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STANDARDIZED CATCH RATES OF SHORTFIN MAKO (*ISURUS OXYRINCHUS*) CAUGHT BY THE SPANISH SURFACE LONGLINE FISHERY TARGETING SWORDFISH IN THE ATLANTIC OCEAN DURING THE PERIOD 1990-2010

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SUMMARY

*Standardized catches per unit of effort (in number and weight) were obtained for the Atlantic shortfin mako (*Isurus_oxyrinchus*) using General Linear Modeling (GLM) procedures based on trip data from the Spanish surface longline fleet targeting swordfish in the North and South Atlantic Ocean over the period 1990-2010. In all cases area was considered to be the most relevant factor in explaining CPUE variability. Area, area* quarter and ratio were the most important factors in the North Atlantic, and area, year and quarter or area* quarter in the South Atlantic. Other factors were also identified as significant but with a minor effect on CPUE variability. Part of the CPUE variability was explained by the targeting criteria or ratio between the two most prevalent species in the catches, especially in the North Atlantic case. The significant models explained between 35% and 44% of CPUE variability. The mean variability of the predicted standardized CPUE between pairs of consecutive years was between 14% and 16% or around +2% when their absolute increments or both positive and negative increments were considered, respectively.*

RÉSUMÉ

*Les prises standardisées par unité d'effort (en nombre et en poids) ont été obtenues pour le requin-taupe bleu de l'Atlantique (*Isurus oxyrinchus*) au moyen des procédures du modèle linéaire généralisé (GLM) reposant sur les données des sorties de la flottille palangrière de surface espagnole ciblant l'espadon dans l'Atlantique Nord et Sud au cours de la période 1990-2010. Dans tous les cas, le facteur "zone" a été considéré comme étant le facteur le plus pertinent pour expliquer la variabilité de la CPUE. Les facteurs zone, zone* trimestre et ratio étaient les facteurs les plus importants dans l'Atlantique Nord, tandis que dans l'Atlantique Sud, les facteurs prédominants étaient la zone, l'année, et le trimestre ou la zone*trimestre. L'importance d'autres facteurs a également été identifiée, mais ceux-ci n'avaient qu'un effet limité sur la variabilité de la CPUE. Une partie de la variabilité de la CPUE a été expliquée par le ratio ou le critère de ciblage entre les deux espèces dominantes des prises, notamment dans l'Atlantique Nord. Les modèles significatifs expliquaient entre 35 et 44% de la variabilité de la CPUE. La variabilité moyenne de la CPUE standardisée prédite entre des paires d'années consécutives oscillait entre 14 et 16% ou autour de+2% lorsque leurs incréments absolus ou les incréments positifs et négatifs étaient pris en compte, respectivement.*

RESUMEN

*Tasas estandarizadas de captura por unidad de esfuerzo (en número y peso) fueron obtenidas para el tiburón marrajo dientuso del Atlántico (*Isurus oxyrinchus*) usando Modelos Lineales Generalizados (GLM) a partir de datos por marea de la flota española de palangre de superficie que captura pez espada en el Atlántico Norte y Sur durante el periodo 1990-2010. El factor área fue identificado como el más relevante en todos los casos para explicar la variabilidad de la CPUE. Los principales factores significativos fueron área, área*trimestre y ratio para el Atlántico Norte, y área, año y trimestre o trimestre* área para el Atlántico Sur. Otros factores fueron identificados también como significativos aunque de menor importancia. Una parte relativamente menor de la variabilidad es atribuida al criterio de direccionamiento de los patrones de pesca hacia las dos especies más prevalentes en los desembarcos, especialmente en el caso del Atlántico Norte. Los modelos significativos explicaron entre el*

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35% y 44% de la variabilidad de la CPUE. La variabilidad interanual media de la CPUE estandarizada comparando pares de años consecutivos fue entre el 14% y 16% o sobre el +2% cuando se consideraron los incrementos absolutos o sus respectivos incrementos positivos y negativos, respectivamente.

KEYWORDS

Shortfin mako, sharks, CPUE, GLM, longline, Spanish fleet.

1. Introduction

The shortfin mako (*Isurus oxyrinchus*) is a highly migratory, oceanic-epipelagic and wide-ranging circumglobal shark species distributed mostly, but not exclusively, between 50ºN-50ºS. This species covers tropical, subtropical and temperate waters although some specimens were also observed in cold waters near the extreme areas of their distributions. Blue shark (*Prionace glauca*) is regularly one of the most prevalent fish species in the epipelagic layers because of its efficient reproductive strategy, and it is the most prevalent shark in the epipelagic-oceanic habitat. While the shortfin mako is less prevalent than the blue shark, it is also a fairly frequent large pelagic oceanic shark with smaller litter sizes (4 -16 pups per litter), exhibiting an ovoviviparous strategy and uterine cannibalism (Compagno 1984). Both species of sharks are within the range of the fishing areas-gears targeting tunas and/or swordfish around the world and may also come under the scope of game fishing, recreational or recreational-charter fisheries in some countries. Data from pop-up satellite archival tags (Abascal *et al.* 2011) suggest that the shortfin mako can be a fast swimmer if required, but the average estimated rate of horizontal movements was around 27 km per day. This species spent most of its time in the mixed layers but undertook dives down to 888 m. A very clear diel pattern in depth behavior was not described in Pacific areas by the latter authors, but the mean vertical distribution was observed to be deeper during the daytime and shallower at night when it would be more susceptible to the surface fishing gears.

The Spanish surface longline fishery targeting swordfish began operating in the Mediterranean Sea and the Atlantic Ocean centuries ago. The most important shark bycatch in the Atlantic areas historically consisted mainly of the blue shark (BSH) and secondly the shortfin mako (SMA). The shortfin mako is clearly a less prevalent species in the epipelagic system than the blue shark, but individual/s are observed as a regular bycatch on most trips. This species was historically a highly prized, marketable species with full retention onboard. Therefore, landings and catches are historically equivalent concepts in the Spanish longline fisheries for this species (Mejuto and González-Garcés 1984, Mejuto 1985, Fernández-Costa and Mejuto 2010) with full retention of the complete bodies in fresh landing-markets or carcasses and fins in the more recent frozen fish markets. This surface longline fleet targeting swordfish has historically used the traditional plurifilament longline with a similar number of hooks per basket. This traditional style remained relatively constant for decades in terms of general structure and configuration (Rey *et al.* 1988, Hoey *et al.* 1988). Some technological improvements have been introduced in the traditional gear over the historical period. The most common were related to new elements to facilitate handling, setting out and hauling back the fishing gear and also tended to allow for a greater number of hooks per set, which were appropriately considered as nominal effort. However, at the end of the 20th century, the monofilament style or the so-called “American style” gear was largely imported by most of the Spanish fleet. Major changes in fishing strategy and targeting criteria have also been described (Mejuto and De la Serna 1997, 2000, Mejuto *et al*. 1997, 1998, 1999). The more diffuse targeting criteria applied to swordfish and/or blue shark could be pointed out as the main changes in the fishing patterns of this fishery at the end of the last century. The fishing activity targeting swordfish covers the surface layers, usually around 50 m depth, with night sets being carried out.

Other longline flag-fleets targeting mostly tunas or having mixed or more diffuse fishing strategies involving tunas-swordfish, may change the number of hooks per basket (or between buoys) or other configurations depending on the depth of the gear and/or on the hours of fishing selected, the targeted species, the respective local abundance of the different species or even the economic worth of the different species on priority international markets. In such cases, the number of hooks per basket or between buoys, as well as other elements used as proxies, could help in CPUE standardization in order to identify the target species and fishing strategies or the priorities of skippers. Some of these factors may, in some cases, explain the CPUE discrepancies detected between apparently similar longline styles (Saito and Yokawa 2001, 2003, Nishida and Wang 2006, Okamoto *et* *al*. 2001, Wang *et al.* 2006). In the latter case, the interpretation of CPUE data as abundance indicators becomes more difficult.

The standardized catch per unit of effort data (CPUE) from commercial fleets are regularly used as abundance indicators in a great number of fisheries targeting large pelagic fish. These CPUEs are assumed to be reliable indicators of abundance for most large pelagic species due to the lack of direct abundance indicators, especially when the available data cover large oceanic areas where these species are broadly distributed. However, this interpretation may not necessarily be assumed in all cases. CPUE indicators must be evaluated on a case by case basis taking into account the empirical knowledge of the fishery and the quality of the data, the spatial-temporal coverage in relation to stock distribution, as well as the biological plausibility of the interannual CPUE variability in this type of long-span species (Ramos-Cartelle *et al.* 2011). The limits and risks involved in this assumption must also be considered. The consistency in the fishing patterns of the fleets over time facilitates the interpretation of these indices as abundance indicators.

The Generalized Linear Modeling technique (GLM) (Robson 1966, Gavaris 1980, Kimura 1981) has been used to estimate standardized catch rates based on data from commercial fleets with unbalanced spatial-temporal activity as regularly observed because of the complex migratory behavior of the large pelagic species linked to environment requirements (habitats) and their respective biological process. The standardized catch rates of the Atlantic swordfish (*Xiphias gladius*) and several shark species were obtained in recent decades by means of GLM based on data from several commercial fleets or combinations thereof (e.g. Anon. 1989, 1991, Hoey *et al*. 1989, 1993, Nakano 1993, Mejuto 1993, 1994, Scott *et al*. 1993, Mejuto and De la Serna 1995, Mejuto *et al*. 1999, Ortiz *et al*. 2007; Babcock and Skomal 2008, Brown 2008, Cortés 2008, 2009, 2010, Fowler and Campana 2009, Matsunaga 2008, Mourato *et al.* 2007, 2008, Pons and Domingo 2008). CPUE standardizations of the Spanish longline fishery were also carried out recently for the most prevalent large epipelagic shark species (*Prionace glauca*, *Isurus oxyrinchus)* (Mejuto *et al.* 2009) as well as for the sporadic occurrence of shark by-catch in this fishery (*Lamna nasus*) (Mejuto *et al.* 2010).

2. Material and methods

The methodology used is based on previous research carried out on the Spanish longline fleet in the Atlantic and used in the swordfish, shortfin mako and other by-catch CPUE analysis of the Spanish as well as other Atlantic longline fleets combined (Mejuto and De la Serna 2000, Ortiz 2007, Ortiz *et al.* 2007, Mejuto *et al.* 2009). The data used consisted of trip records voluntarily provided for research covering the 1990-2010 period. Nominal effort was defined by thousands of hooks per set-day and fishing days. The nominal landings per unit of effort of shortfin mako were calculated as number of fish and kilograms of round weight per thousand hooks, respectively. The variable 'ratio' was defined for each available record as the percentage of swordfish related to both the swordfish and blue shark caught. After analyzing the behavior of the Spanish fleet in different oceans, it was concluded that this ratio might be a good proxy indicator of target criteria mainly and clearly directed at swordfish at the beginning of the time series vs. a more diffuse fishing strategy aimed at the two main species caught combined or in favor of the blue shark in the most recent period (Mejuto and De la Serna 2000, Anon. 2001). The ratio values were categorized into ten 'ratio' levels of 10% intervals for modeling.

Two main types of longline styles were clearly identified: the Spanish traditional multifilament gear and the monofilament or 'American style' gear introduced more recently. Additionally, information on other gear characteristics or fishing practices was also compiled by means of skipper surveys (light sticks, clips, species declared as preference, etc.). A total of eight 'gear' levels were finally categorized.

The standardized log (CPUE) analyses were done using the GLM procedure (*SAS 9.2*). The quarters and the spatial definitions used for GLM runs were the same as those used for the Atlantic swordfish (Mejuto *et al*. 1999, Mejuto and De la Serna 2000) and also for the shortfin mako and blue shark (Mejuto *et al.* 2009) assuming a hypothetical boundary line between North and South 'stocks' located at 5º N latitude (**Figure 1**). Five and six areas were finally categorized for each of the North and South Atlantic runs, respectively. The period 1990-2010 was considered in all runs. Values of least squared mean predictions, standard error, CPUE values and 95% confidence intervals were obtained. Re-scaled standardized indices were plotted using the maximum standardized CPUE value as reference.

The log-normal model defined includes 'year', 'quarter', 'area', 'ratio' and 'gear' as main factors, as well as the 'quarter*area' interaction: $Ln(CPUE) = u + Y + Q + A + R + G + Q * A + e$. Where, u= overall mean, Y= effect year, Q= effect quarter, A= effect area, R= effect ratio, G= effect gear, e= logarithm of the normally distributed error term.

3. Results and discussion

A total number of 19,561 trip records from the North and South Atlantic areas were available for the period 1990-2010. The mean coverage of the observations used represents the 84.5% (CI95%=±4.1%) and the 86.3% (CI95%=±3.6%) of the total fishing effort of this fleet (task II data) during the whole period in the North and South Atlantic 'stocks', respectively. The fishing effort of the observations, aggregated in 5x5 degree squares (**Figure 2**) shows that major part of the regular fishing areas of this fleet were considered for modeling. Some spatial-temporal limitations were observed for data at the beginning of the time series due to the progressive geographical expansion of the fleet during the initial periods, particularly in the South Atlantic. These limitations are often observed in the data sets obtained from most of the oceanic longline fleets when accessing new fishing areas during the geographical expansion periods or owing to shifts to other fishing areas or tuna species targeted.

Tables 1 and **2** provide the ANOVA summary, including R-square, mean square error (root), F-statistics and significance level as well as the Type III SS for each factor used. The significant models tested explained between 35% and 44% of the CPUE variability depending on the "stock" considered (North or South) and the units (number of fish or weight). The CPUE variability (Type III SS) of shortfin mako may be mainly attributed to the area factor in all runs. The area, area*quarter, ratio were identified as the most important factors in the case of the North Atlantic runs. Area, year, quarter or quarter*area were identified as the most important factors in the case of the South Atlantic runs. The ratio factor takes into account the progressive change in the fishing practices and targeting criteria described for the Spanish longline fleet during the recent periods, especially in the North Atlantic areas, with some implications as regards the preference of swordfish and/or in favor of blue shark catches during the most recent period (Mejuto and De la Serna 2000, Mejuto *et al.* 2009). The significance of the 'ratio' factor between the main desirable species retained onboard has been described for several important oceanic longline fleets fishing in the North and South Atlantic areas and more recently for the Pacific and Indian Ocean, as well (Chang *et al.* 2007, Hazin *et al.* 2007[a,b], Mejuto and De la Serna 2000, Mourato *et al.* 2007, Ortiz 2007, Ortiz *et al.* 2007, Paul and Neilson 2007, Yokawa 2007). The results obtained in this case suggest that this factor is less important than in the case of the swordfish and blue shark analyses probably because the shortfin mako was and still is a regular by-catch with relatively low prevalence rates as compared to the main species. However the fishing strategy suggests a moderate influence of this factor on the shortfin mako standardized catch rates particularly in the North Atlantic case. **Figure 3** provides the normal probability *qq-plot* obtained for each run and a box-plot of the standardized residuals obtained by year. The least squared mean, standard error and CPUE values obtained and their respective confidence intervals (95%) are shown in **Table 3.** Re-scaled CPUE trends over time and their respective confidence intervals are also plotted (**Figure 4**).

In long life span species, such as swordfish (Mediterranean stock excluded) as well as large pelagic sharks such as blue shark and shortfin mako, the populations regularly include individuals up to 10+ years of age. Intermediate ages generally account for the largest part of the stock biomass. Selectivity patterns are not usually focused on juvenile fish for several different reasons including the behaviour of these species, the commercial fishing gears regularly used in oceanic areas and the target-commercial criteria in addition to other factors. As a result, abrupt natural changes in their biomasses (abundances) would not be expected between consecutive years. The population's age structure usually attenuates biomass fluctuations even in highly-variable recruitment scenarios and/or high fishing mortality scenarios, as observed in North Atlantic swordfish assessment (Anon. 2010) and population simulations. Therefore, biomass trends over time tend to be based on multiannual cycles or stages, basically depending on recruitment scenarios or phases which are expected to have a much lower variability in the case of large pelagic sharks than in most teleosts because of their different reproduction-recruitment strategies and the different influence of the environment on the survival of the pups versus the egg-larva-juvenile stages, respectively. The standardized CPUE predictions for the 1990-2010 period analyzed in this paper suggest that changes of biomass between pairs of consecutive years ($CPUE_{yr+1}$ vs. $CPUE_{yr}$) were relatively moderate with average year-to-year variations between 14% and 16% if absolute increments are considered and around +2% if the mean values between positive and negative increments are considered.

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Table 1. Number of observations used in the GLM analysis (N), periods considered and summary of ANOVA for each GLM run: F-statistics, R-squared and mean squared error (root). SMA= shortfin mako.

Species	*Stock*	*Years*	*Unit*	*N*	*F-value*	*Pr>F*	*R-squared*	*RMSE*
SMA	North	1990-2010	number	13680	134.86	<0.0001	0.3523	1.0812
SMA	North	1990-2010	weight	13690	134.14	<0.0001	0.3511	1.0345
SMA	South	1990-2010	number	5871	80.81	<0.0001	0.4421	0.8279
SMA	South	1990-2010	weight	5871	68.41	<0.0001	0.4015	0.8194

Table 2. Summary of the type III SS for each factor considered in the GLM runs. SMA= shortfin mako.

				Type III SS					
Species	*Stock*	*Years*	*Unit*	*YR*	*QTR*	*Area*	*Ratio*	*Gear*	*QTR*Area*
SMA	North	1990-2010	number	462.4	152.3	2957.5	656.7	381.6	1050.0
SMA	North	1990-2010	weight	538.4	223.7	2224.3	656.8	144.6	1029.4
SMA	South	1990-2010	number	180.4	150.2	833.1	118.0	62.1	122.6
SMA	South	1990-2010	weight	127.5	110.8	814.2	109.2	50.4	116.8

Table 3.a. Least squared mean, standard error, predicted CPUE in number of fish and weight and 95% confidence intervals, for the North Atlantic stock of the shortfin mako during the 1990-2010 period.

North Atlantic										
	Number of fish					Weight				
YR	LSMEAN	STDERR	Ucpue	cpue	Lcpue	LSMEAN	STDERR	Ucpue	cpue	Lcpue
1990	0.1796	0.1165	1.5139	1.2048	0.9589	4.0674	0.1115	73.1215	58.7715	47.2376
1991	0.1314	0.1165	1.4426	1.1482	0.9139	4.0905	0.1114	74.8209	60.1405	48.3404
1992	0.3091	0.1171	1.7255	1.3716	1.0903	4.2976	0.1121	92.1560	73.9850	59.3970
1993	0.2200	0.1161	1.5750	1.2545	0.9993	4.1968	0.1111	83.1472	66.8827	53.7998
1994	0.0947	0.1150	1.3864	1.1066	0.8833	4.0323	0.1101	70.3890	56.7325	45.7255
1995	0.2761	0.1121	1.6523	1.3263	1.0646	3.9704	0.1073	65.7871	53.3103	43.1997
1996	0.5818	0.1121	2.2429	1.8006	1.4455	4.1388	0.1072	77.8447	63.0895	51.1311
1997	0.0878	0.1125	1.3698	1.0987	0.8813	3.6189	0.1077	46.3242	37.5125	30.3770
1998	0.2370	0.1127	1.5909	1.2755	1.0227	3.7327	0.1078	51.9288	42.0351	34.0265
1999	0.1721	0.1143	1.4960	1.1956	0.9556	3.7019	0.1094	50.5137	40.7660	32.8993
2000	0.2498	0.1163	1.6236	1.2925	1.0290	3.6688	0.1113	49.0682	39.4500	31.7171
2001	0.2278	0.1165	1.5887	1.2643	1.0062	3.6500	0.1115	48.1670	38.7138	31.1158
2002	0.5028	0.1162	2.0902	1.6645	1.3255	3.9670	0.1112	66.0904	53.1512	42.7452
2003	0.7008	0.1179	2.5570	2.0295	1.6108	4.1790	0.1128	81.9785	65.7194	52.6851
2004	0.8090	0.1194	2.8578	2.2618	1.7900	4.1987	0.1142	83.8493	67.0343	53.5914
2005	0.7341	0.1195	2.6526	2.0985	1.6602	4.1165	0.1144	77.2631	61.7466	49.3462
2006	0.6392	0.1217	2.4234	1.9091	1.5039	3.9814	0.1165	67.7942	53.9589	42.9471
2007	0.9108	0.1246	3.1985	2.5056	1.9628	4.2600	0.1192	90.0806	71.3138	56.4568
2008	0.9455	0.1243	3.3098	2.5940	2.0330	4.3251	0.1190	96.0921	76.1080	60.2799
2009	0.8693	0.1229	3.0576	2.4033	1.8890	4.2952	0.1175	92.9893	73.8545	58.6571
2010	0.7172	0.1228	2.6259	2.0643	1.6228	4.1285	0.1175	78.6974	62.5131	49.6572

Table 3.b. Least squared mean, standard error, predicted CPUE in number of fish and weight and 95% confidence intervals, for the South Atlantic stock of the shortfin mako during the 1990-2010 period.

South Atlantic										
	Number of fish					*Weight*				
YR	*LSMEAN*	*STDERR*	*Ucpue*	*cpu1*	*Lcpue*	*LSMEAN*	*STDERR*	*Ucpue*	*cpue*	*Lcpue*
1990	0.1129	0.1097	1.3964	1.1263	0.9085	4.1428	0.1085	78.3701	63.3518	51.2116
1991	-0.1379	0.1058	1.0779	0.8761	0.7120	3.7852	0.1047	54.3732	44.2859	36.0700
1992	0.0820	0.0995	1.3256	1.0908	0.8976	4.0131	0.0985	67.4159	55.5854	45.8310
1993	0.1074	0.0938	1.3440	1.1182	0.9304	3.9812	0.0929	64.5555	53.8106	44.8542
1994	0.1308	0.0951	1.3793	1.1448	0.9502	3.9562	0.0941	63.1245	52.4924	43.6511
1995	0.2669	0.0875	1.5562	1.3109	1.1042	4.0883	0.0866	70.9376	59.8600	50.5122
1996	0.2577	0.0743	1.5009	1.2976	1.1218	4.1723	0.0735	75.1244	65.0420	56.3127
1997	-0.0866	0.0702	1.0549	0.9193	0.8012	3.9451	0.0695	59.3659	51.8084	45.2130
1998	-0.3426	0.0743	0.8235	0.7119	0.6154	3.7332	0.0735	48.4244	41.9244	36.2968
1999	-0.5581	0.0729	0.6620	0.5738	0.4974	3.5392	0.0722	39.7775	34.5286	29.9724
2000	-0.0529	0.0736	1.0987	0.9511	0.8233	4.0139	0.0729	64.0325	55.5090	48.1201
2001	0.1686	0.0649	1.3472	1.1862	1.0444	4.2238	0.0643	77.6187	68.4301	60.3292
2002	0.1098	0.0684	1.2793	1.1187	0.9783	4.1781	0.0677	74.6751	65.3910	57.2612
2003	0.1092	0.0718	1.2872	1.1183	0.9715	4.1724	0.0711	74.7492	65.0322	56.5783
2004	0.0013	0.0764	1.1664	1.0042	0.8646	4.0763	0.0756	68.5312	59.0938	50.9560
2005	0.1514	0.0824	1.3720	1.1674	0.9934	4.2618	0.0815	83.5071	71.1749	60.6639
2006	-0.0360	0.0714	1.1124	0.9671	0.8407	4.0911	0.0707	68.8708	59.9574	52.1976
2007	-0.0784	0.0814	1.0882	0.9277	0.7909	4.0076	0.0806	64.6368	55.1935	47.1298
2008	-0.1441	0.0758	1.0074	0.8683	0.7484	3.9285	0.0750	59.0526	50.9761	44.0042
2009	0.0428	0.0730	1.2074	1.0465	0.9070	4.1356	0.0722	72.2263	62.6917	54.4158
2010	0.1603	0.0755	1.3650	1.1773	1.0153	4.2308	0.0747	79.8459	68.9662	59.5690

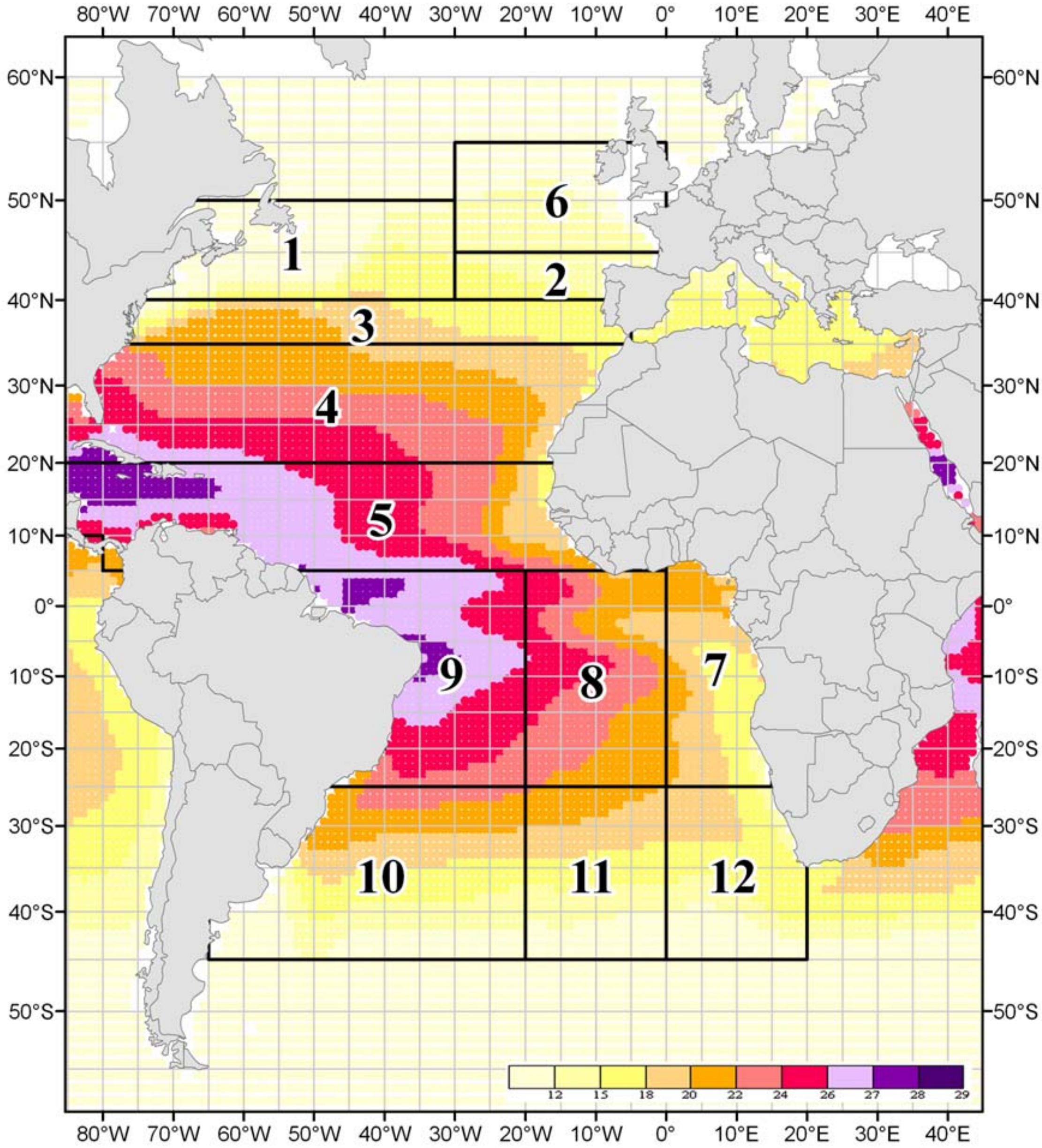

Figure 1. Geographical 'area' stratification used for the GLM runs of shortfin mako. The areas were kept as in previous analyses. Areas are superimposed on average sea temperature ºC at 50m depth.

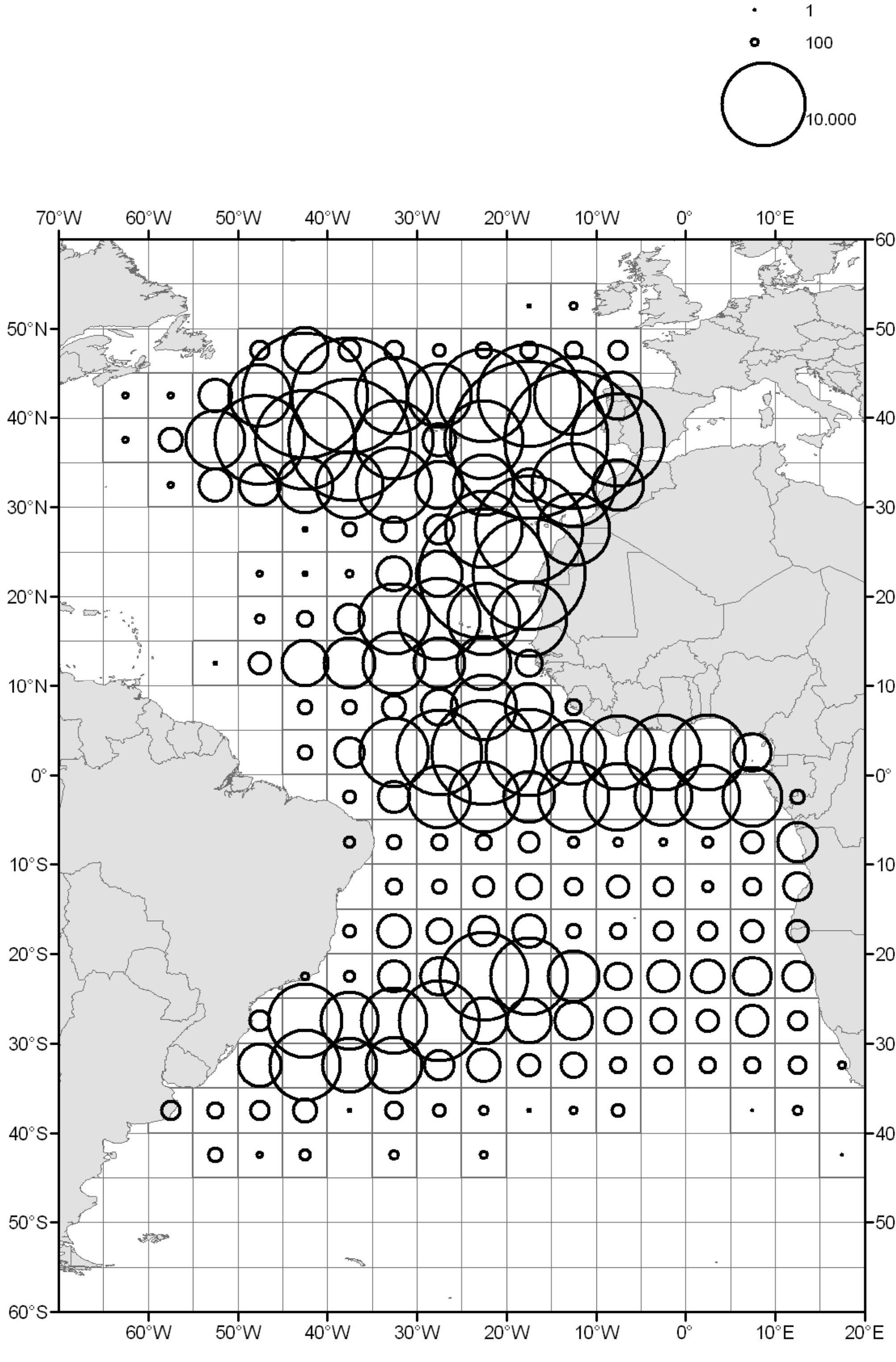

Figure 2. Fishing effort (thousand hooks) of the observations used for the GLM analyses, aggregated in 5x5 degrees squares and years combined for the 1990-2010 period.

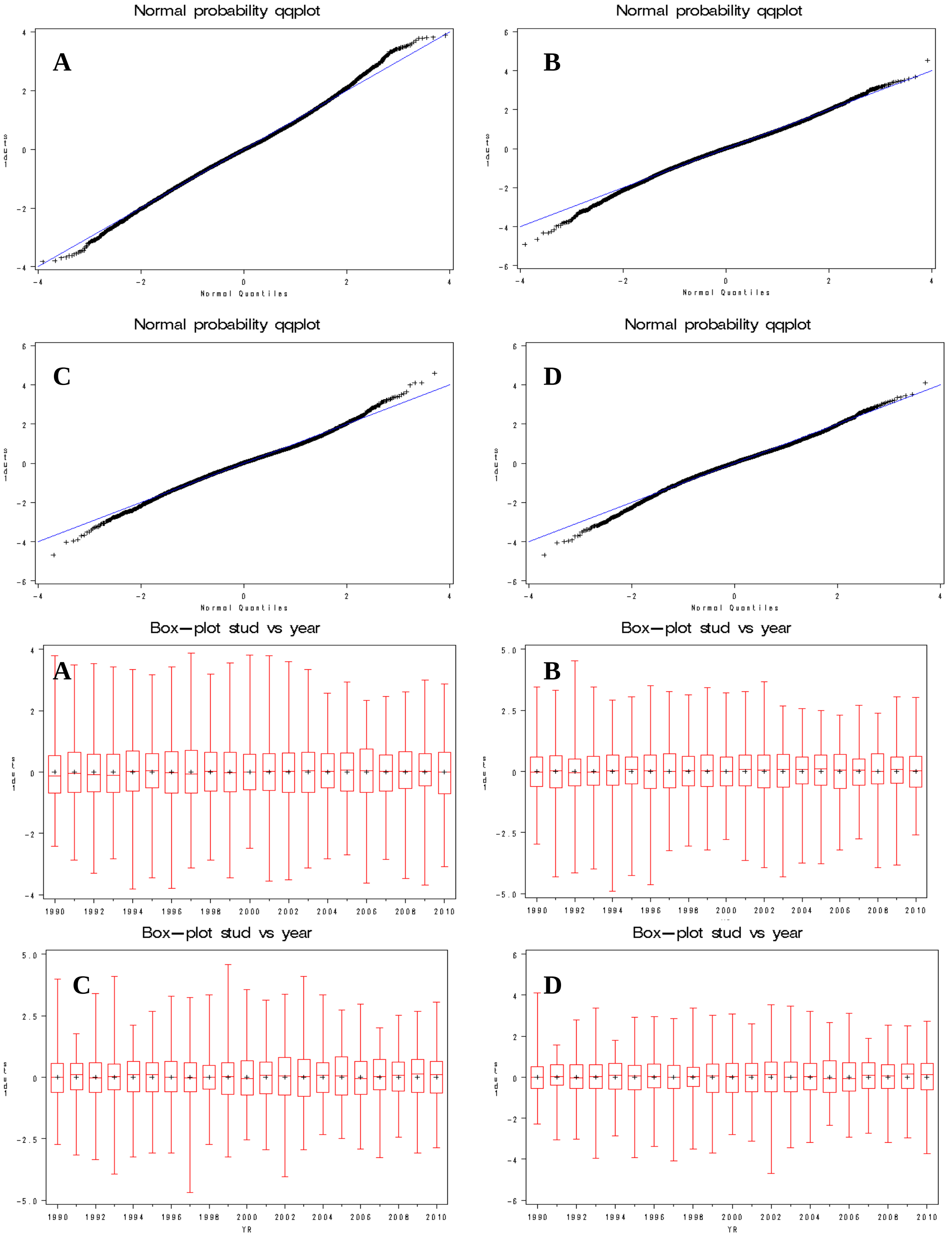

Figure 3. Normal probability qq-plots (upper panels) and box-plots of stud. vs. year (lower panels) for the standardized CPUE in number of fish and in weight for the North and South Atlantic stocks of the shortfin mako during the period 1990-2010. A and C: CPUE in number. B and D: CPUE in weight. A and B: North Atlantic. C and D: South Atlantic.

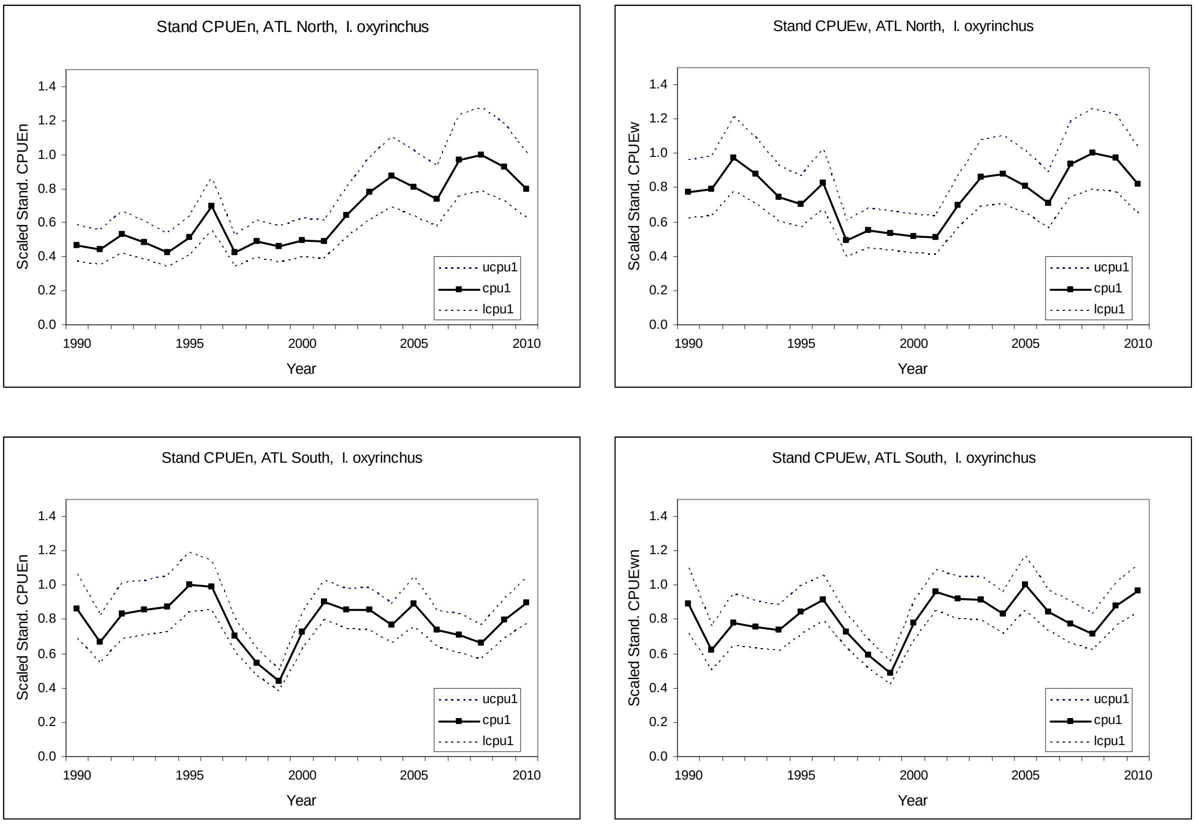

Figure 4. Re-scaled standardized CPUE by year, in number of fish (CPUEn), in weight (CPUEw) and confidence intervals (95%) for the North and South Atlantic stocks of the shortfin mako during the 1990-2010 period.