Northwest Atlantic Fisheries Organization

Serial No. N5664 **NAFO SCR Doc. 09/29**

SCIENTIFIC COUNCIL MEETING – JUNE 2009

An Assessment of Beaked Redfish (*S. mentella and S. fasciatus*) in NAFO Division 3M Based on Revised 2005-2008 catches (*Is a Retrospective Biased Assessment Necessarily Useless in Terms of Scientific Advice?*)

By

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Abstract

The 3M redfish assessment is focused on the beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the 3M redfish commercial catch until 2005. However a new golden redfish fishery (*S. marinus*) started on September 2005 on shallower depths of the Flemish Cap bank above 300m. This new reality implied a revision of catch estimates, in order to split recent redfish commercial catch from the major fleets on Div. 3M into golden (*S. marinus*) and beaked (*S. mentella* and *S. fasciatus*) redfish catches.

An Extended Survivor Analysis (Shepherd, 1999) was performed using the previous XSA framework and the 1989-2008 EU survey abundance at age matrix as the tuning input file. The sequence of negative-positive regions on the *log q*'s residuals that mark the 1989-2000 interval lead the authors to consider an alternate XSA framework: the 1989-2008 EU survey series was sliced into "three consecutive surveys" (EU survey I, 1989-1993; EU survey II, 1994-2000; and EU survey III, 2001-2008) corresponding to the three regions of the *log q*'s matrix of residuals. This option resulted on improved catchability diagnostics but with a worst XSA performance in terms of retrospective bias, correlation with the tuning survey and convergence. Sensitivity analysis shown that the model runs better with long survey series based mean *log q*'s, despite the well defined residual patterns inherent to this option.

Very high fishing mortalities until 1996 forced a rapid and steep decline of the 3M beaked redfish stock. With lower fishing mortalities since then the stock decline was halted. But the weak 1991-1997 year classes kept the stock size at a low level till 2002, basically sustained by the survival and growth of the existing cohorts. The cohort's size at age 4 increased continuously from 1998 onwards, reaching an historical high with the 2002 year class. The 2000-2004 sequence of above average year classes pumped abundance and 4+ biomass to high levels at the beginning of 2008. The reproductive potential of the stock has been well above average over the past ten years and female spawning stock biomass (SSB) is now increasing at a faster rate. But in 2008 female SSB was still far away from a target of 40,000 tons, beyond which the two consecutive above average recruitments from the beginning of the series occurred.

Retrospective analysis show more severe retrospective patterns from 2008 to 2009 (however, and regardless the downward revisions of their trajectories, exploitable biomass and SSB on the final year of most recent assessments have very close estimates). Assuming that the retrospective bias observed between the two last assessments can be repeated between the present and next year assessment, cohort dependent retrospective *log* linear functions were adjusted to observed *log* $XSA_{2009/2008}$ ratios, for abundance and fishing mortality. These functions provide the initial population and fishing mortality at age of a projection with two sets of age/cohort specific bias correctors that can be used to minimize in the short term likely discrepancies on SSB and yield trajectories due to retrospective patterns between consecutive age based assessments.

Consecutive medium term stochastic projections of female SSB and yield, starting in 2007, 2008 and 2009, run under constant 2006-2008 fishing mortality and bellow average recruitment. The purpose was to assess the impact of retrospective patterns on the consistency of predicted SSB and yield trajectories from sequential projections. The possibility of a retrospective 2010/2009 replicate of the (severe) retrospective bias observed between the 2009/2008 XSA's, was taken into account by a final 2009 bias corrected stochastic projection. Regardless the generally poor diagnostics of the XSA's, the retrospective biases between consecutive assessments, and the adopted low productivity regime, under the present average level of fishing mortality the SSB trajectories (50% percentile) given by the (2007-2009)-2016 projections are similar and gave the same signal: survival and growth of the above average year classes from the first half of this decade will drive SSB above the 40,000 tons target within the next couple of years. And even if the 2009 projection departs from a "retrospective corrected" initial population and fishing mortality, SSB is still expected to reach the vicinity of its target level in a foreseeable future.

The translation of these SSB projections into yield (for the 5% percentile) predicts a catch within the 12,200-14,800 tons interval, while for 2011 the same fishing mortality is expected to generate a catch between 13,300 and 15,700 tons. All of these high probability predicted catches associated with predicted SSB's, remained well above 10,000 tons on 2010-2011.

Introduction

There are three stocks of redfish in NAFO Division 3M: deep-sea redfish (*Sebastes mentella*) with a maximum abundance at depths greater than 300m, golden redfish (*Sebastes marinus*) and Acadian redfish (*Sebastes fasciatus*) preferring shallower waters of less than 400m. Due to their external resemblance *S. mentella* and *S. fasciatus* are commonly designated as beaked redfish. The identity of the Flemish Cap redfish populations is supported by morphometric studies (Saborido Rey, 1998).

The 3M redfish assessment is focused on the beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the 3M redfish commercial catch until 2005. During the entire series of EU Flemish Cap surveys (1988-2008) beaked redfish also represents the majority of redfish survey biomass (76%). But at present this majority is down to 63% due to the rise of golden redfish survey indices on recent years (2003-2008).

Flemish Cap beaked redfish are long living species presenting slow growth, slow maturation and a long recruitment process to the bottom, extending to lengths up to 30-32cm. The *S. mentella* and *S. fasciatus populations* have similar length growth, namely females, up to 20 years old (Saborido Rey, 2001). Redfish are viviparous with the larvae eclosion occurring right before or after birth. Mean length of female first maturation varies from 26,5cm (at age 8) for Acadian redfish to 30.1cm (at age 10) for deep-sea redfish (Saborido Rey, *pers. comm.* 2000). Spawning on Flemish Cap occurs through February till the first half of April for deep-sea redfish while for Acadian redfish spawning reach its maximum in July – August (Saborido Rey, 1994).

Description of the fishery

The 3M redfish stocks have been exploited over the past both by pelagic and bottom trawl. Due to the similarity of their external morphology the commercial catches of 3M redfish are reported together. Historically the majority of pelagic and bottom commercial catches from the 3M redfish fisheries are a mixture of *S.mentella* and *S.fasciatus*. The redfish by-catch from the 3M Greenland halibut fishery is 100% *S. mentella*.

The redfish fishery on Division 3M increased from 20,000 tons in 1985 to 81,000 tons in 1990, falling continuously since then till 1998-1999, when a minimum catch around 1,000 tons has been recorded most as by-catch of the Greenland halibut fishery (Table 1a, Fig. 1a). The drop of the 3M redfish catches from 1990 onwards is related with the quick decline of the stock biomass followed by an abrupt decline of fishing effort deployed in this fishery.

The relative increase of the catch on 2000-2002 (3,700-2,900 tons respectively) reflected an increase of the fishing effort directed to 3M redfish, pursued by Portugal and Russia fleets. However in 2003 Russian catch fall by 90% and the overall catch didn't reach 2,000 tons. In 2004 catch increased again to almost 3,000 tons and Portugal consolidated its major role in the fishery with 2,500 tons, while Russia records a catch near zero (Table 1a, Fig. 1a).

From July 2004 to July 2006 Flemish Cap EU survey showed a 3.5 fold increase in bottom biomass of both golden and beaked redfish (Casas, 2007). Redfish catches followed the biomass increase and were raised to a higher level (6,500-8,500 tons) between 2005 and 2008. Furthermore the increase of golden redfish biomass matches with an important increase of cod biomass and justified a new golden redfish fishery from September 2005 onwards on shallower depths above 300m. This new fishery is basically pursued by Portuguese bottom trawl and Russia pelagic trawl.

This new reality implied a revision of catch estimates, in order to split recent commercial catch from the major fleets on the Flemish Cap bank (Portugal, Russia and Spain) into golden and beaked redfish catches and to have for each of the main fleets the available length sampling separated as well between these two “species”.

In order to estimate a proxy of the beaked redfish catch by fleet, a 2005-2008 revision of the logbooks from the monitored vessels has been carried by the national sampling programmes of Portugal, Spain and Russia. For each fleet the observed hauls were assembled by depth intervals (<200m; 200-300m; 300-400m; 400-700m and >700m) and the proportion of beaked redfish found in the EU survey redfish catch (excluding juveniles) at each of these intervals was applied to the correspondent commercial redfish observed catch. The ratio between estimated beaked redfish catch and observed redfish catch for the monitored vessels was then applied to the fleet annual STACFIS catch in order to get an annual beaked redfish catch estimate for that fleet. This exercise was performed for the Portuguese bottom trawl (2005-2008), Spanish bottom trawl (2005-2007) and Russian pelagic trawl (2005-2008).

The 2005-2007 3M redfish catches of Japan and Baltic States were assigned to beaked redfish. For 2008 the available catch data is given by the NAFO Circ. Letter with the “Recording of Provisional Catches for December 2008” (12th February 2009). As regards the European Union catches were not yet disaggregated by country and so the Portuguese beaked redfish proportion for 2008 was applied to the whole EU provisional redfish catch.

The 1989-2008 redfish nominal catch is presented on Table 1a, STACFIS redfish catch on Table 1b and the beaked redfish landings used in the 2009 assessment on Table 1c. Finally on Table 1d are tabulated the golden and beaked redfish proportions by depth, found in the 2005-2008 EU surveys and used to get the beaked redfish catch estimates.

The boom in 1993 and further settlement of a shrimp fishery in Flemish Cap lead to high levels of redfish by-catch in 1993-1994. From 1995 onwards by-catch in weight fell to apparent low levels but since 2001 increase again, reaching 1006 tons in 2003. That increase does not reflect any expansion of the 3M shrimp fishery and was supported by above average year classes occurring since 2000. From Canadian observer data, the redfish by-catch on the 3M shrimp fishery declined to 471 ton in 2004 and again to 80 ton in 2005 (Table 1e), reflecting an important reduction of the 3M shrimp catch observed in recent years (Skúladóttir and Pétursson, 2006). The overall level of the 2006-2008 redfish by-catch remains unknown. Length sampling of this by-catch is also unavailable.

In 2001-2003 the redfish by-catch in numbers from the Flemish Cap shrimp fishery justified 78% of the total 3M redfish catch. In 2004 represented 44% and just 15% of the total catch in 2005 (Table 1f, Fig. 1b). The present dynamics of the Flemish Cap beaked redfish stock is driven by the commercial catch and associated fishing mortality.

Length composition of the commercial catch and by-catch

The 1998-2006 3M beaked redfish commercial length weight relationships from the Portuguese commercial catch (Alpoim and Vargas, 2004; Vargas *et al*, 2005 and 2007-2009) were used to compute the mean weights of all commercial catches and correspondent catch numbers at length (Table 2a). The EU survey length weight relationships (Table 2b: Troncoso and Casas, *pers. comm.* 2005-2009) were used to compute the mean weights of the by-catch and correspondent by-catch numbers at length.

Length sampling from the Portuguese bottom trawl and from the Russian pelagic trawl is the major input to the length composition of the 3M beaked redfish commercial catch. The Russian beaked redfish length sampling from pelagic trawl is just applied to the Russian beaked redfish pelagic catches. The pelagic catch is near 100% of the Russian catch but for 1996, 1998-1999 and 2003-004. The Portuguese beaked redfish length sampling is applied to the beaked redfish catch of bottom trawl fleets with the exception of the Spanish and Japanese fleets for the years where respective length sampling data is available (Table 3a). In order to overcome the lack of the length sampling of the Portuguese catches on 1993-1994 and of the Russian catches on 1992-1994, for each year and fleet an expected length composition of the commercial catch was derived from the permile length composition of the correspondent EU survey catch, using a "exploitation pattern at length" calculated previously for each commercial trawl gear.

The exploitation pattern at length for the EU bottom trawl is given by the average ratios of the permile at length composition of the EU commercial *versus* the EU survey catch, for the years within the former *RV Cornide de Saavedra* series (1989-2002) when both commercial and survey length data are available. The average ratio at length vector was finally smoothed by moving averages, before being applied to the EU survey permile length composition for those years were EU commercial length sampling was missing, in order to derive an expected permile length composition of the EU commercial catch. The same exercise was carried out with the Russian per mile length compositions of the Russian pelagic catch. Exploitation patterns at length are presented in Table 3b and Fig. 2a.

Length structure of the annual commercial catch shown relative stability between 1989 and 2001 with most mean lengths within 28-31cm (smaller mean lengths on 1995-1996 were close to 28cm). Small lengths increase their presence in the commercial catch afterwards, being responsible to the mean lengths bellow 28cm in most of the recent years and for the wide oscillations in the catch structure at length observed over 2002-2008. These quantities of small redfish in the commercial catch don't reflect either a shift of the exploitation pattern towards smaller sizes or a quick decline on stock size, but several recruitment processes from a sequence of abundant year classes occurring since early 2000's (Table 3c, Fig. 2b).

Redfish by-catch proportion in weight of the shrimp catch and redfish by-catch in numbers at length for the 3M shrimp fishery were available from 1993 till 2004, based on data collected on board of Norwegian (1993-1998) and Canadian (1993-1997; 1999-2004) vessels (Kulka, 1999 and *pers. comm.*, 2000-2005; Firth, *pers. comm.* 2004-2005). The sum of the absolute length compositions of the 1989-2008 commercial catch with the absolute length compositions of the 1993-2004 by-catch is the 3M redfish catch at length input of this assessment (Table 3d).

Age composition of the catch

Age composition of the total catch was obtained using the *S.mentella* age length keys from the 1990-2007 EU surveys. No *S.mentella* age length key is available for 2008: a synthetic survey based *S.mentella* age length key was constructed for the final year and applied both to commercial and survey length compositions (Fran Saborido-Rey, *pers. comm.* 2009; see details bellow). On the first years of the assessment, before 1993, age group 8 was the most abundant and consecutive 1981-1984 cohorts were the most important in the commercial catch when passing through this age. The lack of sorting grades on shrimp trawl at the beginning of the 3M shrimp fishery justified that the most abundant age group in the catch (including redfish by-catch) moved back to age 4 and 5 in 1993-1995, targeting prematurely the above average 1989 and 1990 cohorts. The expansion of the shrimp fishery with sorting grade escape device and the decline of the redfish fishery lead to even younger modal age groups between 1996 and 2004, when age 2 was the most abundant on the redfish catch most of the years (nevertheless 1990 year class dominated again the commercial catch in 2000). The promising 1999 year class was prematurely overfished at age 2 in 2001, followed by the 2000 year class next year (though to a lesser extent, since this year class returned to be the most abundant in the 2006-2007 catch). Catch at age don't include redfish by-catch since 2005 but nevertheless age 2 was still the most abundant age group in the commercial catch that year, reflecting the above average size of the pre recruited 2003 cohort. The most abundant age group in the redfish catch increased afterwards to ages 6 and 7. The abundant 2002 year class show up in 2004 catch as the most abundant (still caught as by-catch) and dominate again in 2008, this time already in the commercial catch (Table 3e).

The length weight relationships from the Portuguese commercial catch (Table 2a) were used to calculate mean weights at age in the redfish catch (commercial plus by-catch) (Table 3f). Mean weights at age in the commercial catch are analyzed together with the mean weights at age of the stock in the next section.

Research surveys

There are two survey series providing bottom biomass indices as well as length and age structure of the Flemish Cap redfish stocks: one series from Russia (1983-1993; 1995-1996 and 2001-2002) and the other one from the European Union/Spain and Portugal (1988-2009). An earlier bottom trawl survey series has been carried out by Canada from 1979 till 1985. This series was discontinued since then, despite an isolated Canadian bottom trawl survey conducted again on 1996.

For reasons explained in previously (Ávila de Melo *et al*, 2003) the EU survey series is the only source of survey data used in the input files of the assessment framework.

EU survey

The EU survey has been conducted annually in June-July since 1988 as a bottom trawl survey, down to the 731m-depth contour till 2002, extending to 1400m depth since 2003. Swept area is divided according the Flemish Cap bank stratification proposed by Doubleday (1981) and revised and extended by Bishop (1994). The survey series used in the assessment is the original one, covering the nineteen strata of the bank till 731m. Half an hour valid hauls were kept around 120 each year, with the number of hauls in each stratum proportional to the respective swept area. Each haul swept the bottom at a constant speed about 3.3-3.5 knots, with the gear performance controlled at most of the tows with SCANMAR equipment.

During the 1988 and 1989 surveys only golden redfish has been separated from the rest of the redfish catches. Since 1990, juvenile redfish (less than 21cm) has also been separated as an independent category, and 1992 forward all the 3 species and juveniles were separated in each haul catch prior to sampling procedures. However, with the continuation of these surveys, the skill to identify redfish smaller than 21 cm increased. The juvenile redfish that has been identified is directly allocated in its species catch, contributing to the decreasing of the proportion of small redfish classified as juvenile over the most recent years. At present most of the juvenile category is composed of unidentified redfish less than 16cm.

In June 2003 a new Spanish research vessel, the *RV Vizconde de Eza* (VE) replaced the *RV Cornide de Saavedra* (CS) that had carried out so far the EU survey series with the exception of the years of 1989 and 1990. In order to preserve the full use of the 1988-2002 survey indices available for beaked redfish, the original time series were converted to the new *RV* units. The conversion of the original EU survey indices to the new RV units as regards the four different categories of redfish considered in the EU survey (Acadian, deep-sea, golden and juvenile redfish) and their further assemblage in order to get the converted survey time series for beaked redfish (Acadian and deep-sea redfish including the respective juveniles) is fully described in the 2005 EU survey report (Troncoso and Casas, 2005) and is summarized in the 2005 assessment (Ávila de Melo *et al*, 2005).

Length weight relationships from EU survey

Annual length weight relationships for *S. mentella* and *S. fasciatus* (1992-2008) and for the two species combined (1988-2008) were available from survey data (Troncoso and Casas *pers. comm.*, 2005-2009) (Table 2b). In each category all pairs of length-weight observations from the sampling of the survey catch were included in the fit, regardless sex and size. *S. mentella* and *S. fasciatus* length weight relationships were used to get 1992-2008 *SOP* survey biomasses and *SSB* for each species. The *Sebastes sp*. length weight relationships were used to get the 1988-1991 *SOP* survey biomasses and *SSB* for beaked redfish, as well as the 1989-2008 mean weights at age for the stock and for the mature female component.

Beaked redfish survey abundance at length

Each of the redfish categories included in the beaked redfish assemblage had their own survey abundance at length original series (beaked redfish including juveniles, 1988-1989; beaked redfish, 1990-1991; *S. mentella*, 1992-2002; *S. fasciatus*, 1992-2002 and juveniles, 1990-2002) converted to the new RV units using the conversion framework described in the 2005 assessment (Ávila de Melo *et al*, 2005). The transformed *S. mentella, S. fasciatus* and juvenile survey abundance at length series were then linked to with the 2003-2008 *RV Vizconde de Eza* length distributions. For each year and redfish category abundance at length is re-scaled in order to fit the correspondent swept area survey biomass estimate. Finally the matrices of length distributions from all redfish categories were combined in order to give for beaked redfish a single 1988-2008 survey abundance at length series (Table 4a).

Age composition of the survey stock and mature female component

The EU survey abundance at age for the 1989-2008 3M beaked redfish stock and mature female component (Table 4b and 4c) were obtained using the *S.mentella* age length keys from the 1990-2007 EU surveys, with both sexes combined. Due to the scarcity of redfish larger than 40cm either in the survey and commercial catch a plus group was considered at age 19.

Dr. Fran Saborido-Rey (Instituto de Investigaciones Marinas,Vigo, Spain) has carried out age reading of 3M redfish otoliths since 1990 (Saborido-Rey, 1994). Due to the fact that the 1989 *S.mentella* age length key was based on scale readings, the 1990 *S. mentella* age length key was also used in 1989. The ageing criteria of 3M redfish otoliths have been first revised in 1995 (Saborido-Rey, 1995) and 1998 (Saborido Rey *pers. comm*., 1998) and survey age length keys were then standardized accordingly. The purpose of these revisions was to get a clearer consistence on the tracking of the 1990 cohort, a strong year class that showed a density dependent growth (Saborido-Rey, 2001).

Taking into account the poor length coverage of older age groups (> 14 years) in the former 2006 age length key, these age groups were reinforced with more the one hundred new age readings of otoliths from the 2006 survey collection.

However, ageing for 2008 samples was not available. An estimated age-length key was built for 2008 using the age reading in 2005-2006, but excluding the ages of the 1990 cohort, due to its density-dependent growth (Saborido-Rey et al. 2004). For the same reason ages 18 (i.e. the age of 1990 year-class in 2008) were not used to build the estimated 2008 age length key. Length key for age 18 was estimated forecasting sizes from the growth trajectory of the 1990 year class.

The annual beaked redfish length weight relationships from EU survey (Table 2b) were used to calculate the mean weights at age in the 3M beaked redfish stock and female spawning stock 3M (Table 4e and 4f).

Mean weights at age of the stock and in the commercial catch

The 1989-2008 mean weights of each age in the stock and in the commercial catch were used to get the anomalies of the respective annual mean weights over time. These weight anomalies for ages 4 to 18 are presented in Fig's 3a (for the stock) and 3b (for the commercial catch).

All ages in the stock but the first (age 4) present negative weight at age anomalies for the 1990 and subsequent cohorts (Fig. 3a). The pattern reflect not just a marked slower growth of the 1990 year class when compared to older cohorts, which could be accounted to its larger size, but a generalized decline in of the cohorts growth rates over the 1990's till present time. The negative pattern is also present in the weights at age anomalies of the commercial catch though not so marked as in the stock (Fig. 3b). For the past two decades beaked redfish in the Flemish Cap has apparently growing slower and this scenario is expected to be maintained in the near future by the growth of several above average year classes from the early 2000's.

Maturity ogive

An observed maturity ogive for 3M beaked redfish was calculated as the mean proportion of mature females in the survey stock abundance at age (Table 4d) and used in the Extended Survival Analysis to get female spawning biomass estimates. At each age this mean proportion is given by the ratio of the 1989-2008 total of survey mature females to the correspondent total survey stock abundance.

Survey biomass and abundance, 1988-2008

The 1989-2008 EU biomass index for 3M beaked redfish is first presented as mean catch per tow and associated standard errors (Table 5a, Fig. 4a). From 1992 onwards this mean catch is the sum of the mean catch per tow for *S. mentella, S. fasciatus* and beaked redfish juveniles (Casas and Troncoso, 2009). The mean catch per tow for beaked redfish juveniles is estimated with the proportion of beaked redfish found in the sum of products biomass for small redfish up to 21cm length, applied to the juvenile mean catch per tow. The standard error of the beaked redfish mean catch per tow is given by the square root of the sum of squares of the standard errors associated to each mean catch per tow category.

The 1988-2008 interval covered by the EU Flemish Cap survey, started with a continuous decline of bottom biomass till 1991, followed by a period of biomass fluctuation at low level between 1992 and 1996. A further decline occurred in 1997 and 1998, when the lowest survey biomass was recorded. The index increased in 1999 and 2000, recovering to the 1992 size, but between 2001 and 2003 returned to wide oscillations. From 2004 onwards survey biomass rise to the 2006 maximum, three times above the level at the beginning of the survey series in 1988 (Table 5b, Fig. 4b). Sharp increases on both exploited biomass (age 4 and older) and juvenile biomass (ages up to 3 years old) contributed to this peak in 2006 of the survey biomass index. Both exploited and total survey biomasses declined in 2007 and 2008, but were kept well above their level at the beginning of the series (92% increase as regards total biomass and 70% increase as regards exploited biomass).

A similar pattern is observed on survey abundance. After falling by half from the 1988 to 1990, where a minimum was reached, the index was pushed up to a local peak in 1992 by the strong 1990-year class, recruiting then to the survey gear. Abundance was kept at a low level between 1993 and 2001, with the 1990 year-class as the most abundant cohort in the survey for seven consecutive years, between 1994 and 2000 (Table 4c). From 2002 onwards a sequence of average (1998) and above average (2001-2004) year classes (Fig. 4e), together with high survival rates through the age spectrum supported a rapid increase in stock (and exploited stock) survey abundance: an historical high has been attained in 2006. Despite the drop observed in the last couple of years, directly related with a severe reduction in the number of juveniles (as should be expected after a period when good cohorts showed up every year), total and 4 plus abundance were kept at high levels in 2008 (Table 5b, Fig. 4c).

Female spawning survey biomass continues to grow reaching in 2008 the initial (and maximum) 1989-1990 size, that produced the most abundant year classes at age 4 of the 1988-2000 interval (Table 5b, Fig. 4d and 4e). Female spawners component showed a widespread age composition during the first years of the interval, despite its continuous fall from 1989 to 1993. By that time a sequence of cohorts from the 1980's (1981-1985 and 1987) were most abundant on consecutive years at age 8 or 7. From 1996 to 2004 the 1990 year class was the most abundant, with older cohorts loosing their importance on this stock component (Table 4c). The increasing recruitment to the female mature component (and growth) of females from the 1990 year class was responsible for the rise of the survey female spawning stock biomass on 1998-2000. This index quickly fell afterwards till 2003, with the shrinkage in the size of the 1990 cohort. In 2005-2008 the portion of young maturing females at age 6 and 7 from the 1999, 2000 and 2001 year classes, together with the increasing biomass of these cohorts pull up again the SSB survey index to the high 1989-1990 level (Table 4c and 5b, Fig. 4d).

XSA Assessment

Bottom trawl survey indices for Div. 3M redfish presented over the 1990's early 2000's large inter-annual variability, too wide to be explained by changes in stock size from one year to the next. These fluctuations are caused not only by vertical migrations of redfish, all species with both demersal and pelagic distribution, but also by a patchy distribution within the Flemish Cap bank, due to their schooling behaviour.

These fluctuations of survey abundance at age have been considered a strong handicap on the performance of analytical methods, due to its reflection on year patterns in the catchabilities that relate survey indices with stock size. Nevertheless the availability of a survey time series of abundance at age urged the authors to frame an Extended Survivors Analysis (XSA, Shepherd 1999) with the 3M beaked redfish commercial and survey data (Ávila de Melo *et al*., 2000).

The model runs with an algorithm implemented by Shepherd (1999) and included in the Lowestoft VPA Suite (Darby and Flatman, 1994). An XSA summary and formulation to this case study can be found in the 2003 assessment (Ávila de Melo *et al.*, 2003).

Input files

The input files for XSA analysis are presented in Table 6. Natural mortality was assumed constant at 0.1. The proportion of mature females at age is the one observed on the 1989-2008 period (Table 4d) and the month with a peak of spawning for 3M *Sebastes mentella*, February (Saborido-Rey, 1994), was the one adopted to the estimate of the proportion of F and M before spawning. The first age group considered was age 4 (the first age in the catch at age matrix with catches assigned every year) and age 18 was the last true age (from age 19 onwards both survey and commercial sampling data are scarce and so the plus group was set at age 19). Landings were given by the *SOP* of the 4+ catch at age *x* commercial weight at age matrices.

The present Extended Survivor Analysis used as tuning file the 1989-2008 EU survey abundance at age matrix, with the 1989-2002 indices converted into the new *RV Vizconde de Eza* units) (Casas and Troncoso, 2009).

The framework

The model runs free of any of the available *softener* tools:

- No tapered time weighting, in order to give a full use and equal importance to the twenty years of input data, namely the former ones till 1993 when a full-scale redfish fishery occurred on Flemish Cap.
- No shrinkage of fishing mortalities at age on the terminal year (catches and stock size indices have not been stable on recent years).
- Fishing mortalities at oldest true age were not shrunk either.
- Survivors at age were not shrunk to a mean of previous age abundances at the beginning of the last years of the assessment.

A run with catchability independent of year-class strength on all ages till the penultimate true age (17) showed the *t* values for the slopes that linearly relate the log abundance with the log survey index for the recruiting ages (4 and 5) not differing significantly from 1 (*Student's t* test with 18 degrees of freedom = No. points – 2, significance level of 0.05). This lack of a significant trend on the regression slopes for the youngest ages led us to accept catchability independent with respect to year class strength and time through all the age spectrum of the assessment. Catchability was set constant with respect to age only at age 17: after declining between age 4 and 11, catchability does not stabilize on older ages (16-18) showing on the contrary some increase (Table 7, Fig. 5). In order to avoid overweight of the cohort's terminal population estimates by the last true age the minimum allowable standard error of the *log* catchability on the last true age (18) was set at 0.5.

In summary the 2009 XSA framework remains unchanged from previous assessments (Ávila de Melo *et al*., 2007): no recruiting ages with catchability dependent of year-class strength, constant catchability just at the penultimate age and a minimum standard error of the *log* catchability for the last true age of 0.5.

Diagnostics

The diagnostics of the 2009 XSA are presented on Table 7. Mean *log* catchabilities are associated to high standard errors and present a clear pattern of year effects. Positive *log q* residuals dominate during the intermediate years of 1994-2000, while the on the first years, 1989-1991, there is a clear pattern o negative residuals, sometimes very large ones as it is the case of the 1983-1985 cohorts between 1989 and 1991. Despite the negative effect on the terminal year, from 2001 onwards *log q* residuals are generally of a much smaller size and the marked negative/positive pattern of the past is lost.

Downward trend on catchability at age through the age spectrum never reaching a stage of apparent stability (Fig. 5), together with multi annual changes on beaked redfish schooling near the bottom of the survey swept area (amplifying the noise on the mean *log* catchabilities at age and introducing strong year effects) contributed to both high standard errors and residual year patterns that are distinctive of the survey mean catchability at age of the Flemish Cap beaked redfish.

Sensitivity Analysis: testing the three survey option

The sequence of negative-positive regions on the *log q*'s residuals (Table 7) that mark the 1989-2000 interval lead the authors to consider an alternate XSA framework, that could in principle dissolve to some extent such ugly pattern: the 1989-2008 EU survey series could be sliced into "three consecutive surveys" (EU survey I, 1989-1993; EU survey II, 1994-2000; and EU survey III, 2001-2008) corresponding to the three regions of the *log q*'s matrix of residuals. Each one of them with their own mean *q*'s at age and generating their own terminal population estimates from the cohorts descending through their boundaries, each "survey" contributing to the weighted geometric means of these terminal populations in function of its own standard errors. Furthermore the computation of the majority of the survivors by the end of the terminal year would be only dependent of the "last survey" (2001-2008), precisely the one with a "better look" in terms of *log q* residual patterns.

At first glance the "three survey" XSA option seems the right choice: *log q* related diagnostics are better than the ones for the "one survey" XSA. Smaller standard errors associated with the mean *log q*'s and a patchier residual pattern over the years of each of the first two "survey series" (Table 7 and 8, Fig. 5a and 5b). The annual sum of squares of the *log q* residuals illustrate (Fig. 6) smaller year effects on most of the past years till 2000, but more recently the year effects for the mean *log q*'s of the EU survey III (2001-2008) are of same magnitude as the ones for the mean *log q*'s of the single EU survey (1989-2008) on the same 2001-2008 years. These are the critical years to define the present state of the stock.

But when the comparison moves from catchability diagnostics to the fitness of the model to the EU survey, first sympathy towards the "three survey" option starts to fade away: the fitness of analytical models to surveys is traditionally poor in the case of redfish stocks but, at least in the case of 3M beaked redfish, slicing the survey into various consecutive series resulted in a even poorer (in the case of SSB) or virtually non existing adjustment (in the case of 4+ biomass) (Table 9, Fig. 7a and 7b).

No improvement on retrospective bias either. Compared 2008-2005 retrospective analysis shows worst retrospective patterns on 4+ biomass and recruitment and marginal gains on SSB and average fishing mortality (ages 6-16) when the "three surveys" replace the "single survey" in the XSA tuning (Fig. 8a and 8b). This impression is corroborated by the comparison of the $XSA_{2009/2008}$ retro bias: apart 2007 fishing mortalities all four parameters present similar 1989-2007 bias between the results of the two last assessments provided by the two frameworks (Table 10a). Along with these poorer results, the obvious increase in the number of iterations to convergence in all the 2009-2006 assessments (Table 10b) reveals the difficulty of the XSA in finding consistent fishing mortalities at age in the terminal year, when the model is forced to run with three consecutive short survey series instead of the original long one.

In conclusion, improving catchability diagnostics does not necessarily means a better XSA performance: the model runs better with long survey series mean *log q*'s, despite the well defined residual patterns inherent to this option.

2009 XSA Results

Very high fishing mortalities until 1996 forced a rapid and steep decline of abundance, biomass and female spawning biomass of the 3M beaked redfish stock (Table 11, Fig. 9a 4+ Biomass *vs* 4+ Abundance and SSB *vs* FBar). With lower fishing mortalities since then the stock decline was halted. But the weak 1991-1997 year classes kept the stock size at a low level till 2002, basically sustained by the survival and growth of the existing cohorts. The cohort's size at age 4 increased continuously from 1998 onwards, reaching an historical high with the 2002 year class (Table 11, Fig. 9b). Recruitment declined on most recent years, despite the last cohort entering the exploited component (2004) being still well above average on the final year of the assessment (2008). The 2000-2004 sequence of above average year classes pumped abundance and 4+ biomass to high levels at the beginning of 2008 (a 1989-2008 maximum in the case of abundance, near the 1990 level in the case of 4+ biomass) (Table 11, Fig. 9a and 9b).

The reproductive potential of the stock increased steadily from 1996 till 2002 (Fig. 9a, R/SSB). Despite the decline on 2003-2004 all *R/SSB* points from the present decade were higher than the ones from the 1990's. Nevertheless in 2008 female spawning stock biomass was still far away from an SSB frontier of 40,000 tons, beyond which the two consecutive above average recruitments from the 1989 and 1990 year classes occurred (this last one being the most abundant cohort within the 4+ stock throughout the nineties). The initial SSB level should therefore continue to be regarded as a target in terms of recovery of this stock, regardless no apparent relationship between the size of the year classes and the parental female stock biomass from the stock/recruitment plot (Fig. 9a, SR plot).

Retrospective Analysis

A 2009-2006 retrospective XSA was carried out in order to determine the bias on the 4+ biomass, female spawning stock biomass (SSB), fishing mortality (mean F: ages 6-16) and recruitment (age 4) estimates from the last four assessments back in time (Table 12a and 12b, Fig. 10). This retrospective analysis covers both the final true ages of the abundant 1990-1989 cohorts passing trough the exploitable stock and female spawning stock, together with the first ages of the recent above average year classes in the 4+ component. The retrospective XSA present an over bias pattern on exploitable biomass and female SSB, that is more pronounced between the two last assessments. The same pattern, but with opposite sign, is observed in average fishing mortality (apart the year of 2007, at a smaller scale though). The downward revisions on biomasses most likely reflect much higher 2007 fishing mortality estimates over most of the ages given by the present assessment, complemented by a substantial sequential decline on the estimate of the 2002 year class strength by the last three assessments (2007-2009).

From the possible causes of retrospective patterns – patterns of misreporting, patterns in catchability or misspecification of natural mortality (Sinclair *et al*., 1990) – the year patterns in catchability, translated in positive or negative *log* catchability residuals through most of the ages on several years, can be the main cause of bias in a redfish assessment. In long living stocks, cumulative biases over a large number of ages included in the assessment tend to inflate the retrospective pattern. However it seems clear as regards 3M beaked redfish that younger ages still not fully recruited to the exploited stock, but representing on average 77% (2004-2008) of its total size in numbers these days, are the major contributors to XSA retrospective patterns on biomass and fishing mortality. If the sequence of recent above average year classes (2000-2004) consolidate their size estimates in future assessments and are able to pass through their cohorts with high survival rates, abundance will be more evenly spread on the age spectrum and not squeezed within young ages. Furthermore, if the present decline on the size of the year classes recruiting to the exploitable stock every year continues (or stabilize bellow average) in the near future, their contribution to the retrospective patterns of this assessment will be mitigated.

However and regardless the downward revisions of their trajectories, exploitable biomass and SSB present very close estimates on the final year of most recent assessments (2007-2009) (Table 12a, Fig. 10). If that is the case, could these similarities hold the consistency of sequential short-medium term projections despite the retrospective handicap of the last assessments?

Retrospective patterns by cohort between the two last assessments

As stated above retrospective patterns were more severe from 2008 to 2009 XSA. If a similar pattern persists on next year assessment could its magnitude be predicted and if so incorporated in this year scientific recommendation for the management of the 3M beaked redfish stock in 2010-2011?

To address this question the first step was to have an age/year/cohort disaggregated retrospective bias between the two last assessments. This picture can be taken from the abundance and fishing mortality at age ratios of the 2009/2008 XSA results, presented on Table 13a and 13b. Cohorts can present distinctive retro bias (Healey *pers. comm*., 2008) and that possibility was checked through the ages of the year classes surviving as true ages in 2009, as regards abundance (*N*) and fishing mortality (*F*). Each of these cohorts present an average retro bias that seems to be negative dependent on its size and have associated low CV's that increase with the number of ages of the cohort (Table 13a and 13b bottom tables, Fig 11a and 11b). Furthermore *N* and *F* retro bias generally show a steady and discrete increase as they slide down the ages of the cohort (Table 13a and 13b, 1996 cohort retro biases at age are highlighted to illustrate this trend).

The second step was to *log* transform the *N* and *F* retro bias and assemble it by cohorts (Table 13c and 13d). Taking into account the high correlations found in the regressions of *log* retro bias against time (age/year) (Table13c and 13d, r^2 line near the bottom) these transformed observed bias generally fit well to a log linear function specific of each cohort. The *N* retro bias log linear function can be extended to next age-next year in order to get the expected log retro bias for the 2009 survivors of the cohort (when compared to the same fish at the beginning of 2009 but calculated by next year assessment). And the *F* retro bias log linear function can be extended to get the expected log retro bias for a certain level of *F* applied to the survivors of the cohort on 2009 (when compared to the very same *F* on 2009 but calculated by next year assessment). A similar rational, but backwards, was used to get the expected *N* and *F* log retro bias for the two younger ages of each cohort (ages 4 and 5). These three expected *log* retro biases by cohort finally return to their numerical values and are presented on the bottom tables of Table 13c and 13d, as well on Fig 11c and 11d.

Assuming that the retrospective bias observed between the two last assessments can be repeated between the present and next year assessment, this procedure provide the initial population and fishing mortality at age of a projection with two sets of age/cohort specific bias correctors that can be used to minimize in the short term (next year) likely discrepancies on SSB and yield trajectories due to retrospective patterns between two consecutive age based assessments.

Stock projections

Three consecutive medium term stochastic projections of female spawning stock biomass and yield, starting in 2007, 2008 and 2009, were obtained with a program of the CEFAS laboratory (Lowestoft/UK), first applied to a NAFO stock in 2000 (Mahe and Darby, 2000). The purpose was to assess the impact of retrospective patterns on the consistency of predicted SSB and yield trajectories from sequential projections. Input for these projections is supplied by the 2009-2007 retrospective XSA (recruitment, *N* and *F* at age for the initial years), the EU survey series (maturity and stock weights at age) and the Portuguese Sampling Programme (commercial catch weights at age). The *Mterm* algorithm use initial abundance for ages 5 and older, at the beginning of the first year of each projection, abide to a measure of uncertainty. For each projection uncertainty was also associated to the other input parameters. Recruitment (age 4) is constant on the first two years and bootstrapped from the third to the tenth year of the projection. The program has been upgraded to allow projections for long living stocks with a large number of ages included in the analytical assessment (Smith and Darby, *pers. comm*. 2001). The underlying assumptions of all projection were:

- No stock recruitment relationship. On the first and second year of each projection recruitment is given by the 1991-1999 cohort's geo mean at age 4, from the 2007-2009 XSA's. All of these cohorts from the nineties are still engaged in the projections on 2009 and are bellow average. Uncertainty as regards the size of the recent above average year classes when revised by future assessments and the likelihood that poor recruitments will follow the present above average ones justifies the option for a low productivity scenario. From the third year onwards age 4 is given by the re-sampling of the 1995-2003 *log* residuals of the above mentioned recruitment (Table 14a and Fig. 12a).
- The survivors at age 5 and older by the end of terminal year of the 2007-2009 XSA's are the starting populations at the first year of each projection. Being the internal and external standard errors from XSA diagnostics two measures of the uncertainty around the survivor estimate of each "initial" age, their average was adopted as the coefficient of variation associated with the starting population at age (Table 14b and Fig. 12b, as regards projections starting on 2009).
- The 2006-2008 average level of fishing mortality at age (and respective CV's) given by the 2009 XSA is applied to the three stochastic projections (Table 14c and Fig. 12c). Fishing mortality is kept constant trough projection intervals.
- The same applies to maturity at age, given by the average 1989-2008 mature female proportion at age from the EU survey series. However, taking into account the slower growth rates of the cohorts subsequent to the 1990 year class, mean weights at age are given by the last three year averages both for stock and commercial catch (2004-2006, 2005-2007 and 2006-2008).

The possibility of a retrospective 2010/2009 replicate of the (severe) retrospective bias observed between the 2009/2008 XSA's, was taken into account on a final 2009 *Mterm* stochastic projection. All caveats of the former projections were assumed. But first the population at age at the beginning of 2009 and the average *status quo* level of fishing mortality were bias corrected downwards and upwards, according with the value of the retrospective function of each cohort that is expected at the age that the cohort will reach on 2009. Exceptions to this general rule were the initial bias corrected recruitment given by the geometric mean of the bias corrected 1991-1999 cohorts at age 4, and the $F@age_{4,2009\text{-}2018}$ and $F@\text{age}_{5,2009\text{-}2018}$, corrected with the average expected retrospective *F* bias at ages

4 and 5 of the 1991-2003 cohorts (see bottom tables on Table 14a, 14b and 14c; Fig. 12a, 12b and 12c).

The SSB trajectories given by the (2007-2009)-2016 projections (50% percentile profiles, Table 15a) are coupled with the respective XSA's results in Fig. 13a. Regardless the generally poor diagnostics of the XSA's, the retrospective biases between consecutive assessments, and the adopted low productivity regime, under the present average level of fishing mortality the three trajectories are similar and gave the same signal: survival and growth of the above average year classes from the first half of this decade will drive SSB above the 40,000 tons target by 2011. And even if the 2009 *Mterm* projection departs from a "retrospective corrected" initial population and fishing mortality, SSB is still expected to reach the vicinity of its target level in a foreseeable future (Table 15a and Fig. 13a).

The translation of these projections into 2010-2016 catches is presented in Table 13b and Fig. 12b. The yield profiles are for the 5% percentile instead of the 50%, in order to increase the probability that near future SSB's match the expected overcome of SSB target, or at least reach its vicinity, with the recent level of fishing mortality and despite likely downward revisions. For 2010 predicted catch for the 5% percentile lies within the 12,200-14,800 tons interval, while for 2011 the same fishing mortality (for the same probability) is expected to generate a catch between 13,300 and 15,700 tons. All of these high probability predicted catches associated with predicted SSB's, remained well above 10,000 tons on 2010-2011.

Final considerations on the 3M beaked redfish assessment

The results of the present XSA assessment are in line with the 2007 and previous assessments: exploitable biomass and abundance near (or above) the high 1989-1990 level, female spawning biomass now increasing at a faster rate due to the maturation of increasing abundant cohorts, above average recruitments from 2000 onwards and a low level of fishing mortality that since 1997 gave room to stock recovery.

An "erratic" pelagic-demersal distribution, associated with schooling and longevity will always doom bottom survey dependent redfish analytical assessments to poor diagnostics and more or less severe retrospective biases. Nevertheless if the population unit shows year to year consistent signals of a dynamics, these signals can generate comparable quantitative results as regards stock size, when incorporated in an adequate and realistic (*statistical correct free*) framework. And despite year to year retrospective revisions, these model results can initialize similar projections, namely as regards short term yield. As long as treated with caution the final outcome of such a "weak" assessment turns out to be a sound alternative to the usual Scientific Council rule of thumb recommendation around catch averages or to no recommendation at all.

Acknowledgements

This assessment is part of a EU research project supported by the European Commission (DG XIV, Program for the collection of data in fisheries sector), IPIMAR, CSIC, IEO and AZTI.

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Table 1a: 3M Redfish nominal catches (ton) by country, 1989-2008.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007 (a)	2008 (b)
CAN			2		10							5								
CUB	1765	4195	1772	2303	945						2									
DDR		4025																		
GRL				1		26	4	2		2		11								
JPN	885	2082	1432	1424	967	488	553	678	212	439	320	31	80	67	98	209	483	383	613	603
SUN/RUS	13937	34581	24661	2937	2035	2980	3560	52		7	108	1864	1281	1155	115	6	1023	849	780	1212
UKR															5	3		1		
LVA				7441	5099	94	304					13	11			2	48	250		
LTU					2128									10	1		522	397	542	
EST						47	863	13				631	158	5	23	60	1093	1249	728	
E-SP	213	2007	6324	3647	100	610	165	113	129	262	268	348	272	220	633	266	542	596	533	
E PRT	13012	11665	3787	3198	4781	5630	1284	281	83	259	97	925	1590	1513	1113	2574	2696	2594	2357	
EU																				5880
FR-STP										2							10			8
KOR-S	17885	8332	2936	8350	2962															
FAROE IS.				16			15	1						6		6				215
NORWAY						8														
Total	47697	66887	40914	29317	19027	9883	6748	1140	424	971	795	3828	3392	2976	1988	3126	6417	6319	5553	7918

(a) Provisional
(b) From NAFO Circ. Letters

Table 1b: STACFIS Estimates of 3M redfish commercial catches from various sources.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total	**58100**	**81000**	**48500**	**43300**	**29000**	**11300**	**13500**	**5789**	**1300**	**971**	**1068**	**3658**	**3224**	**2934**	**1881**	**2923**	**6550**	**7156**	**6662**	**8465**

Table 1c: STACFIS Estimates of 3M beaked redfish commercial catches from various sources.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total	**58100**	**81000**	**48500**	**43300**	**29000**	**11300**	**13500**	**5789**	**1300**	**971**	**1068**	**3658**	**3224**	**2934**	**1881**	**2923**	**4771**	**6296**	**5470**	**3168**

Table 1d: Percentege of beaked redfish found in the EU survey redfish catch (*excluding juveniles, redfish beyond 700m depth is 100% S. mentella*). *Diana González pers. comm. 2009*

<200m	2005	2006	2007	2008	**200-300**	2005	2006	2007	2008	**300-400**	2005	2006	2007	2008	**400-700**	2005	2006	2007	2008
golden	36.1	51.1	97.9	100.0	golden	54.5	50.7	32.4	68.3	golden	18.8	5.9	12.0	28.5	golden	2.1	5.0	1.3	8.8
beaked	63.9	48.9	2.1	0.0	beaked	45.5	49.3	67.6	31.7	beaked	81.2	94.1	88.0	71.5	beaked	97.9	95.0	98.7	91.2

Table 1e: Redfish by-catch in weight (ton) from the 3M shrimp fishery, 1993-2005.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
By-catch in weight (ton) (a)	11970	5903	374	550	157	191	96	106	738	767	1006	471	80

(a) Kulka, D. and J. Firth pers. comm.

Table 1f: 3M Redfish catch in numbers(millions), 1989-2008.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Comm.	125.3	196.3	104.2	94.1	49.2	24.6	34.9	15.5	3.0	2.2	2.3	9.6	8.5	9.1	4.6	12.5	13.9	29.6	17.0	10.4
By-catch					124.5	62.9	4.0	15.2	3.2	5.2	3.8	3.2	29.1	19.8	21.9	9.9	1.8			
Total	125.3	196.3	104.2	94.1	173.7	87.5	39.0	30.7	6.2	7.4	6.1	12.8	37.6	28.9	26.4	22.4	15.8	29.6	17.0	10.4

Table 2a: Length weight relationships for 3M beaked redfish from commercial catch
(Alpoim and Vargas, 2004; Vargas *et al* , 2005, 2007-2009)

Year	a	b
1998	0.0390	2.7401
1999	0.0466	2.6807
2000	0.0095	3.1110
2001	0.0243	2.8695
2002	0.0433	2.7031
2003	0.0202	2.9025
2004	0.0133	3.0312
2006	0.0096	3.1176
2007	0.0100	3.1018
2008	0.0407	2.6452

Table 2b: Length weight relationships for 3M beaked redfish from EU survey
(Troncoso and Casas, pers. comm. 2005-2009)

	S. mentella		*S. fasciatus*		*Sebastes sp.*	
Year	a	b	a	b	a	b
1988					0.058	2.593
1989					0.022	2.867
1990					0.018	2.928
1991					0.027	2.814
1992	0.019	2.911	0.027	2.841	0.030	2.788
1993	0.013	3.021	0.028	2.824	0.017	2.965
1994	0.017	2.960	0.020	2.927	0.021	2.896
1995	0.011	3.073	0.016	3.001	0.013	3.034
1996	0.017	2.948	0.023	2.876	0.021	2.890
1997	0.014	2.999	0.019	2.960	0.015	3.001
1998	0.013	3.025	0.019	2.944	0.014	3.019
1999	0.014	2.994	0.020	2.910	0.018	2.928
2000	0.018	2.938	0.025	2.853	0.022	2.874
2001	0.012	3.043	0.017	2.978	0.015	3.008
2002	0.012	3.054	0.018	2.967	0.014	3.026
2003	0.011	3.069	0.009	3.151	0.012	3.055
2004	0.014	2.999	0.017	2.977	0.012	3.074
2005	0.015	2.974	0.012	3.061	0.011	3.088
2006	0.011	3.069	0.012	3.066	0.011	3.088
2007	0.010	3.119	0.016	2.996	0.011	3.088
2008	0.019	2.921	0.016	2.983	0.011	3.088

Table 3a: Availability of length data for commercial catches and by-catch of 3M beaked redfish, 1989-2008

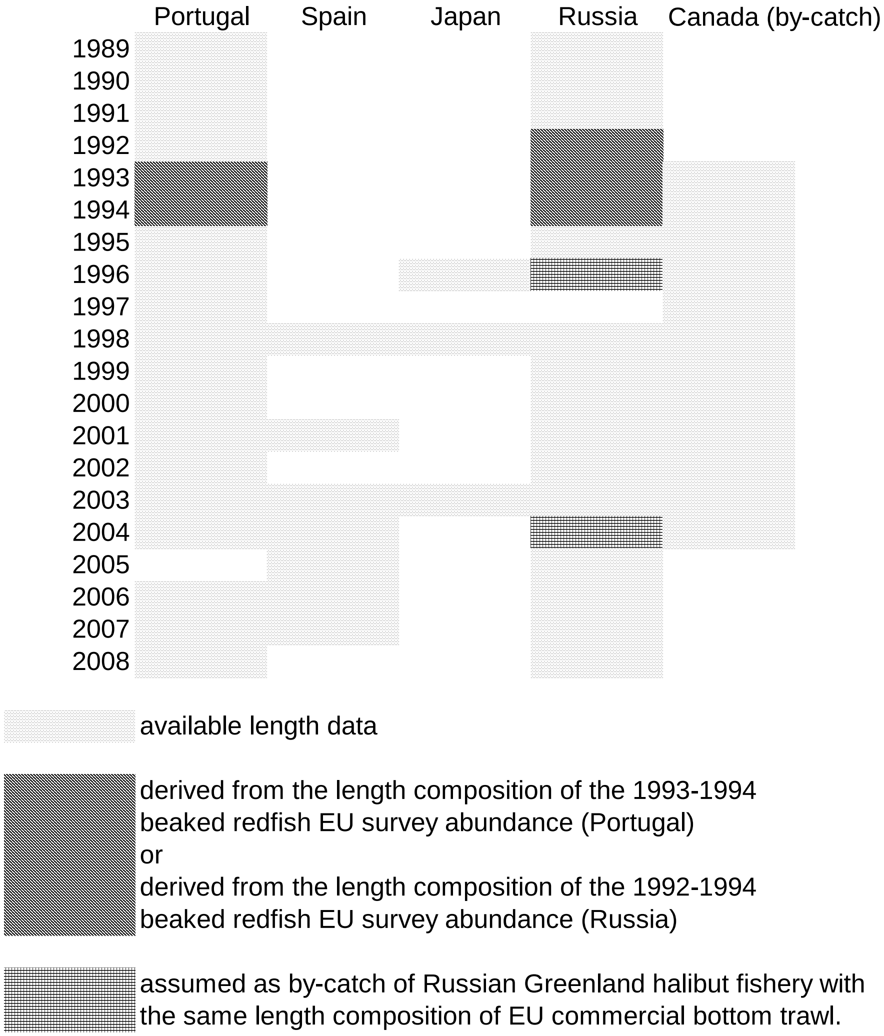

Table 3b: Exploitation pattern at length based on EU survey, 1989-2002

Length	Russia pelagic trawl	EU bottom trawl
10	0.0004	0.0003
11	0.0004	0.0014
12	0.0003	0.0025
13	0.0006	0.0028
14	0.0018	0.0087
15	0.0064	0.0120
16	0.02	0.02
17	0.09	0.02
18	0.21	0.05
19	0.65	0.10
20	1.2	0.2
21	2.2	0.4
22	4.3	0.6
23	4.9	1.0
24	4.7	1.8
25	2.9	3.1
26	2.9	4.8
27	4.0	6.6
28	6.7	9.2
29	9.8	12.8
30	13.6	18.3
31	17.3	26.6
32	17.7	35.1
33	16.4	40.4
34	14.5	43.9
35	13.5	41.4
36	13.7	38.8
37	14.8	34.3
38	16.6	32.2
39	18.9	28.7
40	15.8	22.4
41	11.1	22.7
42	9.0	22.1
43	5.3	19.6
44	3.5	17.5
45	3.7	17.5
46	3.1	11.1

Table 3c: Length composition (absolute frequencies in '000s) of the 3M redfish commercial catch, 1989-2008.

Length	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
10	3													10		0	3	17	12	
11				1	3									48		1	18	42	41	
12	3			1	7							5		220		3	108	92	133	
13	11				5							11		723		5	381	74	172	
14	25	4			40	4						1		590		12	509	96	88	
15	8	73		1	120	15				2		6	4	175		43	474	119	23	6
16	30	190		4	167	66		20				1	4	70		203	516	330	19	13
17	59	724		3	55	244		20	1	2		6	20	53	6	352	423	459	32	11
18	30	2489	156	6	39	607	118	20		1		17	57	84	6	464	285	667	143	44
19	11	5774	647	97	54	922	265	66	6	8	1	27	41	144		666	183	1360	462	154
20	111	6179	1331	418	71	491	1142	360	8	13	1	50	43	187		**1165**	158	2283	397	352
21	383	2904	1234	1987	125	427	2874	964	14	28	1	48	63	173	2	**1513**	134	**3273**	700	579
22	1149	1205	1179	3834	337	408	5895	**2215**	41	52	2	103	117	166	4	**1512**	165	**4155**	518	849
23	3766	1927	945	3016	668	457	5715	**1641**	104	94	1	112	197	175	30	**961**	226	**3854**	752	651
24	8408	5526	1697	1690	1116	701	1691	**1324**	**263**	116	9	206	277	284	89	845	311	**3344**	793	866
25	**14733**	**11932**	3737	2468	1159	870	1157	785	**325**	**222**	118	317	451	414	262	720	623	2372	983	582
26	**14793**	**19979**	6292	7519	1577	1020	793	513	**310**	**223**	112	717	891	511	363	571	828	1489	**1530**	**1113**
27	**11148**	**25688**	**10368**	**11599**	1701	986	953	740	198	**207**	220	**1322**	**1241**	672	**516**	596	**1070**	1228	**1939**	**1263**
28	7059	**26047**	**12852**	**11899**	2456	1688	1185	758	169	173	**303**	**1654**	**1450**	**854**	**535**	553	**1228**	1103	**1469**	**1404**
29	5773	**20113**	**15100**	8677	2448	**2039**	**1476**	855	210	168	**301**	**1467**	**1193**	**841**	**588**	426	**1294**	812	**1433**	762
30	7424	**15200**	**13056**	7505	3277	**1987**	**1506**	899	248	162	191	**1036**	996	**814**	475	384	907	647	**1445**	427
31	6972	**10134**	7456	5452	**3846**	**2327**	**1257**	954	223	172	204	677	537	625	390	269	898	465	1076	267
32	7393	8308	7054	4705	**3974**	**2611**	**1304**	891	248	157	242	451	339	463	359	304	611	371	921	166
33	7030	6551	3519	4150	**4831**	1963	1219	689	268	112	169	321	210	366	331	319	632	276	693	187
34	6927	6397	3891	4309	**4283**	1347	1008	672	107	74	75	300	146	221	258	204	614	203	501	125
35	6520	5486	3101	4286	**3737**	1154	1035	281	76	54	136	187	77	111	200	111	625	178	339	36
36	4920	4398	2620	3104	3474	776	1041	198	43	47	72	151	38	70	94	76	481	131	176	137
37	4080	3047	2394	2336	2914	404	915	220	24	46	65	150	31	26	47	53	123	49	36	63
38	2441	2206	1672	1582	1753	366	749	103	27	33	7	113	37	18	16	50	29	38	30	94
39	1566	1557	1748	1343	2453	328	488	125	11	29	30	56	17	14	8	31	29	15	36	35
40	946	769	1024	917	1151	191	469	45	3	16	2	34	10	7	2	33	8	14	5	81
41	504	581	640	522	517	105	346	38	12	11	4	26	5	1	0	41	39	18	17	39
42	341	345	201	214	476	37	164	46	5	8	0	19	6	2	0	14		12	7	36
43	289	264	283	237	118	10	69	18	1	3	1	25	3	5	2	18		12	4	31
44	135	130	19	172	170	9	50	3	6	2	0	14	2			12		5	9	15
45	143	73	14	39	26	9	34	2	1		2	3	1		1	6		4	4	3
46	75	32	8	9	17		7	4	1	1		10	1			5		4	6	12
47	46	16			17		19	1	1			6						2		4
48	28	12	8	17			4						1			1		1		6
49	4	12																1	3	
50	11	4						27											8	
51	4	12																		
52	4	0																		
53	7	16																1	2	
54		8																		
55		4																		
56																				
57																				
58		4																		
59																				
60																				
61									11											
Mean weight (g)	464	413	465	460	590	460	386	374	438	435	471	379	379	321	410	250	342	213	323	304
Mean length (cm)	30.1	28.8	30.2	30.0	32.9	29.8	27.6	27.6	29.5	29.4	30.9	29.6	28.6	25.6	30.2	24.6	27.0	24.0	27.6	27.1

Table 3d: Length composition (absolute frequencies in '000s) of the 3M redfish total annual catch, 1989-2008 (including redfish by-catch in the 3M shrimp fishery, 1993-2004).

Length	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
5												3	9	10	55	14				
6								147	1	3	15	5	200	60	246	95				
7							5	4306	105	109	115	59	534	381	601	182				
8							7	2412	127	248	550	123	1486	668	1131	242				
9							5	211	71	40	812	55	4218	538	1432	355				
10	3						3	416	258	45	845	193	6537	888	1454	593	3	17	12	
11				1	3		15	1056	569	391	390	593	6275	1655	913	1055	18	42	41	
12	3			1	9	19	36	841	512	1830	313	1011	4996	3205	1368	1498	108	92	133	
13	11				29	338	34	459	164	1721	286	761	2126	5809	2741	1229	381	74	172	
14	25	4			257	979	64	488	120	340	97	182	746	4660	2546	1093	509	96	88	
15	8	73		1	1998	2232	247	731	119	63	90	90	531	1946	1886	1022	474	119	23	6
16	30	190		4	7682	7312	430	1713	647	116	86	50	522	865	1994	999	516	330	19	13
17	59	724		3	29380	17576	758	1182	184	85	62	22	453	430	2513	987	423	459	32	11
18	30	2489	156	6	47422	21654	1105	758	61	32	41	27	339	339	1751	815	285	667	143	44
19	11	5774	647	97	30110	11939	1086	444	68	34	39	35	146	297	657	927	183	1360	462	154
20	111	6179	1331	418	6815	2807	1569	428	85	19	14	60	89	265	224	1398	158	2283	397	352
21	383	2904	1234	1987	1117	745	3001	1058	75	39	7	52	91	209	183	1690	134	3273	700	579
22	1149	1205	1179	3834	697	521	5922	2220	82	65	9	105	142	186	93	1588	165	4155	518	849
23	3766	1927	945	3016	669	457	5722	1641	126	102	6	114	210	187	80	988	226	3854	752	651
24	8408	5526	1697	1690	1116	701	1694	1324	273	135	11	208	288	290	108	857	311	3344	793	866
25	14733	11932	3737	2468	1159	870	1162	785	328	237	122	317	455	417	272	727	623	2372	983	582
26	14793	19979	6292	7519	1577	1020	798	513	311	243	112	719	893	513	364	574	828	1489	1530	1113
27	11148	25688	10368	11599	1701	986	957	740	198	217	223	1322	1242	672	517	597	1070	1228	1939	1263
28	7059	26047	12852	11899	2456	1688	1192	758	169	174	303	1654	1451	855	536	553	1228	1103	1469	1404
29	5773	20113	15100	8677	2448	2039	1483	855	210	169	301	1467	1194	841	589	426	1294	812	1433	762
30	7424	15200	13056	7505	3277	1987	1509	899	248	162	191	1036	996	815	475	384	907	647	1445	427
31	6972	10134	7456	5452	3846	2327	1258	954	223	172	204	677	537	626	390	270	898	465	1076	267
32	7393	8308	7054	4705	3974	2611	1304	891	248	158	242	451	339	464	359	304	611	371	921	166
33	7030	6551	3519	4150	4831	1963	1219	689	268	112	169	321	210	366	331	319	632	276	693	187
34	6927	6397	3891	4309	4283	1347	1008	672	107	75	75	300	146	221	258	204	614	203	501	125
35	6520	5486	3101	4286	3737	1154	1035	281	76	54	136	187	77	111	200	111	625	178	339	36
36	4920	4398	2620	3104	3474	776	1041	198	43	47	72	151	38	70	94	76	481	131	176	137
37	4080	3047	2394	2336	2914	404	915	220	24	46	65	150	31	26	47	53	123	49	36	63
38	2441	2206	1672	1582	1753	366	749	103	27	33	7	113	37	18	16	50	29	38	30	94
39	1566	1557	1748	1343	2453	328	488	125	11	29	30	56	17	14	8	31	29	15	36	35
40	946	769	1024	917	1151	191	469	45	3	16	2	34	10	7	2	33	8	14	5	81
41	504	581	640	522	517	105	346	38	12	11	4	26	5	1	0	41	39	18	17	39
42	341	345	201	214	476	37	164	46	5	8	0	19	6	2	0	14		12	7	36
43	289	264	283	237	118	10	69	18	1	3	1	25	3	5	2	18		12	4	31
44	135	130	19	172	170	9	50	3	6	2		14	2			12		5	9	15
45	143	73	14	39	26	9	34	2	1		2	3	1		1	6		4	4	3
46	75	32	8	9	17		7	4	1	1		10	1			5		4	6	12
47	46	16		0	17		19	1	1			6				0		2		4
48	28	12	8	17			4						1			1		1		6
49	4	12																1	3	
50	11	4						27											8	
51	4	12																		
52	4																			
53	7	16																1	2	
54		8																		
55		4																		
56																				
57																				
58		4																		
59																				
60																				
61									11											
Number ('000)	125310	196321	104246	94117	173677	87505	38979	30697	6180	7385	6051	12800	37620	28932	26441	22436	13934	29616	16955	10415
Weight (ton)	58100	81000	48500	43300	40970	17203	13874	6339	1457	1162	1164	3764	3962	3701	2887	3612	4771	6296	5470	3168

Table 3e: Catch in numbers at age (' 000) of 3M redfish, 1989-2008, including redfish by-catch in the shrimp fishery (1993-2004).

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+	Total	Most abundant year class
1989	0	16	136	444	1057	7890	22978	24054	14508	9716	8792	6213	6366	5883	5199	2965	2122	1969	5003	125310	1981
1990	0	0	5996	10382	2773	5860	28741	47007	32291	18415	11643	6614	5940	5430	4449	2543	1888	1788	4562	196321	1982
1991	0	0	0	1229	3592	6929	18141	22725	16867	8491	6503	4808	3967	2888	1102	1648	1270	780	3305	104246	1983
1992	0	0	0	237	5234	7018	16988	18149	11681	7422	5608	4455	4286	3302	2952	1953	1189	746	1730	92949	1984
1993	0	274	3805	110773	10414	3064	3409	4557	2101	3936	5178	5512	4547	4665	3554	2092	1666	2614	1514	173677	1989
1994	0	755	5135	53804	6411	1630	2399	2522	2550	2819	2521	1956	1459	856	969	460	320	390	551	87505	1990
1995	16	84	979	2770	13324	5399	1889	2423	1554	1471	1869	1137	966	927	1070	833	482	548	1239	38979	1990
1996	7075	2966	2288	1632	3546	4635	1402	1399	1431	983	767	733	393	404	283	202	135	133	289	30697	1995
1997	563	1216	490	692	144	595	800	272	285	322	219	194	98	119	27	28	30	10	76	6180	1995
1998	445	3678	810	109	59	109	285	706	422	69	76	355	45	50	12	33	66	4	52	7385	1996
1999	2337	998	228	151	43	16	70	258	593	367	81	114	263	39	78	79	69	105	147	6037	1998
2000	438	2400	254	89	130	204	387	1018	1436	4211	657	170	71	608	64	38	34	38	558	12804	1990
2001	12984	13397	1805	828	337	386	842	1303	869	856	3229	381	117	62	65	60	19	29	61	37630	1999
2002	2547	11957	6362	1467	358	483	557	858	1013	531	643	1822	337	110	158	57	50	9	54	29373	2000
2003	4920	6570	6494	1712	1946	281	391	546	565	423	365	311	1222	214	22	102	69	23	266	26441	2001
2004	1482	4520	2996	1013	4104	2581	1564	999	611	379	268	203	254	953	19	83	46	19	342	22436	2002
2005	12	4902	3555	2434	1211	2053	1489	1525	1401	1011	720	750	365	357	1049	105	64	16	63	23082	2003
2006	17	430	650	2136	5112	8828	5865	2494	1304	544	414	253	200	189	208	759	85	9	115	29614	2000
2007	12	346	162	470	829	873	4415	2255	2181	672	844	826	375	348	266	1180	546	35	320	16955	2000
2008	0	5	30	228	650	2096	1766	1848	1488	671	361	232	137	133	77	72	78	264	277	10415	2002

Table 3f: Weights at age in the catch and by-catch (Kg) of 3M redfish, 1989-2006.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1989		0.043	0.099	0.174	0.208	0.251	0.293	0.344	0.401	0.453	0.535	0.597	0.644	0.668	0.712	0.729	0.783	0.794	1.005
1990			0.130	0.144	0.183	0.258	0.318	0.364	0.401	0.434	0.508	0.579	0.639	0.658	0.709	0.726	0.773	0.768	1.006
1991				0.147	0.182	0.287	0.347	0.401	0.439	0.511	0.558	0.616	0.672	0.721	0.772	0.853	0.833	0.867	0.964
1992				0.157	0.197	0.269	0.337	0.389	0.437	0.503	0.584	0.626	0.693	0.732	0.750	0.850	0.803	0.933	1.017
1993		0.066	0.093	0.114	0.156	0.250	0.323	0.405	0.442	0.474	0.547	0.588	0.654	0.716	0.740	0.883	0.856	0.870	1.170
1994		0.057	0.098	0.109	0.147	0.264	0.312	0.389	0.436	0.500	0.533	0.572	0.601	0.703	0.694	0.726	0.832	0.855	0.923
1995	0.014	0.041	0.086	0.164	0.184	0.239	0.327	0.397	0.442	0.495	0.552	0.583	0.665	0.725	0.751	0.829	0.835	0.873	1.050
1996	0.011	0.037	0.078	0.093	0.184	0.209	0.316	0.378	0.441	0.498	0.532	0.590	0.635	0.650	0.705	0.747	0.806	0.845	1.075
1997	0.019	0.037	0.074	0.092	0.153	0.266	0.284	0.394	0.442	0.507	0.548	0.595	0.621	0.626	0.672	0.761	0.793	0.741	1.291
1998	0.014	0.043	0.058	0.107	0.165	0.213	0.318	0.295	0.427	0.480	0.519	0.572	0.639	0.712	0.728	0.827	0.839	0.745	1.026
1999	0.020	0.040	0.072	0.101	0.140	0.201	0.325	0.364	0.351	0.433	0.509	0.597	0.553	0.580	0.568	0.583	0.671	0.612	0.737
2000	0.010	0.025	0.045	0.071	0.122	0.167	0.234	0.283	0.348	0.330	0.441	0.520	0.657	0.558	0.496	0.659	0.720	0.763	0.801
2001	0.017	0.032	0.063	0.097	0.148	0.211	0.269	0.322	0.361	0.411	0.404	0.537	0.611	0.674	0.674	0.617	0.797	0.860	0.989
2002	0.018	0.045	0.067	0.115	0.167	0.229	0.266	0.328	0.359	0.423	0.492	0.450	0.577	0.600	0.622	0.704	0.643	0.866	0.876
2003	0.013	0.038	0.066	0.085	0.107	0.190	0.253	0.288	0.341	0.384	0.454	0.500	0.409	0.584	0.587	0.633	0.550	0.692	0.664
2004	0.012	0.032	0.062	0.091	0.131	0.174	0.222	0.272	0.338	0.378	0.453	0.510	0.553	0.441	0.610	0.679	0.569	0.724	0.925
2005	0.000	0.054	0.073	0.105	0.127	0.182	0.243	0.290	0.347	0.383	0.476	0.508	0.517	0.637	0.596	0.693	0.693	0.878	0.929
2006	0.017	0.041	0.075	0.111	0.134	0.183	0.229	0.301	0.366	0.422	0.515	0.610	0.549	0.693	0.831	0.469	0.669	0.628	0.781
Mean	0.014	0.042	0.077	0.115	0.158	0.225	0.290	0.345	0.395	0.445	0.509	0.564	0.605	0.649	0.679	0.720	0.748	0.795	0.957

Table 4a: 3M beaked redfish abundance at length ('000s) from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2008 by RV Vizconde de Eza (VE); former period converted to new RV units).

Length (cm)	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
5											2868										
6		73	239	1042				144			956			455	1091	779					136
7	1203	160	1952	39644	4931	1102		31	2453		695	291		1240	9720	6940	286	499	304	1547	573
8	8538	1890	15439	194701	117561	3160		594	12310	1359	3390	2417	1883	18643	14581	10410	12530	5985	94129	26849	5315
9	8327	2007	11861	90135	75875	1764		1816	6548	2887	6048	12420	6848	152327	44733	31940	69454	8679	410980	214426	4271
10	7082	2894	846	9088	57005	7812	274	1889	867	1615	1573	8840	5242	246451	53017	37818	181225	11172	569937	471628	5446
11	20338	8434	412	17232	332037	36153	1573	3397	1762	4312	2626	3052	4412	29300	52317	37322	178289	47283	83653	269398	21536
12	39345	20228	390	18876	381332	46734	2665	9269	5827	12810	13751	2976	15579	9424	115720	82575	306313	109207	93826	255837	62810
13	27472	21581	1062	5790	90012	29392	5209	4666	5993	14318	22307	4851	30605	16454	247642	176146	217455	305354	168066	460809	135178
14	4000	46259	1865	1174	16174	79964	25338	4768	8609	7064	11124	4639	18860	19286	292527	206425	109487	563721	368890	359968	146220
15	802	87282	2527	1706	27540	165019	58046	9835	16820	13161	14504	19442	6447	31061	99677	77233	59669	496389	570816	235990	109149
16	1034	71271	6765	8180	41045	138724	130198	24357	14379	23773	29969	39114	4277	71951	73453	105506	93021	321931	705419	132602	150419
17	1499	22119	15552	25997	9939	29763	219435	64809	23877	29710	20988	26097	8270	56570	59348	89286	130177	216267	1022160	204730	200256
18	1140	3665	17573	47123	7593	9245	230202	110934	54208	30013	13414	32861	19781	22594	72239	40677	155247	199060	785217	363584	236520
19	4032	2167	10349	74331	14615	4970	121884	144384	108902	36047	14029	29489	27898	12501	74283	28249	179357	182684	502051	489233	195040
20	7430	3097	2514	83897	24467	3328	33879	100682	153048	68928	13962	20335	29190	18149	55461	22778	156658	169721	357550	396759	241170
21	16559	4479	1078	40486	46504	3306	16450	38742	135158	101923	18530	14731	24042	24890	28013	18751	86575	163284	189221	256720	256356
22	33994	9816	3011	10581	70167	5125	8472	9863	83283	98256	33310	17528	21181	25754	23745	12635	48011	179265	120687	144663	241869
23	68369	18570	10028	3744	51568	7222	7632	3978	37902	62655	56319	29378	18209	17298	19916	8313	29273	132897	99934	101176	141913
24	102943	33229	13236	3855	23847	8078	9824	3261	17322	24171	57007	61585	29389	15498	21186	7521	18368	81899	76563	71205	106627
25	108959	50665	28825	7720	10049	5812	11309	3704	7875	9733	33609	75417	54137	14734	16263	7312	11706	41610	57756	42237	61464
26	79514	60423	42888	9638	12417	5431	9941	4600	4102	5921	14895	57490	76085	18293	14695	7561	11260	32227	25060	38613	45511
27	33899	49923	41939	9642	16819	4256	6971	4265	5830	4280	5807	20106	78418	17465	13793	7875	8280	18476	13669	25283	31512
28	13963	31600	28902	8402	18154	4326	8135	4642	4150	3998	2710	6614	54137	13151	12150	6742	7280	12570	8322	13766	20128
29	6818	17451	16287	5836	12743	3066	6925	4694	4325	2790	1258	2472	21494	7232	9235	4988	5204	8890	5071	8331	10536
30	9150	10747	9819	4833	11009	2882	4765	4493	2995	3195	828	804	4582	5003	5643	3945	3753	7874	5648	9541	3737
31	7567	8245	7209	3513	7557	2362	3995	3479	2489	1977	959	701	1715	1439	2210	2264	2651	3273	2393	3284	5765
32	8886	9234	6686	3034	4866	1882	3611	2792	2280	1514	762	652	890	782	818	1556	1835	2954	1722	2100	1171
33	8570	6908	5710	3287	4450	2012	2463	2304	2050	1291	619	470	1120	337	572	756	1132	1085	1340	3374	1034
34	7451	6529	6333	3279	4276	1660	1613	1897	1410	981	517	401	578	405	286	639	762	736	479	909	371
35	5646	6544	4312	2567	3486	1536	1468	1591	948	590	293	347	382	199	122	171	323	310	383	238	312
36	4929	5410	3975	2295	2635	1518	1039	1441	757	544	310	221	388	161	113	207	166	174	192	71	29
37	3631	3912	3065	1811	2014	1425	590	1205	568	305	194	134	357	67	68	135	108	29	0	20	29
38	3166	2501	2223	1488	1620	904	549	717	402	212	142	81	67	80	54	117	98	29	96	10	39
39	3092	4145	2425	1739	2156	1392	520	932	471	212	168	78	131	67	27	117		19	0	0	29
40	2090	2908	1634	1079	1410	831	379	493	266	143	65	39	87	27	14	45			95	10	20
41	1499	1192	842	471	586	378	225	433	243	124	77	26	44	54	14	9	10				10
42	665	742	421	367	426	362	84	313	162	37	26	26		13	14	9					10
43	253	291	253	179	165	103	28	156	69		65	13	29	40	14						
44	84	87	51	53	165	168	28	36	23	25	26		15			9					
45	84	87	67	53	45	26	28	36	23		13	26									
46		58	17	53	30	26		36			13						10				
47			34	11		26		12													
48						39			12												
total	664025	638823	330614	748931	1509292	623284	935746	581692	730719	570876	400725	496163	566768	869393	1434771	1045762	2085973	3325555	6341632	4604910	2442512

Table 4b: 3M beaked redfish abundance at age ('000s) from EU bottom trawl survey series, 1989-2008.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+	Total	Most abundant year class
1989	4130	53137	219406	19357	8071	35188	89946	89433	43605	21698	12392	7202	6537	5939	5301	3013	2467	2189	9812	638823	1985
1990	29489	2710	33397	24565	2605	17585	56217	67444	36082	18378	10186	5630	5333	4816	4009	2318	1851	1730	6269	330614	1982
1991	325523	51145	5421	154995	127962	17655	20481	13300	8086	4187	3884	3393	3014	2479	952	1514	1139	653	3155	748938	1990
1992	198367	866124	59802	58014	144968	71881	30456	26346	16857	9630	6011	4452	4062	3082	2852	2072	1258	1028	2031	1509292	1990
1993	6025	151086	90620	306049	10455	21648	10476	6426	2189	2996	2596	2453	1910	2000	1589	859	874	1414	1619	623284	1989
1994	0	20065	76102	677611	79504	22080	22594	11375	7515	4950	3935	2808	2105	1122	1257	657	482	616	968	935746	1990
1995	2585	18672	63686	114762	332114	8381	8942	8765	4706	3963	4073	2322	1642	1441	1536	1045	605	732	1721	581692	1990
1996	21311	18163	34710	25262	190134	402615	11731	8653	5698	2783	2035	1950	991	1117	886	659	453	436	1132	730719	1990
1997	5861	28568	34939	86326	96940	78135	222658	4967	3731	2768	1494	1269	689	837	236	298	368	124	667	570876	1990
1998	15530	38427	62957	35093	32524	52330	30121	125511	3903	486	396	1990	257	249	77	156	343	28	347	400725	1990
1999	23967	12166	50006	79605	45976	38126	46333	39046	151887	5871	257	337	858	110	246	253	201	435	481	496163	1990
2000	13974	54195	27539	32860	61731	46285	47381	71096	35736	169492	2949	463	158	1548	152	81	83	52	992	566768	1990
2001	419116	55177	121788	86078	52309	42284	29268	20323	8954	5122	26935	853	304	174	198	156	57	64	234	869393	2000
2002	123142	480414	394558	235867	61369	46106	30279	22076	17766	4899	3033	13969	580	164	241	81	60	23	143	1434771	2000
2003	87887	395055	335930	65241	84103	24769	14624	10827	6967	3974	2233	1323	11068	465	53	248	274	52	669	1045762	2001
2004	263500	762669	301354	144943	430177	104125	34401	17198	8319	4654	2365	1301	1182	8772	72	230	248	39	490	2086038	2002
2005	26335	1244660	652407	425205	292846	467795	123484	47163	20489	10868	4939	3849	1663	655	3050	64	45	21	16	3325555	2003
2006	1075350	1210339	1202363	1528343	752862	373958	133664	38139	11992	3707	2477	1591	980	656	592	4168	212	24	215	6341632	2000
2007	714451	986044	933290	537850	652131	384716	283236	66498	25067	3799	3834	2379	1241	1147	576	6720	1515	14	402	4604910	2005
2008	15741	426790	292064	441539	414437	559582	177908	65953	27153	9725	4177	2316	1392	800	258	157	132	2278	111	2442512	2002

Table 4c: 3M beaked redfish mature female abundance at age ('000s) from EU bottom trawl survey series, 1989-2008.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+	Total	Most abundant year class
1989				43	156	1545	7734	11709	7329	4218	3366	2593	2910	2829	2722	1561	1440	1231	7823	59210	1981
1990				13	59	840	5392	9830	6743	3922	2988	2245	2655	2529	2300	1346	1110	1020	4432	47425	1982
1991				55	493	820	2102	2501	2086	1443	1634	1658	1619	1448	596	1054	769	446	2437	21161	1983
1992				18	1610	1817	2280	4334	4320	3147	2222	1829	1981	1668	1644	1413	818	811	1614	31525	1984
1993				0	121	995	925	1009	463	779	778	761	707	834	676	942	598	983	1068	11638	1985
1994				19	247	1006	1912	1682	1508	1510	1247	900	674	478	515	344	302	405	665	13413	1987
1995				86	418	360	910	1343	1005	1105	1269	720	525	523	568	498	296	425	1344	11394	1987
1996				0	1297	2557	1505	1754	1528	980	852	893	521	593	492	394	291	283	793	14731	1990
1997				0	147	2720	6144	2287	1841	1263	705	605	333	403	113	157	201	67	428	17415	1990
1998				0	133	924	1560	5282	785	120	119	647	86	96	26	61	155	9	231	10234	1990
1999				0	155	1129	3118	4737	15007	1341	102	153	340	41	101	99	103	199	307	26931	1990
2000				0	335	1052	3056	10012	9198	29716	1352	162	97	638	83	55	60	34	615	56465	1990
2001				0	554	1329	2140	2777	1922	1815	6695	335	108	65	71	57	20	24	175	18089	1990
2002				230	463	1547	1933	2574	3161	1826	1136	5364	308	82	113	28	26	9	62	18864	1990
2003				9	326	676	1012	1258	1342	1114	913	647	3199	281	36	173	156	39	502	11683	1990
2004				41	1431	2676	3028	2990	2112	1528	1100	749	785	3754	57	161	165	31	333	20942	1990
2005				147	1139	13060	11962	11076	7139	4410	2717	2266	921	469	1840	33	26	12	9	57226	1999
2006				246	2788	10973	12617	8104	4431	1675	1265	750	554	394	430	2012	131	23	187	46580	1999
2007				397	2278	3850	29711	14750	11948	2989	3319	2194	1166	1072	519	5111	1297	9	353	80963	2000
2008				199	2520	19900	23927	21308	13256	5989	2827	1638	986	590	144	69	53	1667	50	95122	2001

Table 4d: Maturity ogive at age for 3M beaked reddish as the average proportion of mature females at age, from the EU survey abundance at age, 1989-2008.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
Ogive	0.000	0.000	0.000	0.000	0.004	0.025	0.086	0.160	0.217	0.241	0.365	0.438	0.445	0.500	0.540	0.629	0.633	0.647	0.744

Table 4e: Weights at age of the 3M beaked redfish stock (Kg) from EU surveys, 1989-2008.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1989	0.012	0.032	0.060	0.100	0.164	0.205	0.248	0.284	0.317	0.349	0.431	0.511	0.563	0.586	0.631	0.643	0.706	0.703	0.880
1990	0.011	0.028	0.082	0.097	0.171	0.212	0.261	0.299	0.331	0.361	0.443	0.524	0.582	0.602	0.652	0.668	0.731	0.727	0.920
1991	0.012	0.029	0.067	0.109	0.135	0.214	0.276	0.337	0.385	0.465	0.515	0.569	0.616	0.649	0.700	0.779	0.764	0.794	0.892
1992	0.013	0.032	0.070	0.096	0.171	0.208	0.292	0.354	0.396	0.452	0.525	0.571	0.635	0.680	0.704	0.807	0.769	0.879	0.933
1993	0.010	0.034	0.051	0.066	0.156	0.212	0.287	0.365	0.395	0.434	0.513	0.554	0.624	0.687	0.714	0.871	0.853	0.867	1.101
1994	0.000	0.045	0.076	0.090	0.130	0.226	0.276	0.348	0.395	0.464	0.493	0.530	0.549	0.673	0.659	0.719	0.816	0.852	0.912
1995	0.011	0.027	0.071	0.102	0.113	0.217	0.288	0.357	0.405	0.456	0.514	0.546	0.632	0.702	0.726	0.812	0.822	0.869	1.067
1996	0.011	0.036	0.062	0.079	0.138	0.141	0.270	0.328	0.384	0.443	0.480	0.533	0.580	0.600	0.649	0.697	0.756	0.794	0.956
1997	0.013	0.031	0.059	0.090	0.127	0.190	0.174	0.355	0.406	0.466	0.505	0.573	0.609	0.621	0.682	0.746	0.787	0.759	0.933
1998	0.010	0.034	0.062	0.089	0.138	0.181	0.229	0.222	0.371	0.422	0.490	0.550	0.624	0.687	0.714	0.809	0.832	0.729	1.103
1999	0.014	0.033	0.064	0.087	0.121	0.176	0.223	0.260	0.246	0.323	0.473	0.564	0.513	0.552	0.541	0.552	0.642	0.615	0.766
2000	0.016	0.037	0.060	0.097	0.132	0.174	0.234	0.285	0.329	0.297	0.418	0.528	0.668	0.564	0.497	0.673	0.718	0.718	0.750
2001	0.015	0.028	0.062	0.085	0.140	0.179	0.238	0.297	0.328	0.384	0.340	0.516	0.598	0.663	0.668	0.616	0.771	0.853	1.010
2002	0.013	0.034	0.052	0.101	0.132	0.184	0.227	0.282	0.323	0.390	0.408	0.398	0.561	0.595	0.629	0.719	0.644	0.894	0.952
2003	0.012	0.034	0.054	0.076	0.109	0.161	0.217	0.264	0.321	0.355	0.413	0.462	0.351	0.558	0.584	0.638	0.509	0.694	0.754
2004	0.015	0.030	0.066	0.094	0.120	0.163	0.221	0.278	0.343	0.378	0.444	0.498	0.553	0.426	0.635	0.684	0.541	0.756	0.755
2005	0.013	0.041	0.061	0.092	0.119	0.166	0.214	0.273	0.339	0.379	0.459	0.481	0.462	0.591	0.502	0.710	0.724	0.904	0.869
2006	0.014	0.044	0.071	0.089	0.115	0.160	0.220	0.272	0.348	0.416	0.447	0.445	0.512	0.555	0.614	0.438	0.574	0.881	0.810
2007	0.014	0.029	0.056	0.107	0.118	0.135	0.204	0.251	0.316	0.401	0.463	0.529	0.551	0.548	0.531	0.403	0.496	0.747	0.563
2008	0.012	0.039	0.069	0.096	0.127	0.166	0.219	0.280	0.335	0.384	0.435	0.460	0.465	0.521	0.607	0.650	0.634	0.472	0.839
Mean	0.012	0.034	0.064	0.092	0.134	0.184	0.241	0.300	0.351	0.401	0.460	0.517	0.562	0.603	0.632	0.682	0.705	0.775	0.888

Table 4f: Weights at age of the 3M mature female beaked redfish stock (Kg) from EU surveys, 1989-2008.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1989				0.157	0.174	0.220	0.267	0.306	0.337	0.376	0.461	0.541	0.575	0.596	0.636	0.647	0.728	0.725	0.886
1990				0.160	0.181	0.228	0.283	0.323	0.352	0.390	0.474	0.553	0.594	0.615	0.658	0.671	0.749	0.746	0.926
1991				0.151	0.163	0.251	0.304	0.354	0.406	0.473	0.528	0.585	0.629	0.661	0.712	0.791	0.778	0.809	0.908
1992				0.157	0.185	0.225	0.310	0.372	0.412	0.459	0.534	0.593	0.656	0.706	0.732	0.828	0.800	0.889	0.947
1993				0.000	0.183	0.226	0.288	0.375	0.411	0.438	0.518	0.558	0.645	0.705	0.728	0.929	0.865	0.875	1.156
1994				0.153	0.169	0.244	0.286	0.357	0.402	0.470	0.502	0.539	0.569	0.702	0.684	0.750	0.824	0.874	0.952
1995				0.153	0.157	0.226	0.296	0.366	0.412	0.459	0.516	0.546	0.638	0.723	0.740	0.837	0.854	0.889	1.079
1996				0.000	0.176	0.187	0.281	0.337	0.389	0.449	0.483	0.536	0.583	0.606	0.658	0.702	0.757	0.799	0.959
1997				0.000	0.188	0.226	0.240	0.358	0.410	0.465	0.503	0.576	0.612	0.625	0.684	0.747	0.790	0.768	0.957
1998				0.000	0.159	0.195	0.266	0.243	0.384	0.436	0.493	0.554	0.626	0.707	0.712	0.815	0.844	0.729	1.128
1999				0.000	0.152	0.193	0.238	0.277	0.264	0.341	0.464	0.572	0.514	0.542	0.534	0.544	0.673	0.643	0.778
2000				0.000	0.162	0.192	0.270	0.304	0.344	0.327	0.424	0.519	0.681	0.574	0.494	0.695	0.724	0.728	0.770
2001				0.000	0.165	0.191	0.246	0.306	0.344	0.390	0.374	0.514	0.602	0.665	0.667	0.622	0.776	0.853	1.035
2002				0.151	0.174	0.209	0.238	0.305	0.340	0.399	0.453	0.408	0.557	0.587	0.616	0.715	0.643	0.888	0.968
2003				0.138	0.148	0.188	0.234	0.274	0.334	0.378	0.432	0.476	0.398	0.560	0.584	0.651	0.524	0.694	0.778
2004				0.149	0.160	0.195	0.243	0.288	0.352	0.399	0.466	0.518	0.566	0.460	0.635	0.675	0.550	0.756	0.718
2005				0.146	0.151	0.193	0.244	0.286	0.345	0.385	0.472	0.493	0.481	0.585	0.514	0.705	0.719	0.900	0.861
2006				0.146	0.167	0.207	0.246	0.297	0.364	0.421	0.465	0.457	0.532	0.563	0.621	0.458	0.568	0.881	0.844
2007				0.146	0.168	0.174	0.266	0.291	0.370	0.405	0.467	0.530	0.553	0.548	0.532	0.412	0.498	0.747	0.564
2008				0.146	0.167	0.206	0.250	0.300	0.344	0.392	0.446	0.465	0.461	0.502	0.575	0.604	0.575	0.465	0.672
Mean				0.098	0.167	0.209	0.265	0.316	0.366	0.413	0.474	0.527	0.574	0.612	0.636	0.690	0.712	0.783	0.894

Table 5a: 3M beaked redfish survey mean catch per tow from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2008 by RV Vizconde de Eza (VE); former period converted to new RV units).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
mean weight per tow (Kg/tow)	199	159	109	85	147	68	125	90	125	104	74	103	146	78	129	57	185	297	532	279	224
SE	32	21	13	10	17	24	38	10	17	18	12	30	57	12	17	7	26	53	79	43	45
CV	16%	13%	12%	12%	12%	36%	30%	11%	14%	18%	16%	29%	39%	16%	13%	13%	14%	18%	15%	15%	20%

Table 5b: 3M beaked redfish abundance, stock and female spwanning biomass ('000 tons) from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2008 by RV Vizconde de Eza (VE); former period converted to new RV units).

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
abundance (millions)	664	639	331	749	1509	623	936	582	731	571	401	496	567	869	1435	1046	2086	3326	6342	4605	2443
4+abundance (millions)	541	362	265	367	385	376	840	497	657	502	284	410	471	273	437	227	759	1402	2854	1971	1708
biomass ('000 ton)	160	128	89	72	119	78	105	73	100	84	60	82	118	64	107	66	157	302	485	386	308
4+ biomass ('000 ton)	155	113	86	67	92	45	100	71	101	82	56	81	116	51	69	34	106	209	333	279	264
spawning biomass ('000 ton)	28	28	23	12	16	8	6	6	6	6	3	8	18	6	6	4	7	17	13	26	28
ssb proportion	18%	22%	25%	16%	13%	10%	6%	9%	6%	8%	5%	9%	16%	9%	6%	7%	5%	6%	3%	7%	9%

Table 6: Input files for 2009 XSA assessment.

REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2009	REDFISH NAFO 3M LANDINGS tons	
1	1	1
red3mla.txt	1989	2008
red3mcn.txt	4	19
red3mcw.txt	5	
red3msw.txt	58086	
red3mnm.txt	80223	
red3mmo.txt	48500	
red3mpf.txt	43300	
red3mpm.txt	43100	
red3mfo.txt	17664	
red3mfn.txt	13879	
red3mtun.txt	6101	
	1408	
	1011	
	1095	
	3665	
	3327	
	2976	
	2273	
	3260	
	4334	
	6228	
	5452	
	3166	

Table 6: Input files for 2009 XSA assessment (cont.).

REDFISH NAFO 3M CATCH NUMBERS thousands

1	2														
1989	2008														
4	19														
1															
444	1057	7890	22978	24054	14508	9716	8792	6213	6366	5883	5199	2965	2122	1969	5003
10382	2773	5860	28741	47007	32291	18415	11643	6614	5940	5430	4449	2543	1888	1788	4562
1229	3592	6929	18141	22725	16867	8491	6503	4808	3967	2888	1102	1648	1270	780	3305
237	5234	7018	16988	18149	11681	7422	5608	4455	4286	3302	2952	1953	1189	746	1730
110773	10414	3064	3409	4557	2101	3936	5178	5512	4547	4665	3554	2092	1666	2614	1514
53804	6411	1630	2399	2522	2550	2819	2521	1956	1459	856	969	460	320	390	551
2770	13324	5399	1889	2423	1554	1471	1869	1137	966	927	1070	833	482	548	1239
1632	3546	4635	1402	1399	1431	983	767	733	393	404	283	202	135	133	289
692	144	595	800	272	285	322	219	194	98	119	27	28	30	10	76
109	59	109	285	706	422	69	76	355	45	50	12	33	66	4	52
151	43	16	70	258	593	367	81	114	263	39	78	79	69	105	147
89	130	204	387	1018	1436	4211	657	170	71	608	64	38	34	38	558
828	337	386	842	1303	869	856	3229	381	117	62	65	60	19	29	61
1467	358	483	557	858	1013	531	643	1822	337	110	158	57	50	9	54
1712	1946	281	391	546	565	423	365	311	1222	214	22	102	69	23	266
1013	4104	2581	1564	999	611	379	268	203	254	953	19	83	46	19	342
2434	1211	2053	1489	1525	1401	1011	720	750	365	357	1049	105	64	16	63
2136	5112	8828	5865	2494	1304	544	414	253	200	189	208	759	85	9	115
470	829	873	4415	2255	2181	672	844	826	375	348	266	1180	546	35	320
228	650	2096	1766	1848	1488	671	361	232	137	133	77	72	78	264	277

REDFISH NAFO 3M CATCH WEIGHT AT AGE kg

1	3														
1989	2008														
4	19														
1															
0.174	0.208	0.251	0.293	0.344	0.401	0.453	0.535	0.597	0.644	0.668	0.712	0.729	0.783	0.794	1.005
0.144	0.183	0.258	0.318	0.364	0.401	0.434	0.508	0.579	0.639	0.658	0.709	0.726	0.773	0.768	1.006
0.147	0.182	0.287	0.347	0.401	0.439	0.511	0.558	0.616	0.672	0.721	0.772	0.853	0.833	0.867	0.964
0.157	0.197	0.269	0.337	0.389	0.437	0.503	0.584	0.626	0.693	0.732	0.750	0.850	0.803	0.933	1.017
0.114	0.152	0.248	0.325	0.406	0.444	0.480	0.556	0.595	0.652	0.710	0.737	0.901	0.868	0.885	1.096
0.109	0.145	0.267	0.316	0.393	0.436	0.509	0.543	0.583	0.609	0.702	0.691	0.745	0.844	0.868	0.902
0.164	0.184	0.239	0.327	0.397	0.442	0.495	0.552	0.583	0.665	0.725	0.751	0.829	0.835	0.873	1.050
0.093	0.184	0.209	0.316	0.378	0.441	0.498	0.532	0.590	0.635	0.650	0.705	0.747	0.806	0.845	1.075
0.092	0.153	0.266	0.284	0.394	0.442	0.507	0.548	0.595	0.621	0.626	0.672	0.761	0.793	0.741	1.291
0.107	0.165	0.213	0.318	0.295	0.427	0.480	0.519	0.572	0.639	0.712	0.728	0.827	0.839	0.745	1.026
0.101	0.140	0.201	0.325	0.364	0.351	0.433	0.509	0.597	0.553	0.580	0.568	0.583	0.671	0.612	0.737
0.069	0.124	0.167	0.237	0.284	0.349	0.332	0.439	0.518	0.659	0.557	0.492	0.662	0.720	0.761	0.817
0.097	0.148	0.211	0.269	0.322	0.361	0.411	0.404	0.537	0.611	0.674	0.674	0.617	0.797	0.860	0.989
0.116	0.165	0.226	0.265	0.328	0.359	0.423	0.491	0.450	0.577	0.601	0.623	0.703	0.643	0.866	0.875
0.085	0.107	0.190	0.253	0.288	0.341	0.384	0.454	0.500	0.409	0.584	0.587	0.633	0.550	0.692	0.664
0.091	0.131	0.174	0.223	0.274	0.338	0.377	0.456	0.513	0.558	0.445	0.610	0.681	0.586	0.724	0.897
0.088	0.113	0.176	0.241	0.288	0.345	0.382	0.476	0.508	0.519	0.635	0.596	0.691	0.690	0.878	0.932
0.102	0.137	0.172	0.214	0.279	0.349	0.400	0.443	0.447	0.538	0.573	0.626	0.461	0.625	0.842	1.004
0.107	0.130	0.146	0.251	0.277	0.354	0.393	0.454	0.493	0.515	0.527	0.538	0.443	0.548	0.701	0.758
0.110	0.134	0.176	0.234	0.289	0.328	0.364	0.425	0.454	0.484	0.608	0.645	0.684	0.717	0.563	1.064

Table 6: Input files for 2009 XSA assessment (cont.).

REDFISH NAFO 3M STOCK WEIGHT AT AGE kg

1	4														
1989	2008														
4	19														
1															
0.100	0.164	0.205	0.248	0.284	0.317	0.349	0.431	0.511	0.563	0.586	0.631	0.643	0.706	0.703	0.880
0.097	0.171	0.212	0.261	0.299	0.331	0.361	0.443	0.524	0.582	0.602	0.652	0.668	0.731	0.727	0.920
0.109	0.135	0.214	0.276	0.337	0.385	0.465	0.515	0.569	0.616	0.649	0.700	0.779	0.764	0.794	0.892
0.096	0.171	0.208	0.292	0.354	0.396	0.452	0.525	0.571	0.635	0.680	0.704	0.807	0.769	0.879	0.933
0.066	0.156	0.212	0.287	0.365	0.395	0.434	0.513	0.554	0.624	0.687	0.714	0.871	0.853	0.867	1.101
0.090	0.130	0.226	0.276	0.348	0.395	0.464	0.493	0.530	0.549	0.673	0.659	0.719	0.816	0.852	0.912
0.102	0.113	0.217	0.288	0.357	0.405	0.456	0.514	0.546	0.632	0.702	0.726	0.812	0.822	0.869	1.067
0.079	0.138	0.141	0.270	0.328	0.384	0.443	0.480	0.533	0.580	0.600	0.649	0.697	0.756	0.794	0.956
0.090	0.127	0.190	0.174	0.355	0.406	0.466	0.505	0.573	0.609	0.621	0.682	0.746	0.787	0.759	0.933
0.089	0.138	0.181	0.229	0.222	0.371	0.422	0.490	0.550	0.624	0.687	0.714	0.809	0.832	0.729	1.103
0.087	0.121	0.176	0.223	0.260	0.246	0.323	0.473	0.564	0.513	0.552	0.541	0.552	0.642	0.615	0.766
0.097	0.132	0.174	0.234	0.285	0.329	0.297	0.418	0.528	0.668	0.564	0.497	0.673	0.718	0.718	0.750
0.085	0.140	0.179	0.238	0.297	0.328	0.384	0.340	0.516	0.598	0.663	0.668	0.616	0.771	0.853	1.010
0.101	0.132	0.184	0.227	0.282	0.323	0.390	0.408	0.398	0.561	0.595	0.629	0.719	0.644	0.894	0.952
0.076	0.109	0.161	0.217	0.264	0.321	0.355	0.413	0.462	0.351	0.558	0.584	0.638	0.509	0.694	0.754
0.094	0.120	0.163	0.221	0.278	0.343	0.378	0.444	0.498	0.553	0.426	0.635	0.684	0.541	0.756	0.755
0.092	0.119	0.166	0.214	0.273	0.339	0.379	0.459	0.481	0.462	0.591	0.502	0.710	0.724	0.904	0.869
0.089	0.115	0.160	0.220	0.272	0.348	0.416	0.447	0.445	0.512	0.555	0.614	0.438	0.574	0.881	0.810
0.107	0.118	0.135	0.204	0.251	0.316	0.401	0.463	0.529	0.551	0.548	0.531	0.403	0.496	0.747	0.563
0.096	0.127	0.166	0.219	0.280	0.335	0.384	0.435	0.460	0.465	0.521	0.607	0.650	0.634	0.472	0.839

REDFISH NAFO 3M NATURAL MORTALITY

1	5														
1989	2008														
4	19														
2															
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

REDFISH NAFO 3M PROPORTION MATURE AT AGE

1	6														
1989	2008														
4	19														
2															
0.000296	0.004	0.025	0.086	0.160	0.217	0.241	0.365	0.438	0.445	0.500	0.540	0.629	0.633	0.647	0.744

Table 6: Input files for 2009 XSA assessment (cont.).

REDFISH NAFO 3M F ON OLDEST AGE GROUP BY YEAR

1	9
1989	2008
4	19
5	
0.5678	
0.6757	
0.7312	
0.5015	
0.9763	
0.4806	
0.6249	
0.2239	
0.0433	
0.0551	
0.1786	
0.3509	
0.2111	
0.1754	
0.2666	
0.168	
0.3067	
0.7411	
1.0842	
1.0842	

REDFISH NAFO 3M PROPORTION OF F BEFORE SPAWNING

1	7
1989	2008
4	19
3	
0.08	

REDFISH NAFO 3M PROPORTION OF M BEFORE SPAWNING

1	8
1989	2008
4	19
3	
0.08	

REDFISH NAFO 3M F AT AGE IN LAST YEAR

1	10														
1989	2008														
4	19														
2															
0.0022	0.0019	0.0053	0.0484	0.0549	0.0764	0.0746	0.1537	0.1431	0.1116	0.0856	0.0981	0.6218	0.0341	1.0842	1.0842

REDFISH NAFO 3M SURVEY TUNNING DATA

101

EU BOTTOM TRAWL SURVEY

1989	2008															
1	1	0.5	0.6													
4	19															
10555	19357	8071	35188	89946	89433	43605	21698	12392	7202	6537	5939	5301	3013	2467	2189	9812
10555	24565	2605	17585	56217	67444	36082	18378	10186	5630	5333	4816	4009	2318	1851	1730	6269
10555	154995	127962	17655	20481	13300	8086	4187	3884	3393	3014	2479	952	1514	1139	653	3155
10555	58014	144968	71881	30456	26346	16857	9630	6011	4452	4062	3082	2852	2072	1258	1028	2031
10555	306049	10455	21648	10476	6426	2189	2996	2596	2453	1910	2000	1589	859	874	1414	1619
10555	677611	79504	22080	22594	11375	7515	4950	3935	2808	2105	1122	1257	657	482	616	968
10555	114762	332114	8381	8942	8765	4706	3963	4073	2322	1642	1441	1536	1045	605	732	1721
10555	25262	190134	402615	11731	8653	5698	2783	2035	1950	991	1117	886	659	453	436	1132
10555	86326	96940	78135	222658	4967	3731	2768	1494	1269	689	837	236	298	368	124	667
10555	35093	32524	52330	30121	125511	3903	486	396	1990	257	249	77	156	343	28	347
10555	79605	45976	38126	46333	39046	151887	5871	257	337	858	110	246	253	201	435	481
10555	32860	61731	46285	47381	71096	35736	169492	2949	463	158	1548	152	81	83	52	992
10555	86078	52309	42284	29268	20323	8954	5122	26935	853	304	174	198	156	57	64	234
10555	235867	61369	46106	30279	22076	17766	4899	3033	13969	580	164	241	81	60	23	143
10555	65241	84103	24769	14624	10827	6967	3974	2233	1323	11068	465	53	248	274	52	669
10555	144943	430177	104125	34401	17198	8319	4654	2365	1301	1182	8772	72	230	248	39	490
10555	425205	292846	467795	123484	47163	20489	10868	4939	3849	1663	655	3050	64	45	21	16
10555	1528343	752862	373958	133664	38139	11992	3707	2477	1591	980	656	592	4168	212	24	215
10555	537850	652131	384716	283236	66498	25067	3799	3834	2379	1241	1147	576	6720	1515	14	402
10555	441539	414437	559582	177908	65953	27153	9725	4177	2316	1392	800	258	157	132	2278	111

Table 7: Extended Survivor Analysis summary of diagnostics for 2009 (single EU survey, 1989-2008).

REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2009
CPUE data from file red3mtun.txt

Catch data for 20 years. 1989 to 2008. Ages 4 to 19.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU BOTTOM TRAWL SURV	1989	2008	4	18	0.5	0.6

Time series weights :
Tapered time weighting not applied

Catchability analysis :
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 17

Terminal population estimation :

Final estimates not shrunk towards mean F
Minimum standard error for population
estimates derived from each fleet = .500
Prior weighting not applied

Tuning converged after 43 iterations

Log catchability residuals.
Fleet : EU BOTTOM TRAWL SURV

Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
4	**-2.04**	**-1.39**	0.9	-0.03	0.76	0.89	0.71	-0.29	0.85	-0.05	0.63	-0.34	0.33	0.54	-1.12	-0.73	-0.01	0.35	0.03	0
5	**-3.15**	**-3.87**	0.61	1.17	-1.15	0.58	0.68	**1.55**	1.26	0.03	0.35	0.52	0.27	0.15	-0.32	0.95	0.12	0.72	-0.36	-0.09
6	**-1.91**	**-2.12**	**-1.64**	0.51	-0.25	0.29	-0.98	1.21	0.98	0.84	0.38	0.56	0.35	0.36	-0.55	0.14	1.27	0.62	0.26	-0.33
7	-1	-0.95	**-1.46**	-0.32	-0.85	0.31	-0.05	-0.02	0.88	0.28	0.94	0.83	0.37	0.27	-0.54	0.06	0.58	0.32	0.64	-0.29
8	-0.53	-0.5	**-1.56**	-0.17	-0.94	-0.17	0.08	0.73	-0.46	0.6	0.83	**1.72**	0.37	0.47	-0.43	-0.03	0.76	-0.25	-0.01	-0.51
9	-0.51	-0.48	**-1.53**	-0.2	-1.63	0.17	-0.29	0.68	0.7	-0.19	1.22	1.28	0.23	0.83	-0.16	-0.2	0.71	-0.05	-0.16	-0.43
10	-0.53	-0.4	**-1.57**	-0.26	-0.76	0.14	0.64	0.05	0.93	-0.69	0.87	**1.94**	0.04	0.3	-0.02	0.04	0.72	-0.34	-0.57	-0.52
11	-0.49	-0.56	-1.11	-0.44	-0.54	0.53	1.07	1.02	0	-0.48	-0.88	0.8	0.63	0.04	0	-0.09	0.6	-0.27	0.21	-0.04
12	-0.77	-0.83	-1.17	-0.44	-0.56	0.4	0.89	**1.4**	1.17	0.57	-0.4	0.02	0.01	0.22	-0.55	-0.32	0.7	-0.28	-0.02	-0.05
13	-0.44	-0.49	-0.89	-0.39	-0.31	0.17	0.84	0.96	1.18	0.01	0.18	-0.79	0.08	0.24	0.32	-0.34	0.28	-0.26	-0.18	-0.19
14	-0.55	-0.23	-0.86	-0.44	-0.3	-0.12	0.36	1.3	1.28	0.43	-0.69	**1.48**	-0.54	-0.2	0.52	0.21	-0.77	-0.48	0.09	-0.49
15	0.18	-0.18	-1.17	0.06	0.04	0.34	**1.52**	0.65	0.5	-0.61	1.11	0.15	0.35	0.48	-0.79	-0.75	-0.42	-0.4	-0.11	-0.95
16	-0.25	-0.38	-1.12	-0.35	-0.73	-0.48	0.76	**1.64**	-0.61	-0.12	0.49	0.12	0.15	-0.59	0.82	0.71	-0.88	-0.33	**2.74**	**-1.61**
17	-0.46	-0.05	-0.58	-1.09	-0.45	-0.83	-0.13	0.73	1.74	-0.48	0.39	-0.37	0.07	-0.44	1.07	**1.48**	-0.12	1.05	-1.33	-0.2
18	0	0.09	0.02	0.12	0.51	0.19	0.37	0.14	-0.16	-0.48	0.05	-0.37	-0.2	-0.44	-0.02	-0.27	-0.21	0.08	-0.07	-0.75

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Mean Log q	-8.1963	-8.2289	-8.3161	-8.426	-8.592	-8.9056	-9.3215	-9.5854	-9.6043	-9.7305	-9.6554	-9.8788	-9.441	-9.2516	-9.2516
S.E(Log q)	0.8082	1.3561	0.988	0.682	0.73	0.7708	0.7668	0.618	0.6863	0.547	0.7045	0.6863	0.9935	0.8329	0.3089

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.05	-0.256	8.07	0.62	20	0.87	-8.2
5	1.51	-1.111	7.06	0.21	20	2.04	-8.23
6	1.35	-1.203	7.64	0.4	20	1.32	-8.32
7	1.33	-1.675	7.91	0.59	20	0.87	-8.43
8	1.5	-2.232	8.04	0.52	20	1	-8.59
9	1.41	-1.766	8.74	0.51	20	1.03	-8.91
10	1.22	-1.1	9.41	0.57	20	0.93	-9.32
11	1.2	-1.268	9.78	0.7	20	0.73	-9.59
12	1.59	-3.388	10.39	0.65	20	0.88	-9.6
13	1.27	-2.444	10.22	0.82	20	0.62	-9.73
14	1.27	-1.907	10.21	0.74	20	0.84	-9.66
15	1.09	-0.734	10.11	0.8	20	0.76	-9.88
16	1.23	-1.217	10.05	0.61	20	1.21	-9.44
17	1.55	-4.011	10.93	0.75	20	0.96	-9.25
18	0.95	1.545	9.12	0.98	20	0.27	-9.32

Table 7: cont.

Terminal year survivor and F summaries :

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	144964	0.828	0	0	1	1	0.001

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	153940	0.711	0.055	0.08	2	1	0.004

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	286191	0.582	0.244	0.42	3	1	0.007

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	97471	0.447	0.184	0.41	4	1	0.017

Age 8 Catchability constant w.r.t. time and dependent on age
Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	52604	0.385	0.298	0.77	5	1	0.033

Age 9 Catchability constant w.r.t. time and dependent on age
Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	27362	0.348	0.307	0.88	6	1	0.05

Age 10 Catchability constant w.r.t. time and dependent on age
Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	16235	0.319	0.171	0.54	7	1	0.039

Age 11 Catchability constant w.r.t. time and dependent on age
Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	5563	0.289	0.15	0.52	8	1	0.06

Age 12 Catchability constant w.r.t. time and dependent on age
Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	3180	0.271	0.125	0.46	9	1	0.067

Age 13 Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	2511	0.247	0.116	0.47	10	1	0.051

Age 14 Catchability constant w.r.t. time and dependent on age
Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1787	0.235	0.118	0.5	11	1	0.068

Age 15 Catchability constant w.r.t. time and dependent on age
Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1147	0.232	0.173	0.74	12	1	0.062

Age 16 Catchability constant w.r.t. time and dependent on age
Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	861	0.226	0.206	0.91	13	1	0.077

Age 17 Catchability constant w.r.t. time and dependent on age
Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	123	0.372	0.207	0.56	14	1	0.471

Age 18 Catchability constant w.r.t. time and age (fixed at the value for age) 17
Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	4449	0.205	0.214	1.04	15	1	0.055

Table 8: Extended Survivor Analysis summary of diagnostics for 2009 (three EU surveys: 1989-1993; 1994-2000 and 2001-2008)

REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2009
CPUE data from file red3mtun.txt

Catch data for 20 years. 1989 to 2008. Ages 4 to 19.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU BOTTOM TRAWL SURV	1989	2008	4	18	0.5	0.6
EU BOTTOM TRAWL SURV	1994	2008	4	18	0.5	0.6
EU BOTTOM TRAWL SURV	2001	2008	4	18	0.5	0.6

Time series weights :
Tapered time weighting not applied

Catchability analysis :
Catchability independent of stock size for all ages
Catchability independent of age for ages >= 17

Terminal population estimation :

Final estimates not shrunk towards mean F
Minimum standard error for population
estimates derived from each fleet = .500
Prior weighting not applied

Tuning converged after 72 iterations

Log catchability residuals.

Fleet :	EU BOTTOM TRAWL SURV I					EU BOTTOM TRAWL SURV II							EU BOTTOM TRAWL SURV III							
Age	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
4	**-1.68**	-1.03	1.26	0.33	1.12	0.53	0.28	-0.68	0.46	-0.36	0.36	-0.59	0.33	0.6	-1.24	-0.71	0	0.78	0.25	0
5	**-1.87**	**-2.59**	**1.89**	2.45	0.13	-0.22	0	0.77	0.53	-0.7	-0.29	-0.1	-0.06	-0.09	-0.49	0.58	-0.11	0.49	-0.18	-0.12
6	-0.83	-1.04	-0.56	**1.59**	0.83	-0.24	-1.51	0.82	0.47	0.38	-0.09	0.18	-0.06	-0.02	-0.85	-0.06	0.86	0.36	-0.03	-0.2
7	-0.09	-0.04	-0.54	0.6	0.07	-0.19	-0.54	-0.52	0.54	-0.19	0.51	0.4	0.08	0.01	-0.77	-0.07	0.55	0.07	0.56	-0.43
8	0.21	0.23	-0.83	0.57	-0.19	-0.68	-0.43	0.22	-0.97	0.23	0.34	1.28	0.13	0.34	-0.54	-0.11	0.82	-0.1	-0.1	-0.43
9	0.35	0.4	-0.66	0.67	-0.76	-0.36	-0.82	0.15	0.17	-0.73	0.83	0.77	-0.04	0.56	-0.32	-0.34	0.64	0.03	0.02	-0.56
10	0.17	0.29	-0.85	0.44	-0.05	-0.44	0.08	-0.53	0.36	-1.26	0.28	1.52	-0.15	0.18	-0.14	0.04	0.75	-0.23	-0.28	-0.16
11	0.13	0.06	-0.49	0.21	0.09	0.24	0.77	0.76	-0.3	-0.78	-1.18	0.48	0.45	-0.31	-0.27	-0.36	0.48	-0.36	0.23	0.15
12	-0.03	-0.08	-0.43	0.3	0.24	-0.2	0.33	0.84	0.64	-0.03	-1	-0.58	-0.16	0.29	-0.68	-0.37	0.66	-0.15	0.17	0.24
13	0.06	0.02	-0.38	0.11	0.19	-0.15	0.45	0.64	0.84	-0.32	-0.24	-1.21	-0.06	0.07	0.42	-0.47	0.26	-0.27	0	0.06
14	-0.14	0.25	-0.37	0.06	0.2	-0.83	-0.1	0.75	0.78	-0.15	-1.28	0.84	-0.45	-0.1	0.59	0.56	-0.66	-0.24	0.33	-0.03
15	0.24	-0.03	-0.91	0.33	0.37	-0.33	0.85	0.34	0.02	-1.07	0.61	-0.41	0.68	0.72	-0.55	-0.56	0.11	-0.15	0.3	-0.54
16	0.16	-0.01	-0.56	0.37	0.05	-0.89	0.39	1.34	-0.67	-0.4	0.29	-0.06	0.05	-0.74	0.6	0.46	-1.2	-0.28	**2.79**	**-1.69**
17	-0.09	0.26	-0.24	-0.42	0.49	-1.28	-0.41	0.62	**1.76**	-0.51	0.23	-0.41	0.05	-0.67	0.8	1.14	-0.47	0.45	-1.55	0.25
18	0	0.07	-0.2	0.12	0.69	-0.14	0.2	0.11	-0.06	-0.23	0.22	-0.01	0.1	-0.08	0.18	-0.15	-0.07	0.12	0.03	-0.93

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
EU BOTTOM TRAWL SURV I															
Mean Log q	-8.5524	-9.5063	-9.3956	-9.3401	-9.327	-9.7678	-10.0169	-10.1987	-10.3329	-10.2165	-10.12	-10.11	-10.1105	-10.0774	-10.0774
S.E(Log q)	1.307	2.2256	1.152	0.4076	0.5351	0.6615	0.5082	0.2819	0.2938	0.2198	0.2558	0.5307	0.3462	0.3696	0.3683
EU BOTTOM TRAWL SURV II															
Mean Log q	-7.7445	-7.4317	-7.7801	-7.9249	-8.0721	-8.3548	-8.7231	-9.2611	-8.9724	-9.267	-8.9242	-9.139	-8.8573	-8.6264	-8.6264
S.E(Log q)	0.5212	0.5028	0.7564	0.4732	0.7602	0.6673	0.8753	0.7674	0.6574	0.7041	0.8397	0.6631	0.7587	0.9796	0.1712
EU BOTTOM TRAWL SURV III															
Mean Log q	-7.9096	-7.6902	-7.7197	-7.9714	-8.2744	-8.5442	-9.092	-9.1928	-9.4206	-9.5466	-9.6983	-10.0504	-9.0846	-8.5656	-8.5656
S.E(Log q)	0.675	0.3564	0.482	0.4488	0.4328	0.4236	0.3354	0.3646	0.4242	0.28	0.4593	0.535	1.3775	0.8694	0.3691

Tab. 8 (cont.)

Regression statistics :
Ages with q independent of year class strength and constant w.r.t. time.
EU BOTTOM TRAWL SURV I

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	1.01	-0.012	8.53	0.24	5	1.53	-8.55
5	-0.47	-2.279	10.82	0.44	5	0.73	-9.51
6	-5.39	-2.656	16.72	0.05	5	3.92	-9.4
7	1.19	-0.639	9.07	0.79	5	0.53	-9.34
8	0.92	0.253	9.44	0.76	5	0.56	-9.33
9	0.7	1.046	9.95	0.8	5	0.46	-9.77
10	0.94	0.145	10.02	0.65	5	0.55	-10.02
11	1.03	-0.096	10.21	0.76	5	0.34	-10.2
12	1.79	-1.382	10.8	0.5	5	0.48	-10.33
13	1.23	-0.608	10.37	0.71	5	0.29	-10.22
14	1.26	-0.575	10.33	0.61	5	0.35	-10.12
15	0.87	0.203	9.98	0.47	5	0.53	-10.11
16	1.54	-0.696	10.88	0.36	5	0.57	-10.11
17	2.32	-1.419	12.26	0.28	5	0.77	-10.08
18	0.94	0.142	9.84	0.64	5	0.36	-9.94
1							

EU BOTTOM TRAWL SURV II

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.76	1.346	8.25	0.86	7	0.37	-7.74
5	0.95	0.16	7.55	0.66	7	0.52	-7.43
6	0.69	0.847	8.29	0.6	7	0.54	-7.78
7	0.68	1.778	8.33	0.86	7	0.28	-7.92
8	0.84	0.423	8.21	0.58	7	0.69	-8.07
9	0.76	1.063	8.41	0.8	7	0.5	-8.35
10	0.63	2.164	8.53	0.87	7	0.44	-8.72
11	0.55	2.003	8.5	0.8	7	0.34	-9.26
12	0.92	0.185	8.84	0.55	7	0.66	-8.97
13	1.01	-0.032	9.3	0.57	7	0.78	-9.27
14	1.06	-0.139	9.07	0.5	7	0.98	-8.92
15	0.86	0.605	8.71	0.78	7	0.6	-9.14
16	1.21	-0.544	9.5	0.56	7	0.98	-8.86
17	2.99	-2.656	14.83	0.26	7	2.07	-8.63
18	0.93	1.626	8.37	0.99	7	0.14	-8.61
1							

EU BOTTOM TRAWL SURV III

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
4	0.98	0.059	7.98	0.58	8	0.71	-7.91
5	0.93	0.514	7.91	0.9	8	0.35	-7.69
6	0.87	0.798	8.06	0.87	8	0.43	-7.72
7	0.91	0.483	8.14	0.83	8	0.43	-7.97
8	1.33	-1.067	7.89	0.64	8	0.57	-8.27
9	1.49	-1.196	8.33	0.49	8	0.61	-8.54
10	1.18	-0.356	9.19	0.39	8	0.42	-9.09
11	0.78	1.278	9.02	0.85	8	0.27	-9.19
12	0.86	0.663	9.22	0.78	8	0.38	-9.42
13	0.9	0.927	9.35	0.93	8	0.25	-9.55
14	0.9	0.616	9.45	0.87	8	0.43	-9.7
15	1	0.013	10.04	0.83	8	0.58	-10.05
16	0.86	0.36	8.68	0.54	8	1.27	-9.08
17	1.73	-2.266	11.19	0.62	8	1.19	-8.57
18	1.23	-5.293	9.76	0.99	8	0.2	-8.67

Table 8: cont.

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 2004

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	108816	0.716	0	0	1	1	0.002

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
108816	0.72	0	1	0	0.002

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 2003

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	92497	0.41	0.176	0.43	2	1	0.007

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
92497	0.41	0.18	2	0.428	0.007

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	138271	0.32	0.273	0.85	3	1	0.014

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
138272	0.32	0.27	3	0.853	0.014

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	70911	0.27	0.201	0.75	4	1	0.023

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
70911	0.27	0.2	4	0.747	0.023

Age 8 Catchability constant w.r.t. time and dependent on age
Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	35126	0.239	0.223	0.93	5	1	0.049

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
35126	0.24	0.22	5	0.934	0.049

Table 8: cont.

Age 9 Catchability constant w.r.t. time and dependent on age
Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	21463	0.217	0.267	1.23	6	1	0.064

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
21463	0.22	0.27	6	1.234	0.064

Age 10 Catchability constant w.r.t. time and dependent on age
Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	8897	0.202	0.13	0.64	7	1	0.069

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
8897	0.2	0.13	7	0.645	0.069

Age 11 Catchability constant w.r.t. time and dependent on age
Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV I	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV II	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV III	3066	0.192	0.158	0.82	8	1	0.106

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
3066	0.19	0.16	8	0.822	0.106

Age 12 Catchability constant w.r.t. time and dependent on age
Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	1070	0.557	0	0	1	0.064	0.187
EU BOTTOM TRAWL SURV	2016	0.188	0.136	0.72	8	0.936	0.104

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
1936	0.18	0.13	9	0.749	0.108

Age 13 Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	1810	0.387	0.227	0.59	2	0.121	0.07
EU BOTTOM TRAWL SURV	1582	0.188	0.134	0.71	8	0.879	0.079

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
1608	0.17	0.11	10	0.667	0.078

Table 8: cont.

Age 14 Catchability constant w.r.t. time and dependent on age
Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	926	0.349	0.14	0.4	3	0.127	0.128
EU BOTTOM TRAWL SURV	1202	0.188	0.083	0.44	8	0.873	0.1

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
1163	0.17	0.07	11	0.436	0.103

Age 15 Catchability constant w.r.t. time and dependent on age
Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	927	0.287	0.287	1	4	0.158	0.076
EU BOTTOM TRAWL SURV	893	0.193	0.161	0.83	8	0.842	0.079

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
898	0.17	0.13	12	0.78	0.078

Age 16 Catchability constant w.r.t. time and dependent on age
Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	919	0.271	0.29	1.07	5	0.192	0.072
EU BOTTOM TRAWL SURV	599	0.199	0.15	0.75	8	0.808	0.108

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
650	0.17	0.14	13	0.799	0.1

Age 17 Catchability constant w.r.t. time and dependent on age
Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	38	0.258	0.172	0.67	6	0.138	1.088
EU BOTTOM TRAWL SURV	25	0.445	0.198	0.44	8	0.862	1.366

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
27	0.39	0.15	14	0.378	1.326

Age 18 Catchability constant w.r.t. time and age (fixed at the value for age) 17
Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1	0	0	0	0	0	0
EU BOTTOM TRAWL SURV	4639	0.255	0.166	0.65	7	0.2	0.053
EU BOTTOM TRAWL SURV	2280	0.215	0.265	1.23	8	0.8	0.105

Weighted prediction :

Survivors atendofyear	Int s.e	Ext s.e	N	Var Ratio	F
2628	0.18	0.19	15	1.062	0.091

Table 9: Correlation between EU survey and XSA's biomasses from "one survey" and "three surveys" XSA options

	SSB	XSA		4+ Biomass	XSA	
	EU survey	one survey	three surveys	EU survey	one survey	three surveys
1989	28014	53159	61361	112928	211669	223251
1990	22537	46520	52441	85996	181214	189237
1991	11584	36506	41092	66573	129847	135809
1992	16276	29133	31603	92382	95399	98491
1993	7273	18808	19036	44731	65791	65672
1994	6427	8725	8143	100301	41847	40043
1995	6521	7166	6384	70650	32020	29892
1996	6114	3631	3005	100562	21187	19148
1997	6253	3428	2658	82073	19289	16964
1998	3259	3912	3172	56030	20825	18326
1999	7582	4136	3488	80764	21164	18662
2000	18715	5223	4363	116234	25156	21922
2001	6181	5430	4652	50620	25184	21608
2002	6588	5994	4992	68752	29178	23696
2003	4394	5760	4661	34318	31439	25244
2004	7276	7253	5697	105776	46448	36068
2005	17077	7999	6205	208766	62397	47413
2006	13486	9257	6816	333461	99998	65471
2007	26110	11331	7957	279266	124442	77301
2008	27555	18869	12301	263611	164274	101777
	r^2	0.3826	0.3077	r^2	0.1634	0.0232

Table 10a: $XSA_{2009/2008}$ retrospective bias for "one survey" and "three surveys" framework options

$XSA_{2009/2008}$	4+ Biomass		SSB		FBAR		REC	
retro bias	one survey	three surveys	one survey	three surveys	one survey	three surveys	one survey	three surveys
1989	0.996	0.999	0.991	0.998	1.005	1.001	0.999	0.999
1990	0.996	0.999	0.991	0.998	1.004	1.001	1.000	0.999
1991	0.997	0.999	0.993	0.998	1.002	1.001	1.000	1.000
1992	0.996	0.999	0.991	0.998	1.003	1.001	0.999	0.999
1993	0.996	0.999	0.991	0.998	1.007	1.002	1.000	1.000
1994	0.950	0.950	0.985	0.995	1.005	1.003	0.860	0.851
1995	0.920	0.927	0.976	0.991	1.007	1.005	0.886	1.004
1996	0.868	0.875	0.962	0.969	1.013	1.014	0.848	0.914
1997	0.830	0.840	0.912	0.905	1.023	1.022	0.819	0.870
1998	0.814	0.825	0.865	0.850	1.021	1.022	0.864	0.906
1999	0.806	0.821	0.827	0.821	1.028	1.040	0.873	0.907
2000	0.810	0.826	0.821	0.819	1.053	1.053	0.929	0.951
2001	0.795	0.812	0.755	0.753	1.108	1.087	0.917	0.948
2002	0.784	0.802	0.723	0.718	1.088	1.071	0.816	0.877
2003	0.782	0.786	0.724	0.728	1.094	1.077	0.796	0.726
2004	0.759	0.761	0.721	0.717	1.146	1.115	0.703	0.718
2005	0.737	0.726	0.700	0.699	1.222	1.164	0.711	0.678
2006	0.734	0.721	0.700	0.690	1.366	1.285	0.742	0.740
2007	0.738	0.678	0.689	0.665	1.812	1.054	0.836	0.577

Table 10b: Number of iterations to convergence

$XSA_{terminal\ year}$	one survey	three surveys
2008	43	72
2007	47	394
2006	45	122
2005	52	168

Table 11: XSA results for 2009 assessment

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Terminal Fs derived using XSA (Without F shrinkage)

(Table 8) Fishing mortality (F) at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
4	0.0086	0.3	0.0563	0.0115	1.8049	0.5406	0.1415	0.1389	0.0539	0.0085
5	0.0157	0.0617	0.1436	0.3186	0.8212	0.3928	0.2185	0.242	0.0146	0.0052
6	0.0848	0.1022	0.1935	0.4056	0.278	0.2488	0.5939	0.0986	0.0521	0.0124
7	0.2132	0.4408	0.459	0.8635	0.3127	0.3248	0.4491	0.265	0.02	0.0287
8	0.3028	0.7703	0.6617	1.0328	0.5219	0.3569	0.5593	0.6236	0.0673	0.0199
9	0.2792	0.7438	0.6165	0.7613	0.2632	0.5512	0.3454	0.6717	0.2168	0.127
10	0.2437	0.6012	0.3868	0.5354	0.5533	0.5915	0.6326	0.3402	0.272	0.067
11	0.307	0.4549	0.3882	0.4227	0.7898	0.7404	0.8942	0.7105	0.1051	0.0851
12	0.279	0.3549	0.305	0.4448	0.8474	0.6975	0.7911	0.9848	0.3415	0.2214
13	0.3814	0.4155	0.3318	0.4329	0.9995	0.4945	0.7998	0.6174	0.2848	0.1102
14	0.3761	0.5758	0.3241	0.4494	1.0545	0.442	0.5964	0.8352	0.3366	0.2055
15	0.6068	0.4806	0.1919	0.5663	1.1238	0.5611	1.46	0.3218	0.1014	0.0456
16	0.6123	0.5998	0.2912	0.5352	0.9077	0.3524	1.2553	1.1704	0.0424	0.1556
17	0.527	0.9024	0.6044	0.314	1.1002	0.2876	0.672	0.5967	0.454	0.1197
18	0.8441	1.0388	1.106	0.7741	2.2674	0.7312	0.9961	0.3456	0.0691	0.0885
+gp	0.8441	1.0388	1.106	0.7741	2.2674	0.7312	0.9961	0.3456	0.0691	0.0885
0 FBAR 6-16	0.3351	0.5036	0.3772	0.5864	0.6956	0.4874	0.7616	0.6036	0.1673	0.098

(Table 8) Fishing mortality (F) at age

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	FBAR **-**
AGE											
4	0.0103	0.0056	0.0387	0.0308	0.0248	0.0098	0.0164	0.0057	0.0026	0.0015	0.0033
5	0.0037	0.0099	0.0236	0.019	0.0469	0.0688	0.013	0.0391	0.0025	0.004	0.0152
6	0.0016	0.0198	0.0333	0.0386	0.0168	0.073	0.0402	0.1117	0.0075	0.0069	0.0421
7	0.0089	0.043	0.0958	0.0555	0.0359	0.11	0.0495	0.1386	0.0676	0.0171	0.0744
8	0.0296	0.1552	0.1786	0.1201	0.0639	0.1089	0.1339	0.0986	0.0653	0.0329	0.0656
9	0.0188	0.2043	0.1725	0.1839	0.0975	0.0851	0.1963	0.1455	0.1055	0.0504	0.1005
10	0.1395	0.1612	0.1617	0.136	0.0978	0.079	0.1772	0.0977	0.0934	0.0386	0.0766
11	0.0941	0.3512	0.1604	0.1575	0.1173	0.0747	0.1894	0.0918	0.1936	0.0599	0.1151
12	0.1592	0.26	0.3143	0.1149	0.0956	0.0796	0.2742	0.0844	0.2383	0.0671	0.1299
13	0.2267	0.1264	0.256	0.4478	0.0946	0.0949	0.1798	0.0976	0.1558	0.0506	0.1013
14	0.1183	1.0506	0.1393	0.3611	0.5048	0.0894	0.168	0.1196	0.2195	0.0684	0.1358
15	0.4998	0.2585	0.2481	0.5467	0.1011	0.0666	0.1207	0.1253	0.2201	0.0619	0.1358
16	0.415	0.4294	0.3648	0.3186	0.732	0.5861	0.5459	0.1083	1.8153	0.0765	0.6667
17	0.4928	0.2806	0.3516	0.52	0.6971	0.7719	1.1369	1.0487	0.0953	0.4712	0.5384
18	0.253	0.4905	0.3643	0.2491	0.4257	0.3663	0.5931	0.399	1.856	0.0549	0.77
+gp	0.253	0.4905	0.3643	0.2491	0.4257	0.3663	0.5931	0.399	1.856	0.0549	
0 FBAR 6-16	0.1556	0.2782	0.1932	0.2255	0.1779	0.1316	0.1886	0.1108	0.2893	0.0482	

(Table 9) Relative F at age

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
4	0.0258	0.5956	0.1494	0.0196	2.5946	1.1092	0.1858	0.2302	0.3223	0.0869
5	0.0469	0.1226	0.3806	0.5433	1.1806	0.806	0.2869	0.401	0.0875	0.0534
6	0.2532	0.2029	0.5128	0.6917	0.3997	0.5105	0.7799	0.1633	0.3116	0.1266
7	0.6361	0.8752	1.2166	1.4727	0.4495	0.6665	0.5897	0.439	0.1193	0.2931
8	0.9036	1.5296	1.7541	1.7613	0.7502	0.7323	0.7344	1.0331	0.4022	0.2025
9	0.8332	1.4768	1.6343	1.2984	0.3784	1.131	0.4535	1.113	1.2959	1.2959
10	0.7273	1.1937	1.0254	0.9132	0.7954	1.2136	0.8307	0.5637	1.6261	0.6829
11	0.9161	0.9033	1.0289	0.7209	1.1353	1.5192	1.1742	1.1771	0.6285	0.8676
12	0.8325	0.7047	0.8086	0.7586	1.2182	1.4311	1.0389	1.6316	2.0417	2.2581
13	1.1382	0.825	0.8796	0.7383	1.4369	1.0147	1.0502	1.023	1.7026	1.1242
14	1.1223	1.1434	0.859	0.7665	1.5159	0.9068	0.7831	1.3838	2.0126	2.0963
15	1.8106	0.9543	0.5088	0.9657	1.6155	1.1513	1.9171	0.5332	0.6061	0.4654
16	1.8271	1.191	0.7718	0.9127	1.3048	0.7232	1.6484	1.9391	0.2535	1.5874
17	1.5726	1.7918	1.602	0.5356	1.5816	0.5901	0.8824	0.9887	2.7141	1.2209
18	2.5189	2.0627	2.9317	1.3201	3.2596	1.5003	1.308	0.5726	0.4134	0.9023
+gp	2.5189	2.0627	2.9317	1.3201	3.2596	1.5003	1.308	0.5726	0.4134	0.9023
0 REFMEAN	0.3351	0.5036	0.3772	0.5864	0.6956	0.4874	0.7616	0.6036	0.1673	0.098

Table 11: XSA results for 2009 assessment (cont)

(Table 9) Relative F at age (cont)

YEAR / AGE	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	MEAN **-**
4	0.0664	0.02	0.2002	0.1364	0.1393	0.0742	0.0868	0.0518	0.009	0.031	0.0306
5	0.024	0.0357	0.1224	0.0843	0.2635	0.5231	0.0691	0.3526	0.0085	0.0832	0.1481
6	0.0101	0.0713	0.1725	0.1713	0.0944	0.5546	0.213	1.0081	0.0261	0.144	0.3927
7	0.0572	0.1546	0.4959	0.2462	0.2017	0.8363	0.2622	1.2508	0.2336	0.3545	0.613
8	0.1902	0.5581	0.9245	0.5327	0.3589	0.8275	0.7099	0.8894	0.2256	0.6819	0.599
9	0.1208	0.7344	0.893	0.8155	0.548	0.6467	1.0408	1.3128	0.3647	1.0463	0.9079
10	0.8965	0.5795	0.8372	0.6029	0.5497	0.6002	0.9393	0.8817	0.323	0.7999	0.6682
11	0.605	1.2626	0.8306	0.6983	0.659	0.5676	1.0039	0.8285	0.6692	1.2426	0.9134
12	1.0231	0.9347	1.6269	0.5094	0.5373	0.6047	1.4534	0.7618	0.8239	1.3917	0.9925
13	1.4573	0.4546	1.3252	1.9855	0.5315	0.7215	0.953	0.8803	0.5387	1.0494	0.8228
14	0.7605	3.7769	0.7214	1.6014	2.8373	0.6793	0.8907	1.0789	0.7588	1.4186	1.0854
15	3.2122	0.9294	1.2842	2.424	0.5681	0.5063	0.64	1.1309	0.7609	1.284	1.0586
16	2.6672	1.5439	1.8887	1.4128	4.1139	4.4552	2.8938	0.9768	6.2755	1.5871	2.9465
17	3.1674	1.0088	1.82	2.3056	3.918	5.8676	6.0268	9.4626	0.3294	9.774	6.522
18	1.6263	1.7634	1.8861	1.1048	2.3927	2.7847	3.1444	3.6001	6.4162	1.1391	3.7185
+gp	1.6263	1.7634	1.8861	1.1048	2.3927	2.7847	3.1444	3.6001	6.4162	1.1391	
0 REFMEAN	0.1556	0.2782	0.1932	0.2255	0.1779	0.1316	0.1886	0.1108	0.2893	0.0482	

(Table 10) Stock number at age (start of year) Numbers*10**-3

YEAR / AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
4	54270	42114	23582	21851	139380	135445	22076	13226	13861	13508
5	71206	48683	28231	20169	19546	20746	71376	17340	10415	11883
6	101969	63424	41412	22128	13271	7780	12673	51909	12317	9287
7	125832	84760	51814	30880	13346	9093	5489	6332	42561	10579
8	96791	92000	49355	29627	11782	8833	5946	3170	4396	37749
9	62603	64700	38531	23041	9544	6326	5594	3075	1538	3719
10	47224	42845	27826	18820	9737	6637	3299	3583	1421	1120
11	34965	33488	21251	17101	9969	5067	3324	1585	2307	980
12	26830	23274	19226	13043	10140	4095	2186	1230	705	1879
13	21104	18367	14768	12823	7564	3931	1845	897	416	453
14	19730	13040	10969	9589	7526	2519	2170	750	438	283
15	12015	12257	6634	7178	5535	2372	1465	1081	294	283
16	6807	5927	6858	4954	3687	1628	1225	308	709	241
17	5446	3339	2944	4638	2625	1346	1036	316	86	615
18	3631	2909	1225	1455	3066	790	913	479	157	50
+gp	9158	7357	5144	3352	1744	1110	2048	1036	1195	645
0 TOTAL	699583	558484	349771	240651	268463	217720	142664	106318	92815	93274

(Table 10) Stock number at age (start of year) Numbers*10**-3

YEAR / AGE	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	GMST 89-**	AMST 89-**
4	15438	16849	22950	50900	73499	109699	157534	392215	189271	160449	0	42249	73244
5	12119	13825	15161	19979	44661	64876	98296	140227	352859	170812	144965	29269	40485
6	10696	10925	12386	13398	17737	38560	54799	87790	122020	318492	153940	22874	32359
7	8299	9663	9691	10840	11663	15782	32435	47631	71038	109578	286191	18693	29261
8	9301	7443	8376	7968	9279	10181	12792	27932	37519	60078	97471	14344	24051
9	33486	8170	5766	6339	6393	7876	8262	10124	22902	31804	52604	9941	16949
10	2963	29735	6027	4391	4772	5248	6545	6143	7920	18648	27362	7245	12686
11	948	2332	22900	4639	3468	3916	4388	4961	5041	6527	16235	5446	9866
12	814	781	1485	17649	3586	2791	3288	3285	4095	3759	5563	3891	7572
13	1363	628	545	982	14236	2949	2332	2262	2732	2920	3180	2726	5970
14	367	983	501	381	568	11719	2427	1763	1856	2115	2511	1972	4762
15	208	295	311	394	241	310	9697	1856	1415	1349	1787	1307	3468
16	245	114	206	220	207	197	262	7777	1482	1028	1147	852	2309
17	186	146	67	130	145	90	99	138	6315	218	861	453	1299
18	494	103	100	43	70	65	38	29	44	5194	123	286	868
+gp	689	1506	209	257	803	1168	147	366	393	5445	9113		
0 TOTAL	97617	103500	106681	138508	191327	275426	393342	734499	826903	898416	803056		

(Table 11) Spawning stock number at age (spawning time) Numbers*10**-3

YEAR / AGE	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
4	16	12	7	6	35	38	6	4	4	4
5	282	192	111	78	73	80	278	67	41	47
6	2512	1560	1011	531	322	189	300	1277	304	230
7	10554	6981	4261	2459	1110	756	452	529	3625	900
8	14996	13730	7430	4330	1794	1363	902	479	694	5982
9	13179	13123	7895	4667	2012	1303	1171	627	325	792
10	11072	9762	6450	4311	2227	1514	750	834	333	266
11	12353	11692	7460	5986	3389	1729	1121	542	828	352
12	11401	9830	8153	5469	4117	1683	892	494	298	802
13	9036	7843	6349	5468	3083	1668	764	377	179	198
14	9496	6177	5301	4588	3431	1206	1026	348	211	138
15	6132	6318	3500	3675	2710	1215	698	565	156	151
16	4045	3525	4181	2962	2139	988	691	175	441	148
17	3279	1951	1761	2840	1510	826	616	189	52	383
18	2178	1718	720	878	1641	479	541	299	100	32
+gp	6318	4997	3475	2326	1074	772	1396	744	877	473

Table 11: XSA results for 2009 assessment (cont.)

(Table 11) Spawning stock number at age (spawning time) Numbers*10**-3

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
4	5	5	7	15	22	32	46	115	56	47
5	48	55	60	79	177	256	390	555	1400	678
6	265	271	306	331	439	951	1355	2158	3024	7894
7	708	822	820	921	992	1335	2756	4019	6028	9336
8	1473	1167	1311	1253	1465	1602	2009	4399	5924	9511
9	7198	1730	1224	1345	1366	1684	1751	2154	4889	6819
10	701	7018	1422	1038	1132	1247	1543	1457	1879	4445
11	341	821	8186	1659	1244	1409	1565	1783	1797	2352
12	349	332	629	7598	1546	1205	1398	1418	1746	1624
13	591	275	236	418	6237	1292	1015	991	1191	1284
14	181	448	246	184	270	5771	1188	866	905	1043
15	107	155	163	202	128	165	5145	984	745	719
16	148	69	125	134	122	117	157	4811	800	637
17	113	90	41	78	86	53	57	79	3935	132
18	311	64	62	27	43	41	23	18	24	3319
+gp	499	1069	150	186	573	837	104	262	250	4001

(Table 12) Stock biomass at age (start of year) Tonnes

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
4	5427	4085	2570	2098	9199	12190	2252	1045	1247	1202
5	11678	8325	3811	3449	3049	2697	8065	2393	1323	1640
6	20904	13446	8862	4603	2813	1758	2750	7319	2340	1681
7	31206	22122	14301	9017	3830	2510	1581	1710	7406	2423
8	27489	27508	16633	10488	4301	3074	2123	1040	1560	8380
9	19845	21416	14834	9124	3770	2499	2265	1181	624	1380
10	16481	15467	12939	8507	4226	3080	1504	1587	662	473
11	15070	14835	10944	8978	5114	2498	1709	761	1165	480
12	13710	12196	10940	7448	5617	2170	1194	656	404	1034
13	11881	10690	9097	8143	4720	2158	1166	520	253	283
14	11562	7850	7119	6520	5170	1695	1523	450	272	194
15	7582	7991	4644	5053	3952	1563	1064	702	201	202
16	4377	3959	5343	3998	3211	1171	994	215	529	195
17	3845	2441	2249	3567	2239	1098	851	239	68	512
18	2553	2115	973	1279	2658	673	794	380	119	36
+gp	8059	6768	4588	3128	1920	1012	2185	991	1115	711
0 TOTALBIO	211669	181214	129847	95399	65791	41847	32020	21187	19289	20825

(Table 12) Stock biomass at age (start of year) Tonnes

YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AGE										
4	1343	1634	1951	5141	5586	10312	14493	34907	20252	15403
5	1466	1825	2123	2637	4868	7785	11697	16126	41637	21693
6	1883	1901	2217	2465	2856	6285	9097	14046	16473	52870
7	1851	2261	2306	2461	2531	3488	6941	10479	14492	23998
8	2418	2121	2488	2247	2450	2830	3492	7598	9417	16822
9	8237	2688	1891	2048	2052	2702	2801	3523	7237	10654
10	957	8831	2314	1712	1694	1984	2481	2556	3176	7161
11	448	975	7786	1893	1432	1739	2014	2218	2334	2839
12	459	412	766	7024	1657	1390	1582	1462	2166	1729
13	699	420	326	551	4997	1631	1077	1158	1505	1358
14	203	554	332	227	317	4992	1434	978	1017	1102
15	113	147	208	248	140	197	4868	1140	752	819
16	135	77	127	158	132	135	186	3406	597	668
17	120	105	52	83	74	49	72	79	3132	138
18	304	74	85	38	48	49	34	25	33	2452
+gp	528	1130	211	244	606	882	128	297	221	4569
0 TOTALBIO	21164	25156	25184	29178	31439	46448	62397	99998	124442	164274

(Table 13) Spawning stock biomass at age (spawning time) Tonnes

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
AGE										
4	2	1	1	1	2	3	1	0	0	0
5	46	33	15	13	11	10	31	9	5	7
6	515	331	216	111	68	43	65	180	58	42
7	2617	1822	1176	718	319	209	130	143	631	206
8	4259	4105	2504	1533	655	474	322	157	246	1328
9	4178	4344	3040	1848	795	515	474	241	132	294
10	3864	3524	2999	1948	967	702	342	369	155	112
11	5324	5180	3842	3143	1738	852	576	260	418	173
12	5826	5151	4639	3123	2281	892	487	263	171	441
13	5087	4565	3911	3472	1924	916	483	219	109	124
14	5565	3718	3441	3120	2357	812	720	209	131	95
15	3869	4119	2450	2587	1935	801	507	366	107	108
16	2601	2355	3257	2390	1863	710	561	122	329	120
17	2315	1426	1346	2184	1288	674	507	143	41	318
18	1531	1249	572	772	1423	408	470	237	76	23
+gp	5560	4597	3100	2170	1182	704	1489	711	818	521
0 TOTSPBIO	53159	46520	36506	29133	18808	8725	7166	3631	3428	3912

Table 11: XSA results for 2009 assessment (cont.)

(Table 13) Spawning stock biomass at age (spawning time) Tonnes

	YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	AGE										
	4	0	0	1	2	2	3	4	10	6	5
	5	6	7	8	10	19	31	46	64	165	86
	6	47	47	55	61	71	155	225	345	408	1310
	7	158	192	195	209	215	295	590	884	1230	2045
	8	383	333	389	353	387	445	548	1196	1487	2663
	9	1771	569	402	434	438	578	594	750	1545	2284
	10	226	2084	546	405	402	471	585	606	754	1707
	11	161	343	2783	677	514	626	718	797	832	1023
	12	197	175	325	3024	714	600	672	631	923	747
	13	303	183	141	235	2189	714	469	507	656	597
	14	100	253	163	109	151	2459	702	481	496	544
	15	58	77	109	127	75	105	2583	604	396	436
	16	81	46	77	96	78	80	111	2107	322	414
	17	72	64	32	50	44	29	41	46	1952	84
	18	191	46	53	24	30	31	21	16	18	1567
	+gp	382	802	152	177	432	632	90	212	141	3357
0	TOTSPBIO	4136	5223	5430	5994	5760	7253	7999	9257	11331	18869

(Table 16) Summary (without SOP correction)

	RECRUITS Age 4	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 6-16	ABUNDANCE
1989	54270	211669	53159	58086	1.0927	0.3351	699583
1990	42114	181214	46520	80223	1.7245	0.5036	558484
1991	23582	129847	36506	48500	1.3285	0.3772	349771
1992	21851	95399	29133	43300	1.4863	0.5864	240651
1993	139380	65791	18808	43100	2.2916	0.6956	268463
1994	135445	41847	8725	17664	2.0245	0.4874	217720
1995	22076	32020	7166	13879	1.9368	0.7616	142664
1996	13226	21187	3631	6101	1.6805	0.6036	106318
1997	13861	19289	3428	1408	0.4107	0.1673	92815
1998	13508	20825	3912	1011	0.2584	0.098	93274
1999	15438	21164	4136	1095	0.2647	0.1556	97617
2000	16849	25156	5223	3665	0.7017	0.2782	103500
2001	22950	25184	5430	3327	0.6127	0.1932	106681
2002	50900	29178	5994	2976	0.4965	0.2255	138508
2003	73499	31439	5760	2273	0.3946	0.1779	191327
2004	109699	46448	7253	3260	0.4494	0.1316	275426
2005	157534	62397	7999	4334	0.5418	0.1886	393342
2006	392215	99998	9257	6228	0.6728	0.1108	734499
2007	189271	124442	11331	5452	0.4812	0.2893	826903
2008	160449	164274	18869	3166	0.1678	0.0482	898416

Table 12a: XSA retrospective analysis, 2009-2006

Biomass	**XSA**			
Year	2009	2008	2007	2006
1989	212	212	210	211
1990	181	182	180	180
1991	130	130	129	129
1992	95	96	95	95
1993	66	66	65	65
1994	42	44	44	46
1995	32	35	35	37
1996	21	24	25	28
1997	19	23	24	28
1998	21	26	27	31
1999	21	26	28	33
2000	25	31	33	39
2001	25	32	34	41
2002	29	37	41	50
2003	31	40	44	53
2004	46	61	62	70
2005	62	85	86	92
2006	100	136	**149**	
2007	124	**169**		
2008	**164**			

SBB	**XSA**			
Year	2009	2008	2007	2006
1989	53	54	52	52
1990	47	47	46	46
1991	37	37	36	36
1992	29	29	29	29
1993	19	19	18	18
1994	9	9	9	9
1995	7	7	7	7
1996	4	4	4	4
1997	3	4	4	4
1998	4	5	5	5
1999	4	5	5	6
2000	5	6	7	8
2001	5	7	8	9
2002	6	8	9	11
2003	6	8	9	11
2004	7	10	11	14
2005	8	11	13	16
2006	9	13	**15**	
2007	11	**16**		
2008	**19**			

Fbar	**XSA**			
Year	2009	2008	2007	2006
1989	0.34	0.33	0.34	0.34
1990	0.50	0.50	0.51	0.51
1991	0.38	0.38	0.38	0.38
1992	0.59	0.58	0.59	0.59
1993	0.70	0.69	0.70	0.70
1994	0.49	0.49	0.49	0.49
1995	0.76	0.76	0.77	0.77
1996	0.60	0.60	0.61	0.61
1997	0.17	0.16	0.17	0.17
1998	0.10	0.10	0.10	0.10
1999	0.16	0.15	0.16	0.16
2000	0.28	0.26	0.27	0.27
2001	0.19	0.17	0.18	0.17
2002	0.23	0.21	0.21	0.20
2003	0.18	0.16	0.16	0.17
2004	0.13	0.11	0.11	0.11
2005	0.19	0.15	0.14	0.16
2006	0.11	0.08	0.08	
2007	0.29	0.16		
2008	0.05			

REC	**XSA**			
Year	2009	2008	2007	2006
1989	54	54	54	54
1990	42	42	42	42
1991	24	24	24	24
1992	22	22	22	22
1993	139	139	139	139
1994	135	158	168	186
1995	22	25	23	25
1996	13	16	17	20
1997	14	17	18	22
1998	14	16	17	20
1999	15	18	19	22
2000	17	18	17	20
2001	23	25	29	35
2002	51	62	71	95
2003	73	92	103	104
2004	110	156	115	84
2005	158	221	222	198
2006	392	529	662	
2007	189	226		
2008	160			

Table 12b: XSA 2009/2008 ratios

Year	**Biomass**	**SSB**	**FBAR**	**REC**
1989	1.00	0.99	1.00	1.00
1990	1.00	0.99	1.00	1.00
1991	1.00	0.99	1.00	1.00
1992	1.00	0.99	1.00	1.00
1993	1.00	0.99	1.01	1.00
1994	0.95	0.99	1.00	0.86
1995	0.92	0.98	1.01	0.89
1996	0.87	0.96	1.01	0.85
1997	0.83	0.91	1.02	0.82
1998	0.81	0.86	1.02	0.86
1999	0.81	0.83	1.03	0.87
2000	0.81	0.82	1.05	0.93
2001	0.80	0.76	1.11	0.92
2002	0.78	0.72	1.09	0.82
2003	0.78	0.72	1.09	0.80
2004	0.76	0.72	1.15	0.70
2005	0.74	0.70	1.22	0.71
2006	0.73	0.70	1.37	0.74
2007	0.74	0.69	1.81	0.84

Tab 13a: N@age average retrospective ratios by cohort, XSA_{2009}/XSA_{2008}

XSA$_{2009/2008}$ N@age ratios	Age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Year 1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.97	0.96
1990	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.99	0.96
1991	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97
1992	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.96
1993	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.98
1994	0.86	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.98	0.96	0.94
1995	0.89	0.78	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99	1.00	0.99	0.97	0.95
1996	0.85	0.87	0.74	1.00	1.00	1.00	1.00	0.99	1.00	0.98	0.99	0.98	0.99	0.97	0.95
1997	0.82	0.83	0.84	0.72	1.00	1.00	1.00	1.00	0.98	0.99	0.97	0.99	0.97	0.98	0.94
1998	0.86	0.81	0.83	0.83	0.72	1.00	0.99	0.99	1.00	0.97	0.99	0.96	0.99	0.97	0.98
1999	0.87	0.86	0.81	0.83	0.83	0.71	1.00	0.99	0.99	1.00	0.97	0.99	0.96	0.98	0.97
2000	0.93	0.87	0.86	0.81	0.82	0.83	0.71	1.00	0.99	0.99	1.00	0.97	0.97	0.94	0.98
2001	0.92	0.93	0.87	0.86	0.80	0.80	0.79	0.68	1.00	0.99	0.99	1.00	0.96	0.96	0.93
2002	0.82	0.91	0.93	0.87	0.85	0.77	0.77	0.77	0.64	1.00	0.99	0.99	1.00	0.94	0.96
2003	0.80	0.81	0.91	0.92	0.86	0.83	0.74	0.75	0.74	0.61	1.00	0.99	0.99	0.99	0.91
2004	0.70	0.79	0.80	0.91	0.92	0.85	0.82	0.72	0.72	0.72	0.59	1.00	0.99	0.98	0.98
2005	0.71	0.70	0.78	0.79	0.90	0.91	0.84	0.81	0.70	0.71	0.70	0.57	1.00	0.97	0.95
2006	0.74	0.71	0.70	0.77	0.78	0.89	0.90	0.82	0.77	0.64	0.67	0.66	0.54	1.00	0.94
2007	0.84	0.74	0.70	0.67	0.75	0.77	0.87	0.89	0.80	0.76	0.62	0.64	0.63	0.51	1.00
2008		0.84	0.74	0.70	0.66	0.74	0.75	0.86	0.87	0.76	0.73	0.57	0.59	*0.22*	0.49

Cohort	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990
av retro bias$_{2009/2008}$		0.84	0.74	0.70	0.69	0.77	0.79	0.90	0.91	0.84	0.82	0.74	0.75	0.78	0.66
CV		0.03%	0.11%	0.90%	2.83%	3.14%	3.15%	2.24%	2.42%	4.40%	5.74%	11.58%	10.98%	10.38%	16.03%

Tab 13b: F@age average retrospective ratios by cohort, XSA$_{2009}$/XSA$_{2008}$

XSA$_{2009/2008}$ F@age ratios	Age 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Year 1989	1.000	1.000	1.000	1.000	1.001	1.000	1.000	1.002	1.004	1.004	1.005	1.010	1.009	1.034	1.058
1990	1.000	1.000	1.000	1.000	1.000	1.001	1.000	1.001	1.003	1.006	1.007	1.007	1.019	1.020	1.076
1991	1.000	1.000	1.001	1.000	1.001	1.000	1.002	1.000	1.001	1.003	1.008	1.010	1.010	1.035	1.056
1992	1.000	1.001	1.000	1.001	1.000	1.001	1.000	1.002	1.000	1.002	1.005	1.013	1.015	1.014	1.070
1993	1.000	1.001	1.001	1.000	1.002	1.000	1.003	1.001	1.005	1.001	1.003	1.012	1.028	1.035	1.060
1994	1.215	1.000	1.001	1.001	1.000	1.004	1.001	1.005	1.002	1.009	1.001	1.007	1.024	1.049	1.084
1995	1.138	1.312	1.000	1.002	1.001	1.001	1.007	1.002	1.011	1.003	1.016	1.004	1.019	1.040	1.095
1996	1.192	1.167	1.366	1.000	1.003	1.003	1.001	1.013	1.005	1.022	1.007	1.025	1.013	1.045	1.066
1997	1.228	1.207	1.192	1.389	1.001	1.005	1.004	1.001	1.022	1.009	1.035	1.012	1.029	1.027	1.061
1998	1.149	1.238	1.204	1.201	1.401	1.000	1.006	1.006	1.001	1.028	1.012	1.041	1.013	1.033	1.036
1999	1.144	1.156	1.231	1.219	1.208	1.403	1.001	1.005	1.006	1.001	1.030	1.017	1.053	1.018	1.039
2000	1.077	1.138	1.158	1.239	1.231	1.234	1.442	1.001	1.007	1.006	1.002	1.037	1.027	1.075	1.029
2001	1.093	1.073	1.152	1.171	1.269	1.272	1.280	1.518	1.001	1.009	1.007	1.005	1.051	1.040	1.104
2002	1.232	1.092	1.078	1.156	1.190	1.322	1.318	1.328	1.596	1.001	1.012	1.011	1.006	1.080	1.053
2003	1.259	1.237	1.098	1.085	1.168	1.213	1.372	1.361	1.372	1.660	1.002	1.016	1.020	1.010	1.129
2004	1.420	1.272	1.254	1.102	1.089	1.180	1.232	1.404	1.399	1.410	1.726	1.003	1.022	1.043	1.017
2005	1.414	1.429	1.288	1.269	1.116	1.103	1.205	1.265	1.482	1.454	1.467	1.804	1.004	1.054	1.084
2006	1.326	1.422	1.456	1.315	1.291	1.133	1.119	1.236	1.302	1.582	1.527	1.541	1.903	1.008	1.112
2007	1.182	1.389	1.415	1.499	1.349	1.320	1.150	1.139	1.278	1.342	1.679	1.623	2.396	1.998	1.038

Cohort	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989
av retro bias$_{2009/2008}$	1.1818	1.3572	1.4169	1.4510	1.2966	1.2673	1.1121	1.0954	1.1842	1.2179	1.3679	1.3339	1.2949	1.5523	1.0040
CV		3.30%	0.30%	2.44%	2.78%	2.66%	2.77%	2.13%	3.96%	4.19%	11.35%	9.65%	9.53%	15.16%	0.96%

Tab 13c: Computation of expected retro bias by cohort between the survivors from the XSA_{2009} and the N@age at the beginning of 2009 from the next XSA_{2010}

$XSA_{2009/2008}$ N@age log ratios	Cohort												
Year	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
1995													-0.12
1996												-0.17	-0.14
1997											-0.20	-0.19	-0.17
1998										-0.15	-0.21	-0.19	-0.18
1999									-0.14	-0.15	-0.21	-0.19	-0.19
2000								-0.07	-0.14	-0.15	-0.21	-0.19	-0.19
2001							-0.09	-0.07	-0.14	-0.15	-0.22	-0.22	-0.23
2002						-0.20	-0.09	-0.08	-0.14	-0.16	-0.26	-0.26	-0.27
2003					-0.23	-0.21	-0.09	-0.08	-0.15	-0.18	-0.30	-0.29	-0.30
2004				-0.35	-0.23	-0.22	-0.09	-0.08	-0.16	-0.20	-0.33	-0.32	-0.33
2005			-0.34	-0.35	-0.25	-0.23	-0.10	-0.09	-0.17	-0.22	-0.35	-0.35	-0.36
2006		-0.30	-0.35	-0.36	-0.26	-0.24	-0.12	-0.11	-0.20	-0.26	-0.44	-0.40	-0.41
2007	-0.18	-0.30	-0.36	-0.39	-0.29	-0.27	-0.13	-0.12	-0.22	-0.28	-0.48	-0.44	-0.45
2008	-0.18	-0.30	-0.36	-0.42	-0.31	-0.29	-0.15	-0.14	-0.27	-0.31	-0.56	-0.53	-1.51
2009	-0.18	-0.30	-0.37	-0.43	-0.32	-0.29	-0.15	-0.13	-0.25	-0.30	-0.52	-0.48	-0.47
age 4	-0.18	-0.30	-0.34	-0.34	-0.22	-0.19	-0.08	-0.06	-0.11	-0.12	-0.14	-0.12	-0.10
age 5	-0.18	-0.30	-0.35	-0.36	-0.24	-0.21	-0.09	-0.07	-0.13	-0.13	-0.17	-0.15	-0.12
r^2	*1.00*	*0.95*	*0.94*	*0.86*	*0.94*	*0.95*	*0.89*	*0.83*	*0.82*	*0.90*	*0.88*	*0.91*	*0.95*
Age in 2009	6	7	8	9	10	11	12	13	14	15	16	17	18
Cohort	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
retro bias beginning 2009	**0.84**	**0.74**	**0.69**	**0.65**	**0.73**	**0.74**	**0.86**	**0.87**	**0.78**	**0.74**	**0.59**	**0.62**	**0.62**
retro bias at age 4	**0.84**	**0.74**	**0.71**	**0.71**	**0.80**	**0.82**	**0.93**	**0.94**	**0.89**	**0.89**	**0.87**	**0.89**	**0.91**
retro bias at age 5	**0.84**	**0.74**	**0.71**	**0.70**	**0.79**	**0.81**	**0.92**	**0.93**	**0.88**	**0.88**	**0.84**	**0.86**	**0.88**
Av retro $bias_{age\ 4}$	0.84												
Av retro $bias_{age\ 5}$	0.83												

expected log retro bias

Tab 13d: Computation of expected retro bias by cohort between the last year F@age from the XSA_{2009} and the same F's from the next XSA_{2010}

$XSA_{2009/2008}$ F@age log ratios	Cohort												
Year	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
1995													0.130
1996												0.176	0.154
1997											0.205	0.188	0.176
1998										0.139	0.214	0.186	0.183
1999	expected log retro bias								0.135	0.145	0.208	0.198	0.189
2000								0.074	0.129	0.147	0.214	0.208	0.210
2001							0.089	0.070	0.142	0.158	0.239	0.241	0.247
2002						0.209	0.088	0.075	0.145	0.174	0.279	0.276	0.284
2003					0.230	0.213	0.094	0.081	0.155	0.193	0.316	0.308	0.316
2004				0.351	0.240	0.227	0.097	0.085	0.166	0.209	0.339	0.336	0.344
2005			0.346	0.357	0.253	0.238	0.110	0.098	0.187	0.235	0.394	0.374	0.383
2006		0.282	0.352	0.376	0.274	0.255	0.125	0.113	0.212	0.264	0.459	0.424	0.433
2007	0.167	0.329	0.347	0.405	0.299	0.278	0.140	0.130	0.245	0.294	0.518	0.484	0.874
2008													
2009	0.1671	0.4218	0.3498	0.4353	0.3283	0.2989	0.1494	0.1352	0.2483	0.3080	0.5260	0.4892	0.4786
age 4	0.1671	0.2819	0.3480	0.3449	0.2251	0.2020	0.0801	0.0627	0.1152	0.1181	0.1517	0.1320	0.1351
age 5	0.1671	0.3285	0.3485	0.3630	0.2423	0.2159	0.0887	0.0708	0.1285	0.1354	0.1829	0.1595	0.1616
r2		*1.0000*	*0.0229*	*0.9248*	*0.9654*	*0.9604*	*0.8878*	*0.8691*	*0.8736*	*0.9367*	*0.8973*	*0.9248*	*0.9581*
Age in 2009	6	7	8	9	10	11	12	13	14	15	16	17	18
Cohort	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
retro bias beginning 2009	**1.18**	**1.52**	**1.42**	**1.55**	**1.39**	**1.35**	**1.16**	**1.14**	**1.28**	**1.36**	**1.69**	**1.63**	**1.61**
retro bias at age 4	**1.18**	**1.33**	**1.42**	**1.41**	**1.25**	**1.22**	**1.08**	**1.06**	**1.12**	**1.13**	**1.16**	**1.14**	**1.14**
retro bias at age 5	**1.18**	**1.39**	**1.42**	**1.44**	**1.27**	**1.24**	**1.09**	**1.07**	**1.14**	**1.14**	**1.20**	**1.17**	**1.18**
Av retro $bias_{age\ 4}$	1.20												
Av retro $bias_{age\ 5}$	1.23												

Table 14a: Recruitment for the Mterm projections (XSA_{2009} or bias $corrected_{2009/2008}$)

XSA_{2009}

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		
COHORT	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
$N@age_4$	22076	13226	13861	13508	15438	16849	22950	50900	73499	109699	157534	392215	189271	160449	89391	$AVERAGE_{1995-2008}$
below av log residuals	0.002	-0.510	-0.463	-0.489	-0.355	-0.268	0.041	0.838	1.205						22027	$GEOMEAN_{1995-2003}$

Bias $corrected_{2009/2008}$

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008		
COHORT	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004		
Expected retro bias at age 4	0.908	0.887	0.869	0.890	0.894	0.941	0.926	0.823	0.802	0.711	0.711	0.742	0.836			
bias corrected $N@age_4$	20044	11728	12048	12021	13799	15858	21249	41898	58980							
below av log residuals	0.032	-0.504	-0.477	-0.479	-0.341	-0.202	0.090	0.769	1.111						19411	$GEOMEAN_{1995-2003}$

Table 14b: Survivors for the Mterm projections starting on 2009 (XSA_{2009} or bias $corrected_{2009/2008}$).

(same CV's on both 2009 options)

XSA_{2009}

Cohort	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	>1991
Age	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19
N@age $surv_{2009}$	22027	144965	153940	286191	97471	52604	27362	16235	5563	3180	2511	1787	1147	861	123	9113
CV's	0.83	0.38	0.41	0.32	0.34	0.33	0.25	0.22	0.20	0.18	0.18	0.20	0.22	0.29	0.21	0.21

Bellow average recruitment geo mean, 1995-2003

av. int and ext st. errors 2009 XSA

Bias $corrected_{2009/2008}$

Cohort	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	>1991
Age	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19+
ret $Nbias_{@age,\ 2009}$		0.829	0.836	0.740	0.692	0.654	0.727	0.745	0.864	0.875	0.781	0.740	0.594	0.616	0.625	0.625
bias corected N@age $surv_{2009}$	19411	120212	128649	211661	67498	34378	19899	12089	4805	2781	1961	1323	682	530	77	5691

bias corrected $N@age_{4,1995-2003}$ geo

cohorts older than 1991 have a constant retro bias given by the bias of the 1991 cohort

Table 14c: Average F@age2006-2008 used in the the Mterm projections starting on 2007, 2008 and 2009 (XSA or bias corrected)

(same CV's on both options)

XSA_{2009}

Cohort	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	>1991
Age	sH4	sH5	sH6	sH7	sH8	sH9	sH10	sH11	sH12	sH13	sH14	sH15	sH16	sH17	sH18	sH19
XSA 2009 av $F@age_{2006-2008}$	0.0033	0.0152	0.0420	0.0744	0.0656	0.1005	0.0766	0.1151	0.1299	0.1013	0.1358	0.1358	0.6667	0.5384	0.7700	0.7700
CV's	0.0022	0.0207	0.0603	0.0610	0.0329	0.0477	0.0330	0.0698	0.0942	0.0527	0.0768	0.0796	0.9948	0.4802	0.9561	0.9561

Bias $corrected_{2009/2008}$

Cohort	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	>1991
Age	sH4	sH5	sH6	sH7	sH8	sH9	sH10	sH11	sH12	sH13	sH14	sH15	sH16	sH17	sH18	sH19
ret $Fbias_{@age2009/2008}$	1.20	1.23	1.18	1.52	1.42	1.55	1.39	1.35	1.16	1.14	1.28	1.36	1.69	1.63	1.61	1.61
bias corected $F@age_{2006-2008}$	0.0039	0.0186	0.0497	0.1135	0.0931	0.1553	0.1063	0.1552	0.1509	0.1160	0.1741	0.1847	1.1282	0.8782	1.2425	1.2425

$=F@age_{2006-2008}$ x ret $Fbias@age_{2009/2008}$

av ret Fbias@age 4 and 5

cohorts older than 1991 have a constant F retro bias given by the bias of the 1991 cohort

Table 15a: Mterm SSB sequential projections (50%Percentil profiles)

Year	XSA_{2007}	XSA_{2008}	XSA_{2009}	$XSA_{2009biascorrected}$
2007	20552			
2008	25959	26176		
2009	35637	34215	28800	20366
2010	47511	45874	36025	24864
2011	56515	57247	45013	30771
2012	61360	65374	52422	35146
2013	72624	74616	60829	39818
2014	71549	77818	63548	40602
2015	64822	72106	62126	39091
2016	60949	66910	58451	35942

Table 15b: Mterm yield sequential projections (5%Percentil profiles)

Year	XSA_{2007}	XSA_{2008}	XSA_{2009}	$XSA_{2009biascorrected}$
2010	12870	14762	13170	12275
2011	13747	15680	14141	13366
2012	12728	15603	13636	12254
2013	14309	15947	14523	12674
2014	14399	16607	14453	11688
2015	13913	15593	14247	11272
2016	14137	16044	14445	10939

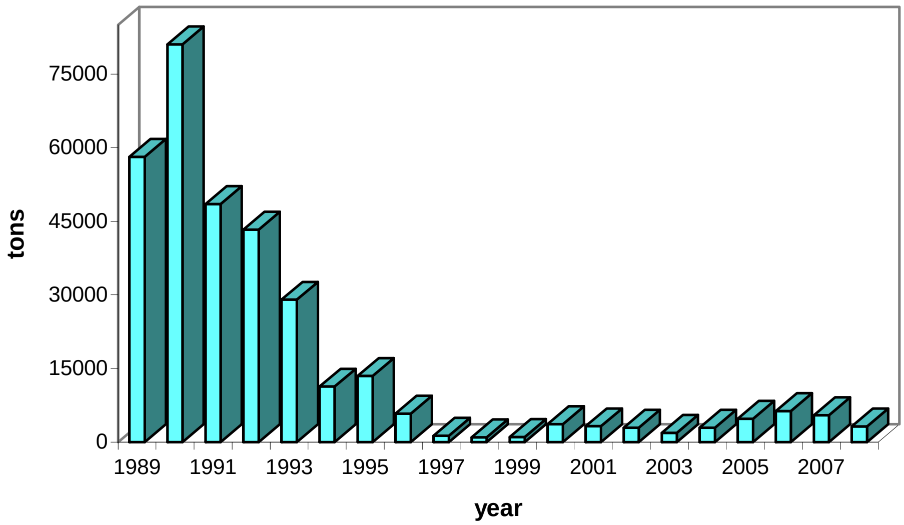

Fig. 1a: STACFIS estimates of beaked redfish commercial catch.

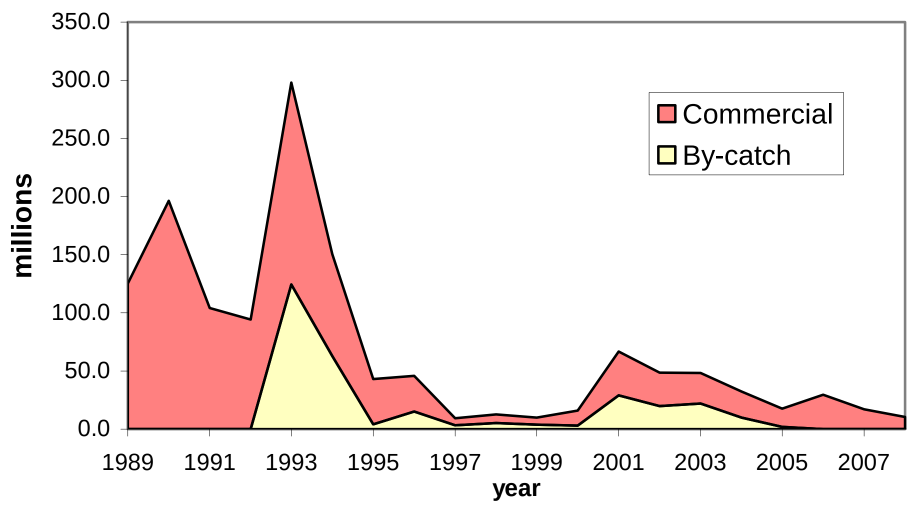

Fig. 1b: Beaked redfish commercial catch and by-catch in numbers

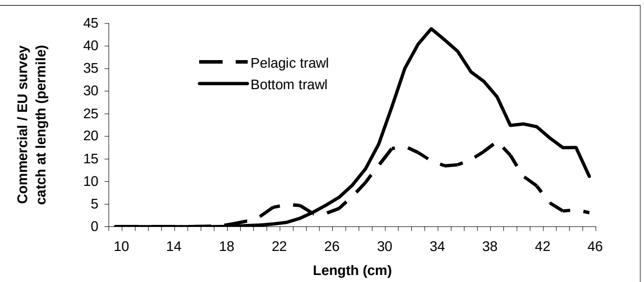

Fig. 2a: Exploitation patterns at length based on EU survey, 1989-2002

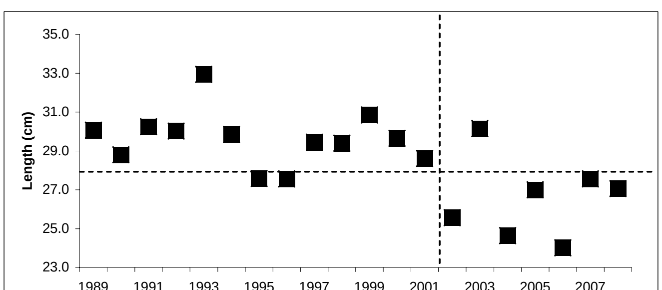

Fig. 2b: Mean length of the commercial catch, 1989-2008

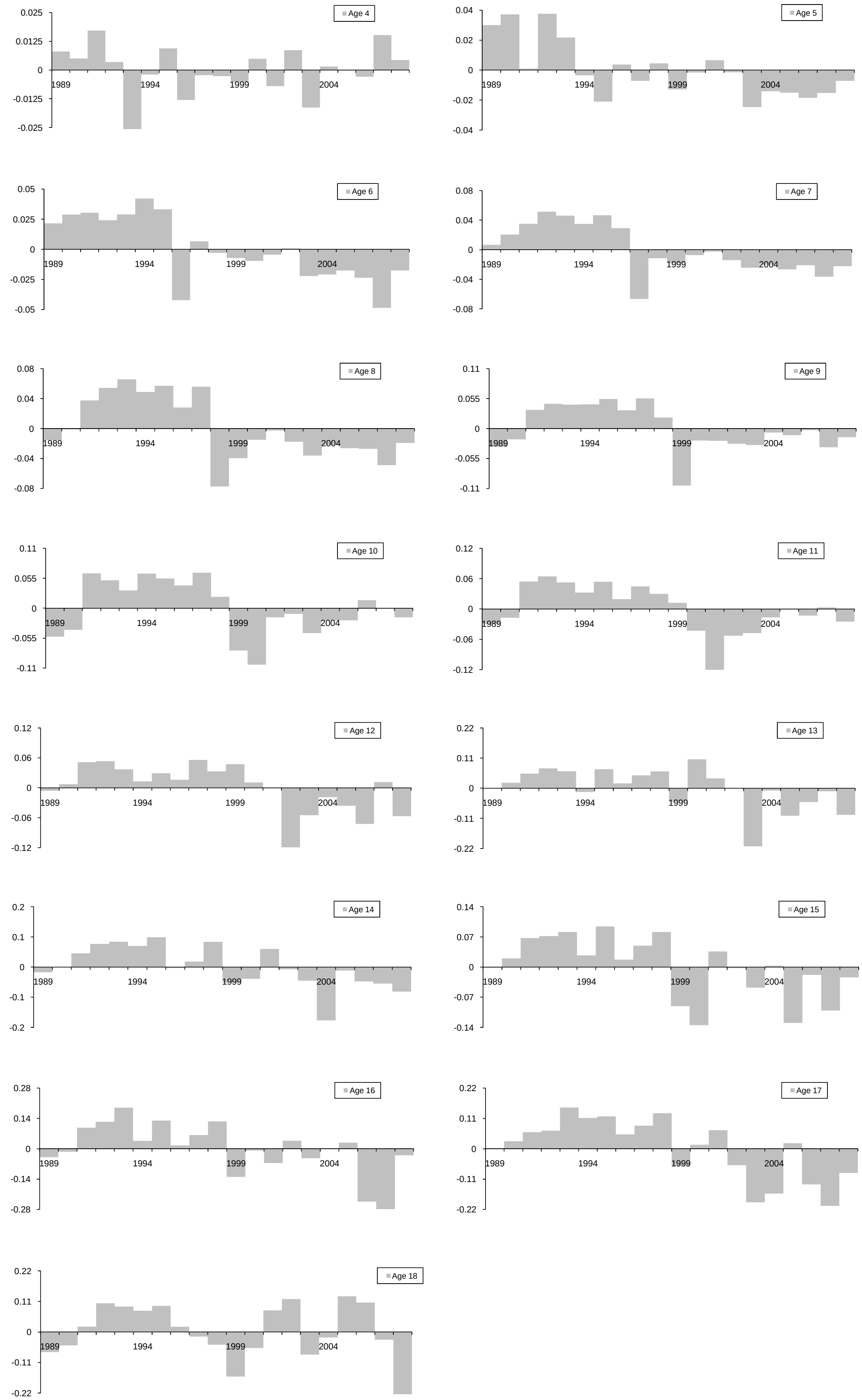

Fig. 3a: Mean weights at age anomalies for the stock, 1989-2008 (*y* axis scale variable with age)

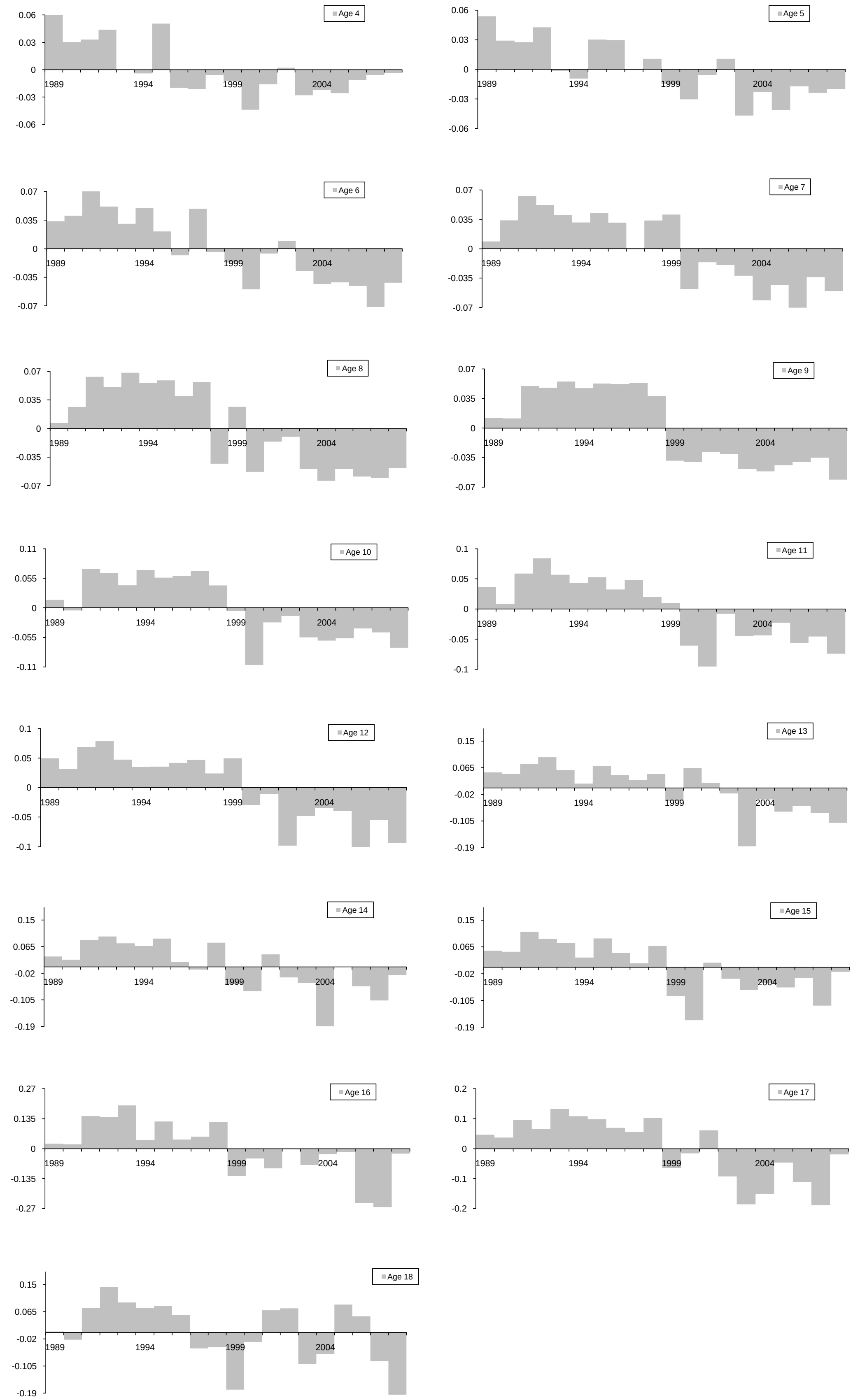

Fig. 3b: Mean weights at age anomalies for the catch, 1989-2008 (*y* axis scale variable with age)

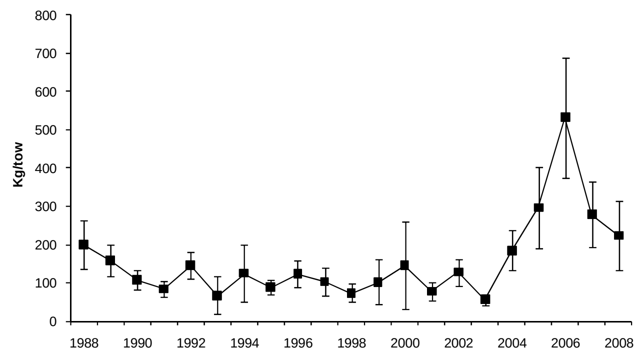

Fig. 4a: mean catch per tow for 3M beaked refish (EU survey, 1988-2008) with associated +/- 1.96 se

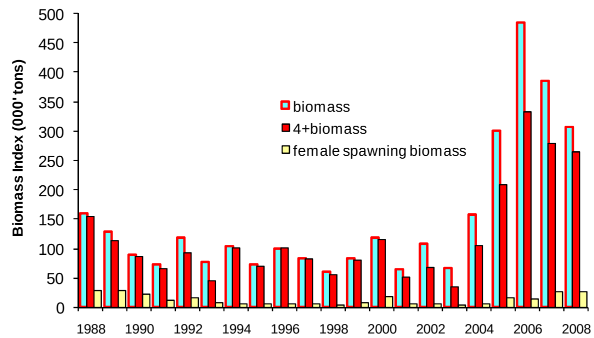

Fig. 4b: 3M Beaked redfish biomass, 4+ biomass and female spawning biomass and abundance (EU survey, 1988-2008)

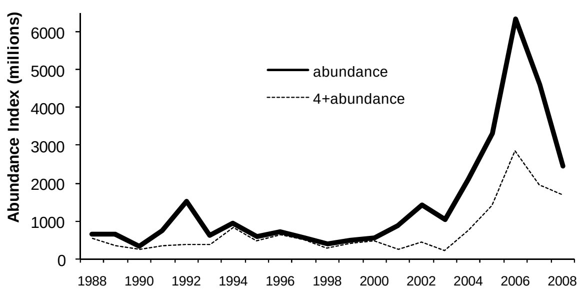

Fig. 4c: 3M Beaked redfish abundance and 4+ abundance (EU survey, 1988-2008)

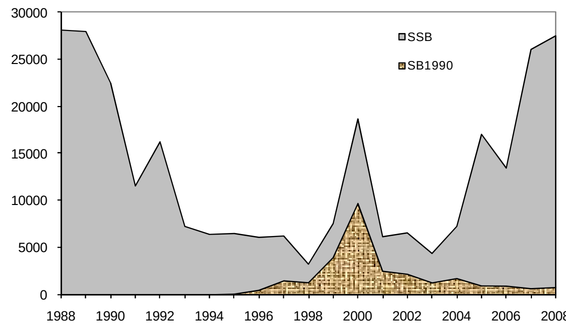

Fig 4d: Survey SSB and the contribution of the 1990 year class

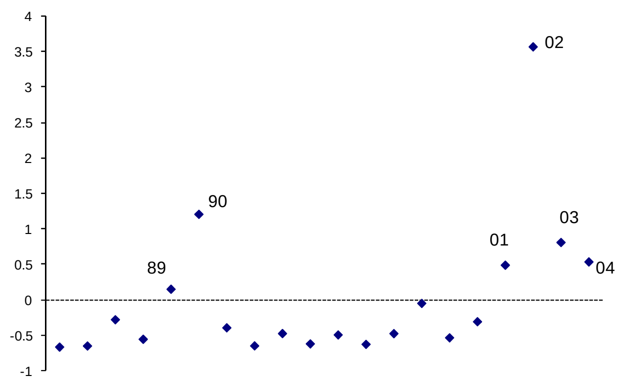

Fig. 4e: Standized year class strength at age 4 given by EU surveys, 1989-2008

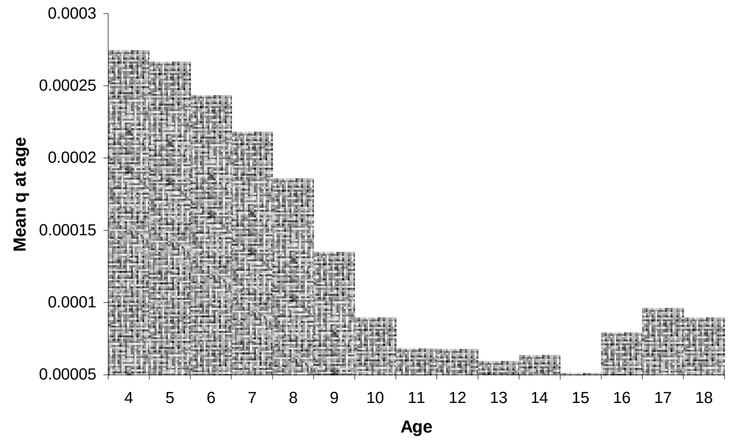

Fig. 5: Mean survey q at age from XSA 2009, ages 4-18

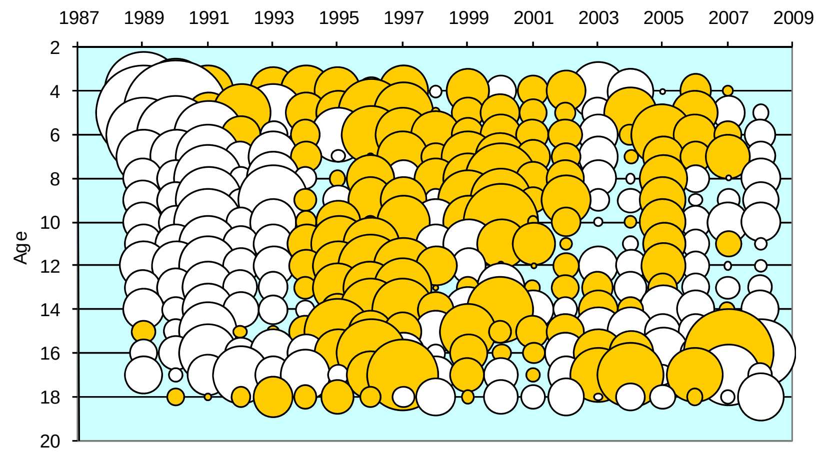

Fig. 5a : Eu survey log q residuals by age and year for a single EU survey series, 1989-2008

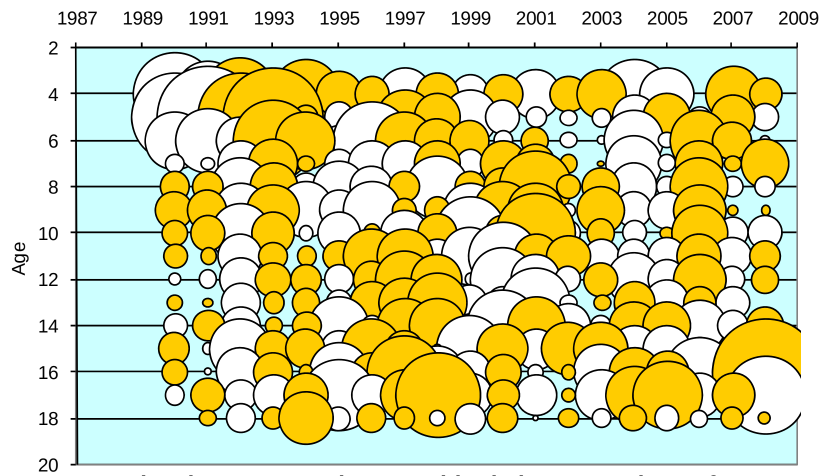

Fig. 5b: Eu survey log q residuals by age and year for three consecutive EU survey series, 1989-2008

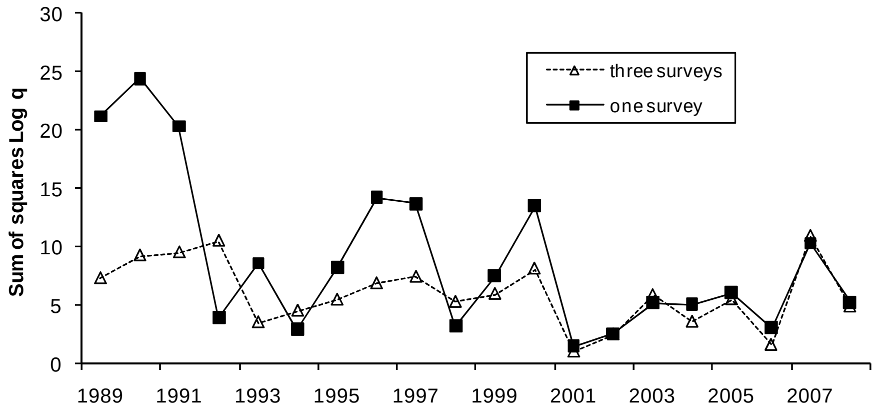

Fig. 6: Sum of squares of log q residuals on XSA2009 for a single EU 1989-2008 survey series versus three consecutive EU surveys series

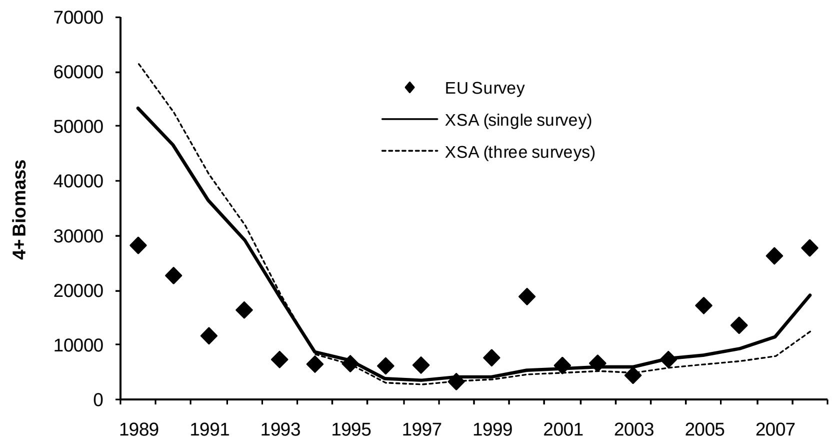

Fig. 7a: Single and three survey XSA versus EU survey female SSB

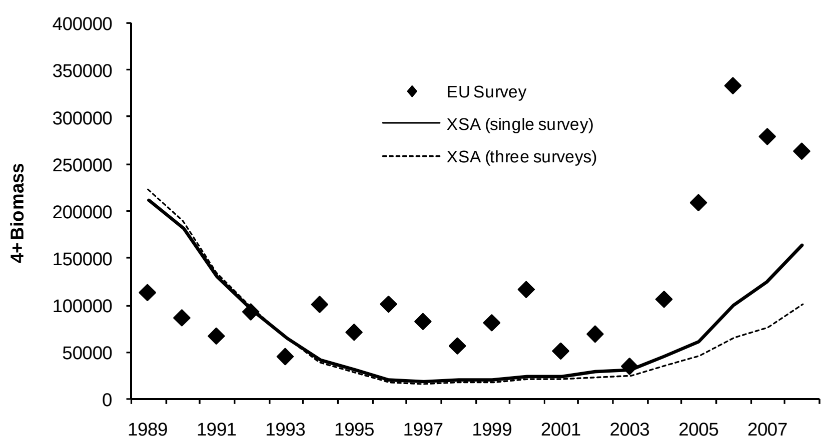

Fig. 7b: Single and three surveys XSA versus EU survey 4+ biomass

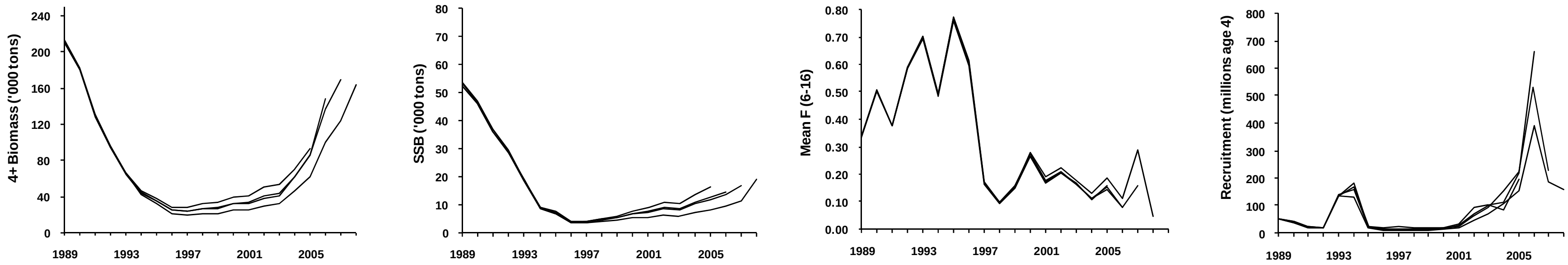

Fig 8a: The single survey XSA retrospective analysis, 2008-2005.

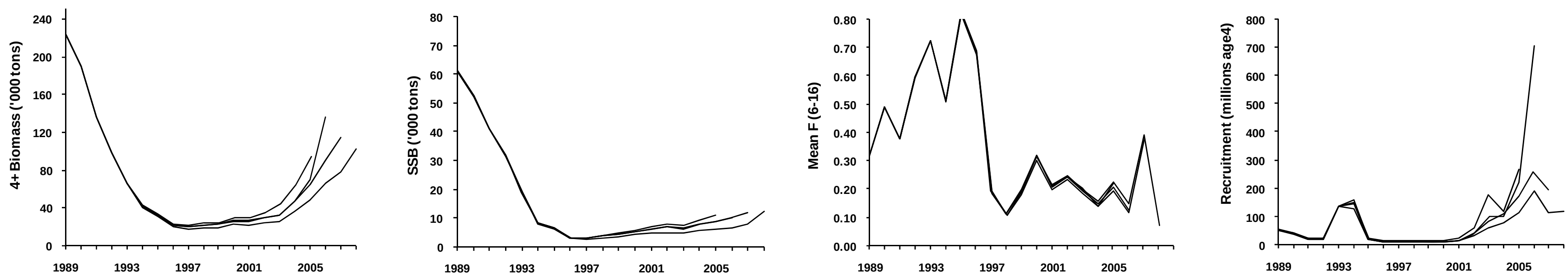

Fig 8b: The three survey XSA retrospective analysis, 2008-2005.

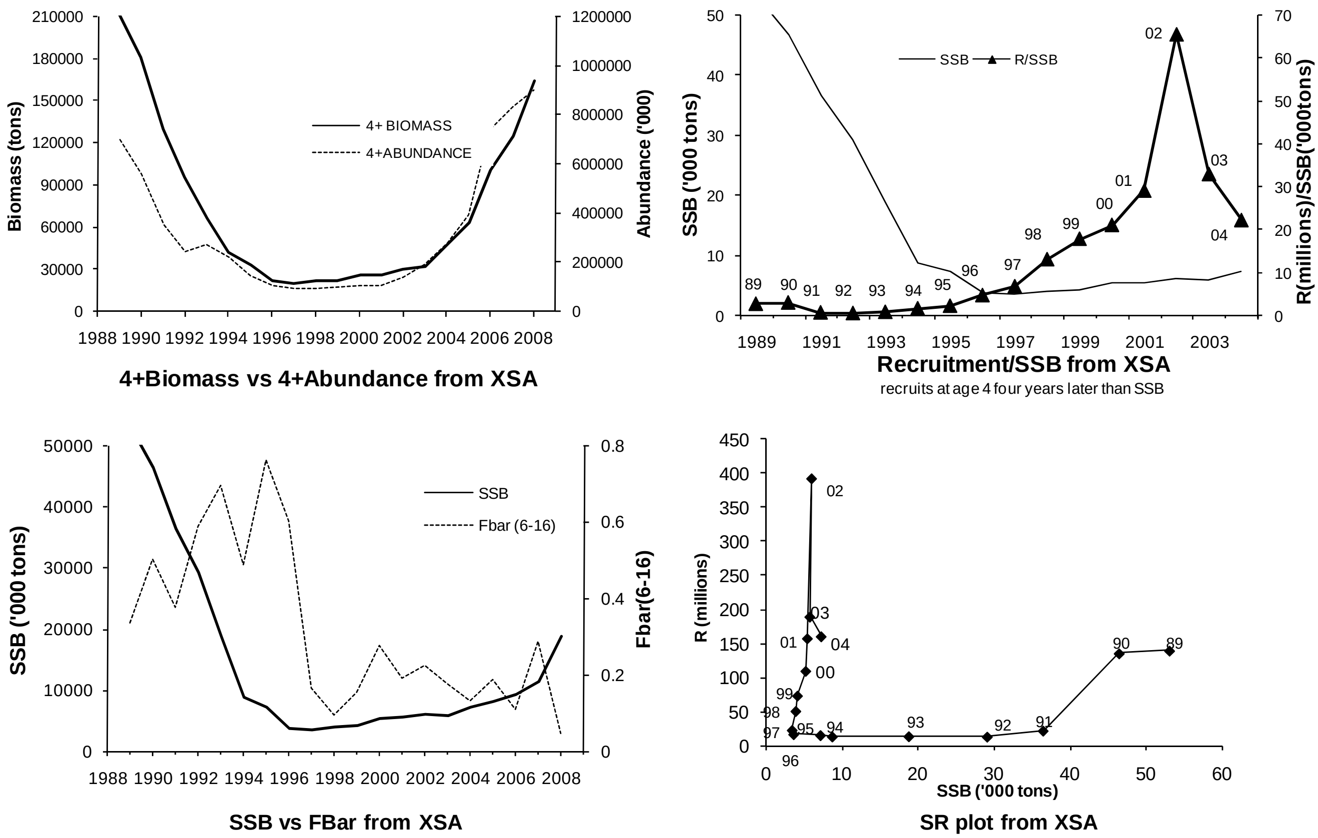

Fig. 9a: XSA results for 2009 assessment.

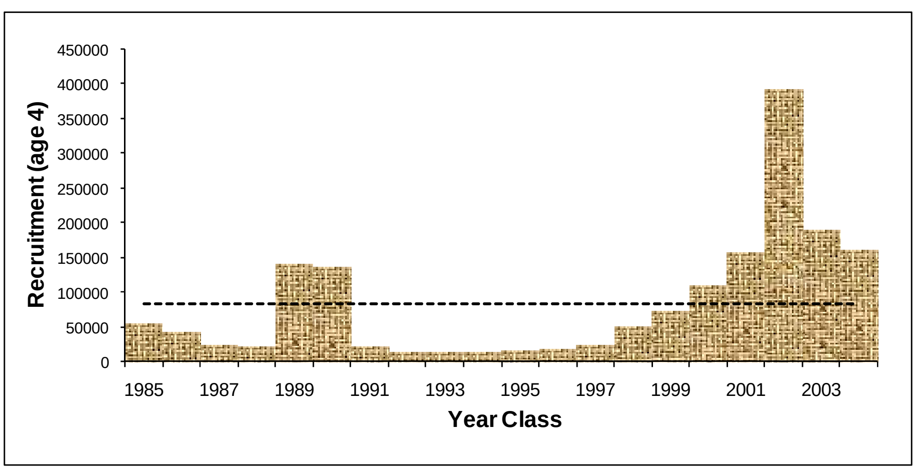

Fig. 9b: Year Class strength at recruitment from 2009 XSA.

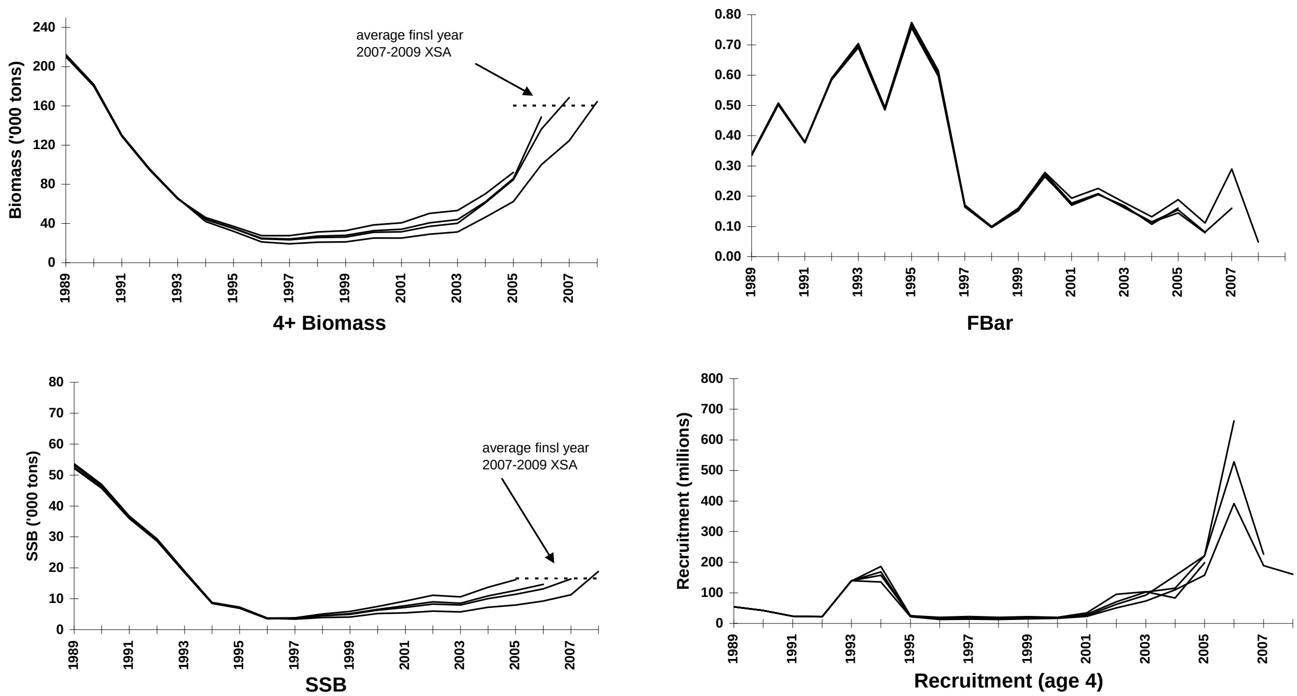

Fig. 10: XSA retrospective analysis, 2009-2006

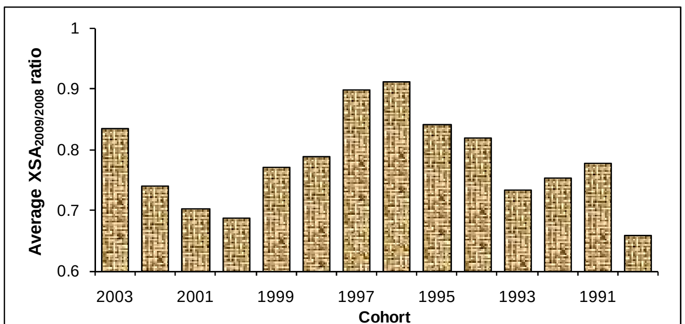

Fig 11a: N@age average ratio by cohort, XSA 2009/2008

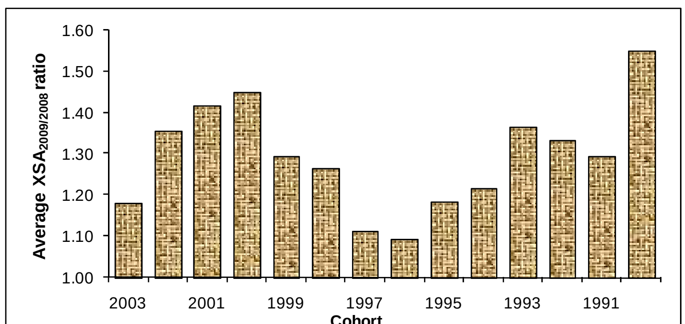

Fig 11b. F@age ratio by cohort, XSA 2009/2008

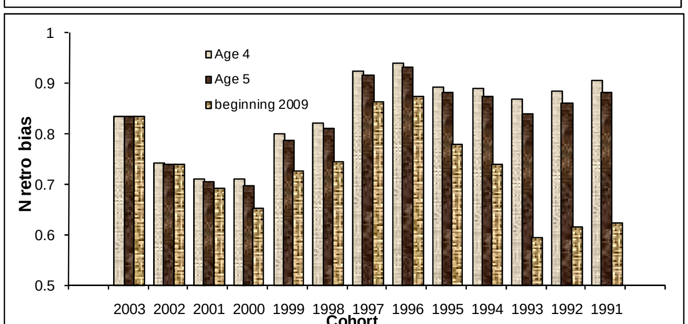

Fig 11c: Expected survivor retro bias by cohort between XSA_{2009} and 2010

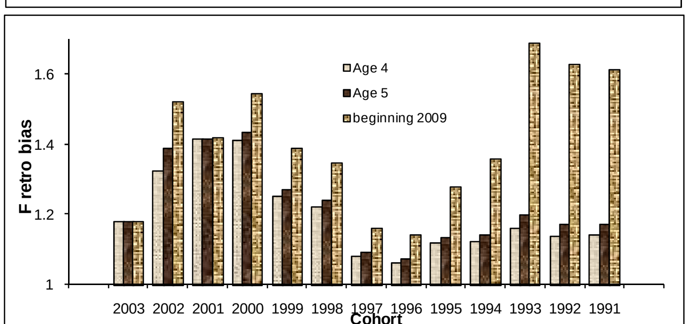

Fig 11d: F retro bias by cohort between XSA_{2009} and 2008

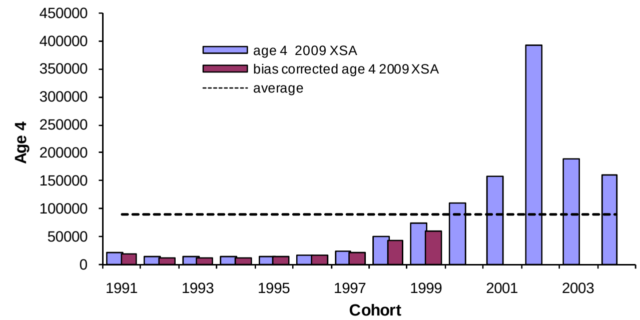

Fig.12a: XSA and bias corrected below average recruitment used in Mterm projections

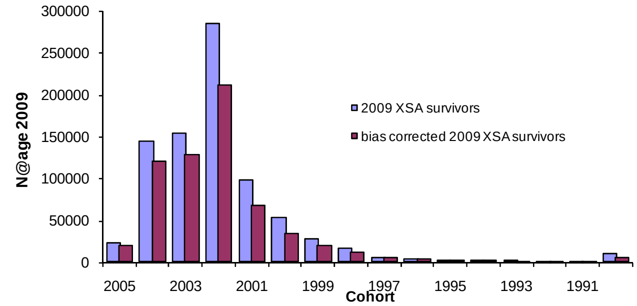

Fig.12b: XSA and bias corrected survivors at the beginning of 2009 used in Mterm projections

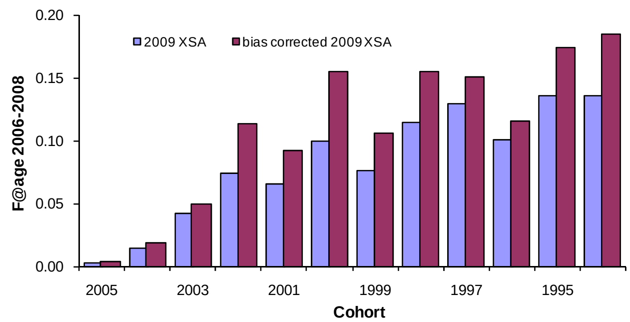

Fig.12c: Average XSA and bias corrected 2006-2008 fishing mortalities used in Mterm projections

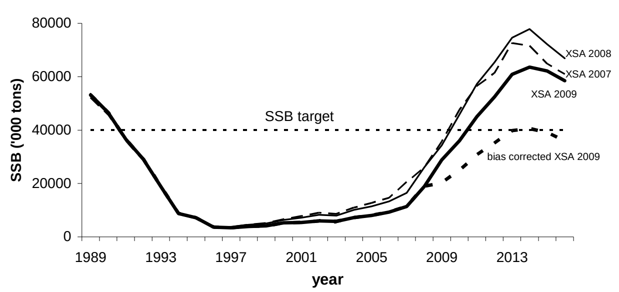

Fig. 13a: Mterm SSB sequential projections (50% percentiles)

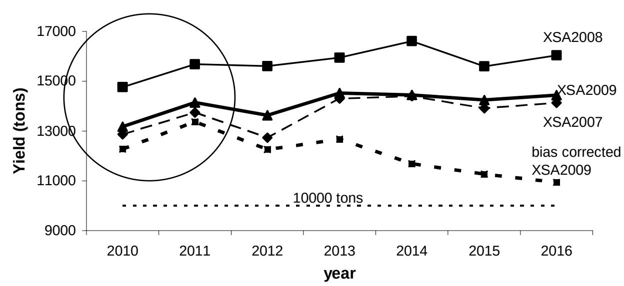

Fig. 13b: Mterm yield sequential projections (5% percentiles)