# 3 Northeast Atlantic boarfish (*Capros aper*)

The boarfish (*Capros aper*, Linnaeus) is a deep bodied, laterally compressed, pelagic shoaling species distributed from Norway to Senegal, including the Mediterranean, Azores, Canaries, Madeira and Great Meteor Seamount (Blanchard & Vandermeirsch 2005).

Boarfish is targeted in a pelagic trawl fishery for fish meal, to the southwest of Ireland. The boarfish fishery is conducted primarily in shelf waters and the first landings were reported in 2001. Landings were at very low levels from 2001-2005. The main expansion period of the fishery was 2006-2010 when unrestricted landings increased from 2 772 t to 137 503 t. A restrictive TAC of 33 000 t was implemented in 2011. In 2011, ICES was asked by the European Commission to provide advice for 2012.

An analysis of bottom trawl survey data suggests a continuity of distribution spanning ICES Subareas 27.4, 6, 7, 8 and 9 (Figure 3.1). Isolated occurrences appear in the North Sea (ICES Subarea 27.4) in some years indicating spill-over into this region. A hiatus in distribution was suggested between ICES Divisions 27.8.c and 9.a as boarfish were considered very rare in northern Portuguese waters but abundant further south (Cardador & Chaves 2010). Results from a dedicated genetic study on the stock structure of boarfish within the Northeast Atlantic and Mediterranean Sea suggests that this hiatus represents a true stock separation (Farrell *et al.* (2016); see section 3.12). Based on these data, a single stock is considered to exist in ICES Subareas 27.4, 6, 7, 8 and the northern part of 9.a. This distribution is slightly broader than the current EC TAC area (27.6, 7 and 8) and for the purposes of assessment in 2020 only data from these areas were utilized.

## 3.1 The fishery

### 3.1.1 Advice and management applicable from 2011 to 2019

In 2011 a TAC was set for this species for the first time, covering ICES Subareas 6, 7 and 8. This TAC was set at 33 000 t. Before 2010, the fishery was unregulated. In October 2010, the European Commission notified national authorities that under the terms of Annex 1 of Regulation 850/1998, industrial fisheries for this species should not proceed with mesh sizes of less than 100 mm. In 2011, the European Parliament voted to change Regulation 850/1998 to allow fishing using mesh sizes ranging from 32 to 54 mm.

For 2012, ICES advised that catches of boarfish should not increase, based on precautionary considerations. As supporting information, ICES noted that it would be cautious that landings did not increase above 82 000 t, the average over the period 2008-2010, during which the stock did not appear to be overexploited. In 2012 the TAC was set at 82 000 t by the Council of the European Union.

For 2013, ICES advised that catches of boarfish should not be more than 82 000 t. This was based on applying a harvest ratio of 12.2% (F0.1, as an $F_{MSY}$ proxy). For 2013, the TAC was set at 82 000 t by the Council of the European Union.

For 2014, ICES advised that, based on $F_{MSY}$ (0.23), catches of boarfish should not be more than 133 957 t, or 127 509 t when the average discard rate of the previous ten years (6 448 t) is taken into account. For 2014 the TAC was set at 133 957 t by the Council of the European Union. This advice was based on a Schaefer state space surplus production model (see section 3.6.3 for further details).

In 2014 there was concern about the use of the production model (see stock annex). ICES considered that the model was no longer suitable for providing category 1 advice and further model development was required. The model is still considered suitable for category 3 advice. The advised catch for 2015 of 53 296 t was based on the data limited stock HCR and an index calculated (method 3.1; ICES, 2012) using the total stock biomass trends from the model. Further work has been undertaken in 2015 to address the issues with the surplus production model and this work has been continued since.

For 2016, ICES advised based on the precautionary approach that catches should be no more than 42 637 t.

For 2017, ICES advised based on the precautionary approach that catches should be no more than 27 288 t. For the first time, the precautionary buffer has been applied resulting in a 36% reduction compared to the year before. The acoustic survey suggested that the stock abundance was at an historic low.

In 2017, the Advice Drafting Group decided the advice of 21 830 proposed (20% reduction) would stand for 2 years. The update assessments in 2018 and 2019 confirms that the biomass is rather stable and at a low level.

In 2019, advice of 19 152 t was issued for each of 2020 and 2021 on the basis of the precautionary approach.

Since 2011, there has been a provision for bycatch of boarfish (also whiting, haddock and mackerel) to be taken from the Western and North Sea horse mackerel EC quotas. These provisions are shown in the text table below. The effect of this is that a quantity not exceeding the value indicated of these 4 species combined may be landed legally and subtracted from quotas for horse mackerel.

| Year | North Sea (t) | Western (t) |
|---|---|---|
| 2011 | 2 031 | 7 779 |
| 2012 | 2 148 | 7 829 |
| 2013 | 1 702 | 7 799 |
| 2014 | 1 392 | 5 736 |
| 2015 | 583 | 4 202 |
| 2016 | 760 | 5 443 |
| 2017 | 912 | 4191 |
| 2018 | 759 | 5053 |
| 2019 | 912 | 4191 |

In 2010, an interim management plan was proposed by Ireland, which included a number of measures to mitigate potential bycatch of other TAC species in the boarfish fishery. A closed season from the 15th March to 31st August was proposed, as anecdotal evidence suggests that mackerel and boarfish are caught in mixed aggregations during this period. A closed season was proposed in ICES Division 7.g from 1st September to 31st October, in order to prevent catches of Celtic Sea herring, which is known to form feeding aggregations in this region at these times. Finally, if catches of a species covered by a TAC, other than boarfish, amount to more than 5%

of the total catch by day by ICES statistical rectangle, then fishing must cease in that rectangle for 5 days.

In August 2012 the Pelagic RAC proposed a long term management plan for boarfish (see section 3.15). The management plan was not fully evaluated by ICES. However, in 2013, ICES advised that Tier 1 of the plan can be considered precautionary if a Category 1 assessment is available.

A revised draft management strategy was proposed by the Pelagic AC in July 2015. This management strategy aims to achieve exploitation of boarfish in line with the precautionary approach to fisheries management, FAO guidelines for new and developing fisheries, and the ICES form of advice. ICES evaluated the plan and considered it to be precautionary, in that that it follows the rationale for TAC setting enshrined in the ICES advice, but with additional caution.

The closed season, in the interim and revised management plans, has been enacted in legislation in Ireland, but not in other countries.

## 3.1.2 The fishery in recent years

The first landings of boarfish were reported in 2001. Landings fluctuated between 100 and 700 t per year up to 2005 (Tables 3.1.2.1 & 3.1.2.2). In 2006 the landings began to increase considerably as a target fishery developed. Cumulative landings since 2001 exceed 500 000 t. The fishery targets dense shoals of boarfish from September to March. Catches are generally free from bycatch from September to February. From March onward a bycatch of mackerel can be found in the catches and the fishery generally ceases at this time. Information on the bycatch of other species in the boarfish fishery is sparse, though thought to be minimal. The fishery uses pelagic pair trawl nets with mesh sizes ranging from 32 to 54 mm. Preliminary information suggests that only the smallest boarfish escape this gear.

From 2001 to 2006 only Ireland reported landings of boarfish. In 2007 UK (Scotland) reported landings of 772 t. Scottish landings peaked at 9 241 t in 2010 and have declined since with no fishery since 2015. Denmark joined the fishery in 2008 and landed 3 098 t. Danish landings increased to 39 805 t in 2010 but have declined considerably to only 29 t in 2015. The fishery has been slowly increasing in recent years with 757 t landed in 2019. The vast majority of catches have come from ICES Division 27.7.j and 27.7.h (Figure 3.1.2.1 and Table 3.1.2.1). Since 2011 landings have been regulated by a TAC.

In 2014 and subsequent years, the full TAC has not been caught. This is thought to be partly due to lesser availability of fishable aggregations, and partly due to economic and administrative reasons. According to the industry, fishable aggregations were not always available during the fishery season which coincides with the mackerel and horse mackerel fisheries. Also, the Irish quota was allocated to individual boats, with non-specialist vessels receiving allocations that were not used. In 2015, Q3 and Q4 individual boat quotas were removed in Ireland, in an attempt to allow the specialist 6-7 vessels target the stock without (what the industry considers to be unnecessary) constraints. The same year, the Netherlands (375 t), UK England (104 t) and Germany (4 t) reported boarfish landings for the first time. These landings were mainly bycatch from freezer trawlers.

In 2016 a total of 19 315 t of boarfish were caught (Table 3.1.2.1). Ireland continued to be the main participant taking 17 496 t but is below its 29 464 t quota. Denmark took only 337 t, significantly under its national quota of 10 463 t. Scotland reported no boarfish landings. Table 3.1.2.2 shows that two thirds of the Irish landings were taken in ICES divisions 7.h and 8.a. Thirty-two Irish registered fishing vessels reported catches with the majority made in Q1 (7 143 t) and Q4 (8 711 t).

Previous to the development of the target fishery, boarfish was a discarded bycatch in pelagic fisheries for mackerel in ICES Subareas 7 and 8. A study by Borges *et al.* (2008) found that boarfish may have accounted for as much as 5% of the total catch of Dutch pelagic freezer trawlers. Boarfish are also discarded in whitefish fisheries, particularly by Spanish demersal trawlers (Table 3.1.2.3).

In 2017 a total of 17 388 t of boarfish were caught Table 3.1.2.1). Ireland continued to be the main participant landing 15 484 t but is almost 20% below its 18 858 quota. Denmark landed only 548 t, not even 10% of its national quota of 6 696 t. UK reported almost null boarfish landings. Discards accounted for 1 173 tonnes overall. About 90% of the Irish landings were taken in ICES divisions 7.h and 8.a. Thirty-five Irish registered fishing vessels reported catches with almost the entirety made in Q1 (8 570 t) and Q4 (6 270 t).

In 2018 a total of 11 286 t of boarfish were caught (Table 3.1.2.1). This represents 55% of the 2018 quota of 20 380 t. Ireland continued to be the main participant landing 9 513 t (68% of its national quota). The Irish catch represents 85% of the total boarfish catch in 2018. Other countries reporting boarfish in 2018 were Denmark (94 t), The Netherlands (172 t), Spain (148t), UK England (0.085 t) and UK Scotland (0.229 t). Discards accounted for 1 359 t overall. Table 3.1.2.2 shows that about 82% of the Irish landings were taken in ICES divisions 7.h and 8.a.

## 3.1.3 The fishery in 2019

A total of 11 312 t of boarfish was caught in 2019 (Table 3.1.2.1). This represents 52% of the 2019 quota of 21 830 t. The main participant in the fishery, Ireland, landed 9 910 t (75% of its national quota). The Irish catch represents 88% of the total boarfish catch in 2019. Other countries reporting boarfish catches in 2019 were Denmark (757 t), the Netherlands (317 t), England (19 t) and Spain (2.5 t). Discards accounted for 306 t overall. Table 3.1.2.2 shows that about 87% of Irish landings were taken in ICES divisions 7.h and 8.a.

## 3.1.4 Regulations and their effects

In 2010, the fishery finished early when the European Commission notified member states that mesh sizes of less than 100 mm were illegal. However, in 2011, the European Parliament voted to change Regulation 850/1998 to allow fishing for boarfish using mesh sizes ranging from 32 to 54 mm. The TAC (33 000 t) that was introduced in 2011 significantly reduced landings.

## 3.1.5 Changes in fishing technology and fishing patterns

The expansion of the fishery in the mid-2000s was associated with developments in the pumping and processing technology for boarfish catches. These changes made it easier to pump boarfish ashore. Efforts are underway to develop a human consumption market and fishery for boarfish. To date the majority of boarfish landings by Danish, Irish and Scottish vessels have been made into Skagen, Denmark and Fuglafjorour, Faroe Islands to be processed into fishmeal. A small number of Irish vessels have landed into Killybegs and Castletownbere, Ireland. These landings into Irish ports were expected to increase in the future with the development of a human consumption fishery but this development now seems unlikely. This is due to the species' small size and difficulty being processed on conventional equipment.

## 3.1.6 Discards

Since 2003, the major sources of discard estimates are the Dutch pelagic freezer trawlers and both the Irish and Spanish demersal fleets. More sporadic discards are observed in German pelagic freezer trawlers and the UK demersal fleet. In 2016, Lithuania declared discards for the first time. Discard estimates are not obtained from French freezer trawlers, though discard patterns in these fleets are likely to be similar to the Dutch fleet. Discard data from the Portuguese bottom otter trawl fleet in ICES Division 9.a are also available but are not included in the assessment as they are outside the TAC area. Table 3.1.2.3 shows available discard estimates.

It is to be expected that discarding occurred before 2003, particularly in demersal fisheries, however it is difficult to predict what the levels may have been.

Discard data were included in the calculation of catch numbers at age. All discards were raised as a single metier using the same age length keys and sampling information as for the landed catches. In the absence of better sampling information on discards, this was considered the best approach. This placed the stock in Category A2 for the ICES Advice in October 2013: Discards 'topped up' onto landings calculations. With the introduction of the discard ban in 2015 this stock was placed in A4: Discards known, with discard ban in place in year +1. As such the advice will be given for catch in ICES Advice October 2014 and onwards.

## 3.2 Biological composition of the catch

### 3.2.1 Catches in numbers-at-age

Catch number-at-age were prepared for Irish, Danish, Dutch, German and English landings using the ALK in Table 3.2.1.1 together with available samples from the fishery (Table 3.2.1.2). This general ALK was constructed based on 814 aged fish from Irish, Danish and Scottish caught samples from 2012 (see the stock annex for a description of ALKs prior to 2012). In 2019, allocations to unsampled metiers were made according to Table 3.2.1.3. In total, 18 samples with the appropriate 0.5 cm length bin measurements were collected in 2019 (Table 3.2.1.4). These samples covered the most heavily fished areas (Table 3.2.1.5) and equated to one sample per 629 t landed. The samples comprised 371 fish measured for length frequency.

The results of the application of the ALK to commercial length-frequency data available for the years 2007-2019 to produce a proxy catch numbers-at-age are available in Table 3.2.1.6. There have been no strong year classes with poor cohort tracking in the catch numbers. A high number of 2 year olds are present in the 2015 data but this does not echo in the number of 3-year-old fish in 2016. The modal age from 2007-2011 was 6 and in 2012-2018 it was 7. It should be noted that in WGWIDE 2011 and 2012 the plus group for boarfish was 20+. This was reduced to 15+ in WGWIDE 2013 due to potential inaccuracy of the age readings of older fish. Ageing was based on the method that has been validated for ages 0-7 by Hüssy *et al*. (2012a; b). The age range is similar to the published growth information presented by White *et al*. (2011).

### 3.2.2 Quality of catch and biological data

Table 3.2.1.3 shows allocations that were made to unsampled métiers in 2018. Length-frequencies of the international commercial landings by year are presented in Table 3.2.2.1.

Sampling in the early years of the fishery (2006-2009) was sparse as there was no dedicated sampling programme in place. The sampling programme was initiated in 2010 and good coverage of the landings has been achieved since then. Full details of the sampling programme in the earlier years are presented in the stock annex. Until 2017, boarfish was not included on the DCF list of species for sampling. Irish sampling comprises only samples from Irish registered vessels. Samples are collected on-board directly from the fish pump during fishing operations and are frozen until the vessel returns to port, which ensures high quality samples. Each sample consists of approximately 6 kg of boarfish. This equates to approximately 150 fish which, given the limited size range of boarfish, is sufficient for determining a representative length frequency. The established sampling target is one sample per 1 000 t of landings per ICES Division, which is also standard in other pelagic fisheries such as mackerel. Since 2017, all fish in each sample should be measured to the 0.5 cm below for length frequency. Following standard protocols 5 fish per 0.5 cm length class should be randomly selected from each sample for biological data collection *i.e.* otolith extraction, measurement to the 1mm below and sex and maturity determination.

There is no sampling programme in place for Scottish catches.

The current surplus production model used to assess boarfish is considered an interim measure prior to the development of an aged-based assessment. In 2017, boarfish was included in the list of species to be sampled by the Data Collection Multi Annual Programme (DCMAP) which should provide estimates of catch at age and facilitate the future development of an age-based stock assessment method.

# 3.3 Fishery Independent Information

## 3.3.1 Acoustic Surveys

The Boarfish Acoustic Survey (BFAS) was first conducted in July 2011 and is now in its tenth year. The 2020 survey was carried out on-board the RV *Celtic Explorer* and run in conjunction the Malin Shelf herring survey as the WESPAS survey (Western European Shelf Pelagic Acoustic Survey). The survey was carried out over a 42-day period beginning on the 3 June in the south (47°30N) and working northwards to 59°30N ending on 10 July.

**Change in abundance calculation method**

The StoX software package and ICES acoustic database have been fully adopted as the processing and repository for acoustic survey data (Johnsen *et al.*, 2019). Survey design and execution of the WESPAS survey adhere to guidelines laid out in the Manual for International Pelagic Surveys (IPS) (ICES, 2015).

**Survey results 2020**

The estimate of boarfish biomass is presented in Table 3.3.1.1 and the spatial distribution of the echotraces attributed to boarfish in 2020 are presented in Figure 3.3.1.1. Overall, the WESPAS survey provided continuous synoptic coverage from south to north over 42 days covering relating to an area coverage of almost 56,686 nmi$^2$ (boarfish strata) and transect mileage of over 5,531 nmi. In total, 35 trawl stations were undertaken with 15 hauls containing boarfish providing 3,091 individual lengths, 1,204 length and weight measurements and 651 otoliths for use during the analysis.

The 2020 estimate of total stock biomass was over double that observed in 2019 (179,000 t in 2019, and 399,000 t in 2020). Over 65.6% of the biomass was observed in the Celtic Sea followed by 22% along the Irish west coast. The southern Celtic Sea/Northern Biscay area was found to contain a high abundance of immature boarfish as observed to a lesser extent in 2019. Immature boarfish represented 41.4% of the total abundance observed across the combined survey area.

The age composition of in 2020 was dominated by oldest age classes (15+), in terms of biomass, followed by the 8 and 9-year-old fish occurring as a second obvious cohort grouping. In terms of abundance, the older fish (15+) dominated (17%) followed by the influence pre-recruit immature fish (0-3-year-old fish), which combined contribute over 41% of the total abundance. The last two years of the survey have observed higher than average numbers of immature fish some of which will recruit to the spawning stock in the next 1 to 3 years. This pulse of recruitment is similar to that observed in the now 7-9-year-old fish (2011-2013 year classes).

During the 2020 survey access to French waters (southernmost transects) was hampered by naval operations which prevented trawling. This was problematic given this area contains variable proportions of immature and mature fish. Trawl samples from further north were applied during the analysis. The use of a static age-length-key to estimate the age composition remains an issue for this survey. Aging of survey derived samples would likely improve the ability to track cohorts more effectively within the survey index and reduce this potential source of error.

### 3.3.2 International bottom trawl survey (IBTS) Indices Investigation

The western IBTS data and CEFAS English Celtic Sea Groundfish Survey were investigated for their use as abundance indices for boarfish for the first time in 2012. An index of abundance was constructed from the following surveys:

- EVHOE, French Celtic Sea and Biscay Survey, (Q4) 1997 to 2011
- IGFS, Irish Groundfish Survey, (Q4) 2003 to 2011
- WCSGFS, West of Scotland, (Q1 and Q4) 1986 to 2009 (survey design changed in 2010)
- SPPGFS, Spanish Porcupine Bank Survey, (Q3) 2001 to 2011
- SPNGFS, Spanish North Coast Survey, (Q3/Q4) 1991 to 2011
- ECSGFS, CEFAS English Celtic Sea Groundfish Survey, (Q4) 1982 to 2003

From the IBTS data, CPUE was computed as the number of boarfish per 30 min haul. The abundance of boarfish per year per ICES statistical rectangle (used for visualisation only) was then calculated by summing the boarfish in a given rectangle and dividing by the total number of hauls in that rectangle. Length frequencies are presented in Table 3.3.2.1 for each survey. These surveys cover the majority of the observed range of boarfish in the ICES Area (Figure 3.1). Figure 3.3.2.1 also includes the spatial range of the Portuguese Groundfish Survey (1990-2011), however this survey is outside the current EC TAC area and has never been used in the assessment.

A detailed analysis of the IBTS data was carried out in 2012 to investigate the main areas of abundance of boarfish in these surveys. This analysis included GAM modelling based on the probability of occurrence of boarfish. The full details of this work are presented in the stock annex. The IBTS appears to give a relative index of abundance, with good resolution between periods of high and low abundance. The main centres of abundance in the survey Figure 3.3.2.2 correspond to the main fishing grounds (Figure 3.1.2.1). Figure 3.3.2.3 shows the signal in abundance, increasing in the 1990s, declining again in the early 2000s, before increasing again.

For subsequent surplus production modelling (see Section 3.6.3), biomass indices were extracted from each of the IBTS surveys using a delta-lognormal model (Stefánsson 1996). Many of the surveys exhibited a large proportion of zero tows with occasionally very large tows, hence the decision to explicitly model the probability of a non-zero tow and the mean of the positive tows. A delta-lognormal fit comprises fitting two generalized linear models (GLMs). The first model (binomial GLM) is used to obtain the proportion of non-zero tows and is fit to the data coded as 1 or 0 if the tow contained a positive or zero CPUE, respectively. The second model is fit to the positive only CPUE data using a lognormal GLM. Both GLMs were fit using ICES statistical rectangle and year as explanatory factor variables. Where the number of tows per rectangle was less than 5 over the entire series, they are grouped into an “others” rectangle. An index per rectangle and year is constructed, according to Stefánsson (1996), by the product of the estimated probability of a positive tow times the mean of the positive tows. The station indices are aggregated by taking estimated average across all rectangles within a year. To propagate the uncertainty, all survey index analyses were conducted in a Bayesian framework using Markov chain Monte

Carlo (MCMC) sampling (Kery 2010). As WinBugs is no longer updated, the analyses were migrated from WinBUGS to JAGS in 2017. Indeed, JAGS has an almost identical language to WinBUGS and its outputs have been proven equivalent to the previous software (Plummer 2003; Spiegelhalter *et al.* 2003). In 2018, the assessment was reverted back to WinBUGS as it MCMC sampler appeared more efficient than that of JAGS. The outputs derived from both software implementations are similar.

## 3.4 Mean weights- at-age, maturity-at-age and natural mortality

Mean weight-at-age was obtained from the ageing studies of Hüssy *et al.* (2012b). These mean weights are presented in the text table below. The variation in weight-at-age is due to small sample size and seasonal variation in weight and maturity stage.

| Age | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean Weight (g) | 0.84 | 6.65 | 14.6 | 19.5 | 23.7 | 26.8 | 33.3 | 37.7 | 40 | 47.1 |

| Age | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean Weight (g) | 50.2 | 51.2 | 62.8 | 56.4 | 62.2 | 68.9 | 50.5 | 86.7 | 77.9 | 64.6 |

| Age | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean Weight (g) | 63.5 | 75 | 86 | 71 | 77 | 84.4 | 79.4 | - | 67.6 | 52.8 |

**Maturity-at-age was obtained from the ageing studies of Hüssy *et al.* (2012a; b) and the reproductive study by Farrell *et al.* (2012).**

| Age | 0 | 1 | 2 | 3 | 4 | 5 | 6+ |
|---|---|---|---|---|---|---|---|
| Prop mature | 0 | 0 | 0.07 | 0.25 | 0.81 | 0.97 | 1 |

Natural mortality (M) was estimated over the life span of the stock using the method described by King (1995). This method assumes that M is the mortality that will reduce a population to 1% of its initial size over the lifespan of the stock. Based on a maximum age of 31, M is calculated as follows

$$M = -ln(0.01)/31$$

Following this procedure, $M$ = 0.16 year$^{-1}$. $M$ = 0.16 is considered a good estimate of natural mortality over the life span of this boarfish stock, as it is similar to the total mortality estimate from 2007, ($Z$ = 0.18, see Section 3.6.5). Given that catches in 2007 were relatively low, this estimate of total mortality is considered a good estimate of natural mortality, assuming negligible fishing mortality in previous years.

Similarly, total mortality was estimated from age-structured IBTS data from 2003 to 2006 (years from which data was available for all areas). The total mortality is considered a good estimate of natural mortality as fishing mortality was assumed to be negligible during this period. Total mortality ranged from 0.09–0.2 with a mean of 0.16.

The special review in 2012, questioned the validity of a single estimate of M across the entire age range. If an age based assessment is possible in the future, age specific estimates of natural mortality are required. However, the current estimate of M, which covers the whole age range, is considered appropriate in the context of the current situation where age data are used as an indicator approach, rather than as a full assessment method. Given that Z and F are also calculated over the entire (fully selected) range (Section 3.6.5) a single value of M is considered appropriate.

## 3.5 Recruitment

The IBTS data were explored as indices of abundance of 1-year-old, and 1-5 years old as a composite recruitment index (Figures 3.5.1 & 3.5.2). The EVHOE and SPNGFS surveys provide the best indices of recruitment as this is where the juveniles appear to be most abundant (Table 3.3.2.1). It appears that recruitment was high in the late 1990s but declined to a low in 2003. However, this apparent dip in recruitment was not observed in the commercial catch-at-age data. The recruitment signal for ages 1-5 combined has been stable since 2004 with a small increase evident in 2015. The recruitment signal for 1-year-old shows a more variable pattern with an increase in 2015 also evident (Figure 3.2.1.1). In 2016, almost all values for age 1 and combined ages 1-5 decreased compared to 2015. The decreases were rather important in the SPNGFS survey and led to historical lows for this survey.

## 3.6 Exploratory assessment

In 2012, a new stock assessment method for Boarfish was tested. In 2013 this Bayesian state space surplus production model (BSP; Meyer & Millar (1999)) was further developed following reviewers' recommendations in 2012. Different applications of a Bayesian biomass dynamic model were run in 2013 incorporating combinations of catch data, abundance data from the groundfish surveys, and estimates of biomass (and associated uncertainty) from the acoustic surveys (see stock annex for more details of the sensitivity runs). The model and settings from the final accepted run in 2013 were used as the basis of ICES category 1 advice for catch in 2014. However, in 2014 there was concern about the use of the production model for a number of reasons and ICES considered this model as no longer suitable for providing category 1 advice. Since 2014, the assessment model has been used as a basis for trends for providing DLS advice (ICES category 3). ICES considers the current basis for the advice on this stock to be an interim measure prior to development of an age-based assessment.

### 3.6.1 IBTS data

The common ALK (Table 3.2.1.1) was applied to the IBTS number-at-length data. The length-frequency is presented in Table 3.3.2.1 and the age-structured index in Table 3.6.1.1 and Figure 3.6.1.1. A cohort effect can be seen with those cohorts from the early 2000s appearing weak. This coincides with a decline in overall abundance in the early 2000s. From the mid-2000s onwards recruitment improved as observed in the abundance of 1-5 year olds in the EVHOE and Spanish northern shelf surveys (Figures 3.5.1 & 3.5.2). It should be noted however that the IBTS data is measured to the 1.0cm not the 0.5cm until 2015. Therefore, application of the common ALK to this data must be viewed with caution.
Some of the IBTS CPUE indices displayed marked variability with a large proportion of zero tows and occasionally very large tows (*e.g.* West of Scotland survey, Figure B.4.7 stock annex).

More southern surveys displayed a consistently higher proportion of positive tows. The variability of the data is reflected in the estimated mean CPUE indices (Figure 3.6.1.2). The West of Scotland survey index had been increasing between 2000 and 2009 but is uncertain, whereas the estimated indices from the other series are typically less variable (Figure 3.6.1.2). In 2014 four of the five current bottom trawl surveys experienced a sharp decline in CPUE, particularly the West of Scotland, the Spanish North Coast, the Spanish Porcupine and Irish Groundfish surveys. Both Spanish surveys remained low in 2015 whereas the latest IGFS and EVHOE surveys indicate an increase. In 2016, values were similar to those of the previous year for all surveys. In 2017, surveys suggest that the stock abundance increased compared to the year before. The only exception is the EVHOE survey but its coverage was only partial year due its research vessel breakdown. The CEFAS English Celtic Sea Groundfish Survey displays a steady increase from the mid-1980s to 2002 with a large but somewhat uncertain estimate in 2003 (Figures 3.6.1.2 & 3.6.1.3). The spatial extent of each survey is shown in Figure 3.3.2.1.

Diagnostics from the positive component of the delta-lognormal fits indicate relatively good agreement with a normal distribution on the natural logarithmic scale (Figure 3.6.1.4). There is an indication of longer tails in some of the surveys (*e.g.* WCSGFS, SPPGFS).

Pair-wise correlation between the annual mean survey indices varied. The IGFS, EVHOE and SPNGFS displayed positive correlation (Figure 3.6.1.5). The WCSGFS also displayed a negative correlation with the 2 Spanish surveys (SPPGFS and SPNGFS). The SPPGFS also displayed a negative correlation with EVHOE (Figure 3.6.1.5). Weighting the correlations by the sum of the pair-wise variances resulted in a largely similar correlation structure, though the WCSGFS and SPPGFS were more strongly correlated with the ECSGFS (Figure 3.6.1.6). Note that though some surveys displayed weak or no correlation, no surveys were excluded a-priori from the assessment. Sensitivity tests were conducted in 2013, which led to the exclusion of the surveys mentioned previously (see the stock annex).

### 3.6.2 Biomass estimates from acoustic surveys

The Boarfish Acoustic Survey (BFAS) series was initiated in July 2011 and is now in its 10th year. The initial survey in 2011 collected data over 24 hours. Since 2012, acoustic data has been collected between the hours of 04:00 and 00:00. The 2011 data was reworked in 2015 to exclude the data between 00:00 and 04:00. A TS model of -66.2dB was developed in 2013 (Fässler *et al.* (2013)) and is applied to all surveys in the time series (Figure 3.3.1.1). Over the time series of the survey total biomass has been estimated in the range 863 kt (in 2012) to 70 kt (2016). The precision on the estimates has been good, with coefficients of variation in the range 11 to 21. An overall downward trend is evident in the first years while estimates have been more stable since 2014. No strong evidence exists for removing any of the survey points from the time series although 2016 may look like an outlier (Table 3.3.1.1).

It should be noted that two acoustic surveys are conducted annually to the south of the southern limit of the dedicated Boarfish survey. In 2016 the PELACUS recorded an increase in biomass from 2015 although not of the order of the decrease seen further north. The Spanish PELGAS surveys recorded low levels of biomass, similar to that in 2015. Both these surveys take place 2-3 months prior to the boarfish survey. Neither survey was conducted in 2020 due to the COVID emergency.

### 3.6.3 Biomass dynamic model

In 2012 an exploratory biomass dynamic model was developed. This was a Bayesian state space surplus production model (Meyer & Millar 1999), incorporating the catch data, IBTS data, and acoustic biomass data. The assessment was peer-reviewed by two independent experts on behalf of ICES. In 2013 a new assessment was provided, which was based on the previous year's work and the reviewers' comments and formed the basis of a category 1 assessment. Details of the review and the associated changes can be found in the stock annex.

In 2014 the Bayesian state space surplus production model was fit using the catch data, delta-lognormal estimated IBTS survey indices, and the acoustic survey estimates. However, the inclusion of the low 2014 acoustic biomass estimate changed the perception on the stock, which raised concerns over the sensitivity and process error of the model and the stock assessment was moved from ICES category 1 to category 3 with the results of the surplus production model being used to calculate an index for the data limited stock approach.

Since 2014, the procedure used to run the model did not change with only the length of the time series used increasing annually. Details of this exploratory run used to calculate the DLS index are described below.

In the Bayesian state space surplus production model the biomass dynamics are given by a difference form of a Schaefer biomass dynamic model:

$$B_t = B_{t-1} + rB_{t-1}\left(1 - \frac{B_{t-1}}{K}\right) - C_{t-1}$$

where $B_t$ is the biomass at time t, r is the intrinsic rate of population growth, $K$ is the carrying capacity, and $C_t$ is the catch, assumed known exactly. To assist estimation, the biomass is scaled by the carrying capacity, denoting the scaled biomass $P_t = B_t / K$. A lognormal error structure is assumed giving the scaled biomass dynamics (process) model:

$$P_t = (P_{t-1} + rP_{t-1}(1 - P_{t-1}) + \frac{C_{t-1}}{K})e^{\mu_t}$$

where the logarithm of process deviations are assumed normal $u_t = N(0, \sigma_2^{\mu})$ with $\sigma_2^{\mu}$ the process error variance.

The starting year biomass is given by $aK$, where a is the proportion of the carrying capacity in the first year. The biomass dynamics process is related to the observations on the indices through the measurement error equation:

$$I_{j,t} = q_j P_t K e^{\varepsilon j,t}$$

where $I_{j,t}$ is the value of abundance index $j$ in year $t$, $q_j$ is survey-specific catchability, $B_t = P_t K$, and the measurement errors are assumed log-normally distributed with $u_t = N(0, \varepsilon_{e,j,t}^2)$ where $\varepsilon_{e,j,t}^2$ is the index-specific measurement error variance. $Var(I_{j,t})$ is obtained from the delta-lognormal survey fits. That is, the variance of the mean annual estimate per survey is inputted directly from the delta-lognormal fits (Figure 3.6.1.2) as opposed to estimating a measurement error within the assessment. The measurement error is obtained from:

$$\sigma_{e,j,t}^2 = ln(1 + \frac{Var(I_{j,t})}{(I_{j,t})^2})$$

For the acoustic survey, the CV of the survey was transformed into a lognormal variance via

$$\sigma_{\varepsilon,acoustic,t}^2 = ln(CV_{acoustic,t}^2 + 1)$$

Prior assumptions on the parameter distributions were:

- Intrinsic rate of population growth: *r ~ U(0.001, 2)*
- Natural logarithm of the carrying capacity: *ln(K) ~ U(ln(max(C), ln(10.sum(C)) = U(ln(144047), ln(4450407))*
- Proportion of carrying capacity in first year of assessment: *a ~ U[0.001, 1.0]*
- Natural logarithm of the survey-specific catchabilities $ln(q_i)$ ~ *U(-16, 0)* (for IBTS only). The acoustic survey prior is discussed below.

- Process error precision $\frac{1}{\sigma_u^2} \sim gamma\,(0.001{,}0.001)$

**Specification**

During the 2013 WGWIDE meeting a number of different iterations of the model were run to discern the best parameters for the assessment. After four initial runs and four sensitivity runs the settings for the final run (run 2.2) were chosen. These settings are shown below and were used for the assessment model since 2014. (More details of the trial runs in 2013 can be found in the stock annex).

The specifications for the final boarfish assessment model runs are:

***Acoustic survey***

Years: 2011–2020

Index value ($I_{acoustic,y}$): 'total' in tonnes (i.e. Definitely Boarfish + Probably Boarfish + Boarfish in a Mix)

Catchability ($q_{acoustic}$): A free, but strong prior (i.e. the acoustic survey is treated as a relative index but is strongly informed, this allows the survey to cover <100% of the stock).

**IBTS surveys**

6 delta log normal indices (WCSGFS, SPPGFS, IGFS, ECSGFS, SPNGFS, EVHOE)

First 5 and last 7 (since 2017, because of change in survey design) years omitted from WCSGFS

First 9 years omitted from ECSGFS

Following plenary discussion of the sensitivity runs in 2013, it was decided that the final run be based on a run that includes all surveys with the omission of the first 5 years of the WCSGFS and first 9 years of the ECSGFS. The reasons for this decision were: * it is unclear whether boarfish were consistently recorded in the early part of the ECSGFS, * the WCSGFS is thought to be at the northern extreme of the distribution and may not be an appropriate index for the whole stock, * the SPNGFS commences in 1991 such that running the assessment from 1991 onwards includes at least three surveys without relying, solely on the ECSGFS and WCSGFS, * surveys are internally weighted such that highly uncertain values receive lower weight.

**Catches**

2003–2020 time series

**Priors**

The final run assumes a strong prior $ln(q_{acoustic}) \sim N\ (1,\ 1/4)$ (mean 1, standard deviation 0.25), which has 95% of the density between 0.5 and 2. Given the short acoustic series (6 years) it is not possible to estimate this parameter freely (*i.e.* using an uninformative prior). The prescription of a strong prior removes the assumption of an absolute index from the acoustic survey. This assumption will be continually updated as additional data accrue.

**Run convergence**

Parameters for the 2020 model run converged with good mixing of the chains and Rhat values lower than 1.1 indicating convergence (Figures 3.6.3.1 & 3.6.3.2). MCMC chain autocorrelation was rather high but was compensated by long MCMC chains providing representative samples of the parameter posteriors (Figure 3.6.3.3).

Diagnostic plots are provided in Figure 3.6.3.4 showing residuals about the model fit. A fairly balanced residual pattern is evident. In some cases, outliers are apparent, for instance in the English survey in the final year (2003). However, these points are down weighted according to the inverse of their variance and hence do not contribute much to the model fit. The west of Scotland IBTS survey, located at the northern extreme of the stock distribution underestimates the stock in the early period (years) and overestimates it in the recent period from all fits. This could be indicative of stock expansion into this area at higher stock sizes and suggests that this index is not representative of the whole stock. Figure 3.6.3.5 shows the prior and posterior distributions of the parameters of the biomass dynamic model. The estimate of q is less than 1.0, leading to a higher estimate of final stock biomass than the acoustic survey.

**Results**

Trajectories of observed and expected indices are shown in Figure 3.6.3.6, along with the stock size over time and a harvest ratio (total catch divided by estimated biomass). Parameter estimates from the model run are summarized in Table 3.6.3.1. Biomass in 2020 is estimated to be 435 kt, continuing the relatively stable but low trend since 2014. The extremely low biomass estimate from the 2016 acoustic survey appears considered as an outlier by the model. Retrospective plots of TSB and F, presented in Figure 3.6.3.7, show that the perception of the stock is stable through time with the exception of 2013 prior to the inclusion of the lower biomass estimates of the acoustic surveys since 2014.

## 3.6.4 Pseudo-cohort analysis

Pseudo-cohort analysis is a procedure where mortality is calculated by means of catch curves derived from catch-at-age from a single year. This is in contrast to cohort analysis, which is the basis of VPA-type assessments. In cohort analysis, mortality is calculated across the ages of a year class, not within a single year. Because only seven years of sampling data were available and owing to the large age range currently in the catches a cohort analysis would only yield information for a very limited age and year range. Therefore, pseudo-cohort analysis was performed to supplement the Bayesian state space model.

Pseudo-cohort $Z$ estimates increased with the rapid expansion of the fishery but decreased in 2011 due to the introduction of the first boarfish TAC (Table 3.6.4.1). By subtracting $M$ (= 0.16), an estimate of $F$ was obtained for each year (ages 7-14). This series was revised to represent ages 7-14, rather than 6-14 as in previous years, because in 2013 age 6 boarfish were not fully selected, *i.e.* age 7 had higher abundance at age.

It can be seen from the text table below that $Z = M$ in 2007, the initial year of the expanded fishery, while $F$ is negligible. $F$ increased to a high of 0.29 in 2012 and has gradually reduced down to 0.15 in 2015 and 2016. In 2017, it increased up to 0.17. There was a weak correlation between catches and pseudo-cohort $F$ ($r^2 = 0.48$). Recent $F$ estimated this way is close to $F_{MSY}$ (0.149) and above $F_{0.1}$ (0.13).

| Year | Z (7-14) | F (Z-M) | Catch (t) |
|---|---|---|---|
| 2007 | 0.17 | 0.01 | 21 576 |
| 2008 | 0.33 | 0.17 | 34 751 |

| | | | |
|---|---|---|---|
| 2009 | 0.36 | 0.20 | 90 370 |
| 2010 | 0.33 | 0.17 | 144 047 |
| 2011 | 0.29 | 0.13 | 37 096 |
| 2012 | 0.45 | 0.29 | 87 355 |
| 2013 | 0.36 | 0.20 | 75 409 |
| 2014 | 0.37 | 0.21 | 45 231 |
| 2015 | 0.31 | 0.15 | 17 766 |
| 2016 | 0.31 | 0.15 | 19 315 |
| 2017 | 0.33 | 0.17 | 17 388 |
| 2018 | 0.36 | 0.20 | 11 286 |
| 2019 | 0.37 | 0.21 | 11 312 |

### 3.6.5 State of the stock

The most recent year assessment indicates that total stock biomass increased from a low to average level from the early to mid-1990s (Figure 3.6.3.6). The stock fluctuated around this level until 2009, before increasing until 2012. A sharp decline is seen between 2013 and 2014. Since 2014, the abundance has remained low but stable. There was concern in 2014 that this decline was exaggerated by an unusually low acoustic biomass estimate that led to a downward revision in stock trajectory. However, the 2014 survey is considered satisfactory in terms of containment. The comparably low 2014 biomass estimate was supported by results of the 2015 survey. The 2016 biomass estimate, the lowest of the time series is considered an outlier and has little influence on stock abundance estimates. The 95% uncertainty bounds are large and increasing with subsequent assessments. This reflects the uncertainty in the survey indices, and short exploitation history of the stock and the treatment of the acoustic survey as a relative biomass index. As more data accumulates from this survey, it is expected that the prior will become increasingly updated, and potentially less variable.

Catch data are available from 2001, the first year of commercial landings, and reasonably comprehensive discard data are available from 2003. Peak catches were recorded in 2010, when over 140 000 t were taken. Elevated fishing mortality was observed, associated with the highest recorded catch in 2010. Fishing mortality, expressed as a harvest ratio (catch divided by total biomass), was first recorded in 2003. Before that time, it is to be expected that some discarding took place, and there were some commercial landings. Fishing mortality increased measurably from 2006, reaching a peak in 2009-2010. F declined in 2011 as catches became regulated by the precautionary TAC but increased year on year until 2015 when reduced catches resulted in a reduction. The considerable catches in recent years do not appear to have significantly truncated the size or age structure of the stock and 15+ group fish are still abundant (Figure 3.2.1.1).

MSY reference points can be estimated from the assessment parameter values. In 2019, $F_{MSY}$ and MSY $B_{trigger}$ are estimated as respectively equal to 0.168 (parameter r / 2) and 137 kt (parameter K / 4). Throughout the history of the fishery, estimates of stock biomass have remained above MSY $B_{trigger}$. Fishing mortality (F) was greater than $F_{MSY}$ in 2009, 2010 and 2014, but has decreased since. In 2019, the stock is in the green area of the Kobe plot (Figure 3.6.6.1).

Estimates of recruitment are not available from the stock assessment. However, an independent index of recruitment is available from groundfish surveys (Section 3.5). Observations from the survey recruitment of 1 year olds show a slight upward trend for 2019 in the Spanish and Irish surveys while the French survey continues to show an upward trend (Figure 3.5.1).

# 3.7 Short Term Projections

As the assessment is exploratory, no short term projections were conducted.

# 3.8 Long term simulations

No long term simulations were conducted.

# 3.9 Candidate precautionary and yield based reference points

## 3.9.1 Yield per Recruit

A yield per recruit analysis was conducted in 2011 (Minto *et al.* 2011) and *F0.1* was estimated to be 0.13 whilst $F_{MAX}$ was estimated in the range 0.23 to 0.33 (Figure 3.9.1.1). *F0.1* was considered to be well estimated (Figure 3.9.1.2). No new yield per recruit analyses were performed in subsequent years.

## 3.9.2 Precautionary reference points

It does not appear that boarfish is an important prey species in the NE Atlantic (Section 3.13). ICES considered that precautionary *F* targets (*Fpa*) should be consistent with F<M for prey species, and F=M for non-prey species. $B_{lim}$ may be defined from the stock size estimates available from the stock assessment and set at *0.2*K* (0.2 * 528400 = 105 680 t), based on the exploratory assessment in 2019).

## 3.9.3 Other yield based reference points

Yield per recruit analysis, following the method of Beverton & Holt (1957), found *F0.1* to be robustly estimated at 0.13 (ICES 2011; Minto *et al.* 2011).

# 3.10 Quality of the assessment

ICES considers the current basis for the advice on this stock to be an interim measure prior to development of an age-based assessment. The acoustic survey has undergone several developments to improve its suitability with updates to methodology in 2012, a change in direction in 2017 and extension of transects at the boundaries to improve containment. The assessment was downgraded from Category 1 to Category 3 in 2014, and it has remained in this category since. The model is still considered suitable for category 3 advice, because it provides the best means of combining the available survey series. The assessment is sensitive to the acoustic series. In addition, a substantial part of the year to year variations in the stock abundance is linked to the process error. The use of some priors (like ratio to virgin biomass in the first year of the assessment) and survey (WCSGFS for instance) may require revision. Additional work to improve the surplus production model were undertaken in since 2015 and will continue next year.

The bottom trawl survey data are considered to be a good index of abundance given that boarfish aggregate near the bottom at this time of year. The trawl surveys record high abundances of the species, but with many zero hauls. The delta-lognormal error structure used in the analyses is considered to be an appropriate means of dealing with such data. The biomass dynamic model used in the stock assessment is based on the recent benchmarked assessment of megrim in Subdivisions 4 and 6. The model was further developed by including acoustic survey biomass estimates. One drawback of the model is that it does not provide estimates of recruitment. However, an estimate of recruitment strength is available from the Spanish and French trawl surveys.

## 3.11 Management considerations

As this stock is now placed in category 3, the ICES advice is based on harvest control rules for data limited stocks (ICES 2017). Since the biomass estimate from the Bayesian model is considered reliable for trend based assessment, an index can be calculated according to Method 3.1 of ICES (2012). The advice is based on a comparison of the average of the two most recent index values with the average of the three preceding values multiplied by the most recent catch. Table 3.6.5.1 shows the biomass estimates from the model from which the index was calculated.

Although no longer accepted as the basis for an analytic assessment, the surplus production model still provides the best unified view of this stock (Figure 3.6.3.6).

## 3.12 Stock structure

A dedicated study on the stock structure of boarfish within the Northeast Atlantic and Mediterranean Sea commenced in October 2013 in order to resolve outstanding questions regarding the stock structure of boarfish and the suitability of assessment data. Results (Farrell *et al.* 2016) indicated strong population structure across the distribution range of boarfish with 7-8 genetic populations identified (Figure 3.12.1).

The eastern Mediterranean (*MED*) samples comprised a single population and were distinct from all other samples. Similarly, the Azorean (*AZA*), Western Saharan (*MOR*) and Alboran (*ALM*) samples were distinct from all others. Of particular relevance to the assessment and management of the boarfish fishery is the identification and delineation of the population structure between southern Portuguese waters (*PTN2B-PTS*) and waters to the geographic north. A distinct and temporally stable mixing zone was evident in the waters around Cabo da Roca. The *PTN2A* sample appeared to be significantly different from all other samples however this sample was relatively small and was considered to represent a mixed sample rather than a true population.

No significant spatial or temporal population structure was found within the samples comprising the NEA population (Figure 3.12.1). A statistically significant but comparatively low level of genetic differentiation was found between this population and the northern Spanish shelf/northern Portuguese samples (NSA-PTN1). However, a high level of migration was revealed between these two populations and no barriers to gene flow were detected between them. Therefore, for the purposes of assessment and management these areas can be considered as one unit.

Analyses indicated a lack of significant immigration into this northeast Atlantic boarfish stock from populations to the south or from insular elements and the strong genetic differentiation among these regions indicate that the purported increases in abundance in the northeast Atlantic area are not the result of a recent influx from other regions. The increase in abundance is most likely the result of demographic processes within the northeast Atlantic stock (Blanchard & Vandermeirsch 2005; Coad *et al.* 2014).

Whilst the current assessment and management area constitutes the majority of the most northern population it should be extended into Northern Portuguese waters and repeated genetic monitoring of the stock in this region should be conducted to ensure the validity of this delineation. Based on analyses of IBTS data the biomass in this area is suspected to be small relative to the overall biomass in the TAC area.

## 3.13 Ecosystem considerations

The ecological role and significance of boarfish in the NE Atlantic is largely unknown. However, in the southeast North Atlantic, in Portuguese waters, they are considered to have an important position in the marine food web (Lopes *et al.* 2006). The diet has been investigated in the eastern Mediterranean, Portuguese waters and at Great Meteor Seamount and consists primarily of copepods, specifically *Calanus helgolandicus*, with some mysid shrimp and euphausiids (Macpherson 1979; Fock *et al.* 2002; Lopes *et al.* 2006). This contrasted with the morphologically similar species, the slender snipefish, *Macroramphosus gracilis* and the longspine snipefish, *M. scolopax*, whose diet comprised *Temora spp.*, copepods and mysid shrimps, respectively (Lopes *et al.* 2006). Despite the obvious potential for these species to feed on fish eggs and larvae, there was no evidence to support this conclusion in Portuguese waters and they were not considered predators of commercial fishes and thus their increase in abundance was unlikely to affect recruitment of commercial fish species. If the NE Atlantic population of boarfish is sufficiently large then there exists the possibility of competition for food with other widely distributed planktivorous species.

Both seasonal and diurnal variations were observed in the diet of boarfish in all three regions. In the eastern Mediterranean and Portuguese waters, mysids become an important component of the diet in autumn, which correlates with their increased abundance in these regions at this time (Macpherson 1979; Lopes *et al.* 2006). Fock *et al.* (2002) found that boarfish at Great Meteor Seamount fed mainly on copepods and euphausiids diurnally and on decapods nocturnally, indicating habitat dependent resource utilization.

Boarfish appear an unlikely target of predation given their array of strong dorsal and anal fin spines and covering of ctenoid scales. However, there is evidence to suggest that they may be an important component of some species' diets. Most studies have focused in the Azores and few have mentioned the NE Atlantic, probably due to the relatively low abundance in the region until recent years. In the Azores, boarfish was found to be one of the most important prey items for tope (*Galeorhinus galeus*), thornback ray (*Raja clavata*), conger eel (*Conger conger*), forkbeard (*Phycis phycis*), bigeye tuna (*Thunnus obesus*), yellowmouth barracuda (*Sphyraena viridensis*), swordfish (*Xiphias gladius*), blackspot seabream (*Pagellus bogaraveo*), axillary seabream (*Pagellus acarne*) and blacktail comber (*Serranus atricauda*) (Clarke *et al.* 1995; Morato *et al.* 1999, 2000, 2001, 2003; Arrizabalaga *et al.* 2008). Many of these species also occur in the NE Atlantic shelf waters although it is unknown whether boarfish represent a significant component of the diet in this region.

In the NE Atlantic boarfish have not previously been recorded in the diets of tope or thornback ray (Holden & Tucker 1974; Ellis *et al.* 1996). However, this does not prove that they are currently not a prey item. A study of conger eel diet in Irish waters from 1998-1999 failed to find boarfish in the diet (O'Sullivan *et al.* 2004). However, in Portuguese waters a recent study has found boarfish to be the most numerous species in the diet of conger eels (Xavier *et al.* 2010). It has been suggested that boarfish are an important component of the diet of hake (*Merluccius merluccius*), as they are sometimes caught together. However, a recent study of the diet of hake in the Celtic Sea and Bay of Biscay did not report any boarfish in the stomachs of hake caught during the 2001 EVHOE survey (Mahe *et al.* 2007).

The conspicuous presence of boarfish in the diet of so many fish species in the Azores is perhaps more related to the lack of other available food sources than to the palatability of boarfish themselves. Given the large abundance in NE Atlantic shelf waters it is likely that they would have been recorded more frequently if they were a significant and important prey item.

Boarfish are also an important component of the diet a number of sea birds in the Azores, most notably the common tern (*Sterna hirundo*) (Granadeiro *et al.* 2002) and Cory's shearwater (*Calonectris diomedea*) (Granadeiro *et al.* 1998). This is surprising given that in the Mediterranean discarded boarfish were rejected by seabirds whereas in the Azores they were actively preyed on (Oro & Ruiz 1997). Cory's shearwaters are capable of diving up to 15 m whilst the common tern is a plunge-diver and may only reach 2-3 m. It is therefore surprising that boarfish are such a significant component of their diet given that it is generally considered a deeper water fish. In the Azores boarfish shoals are sometimes driven to the surface by horse mackerel and barracuda where they are also attacked by diving sea birds (J. Hart, CW Azores, pers. comm.). Anecdotal reports from the Irish fishery indicate that boarfish are rarely found in waters shallower than 40 m. This may suggest that they are outside the range of shearwaters and gannets, the latter having a mean diving depth of 19.7±7.5 m (Brierley & Fernandes 2001). However, the upper depth range of boarfish is within maximum diving depth recorded for auks (50 m) as recorded by Barrett & Furness (1990). Given their frequency in the diets of marine and bird life in the Azores, boarfish appear to be an important component of the marine ecosystem in that region. There is currently insufficient evidence to draw similar conclusions in the NE Atlantic.

The length-frequency distribution of boarfish may be important to consider. IBTS data shows an increase in mean total length with latitude Table 3.3.2.1 and perhaps the smaller boarfish in the southern regions are more easily preyed upon. Length data of boarfish from stomach contents studies of both fish and sea birds in the Azores indicate that the boarfish found are generally < 10 cm (Granadeiro *et al.* 1998, 2002).

## 3.14 Proposed management plan

In 2015 the Pelagic Advisory Council submitted a revised draft management strategy for Northeast Atlantic boarfish. The EU has requested ICES to evaluate the following management plan:

This management strategy aims to achieve sustainable exploitation of boarfish in line with the precautionary approach to fisheries management, FAO guidelines for new and developing fisheries, and the ICES form of advice.

1) The TAC shall be set in accordance with the following procedure, depending on the ICES advice
   a) If category 1 advice (stocks with quantitative assessments) is given based on a benchmarked assessment, the TAC shall be set following that advice.
   b) If category 1 or 2 (qualitative assessments and forecasts) advice is given based on a non-benchmarked assessment the TAC shall be set following this advice.
   c) Categories 3-6 are described below as follows:
      i) Category 3: stocks for which survey-based assessments indicate trends. This category includes stocks with quantitative assessments and forecasts which for a variety of reasons are considered indicative of trends in fishing mortality, recruitment, and biomass.
      ii) Category 4: stocks for which only reliable catch data are available. This category included stocks for which a time series of catch can be used to approximate MSY.

iii ) Category 5: landings only stocks. This category includes stocks for which only landings data are available.

iv ) Category 6: negligible landings stocks and stocks caught in minor amounts as bycatch.

2 ) Notwithstanding paragraph 1, if, in the opinion of ICES, the stock is at risk of recruitment impairment, a TAC may be set a lower level.

3 ) If the stock, estimated in either of the 2 years before the TAC is to be set, is at or below $B_{lim}$ or any suitable proxy thereof, the TAC shall be set at 0 t.

4 ) The TAC shall not exceed 75,000 t in any year.

5 ) The TAC shall not be allowed to increase by more than 25% per year. However, there shall be no limit on the decrease in TAC.

6 ) Closed seasons, closed areas, and moving on procedures shall apply to all directed boarfish fisheries as follows:

i ) A closed season shall operate from 31st March to 31st August. This is because it is known that herring and mackerel are present in these areas and may be caught with boarfish.

ii ) A closed area shall be implemented inside the Irish 12-miles limit south of 52°30 from 12th February to 31st October, in order to prevent catches of Celtic Sea herring, known to form aggregations at these times.

iii ) If catches of other species covered by a TAC amount to more than 5% of the total catch by day by ICES statistical rectangle, then all fishing must cease in that rectangle for 5 consecutive days.

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# 3.16 Tables

**Table 3.1.2.1. Boarfish in ICES Subareas 27.6, 7, 8. Landings, discards and TAC by country by year (t), 2001–2019. (Data provided by Working Group members). These figures may not in all cases correspond to the official statistics and cannot be used for management purposes**

| | Den-mark | Ger-many | Ire-land | Nether-lands | Eng-land | Scot-land | Spain | Unal-loc | Dis-cards | Total | TAC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | | | 120 | | | | | | | 120 | |
| 2002 | | | 91 | | | | | | | 91 | |
| 2003 | | | 458 | | | | | | 10929 | 11387 | |
| 2004 | | | 675 | | | | | | 4476 | 5151 | |
| 2005 | | | 165 | | | | | | 5795 | 5959 | |
| 2006 | | | 2772 | | | | | | 4365 | 7137 | |
| 2007 | | | 17615 | | | 772 | | | 3189 | 21576 | |
| 2008 | 3098 | | 21585 | | | 0.45 | | | 10068 | 34751 | |
| 2009 | 15059 | | 68629 | | | | | | 6682 | 90370 | |
| 2010 | 39805 | | 88457 | | | 9241 | | | 6544 | 144047 | |
| 2011 | 7797 | | 20685 | | | 2813 | | | 5802 | 37096 | 33000 |
| 2012 | 19888 | | 55949 | | | 4884 | | | 6634 | 87355 | 82000 |
| 2013 | 13182 | | 52250 | | | 4380 | | | 5598 | 75409 | 82000 |
| 2014 | 8758 | | 34622 | | | 38 | | | 1813 | 45231 | 133957 |
| 2015 | 29 | 4 | 16325 | 375 | 104 | | | | 929 | 17766 | 53296 |
| 2016 | 337 | 7 | 17496 | 171 | 21 | | | | 1283 | 19315 | 47637 |
| 2017 | 548 | | 15485 | 182 | 0.13 | | | | 1173 | 17388 | 27288 |
| 2018 | 94 | | 9513 | 172 | 0.08 | 0.23 | 148 | | 1359 | 11286 | 21830 |
| 2019 | 757 | | 9910 | 318 | 19 | | 2.5 | | 306 | 11312 | 21830 |

**Table 3.1.2.2. Boarfish in ICES Subareas 27.6, 7, 8. Landings by year (t), 2001–2019 (Data provided by Working Group members). These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.**

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2001 | ALL | | | 120 | | | | | 120 |
| 2002 | ALL | | | 91 | | | | | 91 |
| 2003 | ALL | | | 458 | | | | | 458 |
| 2003 | 6.a | | | 65 | | | | | 65 |
| 2003 | 7.b | | | 214 | | | | | 214 |
| 2003 | 7.j | | | 179 | | | | | 179 |
| 2004 | ALL | | | 675 | | | | | 675 |
| 2004 | 6.a | | | 292 | | | | | 292 |
| 2004 | 7.b | | | 224 | | | | | 224 |
| 2004 | 8.d | | | 38 | | | | | 38 |
| 2004 | 7.j | | | 122 | | | | | 122 |
| 2005 | ALL | | | 165 | | | | | 165 |
| 2005 | 6.a | | | 10 | | | | | 10 |
| 2005 | 7.b | | | 105 | | | | | 105 |
| 2005 | 8.a | | | 38 | | | | | 38 |
| 2005 | 7.j | | | 12 | | | | | 12 |
| 2006 | ALL | | | 2772 | | | | | 2772 |
| 2006 | 6.a | | | 21 | | | | | 21 |
| 2006 | 7.b | | | 15 | | | | | 15 |
| 2006 | 7.g | | | 375 | | | | | 375 |
| 2006 | 8.a | | | 1 | | | | | 1 |
| 2006 | 7.j | | | 2360 | | | | | 2360 |
| 2007 | ALL | | | 17615 | | | 772 | | 18386 |
| 2007 | 5.b2 | | | 6 | | | | | 6 |
| 2007 | 6.a | | | 93 | | | | | 93 |
| 2007 | 7.b | | | 1259 | | | | | 1259 |
| 2007 | 7.g | | | 120 | | | | | 120 |

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 8.a | | | 5 | | | | | 5 |
| 2007 | 7.j | | | 16131 | | | 772 | | 16903 |
| 2008 | ALL | 3098 | | 21584 | | | | | 24682 |
| 2008 | 6.a | | | 28 | | | | | 28 |
| 2008 | 7.b | | | 3 | | | | | 3 |
| 2008 | 7.g | | | 184 | | | | | 184 |
| 2008 | 7.j | | | 21370 | | | | | 21370 |
| 2009 | ALL | 15059 | | 68629 | | | | | 83688 |
| 2009 | 6.a | | | 45 | | | | | 45 |
| 2009 | 7.b | | | 73 | | | | | 73 |
| 2009 | 7.c | | | 1 | | | | | 1 |
| 2009 | 7.g | | | 4912 | | | | | 4912 |
| 2009 | 7.h | | | 18225 | | | | | 18225 |
| 2009 | 7.j | | | 45372 | | | | | 45372 |
| 2010 | ALL | 39805 | | 88457 | | | 9241 | | 137503 |
| 2010 | 6.a | | | 1349 | | | 10 | | 1359 |
| 2010 | 6.aS | | | 7 | | | | | 7 |
| 2010 | 7.b | | | 2258 | | | | | 2258 |
| 2010 | 7.c | | | 35 | | | 4 | | 39 |
| 2010 | 7.e | 2 | | | | | | | 2 |
| 2010 | 7.g | 672 | | 3649 | | | | | 4321 |
| 2010 | 7.h | 1465 | | 8453 | | | 1712 | | 11629 |
| 2010 | 7.j | 37667 | | 72707 | | | 7515 | | 117889 |
| 2011 | ALL | 7797 | | 20685 | | | 2813 | | 31295 |
| 2011 | 6.a | | | 26 | | | | | 26 |
| 2011 | 7.b | | | 274 | | | | | 274 |
| 2011 | 7.c | | | 9 | | | | | 9 |
| 2011 | 7.g | | | 811 | | | | | 811 |
| 2011 | 7.h | 4155 | | 8540 | | | 2813 | | 15508 |

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 8.a | 18 | | | | | | | 18 |
| 2011 | 7.j | 3624 | | 11025 | | | | | 14648 |
| 2012 | ALL | 19888 | | 55949 | | | 4884 | | 80720 |
| 2012 | 6.a | | | 125 | | | | | 125 |
| 2012 | 7.b | 80 | | 4501 | | | 838 | | 5419 |
| 2012 | 7.c | | | 108 | | | 907 | | 1015 |
| 2012 | 7.g | | | 616 | | | | | 616 |
| 2012 | 7.h | 5837 | | 10579 | | | 3139 | | 19554 |
| 2012 | 8.a | 1604 | | 93 | | | | | 1697 |
| 2012 | 7.j | 12366 | | 39928 | | | | | 52294 |
| 2013 | ALL | 13182 | | 52250 | | | 4380 | | 69811 |
| 2013 | 6.a | | | 538 | | | 15 | | 553 |
| 2013 | 7.b | | | 10405 | | | 100 | | 10505 |
| 2013 | 7.e | | | | | | 883 | | 883 |
| 2013 | 7.g | | | 1808 | | | | | 1808 |
| 2013 | 7.h | 955 | | 11355 | | | 1728 | | 14038 |
| 2013 | 8.a | 1354 | | 870 | | | | | 2224 |
| 2013 | 8.d | | | 270 | | | | | 270 |
| 2013 | 7.j | 10873 | | 27003 | | | 1653 | | 39529 |
| 2014 | ALL | 8758 | | 34622 | | | 38 | | 43418 |
| 2014 | 6.a | | | 182 | | | 30 | | 212 |
| 2014 | 7.b | 12 | | 3262 | | | | | 3274 |
| 2014 | 7.g | | | 135 | | | | | 135 |
| 2014 | 7.h | 4808 | | 18389 | | | | | 23196 |
| 2014 | 8.a | | | 119 | | | | | 119 |
| 2014 | 7.j | 3886 | | 12536 | | | 8 | | 16429 |
| 2014 | 7.k | 53 | | | | | | | 53 |
| 2015 | ALL | 29 | 5 | 16325 | 375 | 104 | | | 16837 |
| 2015 | 6.a | 10 | | 116 | | 9 | | | 134 |

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2015 | 7.b | 8 | 4 | 2609 | | 85 | | | 2706 |
| 2015 | 7.c | | | 220 | | | | | 220 |
| 2015 | 7.g | | | 547 | | | | | 547 |
| 2015 | 7.h | 5 | | 8506 | | | | | 8510 |
| 2015 | 8.a | 6 | 1 | 682 | | | | | 688 |
| 2015 | 7.j | | | 3646 | | 10 | | | 3655 |
| 2015 | 6 | | | | 128 | | | | 128 |
| 2015 | 7 | | | | 33 | | | | 33 |
| 2015 | 8 | | | | 214 | | | | 214 |
| 2016 | ALL | 337 | 7 | 17496 | 171 | 21 | | | 18031 |
| 2016 | 6.a | | | 377 | 45 | | | | 422 |
| 2016 | 7.b | | 5 | 1198 | 35 | 0.66 | | | 1239 |
| 2016 | 7.c | | | | 0.08 | | | | 0.08 |
| 2016 | 7.e | | | | 0.02 | | | | 0.02 |
| 2016 | 7.h | 330 | | 6771 | | | | | 7101 |
| 2016 | 7.j | | | 1852 | 90 | 16 | | | 1959 |
| 2016 | 8.a | 2 | 1 | 6173 | | 5 | | | 6181 |
| 2016 | 8.b | | | | | 0.11 | | | 0.11 |
| 2016 | 8.d | 5 | | 1124 | | | | | 1129 |
| 2017 | ALL | 548 | | 15485 | 182 | 0.13 | | | 16215 |
| 2017 | 4.a | | | | 0.03 | | | | 0.03 |
| 2017 | 6.a | 37 | | 907 | 34 | | | | 979 |
| 2017 | 7.b | | | 124 | 118 | | | | 242 |
| 2017 | 7.c | | | | 20 | | | | 20 |
| 2017 | 7.d | 1 | | | | | | | 1 |
| 2017 | 7.e | | | | 0.08 | | | | 0.08 |
| 2017 | 7.f | | | | | 0.02 | | | 0.02 |
| 2017 | 7.g | | | 1 | | 0.02 | | | 1 |
| 2017 | 7.h | 239 | | 2961 | | 0.09 | | | 3200 |

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2017 | 7.j | | | 33 | 9 | | | | 43 |
| 2017 | 8.a | 271 | | 10543 | | | | | 10814 |
| 2017 | 8.d | | | 915 | | | | | 915 |
| 2018 | ALL | 94 | | 9513 | 172 | 0.08 | 0.23 | 148 | 9928 |
| 2018 | 6.a | 67 | | 269 | 78 | | | | 414 |
| 2018 | 7.b | 19 | | 163 | 9 | | | | 191 |
| 2018 | 7.c | 2 | | | 0.51 | | | | 3 |
| 2018 | 7.f | | | | 3 | | | | 3 |
| 2018 | 7.h | 6 | | 2582 | 46 | 0.08 | | | 2634 |
| 2018 | 7.j | | | 1163 | 22 | | 0.23 | | 1185 |
| 2018 | 8.a | | | 5182 | | | | | 5182 |
| 2018 | 8.b | | | | 14 | | | | 14 |
| 2018 | 8.c | | | | | | | 54 | 54 |
| 2018 | 8.d | | | 154 | | | | | 154 |
| 2018 | 9.a | | | | | | | 94 | 94 |
| 2019 | ALL | 757 | | 9910 | 318 | 19 | | 2 | 11005 |
| 2019 | 6.a | 172 | | 568 | 79 | 9 | | | 829 |
| 2019 | 7.b | | | 238 | 150 | 0.36 | | | 388 |
| 2019 | 7.c | | | 3 | 0.29 | | | | 3 |
| 2019 | 7.d | 1 | | | | | | | 1 |
| 2019 | 7.e | | | | 1 | 6 | | | 7 |
| 2019 | 7.f | | | | 6 | | | | 6 |
| 2019 | 7.g | | | 2 | 0.24 | | | | 2 |
| 2019 | 7.h | 268 | | 6197 | 0.19 | 0.21 | | | 6466 |
| 2019 | 7.j | | | 25 | 80 | 3 | | 0.03 | 108 |
| 2019 | 8.a | 315 | | 2805 | | | | | 3121 |
| 2019 | 8.b | | | | 0.17 | | | | 0.17 |
| 2019 | 8.c | | | | | | | 2 | 2 |
| 2019 | 8.d | | | 71 | | | | | 71 |

| Year | Area | Denmark | Germany | Ireland | Netherlands | England | Scotland | Spain | Total |
|---|---|---|---|---|---|---|---|---|---|
| ALL | ALL | 91195 | 12 | 432801 | 1218 | 144 | 22128 | 150 | 547644 |

**Table 3.1.2.3. Boarfish in ICES Subareas 27.6, 7, 8. Discards of boarfish in demersal and non-target pelagic fisheries by year (t), 2003–2019. (Data provided by Working Group members). These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.**

| Year | Germany | Ireland | Netherlands | Spain | UK | Denmark | Lithuania | Total |
|---|---|---|---|---|---|---|---|---|
| 2003 | | 119 | 1998 | 8812 | | | | 10929 |
| 2004 | | 60 | 837 | 3579 | | | | 4476 |
| 2005 | | 55 | 733 | 5007 | | | | 5795 |
| 2006 | | 22 | 411 | 3933 | | | | 4366 |
| 2007 | | 549 | 23 | 2617 | | | | 3189 |
| 2008 | | 920 | 738 | 8410 | | | | 10068 |
| 2009 | | 377 | 1258 | 5047 | | | | 6682 |
| 2010 | | 85 | 512 | 5947 | | | | 6544 |
| 2011 | 49 | 107 | 185 | 5461 | | | | 5802 |
| 2012 | | 181 | 88 | 6365 | | | | 6634 |
| 2013 | 22 | 47 | 11 | 5518 | | | | 5598 |
| 2014 | 117 | 50 | 477 | 1119 | 50 | | | 1813 |
| 2015 | | 7 | | 921 | 1 | | | 929 |
| 2016 | 869 | 20 | 41 | 348 | 4 | | 1 | 1283 |
| 2017 | | 640 | 146 | | | 386 | 1 | 1173 |
| 2018 | | 525 | 89 | | | 744 | 0.55 | 1359 |
| 2019 | | 57 | | 240 | 8 | | | 306 |

**Table 3.2.1.1. Boarfish in ICES Subareas 27.6, 7, 8. General boarfish age length key produced from 2012 commercial samples. Figures highlighted in grey are estimated.**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.25 | 1 | 1 | | | | | | | | | | | | | |
| 7.75 | 1 | 1 | | | | | | | | | | | | | |
| 8.25 | | 1 | | | | | | | | | | | | | |
| 8.75 | | 1 | 1 | | | | | | | | | | | | |
| 9.25 | | 1 | 1 | | | | | | | | | | | | |
| 9.75 | | | 1 | | | | | | | | | | | | |
| 10.25 | | | 1 | | | | | | | | | | | | |
| 10.75 | | | 2 | 10 | 3 | | | | | | | | | | |
| 11.25 | | | 1 | 29 | 14 | 2 | 2 | | | | | | | | |
| 11.75 | | | | 9 | 21 | 21 | 18 | 2 | 2 | 1 | | | | | |
| 12.25 | | | | 4 | 17 | 22 | 38 | 12 | 8 | | | | | | 1 |
| 12.75 | | | | | 5 | 9 | 42 | 37 | 14 | 6 | 2 | | 1 | 1 | 1 |
| 13.25 | | | | | 2 | 4 | 31 | 28 | 24 | 12 | 6 | 2 | 3 | 1 | 5 |
| 13.75 | | | | | 1 | 3 | 25 | 22 | 21 | 14 | 6 | 5 | 4 | 2 | 11 |
| 14.25 | | | | | | | 6 | 8 | 18 | 22 | 8 | 3 | 7 | 1 | 20 |
| 14.75 | | | | | | 1 | 1 | 2 | 3 | 8 | 1 | 6 | 6 | 6 | 30 |
| 15.25 | | | | | | | 1 | 1 | | 2 | 2 | 2 | 5 | 2 | 19 |
| 15.75 | | | | | | | | | | 2 | | | | 2 | 19 |
| 16.25 | | | | | | | | | | | | | | | 8 |
| 16.75 | | | | | | | | | | | | | | | 1 |
| 17.25 | | | | | | | | | | | | | | | 1 |
| 17.75 | | | | | | | | | | | | | | | 1 |
| 18.25 | | | | | | | | | | | | | | | 1 |
| 18.75 | | | | | | | | | | | | | | | 1 |

**Table 3.2.1.2. Boarfish in ICES Subareas 27.6, 7, 8. Number of samples collected from the catch per year.**

| Year | landings | % landings covered by sampling programme | no. samples | no. measured | no. aged |
|---|---|---|---|---|---|
| 2001 | 120 | 0 | 0 | 0 | 0 |
| 2002 | 91 | 0 | 0 | 0 | 0 |
| 2003 | 458 | 0 | 0 | 0 | 0 |
| 2004 | 675 | 0 | 0 | 0 | 0 |
| 2005 | 165 | 0 | 0 | 0 | 0 |
| 2006 | 2772 | 0 | 0 | 0 | 0 |
| 2007 | 18387 | NA | 3 | 217 | 0 |
| 2008 | 24683 | NA | 1 | 152 | 0 |
| 2009 | 83688 | NA | 9 | 1475 | 0 |
| 2010 | 137503 | NA | 95 | 10675 | 403* |
| 2011 | 31295 | NA | 27 | 4066 | 704 |
| 2012 | 80720 | NA | 80 (68)*** | 9656 (8565)*** | 814** |
| 2013 | 69812 | NA | 76 | 9392 | 0**** |
| 2014 | 43418 | NA | 54 | 7008 | 0**** |
| 2015 | 16837 | NA | 32 | 3356 | 0**** |
| 2016 | 18031 | NA | 27 | 3861 | 0**** |
| 2017 | 16215 | NA | 18 | 1140 | 0**** |
| 2018 | 9927 | NA | 12 | 556 | 0**** |
| 2019 | 11006 | NA | 18 | 371 | 0**** |

* A common ALK was developed from fish collected from both commercial and survey samples. This comprehensive ALK was used to produce catch numbers at age data for pseudo-cohort analyses.

** A common ALK was developed from fish collected from samples from Danish, Irish and Scottish commercial landings. This comprehensive ALK was used for all metiers to produce catch numbers-at-age for pseudo-cohort analysis. Only aged fish measured to 0.5cm were included in the ALK.

*** Only Irish collected samples were used for length frequency, see stock annex.

****2012 ALK used

**Table 3.2.1.3. Boarfish in ICES Subareas 5, 27.6, 7, 8. The allocation of Age length keys to unsampled metiers in 2019**

| Country | Area | Quarter | landed | ALK |
|---|---|---|---|---|
| DK | 7.d | 1 | 1 | IE_8.a_Q1 |
| DK | 7.h | 1 | 268 | IE_8.a_Q1 |
| DK | 8.a | 1 | 315 | IE_8.a_Q1 |
| ES | 7.j | 1 | 0.03 | IE_8.a_Q1 |
| ES | 8.c | 2 | 0.25 | IE_8.a_Q1 |
| ES | 8.c | 3 | 2 | IE_8.a_Q4 |
| IE | 7.b | 1 | 148 | IE_7.h_Q4 |
| IE | 7.b | 4 | 15 | IE_7.h_Q4 |
| IE | 7.g | 1 | 0.86 | IE_8.a_Q1 |
| IE | 7.g | 2 | 0.51 | IE_7.h_Q4 |
| IE | 7.g | 3 | 0.33 | IE_7.h_Q4 |
| IE | 7.g | 4 | 0.36 | IE_7.h_Q4 |
| IE | 7.h | 1 | 435 | IE_8.a_Q1 |
| IE | 7.h | 4 | 5762 | IE_7.h_Q4 |
| IE | 7.j | 1 | 22 | IE_8.a_Q1 |
| IE | 7.j | 2 | 2 | IE_7.h_Q4 |
| IE | 7.j | 3 | 0.76 | IE_7.h_Q4 |
| IE | 7.j | 4 | 0.79 | IE_7.h_Q4 |
| IE | 8.a | 1 | 1862 | IE_8.a_Q1 |
| IE | 8.a | 3 | 56 | IE_8.a_Q4 |
| IE | 8.a | 4 | 888 | IE_8.a_Q4 |
| IE | 8.d | 1 | 5 | IE_8.a_Q1 |
| IE | 8.d | 4 | 66 | IE_8.a_Q4 IE_7.h_Q4 |
| NL | 7.b | 3 | 6 | IE_7.h_Q4 |
| NL | 7.b | 4 | 2 | IE_7.h_Q4 |
| NL | 7.c | 3 | 0.29 | IE_7.h_Q4 |
| NL | 7.e | 1 | 1 | IE_8.a_Q1 |
| NL | 7.f | 2 | 5 | IE_7.h_Q4 |

| | | | | |
|---|---|---|---|---|
| NL | 7.f | 4 | 1 | IE_7.h_Q4 |
| NL | 7.g | 4 | 0.24 | IE_7.h_Q4 |
| NL | 7.h | 1 | 0.19 | IE_8.a_Q1 |
| NL | 7.j | 1 | 9 | IE_8.a_Q1 |
| NL | 7.j | 2 | 0.94 | IE_7.h_Q4 |
| NL | 7.j | 3 | 70 | IE_7.h_Q4 |
| NL | 7.j | 4 | 0.47 | IE_7.h_Q4 |
| NL | 8.b | 4 | 0.17 | IE_8.a_Q4 |
| UKE | 7.e | 1 | 6 | IE_8.a_Q1 |
| UKE | 7.h | 1 | 0.21 | IE_8.a_Q1 |
| UKE | 7.j | 1 | 2 | IE_8.a_Q1 |
| UKE | 7.j | 2 | 0.01 | IE_7.h_Q4 |
| UKE | 7.j | 3 | 0.86 | IE_7.h_Q4 |

**Table 3.2.1.4. Boarfish in ICES Subareas 27.6, 7, 8. Catch per country and corresponding number of samples collected in 2019.**

| Country | Official Catch | Num Samples | Num Measured | Num Aged |
|---|---|---|---|---|
| DK | 757 | | | |
| ES | 243 | | | |
| IE | 9967 | 18 | 371 | |
| NL | 318 | | | |
| UKE | 37 | | | |
| UKS | 1 | | | |

**Table 3.2.1.5. Boarfish in ICES Subareas 27.6, 7, 8. Catch per area and corresponding number of samples collected in 2019**

| Area | Official Catch | Num Samples | Num Measured | Num Measured per 1000t |
|---|---|---|---|---|
| 27.6.a | 830 | | | |
| 27.6.b | 42 | | | |
| 27.7.b | 390 | | | |
| 27.7.c | 13 | | | |
| 27.7.d | 1 | | | |
| 27.7.e | 14 | | | |

| Area | Official Catch | Num Samples | Num Measured | Num Measured per 1000t |
|---|---|---|---|---|
| 27.7.f | 8 | | | |
| 27.7.g | 7 | | | |
| 27.7.h | 6529 | 6 | 66 | 10 |
| 27.8.a | 3121 | 12 | 305 | 98 |
| 27.8.b | 12 | | | |
| 27.8.c | 137 | | | |
| 27.8.d | 71 | | | |
| 27.7.j | 189 | | | |
| 27.7.k | 0.04 | | | |

**Table 3.2.1.6. Boarfish in ICES Subareas 27.6, 7, 8. Proxy catch numbers-at-age of the international catches (raised numbers in '000s) for the years 2007-2019**

| Age | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1575 | 2415 | | 28 | 301 | | 5556 | 218 | 1862 | 314 | 17427 |
| 2 | 352 | 5488 | 15043 | 11229 | 2894 | 893 | 7148 | 695 | 116135 | 2385 | 4387 | 1736 | 37620 |
| 3 | 2114 | 21140 | 65744 | 72709 | 41913 | 5467 | 156680 | 49503 | 32248 | 10737 | 8830 | 2628 | 9737 |
| 4 | 40851 | 105575 | 338931 | 294382 | 28148 | 41278 | 58522 | 127520 | 16588 | 25114 | 34448 | 13610 | 9944 |
| 5 | 48915 | 141300 | 475619 | 567689 | 30116 | 110272 | 59797 | 93705 | 24564 | 20263 | 27266 | 15570 | 12682 |
| 6 | 62713 | 195339 | 543707 | 878363 | 175696 | 146582 | 68949 | 67275 | 26566 | 18025 | 21103 | 14731 | 12716 |
| 7 | 26132 | 104031 | 307333 | 522703 | 143967 | 492078 | 302967 | 193061 | 74115 | 61229 | 55189 | 38686 | 29513 |
| 8 | 29766 | 66570 | 172783 | 293719 | 107126 | 365840 | 250341 | 139124 | 52052 | 47573 | 38229 | 26821 | 18819 |
| 9 | 56075 | 53159 | 155477 | 276672 | 77861 | 271916 | 212318 | 121042 | 44615 | 42478 | 32258 | 23670 | 15875 |
| 10 | 44875 | 46893 | 130148 | 232122 | 60022 | 173486 | 160137 | 94225 | 34264 | 35150 | 25716 | 19395 | 11359 |
| 11 | 14019 | 15289 | 42521 | 78588 | 46079 | 69396 | 63025 | 36078 | 12999 | 13297 | 9560 | 7148 | 4272 |
| 12 | 32359 | 21178 | 61350 | 114600 | 40468 | 40968 | 41490 | 24895 | 9114 | 9132 | 7564 | 5846 | 2937 |
| 13 | 4848 | 11854 | 39609 | 59932 | 24352 | 58888 | 59380 | 36309 | 13362 | 13774 | 10922 | 8183 | 4256 |
| 14 | 16837 | 13570 | 31569 | 59060 | 19724 | 30277 | 30355 | 19064 | 7152 | 6682 | 5924 | 4554 | 2156 |
| 15+ | 109481 | 112947 | 196967 | 349320 | 157707 | 217260 | 239366 | 150688 | 59139 | 49589 | 40797 | 32130 | 14864 |

**Table 3.2.2.1. Boarfish in ICES Subareas 27.6, 7, 8. Length-frequency distributions of the international catches (raised numbers in '000s) for the years 2007-2019.**

| Length | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | 14 | | | | | 14 |
| 1 | | | | | | | | | 878 | | | | | 878 |
| 2 | | | | | | | | | 515 | | | | | 515 |
| 3 | | | | 156 | | | | | 810 | | 765 | | 15868 | 17599 |
| 4 | | | | 439 | | | | | 14 | | 4607 | 203 | 70362 | 75625 |
| 5 | | | | 1090 | 522 | 56 | 52 | | 513 | 417 | 5250 | 405 | 80160 | 88465 |
| 6 | | | 1354 | 1574 | | | 551 | | 10598 | 1684 | 12616 | 2635 | 85420 | 116432 |
| 7 | | | 677 | 375 | 1345 | 185 | 1419 | | 80716 | 8685 | 11473 | 4703 | 115154 | 224732 |
| 8 | | | | 1082 | | 555 | 3592 | 1064 | 49508 | 6412 | 10115 | 3559 | 67471 | 143358 |
| 9 | | | 677 | 5382 | 851 | 555 | 7263 | 327 | 10219 | 7104 | 3874 | 6554 | 16504 | 59310 |
| 10 | | 7473 | 17367 | 7883 | 7012 | 641 | 47509 | 4916 | 213 | 23065 | 14047 | 6196 | 3147 | 139469 |
| 11 | 9609 | 11209 | 54130 | 29410 | 33243 | 2791 | 94702 | 31649 | 1211 | 46010 | 32346 | 5559 | 9173 | 361042 |
| 12 | | 52308 | 174796 | 130889 | 15848 | 6132 | 59833 | 71344 | 3865 | 39071 | 36242 | 4450 | 10144 | 604922 |
| 13 | 84555 | 63517 | 343283 | 361774 | 70615 | 24571 | 18359 | 108261 | 12226 | 14181 | 32445 | 17658 | 5796 | 1157241 |
| 14 | | 59781 | 321637 | 655875 | 93487 | 81928 | 20938 | 82470 | 28142 | 18249 | 31589 | 22826 | 22722 | 1439644 |
| 15 | 44199 | 119561 | 297737 | 739025 | 189434 | 264888 | 98564 | 84288 | 41613 | 30975 | 33618 | 24070 | 22353 | 1990325 |
| 16 | | 70990 | 207739 | 564347 | 114904 | 398772 | 204868 | 112826 | 42461 | 51110 | 41650 | 24514 | 17521 | 1851702 |
| 17 | 82633 | 52308 | 147965 | 353484 | 133539 | 419060 | 315063 | 172416 | 59990 | 57000 | 46495 | 30665 | 28815 | 1899433 |

| Length | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | | 29890 | 149314 | 246146 | 51235 | 307533 | 285688 | 153742 | 52625 | 58696 | 43121 | 38698 | 16688 | 1433376 |
| 19 | 117224 | 22418 | 105782 | 224611 | 50857 | 176710 | 210137 | 138549 | 50139 | 76872 | 45353 | 34080 | 20053 | 1272785 |
| 20 | | 14945 | 71273 | 127711 | 25309 | 89726 | 105571 | 74059 | 28771 | 37755 | 39524 | 29908 | 13809 | 658361 |
| 21 | 65338 | 33627 | 47816 | 125463 | 25569 | 52791 | 62175 | 43347 | 16087 | 23137 | 21854 | 15561 | 5710 | 538475 |
| 22 | | 11209 | 13082 | 81386 | 5473 | 25065 | 31122 | 22629 | 8572 | 7841 | 4932 | 5778 | 1513 | 218602 |
| 23 | 13452 | 11209 | 19397 | 24256 | 4181 | 13149 | 14990 | 7672 | 4331 | 625 | 1020 | 1948 | 143 | 116373 |
| 24 | | 3736 | 4061 | 6209 | 2280 | 2738 | 4918 | 2134 | 2081 | 128 | | 54 | 143 | 28482 |
| 25 | | 3736 | 677 | 1913 | 456 | 827 | 1109 | 1361 | 289 | | | | | 10368 |
| 26 | | | | | | | 407 | | 23 | | | | | 430 |
| 27 | | | | 283 | | | 296 | | | | | | | 579 |
| 28 | | | | | | | | | 592 | | | | | 592 |

**Table 3.3.1.1. Boarfish in ICES Subareas 27.6. 7, 8. Acoustic survey abundance and biomass estimates from 2011-2020**

| Age | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| | - | - | - | - | - | - | - | - | - | 1083.9 |
| 1 | 5 | 21.5 | - | - | 198.5 | 4.6 | 110.9 | 76.7 | 782.3 | 896.5 |
| 2 | 11.6 | 10.8 | 78 | - | 319.2 | 35.7 | 126.7 | 31.2 | 389.1 | 1156.7 |
| 3 | 57.8 | 174.1 | 1842.9 | 15 | 16.6 | 45.5 | 344.6 | 115 | 96.8 | 966.7 |
| 4 | 187.4 | 64.8 | 696.4 | 98.2 | 34.3 | 43.6 | 367.3 | 68.3 | 93.1 | 112.6 |
| 5 | 436.7 | 95 | 381.6 | 102.3 | 80 | 6 | 156 | 106.7 | 88.2 | 157.3 |
| 6 | 1165.9 | 736.1 | 253.8 | 104.9 | 112 | 10 | 209 | 165.9 | 105.9 | 183.3 |
| 7 | 1184.2 | 973.8 | 1056.6 | 414.6 | 437.4 | 169 | 493.1 | 320.7 | 445.7 | 912.9 |
| 8 | 703.6 | 758.9 | 879.4 | 343.8 | 362.9 | 112.6 | 468.3 | 197.7 | 182.6 | 884.5 |
| 9 | 1094.5 | 848.6 | 800.9 | 341.9 | 353.5 | 117.6 | 397.2 | 293.4 | 288. | 720.7 |
| 10 | 1031.5 | 955.9 | 703.8 | 332.3 | 360 | 96.6 | 285.8 | 624.7 | 290.1 | 330.9 |
| 11 | 332.9 | 650.9 | 263.7 | 129.9 | 131.7 | 17 | 120.9 | 339.2 | 49.6 | 80.6 |
| 12 | 653.3 | 1099.7 | 202.9 | 104.9 | 113 | 32 | 82.1 | 264.1 | 192.2 | 194.9 |
| 13 | 336 | 857.2 | 296.6 | 166.4 | 174 | 48.7 | 74.4 | 198.4 | 79.1 | 298.7 |
| 14 | 385 | 655.8 | 169.8 | 88.5 | 108 | 18.3 | 220.4 | 116.5 | 57.2 | 266.7 |
| 15+ | 3519 | 6353.7 | 1464.3 | 855.1 | 1195 | 400.1 | 931 | 302.4 | 758.9 | 1641.0 |
| TSN ('000) | 11104 | 14257 | 9091 | 3098 | 3996 | 1157 | 4387 | 3221 | 3899 | 9888 |
| TSB (t) | 670176 | 863446 | 439890 | 187779 | 232634 | 69690 | 230062 | 186252 | 179156 | 399872 |
| SSB (t) | 669392 | 861544 | 423158 | 187654 | 226659 | 69103 | 218810 | 184624 | 169213 | 357871 |
| CV | 21.2 | 10.6 | 17.5 | 15.1 | 17 | 19 | 21.9 | 19.9 | 25.4 | 34.8 |

**Table 3.3.2.1. Boarfish in ICES Subareas 27.6, 7, 8. IBTS length-frequency data**

## EVHOE

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | | 5 | 11 | 7 | 17 | 197 | 2659 | 5020 | 3719 | 3598 | 4429 | 12065 | 16651 | 7198 | 3455 | 501 | 18 | 1 | | |
| 1998 | | 1 | 4 | 26 | 76 | 2093 | 18283 | 8631 | 6125 | 5966 | 7095 | 11730 | 14078 | 9260 | 5076 | 934 | 8 | | | 1 |
| 1999 | | | 13 | 52 | 33 | 245 | 11177 | 26610 | 23947 | 6684 | 2899 | 4709 | 7868 | 6160 | 1353 | 267 | 7 | | | |
| 2000 | | 17 | 79 | 120 | 8 | 1504 | 26894 | 17674 | 9836 | 21967 | 16382 | 29585 | 36853 | 16522 | 5397 | 989 | 75 | | | |
| 2001 | | 1 | 45 | 687 | 489 | 913 | 21297 | 37171 | 13276 | 28355 | 31514 | 18309 | 12232 | 6471 | 3186 | 1270 | 81 | 4 | | |
| 2002 | | 2 | 18 | 23 | 11 | 547 | 9631 | 29874 | 17777 | 13290 | 9470 | 9697 | 9751 | 6268 | 2484 | 641 | 37 | 1 | 1 | |
| 2003 | | | 17 | 47 | 17 | 57 | 426 | 1655 | 7142 | 20018 | 24842 | 20989 | 21263 | 14494 | 7086 | 1550 | 36 | | | |
| 2004 | | | 33 | 512 | 378 | 123 | 1248 | 1419 | 1307 | 1083 | 3102 | 7308 | 7224 | 6353 | 7866 | 3630 | 241 | 5 | | |
| 2005 | | 2 | 93 | 975 | 1285 | 146 | 1100 | 2326 | 1229 | 1553 | 3183 | 13398 | 15758 | 9834 | 6010 | 1658 | 117 | 70 | | |
| 2006 | 1 | 26 | 112 | 79 | 75 | 15510 | 37566 | 10750 | 3622 | 2127 | 1521 | 1955 | 4131 | 3955 | 2535 | 921 | 94 | 2 | 12 | |
| 2007 | | 8 | 187 | 467 | 234 | 1503 | 22689 | 126065 | 64536 | 6341 | 6731 | 5431 | 6004 | 5911 | 4238 | 1409 | 118 | 11 | | |
| 2008 | | 3 | 434 | 2807 | 827 | 5341 | 53189 | 247296 | 165392 | 163200 | 69382 | 38434 | 18390 | 17258 | 9178 | 3490 | 745 | 6 | 1 | |
| 2009 | | 6 | 128 | 194 | 72 | 1496 | 19769 | 35819 | 5264 | 3913 | 9556 | 12269 | 9402 | 10831 | 6720 | 775 | 38 | 1 | | |
| 2010 | | 21 | 529 | 116 | 154 | 5755 | 46438 | 74986 | 27175 | 11952 | 37420 | 58313 | 34737 | 33774 | 14626 | 1561 | 249 | 8 | 1 | |
| 2011 | | 60 | 95 | 215 | 5 | 541 | 2247 | 8368 | 15256 | 33221 | 30237 | 50384 | 56559 | 36673 | 11867 | 3082 | 573 | 159 | 47 | |
| 2012 | | 9 | 145 | 584 | 137 | 2922 | 28865 | 26816 | 6124 | 11739 | 13606 | 22369 | 37135 | 44082 | 19963 | 4893 | 127 | 1 | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2013 | | 3 | 48 | 91 | 10 | 306 | 2185 | 2165 | 2542 | 13649 | 9932 | 14987 | 37755 | 40524 | 20107 | 6918 | 666 | | 2 | |
| 2014 | | 2 | 693 | 1386 | 508 | 84 | 1440 | 885 | 3074 | 8732 | 28586 | 39397 | 74122 | 69736 | 26871 | 3908 | 59 | 433 | | |
| 2015 | | 5 | 183 | 5898 | 4143 | 607 | 19075 | 179269 | 119004 | 15765 | 18014 | 61575 | 62024 | 59904 | 21525 | 5487 | 541 | 429 | 8 | |
| 2016 | 5 | 31 | 379 | 846 | 115 | 733 | 10284 | 14280 | 17251 | 42132 | 25304 | 68583 | 130633 | 131220 | 48538 | 11611 | 1358 | 26 | | |
| 2017 | | 2 | 103 | 129 | 3 | 27 | 269 | 198 | 5 | | | | | | | | | | | |
| 2018 | | 7 | 1846 | 64840 | 57946 | 102 | 5424 | 38028 | 23510 | 13486 | 18312 | 35122 | 54264 | 63350 | 21702 | 6292 | 275 | 9 | | |
| 2019 | 2 | 997 | 6467 | 589 | 10688 | 531908 | 561517 | 329850 | 59733 | 4505 | 3418 | 8451 | 32547 | 61582 | 30031 | 7468 | 962 | 204 | | |

## IGFS

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | | 1 | 32 | 22 | 7 | 22 | 129 | 172 | 879 | 2942 | 2322 | 1326 | 3822 | 4628 | 2898 | 896 | 163 | 38 | | |
| 2004 | | 23 | 63 | 34 | 8 | 96 | 532 | 1431 | 369 | 344 | 410 | 2253 | 4320 | 4698 | 3966 | 1017 | 87 | 2 | 1 | |
| 2005 | | 8 | 59 | 52 | 20 | 203 | 1024 | 585 | 288 | 636 | 341 | 3463 | 11457 | 11348 | 7955 | 1744 | 382 | 2 | 1 | |
| 2006 | 5 | 60 | 68 | 48 | 35 | 212 | 969 | 621 | 2046 | 4190 | 8044 | 7946 | 24208 | 42119 | 32168 | 12296 | 2454 | 532 | | |
| 2007 | 1 | 6 | 44 | 18 | 31 | 501 | 923 | 1251 | 1638 | 1166 | 2510 | 3581 | 8275 | 10740 | 7093 | 1934 | 92 | | | |
| 2008 | | | 26 | 18 | 23 | 127 | 672 | 531 | 2095 | 13780 | 17664 | 19268 | 16980 | 19484 | 15953 | 8789 | 1747 | 76 | 1 | |
| 2009 | | 3 | 80 | 76 | 25 | 94 | 228 | 486 | 1000 | 1139 | 9081 | 7749 | 5138 | 6921 | 5592 | 1084 | 68 | 1 | | |
| 2010 | | 6 | 42 | 3 | 18 | 199 | 272 | 463 | 920 | 393 | 7914 | 34236 | 28611 | 16063 | 8161 | 1974 | 433 | | | |
| 2011 | | 6 | 14 | 5 | 4 | 189 | 772 | 586 | 555 | 670 | 2578 | 20171 | 22082 | 10829 | 5298 | 2207 | 266 | 9 | 6 | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | | 7 | 36 | 20 | 10 | 131 | 271 | 378 | 702 | 2144 | 1183 | 11105 | 34010 | 22742 | 10906 | 3903 | 525 | 4 | | |
| 2013 | 1 | 3 | 9 | 9 | 20 | 127 | 352 | 340 | 1320 | 2833 | 3971 | 15572 | 51637 | 52868 | 20485 | 6560 | 492 | 20 | | |
| 2014 | | 10 | 68 | 54 | 4 | 18 | 13 | 25 | 60 | 130 | 1127 | 3251 | 19125 | 23016 | 10355 | 2988 | 284 | 18 | | |
| 2015 | | 3 | 11 | 16 | 24 | 193 | 1008 | 3708 | 848 | 105 | 713 | 6314 | 29727 | 48221 | 33024 | 17350 | 1885 | 531 | | |
| 2016 | 4 | 31 | 121 | 63 | 7 | 67 | 186 | 1515 | 4057 | 2891 | 1349 | 4110 | 32753 | 57753 | 40907 | 15527 | 3670 | 86 | | |
| 2017 | | 6 | 53 | 10169 | 689915 | 6406 | 1751 | 715 | 11818 | 21886 | 10164 | 11841 | 25588 | 42311 | 35049 | 17110 | 3299 | 369 | | |
| 2018 | 4 | 51 | 247 | 140 | 32 | 45 | 286 | 585 | 1195 | 6107 | 17006 | 15167 | 48895 | 61832 | 36519 | 10722 | 2030 | 63 | | |
| 2019 | 4 | 19 | 117 | 47 | 53 | 266 | 583 | 173 | 106 | 487 | 2677 | 4967 | 6864 | 12080 | 10480 | 5125 | 772 | 71 | 4 | 2 |

## SPNGFS

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | | 1 | | | 31 | 690 | 1311 | 313 | 49 | 9 | 6 | 7 | 7 | 4 | | | | 6 | | |
| 1992 | | 57 | 38 | 9 | 178 | 3290 | 2743 | 282 | 48 | 10 | 8 | 69 | 162 | 390 | 779 | 246 | 95 | | | |
| 1993 | | 57 | 1206 | 488 | 97 | 3730 | 3753 | 421 | 105 | 54 | 7 | 4 | 8 | 3 | 2 | | | | | |
| 1994 | 1 | 40 | 33 | | 342 | 4789 | 10162 | 8920 | 3195 | 53 | 106 | 20 | 9 | 12 | 1 | | | | | |
| 1995 | | 84 | 108 | 4 | 342 | 3063 | 2157 | 220 | 84 | 65 | 58 | 105 | 105 | 90 | 20 | 4 | | | | |
| 1996 | | 218 | 537 | 143 | 245 | 4457 | 4449 | 267 | 820 | 722 | 82 | 145 | 126 | 219 | 96 | 39 | 2 | | | |
| 1997 | 2 | 102 | 809 | 441 | 235 | 3458 | 6824 | 2189 | 1923 | 534 | 156 | 353 | 161 | 88 | 3 | | | | | |
| 1998 | 3 | 2 | 7 | 4 | 49 | 1920 | 4685 | 1815 | 337 | 153 | 125 | 88 | 147 | 135 | 86 | 13 | 2 | 3 | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1999 | | 6 | 59 | 13 | 134 | 2736 | 3010 | 193 | 106 | 83 | 109 | 143 | 390 | 645 | 402 | 69 | | | | |
| 2000 | | 7 | 3729 | 2046 | 17 | 554 | 1947 | 489 | 277 | 486 | 756 | 1252 | 999 | 1021 | 199 | 34 | 13 | | | |
| 2001 | | 68 | 4 | 1 | 153 | 3241 | 5085 | 659 | 225 | 206 | 205 | 236 | 692 | 407 | 120 | 22 | 9 | | | |
| 2002 | | 4 | 20 | | 133 | 2333 | 2013 | 284 | 50 | 58 | 54 | 60 | 231 | 314 | 72 | 9 | | | | |
| 2003 | | 4 | 950 | 567 | 4 | 77 | 221 | 57 | 39 | 28 | 16 | 22 | 17 | 23 | 16 | 5 | 1 | | | |
| 2004 | | 6 | 22 | 4 | 43 | 2289 | 3808 | 443 | 110 | 83 | 58 | 219 | 931 | 776 | 303 | 2 | 1 | | | |
| 2005 | | 16 | 451 | 25 | 9 | 754 | 1007 | 207 | 85 | 102 | 30 | 54 | 257 | 218 | 90 | 44 | 2 | | | |
| 2006 | | 14 | 156 | 160 | 50 | 2238 | 8913 | 4507 | 175 | 94 | 9 | 36 | 229 | 419 | 169 | 9 | 2 | | | |
| 2007 | | 49 | 40 | 1 | 111 | 3025 | 6620 | 1099 | 129 | 260 | 81 | 7 | 93 | 215 | 89 | 21 | 3 | | | |
| 2008 | 7 | 4 | 92 | 247 | 1 | 936 | 1561 | 1326 | 234 | 1483 | 304 | 537 | 11 | 833 | 201 | 186 | 11 | | | |
| 2009 | 1 | 17 | 53 | 125 | 9 | 2582 | 3816 | 4105 | 119 | 250 | 45 | 142 | 59 | 819 | 120 | 17 | 1 | 1 | | |
| 2010 | | 55 | 102 | 5 | 232 | 13090 | 22032 | 3169 | 1160 | 1056 | 89 | 82 | 179 | 1007 | 1981 | 518 | 9 | | | |
| 2011 | | 29 | 260 | 105 | 46 | 2805 | 5511 | 1278 | 148 | 340 | 145 | 100 | 144 | 591 | 724 | 134 | 3 | 1 | | |
| 2012 | | 29 | 132 | 35 | 556 | 7550 | 7844 | 1364 | 88 | 53 | 59 | 170 | 1051 | 2394 | 1553 | 432 | 21 | | | |
| 2013 | | | 2 | 11 | 126 | 2163 | 4664 | 854 | 302 | 609 | 251 | 61 | 110 | 123 | 140 | 64 | 7 | | | |
| 2014 | | 75 | 117 | 6 | 12 | 263 | 465 | 79 | 1083 | 1175 | 1174 | 1266 | 998 | 2444 | 3623 | 817 | 31 | 1 | | |
| 2015 | | 13 | 67 | 3 | 58 | 1889 | 4248 | 534 | 75 | 465 | 750 | 970 | 695 | 1173 | 1473 | 453 | 70 | 1 | | |
| 2016 | | 0.16 | 0.85 | 0.04 | 0.39 | 9 | 24 | 4 | 9 | 7 | 3 | 6 | 5 | 6 | 2 | 0.25 | 0.03 | | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2017 | 0.01 | 0.2 | 0.18 | 0.01 | 0.14 | 6 | 18 | 7 | 1 | 2 | 3 | 4 | 6 | 10 | 9 | 2 | 0.11 | 0.03 | | |
| 2018 | | | 0.02 | | 0.43 | 7 | 15 | 2 | 0.61 | 0.91 | 2 | 4 | 9 | 20 | 26 | 6 | 0.04 | 0.02 | | 0.02 |
| 2019 | | 0.1 | | | 2 | 33 | 38 | 4 | 0.2 | 0.8 | 2 | 2 | 4 | 23 | 46 | 13 | 1 | | | |

## SPPGFS

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | | 2 | | 2 | 2 | 4 | | 88 | 10 | 104 | 266 | 323 | 1334 | 2259 | 460 | 81 | | | | |
| 2002 | | | | | | | | | 1 | 4 | 90 | 212 | 791 | 843 | 313 | 60 | | | | |
| 2003 | | | | | | 1 | | 3 | 15 | 22 | 21 | 62 | 268 | 426 | 249 | 51 | 2 | 1 | | |
| 2004 | | 1 | | | | 5 | 2 | | 4 | 5 | 18 | 100 | 312 | 483 | 319 | 43 | 1 | | | |
| 2005 | | 1 | | 1 | 6 | 1 | 18 | 10 | 9 | 14 | 7 | 101 | 530 | 935 | 705 | 226 | 18 | | | |
| 2006 | | | 1 | 1 | 6 | 91 | 89 | 21 | 34 | 75 | 27 | 45 | 335 | 670 | 555 | 197 | 10 | 1 | | |
| 2007 | | | | | 3 | 4 | 9 | 15 | 12 | 9 | 27 | 25 | 72 | 151 | 144 | 26 | 4 | | | |
| 2008 | | 1 | | | | 1 | 13 | 7 | 16 | 13 | 55 | 106 | 237 | 457 | 302 | 78 | 5 | | | |
| 2009 | | 6 | 5 | | 2 | 7 | 8 | 1 | | 1 | 154 | 318 | 924 | 1201 | 1172 | 324 | 7 | | | |
| 2010 | 1 | | | 1 | 5 | 14 | 3 | 1 | 5 | 2 | 31 | 284 | 521 | 717 | 459 | 123 | 10 | | | |
| 2011 | | | | | | | | 3 | 16 | 18 | 5 | 147 | 671 | 792 | 429 | 122 | 13 | | 2 | |
| 2012 | | | | 1 | 1 | | | 2 | 2 | 1 | 8 | 70 | 369 | 468 | 218 | 66 | 3 | | | |
| 2013 | | | | 1 | | 7 | 22 | 6 | 9 | | 1 | 42 | 435 | 889 | 480 | 141 | 12 | 1 | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | | 10 | 9 | | 1 | | 3 | 17 | 62 | 11 | 6 | 85 | 2453 | 6703 | 3168 | 2115 | 162 | 82 | | |
| 2015 | | | | 2 | 1 | | | 1 | 1 | | | 32 | 300 | 471 | 316 | 151 | 43 | | | |
| 2016 | | | 0.04 | | | | 0.02 | | 0.16 | 0.06 | | 0.1 | 2 | 4 | 3 | 1 | 0.25 | | | |
| 2017 | | 1 | 0.35 | | | | 0.2 | | | 0.02 | 0.35 | 0.52 | 3 | 10 | 10 | 5 | 0.33 | | | |
| 2018 | | 0.04 | 0.02 | 0.02 | | | | | | | | 0.68 | 21 | 66 | 45 | 21 | 3 | | | |
| 2019 | 0.09 | 0.69 | 0.08 | | | | | | 0.06 | 0.08 | | 0.29 | 8 | 19 | 16 | 4 | 0.29 | | | |

## WCSGFS

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | | | | | | 0.5 | | | | | | | | | | | | |
| 1987 | | | | | | | | 0.5 | 0.5 | 2 | 0.5 | | | | | | | | | |
| 1988 | | | | 0.5 | | | | | | | | | | | | | | | | |
| 1989 | | | | | | | 0.5 | | | | | | | | | | | | | |
| 1990 | | | | 1 | | 0.5 | 1 | 2 | 24 | 54 | 50 | 43 | 12 | 1 | | | | | | |
| 1991 | | | | | | 1 | 0.5 | 8 | 38 | 183 | 266 | 316 | 48 | 16 | | | | | | |
| 1992 | | | | | | 1 | | 10 | 38 | 468 | 1145 | 4001 | 1626 | 486 | | | | | | |
| 1993 | | | | | | | 4 | | 2 | 9 | 60 | 155 | 72 | 16 | | 0.5 | | | | |
| 1994 | | | | | | | | | 0.5 | 0.5 | 0.5 | | | 0.5 | | | | | | |
| 1995 | | | | | | | | | 8 | 36 | 194 | 294 | 398 | 199 | 22 | | | | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1996 | | | | 2 | | 4 | 3 | | | | 1 | 55 | 610 | 1574 | 304 | | | | | |
| 1997 | | | 4 | | | 0.5 | 6 | 9 | 4 | 6 | 25 | 108 | 203 | 157 | 40 | 4 | | | | |
| 1998 | | | | 1 | | 1 | 5 | 2 | | 1 | 2 | | 3 | | | | | | | |
| 1999 | | | 1 | | | 2 | 5 | 1 | 1 | | 1 | 2 | 1 | | | | | | | |
| 2000 | | | | | | | 2 | 2 | 39 | 110 | 216 | 288 | 182 | 92 | 46 | 6 | | | | |
| 2001 | | 1 | | | | | | 1 | 4 | 15 | 28 | 59 | 134 | 240 | 103 | 10 | 4 | | | |
| 2002 | | | | | | 1 | 8 | 2 | 1 | 82 | 742 | 3211 | 5601 | 5772 | 1497 | 167 | 1 | | | |
| 2003 | | | 1 | | | | 3 | 52 | | 53 | 281 | 1473 | 3066 | 4895 | 3083 | 309 | 28 | | | |
| 2004 | | | | 1 | | | 2 | 2 | 43 | 82 | 743 | 4569 | 8600 | 9514 | 5692 | 948 | 84 | | | |
| 2005 | | 2 | | | | | 24 | 3 | 23 | 25 | 110 | 435 | 1085 | 1708 | 792 | 130 | 6 | | | |
| 2006 | | 1 | 2 | 1 | | 1 | 4 | | 10 | 218 | 232 | 452 | 1396 | 2852 | 2051 | 434 | 72 | | | |
| 2007 | | | 2 | 2 | | 2 | 1 | 3 | 21 | 159 | 780 | 2923 | 5194 | 6888 | 5283 | 1523 | 116 | | | |
| 2008 | | 1 | 1 | | | 16 | 37 | 36 | 187 | 468 | 1395 | 3213 | 9893 | 22758 | 18399 | 6288 | 575 | 71 | | |
| 2009 | | | 1 | | | 1 | | 4 | 52 | 2442 | 2093 | 440 | 331 | 287 | 246 | 129 | 10 | | | |
| 2010 | | | | | | | | | | | 530 | 1443 | 1384 | 1357 | 828 | 149 | 29 | | | |
| 2011 | | 1 | 4 | 1 | | 1 | 5 | 254 | 1015 | 2034 | 7613 | 18918 | 14478 | 6445 | 2006 | 236 | 23 | | | |
| 2012 | | | 1 | | | 1 | 2 | | 103 | 9 | 1267 | 6545 | 26337 | 29361 | 27333 | 15857 | 1505 | 496 | | |
| 2013 | | | | 1 | | | 1 | | | 1 | 143 | 3201 | 15282 | 11288 | 3934 | 858 | 6 | 1 | | |

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | | 48 | 457 | 386 | 48 | 3 | 7 | 63 | 21 | 98 | 876 | 11668 | 30267 | 39236 | 10933 | 1363 | 111 | 1 | | |
| 2015 | | | 4 | 18 | 14 | 115 | 102 | 18 | 5 | | | 30 | 262 | 345 | 220 | 86 | 10 | 1 | | 1 |
| 2016 | | | | 1 | 2 | 49 | 1413 | 2439 | 2065 | 342 | 436 | 4088 | 24632 | 33254 | 14568 | 3484 | 508 | 102 | | |
| 2017 | | | | | | | | | | | | | | | | | | | | |
| 2018 | | | | | | | | | | | | | | | | | | | | |
| 2019 | | | | | | | | | | | | | | | | | | | | |

**Table 3.6.1.1. Boarfish in ICES Subareas 27.6, 7, 8. IBTS length-frequency data converted to age-structured index by application of the 2010 common ALK rounded down to 1cm length classes.**

## EVHOE (0–15)

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 23 | 1877 | 6003 | 3741 | 3911 | 3938 | 7066 | 5867 | 4218 | 4832 | 4259 | 1461 | 2428 | 1699 | 1214 | 623 |
| 1998 | 31 | 12978 | 15997 | 6247 | 6247 | 5591 | 7435 | 5732 | 3777 | 4806 | 4386 | 1463 | 2843 | 1635 | 1619 | 676 |
| 1999 | 65 | 7577 | 31224 | 19915 | 8732 | 3499 | 3308 | 2715 | 1905 | 2720 | 2357 | 744 | 1540 | 975 | 893 | 285 |
| 2000 | 216 | 17676 | 27730 | 12586 | 17986 | 15525 | 18740 | 14297 | 9737 | 11041 | 9490 | 3208 | 5160 | 3797 | 2556 | 1266 |
| 2001 | 733 | 14389 | 41313 | 20357 | 25467 | 21921 | 16211 | 9247 | 4525 | 4543 | 3951 | 1332 | 2057 | 1322 | 1099 | 578 |
| 2002 | 43 | 6720 | 31728 | 18455 | 12784 | 8389 | 7115 | 4767 | 2851 | 3429 | 3018 | 994 | 1806 | 1123 | 1009 | 421 |
| 2003 | 64 | 509 | 3993 | 7348 | 18371 | 17276 | 16113 | 10798 | 6270 | 7620 | 6852 | 2267 | 4294 | 2501 | 2456 | 1009 |
| 2004 | 545 | 1265 | 1975 | 1261 | 1722 | 2227 | 4124 | 3228 | 2061 | 2871 | 3058 | 1066 | 2426 | 939 | 1509 | 901 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 1070 | 2101 | 2603 | 1497 | 2099 | 3015 | 7160 | 5992 | 4177 | 5301 | 4873 | 1642 | 3144 | 1796 | 1776 | 833 |
| 2006 | 217 | 35834 | 26593 | 4803 | 2199 | 1386 | 1489 | 1332 | 947 | 1521 | 1484 | 485 | 1170 | 557 | 725 | 311 |
| 2007 | 662 | 16817 | 122140 | 65369 | 16986 | 4919 | 4316 | 2967 | 1715 | 2452 | 2392 | 788 | 1802 | 820 | 1124 | 484 |
| 2008 | 3244 | 41612 | 258758 | 168378 | 134062 | 77106 | 37738 | 18750 | 8277 | 9132 | 8183 | 2660 | 4868 | 2458 | 2992 | 1226 |
| 2009 | 328 | 13338 | 36829 | 12194 | 5626 | 5982 | 7788 | 5443 | 3054 | 4443 | 4230 | 1364 | 3079 | 1382 | 1965 | 618 |
| 2010 | 666 | 33602 | 83903 | 35048 | 21677 | 23503 | 34210 | 23037 | 12643 | 16303 | 14519 | 4647 | 9008 | 4716 | 5551 | 1689 |
| 2011 | 370 | 2212 | 12471 | 14982 | 28729 | 26114 | 31844 | 23915 | 15535 | 19473 | 16964 | 5542 | 10176 | 6534 | 5663 | 2262 |
| 2012 | 738 | 20090 | 34348 | 11535 | 11098 | 10795 | 14979 | 13308 | 9004 | 15662 | 14714 | 4598 | 11467 | 5540 | 7325 | 2325 |
| 2013 | 142 | 1647 | 3695 | 3805 | 10388 | 9207 | 11385 | 11271 | 8299 | 14485 | 13797 | 4374 | 10961 | 5364 | 6893 | 2550 |
| 2014 | 2081 | 1524 | 2365 | 3805 | 12988 | 17314 | 27692 | 24954 | 17460 | 27410 | 25016 | 7911 | 18267 | 9918 | 11160 | 3465 |
| 2015 | 6086 | 19233 | 175572 | 108367 | 35891 | 17618 | 33197 | 26770 | 17433 | 25562 | 22840 | 7208 | 15396 | 8396 | 9445 | 3078 |
| 2016 | 1256 | 7360 | 21027 | 18355 | 32937 | 28679 | 43627 | 41581 | 30274 | 49797 | 45444 | 14238 | 33654 | 17999 | 20815 | 6633 |
| 2017 | 234 | 187 | 263 | 50 | 0.92 | | | | | | | | | | | |
| 2018 | 66693 | 61905 | 37678 | 23753 | 16636 | 14374 | 22348 | 19805 | 13380 | 22885 | 20805 | 6396 | 15571 | 8029 | 9892 | 2972 |
| 2019 | 8053 | 799246 | 572542 | 111704 | 14384 | 3449 | 6655 | 9040 | 6614 | 17118 | 16938 | 5089 | 15345 | 6290 | 10428 | 2925 |

**EVHOE (16–29)**

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1215 | 159 | 659 | 623 | 848 | 768 | 214 | 325 | 543 | 100 | 158 | 51 | 314 | 416 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 1224 | 232 | 904 | 676 | 965 | 1042 | 327 | 476 | 752 | 187 | 231 | 93 | 461 | 353 |
| 1999 | 647 | 62 | 474 | 285 | 477 | 509 | 91 | 246 | 317 | 53 | 62 | 27 | 123 | 197 |
| 2000 | 2604 | 253 | 1384 | 1266 | 1782 | 1538 | 374 | 714 | 1022 | 198 | 245 | 99 | 491 | 921 |
| 2001 | 959 | 153 | 684 | 578 | 780 | 710 | 304 | 456 | 508 | 254 | 147 | 129 | 290 | 306 |
| 2002 | 796 | 117 | 572 | 421 | 617 | 625 | 192 | 324 | 429 | 128 | 113 | 65 | 227 | 244 |
| 2003 | 1838 | 326 | 1387 | 1009 | 1462 | 1557 | 491 | 763 | 1104 | 310 | 322 | 155 | 644 | 532 |
| 2004 | 917 | 382 | 1142 | 901 | 1100 | 1160 | 817 | 925 | 962 | 726 | 360 | 366 | 715 | 181 |
| 2005 | 1368 | 285 | 1065 | 833 | 1140 | 1184 | 486 | 639 | 877 | 332 | 308 | 201 | 546 | 394 |
| 2006 | 445 | 125 | 464 | 311 | 434 | 496 | 245 | 308 | 373 | 184 | 116 | 93 | 242 | 103 |
| 2007 | 678 | 204 | 715 | 484 | 668 | 778 | 381 | 467 | 594 | 282 | 198 | 146 | 385 | 150 |
| 2008 | 1876 | 492 | 1919 | 1226 | 1765 | 2062 | 1064 | 1237 | 1523 | 698 | 420 | 352 | 835 | 460 |
| 2009 | 1114 | 309 | 1064 | 618 | 956 | 1295 | 398 | 493 | 957 | 155 | 306 | 78 | 611 | 235 |
| 2010 | 3457 | 690 | 2957 | 1689 | 2745 | 3490 | 921 | 1368 | 2435 | 312 | 669 | 160 | 1331 | 868 |
| 2011 | 4513 | 597 | 3197 | 2262 | 3408 | 3485 | 1077 | 1762 | 2339 | 616 | 619 | 388 | 1126 | 1414 |
| 2012 | 4142 | 920 | 4165 | 2325 | 3703 | 4595 | 1448 | 2356 | 3218 | 979 | 908 | 490 | 1815 | 928 |
| 2013 | 4068 | 981 | 4205 | 2550 | 3816 | 4494 | 1872 | 2650 | 3227 | 1384 | 914 | 692 | 1830 | 944 |
| 2014 | 7107 | 1227 | 5977 | 3465 | 5645 | 6813 | 1636 | 2961 | 4634 | 782 | 1438 | 607 | 2443 | 1853 |
| 2015 | 5952 | 1033 | 5325 | 3078 | 4950 | 5809 | 1744 | 2969 | 3937 | 1097 | 1193 | 763 | 1965 | 1551 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 12839 | 2342 | 11704 | 6633 | 10734 | 12885 | 3911 | 6423 | 8785 | 2322 | 2219 | 1174 | 4413 | 3266 |
| 2017 | | | | | | | | | | | | | | |
| 2018 | 5679 | 1014 | 5603 | 2972 | 4952 | 5987 | 1726 | 3238 | 4008 | 1258 | 991 | 634 | 1973 | 1357 |
| 2019 | 4917 | 1461 | 6057 | 2925 | 4850 | 6771 | 2496 | 3418 | 4847 | 1494 | 1467 | 849 | 2730 | 814 |

**IGFS (0–15)**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 55 | 126 | 517 | 929 | 2306 | 1859 | 1433 | 1244 | 842 | 1549 | 1546 | 495 | 1309 | 576 | 842 | 317 |
| 2004 | 120 | 418 | 1422 | 594 | 396 | 484 | 1303 | 1341 | 993 | 1713 | 1773 | 589 | 1491 | 618 | 948 | 390 |
| 2005 | 119 | 814 | 982 | 379 | 542 | 665 | 2302 | 2884 | 2364 | 4129 | 4140 | 1360 | 3431 | 1569 | 2142 | 822 |
| 2006 | 176 | 850 | 1572 | 1988 | 4719 | 5051 | 6885 | 7522 | 5179 | 12177 | 13018 | 4151 | 12178 | 4448 | 8189 | 3297 |
| 2007 | 68 | 1052 | 1866 | 1385 | 1605 | 1648 | 2625 | 2628 | 1855 | 3547 | 3577 | 1145 | 3059 | 1292 | 1987 | 723 |
| 2008 | 44 | 589 | 1710 | 3445 | 12363 | 12597 | 13266 | 9219 | 5227 | 7773 | 7797 | 2576 | 6069 | 2491 | 3886 | 2029 |
| 2009 | 159 | 268 | 776 | 1076 | 3174 | 4543 | 5513 | 3620 | 1839 | 2701 | 2706 | 886 | 2101 | 818 | 1373 | 491 |
| 2010 | 51 | 374 | 746 | 902 | 3021 | 6591 | 17251 | 13258 | 8630 | 10098 | 8924 | 3002 | 5053 | 3150 | 2750 | 1284 |
| 2011 | 25 | 642 | 951 | 598 | 1500 | 3223 | 10092 | 8432 | 5965 | 6989 | 6169 | 2095 | 3519 | 2333 | 1835 | 1014 |
| 2012 | 63 | 302 | 673 | 754 | 1773 | 2197 | 7201 | 8422 | 7104 | 10272 | 9476 | 3134 | 6741 | 3972 | 3834 | 1736 |
| 2013 | 21 | 373 | 862 | 1243 | 3026 | 3903 | 10918 | 13284 | 10691 | 18929 | 17531 | 5483 | 13636 | 7177 | 8471 | 2878 |
| 2014 | 132 | 29 | 47 | 90 | 423 | 794 | 2958 | 4429 | 3697 | 7450 | 7127 | 2213 | 5965 | 2873 | 3818 | 1248 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 30 | 814 | 3473 | 1377 | 516 | 943 | 4845 | 7454 | 5858 | 14016 | 14639 | 4623 | 13524 | 5243 | 9030 | 3979 |
| 2016 | 215 | 282 | 2400 | 2888 | 2682 | 1761 | 4458 | 7773 | 6173 | 16077 | 17088 | 5386 | 16240 | 6066 | 10938 | 4231 |
| 2017 | 10228 | 696697 | 6080 | 9322 | 16417 | 11347 | 9585 | 8818 | 5853 | 12738 | 13721 | 4436 | 12670 | 4564 | 8475 | 3944 |
| 2018 | 438 | 273 | 1086 | 2052 | 7920 | 9719 | 13658 | 14344 | 10383 | 20166 | 20022 | 6346 | 17086 | 7532 | 11049 | 3955 |
| 2019 | 183 | 631 | 450 | 243 | 1035 | 1656 | 3072 | 2785 | 1752 | 3700 | 4002 | 1298 | 3660 | 1270 | 2463 | 1160 |

**IGFS (16–29)**

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 467 | 148 | 527 | 317 | 462 | 585 | 287 | 324 | 441 | 179 | 151 | 109 | 263 | 96 |
| 2004 | 543 | 189 | 584 | 390 | 537 | 672 | 317 | 350 | 525 | 203 | 181 | 103 | 362 | 108 |
| 2005 | 1289 | 400 | 1283 | 822 | 1177 | 1509 | 689 | 703 | 1154 | 349 | 363 | 175 | 724 | 286 |
| 2006 | 3989 | 1708 | 5570 | 3297 | 4613 | 6048 | 3673 | 3775 | 4731 | 2459 | 1728 | 1496 | 2924 | 605 |
| 2007 | 1072 | 332 | 1196 | 723 | 1058 | 1334 | 553 | 722 | 999 | 387 | 322 | 193 | 645 | 207 |
| 2008 | 2183 | 900 | 2996 | 2029 | 2637 | 3017 | 2303 | 2367 | 2409 | 1758 | 763 | 917 | 1451 | 424 |
| 2009 | 727 | 261 | 802 | 491 | 707 | 955 | 390 | 433 | 738 | 217 | 255 | 109 | 508 | 128 |
| 2010 | 2303 | 414 | 1616 | 1284 | 1786 | 1832 | 742 | 897 | 1330 | 395 | 371 | 197 | 742 | 715 |
| 2011 | 1683 | 267 | 1165 | 1014 | 1352 | 1212 | 568 | 780 | 873 | 441 | 245 | 225 | 488 | 552 |
| 2012 | 2907 | 548 | 2360 | 1736 | 2447 | 2518 | 1096 | 1491 | 1807 | 781 | 498 | 392 | 991 | 850 |
| 2013 | 5165 | 980 | 4941 | 2878 | 4530 | 5265 | 1784 | 2964 | 3613 | 1312 | 941 | 666 | 1862 | 1291 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2014 | 2146 | 499 | 2236 | 1248 | 1967 | 2437 | 883 | 1317 | 1717 | 598 | 480 | 308 | 941 | 478 |
| 2015 | 4494 | 1690 | 6438 | 3979 | 5486 | 6393 | 3990 | 4977 | 4886 | 3470 | 1767 | 2000 | 3002 | 743 |
| 2016 | 5302 | 2226 | 7389 | 4231 | 6036 | 8062 | 4880 | 4910 | 6258 | 3105 | 1902 | 1596 | 3719 | 819 |
| 2017 | 4195 | 1923 | 6278 | 3944 | 5266 | 6491 | 4624 | 4744 | 5168 | 3422 | 1778 | 1896 | 3186 | 640 |
| 2018 | 6037 | 1863 | 6800 | 3955 | 5887 | 7590 | 3544 | 4077 | 5658 | 2144 | 1691 | 1104 | 3320 | 1222 |
| 2019 | 1197 | 554 | 1821 | 1160 | 1538 | 1862 | 1298 | 1402 | 1485 | 1025 | 512 | 548 | 956 | 174 |

**SPNGFS (0–15)**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 1 | 1403 | 881 | 103 | 15 | 6 | 5 | 3 | 2 | 2 | 2 | 0.62 | 0.98 | 0.78 | 0.5 | 0.18 |
| 1992 | 104 | 4609 | 1830 | 95 | 17 | 13 | 41 | 53 | 36 | 103 | 156 | 57 | 175 | 37 | 120 | 64 |
| 1993 | 1751 | 5508 | 2424 | 164 | 50 | 19 | 6 | 3 | 2 | 2 | 2 | 0.67 | 1 | 0.79 | 0.56 | 0.29 |
| 1994 | 73 | 10576 | 12411 | 3844 | 643 | 57 | 35 | 17 | 5 | 5 | 4 | 1 | 2 | 1 | 2 | 0.27 |
| 1995 | 196 | 4230 | 1525 | 107 | 66 | 51 | 64 | 48 | 30 | 41 | 35 | 11 | 22 | 14 | 13 | 4 |
| 1996 | 898 | 6707 | 2908 | 584 | 554 | 254 | 109 | 66 | 38 | 72 | 68 | 20 | 54 | 23 | 36 | 11 |
| 1997 | 1352 | 7306 | 5446 | 1609 | 680 | 249 | 203 | 121 | 67 | 69 | 56 | 18 | 22 | 18 | 11 | 4 |
| 1998 | 13 | 4493 | 3640 | 638 | 175 | 100 | 79 | 58 | 37 | 55 | 53 | 17 | 40 | 19 | 25 | 9 |
| 1999 | 78 | 4258 | 1802 | 116 | 93 | 80 | 113 | 121 | 85 | 191 | 195 | 61 | 175 | 70 | 117 | 35 |
| 2000 | 5782 | 1661 | 1324 | 346 | 518 | 553 | 750 | 537 | 315 | 443 | 379 | 116 | 237 | 139 | 146 | 37 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 73 | 5952 | 3099 | 309 | 205 | 161 | 197 | 190 | 149 | 199 | 175 | 58 | 115 | 77 | 62 | 25 |
| 2002 | 24 | 3316 | 1395 | 104 | 54 | 43 | 55 | 63 | 47 | 98 | 88 | 26 | 70 | 37 | 46 | 10 |
| 2003 | 1521 | 203 | 155 | 38 | 26 | 16 | 14 | 10 | 5 | 9 | 9 | 3 | 7 | 3 | 4 | 2 |
| 2004 | 32 | 4268 | 2243 | 177 | 83 | 68 | 171 | 219 | 186 | 303 | 279 | 89 | 209 | 118 | 125 | 37 |
| 2005 | 492 | 1253 | 702 | 108 | 78 | 46 | 51 | 60 | 51 | 84 | 78 | 25 | 59 | 33 | 35 | 15 |
| 2006 | 330 | 7296 | 7378 | 1191 | 85 | 34 | 36 | 56 | 44 | 116 | 112 | 33 | 100 | 43 | 68 | 14 |
| 2007 | 90 | 6646 | 3990 | 367 | 180 | 106 | 37 | 30 | 18 | 55 | 54 | 16 | 50 | 20 | 35 | 8 |
| 2008 | 343 | 1736 | 1886 | 629 | 908 | 597 | 329 | 178 | 62 | 202 | 183 | 47 | 158 | 53 | 122 | 28 |
| 2009 | 195 | 4487 | 5078 | 1085 | 167 | 103 | 78 | 71 | 26 | 174 | 155 | 37 | 147 | 56 | 113 | 9 |
| 2010 | 162 | 24558 | 13572 | 1504 | 792 | 346 | 101 | 85 | 41 | 222 | 365 | 132 | 436 | 76 | 306 | 146 |
| 2011 | 394 | 5730 | 3656 | 431 | 244 | 163 | 94 | 77 | 38 | 141 | 182 | 61 | 198 | 48 | 140 | 50 |
| 2012 | 196 | 11653 | 5359 | 384 | 62 | 55 | 160 | 276 | 202 | 620 | 657 | 201 | 638 | 228 | 440 | 140 |
| 2013 | 13 | 4763 | 2946 | 446 | 439 | 276 | 110 | 59 | 30 | 45 | 49 | 17 | 44 | 16 | 28 | 16 |
| 2014 | 198 | 542 | 611 | 767 | 1131 | 910 | 875 | 626 | 323 | 711 | 913 | 317 | 926 | 228 | 635 | 271 |
| 2015 | 83 | 4207 | 2430 | 248 | 462 | 516 | 616 | 432 | 233 | 403 | 463 | 158 | 419 | 125 | 281 | 130 |
| 2016 | 1 | 23 | 17 | 7 | 6 | 4 | 4 | 3 | 2 | 2 | 2 | 0.65 | 1 | 0.75 | 0.93 | 0.24 |
| 2017 | 0.39 | 16 | 14 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 1 | 2 | 0.76 |
| 2018 | 0.02 | 15 | 9 | 1 | 1 | 1 | 3 | 3 | 2 | 5 | 7 | 2 | 7 | 2 | 5 | 2 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2019 | 0.1 | 53 | 23 | 1 | 0.98 | 1 | 2 | 2 | 1 | 5 | 8 | 3 | 10 | 2 | 7 | 3 |

**SPNGFS (16–29)**

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1991 | 0.48 | | 0.25 | 0.18 | 0.3 | 0.25 | | 0.12 | 0.12 | | 3 | 3 | | 0.18 |
| 1992 | 56 | 45 | 94 | 64 | 76 | 114 | 98 | 61 | 102 | 49 | 35 | 25 | 71 | 4 |
| 1993 | 0.58 | 0.09 | 0.28 | 0.29 | 0.38 | 0.37 | 0.09 | 0.09 | 0.28 | | 0.09 | | 0.18 | 0.2 |
| 1994 | 0.87 | 0.05 | 0.8 | 0.27 | 0.65 | 0.84 | 0.05 | 0.38 | 0.47 | | 0.05 | | 0.09 | 0.22 |
| 1995 | 9 | 0.91 | 7 | 4 | 7 | 7 | 1 | 4 | 5 | 0.8 | 0.91 | 0.4 | 2 | 3 |
| 1996 | 18 | 5 | 22 | 11 | 18 | 23 | 9 | 15 | 16 | 8 | 4 | 4 | 9 | 3 |
| 1997 | 11 | 0.14 | 6 | 4 | 7 | 6 | 0.14 | 3 | 3 | | 0.14 | | 0.27 | 4 |
| 1998 | 15 | 4 | 14 | 9 | 13 | 17 | 6 | 7 | 12 | 3 | 5 | 3 | 8 | 4 |
| 1999 | 58 | 18 | 65 | 35 | 55 | 77 | 25 | 34 | 57 | 14 | 18 | 7 | 37 | 10 |
| 2000 | 91 | 10 | 78 | 37 | 69 | 85 | 18 | 39 | 53 | 7 | 9 | 3 | 18 | 25 |
| 2001 | 53 | 6 | 34 | 25 | 38 | 38 | 11 | 17 | 25 | 4 | 5 | 2 | 11 | 17 |
| 2002 | 25 | 3 | 24 | 10 | 20 | 26 | 4 | 12 | 16 | 2 | 3 | 0.9 | 7 | 6 |
| 2003 | 2 | 0.83 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 0.73 | 0.5 | 1 | 0.42 |
| 2004 | 85 | 14 | 63 | 37 | 61 | 76 | 14 | 25 | 52 | 0.4 | 14 | 0.2 | 28 | 23 |
| 2005 | 24 | 4 | 22 | 15 | 22 | 22 | 9 | 16 | 15 | 9 | 4 | 4 | 8 | 6 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2006 | 32 | 8 | 35 | 14 | 27 | 42 | 9 | 15 | 29 | 2 | 8 | 0.9 | 15 | 6 |
| 2007 | 15 | 4 | 20 | 8 | 15 | 22 | 7 | 11 | 15 | 4 | 4 | 2 | 8 | 2 |
| 2008 | 36 | 10 | 81 | 28 | 54 | 73 | 32 | 63 | 47 | 37 | 9 | 19 | 18 | 0.28 |
| 2009 | 34 | 6 | 58 | 9 | 34 | 62 | 8 | 29 | 37 | 3 | 6 | 2 | 11 | 1 |
| 2010 | 130 | 91 | 206 | 146 | 178 | 245 | 145 | 135 | 213 | 104 | 90 | 52 | 180 | 4 |
| 2011 | 59 | 33 | 84 | 50 | 68 | 103 | 48 | 45 | 85 | 27 | 33 | 14 | 66 | 4 |
| 2012 | 198 | 73 | 266 | 140 | 215 | 295 | 122 | 161 | 220 | 86 | 71 | 43 | 141 | 26 |
| 2013 | 16 | 7 | 21 | 16 | 19 | 22 | 16 | 17 | 18 | 13 | 6 | 6 | 13 | 3 |
| 2014 | 291 | 168 | 402 | 271 | 348 | 488 | 259 | 240 | 412 | 163 | 165 | 82 | 329 | 25 |
| 2015 | 138 | 74 | 193 | 130 | 166 | 221 | 140 | 127 | 185 | 91 | 67 | 46 | 134 | 17 |
| 2016 | 0.53 | 0.09 | 0.49 | 0.24 | 0.43 | 0.56 | 0.13 | 0.24 | 0.38 | 0.05 | 0.09 | 0.02 | 0.18 | 0.12 |
| 2017 | 1 | 0.42 | 1 | 0.76 | 1 | 1 | 0.65 | 0.71 | 1 | 0.4 | 0.42 | 0.22 | 0.82 | 0.15 |
| 2018 | 2 | 1 | 3 | 2 | 3 | 4 | 2 | 2 | 3 | 1 | 1 | 0.61 | 2 | 0.24 |
| 2019 | 3 | 2 | 5 | 3 | 4 | 6 | 4 | 3 | 5 | 3 | 2 | 1 | 4 | 0.11 |

**SPPGFS (0–15)**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 4 | 6 | 74 | 48 | 128 | 163 | 290 | 369 | 271 | 650 | 581 | 165 | 482 | 241 | 324 | 62 |
| 2002 | | 0.03 | 0.4 | 4 | 29 | 57 | 162 | 201 | 162 | 294 | 272 | 84 | 214 | 112 | 134 | 40 |
| 2003 | | 1 | 7 | 12 | 21 | 21 | 50 | 69 | 54 | 125 | 126 | 39 | 114 | 47 | 76 | 23 |
| 2004 | 1 | 6 | 3 | 3 | 10 | 18 | 66 | 86 | 65 | 146 | 150 | 47 | 135 | 54 | 89 | 27 |
| 2005 | 2 | 18 | 18 | 9 | 13 | 17 | 81 | 132 | 103 | 263 | 283 | 90 | 269 | 98 | 181 | 68 |
| 2006 | 2 | 137 | 77 | 33 | 53 | 36 | 51 | 84 | 64 | 180 | 200 | 64 | 197 | 67 | 134 | 53 |
| 2007 | | 12 | 19 | 12 | 14 | 15 | 22 | 24 | 16 | 41 | 47 | 15 | 47 | 15 | 32 | 11 |
| 2008 | 1 | 9 | 15 | 13 | 25 | 35 | 72 | 79 | 53 | 130 | 135 | 42 | 124 | 46 | 85 | 27 |
| 2009 | 11 | 13 | 5 | 5 | 45 | 91 | 228 | 263 | 197 | 390 | 429 | 143 | 394 | 144 | 257 | 109 |
| 2010 | 1 | 19 | 5 | 4 | 15 | 41 | 156 | 167 | 121 | 236 | 236 | 75 | 201 | 84 | 131 | 46 |
| 2011 | | 0.42 | 7 | 11 | 17 | 22 | 109 | 159 | 133 | 261 | 256 | 81 | 216 | 100 | 138 | 48 |
| 2012 | 1 | 1 | 2 | 2 | 4 | 10 | 57 | 86 | 72 | 149 | 143 | 44 | 121 | 57 | 78 | 26 |
| 2013 | 1 | 19 | 17 | 6 | 3 | 5 | 49 | 103 | 80 | 235 | 239 | 72 | 226 | 88 | 155 | 47 |
| 2014 | 19 | 4 | 31 | 38 | 20 | 14 | 219 | 597 | 438 | 1632 | 1647 | 478 | 1602 | 603 | 1126 | 417 |
| 2015 | 2 | 1 | 1 | 0.77 | 0.84 | 3 | 35 | 67 | 56 | 136 | 142 | 45 | 132 | 52 | 88 | 37 |
| 2016 | 0.04 | 0.02 | 0.05 | 0.09 | 0.06 | 0.03 | 0.19 | 0.45 | 0.36 | 1 | 1 | 0.36 | 1 | 0.4 | 0.77 | 0.29 |
| 2017 | 1 | 0.12 | 0.08 | 0.01 | 0.11 | 0.19 | 0.51 | 0.91 | 0.58 | 2 | 3 | 0.93 | 3 | 0.85 | 2 | 1 |
| 2018 | 0.08 | | | | 0.01 | 0.07 | 2 | 5 | 4 | 16 | 17 | 5 | 17 | 6 | 12 | 5 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2019 | 0.77 | | 0.02 | 0.04 | 0.06 | 0.05 | 0.74 | | | | | | | | | |

**SPPGFS (16–29)**

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 158 | 21 | 170 | 62 | 133 | 183 | 29 | 87 | 112 | 16 | 21 | 8 | 42 | 33 |
| 2002 | 80 | 14 | 73 | 40 | 66 | 81 | 20 | 38 | 55 | 12 | 14 | 6 | 28 | 20 |
| 2003 | 38 | 12 | 43 | 23 | 36 | 50 | 17 | 24 | 36 | 10 | 12 | 6 | 23 | 7 |
| 2004 | 45 | 15 | 49 | 27 | 42 | 59 | 19 | 24 | 44 | 9 | 14 | 4 | 29 | 8 |
| 2005 | 88 | 34 | 115 | 68 | 97 | 126 | 62 | 74 | 97 | 45 | 32 | 23 | 64 | 13 |
| 2006 | 63 | 26 | 88 | 53 | 74 | 94 | 49 | 60 | 73 | 39 | 26 | 20 | 50 | 8 |
| 2007 | 15 | 7 | 19 | 11 | 16 | 23 | 11 | 10 | 19 | 5 | 7 | 3 | 13 | 2 |
| 2008 | 40 | 14 | 51 | 27 | 42 | 57 | 24 | 30 | 43 | 16 | 14 | 8 | 27 | 6 |
| 2009 | 137 | 54 | 161 | 109 | 146 | 183 | 88 | 102 | 145 | 65 | 53 | 32 | 107 | 23 |
| 2010 | 69 | 22 | 79 | 46 | 69 | 89 | 37 | 47 | 66 | 25 | 21 | 12 | 42 | 13 |
| 2011 | 78 | 21 | 82 | 48 | 73 | 91 | 37 | 49 | 66 | 24 | 20 | 12 | 41 | 17 |
| 2012 | 43 | 10 | 46 | 26 | 40 | 50 | 18 | 28 | 35 | 13 | 10 | 7 | 20 | 9 |
| 2013 | 71 | 23 | 93 | 47 | 75 | 102 | 41 | 56 | 74 | 28 | 22 | 15 | 44 | 11 |
| 2014 | 476 | 160 | 791 | 417 | 626 | 739 | 420 | 632 | 530 | 423 | 185 | 252 | 288 | 61 |
| 2015 | 44 | 19 | 63 | 37 | 52 | 67 | 47 | 45 | 52 | 30 | 14 | 15 | 29 | 8 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 0.36 | 0.16 | 0.51 | 0.29 | 0.41 | 0.57 | 0.34 | 0.32 | 0.45 | 0.2 | 0.14 | 0.1 | 0.27 | 0.05 |
| 2017 | 0.92 | 0.49 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0.45 | 0.5 | 0.91 | 0.08 |
| 2018 | 5 | 2 | 9 | 5 | 7 | 9 | 5 | 6 | 7 | 4 | 2 | 2 | 4 | 0.53 |
| 2019 | | 0.73 | | | | | | | | 0.75 | 0.7 | 0.37 | 1 | 0.21 |

**WCSGFS (0–15)**

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | 0.38 | 0.12 | | | | | | | | | | | | |
| 1987 | | 0.01 | 0.58 | 0.64 | 1 | 0.76 | 0.18 | 0.05 | 0.01 | | | | | | | |
| 1988 | 0.5 | | | | | | | | | | | | | | | |
| 1989 | | 0.3 | 0.2 | | | | | | | | | | | | | |
| 1990 | 1 | 2 | 10 | 21 | 46 | 39 | 31 | 16 | 7 | 5 | 4 | 2 | 0.76 | 0.96 | 0.12 | 0.3 |
| 1991 | | 2 | 23 | 52 | 175 | 185 | 193 | 105 | 45 | 36 | 28 | 9 | 5 | 5 | 2 | 1 |
| 1992 | | 2 | 34 | 115 | 616 | 975 | 1952 | 1270 | 712 | 662 | 524 | 178 | 157 | 152 | 61 | 41 |
| 1993 | | 2 | 2 | 4 | 23 | 41 | 80 | 52 | 29 | 26 | 21 | 7 | 6 | 6 | 2 | 2 |
| 1994 | | 0.01 | 0.15 | 0.34 | 0.48 | 0.33 | 0.13 | 0.06 | 0.01 | 0.09 | 0.08 | 0.02 | 0.08 | 0.03 | 0.06 | |
| 1995 | | 0.21 | 3 | 15 | 74 | 114 | 190 | 151 | 103 | 121 | 101 | 33 | 54 | 42 | 27 | 11 |
| 1996 | 2 | 5 | 2 | 0.03 | 1 | 6 | 67 | 153 | 112 | 391 | 353 | 95 | 318 | 144 | 224 | 29 |
| 1997 | 4 | 4 | 11 | 6 | 12 | 22 | 63 | 62 | 47 | 69 | 60 | 19 | 40 | 25 | 23 | 7 |

| **Year** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 1 | 4 | 4 | 0.67 | 1 | 1 | 0.72 | 0.65 | 0.56 | 0.45 | 0.38 | 0.15 | 0.15 | 0.22 | | 0.08 |
| 1999 | 1 | 5 | 3 | 0.8 | 0.47 | 0.58 | 1 | 0.7 | 0.4 | 0.31 | 0.25 | 0.09 | 0.05 | 0.08 | | 0.02 |
| 2000 | | 2 | 16 | 41 | 124 | 143 | 179 | 116 | 65 | 68 | 59 | 20 | 30 | 19 | 16 | 7 |
| 2001 | 1 | 0.11 | 2 | 5 | 17 | 21 | 40 | 44 | 30 | 70 | 67 | 20 | 58 | 25 | 39 | 9 |
| 2002 | | 6 | 8 | 35 | 291 | 631 | 1838 | 1814 | 1320 | 2185 | 1935 | 594 | 1386 | 781 | 858 | 225 |
| 2003 | 1 | 2 | 42 | 28 | 127 | 272 | 867 | 971 | 691 | 1498 | 1519 | 476 | 1339 | 536 | 892 | 248 |
| 2004 | 1 | 2 | 16 | 57 | 327 | 770 | 2590 | 2686 | 1983 | 3447 | 3359 | 1079 | 2693 | 1240 | 1707 | 569 |
| 2005 | 2 | 15 | 19 | 19 | 53 | 93 | 276 | 325 | 236 | 519 | 501 | 153 | 429 | 188 | 286 | 76 |
| 2006 | 4 | 4 | 12 | 39 | 183 | 196 | 341 | 423 | 294 | 781 | 834 | 261 | 795 | 283 | 543 | 172 |
| 2007 | 4 | 3 | 14 | 56 | 339 | 638 | 1707 | 1727 | 1220 | 2309 | 2385 | 775 | 2056 | 820 | 1341 | 522 |
| 2008 | 2 | 41 | 110 | 208 | 689 | 989 | 2324 | 3054 | 2082 | 6013 | 6662 | 2108 | 6560 | 2164 | 4517 | 1712 |
| 2009 | 1 | 2 | 100 | 387 | 1816 | 1538 | 759 | 363 | 137 | 139 | 136 | 46 | 95 | 43 | 58 | 32 |
| 2010 | | | | 17 | 160 | 347 | 785 | 626 | 398 | 580 | 549 | 179 | 394 | 189 | 245 | 87 |
| 2011 | 6 | 31 | 531 | 1086 | 3514 | 5387 | 10238 | 7369 | 4589 | 4924 | 4157 | 1403 | 2004 | 1489 | 988 | 477 |
| 2012 | 1 | 5 | 28 | 97 | 469 | 1148 | 4804 | 6462 | 5298 | 9990 | 10765 | 3610 | 9632 | 3810 | 6155 | 3487 |
| 2013 | 1 | 0.6 | 0.43 | 5 | 101 | 381 | 2420 | 3378 | 3003 | 4670 | 4228 | 1361 | 3064 | 1852 | 1769 | 647 |
| 2014 | 891 | 55 | 60 | 67 | 509 | 1549 | 6999 | 8472 | 6502 | 12849 | 11622 | 3475 | 9135 | 4722 | 5898 | 1390 |
| 2015 | 22 | 173 | 73 | 7 | 2 | 3 | 31 | 57 | 49 | 106 | 108 | 34 | 97 | 41 | 63 | 25 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 1 | 946 | 2978 | 1730 | 751 | 680 | 3544 | 5695 | 4735 | 10264 | 9850 | 3016 | 8414 | 3926 | 5481 | 1626 |
| 2017 | | | | | | | | | | | | | | | | |
| 2018 | | | | | | | | | | | | | | | | |
| 2019 | | | | | | | | | | | | | | | | |

### WCSGFS (16–29)

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1986 | | | | | | | | | | | | | | |
| 1987 | | | | | | | | | | | | | | |
| 1988 | | | | | | | | | | | | | | |
| 1989 | | | | | | | | | | | | | | |
| 1990 | 0.63 | | 0.06 | 0.3 | 0.33 | 0.06 | | 0.03 | 0.03 | | | | | 0.3 |
| 1991 | 3 | | 1 | 1 | 2 | 1 | | 0.5 | 0.5 | | | | | 1 |
| 1992 | 96 | | 30 | 41 | 56 | 30 | | 15 | 15 | | | | | 41 |
| 1993 | 4 | | 1 | 2 | 2 | 1 | 0.05 | 0.6 | 0.5 | 0.1 | | 0.05 | | 2 |
| 1994 | 0.02 | | 0.03 | | 0.02 | 0.03 | | 0.02 | 0.02 | | | | | |
| 1995 | 27 | 1 | 13 | 11 | 17 | 14 | 1 | 6 | 8 | | 1 | | 2 | 10 |
| 1996 | 94 | 14 | 112 | 29 | 78 | 126 | 14 | 49 | 77 | | 14 | | 28 | 15 |
| 1997 | 17 | 2 | 12 | 7 | 12 | 13 | 2 | 6 | 9 | 0.8 | 2 | 0.4 | 4 | 5 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | 0.15 | | | 0.08 | 0.08 | | | | | | | | | 0.08 |
| 1999 | 0.05 | | | 0.02 | 0.02 | | | | | | | | | 0.02 |
| 2000 | 14 | 2 | 8 | 7 | 10 | 10 | 3 | 4 | 7 | 1 | 2 | 0.6 | 4 | 5 |
| 2001 | 19 | 5 | 21 | 9 | 17 | 25 | 7 | 10 | 18 | 2 | 5 | 1 | 9 | 3 |
| 2002 | 528 | 68 | 446 | 225 | 405 | 497 | 85 | 214 | 317 | 33 | 68 | 17 | 136 | 140 |
| 2003 | 446 | 143 | 480 | 248 | 401 | 592 | 182 | 215 | 439 | 62 | 140 | 31 | 280 | 77 |
| 2004 | 986 | 267 | 957 | 569 | 866 | 1129 | 387 | 487 | 832 | 190 | 259 | 95 | 517 | 215 |
| 2005 | 144 | 37 | 156 | 76 | 130 | 180 | 51 | 79 | 127 | 26 | 36 | 13 | 72 | 27 |
| 2006 | 252 | 100 | 322 | 172 | 261 | 379 | 165 | 176 | 290 | 87 | 93 | 43 | 186 | 35 |
| 2007 | 715 | 252 | 835 | 522 | 738 | 934 | 439 | 520 | 719 | 305 | 240 | 152 | 480 | 130 |
| 2008 | 2042 | 894 | 2945 | 1712 | 2424 | 3210 | 1695 | 1969 | 2499 | 1258 | 872 | 664 | 1673 | 247 |
| 2009 | 37 | 12 | 43 | 32 | 41 | 42 | 28 | 35 | 33 | 26 | 11 | 13 | 22 | 8 |
| 2010 | 149 | 41 | 140 | 87 | 130 | 166 | 64 | 72 | 123 | 30 | 38 | 15 | 75 | 35 |
| 2011 | 1016 | 93 | 520 | 477 | 678 | 590 | 124 | 249 | 388 | 47 | 91 | 24 | 182 | 362 |
| 2012 | 3477 | 1393 | 4814 | 3487 | 4404 | 4621 | 3430 | 4089 | 3703 | 3171 | 1490 | 1834 | 2485 | 658 |
| 2013 | 1296 | 179 | 971 | 647 | 999 | 1064 | 267 | 524 | 712 | 172 | 179 | 86 | 358 | 382 |
| 2014 | 3236 | 508 | 3097 | 1390 | 2616 | 3468 | 678 | 1499 | 2242 | 273 | 497 | 137 | 994 | 757 |
| 2015 | 34 | 11 | 41 | 25 | 36 | 44 | 23 | 28 | 33 | 17 | 10 | 9 | 20 | 8 |

| Year | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 2933 | 713 | 3140 | 1626 | 2666 | 3504 | 1214 | 1736 | 2465 | 697 | 713 | 399 | 1324 | 616 |
| 2017 | | | | | | | | | | | | | | |
| 2018 | | | | | | | | | | | | | | |
| 2019 | | | | | | | | | | | | | | |

**Table 3.6.3.1. Boarfish in ICES Subareas 27.6, 7, 8. Key parameter estimates from the exploratory Schaeffer state space surplus production model. Posterior parameter distributions are provided in Figure 3.6.3.5.**

| | Mean | SD | 2.5 | 25 | 50 | 75 | 97.5 |
|---|---|---|---|---|---|---|---|
| r | 0.34 | 0.17 | 0.05 | 0.21 | 0.33 | 0.46 | 0.72 |
| K | 628454 | 393579 | 305500 | 429025 | 528400 | 683100 | 1659925 |
| $F_{MSY}$ | 0.17 | 0.09 | 0.03 | 0.11 | 0.17 | 0.23 | 0.36 |
| $B_{MSY}$ | 157000 | 98400 | 76400 | 107000 | 132000 | 171000 | 415000 |
| TSB | 480000 | 202000 | 222000 | 345000 | 436000 | 567000 | 992000 |

**Table 3.6.4.1. Boarfish in ICES Subareas 27.6, 7, 8. Pseudo-cohort derived estimates of fishing mortality (F) and total mortality (Z), in comparison with total catch per year. Pearson correlation coefficient of F vs. catch (tonnes) indicated.**

| Age | Raised Numbers | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 1 | 0 | 0 | 1575 | 2415 | 0 | 28 | 301 | 0 | 5556 | 218 | 1862 | 314 | 17427 |
| 2 | 352 | 5488 | 15043 | 11229 | 2894 | 893 | 7148 | 695 | 116135 | 2385 | 4387 | 1736 | 37620 |
| 3 | 2114 | 21140 | 65744 | 72709 | 41913 | 5467 | 156680 | 49503 | 32248 | 10737 | 8830 | 2628 | 9737 |
| 4 | 40851 | 105575 | 338931 | 294382 | 28148 | 41278 | 58522 | 127520 | 16588 | 25114 | 34448 | 13610 | 9944 |
| 5 | 48915 | 141300 | 475619 | 567689 | 30116 | 110272 | 59797 | 93705 | 24564 | 20263 | 27266 | 15570 | 12682 |
| 6 | 62713 | 195339 | 543707 | 878363 | 175696 | 146582 | 68949 | 67275 | 26566 | 18025 | 21103 | 14731 | 12716 |
| 7 | 26132 | 104031 | 307333 | 522703 | 143967 | 492078 | 302967 | 193061 | 74115 | 61229 | 55189 | 38686 | 29513 |
| 8 | 29766 | 66570 | 172783 | 293719 | 107126 | 365840 | 250341 | 139124 | 52052 | 47573 | 38229 | 26821 | 18819 |
| 9 | 56075 | 53159 | 155477 | 276672 | 77861 | 271916 | 212318 | 121042 | 44615 | 42478 | 32258 | 23670 | 15875 |
| 10 | 44875 | 46893 | 130148 | 232122 | 60022 | 173486 | 160137 | 94225 | 34264 | 35150 | 25716 | 19395 | 11359 |
| 11 | 14019 | 15289 | 42521 | 78588 | 46079 | 69396 | 63025 | 36078 | 12999 | 13297 | 9560 | 7148 | 4272 |
| 12 | 32359 | 21178 | 61350 | 114600 | 40468 | 40968 | 41490 | 24895 | 9114 | 9132 | 7564 | 5846 | 2937 |
| 13 | 4848 | 11854 | 39609 | 59932 | 24352 | 58888 | 59380 | 36309 | 13362 | 13774 | 10922 | 8183 | 4256 |
| 14 | 16837 | 13570 | 31569 | 59060 | 19724 | 30277 | 30355 | 19064 | 7152 | 6682 | 5924 | 4554 | 2164 |
| 15+ | 109481 | 112947 | 196967 | 349320 | 157707 | 217260 | 239366 | 150688 | 59139 | 49589 | 40797 | 32130 | 14864 |

| Age | ln(Raised Numbers) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| 1 | 0 | 0 | 7 | 8 | 0 | 3 | 6 | 0 | 9 | 5 | 8 | 6 | 10 |
| 2 | 6 | 9 | 10 | 9 | 8 | 7 | 9 | 7 | 12 | 8 | 8 | 7 | 11 |
| 3 | 8 | 10 | 11 | 11 | 11 | 9 | 12 | 11 | 10 | 9 | 9 | 8 | 9 |
| 4 | 11 | 12 | 13 | 13 | 10 | 11 | 11 | 12 | 10 | 10 | 10 | 10 | 9 |
| 5 | 11 | 12 | 13 | 13 | 10 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 |
| 6 | 11 | 12 | 13 | 14 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 |
| 7 | 10 | 12 | 13 | 13 | 12 | 13 | 13 | 12 | 11 | 11 | 11 | 11 | 10 |
| 8 | 10 | 11 | 12 | 13 | 12 | 13 | 12 | 12 | 11 | 11 | 11 | 10 | 10 |
| 9 | 11 | 11 | 12 | 13 | 11 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 |
| 10 | 11 | 11 | 12 | 12 | 11 | 12 | 12 | 11 | 10 | 10 | 10 | 10 | 9 |
| 11 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 10 | 9 | 9 | 9 | 9 | 8 |
| 12 | 10 | 10 | 11 | 12 | 11 | 11 | 11 | 10 | 9 | 9 | 9 | 9 | 8 |
| 13 | 8 | 9 | 11 | 11 | 10 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 8 |
| 14 | 10 | 10 | 10 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 |
| 15+ | 12 | 12 | 12 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 10 | 10 |
| Z (7-14) | 0.17 | 0.33 | 0.36 | 0.33 | 0.29 | 0.45 | 0.36 | 0.37 | 0.31 | 0.31 | 0.33 | 0.36 | 0.37 |
| F (M=0.16) | 0.01 | 0.17 | 0.2 | 0.17 | 0.13 | 0.29 | 0.2 | 0.21 | 0.15 | 0.15 | 0.17 | 0.2 | 0.21 |

| Age | ln(Raised Numbers) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** |
| Catches (t) | 21576 | 34751 | 90370 | 144047 | 37096 | 87355 | 75409 | 45231 | 17766 | 19315 | 17388 | 11286 | 11323 |
| Corr coef landings vs F | 0.33 | | | | | | | | | | | | |

**Table 3.6.5.1. Boarfish in ICES Subareas 27.6, 7, 8. Estimates of total stock biomass and F.**

| Year | TSB.2.5 | TSB.50 | TSB.97.5 | F.2.5 | F.50 | F.97.5 |
|---|---|---|---|---|---|---|
| 1991 | 99831 | 187300 | 417490 | | | |
| 1992 | 164100 | 291500 | 625690 | | | |
| 1993 | 198500 | 353600 | 755587 | | | |
| 1994 | 233002 | 418600 | 908197 | | | |
| 1995 | 201200 | 360400 | 771095 | | | |
| 1996 | 204500 | 362400 | 787985 | | | |
| 1997 | 174702 | 305750 | 654895 | | | |
| 1998 | 235505 | 410750 | 880680 | | | |
| 1999 | 175702 | 308150 | 658430 | | | |
| 2000 | 149902 | 264100 | 563787 | | | |
| 2001 | 163705 | 282200 | 597055 | | | |
| 2002 | 142000 | 243400 | 510680 | | | |
| 2003 | 127000 | 216600 | 463282 | 0.02 | 0.05 | 0.09 |
| 2004 | 180905 | 311700 | 662297 | 0.01 | 0.02 | 0.03 |
| 2005 | 176100 | 301700 | 638880 | 0.01 | 0.02 | 0.03 |
| 2006 | 223500 | 376800 | 795895 | 0.01 | 0.02 | 0.03 |
| 2007 | 195202 | 331650 | 699292 | 0.03 | 0.07 | 0.11 |
| 2008 | 246300 | 410450 | 850965 | 0.04 | 0.08 | 0.14 |
| 2009 | 252702 | 419300 | 866795 | 0.01 | 0.22 | 0.36 |
| 2010 | 368712 | 607300 | 1270000 | 0.11 | 0.24 | 0.39 |
| 2011 | 326705 | 544700 | 1150925 | 0.03 | 0.07 | 0.11 |
| 2012 | 464902 | 745200 | 1538900 | 0.06 | 0.12 | 0.19 |
| 2013 | 318805 | 523300 | 1094975 | 0.07 | 0.14 | 0.24 |
| 2014 | 147702 | 240800 | 507200 | 0.09 | 0.19 | 0.31 |
| 2015 | 174700 | 290500 | 613395 | 0.03 | 0.06 | 0.1 |
| 2016 | 125300 | 210000 | 438187 | 0.04 | 0.09 | 0.15 |
| 2017 | 224202 | 369900 | 778192 | 0.02 | 0.05 | 0.08 |
| 2018 | 226405 | 374700 | 786990 | 0.01 | 0.03 | 0.05 |

| Year | TSB.2.5 | TSB.50 | TSB.97.5 | F.2.5 | F.50 | F.97.5 |
|---|---|---|---|---|---|---|
| 2019 | 206502 | 347350 | 730597 | 0.02 | 0.03 | 0.05 |
| 202 | 222000 | 435900 | 992500 | | | |

# 3.17 Figures

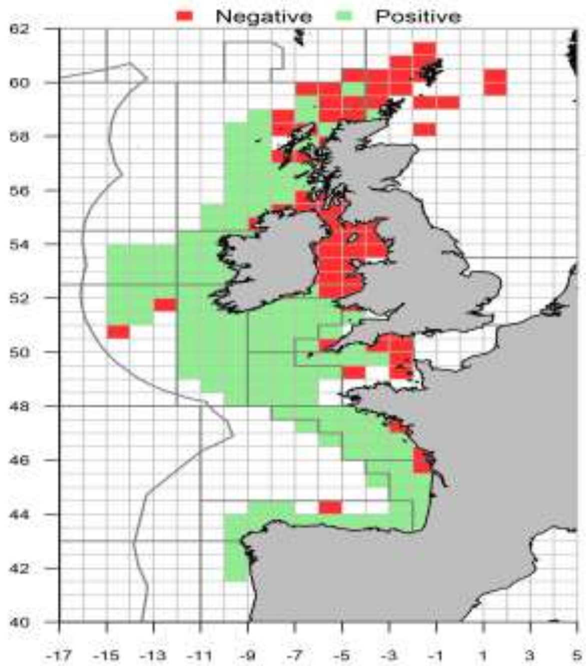


**Figure 3.1. Boarfish in ICES Subareas 4, 27.6, 7, 8 and 9. Distribution of boarfish in the NE Atlantic area based on presence and absence in IBTS surveys (all years).**

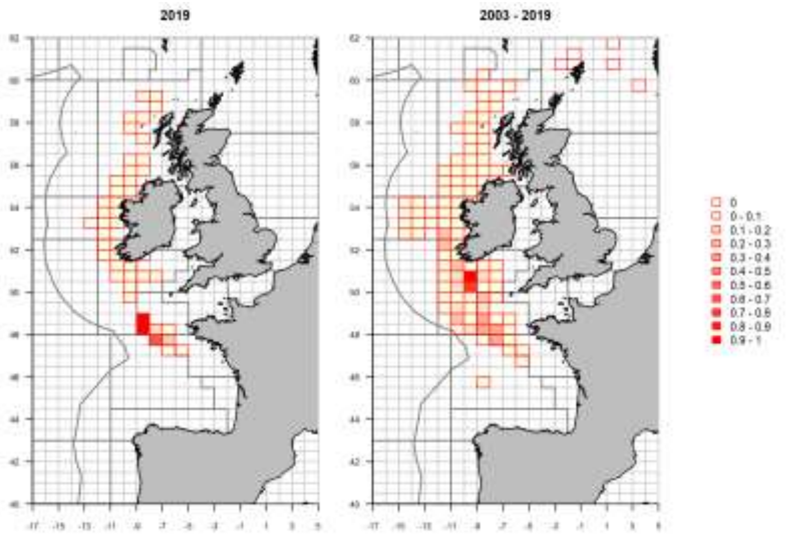


**Figure 3.1.2.1. Boarfish in ICES Subareas 27.6, 7, 8. Combined Irish boarfish landings 2003-2019 by ICES rectangle (Right). Irish boarfish landings 2019 by ICES rectangle (Left).**

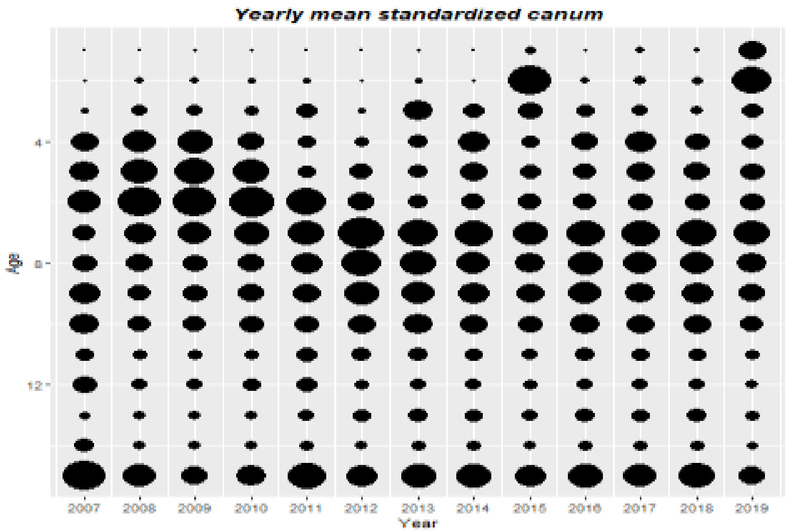


**Figure 3.2.1.1. Boarfish in ICES Subareas 27.6, 7, 8. Catch numbers-at-age standardised by yearly mean. 15+ is the plus group.**

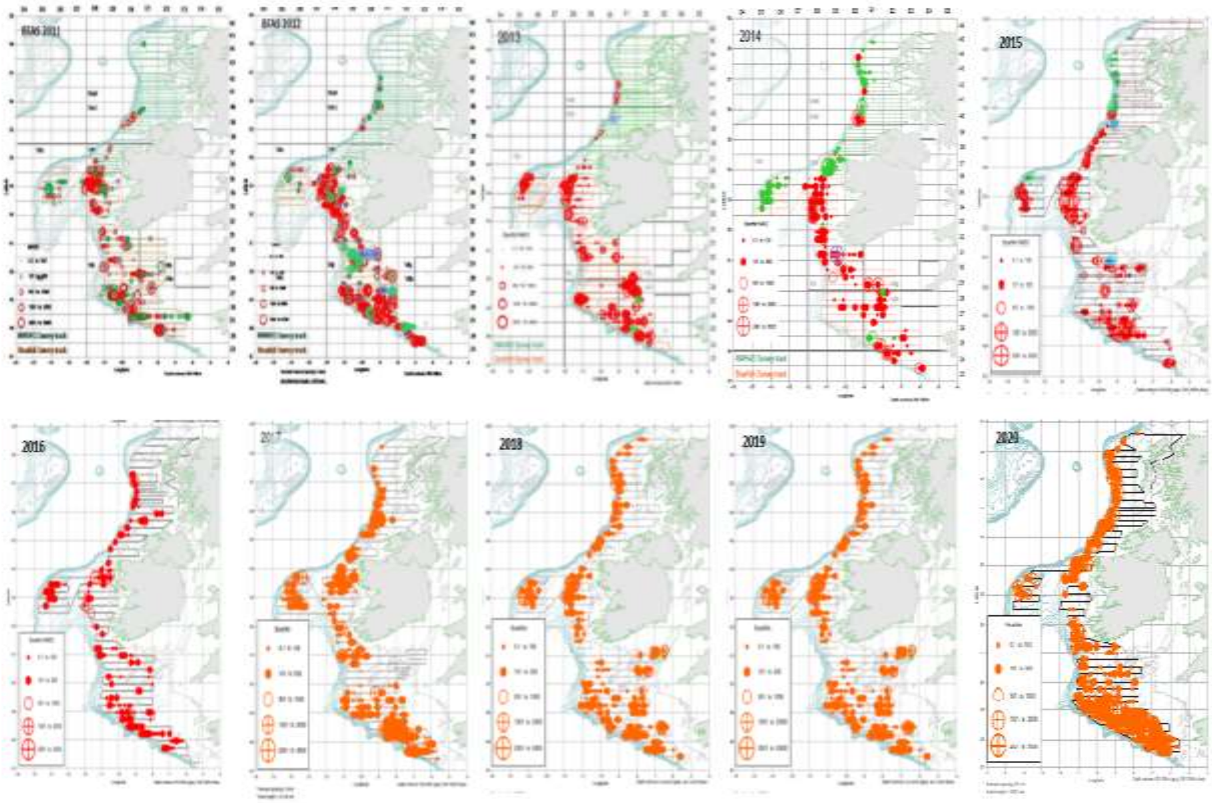


**Figure 3.3.1.1. Boarfish in ICES Subareas 27.6, 7, 8. Boarfish acoustic survey track and haul positions from acoustic survey 2011-2020.**

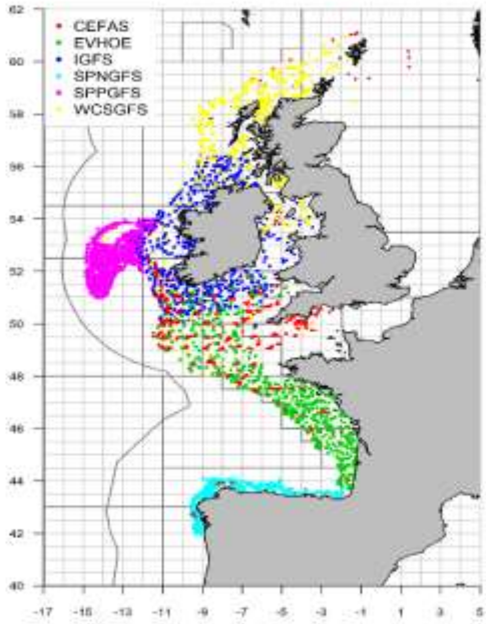


**Figure 3.3.2.1. Boarfish in ICES Subareas 27.6, 7, 8. The haul positions of bottom trawl surveys analysed as an index for boarfish abundance. Note the Portuguese Groundfish survey included here was not included in the 2016 assessment.**

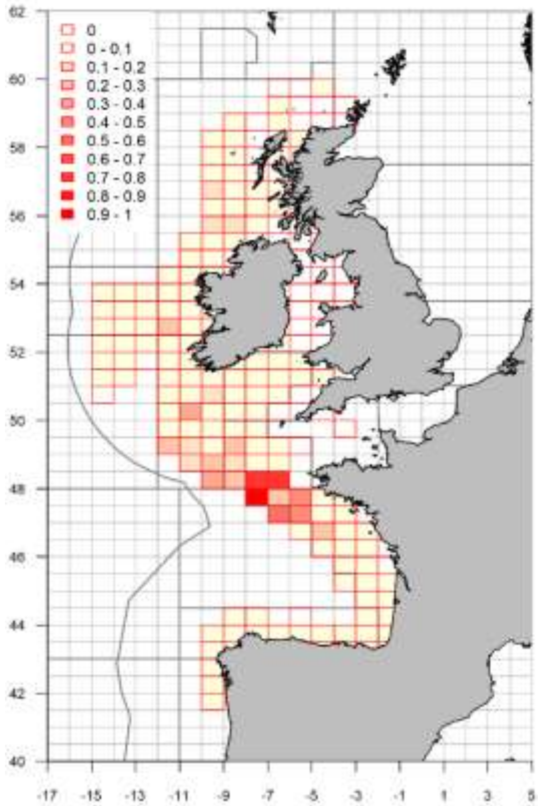


**Figure 3.3.2.2. Boarfish in ICES Subareas 27.6, 7, 8. Distribution of boarfish in the NE Atlantic showing proposed management area.**

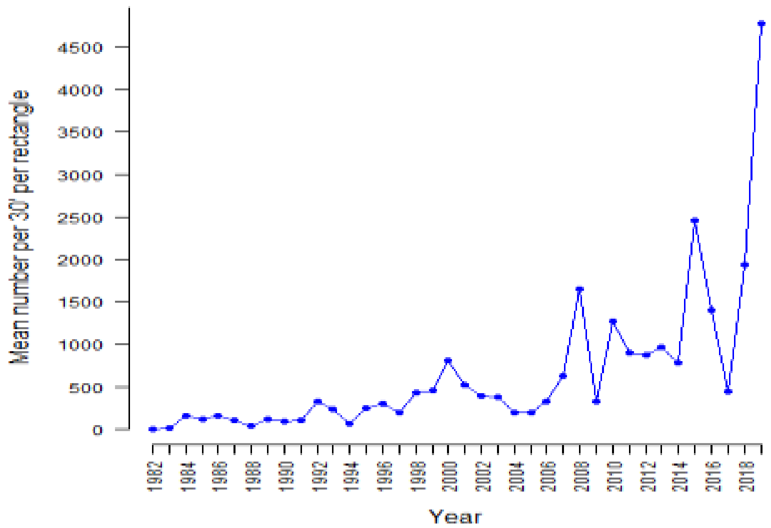


**Figure 3.3.2.3. Boarfish in ICES Subareas 27.6, 7, 8. CPUE in number per 30-minute haul of boarfish per rectangle in the western IBTS survey 1982 to 2019.**

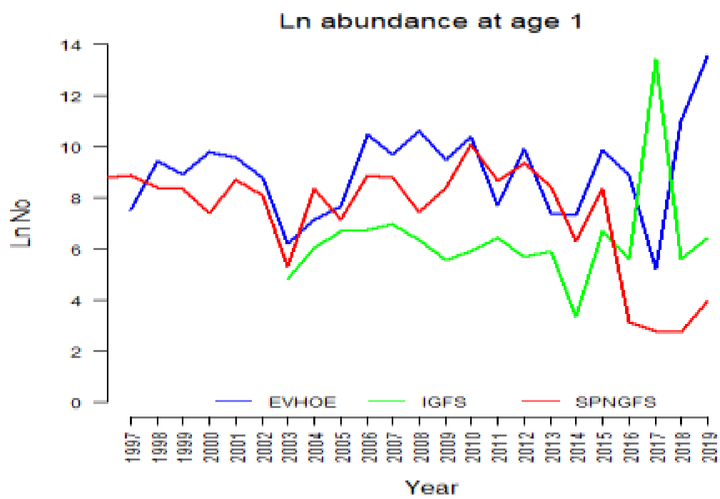


**Figure 3.5.1. Boarfish in ICES Subareas 27.6, 7, 8. Recruitment-at-age 1, from various IBTS.**

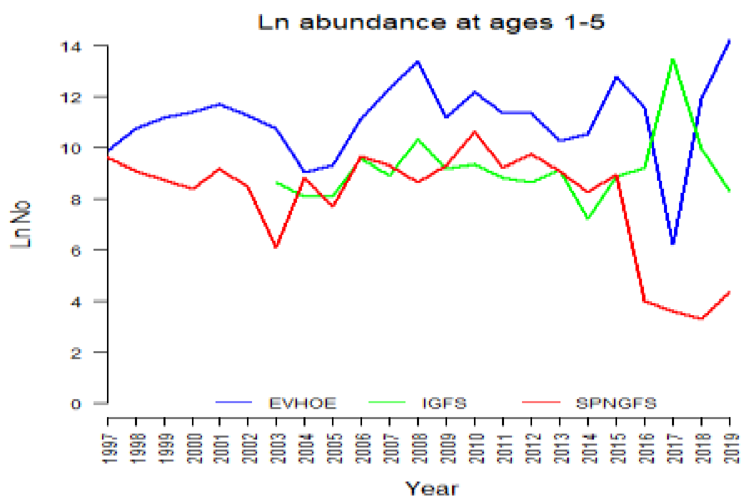


**Figure 3.5.2. Boarfish in ICES Subareas 27.6, 7, 8. Recruitment-at-ages 1-5, from various IBTS.**

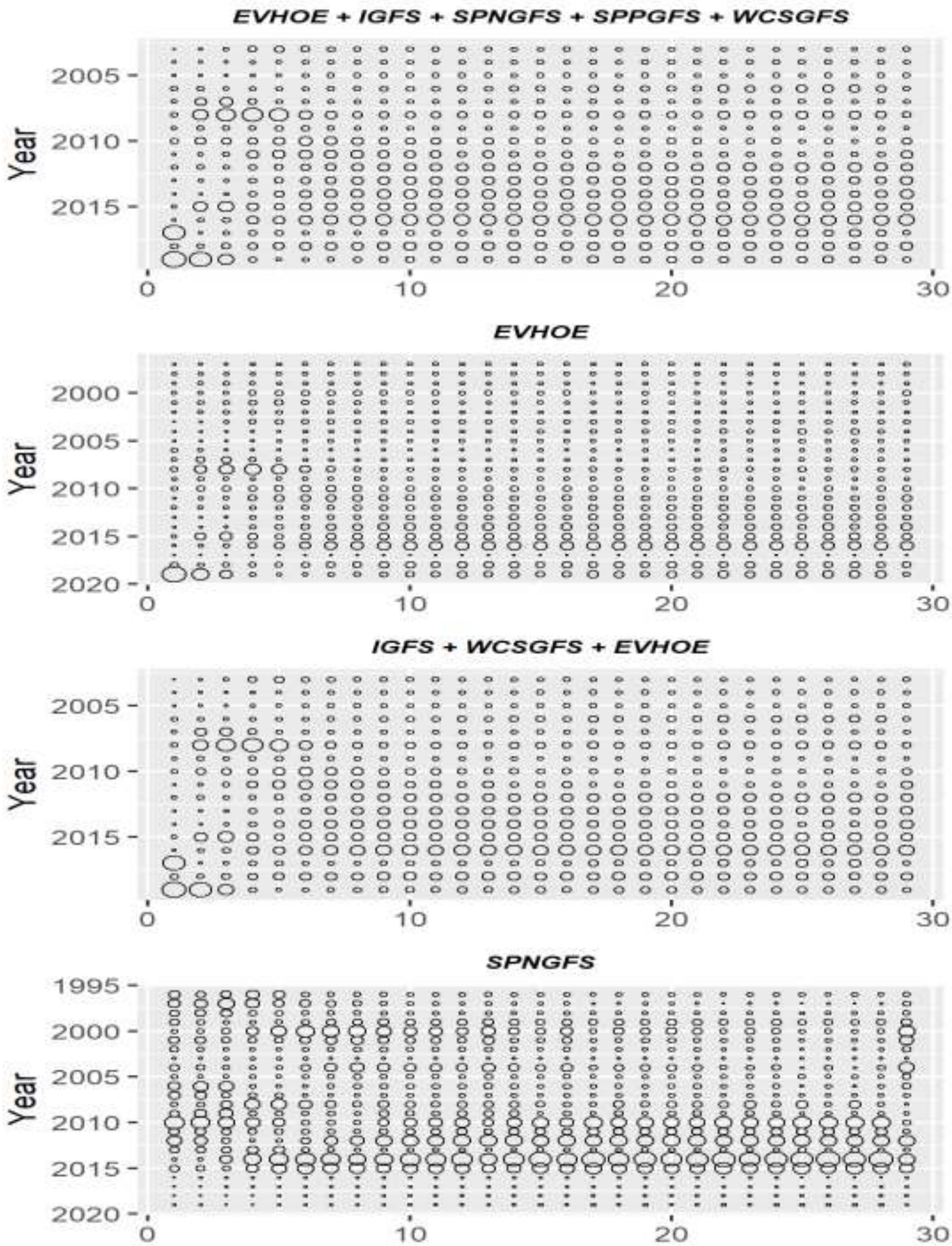


**Figure 3.6.1.1. Boarfish in ICES Subareas 27.6, 7, 8. Abundance-at-age in constituent western IBTS. Yearly mean standardised abundance-at-age.**

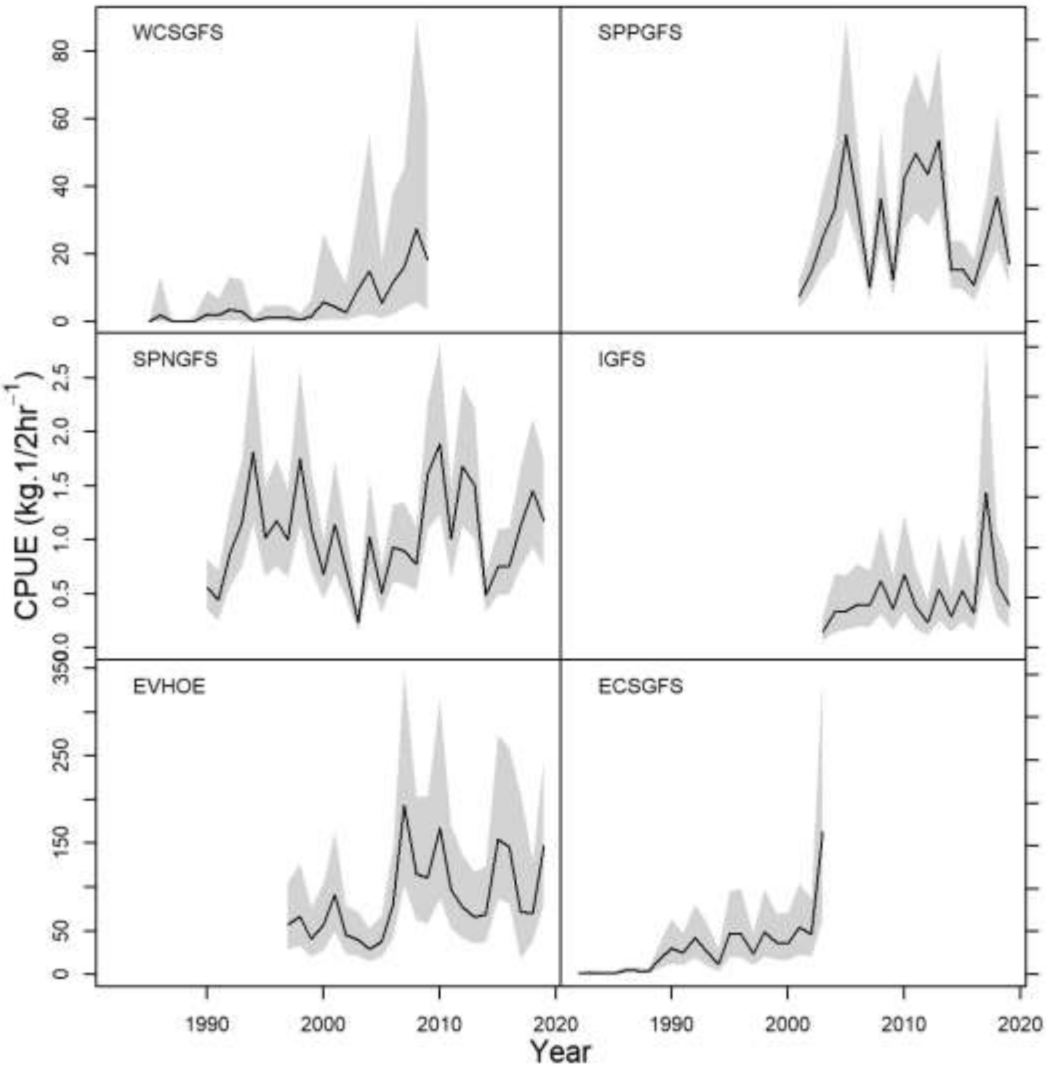


**Figure 3.6.1.2. Boarfish in ICES Subareas 27.6, 7, 8. Boarfish IBTS survey CPUE fitted delta-lognormal mean (solid line) and 95% credible intervals (grey region).**

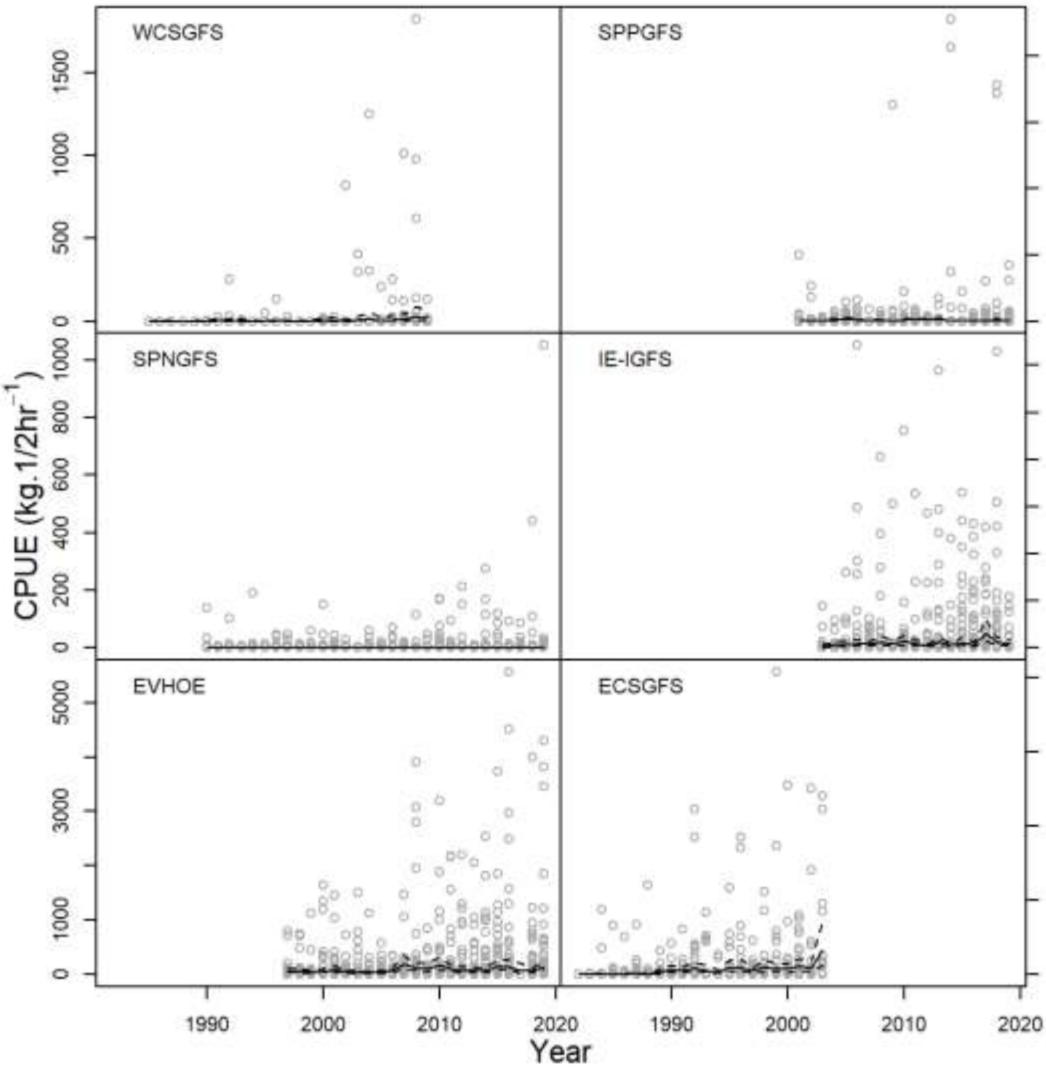


**Figure 3.6.1.3. Boarfish in ICES Subareas 27.6, 7, 8. Boarfish IBTS survey CPUE data (grey points) and fitted delta-lognormal mean (solid line) and 95% credible intervals (dashed lines).**

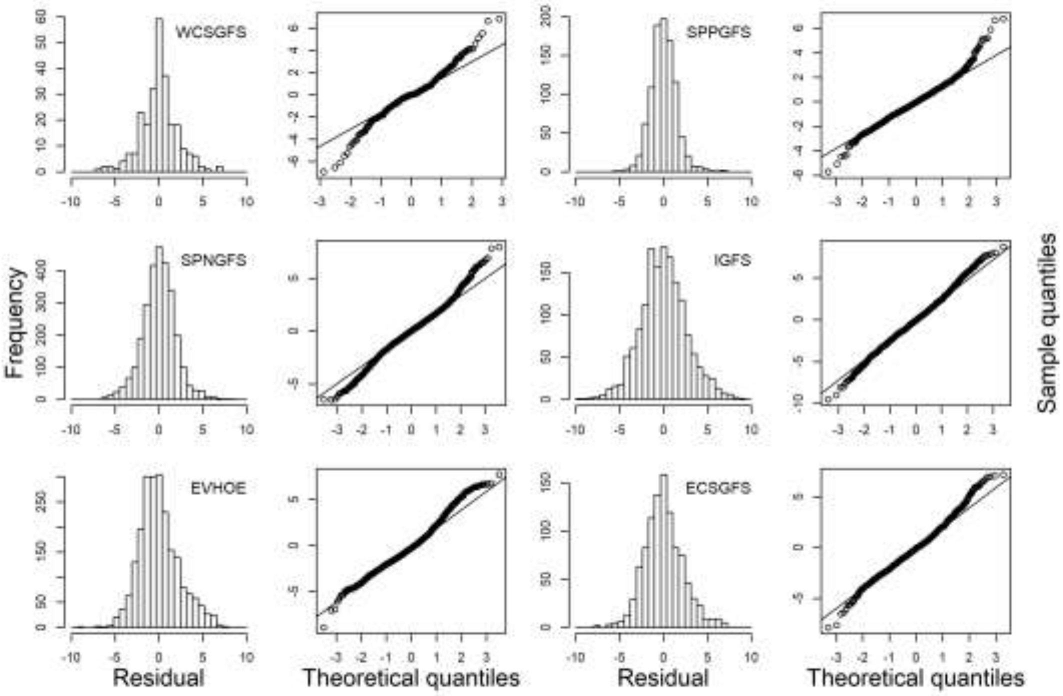


**Figure 3.6.1.4. Boarfish in ICES Subareas 27.6, 7, 8. Diagnostics from the positive component of the delta-lognormal fits**

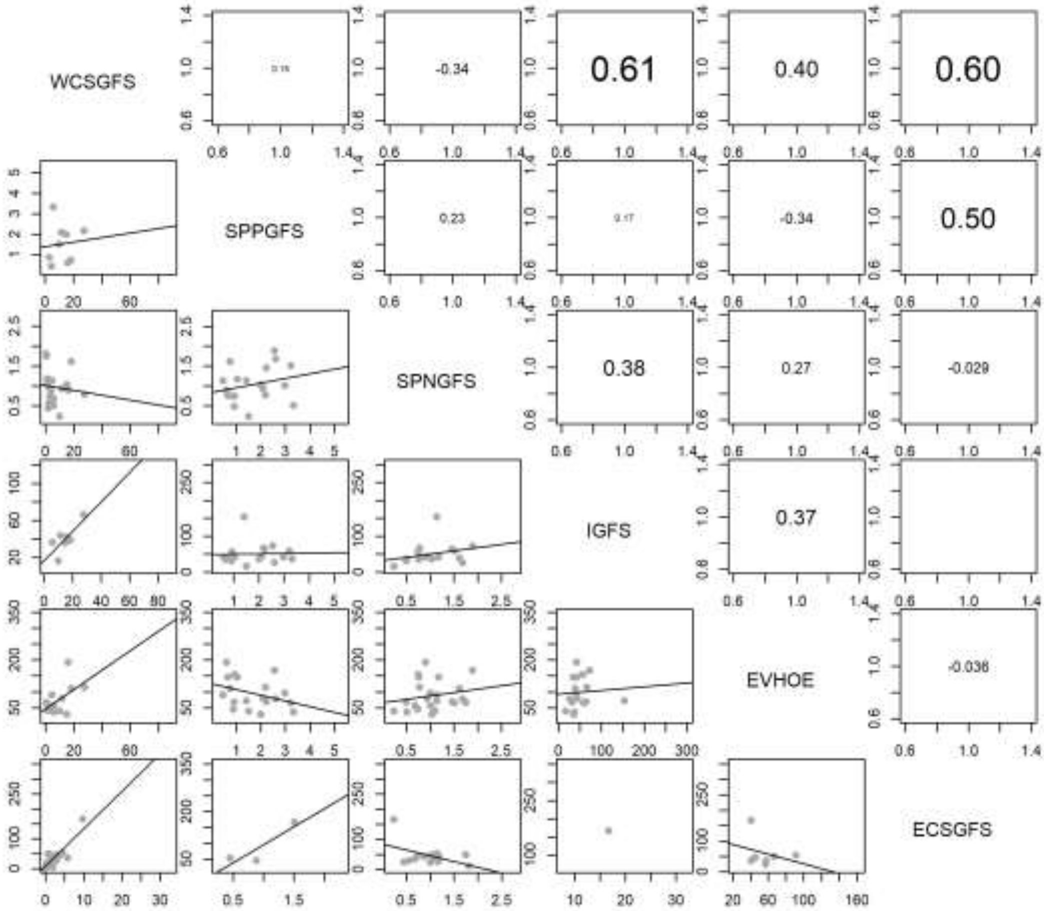


**Figure 3.6.1.5. Boarfish in ICES Subareas 27.6, 7, 8. Pair-wise correlation between the annual mean survey indices.**

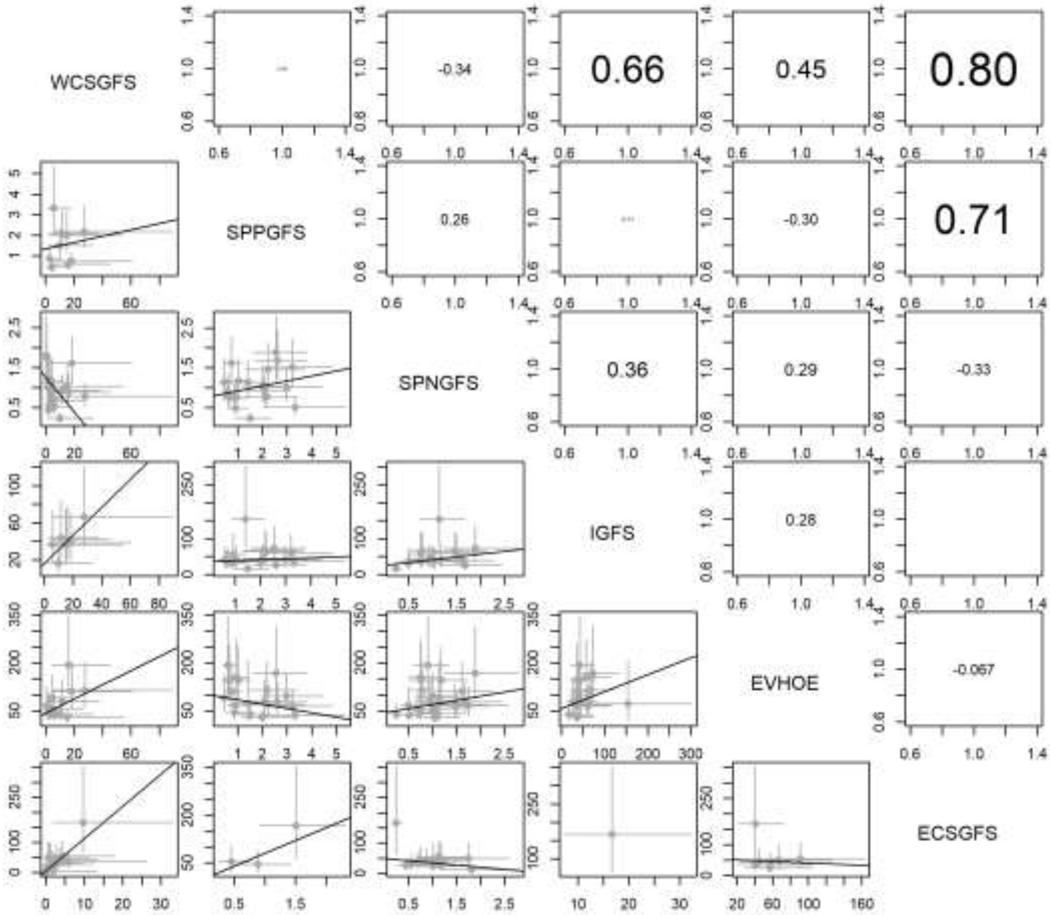


**Figure 3.6.1.6. Boarfish in ICES Subareas 27.6, 7, 8. Weighted correlation between the annual mean survey indices. Correlations are weighted by the sum of the pair-wise variances.**

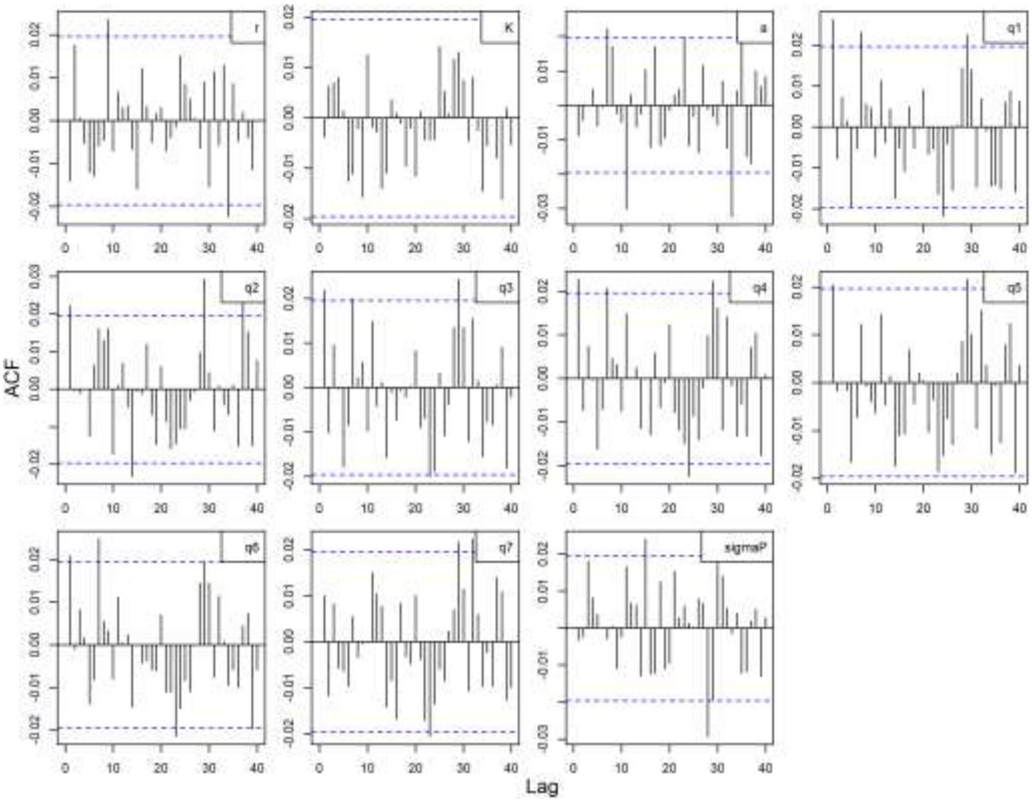


**Figure 3.6.3.1. Boarfish in ICES Subareas 27.6, 7, 8. Parameters for final run converged with good mixing of the chains.**

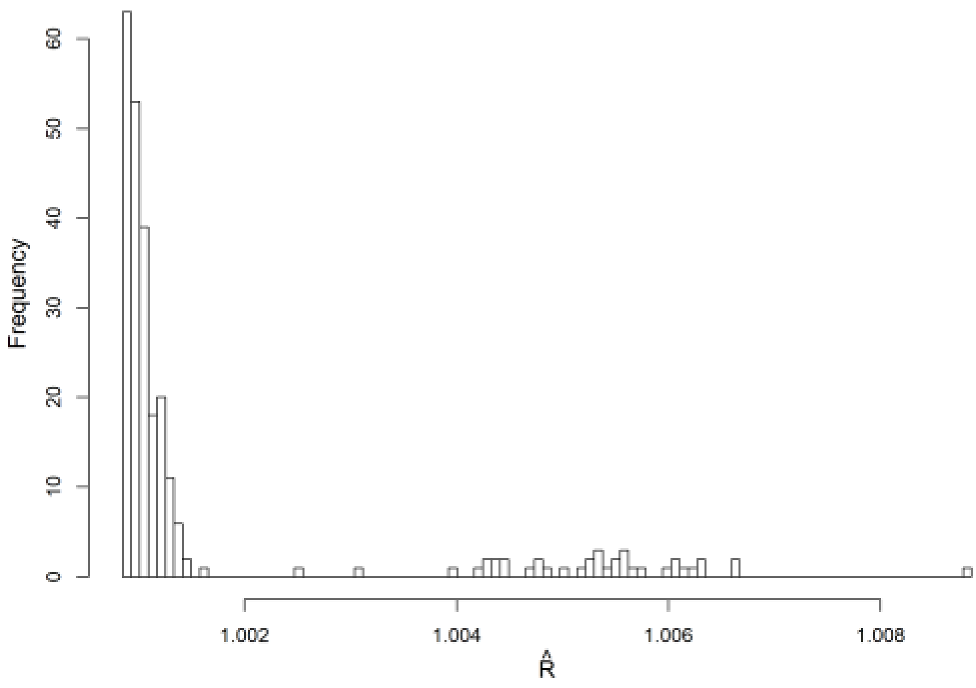


**Figure 3.6.3.2. Boarfish in ICES Subareas 27.6, 7, 8. Rhat values lower than 1.1 indicating convergence.**

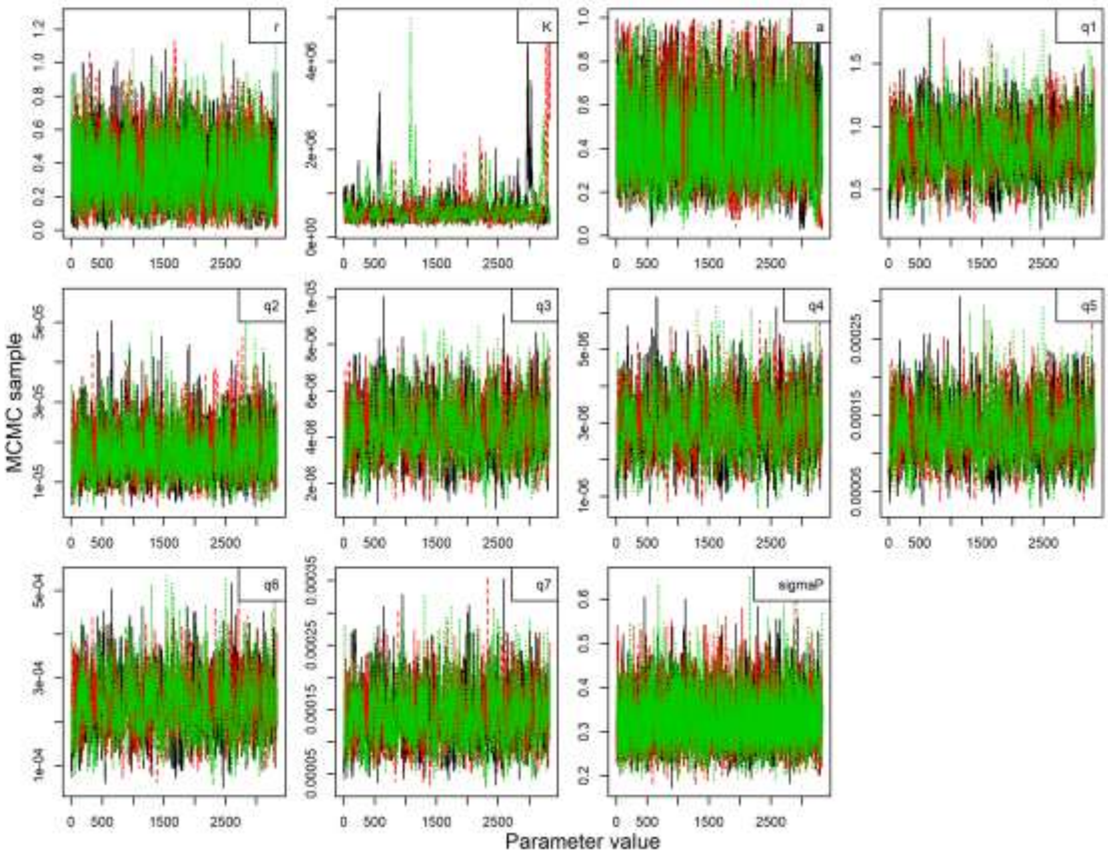


**Figure 3.6.3.3. Boarfish in ICES Subareas 27.6, 7, 8. MCMC chain autocorrelation for final run.**

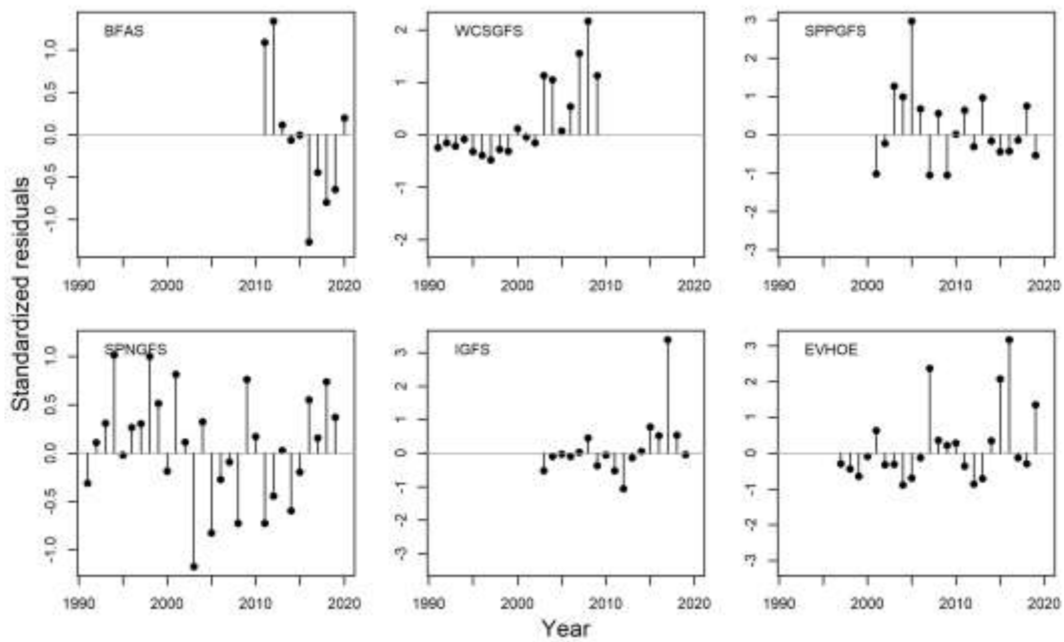


**Figure 3.6.3.4. Boarfish in ICES Subareas 27.6, 7, 8. Residuals around the model fit for the final assessment run.**

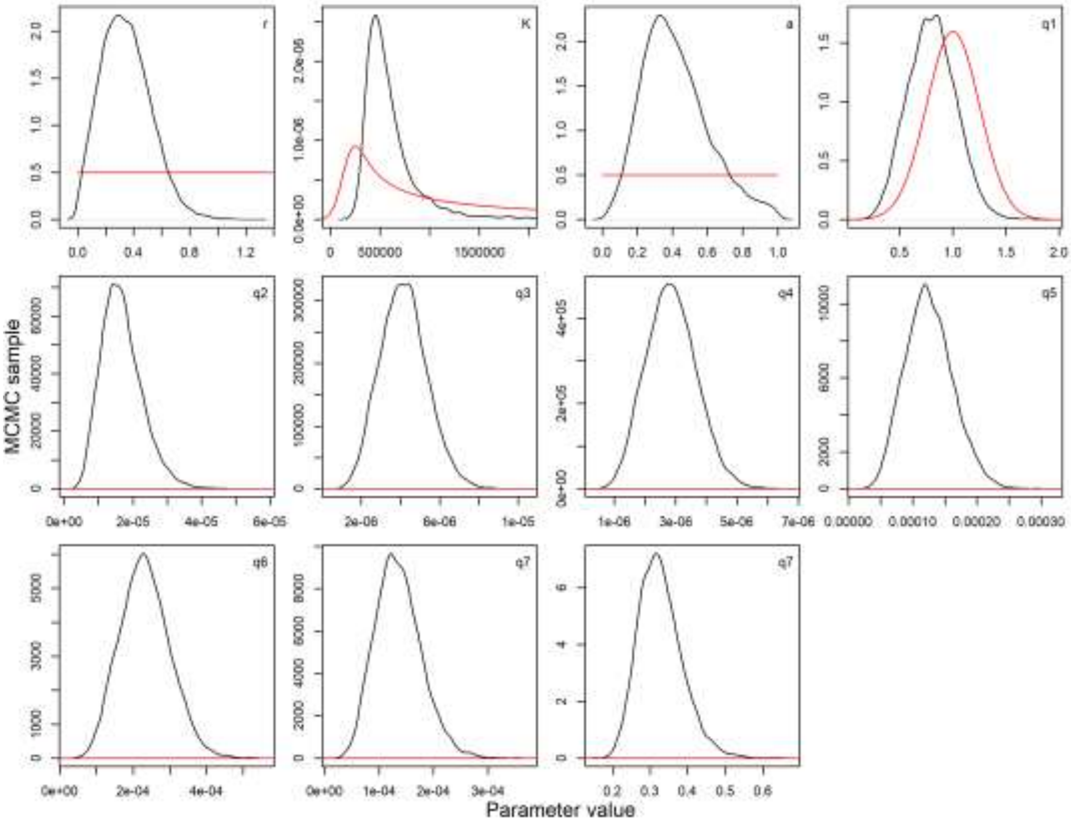


**Figure 3.6.3.5. Boarfish in ICES Subareas 27.6, 7, 8. Prior (red) and posterior (black) distributions of the parameters of th e biomass dynamic model.**

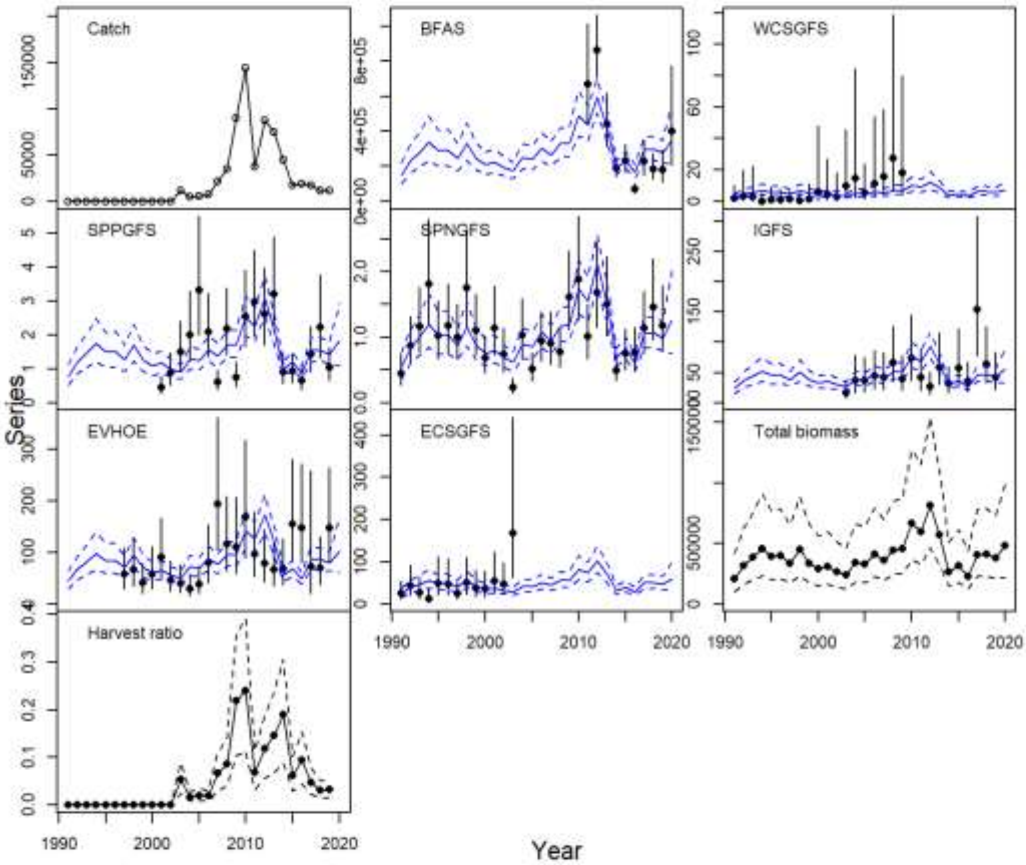


**Figure 3.6.3.6. Boarfish in ICES Subareas 27.6, 7, 8. Trajectories of observed and expected indices for the final assessment run. The stock size over time and a harvest ratio (total catch divided by estimated biomass) are also shown.**

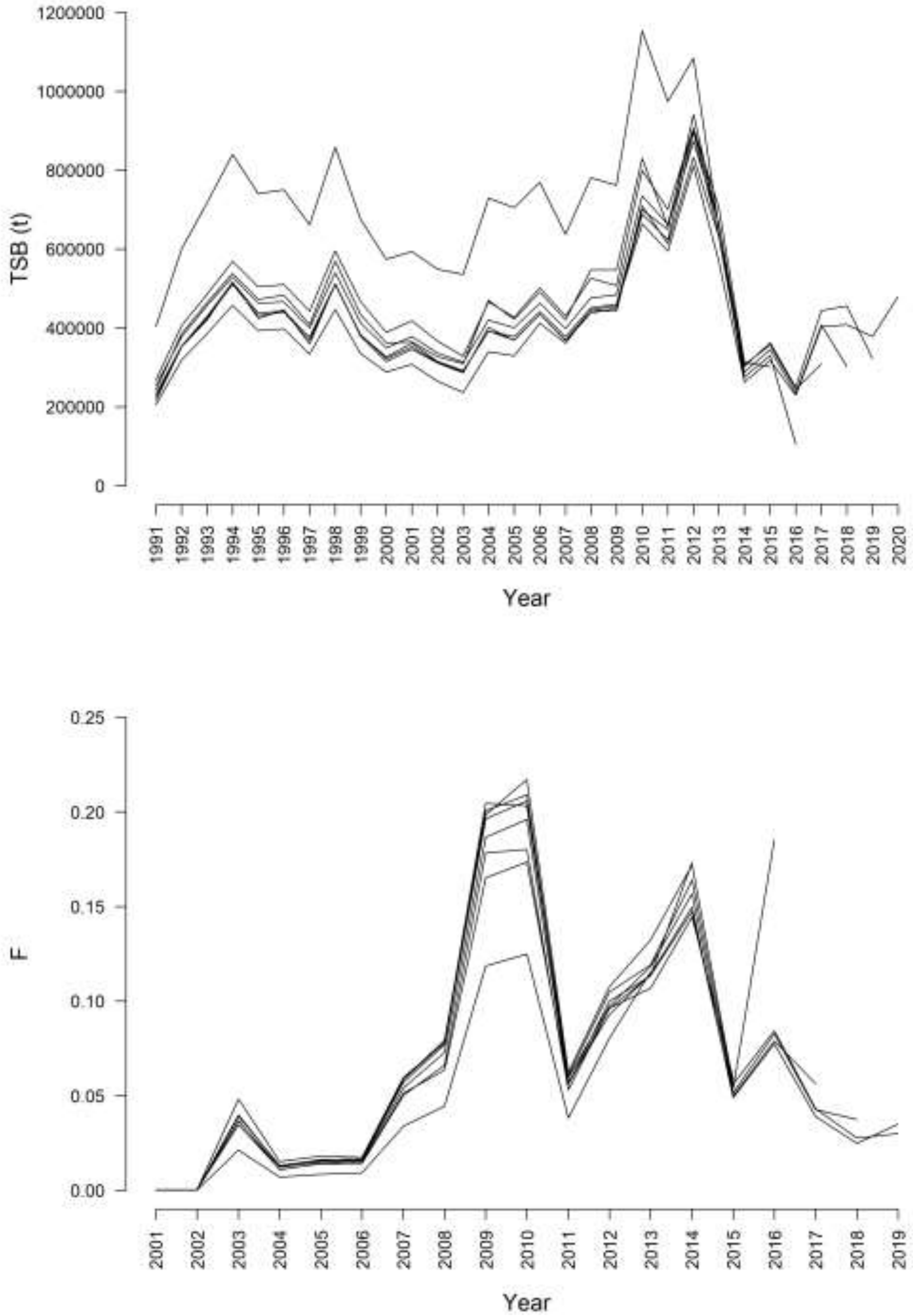


**Figure 3.6.3.7. Boarfish in ICES Subareas 27.6, 7, 8. Retrospective plot of total stock biomass (above) and fishing mortality (below) from the surplus production model in 2013-2019.**

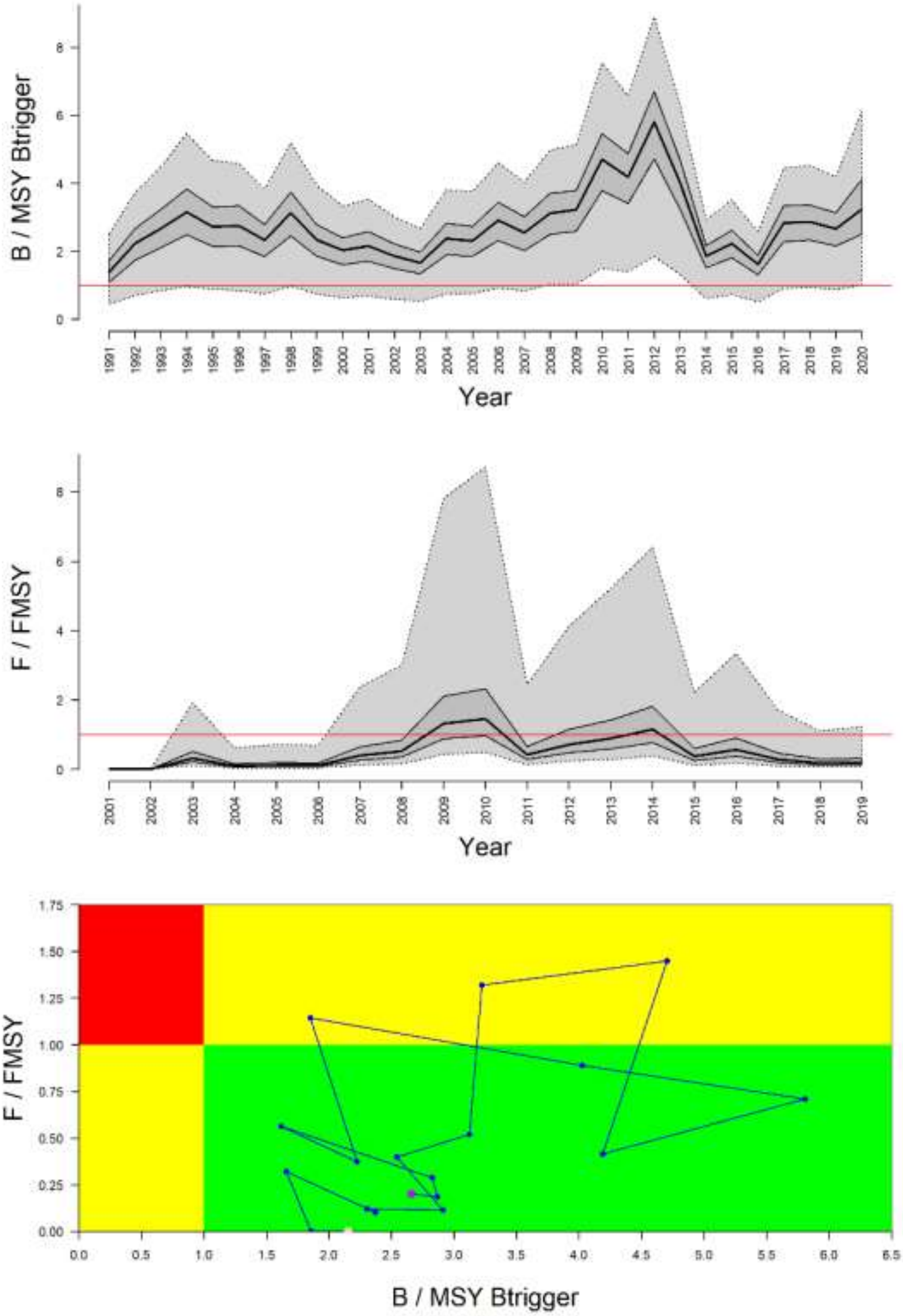


**Figure 3.6.6.1. Boarfish in ICES Subareas 27.6, 7, 8. Ratios 'B / MSYBtrigger' and 'F / FMSY' through time and corresponding Kobe plot. Confidence intervals (50 and 95%) are given for the first two panels, the third displays median estimates only with the pink point representing the first point of the time series and the purple point the last.**

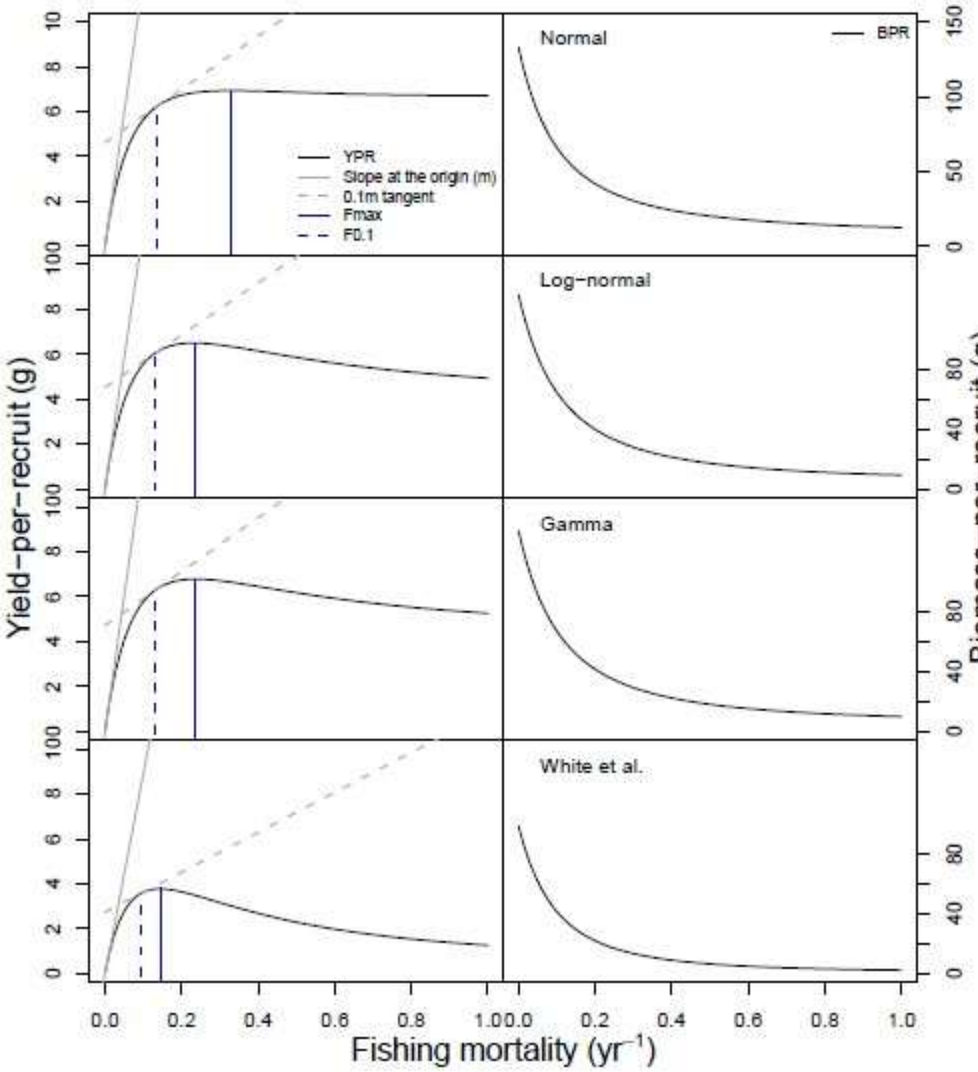


**Figure 3.9.1.1. Boarfish in ICES Subareas 27.6, 7, 8. Results of exploratory yield per recruit analysis. Beverton and Holt model applied to various fits of the VBGF and for comparison with the VBGF parameters provided by White *et al*. 2011.**

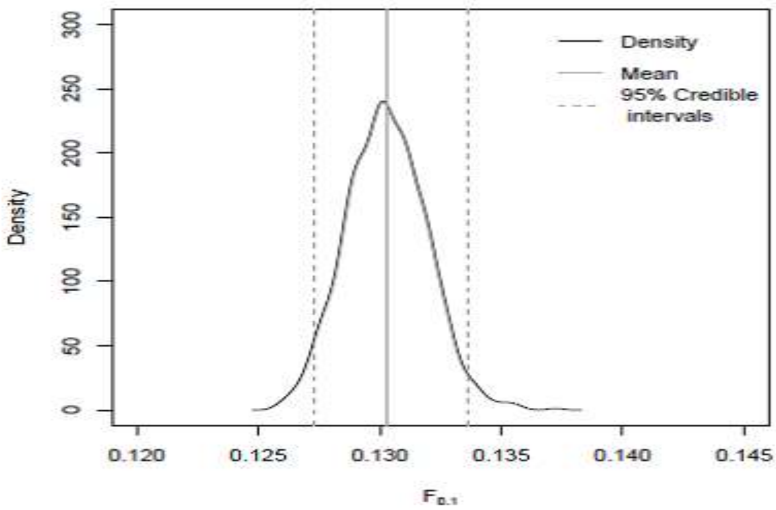


**Figure 3.9.1.2. Boarfish in ICES Subareas 27.6, 7, 8. Sensitivity of estimation of F0.1.**

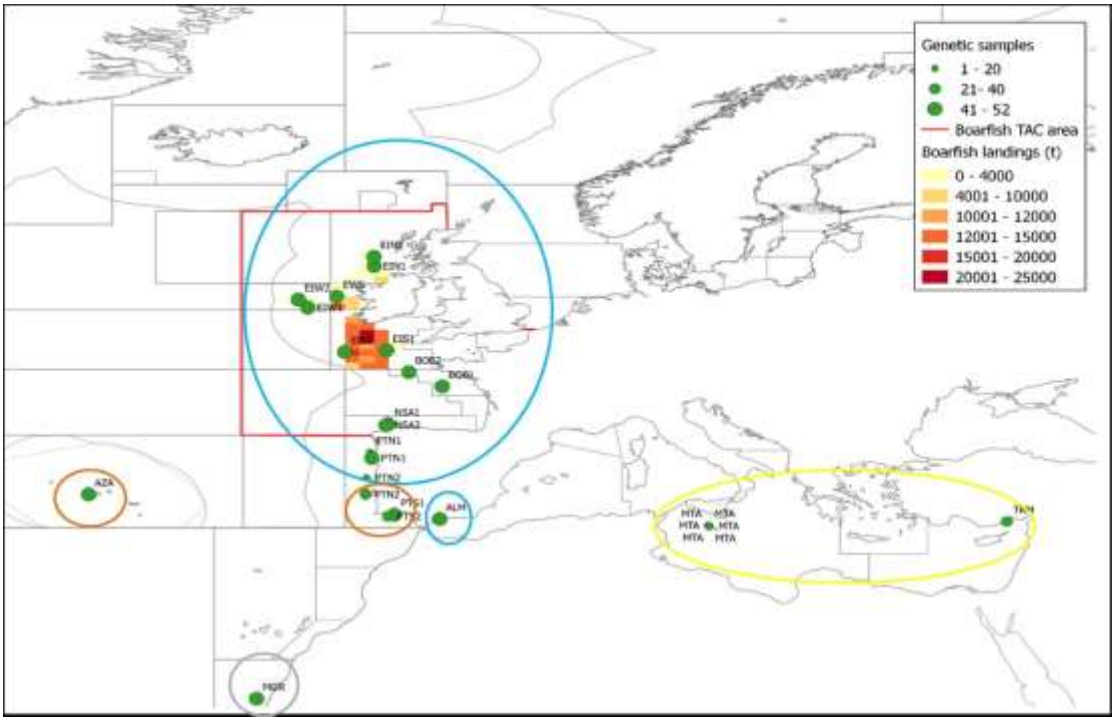


**Figure 3.12.1. Boarfish in ICES Subareas 27.6, 7, 8. Boarfish samples included in the genetic stock identification study are indicated in green. Population clusters identified by the STRUCTURE analyses are indicated by colour coded circles.**