 Collect. Vol. Sci. Pap. ICCAT, 73(1): 323-368 (2017)

STANDARDIZED CATCH RATE IN NUMBER AND WEIGHT OF YELLOWFIN TUNA (*THUNNUS ALBACARES*) FROM THE UNITED STATES PELAGIC LONGLINE FISHERY 1987-2015

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SUMMARY

Six indices of abundance of yellowfin tuna from the United States pelagic longline fishery are presented for 1987-2007. These are: 1: Entire Atlantic (ATL) and Gulf of Mexico (GOM) CPUE in number; 2: Entire ATL and GOM CPUE in weight; 3: ATL CPUE in number; 4: ATL CPUE in weight; 5. GOM in number and 6. GOM in weight. The standardization procedure evaluated year, area, season, number of light sticks per hook, time of set (am or pm), number of hooks between floats, bait type (live, dead or mix), gangion length, float line length, number of hooks set and sea surface temperature as factors in the models. Final models included only terms and first order interactions that reduced the total model deviance by >5% with interactions with year modeled as random effects. Indices for the Atlantic have declined since 1987 and were some of lowest on record for 2008-2010 but show some slight increasing trends in the most recent years. Indices for the Gulf of Mexico show increased interannual variability but a reduced level of overall decline. Length frequencies and changes in median length over time are also reported and there is little detectable trend in either.

RÉSUMÉ

Six indices d'abondance de l'albacore de la pêcherie palangrière pélagique des Etats-Unis sont présentés pour la période 1987-2007. Il s'agit de : 1: CPUE en nombre de l'ensemble de l'Atlantique (ATL) et du golfe du Mexique (GOM) ; 2 : CPUE en poids de tout ATL et GOM ; 3 : CPUE en nombre de ATL ; 4 : CPUE en poids de ATL ; 5 : GOM en nombre et 6 : GOM en poids. La procédure de standardisation évaluait l'année, la zone, la saison, le nombre de baguettes lumineuses par hameçon, l'heure de l'opération (matin ou soir), le nombre d'hameçons entre flotteurs, le type d'appât (vivant, mort ou mixte), la longueur des lignes secondaires, la longueur des lignes de flotteurs, le nombre d'hameçons fixés et la température à la surface de la mer comme facteurs dans le modèle. Les modèles finaux incluaient seulement des termes et des interactions de premier ordre qui réduisaient de plus de 5% la déviance totale du modèle avec des interactions avec l'année modélisées comme effets aléatoires. Les indices pour l'Atlantique chutent depuis 1987 et sont parmi les plus bas pour la période 2008-2010 mais ils dégagent des tendances légèrement à la hausse au cours de ces dernières années. Les indices pour le golfe du Mexique font apparaître une variabilité interannuelle accrue mais un niveau réduit de baisse globale. Les fréquences de taille et les changements de longueur moyenne dans le temps sont également déclarés et une tendance légère est détectable entre les deux.

RESUMEN

Se presentan seis índices de abundancia de rabil de la pesquería de palangre pelágica estadounidense para 1987-2007. Estas son: 1: Atlántico total (ATL) y Golfo de México (GOM) CPUE en número; 2: Atlántico total y GOM CPUE en peso; 3: ATL CPUE en número; 4: ATL CPUE en peso; 5. GOM en número y 6. GOM en peso El procedimiento de estandarización evaluó año, área, temporada, número de bastones luminosos por anzuelo, hora de la operación (por la mañana o por la tarde), número de anzuelos entre flotadores, tipo de anzuelo (vivo, muerto o ambos), longitud del a brazolada, longitud de la línea de flotación, número de anzuelos colocados y temperatura del mar como factores en el modelo. Los modelos finales incluían términos e interacciones de primer orden que redujeron la desviación total del modelo en más de un 5% con interacciones con año modeladas como efectos aleatorios. Los índices para el Atlántico han descendido desde

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1987 y fueron uno de los más bajos registrados para el periodo 2008-2010, pero muestran algunas tendencias ligeramente crecientes en los años más recientes. Los índices del golfo de México muestran una variabilidad interanual creciente pero un nivel reducido de descenso general. También se comunican las frecuencias de tallas y los cambios en la mediana de tallas en el tiempo, observándose en ambas escasas tendencias detectables.

KEYWORDS

Yellowfin tuna, longline, stock assessment, catch/effort, pelagic fisheries, logbooks

1. Introduction

Relative abundance indices are critical indicators of stock status as well as essential inputs into stock assessments. Fishery catch per unit effort (CPUE) indices operate under the basic assumption that catch per unit effort is proportional to stock size. Numerous factors including changes in vessel characteristics, fishing locations, methods, and targeting of alternative species erode this basic relationship and complicate the interpretation of raw CPUE. Provided that data on covariates that influence the relationship between CPUE and abundance exist, these can be incorporated into standardized measures that presumably more accurately reflect population relative abundance (Maunder and Punt 2004).

This report presents delta lognormal CPUE standardization models for the US pelagic longline using vessel logbook data for the Atlantic and Gulf of Mexico. We employ a similar treatment to the data as used in a previous version of this index for the 2011 stock assessment (Walter 2011) which differed slightly from the index used in the 2008 stock assessment (Walter et al. 2007). The primary differences were in the removal of the operations code as a factor, the exclusion of sets in closed areas pre- and post-closure and the addition of several factors such as time of day of set, bait type and hooks between floats. Recent advances in index derivation have warranted several additional changes since the 2011 index. These are consideration of several additional gear configuration variables and the removal of several areas which cause strong year*area interactions, notably the removal of data from the Northeast Distant Waters areas after 2003 and parts of the Florida East coast area close to longlining.

These six indices are otherwise similar to indices constructed from the United States Pelagic longline vessel logbook program data used in the 2008 and the 2011 ICCAT YFT stock assessments. The CPUE index for the Atlantic only was used, in number, in the VPA and in weight in the production models.

2. Materials and Methods

Data for this analysis come from the United States Atlantic and Gulf of Mexico Pelagic Longline fishery described in detail by Hoey and Bertolino (1988). Swordfish, yellowfin and bigeye tuna are the predominant target species. The pelagic longline fishing grounds of the US fleet extends from the Grand Banks in the North Atlantic to 5-10° south of the Equator, mainly in the Western Atlantic including the Caribbean Sea and the Gulf of Mexico (**Figure 1**). The fishery has operated under several time-area restrictions since 2000 due to management regulations related to swordfish and other species (Federal Register 2000, **Figure 1**). These restrictions included two permanent closures to pelagic longline fishing, one in the Gulf of Mexico known as the Desoto Canyon, effective since November 1st 2000, and the second permanent closure was the Florida East Coast effective since March 1st 2001. In addition, three time-area restrictions were also imposed for the pelagic longline gear in the US Atlantic coast: Charleston Bump, an area off the North Carolina coast closed from February 1st to April 30th starting in 2001 year, the Bluefin tuna protection area off the South New England coast closed from June 1st to June 30th starting in 1999, and the Grand Banks area that was closed from July 17 2001 to January 9 2002 as a result of an emergency rule implementation (Cramer 2002). The Northeast distant area (NED) was closed for fishing from September 15, 2001 through January 9, 2002 2001 but then reopened with specific gear deployment modifications and requirements for turtle safe handling and release. Additional time area closures have been instituted for the Gulf of Mexico to protect spawning Bluefin tuna. These closures are in place in certain high CPUE areas of the Gulf of Mexico for April and May (green areas in the year 2015 in **Figure 2**).

Catch and effort data is available from three sources: pelagic logbooks reported daily by vessel captains (Scott et al. 1993). Logbook data is available from 1986, however from 1986 to 1991, submission of logbooks was voluntary, and became mandatory in 1992. In this paper we use vessel logbook reports however previous papers have explored the use of dealer weigh-out data and found that it followed a similar trend to logbook reports (Ortiz and Diaz 2004). These data and further descriptions of the data collection and processing are available from the National Marine Fisheries Service Southeast Fisheries Science Center (http://www.sefsc.noaa.gov/commercialprograms.jsp).

The Pelagic longline logbook data comprises a total of 348,834 recorded sets from 1986 through 2015. Each record contains information of catch by set, including: date-time, geographical location, catch in numbers of targeted and bycatch species, number of hooks, light sticks and various other gear parameters for each set as well as environmental conditions such as temperature. As only part of the year 1986 was included, sets were restricted to only ones made after 1987, only those made specifically with pelagic longline gear and not bottom longline gear, those with greater than 100 hooks per set, those from vessels that caught greater than 10 YFT over the entire time series and those with complete catch, effort, location and date information. A further restriction was made whereby any sets in closed areas prior to or after the closure were removed. For short time-area closures such as single month closures, all data from that are and that month were removed pre and post closure. These restrictions resulted in a total of 251,479 sets, of which 157,626 (62%) reported positive catches of yellowfin tuna.

Length data comes from measurements made by onboard observers who are directed to record lengths of all species brought onboard and to estimate lengths for all released or discarded animals for which it is not possible to physically measure. Measurements for all tuna species are straight-line fork length taken from the tip of the upper jaw to the fork of the tail. If this measurement is not possible due to the fish processing then lengths are measured as the straight length from the anterior insertion of pectoral fin to the fork of tail. In addition observers record sex and weigh the fish if possible. For this study we use only physically recorded lengths rather than estimated lengths (**Figures 3-5**).

2.1 Dependent variables

Fishing effort is reported as number of hooks per set, and nominal catch rates in number of fish were calculated as number of yellowfin tuna caught (kept+discarded) per 1000 hooks (**CPUEN**) for each observation. We estimated relative abundances of yellowfin tuna in biomass (**CPUEW**) assigning a mean straight-line fork length of yellowfin tuna by year, area and quarter of the year to each logbook record. Lengths were obtained from the US Pelagic Observer Program (PLOP) measured yellowfin tuna for 1992-2006. Average sizes were transformed to weights using the current length-weight relationship where weight (kg) = 2.1527×10^{-5} * length $(cm)^{2.976}$. Caveriviere (1976) (http://www.iccat.es/Documents/SCRS/DetRep/DET_yft.pdf). When the number of fish measured per strata was less than 50, the mean value for the higher strata level was used (i.e. year-area). The PLOP recorded size measurements for 56,872 yellowfin tuna from 1992 to 2011. Although observer coverage was good for most year-area-quarter combinations, the observer size data started in 1992, thus for years 1987-1991 the mean value for 1992-area-quarter was used to convert numbers of fish to biomass of yellowfin tuna. Standardized and nominal catch rates were calculated as kilograms of yellowfin tuna per 1000 hooks.

2.2 Data exclusions

Various data restrictions were necessary to eliminate incomplete or erroneous records or records that were non-standard, such as very short sets of fewer than 100 hooks, weight of fish incorrectly recorded as number, vessels with op code 1 or 3 as there were very few sets from these, or sets with zero fish of any species captured, vessels capturing less than 10 total YFT recorded over the time series, sets with no latitude or longitude and bottom longline sets. Restricting the logbook data only to sets from 1986 onward, those with greater than 100 hooks per set, and with complete catch, effort, location and date information and with the regulatory restrictions defined below, resulted in a total of 290,704 sets, of which ~65% were positive for YFT.

As noted above, sets in closed areas were excluded before and after the closure, sets that occurred in the Northeast Distant waters after 2003 were excluded and sets in the FEC at latitudes lower than 28ºN latitude were removed as the closures of the Florida straits shifted effort away from the Florida Straits towards the area north of the Bahamas (not shown due to data confidentiality). This spatial shift in effort clearly impacted the CPUE in the FEC as a whole, creating a spurious year*area interaction that was mitigated by removing FEC at latitudes lower than 28ºN latitude.

2.3 Factors

The factors used in these models diff slightly from those used in previous treatments of the data. Eleven fixed factors and all two-way interactions were evaluated. Eight geographical areas (**area**) of longline fishing have been traditionally used for classification; these include: the Caribbean, Gulf of Mexico, Florida East coast, South Atlantic Bight, Mid-Atlantic Bight, New England coastal, northeast distant waters, the Sargasso Sea, and the offshore area (**Figure 1**). Calendar quarters (season) were used to account for seasonal fishery distribution through the year (Jan-Mar, Apr-Jun, Jul-Sep, and Oct-Dec). Other factors included in the analyses of catch rates included; the use and number of light-sticks (lightc) expressed as the ratio of light-sticks per hook, hooks between floats (HBFL2) or the numbers of hooks between floats which alters the depth of the hooks, modeled as a categorical factor with 7 levels, time of day of set (BSPM2) which was either AM, PM or unknown and bait use (Bait_use) which was modeled as a categorical variable with four levels Live, dead and mix and unknown bait types. Other factors included the length of gangion, the length of floatline, a categorical variable for the number of hooks set (hookcat) and a categorical factor for sea surface temperature (temp). Categories were chosen visually to obtain representative categories. Plots of nominal catch rates by factor levels are shown in **Figures 6-8** and plots of the relative distribution of model categories by year are shown in **Figures 9 and 10**. These are informative to see whether the distribution of factor categories might change over time.

In previous treatments of these data we have defined targeting (targ2) as a categorical variable with four levels based on the proportion of the number of swordfish caught to the total number of fish per set, with four discrete target categories corresponding to the ranges 0-25%, 25-50%, 50-75%, and 75-100%. For this paper we have abandoned this variable as we deem it preferable to use gear configuration variables rather than a function of the dependent variable as a model factor. A factor related to the type of vessel was also used in previous models (operations code) but since 20-30% of the fleet no longer has a code assigned, it would have resulted in a substantial loss of information and was not used in this analysis.

Fishing effort is reported as number of hooks per set, and nominal catch rates were calculated as number of yellowfin tuna caught per 1000 hooks for each observation. The US Atlantic longline fleet targets mainly swordfish and yellowfin tuna, but other tuna species are also targeted including bigeye tuna and albacore (to a lesser extent, some of the trips-sets target other pelagic species including sharks, dolphin and small tunas).

2.4 Analytical approach

Analyses were done using Glimmix and Mixed procedures from the SAS® statistical computer software (SAS Institute Inc, 1997, Littell et al 1996). A step-wise regression procedure was used to determine the set of factors and interactions that significantly explained the observed variability. We used criterion which assumes that the difference in deviance between two consecutive models follows a Chi-square distribution. The deviance is essentially a measure of the variability explained by the model. Using this statistic, with degrees of freedom equal to the number of additional parameters estimated minus one, a Chi-square test was constructed which indicates if the additional factor is or is not statistically significant (McCullagh and Nelder, 1989). Deviance analysis tables were constructed for both components of the delta model: Proportion of successful trips/sets, and mean catch rate in both numbers and weights of positive trips/sets. Each deviance table includes the deviance explained by the additional factor or interaction, the overall percent explained by each factor, and the Chi-square probability test. Final selection of explanatory factors was conditional to a) the relative percent of deviance explained by the added factor, normally factors that explained more than 5% of deviance were included and b) the Chi-square significance test. Once a set of fixed factors was specified, all possible 1^{st} level interactions were evaluated, in particular interactions between the year effect and other factors. These interactions were then modeled as random effects in the final model.

Indices of abundance of yellowfin were estimated by a generalized linear modeling approach assuming a delta lognormal model (Lo et al. 2002). The standardization procedure splits the dependent data into two parts, one of which models the proportion of positive sets which is assumed to have a binomial error distribution. The second part models the mean catch rate (CPUEN or CPUEW) of successful sets and assumes a lognormal error distribution. The standardized index is the product of the two. Parameterization of the model used the GLM structure where the proportion of successful sets is a linear function of the fixed factors the random year effect and random year-interaction effects when the year term was within the interaction. The logit function was used as the link between the linear factor component and the binomial error.

Standardized indices of abundance were calculated as the product of the year effect least square means (LSmeans) from the binomial and the lognormal components of the delta lognormal model. Lognormal estimates also included a bias back-transformation correction factor as describe by Lo et al (1992). Variances were obtained using the Goodman (1960) exact estimator for the variance of the product of two uncorrelated random variables (Goodman 1960) as recommended by Lauretta et al. (2015).

3. Results and Discussion

3.1 Overall results

For the time period 1987-2015, an annual average of 11619 longline sets were recorded in the pelagic logbook database (**Table 1**). These comprise the most complete records of US pelagic longline CPUE available for the Atlantic and Gulf of Mexico. During this time period, there has been a reduction in the total numbers of vessels in the fishery from a high of 300 to the present value of ~110. The concomitant increase in the number of hooks set per vessel has kept overall fishing effort relatively constant, however effort has been displaced from a series of time area closures (**Figures 1, 2**) and the closure of the Gulf of Mexico to fishing for much of 2010 due to the Deepwater Horizon oil spill. Ortiz and Diaz (2004) conducted a preliminary evaluation of the effects of area closures on nominal catch rates and found that historic catch rates for most closure areas were lower compared to the average rates in non-closure areas. Fishing effort started to reduce in the closure areas as early as 1996-97 prior to the implementation of most closures. The current treatment of area closures to exclude all data from closed areas pre- and post-closure represents a departure from some previous treatments which have either attempted to estimate a closed area affect or ignored the potential effects of area closures. It may be unlikely that a closed area affect can simply be estimated, as it is likely that the effects of the closures will be confounded with abundance changes over time and the magnitude and direction of any effect of closing part of an area is likely to vary by area, depending upon the reason for the closure.

Figure 2 shows the geographic distribution of fishing effort and nominal catch rates for yellowfin tuna from the pelagic logbooks for two time periods: from 1987 through 2015. The plotted values are the annual numbers of hooks deployed and annual mean catch of fish per 1000 hooks. The plots show the substantial reduction of fishing effort, and particularly the effects of time/area closures.

Length frequencies by year, area and mean lengths over time and area are shown in **Figures 3-5**. Overall there does not appear to be much trend in lengths over time. The Gulf of Mexico has the largest YFT.

An analysis of nominal catch rates by area indicate declines in CPUE (#/1000 hooks) in the GOM and the presence of fairly strong year*area interactions (**Figure 11**). One putative reason for the decline in catch rates was the prohibition on the use of live bait in the Gulf of Mexico after September 1, 2000, though Brown (2007) found this not to influence catch rates and bait type was not found to be significant in the overall model but it was in the Gulf of Mexico only models. Concomitant with these decreases in CPUE in the GOM was an increase in the proportion of positive which will tend to stabilize delta-lognormal catch rates that are the product of proportion success and mean CPUE of positive trips. One of the apparent effects of the closure of the Florida Straits to longlining since March 1st 2001 was to displace the remaining fishing effort in the Florida East area to north of the Bahamas where catch rates of yellowfin tuna are higher than generally observed within the straights (**Figure 11**). For the dataset used for the indices, all sets from this part of the Florida straits were removed. The other clear pattern in the data is the decline to very low levels in the NED after 2003, which likely coincides with regulatory changes to allowing only mackerel bait in 2004 to minimize turtle bycatch. Hence all NED data after 2003 was also removed from the modeling dataset.

Examination of histograms of log of the CPUEN and CPUEW indicate that both are fairly normally distributed but likely exhibit some overdispersion (**Figures 12 and 13**). Examination of model residual patterns showed some departures from (**Figures 14-16**) from distributional assumptions at the tails, though generally adequate fits for both the proportion positive and the lognormal models.

3.2 Model selection

For indices in weight and number, the same model factors were used as it was deemed unlikely that the model factors would change between the CPUE in number or weight.

Null Models

Proportion Positive = year+season+area+lights+temp+hbfl + hookcat+ gangion+ floatline+ bait+ BSPM + all 2-way interactions

log(CPUEN) = = year+season+area+lights+temp+hbfl + gangion+ floatline+ bait+ BSPM + all 2-way interactions

The final models selected were:

Index 1 and 2, CPUE in wt and number

FINAL_ATLGULF_BIN=ppos("year+season+area+lights+temp+~~hookcat~~[R] + *year*area*")
FINAL_ATLGULF_LN =poscpue("year+season+area+lights+ *year*area*")
[R]note that hookcat was removed from model due to non-convergence

Index 3 and 4, CPUE in wt and number

FINAL_ATL_MODEL_BIN=ppos("year+season+area+~~temp~~[R]+hookcat + *year*area*")
FINAL_ATL_MODEL_LN= poscpue("year+season+area+temp+lights + *year*area* + *year*temp*")
[R]note that temp was removed from model due to non-convergence

Index 5 and 6, CPUE in wt and number

FINAL_GULF_BIN=ppos("year+season+lights+hbfl+hookcat + *year*lights*")
FINAL_GULF_LN=poscpue("year+season+bspm+lights+bait + *year*season*")

Where year*factor interactions were modeled as random effects. Model selection was performed according to the reduction in explained deviance, with factors being retained if they result in greater than a 5% reduction in explained deviance. First main factors were chosen, and then all two-way interactions were tested. Season and Year were included initially in all models regardless of explained deviance to facilitate obtaining annual and seasonal means. Model selection was performed in R and final model estimation was performed in SAS with proc GLIMMIX or Proc Genmod.

Deviance analysis (**Tables 2-7**) for the indicated that the factors Area and Season were almost always selected. Variables that often account for the depth of fishing and the target species such as hooks between floats (Hbfl), number of light sticks (Lightc) and time of day of set (BSPM2) were also usually selected. Interactions between year and area were also usually significant and included as random effects. For the Gulf of Mexico, Bait_Use (Live, dead or mix) was significant and used in the models.

3.3 Indices

Six indices plus a continuity index (using the same model and data treatments as in Walter (2011) for CPUE in number (for the Gulf and Atlantic) were constructed **Figures 17-19, Tables 10-15**). The continuity index is plotted on **Figure 17** but not provided in a table. Both standardized catch in number and weight show very similar patterns for the entire area and the Atlantic only (**Figure 17-19**) reflective of the absence of a trend in mean size over the time period for the entire fishery. Indices for the Atlantic have declined since 1987 and were some of lowest on record for 2008-2010 but show some slight increasing trends in the most recent years. Indices for the Gulf of Mexico show increased interannual variability compared to the Atlantic but a reduced level of overall decline. Indices in the Atlantic appear to differ from the more stable long term trend in the GOM (**Figure 21**). When combined, the indices for the entire area show an intermediate trend, reflective of the modeling decision to include year*area interactions as random effects. Alternative index constructions, e.g. explicitly accounting for area and summing densities up by area (Campbell et al 2015) might be considered for future treatments of this index.

The multiple index configurations represent options for partitioning indices for different assessment models. If seasonal structure is necessary any of the indices can be constructed by season but they have not been included in this document for brevity. Overall the current index construction uses more factors that account for how the gear is fished rather than relying upon the operations code or an ad hoc targeting variable to standardize the indices. These ad hoc approaches were necessary as many of the variables such as hooks between floats, set time, and bait type were not available in the early years of data collection. Now, as more years of complete data become available, it is desirable to use these factors, however it should be noted that the first four years of the time series often did not include complete information on time of day of set, bait type and other gear information. Furthermore, in these first four years logbooks participation was not mandatory so there is less effort than in subsequent years. The previous (2011) and current constructions of the index both exhibit some the greatest divergence from the nominal values in the first four years (**Figure 18**). Inspection of which model factor appears to be creating the divergence (**Figure 20**) that it is the fraction of lightsticks used that substantively shifts in the Atlantic region after 1991. It does not shift as much in the Gulf, which showed less of a divergence from the nominal. Given this large shift from high light stick usage targeting SWO to fewer light sticks per hook, it is most likely this factor in the lognormal components of both models that is driving this divergence. Furthermore, it is likely correctly accounting for this shift in light stick utilization as a proxy for targeting.

Several recent events have affected effort in the Gulf of Mexico. The Deepwater Horizon oil spill in April 2010 and subsequent fishing closures and related activities extending into 2011 appeared to have substantially reduced effort in the Gulf of Mexico particularly for the latter part of 2010 and early 2011 (**Figure 20**). Presumably the model standardization with season as a factor can account for the loss of much effort during this time period, however the data- and any annual effect for 2010 and 2011 will be a product of a reduced set of information.

Second, in 2015, new Bluefin tuna regulations including April and May spatial closures for a large part of the Northern Gulf of Mexico and bycatch quotas appear to have also reduced effort particularly in April – June when most BFT bycatch occurs (**Figure 20**) and potentially also in other quarters. It is also likely that there have been other measures taken to avoid BFT bycatch which may affect other species such as YFT. In this modeling exercise all data for April and May in the closed areas were removed back in time, to avoid bias imparted by a forced spatial shifting of effort. However this is an ad hoc approach that may warrant further consideration as to whether a closed area effect can be estimated for this region.

Lastly, in 2011 regulations required mandatory use of ‘weak’ hooks in the Gulf of Mexico beginning on May 5, 2011. According to extensive testing by the U.S. National Marine Fisheries Service (Foster & Bergman 2012) there was no significant change in YFT catch rate so no correction to the index was made.

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Table 1. Total numbers of vessels, sets, hooks set and yellowfin tuna reported in pelagic vessel logbooks.

year	*Total vessels*	*Total sets*	*Total hooks set*	*Hooks set per boat*	*total yellowfin*	*CPUE (# per 1000 hooks)*	*percent positive trips*
1986	137	2026	749392	5470.015	10132	12.190	56%
1987	266	14837	6368024	23939.94	58665	8.381	58%
1988	320	16011	6600575	20626.8	53638	7.379	49%
1989	344	17734	7172488	20850.26	56647	7.024	48%
1990	287	16185	6714673	23396.07	51034	6.643	48%
1991	254	15033	7194309	28324.05	68422	8.581	53%
1992	265	15021	8176497	30854.71	90000	9.579	57%
1993	287	14630	8497458	29607.87	60103	6.335	50%
1994	299	15749	9530486	31874.54	71268	6.574	50%
1995	311	16842	10845958	34874.46	84041	7.081	55%
1996	260	16201	10315078	39673.38	64433	5.580	55%
1997	253	15311	9945959	39312.09	76912	6.960	59%
1998	207	11946	7849502	37920.3	52444	6.086	57%
1999	208	12298	8029755	38604.59	76912	8.716	67%
2000	170	11704	7813236	45960.21	68506	8.730	66%
2001	157	10473	7370610	46946.56	51818	7.254	68%
2002	146	9826	7147408	48954.85	58888	8.254	74%
2003	127	9699	7172967	56480.06	51633	7.320	66%
2004	116	9865	7381003	63629.34	64422	8.844	71%
2005	111	8013	6018515	54220.86	44773	8.027	68%
2006	105	7600	5674062	54038.69	56383	10.901	71%
2007	118	8649	6148446	52105.48	57004	9.693	72%
2008	122	8813	6466329	53002.7	34920	5.480	62%
2009	117	9271	6930949	59238.88	42188	6.328	68%
2010	117	7603	5829592	49825.57	34503	5.794	61%
2011	117	8219	6085781	52015.22	42562	7.016	57%
2012	122	10899	7953677	65194.07	60897	7.810	71%
2013	116	10523	7548810	65075.95	41878	6.023	65%
2014	110	9711	6973686	63397.15	42063	6.674	64%
2015	104	7900	5677569	54592.01	28209	5.576	65%
average	189.1	11619.73	7206093	43000.22	55176.6	7.561149	61%

Table 2. Deviance analysis table of yellowfin catch rates in number (CPUEN) and proportion of positive sets (top) and for the log(CPUE) bottom for Index 1: Atlantic and Gulf of Mexico. Percent of total deviance refers to the deviance explained by the full model. Table is only shown for the final models but model selection was conducted by stepwise addition of a single factor.

FINAL_ATLGULF_BIN		Df	Deviance	Resid. Df	Resid. Dev	% Explained deviance	%Overall deviance
	NULL	NA	NA	348833	470983.1	NA	NA
	year	30	9246.0	348803	461737.0	6.484	1.963
	season	3	6967.3	348800	454769.7	4.886	1.479
	area	10	78931.8	348790	375837.9	55.354	16.759
	lights	3	17885.4	348787	357952.6	12.543	3.797
	temp	8	6419.8	348779	351532.8	4.502	1.363
	hookcat	7	9744.1	348772	341788.7	6.833	2.069
	year:area	280	13400.6	348492	328388.1	9.398	2.845

FINAL_ATLGULF_LN		Df	Deviance	Resid. Df	Resid. Dev	% Explained deviance	%Overall deviance
	NULL	NA	NA	207469	213381.0	NA	NA
	year	30	5497.9	207439	207883.0	14.270	2.577
	season	3	2644.1	207436	205239.0	6.863	1.239
	area	10	19452.6	207426	185786.4	50.488	9.116
	lights	3	4899.5	207423	180886.9	12.716	2.296
	year:area	277	6034.8	207146	174852.1	15.663	2.828

Table 3. Deviance analysis table of yellowfin catch rates in number (CPUEN) and proportion of positive sets (top) and for the log(CPUE) bottom for Index 3: Atlantic. Percent of total deviance refers to the deviance explained by the full model. Table is only shown for the final models but model selection was conducted by stepwise addition of a single factor.

	Df	Deviance	Resid. Df	Resid. Dev	Dev.Exp1	Dev.Exp2
NULL	NA	NA	230505	319314.0	NA	NA
year	30	3437.7	230475	315876.3	4.478	1.077
season	3	6760.4	230472	309115.9	8.805	2.117
area	9	42540.1	230463	266575.8	55.409	13.322
temp	8	8150.4	230455	258425.4	10.616	2.552
hookcat	7	4654.6	230448	253770.9	6.063	1.458
year:area	250	11231.9	230198	242538.9	14.630	3.518

	Df	Deviance	Resid. Df	Resid. Dev	% Explained deviance	%Overall deviance
NULL	NA	NA	111571	127306.0	NA	NA
year	30	3699.1	111541	123606.9	13.132	2.906
season	3	2931.1	111538	120675.8	10.406	2.302
area	9	12080.8	111529	108595.0	42.887	9.490
temp	8	2394.4	111521	106200.6	8.500	1.881
lights	3	1611.5	111518	104589.1	5.721	1.266
year:area	246	3580.1	111272	101009.0	12.709	2.812
year:temp	221	1871.8	111051	99137.3	6.645	1.470

Table 4. Deviance analysis table of yellowfin catch rates in number (CPUEN) and proportion of positive sets (top) and for the log(CPUE) bottom for Index 3: GOM. Percent of total deviance refers to the deviance explained by the full model. Table is only shown for the final models but model selection was conducted by stepwise addition of a single factor.

FINAL_GULF_BIN	Df	Deviance	Resid. Df	Resid. Dev	% Explained deviance	%Overall deviance
NULL	NA	NA	116760	111965.6	NA	NA
year	30	4841.2	116730	107124.4	10.716	4.324
season	3	3685.0	116727	103439.5	8.157	3.291
lights	3	26580.6	116724	76858.8	58.837	23.740
hbfl	9	4391.2	116715	72467.6	9.720	3.922
hookcat	7	3137.2	116708	69330.4	6.944	2.802
year:lights	90	2541.4	116618	66789.0	5.625	2.270
FINAL_GULF_LN						
NULL	Df	Deviance	Resid. Df	Resid. Dev	% Explained deviance	%Overall deviance
year	30	5093.4	95867	75637.6	41.769	6.309
season	3	1280.4	95864	74357.2	10.500	1.586
bspm	2	2380.2	95862	71977.0	19.519	2.948
lights	3	965.4	95859	71011.6	7.917	1.196
bait	3	563.0	95856	70448.6	4.617	0.697
year:season	86	1911.9	95770	68536.7	15.679	2.368

Table 5. Fixed factor estimates for proportion positive submodel for model 1.

Effect	YEAR	SEASON	AREA	LIGHTS	TEMP	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept	_			_		0.507	0.375	259	1.35	0.178	-0.232	1.245
YEAR	1987			_		0.384	0.243	259	1.58	0.115	-0.094	0.862
YEAR	1988			_		0.228	0.24	259	0.95	0.344	-0.245	0.7
YEAR	1989			_		0.134	0.232	259	0.58	0.566	-0.324	0.591
YEAR	1990			_		0.028	0.233	259	0.12	0.903	-0.43	0.487
YEAR	1991			_		-0.202	0.237	259	-0.85	0.394	-0.669	0.264
YEAR	1992			_		0.079	0.232	259	0.34	0.734	-0.378	0.537
YEAR	1993			_		-0.323	0.233	259	-1.38	0.168	-0.782	0.136
YEAR	1994			_		-0.288	0.232	259	-1.24	0.216	-0.746	0.17
YEAR	1995			_		-0.021	0.232	259	-0.09	0.927	-0.479	0.436
YEAR	1996			_		-0.322	0.229	259	-1.41	0.161	-0.773	0.129
YEAR	1997			_		-0.196	0.232	259	-0.85	0.399	-0.653	0.261
YEAR	1998			_		-0.384	0.234	259	-1.64	0.102	-0.844	0.076
YEAR	1999			_		-0.08	0.24	259	-0.33	0.74	-0.552	0.393
YEAR	2000			_		0.1	0.242	259	0.41	0.679	-0.376	0.577
YEAR	2001			_		-0.278	0.242	259	-1.15	0.252	-0.754	0.199
YEAR	2002			_		0.068	0.24	259	0.28	0.778	-0.404	0.539
YEAR	2003			_		-0.44	0.244	259	-1.8	0.073	-0.921	0.041
YEAR	2004			_		0.112	0.25	259	0.45	0.654	-0.38	0.605
YEAR	2005			_		0.122	0.248	259	0.49	0.624	-0.367	0.611
YEAR	2006			_		0.074	0.25	259	0.3	0.768	-0.419	0.566
YEAR	2007			_		0.245	0.254	259	0.97	0.335	-0.255	0.745
YEAR	2008			_		-0.387	0.249	259	-1.55	0.121	-0.876	0.103
YEAR	2009			_		-0.249	0.251	259	-0.99	0.321	-0.743	0.244
YEAR	2010			_		-0.051	0.249	259	-0.21	0.836	-0.541	0.438
YEAR	2011			_		-0.314	0.249	259	-1.26	0.208	-0.805	0.176
YEAR	2012			_		0.198	0.252	259	0.78	0.434	-0.299	0.694
YEAR	2013			_		-0.004	0.247	259	-0.01	0.988	-0.489	0.482
YEAR	2014			_		-0.094	0.248	259	-0.38	0.704	-0.582	0.394
YEAR	2015			_		0	.	.	.	.	.	.
SEASON	_	Apr-Jun		_		-0.659	0.034	9382	-19.33	<.0001	-0.725	-0.592
SEASON	_	Jan-Mar		_		-0.857	0.037	9382	-23.37	<.0001	-0.928	-0.785
SEASON	_	Jul-Sep		_		-0.209	0.037	9382	-5.62	<.0001	-0.282	-0.136
SEASON	_	Oct-Dec		_		0	.	.	.	.	.	.
AREA	_		CAR	_		-2.007	0.251	259	-7.99	<.0001	-2.502	-1.512
AREA	_		FEC	_		-1.298	0.248	259	-5.23	<.0001	-1.787	-0.809
AREA	_		GOM	_		-0.889	0.247	259	-3.6	4E-04	-1.375	-0.403
AREA	_		MAB	_		-1.394	0.249	259	-5.59	<.0001	-1.885	-0.903
AREA	_		NCA	_		-2.376	0.267	259	-8.89	<.0001	-2.903	-1.85
AREA	_		NEC	_		-1.107	0.252	259	-4.4	<.0001	-1.603	-0.612
AREA	_		NED	_		-3.565	0.268	259	-13.3	<.0001	-4.093	-3.037
AREA	_		SAB	_		-2.725	0.247	259	-11.04	<.0001	-3.212	-2.239
AREA	_		SAR	_		-2.185	0.261	259	-8.36	<.0001	-2.7	-1.671
AREA	_		TUN	_		0.227	0.282	259	0.8	0.423	-0.329	0.782
AREA	_		TUS	_		0	.	.	.	.	.	.
LIGHTS	_			0		1.539	0.036	9382	42.87	<.0001	1.469	1.609
LIGHTS	_			1		1.555	0.037	9382	42.25	<.0001	1.483	1.627
LIGHTS	_			2		0.931	0.035	9382	26.71	<.0001	0.863	0.999
LIGHTS	_			3		0	.	.	.	.	.	.
TEMP	_			_	(50,60]	-0.583	0.237	9382	-2.46	0.014	-1.046	-0.119
TEMP	_			_	(60,65]	0.205	0.233	9382	0.88	0.379	-0.252	0.661
TEMP	_			_	(65,70]	0.854	0.231	9382	3.7	2E-04	0.402	1.305
TEMP	_			_	(70,75]	1.382	0.229	9382	6.03	<.0001	0.933	1.831
TEMP	_			_	(75,80]	1.31	0.229	9382	5.71	<.0001	0.86	1.759
TEMP	_			_	(80,85]	1.51	0.231	9382	6.54	<.0001	1.058	1.963
TEMP	_			_	(85,95]	1.558	0.236	9382	6.6	<.0001	1.095	2.021
TEMP	_			_	[0,50]	0	.	.	.	.	.	.

Table 6. Fixed factor estimates for lognormal submodel for model 1.

Effect	SEASON	AREA	YEAR	LIGHTS	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept					1.576	0.114	255	13.81	<.0001	1.352	1.801
YEAR			1987		0.621	0.118	255	5.27	<.0001	0.389	0.852
YEAR			1988		0.710	0.114	255	6.2	<.0001	0.484	0.935
YEAR			1989		0.698	0.113	255	6.19	<.0001	0.476	0.920
YEAR			1990		0.561	0.113	255	4.98	<.0001	0.339	0.782
YEAR			1991		0.433	0.115	255	3.78	2E-04	0.207	0.659
YEAR			1992		0.475	0.113	255	4.19	<.0001	0.252	0.698
YEAR			1993		0.299	0.114	255	2.63	0.009	0.075	0.523
YEAR			1994		0.340	0.113	255	3	0.003	0.116	0.563
YEAR			1995		0.354	0.113	255	3.14	0.002	0.132	0.576
YEAR			1996		0.117	0.111	255	1.05	0.294	-0.102	0.336
YEAR			1997		0.168	0.112	255	1.49	0.137	-0.054	0.389
YEAR			1998		0.012	0.113	255	0.1	0.919	-0.211	0.234
YEAR			1999		0.117	0.116	255	1.01	0.314	-0.111	0.344
YEAR			2000		0.126	0.116	255	1.09	0.275	-0.101	0.354
YEAR			2001		0.170	0.118	255	1.45	0.149	-0.062	0.402
YEAR			2002		-0.005	0.116	255	-0.04	0.967	-0.233	0.223
YEAR			2003		0.142	0.121	255	1.17	0.243	-0.097	0.380
YEAR			2004		0.361	0.124	255	2.92	0.004	0.117	0.605
YEAR			2005		0.239	0.118	255	2.03	0.044	0.007	0.471
YEAR			2006		0.268	0.120	255	2.24	0.026	0.032	0.503
YEAR			2007		0.294	0.121	255	2.43	0.016	0.056	0.533
YEAR			2008		-0.101	0.120	255	-0.84	0.401	-0.336	0.135
YEAR			2009		-0.087	0.122	255	-0.72	0.474	-0.326	0.152
YEAR			2010		0.047	0.118	255	0.4	0.691	-0.186	0.280
YEAR			2011		0.145	0.120	255	1.21	0.229	-0.092	0.381
YEAR			2012		0.149	0.119	255	1.25	0.212	-0.086	0.384
YEAR			2013		0.164	0.117	255	1.39	0.164	-0.067	0.394
YEAR			2014		0.042	0.119	255	0.36	0.722	-0.192	0.277
YEAR			2015		0.000	.	.	.	.	.	.
SEASON	Apr-Jun				0.028	0.006	1.9E5	4.27	<.0001	0.015	0.040
SEASON	Jan-Mar				-0.111	0.007	1.9E5	-15.57	<.0001	-0.125	-0.097
SEASON	Jul-Sep				0.080	0.006	1.9E5	13.81	<.0001	0.069	0.091
SEASON	Oct-Dec				0.000	.	.	.	.	.	.
AREA		CAR			-0.661	0.091	255	-7.23	<.0001	-0.841	-0.481
AREA		FEC			-0.268	0.089	255	-3.01	0.003	-0.444	-0.093
AREA		GOM			0.034	0.089	255	0.39	0.699	-0.140	0.209
AREA		MAB			0.061	0.089	255	0.68	0.495	-0.114	0.235
AREA		NCA			-0.892	0.099	255	-8.98	<.0001	-1.087	-0.696
AREA		NEC			-0.279	0.089	255	-3.14	0.002	-0.454	-0.104
AREA		NED			-1.130	0.102	255	-11.08	<.0001	-1.331	-0.929
AREA		SAB			-0.300	0.089	255	-3.37	9E-04	-0.475	-0.124
AREA		SAR			-1.025	0.094	255	-10.92	<.0001	-1.210	-0.840
AREA		TUN			0.214	0.091	255	2.35	0.02	0.035	0.393
AREA		TUS			0.000	.	.	.	.	.	.
LIGHTS				0	0.469	0.009	1.9E5	53.3	<.0001	0.452	0.487
LIGHTS				1	0.152	0.009	1.9E5	17.36	<.0001	0.135	0.169
LIGHTS				2	0.049	0.009	1.9E5	5.44	<.0001	0.031	0.067
LIGHTS				3	0.000	.	.	.	.	.	.

Table 7. Fixed factor estimates for proportion positive submodel for model 3.

Effect	YEAR	SEASON	AREA	HOOKCAT	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept	_				2.311	0.319	227	7.25	<.0001	1.683	2.940
YEAR	1987				0.096	0.282	227	0.34	0.735	-0.460	0.651
YEAR	1988				0.184	0.277	227	0.66	0.5081	-0.363	0.730
YEAR	1989				0.061	0.268	227	0.23	0.8215	-0.468	0.589
YEAR	1990				0.159	0.268	227	0.59	0.5551	-0.370	0.687
YEAR	1991				-0.026	0.273	227	-0.1	0.9227	-0.564	0.511
YEAR	1992				0.229	0.267	227	0.86	0.3922	-0.297	0.754
YEAR	1993				-0.209	0.267	227	-0.78	0.435	-0.736	0.318
YEAR	1994				-0.152	0.267	227	-0.57	0.5698	-0.677	0.374
YEAR	1995				0.194	0.266	227	0.73	0.4675	-0.331	0.719
YEAR	1996				-0.197	0.262	227	-0.75	0.4536	-0.714	0.320
YEAR	1997				-0.055	0.266	227	-0.21	0.8351	-0.579	0.468
YEAR	1998				-0.285	0.268	227	-1.06	0.2884	-0.813	0.243
YEAR	1999				-0.091	0.275	227	-0.33	0.7405	-0.633	0.451
YEAR	2000				-0.044	0.278	227	-0.16	0.8733	-0.592	0.503
YEAR	2001				-0.353	0.278	227	-1.27	0.2054	-0.901	0.195
YEAR	2002				-0.253	0.274	227	-0.92	0.3576	-0.793	0.287
YEAR	2003				-0.713	0.281	227	-2.54	0.0117	-1.266	-0.160
YEAR	2004				-0.112	0.289	227	-0.39	0.6986	-0.683	0.458
YEAR	2005				-0.113	0.286	227	-0.4	0.6922	-0.677	0.450
YEAR	2006				-0.099	0.288	227	-0.35	0.7304	-0.667	0.468
YEAR	2007				0.085	0.294	227	0.29	0.7713	-0.493	0.664
YEAR	2008				-0.535	0.286	227	-1.87	0.0629	-1.100	0.029
YEAR	2009				-0.451	0.290	227	-1.56	0.1209	-1.021	0.120
YEAR	2010				-0.195	0.286	227	-0.68	0.4955	-0.758	0.368
YEAR	2011				-0.435	0.287	227	-1.52	0.1308	-1.001	0.130
YEAR	2012				0.177	0.292	227	0.61	0.5443	-0.397	0.752
YEAR	2013				0.018	0.284	227	0.06	0.9496	-0.542	0.578
YEAR	2014				-0.044	0.286	227	-0.15	0.8782	-0.608	0.520
YEAR	2015				0.000	.	.	.	.	.	.
SEASON	_	Apr-Jun			-0.363	0.037	3873	-9.74	<.0001	-0.436	-0.290
SEASON	_	Jan-Mar			-0.795	0.041	3873	-19.62	<.0001	-0.874	-0.715
SEASON	_	Jul-Sep			0.214	0.035	3873	6.14	<.0001	0.146	0.282
SEASON	_	Oct-Dec			0.000	.	.	.	.	.	.
AREA	_		CAR		-1.881	0.260	227	-7.25	<.0001	-2.392	-1.369
AREA	_		FEC		-1.158	0.256	227	-4.52	<.0001	-1.662	-0.653
AREA	_		MAB		-0.837	0.254	227	-3.3	0.0011	-1.338	-0.337
AREA	_		NCA		-2.474	0.275	227	-9	<.0001	-3.016	-1.932
AREA	_		NEC		-0.789	0.256	227	-3.09	0.0023	-1.293	-0.285
AREA	_		NED		-4.366	0.272	227	-16.06	<.0001	-4.901	-3.830
AREA	_		SAB		-2.285	0.254	227	-8.98	<.0001	-2.786	-1.784
AREA	_		SAR		-2.100	0.268	227	-7.82	<.0001	-2.629	-1.571
AREA	_		TUN		0.929	0.289	227	3.22	0.0015	0.360	1.497
AREA	_		TUS		0.000	.	.	.	.	.	.
HOOKCAT	_			(100,500]	-0.644	0.053	3873	-12.14	<.0001	-0.748	-0.540
HOOKCAT	_			(1e+03,2e+03]	-0.213	0.074	3873	-2.87	0.0041	-0.358	-0.068
HOOKCAT	_			(2000,8000]	-2.489	1.747	3873	-1.43	0.1542	-5.914	0.935
HOOKCAT	_			(500,600]	-0.300	0.057	3873	-5.25	<.0001	-0.413	-0.188
HOOKCAT	_			(600,700]	-0.175	0.060	3873	-2.91	0.0036	-0.292	-0.057
HOOKCAT	_			(700,800]	-0.223	0.058	3873	-3.85	0.0001	-0.336	-0.110
HOOKCAT	_			(800,900]	-0.158	0.061	3873	-2.56	0.0104	-0.278	-0.037
HOOKCAT	_			(900,1e+03]	0.000	.	.	.	.	.	.

Table 8. Fixed factor estimates for lognormal submodel for model 3. Atlantic.

Effect	SEASON	AREA	TEMP	YEAR	LIGHTS	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept						1.716	0.216	184	7.94	<.0001	1.289	2.142
YEAR				1987		0.523	0.171	184	3.07	0.0025	0.186	0.859
YEAR				1988		0.508	0.169	184	3.02	0.0029	0.176	0.841
YEAR				1989		0.607	0.167	184	3.63	0.0004	0.277	0.937
YEAR				1990		0.542	0.167	184	3.24	0.0014	0.212	0.871
YEAR				1991		0.427	0.168	184	2.54	0.0119	0.095	0.759
YEAR				1992		0.250	0.167	184	1.5	0.1357	-0.079	0.579
YEAR				1993		0.134	0.167	184	0.8	0.4249	-0.196	0.464
YEAR				1994		0.221	0.167	184	1.32	0.1887	-0.109	0.551
YEAR				1995		0.302	0.166	184	1.82	0.0697	-0.025	0.629
YEAR				1996		0.120	0.166	184	0.72	0.4708	-0.208	0.448
YEAR				1997		-0.036	0.167	184	-0.21	0.8312	-0.366	0.294
YEAR				1998		-0.145	0.167	184	-0.87	0.386	-0.475	0.185
YEAR				1999		0.078	0.169	184	0.46	0.6441	-0.256	0.413
YEAR				2000		-0.019	0.170	184	-0.11	0.9093	-0.354	0.315
YEAR				2001		0.199	0.171	184	1.16	0.2472	-0.139	0.537
YEAR				2002		-0.195	0.171	184	-1.14	0.2549	-0.531	0.142
YEAR				2003		0.013	0.175	184	0.08	0.9397	-0.332	0.359
YEAR				2004		0.171	0.178	184	0.96	0.3385	-0.180	0.522
YEAR				2005		0.102	0.172	184	0.59	0.5547	-0.237	0.441
YEAR				2006		0.046	0.174	184	0.26	0.7923	-0.297	0.389
YEAR				2007		0.127	0.175	184	0.73	0.4679	-0.218	0.472
YEAR				2008		-0.346	0.174	184	-1.98	0.0487	-0.690	-0.002
YEAR				2009		-0.269	0.176	184	-1.53	0.127	-0.616	0.077
YEAR				2010		-0.100	0.172	184	-0.58	0.562	-0.440	0.240
YEAR				2011		-0.148	0.174	184	-0.85	0.3954	-0.492	0.195
YEAR				2012		-0.078	0.174	184	-0.45	0.6538	-0.420	0.264
YEAR				2013		-0.066	0.173	184	-0.38	0.7044	-0.407	0.276
YEAR				2014		-0.036	0.175	184	-0.21	0.8363	-0.382	0.309
YEAR				2015		0.000	.	.	.	.	.	.
SEASON	Apr-Jun					-0.141	0.010	9.6E+04	-13.51	<.0001	-0.161	-0.120
SEASON	Jan-Mar					-0.096	0.013	9.6E+04	-7.64	<.0001	-0.120	-0.071
SEASON	Jul-Sep					-0.138	0.010	9.6E+04	-14.45	<.0001	-0.157	-0.119
SEASON	Oct-Dec					0.000	.	.	.	.	.	.
SEASON	Apr-Jun					0.001	0.010	9.6E+04	-12.807	<.0001	-0.141	-0.102
AREA		FEC				-0.199	0.095	227	-2.09	0.0376	-0.386	-0.012
AREA		MAB				0.362	0.095	227	3.8	0.0002	0.174	0.549
AREA		NCA				-0.862	0.106	227	-8.17	<.0001	-1.071	-0.654
AREA		NEC				0.064	0.095	227	0.68	0.5003	-0.124	0.252
AREA		NED				-0.730	0.110	227	-6.67	<.0001	-0.946	-0.515
AREA		SAB				-0.182	0.095	227	-1.92	0.0563	-0.369	0.005
AREA		SAR				-0.941	0.100	227	-9.38	<.0001	-1.138	-0.743
AREA		TUN				0.210	0.097	227	2.17	0.0311	0.019	0.401
AREA		TUS				0.000	.	.	.	.	.	.
TEMP			(50,60]			-0.727	0.162	184	-4.48	<.0001	-1.048	-0.407
TEMP			(60,65]			-0.532	0.161	184	-3.31	0.0011	-0.849	-0.215
TEMP			(65,70]			-0.271	0.160	184	-1.69	0.093	-0.587	0.046
TEMP			(70,75]			-0.148	0.160	184	-0.93	0.3555	-0.465	0.168
TEMP			(75,80]			-0.026	0.160	184	-0.16	0.8731	-0.342	0.291
TEMP			(80,85]			0.182	0.160	184	1.13	0.2579	-0.134	0.499
TEMP			(85,95]			0.236	0.162	184	1.46	0.1468	-0.084	0.555
TEMP			[0,50]			0.000	.	.	.	.	.	.
LIGHTS					0	0.393	0.012	9.6E+04	32.24	<.0001	0.370	0.417
LIGHTS					1	0.103	0.011	9.6E+04	8.99	<.0001	0.080	0.125
LIGHTS					2	0.010	0.011	9.6E+04	0.9	0.3662	-0.012	0.032
LIGHTS					3	0.000	.	.	.	.	.	.

Table 9. Fixed factor estimates for proportion positive submodel for model 5 Gulf of Mexico

Effect	YEAR	SEASON	LIGHTS	HBFLcut	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept	_		_		-2.00	0.40	84	-5.01	<.0001	-2.79	-1.21
YEAR	1987		_		1.02	0.51	84	2.01	0.05	0.01	2.03
YEAR	1988		_		0.32	0.50	84	0.64	0.52	-0.68	1.32
YEAR	1989		_		0.85	0.51	84	1.68	0.10	-0.16	1.85
YEAR	1990		_		0.33	0.51	84	0.66	0.51	-0.67	1.34
YEAR	1991		_		0.50	0.50	84	0.98	0.33	-0.51	1.50
YEAR	1992		_		0.79	0.50	84	1.57	0.12	-0.21	1.80
YEAR	1993		_		0.71	0.52	84	1.38	0.17	-0.32	1.73
YEAR	1994		_		0.49	0.52	84	0.94	0.35	-0.54	1.52
YEAR	1995		_		0.37	0.51	84	0.73	0.46	-0.64	1.39
YEAR	1996		_		0.46	0.51	84	0.9	0.37	-0.55	1.46
YEAR	1997		_		0.61	0.51	84	1.19	0.24	-0.40	1.62
YEAR	1998		_		0.50	0.51	84	0.99	0.33	-0.51	1.52
YEAR	1999		_		0.97	0.52	84	1.89	0.06	-0.05	2.00
YEAR	2000		_		0.84	0.51	84	1.63	0.11	-0.18	1.86
YEAR	2001		_		-0.05	0.51	84	-0.1	0.92	-1.06	0.96
YEAR	2002		_		1.36	0.52	84	2.63	0.01	0.33	2.38
YEAR	2003		_		0.42	0.51	84	0.83	0.41	-0.59	1.44
YEAR	2004		_		0.90	0.51	84	1.75	0.08	-0.12	1.92
YEAR	2005		_		0.51	0.51	84	0.99	0.32	-0.51	1.52
YEAR	2006		_		0.46	0.51	84	0.9	0.37	-0.56	1.48
YEAR	2007		_		0.22	0.51	84	0.44	0.66	-0.79	1.24
YEAR	2008		_		0.08	0.51	84	0.15	0.88	-0.94	1.09
YEAR	2009		_		0.29	0.51	84	0.57	0.57	-0.73	1.31
YEAR	2010		_		-0.14	0.52	84	-0.26	0.79	-1.17	0.89
YEAR	2011		_		0.54	0.54	84	1	0.32	-0.53	1.61
YEAR	2012		_		0.84	0.51	84	1.65	0.10	-0.17	1.86
YEAR	2013		_		0.45	0.51	84	0.89	0.38	-0.56	1.47
YEAR	2014		_		-0.04	0.51	84	-0.08	0.93	-1.06	0.98
YEAR	2015		_		0.00	.	.	.	.	.	.
SEASON	_	Apr-Jun	_		-0.39	0.06	5591	-6.15	<.0001	-0.51	-0.26
SEASON	_	Jan-Mar	_		-0.72	0.06	5591	-12.06	<.0001	-0.84	-0.61
SEASON	_	Jul-Sep	_		0.14	0.07	5591	2	0.05	0.00	0.27
SEASON	_	Oct-Dec	_		0.00	.	.	.	.	.	.
LIGHTS	_		0		3.56	0.18	84	19.39	<.0001	3.19	3.92
LIGHTS	_		1		3.39	0.18	84	18.33	<.0001	3.02	3.75
LIGHTS	_		2		2.67	0.19	84	14.24	<.0001	2.29	3.04
LIGHTS	_		3		0.00	.	.	.	.	.	.
HBFLcut	_		_	(2,3]	0.43	0.08	5591	5.19	<.0001	0.27	0.60
HBFLcut	_		_	(3,4]	1.26	0.09	5591	14.21	<.0001	1.08	1.43
HBFLcut	_		_	(4,5]	1.14	0.10	5591	10.99	<.0001	0.94	1.34
HBFLcut	_		_	(40,1e+03]	-1.39	0.14	5591	-9.96	<.0001	-1.66	-1.12
HBFLcut	_		_	(5,6]	0.82	0.13	5591	6.51	<.0001	0.57	1.06
HBFLcut	_		_	(6,7]	-0.03	0.28	5591	-0.09	0.93	-0.57	0.51
HBFLcut	_		_	(7,8]	0.64	0.36	5591	1.8	0.07	-0.06	1.35
HBFLcut	_		_	(8,9]	0.22	0.68	5591	0.33	0.74	-1.11	1.56
HBFLcut	_		_	(9,40]	-0.55	0.14	5591	-4.02	<.0001	-0.82	-0.28
HBFLcut	_		_	NA	-0.82	0.15	5591	-5.31	<.0001	-1.12	-0.52
HBFLcut	_		_	[1,2]	0.00	.	.	.	.	.	.

Table 10. Fixed factor estimates for lognormal submodel for model 5 Gulf of Mexico.

Effect	SEASON	BSPM2	BAIT	YEAR	LIGHTS	Estimate	Standard Error	DF	t Value	Pr > |t|	Lower	Upper
Intercept						1.850	0.122	84	15.23	<.0001	1.61	2.09
YEAR				1987		0.194	0.151	84	1.29	0.202	-0.11	0.50
YEAR				1988		0.374	0.152	84	2.47	0.016	0.07	0.67
YEAR				1989		0.460	0.151	84	3.05	0.003	0.16	0.76
YEAR				1990		0.145	0.151	84	0.96	0.340	-0.16	0.45
YEAR				1991		0.411	0.138	84	2.98	0.004	0.14	0.69
YEAR				1992		0.816	0.138	84	5.92	<.0001	0.54	1.09
YEAR				1993		0.616	0.138	84	4.46	<.0001	0.34	0.89
YEAR				1994		0.400	0.138	84	2.9	0.005	0.13	0.67
YEAR				1995		0.189	0.138	84	1.37	0.173	-0.08	0.46
YEAR				1996		0.108	0.138	84	0.78	0.436	-0.17	0.38
YEAR				1997		0.348	0.138	84	2.53	0.013	0.07	0.62
YEAR				1998		0.341	0.138	84	2.47	0.016	0.07	0.61
YEAR				1999		0.565	0.138	84	4.1	<.0001	0.29	0.84
YEAR				2000		0.350	0.138	84	2.54	0.013	0.08	0.62
YEAR				2001		0.165	0.138	84	1.2	0.233	-0.11	0.44
YEAR				2002		0.487	0.138	84	3.54	0.001	0.21	0.76
YEAR				2003		0.298	0.138	84	2.17	0.033	0.02	0.57
YEAR				2004		0.263	0.138	84	1.91	0.059	-0.01	0.54
YEAR				2005		0.151	0.138	84	1.1	0.276	-0.12	0.43
YEAR				2006		0.256	0.138	84	1.86	0.067	-0.02	0.53
YEAR				2007		0.183	0.138	84	1.32	0.189	-0.09	0.46
YEAR				2008		-0.081	0.138	84	-0.59	0.559	-0.36	0.19
YEAR				2009		0.109	0.138	84	0.79	0.432	-0.17	0.38
YEAR				2010		0.060	0.142	84	0.42	0.672	-0.22	0.34
YEAR				2011		0.419	0.141	84	2.97	0.004	0.14	0.70
YEAR				2012		0.353	0.138	84	2.56	0.012	0.08	0.63
YEAR				2013		0.230	0.138	84	1.66	0.100	-0.04	0.50
YEAR				2014		0.036	0.138	84	0.26	0.795	-0.24	0.31
YEAR				2015		0.000	.	.	.	.	.	.
SEASON	Apr-Jun					0.067	0.051	84	1.31	0.192	-0.03	0.17
SEASON	Jan-Mar					-0.102	0.051	84	-1.99	0.050	-0.20	0.00
SEASON	Jul-Sep					0.075	0.051	84	1.47	0.144	-0.03	0.18
SEASON	Oct-Dec					0.000	.	.	.	.	.	.
BSPM2		AM				-0.222	0.061	9E+04	-3.62	0.000	-0.34	-0.10
BSPM2		PM				-0.446	0.061	9E+04	-7.27	<.0001	-0.57	-0.33
BSPM2		unk				0.000	.	.	.	.	.	.
LIGHTS					0	0.431	0.016	9E+04	27.28	<.0001	0.40	0.46
LIGHTS					1	0.287	0.015	9E+04	18.79	<.0001	0.26	0.32
LIGHTS					2	0.233	0.016	9E+04	14.15	<.0001	0.20	0.27
LIGHTS					3	0.000	.	.	.	.	.	.
BAIT			D			-0.099	0.016	9E+04	-6.35	<.0001	-0.13	-0.07
BAIT			L			0.202	0.019	9E+04	10.83	<.0001	0.17	0.24
BAIT			MIX_ARTI			0.018	0.027	9E+04	0.66	0.507	-0.04	0.07
BAIT			unk			0.000	.	.	.	.	.	.

Table 10. Nominal and standardized catch rates of yellowfin tuna in #/1000 hooks (CPUEN) from the pelagic logbook data for Index 1: Atlantic and Gulf of Mexico. Nominal CPUE includes zero catches.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	10.39	0.67	9887	1.69	1.06	0.10	1.38	2.06	10.69	1.27
1988	9.28	0.57	11125	1.75	1.07	0.10	1.44	2.12	11.08	1.14
1989	8.84	0.56	12003	1.66	1.00	0.09	1.38	2.01	10.55	1.08
1990	8.19	0.57	11542	1.38	0.84	0.10	1.14	1.68	8.78	1.00
1991	10.57	0.62	10983	1.10	0.71	0.10	0.90	1.35	7.00	1.29
1992	10.45	0.63	11661	1.29	0.79	0.10	1.07	1.57	8.20	1.28
1993	6.98	0.55	11173	0.91	0.58	0.10	0.74	1.11	5.76	0.85
1994	7.51	0.57	12145	0.96	0.61	0.10	0.79	1.17	6.08	0.92
1995	8.14	0.63	13164	1.11	0.67	0.10	0.91	1.34	7.02	1.00
1996	6.36	0.61	12483	0.76	0.47	0.10	0.63	0.92	4.81	0.78
1997	8.01	0.65	12222	0.85	0.52	0.10	0.70	1.03	5.38	0.98
1998	6.75	0.62	9621	0.66	0.42	0.10	0.54	0.81	4.18	0.83
1999	9.85	0.75	9456	0.85	0.54	0.10	0.69	1.04	5.39	1.21
2000	10.06	0.73	9281	0.93	0.58	0.10	0.76	1.13	5.87	1.23
2001	7.37	0.68	9698	0.82	0.55	0.11	0.66	1.01	5.18	0.90
2002	8.04	0.73	9204	0.80	0.51	0.10	0.66	0.98	5.08	0.98
2003	7.27	0.66	9188	0.73	0.52	0.11	0.58	0.91	4.62	0.89
2004	9.33	0.74	8701	1.18	0.82	0.11	0.94	1.46	7.45	1.14
2005	8.56	0.72	7124	1.04	0.68	0.10	0.85	1.28	6.62	1.05
2006	11.80	0.74	6771	1.06	0.71	0.11	0.85	1.30	6.69	1.45
2007	10.19	0.74	8081	1.17	0.78	0.11	0.94	1.44	7.39	1.25
2008	5.71	0.63	8108	0.59	0.42	0.11	0.47	0.73	3.72	0.70
2009	6.61	0.70	8537	0.64	0.46	0.11	0.51	0.80	4.07	0.81
2010	6.18	0.63	6952	0.82	0.55	0.11	0.66	1.01	5.17	0.76
2011	7.35	0.59	7767	0.78	0.56	0.11	0.63	0.98	4.97	0.90
2012	8.04	0.73	9943	0.99	0.65	0.10	0.80	1.22	6.26	0.98
2013	6.36	0.67	9590	0.92	0.61	0.10	0.75	1.14	5.86	0.78
2014	6.95	0.66	9045	0.79	0.53	0.11	0.63	0.97	4.98	0.85
2015	5.74	0.67	7461	0.79	0.52	0.11	0.64	0.97	4.98	0.70

Table 11. Nominal and standardized catch rates of yellowfin tuna in kg/1000 hooks (CPUEW) from the Pelagic Logbook data Index 2: Atlantic and Gulf of Mexico.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	409.57	0.665	9887	1.74	46.51	0.11	1.39	2.18	412.33	1.32
1988	359.99	0.571	11125	1.77	45.62	0.11	1.42	2.20	418.80	1.16
1989	339.57	0.563	12003	1.68	42.59	0.11	1.36	2.08	398.69	1.09
1990	302.26	0.566	11542	1.40	35.74	0.11	1.13	1.74	331.45	0.97
1991	386.56	0.616	10983	1.13	30.30	0.11	0.90	1.41	267.31	1.25
1992	392.79	0.633	11661	1.33	34.29	0.11	1.07	1.65	315.00	1.27
1993	245.95	0.553	11173	0.82	22.08	0.11	0.65	1.03	194.27	0.79
1994	224.19	0.566	12145	0.75	20.11	0.11	0.60	0.94	178.38	0.72
1995	281.44	0.625	13164	1.07	27.60	0.11	0.86	1.33	254.15	0.91
1996	275.01	0.611	12483	0.92	23.82	0.11	0.74	1.15	218.72	0.89
1997	310.51	0.652	12222	0.89	23.13	0.11	0.72	1.11	211.46	1.00
1998	250.07	0.623	9621	0.62	16.43	0.11	0.49	0.77	146.12	0.81
1999	380.26	0.753	9456	0.92	24.73	0.11	0.73	1.15	217.83	1.22
2000	382.12	0.728	9281	0.90	23.69	0.11	0.72	1.12	212.11	1.23
2001	311.50	0.681	9698	0.88	24.73	0.12	0.69	1.11	207.90	1.00
2002	341.24	0.728	9204	0.71	19.01	0.11	0.57	0.89	168.87	1.10
2003	294.73	0.659	9188	0.58	17.36	0.13	0.45	0.75	137.82	0.95
2004	371.14	0.74	8701	1.13	33.70	0.13	0.88	1.46	268.81	1.20
2005	313.14	0.717	7124	1.00	27.65	0.12	0.79	1.26	237.11	1.01
2006	430.43	0.742	6771	1.07	30.43	0.12	0.85	1.36	254.55	1.39
2007	417.90	0.741	8081	1.29	36.74	0.12	1.01	1.64	305.25	1.35
2008	229.74	0.634	8108	0.68	20.19	0.13	0.53	0.87	160.73	0.74
2009	256.90	0.698	8537	0.58	17.44	0.13	0.45	0.75	137.64	0.83
2010	220.84	0.627	6952	0.81	22.76	0.12	0.64	1.02	191.26	0.71
2011	261.52	0.59	7767	0.74	21.97	0.13	0.58	0.95	175.47	0.84
2012	306.58	0.727	9943	0.97	27.31	0.12	0.77	1.23	230.89	0.99
2013	240.66	0.67	9590	0.97	26.91	0.12	0.77	1.23	229.78	0.78
2014	255.60	0.66	9045	0.81	23.29	0.12	0.64	1.04	192.82	0.82
2015	211.16	0.667	7461	0.82	22.95	0.12	0.64	1.03	193.47	0.68

Table 12. Nominal and standardized catch rates of yellowfin tuna in number/1000 hooks (CPUEN) from the Pelagic Logbook data Index 3: Atlantic.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	6.749	0.502	5667	1.605	1.231	0.153	1.18	2.18	8.05	0.98
1988	6.221	0.497	7220	1.647	1.221	0.148	1.23	2.21	8.26	0.90
1989	6.209	0.491	8407	1.719	1.279	0.148	1.28	2.31	8.62	0.90
1990	7.029	0.528	8753	1.684	1.229	0.145	1.26	2.25	8.45	1.02
1991	10.139	0.553	7808	1.377	1.052	0.152	1.02	1.86	6.91	1.47
1992	7.438	0.568	8003	1.297	0.935	0.144	0.97	1.73	6.51	1.07
1993	4.544	0.459	8350	0.935	0.727	0.155	0.69	1.27	4.69	0.66
1994	5.973	0.485	9364	1.051	0.808	0.153	0.77	1.43	5.27	0.86
1995	7.819	0.563	9910	1.347	0.966	0.143	1.01	1.79	6.76	1.13
1996	4.995	0.516	8359	0.928	0.709	0.152	0.69	1.26	4.66	0.72
1997	6.735	0.555	7762	0.855	0.644	0.150	0.63	1.15	4.29	0.97
1998	4.220	0.498	6283	0.678	0.533	0.157	0.50	0.93	3.40	0.61
1999	6.844	0.614	5344	0.940	0.732	0.155	0.69	1.28	4.72	0.99
2000	9.600	0.578	5189	0.873	0.678	0.155	0.64	1.19	4.38	1.39
2001	6.318	0.579	5506	0.920	0.763	0.165	0.66	1.28	4.61	0.91
2002	4.419	0.542	4903	0.657	0.530	0.161	0.48	0.90	3.30	0.64
2003	4.348	0.412	4362	0.612	0.552	0.180	0.43	0.87	3.07	0.63
2004	9.635	0.552	3771	1.019	0.857	0.168	0.73	1.42	5.11	1.39
2005	9.340	0.573	3501	0.951	0.768	0.161	0.69	1.31	4.77	1.35
2006	13.802	0.639	3766	0.906	0.742	0.163	0.65	1.25	4.54	1.99
2007	11.384	0.644	4293	1.075	0.863	0.160	0.78	1.48	5.39	1.65
2008	5.196	0.52	5124	0.478	0.422	0.176	0.34	0.68	2.40	0.75
2009	5.378	0.563	4785	0.544	0.479	0.175	0.38	0.77	2.73	0.78
2010	6.127	0.594	5579	0.745	0.612	0.164	0.54	1.03	3.74	0.89
2011	6.394	0.525	5824	0.619	0.538	0.173	0.44	0.87	3.11	0.92
2012	7.106	0.641	6425	0.913	0.715	0.156	0.67	1.25	4.58	1.03
2013	5.116	0.605	6295	0.859	0.683	0.159	0.63	1.18	4.31	0.74
2014	6.598	0.589	6087	0.858	0.700	0.163	0.62	1.19	4.30	0.95
2015	4.998	0.598	5445	0.909	0.729	0.160	0.66	1.25	4.56	0.72

Table 13. Nominal and standardized catch rates of yellowfin tuna in kg/1000 hooks (CPUEW) from the Pelagic Logbook data Index 4: Atlantic.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	237.47	0.502	5667	1.68	43.20	0.16	1.22	2.33	263.26	1.128
1988	217.42	0.497	7220	1.70	41.97	0.16	1.24	2.32	265.03	1.033
1989	216.57	0.491	8407	1.77	43.99	0.16	1.29	2.43	277.39	1.029
1990	242.42	0.528	8753	1.74	42.34	0.16	1.27	2.37	271.49	1.152
1991	345.71	0.553	7808	1.44	36.59	0.16	1.04	1.99	225.07	1.643
1992	252.68	0.568	8003	1.36	32.79	0.15	1.00	1.84	211.92	1.201
1993	134.47	0.459	8350	0.77	19.87	0.17	0.55	1.07	120.14	0.639
1994	130.57	0.485	9364	0.75	19.14	0.16	0.54	1.04	116.89	0.620
1995	229.32	0.563	9910	1.27	30.54	0.15	0.94	1.73	198.68	1.090
1996	231.24	0.516	8359	1.17	29.71	0.16	0.85	1.62	183.29	1.099
1997	217.64	0.555	7762	0.91	22.81	0.16	0.66	1.25	142.10	1.034
1998	125.17	0.498	6283	0.63	16.36	0.17	0.45	0.88	98.34	0.595
1999	190.29	0.614	5344	1.04	27.00	0.17	0.75	1.45	163.09	0.904
2000	263.93	0.578	5189	0.85	21.93	0.16	0.61	1.18	132.95	1.254
2001	206.24	0.579	5506	0.98	26.75	0.18	0.69	1.38	152.71	0.980
2002	106.58	0.542	4903	0.58	15.53	0.17	0.41	0.82	90.88	0.506
2003	98.26	0.412	4362	0.46	13.71	0.19	0.32	0.67	72.28	0.467
2004	261.75	0.552	3771	0.97	27.47	0.18	0.68	1.39	152.32	1.244
2005	248.12	0.573	3501	0.92	24.60	0.17	0.65	1.29	143.07	1.179
2006	386.83	0.639	3766	0.91	24.82	0.17	0.64	1.29	142.27	1.838
2007	365.04	0.644	4293	1.13	30.27	0.17	0.80	1.58	176.03	1.735
2008	154.55	0.52	5124	0.52	15.27	0.19	0.36	0.76	81.99	0.734
2009	146.08	0.563	4785	0.46	13.57	0.19	0.32	0.67	72.68	0.694
2010	197.06	0.594	5579	0.76	20.67	0.17	0.54	1.07	118.36	0.936
2011	185.28	0.525	5824	0.59	17.03	0.18	0.41	0.85	92.55	0.880
2012	211.27	0.641	6425	0.87	22.91	0.17	0.63	1.22	136.53	1.004
2013	154.21	0.605	6295	0.96	25.50	0.17	0.69	1.35	150.15	0.733
2014	201.38	0.589	6087	0.87	23.67	0.17	0.61	1.23	135.82	0.957
2015	145.79	0.598	5445	0.93	24.93	0.17	0.66	1.31	145.69	0.693

Table 14. Nominal and standardized catch rates of yellowfin tuna in number /1000 hooks (CPUEN) from the Pelagic Logbook data Index 5: Gulf of Mexico.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	15.28	0.88	4220	0.99	1.12	0.13	0.76	1.29	8.45	1.44
1988	14.95	0.71	3905	1.00	1.26	0.15	0.74	1.34	8.50	1.41
1989	14.99	0.73	3596	1.25	1.44	0.14	0.95	1.63	10.64	1.41
1990	11.82	0.69	2789	0.78	1.01	0.15	0.58	1.06	6.70	1.11
1991	11.62	0.77	3175	1.12	1.27	0.13	0.86	1.46	9.58	1.09
1992	17.04	0.78	3658	1.77	1.91	0.13	1.37	2.28	15.10	1.60
1993	14.20	0.83	2823	1.46	1.62	0.13	1.12	1.89	12.46	1.34
1994	12.70	0.84	2781	1.09	1.28	0.14	0.83	1.43	9.29	1.20
1995	9.14	0.81	3254	0.85	1.01	0.14	0.65	1.13	7.29	0.86
1996	9.12	0.81	4124	0.83	0.95	0.13	0.63	1.08	7.07	0.86
1997	10.24	0.82	4460	1.07	1.19	0.13	0.82	1.38	9.11	0.96
1998	11.52	0.86	3338	1.05	1.22	0.14	0.80	1.38	8.99	1.08
1999	13.75	0.93	4112	1.44	1.52	0.12	1.13	1.85	12.33	1.29
2000	10.63	0.92	4092	1.14	1.22	0.13	0.88	1.46	9.71	1.00
2001	8.74	0.82	4192	0.70	0.93	0.16	0.51	0.95	5.97	0.82
2002	12.17	0.94	4301	1.44	1.44	0.12	1.14	1.82	12.33	1.15
2003	9.90	0.88	4826	0.98	1.14	0.14	0.74	1.28	8.34	0.93
2004	9.09	0.89	4930	1.06	1.13	0.12	0.83	1.36	9.05	0.86
2005	7.82	0.86	3623	0.83	0.97	0.14	0.64	1.10	7.13	0.74
2006	9.30	0.87	3005	0.91	1.08	0.14	0.69	1.20	7.78	0.88
2007	8.84	0.85	3788	0.82	1.00	0.14	0.62	1.09	7.01	0.83
2008	6.59	0.83	2984	0.58	0.75	0.15	0.43	0.79	4.97	0.62
2009	8.17	0.87	3752	0.77	0.94	0.14	0.58	1.02	6.58	0.77
2010	6.37	0.76	1373	0.66	0.93	0.16	0.48	0.92	5.67	0.60
2011	10.20	0.79	1943	1.11	1.35	0.14	0.84	1.48	9.48	0.96
2012	9.76	0.88	3518	1.14	1.23	0.13	0.89	1.47	9.78	0.92
2013	8.74	0.79	3295	0.92	1.07	0.14	0.70	1.20	7.83	0.82
2014	7.67	0.81	2958	0.62	0.84	0.16	0.46	0.86	5.34	0.72
2015	7.75	0.86	2016	0.61	0.84	0.16	0.44	0.84	5.22	0.73

Table 15. Nominal and standardized catch rates of yellowfin tuna in kg/1000 hooks (CPUEW) from the Pelagic Logbook data Index 6: Gulf of Mexico.

year	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
1987	640.68	0.884	4220	0.89	48.01	0.14	0.68	1.17	349.08	1.31
1988	623.58	0.707	3905	0.90	53.67	0.15	0.66	1.21	351.42	1.28
1989	627.12	0.732	3596	1.12	61.42	0.14	0.85	1.48	439.82	1.29
1990	490.05	0.686	2789	0.71	42.70	0.15	0.52	0.96	276.89	1.01
1991	487.01	0.771	3175	1.01	54.34	0.14	0.77	1.33	396.06	1.00
1992	699.31	0.776	3658	1.59	82.07	0.13	1.22	2.07	624.15	1.43
1993	575.71	0.831	2823	1.29	68.47	0.14	0.99	1.69	506.90	1.18
1994	539.44	0.839	2781	1.02	56.66	0.14	0.77	1.35	399.20	1.11
1995	440.19	0.811	3254	0.90	50.54	0.14	0.68	1.20	352.97	0.90
1996	363.72	0.805	4124	0.74	40.19	0.14	0.56	0.97	289.30	0.75
1997	472.13	0.821	4460	1.07	56.59	0.14	0.82	1.40	418.66	0.97
1998	485.18	0.859	3338	0.98	53.70	0.14	0.74	1.29	383.66	1.00
1999	627.13	0.932	4112	1.44	72.35	0.13	1.11	1.86	564.58	1.29
2000	532.00	0.919	4092	1.22	62.45	0.13	0.94	1.58	478.60	1.09
2001	449.76	0.815	4192	0.75	47.51	0.16	0.55	1.04	296.22	0.92
2002	608.74	0.94	4301	1.55	74.39	0.12	1.21	1.98	608.18	1.25
2003	472.31	0.883	4826	1.02	56.45	0.14	0.77	1.35	401.49	0.97
2004	454.82	0.885	4930	1.16	58.88	0.13	0.89	1.50	454.52	0.93
2005	375.96	0.857	3623	0.87	48.37	0.14	0.66	1.16	343.38	0.77
2006	485.06	0.871	3005	1.01	56.70	0.14	0.76	1.35	397.57	1.00
2007	477.80	0.85	3788	0.96	55.06	0.15	0.72	1.28	375.75	0.98
2008	358.87	0.829	2984	0.68	41.03	0.15	0.50	0.92	265.36	0.74
2009	398.22	0.869	3752	0.81	46.61	0.15	0.60	1.08	317.59	0.82
2010	317.48	0.761	1373	0.72	47.06	0.17	0.51	1.00	281.46	0.65
2011	490.07	0.785	1943	1.17	67.56	0.15	0.87	1.57	459.14	1.01
2012	480.64	0.884	3518	1.23	62.84	0.13	0.95	1.59	482.92	0.99
2013	405.82	0.794	3295	0.93	51.83	0.14	0.71	1.24	366.81	0.83
2014	367.17	0.806	2958	0.63	39.85	0.16	0.45	0.86	245.78	0.75
2015	387.71	0.855	2016	0.65	41.89	0.16	0.47	0.90	254.76	0.80

Table 16. Nominal and standardized catch rates of yellowfin tuna in number/1000 hooks (CPUEN) from the Pelagic Logbook data Index1: Gulf of Mexico and Atlantic by year and season.

Year season	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
19871	7.144	0.569	2058	1.135	0.792	0.111	0.910	1.416	7.139	0.900
19872	8.548	0.649	2282	1.388	0.891	0.102	1.132	1.701	8.729	1.076
19873	12.165	0.675	3365	2.059	1.237	0.096	1.702	2.491	12.949	1.532
19874	12.644	0.757	2182	2.250	1.331	0.094	1.865	2.714	14.148	1.592
19881	5.712	0.492	2689	0.790	0.548	0.110	0.634	0.984	4.967	0.719
19882	9.882	0.595	2264	1.660	1.023	0.098	1.366	2.019	10.443	1.244
19883	11.587	0.592	3426	2.567	1.456	0.090	2.144	3.073	16.144	1.459
19884	9.419	0.601	2746	1.887	1.109	0.093	1.566	2.274	11.871	1.186
19891	6.424	0.5	3185	1.078	0.692	0.102	0.880	1.322	6.783	0.809
19892	7.399	0.524	2334	1.392	0.860	0.098	1.145	1.694	8.758	0.932
19893	9.606	0.603	3640	1.936	1.105	0.091	1.615	2.321	12.176	1.210
19894	11.748	0.615	2844	2.428	1.360	0.089	2.032	2.900	15.270	1.479
19901	6.853	0.486	3157	1.217	0.749	0.098	1.001	1.480	7.656	0.863
19902	10.397	0.66	2140	1.831	1.060	0.092	1.524	2.200	11.516	1.309
19903	8.489	0.632	3690	1.306	0.786	0.096	1.079	1.581	8.212	1.069
19904	7.550	0.49	2555	1.051	0.678	0.103	0.856	1.289	6.608	0.951
19911	5.162	0.452	2557	0.719	0.503	0.111	0.576	0.898	4.521	0.650
19912	7.708	0.606	1976	0.918	0.637	0.110	0.737	1.144	5.774	0.971
19913	14.121	0.645	3747	1.296	0.860	0.106	1.050	1.599	8.150	1.778
19914	12.841	0.737	2703	1.516	0.890	0.093	1.259	1.827	9.537	1.617
19921	6.611	0.582	2941	0.839	0.522	0.099	0.689	1.022	5.279	0.833
19922	14.660	0.678	2299	1.736	1.045	0.096	1.434	2.102	10.921	1.846
19923	11.248	0.646	3928	1.464	0.900	0.098	1.205	1.779	9.209	1.416
19924	9.840	0.633	2493	1.333	0.800	0.095	1.102	1.613	8.385	1.239
19931	5.349	0.428	2466	0.673	0.477	0.113	0.537	0.842	4.230	0.674
19932	8.597	0.582	2134	1.061	0.703	0.105	0.860	1.309	6.676	1.083
19933	7.485	0.607	4085	0.919	0.591	0.102	0.749	1.126	5.777	0.943
19934	6.396	0.562	2488	0.959	0.591	0.098	0.789	1.166	6.031	0.805
19941	3.783	0.377	2509	0.440	0.331	0.120	0.347	0.559	2.769	0.476
19942	7.341	0.533	2587	0.832	0.567	0.108	0.670	1.033	5.233	0.925
19943	10.111	0.631	3900	1.124	0.707	0.100	0.921	1.372	7.069	1.273
19944	7.407	0.665	3149	1.419	0.791	0.089	1.189	1.694	8.927	0.933
19951	3.955	0.459	3015	0.759	0.502	0.105	0.615	0.936	4.771	0.498
19952	7.692	0.635	2918	1.254	0.748	0.095	1.038	1.516	7.889	0.969
19953	9.614	0.662	4718	1.109	0.670	0.096	0.916	1.344	6.977	1.211
19954	10.937	0.742	2513	1.188	0.688	0.092	0.989	1.428	7.472	1.377
19961	2.363	0.39	2542	0.364	0.258	0.112	0.291	0.456	2.291	0.298
19962	7.468	0.63	2952	0.783	0.500	0.102	0.639	0.959	4.926	0.940
19963	7.589	0.725	4376	0.982	0.570	0.092	0.816	1.180	6.173	0.956
19964	6.934	0.615	2613	0.951	0.556	0.093	0.790	1.145	5.982	0.873
19971	5.165	0.499	3067	0.592	0.405	0.109	0.476	0.735	3.722	0.650
19972	8.567	0.703	2288	0.839	0.533	0.101	0.686	1.026	5.276	1.079
19973	9.959	0.702	4419	1.007	0.595	0.094	0.835	1.215	6.336	1.254
19974	7.556	0.707	2448	0.918	0.540	0.094	0.762	1.107	5.775	0.951
19981	3.243	0.435	2166	0.282	0.219	0.123	0.221	0.361	1.775	0.408
19982	7.459	0.711	1797	0.824	0.522	0.101	0.674	1.007	5.180	0.939
19983	7.869	0.684	3121	0.815	0.516	0.101	0.667	0.996	5.124	0.991

19984	7.877	0.646	2537	0.917	0.564	0.098	0.755	1.115	5.769	0.992
19991	7.483	0.672	1935	0.596	0.428	0.114	0.474	0.748	3.746	0.942
19992	10.089	0.764	2089	0.794	0.535	0.107	0.641	0.983	4.995	1.270
19993	10.082	0.764	2815	0.802	0.523	0.104	0.652	0.986	5.043	1.270
19994	11.150	0.791	2617	1.172	0.702	0.095	0.969	1.417	7.370	1.404
20001	6.269	0.606	1810	0.581	0.444	0.121	0.456	0.740	3.656	0.789
20002	9.520	0.739	2018	1.038	0.657	0.101	0.850	1.269	6.531	1.199
20003	10.461	0.74	3030	0.880	0.564	0.102	0.718	1.079	5.535	1.317
20004	12.822	0.796	2423	1.081	0.624	0.092	0.900	1.298	6.797	1.615
20011	2.611	0.427	1662	0.310	0.262	0.135	0.237	0.405	1.948	0.329
20012	6.457	0.603	2364	0.688	0.497	0.115	0.547	0.865	4.327	0.813
20013	8.674	0.769	3397	1.038	0.683	0.105	0.843	1.279	6.529	1.092
20014	9.833	0.817	2275	1.420	0.845	0.095	1.176	1.715	8.932	1.238
20021	5.416	0.658	1870	0.600	0.404	0.107	0.484	0.743	3.772	0.682
20022	8.445	0.723	2082	0.826	0.540	0.104	0.671	1.016	5.193	1.063
20023	9.804	0.752	3124	0.887	0.578	0.104	0.722	1.091	5.580	1.235
20024	7.371	0.759	2128	0.800	0.496	0.099	0.658	0.974	5.034	0.928
20031	4.741	0.595	1949	0.515	0.405	0.125	0.401	0.660	3.238	0.597
20032	6.865	0.609	2224	0.664	0.516	0.123	0.519	0.850	4.178	0.865
20033	8.758	0.693	2786	0.787	0.592	0.120	0.620	0.999	4.947	1.103
20034	8.012	0.724	2229	0.925	0.634	0.109	0.745	1.150	5.821	1.009
20041	5.889	0.666	1906	1.010	0.734	0.116	0.803	1.272	6.355	0.742
20042	6.524	0.575	2341	0.839	0.659	0.125	0.654	1.076	5.274	0.822
20043	13.959	0.868	2329	1.507	1.023	0.108	1.215	1.869	9.479	1.758
20044	10.417	0.848	2125	1.232	0.829	0.107	0.995	1.525	7.746	1.312
20051	5.729	0.702	1996	0.875	0.593	0.108	0.706	1.085	5.504	0.722
20052	7.189	0.636	1947	0.845	0.607	0.114	0.673	1.061	5.313	0.905
20053	10.727	0.823	1888	1.112	0.724	0.103	0.905	1.367	6.994	1.351
20054	11.857	0.709	1293	1.254	0.842	0.107	1.013	1.551	7.885	1.493
20061	5.316	0.565	1208	0.629	0.492	0.124	0.491	0.806	3.956	0.669
20062	7.909	0.602	1588	0.851	0.612	0.114	0.678	1.069	5.355	0.996
20063	14.532	0.884	2258	1.424	0.928	0.104	1.158	1.751	8.954	1.830
20064	16.386	0.808	1717	1.424	0.945	0.105	1.154	1.758	8.957	2.063
20071	8.653	0.709	1548	1.316	0.904	0.109	1.058	1.636	8.274	1.090
20072	8.883	0.516	1649	0.724	0.578	0.127	0.563	0.933	4.556	1.119
20073	12.807	0.862	2702	1.479	0.943	0.101	1.209	1.811	9.305	1.613
20074	9.028	0.784	2182	1.057	0.689	0.104	0.860	1.300	6.651	1.137
20081	3.917	0.564	1627	0.577	0.430	0.119	0.455	0.730	3.627	0.493
20082	4.114	0.481	1957	0.470	0.375	0.127	0.365	0.605	2.954	0.518
20083	8.437	0.794	2388	0.714	0.504	0.112	0.571	0.893	4.492	1.062
20084	5.492	0.647	2136	0.542	0.395	0.116	0.430	0.682	3.406	0.692
20091	4.876	0.622	1503	0.621	0.475	0.121	0.488	0.791	3.908	0.614
20092	5.383	0.549	2039	0.470	0.380	0.128	0.364	0.608	2.959	0.678
20093	8.457	0.824	2814	0.747	0.511	0.109	0.601	0.928	4.696	1.065
20094	6.550	0.727	2181	0.710	0.495	0.111	0.569	0.885	4.464	0.825
20101	4.233	0.618	1624	0.704	0.503	0.113	0.562	0.883	4.429	0.533
20102	3.202	0.418	1989	0.409	0.324	0.126	0.318	0.525	2.570	0.403
20103	11.021	0.838	1978	1.328	0.837	0.100	1.088	1.622	8.355	1.388
20104	5.799	0.637	1361	0.991	0.653	0.105	0.804	1.221	6.231	0.730
20111	1.942	0.414	1234	0.699	0.542	0.123	0.547	0.894	4.398	0.245
20112	4.439	0.322	1906	0.466	0.398	0.136	0.355	0.611	2.930	0.559
20113	12.133	0.767	2385	1.052	0.714	0.108	0.849	1.305	6.619	1.528

20114	7.698	0.726	2242	0.926	0.621	0.107	0.749	1.145	5.825	0.969
20121	7.397	0.676	2064	1.223	0.801	0.104	0.994	1.506	7.695	0.932
20122	6.528	0.564	2158	0.688	0.503	0.116	0.546	0.867	4.328	0.822
20123	10.663	0.848	3088	1.139	0.718	0.100	0.933	1.391	7.164	1.343
20124	6.723	0.759	2633	0.868	0.569	0.104	0.705	1.068	5.459	0.847
20131	3.798	0.567	1805	0.656	0.474	0.115	0.522	0.825	4.125	0.478
20132	6.450	0.545	2431	0.852	0.603	0.112	0.681	1.066	5.361	0.812
20133	8.030	0.809	3050	1.101	0.684	0.099	0.904	1.341	6.927	1.011
20134	6.060	0.698	2304	1.040	0.656	0.100	0.851	1.270	6.541	0.763
20141	3.403	0.505	1729	0.588	0.442	0.120	0.463	0.746	3.697	0.428
20142	6.143	0.489	2260	0.601	0.460	0.122	0.472	0.766	3.780	0.774
20143	9.862	0.856	2848	1.048	0.656	0.099	0.859	1.277	6.588	1.242
20144	6.788	0.702	2208	0.882	0.573	0.103	0.718	1.084	5.549	0.855

Table 17. Nominal and standardized catch rates of yellowfin tuna in kg/1000 hooks (CPUEN) from the Pelagic Logbook data Index2: Gulf of Mexico and Atlantic by year and season.

Year_season	Nominal CPUE	Obs. Prop Pos	Numb obs	Index	Std Error	Index Coeff Var	Low CI 95%	Upp CI 95%	Stand. CPUE	scaled Nominal CPUE
19871	286.664	0.569	2058	1.152	33.193	0.123	0.902	1.473	269.739	0.949
19872	323.652	0.649	2282	1.377	37.157	0.115	1.095	1.733	322.369	1.071
19873	500.123	0.675	3365	2.262	58.008	0.110	1.818	2.814	529.413	1.655
19874	475.709	0.757	2182	2.265	57.437	0.108	1.825	2.812	530.206	1.574
19881	225.653	0.492	2689	0.790	22.408	0.121	0.620	1.006	184.886	0.747
19882	374.364	0.595	2264	1.635	42.134	0.110	1.313	2.036	382.689	1.239
19883	468.470	0.592	3426	2.715	65.697	0.103	2.210	3.337	635.583	1.550
19884	344.334	0.601	2746	1.878	46.682	0.106	1.520	2.322	439.677	1.140
19891	248.744	0.5	3185	1.075	28.541	0.113	0.857	1.347	251.514	0.823
19892	273.318	0.524	2334	1.377	35.475	0.110	1.106	1.715	322.288	0.905
19893	389.200	0.603	3640	2.033	49.276	0.104	1.653	2.499	475.751	1.288
19894	432.133	0.615	2844	2.418	57.773	0.102	1.973	2.964	565.972	1.430
19901	252.238	0.486	3157	1.209	31.067	0.110	0.971	1.505	282.976	0.835
19902	391.415	0.66	2140	1.817	44.508	0.105	1.475	2.239	425.242	1.295
19903	328.987	0.632	3690	1.357	34.276	0.108	1.094	1.683	317.537	1.089
19904	250.791	0.49	2555	1.041	27.771	0.114	0.829	1.306	243.543	0.830
19911	188.320	0.452	2557	0.724	20.717	0.122	0.568	0.924	169.539	0.623
19912	289.119	0.606	1976	0.918	26.060	0.121	0.721	1.169	214.790	0.957
19913	536.603	0.645	3747	1.380	37.816	0.117	1.093	1.743	323.079	1.776
19914	437.331	0.737	2703	1.520	37.782	0.106	1.229	1.878	355.653	1.447
19921	257.697	0.582	2941	0.849	22.164	0.112	0.680	1.061	198.736	0.853
19922	548.871	0.678	2299	1.748	44.467	0.109	1.407	2.171	409.023	1.816
19923	431.597	0.646	3928	1.566	40.489	0.110	1.256	1.952	366.553	1.428
19924	347.062	0.633	2493	1.343	34.096	0.108	1.082	1.668	314.389	1.149
19931	215.422	0.428	2466	0.611	17.734	0.124	0.477	0.782	143.063	0.713
19932	303.379	0.582	2134	0.989	27.139	0.117	0.783	1.250	231.563	1.004
19933	267.942	0.607	4085	0.947	25.370	0.114	0.754	1.189	221.593	0.887
19934	190.861	0.562	2488	0.693	17.961	0.111	0.556	0.864	162.170	0.632
19941	148.574	0.377	2509	0.357	10.873	0.130	0.276	0.463	83.571	0.492
19942	250.164	0.533	2587	0.702	19.690	0.120	0.553	0.891	164.239	0.828
19943	268.693	0.631	3900	0.938	24.701	0.113	0.750	1.174	219.564	0.889
19944	207.993	0.665	3149	0.987	23.678	0.103	0.804	1.211	230.999	0.688
19951	164.925	0.459	3015	0.682	18.610	0.117	0.540	0.860	159.563	0.546
19952	278.474	0.635	2918	1.222	30.715	0.107	0.986	1.513	285.933	0.922
19953	324.481	0.662	4718	1.127	28.614	0.109	0.907	1.399	263.678	1.074
19954	343.883	0.742	2513	1.157	28.451	0.105	0.938	1.427	270.828	1.138
19961	114.718	0.39	2542	0.471	13.536	0.123	0.369	0.602	110.331	0.380
19962	321.000	0.63	2952	0.876	23.169	0.113	0.700	1.098	205.147	1.062
19963	320.459	0.725	4376	1.188	29.135	0.105	0.964	1.464	278.127	1.061
19964	302.862	0.615	2613	1.224	30.176	0.105	0.992	1.510	286.488	1.002
19971	218.906	0.499	3067	0.568	15.888	0.120	0.447	0.720	132.877	0.724
19972	396.984	0.703	2288	0.939	24.760	0.113	0.750	1.176	219.863	1.314
19973	347.099	0.702	4419	1.082	26.918	0.106	0.875	1.338	253.262	1.149
19974	278.387	0.707	2448	0.978	24.266	0.106	0.791	1.208	228.858	0.921
19981	149.425	0.435	2166	0.290	8.997	0.133	0.222	0.377	67.775	0.495
19982	249.739	0.711	1797	0.701	18.444	0.112	0.560	0.877	163.968	0.827
19983	299.136	0.684	3121	0.795	20.899	0.112	0.635	0.995	186.073	0.990

19984	275.880	0.646	2537	0.807	20.751	0.110	0.648	1.005	188.931	0.913
19991	330.814	0.672	1935	0.638	18.697	0.125	0.497	0.819	149.387	1.095
19992	386.881	0.764	2089	0.798	22.178	0.119	0.629	1.011	186.675	1.280
19993	384.625	0.764	2815	0.877	23.762	0.116	0.696	1.104	205.157	1.273
19994	406.827	0.791	2617	1.345	34.114	0.108	1.084	1.670	314.867	1.346
20001	276.561	0.606	1810	0.526	16.174	0.131	0.405	0.683	123.085	0.915
20002	383.770	0.739	2018	1.015	26.751	0.113	0.810	1.270	237.465	1.270
20003	416.177	0.74	3030	0.900	23.982	0.114	0.717	1.129	210.564	1.377
20004	417.022	0.796	2423	0.996	24.466	0.105	0.808	1.228	233.102	1.380
20011	103.805	0.427	1662	0.299	10.066	0.144	0.224	0.398	69.867	0.344
20012	289.243	0.603	2364	0.777	22.902	0.126	0.605	0.999	181.920	0.957
20013	395.614	0.769	3397	1.162	31.749	0.117	0.920	1.466	271.875	1.309
20014	360.782	0.817	2275	1.490	37.673	0.108	1.202	1.849	348.839	1.194
20021	234.234	0.658	1870	0.519	14.415	0.119	0.410	0.657	121.444	0.775
20022	327.211	0.723	2082	0.699	18.982	0.116	0.555	0.881	163.596	1.083
20023	427.650	0.752	3124	0.829	22.438	0.116	0.658	1.044	193.993	1.415
20024	322.142	0.759	2128	0.738	19.205	0.111	0.592	0.922	172.826	1.066
20031	214.211	0.595	1949	0.407	12.966	0.136	0.310	0.533	95.150	0.709
20032	311.700	0.609	2224	0.550	17.384	0.135	0.420	0.720	128.730	1.032
20033	346.357	0.693	2786	0.615	18.955	0.132	0.473	0.799	143.970	1.146
20034	283.666	0.724	2229	0.726	20.738	0.122	0.569	0.926	169.953	0.939
20041	272.133	0.666	1906	0.958	29.163	0.130	0.739	1.241	224.127	0.901
20042	278.303	0.575	2341	0.741	24.053	0.139	0.563	0.977	173.530	0.921
20043	526.486	0.868	2329	1.491	43.098	0.124	1.166	1.907	348.951	1.742
20044	391.968	0.848	2125	1.244	35.747	0.123	0.974	1.589	291.123	1.297
20051	251.834	0.702	1996	0.836	23.594	0.121	0.657	1.063	195.653	0.833
20052	295.103	0.636	1947	0.832	24.599	0.126	0.647	1.070	194.779	0.977
20053	350.192	0.823	1888	1.011	27.641	0.117	0.801	1.276	236.600	1.159
20054	380.810	0.709	1293	1.225	34.355	0.120	0.965	1.556	286.786	1.260
20061	242.482	0.565	1208	0.653	20.793	0.136	0.498	0.857	152.940	0.802
20062	271.572	0.602	1588	0.823	24.413	0.127	0.639	1.059	192.590	0.899
20063	546.711	0.884	2258	1.491	40.981	0.117	1.180	1.884	348.999	1.809
20064	556.650	0.808	1717	1.480	41.245	0.119	1.168	1.877	346.496	1.842
20071	364.439	0.709	1548	1.274	36.702	0.123	0.997	1.628	298.188	1.206
20072	320.631	0.516	1649	0.756	24.568	0.139	0.573	0.997	176.914	1.061
20073	542.517	0.862	2702	1.784	48.509	0.116	1.415	2.249	417.533	1.795
20074	375.016	0.784	2182	1.247	34.484	0.118	0.986	1.579	291.976	1.241
20081	191.514	0.564	1627	0.667	20.411	0.131	0.514	0.865	156.023	0.634
20082	166.362	0.481	1957	0.510	16.544	0.138	0.387	0.672	119.471	0.551
20083	343.013	0.794	2388	0.933	27.284	0.125	0.727	1.196	218.274	1.135
20084	190.297	0.647	2136	0.580	17.432	0.128	0.449	0.749	135.811	0.630
20091	200.847	0.622	1503	0.514	16.168	0.134	0.394	0.672	120.392	0.665
20092	240.436	0.549	2039	0.428	14.105	0.141	0.324	0.567	100.249	0.796
20093	319.868	0.824	2814	0.731	21.076	0.123	0.572	0.935	171.147	1.059
20094	229.657	0.727	2181	0.631	18.431	0.125	0.492	0.809	147.581	0.760
20101	192.268	0.618	1624	0.699	20.565	0.126	0.544	0.898	163.595	0.636
20102	141.142	0.418	1989	0.392	12.569	0.137	0.298	0.514	91.634	0.467
20103	326.768	0.838	1978	1.300	34.671	0.114	1.035	1.631	304.176	1.081
20104	217.460	0.637	1361	1.041	28.763	0.118	0.823	1.317	243.636	0.720
20111	77.315	0.414	1234	0.655	20.726	0.135	0.500	0.857	153.315	0.256
20112	164.849	0.322	1906	0.446	15.339	0.147	0.333	0.598	104.461	0.546
20113	386.645	0.767	2385	0.967	27.514	0.122	0.759	1.232	226.224	1.280

20114	311.999	0.726	2242	0.895	25.236	0.120	0.704	1.138	209.566	1.033
20121	321.827	0.676	2064	1.110	30.613	0.118	0.878	1.404	259.908	1.065
20122	230.668	0.564	2158	0.666	20.040	0.129	0.516	0.860	155.914	0.763
20123	356.683	0.848	3088	1.118	29.950	0.114	0.890	1.405	261.789	1.180
20124	298.070	0.759	2633	0.924	25.485	0.118	0.731	1.169	216.272	0.986
20131	164.368	0.567	1805	0.686	20.358	0.127	0.533	0.883	160.588	0.544
20132	259.563	0.545	2431	0.960	27.949	0.124	0.749	1.230	224.663	0.859
20133	275.041	0.809	3050	1.066	28.043	0.112	0.852	1.334	249.484	0.910
20134	234.959	0.698	2304	1.103	29.385	0.114	0.879	1.384	258.229	0.778
20141	119.443	0.505	1729	0.511	15.749	0.132	0.393	0.664	119.625	0.395
20142	210.681	0.489	2260	0.608	19.011	0.133	0.466	0.794	142.407	0.697
20143	373.563	0.856	2848	1.227	32.684	0.114	0.977	1.539	287.083	1.236
20144	256.047	0.702	2208	0.930	25.500	0.117	0.736	1.175	217.693	0.847

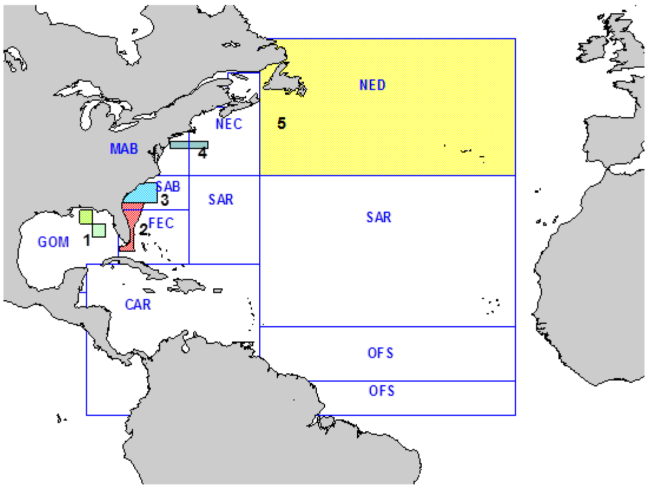

Figure 1. Geographical areas for the US Pelagic Longline fishery: CAR Caribbean, GOM Gulf of Mexico, FEC Florida east coast, SAB South Atlantic bight, MAB mid Atlantic bight, NEC North east coastal Atlantic, NED North east distant waters, SNA Sargasso Sea, and OFS Offshore waters. Shaded areas represent the current time-area closures affecting the pelagic longline fisheries. Permanent closures: (1) the DeSoto Canyon in the Gulf of Mexico and (2) The Florida east coast areas. Non-permanent closures: (3) the Charleston Bump area closed Feb-Apr, (4) the Bluefin tuna protection area closed in June, and (5) the Grand Banks closed since Oct-2000.

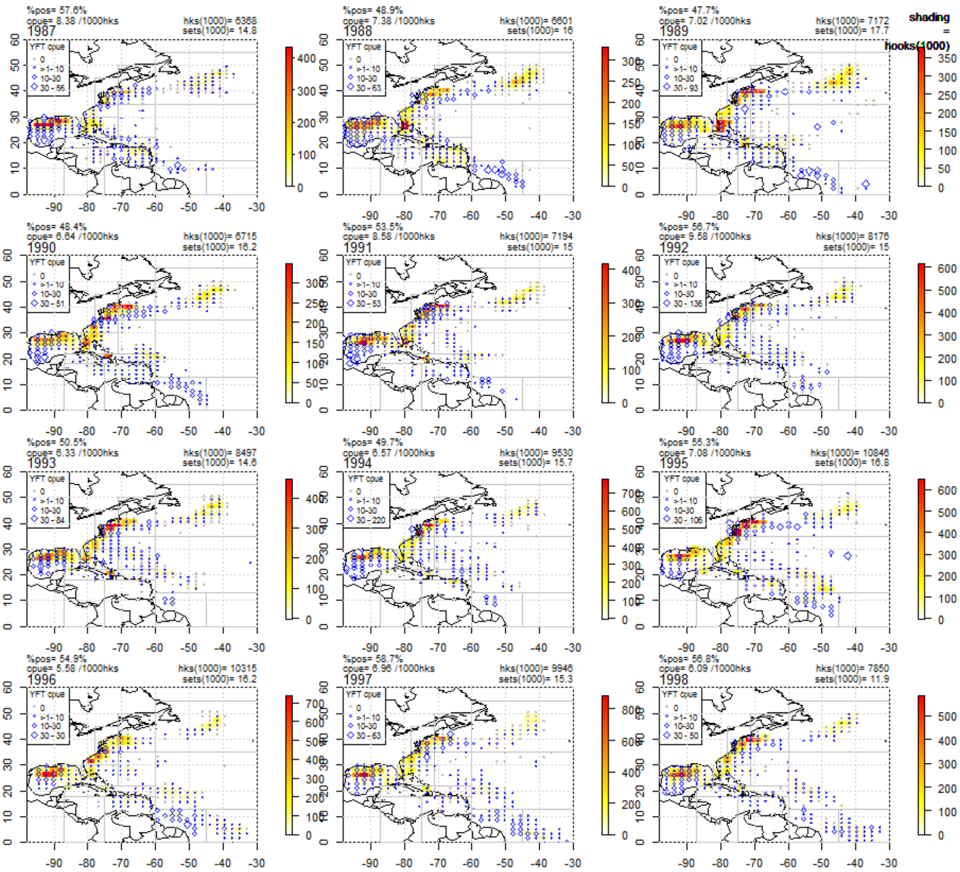

Figure 2. Spatial distribution of catch and effort in the US Pelagic longline fishery for years 1986-2015. Scale is 1000 hooks set per grid cell. Cell size is approximately 2 x 2 degrees.

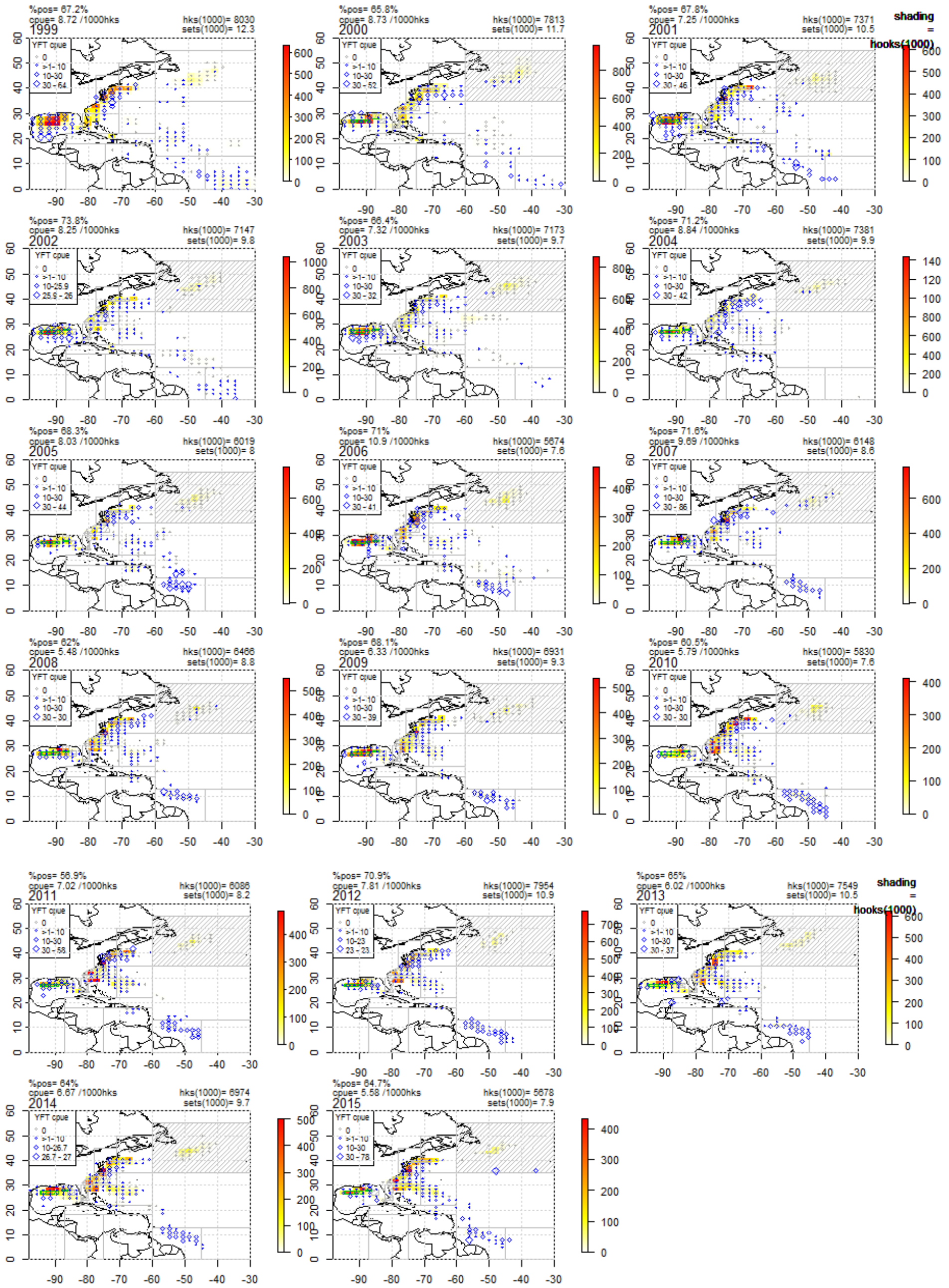

Figure 2, cont.

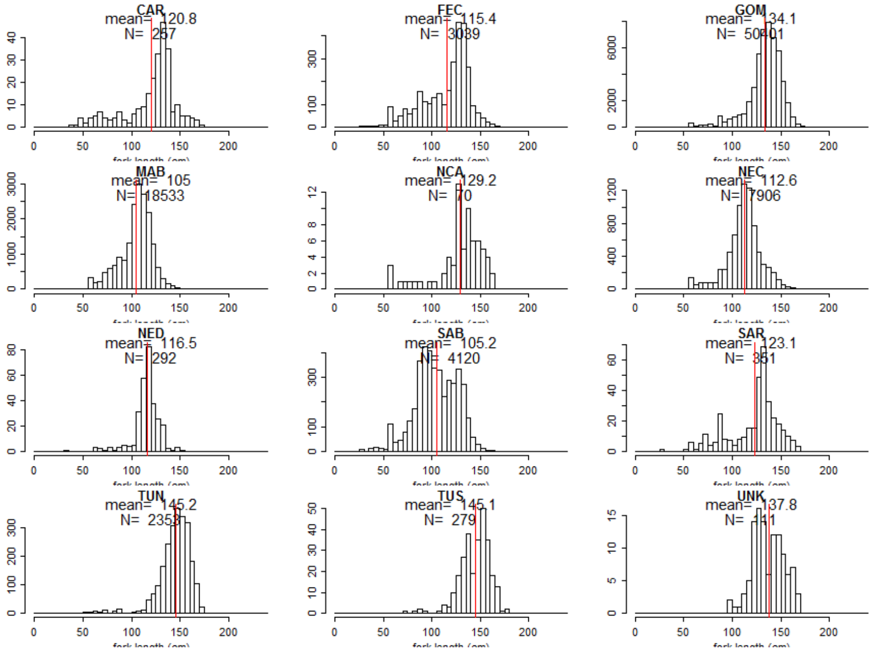

Figure 3. Histograms of yellowfin tuna straight line fork length (cm) by area. Red lines indicate mean fork length.

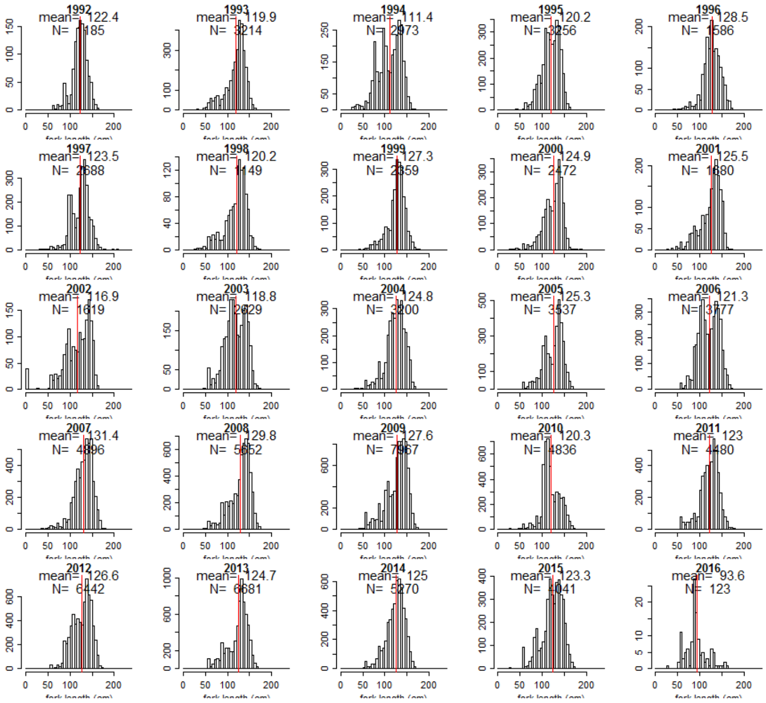

Figure 4. Histograms of yellowfin tuna straight line fork length (cm) by year. Red lines indicate mean fork length.

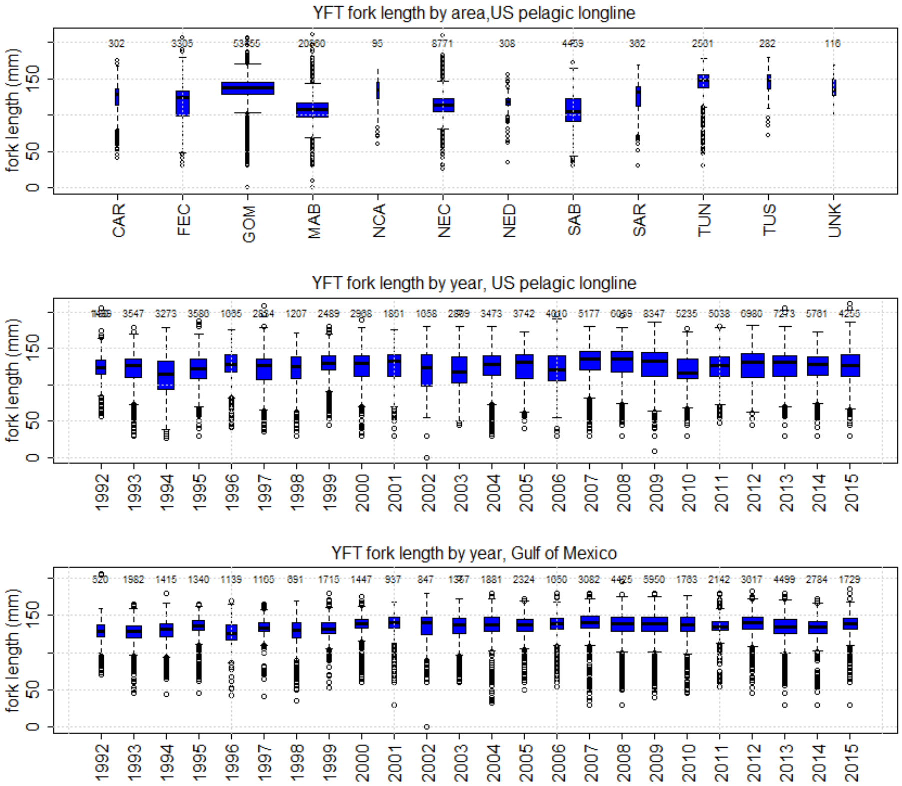

Figure 5. Box and whisker plots (median, 1st, 3rd quartile, minimum and maximum) of yellowfin tuna straight line fork length by area (A), year (B) and year just for the Gulf of Mexico (C). Box widths are proportional to sample size and dots represent lengths that are outside the 1.5*interquartile range. Solid dots represent means.

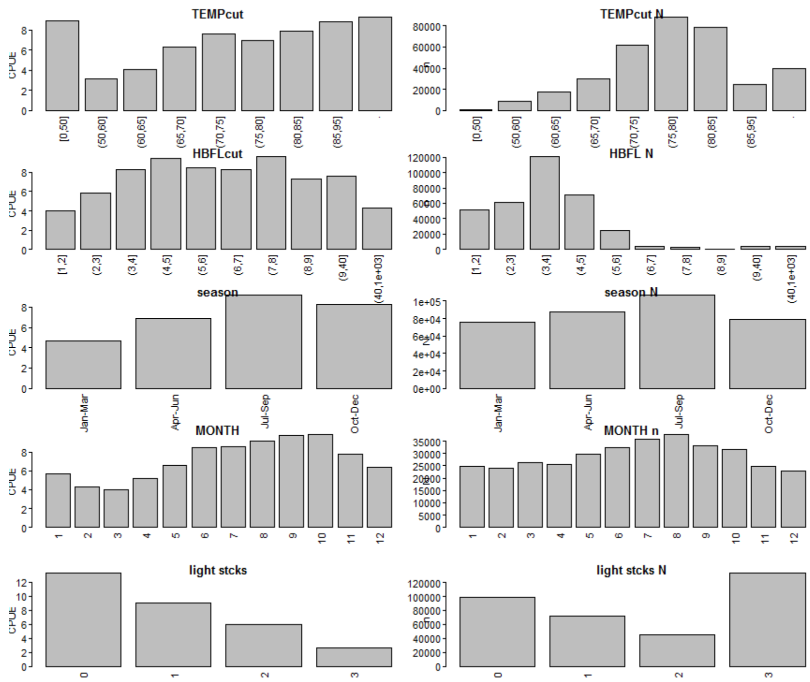

Figure 6. Plot of nominal mean YFT /1000 hooks by model factors.

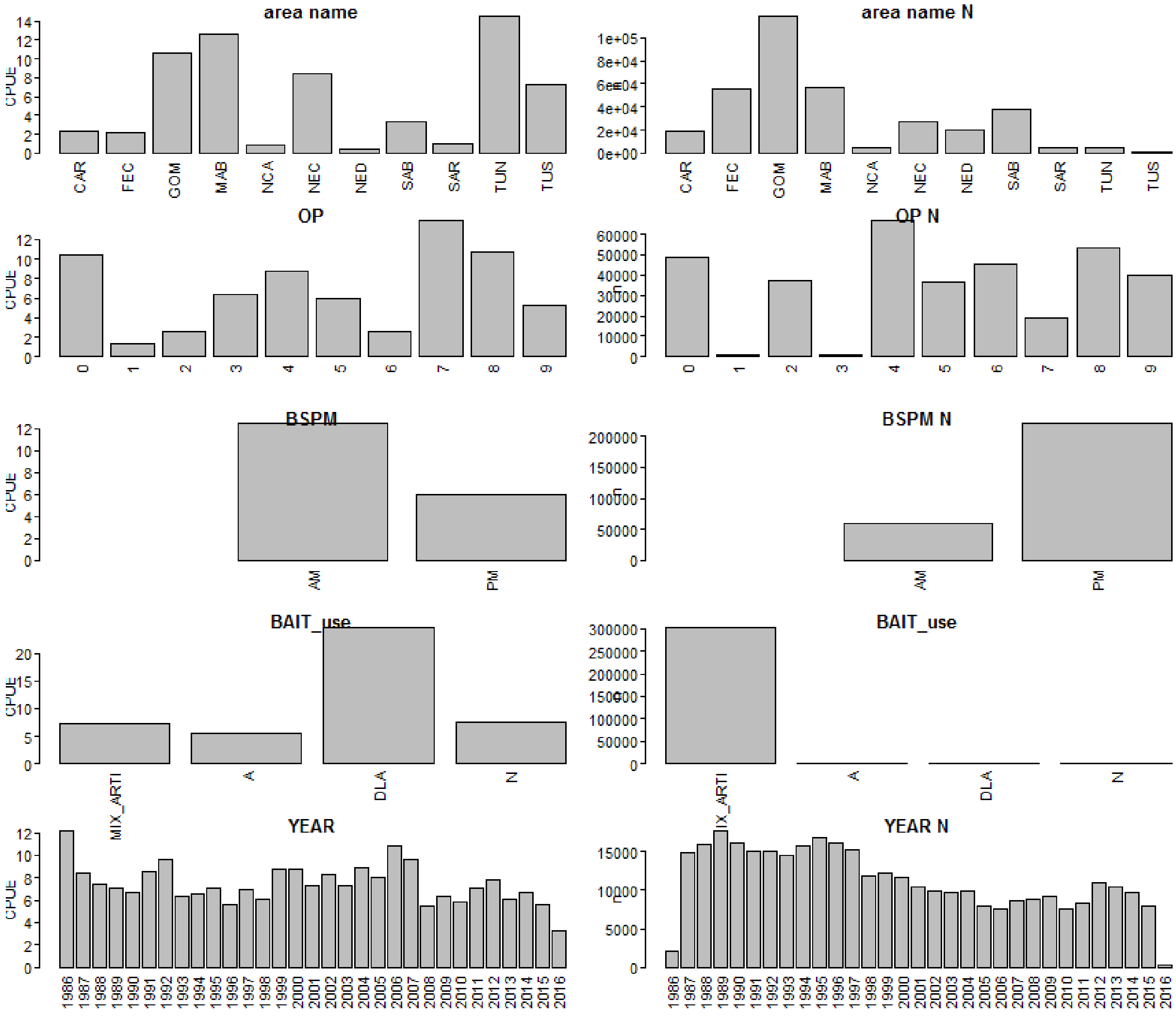

Figure 7. Plot of nominal mean YFT /1000 hooks by more model factors.

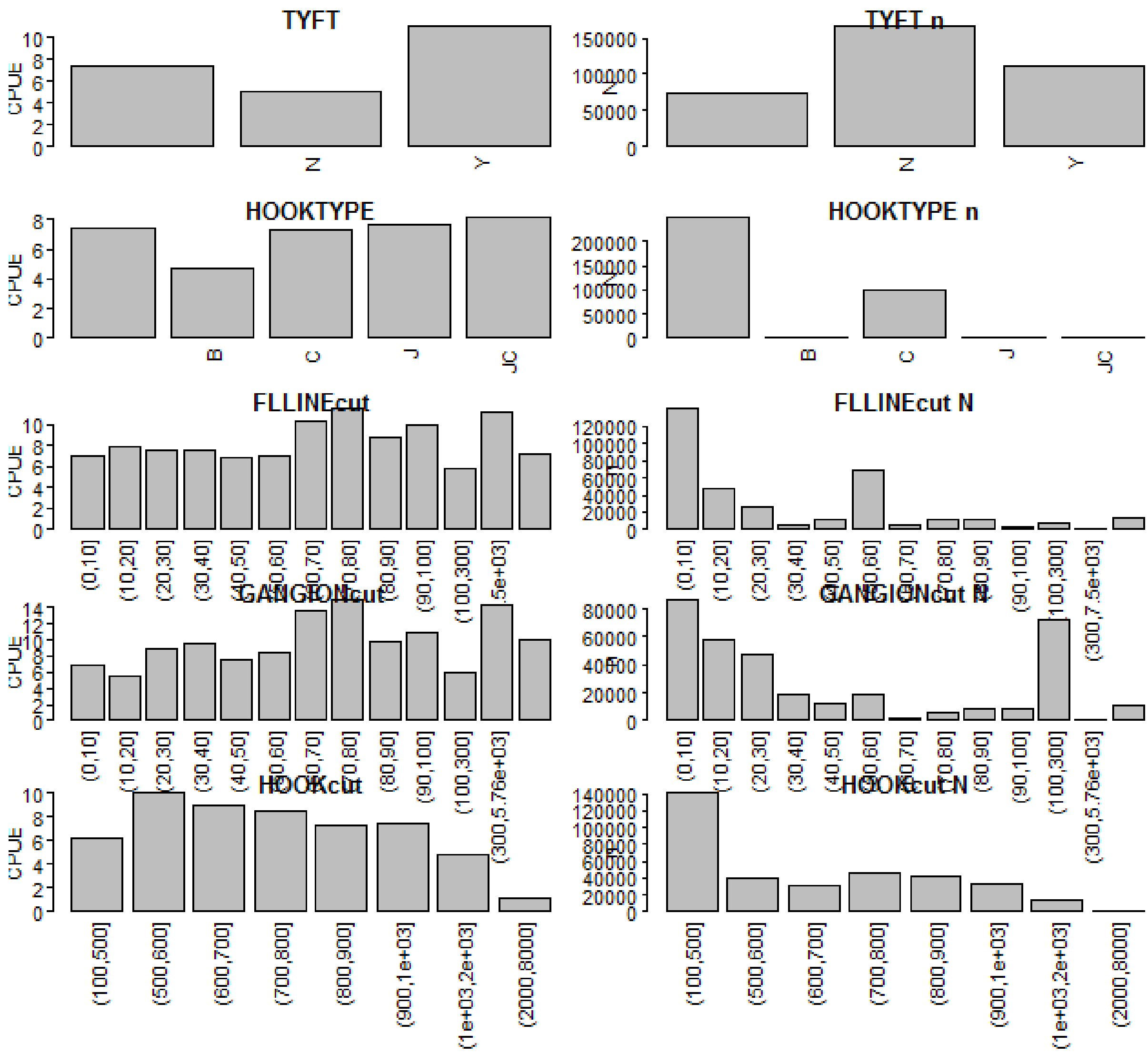

Figure 8. Plot of nominal mean YFT /1000 hooks by more model factors.

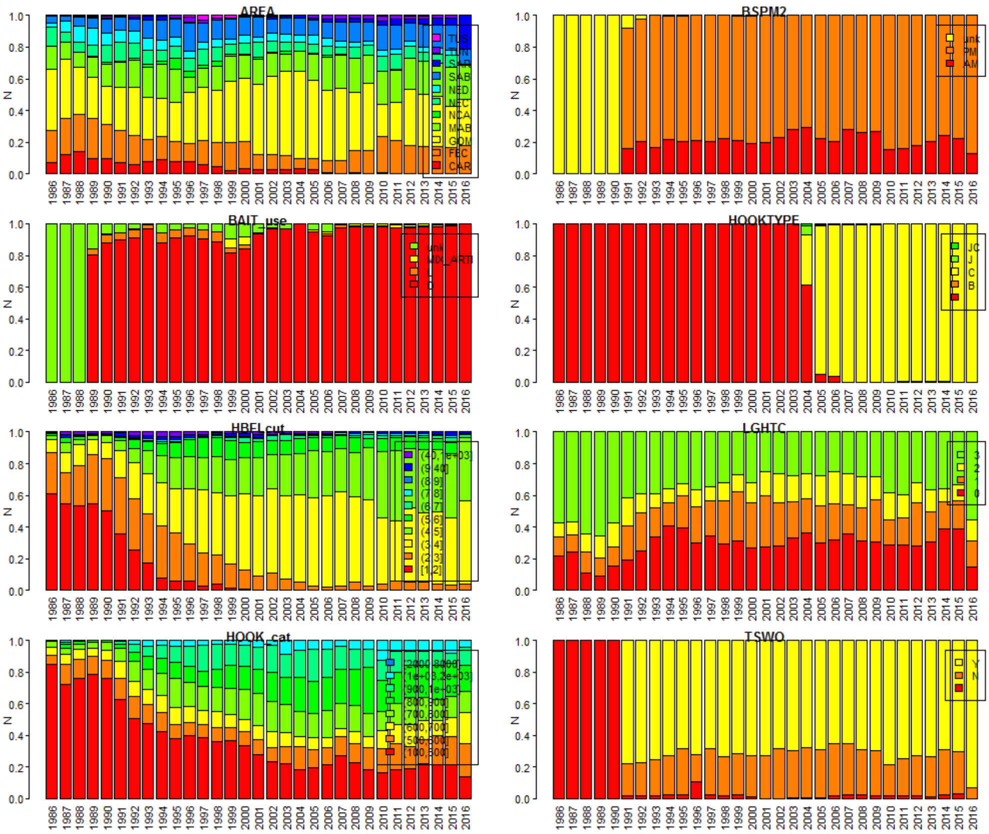

Figure 9. Plots of distribution of factor categories by year.

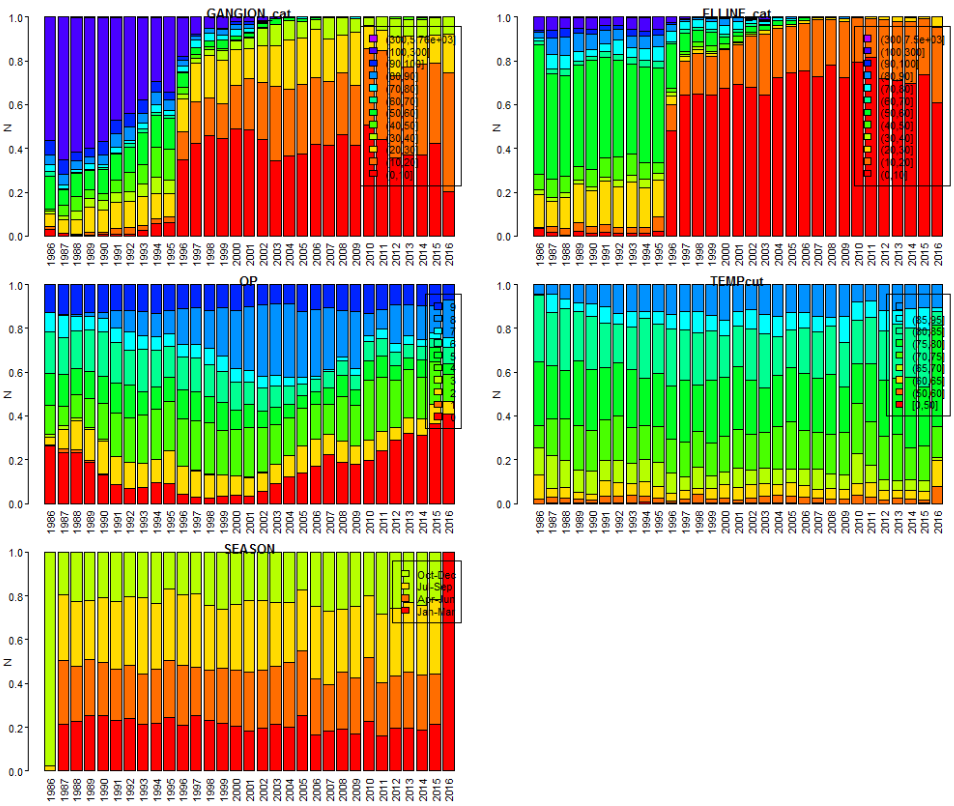

Figure 10. Plots of distribution of factor categories by year.

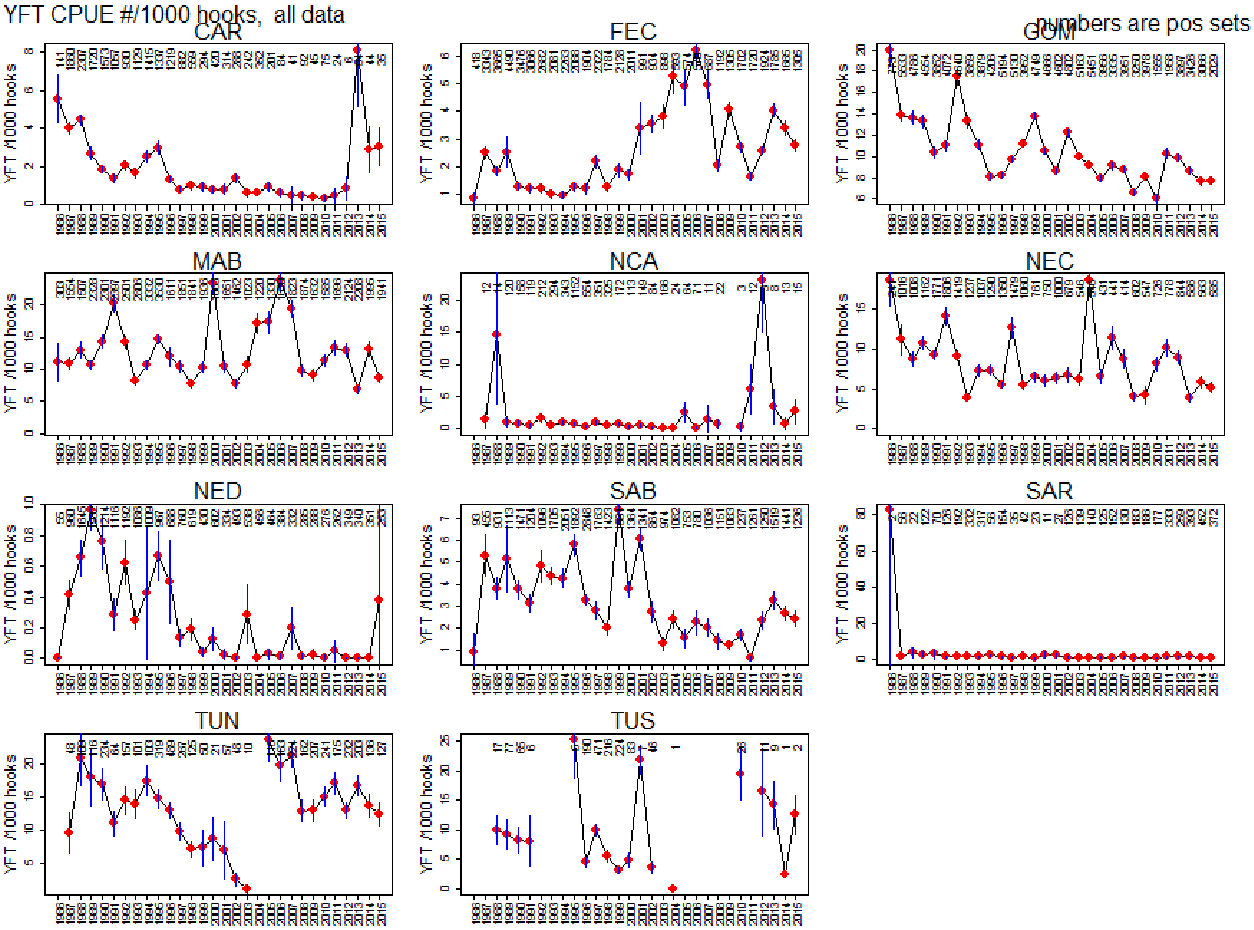

Figure 11. Nominal yellowfin tuna catch per 1000 hooks for each area from logbook data. Upper and lower limits are 95% confidence intervals. Numbers are the total number of sets.

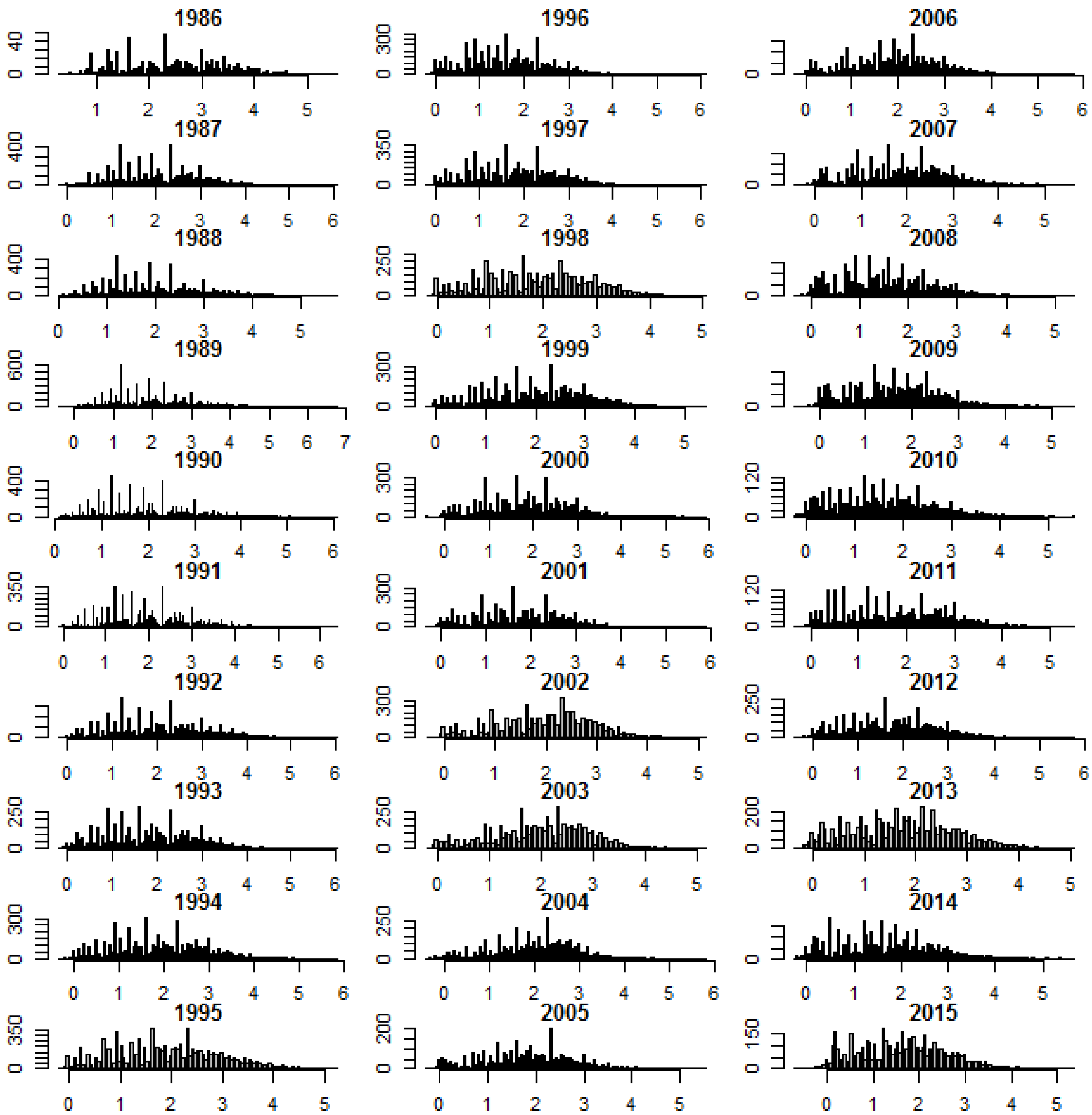

Figure 12. Histograms of CPUE in number by year.

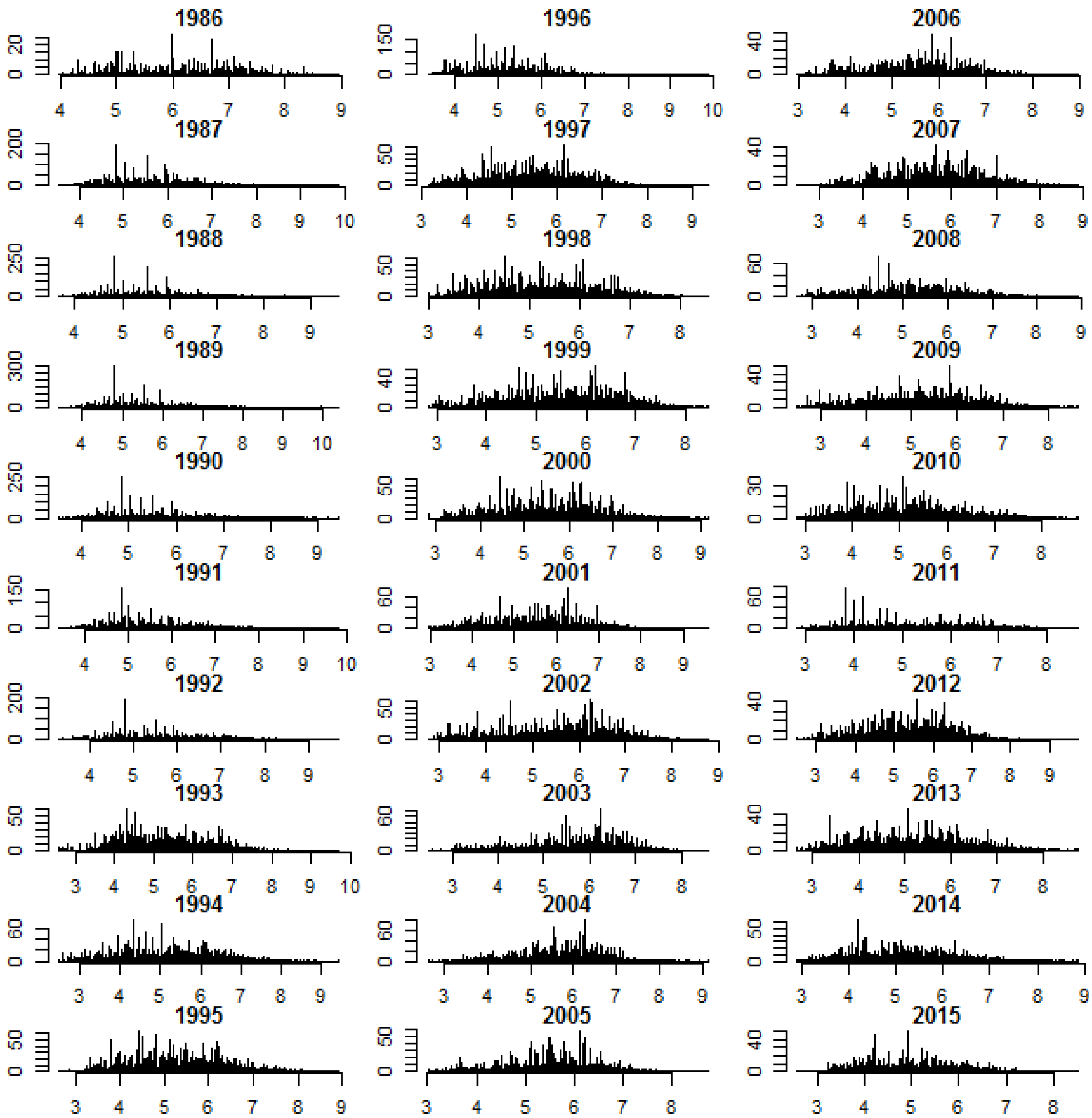

Figure 13. Histograms of CPUE in weight by year.

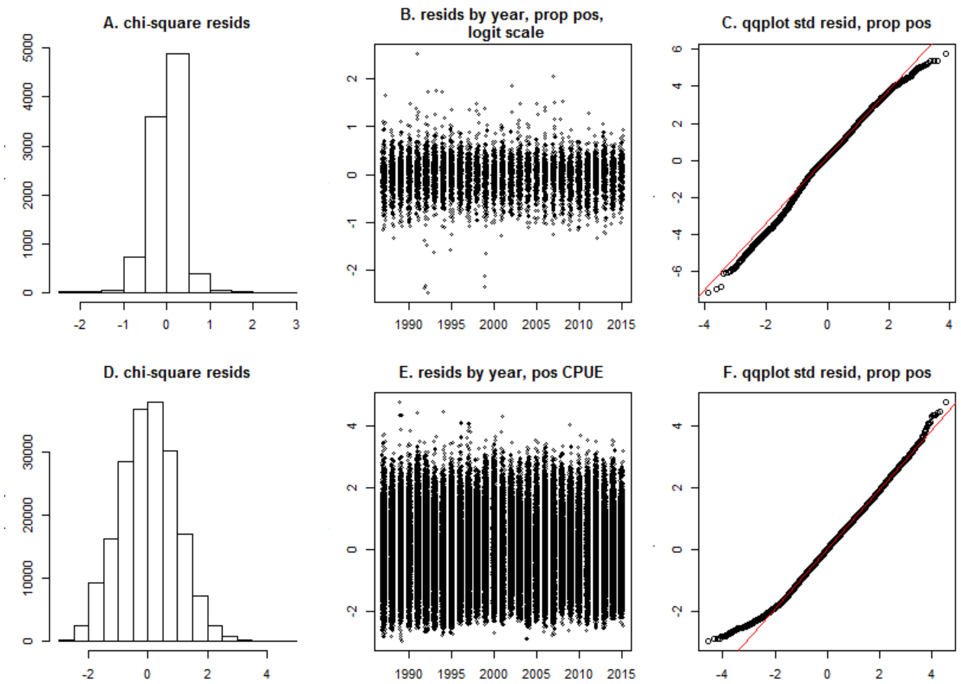

Figure 14. Diagnostic plots for the model 3. Top row, for binomial submodel, (A) overall studentized residuals, (B) raw residuals by year and (C) qq plot of residuals. Bottom row, for lognormal submodel (D) histogram of studentized residuals, (E) raw residuals by year and (F) qq plot of residuals.

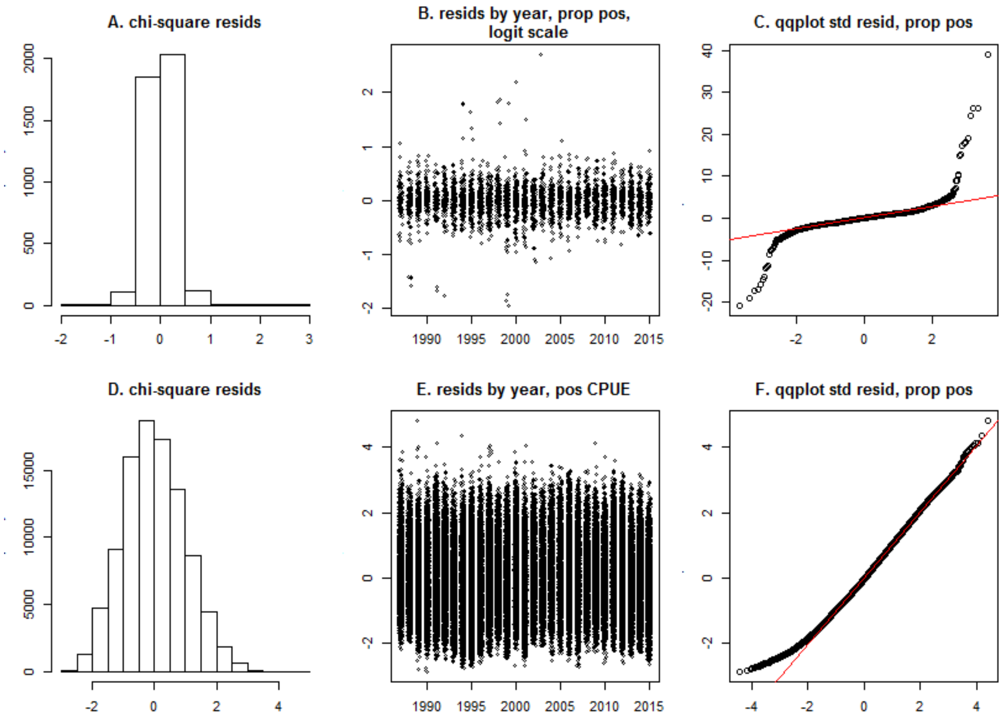

Figure 15. Diagnostic plots for the model 4, Atlantic only index. Top row, for binomial submodel, (A) overall studentized residuals , (B) raw residuals by year and (C) qq plot of residuals. Bottom row, for lognormal submodel (D) histogram of studentized residuals, (E) raw residuals by year and (F) qq plot of residuals.

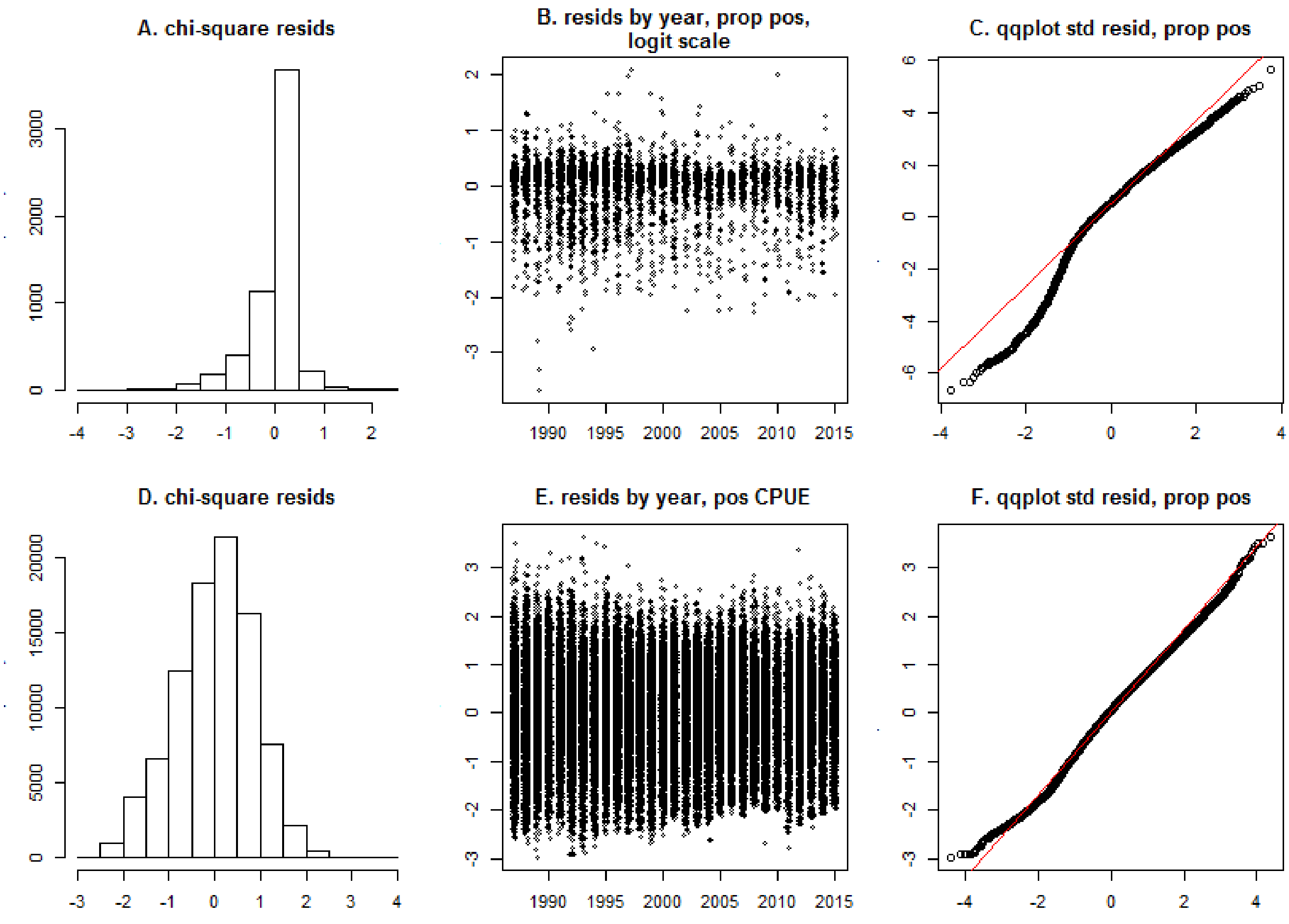

Figure 16. Diagnostic plots for the model 4, Gulf of Mexico index. Top row, for binomial submodel, (A) overall studentized residuals , (B) raw residuals by year and (C) qq plot of residuals. Bottom row, for lognormal submodel (D) histogram of studentized residuals, (E) raw residuals by year and (F) qq plot of residuals.

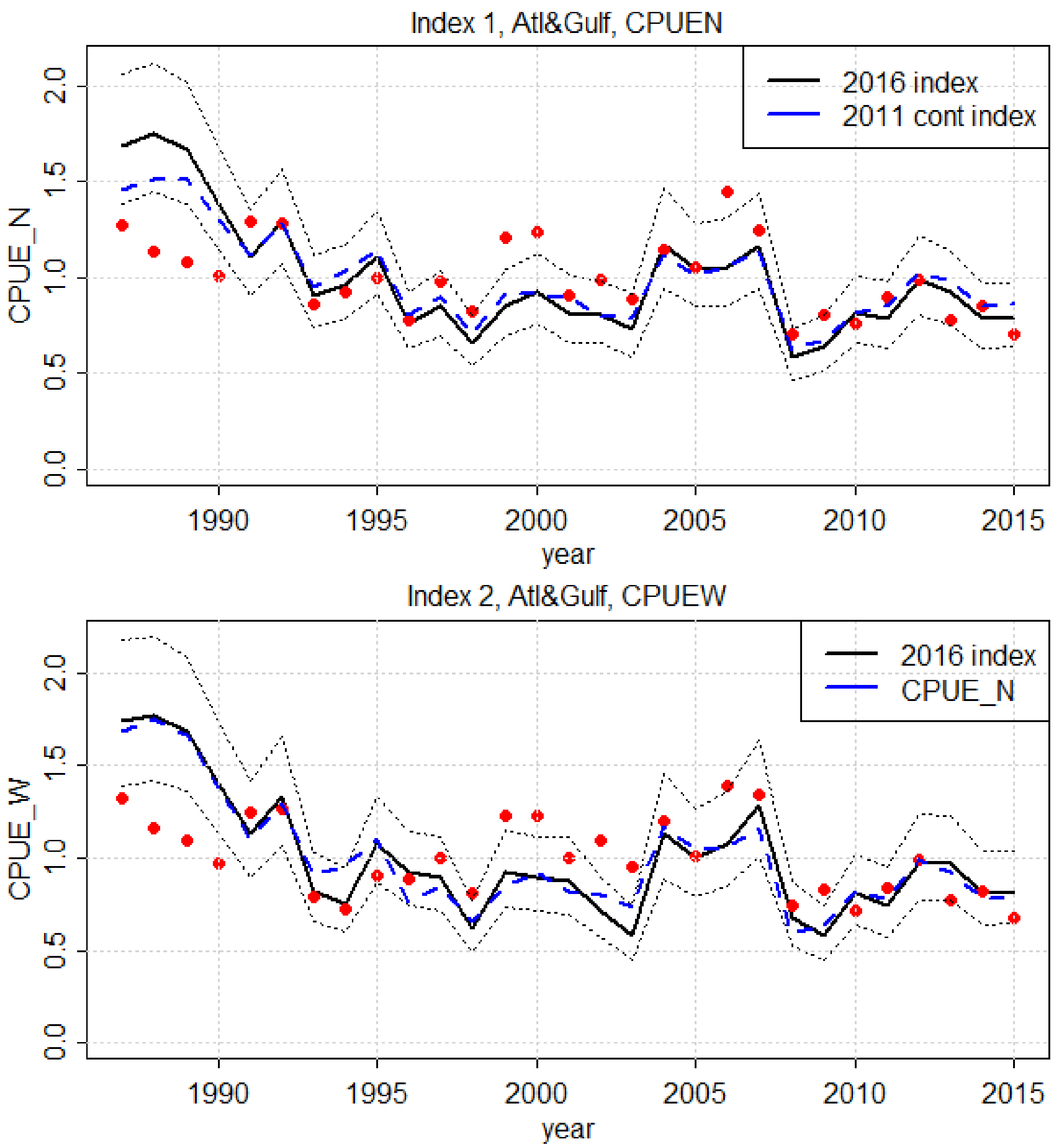

Figure 17. Nominal (blue circles) and standardized (red line) catch rates for yellowfin tuna from the Pelagic Logbook data for index 1 (CPUEN) and index 2 (CPUEW), Atlantic and Gulf of Mexico. The blue line in the upper figure is the continuity index from 2011, constructed using the previous methods.

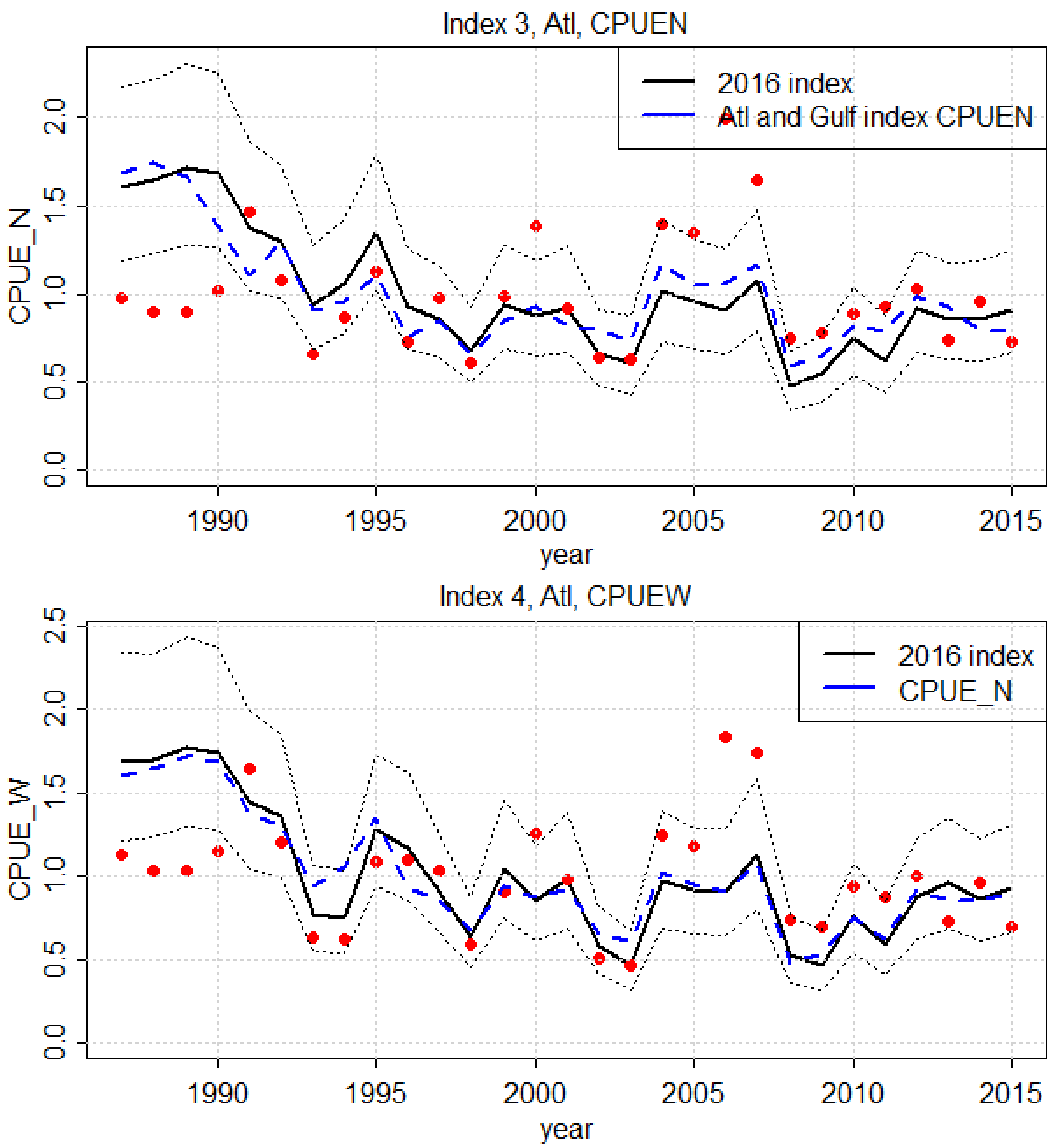

Figure 18. Nominal (blue circles) and standardized (red line) catch rates for yellowfin tuna from the Pelagic Logbook data for index 3 (CPUEN) and index 4 (CPUEW), Atlantic and Gulf of Mexico. The blue line in the upper figure is the index for the Atlantic and Gulf combined.

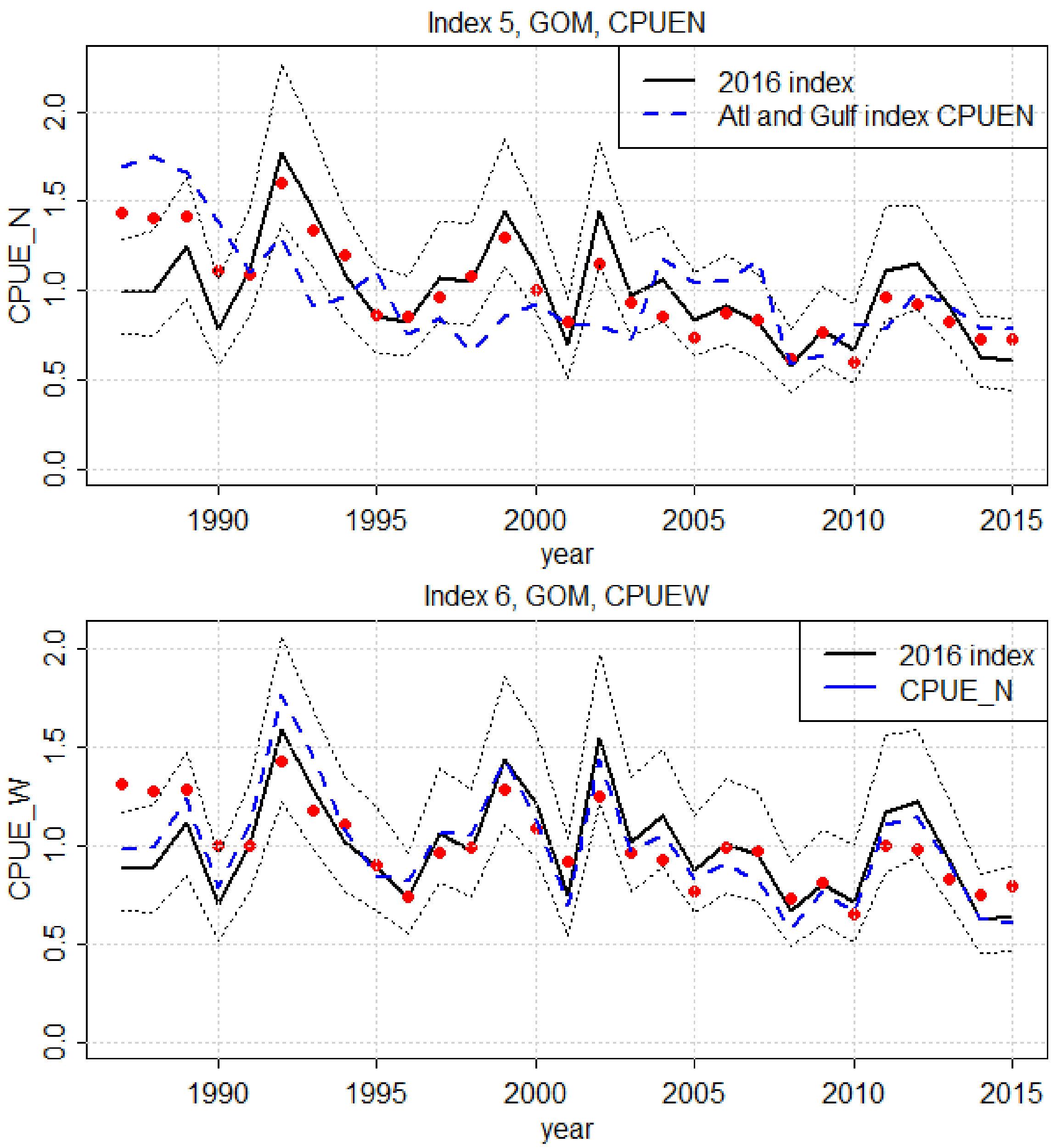

Figure 19. Nominal (blue circles) and standardized (red line) catch rates for yellowfin tuna from the Pelagic Logbook data for index 5 (CPUEN) and index 6 (CPUEW), Gulf of Mexico. The blue line in the upper figure is the index for the Atlantic and Gulf combined.

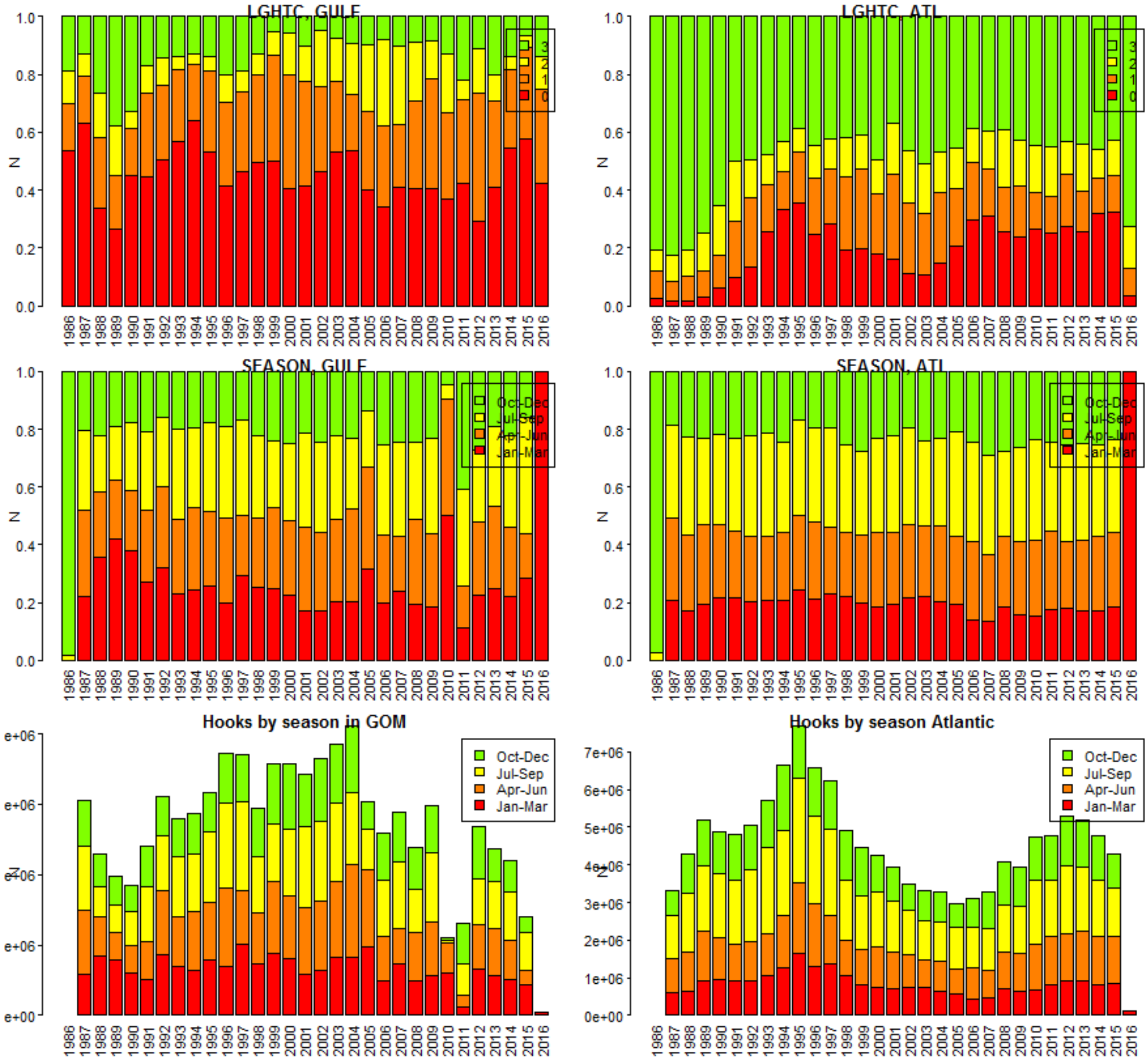

Figure 20. Fractional light stick utilization over time for the Gulf of Mexico and Atlantic regions showing the factor most likely accounting for the divergence between nominal and estimated index values for 1987-1990. Lower figure shows effort in number of hooks by Gulf and Atlantic by year and season showing the reduction in effort in the GOM following the 2010 Deepwater Horizon event and also in 2015, potentially as a result of new Bluefin tuna regulations.

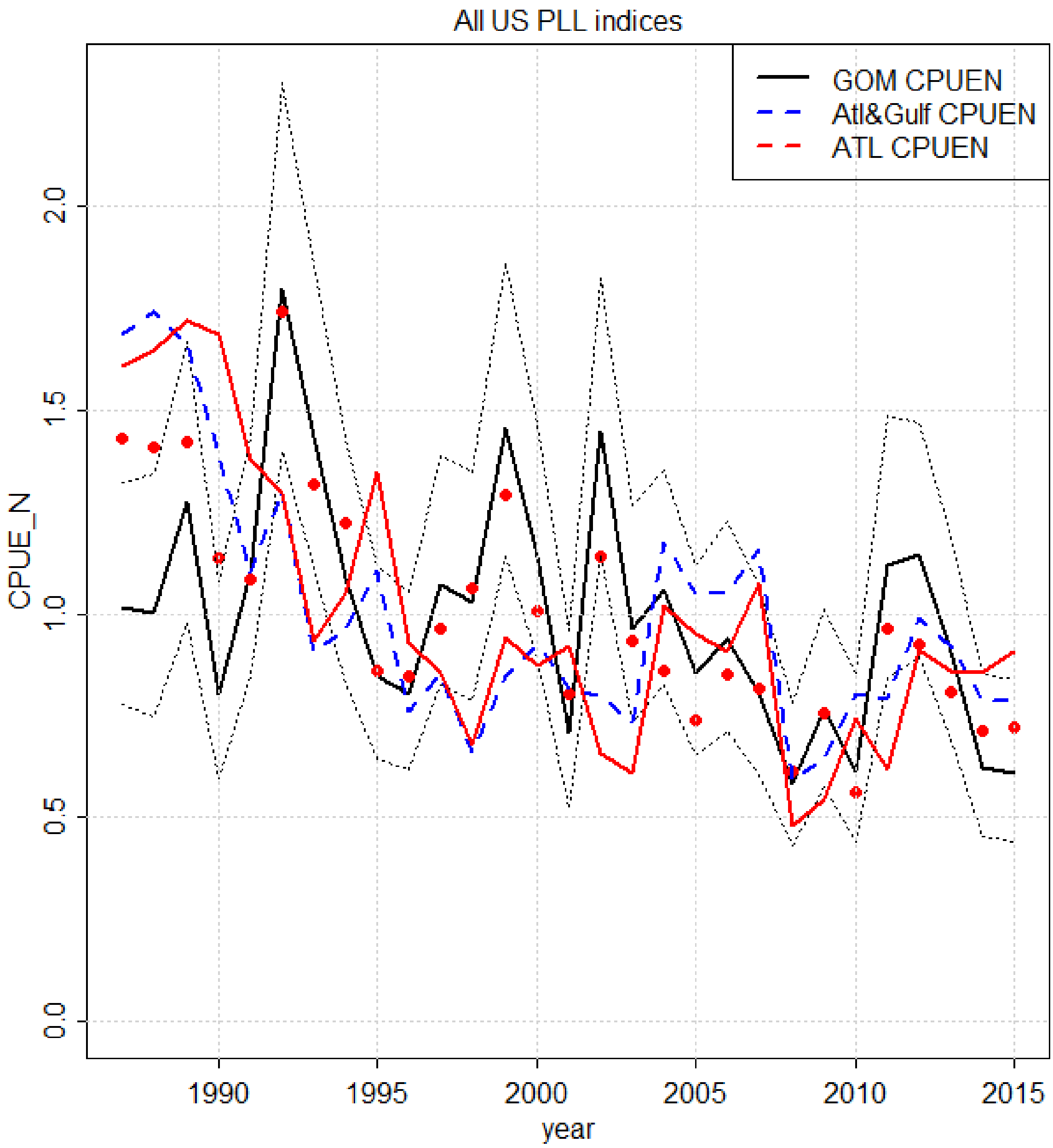

Figure 21. All indices plotted together CPUEN.