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# SIZE AND AREA DISTRIBUTION OF PORBEAGLE (*LAMNA NASUS*) INFERRED FROM A DATA MINING IN THE SPANISH LONGLINE FISHERY TARGETING SWORDFISH (*XIPHIAS GLADIUS*) IN THE ATLANTIC FOR THE 1987-2017 PERIOD

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*SUMMARY*

*A total of 5,136 size observations of porbeagle were recovered for the period 1987-2017. The GLM results explained very moderately the variability of the sizes considering three main factors, suggesting minor but significant differences in some cases especially for the year factor and non-significant differences in other factors depending on the analysis. The greatest differences in the standardized mean length between some zones were caused by some large fish of unidentified sex. The standardized mean length data for the northern zones showed stability throughout the time series, very stable range of mean values and very few differences between sexes. The size distribution for northern areas indicated an FL-overall mean of 158 cm. The size showed a normal distribution confirming that a small fraction of individuals of this stock/s is available in the oceanic areas where the North Atlantic fleet is regularly fishing and the fishes are not fully recruited to those areas and / or this fishing gear up to 160 cm. The data suggests that some individuals could sporadically reach some intertropical areas of the eastern Atlantic.*

*RÉSUMÉ*

*Un total de 5.136 observations de taille de requins-taupes communs ont été récupérées pour la période 1987-2017. Les résultats du GLM expliquent très modérément la variabilité des tailles en tenant compte de trois facteurs principaux, ce qui suggère des différences mineures mais significatives dans certains cas, notamment pour le facteur année et des différences non significatives pour d'autres facteurs selon le type d'analyse. Les plus grandes différences de taille moyenne standardisée entre certaines zones ont été causées par quelques grands poissons de sexe non identifié. Les données sur la taille moyenne standardisée des zones nordiques ont montré une stabilité tout au long de la série temporelle dans une gamme très stable de valeurs moyennes et très peu de différences entre les sexes. La distribution des tailles des zones nordiques indiquait une moyenne globale de 158 cm de longueur à la fourche. La taille présentait une distribution normale confirmant qu'une petite fraction des spécimens de ce stock disponible dans des zones océaniques où la flottille opérant dans l'Atlantique Nord pêche régulièrement n'est pas entièrement recrutée dans ces zones et/ou par cet engin de pêche jusqu'à 160 cm. Les données suggèrent que certains spécimens pourraient atteindre sporadiquement certaines zones intertropicales de l'Atlantique Est.*

*RESUMEN*

*Un total de 5.136 observaciones de talla de marrajo sardinero fueron recuperadas para el periodo 1987-2017. Los resultados del GLM explicaron muy moderadamente la variabilidad de las tallas considerando tres factores principales, sugiriendo diferencias significativas en algunos casos especialmente para el factor año, y diferencias no significativas en otros casos según el tipo de análisis. Las mayores diferencias en la talla media estandarizada entre algunas de las zonas fueron causadas por algunos peces grandes de sexo no identificado. Los datos de talla media estandarizada de las zonas del Norte mostraron estabilidad a lo largo de la serie dentro de un rango de valores medios muy estable con diferencias muy escasas entre*

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*sexos. La distribución de tallas para zonas del Norte indicó que la FL media global fue 158 cm. La talla mostró una distribución normal confirmando que la pequeña fracción de individuos de este stock/s disponibles en áreas oceánicas donde pesca esta flota en el Norte no se recluta plenamente a esas zonas y/o a este arte de pesca hasta los 160 cm. Los datos sugieren que algunos individuos de esta especie podrían alcanzar de forma esporádica hasta algunas áreas intertropicales dentro del Atlántico Este.*

*KEYWORDS*

*shark, porbeagle, size, biology, distribution*

## 1. Introduction

The porbeagle (*Lamna nasus*) is a large-highly migratory Lamnidae shark distributed across the North Atlantic (including the Mediterranean Sea) and also in a circumglobal band in the southern Atlantic, southern Indian, southern Pacific and Antarctic Oceans (Anon. 2004, Compagno 2001, Karamidas 2019). It is a long-lived pelagic shark that mainly inhabits cold and also some temperate waters. It is among the most cold-tolerant of the large pelagic sharks commonly found in the cold, continental offshore fishing areas as well as in the epipelagic layers of cold oceanic waters from the surface down to at least 700 m. The temperature in the brain and eyes of the porbeagle is around 5°C warmer than the water where this species lives (Carey *et al.* 1969, 1985). This species is considered a slow-growing and late maturing shark.

This species could be distributed in water temperatures colder than 18° and down to 1°C but usually between 5º-10ºC (Campana and Joyce 2004). The preference for cold water habitats with schools of high prey availability conditions its geographic distribution. In the Atlantic, porbeagle is regularly more prevalent in the respective boreal and austral regions near or around continents (Anon. 2010) but in some cases presenting an almost continuous distribution in high latitudes of cold waters between both sides of the North Atlantic. Sporadic records or rare occurrence of this species are also described in other areas and some individuals have been cited from warmer SST waters (Compagno 2001). These are some of the reason why the areas of overlapping between porbeagle distribution and most temperate and tropical tuna and tuna-like fisheries are regularly very scarce.

Some tagging data suggest that this species carries out broad seasonal and repetitive migratory movements among some areas (Stevens *et al.* 1983, Stevens 1990, Francis *et al.* 2008, Kohler *et al.* 2002, Pade *et al.* 2009). Occurrence of porbeagle in some areas is related to the seasonal mackerel migrations or local abundance of other small pelagic bony fish. Like many other highly migratory shark species, it tends to segregate by size and sex, depending on biological processes (feeding, mating, gestation, parturition). Over the course of history, the greater or lesser extent to which individuals aggregate, depending on the zone and season, has had a major impact on the development of the most important targeted fisheries done by some non-tuna related fleets of the North Atlantic which have in some cases been operating since 1960s or even for centuries in some countries. In addition to these targeted fisheries historically developed and described in some NE and NW Atlantic areas (Campana *et al*. 2002, Anon. 2004, ICES 2007, Campana and Gibson 2008) some individuals may be sporadically caught as a rare bycatch in a variety of fisheries-gears in the Atlantic Ocean including surface and bottom longlines, pelagic and bottom trawls, gillnets and handlines. Some of these gears are used for targeting tuna or tuna-like species, but the areas having the most intense fisheries targeting temperate and tropical tuna or tuna-like species are usually allocated outside the major porbeagle distribution areas or in their margins owing to high thermal dependence of the tuna or tuna-like species and the fact that most have a preference for temperate and/or warm waters. However some individuals of porbeagle could be sporadically caught and reported as a bycatch in some tuna and tuna-like fisheries (i.e. Domingo *et al*. 2002, Matsunaga and Nakano 2002, Mejuto and González-Garcés 1984, Mejuto 1985). Catches of other similar shark species may be misidentified as porbeagle in some cases which would lead to disproportionate amounts being officially reported (i.e. FAO statistics) in regard to other shark species that are close in taxonomic level or similar in common local names (Fernández-Costa and Mejuto 2010).

The Spanish surface longline fleet targeting swordfish (*Xiphias gladius*) has sporadically caught some porbeagle individuals as a very low bycatch. First descriptions of porbeagle as a minor bycatch in this fishery probably dated from the early eighties when main part of this fleet was operating in oceanic areas of the NE Atlantic regularly between 35º-45º latitude N and eastern of 25ºW (Mejuto and González-Garcés 1984, Mejuto 1985). These authors estimated annual catches for this fleet providing size at sex, size-weight relationships by sex, etc.

During those years the porbeagle accounted around 6.6% of the catch of shortfin mako and porbeagle species combined. However, in subsequent years due to the fact that this fleet shifted fishing grounds moving toward the South and West, it would be predictable a considerable reduction of this porbeagle bycatch ratio in the later periods. Other authors have also described the presence of porbeagle as a very sporadic bycatch in this longline fleet (González-Garcés and Rey 1984, Rey *et al*. 1988, Moreno 1992, Buencuerpo *et al*. 1998).

Various studies on this species have been carried out in this fleet since 1983. Data on catch levels, size composition by sex, identifying biases in catch official reports because species misidentification, length-weight relationships and conversion factors, as well as estimating catch rates standardized based on scientifically verified data, were some of the studies previously provided (i.e. Mejuto and González-Garcés 1984, Mejuto 1985, Fernández-Costa and Mejuto 2010, Mejuto *et al*. 2010[a,b,c]). In order to complement the aforementioned scientific studies, the present document analyzes records gathered from the mid 1980s in order to obtain additional size data of porbeagle for the North and South Atlantic ICCAT sampling areas where this surface longline fleet has operated.

## 2. Material and methods

Fork-Length data (FL cm) were obtained through a data mining work initiated in year 2009 to retrieve length records of porbeagle caught as a low-prevalence bycatch in surface longline fishery targeting swordfish. The data analyzed comes mostly from scientific records obtained at landing ports, recorded by scientific samplers on board, or recorded in personal records of fishing that were voluntarily provided to us under a collaborative science action. The fork-length size (FL cm) was the measure considered in all cases, using the lower limit of each size class of 5 cm.

Observations were recorded by year and allocated according to the geographical position of the catch initially considering 5x5 degree grids. They were classified into four zones (ICCAT statistical areas: NW, NE, SE, SW) for descriptive and analytical purposes. The NE and NW zones were denominated as "North" and the SW and SE zones were denominated as "South". Sex was identified according to the presence or absence of pterygopodia-claspers and recorded when possible. In some specimens the sex was not identified and in such case these observations were classified as sex “indet.” Therefore, three levels of sex were considered in some of the analyses (female, male, indet.) while in other analyzes only those observations with identified sex (female, male) were considered. The month variable could not be considered in this case due to the few or no observations in some cases and because one priority was to assess the trend and inter-annual variability by zone and sex for the stock assessment. Therefore, the authors had to establish a compromise when selecting variables.

Descriptive analyzes of the basic statistics of the length data were obtained for each year and for different combinations of the main variables considered (year, zone, sex). Being aware that at least the North and South Atlantic stocks are different in terms of the structure assumed for the assessment and that exchanges between the two hemispheres are highly unlikely based on the results of genetic analyzes and other evidence, considering that the number of observations available from the southern hemisphere is very limited; a preliminary exploratory exercise was performed with all the available data and using a GLM model under a hypothesis of normality to assess the possible significance of the main factors considered (year, zone, sex) and explain the observed variability of lengths. However, more detailed analyses and specific GLMs were performed for Northern observations considering the two defined zones (sampling areas) and two or three levels of “sex”, respectively.

## 3. Results and discussion

A total of 5,136 length observations (FL cm) of *Lamna nasus* were recovered for the period 1987-2017. Of these 4,770 and 366 observations belonged to the North or South zones and were obtained between the periods 1987-2017 or 1994-2017, respectively (**Figure 1**). The data suggests that some individuals could sporadically reach some intertropical areas within the Atlantic. The information available from 2009 is considered scarce and unrepresentative due to the regulatory measures implemented at the domestic level[2]. Therefore, the length data recorded in years after 2008 correspond to discarded-released live fish. However, all available observations were included in the analyses, although the authors recommend not using those observations from years after 2008.

2 Council Regulation (EU) No 23/2010 of 14 January 2010 for porbeagle catches in international waters.

**Tables 1-11** summarize the number of observations available of the length variable during the period 1987-2017 for the zones observed in the Atlantic (North and South), by level of sex or sexes combined and by zones. The tables also include descriptive statistics by year (FL mean, Standard Deviation, Min, Max and CVs).

### *3.1 Total Atlantic (North and South zones)*

Initial descriptive analyzes were performed considering all available observations from the North and South zones. The authors are aware of the relatively few observations available from the southern zones and of some "spot" observations of very small specimens that appeared in 2011 in a very specific area of the South Atlantic. So, the results of combining the data from all the zones would primarily represent the Northern zones. Descriptive analysis of the length distribution of all individuals showed an almost perfect unimodal / normal distribution (FL mean: 157.36, Std.: 37.12, Median: 160) (**Figure 2**).

The GLM results for the complete set of observations suggested that the three main factors considered (year, zone, sex) were significant, although the model explained very moderately the observed variability. The zone factor was in this case the most important due to the size differences between some of the zones considered, followed by the year factor and to a lesser extent sex. The FL lsmean values of the year factor generally showed stability throughout the series, especially during the period 1987-2005, suggesting moderate differences between the zones of both hemispheres (North vs. South). The NW zone presented the highest FL lsmean values in relation to the other three zones considered (**Figure 3**). Moderate but significant difference between FL lsmeans was identified between the two defined zones within the North (NE-NW) with values of 159 cm and 175 cm, respectively. However, this difference was mainly caused by a group of fish with largest sizes and sex "indet.". When that group "indet." was excluded, the difference in FL lsmeans between the two northern areas was not significant and the numerical difference between the two was irrelevant. On the other hand, the FL lsmean values of the sex variable indicated that the differences are probably significant but minor. The mean values of their FL means are almost imperceptible and are in the range of about 3 cm between the two levels with identified sex considered. However, FL lsmean for the sex category "indet." would be about 15 or 19 cm higher in relation to the FL lsmean values of the two categories with identified sex (female, male), thus confirming that a part of the largest individuals with sex "indet" were the ones that contributed the most to the differences in FL lsmeans between zones and levels of sex. Variability chart, box-plots and standard deviation by year as well as overall average FL is provided (**Figure 4**).

### *3.2 Northern Atlantic zones*

Considering the availability of observations, subsequent analyzes focused on those observations from the northern areas. The results provided interesting information for the number of records available for the period 1987-2017.

*3.2.a. Male and female sexes*: The analysis considered those observations in which the sex was identified (males, females). The descriptive analysis indicated that the FL mean for the whole of that series was 158 cm. The sizes of the individuals showed an almost perfect unimodal/normal distribution (FL mean: 158.45, Std.: 35.40, median: 160) suggesting that the fraction of individuals of this stock/s available in the oceanic fishing areas where this fleet is fishing in the Northern areas, and/or because selectivity of the fishing gear, are not fully recruited until approximately 160 cm FL. Their period of availability in these oceanic areas or for this fishing gear is probably very short considering the shape of the distribution. The stepwise model to assess potentially significant factors (year, zone, sex) using AICs suggests the existence of significant differences between some of the years considered but not among others. The zones considered in the North (NW and NE) did not result with significant differences when the observations with identified sexes were considered. The sex factor was statistical significant in this case, although in the analyzed series as a whole the difference between the mean sizes would be quantitatively irrelevant, only about 3 cm in terms of their FL overall means. Considering these results and that an assessment of this species by sex is not probably feasible, we chose to focus the following analyzes from the North by zone and levels of sex combined. However, plots by sex are also included for merely descriptive purposes (**Figure 5**).

*3.2.b. Sexes combined*: Descriptive analysis of the size distribution for the Northern zones and the three combined levels of sex (males + females + indet.) indicated that the FL mean was 158 cm. The size distribution also showed an almost perfect unimodal/normal distribution (FL mean: 158.83, Std.: 35.89, median: 160) (**Figure 6**) confirming that the fraction of individuals of this stock/s available in the oceanic fishing areas where this fleet is fishing, and/or because selectivity of this fishing gear, are not fully recruited until approximately 160 cm FL. Their period of availability in the oceanic areas or gear is probably very short considering the shape of the distribution. The GLM results for the set of observations from the North suggested that the three main factors considered (year, zone, sex) were significant, although the model explained the variability of size observed very moderately. The year factor was shown in this case as the most important due to the significant differences between some of the years, followed by a significant effect but lesser for the other two factors considered such sex and zone. However, the most relevant differential element for the FL lsmean between the NE and NW zones was caused by those fish of unidentified sex which provided some of the largest individuals observed (**Figures 7-8**).

The FL lsmean values of the year factor generally confirmed stability throughout the whole series analyzed especially for the period 1987-2007. Significant but very moderate difference of FL lsmeans was identified between the two zones defined within the North (NE-NW) with values of 159 cm and 175 cm, respectively (**Figure 7**). However, this difference reiterates that it was mainly caused by the group of fish with sex "indet." who provided some of the largest size records. When said groups of fish were eliminated from the analysis, the differences between the FL lsmeans from both northern zones were not significant and their numerical differences become irrelevant. On the other hand, the FL lsmean values of the sex variable indicated that the differences are probably significant but very small in the range of about 3 cm between the two categories with sex identified. However, the FL lsmean for the sex category "indet." would be about 15 or 19 cm higher in relation to the FL lsmean values of the two categories with sex identified (female, male), thus confirming that a part of the largest individuals than they were not sexed contributed the most to the differences in FL lsmeans between sex and the Northern zone levels. Variability chart, box-plots and standard deviation by year as well as overall average FL is provided (**Figure 9**). The authors reiterate their recommendation not to use length data after 2009.

### *3.3 Areas of distribution*

The present paper provides information on catch-at-size from North and South Atlantic zones. Some considered as sporadic or "*rare*" observations were reported from eastern areas of the Atlantic between 20° North-20° South of latitude (**Figure 1**). These so called "*rare*" records could extend the range of the distribution regularly described for this species, although some other descriptions had also suggested similar findings (Compagno 2001). On the other hand, in an exercise carried out during the 2020 porbeagle's assessment meeting the ICCAT Secretariat presented information from Task 1 (catches) which also showed some porbeagle catch records provided by other fleet in those areas, particularly Japan. So both sources of information based on oceanic longline data targeting different species seems to be consistent and suggesting -or confirming- a broader distribution of porbeagle because the so-called "*rare events*" observed in those inter-tropical eastern areas.

The authors of the present paper point out the verifications previously done of those presumed "*rare*" records because some of them were coming from low latitudes of eastern Atlantic with high SSTs. However, those findings were recorded during different years, reported form different sources such as different highly qualified scientists on board and also some collaborative skippers. The unlikely misidentification to shortfin mako individuals was discarded after an in deep revision of the whole records by species provided by the different sources and the high skill of the respective observers.

The authors warn that those "*rare*" records are likely related to the colder waters in mid-deeper layers because the characteristic upwelling events in western African coasts as well as the effect of the cold surface currents flowing along African continent in eastern Atlantic -that manifests itself when studying the temperature profiles in relation to depth instead only the SSTs-, as well the high food availability of small pelagic bony fish in those highly productive eastern areas.

Although the distribution of porbeagle is regularly and mostly related to high latitudes and cold surface waters, the authors caution that SST or latitude is just a simplification of the expected thermal characteristics in the epipelagic layers and it should not be the only variable to be considered in all areas to explain the total areas of distribution or to rule out possible or sporadic occurrence of "*rare events*" of porbeagle; and even less in those eastern Atlantic regions affected by mid-deep cold waters and cold surface current which can serve as cold-water-corridors from higher to lower latitudes, so that some individuals can reach lower latitudes than those most frequent and regularly described in literature. These oceanic characteristics in the eastern Atlantic could explain some of our observations in low latitudinal areas, but probably also those reported by Japanese deep-lonline targeting bigeye tuna. In fact, the reviewed mean sea-temperature at 50m depth (**Figure 10**- Fernández-Costa *et al.* 2017) or their monthly evolution throughout the year (Mejuto and García-Cortés 2014[3]) dramatically changes the perception on temperatures in those areas and the possible migratory pathways of porbeagle between high latitudes and the inter-tropical areas of the eastern Atlantic.

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[3] http://www.co.ieo.es/tunidos/documentos/revistas/2014/repro.gif

Mean annual temperatures at 50m depth in the inter-tropical areas of the eastern Atlantic could be similar to those observed at the same depth but at 25ºS of latitude in the western Atlantic near coastal areas of east South America where presence of porbeagle have been described (Domingo *et al*. 2002). Similar range of mean annual temperatures at 50m depth, or deeper, can be also found along the eastern Atlantic areas between 30ºS and 05ºS. One again, the sea temperature at 50m depth -or deeper- could probably explain better the complete or potential areas of the porbeagle`s distribution than only considering SST or latitude.

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[4] http://www.co.ieo.es/tunidos/documentos/revistas/2014/repro.gif

**Table 1**. Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for all zones considered in the Atlantic (North and South) and for combined sexes. More representative statistics are presented for each year (FL mean, Standard Deviation, Min, Max, CVs).

| Year | N_Obs. | FL_mean | Std. | FL_min. | FL_max. | CV |
|---|---|---|---|---|---|---|
| 1987 | 104 | 183.13 | 30.40 | 80 | 245 | 16.60 |
| 1988 | 616 | 159.61 | 35.13 | 60 | 285 | 22.01 |
| 1989 | 362 | 165.44 | 37.50 | 70 | 305 | 22.67 |
| 1990 | 321 | 162.68 | 31.29 | 55 | 230 | 19.23 |
| 1991 | 357 | 153.24 | 35.97 | 80 | 245 | 23.48 |
| 1992 | 127 | 172.80 | 39.31 | 60 | 275 | 22.75 |
| 1993 | 170 | 165.59 | 34.29 | 95 | 300 | 20.71 |
| 1994 | 477 | 164.86 | 33.27 | 85 | 285 | 20.18 |
| 1995 | 208 | 176.49 | 30.27 | 85 | 260 | 17.15 |
| 1996 | 616 | 151.56 | 30.11 | 70 | 245 | 19.86 |
| 1997 | 377 | 154.80 | 33.82 | 70 | 275 | 21.85 |
| 1998 | 212 | 152.71 | 44.95 | 70 | 270 | 29.43 |
| 1999 | 226 | 151.17 | 41.98 | 70 | 270 | 27.77 |
| 2000 | 88 | 142.90 | 40.62 | 75 | 280 | 28.42 |
| 2001 | 97 | 145.15 | 38.33 | 75 | 225 | 26.40 |
| 2002 | 83 | 158.67 | 32.67 | 95 | 260 | 20.59 |
| 2003 | 45 | 180.22 | 37.63 | 95 | 310 | 20.88 |
| 2004 | 124 | 161.37 | 33.47 | 65 | 250 | 20.74 |
| 2005 | 37 | 176.35 | 26.42 | 115 | 220 | 14.98 |
| 2006 | 173 | 151.82 | 30.30 | 80 | 215 | 19.96 |
| 2007 | 90 | 130.67 | 44.01 | 75 | 290 | 33.68 |
| 2008 | 64 | 137.66 | 41.79 | 55 | 290 | 30.36 |
| 2009 | 32 | 139.38 | 27.58 | 85 | 185 | 19.79 |
| 2010 | 2 | 160.00 | 49.50 | 125 | 195 | 30.94 |
| 2011 | 91 | 92.36 | 30.92 | 60 | 170 | 33.48 |
| 2012 | 7 | 137.14 | 32.13 | 85 | 180 | 23.43 |
| 2017 | 30 | 162.33 | 14.00 | 140 | 200 | 8.63 |
| **Total** | **5136** | | | | | |

**Table 2**. Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for all areas of the Atlantic (North and South), for sex = female. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNF = females.

| YR | N_LNF | Mean_LNF | SD_LNF | Min_LNF | Max_LNF | CV_LNF |
|---|---|---|---|---|---|---|
| 1987 | 34 | 175.74 | 33.03 | 110 | 225 | 18.80 |
| 1988 | 199 | 155.13 | 32.42 | 60 | 235 | 20.90 |
| 1989 | 143 | 164.41 | 38.06 | 80 | 305 | 23.15 |
| 1990 | 171 | 161.08 | 34.69 | 55 | 230 | 21.53 |
| 1991 | 156 | 152.76 | 37.62 | 80 | 245 | 24.62 |
| 1992 | 64 | 174.92 | 41.16 | 60 | 275 | 23.53 |
| 1993 | 72 | 173.19 | 35.63 | 95 | 300 | 20.57 |
| 1994 | 213 | 165.14 | 36.17 | 85 | 285 | 21.90 |
| 1995 | 100 | 179.95 | 32.52 | 85 | 260 | 18.07 |
| 1996 | 248 | 147.92 | 29.44 | 75 | 240 | 19.90 |
| 1997 | 137 | 150.33 | 34.81 | 70 | 215 | 23.15 |
| 1998 | 103 | 148.16 | 45.55 | 75 | 235 | 30.74 |
| 1999 | 90 | 139.28 | 42.08 | 70 | 230 | 30.22 |
| 2000 | 36 | 128.33 | 30.91 | 80 | 205 | 24.09 |
| 2001 | 36 | 143.19 | 42.81 | 75 | 215 | 29.90 |
| 2002 | 40 | 152.00 | 33.14 | 95 | 220 | 21.80 |
| 2003 | 11 | 167.73 | 36.90 | 95 | 215 | 22.00 |
| 2004 | 21 | 150.71 | 31.87 | 100 | 215 | 21.15 |
| 2005 | 10 | 178.00 | 33.35 | 115 | 220 | 18.74 |
| 2006 | 59 | 153.14 | 29.94 | 85 | 210 | 19.55 |
| 2007 | 5 | 175.00 | 28.94 | 130 | 210 | 16.54 |
| 2008 | 26 | 135.19 | 34.97 | 85 | 205 | 25.87 |
| 2009 | 18 | 143.61 | 21.61 | 105 | 180 | 15.05 |
| 2010 | 0 | NA | NA | NA | NA | NA |
| 2011 | 47 | 87.34 | 26.04 | 60 | 155 | 29.81 |
| 2012 | 2 | 120.00 | 49.50 | 85 | 155 | 41.25 |
| 2017 | 21 | 159.05 | 11.25 | 140 | 190 | 7.07 |

**Table 3.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for all areas of the Atlantic (North and South), for sex = male. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNM = males.

| YR | N_LNM | Mean_LNM | SD_LNM | Min_LNM | Max_LNM | CV_LNM |
|---|---|---|---|---|---|---|
| 1987 | 70 | 186.71 | 28.59 | 80 | 245 | 15.31 |
| 1988 | 406 | 161.58 | 36.31 | 60 | 285 | 22.47 |
| 1989 | 212 | 168.54 | 34.62 | 70 | 240 | 20.54 |
| 1990 | 148 | 164.26 | 27.00 | 90 | 215 | 16.44 |
| 1991 | 201 | 153.61 | 34.74 | 85 | 245 | 22.61 |
| 1992 | 61 | 168.69 | 36.53 | 95 | 235 | 21.65 |
| 1993 | 97 | 159.95 | 32.50 | 95 | 210 | 20.32 |
| 1994 | 264 | 164.64 | 30.81 | 85 | 280 | 18.71 |
| 1995 | 99 | 174.09 | 27.89 | 95 | 235 | 16.02 |
| 1996 | 341 | 152.29 | 29.57 | 70 | 235 | 19.42 |
| 1997 | 201 | 154.38 | 30.96 | 75 | 220 | 20.05 |
| 1998 | 103 | 154.37 | 42.02 | 70 | 260 | 27.22 |
| 1999 | 120 | 152.75 | 35.92 | 80 | 215 | 23.52 |
| 2000 | 42 | 140.95 | 36.26 | 75 | 200 | 25.73 |
| 2001 | 44 | 144.20 | 36.71 | 75 | 205 | 25.46 |
| 2002 | 19 | 151.32 | 27.83 | 100 | 200 | 18.39 |
| 2003 | 30 | 178.50 | 30.46 | 95 | 225 | 17.06 |
| 2004 | 30 | 171.33 | 35.33 | 100 | 250 | 20.62 |
| 2005 | 25 | 174.40 | 23.69 | 120 | 220 | 13.58 |
| 2006 | 109 | 149.77 | 30.33 | 80 | 215 | 20.25 |
| 2007 | 6 | 160.83 | 42.48 | 85 | 210 | 26.41 |
| 2008 | 28 | 149.29 | 31.50 | 95 | 210 | 21.10 |
| 2009 | 14 | 133.93 | 33.87 | 85 | 185 | 25.29 |
| 2010 | 0 | NA | NA | NA | NA | NA |
| 2011 | 42 | 96.43 | 33.79 | 60 | 170 | 35.04 |
| 2012 | 4 | 135.00 | 20.82 | 110 | 160 | 15.42 |
| 2017 | 4 | 185.00 | 12.91 | 170 | 200 | 6.98 |

**Table 4.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for all areas of the Atlantic (North and South), for sex = indet. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNO = sex indet.

| YR | N_LNO | Mean_LNO | SD_LNO | Min_LNO | Max_LNO | CV_LNO |
|---|---|---|---|---|---|---|
| 1987 | 0 | NA | NA | NA | NA | NA |
| 1988 | 11 | 168.18 | 32.50 | 120 | 220 | 19.33 |
| 1989 | 7 | 92.86 | 40.71 | 75 | 185 | 43.84 |
| 1990 | 2 | 182.50 | 3.54 | 180 | 185 | 1.94 |
| 1991 | 0 | NA | NA | NA | NA | NA |
| 1992 | 2 | 230.00 | 7.07 | 225 | 235 | 3.07 |
| 1993 | 1 | 165.00 | NA | 165 | 165 | NA |
| 1994 | 0 | NA | NA | NA | NA | NA |
| 1995 | 9 | 164.44 | 26.63 | 115 | 200 | 16.19 |
| 1996 | 27 | 175.74 | 32.13 | 70 | 245 | 18.28 |
| 1997 | 39 | 172.69 | 39.18 | 120 | 275 | 22.69 |
| 1998 | 6 | 202.50 | 58.89 | 125 | 270 | 29.08 |
| 1999 | 16 | 206.25 | 39.81 | 140 | 270 | 19.30 |
| 2000 | 10 | 203.50 | 35.98 | 160 | 280 | 17.68 |
| 2001 | 17 | 151.76 | 33.54 | 100 | 225 | 22.10 |
| 2002 | 24 | 175.63 | 30.23 | 135 | 260 | 17.21 |
| 2003 | 4 | 227.50 | 60.62 | 165 | 310 | 26.65 |
| 2004 | 73 | 160.34 | 32.45 | 65 | 225 | 20.24 |
| 2005 | 2 | 192.50 | 31.82 | 170 | 215 | 16.53 |
| 2006 | 5 | 181.00 | 20.74 | 155 | 205 | 11.46 |
| 2007 | 79 | 125.57 | 42.77 | 75 | 290 | 34.06 |
| 2008 | 10 | 111.50 | 68.23 | 55 | 290 | 61.20 |
| 2009 | 0 | NA | NA | NA | NA | NA |
| 2010 | 2 | 160.00 | 49.50 | 125 | 195 | 30.94 |
| 2011 | 2 | 125.00 | 63.64 | 80 | 170 | 50.91 |
| 2012 | 1 | 180.00 | NA | 180 | 180 | NA |
| 2017 | 5 | 158.00 | 8.37 | 150 | 170 | 5.30 |

**Table 5.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas North of 5º N, for sex = females. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNF = sex female.

| Yr | Stock | Obs_LNF | Mean_LNF | SD_LNF | Min_LNF | Max_LNF | CV_LNF |
|---|---|---|---|---|---|---|---|
| 1987 | N | 34 | 175.74 | 33.03 | 110 | 225 | 18.80 |
| 1988 | N | 199 | 155.13 | 32.42 | 60 | 235 | 20.90 |
| 1989 | N | 143 | 164.41 | 38.06 | 80 | 305 | 23.15 |
| 1990 | N | 171 | 161.08 | 34.69 | 55 | 230 | 21.53 |
| 1991 | N | 156 | 152.76 | 37.62 | 80 | 245 | 24.62 |
| 1992 | N | 64 | 174.92 | 41.16 | 60 | 275 | 23.53 |
| 1993 | N | 72 | 173.19 | 35.63 | 95 | 300 | 20.57 |
| 1994 | N | 209 | 164.83 | 36.38 | 85 | 285 | 22.07 |
| 1995 | N | 100 | 179.95 | 32.52 | 85 | 260 | 18.07 |
| 1996 | N | 248 | 147.92 | 29.44 | 75 | 240 | 19.90 |
| 1997 | N | 137 | 150.33 | 34.81 | 70 | 215 | 23.15 |
| 1998 | N | 103 | 148.16 | 45.55 | 75 | 235 | 30.74 |
| 1999 | N | 90 | 139.28 | 42.08 | 70 | 230 | 30.22 |
| 2000 | N | 36 | 128.33 | 30.91 | 80 | 205 | 24.09 |
| 2001 | N | 36 | 143.19 | 42.81 | 75 | 215 | 29.90 |
| 2002 | N | 40 | 152.00 | 33.14 | 95 | 220 | 21.80 |
| 2003 | N | 11 | 167.73 | 36.90 | 95 | 215 | 22.00 |
| 2004 | N | 21 | 150.71 | 31.87 | 100 | 215 | 21.15 |
| 2005 | N | 10 | 178.00 | 33.35 | 115 | 220 | 18.74 |
| 2006 | N | 59 | 153.14 | 29.94 | 85 | 210 | 19.55 |
| 2007 | N | 5 | 175.00 | 28.94 | 130 | 210 | 16.54 |
| 2008 | N | 26 | 135.19 | 34.97 | 85 | 205 | 25.87 |
| 2009 | N | 18 | 143.61 | 21.61 | 105 | 180 | 15.05 |
| 2010 | N | 0 | NA | NA | NA | NA | NA |
| 2011 | N | 1 | 100.00 | NA | 100 | 100 | NA |
| 2012 | N | 2 | 120.00 | 49.50 | 85 | 155 | 41.25 |
| 2017 | N | 1 | 190.00 | NA | 190 | 190 | NA |

**Table 6.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas North of 5º N, for sex = males. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNM = sex male.

| Yr | Stock | Obs_LNM | Mean_LNM | SD_LNM | Min_LNM | Max_LNM | CV_LNM |
|---|---|---|---|---|---|---|---|
| 1987 | N | 70 | 186.71 | 28.59 | 80 | 245 | 15.31 |
| 1988 | N | 406 | 161.58 | 36.31 | 60 | 285 | 22.47 |
| 1989 | N | 212 | 168.54 | 34.62 | 70 | 240 | 20.54 |
| 1990 | N | 148 | 164.26 | 27.00 | 90 | 215 | 16.44 |
| 1991 | N | 201 | 153.61 | 34.74 | 85 | 245 | 22.61 |
| 1992 | N | 61 | 168.69 | 36.53 | 95 | 235 | 21.65 |
| 1993 | N | 97 | 159.95 | 32.50 | 95 | 210 | 20.32 |
| 1994 | N | 262 | 164.81 | 30.87 | 85 | 280 | 18.73 |
| 1995 | N | 99 | 174.09 | 27.89 | 95 | 235 | 16.02 |
| 1996 | N | 341 | 152.29 | 29.57 | 70 | 235 | 19.42 |
| 1997 | N | 201 | 154.38 | 30.96 | 75 | 220 | 20.05 |
| 1998 | N | 103 | 154.37 | 42.02 | 70 | 260 | 27.22 |
| 1999 | N | 120 | 152.75 | 35.92 | 80 | 215 | 23.52 |
| 2000 | N | 42 | 140.95 | 36.26 | 75 | 200 | 25.73 |
| 2001 | N | 44 | 144.20 | 36.71 | 75 | 205 | 25.46 |
| 2002 | N | 19 | 151.32 | 27.83 | 100 | 200 | 18.39 |
| 2003 | N | 30 | 178.50 | 30.46 | 95 | 225 | 17.06 |
| 2004 | N | 30 | 171.33 | 35.33 | 100 | 250 | 20.62 |
| 2005 | N | 25 | 174.40 | 23.69 | 120 | 220 | 13.58 |
| 2006 | N | 109 | 149.77 | 30.33 | 80 | 215 | 20.25 |
| 2007 | N | 6 | 160.83 | 42.48 | 85 | 210 | 26.41 |
| 2008 | N | 28 | 149.29 | 31.50 | 95 | 210 | 21.10 |
| 2009 | N | 14 | 133.93 | 33.87 | 85 | 185 | 25.29 |
| 2010 | N | 0 | NA | NA | NA | NA | NA |
| 2011 | N | 0 | NA | NA | NA | NA | NA |
| 2012 | N | 4 | 135.00 | 20.82 | 110 | 160 | 15.42 |
| 2017 | N | 1 | 200.00 | NA | 200 | 200 | NA |

**Table 7.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas North of 5º N, for sex = indet.. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNO = sex indet.

| Yr | Stock | Obs_LNO | Mean_LNO | SD_LNO | Min_LNO | Max_LNO | CV_LNO |
|---|---|---|---|---|---|---|---|
| 1987 | N | 0 | NA | NA | NA | NA | NA |
| 1988 | N | 11 | 168.18 | 32.50 | 120 | 220 | 19.33 |
| 1989 | N | 7 | 92.86 | 40.71 | 75 | 185 | 43.84 |
| 1990 | N | 2 | 182.50 | 3.54 | 180 | 185 | 1.94 |
| 1991 | N | 0 | NA | NA | NA | NA | NA |
| 1992 | N | 2 | 230.00 | 7.07 | 225 | 235 | 3.07 |
| 1993 | N | 1 | 165.00 | NA | 165 | 165 | NA |
| 1994 | N | 0 | NA | NA | NA | NA | NA |
| 1995 | N | 0 | NA | NA | NA | NA | NA |
| 1996 | N | 2 | 180.00 | 14.14 | 170 | 190 | 7.86 |
| 1997 | N | 17 | 152.06 | 37.79 | 120 | 225 | 24.85 |
| 1998 | N | 5 | 205.00 | 65.48 | 125 | 270 | 31.94 |
| 1999 | N | 5 | 188.00 | 49.19 | 140 | 270 | 26.17 |
| 2000 | N | 10 | 203.50 | 35.98 | 160 | 280 | 17.68 |
| 2001 | N | 7 | 142.86 | 43.48 | 100 | 225 | 30.44 |
| 2002 | N | 13 | 188.08 | 31.19 | 140 | 260 | 16.59 |
| 2003 | N | 3 | 248.33 | 53.93 | 210 | 310 | 21.72 |
| 2004 | N | 5 | 164.00 | 37.32 | 100 | 195 | 22.75 |
| 2005 | N | 2 | 192.50 | 31.82 | 170 | 215 | 16.53 |
| 2006 | N | 5 | 181.00 | 20.74 | 155 | 205 | 11.46 |
| 2007 | N | 4 | 232.50 | 66.52 | 170 | 290 | 28.61 |
| 2008 | N | 2 | 225.00 | 91.92 | 160 | 290 | 40.86 |
| 2009 | N | 0 | NA | NA | NA | NA | NA |
| 2010 | N | 2 | 160.00 | 49.50 | 125 | 195 | 30.94 |
| 2011 | N | 0 | NA | NA | NA | NA | NA |
| 2012 | N | 0 | NA | NA | NA | NA | NA |
| 2017 | N | 0 | NA | NA | NA | NA | NA |

**Table 8.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas South of 5º N, for sex = female. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNF = sex female.

| Yr | Stock | Obs_LNF | Mean_LNF | SD_LNF | Min_LNF | Max_LNF | CV_LNF |
|---|---|---|---|---|---|---|---|
| 1994 | S | 4 | 181.25 | 17.50 | 160 | 200 | 9.66 |
| 1995 | S | 0 | NA | NA | NA | NA | NA |
| 1996 | S | 0 | NA | NA | NA | NA | NA |
| 1997 | S | 0 | NA | NA | NA | NA | NA |
| 1998 | S | 0 | NA | NA | NA | NA | NA |
| 1999 | S | 0 | NA | NA | NA | NA | NA |
| 2001 | S | 0 | NA | NA | NA | NA | NA |
| 2002 | S | 0 | NA | NA | NA | NA | NA |
| 2003 | S | 0 | NA | NA | NA | NA | NA |
| 2004 | S | 0 | NA | NA | NA | NA | NA |
| 2007 | S | 0 | NA | NA | NA | NA | NA |
| 2008 | S | 0 | NA | NA | NA | NA | NA |
| 2011 | S | 46 | 87.07 | 26.26 | 60 | 155 | 30.16 |
| 2012 | S | 0 | NA | NA | NA | NA | NA |
| 2017 | S | 20 | 157.50 | 8.96 | 140 | 175 | 5.69 |

**Table 9.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas South of 5º N, for sex = male. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNM = sex male.

| Yr | Stock | Obs_LNM | Mean_LNM | SD_LNM | Min_LNM | Max_LNM | CV_LNM |
|---|---|---|---|---|---|---|---|
| 1994 | S | 2 | 142.50 | 3.54 | 140 | 145 | 2.48 |
| 1995 | S | 0 | NA | NA | NA | NA | NA |
| 1996 | S | 0 | NA | NA | NA | NA | NA |
| 1997 | S | 0 | NA | NA | NA | NA | NA |
| 1998 | S | 0 | NA | NA | NA | NA | NA |
| 1999 | S | 0 | NA | NA | NA | NA | NA |
| 2001 | S | 0 | NA | NA | NA | NA | NA |
| 2002 | S | 0 | NA | NA | NA | NA | NA |
| 2003 | S | 0 | NA | NA | NA | NA | NA |
| 2004 | S | 0 | NA | NA | NA | NA | NA |
| 2007 | S | 0 | NA | NA | NA | NA | NA |
| 2008 | S | 0 | NA | NA | NA | NA | NA |
| 2011 | S | 42 | 96.43 | 33.79 | 60 | 170 | 35.04 |
| 2012 | S | 0 | NA | NA | NA | NA | NA |
| 2017 | S | 3 | 180.00 | 10.00 | 170 | 190 | 5.56 |

**Table 10.** Number of observations (FL cm) of *Lamna nasus* during the period 1987-2017 for Atlantic areas South of 5º N, for sex = indet. The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs). LNO = sex indet..

| Yr | Stock | Obs_LNO | Mean_LNO | SD_LNO | Min_LNO | Max_LNO | CV_LNO |
|---|---|---|---|---|---|---|---|
| 1994 | S | 0 | NA | NA | NA | NA | NA |
| 1995 | S | 9 | 164.44 | 26.63 | 115 | 200 | 16.19 |
| 1996 | S | 25 | 175.40 | 33.29 | 70 | 245 | 18.98 |
| 1997 | S | 22 | 188.64 | 32.85 | 125 | 275 | 17.41 |
| 1998 | S | 1 | 190.00 | NA | 190 | 190 | NA |
| 1999 | S | 11 | 214.55 | 34.17 | 170 | 270 | 15.92 |
| 2001 | S | 10 | 158.00 | 25.19 | 120 | 190 | 15.94 |
| 2002 | S | 11 | 160.91 | 22.23 | 135 | 210 | 13.81 |
| 2003 | S | 1 | 165.00 | NA | 165 | 165 | NA |
| 2004 | S | 68 | 160.07 | 32.36 | 65 | 225 | 20.22 |
| 2007 | S | 75 | 119.87 | 33.14 | 75 | 195 | 27.64 |
| 2008 | S | 8 | 83.13 | 13.35 | 55 | 95 | 16.06 |
| 2011 | S | 2 | 125.00 | 63.64 | 80 | 170 | 50.91 |
| 2012 | S | 1 | 180.00 | NA | 180 | 180 | NA |
| 2017 | S | 5 | 158.00 | 8.37 | 150 | 170 | 5.30 |

**Table 11[a]**. Number of observations of size (FL cm) of *Lamna nasus* during the period 1987-1998 for each zone North of 5ºN and for the sex levels considered (LNF = female, LNM = male, LNO = indet.). The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs).

| Year | Zone | Sp_Sex | # Observ. | FL_Mean | Std. | Min | Max | CV |
|---|---|---|---|---|---|---|---|---|
| 1987 | AT-NE | LNF | 33 | 174.24 | 32.36 | 110 | 225 | 18.57 |
| 1987 | AT-NE | LNM | 69 | 186.45 | 28.71 | 80 | 245 | 15.40 |
| 1987 | AT-NW | LNF | 1 | 225.00 | NA | 225 | 225 | NA |
| 1987 | AT-NW | LNM | 1 | 205.00 | NA | 205 | 205 | NA |
| 1988 | AT-NE | LNF | 191 | 155.24 | 31.52 | 60 | 235 | 20.30 |
| 1988 | AT-NE | LNM | 372 | 162.73 | 32.03 | 70 | 285 | 19.69 |
| 1988 | AT-NE | LNO | 11 | 168.18 | 32.50 | 120 | 220 | 19.33 |
| 1988 | AT-NW | LNF | 8 | 152.50 | 52.44 | 80 | 210 | 34.39 |
| 1988 | AT-NW | LNM | 34 | 148.97 | 66.81 | 60 | 235 | 44.85 |
| 1989 | AT-NE | LNF | 139 | 164.78 | 38.10 | 80 | 305 | 23.12 |
| 1989 | AT-NE | LNM | 208 | 168.05 | 34.75 | 70 | 240 | 20.68 |
| 1989 | AT-NE | LNO | 7 | 92.86 | 40.71 | 75 | 185 | 43.84 |
| 1989 | AT-NW | LNF | 4 | 151.25 | 39.66 | 100 | 185 | 26.22 |
| 1989 | AT-NW | LNM | 4 | 193.75 | 11.81 | 185 | 210 | 6.10 |
| 1990 | AT-NE | LNF | 171 | 161.08 | 34.69 | 55 | 230 | 21.53 |
| 1990 | AT-NE | LNM | 148 | 164.26 | 27.00 | 90 | 215 | 16.44 |
| 1990 | AT-NE | LNO | 2 | 182.50 | 3.54 | 180 | 185 | 1.94 |
| 1991 | AT-NE | LNF | 155 | 152.35 | 37.40 | 80 | 245 | 24.55 |
| 1991 | AT-NE | LNM | 201 | 153.61 | 34.74 | 85 | 245 | 22.61 |
| 1991 | AT-NW | LNF | 1 | 215.00 | NA | 215 | 215 | NA |
| 1992 | AT-NE | LNF | 64 | 174.92 | 41.16 | 60 | 275 | 23.53 |
| 1992 | AT-NE | LNM | 61 | 168.69 | 36.53 | 95 | 235 | 21.65 |
| 1992 | AT-NE | LNO | 2 | 230.00 | 7.07 | 225 | 235 | 3.07 |
| 1993 | AT-NE | LNF | 72 | 173.19 | 35.63 | 95 | 300 | 20.57 |
| 1993 | AT-NE | LNM | 97 | 159.95 | 32.50 | 95 | 210 | 20.32 |
| 1993 | AT-NE | LNO | 1 | 165.00 | NA | 165 | 165 | NA |
| 1994 | AT-NE | LNF | 206 | 164.34 | 36.42 | 85 | 285 | 22.16 |
| 1994 | AT-NE | LNM | 260 | 164.79 | 30.98 | 85 | 280 | 18.80 |
| 1994 | AT-NW | LNF | 3 | 198.33 | 2.89 | 195 | 200 | 1.46 |
| 1994 | AT-NW | LNM | 2 | 167.50 | 10.61 | 160 | 175 | 6.33 |
| 1995 | AT-NE | LNF | 98 | 179.29 | 32.51 | 85 | 260 | 18.13 |
| 1995 | AT-NE | LNM | 99 | 174.09 | 27.89 | 95 | 235 | 16.02 |
| 1995 | AT-NW | LNF | 2 | 212.50 | 3.54 | 210 | 215 | 1.66 |
| 1996 | AT-NE | LNF | 248 | 147.92 | 29.44 | 75 | 240 | 19.90 |
| 1996 | AT-NE | LNM | 341 | 152.29 | 29.57 | 70 | 235 | 19.42 |
| 1996 | AT-NE | LNO | 2 | 180.00 | 14.14 | 170 | 190 | 7.86 |
| 1997 | AT-NE | LNF | 136 | 150.15 | 34.87 | 70 | 215 | 23.22 |
| 1997 | AT-NE | LNM | 201 | 154.38 | 30.96 | 75 | 220 | 20.05 |
| 1997 | AT-NE | LNO | 13 | 133.85 | 18.61 | 120 | 185 | 13.91 |
| 1997 | AT-NW | LNF | 1 | 175.00 | NA | 175 | 175 | NA |
| 1997 | AT-NW | LNO | 4 | 211.25 | 11.09 | 200 | 225 | 5.25 |
| 1998 | AT-NE | LNF | 102 | 148.77 | 45.33 | 75 | 235 | 30.47 |
| 1998 | AT-NE | LNM | 103 | 154.37 | 42.02 | 70 | 260 | 27.22 |
| 1998 | AT-NE | LNO | 3 | 168.33 | 58.59 | 125 | 235 | 34.81 |
| 1998 | AT-NW | LNF | 1 | 85.00 | NA | 85 | 85 | NA |
| 1998 | AT-NW | LNO | 2 | 260.00 | 14.14 | 250 | 270 | 5.44 |

**Table 11b.** Number of observations of size (FL cm) of *Lamna nasus* during the period 1999-2009 for each zone North of 5ºN and for the sex levels considered (LNF = female, LNM = male, LNO = indet.). The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs).

| Year | Zone | Sp_Sex | # Observ. | FL_Mean | Std. | Min | Max | CV |
|---|---|---|---|---|---|---|---|---|
| 1999 | AT-NE | LNF | 90 | 139.28 | 42.08 | 70 | 230 | 30.22 |
| 1999 | AT-NE | LNM | 120 | 152.75 | 35.92 | 80 | 215 | 23.52 |
| 1999 | AT-NE | LNO | 4 | 167.50 | 20.62 | 140 | 190 | 12.31 |
| 1999 | AT-NW | LNO | 1 | 270.00 | NA | 270 | 270 | NA |
| 2000 | AT-NE | LNF | 33 | 132.58 | 28.67 | 85 | 205 | 21.63 |
| 2000 | AT-NE | LNM | 39 | 145.38 | 33.67 | 75 | 200 | 23.16 |
| 2000 | AT-NE | LNO | 2 | 185.00 | 21.21 | 170 | 200 | 11.47 |
| 2000 | AT-NW | LNF | 3 | 81.67 | 2.89 | 80 | 85 | 3.53 |
| 2000 | AT-NW | LNM | 3 | 83.33 | 7.64 | 75 | 90 | 9.17 |
| 2000 | AT-NW | LNO | 8 | 208.13 | 38.45 | 160 | 280 | 18.47 |
| 2001 | AT-NE | LNF | 36 | 143.19 | 42.81 | 75 | 215 | 29.90 |
| 2001 | AT-NE | LNM | 44 | 144.20 | 36.71 | 75 | 205 | 25.46 |
| 2001 | AT-NE | LNO | 6 | 129.17 | 26.35 | 100 | 165 | 20.40 |
| 2001 | AT-NW | LNO | 1 | 225.00 | NA | 225 | 225 | NA |
| 2002 | AT-NE | LNF | 39 | 150.64 | 32.43 | 95 | 220 | 21.53 |
| 2002 | AT-NE | LNM | 19 | 151.32 | 27.83 | 100 | 200 | 18.39 |
| 2002 | AT-NE | LNO | 9 | 177.78 | 24.38 | 140 | 215 | 13.71 |
| 2002 | AT-NW | LNF | 1 | 205.00 | NA | 205 | 205 | NA |
| 2002 | AT-NW | LNO | 4 | 211.25 | 35.68 | 180 | 260 | 16.89 |
| 2003 | AT-NE | LNF | 9 | 165.00 | 40.62 | 95 | 215 | 24.62 |
| 2003 | AT-NE | LNM | 25 | 176.00 | 32.11 | 95 | 225 | 18.25 |
| 2003 | AT-NE | LNO | 1 | 225.00 | NA | 225 | 225 | NA |
| 2003 | AT-NW | LNF | 2 | 180.00 | 7.07 | 175 | 185 | 3.93 |
| 2003 | AT-NW | LNM | 5 | 191.00 | 17.46 | 175 | 220 | 9.14 |
| 2003 | AT-NW | LNO | 2 | 260.00 | 70.71 | 210 | 310 | 27.20 |
| 2004 | AT-NE | LNF | 21 | 150.71 | 31.87 | 100 | 215 | 21.15 |
| 2004 | AT-NE | LNM | 26 | 166.54 | 33.52 | 100 | 210 | 20.13 |
| 2004 | AT-NE | LNO | 5 | 164.00 | 37.32 | 100 | 195 | 22.75 |
| 2004 | AT-NW | LNM | 4 | 202.50 | 34.76 | 170 | 250 | 17.17 |
| 2005 | AT-NE | LNF | 10 | 178.00 | 33.35 | 115 | 220 | 18.74 |
| 2005 | AT-NE | LNM | 25 | 174.40 | 23.69 | 120 | 220 | 13.58 |
| 2005 | AT-NW | LNO | 2 | 192.50 | 31.82 | 170 | 215 | 16.53 |
| 2006 | AT-NE | LNF | 58 | 152.16 | 29.23 | 85 | 210 | 19.21 |
| 2006 | AT-NE | LNM | 108 | 149.58 | 30.41 | 80 | 215 | 20.33 |
| 2006 | AT-NE | LNO | 5 | 181.00 | 20.74 | 155 | 205 | 11.46 |
| 2006 | AT-NW | LNF | 1 | 210.00 | NA | 210 | 210 | NA |
| 2006 | AT-NW | LNM | 1 | 170.00 | NA | 170 | 170 | NA |
| 2007 | AT-NE | LNF | 5 | 175.00 | 28.94 | 130 | 210 | 16.54 |
| 2007 | AT-NE | LNM | 6 | 160.83 | 42.48 | 85 | 210 | 26.41 |
| 2007 | AT-NE | LNO | 1 | 170.00 |  | 170 | 170 | NA |
| 2007 | AT-NW | LNO | 3 | 253.33 | 63.51 | 180 | 290 | 25.07 |
| 2008 | AT-NE | LNF | 26 | 135.19 | 34.97 | 85 | 205 | 25.87 |
| 2008 | AT-NE | LNM | 28 | 149.29 | 31.50 | 95 | 210 | 21.10 |
| 2008 | AT-NE | LNO | 1 | 160.00 | NA | 160 | 160 | NA |
| 2008 | AT-NW | LNO | 1 | 290.00 | NA | 290 | 290 | NA |
| 2009 | AT-NE | LNF | 18 | 143.61 | 21.61 | 105 | 180 | 15.05 |
| 2009 | AT-NE | LNM | 14 | 133.93 | 33.87 | 85 | 185 | 25.29 |

**Table 11[c].** Number of observations of size (FL cm) of *Lamna nasus* during the period 2010-2017 for each zone North of 5ºN and for the sex levels considered (LNF = female, LNM = male, LNO = indet.). The most representative statistics are provided (FL mean, Standard Deviation, min, max and CVs).

| Year | Zone | Sp_Sex | # Observ. | FL_mean | Std. | Min | Max | CV |
|---|---|---|---|---|---|---|---|---|
| 2010 | AT-NE | LNO | 2 | 160.00 | 49.50 | 125 | 195 | 30.94 |
| 2011 | AT-NE | LNF | 1 | 100.00 | NA | 100 | 100 | NA |
| 2012 | AT-NE | LNF | 2 | 120.00 | 49.50 | 85 | 155 | 41.25 |
| 2012 | AT-NE | LNM | 4 | 135.00 | 20.82 | 110 | 160 | 15.42 |
| 2017 | AT-NE | LNF | 1 | 190.00 | NA | 190 | 190 | NA |
| 2017 | AT-NE | LNM | 1 | 200.00 | NA | 200 | 200 | NA |

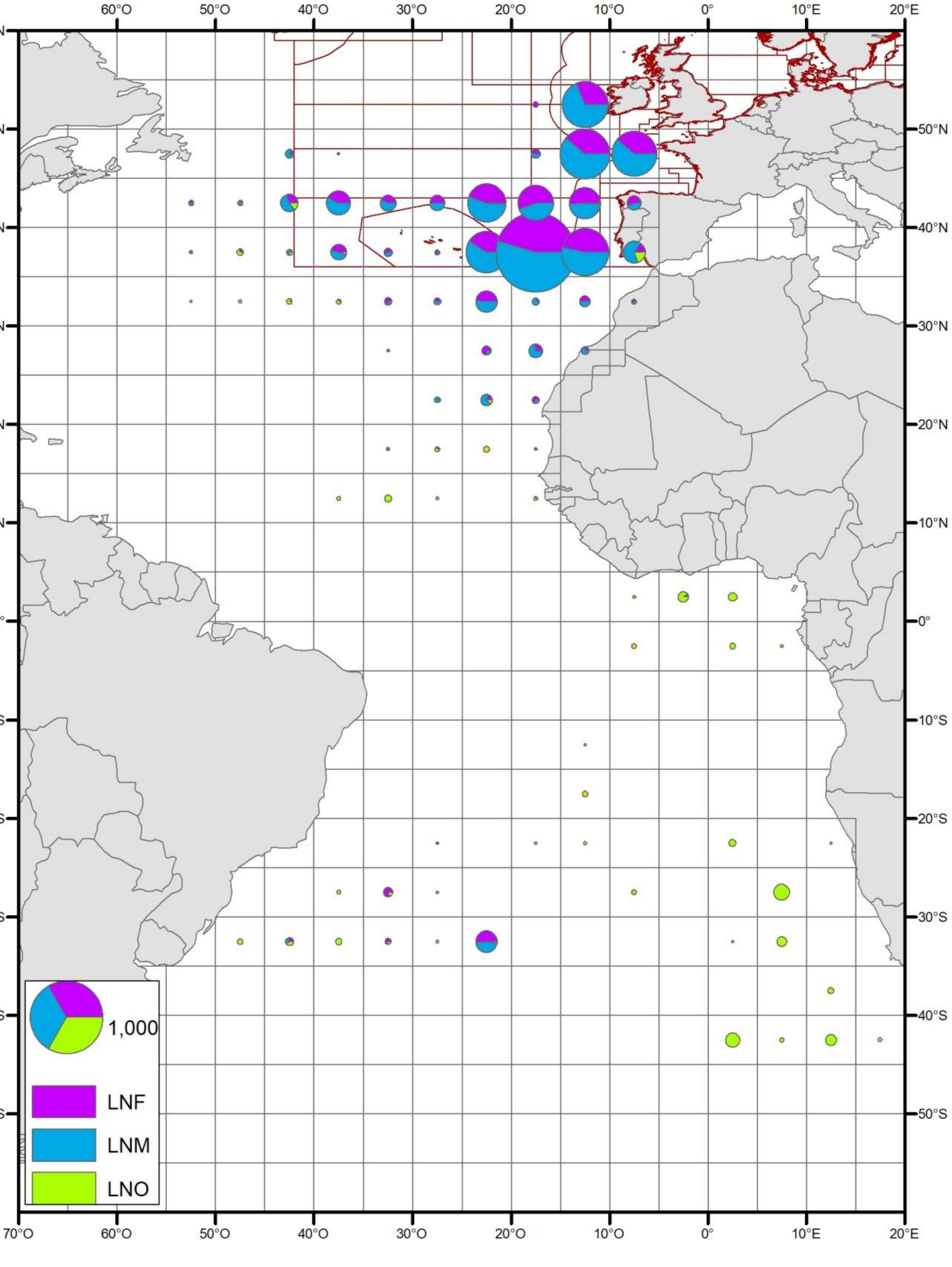
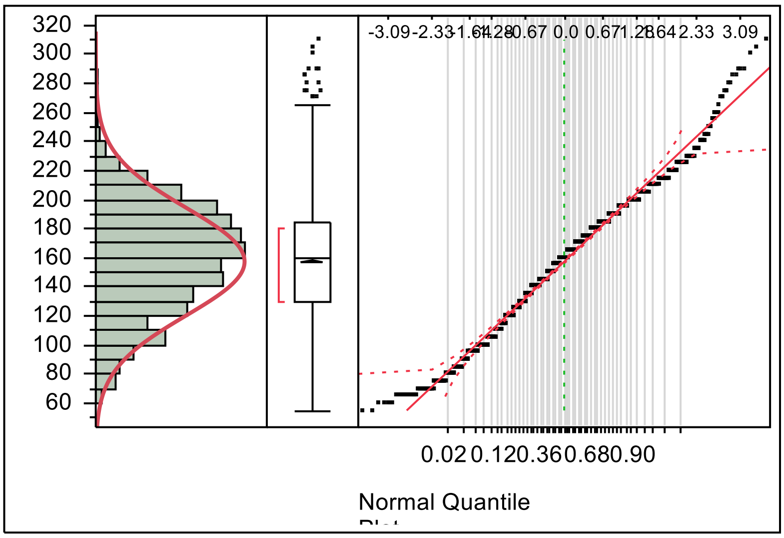



**Figure 1.** Map of the number of size (FL cm) observations of the porbeagle (*Lamna nasus*) available from the combined period 1987-2017. LNF = females, LNM = males, LNO = indet.




| | |
|---|---|
| Median | 160 |
| Mean | 157.36079 |
| Std Dev. | 37.117148 |
| Std Err Mean | 0.5179193 |
| Upper 95% Mean | 158.37613 |
| Lower 95% Mean | 156.34544 |
| N | 5136 |

**Figure 2.** Size distribution (FL cm) and Normal Quantile Plot of porbeagle in the North and South Atlantic for zones (NE, NW, SE, SW) and for sexes (female + male + indet.) combined, during the period 1987-2017.

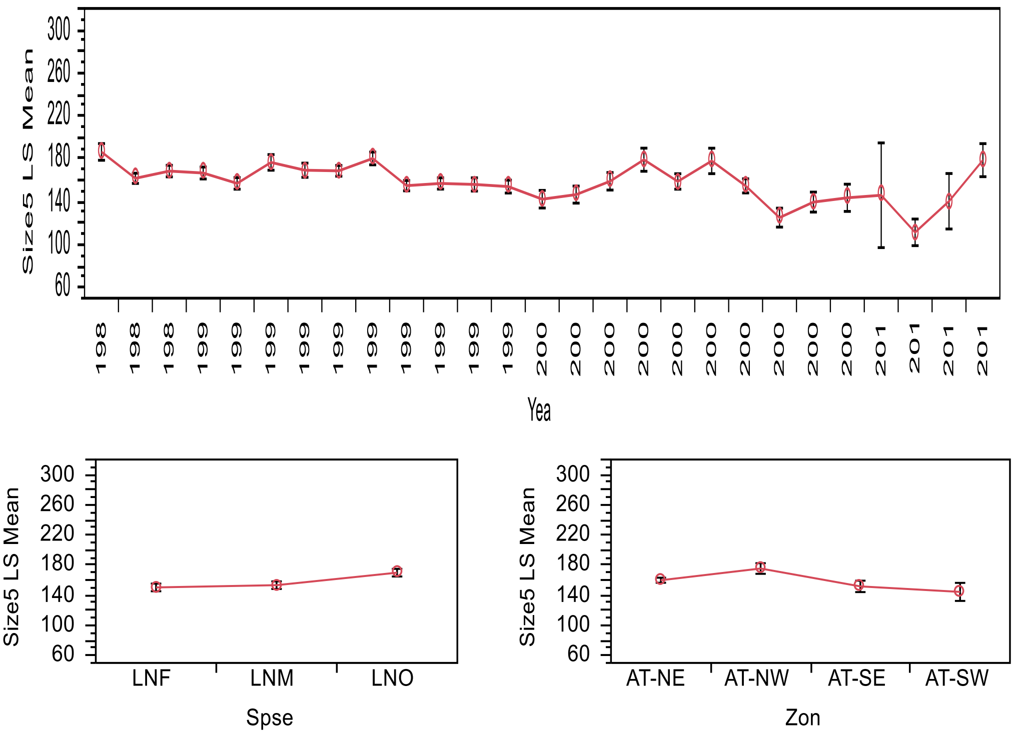



**Figure 3.** FL lsmeans (cm) and CI95% values of the year, sex, zone factors obtained from a GLM considering all available observations of the North Atlantic (zones NE, NW) and South (zones SE, SW). LNF = females, LNM = males, LNO = indet.

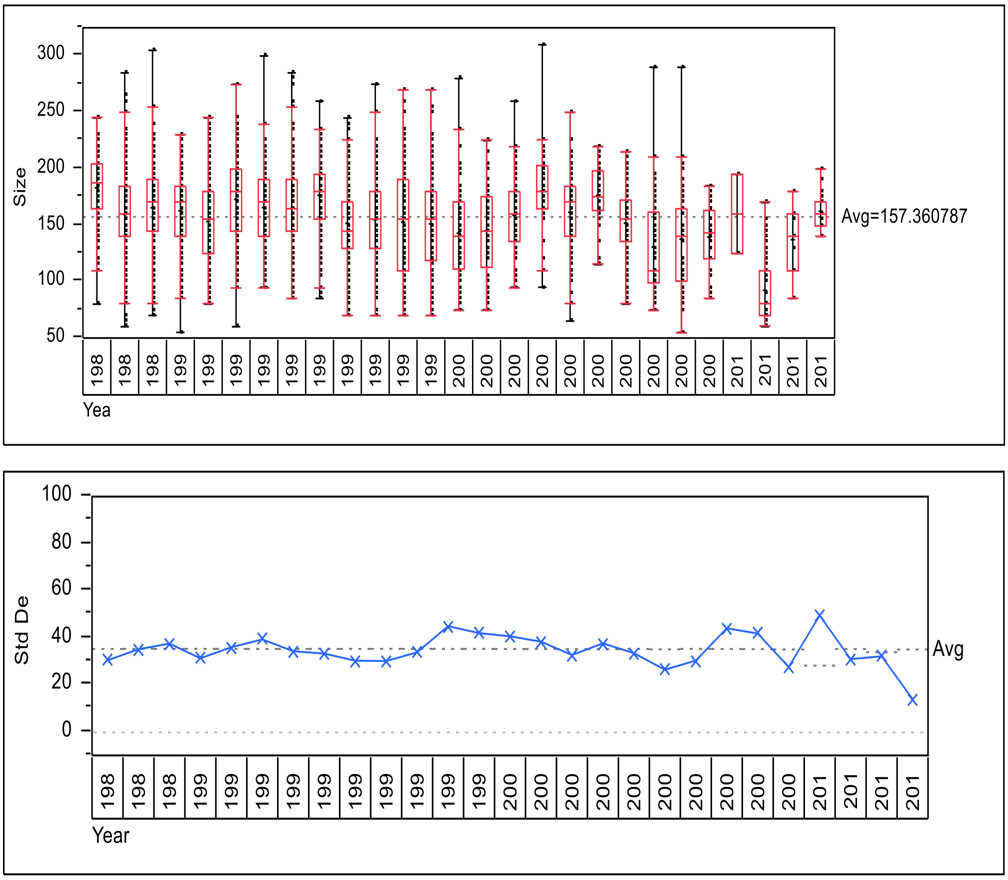
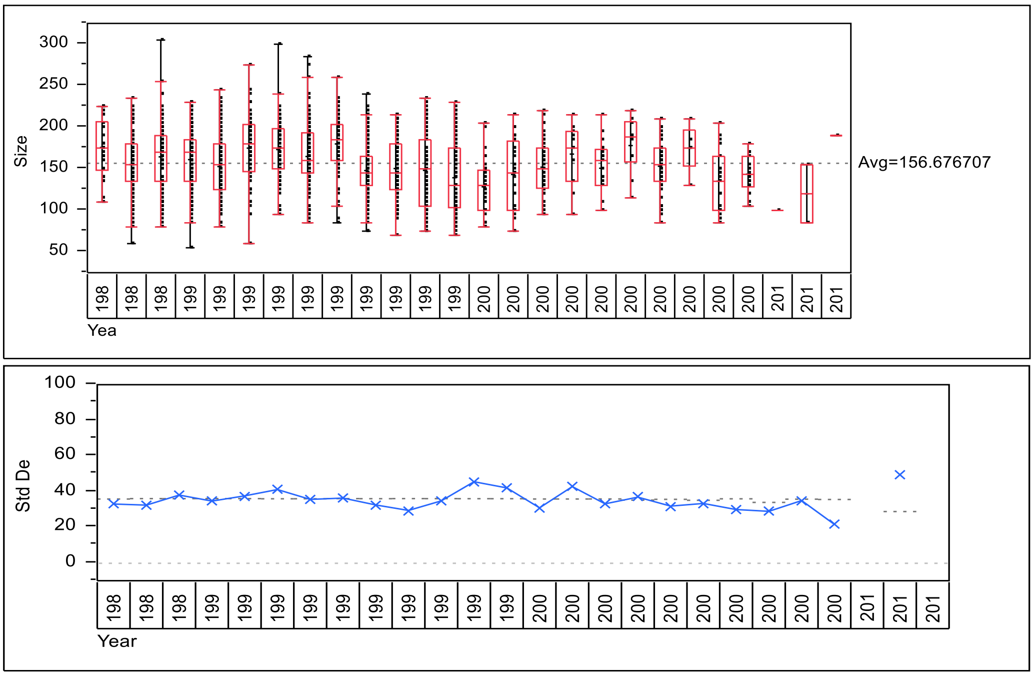



**Figure 4.** Variability chart, box-plots and standard deviation of size (FL cm) observed during the period 1987-2017, considering all available observations of the Atlantic (North: zones NE, NW; South: zones SE, SW) and sexes combined. (female+male+indet.)

## Females




## Males

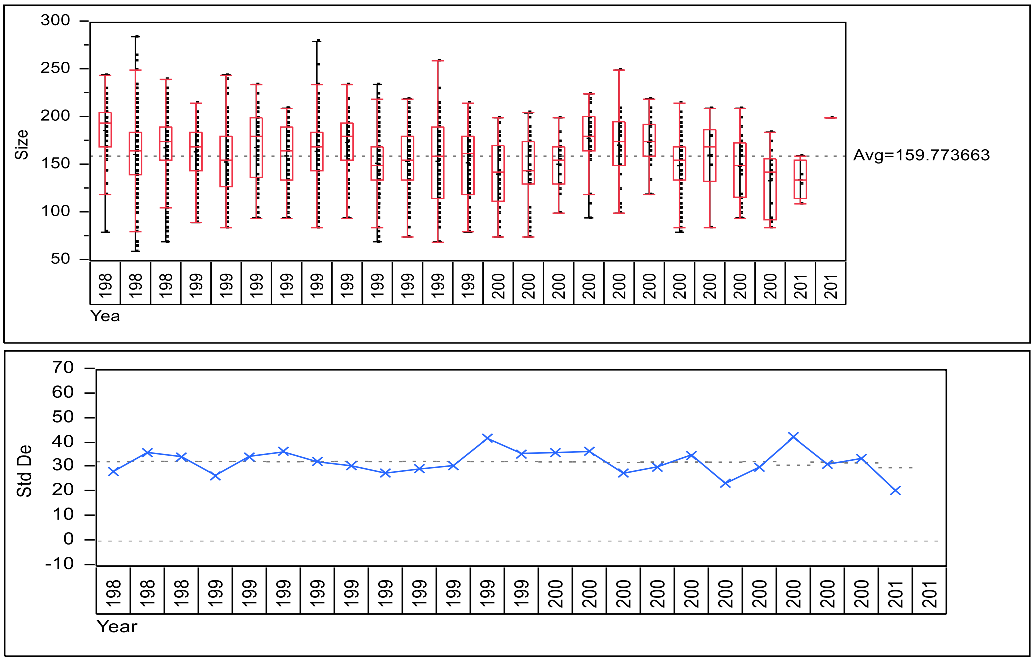
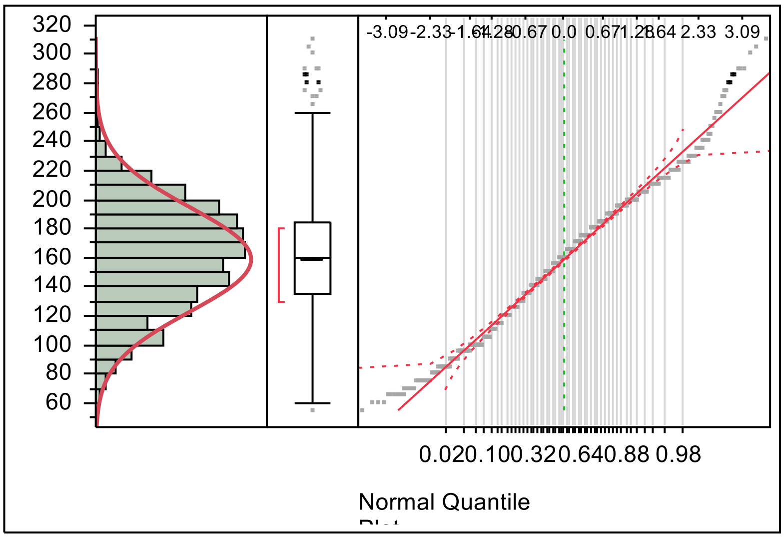



**Figure 5.** Variability chart, box-plots and standard deviation of the sizes (FL cm) observed during the period 1987-2017, considering all the observations available from the North Atlantic (zones: NE, NW) and for each identified sex (Females: upper panels, Males: lower panels).




| | |
|---|---|
| Median | 160.00 |
| Mean | 158.83 |
| Std Dev. | 35.89 |
| Std Err Mean | 0.5196 |
| Upper 95% Mean | 159.8468 |
| Lower 95% Mean | 157.8094 |
| N | 4770 |

**Figure 6.** Size distribution (FL cm) of porbeagle in the North Atlantic zones (NE and NW combined) and for combined sexes (female + male + indet.) during the combined period 1987-2017.

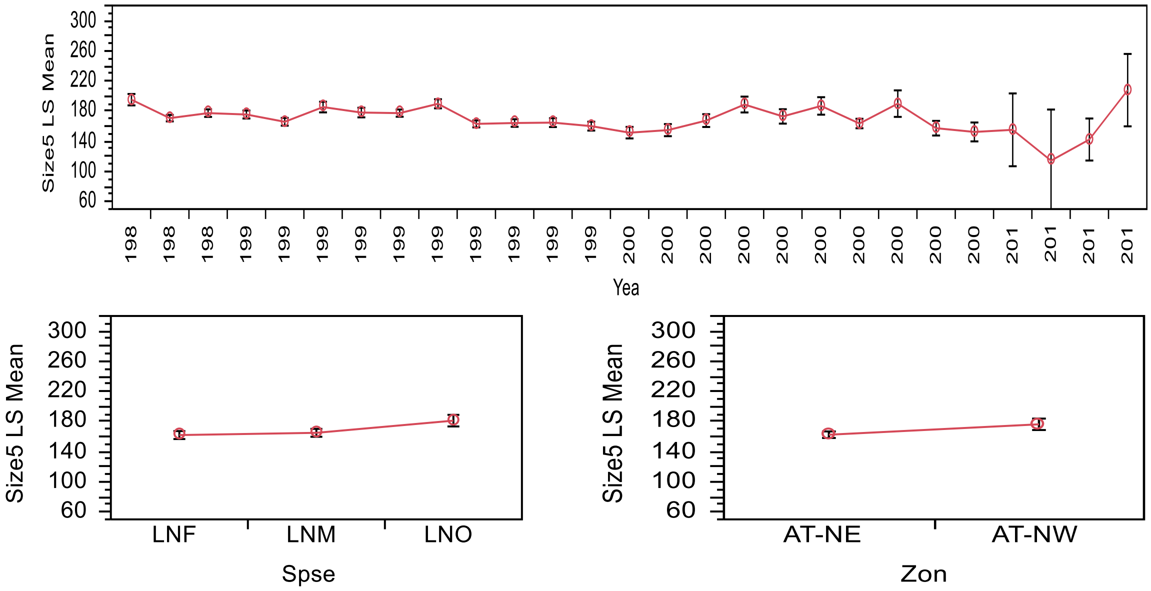



**Figure 7.** FL_lsmeans (cm) and CI95% values of the year, sex, zone factors obtained from a GLM considering all the observations available from the North Atlantic (zones NE, NW). LNF = females, LNM = males, LNO = indet.

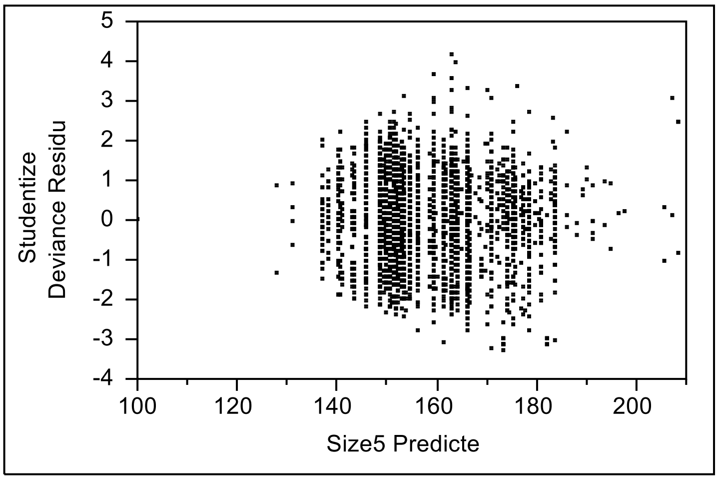
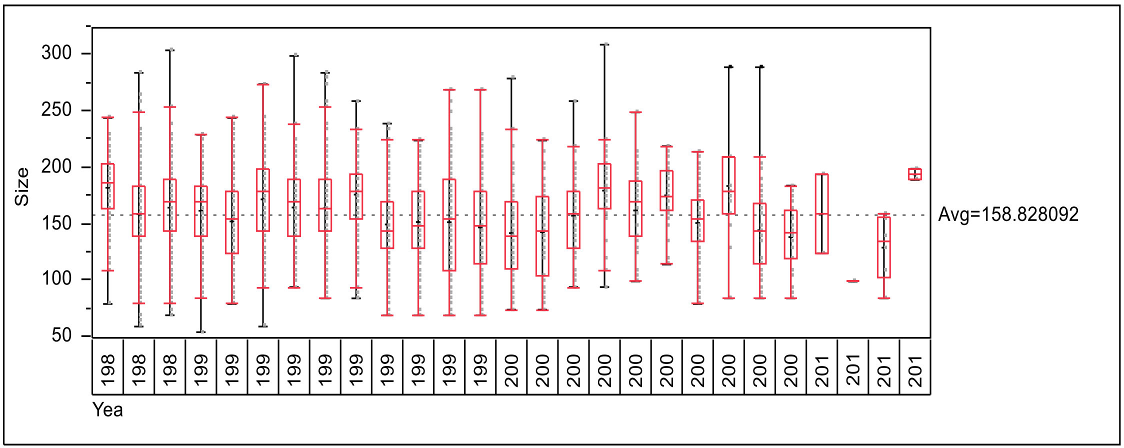



**Figure 8.** Studentized deviance residual by predicted size (FL cm) of the factors year, sex and zone obtained from a GLM considering all available observations of the North Atlantic (zones NE, NW).



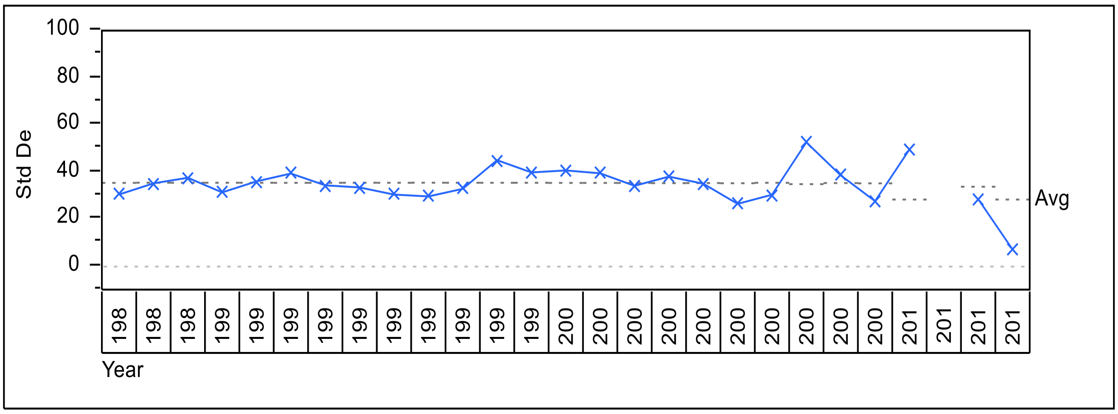




**Figure 9.** Variability chart, box-plots and standard deviation of the sizes (FL cm) observed during the period 1987-2017, considering all the available observations of the North Atlantic (zones NE, NW) and sexes combined (female + male + indet.).

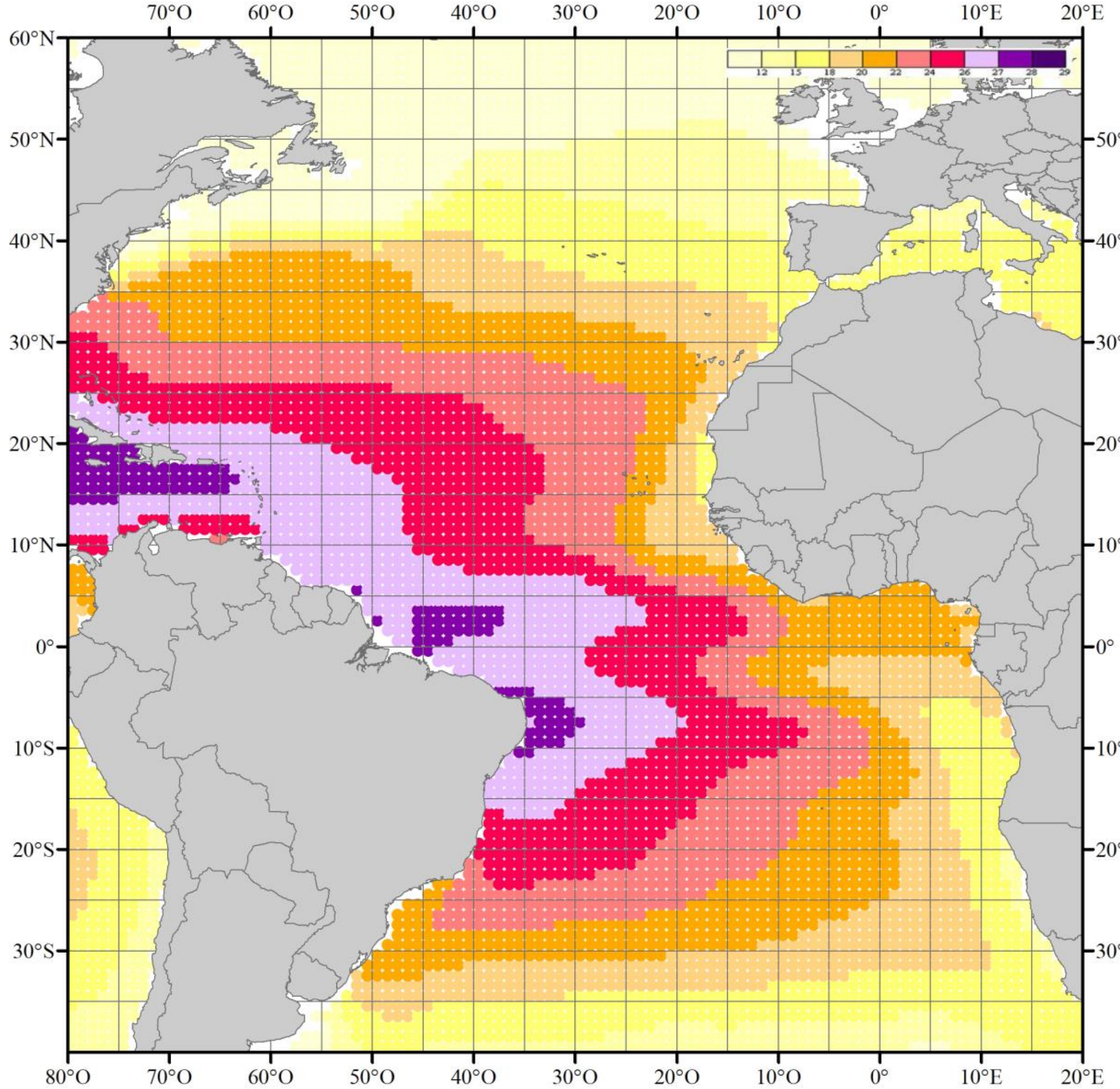



**Figure 10.** Mean-annual sea temperature (ºC) at 50m depth (Fernandez-Costa *et al.* 2017). Monthly evolution of sea temperature at 50m depth can be found in http://www.co.ieo.es/tunidos/documentos/revistas/2014/repro.gif