# UPDATED STANDARDIZED BLUEFIN CPUE FROM THE JAPANESE LONGLINE FISHERY IN THE ATLANTIC TO 2012 FISHING YEAR

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*SUMMARY*

*Abundance indices of bluefin tuna from the Japanese longline fishery in the West and Northeast Atlantic were provided up to 2012 fishing year. The indices were standardized with delta-lognormal model with random effect. West Atlantic index fluctuated significantly since 2007 fishing year, showing considerably high values in several fishing years. These high indices might be related to the abundance of relatively small-sized bluefin (50-60kg). Abundance index in the Northeast Atlantic showed a steep increasing trend since 2009 fishing year, and the size of bluefin caught showed a continuous contribution from 2003 year class. This study also made the first trial to provide the nominal CPUE by year class. Japanese longline possibly gradually exploited the 2003 year class since 2009 fishing year. This strong year class will migrate into the spawning areas, and it would be beneficial to monitor the other fisheries which target larger fish both in the West and East stocks. It was suggested that careful considerations would be needed for the use of Japanese CPUE series in the stock assessment of both west and east stocks.*

*RÉSUMÉ*

*Les indices d'abondance de la pêcherie palangrière japonaise ciblant le thon rouge et opérant dans l'Atlantique Ouest et Nord-Est ont été fournis jusqu'à l'année de pêche 2012. Les indices ont été standardisés au moyen d'un modèle delta-*normal *avec effet aléatoire. L'indice de l'Atlantique Ouest présente des fluctuations considérables depuis l'année de pêche 2007 et affiche des valeurs considérablement élevées pour plusieurs années de pêche. Ces forts indices pourraient avoir un rapport avec l'abondance du thon rouge de taille relativement réduite (50-60kg). L'indice d'abondance de l'Atlantique Nord-Est présentait une tendance rapide à la hausse depuis l'année de pêche 2009 et la taille des thons rouges capturés présentait la contribution continue de la classe d'âge de 2003. Cette étude a également fait le premier essai pour fournir la CPUE nominale par classe annuelle. Il se peut que la palangre japonaise ait graduellement exploité la classe de 2003 depuis l'année de pêche 2009. Cette forte classe annuelle migrera dans les zones de ponte et il serait judicieux d'effectuer un suivi des autres pêcheries qui ciblent des poissons plus grands dans les stocks Ouest et Est. Il a été suggéré qu'il conviendrait de faire preuve de prudence en utilisant cette série de CPUE dans l'évaluation des stocks de l'Est et de l'Ouest.*

*RESUMEN*

*Se facilitan como caso base índices de abundancia de atún rojo de la pesquería palangrera japonesa en el Atlántico occidental y nororiental hasta el año pesquero 2012. Los índices se estandarizaron mediante un modelo delta-lognormal con efectos aleatorios. El índice del Atlántico occidental fluctuó significativamente desde el año pesquero 2007, mostrando valores considerablemente elevados en varios años pesqueros. Estos índices elevados podrían estar relacionados con la abundancia de atún rojo de talla relativamente pequeña (50-60 kg). El índice de abundancia del Atlántico nordeste mostraba una marcada tendencia ascendente desde el año pesquero 2009, y la talla del atún rojo capturado mostraba la contribución continua de la clase anual de 2003. En el estudio se realizó también la primera prueba para proporcionar CPUE nominal por clase anual. Es posible que el palangre japonés haya explotado gradualmente la clase anual de 2003 desde el año pesquero 2009. Esta fuerte clase anual migró a zonas de reproducción, y sería beneficioso hacer un seguimiento de otras pesquerías que se dirigen a peces más grandes tanto en los stocks del este como del oeste. Se sugirió que se requerirá una consideración minuciosa al utilizar estas series de CPUE en la evaluación de stock, tanto de los stocks del este como del oeste.*

*KEYWORDS*

*Bluefin tuna, Stock abundance, Catch and effort, CPUE standardization, Delta-lognormal model, Generalized Linear Mixed Model, Long lining, Size*

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## 1. Introduction

Japanese longline fishery data in the North Atlantic are valuable information for studying the bluefin tuna stock in the Atlantic. This fishery covers wide geographical areas in the North Atlantic and the Mediterranean Sea, where bluefin tuna were distributed, for more than five decades (Kimoto *et al.*, 2011b). This wide temporal/spacious coverage, together with a good accurate quality of the data is the most important advantages in providing reliable abundance trend for this species.

However, the patterns and areas of fishing by the Japanese longline fishery changed through the history especially in the recent years (**Figure 1**), due to the introduction of IQ (individual vessels quota) and limited entry system to the Japanese longline vessels, voluntarily since August 2007 and by law August 2009 (Japan, 2011). Because both the amount of catch and the number of vessels have been significantly reduced, the Japanese longline fishery is not a major fishery for bluefin anymore. Although the abundance indices from this fishery are still very reliable and useful, it is strongly recommended to develop valid and reliable indices for other major fisheries (e.g. Mediterranean purse seine) while continued effort in improving Japanese longline standardized CPUE index is also desirable.

This paper provides updated, to 2012 fishing season, abundance indices for the bluefin stocks in the Atlantic given in the previous studies (Oshima *et al*., 2008 and 2009, Kimoto *et al*., 2011b, and Kimoto *et al*., 2013b), i.e. the CPUE series standardized by application of Generalized Linear Modeling technique. It also provides some exploratory abundance indices for the Japanese longline fleet, observing very rapid changes in its fishing patterns, due to the introduction of a new regulatory measure for bluefin tuna mentioned above, and examining the 2003 strong year class dominated in the Japanese longline catches since 2009 (Kimoto *et al*., 2011b).

## 2. Materials and methods

The catch and effort data (individual operation data) of the Japanese longline fishery were obtained from the logbook data compiled by the National Research Institute of Far Seas Fisheries (NRIFSF), and used for the CPUE standardization for the period from 1975 to 2012 fishing years. The fishing years were used in this report; 2012FY refers to the period from August 1, 2011 to July 31, 2012. The data in 2013FY were incomplete and used only in the exploratory abundance indices. Information on the number of hooks between floats (NHBF) is available since 1975 (indicative of the depth of the line). The catch history by the Japanese longline fishery dates back to much earlier period (back to 1958) but the catches before the mid-1970s mostly came from different areas (mostly tropical waters) from the current fishing grounds. In addition, there were no reliable and sufficient size data available for them. It should be noted that the fleets are very mobile and their operational practice and fishing techniques have been constantly modified during its history (Miyake *et al*, 2010).

The size measurement (or composition) data for bluefin tuna caught by the Japanese longline fishery have been collected through the research programs by the NRIFSF and observer program by the Fishery Agency of Japan (Kimoto *et al*., 2011a). In August 2008, Fishery Agency of Japan started to tag of the individual bluefin tuna caught by the Japanese longliners (for identification) and collect their weight (Japan, 2011). Therefore from 2009FY converted size (length) data, using weight-length relationship by ICCAT (Anon, 2011), are available for all fish caught; the number of available size data being 23,451, 17,899, 13,526, 9,449 and 8,824 in 2009FY, 2010FY, 2011FY, 2012FY, and 2013FY respectively. Applying slicing procedures to the size frequencies of bluefin caught by the Japanese longliners, catch at age was estimated for 2009 through 2013FYs from the converted size data. For slicing, the von Bertalanffy growth function estimated by ICCAT (Anon, 2011) was used.

The CPUE were standardized respectively for the traditional three areas by applying the same method as previously described by Oshima *et al*. (2008 and 2009) and Kimoto *et al.* (2010b and 2012b). These three areas are West Atlantic (off US and Canada, north of 30°N and west of 45°W), Northeast Atlantic (off Iceland north of 40°N and east of 45°W), and East Atlantic (30°N to 40°N, off Gibraltar to western Mediterranean Sea). The area definitions are shown in **Figures 2 and 3**. Total accumulative numbers of observations (set by set data) throughout the period to 2013FY for the standardized CPUEs are 57,375 in the West Atlantic, 86,132 in the Northeast Atlantic, and 64,308 in the East Atlantic (**Tables 1-3**), after eliminating some anomalies due to a technical error.

***Updated standardized CPUE to 2012FY***

In the east of 45°W, the Japanese longline vessels almost limited their operations solely in the Northeast Atlantic and rarely in the East Atlantic, since 2010FY, due to the IQ system and the small quota for each vessel (**Tables 2 and 3**). Therefore the CPUE series were updated to 2012FY for only in the West (1976-2012FY) and Northeast Atlantic (1990-2012FY) from the previous study (Kimoto *et al*., 2013b), whereas the CPUE in the East Atlantic was not updated since 2010FY.

In the CPUE standardization, fishing year, month, area, main and branch line material and NHBF were considered as main effects in the model, and interactions between month and area were included as a random effect. The original area stratification of each index was shown in **Figure 2**. Information on materials for main and branch lines is only available since 1994 and classified as either nylon or other materials. The lines used before 1994 were assumed as other materials. In order to keep the interaction in the model (avoiding lack of observations), some adjacent categories (month and area) were aggregated (**Figure 3**). Categories in each main effect adopted in the model are shown below. Delta-lognormal model (Lo *et al*., 1992) with binomial distribution to model successful/unsuccessful sets and lognormal for positive catch rate was applied for standardizing CPUE, because the data set includes many zero-catch observations. Model formula of logistic regression model of the 1st step model is as follows,

$$\log\frac{p}{1-p} = \text{Intercept} + (\text{Main effects}) + (\text{Interaction term}) \qquad (1)$$

where Log($p/(1-p)$) is logit link function, $p$ indicates ratio of positive catch and is assumed to binomially distributed. The model formula of lognormal model of the 2nd step is as follows,

$$\text{logCPUE} = \text{Intercept} + (\text{Main effects}) + (\text{Interaction term}) + \text{Error} \quad (2)$$

where logCPUE indicates natural logarithm of catch rate of positive set, that is the number of bluefin tuna per 1000 hooks, and error is also assumed to be distributed normally. The fitting was conducted by GLIMMIX macro and MIXED procedure of SAS/STAT package (Version 9.3) for the 1st and 2nd steps, respectively. Only significant variables among the considered main effects in the 1st step were used in the final model for each area, West, Northeast, and East Atlantic.

| ***Main effect / Area*** | ***West Atlantic*** | ***Northeast Atlantic*** |
|---|---|---|
| Stock | West | East |
| Fishing Year | 1976-2012 | 1990-2012 |
| Month | Nov, Dec, Jan, Feb | Aug-Oct, Nov, Dec, Jan-Mar |
| Area (**Figure 3**) | 5 areas | 4 areas |
| Material of main line | Nylon, others (since 1994) | Nylon, others (since 1994) |
| Material of branch line | Nylon, others (since 1994) | Nylon, others (since 1994) |
| Hooks between floats | 5– 13 (individual) | 4 - 7, 8 - 12 hooks |

***Exploratory CPUE series***

As explained earlier, the standardization of CPUE of the Japanese longline fishery becomes much more complicated, since the IQ system has been introduced. These complications are studied in the discussion section later. In order to help understanding of the changes and fluctuations of CPUE, several exploratory CPUE series were examined. They include updating to 2013FY both in the West and Northeast Atlantic shown with their model diagnostics.

*Updated standardized CPUE to 2013FY*

Using exactly the same method as above with the final chosen categories, the CPUE series were updated to 2013FY in the West and the Northeast Atlantic. The data for 2013FY are, however, incomplete.

*Nominal CPUE of 2003 year class, and the older and the younger year classes*

In these series, the nominal CPUEs for 2003 year class and the older and the younger year classes were analyzed separately both in the West and Northeast Atlantic, because the continuous utilization of 2003 year class in the both areas has been observed (Kimoto *et al*., 2013a and 2013b). These studies also noted that the CPUEs in the recent years substantially changed longline operations and resulted in their highly concentrated and limited catch pattern in time and space, due to the high CPUEs, small quota for each vessel, and the introduction of IQ system voluntarily since 2008FY (August 2007). Since August 2008, Fishery Agency of Japan started to collect the weight of all of the individual bluefin tuna caught by the Japanese longliners (Japan, 2011). Using these data and logbook data, the catch were roughly divided into three categories: 2003, the older, and the younger year classes and each nominal CPUE was calculated. The rough criteria in round weight to distinguish 2003 year class in each fishing year was used as follows: 30-75kg in 2009FY, 60-105 kg in 2010FY, 80-145 kg in 2011FY, 100-180 kg in 2012FY, and 120-210 kg in 2013FY. The nominal CPUE by stock, fishing year, and category was calculated as the number of bluefin tuna divided by the total hooks (in the thousands) in the fishing year, and the data set using the same data manner (the months and the areas) with the standardization described above.

## 3. Results and discussion

***Updated standardized CPUE to 2012FY***

Results of type III test for positive catch ratio (1st step) and CPUE of positive catch (2nd step) in the final model were shown in **Table 4**. The variables of main and branch line materials among the considered main effects were not significant for the West and Northeast Atlantic. They were excluded in the 1st and 2nd steps for these areas.

Residual patterns of positive CPUE in the 2nd step were slightly skewed to the right in these areas (**Figure 4**). Additionally, the residual distribution in the Northeast Atlantic had two modes. There were large annual fluctuations in observed and predicted proportions of positive catch in the West Atlantic (**Figure 4**), while the proportions in the Northeast Atlantic showed less fluctuations compared to that in the West.

Observed CPUE of positive catch in the West Atlantic fluctuated without any trend during 1976-2012FY, and it jumped up sharply in 2007 and 2011FYs in the West (**Figure 4**). On the other hand, the CPUE in the Northeast Atlantic were stable until 2008FY except for 1996FY, and demonstrated an upward trend in the recent four years to 2012FY.

Standardized CPUE based on the Least Square Mean are shown in **Figure 5** and **Table 6**. In the West Atlantic, the abundance indices showed gradual decline with large fluctuations from 1976FY to the mid-1980s, having reached the lowest in 1986FY. It recovered since then and showed relatively stable until the mid-2000s except for the sudden increase in 1996FY. It exhibited an increase after 2005FY with large fluctuations. In 2007, 2009, 2011 and 2012FYs, they showed very high levels. Relatively smaller-sized fish (135-150cm in fork length, 50-60kg) were abundant in 2009 and 2011FYs in the catches off Canada (**Figures 1 and 2**, areas 18-19) in January, which were similar to 2007FY (Kimoto *et al*., 2011a). This is well shown in the size and age composition data (**Figures 6 and 7**) of bluefin caught by Japanese longline, collected by Fishery Agency of Japan since 2009FY. In addition, the jump of the CPUEs in 2011 and 2012 FYs was also due to the good catch of medium-sized fish (165-185cm, 95-120kg in 2011FY, and 180-200cm, 115-165kg in 2012FY) from October to January, which was a similar size range appeared in the Northeast fishing ground between October and November. The large difference and the opposite trend in 2012FY were considered to be of less concern, because the magnitude of 2012FY CPUE (**Figure 4**) in the west fish was large but it remains within the range of variations of constant CV of lognormal error (normal error in the log-scale) (**Figure 8**). The sharp decline in the CPUEs in 2010FY was mainly because of many zero catch data (**Figure 4**). This may be related to a good catch rate of bigeye tuna, particularly in 2010FY, and that some vessels targeted bigeye rather than bluefin. The low CPUE in 2010FY were also caused by the shift of main fishing ground to south (25-35°N and 65-75°W) part of which was outside of the defined area to which CPUE was standardized, and hence large portion of data are not included in the analyses.

In the West Atlantic, the fishing ground changed substantially between years, and the area of the fishing ground shrank in recent years (**Figure 1**). There characteristics appeared since 2008FY when the fishermen's association introduced IQ system, and became more significant since 2010FY, when the IQ system was officially applied by law while the total TAC has gradually reduced. The fishing operation normally started in November before the IQ system, but since 2010FY the fishermen's strategy was changed and nearly half of their operations were mostly occurred in the period between August and October by targeting both bigeye and bluefin tuna in the fishing year (**Figure 9**). Therefore, development of new separate CPUE time series which start in August may be recommended.

The CPUE series in the West Atlantic sometimes detected high abundance of relatively small-sized fish (135-150cm, 50-60kg: **Figure 6**). Moreover, the nominal CPUE values of some sets since 2011FY in the West area were as high as those observed in the Northeast, and the size range of fish in the main fishing area and season (40-45°N, 45-55°W, November and December) being similar to the Northeast Atlantic (50-60°N and 15-35°W, October to November), especially in 2012FY (**Figure 10**). These findings possibly suggested migration of fish from the east stock into the western of the stock boundary. However, the possibility of simultaneous appearance of a strong year class of 2003 in the west stock as in the east stock cannot be rejected.

The Northeast Atlantic, north of 40°N (Areas 31-34 in **Figure 3**) was exploited by the Japanese longline fleet around 1990, and this fishing ground has been constantly exploited since then, i.e. for more than 20 years. Especially in recent years, the Japanese longline concentrated its activities in this area, while there were hardly any operations in the south of 40°N including the Mediterranean Sea. It seems that this pattern would be maintained. Therefore, the abundance index in the Northeast Atlantic would become more valuable for the stock assessment of the east stock.

In the Northeast Atlantic, overall abundance indices showed a slight increasing trend since 1990FY (**Figure 5**). The high value was observed in 1996FY and decreased thereafter and remained at the average level since 1999FY until 2005FY. It started increasing again in 2009FY and reached the highest value in the latest fishing year of analysis, 2012FY. In the recent years, the high CPUEs were observed in October and November, in the northern areas: 50-60°N and 15-35°W (**Figure 1**), where and when the most of the operations are concentrated, because the fish of high quality and value are available. Interestingly, the longline catch since 2010FY were consisted mainly of 2003 year class (**Figures 6 and 7**), while they already appeared in 2009FY catch. The similar result was observed in the analyses, which used roughly only 2003 year class data (exploratory CPUE: **Figure 14**). Recruitment of the strong 2003 year class to this fishery contributed to the increase in the longline CPUE in that area. This strong year class showed up for the first time in the Japanese longline catches in 2009FY and thereafter (**Figures 6 and 7**). It might suggest that younger bluefin is not fully available in the northern fishing ground (north of 50°N). It would be very helpful to understand their migration pattern by age and this issue e.g. by encouraging more electronic tagging studies. At the same time, the introduction of strict IQ system by law possibly has affected the skippers' behavior and efficiency, having also probably contributed this increase of the CPUEs. Further study would be needed.

In the recent years, the fishing grounds changed or shrank (**Figure 1**) due to the introduction of IQ system for Japanese longline vessels, and/or the small quota, high CPUE, and increment of average weight in catch related to the growth of 2003 year class, having resulted in the extremely shortened fishing season, especially in the Northeast Atlantic (**Figure 11**). Since the 2012FY, these conditions became even more significant, showing the extremely high CPUE. Under current small quota, the continuity of the high CPUEs will remain the total fishing efforts reduced substantially and will result in the limited temporal/spacious coverage of efforts. It is possible that the representativeness of the CPUE series of stock abundance may have changed, and the uncertainty in the stock assessment results could be increased. It may be desirable to separate the CPUE series into different time blocks at the introduction of the IQ system. Additionally, if age-specific CPUE series could be developed, they might help understanding the observed fluctuations in CPUE.

The good CPUEs were observed in other fisheries (Anon. 2013) both in the West and East Atlantic. The bluefin currently utilized by the Japanese longliners in the Northeast Atlantic, 2003 year class, will migrate into the spawning areas. The similar phenomenon may affect their CPUE series targeting large fish, and the careful attention would be necessary.

***Exploratory CPUE series***

*Updated standardized CPUE to 2013FY*

The standardized CPUE in the West Atlantic was updated up to 2013FY and provided in **Figure 12**, whereas the model for the Northeast Atlantic was not converged and its nominal CPUE was shown in **Figure 13**.

In the West Atlantic, the observed and the estimated CPUEs showed also high levels in 2013FY. These CPUEs in logarithmic scale were similar (**Figure 8**). As described above, these high CPUEs since 2011FY were mainly due to the good catch of medium size fish (165-185cm in 2011FY, 180-200cm in 2012FY, and 190-220cm in 2013FY) from October to January, which was a similar size range, appeared in the Northeast fishing ground between October and November. These good catches were produced in the areas 19 and 20 (40-45°N, 45-55°W) in **Figure 2**, and these fish were speculated to be same school which migrated from the Northeast fishing ground from their captured month and the sizes. These high CPUEs would be continued as far as a small quota continues and the 2003 strong year class continues to contribute to the catch.

In the Northeast Atlantic, substantially high nominal CPUE observed in 2012FY was remained in 2013FY, and the 2003 year class again dominated catches (**Figures 6 and 7**). The increasing trend of CPUE in the Northeast Atlantic was stopped and was slightly decreased in 2013FY. Even if the future CPUE already started to decline, it could be expected that it also remain high level if Japanese longliners continue to utilize mainly the 2003 year class.

*Nominal CPUE of 2003 year class, and the older and the younger year classes*

As the size data of Japanese longline catches have been improved since 2009FY (100% coverage), and hence the age-based CPUE are possible for recent periods. This is the first trial to roughly examine the trend of CPUE by year class, thus only nominal CPUEs were provided for the 2003 year class and the older and the younger year classes both in the West and Northeast Atlantic.

In the West Atlantic, the overall CPUE (**Figures 5 and 12**) mainly consisted by 2003 and the younger year classes, which also contributed to the highly fluctuated CPUE (**Figure 14**), as already explained above. The CPUE for the younger year classes detected relatively good recruitment in 2011FY, and also showed the increase in 2013FY. It would be good to monitor these year classes in the future CPUE, and Japanese longline CPUE might show some references about the strength of the year class.

In the Northeast Atlantic, the overall CPUE trend was similar to those for the 2003 year classes. This was already pointed out that this year class were already appeared in 2009FY and the main size of the catches chiefly consisted by this year class since 2011FY. The 2003 year class in the Japanese Northeast fishing ground will migrate into the spawning areas, and would gradually contribute to the other fisheries which target larger fish both in the West and East stocks. In the case of east stock, it would be beneficial to explore signals of the 2003 year class from size compositions of fisheries in the eastern Atlantic and Mediterranean Sea, as shown in **Figure 6** for Japanese longline in this study. It is encouraged to continue to collect and monitor the size information of the catch in each fishery. However, current high CPUEs possibly may not fully detect the year class under the shortened fishing period with the current national quotas.

The CPUE for the younger year class showed small increase in 2013FY. Similar to the West CPUE, it would help to understand the magnitude of the year class by monitoring the future CPUE, and the study analyzing 2003 year class would be also helpful to decide the magnitude of year class at their early age. Japanese longliners catch over 30kg in the North Atlantic, and their CPUE sometimes catch some high recruitment sign when the fish is about 4-5 age. It also can be preferable to compare those indices to the CPUEs in the Mediterranean Sea and Bay of Biscay for the east stock, and in the Gulf of Mexico and Mid-Atlantic Bight for the west stock for the better understanding of Atlantic bluefin tuna. This study showed the first trial to examine the trend of CPUE by year class for Japanese longline fishery, and this will be improved in the future study. It is considered that these CPUE will contribute as a good indicator that reflect the abundance, and contribute to reduce uncertainty of the stock assessment.

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**Table 1.** Number of longline sets by various strata for the West Atlantic CPUE standardization. Observations were aggregated by month, area (prefixed by A), materials of main line (M1=others, M2=nylon) and branch line (F1=others, F2=nylon), number of hooks between floats (prefixed by B). Area definition is shown in **Figure 2**. Year is fishing year (2013 means August 2012 to March 2013).

| Year | Nov | Dec | Jan | Feb | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | 347 | 322 | 266 | 208 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 163 | 196 | 2 | 0 | 0 | 0 | 14 | 268 | 19 |
| 1977 | 534 | 522 | 519 | 212 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 10 | 82 | 507 | 155 | 0 | 0 | 0 | 5 | 79 | 195 |
| 1978 | 516 | 559 | 377 | 45 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 3 | 202 | 238 | 94 | 0 | 2 | 0 | 5 | 24 | 184 |
| 1979 | 755 | 680 | 749 | 179 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 19 | 239 | 773 | 122 | 0 | 19 | 11 | 9 | 105 | 472 |
| 1980 | 824 | 777 | 683 | 170 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 254 | 113 | 54 | 0 | 3 | 3 | 56 | 898 |
| 1981 | 1513 | 1512 | 902 | 341 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 237 | 404 | 338 | 220 | 10 | 3 | 6 | 191 | 825 |
| 1982 | 1753 | 846 | 206 | 116 | 0 | 2 | 1 | 3 | 1 | 0 | 0 | 0 | 337 | 213 | 144 | 52 | 0 | 0 | 1 | 46 | 68 |
| 1983 | 891 | 694 | 623 | 504 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 151 | 173 | 235 | 10 | 0 | 0 | 0 | 50 | 1059 |
| 1984 | 629 | 624 | 572 | 212 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 | 188 | 71 | 9 | 1 | 2 | 0 | 56 | 969 |
| 1985 | 723 | 851 | 655 | 344 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 279 | 55 | 5 | 0 | 1 | 1 | 187 | 566 |
| 1986 | 688 | 641 | 551 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 129 | 85 | 5 | 36 | 11 | 0 | 23 | 326 |
| 1987 | 897 | 944 | 710 | 42 | 0 | 30 | 11 | 0 | 21 | 7 | 0 | 0 | 6 | 297 | 287 | 1 | 0 | 0 | 0 | 170 | 669 |
| 1988 | 891 | 869 | 651 | 364 | 0 | 1 | 0 | 0 | 0 | 10 | 0 | 0 | 27 | 458 | 507 | 41 | 11 | 0 | 0 | 311 | 786 |
| 1989 | 804 | 1051 | 521 | 247 | 0 | 0 | 1 | 126 | 333 | 51 | 0 | 0 | 3 | 170 | 338 | 6 | 0 | 0 | 0 | 126 | 412 |
| 1990 | 663 | 782 | 766 | 296 | 0 | 0 | 5 | 57 | 294 | 81 | 0 | 0 | 0 | 63 | 171 | 37 | 15 | 0 | 0 | 59 | 462 |
| 1991 | 516 | 479 | 502 | 154 | 0 | 0 | 0 | 17 | 33 | 118 | 4 | 0 | 0 | 9 | 18 | 40 | 5 | 0 | 0 | 103 | 348 |
| 1992 | 310 | 667 | 392 | 2 | 0 | 0 | 0 | 0 | 41 | 21 | 3 | 0 | 0 | 6 | 9 | 1 | 10 | 0 | 0 | 16 | 172 |
| 1993 | 664 | 622 | 343 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 2 | 0 | 0 | 0 | 13 | 352 |
| 1994 | 336 | 574 | 533 | 92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 9 | 9 | 26 | 0 | 0 | 6 | 308 |
| 1995 | 235 | 217 | 112 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 3 | 0 | 1 | 0 | 0 | 220 |
| 1996 | 38 | 371 | 70 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 24 | 52 |
| 1997 | 73 | 613 | 133 | 0 | 0 | 0 | 0 | 0 | 6 | 34 | 28 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 0 | 7 | 58 |
| 1998 | 31 | 746 | 375 | 33 | 0 | 0 | 17 | 0 | 26 | 5 | 0 | 0 | 0 | 8 | 79 | 1 | 3 | 30 | 0 | 0 | 154 |
| 1999 | 316 | 585 | 244 | 127 | 0 | 0 | 3 | 90 | 91 | 40 | 74 | 0 | 0 | 0 | 1 | 4 | 2 | 3 | 0 | 0 | 14 |
| 2000 | 347 | 565 | 201 | 153 | 0 | 0 | 0 | 23 | 93 | 31 | 112 | 0 | 0 | 2 | 5 | 0 | 0 | 1 | 0 | 1 | 166 |
| 2001 | 190 | 672 | 221 | 134 | 0 | 0 | 1 | 67 | 209 | 117 | 140 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 1 |
| 2002 | 638 | 837 | 320 | 395 | 0 | 22 | 7 | 96 | 245 | 390 | 140 | 0 | 0 | 27 | 29 | 0 | 7 | 10 | 0 | 0 | 14 |
| 2003 | 163 | 442 | 57 | 106 | 0 | 82 | 10 | 5 | 125 | 37 | 86 | 0 | 0 | 0 | 0 | 0 | 3 | 13 | 0 | 0 | 2 |
| 2004 | 41 | 156 | 461 | 167 | 0 | 72 | 2 | 52 | 137 | 72 | 27 | 0 | 0 | 30 | 42 | 5 | 1 | 0 | 0 | 0 | 18 |
| 2005 | 10 | 214 | 790 | 761 | 5 | 195 | 0 | 107 | 135 | 108 | 28 | 0 | 0 | 543 | 124 | 5 | 1 | 5 | 0 | 20 | 42 |
| 2006 | 0 | 136 | 561 | 368 | 18 | 121 | 4 | 73 | 180 | 136 | 32 | 0 | 0 | 38 | 165 | 2 | 0 | 0 | 0 | 1 | 119 |
| 2007 | 6 | 83 | 132 | 149 | 42 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 21 | 7 | 1 | 0 | 0 | 0 | 6 |
| 2008 | 0 | 55 | 143 | 40 | 81 | 121 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 12 |
| 2009 | 6 | 18 | 18 | 0 | 4 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| 2010 | 89 | 51 | 6 | 0 | 1 | 34 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 99 | 100 | 84 | 2 | 11 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2012 | 102 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | 121 | 108 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 16759 | 20039 | 14453 | 6070 | 171 | 823 | 74 | 717 | 1970 | 1258 | 676 | 32 | 1670 | 5100 | 3268 | 520 | 155 | 97 | 44 | 1942 | 9973 |

**Table 1.** Continued.

| Year | A18 | A19 | A20 | A21 | A22 | A23 | A24 | M1 | M2 | F1 | F2 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1976 | 7 | 442 | 19 | 0 | 0 | 3 | 0 | 1143 | 0 | 1143 | 0 | 971 | 172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1143 |
| 1977 | 166 | 509 | 74 | 0 | 0 | 0 | 0 | 1787 | 0 | 1787 | 0 | 1474 | 313 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1787 |
| 1978 | 54 | 677 | 8 | 0 | 0 | 1 | 0 | 1497 | 0 | 1497 | 0 | 1399 | 95 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 1497 |
| 1979 | 83 | 474 | 35 | 0 | 0 | 0 | 0 | 2363 | 0 | 2363 | 0 | 1938 | 378 | 28 | 0 | 0 | 19 | 0 | 0 | 0 | 2363 |
| 1980 | 563 | 397 | 16 | 0 | 0 | 0 | 0 | 2454 | 0 | 2454 | 0 | 1989 | 384 | 50 | 28 | 0 | 3 | 0 | 0 | 0 | 2454 |
| 1981 | 545 | 1250 | 210 | 0 | 0 | 0 | 29 | 4268 | 0 | 4268 | 0 | 2650 | 998 | 278 | 94 | 107 | 141 | 0 | 0 | 0 | 4268 |
| 1982 | 201 | 1519 | 322 | 0 | 0 | 0 | 11 | 2921 | 0 | 2921 | 0 | 1223 | 811 | 180 | 116 | 135 | 317 | 99 | 40 | 0 | 2921 |
| 1983 | 186 | 778 | 47 | 0 | 0 | 0 | 22 | 2712 | 0 | 2712 | 0 | 906 | 1301 | 117 | 174 | 0 | 209 | 0 | 5 | 0 | 2712 |
| 1984 | 267 | 337 | 86 | 0 | 0 | 0 | 6 | 2037 | 0 | 2037 | 0 | 432 | 1345 | 144 | 20 | 6 | 65 | 19 | 6 | 0 | 2037 |
| 1985 | 183 | 1060 | 164 | 0 | 0 | 1 | 2 | 2573 | 0 | 2573 | 0 | 43 | 1414 | 987 | 0 | 25 | 6 | 3 | 46 | 49 | 2573 |
| 1986 | 67 | 977 | 236 | 0 | 0 | 0 | 19 | 1933 | 0 | 1933 | 0 | 21 | 742 | 831 | 198 | 0 | 59 | 5 | 0 | 77 | 1933 |
| 1987 | 251 | 662 | 161 | 0 | 0 | 2 | 18 | 2593 | 0 | 2593 | 0 | 26 | 1083 | 1279 | 138 | 10 | 30 | 0 | 27 | 0 | 2593 |
| 1988 | 258 | 344 | 11 | 0 | 0 | 0 | 10 | 2775 | 0 | 2775 | 0 | 5 | 115 | 2326 | 275 | 0 | 14 | 0 | 10 | 30 | 2775 |
| 1989 | 413 | 504 | 113 | 0 | 0 | 1 | 26 | 2623 | 0 | 2623 | 0 | 0 | 383 | 1777 | 270 | 14 | 108 | 21 | 50 | 0 | 2623 |
| 1990 | 515 | 575 | 128 | 0 | 0 | 0 | 45 | 2507 | 0 | 2507 | 0 | 0 | 383 | 1961 | 132 | 0 | 17 | 0 | 14 | 0 | 2507 |
| 1991 | 152 | 600 | 121 | 0 | 0 | 11 | 72 | 1651 | 0 | 1651 | 0 | 15 | 147 | 1165 | 277 | 0 | 1 | 1 | 0 | 45 | 1651 |
| 1992 | 215 | 583 | 150 | 0 | 1 | 1 | 142 | 1371 | 0 | 1371 | 0 | 0 | 219 | 830 | 279 | 26 | 14 | 0 | 0 | 3 | 1371 |
| 1993 | 378 | 849 | 67 | 0 | 0 | 0 | 12 | 1682 | 0 | 1682 | 0 | 36 | 295 | 1066 | 208 | 25 | 46 | 0 | 6 | 0 | 1682 |
| 1994 | 245 | 629 | 282 | 0 | 0 | 0 | 4 | 1524 | 11 | 1463 | 72 | 25 | 175 | 1048 | 197 | 76 | 0 | 0 | 14 | 0 | 1535 |
| 1995 | 92 | 145 | 75 | 0 | 0 | 0 | 4 | 510 | 55 | 378 | 187 | 33 | 2 | 191 | 207 | 76 | 28 | 28 | 0 | 0 | 565 |
| 1996 | 15 | 138 | 177 | 0 | 0 | 0 | 49 | 151 | 328 | 192 | 287 | 0 | 15 | 127 | 237 | 91 | 9 | 0 | 0 | 0 | 479 |
| 1997 | 29 | 250 | 186 | 0 | 0 | 0 | 215 | 109 | 710 | 195 | 624 | 1 | 22 | 166 | 344 | 131 | 53 | 68 | 0 | 34 | 819 |
| 1998 | 38 | 224 | 354 | 0 | 0 | 0 | 246 | 156 | 1029 | 163 | 1022 | 0 | 0 | 322 | 645 | 85 | 101 | 32 | 0 | 0 | 1185 |
| 1999 | 23 | 357 | 388 | 0 | 0 | 0 | 182 | 76 | 1196 | 193 | 1079 | 0 | 59 | 129 | 855 | 47 | 108 | 0 | 53 | 21 | 1272 |
| 2000 | 48 | 493 | 235 | 0 | 0 | 0 | 56 | 39 | 1227 | 83 | 1183 | 0 | 3 | 120 | 639 | 256 | 116 | 51 | 33 | 48 | 1266 |
| 2001 | 3 | 270 | 112 | 0 | 0 | 1 | 293 | 6 | 1211 | 19 | 1198 | 0 | 6 | 133 | 808 | 61 | 162 | 20 | 20 | 7 | 1217 |
| 2002 | 14 | 314 | 230 | 0 | 0 | 0 | 645 | 70 | 2120 | 168 | 2022 | 0 | 0 | 60 | 1398 | 369 | 205 | 2 | 127 | 29 | 2190 |
| 2003 | 5 | 108 | 209 | 0 | 0 | 0 | 83 | 0 | 768 | 0 | 768 | 0 | 0 | 26 | 333 | 259 | 85 | 1 | 64 | 0 | 768 |
| 2004 | 10 | 64 | 273 | 0 | 0 | 0 | 20 | 79 | 746 | 32 | 793 | 0 | 0 | 105 | 442 | 231 | 47 | 0 | 0 | 0 | 825 |
| 2005 | 91 | 172 | 194 | 0 | 0 | 0 | 0 | 66 | 1709 | 229 | 1546 | 0 | 2 | 12 | 704 | 923 | 73 | 0 | 32 | 29 | 1775 |
| 2006 | 17 | 73 | 72 | 0 | 0 | 0 | 14 | 18 | 1047 | 117 | 948 | 0 | 0 | 2 | 471 | 431 | 96 | 0 | 48 | 17 | 1065 |
| 2007 | 63 | 77 | 6 | 0 | 0 | 0 | 2 | 0 | 370 | 46 | 324 | 0 | 0 | 0 | 141 | 203 | 26 | 0 | 0 | 0 | 370 |
| 2008 | 3 | 11 | 7 | 0 | 0 | 0 | 1 | 43 | 195 | 53 | 185 | 0 | 0 | 0 | 22 | 216 | 0 | 0 | 0 | 0 | 238 |
| 2009 | 1 | 11 | 1 | 0 | 0 | 0 | 6 | 4 | 38 | 4 | 38 | 0 | 0 | 0 | 28 | 12 | 2 | 0 | 0 | 0 | 42 |
| 2010 | 30 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 146 | 0 | 146 | 0 | 0 | 0 | 101 | 37 | 8 | 0 | 0 | 0 | 146 |
| 2011 | 3 | 177 | 67 | 0 | 0 | 0 | 0 | 0 | 285 | 0 | 285 | 0 | 0 | 0 | 78 | 207 | 0 | 0 | 0 | 0 | 285 |
| 2012 | 2 | 103 | 51 | 0 | 0 | 0 | 0 | 0 | 156 | 0 | 156 | 0 | 0 | 0 | 105 | 51 | 0 | 0 | 0 | 0 | 156 |
| 2013 | 0 | 108 | 119 | 0 | 0 | 0 | 6 | 0 | 233 | 0 | 233 | 0 | 0 | 0 | 126 | 107 | 0 | 0 | 0 | 0 | 233 |
| Total | 5236 | 16327 | 5006 | 0 | 1 | 21 | 2240 | 43741 | 13580 | 44225 | 13096 | 13187 | 10862 | 15460 | 10090 | 4217 | 2171 | 350 | 595 | 389 | 57321 |

**Table 2.** Number of longline sets by various strata for the Northeast Atlantic CPUE standardization. Observations were aggregated by month, area (prefixed by A), materials of main line (M1=others, M2=nylon) and branch line (F1=others, F2=nylon), number of hooks between floats (prefixed by B). Area definition is shown in **Figure 2**. Year is fishing year.

| Year | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | A31 | A32 | A33 | A34 | A35 | M1 | M2 | F1 | F2 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 0 | 0 | 21 | 136 | 245 | 155 | 56 | 6 | 613 | 0 | 6 | 0 | 0 | 619 | 0 | 619 | 0 | 0 | 6 | 304 | 230 | 38 | 30 | 11 | 0 | 0 | 619 |
| 1991 | 0 | 32 | 233 | 734 | 1100 | 312 | 86 | 25 | 2519 | 0 | 3 | 0 | 0 | 2522 | 0 | 2522 | 0 | 0 | 85 | 887 | 920 | 373 | 78 | 107 | 55 | 17 | 2522 |
| 1992 | 0 | 58 | 724 | 1738 | 1289 | 477 | 103 | 11 | 4288 | 97 | 15 | 0 | 0 | 4400 | 0 | 4400 | 0 | 79 | 170 | 2149 | 1409 | 443 | 34 | 91 | 0 | 25 | 4400 |
| 1993 | 16 | 341 | 1219 | 1366 | 869 | 323 | 39 | 0 | 1250 | 2592 | 77 | 254 | 0 | 4173 | 0 | 4173 | 0 | 29 | 93 | 3421 | 473 | 22 | 26 | 30 | 6 | 73 | 4173 |
| 1994 | 0 | 24 | 458 | 902 | 738 | 350 | 116 | 8 | 1438 | 1157 | 1 | 0 | 0 | 2575 | 21 | 2486 | 110 | 0 | 16 | 2079 | 365 | 5 | 0 | 0 | 0 | 131 | 2596 |
| 1995 | 0 | 105 | 282 | 646 | 459 | 108 | 18 | 0 | 254 | 259 | 232 | 873 | 0 | 1270 | 348 | 827 | 791 | 0 | 68 | 740 | 419 | 278 | 113 | 0 | 0 | 0 | 1618 |
| 1996 | 61 | 610 | 1227 | 910 | 233 | 0 | 0 | 0 | 245 | 454 | 3 | 2339 | 0 | 932 | 2109 | 980 | 2061 | 0 | 0 | 156 | 1625 | 1065 | 195 | 0 | 0 | 0 | 3041 |
| 1997 | 122 | 2044 | 1660 | 1555 | 3 | 0 | 0 | 0 | 800 | 1062 | 45 | 3477 | 0 | 885 | 4499 | 1141 | 4243 | 0 | 0 | 249 | 3004 | 1946 | 184 | 1 | 0 | 0 | 5384 |
| 1998 | 651 | 1469 | 2296 | 1846 | 6 | 0 | 0 | 0 | 248 | 928 | 8 | 5020 | 64 | 675 | 5593 | 719 | 5549 | 0 | 59 | 5 | 4350 | 1683 | 166 | 2 | 2 | 1 | 6268 |
| 1999 | 1163 | 1774 | 1878 | 614 | 90 | 3 | 0 | 0 | 177 | 692 | 4 | 4330 | 319 | 383 | 5139 | 961 | 4561 | 0 | 1 | 183 | 2452 | 2787 | 52 | 47 | 0 | 0 | 5522 |
| 2000 | 877 | 1510 | 1836 | 1594 | 1149 | 10 | 0 | 0 | 1802 | 939 | 79 | 3974 | 182 | 561 | 6415 | 483 | 6493 | 0 | 1 | 76 | 2685 | 3955 | 254 | 4 | 0 | 1 | 6976 |
| 2001 | 637 | 1230 | 1685 | 1679 | 105 | 88 | 49 | 59 | 741 | 1282 | 15 | 3447 | 47 | 297 | 5235 | 326 | 5206 | 0 | 0 | 49 | 2052 | 3128 | 196 | 31 | 5 | 71 | 5532 |
| 2002 | 473 | 1063 | 1623 | 806 | 67 | 23 | 21 | 7 | 908 | 678 | 22 | 2357 | 118 | 188 | 3895 | 415 | 3668 | 0 | 0 | 0 | 620 | 3307 | 143 | 3 | 10 | 0 | 4083 |
| 2003 | 270 | 941 | 1390 | 949 | 14 | 0 | 0 | 0 | 99 | 141 | 39 | 3255 | 30 | 125 | 3439 | 194 | 3370 | 0 | 1 | 1 | 333 | 2957 | 272 | 0 | 0 | 0 | 3564 |
| 2004 | 591 | 1233 | 1611 | 1513 | 1160 | 16 | 0 | 0 | 331 | 310 | 866 | 4615 | 2 | 420 | 5704 | 360 | 5764 | 0 | 0 | 1 | 706 | 4618 | 670 | 124 | 5 | 0 | 6124 |
| 2005 | 262 | 1113 | 1723 | 1947 | 1427 | 117 | 0 | 2 | 713 | 135 | 2569 | 3174 | 0 | 362 | 6229 | 604 | 5987 | 0 | 7 | 2 | 392 | 5231 | 910 | 49 | 0 | 0 | 6591 |
| 2006 | 256 | 826 | 1502 | 1514 | 1100 | 52 | 3 | 0 | 851 | 375 | 979 | 3048 | 0 | 226 | 5027 | 592 | 4661 | 0 | 0 | 0 | 366 | 3954 | 837 | 89 | 4 | 3 | 5253 |
| 2007 | 68 | 393 | 989 | 774 | 696 | 226 | 17 | 0 | 327 | 117 | 1396 | 1323 | 0 | 123 | 3040 | 291 | 2872 | 0 | 0 | 0 | 0 | 2943 | 220 | 0 | 0 | 0 | 3163 |
| 2008 | 51 | 482 | 790 | 665 | 539 | 204 | 5 | 0 | 313 | 48 | 848 | 1527 | 0 | 77 | 2659 | 354 | 2382 | 0 | 0 | 0 | 73 | 2639 | 24 | 0 | 0 | 0 | 2736 |
| 2009 | 186 | 731 | 864 | 846 | 384 | 33 | 0 | 0 | 444 | 534 | 229 | 1837 | 0 | 198 | 2846 | 198 | 2846 | 0 | 0 | 0 | 1 | 2712 | 325 | 6 | 0 | 0 | 3044 |
| 2010 | 0 | 217 | 789 | 429 | 46 | 1 | 0 | 0 | 23 | 87 | 5 | 1367 | 0 | 194 | 1288 | 69 | 1413 | 0 | 0 | 0 | 0 | 1373 | 109 | 0 | 0 | 0 | 1482 |
| 2011 | 0 | 16 | 488 | 173 | 0 | 0 | 0 | 0 | 1 | 95 | 0 | 581 | 0 | 79 | 598 | 59 | 618 | 0 | 0 | 0 | 0 | 633 | 44 | 0 | 0 | 0 | 677 |
| 2012 | 0 | 5 | 343 | 14 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 353 | 0 | 33 | 329 | 47 | 315 | 0 | 0 | 0 | 0 | 336 | 26 | 0 | 0 | 0 | 362 |
| 2013 | 0 | 0 | 301 | 79 | 0 | 0 | 0 | 0 | 0 | 63 | 0 | 317 | 0 | 11 | 369 | 11 | 369 | 0 | 0 | 0 | 0 | 332 | 48 | 0 | 0 | 0 | 380 |
| Total | 5684 | 16217 | 25932 | 23429 | 11719 | 2498 | 513 | 118 | 18387 | 12052 | 7441 | 47468 | 762 | 21328 | 64782 | 22831 | 63279 | 108 | 507 | 10302 | 22475 | 46758 | 4956 | 595 | 87 | 322 | 86110 |

**Table 3.** Number of longline sets by various strata for the East Atlantic CPUE. Observations were aggregated by month, area (prefixed by A), materials of main line (M1=others, M2=nylon) and branch line (F1=others, F2=nylon), number of hooks between floats (prefixed by B). Area definition is shown in **Figure 2**. Year is fishing year.

| Year | Mar | Apr | May | Jun | July | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | M1 | M2 | F1 | F2 | B4 | B5 | B6 | B7 | B8 | B9 | B10 | B11 | B12 | B13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1975 | 263 | 681 | 1433 | 218 | 235 | 789 | 1221 | 14 | 14 | 196 | 259 | 243 | 89 | 5 | 2830 | 0 | 2830 | 0 | 1620 | 958 | 252 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2830 |
| 1976 | 148 | 717 | 727 | 118 | 268 | 116 | 882 | 1 | 3 | 79 | 366 | 267 | 259 | 5 | 1978 | 0 | 1978 | 0 | 1278 | 557 | 91 | 0 | 52 | 0 | 0 | 0 | 0 | 0 | 1978 |
| 1977 | 137 | 218 | 455 | 397 | 207 | 147 | 657 | 0 | 10 | 174 | 259 | 157 | 10 | 0 | 1414 | 0 | 1414 | 0 | 909 | 265 | 229 | 6 | 0 | 0 | 5 | 0 | 0 | 0 | 1414 |
| 1978 | 317 | 307 | 205 | 129 | 12 | 340 | 216 | 4 | 33 | 308 | 21 | 44 | 4 | 0 | 970 | 0 | 970 | 0 | 500 | 31 | 77 | 179 | 5 | 46 | 132 | 0 | 0 | 0 | 970 |
| 1979 | 118 | 167 | 177 | 116 | 25 | 47 | 297 | 0 | 39 | 163 | 27 | 26 | 4 | 0 | 603 | 0 | 603 | 0 | 438 | 115 | 22 | 15 | 13 | 0 | 0 | 0 | 0 | 0 | 603 |
| 1980 | 209 | 382 | 309 | 18 | 4 | 268 | 436 | 0 | 7 | 39 | 61 | 94 | 17 | 0 | 922 | 0 | 922 | 0 | 389 | 226 | 265 | 37 | 5 | 0 | 0 | 0 | 0 | 0 | 922 |
| 1981 | 300 | 335 | 190 | 34 | 15 | 269 | 238 | 0 | 1 | 209 | 112 | 42 | 3 | 0 | 874 | 0 | 874 | 0 | 447 | 93 | 189 | 96 | 46 | 0 | 3 | 0 | 0 | 0 | 874 |
| 1982 | 78 | 323 | 585 | 481 | 327 | 27 | 172 | 16 | 43 | 944 | 327 | 261 | 4 | 0 | 1794 | 0 | 1794 | 0 | 1033 | 454 | 136 | 0 | 0 | 46 | 63 | 6 | 56 | 0 | 1794 |
| 1983 | 180 | 552 | 664 | 614 | 195 | 126 | 284 | 0 | 75 | 1287 | 195 | 225 | 13 | 0 | 2205 | 0 | 2205 | 0 | 1622 | 157 | 141 | 43 | 15 | 21 | 180 | 25 | 1 | 0 | 2205 |
| 1984 | 349 | 903 | 956 | 517 | 271 | 225 | 558 | 3 | 17 | 1294 | 306 | 486 | 83 | 24 | 2996 | 0 | 2996 | 0 | 2318 | 155 | 285 | 58 | 63 | 22 | 41 | 48 | 6 | 0 | 2996 |
| 1985 | 44 | 677 | 686 | 71 | 38 | 36 | 190 | 58 | 4 | 380 | 70 | 705 | 73 | 0 | 1516 | 0 | 1516 | 0 | 1189 | 112 | 96 | 0 | 0 | 46 | 23 | 37 | 13 | 0 | 1516 |
| 1986 | 140 | 700 | 716 | 122 | 16 | 64 | 514 | 0 | 41 | 519 | 157 | 336 | 63 | 0 | 1694 | 0 | 1694 | 0 | 1360 | 98 | 78 | 51 | 8 | 20 | 8 | 16 | 55 | 0 | 1694 |
| 1987 | 241 | 590 | 429 | 93 | 12 | 112 | 587 | 9 | 6 | 197 | 179 | 229 | 35 | 11 | 1365 | 0 | 1365 | 0 | 960 | 128 | 114 | 31 | 66 | 3 | 19 | 10 | 34 | 0 | 1365 |
| 1988 | 387 | 894 | 684 | 125 | 56 | 16 | 780 | 56 | 8 | 756 | 227 | 212 | 63 | 28 | 2146 | 0 | 2146 | 0 | 1912 | 45 | 7 | 21 | 102 | 42 | 0 | 15 | 2 | 0 | 2146 |
| 1989 | 229 | 616 | 405 | 80 | 16 | 18 | 704 | 60 | 22 | 354 | 43 | 93 | 51 | 1 | 1346 | 0 | 1346 | 0 | 1003 | 161 | 60 | 53 | 12 | 21 | 0 | 11 | 12 | 13 | 1346 |
| 1990 | 311 | 735 | 591 | 260 | 14 | 192 | 770 | 44 | 79 | 659 | 70 | 93 | 2 | 2 | 1911 | 0 | 1911 | 0 | 947 | 651 | 81 | 63 | 55 | 0 | 4 | 0 | 28 | 82 | 1911 |
| 1991 | 172 | 739 | 779 | 528 | 58 | 348 | 328 | 44 | 338 | 958 | 157 | 102 | 0 | 1 | 2276 | 0 | 2276 | 0 | 1266 | 520 | 296 | 122 | 20 | 0 | 45 | 0 | 2 | 5 | 2276 |
| 1992 | 189 | 1029 | 1113 | 969 | 259 | 762 | 208 | 31 | 550 | 1555 | 256 | 161 | 22 | 14 | 3559 | 0 | 3559 | 0 | 1998 | 663 | 545 | 245 | 80 | 0 | 0 | 3 | 22 | 3 | 3559 |
| 1993 | 208 | 787 | 708 | 475 | 134 | 750 | 49 | 46 | 323 | 701 | 66 | 203 | 115 | 59 | 2312 | 0 | 2312 | 0 | 1248 | 413 | 457 | 54 | 102 | 0 | 6 | 15 | 14 | 3 | 2312 |
| 1994 | 182 | 1134 | 1093 | 29 | 4 | 666 | 107 | 50 | 352 | 510 | 155 | 280 | 136 | 186 | 1969 | 473 | 1637 | 805 | 1512 | 668 | 232 | 13 | 16 | 0 | 0 | 0 | 1 | 0 | 2442 |
| 1995 | 216 | 1273 | 1371 | 260 | 0 | 476 | 484 | 1 | 291 | 1062 | 360 | 68 | 184 | 194 | 1784 | 1336 | 1326 | 1794 | 551 | 782 | 1459 | 114 | 171 | 0 | 6 | 0 | 37 | 0 | 3120 |
| 1996 | 349 | 1232 | 1679 | 4 | 33 | 1112 | 398 | 21 | 252 | 461 | 71 | 552 | 148 | 282 | 771 | 2526 | 655 | 2642 | 78 | 512 | 1720 | 771 | 83 | 30 | 19 | 7 | 54 | 23 | 3297 |
| 1997 | 902 | 1468 | 1056 | 15 | 0 | 1241 | 1023 | 3 | 341 | 373 | 162 | 201 | 29 | 68 | 503 | 2938 | 482 | 2959 | 0 | 72 | 711 | 2053 | 373 | 88 | 13 | 49 | 23 | 59 | 3441 |
| 1998 | 882 | 1456 | 856 | 21 | 7 | 544 | 1424 | 33 | 148 | 470 | 183 | 20 | 100 | 300 | 396 | 2826 | 484 | 2738 | 0 | 0 | 257 | 2213 | 723 | 18 | 0 | 0 | 7 | 4 | 3222 |
| 1999 | 379 | 662 | 667 | 0 | 7 | 149 | 786 | 30 | 77 | 156 | 48 | 18 | 117 | 334 | 89 | 1626 | 166 | 1549 | 0 | 19 | 172 | 1317 | 197 | 10 | 0 | 0 | 0 | 0 | 1715 |
| 2000 | 400 | 520 | 405 | 0 | 0 | 139 | 446 | 22 | 92 | 253 | 12 | 123 | 121 | 117 | 11 | 1314 | 76 | 1249 | 0 | 27 | 182 | 887 | 213 | 8 | 7 | 0 | 1 | 0 | 1325 |
| 2001 | 248 | 578 | 431 | 0 | 0 | 85 | 287 | 86 | 131 | 214 | 8 | 107 | 131 | 208 | 144 | 1113 | 81 | 1176 | 0 | 32 | 173 | 669 | 349 | 27 | 7 | 0 | 0 | 0 | 1257 |
| 2002 | 389 | 405 | 771 | 0 | 0 | 441 | 17 | 151 | 53 | 192 | 1 | 217 | 97 | 396 | 107 | 1458 | 130 | 1435 | 0 | 0 | 336 | 750 | 407 | 72 | 0 | 0 | 0 | 0 | 1565 |
| 2003 | 155 | 427 | 799 | 6 | 0 | 119 | 132 | 53 | 17 | 172 | 6 | 278 | 141 | 469 | 100 | 1287 | 100 | 1287 | 0 | 0 | 316 | 662 | 303 | 32 | 74 | 0 | 0 | 0 | 1387 |
| 2004 | 27 | 328 | 608 | 2 | 0 | 22 | 67 | 131 | 8 | 130 | 0 | 271 | 171 | 165 | 51 | 914 | 72 | 893 | 0 | 0 | 128 | 440 | 219 | 79 | 99 | 0 | 0 | 0 | 965 |
| 2005 | 323 | 750 | 979 | 1 | 1 | 234 | 373 | 79 | 21 | 211 | 262 | 412 | 462 | 0 | 165 | 1889 | 200 | 1854 | 0 | 1 | 69 | 508 | 1260 | 204 | 12 | 0 | 0 | 0 | 2054 |
| 2006 | 464 | 384 | 331 | 18 | 0 | 234 | 344 | 194 | 6 | 49 | 29 | 313 | 28 | 0 | 77 | 1120 | 128 | 1069 | 0 | 0 | 0 | 241 | 641 | 227 | 44 | 0 | 44 | 0 | 1197 |
| 2007 | 111 | 535 | 560 | 0 | 0 | 66 | 252 | 6 | 3 | 89 | 269 | 459 | 62 | 0 | 125 | 1081 | 193 | 1013 | 0 | 0 | 0 | 242 | 884 | 57 | 13 | 3 | 2 | 5 | 1206 |
| 2008 | 139 | 452 | 482 | 0 | 0 | 65 | 430 | 0 | 2 | 67 | 138 | 367 | 4 | 0 | 183 | 890 | 161 | 912 | 0 | 0 | 0 | 103 | 928 | 35 | 7 | 0 | 0 | 0 | 1073 |
| 2009 | 0 | 44 | 161 | 0 | 0 | 12 | 28 | 3 | 0 | 4 | 17 | 141 | 0 | 0 | 103 | 102 | 103 | 102 | 0 | 0 | 0 | 0 | 137 | 67 | 1 | 0 | 0 | 0 | 205 |
| 2010 | 38 | 69 | 0 | 0 | 0 | 103 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 95 | 4 | 103 | 0 | 0 | 0 | 0 | 4 | 28 | 8 | 47 | 20 | 0 | 107 |
| 2011 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| 2012 | 11 | 3 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 6 | 8 | 0 | 0 | 0 | 14 |
| 2013 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 9240 | 23072 | 24061 | 5721 | 2214 | 10379 | 15693 | 1249 | 3407 | 15185 | 4879 | 7806 | 2841 | 2869 | 41301 | 23007 | 40709 | 23599 | 24578 | 7915 | 9176 | 12057 | 7552 | 1260 | 847 | 292 | 434 | 197 | 64308 |

**Table 4.** Statistical results from GLMM analysis for positive catch ratio (1st step) and CPUE of positive catch (2nd step) in the final model for the updated standardized CPUEs to 2012FY.

**West Atlantic**

Type 3 test of fixed effect for proportion of positive catch

| Effect | Num. DF | Den. DF | Chi-square | F Value | Pr > ChiSq | Pr > F |
|---|---|---|---|---|---|---|
| year | 36 | 503 | 136.23 | 3.78 | <.0001 | <.0001 |
| month | 3 | 503 | 137.19 | 45.73 | <.0001 | <.0001 |
| area | 4 | 503 | 129.83 | 32.46 | <.0001 | <.0001 |
| nhbf | 8 | 944 | 190.79 | 23.85 | <.0001 | <.0001 |

Type 3 test of fixed effect for LogCPUE with positive

| Effect | Num. DF | Den. DF | F Value | Pr > F |
|---|---|---|---|---|
| year | 36 | 419 | 2.92 | <.0001 |
| month | 3 | 419 | 86.26 | <.0001 |
| area | 4 | 419 | 8.03 | <.0001 |
| nhbf | 8 | 30000 | 15.91 | <.0001 |

**Northeast Atlantic**

Type 3 test of fixed effect for proportion of positive catch

| Effect | Num. DF | Den. DF | Chi-square | F Value | Pr > ChiSq | Pr > F |
|---|---|---|---|---|---|---|
| year | 22 | 219 | 220.33 | 10.01 | <.0001 | <.0001 |
| month | 3 | 219 | 153.82 | 51.27 | <.0001 | <.0001 |
| area | 3 | 219 | 30.52 | 10.17 | <.0001 | <.0001 |
| nhbf | 1 | 136 | 10.12 | 10.12 | 0.0015 | 0.0018 |

Type 3 test of fixed effect for LogCPUE with positive

| Effect | Num. DF | Den. DF | F Value | Pr > F |
|---|---|---|---|---|
| year | 22 | 210 | 10.34 | <.0001 |
| month | 3 | 210 | 35.03 | <.0001 |
| area | 3 | 210 | 1.63 | 0.1844 |
| nhbf | 1 | 65000 | 18.01 | <.0001 |

**Table 5.** Statistical results from GLMM analysis for positive catch ratio (1st step) and CPUE of positive catch (2nd step) in the final model for the standardized CPUE in the West Atlantic to 2013FY.

Type 3 test of fixed effect for proportion of positive catch

| Effect | Num. DF | Den. DF | Chi-square | F Value | Pr > ChiSq | Pr > F |
|---|---|---|---|---|---|---|
| year | 37 | 509 | 143.41 | 3.88 | <.0001 | <.0001 |
| month | 3 | 509 | 138.66 | 46.22 | <.0001 | <.0001 |
| area | 4 | 509 | 130.8 | 32.7 | <.0001 | <.0001 |
| nhbf | 8 | 947 | 191.88 | 23.99 | <.0001 | <.0001 |

Type 3 test of fixed effect for LogCPUE with positive

| Effect | Num. DF | Den. DF | F Value | Pr > F |
|---|---|---|---|---|
| year | 37 | 422 | 3 | <.0001 |
| month | 3 | 422 | 87.62 | <.0001 |
| area | 4 | 422 | 8.26 | <.0001 |
| nhbf | 8 | 30000 | 15.91 | <.0001 |

**Table 6.** Nominal CPUE, number of sets, and abundance index statistics for the updated standardized CPUE to 2012FY in the West and Northeast Atlantic.

**West Atlantic**

| Year | Sets | Nominal CPUE | Lower 95% CI | Upper 95% CI | Std. CPUE | CV |
|---|---|---|---|---|---|---|
| 1976 | 1143 | 3.162 | 0.058 | 0.306 | 0.576 | 0.434 |
| 1977 | 1787 | 6.412 | 0.337 | 0.791 | 2.233 | 0.216 |
| 1978 | 1497 | 4.091 | 0.141 | 0.440 | 1.078 | 0.290 |
| 1979 | 2363 | 1.311 | 0.103 | 0.282 | 0.739 | 0.255 |
| 1980 | 2454 | 2.335 | 0.215 | 0.492 | 1.405 | 0.209 |
| 1981 | 4268 | 2.996 | 0.310 | 0.575 | 1.826 | 0.155 |
| 1982 | 2921 | 0.694 | 0.095 | 0.252 | 0.668 | 0.249 |
| 1983 | 2712 | 1.036 | 0.051 | 0.176 | 0.411 | 0.316 |
| 1984 | 2037 | 1.722 | 0.145 | 0.341 | 0.962 | 0.216 |
| 1985 | 2573 | 2.924 | 0.172 | 0.392 | 1.122 | 0.209 |
| 1986 | 1933 | 0.399 | 0.006 | 0.059 | 0.084 | 0.604 |
| 1987 | 2593 | 1.835 | 0.102 | 0.289 | 0.741 | 0.265 |
| 1988 | 2775 | 2.109 | 0.172 | 0.388 | 1.118 | 0.205 |
| 1989 | 2623 | 1.145 | 0.142 | 0.332 | 0.939 | 0.214 |
| 1990 | 2507 | 1.072 | 0.111 | 0.290 | 0.776 | 0.243 |
| 1991 | 1651 | 0.988 | 0.108 | 0.299 | 0.775 | 0.260 |
| 1992 | 1371 | 1.854 | 0.180 | 0.418 | 1.185 | 0.213 |
| 1993 | 1682 | 1.241 | 0.172 | 0.422 | 1.165 | 0.227 |
| 1994 | 1535 | 2.114 | 0.161 | 0.385 | 1.078 | 0.220 |
| 1995 | 565 | 1.046 | 0.105 | 0.327 | 0.803 | 0.289 |
| 1996 | 479 | 4.150 | 0.371 | 0.825 | 2.390 | 0.202 |
| 1997 | 819 | 2.325 | 0.214 | 0.571 | 1.509 | 0.250 |
| 1998 | 1185 | 1.413 | 0.094 | 0.287 | 0.711 | 0.285 |
| 1999 | 1272 | 1.178 | 0.100 | 0.327 | 0.782 | 0.302 |
| 2000 | 1266 | 1.495 | 0.133 | 0.381 | 0.974 | 0.267 |
| 2001 | 1217 | 0.704 | 0.068 | 0.309 | 0.627 | 0.392 |
| 2002 | 2190 | 0.560 | 0.094 | 0.303 | 0.727 | 0.300 |
| 2003 | 768 | 0.869 | 0.078 | 0.350 | 0.715 | 0.388 |
| 2004 | 825 | 2.051 | 0.071 | 0.305 | 0.634 | 0.377 |
| 2005 | 1775 | 1.209 | 0.113 | 0.273 | 0.759 | 0.223 |
| 2006 | 1065 | 1.596 | 0.195 | 0.475 | 1.315 | 0.225 |
| 2007 | 370 | 5.224 | 0.300 | 0.729 | 2.020 | 0.225 |
| 2008 | 238 | 1.479 | 0.100 | 0.383 | 0.847 | 0.344 |
| 2009 | 54 | 2.200 | 0.234 | 0.854 | 1.933 | 0.332 |
| 2010 | 146 | 0.343 | 0.084 | 0.337 | 0.726 | 0.359 |
| 2011 | 285 | 5.211 | 0.446 | 1.139 | 3.080 | 0.238 |
| 2012 | 156 | 2.751 | 0.563 | 1.777 | 4.322 | 0.294 |

**Northeast Atlantic**

| Year | Sets | Nominal CPUE | Lower 95% CI | Upper 95% CI | Std. CPUE | CV |
|---|---|---|---|---|---|---|
| 1990 | 619 | 0.840 | 0.021 | 0.074 | 0.365 | 0.328 |
| 1991 | 2522 | 0.901 | 0.029 | 0.085 | 0.459 | 0.278 |
| 1992 | 4400 | 1.055 | 0.060 | 0.116 | 0.776 | 0.167 |
| 1993 | 4173 | 0.951 | 0.063 | 0.108 | 0.765 | 0.138 |
| 1994 | 2596 | 1.496 | 0.071 | 0.136 | 0.914 | 0.161 |
| 1995 | 1618 | 1.724 | 0.079 | 0.136 | 0.963 | 0.136 |
| 1996 | 3041 | 2.520 | 0.212 | 0.357 | 2.559 | 0.130 |
| 1997 | 5384 | 1.332 | 0.136 | 0.226 | 1.628 | 0.129 |
| 1998 | 6268 | 0.960 | 0.067 | 0.126 | 0.853 | 0.161 |
| 1999 | 5522 | 1.031 | 0.097 | 0.174 | 1.208 | 0.148 |
| 2000 | 6976 | 1.025 | 0.105 | 0.167 | 1.229 | 0.116 |
| 2001 | 5532 | 1.359 | 0.123 | 0.200 | 1.459 | 0.122 |
| 2002 | 4083 | 0.859 | 0.094 | 0.155 | 1.117 | 0.126 |
| 2003 | 3564 | 1.141 | 0.093 | 0.164 | 1.147 | 0.143 |
| 2004 | 6124 | 0.976 | 0.088 | 0.141 | 1.035 | 0.118 |
| 2005 | 6591 | 0.763 | 0.064 | 0.101 | 0.746 | 0.116 |
| 2006 | 5253 | 0.951 | 0.076 | 0.120 | 0.883 | 0.115 |
| 2007 | 3163 | 0.976 | 0.077 | 0.122 | 0.902 | 0.116 |
| 2008 | 2736 | 1.320 | 0.090 | 0.143 | 1.055 | 0.116 |
| 2009 | 3044 | 2.025 | 0.133 | 0.210 | 1.554 | 0.115 |
| 2010 | 1482 | 3.516 | 0.210 | 0.352 | 2.527 | 0.130 |
| 2011 | 677 | 4.628 | 0.327 | 0.638 | 4.243 | 0.168 |
| 2012 | 362 | 7.378 | 0.654 | 1.528 | 9.290 | 0.215 |

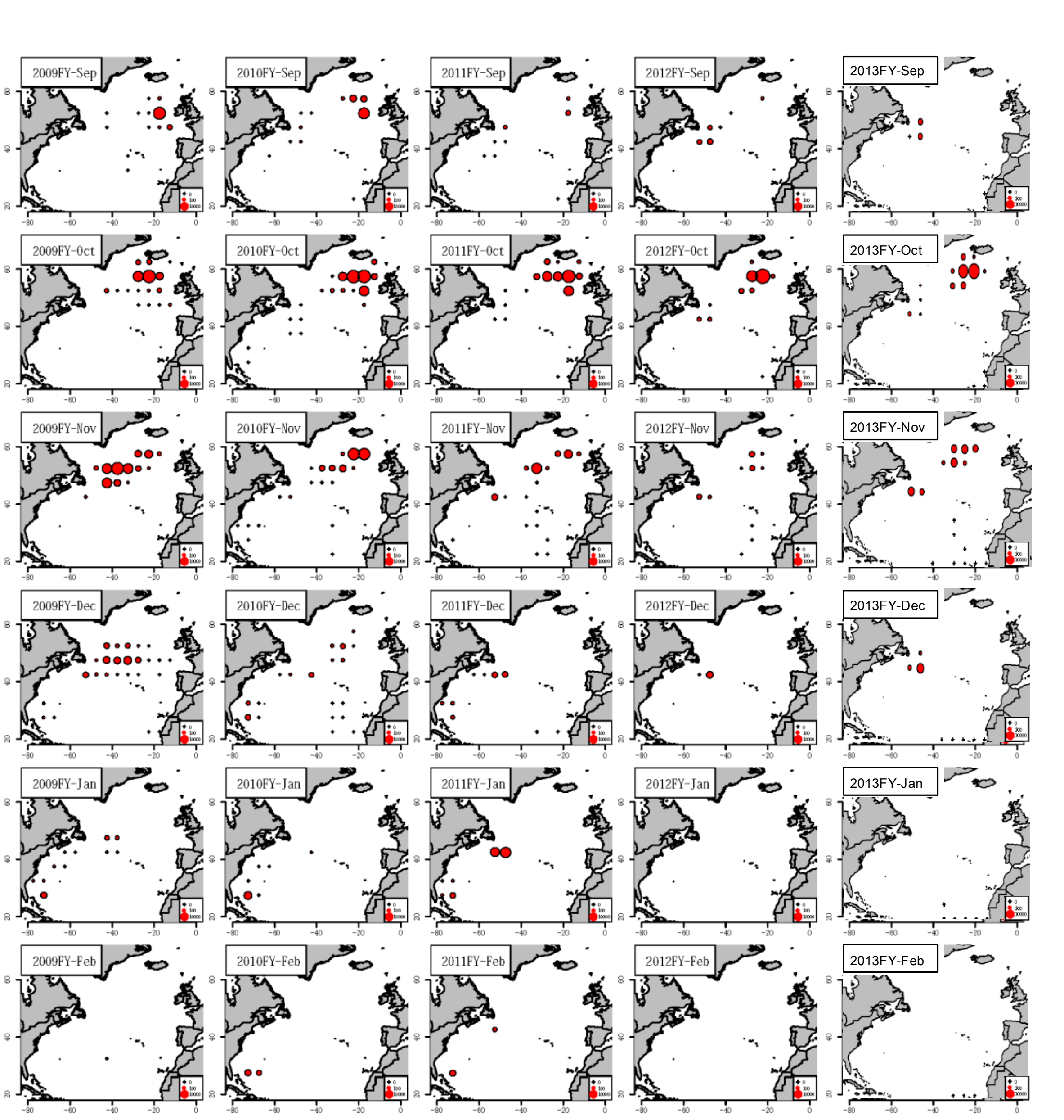



**Figure 1.** Monthly distributions of accumulative bluefin catch in number by Japanese longliners by 5x5 degree area in the main season (September-February: top to bottom) in the period between 2009 and 2012 FYs (left to right).

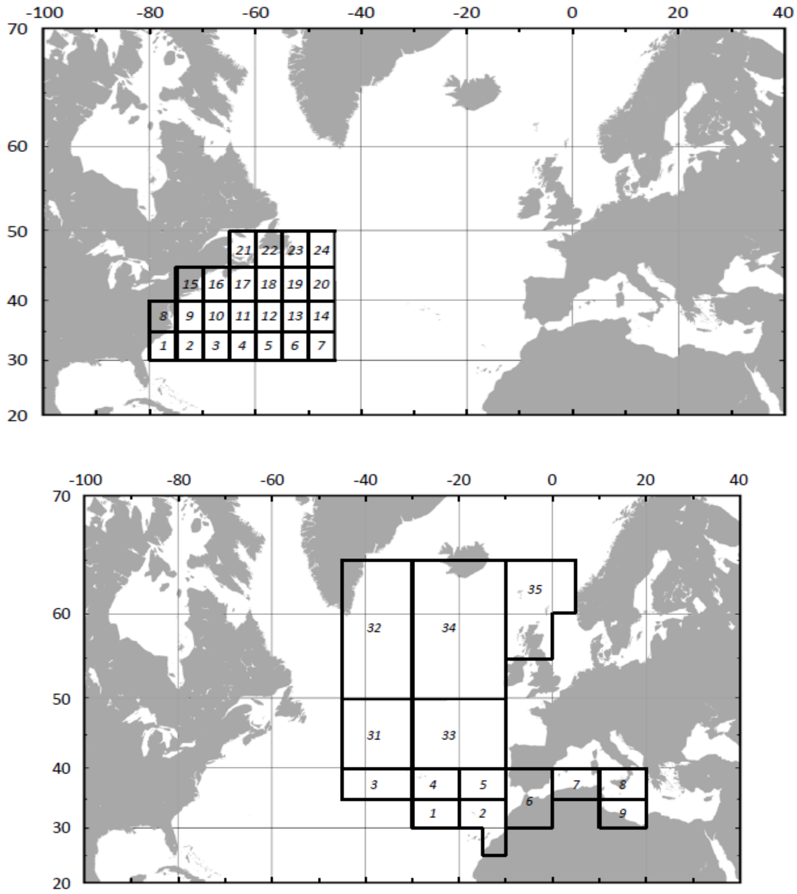



**Figure 2.** Areas considered in the CPUE standardization. Upper panel indicates area stratification used for the West Atlantic. Lower panel shows the same information for the Northeast and East Atlantic for the east stock. Numbers from 31 through 35 and from 1 through 9 denote for these area, respectively. Numbers indicate original area stratification used in **Tables 1-3**.

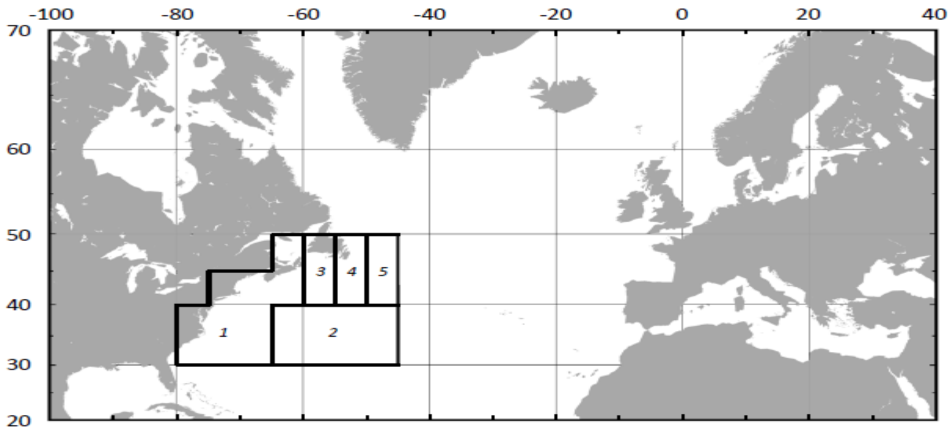



**Figure 3.** Combined areas used in the CPUE standardization for the West and the Northeast Atlantic. Numbers from 1 through 5 and from 31 through 34 denote for the West and the Northeast Atlantic, respectively.

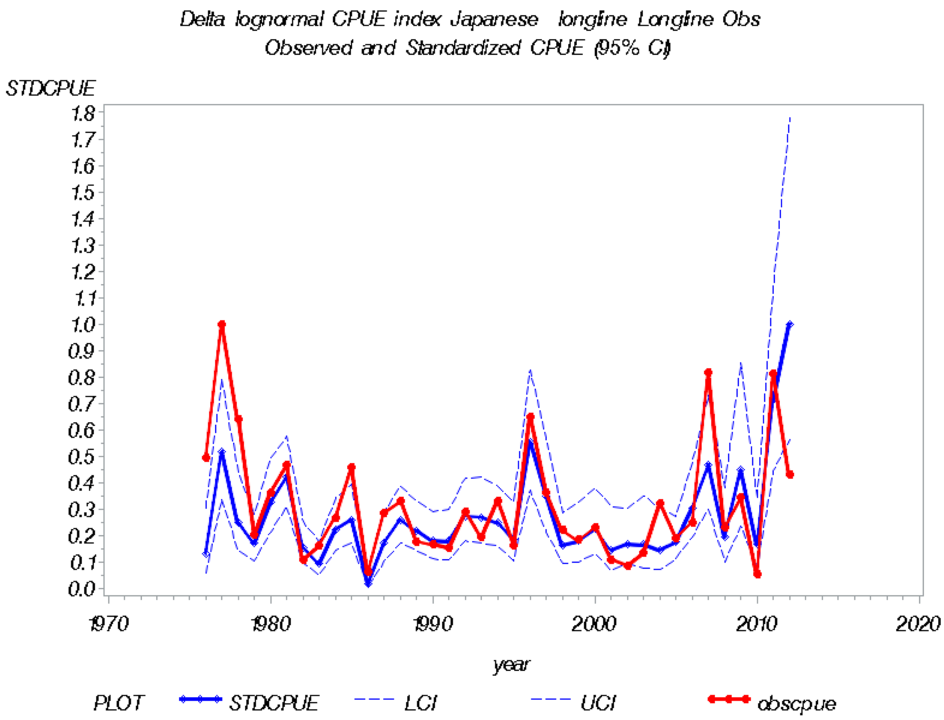
## Updated standardized CPUE to 2012FY

### West Atlantic


**Figure 4.** Model diagnostics for the CPUE series up to 2012FY: residual distributions in the 2nd steps of CPUE standardization with positive catch (left), observed and predicted proportion of positive catch observation (middle), and observed and predicted CPUE of positive catch set (right) using delta-lognormal model. Red and blue lines show the observed and the predicted values, respectively. Upper panel, West Atlantic; lower panel, Northeast Atlantic.

## Updated standardized CPUE to 2012FY

### West Atlantic



**Northeast Atlantic**

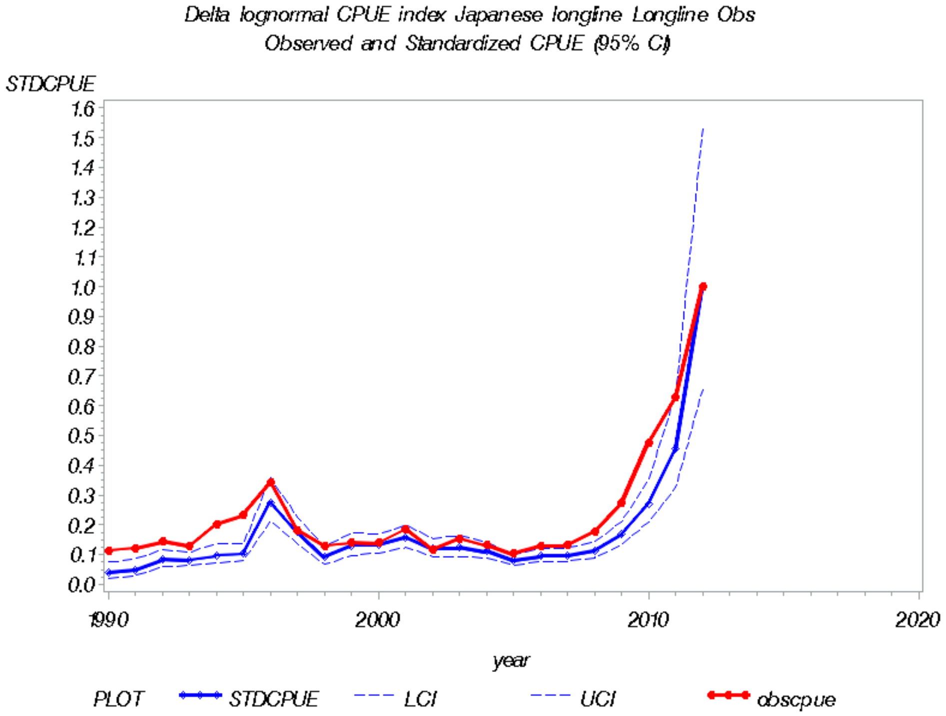



**Figure 5.** Standardized CPUE (blue line) with 95% confidence intervals and nominal CPUE (red line) for the CPUE series up to 2012FY. Upper panel, West Atlantic; lower panel, Northeast Atlantic.

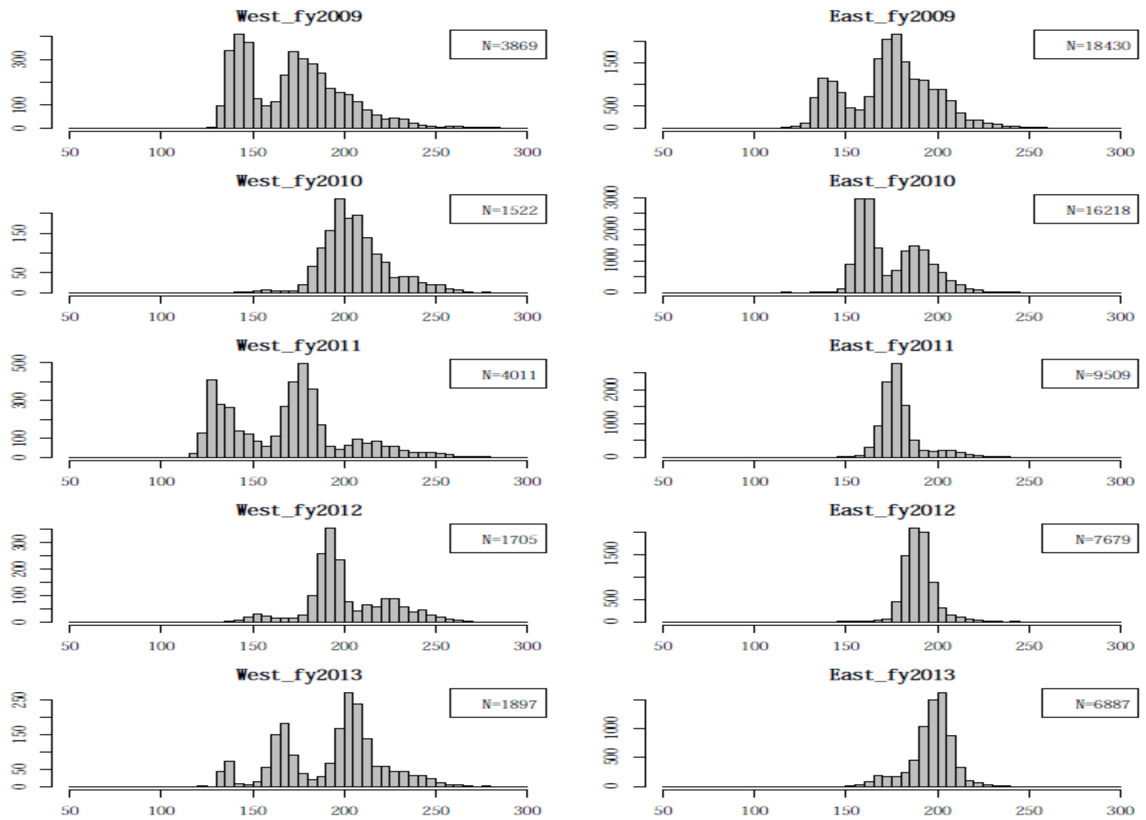



**Figure 6.** Converted fork length frequencies using the length-weight conversion factors (Anon, 2011) from 2009 to 2013FY measured by on board size measurement program in the west Atlantic (left panel) and the Northeast Atlantic (right panel).

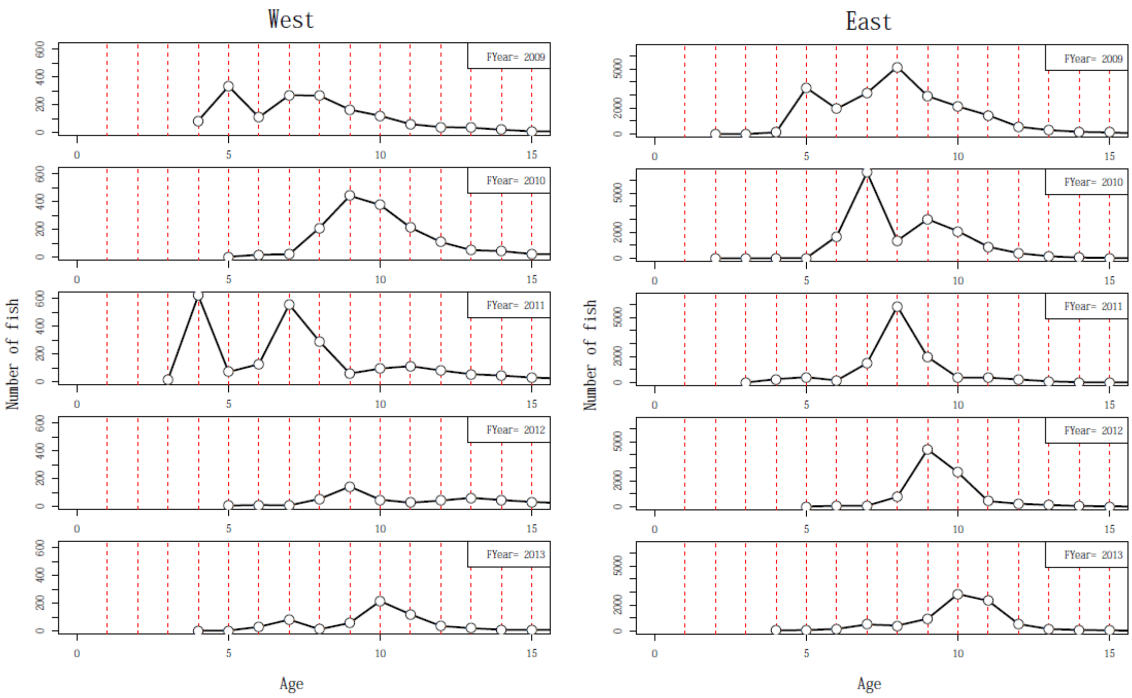



**Figure 7.** Catch at age was estimated for 2009 through 2013FYs from the converted size data in the West (right panel) and Northeast Atlantic (left panel), applying slicing procedures to the size frequencies of bluefin caught by the Japanese longliners.

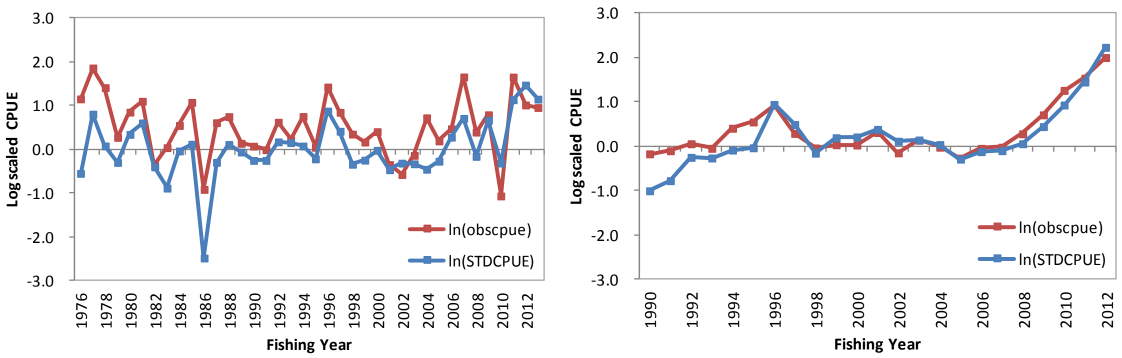



**Figure 8.** Standardized CPUE and nominal CPUE in logarithmic scale with 95% confidence intervals and nominal CPUE for the CPUE series up to 2012FY. Left panel, West Atlantic; right panel, Northeast Atlantic.

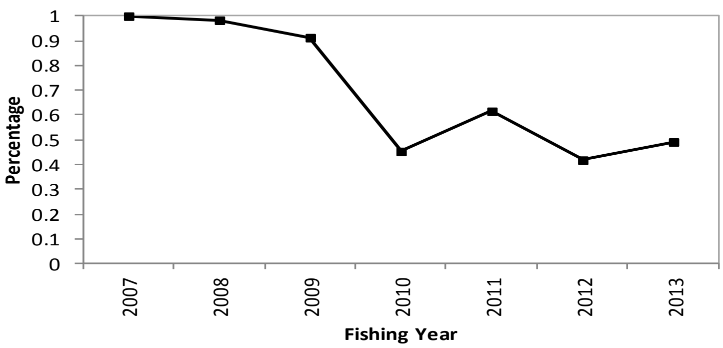



**Figure 9**. The percentage of operations in between November to February among those in between August to February in each fishing year.

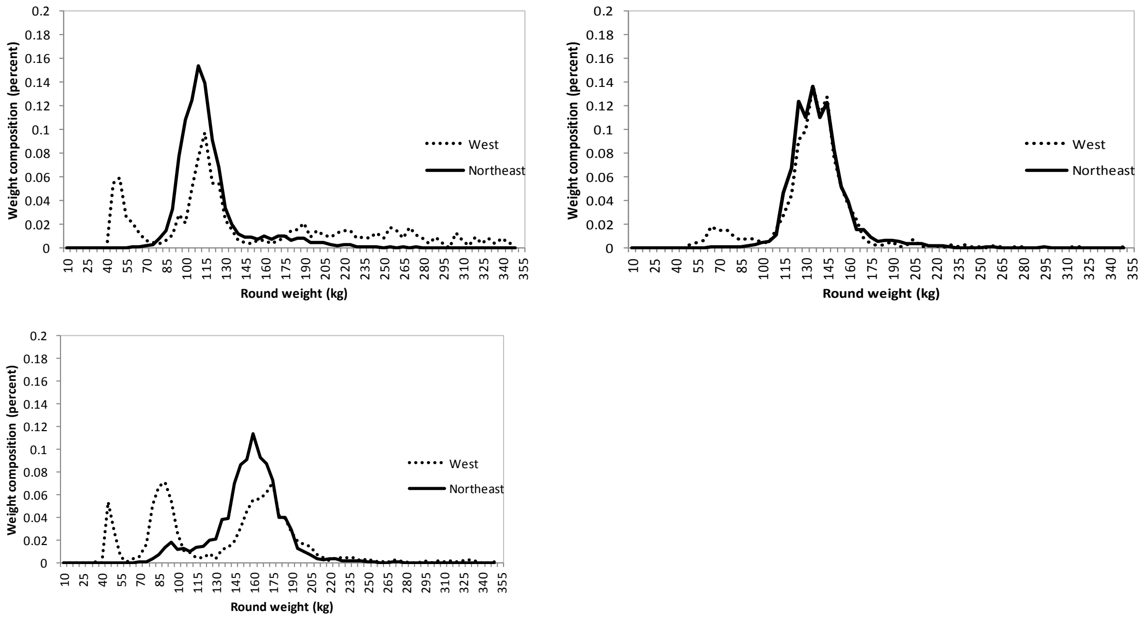



**Figure 10.** The weight composition (kg) in the main fishing area and season in the West (40-45°N, 45-55°W, in November and December, dotted line) and Northeast Atlantic (50-60°N and 15-35°W, in October and November, solid line) in 2011 (a), 2012 (b), and 2013 (c) FYs.

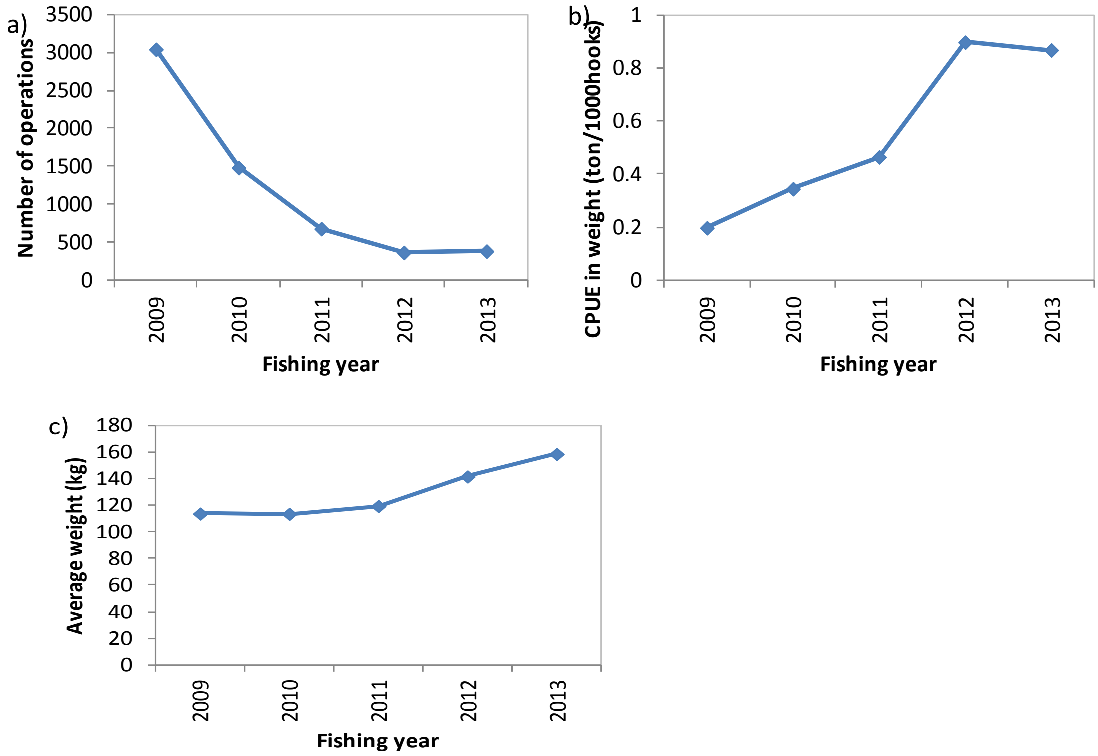
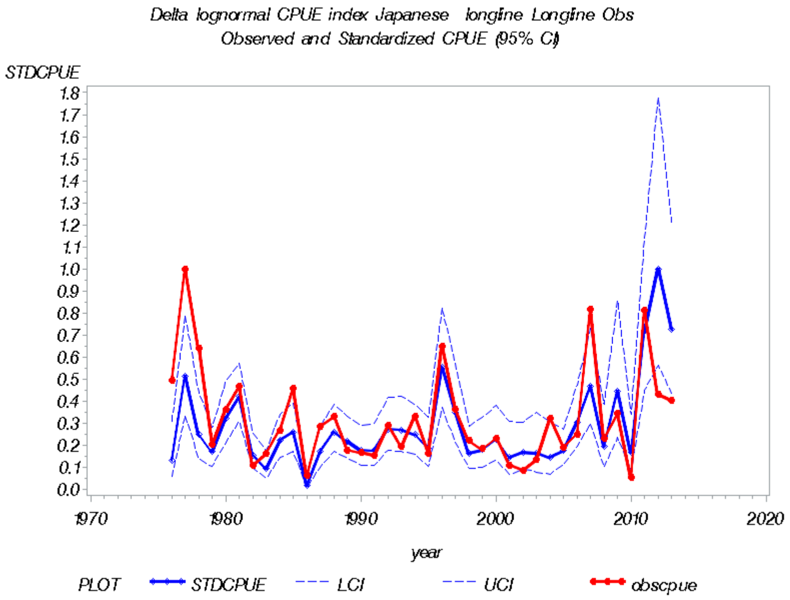



**Figure 11.** The number of operations (a), the nominal CPUE in weight (ton/1000hooks, b), and the average weight in kg (c) in the period between 2009 and 2013 FYs in the Northeast Atlantic.

## Other examined CPUE series

### *Updated standardized CPUE to 2013FY: West Atlantic*

*Standardized and Nominal CPUEs*




*Diagnostics*

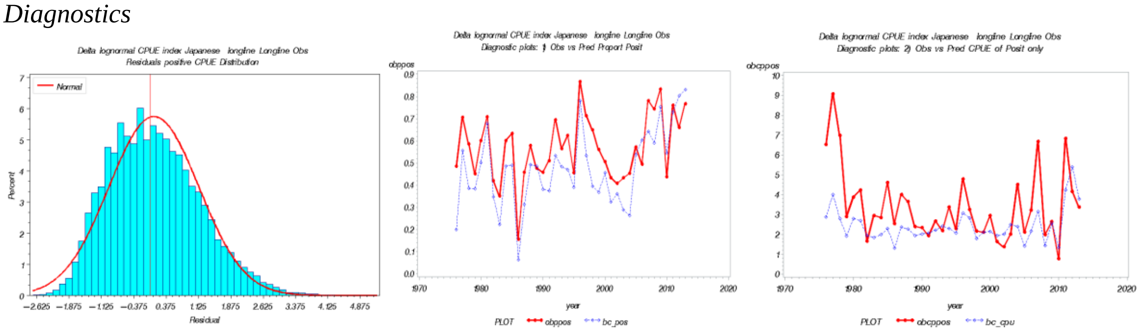



**Figure 12.** Standardized CPUE in the West Atlantic with 95% confidence intervals, nominal CPUE, and its diagnostics: residual distributions in the 2nd steps of CPUE standardization with positive catch (left), observed and predicted proportion of positive catch observation (middle), and observed and predicted CPUE of positive catch set (right) using delta-lognormal model.

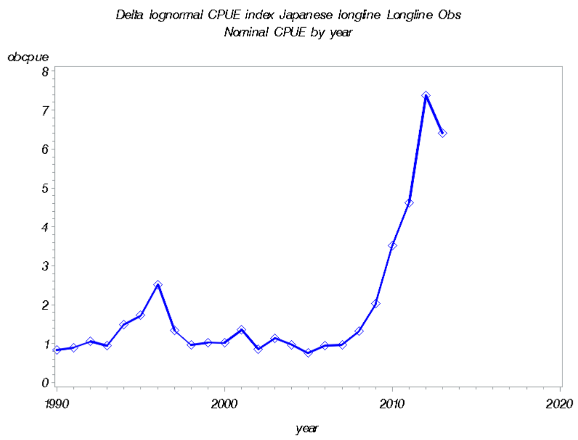



**Figure 13.** Nominal CPUE to 2013FY in the Northeast Atlantic.

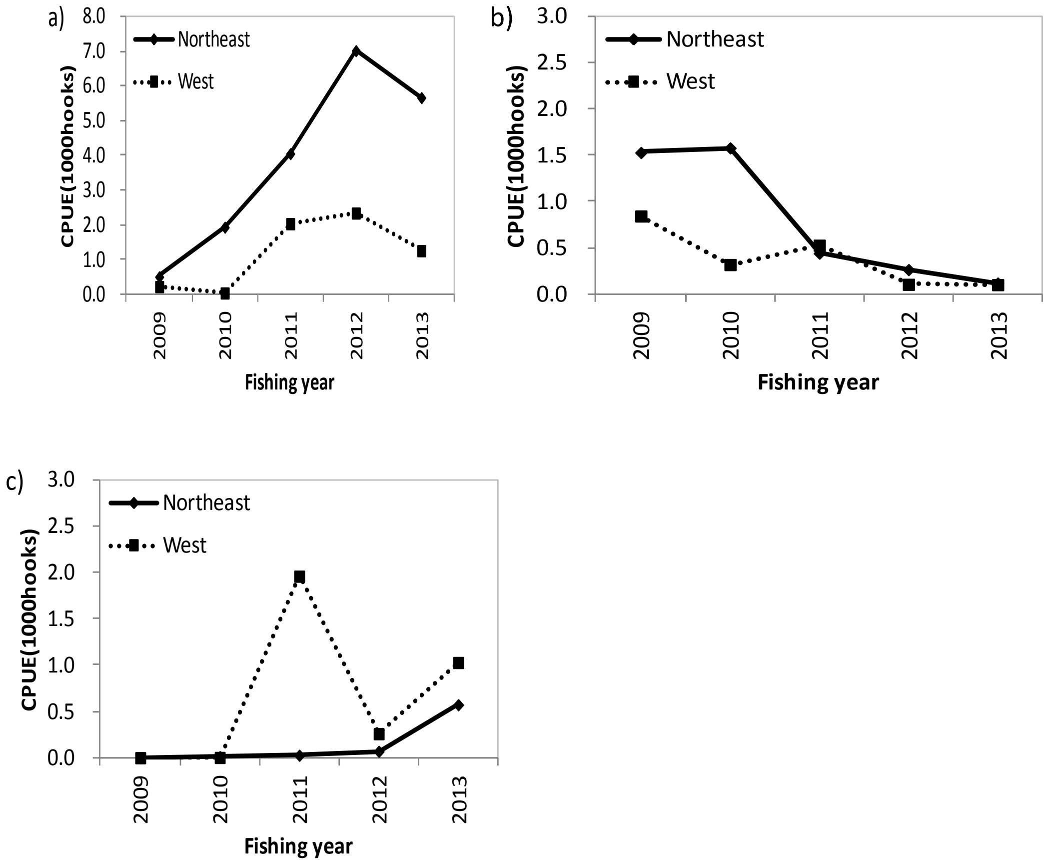



**Figure 14.** The nominal CPUE of 2003 year class (a), and the older (b) and the younger (c) year class in the West (dotted line) and Northeast (solid line) Atlantic in the period between 2009 and 2013 FYs.