AGE-SPECIFIC STANDARDIZED CATCH RATES FOR ALBACORE *(THUNNUS ALALUNGA)* FROM THE SPANISH SURFACE FLEETS IN THE NORTH ATLANTIC, YEARS 1983-92

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SUMMARY

As in previous years, data from individual trips, carried out using traditional gears for the Spanish fishery of albacore, trolling and baitboat, from the 1983-1992 period were analyzed.

Standardized age-specific catch rates were developed by means of General Linear Modeling (GLM) procedures and the available age length key, using the same methodology as in previous analyses. Available information (year, gear, area and time) were incorporated into the model. The variability rate by age explained by the model ranged between 35% and 43%.

RESUME

Comme les années précédentes, les données provenant des marées individuelles réalisées entre 1983 et 1992 par la flottille espagnole qui vise le germon de l'Atlantique nord en utilisant des engins traditionnels --ligneurs et canneurs-- ont été analysées pour obtenir des indices standardisés de taux de capture.

On a obtenu des indices standardisés par classes d'âge en utilisant un modèle linéaire généralisé (GLM). Les variables année, engin, zone et période ont été incorporées dans le modèle. Les taux de variabilité par âge expliquées par le modèle vont de 35 à 43%.

RESUMEN

Como en años anteriores, datos procedentes de mareas individuales realizadas entre 1983 y 1992 por la flota española dirigida al atún blanco en el Atlántico norte usando artes tradicionales - curricán y cebo vivo - fueron analizados para obtener índices estandarizados de tasas de captura.

Se obtuvieron índices estandarizados por clases de edad usando un modelo lineal generalizado (GLM). Las variables año, arte, área y tiempo fueron incorporadas dentro del modelo. Las tasas de variabilidad por edad explicadas por el modelo se encuentran dentro del rango de 35% a 43%.

INTRODUCTION.

The data corresponding to catch per unit of effort (CPUE) from commercial fleets have frequently been used to estimate relative trends in stock abundance and to tune virtual population analyses (VPA) and to fit production models.

The generalized linear modelling technique (GLM) (ROBSON, 1966; GAVARIS, 1980, KIMURA, 1981) has proved to be a suitable methodology to obtain relative standardized catch rates, assumed as relative abundance indices.

The purpose of this paper is to update previous analyses and to develop age-specific standardized CPUE trends for albacore using trip-by-trip data from the traditional Spanish bait boat and trolling fleets by means of similar methodology and criteria as in previous GLM analyses (MEJUTO, CONSER & GARCIA 1992, MEJUTO & GARCIA 1993). More details on the methodology can be found in the papers previously cited (they should be read before) as well as comments which may be probably useful in the interpretation of the results.

1. DATA.

Data records were taken during the landing from trips carried out using traditional gears for the Spanish fishery of albacore in the North Atlantic -trolling and bait boat- during the period 1983-1992.

These trip records contain the following data:
(1) landing date
(2) type of gear
(3) number of fishing days
(4) location of the fishing effort (5 X 5 degree square)
(5) catch in numbers
(6) catch in weight (kg)
(7) number sampled at the landing port
(8) sample frequency distribution of catch-at-size (FL=30 to 135, in 1 cm intervals)

2. METHODS.

2.1. AGEING:

The transformation of the size distributions into ages (for ages 1, 2, 3, and 4) was done using one set of yearly age length key (YALKs) obtained from MULTIFAN (ANONYMOUS (II), 1991; SANTIAGO, SCRS 92/48, pers. communication), using data from the period 1983-1990. ALK of 1990 was carried on to ALKs of 1991 and 1992. So catch by age data base was created and then analyzed. More methodological details are included in papers previously cited.

As in the past, the fishery carried out by the Spanish fleet during the Fall of 1990, 1991 and 1992 in the areas around the Azores (or between Azores and Iberian Peninsula) and records from the Mediterranean Sea were excluded from the analysis. Therefore records from the traditional fishery were used.

2.2. MODEL AND SPECIFICATIONS.

The two traditional gears used by the Spanish surface fleet, bait boat and trolling, were included in the analysis.

The seasonal migratory behavior of albacore, the fishing pattern of the Spanish fleets, and the number of trip observations available, were used jointly to establish area and time strata for the GLM analyses.

The areas used in the model are shown in Figure 1. The following time strata were selected:

T1 = January - July
T3 = August and September
T2 = October - December

Although indices of abundance were developed for ages 1, 2, 3, and 4, the fishery generally targets ages 2-4, with the current catch being dominated by ages 2 and 3.

The analyses were carried out using GLM procedures (under SAS computer software). The main effects were considered to be year, gear, area and time. The following model was defined:

$$(1)\ \mathrm{LOG}\ (CPUE) = u + Y_i + G_j + A_k + Q_l + e_{ijkl}$$

where the CPUE = the nominal CPUE of the observation (catch in number of fish of the corresponding age divided by the number of fishing days of the trip carried out in year i, by gear j, in area k, and time l).

u= overall mean.
Y_i = logarithm of the effect of year i
G_j = logarithm of the effect of gear j
A_k = logarithm of the effect of area k
Q_l = logarithm of the effect of time l
e = logarithm of the normally distributed error term

Observations having values of CPUE=0 were omitted from the analysis.

Exploratory analyses were carried out in recent, years introducing a gear*area interaction term into the model. However results have indicated that they contribute to a minor extent to the overall sum of squares in a variety of exploratory runs. Because of this, (and lack of time) interactions were not included in these runs.

RESULTS AND DISCUSSION.

A total of 2461 trips from 1983 to 1992 (23261 fishing days) were classified in spatial/temporal strata, as described above, and then analyzed.

As in previous analyses, a 'second pass' GLM procedure was used to overcome the problems of residuals with absolute values greater than 2.5 . Records having an absolute residual value was greater than 2.5 in the 'first pass' (in most cases negative) were omitted from the analysis.

Table 1 shows data for number of observations by year, area and time strata considered in the final runs.

Table 2 is a summary of the ANOVA results (second pass) subjected to these conditions. The variability rate by age explained by the model (R-squared) is between 35% and 43%, very close to previous results.

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

Table 3 supplies information on estimated parameters, their standard error, the relative CPUE and upper and lower 95% confidence limits considered by age.

Age 1 (Fig. 3) shows trends that could be interpreted as exhibiting wide yearly fluctuations which could be justified based on the different strength of the recruitments. However, we must remember again that age 1 is not usually a target catch (in some cases it is even avoided) for the traditional fleets.

Figure 3 shows trends obtained for ages 1, 2, 3 and 4, respectively. This catch-rates is contingent upon a number of factors such as availability in the area/time stratum as well as the results obtained from the fishery among ages. Thus trends obtained for ages 1 (especially) and 4 should not be interpreted strictly in terms of abundance. As was explained in last year's analyses, the resulting indices for ages 2 and 3 are probably less affected by similar problems.

These ages (2 and 3) are highly represented in the catches of both fleets and are the targets of their activity. These indices have a strong empirical basis, are consistent (i.e. good transition between ages 2 and 3), and the model, residuals and other diagnostics behave well.

More details about possible interpretation of the results were given in papers previously cited.

ACKNOWLEDGMENTS.

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LITERATURE.

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Span.North Atl. ALB CPUEs 1983-1992, YRLS 83-90 (91-92 est por [illegible])
14:57 Thursday, September 30, 1993

TABLE 1 OF AREA BY QTR
CONTROLLING FOR YR=83

AREA / Frequency	QTR 1	2	3	Total
1	2	3	44	49
2	1	16	26	43
3	0	0	0	0
4	27	0	20	47
Total	30	19	90	139

TABLE 2 OF AREA BY QTR
CONTROLLING FOR YR=84

AREA / Frequency	QTR 1	2	3	Total
1	12	0	29	41
2	3	0	12	15
3	0	0	0	0
4	24	0	30	54
Total	39	0	71	110

TABLE 3 OF AREA BY QTR
CONTROLLING FOR YR=85

AREA / Frequency	QTR 1	2	3	Total
1	0	10	23	33
2	22	2	58	82
3	2	0	1	3
4	28	0	13	41
Total	52	12	95	159

TABLE 4 OF AREA BY QTR
CONTROLLING FOR YR=86

AREA / Frequency	QTR 1	2	3	Total
1	1	23	49	73
2	2	13	15	30
3	34	0	3	37
4	17	0	24	41
Total	54	36	91	181

TABLE 5 OF AREA BY QTR
CONTROLLING FOR YR=87

AREA / Frequency	QTR 1	2	3	Total
1	0	10	15	25
2	1	4	6	11
3	3	0	3	6
4	16	0	17	33
Total	20	14	41	75

TABLE 6 OF AREA BY QTR
CONTROLLING FOR YR=88

AREA / Frequency	QTR 1	2	3	Total
1	6	22	54	82
2	6	28	48	82
3	31	0	9	40
4	16	0	34	50
Total	59	50	145	254

TABLE 7 OF AREA BY QTR
CONTROLLING FOR YR=89

AREA / Frequency	QTR 1	2	3	Total
1	7	41	74	122
2	17	23	54	94
3	47	0	3	50
4	52	10	79	141
Total	123	74	210	407

TABLE 8 OF AREA BY QTR
CONTROLLING FOR YR=90

AREA / Frequency	QTR 1	2	3	Total
1	2	32	27	61
2	15	34	90	139
3	64	5	4	73
4	60	0	73	133
Total	141	71	194	406

TABLE 9 OF AREA BY QTR
CONTROLLING FOR YR=91

AREA / Frequency	QTR 1	2	3	Total
1	3	1	23	27
2	13	47	75	135
3	84	1	2	87
4	64	0	115	179
Total	164	49	215	428

TABLE 10 OF AREA BY QTR
CONTROLLING FOR YR=92

AREA / Frequency	QTR 1	2	3	Total
1	5	2	50	57
2	42	29	86	157
3	53	2	2	57
4	56	0	47	103
Total	156	33	185	374

Table 1.- Number of trips (number of observations) by year, area and time strata used in the analyses, years 1983-1992.

AGE	Numb. Obsrv.	R-square	Root Mean Square Err.	F Stat.
1	2352	0.3525	1.165	84.80
2	2441	0.4265	0.978	120.23
3	2441	0.4079	0.851	111.37
4	2413	0.3565	1.029	88.55

Table 2.- Number of observations, R-square, mean square error (root) and F statistic for each age class considered in the analyses.

North Atlantic Spanish ALB, CPUE ,<second pass>

YR	LSMEAN	STDERR	UCPU1	CPU1	LCPU1
92	3.17004	0.06861	27.2993	23.8646	20.8620
91	3.62070	0.06294	42.3532	37.4380	33.0931
90	2.85442	0.06464	19.7511	17.4007	15.3299
89	2.50375	0.06434	13.9007	12.2536	10.8018
88	3.20123	0.07717	28.6586	24.6360	21.1780
87	0.16986	0.15969	1.6415	1.2004	0.8778
86	2.62860	0.09344	16.7117	13.9149	11.5862
85	3.00971	0.10111	24.8532	20.3854	16.7207
84	2.69893	0.12019	18.9485	14.9715	11.8292
83	1.36887	0.11515	4.9589	3.9570	3.1576

YR	LSMEAN	STDERR	UCPU2	CPU2	LCPU2
92	3.91562	0.05752	56.2611	50.2631	44.9046
91	4.06658	0.05286	64.8178	58.4389	52.6877
90	3.63177	0.05373	42.0355	37.8342	34.0528
89	3.26692	0.05247	29.1115	26.2666	23.6997
88	3.74908	0.06506	48.3618	42.5721	37.4755
87	3.70500	0.11400	51.1586	40.9150	32.7225
86	3.45760	0.07565	36.9193	31.8317	27.4452
85	3.02525	0.08406	24.3746	20.6721	17.5319
84	3.26163	0.10087	31.9582	26.2252	21.5207
83	3.45654	0.08669	37.7208	31.8263	26.8529

YR	LSMEAN	STDERR	UCPU3	CPU3	LCPU3
92	3.28198	0.050347	29.4274	26.6622	24.1568
91	2.90814	0.046922	20.1098	18.3429	16.7312
90	3.13290	0.047296	25.1968	22.9661	20.9328
89	3.18914	0.044591	26.5103	24.2917	22.2588
88	3.35126	0.055702	31.8802	28.5829	25.6267
87	3.80768	0.099196	54.9832	45.2681	37.2696
86	3.26718	0.064969	29.8632	26.2926	23.1489
85	3.22130	0.071673	28.9145	25.1251	21.8322
84	3.31292	0.087219	32.7096	27.5698	23.2376
83	3.83539	0.074876	53.7824	46.4413	40.1022

YR	LSMEAN	STDERR	UCPU4	CPU4	LCPU4
92	2.31976	0.06098	11.4861	10.1922	9.0440
91	2.09757	0.05713	9.1264	8.1596	7.2952
90	2.26573	0.05690	10.7927	9.6537	8.6350
89	2.07335	0.05439	8.8589	7.9632	7.1580
88	2.63119	0.06803	15.9083	13.9224	12.1845
87	2.06931	0.12157	10.1246	7.9781	6.2866
86	2.75214	0.07854	18.3414	15.7246	13.4812
85	2.15145	0.08686	10.2316	8.6298	7.2788
84	2.63617	0.10480	17.2374	14.0365	11.4301
83	2.73387	0.09086	18.4687	15.4560	12.9347

Table 3.- Estimated parameters, standard error, relative CPUEs, and upper and lower 95% confidence limits, obtained in the final run,

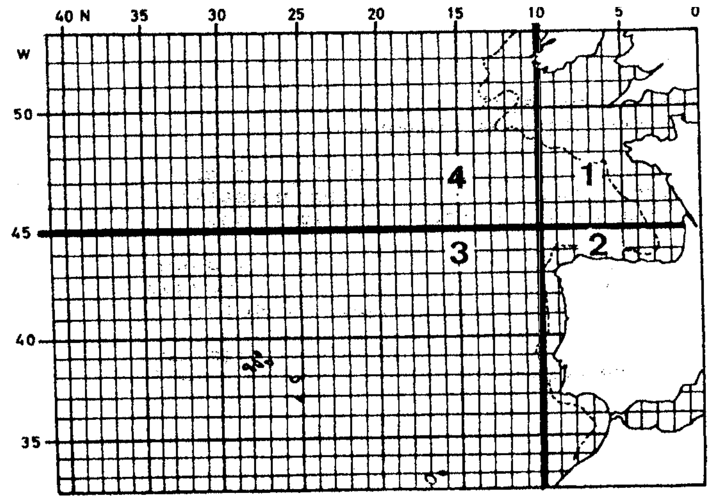

Figure 1: Geographical areas division used for the GLM analyses for he spanish albacore catch and effort data.

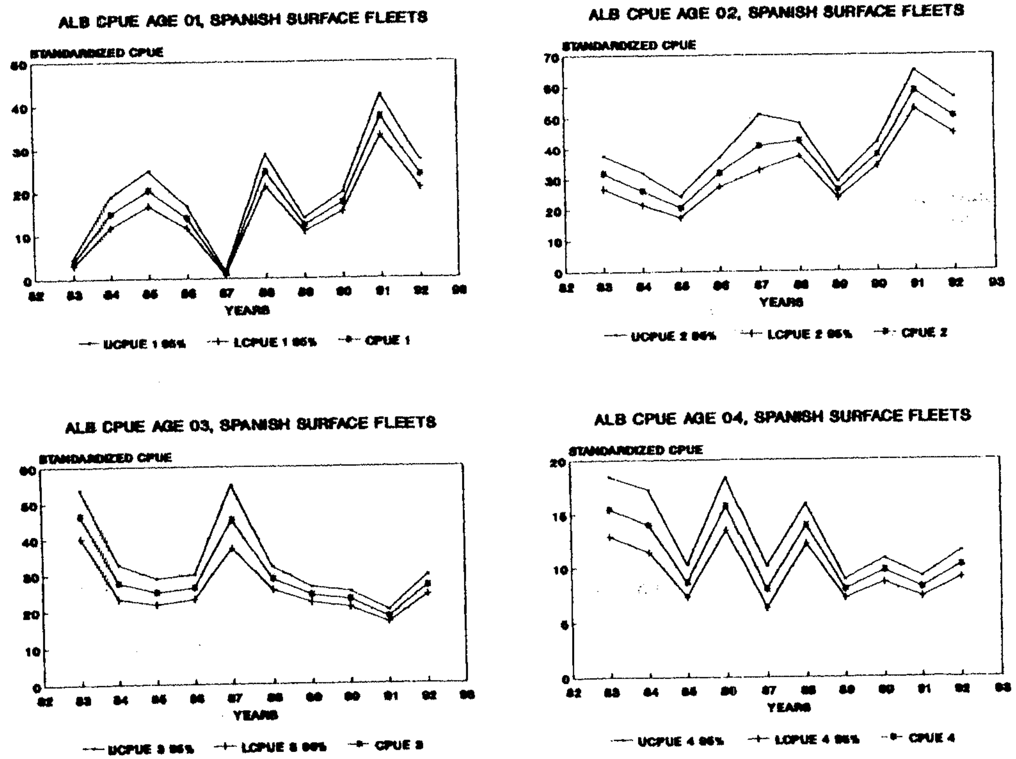

Figure 2.- Annual change of standardized CPUE, by age class 1, 2, 3 and 4.