STANDARDIZED INDICES OF ABUNDANCE AT AGE FOR SWORDFISH *(XIPHIAS GLADIUS)* FROM THE SPANISH LONGLINE FLEET IN THE ATLANTIC, 1983-92

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SUMMARY

As in previous papers, standardized age-specific indices of abundance were developed using General Linear Modeling (GLM) procedures using trips carried out by the Spanish surface longline fleet targeting swordfish in the Atlantic from 1983-1992.

Indices were developed for ages ranging from 1 to 5+ obtained by slicing corresponding to each one of the stock hypotheses traditionally adopted by ICCAT. The criteria used to define areas and time periods were very similar to those used in previous analyses.

The variability rate explained by the model was within the range 14% to 41%, very close to those obtained in previous analyses.

RESUME

A partir des données de marées réalisées par la flottille espagnole palangrière de surface qui vise l'espadon dans l'océan Atlantique durant la période 1983-92, des indices d'abondance standardisés ont été élaborés, par classes d'âge, en utilisant pour cela les méthodes du Modèle linéaire généralisé (GLM).

Les indices ont été élaborés pour les âges 1 à 5+ pour chacune des hypothèses de stock traditionnnellement adoptées par l'ICCAT. Les critères dans la définition des strates spatio-temporelles ont été semblables à celles réalisées dans des analyses précédentes.

Le taux de variabilité indiqué par le modèle se situait entre 14 et 41%, dans la gamme des valeurs d'analyses précédentes.

RESUMEN

A partir de datos de mareas realizadas por la flota española de palangre de superficie dirigida al pez espada en el Océano Atlántico durante el período 1983-1992, se han desarrollado índices de abundancia estandarizados, por clases de edad, usando para ello procesos de Modelo Lineal Generalizado (GLM).

Los índices fueron desarrollados para las edades 1 a 5+ para cada una de las hipótesis de stock tradicionalmente asumidas por ICCAT. Los criterios en la definición de estratos espacio-temporales fueron similares a los realizados en análisis precedentes.

La tasa de variabilidad mostrada por el modelo se encontró entre el 14% y el 41%, dentro del rango de valores de análisis precedentes.

1. BACKGROUND

The CPUE data from the Spanish surface longline fleet targeting Atlantic swordfish have been traditionally used at the ICCAT workshops to define trends in the stock(s) of this Atlantic species.

Until 1987, the overall nominal indices in weight were used to estimate these trends (MEJUTO & GARCES, 1988). After the SWO workshop in 1987, standardized indices were developed as a ICCAT routine bases with data from the Spanish longline fleet (ANONYMOUS, 1988).

Standardized indices of relative abundance of swordfish by size groups, assumed as "ages", have been developed in the last few years using commercial fleet data, (HOEY et al., 1989; ANONYMOUS, 1989; ANONYMOUS, 1991; ANONYMOUS, 1992; MEJUTO, en prensa).

The Generalized Linear Modelling technique (GLM) (ROBSON, 1966; GAVARIS, 1980; KIMURA, 1981) seems to be a very useful instrument in the estimation of relative abundance indices, based on data from commercial fleets with unbalanced spatial and temporal fishing patterns.

2. MATERIAL AND METHODS

2.1 BASIC DATA:

The records used in the analyses are from Spanish longline activity in the Atlantic Ocean. Data are usually provided by records per trip obtained by the Spanish Oceanography Institute (IEO) when fish are landed at the different base ports used by the Atlantic fleet. Records from the Mediterranean sea were rejected.

In recent years, with the introduction of vessels having freezing systems on board, and whose trips last over 60 days at sea, the use of log-books designed specifically for this fleet has been recommended to be introduced progressively and voluntarily.

In this case, the information obtained per set is compiled in a "sub-trip" (sets carried out consecutively in the same 5 x 5 degree squares) and is treated as an observation or trip of the traditional fleet.

Following the traditional criteria, nominal effort was defined by number of hooks (in thousands of hooks), calculated from the number of sets carried out, and the mean number of hooks per set or computing the number of hooks by set.

2.2. AGEING

As in previous years, the transformation of the distribution from sizes to ages 1, 2, 3, 4, 5+ was done by applying the technique known as "slicing", assuming that no overlapping existed between consecutive ages. The growth equation used was generated from mark-recapture data, assuming combined sexes (ANONYMOUS, 1989).

2.3. MODEL AND SPECIFICATIONS

The areas used in the analysis are shown in Figures 1. We have used the same criteria to define the areas as in previous year (MEJUTO in press).

For the North-South Atlantic analyses, the hypothetical boundary line was assumed to be located at 5º N latitude.

The year sequence from 1983 to 1992 was analyzed when available. A few observations available for the South Atlantic from 1988 to 1991 were tentatively analyzed.

The temporal definition corresponded to "quarters" as follows:
Q1 = January, February, March
Q2 = April, May, June
Q3 = July, August, September
Q4 = October, November, December

The surface longline gear of the Spanish fleet has remained constant over the years analyzed in terms of structure and configuration (REY, et al., 1988; HOEY et al., 1988). Therefore, this variable was not taken into account in the model.

The analyses were done using the GLM procedure (under SAS computer PC software). The main effects considered were year, time and area.

The following model was defined:

$$LOG(CPUE) = u + Yi + Qj + Ak + Aj * Qk + eijk$$

u = overall mean.
Yi = logarithm of the effect year i.
Qj = logarithm of the effect time j.
Ak = logarithm of the effect area k.
e = logarithm of the normally distributed error term.

As in the previous works:
1.- Observations with values of CPUE = 0 were omitted from the analyses.
2.- Trip records in which the number of fish sampled was less than 85% of the capture in number were not used.

Areas 2 and 6 were combined and considered as area 2, just as areas 4 and 5 were combined as area 4 in order to improve the observation scheme (Figure 1).

Aditional methodological information can be seem in papers previously done.

3. RESULTS AND DISCUSSION

Tables 1 to 3 show the number of observations used for each stock hypothesis.

In general, the number of area/time observations are satisfactory. However, for the South Atlantic there are very few available observations and the tentative analyses are presented for information purposes.

As in previous analyses, standardized residual patterns for each age/stock considered in general show a normal distribution when the number of observations is suitable. The residual plots are not included in this paper because they show the same pattern as in previous works.

Table 4 is a summary of the ANOVA results for each stock hypothesis. Number of observations, R-square, mean square error (root) and F statistics for each age class/stock hypothesis. The variability rate explained by the model (R-squared) is between 14% and 41%. This variability rate was within the range of values obtained in analyses carried out in previous years.

Tables 5 to 7 provide information on estimated parameters, their standard error, relative CPUEs and upper and lower 95% confidence limits obtained for each age and stock hypothesis. The CPUE trends and their confidence limits by age and hypothesis are shown in figures 2 to 4.

Additional data from long print-out results are available from the author upon request .

ACKNOWLEDGMENTS.

I would like to sincerely thank J.M. de la Serna, B. García, M. Quintans and E. Alot for their untiring work creating data bases.

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Spanish Total Atlantic LL CPUE, 1983-1992
10:26 Monday, October 18, 1993

TABLE 1 OF AREA BY QTR
CONTROLLING FOR YR=1983

AREA QTR

Frequency	1	2	3	4	Total
1	1	3	0	0	4
2	21	3	23	65	112
3	13	16	2	2	33
4	1	1	0	0	2
7	0	0	0	0	0
8	0	0	0	0	0
Total	36	23	25	67	151

TABLE 2 OF AREA BY QTR
CONTROLLING FOR YR=1984

AREA QTR

Frequency	1	2	3	4	Total
1	1	0	9	3	13
2	36	33	11	43	123
3	13	13	0	17	43
4	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
Total	50	46	20	63	179

TABLE 3 OF AREA BY QTR
CONTROLLING FOR YR=1985

AREA QTR

Frequency	1	2	3	4	Total
1	7	18	6	3	34
2	12	23	26	46	107
3	56	10	3	19	88
4	0	0	0	0	0
7	0	0	0	0	0
8	0	0	0	0	0
Total	75	51	35	68	229

TABLE 4 OF AREA BY QTR
CONTROLLING FOR YR=1986

AREA QTR

Frequency	1	2	3	4	Total
1	4	36	49	12	101
2	14	18	19	70	121
3	87	28	21	80	216
4	1	1	1	3	6
7	0	0	0	0	0
8	0	0	0	0	0
Total	106	83	90	165	444

TABLE 5 OF AREA BY QTR
CONTROLLING FOR YR=1987

AREA QTR

Frequency	1	2	3	4	Total
1	14	49	28	8	99
2	17	7	3	23	50
3	46	17	5	71	139
4	2	4	2	7	15
7	0	0	0	0	0
8	0	0	0	0	0
Total	79	77	38	109	303

TABLE 6 OF AREA BY QTR
CONTROLLING FOR YR=1988

AREA QTR

Frequency	1	2	3	4	Total
1	6	50	40	4	98
2	2	11	27	62	102
3	19	39	16	57	131
4	17	53	32	31	133
7	0	0	2	1	3
8	0	0	0	0	0
Total	42	153	117	155	467

TABLE 7 OF AREA BY QTR
CONTROLLING FOR YR=1989

AREA QTR

Frequency	1	2	3	4	Total
1	7	47	26	9	89
2	24	16	17	56	113
3	69	12	12	96	189
4	35	23	18	31	107
7	9	5	2	8	24
8	0	0	0	0	0
Total	124	103	75	200	502

TABLE 8 OF AREA BY QTR
CONTROLLING FOR YR=1990

AREA QTR

Frequency	1	2	3	4	Total
1	1	46	27	3	77
2	8	7	30	23	66
3	104	23	11	86	224
4	31	31	18	20	100
7	0	0	6	19	25
8	0	1	2	0	3
Total	144	108	94	151	497

TABLE 9 OF AREA BY QTR
CONTROLLING FOR YR=1991

AREA QTR

Frequency	1	2	3	4	Total
1	2	36	37	0	75
2	6	8	30	60	104
3	109	31	14	86	240
4	18	40	32	24	114
7	4	7	13	27	51
8	3	19	8	11	41
Total	142	141	134	208	625

TABLE 10 OF AREA BY QTR
CONTROLLING FOR YR=1992

AREA QTR

Frequency	1	2	3	4	Total
1	1	50	24	3	78
2	10	11	40	39	100
3	56	17	19	84	176
4	80	43	57	70	250
7	0	16	34	43	93
8	8	39	0	9	56
Total	155	176	174	248	753

Table 1.- Number of trips (number of observations) by year, area and time strata used in the analyses for the TOTAL Atlantic hypothesis.

Spanish NORTH Atlantic LL CPUE, 1983-1992
4:27 Monday, October 18, 1993

TABLE 1 OF AREA BY QTR
CONTROLLING FOR YR=1983

AREA QTR

Frequency	1	2	3	4	Total
1	1	3	0	0	4
2	21	3	23	65	112
3	13	16	2	2	33
4	1	1	0	0	2
Total	36	23	25	67	151

TABLE 2 OF AREA BY QTR
CONTROLLING FOR YR=1984

AREA QTR

Frequency	1	2	3	4	Total
1	1	0	9	3	13
2	36	33	11	43	123
3	13	13	0	17	43
4	0	0	0	0	0
Total	50	46	20	63	179

TABLE 3 OF AREA BY QTR
CONTROLLING FOR YR=1985

AREA QTR

Frequency	1	2	3	4	Total
1	7	18	6	3	34
2	12	23	26	46	107
3	56	10	3	19	88
4	0	0	0	0	0
Total	75	51	35	68	229

TABLE 4 OF AREA BY QTR
CONTROLLING FOR YR=1986

AREA QTR

Frequency	1	2	3	4	Total
1	4	36	49	12	101
2	14	18	19	70	121
3	87	28	21	80	216
4	1	1	1	3	6
Total	106	83	90	165	444

TABLE 5 OF AREA BY QTR
CONTROLLING FOR YR=1987

AREA QTR

Frequency	1	2	3	4	Total
1	14	49	28	8	99
2	17	7	3	23	50
3	46	17	5	71	139
4	2	4	2	7	15
Total	79	77	38	109	303

TABLE 6 OF AREA BY QTR
CONTROLLING FOR YR=1988

AREA QTR

Frequency	1	2	3	4	Total
1	6	50	40	4	98
2	2	11	27	62	102
3	19	39	16	57	131
4	17	53	32	31	133
Total	42	153	115	154	464

TABLE 7 OF AREA BY QTR
CONTROLLING FOR YR=1989

AREA QTR

Frequency	1	2	3	4	Total
1	7	47	26	9	89
2	24	16	17	56	113
3	69	12	12	96	189
4	35	23	18	31	107
Total	115	98	73	192	478

TABLE 8 OF AREA BY QTR
CONTROLLING FOR YR=1990

AREA QTR

Frequency	1	2	3	4	Total
1	1	46	27	3	77
2	8	7	30	23	68
3	104	23	11	86	224
4	31	31	18	20	100
Total	144	107	86	132	469

TABLE 9 OF AREA BY QTR
CONTROLLING FOR YR=1991

AREA QTR

Frequency	1	2	3	4	Total
1	2	36	37	0	75
2	6	8	30	60	104
3	109	31	14	86	240
4	18	40	32	24	114
Total	135	115	113	170	533

TABLE 10 OF AREA BY QTR
CONTROLLING FOR YR=1992

AREA QTR

Frequency	1	2	3	4	Total
1	1	50	24	3	78
2	10	11	40	39	100
3	56	17	19	84	176
4	80	43	57	70	250
Total	147	121	140	196	604

Table 2.- Number of trips (number of observations) by year, area and time strata used in the analyses for the NORTH Atlantic hypothesis.

Spanish SOUTH Atlantic LL CPUE, 1981-1992
14:42 Monday, October 18, 1993

TABLE 1 OF AREA BY QTR
CONTROLLING FOR YR=1988

AREA	QTR				
Frequency	1	2	3	4	Total
7	0	0	2	1	3
8	0	0	0	0	0
Total	0	0	2	1	3

TABLE 2 OF AREA BY QTR
CONTROLLING FOR YR=1989

AREA	QTR				
Frequency	1	2	3	4	Total
7	9	5	2	8	24
8	0	0	0	0	0
Total	9	5	2	8	24

TABLE 3 OF AREA BY QTR
CONTROLLING FOR YR=1990

AREA	QTR				
Frequency	1	2	3	4	Total
7	0	0	6	19	25
8	0	1	2	0	3
Total	0	1	8	19	28

TABLE 4 OF AREA BY QTR
CONTROLLING FOR YR=1991

AREA	QTR				
Frequency	1	2	3	4	Total
7	4	7	13	27	51
8	3	19	8	11	41
Total	7	26	21	38	92

TABLE 5 OF AREA BY QTR
CONTROLLING FOR YR=1992

AREA	QTR				
Frequency	1	2	3	4	Total
7	0	16	34	43	93
8	8	39	0	9	56
Total	8	55	34	52	149

Table 3.- Number of trips (number of observations) by year, area and time strata used in the analyses for the SOUTH Atlantic hypothesis.

Stock Hypothesis	Age	Number Observa.	R Square	Root mean Square error	F Stat.
Atl. total	1	3609	.3893	.9769	71.25
Atl. total	2	4027	.3004	.7558	53.60
Atl. total	3	4078	.2143	.6871	34.47
Atl. total	4	4060	.2070	.6481	32.84
Atl. total	5+	4039	.2967	.7117	52.81
Atl. north	1	3382	.4069	.9493	95.95
Atl. north	2	3854	.3028	.7676	67.10
Atl. north	3	3782	.1764	.6925	33.52
Atl. north	4	3764	.1407	.6537	25.52
Atl. north	5+	3743	.2510	.7186	51.93
Atl. Sur	1	227	.2305	1.3056	5.85
Atl. Sur	2	294	.2883	.5593	10.39
Atl. Sur	3	296	.2702	.5716	9.56
Atl. Sur	4	296	.2982	.5448	10.97
Atl. Sur	5+	296	.1635	.6161	5.05

Table 4.- Number of observations, R square, mean square error (root) and F statistic for each age class and stock hypothesis considered in the analyses.

TOTAL Atlantic Spanish LL SWO, Age 1
10:26 Monday, October 18, 1993

YR	LSMEAN	STDERR	UCPM1	CPM1	LCPM1
1992	-1.19375	0.04851	0.33370	0.30344	0.27592
1991	-1.26357	0.05004	0.31216	0.28308	0.25656
1990	-1.14105	0.05777	0.35038	0.32002	0.29576
1989	-0.72630	0.05550	0.54119	0.48541	0.43530
1988	-0.56268	0.05760	0.63083	0.57063	0.50971
1987	-0.66750	0.06837	0.58792	0.53419	0.46970
1986	-0.93828	0.06257	0.44322	0.39207	0.34682
1985	-1.40727	0.08411	0.28968	0.24565	0.20832
1984	-1.48813	0.10089	0.29961	0.24585	0.20174
1983	-1.41755	0.10193	0.29743	0.24357	0.19946

TOTAL Atlantic Spanish LL SWO, Age 2
10:26 Monday, October 18, 1993

YR	LSMEAN	STDERR	UCPM2	CPM2	LCPM2
1992	-0.11951	0.033498	0.94810	0.88785	0.83143
1991	-0.06724	0.035429	1.00284	0.93556	0.87280
1990	0.21870	0.040517	1.34843	1.24549	1.15040
1989	0.07536	0.039760	1.16658	1.07912	0.99822
1988	-0.11147	0.041931	0.97199	0.89530	0.82466
1987	0.00635	0.049357	1.10994	1.00759	0.91468
1986	-0.27788	0.043409	0.82689	0.75871	0.69683
1985	-0.30676	0.057214	0.82449	0.73703	0.65884
1984	-0.58160	0.065929	0.63750	0.56022	0.49231
1983	-0.45258	0.069364	0.73036	0.63752	0.55648

TOTAL Atlantic Spanish LL SWO, Age 3
10:26 Monday, October 18, 1993

YR	LSMEAN	STDERR	UCPM3	CPM3	LCPM3
1992	0.27333	0.030351	1.39554	1.31494	1.23900
1991	0.40100	0.031910	1.59050	1.49408	1.40349
1990	0.37450	0.036756	1.56471	1.45595	1.35475
1989	0.06117	0.036201	1.14218	1.06378	0.99076
1988	0.12941	0.038029	1.22711	1.13898	1.05717
1987	0.25213	0.044828	1.40633	1.28806	1.17973
1986	0.14893	0.039110	1.25401	1.16148	1.07577
1985	0.26488	0.050824	1.44164	1.30496	1.18123
1984	0.25590	0.058156	1.45014	1.29391	1.15452
1983	0.23414	0.062866	1.48188	1.24119	1.09898

TOTAL Atlantic Spanish LL SWO, Age 4
10:26 Monday, October 18, 1993

YR	LSMEAN	STDERR	UCPM4	CPM4	LCPM4
1992	-0.01761	0.028694	1.03981	0.98295	0.92920
1991	0.01181	0.030189	1.07404	1.01234	0.95417
1990	-0.13277	0.034951	0.97833	0.87620	0.81819
1989	-0.20158	0.034320	0.87483	0.81792	0.76471
1988	-0.12971	0.035962	0.94311	0.87892	0.81910
1987	0.00879	0.042305	1.09702	1.00973	0.92938
1986	0.03766	0.036758	1.11670	1.03908	0.96685
1985	0.29613	0.047705	1.47811	1.34617	1.22601
1984	0.33681	0.054435	1.56847	1.40255	1.26062
1983	0.29447	0.058355	1.50765	1.34471	1.19937

TOTAL Atlantic Spanish LL SWO, Age 5+
10:26 Monday, October 18, 1993

YR	LSMEAN	STDERR	UCPM5	CPM5	LCPM5
1992	-0.09865	0.031572	0.96838	0.90651	0.85211
1991	-0.16988	0.033233	0.90105	0.84423	0.79099
1990	-0.29256	0.038505	0.80545	0.74690	0.69261
1989	-0.30070	0.037854	0.79789	0.74083	0.68786
1988	-0.17988	0.039607	0.90351	0.83602	0.77358
1987	-0.03934	0.046308	1.05407	0.96246	0.87881
1986	0.10068	0.040396	1.19802	1.10603	1.02258
1985	0.30592	0.052376	1.50675	1.35974	1.22708
1984	0.42643	0.059629	1.72475	1.53450	1.36525
1983	0.38560	0.063853	1.66994	1.47350	1.30016

Table 5.- Estimated parameters, standard error, relative CPUEs, and upper and lower 95% confidence limits by age group for the TOTAL Atlantic hypothesis.

NORTH Atlantic Spanish LL BMS, Age 1
9:27 Monday, October 18, 1993

YR	LSMEAN	STDERR	DCP01	CP01	LCP01
1992	-1.15690	0.043673	0.36339	0.31413	0.28836
1991	-1.25667	0.047391	0.31190	0.28435	0.25923
1990	-1.17431	0.050421	0.35900	0.32529	0.29468
1989	-0.65055	0.047956	0.56904	0.51819	0.47109
1988	-0.57328	0.047895	0.56264	0.50505	0.52263
1987	-0.63778	0.050215	0.99454	0.52939	0.47138
1986	-0.90951	0.053185	0.44760	0.40329	0.36339
1985	-1.37046	0.076071	0.25333	0.25270	0.21760
1984	-1.37761	0.093073	0.30790	0.25323	0.23100
1983	-1.38623	0.096474	0.30163	0.25064	0.20827

NORTH Atlantic Spanish LL BMS, Age 2
9:27 Monday, October 18, 1993

YR	LSMEAN	STDERR	DCP02	CP02	LCP02
1992	-0.13033	0.036673	0.93571	0.87489	0.81837
1991	-0.18081	0.036422	0.96467	0.89821	0.83633
1990	0.23158	0.038184	1.34568	1.26005	1.15898
1989	0.04298	0.037386	1.12388	1.04468	0.97099
1988	-0.13585	0.037929	0.94182	0.87368	0.81191
1987	-0.01595	0.043987	1.07771	0.98521	0.90044
1986	-0.29944	0.039361	0.88114	0.74180	0.68686
1985	-0.32917	0.054395	0.80164	0.72059	0.64771
1984	-0.60449	0.063525	0.63005	0.56746	0.48337
1983	-0.67542	0.067435	0.71108	0.63304	0.54590

NORTH Atlantic Spanish LL BMS, Age 3
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YR	LSMEAN	STDERR	DCP03	CP03	LCP03
1992	0.08059	0.030790	1.16496	1.09315	1.02930
1991	0.19001	0.031603	1.30686	1.20749	1.11300
1990	0.16213	0.036349	1.25066	1.17671	1.10095
1989	-0.10341	0.033681	0.89018	0.83291	0.77939
1988	-0.08623	0.034179	0.90153	0.91792	0.85464
1987	0.03781	0.041304	1.12766	1.03962	0.95859
1986	-0.06530	0.035093	1.00421	0.93746	0.87515
1985	0.05868	0.047643	1.15673	1.05319	0.95852
1984	0.04893	0.055648	1.16317	1.04330	0.93513
1983	-0.00005	0.059059	1.12644	1.00174	0.89085

NORTH Atlantic Spanish LL BMS, Age 4
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YR	LSMEAN	STDERR	DCP04	CP04	LCP04
1992	-0.24506	0.029448	0.82892	0.78299	0.73960
1991	-0.23484	0.030066	0.84996	0.79171	0.74532
1990	-0.39798	0.032769	0.71662	0.67284	0.63073
1989	-0.47567	0.032090	0.66215	0.62179	0.58388
1988	-0.38133	0.032357	0.72895	0.68391	0.64132
1987	-0.24608	0.029023	0.84634	0.78402	0.72629
1986	-0.21507	0.032961	0.86077	0.80692	0.75644
1985	0.04331	0.044913	1.16151	1.04532	0.95723
1984	0.06350	0.051993	1.20522	1.08064	0.98334
1983	0.04192	0.056206	1.16431	1.04667	0.93535

NORTH Atlantic Spanish LL BMS, Age 5+
9:27 Monday, October 18, 1993

YR	LSMEAN	STDERR	DCP05	CP05	LCP05
1992	-0.36394	0.032684	0.74842	0.69529	0.65291
1991	-0.44381	0.034981	0.68619	0.64196	0.60057
1990	-0.57485	0.036184	0.60455	0.56316	0.52466
1989	-0.58418	0.035506	0.59812	0.55791	0.52041
1988	-0.45639	0.035184	0.67993	0.63397	0.59112
1987	-0.31590	0.042838	0.79397	0.73883	0.67124
1986	-0.17553	0.036286	0.90145	0.83956	0.78193
1985	0.02966	0.049387	1.13619	1.03136	0.93621
1984	0.15895	0.056924	1.30114	1.16377	1.04091
1983	0.10645	0.061673	1.26142	1.11779	0.99052

Table 6.- Estimated parameters, standard error, relative CPUEs, and upper and lower 95% confidence limits by age group for the NORTH Atlantic hypothesis.

South Atlantic Spanish LL BMS, Age 1
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YR	LSMEAN	STDERR	DCP01	CP01	LCP01
1992	-1.23246	0.17223	0.41476	0.29593	0.21115
1991	-1.11684	0.16607	0.46186	0.33223	0.23899
1990	-0.92140	0.29935	0.74828	0.41619	0.23150
1989	-1.73548	0.32762	0.35300	0.18600	0.09798
1988	0.02225	0.77307	6.27324	1.37861	0.30296

South Atlantic Spanish LL BMS, Age 2
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YR	LSMEAN	STDERR	DCP02	CP02	LCP02
1992	-0.14466	0.06836	0.87574	0.86689	0.77819
1991	0.05277	0.06407	1.19763	1.05629	0.93163
1990	-0.23118	0.11757	1.02650	0.81524	0.64746
1989	0.36623	0.13987	1.87615	1.45451	1.13761
1988	0.28000	0.12889	2.47615	1.29963	0.68213

South Atlantic Spanish LL BMS, Age 3
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YR	LSMEAN	STDERR	DCP03	CP03	LCP03
1992	0.51715	0.06130	1.85494	1.66040	1.45815
1991	0.78263	0.06517	2.49050	2.19107	1.92905
1990	0.79541	0.12903	3.71252	2.14388	1.69444
1989	1.26431	0.13263	4.63183	3.57157	2.75402
1988	0.96836	0.23666	5.38465	2.70644	1.44213

South Atlantic Spanish LL BMS, Age 4
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YR	LSMEAN	STDERR	DCP04	CP04	LCP04
1992	0.34583	0.05043	1.58735	1.41557	1.26239
1991	0.45652	0.06212	1.78639	1.58162	1.40032
1990	0.50879	0.11441	1.75127	1.79983	1.43764
1989	0.85464	0.12641	3.03565	2.36944	1.84943
1988	0.61448	0.32834	2.59519	1.59328	0.85037

South Atlantic Spanish LL BMS, Age 5+
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YR	LSMEAN	STDERR	DCP05	CP05	LCP05
1992	0.39699	0.04668	1.69668	1.49058	1.30952
1991	0.36297	0.07024	1.65385	1.44174	1.25588
1990	0.36408	0.12937	1.87008	1.45316	1.12613
1989	0.64864	0.14295	2.87723	1.56966	1.18612
1988	0.50210	0.36224	3.58034	1.78422	0.86738

Table 7.- Estimated parameters, standard error, relative CPUEs, and upper and lower 95% confidence limits by age group for the SOUTH Atlantic hypothesis.

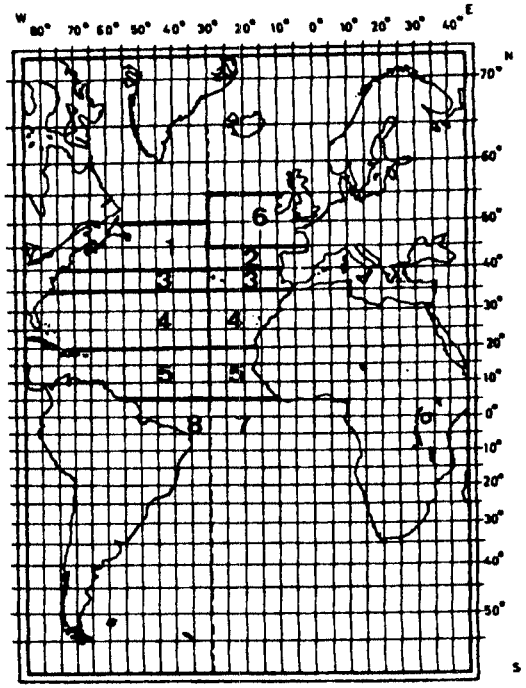

Figure 1.- Geographical areas division used for preliminary GLM analyses for the Spanish longline catch and effort data.

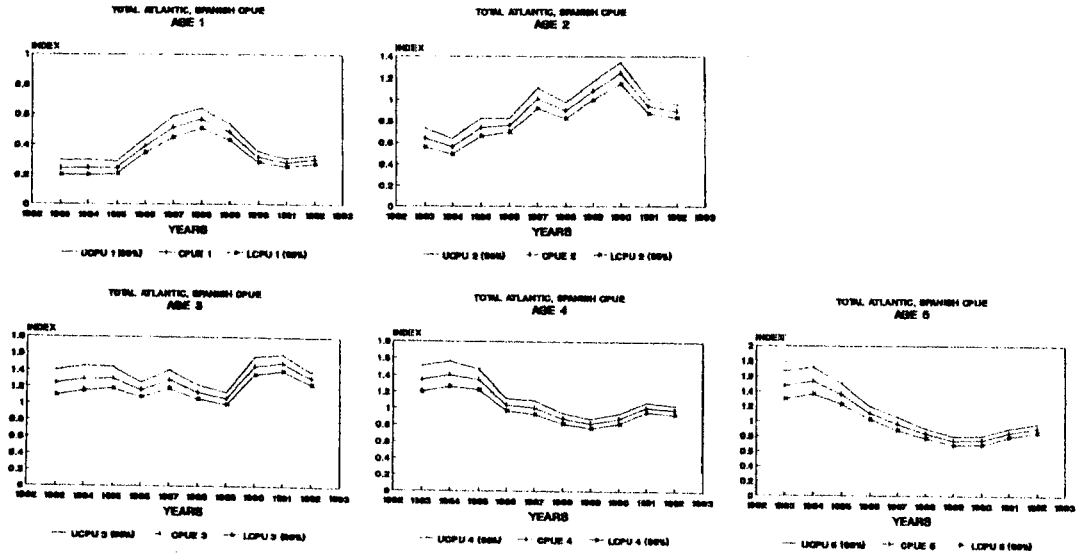

Figure 2.- Annual change of standardized CPUE index by age class 1, 2, 3, 4, 5+ for the TOTAL Atlantic hypothesis.

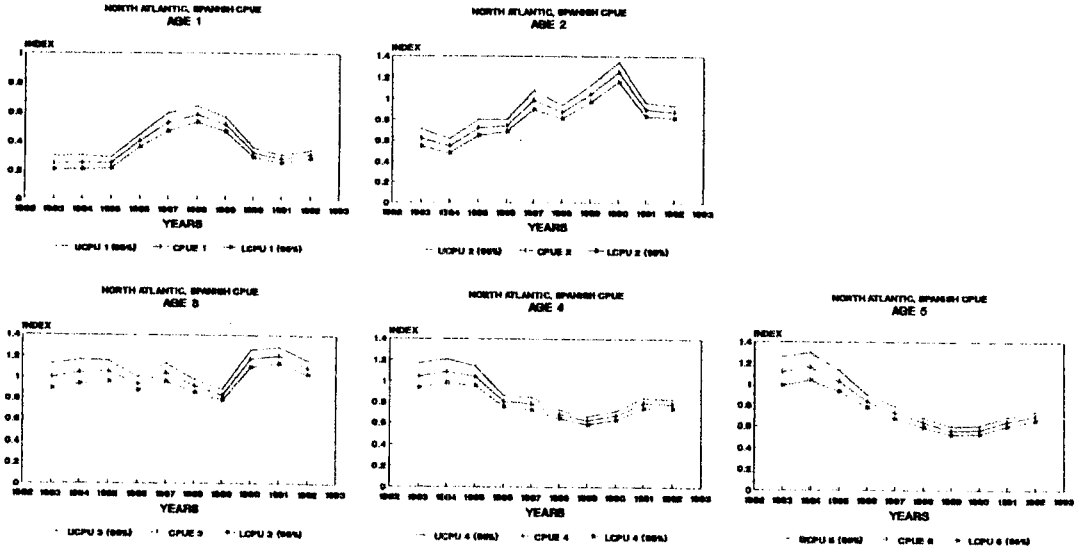

Figure 3.- Annual change of standardized CPUE index by age class 1, 2, 3, 4, 5+ for the NORTH Atlantic hypothesis.

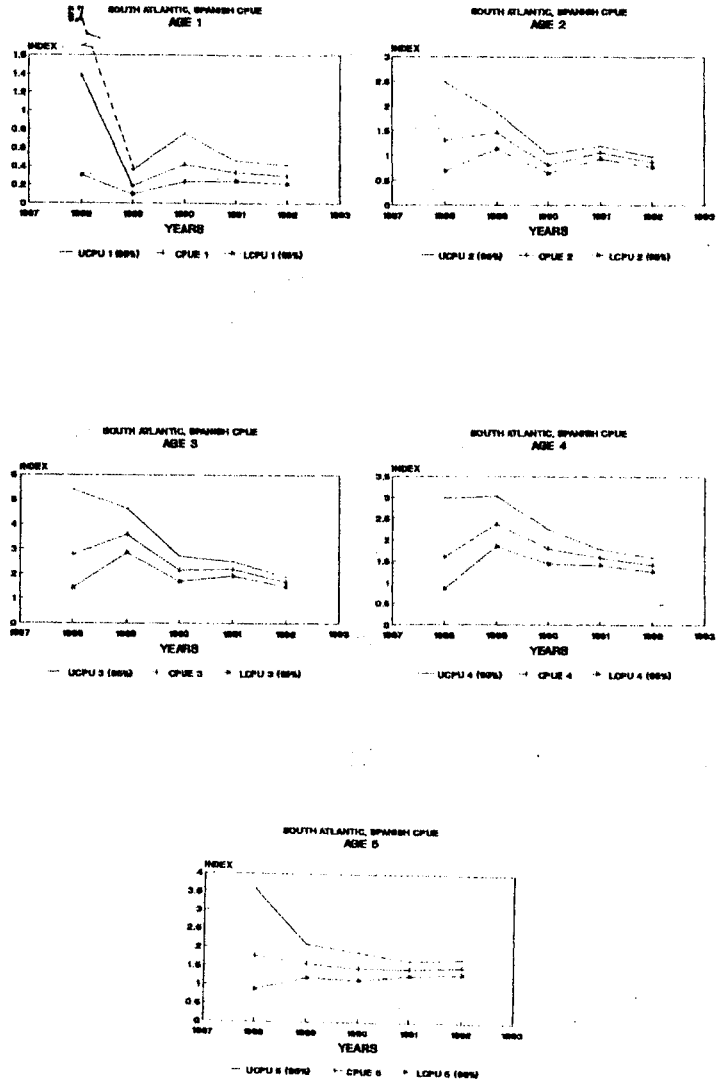

Figure 4 .- Annual change of standardized CPUE index by age class 1, 2, 3, 4, 5+ for the SOUTH Atlantic hypothesis.