476
10	Q4	0.39792	0.23191	0.68279
11	A1	0.32917	0.12874	0.84166
12	A2	0.57064	0.34110	0.95464
13	A3	0.60355	0.43421	0.83893
14	A4	0.48433	0.35648	0.65803
15	A6	0.26353	0.14841	0.46793
16	A7	0.31909	0.18066	0.56360
17	A8	0.20975	0.06368	0.69084
18	A9	0.37628	0.20786	0.68115
19	SS2	1.03019	0.67322	1.57646
20	SS3	0.62147	0.40906	0.94416
21	SS5	0.21448	0.13405	0.34319
22	DF1	0.11142	0.07623	0.16286
23	DF2	0.53522	0.38980	0.73488
24	DF3	0.14475	0.08714	0.24044
25	DF4	0.16806	0.10449	0.27033
26	DF6	0.35157	0.22533	0.54855
27	DF7	0.12705	0.07819	0.20646
28	DF8	0.17328	0.13189	0.22766
29	Q1A1	0.42380	0.12954	1.38656
30	Q1A2	0.76325	0.29529	1.97282
31	Q1A3	0.28295	0.13009	0.61545
32	Q1A4	0.67756	0.26495	1.73269
33	Q1A6	0.20757	0.08757	0.49204
34	Q1A7	0.11988	0.04873	0.29491
35	Q1A9	0.39109	0.17233	0.88756
36	Q2A1	0.70337	0.23679	2.08928
37	Q2A2	0.40800	0.17484	0.95210
38	Q2A3	0.18795	0.10299	0.34300
39	Q2A4	0.20637	0.11137	0.38240
40	Q2A6	0.11538	0.05773	0.23062
41	Q2A7	0.12927	0.04361	0.38318
42	Q2A9	0.19592	0.09981	0.38456
43	Q4A1	0.25315	0.08213	0.78026
44	Q4A2	0.33683	0.14666	0.77358
45	Q4A3	0.26741	0.13774	0.51914
46	Q4A4	0.47300	0.24518	0.91249
47	QAA6	0.33138	0.16122	0.68112
48	Q4A7	0.19039	0.09388	0.38614
49	Q4A9	0.30162	0.14673	0.62005
50	A102	0.14562	0.06484	0.32704
51	A401	0.64536	0.23917	1.74138
52	A402	0.09743	0.04432	0.21428

2. Parameter estimates and 90% confidence intervals for model terms in the GLM analyses of U.S. and Spanish catch rates of swordfish greater than 109 cm but less than 170 cm LJFL.

	CODE	ESTIMATE	LOWER 90% CI	UPPER 90% CI
1	CONST	12.03919	9.36564	15.47595
2	Y81	12.51707	9.21773	16.99735
3	Y82	14.68867	11.27300	19.13927
4	Y83	12.24990	9.52884	15.74798
5	Y85	13.36425	10.43297	17.11910
6	Y86	12.67588	9.92279	16.19281
7	Y87	13.72713	10.75906	17.51398
8	Q1	8.42156	5.39049	13.15698
9	Q2	11.36388	8.25801	15.63787
10	Q4	11.17361	8.22801	15.17372
11	A1	13.55376	7.17044	25.61969
12	A2	2.62922	1.96974	3.50951
13	A3	6.05387	4.96941	7.37498
14	A4	4.16261	3.47838	4.98143
15	A6	7.75327	5.45139	11.02715
16	A7	5.53244	3.95991	7.72943
17	A8	1.25146	0.82127	1.90698
18	A9	7.15503	4.98795	10.26364
19	SS1	35.75346	20.86037	61.27936
20	SS2	36.72522	28.58730	47.17977
21	SS3	29.22610	22.83733	37.40213
22	SS5	11.42709	8.75765	14.91020
23	OP1	8.22353	6.71287	10.07415
24	OP2	14.25029	11.76917	17.25447
25	OP3	10.57468	7.86939	14.20996
26	OP4	9.23263	6.97384	12.22302
27	OP6	13.93360	10.78842	17.99569
28	OP7	3.07047	2.29510	4.10780
29	OP8	3.55744	2.99684	4.22290
30	Q1A1	10.52793	4.86291	22.79238
31	Q1A2	18.87696	10.82077	32.93109
32	Q1A3	8.58929	5.36906	13.74093
33	Q1A4	20.31141	11.59098	35.59261
34	Q1A6	11.17807	6.72957	18.56719
35	Q1A7	12.22990	7.38906	20.24215
36	Q1A9	19.55977	11.85882	32.26160
37	Q2A1	7.38280	3.59942	15.14294
38	Q2A2	8.65710	5.35202	14.00320
39	Q2A3	8.78376	6.17491	12.49482
40	Q2A4	11.36056	7.97949	16.17425
41	Q2A6	6.09651	4.09513	9.07600
42	Q2A7	7.77585	4.69343	12.88266
43	Q2A9	8.12588	5.42823	12.16417
44	Q4A1	8.71908	4.18916	18.14741
45	Q4A2	16.52620	10.30853	26.49411
46	Q4A3	13.07020	8.94134	19.10565
47	Q4A4	19.88367	13.67005	28.92165
48	QAA6	17.28415	11.32140	26.38737
49	Q4A7	11.90908	8.00776	17.71110
50	Q4A9	20.23401	13.28383	30.82056
51	A102	7.91179	4.88817	12.80570
52	A401	15.38187	9.02080	26.22848
53	A402	9.61614	5.99922	15.41369

3. Parameter estimates and 90% confidence intervals for model terms in the GLM analyses of U.S. and Spanish catch rates of swordfish greater than 169 cm but less than 235 cm LJFL.

CODE	ESTIMATE	LOWER 90% CI	UPPER 90% CI	
1	CONST	12.13685	9.35980	15.73785
2	Y81	31.46570	22.84277	43.34371
3	Y82	24.48692	18.63057	32.18415
4	Y83	13.21398	10.19215	17.13175
5	Y85	11.58741	8.97113	14.96668
6	Y86	8.98641	6.97630	11.57570
7	Y87	8.12978	6.31932	10.45893
8	Q1	24.62793	15.60068	38.87875
9	Q2	16.87093	12.17139	23.38503
10	Q4	11.02452	8.04448	15.10851
11	A1	11.11658	5.78594	21.35840
12	A2	1.35446	0.96470	1.90169
13	A3	1.42851	1.14848	1.77683
14	A4	1.79941	1.47413	2.19648
15	A6	6.74768	4.70290	9.68150
16	A7	11.43121	8.11944	16.09380
17	A8	15.13874	10.02428	22.86262
18	A9	6.99018	4.82916	10.11824
19	SS1	29.55045	17.70642	49.31710
20	SS2	25.62054	19.71274	33.29887
21	SS3	20.39647	15.75962	26.39760
22	SS5	12.47219	9.46086	16.44200
23	OP1	6.67506	5.41821	8.22346
24	OP2	10.51469	8.60490	12.84836
25	OP3	11.67197	8.58299	15.87267
26	OP4	10.90880	8.14682	14.60718
27	OP6	12.37017	9.48996	16.12453
28	OP7	5.21397	3.81730	7.12166
29	OP8	1.67055	1.40382	1.98797
30	Q1A1	3.44209	1.56478	7.57166
31	Q1A2	6.77426	3.71626	12.34860
32	Q1A3	9.82753	6.04996	15.96381
33	Q1A4	11.98175	6.75092	21.26561
34	Q1A6	14.49251	8.62861	24.34145
35	Q1A7	6.67842	3.99258	11.17103
36	Q1A9	6.29996	3.77774	10.50617
37	Q2A1	3.62215	1.74036	7.53867
38	Q2A2	7.65187	4.05817	14.42799
39	Q2A3	15.71139	10.91731	22.61067
40	Q2A4	12.19182	8.48176	17.52474
41	Q2A6	10.84326	7.22242	16.27936
42	Q2A7	4.79689	2.86655	8.02710
43	Q2A9	5.37118	3.55752	8.10947
44	Q4A1	5.17483	2.44888	10.93511
45	Q4A2	9.57837	5.67730	16.15999
46	Q4A3	14.66302	9.87818	21.76556
47	Q4A4	13.93733	9.48443	20.48085
48	QAA6	31.71647	20.58240	48.87352
49	Q4A7	11.82480	7.88414	17.73509
50	Q4A9	18.40324	11.96962	28.29492
51	A102	11.30355	6.88686	18.55275
52	A401	21.16392	12.17956	36.77566
53	A402	13.67604	8.40876	22.24275

4. Parameter estimates and 90% confidence intervals for model terms in the GLM analyses of U.S. and Spanishish catch rates of swordfish greater than or equal to 235 cm LJFL.

	CODE	ESTIMATE	LOWER 90% CI	UPPER 90% CI
1	CONST	0.42659	0.29432	0.61829
2	YB1	0.91587	0.58264	1.43968
3	YB2	0.49117	0.32985	0.73140
4	YB3	0.54510	0.37570	0.79088
5	YB5	0.44163	0.30422	0.64111
6	YB6	0.39341	0.27376	0.56536
7	YB7	0.36542	0.25359	0.52656
8	Q1	0.62805	0.34564	1.14121
9	Q2	0.55979	0.34709	0.90283
10	Q4	0.50554	0.33074	0.77274
11	A1	0.26668	0.08317	0.85514
12	A2	0.24569	0.12199	0.49482
13	A3	0.47188	0.32246	0.69056
14	A4	0.40674	0.29255	0.56550
15	A6	0.52883	0.24093	1.16080
16	A7	0.97124	0.57566	1.63866
17	A8	2.39530	1.39958	4.09943
18	A9	0.38801	0.20976	0.71773
19	SS1	7.34096	3.02608	17.80842
20	SS2	0.81819	0.57468	1.16488
21	SS3	0.53806	0.37938	0.76311
22	SS5	0.53836	0.36080	0.80331
23	DP1	0.22035	0.17197	0.28234
24	DP2	0.33563	0.25290	0.44542
25	DP3	0.26377	0.16559	0.42017
26	DP4	0.27492	0.17692	0.42721
27	DP6	0.54663	0.37119	0.80499
28	DP7	0.63527	0.34172	1.18099
29	DP8	0.03967	0.03026	0.05200
30	Q1A1	0.51656	0.14111	1.89094
31	Q1A2	0.29783	0.10846	0.81780
32	Q1A3	0.37892	0.19368	0.74133
33	Q1A4	0.70850	0.32897	1.52589
34	Q1A6	0.33861	0.13713	0.83609
35	Q1A7	0.13089	0.06307	0.27165
36	Q1A9	0.32214	0.15181	0.68359
37	Q2A1	0.56837	0.16054	2.01232
38	Q2A2	0.61077	0.15829	2.35675
39	Q2A3	0.29757	0.17143	0.51653
40	Q2A4	0.65485	0.38467	1.11478
41	Q2A6	0.24410	0.10597	0.56228
42	Q2A7	0.20518	0.09289	0.45322
43	Q2A9	0.35879	0.18223	0.70640
44	Q4A1	0.84754	0.24237	2.96371
45	Q4A2	0.37220	0.13532	1.02373
46	Q4A3	0.42699	0.24125	0.75571
47	Q4A4	0.47161	0.28054	0.79282
48	Q4A6	0.51115	0.22673	1.15235
49	Q4A7	0.26853	0.15358	0.46954
50	Q4A9	0.55705	0.29090	1.06673
51	A102	0.40697	0.20180	0.82071
52	A401	0.27979	0.13662	0.57296
53	A402	0.33726	0.16427	0.69241