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# An Assessment of Beaked Redfish (*S. mentella and S. fasciatus*) in NAFO Division 3M (*With an Approach to the Likely Impact of Recent 3M Cod Growth on Redfish Natural Mortality*)

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 used with the same framework of previous assessments and with the tuning of the 1989-2010 EU survey. Recent survey results suggest that the beaked redfish stock has not been able to hold its growth and sustain an above average level, suffering instead a severe decline on the second half of the 2000's. For several reasons, the most likely hypothesis to justify this unexpected downward trend on stock size is an increase in mortality other than fishing mortality. From the sensitive analysis, carried out for a set of natural mortality options, a natural mortality of 0.4 (fixed for ages 4-6 through 2006-2010, and ages 7+ on 2009 and 2011) was adopted. This is the lowest possible level of natural mortality giving assessment results in line with the recent survey declines and at the same time with key diagnostics very close to the best ones, obtained with a higher natural mortality of 0.55. A 2011-2007 retrospective XSA was also carried out. When compared to previous assessments, these retrospective present more consistent trends namely as regards female spawning biomass and average fishing mortality, coupled with a non systematic bias signal.

Very high fishing mortalities until 1996 forced a rapid decline of abundance, biomass and female spawning biomass. With lower fishing mortalities since then, the stock decline was halted. The weak 1991-1997 year classes kept the stock size at a low level till 2003, basically sustained by the survival and growth of the existing cohorts. Recruitment at age 4 increased from 2002 till 2006, when the 2002 year class was at an historical high, and from 2006 to 2008 fell as fast as it went up, still continuing to decrease on most recent years and being on 2010 just bellow average. Above average year classes coupled with fishing mortalities in the vicinity of $F_{0.1}$ or even lower allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2007-2008. However the stock decreased on the last couple of years despite low catch and, being still above average level, there are no signs that the present decline rate is slowing down. Female spawning stock component experienced a similar decline.

Short and medium term stochastic projections were obtained for female spawning stock biomass (SSB) under $F_{statusquo}$ (average 2008-2010 fishing mortality), together with SSB and yield medium term probability profiles. Keeping fishing mortality at its present low level well below $F_{0.1}$ will sustain on the short term the female spawning stock biomass above the SSB interval from where all the abundant year classes from the past decade where generated. But on the long term it will be natural mortality to determine the future of beaked redfish as a fishery resource. The average 2012-2013 $F_{statusquo}$ catch for beaked redfish will be

of 3,200 tons. According to 2008-2010 observed catch data from the Portuguese, Spanish and Russian National Sampling Programmes on board, a beaked redfish annual catch of 3,200 tons would correspond to an overall 3M redfish catch (including the shallower golden redfish catches) near 7,000 tons (6,840 tons).

## 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 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 dominance of this group in the 3M redfish commercial catch. During the entire series of EU Flemish Cap surveys (1988-2010) beaked redfish also represents the majority of redfish survey biomass (71%).

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 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). This drop of the 3M redfish catches was 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 (to a level between 3,700 and 2,900 tons) reflected an increase of the fishing effort directed to 3M redfish, pursued by the Portuguese and Russian fleets. However, in 2003, catch from Russia 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 (Table 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 *et al.*, 2007). Redfish catches followed that increase and, despite posterior stock declines, were kept at a relative high level of 7,000-11,000 tons between 2006 and 2010. The rapid increase of golden redfish biomass allowed a new golden redfish fishery from September 2005 onwards on shallower waters above 300m. So over the most recent years we have at the same time two redfish fisheries occurring at depths above (golden redfish) and below (beaked redfish) 300m, basically pursued by Portuguese bottom trawl and Russian pelagic trawl.

Furthermore the high levels of both golden and beaked redfish biomass match with an important increase of cod biomass since 2006, with increasing cod by-catches and finally the reopening of the Flemish Cap cod fishery in 2010 with a TAC of 5,500 tons. This would necessarily imply another contribution to the maintenance of a relatively high level of redfish catches, in this case associated with increasing fishing effort directed to cod.

These new realities forced a revision of redfish catch estimates, in order to split recent commercial catch of the major fleets on the Flemish Cap bank (Portugal, Russia and Spain) into golden and beaked redfish and to have for each of the main fleets the available length sampling separated as well.

In order to estimate a proxy of the beaked redfish catch by fleet, a 2005-2010 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 (<300m; 300-400m; 400-700m and >700m). 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 taken from the same depth interval in order to get a beaked redfish catch estimate. The ratio between estimated beaked redfish catch and observed redfish catch for the monitored vessels was then applied to the fleet annual catch in order to get a beaked redfish catch estimate for that fleet. This exercise was performed for the Portuguese bottom trawl (2005-201), Spanish bottom trawl (2005-2009) and Russian pelagic trawl (2005-2010).

The 2005-2008 3M redfish catches of Japan were assigned to beaked redfish. The 2005-2009 3M beaked redfish catches of the Baltic States were estimated with an average beaked redfish proportion found on the redfish catches of Portugal and Spain on each of those years. For 2010, the European Union catch, given in the NAFO Circ. Letter with the “Recording of Provisional Catches for December 2010” (11th February 2011, Ref. No.: GFS/11-056), is not yet disaggregated by country. So the Portuguese beaked redfish proportion for 2010 was applied to the whole EU provisional redfish catch of last year.

The 1989-2010 redfish nominal catch is presented on Table 1a, STACFIS redfish catch on Table 1b and the beaked redfish landings used in this assessment on Table 1c and Fig. 1a. Finally on Table 1d are tabulated the golden and beaked redfish proportions by depth found in the 2005-2010 EU surveys (Gonzalez, *pers. comm.*,2009-2011), that were used to get the beaked redfish commercial catch estimates by fleet.

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 increased 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 on 2001-2003. From Canadian observer data (Kulka and Firth, *pers. comm.*, 1999-2005) 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 2006-2010 redfish by-catch remains unknown.

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). On most recent years (2006-2010) the beaked redfish catch in the assessment is assumed to be the commercial catch.

**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 2007-2011) were used to compute the mean weights of all commercial catches and correspondent catch numbers at length (Table 2a). The 1993-2004 beaked redfish length weight relationships from the EU survey (Table 2b: Troncoso and Casas, *pers. comm.* 2005) 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 are 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 are 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 (Ávila de Melo et al., 2009).

Length structure of the commercial catch show relative stability between 1989 and 2001, with most of the annual mean lengths falling within 27-31cm. Small sizes increase their presence in the commercial catch afterwards, being responsible of annual mean lengths bellow 28cm and wide oscillations in the catch structure at length. Until very recently this presence of small redfish in the commercial catch was the outcome of several recruitment processes from a sequence of abundant year classes. However the severe decline of the commercial mean length between 2009 and 2010 may also reflect a decline on the size of the exploitable stock, as suggested by the EU survey results (Table 3b, Fig. 2).

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 1989-2010 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 3c).

**Age composition of the catch**

Age composition of the total catch was obtained using the *S.mentella* age length keys from the 1990-2007 and 2009-2010 EU surveys. No *S.mentella* age length key was available for 2008: a synthetic *S.mentella* age length key was applied both to commercial and survey length compositions (Fran Saborido-Rey, *pers. comm.* 2009). Before 1993 age group 8 was the most abundant in the commercial catch and consecutive 1981-1984 cohorts were the most important 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 1999-2005 cohorts dominated sequentially the overall catch through most years of the past decade (with the exception of 2005), some of them on several years, first still in the shrimp by-catch and later on in the commercial fishery (Table 3d).

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 3e).

## 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 (1988-2010). 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 assessment.

**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 to 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 during most of the tows with SCANMAR equipment.

On 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 for the stock**

Annual length weight relationships for *S. mentella* and *S. fasciatus* (1992-2010) and for the two species combined (1988-2010) were available from survey data (Troncoso and Casas *pers. comm.*, 2005-2011) (Table 2b). *S. mentella* and *S. fasciatus* length weight relationships were used to get 1992-2011 *SOP* survey biomasses and *SSB* for each redfish species. The *Sebastes sp*. length weight relationships were used to get the 1988-1991 *SOP* survey biomass and *SSB* for beaked redfish.

**Beaked redfish survey abundance and mature female abundance at length**

Each of the redfish categories included in the beaked redfish unit (beaked redfish including juveniles, 1988-1989; beaked redfish, 1990-1991; *S. mentella*, 1992-2002; *S. fasciatus*, 1992-2002 and juveniles, 1990-2002) had their own survey abundance at length original series 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 2003-2010 *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 assembled into a single survey abundance at length series for beaked redfish (Table 4a).

A similar process is carried out in order to get a mature female abundance at length series, were the original female abundance at length series of each of the above mentioned redfish categories is transformed into a mature female at length series using the adequate maturity ogive available (Saborido-Rey, 1994 and Saborido-Rey, *pers. comm*. 2000). Details of the process can be found in the 2003 assessment (Ávila de Melo *et al.*, 2003).

**Age composition of the survey stock and mature female component**

The survey abundance at age for the 1989-2010 3M beaked redfish stock and mature female component (Table 4b and 4c) were obtained using the *S.mentella* age length keys from the 1990-2010 surveys. Due to the scarcity of redfish larger than 40cm either in the survey and commercial catch, a plus group was considered at age 19.

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 most abundant cohorts. Details regarding the building of the synthetic 2008 age length key are available on last assessment (Ávila de Melo *et al.*, 2009).

The annual beaked redfish length weight relationships from the 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).

**Maturity ogives**

Annual maturity ogives for 3M beaked redfish were available as the proportion of mature females in the survey stock abundance at age (Table 4d). This matrix was included in the Extended Survival Analysis to get annual female spawning biomass.

**Survey biomass and abundance, 1988-2010**

The 1989-2010 survey mean catch per tow for beaked redfish is presented on Table 5a and Fig. 3a. Details on the computation of this combined index can be found in 2003 assessment (Ávila de Melo et al, 2003). Survey year class strength at age 4, abundance and biomass for the total stock unit, exploitable and female spawning stock can be found on Table 5b. Trends of the respective standardized series are at Fig.'s 3b to 3e.

The survey biomass and abundance declined on the first years of the interval till 1990-1991, and fluctuate at low level until 2001-2003. A sequence of increasingly strong year classes (2000-2002) lead rapidly the stock to a maximum in 2006. The size of the most recent year classes recruiting at age 4 (2003-2006) declined as fast as their predecessors went up, and the 2006 cohort in 2010 returned to the average level. Both overall and exploitable stocks follow very similar trends to recruitment since 2006 and are in the vicinity of their respective average levels on the terminal year. As for the survey indices related to female spawning stock component their increase observed since 2002 was halted with a drop from 2009 to 2010, but still keeping its size well above average.

Despite a sequence of relatively abundant and abundant year classes (2001-2005) and a low to very low exploitation regime over the last fifteen years, survey results suggest that the beaked redfish stock has not been able to hold its growth and sustain an above average level, suffering instead a severe decline on the second half of the 2000's. Migration to the neighbouring waters of northern Grand Bank is an unlikely hypothesis, taking into account the Flemish Pass barrier. Being so, this unexpected downward trend on stock size can only be attributed to mortality other than fishing mortality.

The strong possibility of an important increase on natural mortality can be associated to cod growth on Flemish Cap: not only in terms of abundance but also in terms of individual growth, leading to a consistent increase of cod biomass from 2006 onwards (Gonzalez *et al*, 2010). The likely increase of redfish natural mortality, due to an increase of redfish on the Flemish Cap cod diet, is analysed next in the sensitivity analysis of the present assessment.

## XSA Assessment

Wide inter-annual variability can be observed on bottom trawl survey indices for redfish, caused by the scattered occurrence of large schools and changes in redfish availability as regards the vertical opening of the bottom net. These fluctuations originate year patterns in the catchabilities that relate survey indices with stock size at age that in turn will print retrospective patterns on the assessment results. Nevertheless, the long EU survey series seems to reflect well the overall dynamic of the stock, rich of contrasting trends over the last 22 years, and so is considered by the authors a valid tool to frame an Extended Survivors Analysis (XSA, Shepherd 1999) despite the above mentioned caveats.

The model runs with an XSA algorithm 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. As on previous assessments natural mortality was assumed constant at 0.1 on a first standard run, but allowed to vary over age and time afterwards in order to select a magnitude of $M$ in line with the most recent stock trends given by the survey . The proportion of mature females at age is the one observed through the 1989-2010 period, though on an annual basis (Table 4d). The month with a peak of spawning for 3M *Sebastes mentella*, February (Saborido-Rey, 1994), was the one chosen to the estimate 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 and commercial weight at age matrices.

The present Extended Survivor Analysis used as tuning file the 1989-2010 EU survey abundance at age matrix, with the 1989-2002 indices converted into the new *RV Vizconde de Eza* units (Casas *et al*., 2011).

**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 two 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 20 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. Catchability was set constant with respect to age only at age 17: after declining between age 4 and 10, catchability is relatively stable on older ages (11-17) but assuming a constant $q$ will lead to poorer diagnostics. In order to avoid overweight of the cohort's terminal population estimate by the last true age, the minimum allowable standard error of the *log* catchability on the last true age (18) of was set at 0.5.

In summary, apart the input of annual maturity ogives and the possibility of a $M$ higher than 0.1 on recent years, the principles underlying the 2011 XSA framework remained unchanged from previous assessments (Ávila de Melo *et al*., 2009): 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.

**Sensitivity Analysis and XSA diagnostics: adjusting the model to recent survey trends.**

Going back to the survey trends for year class strength at age 4 (Fig. 3b), exploitable stock (Fig. 3d) and female spawning stock (Fig. 3e) it is obvious that the first two components started their decline earlier, on 2006, while the third component started later, on 2009. Over recent years (2006-2010) the major contribution to the survey exploitable biomass came from ages 4 to 6 (55-85%) while for female spawning stock biomass (SSB) the major contribution came from ages 7 and older (75-98%). So, when considering a set of runs for a range of $M$ 's higher than the standard value for redfish species (0.1), these facts determined the definition of two time/age boxes where natural mortality increased: (1) 2006-2010 for ages 4 to 6, and (2) 2009-2010 for ages 7 and older. For years before 2006 $M$ was kept at 0.1.

The interval of magnitude for natural mortality to be considered on the sensitivity runs was set from 0.1 to 1.0, with 0.1 increments. For reasons explained below, a 0.5 increment was after included between 0.4 and 0.6. On each of these runs natural mortality was kept constant within the boxes predefined above. Finally other two runs were performed with *annual* natural mortality increasing in the boxes at the same rate of the Flemish Cap 1) cod abundance and 2) cod biomass. The conversion of *annual* to *instant* natural mortality ( $M$ ) is presented in Table 7a. Values of $M$ >1.0 were rejected and $M$ was set at 1.0 in those cases.

The goodness of fit of the model for each of the $M$ options is given by the sum of squared $\log q_{age}$ residuals for 2006-2010, the most recent period where the survey indices declined and is assumed that $M$ increased. These results have a minimum $SS$ plateau, for $M$ between 0.4 and 0.6 (Table 7b, Fig. 4a). Continuing at a finer scale, with $M$ =0.45 and 0.55, allowed to locate the objective function in the vicinity of $M$ = 0.55.

The set of exploitable and female spawning biomass trends given by the $M$ 's within the minimum plateau is plotted on Fig.'s 4b and 4c against the trends given by the survey and the standard $M$ , with all series standardized to the respective mean and unit standard deviation. All trends from the best $M$ 's were in line with the survey story, while the standard run simply ignores what is going on.

Obviously the lower $M$ = 0.4 of this selection gave the less pessimistic results. Nevertheless a four fold increase on natural mortality puts a tremendous pressure on long living and slow growing fish: it means that even without exploitation a cohort will suffer a 99% reduction from age 4 to age 15 when under the standard $M$ = 0.1 that same reduction would be of 67%. That is why choosing the "best" fit with $M$ = 0.55 would be an unrealistic heavy option leaving little room to recovery, that could only be justified by a clear improvement on the model performance leading to much more robust results. When looking at the key diagnostics of the five XSA runs with $M$ ranging from 0.40 to 0.60 (Table 7c. Fig's 5a to 5d) that seems not to be the case: $M$ going up from 0.4 to 0.6 turns on a minimal improvement on the diagnostics of the assessment.

On this redfish age based assessment, mean *log* catchabilities present a pattern of year effects that mark all $\log q_{age}$ residuals bubble plots from the several XSA runs considered in the sensitivity analysis (the plots for the most important runs for this analysis are assembled on Fig. 6). Positive *log q* residuals dominate during the intermediate years of 1994-2002, while the on the first years, 1989-1993, there is a clear negative pattern, sometimes with very large residuals as it is the case of the 1983-1985 cohorts between 1989 and 1991. From 2004 onwards residuals are generally of a much smaller size and the marked negative/positive pattern of the past is lost. An improvement on the last year pattern is observed when XSA increase $M$ from standard 0.1 to 0.4, but that is not so obvious on further increases between 0.4 and higher natural mortalities.

As it was concluded for other diagnostics, choosing the best $M$ based on a strict statistical criterion has little impact on the goodness of fit. This evidence is also illustrated on Fig. 6 by the similarity of the residual patterns of $\log q_{age}$ residuals when the model runs with $M$ ranging between 0.4 and 0.6.

Taking into account the results of the sensitivity analysis natural mortality level at 0.4 was fixed in the present XSA assessment for ages 4-6 through 2006-2010, and ages 7+ on 2009 and 2011. The full diagnostics output for the chosen $M$ option are presented on Table 8.

**Retrospective Analysis**

A 2011-2007 retrospective XSA was carried out in order to check the bias on the main results of the recent assessments back in time (Table 9a and 9b, Fig. 7). This retrospective analysis covers a period of rapid and profound contrast on the dynamics of the stock and is a useful check to measure how good the model fit to new natural mortality levels assumed recently. When compared to previous assessments (Ávila de Melo *et al*, 2007 and 2009) this retrospective XSA present more consistent trends, namely as regards female spawning biomass (SSB) and average fishing mortality, coupled with a non systematic bias signal (for instance the XSA 2009 biomass lies between the ones given by the 2010 and 2011 assessments, the same occurring to the XSA 2011 SSB, staying between the ones from the 2009 and 2010 XSA's). On comparison the bias magnitude for the last retrospective assessments, 2011 XSA presents the best results for one and three year revisions (Table 9b).

From the possible causes of retrospective patterns – patterns of catch misreporting, patterns in catchability or misspecification of natural mortality (Sinclair *et al*., 1990) – the last two causes seem to be the most likely causes of bias in this redfish assessment. However, the assumption of a higher level of $M$ over most recent year seems to attenuate both the magnitude and the typical pattern of this type of bias.

**Final considerations on the diagnostics**

An "erratic" pelagic-demersal distribution, associated with schooling and longevity will always doom bottom survey dependent redfish analytical assessments to relatively poor diagnostics and more or less severe retrospective biases. Nevertheless, if the stock unit shows a consistent dynamics, as it is the case for 3M beaked redfish over the 2000's, the correspondent signals can generate consistent results over time without the help of the XSA statistical facilities commonly used to smooth ugly retrospective patterns. Despite year to year biases, this assessment results are able to initialize similar projections from consecutive assessments, namely as regards short term yield (*see retroprojections from last assessment*, António Ávila de Melo *et al*, 2009). Being so, the final outcome of the 3M beaked redfish 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.

**2011 XSA Results**

Very high fishing mortalities until 1996 forced a rapid decline of abundance, biomass and female spawning biomass (Table 10, Fig. 8a: *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 2003, basically sustained by the survival and growth of the existing cohorts. The recruitment at age 4 increased from 2002 till 2006, when the 2002 year class was at an historical high, and from 2006 to 2008 fell as fast as it went up, still continuing to decrease on most recent years and being on 2010 just bellow average (Table 10, Fig. 8b). Above average year classes coupled with fishing mortalities in the vicinity of $F_{0.1}$ or even lower allowed a rapid growth of biomass and abundance since 2003 and sustained the stock at a high level on 2007-2008. However the stock decreased on the last couple of years for causes other than fishing and, despite the stock size being still above average level, there are no signs that the present decline rate is slowing down. These stock trends have been followed by the female spawning stock component (Table 10, Fig. 8a).

The reproductive potential of the stock increased steadily on the late 1990's-early 2000's but fell from 2002 to 2004 and record a further decline on 2006 (Fig. 8a, R/SSB plot). The stock seems to have returned recently to the low productivity regime observed until 1998. But in 2010 the SSB was still well above average (see summary table on the bottom of Table 10) and above the level where the highest recruitments have occurred (Fig. 8a, SR plot). Furthermore, this apparent decline on reproductive potential may reflect higher natural mortalities at pre-recruited ages, rather than the return to a low productivity regime.

Regardless no apparent relationship between the size of the year classes at age 4 and the parental female stock biomass (Fig. 9a, SR plot), and the possible negative impact of high $M$ 's prior the entry of young redfish in the exploitable stock, keeping female spawning stock biomass within or above the range of SSB's that generated the good year classes of the 2000's is in the short term the main concern as regards the management of this stock.

## Stock projections

Short and medium term stochastic projections of female spawning stock biomass (SSB) under a gradient of *F status quo* percentages, together with SSB and yield medium term probability profiles under *F status quo,* were obtained with a program of the CEFAS laboratory (Lowestoft/UK), first applied to a NAFO stock in 2000 (Mahe and Darby, 2000). This *Mterm* algorithm use initial abundance for ages 5 and older, at the beginning of the first year of the projection interval (2011, given by the XSA survivors by the end of 2010) abide to a measure of uncertainty. It bootstraps recruitment (age 4) from the third to the tenth year of the projection (on the first two years of the projection, 2011 and 2012, recruitment is set at the 1989-2008 geomean). 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 input data were aggregated in two categories of files:

a. *.srr* file (Table 11a), assuming no stock recruitment relationship and with a random recruitment around the geo-mean of the 1989-2008 recruitments (numbers at age 4, from the XSA). The first age at the beginning of each year is given by the re-sampling of the *log* residuals of the 1989-2008 recruitments. The 2009 and 2010 recruitments were excluded from the average due to the greater uncertainty of their estimate by the present XSA.

b. *.sen* sensitivity file (Table 11b), including the usual vectors needed to forward projections, with uncertainty associated to all vectors but natural mortality, which was fixed at 0.4 for all ages and years. Maturity ogive, as well as stock and catch weights at age are the 2008-2010 averages with associated errors. The XSA survivors at age 5+ coupled with the geomean recruitment at age 4, are the basis to get the starting population at the beginning of 2011 (the same level of recruitment is assumed for 2012). Being the internal and external standard errors from XSA diagnostics (Table 8/ Terminal year survivor and F estimates) two measures of the uncertainty around the survivor estimate for each age, their average was adopted as the coefficients of variation associated with the starting population at age. Fishing mortality was kept constant through projections at $F_{statusquo}$, corresponding to the 2008-2010 $\bar{F}_{age}$.

The reason for keeping fishing mortality at $F_{statusquo}$ is that the assessment is based on the assumption that natural mortality is at present well above the usual level considered on redfish stocks, being the major force driving the actual stock decline. With $M$ at 0.4, average 2008-2010 fishing mortality represents just 15% of total mortality and is kept at a level well below $F_{0.1}$ (Ávila de Melo *et al*, 2003) over the projection interval.

The results of the *Mterm* projections (Table 12a and 12b, Figures 9a and 9b, 10a and 10b) showed that, on the short term (2012-2013), with an average $F_{statusquo}$ catch of 3,200 tons the probability of keeping SSB at a safe level above 20,000 tons is high. However, and despite all the uncertainty related with the recent level of $M$, that turn medium term projections meaningless, if high natural mortalities of the order of magnitude assumed in this assessment persist the stock will continue to decline even under low/very low fishing mortalities.

According to 2008-2010 observed catch data from the Portuguese, Spanish and Russian National Sampling Programmes on board, a beaked redfish annual catch of 3,200 tons would correspond to an overall 3M redfish catch (including the shallower golden redfish catches) near 7,000 tons (6,840 tons).

## Conclusions

The results of the present Extended Survivors Analysis are not in line with previous assessments: the declines on survey stock abundance and biomass first observed in 2007-2008 were confirmed in 2009-2010 and extended to the survey female spawning component. These new declines could not be explained by a commercial catch that has been chronically small for more than a decade and a half. The new assessment results can only reflect the declines foreseen by the survey if natural mortality is allowed to suffer an important increase since 2006, first just over the younger ages and later on covering the full age spectrum. The most likely cause of such sudden shift downwards on the beaked redfish stock size would be depletion by cod. Individual cod from consecutive good year classes have been growing at a much faster rate on the Flemish Cap bank, pushing the cod stock recovery from severe depletion and finally allowing its reopening to direct fishing last year. Keeping fishing mortality at its present low level will sustain on the short term the female spawning stock biomass above the SSB interval from where all the abundant year classes from the past decade where generated. But on the long term it will be natural mortality to determine the future of beaked redfish as a fishery resource.

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Table 1a: 3M Redfish nominal catches (ton) by country, 1989-2010.

| Country | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CAN | | | 2 | | 10 | | | | | | | 5 | | | | | | | | | | |
| CUB | 1765 | 4195 | 1772 | 2303 | 945 | | | | | | 2 | | | | | | | | | | | 875 |
| 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 | 1184 | 961 |
| UKR | | | | | | | | | | | | | | | 5 | 3 | | 1 | | | | |
| E-LVA | | | | 7441 | 5099 | 94 | 304 | | | | | 13 | 11 | | | 2 | 48 | 250 | | | 58 | |
| E-LTU | | | | | 2128 | | | | | | | | | 10 | 1 | | 522 | 397 | 542 | | | |
| E-EST | | | | | | 47 | 863 | 13 | | | | 631 | 158 | 5 | 23 | 60 | 1093 | 1249 | 728 | 950 | 1643 | |
| E-SP | 213 | 2007 | 6324 | 3647 | 100 | 610 | 165 | 113 | 129 | 262 | 268 | 348 | 272 | 220 | 633 | 266 | 542 | 596 | 533 | 1225 | 745 | |
| E PRT | 13012 | 11665 | 3787 | 3198 | 4781 | 5630 | 1284 | 281 | 83 | 259 | 97 | 925 | 1590 | 1513 | 1113 | 2574 | 2696 | 2594 | 2357 | 3707 | 5027 | |
| EU | | | | | | | | | | | | | | | | | | | | | | 6096 |
| FR-STP | | | | | | | | | | 2 | | | | | | | 10 | | | 8 | | |
| KOR-S | 17885 | 8332 | 2936 | 8350 | 2962 | | | | | | | | | | | | | | | | | |
| FAROE IS. | | | | 16 | | | 15 | 1 | | | | | | 6 | | 6 | | | | 215 | 1 | 42 |
| NORWAY | | | | | | 8 | | | | | | | | | | | | | | | | |
| Total | 47697 | 66887 | 40914 | 29317 | 19027 | 9883 | 6748 | 1140 | 423.8 | 970.7 | 795 | 3828 | 3392 | 2976 | 1988 | 3126 | 6417 | 6319 | 5553 | 7920 | 8658 | 7974 |

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 | 2009 | 2010[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 58100 | 81000 | 48500 | 43300 | 29000 | 11300 | 13500 | 5789 | 1300 | 971 | 1068 | 3658 | 3224 | 2934 | 1881 | 2923 | 6550 | 7156 | 6662 | 8465 | 11317 | 7974 |

Table 1c: STACFIS Estimates of 3M beaked redfish commercial catches from various sources. From 2005 onwards also using information on distribution by depth of the EU survey catch (D. Gonzalez *pers. comm.*) and of the commercial catch of Portugal, Russia (M. Pochtar *pers.comm.*) and Spain (F. Gonzalez *pers. comm.*)

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 58100 | 81000 | 48500 | 43300 | 29000 | 11300 | 13500 | 5789 | 1300 | 971 | 1068 | 3658 | 3224 | 2934 | 1881 | 2923 | 4148 | 5997 | 5149 | 4277 | 3656 | 5056 |

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

| **<200m** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | **200-300m** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| golden | 36.1 | 51.1 | 97.9 | 100.0 | 100.0 | 100.0 | golden | 54.5 | 50.7 | 32.4 | 68.3 | 84.9 | 68.3 |
| beaked | 63.9 | 48.9 | 2.1 | 0.0 | 0.0 | 0.0 | beaked | 45.5 | 49.3 | 67.6 | 31.7 | 15.1 | 31.7 |
| | | | | | | | | | | | | | |
| **300-400m** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | **400-700m** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| golden | 18.8 | 5.9 | 12.0 | 28.5 | 22.0 | 28.5 | golden | 2.1 | 5.0 | 1.3 | 8.8 | 0.9 | 8.8 |
| beaked | 81.2 | 94.1 | 88.0 | 71.5 | 78.0 | 71.5 | beaked | 97.9 | 95.0 | 98.7 | 91.2 | 99.1 | 91.2 |

Table 1e: Redfish by-catch in weight (ton) from the 3M shrimp fishery, 1993-2005 (Kulka, D. and J. Firth *pers. comm.*)

| | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| By-catch in weight (ton) [2] | 11970 | 5903 | 374 | 550 | 157 | 191 | 96 | 106 | 738 | 767 | 1006 | 471 | 80 |

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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 12.5 | 28.2 | 16.1 | 15.3 | 11.6 | 22.7 |
| 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 | 14.4 | 28.2 | 16.1 | 15.3 | 11.6 | 22.7 |

Table 2a: Length weight relationships for 3M beaked redfish from commercial catch (Alpoim,2004; Vargas, 2005, 2007-2011)

| 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 |
| 2009 | 0.0120 | 3.0635 |
| 2010 | 0.0145 | 2.9911 |

Table 2b: Length weight relationships for 3M beaked redfish from EU survey (Troncoso and Casas, *pers. comm. 2005-2011*)

| | *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 | 0.014 | 3.026 |
| 2008 | 0.019 | 2.921 | 0.016 | 2.983 | 0.020 | 2.902 |
| 2009 | 0.012 | 3.067 | 0.016 | 2.983 | 0.015 | 3.004 |
| 2010 | 0.013 | 3.021 | 0.024 | 2.850 | 0.018 | 2.925 |

Table 3a: Availability of length data for commercial catches and by-catch of 3M beaked redfish, 1989-2010

| | Portugal | Spain | Japan | Russia | Canada (by-catch) |
|---|---|---|---|---|---|
| 1989 | | | | | |
| 1990 | | | | | |
| 1991 | | | | | |
| 1992 | | | | | |
| 1993 | | | | | |
| 1994 | | | | | |
| 1995 | | | | | |
| 1996 | | | | | |
| 1997 | | | | | |
| 1998 | | | | | |
| 1999 | | | | | |
| 2000 | | | | | |
| 2001 | | | | | |
| 2002 | | | | | |
| 2003 | | | | | |
| 2004 | | | | | |
| 2005 | | | | | |
| 2006 | | | | | |
| 2007 | | | | | |
| 2008 | | | | | |
| 2009 | | | | | |
| 2010 | | | | | |

available length data

derived from the length composition of the 1993-1994 beaked redfish EU survey abundance (Portugal)
or
derived from the length composition of the 1992-1994 beaked redfish EU survey abundance (Russia)

assumed as by-catch of Russian Greenland halibut fishery with the same length composition of EU commercial bottom trawl.

Table 3b: Length composition (absolute frequencies in'000s) of the 3M redfish commercial catch, 1989-2010.

| Length | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 3 | | | | | | | | | | | | | 10 | | | 3 | 16 | 12 | | | | | |
| 11 | | | | 1 | 3 | | | | | | | | | 48 | | 1 | 18 | 40 | 41 | | | 3 | | |
| 12 | 3 | | | 1 | 7 | | | | | | | 5 | | 220 | | 3 | 108 | 86 | 133 | | 1 | 9 | | |
| 13 | 11 | | | | 5 | | | | | | | 11 | | 723 | | 5 | 381 | 70 | 172 | | 5 | 28 | | |
| 14 | 25 | 4 | | | 40 | 4 | | | | | | 1 | | 590 | | 12 | 509 | 91 | 88 | | 5 | 99 | | |
| 15 | 8 | 73 | | 1 | 120 | 15 | | | | 2 | | 6 | 4 | 175 | | 43 | 474 | 112 | 23 | 6 | 37 | 248 | | |
| 16 | 30 | 190 | | 4 | 167 | 66 | | 20 | | | | 1 | 4 | 70 | | 203 | 516 | 313 | 18 | 14 | 68 | 341 | | |
| 17 | 59 | 724 | | 3 | 55 | 244 | | 20 | 1 | 2 | | 6 | 20 | 53 | 6 | 352 | 423 | 436 | 31 | 12 | 102 | 481 | | |
| 18 | 30 | 2489 | 156 | 6 | 39 | 607 | 118 | 20 | | 1 | | 17 | 57 | 84 | 6 | 464 | 285 | 635 | 138 | 47 | 121 | 669 | | |
| 19 | 11 | 5774 | 647 | 97 | 54 | 922 | 265 | 66 | 6 | 8 | 1 | 27 | 41 | 144 | | 666 | 183 | 1296 | 433 | 166 | 147 | 912 | | |
| 20 | 111 | 6179 | 1331 | 418 | 71 | 491 | 1142 | 360 | 8 | 13 | 1 | 50 | 43 | 187 | | **1165** | 157 | 2168 | 371 | 381 | 226 | 1559 | | |
| 21 | 383 | 2904 | 1234 | 1987 | 125 | 427 | 2874 | 964 | 14 | 28 | 1 | 48 | 63 | 173 | 2 | **1513** | 132 | **3104** | 658 | 622 | 308 | **2254** | | |
| 22 | 1149 | 1205 | 1179 | 3834 | 337 | 408 | 5895 | **2215** | 41 | 52 | 2 | 103 | 117 | 166 | 4 | **1512** | 159 | **3939** | 490 | 1032 | 535 | **3696** | | |
| 23 | 3766 | 1927 | 945 | 3016 | 668 | 457 | 5715 | **1641** | 104 | 94 | 1 | 112 | 197 | 175 | 30 | **961** | 216 | **3658** | 720 | 794 | 869 | **3261** | | |
| 24 | 8408 | 5526 | 1697 | 1690 | 1116 | 701 | 1691 | **1324** | **263** | 116 | 9 | 206 | 277 | 284 | 89 | 845 | 287 | **3179** | 760 | 1198 | 981 | 1671 | | |
| 25 | **14733** | **11932** | 3737 | 2468 | 1159 | 870 | 1157 | 785 | **325** | **222** | 118 | 317 | 451 | 414 | 262 | 720 | 555 | 2261 | 947 | 787 | **1257** | 1151 | | |
| 26 | **14793** | **19979** | 6292 | 7519 | 1577 | 1020 | 793 | 513 | **310** | **223** | 112 | 717 | 891 | 511 | 363 | 571 | 724 | 1427 | **1471** | **1760** | **1266** | 848 | | |
| 27 | **11148** | **25688** | **10368** | **11599** | 1701 | 986 | 953 | 740 | 198 | **207** | 220 | **1322** | **1241** | 672 | **516** | 596 | **927** | 1181 | **1876** | **2050** | **1145** | 775 | | |
| 28 | 7059 | **26047** | **12852** | **11899** | 2456 | 1688 | 1185 | 758 | 169 | 173 | **303** | **1654** | **1450** | **854** | **535** | 553 | **1057** | 1058 | **1405** | **2306** | **1086** | 886 | | |
| 29 | 5773 | **20113** | **15100** | 8677 | 2448 | **2039** | **1476** | 855 | 210 | 168 | **301** | **1467** | **1193** | **841** | **588** | 426 | **1111** | 779 | **1348** | 1244 | 877 | 870 | | |
| 30 | 7424 | **15200** | **13056** | 7505 | 3277 | **1987** | **1506** | 899 | 248 | 162 | 191 | **1036** | 996 | **814** | 475 | 384 | 779 | 619 | **1350** | 692 | 590 | 838 | | |
| 31 | 6972 | **10134** | 7456 | 5452 | **3846** | **2327** | **1257** | 954 | 223 | 172 | 204 | 677 | 537 | 625 | 390 | 269 | 770 | 444 | 998 | 437 | 596 | 627 | | |
| 32 | 7393 | 8308 | 7054 | 4705 | **3974** | **2611** | **1304** | 891 | 248 | 157 | 242 | 451 | 339 | 463 | 359 | 304 | 525 | 353 | 850 | 272 | 434 | 500 | | |
| 33 | 7030 | 6551 | 3519 | 4150 | **4831** | 1963 | 1219 | 689 | 268 | 112 | 169 | 321 | 210 | 366 | 331 | 319 | 543 | 262 | 639 | 311 | 300 | 398 | | |
| 34 | 6927 | 6397 | 3891 | 4309 | **4283** | 1347 | 1008 | 672 | 107 | 74 | 75 | 300 | 146 | 221 | 258 | 204 | 527 | 193 | 463 | 208 | 216 | 234 | | |
| 35 | 6520 | 5486 | 3101 | 4286 | **3737** | 1154 | 1035 | 281 | 76 | 54 | 136 | 187 | 77 | 111 | 200 | 111 | 536 | 169 | 312 | 59 | 156 | 181 | | |
| 36 | 4920 | 4398 | 2620 | 3104 | 3474 | 776 | 1041 | 198 | 43 | 47 | 72 | 151 | 38 | 70 | 94 | 76 | 412 | 124 | 162 | 230 | 88 | 101 | | |
| 37 | 4080 | 3047 | 2394 | 2336 | 2914 | 404 | 915 | 220 | 24 | 46 | 65 | 150 | 31 | 26 | 47 | 53 | 105 | 47 | 33 | 105 | 64 | 57 | | |
| 38 | 2441 | 2206 | 1672 | 1582 | 1753 | 366 | 749 | 103 | 27 | 33 | 7 | 113 | 37 | 18 | 16 | 50 | 25 | 36 | 28 | 158 | 44 | 34 | | |
| 39 | 1566 | 1557 | 1748 | 1343 | 2453 | 328 | 488 | 125 | 11 | 29 | 30 | 56 | 17 | 14 | 8 | 31 | 25 | 15 | 34 | 59 | 14 | 2 | | |
| 40 | 946 | 769 | 1024 | 917 | 1151 | 191 | 469 | 45 | 3 | 16 | 2 | 34 | 10 | 7 | 2 | 33 | 7 | 14 | 5 | 137 | 5 | 4 | | |
| 41 | 504 | 581 | 640 | 522 | 517 | 105 | 346 | 38 | 12 | 11 | 4 | 26 | 5 | 1 | | 41 | 34 | 17 | 16 | 65 | 4 | | | |
| 42 | 341 | 345 | 201 | 214 | 476 | 37 | 164 | 46 | 5 | 8 | | 19 | 6 | 2 | | 14 | | 11 | 6 | 61 | 2 | | | |
| 43 | 289 | 264 | 283 | 237 | 118 | 10 | 69 | 18 | 1 | 3 | 1 | 25 | 3 | 5 | 2 | 18 | | 11 | 3 | 52 | 1 | | | |
| 44 | 135 | 130 | 19 | 172 | 170 | 9 | 50 | 3 | 6 | 2 | | 14 | 2 | | | 12 | | 4 | 8 | 26 | 2 | | | |
| 45 | 143 | 73 | 14 | 39 | 26 | 9 | 34 | 2 | 1 | | 2 | 3 | 1 | | 1 | 6 | | 3 | 3 | 5 | 2 | | | |
| 46 | 75 | 32 | 8 | 9 | 17 | | 7 | 4 | 1 | 1 | | 10 | 1 | | | 5 | | 4 | 5 | 20 | | | | |
| 47 | 46 | 16 | | | 17 | | 19 | 1 | 1 | | | 6 | | | | | | 1 | | 7 | 1 | | | |
| 48 | 28 | 12 | 8 | 17 | | | 4 | | | | | | 1 | | | 1 | | 1 | | 10 | | | | |
| 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 | | | | | | | | | | | | | | | |
| mean weight (g) | 464 | 413 | 465 | 460 | 590 | 460 | 386 | 374 | 438 | 435 | 471 | 379 | 379 | 321 | 410 | 250 | 331 | 213 | 321 | 279 | 316 | 222 | | 28.2934 |
| 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 | 26.6 | 24.0 | 27.5 | 27.6 | 27.1 | 24.3 | | 28.2934 |

Table 3c: Length composition (absolute frequencies in'000s) of the 3M redfish total annual catch, 1989-2010 (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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 16 | 12 | | | |
| 11 | | | | 1 | 3 | | 15 | 1056 | 569 | 391 | 390 | 593 | 6275 | 1655 | 913 | 1055 | 18 | 40 | 41 | | | 3 |
| 12 | 3 | | | 1 | 9 | 19 | 36 | 841 | 512 | 1830 | 313 | 1011 | 4996 | 3205 | 1368 | 1498 | 108 | 86 | 133 | | 1 | 9 |
| 13 | 11 | | | 0 | 29 | 338 | 34 | 459 | 164 | 1721 | 286 | 761 | 2126 | 5809 | 2741 | 1229 | 381 | 70 | 172 | | 5 | 28 |
| 14 | 25 | 4 | | 0 | 257 | 979 | 64 | 488 | 120 | 340 | 97 | 182 | 746 | 4660 | 2546 | 1093 | 509 | 91 | 88 | | 5 | 99 |
| 15 | 8 | 73 | | 1 | 1998 | 2232 | 247 | 731 | 119 | 63 | 90 | 90 | 531 | 1946 | 1886 | 1022 | 474 | 112 | 23 | 6 | 37 | 248 |
| 16 | 30 | 190 | | 4 | 7682 | 7312 | 430 | 1713 | 647 | 116 | 86 | 50 | 522 | 865 | 1994 | 999 | 516 | 313 | 18 | 14 | 68 | 341 |
| 17 | 59 | 724 | | 3 | 29380 | 17576 | 758 | 1182 | 184 | 85 | 62 | 22 | 453 | 430 | 2513 | 987 | 423 | 436 | 31 | 12 | 102 | 481 |
| 18 | 30 | 2489 | 156 | 6 | 47422 | 21654 | 1105 | 758 | 61 | 32 | 41 | 27 | 339 | 339 | 1751 | 815 | 285 | 635 | 138 | 47 | 121 | 669 |
| 19 | 11 | 5774 | 647 | 97 | 30110 | 11939 | 1086 | 444 | 68 | 34 | 39 | 35 | 146 | 297 | 657 | 927 | 183 | 1296 | 433 | 166 | 147 | 912 |
| 20 | 111 | 6179 | 1331 | 418 | 6815 | 2807 | 1569 | 428 | 85 | 19 | 14 | 60 | 89 | 265 | 224 | 1398 | 157 | 2168 | 371 | 381 | 226 | 1559 |
| 21 | 383 | 2904 | 1234 | 1987 | 1117 | 745 | 3001 | 1058 | 75 | 39 | 7 | 52 | 91 | 209 | 183 | 1690 | 132 | 3104 | 658 | 622 | 308 | 2254 |
| 22 | 1149 | 1205 | 1179 | 3834 | 697 | 521 | 5922 | 2220 | 82 | 65 | 9 | 105 | 142 | 186 | 93 | 1588 | 159 | 3939 | 490 | 1032 | 535 | 3696 |
| 23 | 3766 | 1927 | 945 | 3016 | 669 | 457 | 5722 | 1641 | 126 | 102 | 6 | 114 | 210 | 187 | 80 | 988 | 216 | 3658 | 720 | 794 | 869 | 3261 |
| 24 | 8408 | 5526 | 1697 | 1690 | 1116 | 701 | 1694 | 1324 | 273 | 135 | 11 | 208 | 288 | 290 | 108 | 857 | 287 | 3179 | 760 | 1198 | 981 | 1671 |
| 25 | 14733 | 11932 | 3737 | 2468 | 1159 | 870 | 1162 | 785 | 328 | 237 | 122 | 317 | 455 | 417 | 272 | 727 | 555 | 2261 | 947 | 787 | 1257 | 1151 |
| 26 | 14793 | 19979 | 6292 | 7519 | 1577 | 1020 | 798 | 513 | 311 | 243 | 112 | 719 | 893 | 513 | 364 | 574 | 724 | 1427 | 1471 | 1760 | 1266 | 848 |
| 27 | 11148 | 25688 | 10368 | 11599 | 1701 | 986 | 957 | 740 | 198 | 217 | 223 | 1322 | 1242 | 672 | 517 | 597 | 927 | 1181 | 1876 | 2050 | 1145 | 775 |
| 28 | 7059 | 26047 | 12852 | 11899 | 2456 | 1688 | 1192 | 758 | 169 | 174 | 303 | 1654 | 1451 | 855 | 536 | 553 | 1057 | 1058 | 1405 | 2306 | 1086 | 886 |
| 29 | 5773 | 20113 | 15100 | 8677 | 2448 | 2039 | 1483 | 855 | 210 | 169 | 301 | 1467 | 1194 | 841 | 589 | 426 | 1111 | 779 | 1348 | 1244 | 877 | 870 |
| 30 | 7424 | 15200 | 13056 | 7505 | 3277 | 1987 | 1509 | 899 | 248 | 162 | 191 | 1036 | 996 | 815 | 475 | 384 | 779 | 619 | 1350 | 692 | 590 | 838 |
| 31 | 6972 | 10134 | 7456 | 5452 | 3846 | 2327 | 1258 | 954 | 223 | 172 | 204 | 677 | 537 | 626 | 390 | 270 | 770 | 444 | 998 | 437 | 596 | 627 |
| 32 | 7393 | 8308 | 7054 | 4705 | 3974 | 2611 | 1304 | 891 | 248 | 158 | 242 | 451 | 339 | 464 | 359 | 304 | 525 | 353 | 850 | 272 | 434 | 500 |
| 33 | 7030 | 6551 | 3519 | 4150 | 4831 | 1963 | 1219 | 689 | 268 | 112 | 169 | 321 | 210 | 366 | 331 | 319 | 543 | 262 | 639 | 311 | 300 | 398 |
| 34 | 6927 | 6397 | 3891 | 4309 | 4283 | 1347 | 1008 | 672 | 107 | 75 | 75 | 300 | 146 | 221 | 258 | 204 | 527 | 193 | 463 | 208 | 216 | 234 |
| 35 | 6520 | 5486 | 3101 | 4286 | 3737 | 1154 | 1035 | 281 | 76 | 54 | 136 | 187 | 77 | 111 | 200 | 111 | 536 | 169 | 312 | 59 | 156 | 181 |
| 36 | 4920 | 4398 | 2620 | 3104 | 3474 | 776 | 1041 | 198 | 43 | 47 | 72 | 151 | 38 | 70 | 94 | 76 | 412 | 124 | 162 | 230 | 88 | 101 |
| 37 | 4080 | 3047 | 2394 | 2336 | 2914 | 404 | 915 | 220 | 24 | 46 | 65 | 150 | 31 | 26 | 47 | 53 | 105 | 47 | 33 | 105 | 64 | 57 |
| 38 | 2441 | 2206 | 1672 | 1582 | 1753 | 366 | 749 | 103 | 27 | 33 | 7 | 113 | 37 | 18 | 16 | 50 | 25 | 36 | 28 | 158 | 44 | 34 |
| 39 | 1566 | 1557 | 1748 | 1343 | 2453 | 328 | 488 | 125 | 11 | 29 | 30 | 56 | 17 | 14 | 8 | 31 | 25 | 15 | 34 | 59 | 14 | 2 |
| 40 | 946 | 769 | 1024 | 917 | 1151 | 191 | 469 | 45 | 3 | 16 | 2 | 34 | 10 | 7 | 2 | 33 | 7 | 14 | 5 | 137 | 5 | 4 |
| 41 | 504 | 581 | 640 | 522 | 517 | 105 | 346 | 38 | 12 | 11 | 4 | 26 | 5 | 1 | | 41 | 34 | 17 | 16 | 65 | 4 | |
| 42 | 341 | 345 | 201 | 214 | 476 | 37 | 164 | 46 | 5 | 8 | | 19 | 6 | 2 | | 14 | | 11 | 6 | 61 | 2 | |
| 43 | 289 | 264 | 283 | 237 | 118 | 10 | 69 | 18 | 1 | 3 | 1 | 25 | 3 | 5 | 2 | 18 | | 11 | 3 | 52 | 1 | |
| 44 | 135 | 130 | 19 | 172 | 170 | 9 | 50 | 3 | 6 | 2 | | 14 | 2 | | | 12 | | 4 | 8 | 26 | 2 | |
| 45 | 143 | 73 | 14 | 39 | 26 | 9 | 34 | 2 | 1 | | 2 | 3 | 1 | | 1 | 6 | | 3 | 3 | 5 | 2 | |
| 46 | 75 | 32 | 8 | 9 | 17 | | 7 | 4 | 1 | 1 | | 10 | 1 | | | 5 | | 4 | 5 | 20 | | |
| 47 | 46 | 16 | | | 17 | | 19 | 1 | 1 | | | 6 | | | | | | 1 | | 7 | 1 | |
| 48 | 28 | 12 | 8 | 17 | | | 4 | | | | | | 1 | | | 1 | | 1 | | 10 | | |
| 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 | | | | | | | | | | | | | |
| number ('000) | 125310 | 196321 | 104246 | 94117 | 173677 | 87505 | 38979 | 30697 | 6180 | 7385 | 6051 | 12800 | 37620 | 28932 | 26441 | 22436 | 12515 | 28179 | 16062 | 15333 | 11556 | 22735 |
| weight (ton) | 58100 | 81000 | 48500 | 43300 | 40970 | 17203 | 13874 | 6339 | 1457 | 1162 | 1164 | 3764 | 3962 | 3701 | 2887 | 3612 | 4148 | 5997 | 5149 | 4277 | 3656 | 5056 |

Table 3d: Catch in numbers at age (' 000) of 3M redfish, 1989-2010, 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 | 2545 | 11722 | 6220 | 1435 | 350 | 478 | 554 | 854 | 1009 | 530 | 642 | 1819 | 337 | 109 | 157 | 57 | 50 | 9 | 54 | 28932 | 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 | 3 | 1228 | 891 | 611 | 311 | 683 | 875 | 1264 | 1462 | 1122 | 820 | 860 | 423 | 418 | 1240 | 126 | 75 | 21 | 84 | 12515 | 2003 |
| 2006 | 16 | 407 | 617 | 2031 | 4853 | 8382 | 5584 | 2388 | 1250 | 521 | 395 | 242 | 191 | 179 | 198 | 725 | 80 | 9 | 112 | 28179 | 2000 |
| 2007 | 12 | 345 | 161 | 442 | 782 | 824 | 4237 | 2165 | 2063 | 630 | 784 | 763 | 347 | 322 | 246 | 1106 | 505 | 32 | 296 | 16062 | 2000 |
| 2008 | 0 | 5 | 31 | 246 | 723 | 2619 | 2553 | 2934 | 2426 | 1095 | 592 | 380 | 226 | 221 | 128 | 120 | 130 | 436 | 467 | 15333 | 2000 |
| 2009 | 0 | 66 | 163 | 434 | 468 | 1419 | 1613 | 1645 | 1455 | 1452 | 741 | 453 | 136 | 304 | 53 | 110 | 35 | 147 | 862 | 11556 | 2001 |
| 2010 | 0 | 1035 | 1015 | 2532 | 5020 | 3894 | 3321 | 916 | 670 | 959 | 1308 | 527 | 478 | 234 | 66 | 113 | 63 | 40 | 545 | 22735 | 2005 |

Table 3e: Weights at age in the catch and by-catch (Kg) of 3M redfish, 1989-2010.

| 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 | | 0.065 | 0.094 | 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 |
| 1994 | | 0.057 | 0.098 | 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 |
| 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 | 0.069 | 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 |
| 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 | 0.066 | 0.115 | 0.165 | 0.227 | 0.265 | 0.328 | 0.359 | 0.423 | 0.491 | 0.450 | 0.577 | 0.601 | 0.623 | 0.703 | 0.643 | 0.866 | 0.877 |
| 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 | 0.223 | 0.274 | 0.338 | 0.377 | 0.456 | 0.513 | 0.558 | 0.445 | 0.610 | 0.681 | 0.586 | 0.724 | 0.897 |
| 2005 | 0.017 | 0.042 | 0.065 | 0.088 | 0.114 | 0.184 | 0.252 | 0.294 | 0.349 | 0.384 | 0.476 | 0.508 | 0.519 | 0.638 | 0.598 | 0.692 | 0.693 | 0.878 | 0.932 |
| 2006 | 0.015 | 0.037 | 0.073 | 0.102 | 0.137 | 0.172 | 0.215 | 0.279 | 0.349 | 0.400 | 0.443 | 0.447 | 0.537 | 0.573 | 0.626 | 0.460 | 0.625 | 0.842 | 1.024 |
| 2007 | 0.015 | 0.028 | 0.050 | 0.107 | 0.130 | 0.146 | 0.251 | 0.277 | 0.354 | 0.392 | 0.453 | 0.493 | 0.515 | 0.527 | 0.538 | 0.441 | 0.547 | 0.701 | 0.757 |
| 2008 | 0.000 | 0.058 | 0.082 | 0.113 | 0.135 | 0.172 | 0.219 | 0.260 | 0.289 | 0.316 | 0.360 | 0.381 | 0.402 | 0.489 | 0.514 | 0.540 | 0.563 | 0.457 | 0.786 |
| 2009 | 0.000 | 0.059 | 0.078 | 0.155 | 0.140 | 0.212 | 0.233 | 0.267 | 0.326 | 0.351 | 0.450 | 0.370 | 0.538 | 0.475 | 0.531 | 0.506 | 0.708 | 0.626 | 0.566 |
| 2010 | 0.000 | 0.064 | 0.094 | 0.122 | 0.155 | 0.180 | 0.221 | 0.276 | 0.310 | 0.358 | 0.392 | 0.442 | 0.492 | 0.501 | 0.530 | 0.575 | 0.497 | 0.529 | 0.589 |

Table 4a: 3M beaked redfish abundance at length ('000s) from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2010 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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | | | 2868 | | | | | | | | | | | | |
| 6 | | 73 | 239 | 1042 | | | | 144 | | | 956 | | | 455 | 1091 | 779 | | | | | 136 | 54 | 61 |
| 7 | 1203 | 160 | 1952 | 39644 | 4931 | 1102 | | 31 | 2453 | | 695 | 291 | | 1240 | 9720 | 6940 | 286 | 499 | 304 | 1547 | 573 | 477 | 544 |
| 8 | 8538 | 1890 | 15439 | 194701 | 117561 | 3160 | | 594 | 12310 | 1359 | 3390 | 2417 | 1883 | 18643 | 14581 | 10410 | 12530 | 5985 | 94129 | 26849 | 5315 | 2640 | 3263 |
| 9 | 8327 | 2007 | 11861 | 90135 | 75875 | 1764 | | 1816 | 6548 | 2887 | 6048 | 12420 | 6848 | 152327 | 44733 | 31940 | 69454 | 8679 | 410980 | 214426 | 4271 | 5731 | 6535 |
| 10 | 7082 | 2894 | 846 | 9088 | 57005 | 7812 | 274 | 1889 | 867 | 1615 | 1573 | 8840 | 5242 | 246451 | 53017 | 37818 | 181225 | 11172 | 569937 | 471628 | 5446 | 3386 | 3861 |
| 11 | 20338 | 8434 | 412 | 17232 | 332037 | 36153 | 1573 | 3397 | 1762 | 4312 | 2626 | 3052 | 4412 | 29300 | 52317 | 37322 | 178289 | 47283 | 83653 | 269398 | 21536 | 5348 | 6099 |
| 12 | 39345 | 20228 | 390 | 18876 | 381332 | 46734 | 2665 | 9269 | 5827 | 12810 | 13751 | 2976 | 15579 | 9424 | 115720 | 82575 | 306313 | 109207 | 93826 | 255837 | 62810 | 7229 | 8244 |
| 13 | 27472 | 21581 | 1062 | 5790 | 90012 | 29392 | 5209 | 4666 | 5993 | 14318 | 22307 | 4851 | 30605 | 16454 | 247642 | 176520 | 217455 | 305354 | 168066 | 460809 | 135178 | 7342 | 7478 |
| 14 | 4000 | 46259 | 1865 | 1174 | 16174 | 79964 | 25338 | 4768 | 8609 | 7064 | 11124 | 4639 | 18860 | 19286 | 292527 | 206474 | 109487 | 563721 | 368890 | 359968 | 146220 | 14300 | 13152 |
| 15 | 802 | 87282 | 2527 | 1706 | 27540 | 165019 | 58046 | 9835 | 16820 | 13161 | 14504 | 19442 | 6447 | 31061 | 99677 | 63031 | 59669 | 496389 | 570816 | 235990 | 109149 | 37040 | 23025 |
| 16 | 1034 | 71271 | 6765 | 8180 | 41045 | 138724 | 130198 | 24357 | 14379 | 23773 | 29969 | 39114 | 4277 | 71951 | 73453 | 45579 | 93021 | 321931 | 705419 | 132602 | 150419 | 74563 | 31410 |
| 17 | 1499 | 22119 | 15552 | 25997 | 9939 | 29763 | 219435 | 64809 | 23877 | 29710 | 20988 | 26097 | 8270 | 56570 | 59348 | 29838 | 130177 | 216267 | 1022160 | 204730 | 200256 | 106859 | 35142 |
| 18 | 1140 | 3665 | 17573 | 47123 | 7593 | 9245 | 230202 | 110934 | 54208 | 30013 | 13414 | 32861 | 19781 | 22594 | 72239 | 31830 | 155247 | 199060 | 785217 | 363584 | 236520 | 147862 | 63068 |
| 19 | 4032 | 2167 | 10349 | 74331 | 14615 | 4970 | 121884 | 144384 | 108902 | 36047 | 14029 | 29489 | 27898 | 12501 | 74283 | 37393 | 179357 | 182684 | 502051 | 489233 | 195040 | 182429 | 88904 |
| 20 | 7430 | 3097 | 2514 | 83897 | 24467 | 3328 | 33879 | 100682 | 153048 | 68928 | 13962 | 20335 | 29190 | 18149 | 55461 | 32007 | 156658 | 169721 | 357550 | 396759 | 241170 | 274446 | 108084 |
| 21 | 16559 | 4479 | 1078 | 40486 | 46504 | 3306 | 16450 | 38742 | 135158 | 101923 | 18530 | 14731 | 24042 | 24890 | 28013 | 24617 | 86575 | 163284 | 189221 | 256720 | 256356 | 244424 | 138243 |
| 22 | 33994 | 9816 | 3011 | 10581 | 70167 | 5125 | 8472 | 9863 | 83283 | 98256 | 33310 | 17528 | 21181 | 25754 | 23745 | 16788 | 48011 | 179265 | 120687 | 144663 | 241869 | 209744 | 150168 |
| 23 | 68369 | 18570 | 10028 | 3744 | 51568 | 7222 | 7632 | 3978 | 37902 | 62655 | 56319 | 29378 | 18209 | 17298 | 19916 | 14445 | 29273 | 132897 | 99934 | 101176 | 141913 | 137275 | 112686 |
| 24 | 102943 | 33229 | 13236 | 3855 | 23847 | 8078 | 9824 | 3261 | 17322 | 24171 | 57007 | 61585 | 29389 | 15498 | 21186 | 26716 | 18368 | 81899 | 76563 | 71205 | 106627 | 138138 | 74872 |
| 25 | 108959 | 50665 | 28825 | 7720 | 10049 | 5812 | 11309 | 3704 | 7875 | 9733 | 33609 | 75417 | 54137 | 14734 | 16263 | 52455 | 11706 | 41610 | 57756 | 42237 | 61464 | 93215 | 61323 |
| 26 | 79514 | 60423 | 42888 | 9638 | 12417 | 5431 | 9941 | 4600 | 4102 | 5921 | 14895 | 57490 | 76085 | 18293 | 14695 | 74506 | 11260 | 32227 | 25060 | 38613 | 45511 | 49136 | 37645 |
| 27 | 33899 | 49923 | 41939 | 9642 | 16819 | 4256 | 6971 | 4265 | 5830 | 4280 | 5807 | 20106 | 78418 | 17465 | 13793 | 77547 | 8280 | 18476 | 13669 | 25283 | 31512 | 37652 | 24648 |
| 28 | 13963 | 31600 | 28902 | 8402 | 18154 | 4326 | 8135 | 4642 | 4150 | 3998 | 2710 | 6614 | 54137 | 13151 | 12150 | 53878 | 7280 | 12570 | 8322 | 13766 | 20128 | 19937 | 16266 |
| 29 | 6818 | 17451 | 16287 | 5836 | 12743 | 3066 | 6925 | 4694 | 4325 | 2790 | 1258 | 2472 | 21494 | 7232 | 9235 | 20825 | 5204 | 8890 | 5071 | 8331 | 10536 | 19353 | 10922 |
| 30 | 9150 | 10747 | 9819 | 4833 | 11009 | 2882 | 4765 | 4493 | 2995 | 3195 | 828 | 804 | 4582 | 5003 | 5643 | 4343 | 3753 | 7874 | 5648 | 9541 | 3737 | 6364 | 6414 |
| 31 | 7567 | 8245 | 7209 | 3513 | 7557 | 2362 | 3995 | 3479 | 2489 | 1977 | 959 | 701 | 1715 | 1439 | 2210 | 1384 | 2651 | 3273 | 2393 | 3284 | 5765 | 4025 | 2468 |
| 32 | 8886 | 9234 | 6686 | 3034 | 4866 | 1882 | 3611 | 2792 | 2280 | 1514 | 762 | 652 | 890 | 782 | 818 | 510 | 1835 | 2954 | 1722 | 2100 | 1171 | 2631 | 1586 |
| 33 | 8570 | 6908 | 5710 | 3287 | 4450 | 2012 | 2463 | 2304 | 2050 | 1291 | 619 | 470 | 1120 | 337 | 572 | 1097 | 1132 | 1085 | 1340 | 3374 | 1034 | 2360 | 1450 |
| 34 | 7451 | 6529 | 6333 | 3279 | 4276 | 1660 | 1613 | 1897 | 1410 | 981 | 517 | 401 | 578 | 405 | 286 | 630 | 762 | 736 | 479 | 909 | 371 | 175 | 572 |
| 35 | 5646 | 6544 | 4312 | 2567 | 3486 | 1536 | 1468 | 1591 | 948 | 590 | 293 | 347 | 382 | 199 | 122 | 305 | 323 | 310 | 383 | 238 | 312 | 1587 | 151 |
| 36 | 4929 | 5410 | 3975 | 2295 | 2635 | 1518 | 1039 | 1441 | 757 | 544 | 310 | 221 | 388 | 161 | 113 | 363 | 166 | 174 | 192 | 71 | 29 | 563 | 60 |
| 37 | 3631 | 3912 | 3065 | 1811 | 2014 | 1425 | 590 | 1205 | 568 | 305 | 194 | 134 | 357 | 67 | 68 | 320 | 108 | 29 | | 20 | 29 | 249 | 50 |
| 38 | 3166 | 2501 | 2223 | 1488 | 1620 | 904 | 549 | 717 | 402 | 212 | 142 | 81 | 67 | 80 | 54 | 58 | 98 | 29 | 96 | 10 | 39 | 46 | 30 |
| 39 | 3092 | 4145 | 2425 | 1739 | 2156 | 1392 | 520 | 932 | 471 | 212 | 168 | 78 | 131 | 67 | 27 | 131 | | 19 | | | 29 | 46 | 101 |
| 40 | 2090 | 2908 | 1634 | 1079 | 1410 | 831 | 379 | 493 | 266 | 143 | 65 | 39 | 87 | 27 | 14 | 87 | | | 95 | 10 | 20 | 1657 | |
| 41 | 1499 | 1192 | 842 | 471 | 586 | 378 | 225 | 433 | 243 | 124 | 77 | 26 | 44 | 54 | 14 | 44 | 10 | | | | 10 | 37 | |
| 42 | 665 | 742 | 421 | 367 | 426 | 362 | 84 | 313 | 162 | 37 | 26 | 26 | | 13 | 14 | | | | | | 10 | | 10 |
| 43 | 253 | 291 | 253 | 179 | 165 | 103 | 28 | 156 | 69 | 0 | 65 | 13 | 29 | 40 | 14 | | | | | | | | |
| 44 | 84 | 87 | 51 | 53 | 165 | 168 | 28 | 36 | 23 | 25 | 26 | | 15 | | | 15 | | | | | | | |
| 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 | 1201521 | 2085973 | 3325555 | 6341632 | 4604910 | 2442512 | 1838324 | 1038539 |

Table 4b: 3M beaked redfish abundance at age ('000s) from EU bottom trawl survey series, 1989-2010.

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 18068 | 94236 | 10657 | 19600 | 28673 | 105880 | 172047 | 106189 | 37983 | 18147 | 11580 | 7031 | 6836 | 6017 | 5102 | 2919 | 2365 | 2162 | 8533 | 541062 | 1981 |
| 1989 | 4130 | 53137 | 219406 | 19357 | 8071 | 35188 | 89946 | 89433 | 43605 | 21698 | 12392 | 7202 | 6537 | 5939 | 5301 | 3013 | 2467 | 2189 | 9812 | 638823 | 1986 |
| 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 | 263495 | 762656 | 301339 | 144934 | 430153 | 104119 | 34399 | 17197 | 8318 | 4654 | 2365 | 1301 | 1182 | 8772 | 72 | 232 | 250 | 42 | 492 | 2085973 | 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 |
| 2009 | 14963 | 89897 | 180844 | 353754 | 396975 | 290371 | 250188 | 127865 | 59244 | 37189 | 9903 | 10772 | 1017 | 3811 | 480 | 752 | 300 | 1352 | 8645 | 1838324 | 2004 |
| 2010 | 14325 | 111084 | 88995 | 187503 | 250123 | 157413 | 138615 | 34940 | 18552 | 15351 | 12900 | 4018 | 1728 | 910 | 286 | 310 | 209 | 145 | 1189 | 1038598 | 2005 |

Table 4c: 3M beaked redfish mature female abundance at age ('000s) from EU bottom trawl survey series, 1989-2010.

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | | | | 124 | 456 | 3852 | 11667 | 11447 | 6085 | 3947 | 3723 | 2798 | 3047 | 2824 | 2606 | 1536 | 1405 | 1278 | 6465 | 63260 | 1981 |
| 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 | | | | 155 | 1043 | 1945 | 5179 | 7552 | 6024 | 3076 | 1340 | 684 | 7277 | 277 | 36 | 295 | 124 | 69 | 716 | 35793 | 1990 |
| 2004 | | | | 41 | 1431 | 2676 | 3028 | 2990 | 2112 | 1528 | 1100 | 749 | 785 | 3754 | 57 | 161 | 165 | 31 | 333 | 20942 | 1990 |
| 2005 | | | | 1628 | 2581 | 13745 | 11962 | 11076 | 7139 | 4410 | 2717 | 2266 | 921 | 469 | 1840 | 33 | 26 | 12 | 9 | 60834 | 1999 |
| 2006 | | | | 4246 | 5755 | 11696 | 12617 | 8104 | 4431 | 1675 | 1265 | 750 | 554 | 394 | 430 | 2012 | 131 | 23 | 187 | 54269 | 1999 |
| 2007 | | | | 2236 | 4799 | 4890 | 29711 | 14750 | 11948 | 2989 | 3319 | 2194 | 1166 | 1072 | 519 | 5111 | 1297 | 9 | 353 | 86362 | 2000 |
| 2008 | | | | 1138 | 3490 | 20273 | 23927 | 21308 | 13256 | 5989 | 2827 | 1638 | 986 | 590 | 144 | 69 | 53 | 1667 | 50 | 97404 | 2001 |
| 2009 | | | | 5054 | 4452 | 16405 | 18890 | 18985 | 16470 | 16945 | 6487 | 5358 | 838 | 2691 | 321 | 591 | 280 | 1205 | 6647 | 121620 | 2001 |
| 2010 | | | | 2012 | 4546 | 8402 | 21248 | 11573 | 8155 | 8378 | 8127 | 2652 | 1301 | 678 | 249 | 263 | 154 | 127 | 912 | 78778 | 2003 |

Table 4d: annual maturity ogives for 3M beaked redfish as the relative abundance of mature females at each age, from the EU survey abundance at age 1988-2010.

| Year\Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | | | | 0.006 | 0.016 | 0.036 | 0.068 | 0.108 | 0.160 | 0.218 | 0.322 | 0.398 | 0.446 | 0.469 | 0.511 | 0.526 | 0.594 | 0.591 | 0.758 |
| 1989 | | | | 0.002 | 0.019 | 0.044 | 0.086 | 0.131 | 0.168 | 0.194 | 0.272 | 0.360 | 0.445 | 0.476 | 0.513 | 0.518 | 0.584 | 0.562 | 0.797 |
| 1990 | | | | 0.001 | 0.023 | 0.048 | 0.096 | 0.146 | 0.187 | 0.213 | 0.293 | 0.399 | 0.498 | 0.525 | 0.574 | 0.581 | 0.599 | 0.590 | 0.707 |
| 1991 | | | | 0.000 | 0.004 | 0.046 | 0.103 | 0.188 | 0.258 | 0.345 | 0.421 | 0.489 | 0.537 | 0.584 | 0.626 | 0.696 | 0.675 | 0.683 | 0.772 |
| 1992 | | | | 0.000 | 0.011 | 0.025 | 0.075 | 0.164 | 0.256 | 0.327 | 0.370 | 0.411 | 0.488 | 0.541 | 0.576 | 0.682 | 0.650 | 0.789 | 0.795 |
| 1993 | | | | 0.000 | 0.012 | 0.046 | 0.088 | 0.157 | 0.212 | 0.260 | 0.300 | 0.310 | 0.370 | 0.417 | 0.425 | 1.096 | 0.684 | 0.696 | 0.659 |
| 1994 | | | | 0.000 | 0.003 | 0.046 | 0.085 | 0.148 | 0.201 | 0.305 | 0.317 | 0.320 | 0.320 | 0.426 | 0.409 | 0.523 | 0.628 | 0.656 | 0.687 |
| 1995 | | | | 0.001 | 0.001 | 0.043 | 0.102 | 0.153 | 0.213 | 0.279 | 0.312 | 0.310 | 0.320 | 0.363 | 0.370 | 0.477 | 0.490 | 0.580 | 0.781 |
| 1996 | | | | 0.000 | 0.007 | 0.006 | 0.128 | 0.203 | 0.268 | 0.352 | 0.418 | 0.458 | 0.525 | 0.531 | 0.555 | 0.598 | 0.642 | 0.649 | 0.700 |
| 1997 | | | | 0.000 | 0.002 | 0.035 | 0.028 | 0.460 | 0.493 | 0.456 | 0.472 | 0.477 | 0.483 | 0.482 | 0.478 | 0.525 | 0.546 | 0.545 | 0.643 |
| 1998 | | | | 0.000 | 0.004 | 0.018 | 0.052 | 0.042 | 0.201 | 0.247 | 0.301 | 0.325 | 0.334 | 0.386 | 0.332 | 0.392 | 0.451 | 0.318 | 0.665 |
| 1999 | | | | 0.000 | 0.003 | 0.030 | 0.067 | 0.121 | 0.099 | 0.228 | 0.399 | 0.454 | 0.396 | 0.372 | 0.411 | 0.391 | 0.510 | 0.457 | 0.639 |
| 2000 | | | | 0.000 | 0.005 | 0.023 | 0.065 | 0.141 | 0.257 | 0.175 | 0.458 | 0.350 | 0.614 | 0.412 | 0.546 | 0.682 | 0.720 | 0.647 | 0.619 |
| 2001 | | | | 0.000 | 0.011 | 0.031 | 0.073 | 0.137 | 0.215 | 0.354 | 0.249 | 0.392 | 0.355 | 0.376 | 0.360 | 0.365 | 0.361 | 0.369 | 0.749 |
| 2002 | | | | 0.001 | 0.008 | 0.034 | 0.064 | 0.117 | 0.178 | 0.373 | 0.374 | 0.384 | 0.531 | 0.503 | 0.468 | 0.345 | 0.433 | 0.417 | 0.436 |
| 2003 | | | | 0.002 | 0.012 | 0.079 | 0.354 | 0.698 | 0.865 | 0.774 | 0.600 | 0.517 | 0.657 | 0.596 | 0.677 | 1.187 | 0.453 | 1.330 | 1.071 |
| 2004 | | | | 0.000 | 0.003 | 0.026 | 0.088 | 0.174 | 0.254 | 0.328 | 0.465 | 0.576 | 0.664 | 0.428 | 0.784 | 0.695 | 0.660 | 0.758 | 0.676 |
| 2005 | | | | 0.004 | 0.009 | 0.029 | 0.097 | 0.235 | 0.348 | 0.406 | 0.550 | 0.589 | 0.554 | 0.716 | 0.603 | 0.514 | 0.568 | 0.592 | 0.571 |
| 2006 | | | | 0.003 | 0.008 | 0.031 | 0.094 | 0.212 | 0.369 | 0.452 | 0.511 | 0.471 | 0.565 | 0.601 | 0.725 | 0.483 | 0.615 | 0.959 | 0.871 |
| 2007 | | | | 0.004 | 0.007 | 0.013 | 0.105 | 0.222 | 0.477 | 0.787 | 0.866 | 0.922 | 0.939 | 0.934 | 0.902 | 0.761 | 0.856 | 0.656 | 0.877 |
| 2008 | | | | 0.003 | 0.008 | 0.036 | 0.134 | 0.323 | 0.488 | 0.616 | 0.677 | 0.707 | 0.709 | 0.737 | 0.557 | 0.438 | 0.406 | 0.732 | 0.454 |
| 2009 | | | | 0.014 | 0.011 | 0.056 | 0.076 | 0.148 | 0.278 | 0.456 | 0.655 | 0.497 | 0.824 | 0.706 | 0.668 | 0.785 | 0.933 | 0.892 | 0.769 |
| 2010 | | | | 0.011 | 0.018 | 0.053 | 0.153 | 0.331 | 0.440 | 0.546 | 0.630 | 0.660 | 0.753 | 0.745 | 0.871 | 0.847 | 0.739 | 0.874 | 0.767 |

Table 4e: Weights at age of the 3M beaked redfish stock (Kg) from EU surveys, 1988-2010.

| Year\Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | 0.017 | 0.040 | 0.093 | 0.158 | 0.185 | 0.220 | 0.252 | 0.282 | 0.317 | 0.362 | 0.456 | 0.523 | 0.563 | 0.583 | 0.623 | 0.638 | 0.696 | 0.697 | 0.847 |
| 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 | 0.685 | 0.543 | 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 | 0.088 | 0.114 | 0.157 | 0.215 | 0.265 | 0.337 | 0.401 | 0.431 | 0.429 | 0.492 | 0.533 | 0.588 | 0.422 | 0.551 | 0.839 | 0.773 |
| 2007 | 0.015 | 0.030 | 0.058 | 0.109 | 0.120 | 0.137 | 0.205 | 0.250 | 0.314 | 0.397 | 0.457 | 0.520 | 0.542 | 0.539 | 0.523 | 0.399 | 0.489 | 0.730 | 0.553 |
| 2008 | 0.014 | 0.043 | 0.074 | 0.101 | 0.130 | 0.168 | 0.218 | 0.275 | 0.325 | 0.369 | 0.415 | 0.438 | 0.442 | 0.492 | 0.567 | 0.605 | 0.591 | 0.448 | 0.769 |
| 2009 | 0.015 | 0.056 | 0.081 | 0.117 | 0.133 | 0.177 | 0.190 | 0.227 | 0.260 | 0.319 | 0.396 | 0.326 | 0.543 | 0.436 | 0.476 | 0.501 | 0.676 | 0.817 | 0.532 |
| 2010 | 0.013 | 0.058 | 0.095 | 0.118 | 0.151 | 0.182 | 0.219 | 0.263 | 0.290 | 0.325 | 0.364 | 0.387 | 0.457 | 0.451 | 0.622 | 0.527 | 0.473 | 0.518 | 0.517 |

Table 4f: Weights at age of the 3M mature female beaked redfish stock (Kg) from EU surveys, 1988-2010.

| Year\Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1988 | | | | 0.180 | 0.198 | 0.235 | 0.268 | 0.307 | 0.354 | 0.403 | 0.480 | 0.537 | 0.572 | 0.593 | 0.631 | 0.645 | 0.711 | 0.711 | 0.853 |
| 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 | 0.886 |
| 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 | | | | 0.098 | 0.127 | 0.208 | 0.244 | 0.272 | 0.320 | 0.344 | 0.396 | 0.456 | 0.344 | 0.576 | 0.584 | 0.675 | 0.590 | 0.694 | 0.782 |
| 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 | | | | 0.108 | 0.131 | 0.189 | 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 | | | | 0.098 | 0.138 | 0.198 | 0.239 | 0.288 | 0.352 | 0.406 | 0.447 | 0.440 | 0.511 | 0.540 | 0.595 | 0.441 | 0.545 | 0.839 | 0.804 |
| 2007 | | | | 0.118 | 0.143 | 0.163 | 0.265 | 0.290 | 0.367 | 0.400 | 0.461 | 0.522 | 0.543 | 0.539 | 0.524 | 0.408 | 0.490 | 0.730 | 0.554 |
| 2008 | | | | 0.115 | 0.156 | 0.204 | 0.247 | 0.292 | 0.333 | 0.376 | 0.425 | 0.442 | 0.438 | 0.475 | 0.539 | 0.565 | 0.539 | 0.442 | 0.624 |
| 2009 | | | | 0.168 | 0.139 | 0.219 | 0.236 | 0.270 | 0.317 | 0.331 | 0.401 | 0.336 | 0.552 | 0.448 | 0.494 | 0.506 | 0.676 | 0.852 | 0.565 |
| 2010 | | | | 0.123 | 0.159 | 0.205 | 0.244 | 0.274 | 0.297 | 0.331 | 0.368 | 0.397 | 0.461 | 0.456 | 0.638 | 0.523 | 0.479 | 0.518 | 0.519 |

Table 5a: 3M beaked redfish survey mean catch per tow from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2010 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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **mean weight per tow** (Kg/tow) | 199 | 159 | 109 | 85 | 147 | 68 | 125 | 90 | 125 | 104 | 74 | 103 | 146 | 78 | 129 | 59 | 185 | 297 | 532 | 279 | 224 | 342 | 178 |
| **SE** | 32 | 21 | 13 | 10 | 17 | 24 | 38 | 10 | 17 | 18 | 12 | 30 | 57 | 12 | 17 | 7 | 26 | 53 | 79 | 43 | 45 | 92 | 34 |
| **CV** | 16% | 13% | 12% | 12% | 12% | 36% | 30% | 11% | 14% | 18% | 16% | 29% | 39% | 16% | 13% | 12% | 14% | 18% | 15% | 15% | 20% | 27% | 19% |

Table 5b: 3M beaked redfish year class strenght, total stock, exploitable stock and female spwanning stock from EU bottom trawl survey series.
1988-2002 by RV Cornide Saavedra (CS), 2003-2010 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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **year class strengh at age 4** (millions) | 20 | 19 | 25 | 155 | 58 | 306 | 678 | 115 | 25 | 86 | 35 | 80 | 33 | 86 | 236 | 65 | 145 | 425 | 1528 | 538 | 442 | 354 | 188 |
| **abundance** (millions) | 664 | 639 | 331 | 749 | 1509 | 623 | 936 | 582 | 731 | 571 | 401 | 496 | 567 | 869 | 1435 | 1202 | 2086 | 3326 | 6342 | 4605 | 2443 | 1838 | 1039 |
| **4+abundance** (millions) | 541 | 362 | 265 | 367 | 385 | 376 | 840 | 497 | 657 | 502 | 284 | 410 | 471 | 273 | 437 | 227 | 759 | 1402 | 2854 | 1971 | 1708 | 1553 | 824 |
| **biomass** ('000 ton) | 160 | 128 | 89 | 72 | 119 | 78 | 105 | 73 | 100 | 84 | 60 | 82 | 118 | 64 | 107 | 132 | 157 | 302 | 485 | 386 | 308 | 286 | 162 |
| **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 | 266 | 147 |
| **spawning biomass** ('000 ton) | 28 | 28 | 23 | 12 | 16 | 8 | 7 | 6 | 6 | 6 | 3 | 8 | 18 | 6 | 7 | 11 | 8 | 17 | 14 | 27 | 28 | 38 | 23 |
| **ssb proportion** | 18% | 22% | 25% | 16% | 13% | 10% | 6% | 9% | 6% | 8% | 5% | 9% | 16% | 9% | 6% | 8% | 5% | 6% | 3% | 7% | 9% | 13% | 13% |

| | | | | | |
|---|---|---|---|---|---|
| Table 6: Input files for 2011 XSA assessment. | | | | | |
| | | | | | |
| REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2011 | | | | | |
| 1 | | | | | |
| red3mla.txt | | | | | |
| red3mcn.txt | | | | | |
| red3mcw.txt | | | | | |
| red3msw.txt | | | | | |
| red3mnm.txt | | | | | |
| red3mmo.txt | | | | | |
| red3mpf.txt | | | | | |
| red3mpm.txt | | | | | |
| red3mfo.txt | | | | | |
| red3mfn.txt | | | | | |
| red3mtun.txt | | | | | |

| | | | |
|---|---|---|---|
| REDFISH NAFO 3M LANDINGS tons | | | |
| 1 | 1 | | |
| 1989 | 2010 | | |
| 4 | 19 | | |
| 5 | | | |
| 58086 | | | |
| 80223 | | | |
| 48500 | | | |
| 43300 | | | |
| 43100 | | | |
| 17664 | | | |
| 13879 | | | |
| 6101 | | | |
| 1408 | | | |
| 1011 | | | |
| 1095 | | | |
| 3665 | | | |
| 3327 | | | |
| 2964 | | | |
| 2273 | | | |
| 3260 | | | |
| 4039 | | | |
| 5936 | | | |
| 5131 | | | |
| 4274 | | | |
| 3639 | | | |
| 4894 | | | |

| REDFISH NAFO 3M CATCH NUMBERS thousands | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 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 |
| 1435 | 350 | 478 | 554 | 854 | 1009 | 530 | 642 | 1819 | 337 | 109 | 157 | 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 |
| 611 | 311 | 683 | 875 | 1264 | 1462 | 1122 | 820 | 860 | 423 | 418 | 1240 | 126 | 75 | 21 | 84 |
| 2031 | 4853 | 8382 | 5584 | 2388 | 1250 | 521 | 395 | 242 | 191 | 179 | 198 | 725 | 80 | 9 | 112 |
| 442 | 782 | 824 | 4237 | 2165 | 2063 | 630 | 784 | 763 | 347 | 322 | 246 | 1106 | 505 | 32 | 296 |
| 246 | 723 | 2619 | 2553 | 2934 | 2426 | 1095 | 592 | 380 | 226 | 221 | 128 | 120 | 130 | 436 | 467 |
| 434 | 468 | 1419 | 1613 | 1645 | 1455 | 1452 | 741 | 453 | 136 | 304 | 53 | 110 | 35 | 147 | 862 |
| 2532 | 5020 | 3894 | 3321 | 916 | 670 | 959 | 1308 | 527 | 478 | 234 | 66 | 113 | 63 | 40 | 545 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDFISH NAFO 3M CATCH WEIGHT AT AGE kg | | | | | | | | | | | | | | | |
| 1 | 3 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 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 |
| 0.115 | 0.165 | 0.227 | 0.265 | 0.328 | 0.359 | 0.423 | 0.491 | 0.450 | 0.577 | 0.601 | 0.623 | 0.703 | 0.643 | 0.866 | 0.877 |
| 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 | 0.114 | 0.184 | 0.252 | 0.294 | 0.349 | 0.384 | 0.476 | 0.508 | 0.519 | 0.638 | 0.598 | 0.692 | 0.693 | 0.878 | 0.932 |
| 0.102 | 0.137 | 0.172 | 0.215 | 0.279 | 0.349 | 0.400 | 0.443 | 0.447 | 0.537 | 0.573 | 0.626 | 0.460 | 0.625 | 0.842 | 1.024 |
| 0.107 | 0.130 | 0.146 | 0.251 | 0.277 | 0.354 | 0.392 | 0.453 | 0.493 | 0.515 | 0.527 | 0.538 | 0.441 | 0.547 | 0.701 | 0.757 |
| 0.113 | 0.135 | 0.172 | 0.219 | 0.260 | 0.289 | 0.316 | 0.360 | 0.381 | 0.402 | 0.489 | 0.514 | 0.540 | 0.563 | 0.457 | 0.786 |
| 0.155 | 0.140 | 0.212 | 0.233 | 0.267 | 0.326 | 0.351 | 0.450 | 0.370 | 0.538 | 0.475 | 0.531 | 0.506 | 0.708 | 0.626 | 0.566 |
| 0.122 | 0.155 | 0.180 | 0.221 | 0.276 | 0.310 | 0.358 | 0.392 | 0.442 | 0.492 | 0.501 | 0.530 | 0.575 | 0.497 | 0.529 | 0.589 |

| REDFISH NAFO 3M STOCK WEIGHT AT AGE kg | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 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 | 0.685 | 0.543 | 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 |
| 0.088 | 0.114 | 0.157 | 0.215 | 0.265 | 0.337 | 0.401 | 0.431 | 0.429 | 0.492 | 0.533 | 0.588 | 0.422 | 0.551 | 0.839 | 0.773 |
| 0.109 | 0.120 | 0.137 | 0.205 | 0.250 | 0.314 | 0.397 | 0.457 | 0.520 | 0.542 | 0.539 | 0.523 | 0.399 | 0.489 | 0.730 | 0.553 |
| 0.101 | 0.130 | 0.168 | 0.218 | 0.275 | 0.325 | 0.369 | 0.415 | 0.438 | 0.442 | 0.492 | 0.567 | 0.605 | 0.591 | 0.448 | 0.769 |
| 0.117 | 0.133 | 0.177 | 0.190 | 0.227 | 0.260 | 0.319 | 0.396 | 0.326 | 0.543 | 0.436 | 0.476 | 0.501 | 0.676 | 0.817 | 0.532 |
| 0.118 | 0.151 | 0.182 | 0.219 | 0.263 | 0.290 | 0.325 | 0.364 | 0.387 | 0.457 | 0.451 | 0.622 | 0.527 | 0.473 | 0.518 | 0.517 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDFISH NAFO 3M NATURAL MORTALITY (standard run) | | | | | | | | | | | | | | | |
| 1 | 5 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 4 | 19 | | | | | | | | | | | | | | |
| 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 0.1 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDFISH NAFO 3M PROPORTION MATURE AT AGE | | | | | | | | | | | | | | | |
| 1 | 6 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 4 | 19 | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | |
| 0.006 | 0.016 | 0.036 | 0.068 | 0.108 | 0.160 | 0.218 | 0.322 | 0.398 | 0.446 | 0.469 | 0.511 | 0.526 | 0.594 | 0.591 | 0.758 |
| 0.002 | 0.019 | 0.044 | 0.086 | 0.131 | 0.168 | 0.194 | 0.272 | 0.360 | 0.445 | 0.476 | 0.513 | 0.518 | 0.584 | 0.562 | 0.797 |
| 0.001 | 0.023 | 0.048 | 0.096 | 0.146 | 0.187 | 0.213 | 0.293 | 0.399 | 0.498 | 0.525 | 0.574 | 0.581 | 0.599 | 0.590 | 0.707 |
| 0.000 | 0.004 | 0.046 | 0.103 | 0.188 | 0.258 | 0.345 | 0.421 | 0.489 | 0.537 | 0.584 | 0.626 | 0.696 | 0.675 | 0.683 | 0.772 |
| 0.000 | 0.011 | 0.025 | 0.075 | 0.164 | 0.256 | 0.327 | 0.370 | 0.411 | 0.488 | 0.541 | 0.576 | 0.682 | 0.650 | 0.789 | 0.795 |
| 0.000 | 0.012 | 0.046 | 0.088 | 0.157 | 0.212 | 0.260 | 0.300 | 0.310 | 0.370 | 0.417 | 0.425 | 1.096 | 0.684 | 0.696 | 0.659 |
| 0.000 | 0.003 | 0.046 | 0.085 | 0.148 | 0.201 | 0.305 | 0.317 | 0.320 | 0.320 | 0.426 | 0.409 | 0.523 | 0.628 | 0.656 | 0.687 |
| 0.001 | 0.001 | 0.043 | 0.102 | 0.153 | 0.213 | 0.279 | 0.312 | 0.310 | 0.320 | 0.363 | 0.370 | 0.477 | 0.490 | 0.580 | 0.781 |
| 0.000 | 0.007 | 0.006 | 0.128 | 0.203 | 0.268 | 0.352 | 0.418 | 0.458 | 0.525 | 0.531 | 0.555 | 0.598 | 0.642 | 0.649 | 0.700 |
| 0.000 | 0.002 | 0.035 | 0.028 | 0.460 | 0.493 | 0.456 | 0.472 | 0.477 | 0.483 | 0.482 | 0.478 | 0.525 | 0.546 | 0.545 | 0.643 |
| 0.000 | 0.004 | 0.018 | 0.052 | 0.042 | 0.201 | 0.247 | 0.301 | 0.325 | 0.334 | 0.386 | 0.332 | 0.392 | 0.451 | 0.318 | 0.665 |
| 0.000 | 0.003 | 0.030 | 0.067 | 0.121 | 0.099 | 0.228 | 0.399 | 0.454 | 0.396 | 0.372 | 0.411 | 0.391 | 0.510 | 0.457 | 0.639 |
| 0.000 | 0.005 | 0.023 | 0.065 | 0.141 | 0.257 | 0.175 | 0.458 | 0.350 | 0.614 | 0.412 | 0.546 | 0.682 | 0.720 | 0.647 | 0.619 |
| 0.000 | 0.011 | 0.031 | 0.073 | 0.137 | 0.215 | 0.354 | 0.249 | 0.392 | 0.355 | 0.376 | 0.360 | 0.365 | 0.361 | 0.369 | 0.749 |
| 0.001 | 0.008 | 0.034 | 0.064 | 0.117 | 0.178 | 0.373 | 0.374 | 0.384 | 0.531 | 0.503 | 0.468 | 0.345 | 0.433 | 0.417 | 0.436 |
| 0.002 | 0.012 | 0.079 | 0.354 | 0.698 | 0.865 | 0.774 | 0.600 | 0.517 | 0.657 | 0.596 | 0.677 | 1.187 | 0.453 | 1.330 | 1.071 |
| 0.000 | 0.003 | 0.026 | 0.088 | 0.174 | 0.254 | 0.328 | 0.465 | 0.576 | 0.664 | 0.428 | 0.784 | 0.695 | 0.660 | 0.758 | 0.676 |
| 0.004 | 0.009 | 0.029 | 0.097 | 0.235 | 0.348 | 0.406 | 0.550 | 0.589 | 0.554 | 0.716 | 0.603 | 0.514 | 0.568 | 0.592 | 0.571 |
| 0.003 | 0.008 | 0.031 | 0.094 | 0.212 | 0.369 | 0.452 | 0.511 | 0.471 | 0.565 | 0.601 | 0.725 | 0.483 | 0.615 | 0.959 | 0.871 |
| 0.004 | 0.007 | 0.013 | 0.105 | 0.222 | 0.477 | 0.787 | 0.866 | 0.922 | 0.939 | 0.934 | 0.902 | 0.761 | 0.856 | 0.656 | 0.877 |
| 0.003 | 0.008 | 0.036 | 0.134 | 0.323 | 0.488 | 0.616 | 0.677 | 0.707 | 0.709 | 0.737 | 0.557 | 0.438 | 0.406 | 0.732 | 0.454 |
| 0.014 | 0.011 | 0.056 | 0.076 | 0.148 | 0.278 | 0.456 | 0.655 | 0.497 | 0.824 | 0.706 | 0.668 | 0.785 | 0.933 | 0.892 | 0.769 |
| 0.011 | 0.018 | 0.053 | 0.153 | 0.331 | 0.440 | 0.546 | 0.630 | 0.660 | 0.753 | 0.745 | 0.871 | 0.847 | 0.739 | 0.874 | 0.767 |

| REDFISH NAFO 3M F ON OLDEST AGE GROUP BY YEAR | | | | | |
|---|---|---|---|---|---|
| 1 | 9 | | | | |
| 1989 | 2010 | | | | |
| 4 | 19 | | | | |
| 5 | | | | | |
| 0.844 | | | | | |
| 1.039 | | | | | |
| 1.106 | | | | | |
| 0.774 | | | | | |
| 2.267 | | | | | |
| 0.731 | | | | | |
| 0.996 | | | | | |
| 0.346 | | | | | |
| 0.069 | | | | | |
| 0.089 | | | | | |
| 0.253 | | | | | |
| 0.491 | | | | | |
| 0.364 | | | | | |
| 0.249 | | | | | |
| 0.426 | | | | | |
| 0.366 | | | | | |
| 0.593 | | | | | |
| 0.399 | | | | | |
| 1.856 | | | | | |
| 0.055 | | | | | |
| 0.770 | | | | | |
| 0.770 | | | | | |

| REDFISH NAFO 3M PROPORTION OF F BEFORE SPAWNING | | | | | |
|---|---|---|---|---|---|
| 1 | 7 | | | | |
| 1989 | 2010 | | | | |
| 4 | 19 | | | | |
| 3 | | | | | |
| 0.08 | | | | | |

| REDFISH NAFO 3M PROPORTION OF M BEFORE SPAWNING | | | | | |
|---|---|---|---|---|---|
| 1 | 8 | | | | |
| 1989 | 2010 | | | | |
| 4 | 19 | | | | |
| 3 | | | | | |
| 0.08 | | | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDFISH NAFO 3M F AT AGE IN LAST YEAR | | | | | | | | | | | | | | | |
| 1 | 10 | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | |
| 4 | 19 | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | |
| 0.0033 | 0.0152 | 0.0421 | 0.0744 | 0.0656 | 0.1005 | 0.0766 | 0.1151 | 0.1299 | 0.1013 | 0.1358 | 0.1358 | 0.6667 | 0.5384 | 0.77 | 0.77 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REDFISH NAFO 3M SURVEY TUNNING DATA | | | | | | | | | | | | | | | | |
| 101 | | | | | | | | | | | | | | | | |
| EU BOTTOM TRAWL SURVEY | | | | | | | | | | | | | | | | |
| 1989 | 2010 | | | | | | | | | | | | | | | |
| 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 | 144934 | 430153 | 104119 | 34399 | 17197 | 8318 | 4654 | 2365 | 1301 | 1182 | 8772 | 72 | 232 | 250 | 42 | 492 |
| 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 |
| 10555 | 353754 | 396975 | 290371 | 250188 | 127865 | 59244 | 37189 | 9903 | 10772 | 1017 | 3811 | 480 | 752 | 300 | 1352 | 8645 |
| 10555 | 187503 | 250123 | 157413 | 138615 | 34940 | 18552 | 15351 | 12900 | 4018 | 1728 | 910 | 286 | 310 | 209 | 145 | 1189 |

| Table 7a: 2006-2010 Increase of instant rate of natural mortality (M) for ages 4-6 and 7+ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| Ages 4-6 | Cod numbers* | Cod increase | M annual | **M** | | Ages 4-6 | Cod biomass* | Cod increase | M annual | **M** |
| 2005 | 6404 | | 0.095 | **0.10** | | 2005 | 5004 | | 0.095 | **0.10** |
| 2006 | 16558 | 2.586 | 0.246 | **0.28** | | 2006 | 8383 | 1.675 | 0.159 | **0.17** |
| 2007 | 24788 | 1.497 | 0.368 | **0.46** | | 2007 | 16755 | 1.999 | 0.319 | **0.38** |
| 2008 | 29065 | 1.173 | 0.432 | **0.57** | | 2008 | 26711 | 1.594 | 0.508 | **0.71** |
| 2009 | 35165 | 1.210 | 0.523 | **0.74** | | 2009 | 39702 | 1.486 | 0.755 | **1.00** |
| 2010 | 38044 | 1.082 | 0.565 | **0.83** | | 2010 | 70256 | 1.770 | 1.336 | **1.00** |
| | | | | | | | | | | |
| Ages 7+ | Cod numbers* | Cod increase | M annual | **M** | | Ages 7+ | Cod biomass* | Cod increase | M annual | **M** |
| 2008 | 29065 | | 0.0951626 | **0.10** | | 2008 | 26711 | | 0.0951626 | **0.10** |
| 2009 | 35165 | 1.209874419 | 0.1151348 | **0.12** | | 2009 | 39702 | 1.486353937 | 0.1414453 | **0.15** |
| 2010 | 38044 | 1.081871179 | 0.124561 | **0.13** | | 2010 | 70256 | 1.769583396 | 0.2502992 | **0.29** |
| | | | | | | | | | | |
| * Gonzalez *et al.* , 2010 | | | | | | | | | | |

| Table 7b: Goodness of fit of XSA2010 for several M options between 2006 and 2010. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $M_{ages4-6,2006-2010;7+,2009-2010}$ | 0.1 | 0.2 | 0.3 | 0.4 | 0.45 | 0.5 | 0.55 | 0.6 | 0.7 | 0.8 | $M_{codBincrease}$ | $M_{codNincrease}$ | 0.9 | 1.0 |
| SS log q resiuals$_{2006-2010}$ | 29.89 | 27.37 | 25.56 | 24.27 | 23.89 | 23.69 | 23.68 | 23.84 | 24.57 | 25.94 | 26.39 | 26.73 | 28.00 | 30.80 |
| no iteractions | 50 | 51 | 51 | 52 | 52 | 52 | 52 | 52 | 52 | 51 | 51 | 51 | 51 | 51 |

Table 7c: Key diagnostics of five $XSA_{2010}$ runs with M ranging from 0.40 to 0.60 for ages 4 - 6 through 2006 - 2010, and ages 7+ on 2009 and 2011.

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

| M\Ages | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Av. se log q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.40 | 0.777 | 1.270 | 0.925 | 0.638 | 0.721 | 0.735 | 0.731 | 0.591 | 0.696 | 0.526 | 0.702 | 0.686 | 0.758 | 0.887 | 0.382 | 0.691 |
| 0.45 | 0.778 | 1.266 | 0.920 | 0.635 | 0.714 | 0.731 | 0.731 | 0.591 | 0.695 | 0.526 | 0.704 | 0.685 | 0.758 | 0.888 | 0.383 | 0.689 |
| 0.50 | 0.782 | 1.263 | 0.915 | 0.633 | 0.708 | 0.728 | 0.732 | 0.591 | 0.694 | 0.526 | 0.707 | 0.684 | 0.759 | 0.889 | 0.383 | 0.688 |
| 0.55 | 0.787 | 1.260 | 0.910 | 0.631 | 0.702 | 0.725 | 0.732 | 0.592 | 0.694 | 0.527 | 0.710 | 0.683 | 0.760 | 0.890 | 0.383 | 0.688 |
| 0.60 | 0.795 | 1.258 | 0.906 | 0.629 | 0.697 | 0.722 | 0.734 | 0.593 | 0.694 | 0.528 | 0.714 | 0.683 | 0.761 | 0.891 | 0.383 | 0.687 |

Internal st errors of survivors at age

| M\Ages | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Av. $se_{int}$ surv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.40 | 0.794 | 0.677 | 0.551 | 0.421 | 0.366 | 0.329 | 0.302 | 0.272 | 0.255 | 0.233 | 0.229 | 0.218 | 0.214 | 0.216 | 0.212 | 0.294 |
| 0.45 | 0.796 | 0.678 | 0.550 | 0.420 | 0.364 | 0.327 | 0.301 | 0.271 | 0.254 | 0.232 | 0.228 | 0.217 | 0.213 | 0.215 | 0.211 | 0.293 |
| 0.50 | 0.799 | 0.680 | 0.550 | 0.419 | 0.363 | 0.326 | 0.300 | 0.270 | 0.254 | 0.232 | 0.227 | 0.217 | 0.212 | 0.214 | 0.209 | 0.292 |
| 0.55 | 0.805 | 0.683 | 0.550 | 0.419 | 0.362 | 0.325 | 0.299 | 0.269 | 0.253 | 0.231 | 0.227 | 0.216 | 0.212 | 0.214 | 0.208 | 0.291 |
| 0.60 | 0.813 | 0.687 | 0.552 | 0.419 | 0.361 | 0.325 | 0.299 | 0.269 | 0.253 | 0.231 | 0.227 | 0.216 | 0.212 | 0.213 | 0.207 | 0.291 |

External st errors of survivors at age

| M\Ages | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | Av. $se_{ext}$ surv |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.40 | | 0.030 | 0.101 | 0.050 | 0.327 | 0.218 | 0.215 | 0.216 | 0.128 | 0.172 | 0.102 | 0.161 | 0.105 | 0.141 | 0.157 | 0.161 |
| 0.45 | | 0.047 | 0.095 | 0.067 | 0.303 | 0.206 | 0.214 | 0.217 | 0.126 | 0.174 | 0.102 | 0.159 | 0.102 | 0.141 | 0.158 | 0.159 |
| 0.50 | | 0.065 | 0.094 | 0.091 | 0.280 | 0.197 | 0.213 | 0.219 | 0.126 | 0.176 | 0.102 | 0.157 | 0.101 | 0.141 | 0.159 | 0.158 |
| 0.55 | | 0.082 | 0.100 | 0.118 | 0.259 | 0.189 | 0.213 | 0.221 | 0.126 | 0.178 | 0.103 | 0.155 | 0.099 | 0.142 | 0.160 | 0.159 |
| 0.60 | | 0.100 | 0.112 | 0.145 | 0.240 | 0.184 | 0.214 | 0.223 | 0.126 | 0.181 | 0.105 | 0.154 | 0.098 | 0.142 | 0.162 | 0.160 |

S difference between internal and external st errors of survivors at age

| M\Ages | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | SS ($se_{int}$-$se_{ext}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.40 | | 0.419 | 0.203 | 0.138 | 0.002 | 0.012 | 0.008 | 0.003 | 0.016 | 0.004 | 0.016 | 0.003 | 0.012 | 0.006 | 0.003 | 0.843 |
| 0.45 | | 0.398 | 0.207 | 0.125 | 0.004 | 0.015 | 0.008 | 0.003 | 0.016 | 0.003 | 0.016 | 0.003 | 0.012 | 0.005 | 0.003 | 0.818 |
| 0.50 | | 0.378 | 0.208 | 0.108 | 0.007 | 0.017 | 0.008 | 0.003 | 0.016 | 0.003 | 0.016 | 0.004 | 0.012 | 0.005 | 0.003 | 0.786 |
| 0.55 | | 0.361 | 0.203 | 0.091 | 0.011 | 0.018 | 0.007 | 0.002 | 0.016 | 0.003 | 0.015 | 0.004 | 0.013 | 0.005 | 0.002 | 0.751 |
| 0.60 | | 0.345 | 0.194 | 0.075 | 0.015 | 0.020 | 0.007 | 0.002 | 0.016 | 0.003 | 0.015 | 0.004 | 0.013 | 0.005 | 0.002 | 0.715 |

Table 8: Extended Survivor Analysis summary of diagnostics for 2011 (Lowestoft VPA Version 3.1).

| | | | | | | |
|---|---|---|---|---|---|---|
| single EU survey, 1989-2010 | | | | | | |
| M=0.1 all ages 1989-2005 | | | | | | |
| M=0.4 ages 4-6 2006-2010 and ages 7+ 2009-2010 | | | | | | |
| | | | | | | |
| REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2011 | | | | | | |
| CPUE data from file red3mtun.txt | | | | | | |
| | | | | | | |
| Catch data for 22 years. 1989 to 2010. Ages 4 to 19. | | | | | | |
| | | | | | | |
| Fleet | Fi | Last | First | Last | Alpha | Beta |
| | year | year | age | age | | |
| EU BOTTOM TRAWL SURV | 1989 | 2010 | 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 52 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 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | **-1.99** | **-1.34** | 0.95 | 0.02 | 0.81 | 0.86 | 0.57 | -0.18 | 0.86 | 0.01 | 0.62 | -0.27 | 0.24 | 0.59 | -1.22 | -0.87 | -0.16 | 0.61 | -0.1 | 0 | -0.02 | 0 |
| 5 | **-3.15** | **-3.88** | 0.6 | 1.16 | -1.16 | 0.57 | 0.55 | **1.32** | 1.32 | -0.01 | 0.37 | 0.45 | 0.29 | 0 | -0.32 | 0.79 | -0.09 | 0.68 | 0.14 | 0.03 | 0.27 | 0.05 |
| 6 | **-1.93** | **-2.13** | **-1.66** | 0.49 | -0.27 | 0.26 | -1 | 1.05 | 0.71 | 0.89 | 0.33 | 0.56 | 0.27 | 0.37 | -0.71 | 0.13 | 1.08 | 0.55 | 0.5 | 0.47 | 0.16 | -0.14 |
| 7 | -0.99 | -0.95 | **-1.45** | -0.32 | -0.85 | 0.31 | -0.06 | -0.02 | 0.74 | 0.02 | 1.01 | 0.8 | 0.4 | 0.21 | -0.5 | -0.1 | 0.58 | 0.12 | 0.73 | 0.12 | 0.22 | -0.02 |
| 8 | -0.45 | -0.42 | **-1.49** | -0.09 | -0.86 | -0.1 | 0.15 | 0.78 | -0.39 | 0.52 | 0.64 | **1.87** | 0.41 | 0.57 | -0.42 | 0.08 | 0.65 | -0.19 | -0.16 | -0.33 | 0.33 | -1.09 |
| 9 | -0.43 | -0.4 | **-1.44** | -0.12 | -1.55 | 0.24 | -0.22 | 0.75 | 0.75 | -0.11 | 1.15 | 1.07 | 0.4 | 0.86 | -0.06 | -0.2 | 0.84 | -0.2 | -0.1 | -0.58 | 0.2 | -0.86 |
| 10 | -0.49 | -0.36 | **-1.54** | -0.23 | -0.73 | 0.18 | 0.66 | 0.07 | 0.94 | -0.68 | 0.9 | **1.82** | -0.27 | 0.43 | -0.03 | 0.1 | 0.68 | -0.25 | -0.79 | -0.49 | 0.43 | -0.34 |
| 11 | -0.46 | -0.52 | -1.07 | -0.41 | -0.5 | 0.54 | 1.09 | 1 | 0.01 | -0.48 | -0.88 | 0.83 | 0.48 | -0.32 | 0.15 | -0.1 | 0.69 | -0.31 | 0.3 | -0.25 | 0.12 | 0.11 |
| 12 | -0.76 | -0.82 | -1.16 | -0.42 | -0.59 | 0.39 | 0.84 | **1.34** | 1.1 | 0.56 | -0.42 | -0.02 | 0.01 | 0.02 | -0.98 | -0.19 | 0.67 | -0.2 | -0.11 | 0.03 | 1.03 | -0.33 |
| 13 | -0.37 | -0.42 | -0.82 | -0.31 | -0.23 | 0.17 | 0.87 | 0.92 | 1.15 | -0.01 | 0.23 | -0.75 | 0.1 | 0.3 | 0.17 | -0.73 | 0.53 | -0.21 | -0.03 | -0.22 | -0.24 | -0.09 |
| 14 | -0.54 | -0.23 | -0.86 | -0.44 | -0.29 | -0.1 | 0.26 | 1.2 | 1.12 | 0.32 | -0.78 | 1.42 | -0.55 | -0.26 | 0.5 | -0.02 | -1.26 | -0.24 | 0.06 | -0.36 | 1.04 | 0.04 |
| 15 | 0.29 | -0.05 | -1.04 | 0.17 | 0.13 | 0.45 | **1.61** | 0.61 | 0.47 | -0.66 | 1.07 | 0.17 | 0.37 | 0.57 | -0.74 | -0.65 | -0.53 | -0.81 | 0.29 | -0.83 | -0.17 | -0.7 |
| 16 | -0.1 | -0.28 | -0.96 | -0.2 | -0.63 | -0.4 | 0.8 | **1.61** | -0.64 | -0.12 | 0.43 | 0.03 | 0.18 | -0.57 | 0.88 | 0.77 | -0.68 | -0.41 | **1.66** | -1.09 | 0.23 | -0.5 |
| 17 | -0.27 | 0.17 | -0.41 | -0.78 | -0.25 | -0.64 | 0.02 | 0.76 | 1.69 | -0.35 | 0.47 | -0.36 | 0.02 | -0.35 | 1.13 | 1.56 | -0.02 | **1.4** | -1.27 | -1.88 | -0.08 | -0.56 |
| 18 | 0 | 0.05 | -0.01 | 0.09 | 0.48 | 0.2 | 0.36 | 0.16 | -0.22 | -0.62 | 0.13 | -0.45 | -0.31 | -0.6 | -0.07 | -0.3 | -0.29 | 0.06 | -0.12 | -0.7 | 0.85 | -0.3 |

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 | -8.2484 | -8.2281 | -8.303 | -8.4344 | -8.6738 | -8.9931 | -9.3668 | -9.632 | -9.6264 | -9.8234 | -9.6962 | -10.056 | -9.6703 | -9.6508 | -9.6508 |
| S.E(Log q) | 0.7767 | 1.2698 | 0.9247 | 0.638 | 0.721 | 0.735 | 0.7313 | 0.5909 | 0.6956 | 0.526 | 0.7015 | 0.6862 | 0.7575 | 0.8869 | 0.3819 |

| 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 | 1.06 | -0.338 | 8.1 | 0.64 | 22 | 0.84 | -8.25 |
| 5 | 1.27 | -0.768 | 7.58 | 0.29 | 22 | 1.63 | -8.23 |
| 6 | 1.15 | -0.65 | 7.99 | 0.48 | 22 | 1.08 | -8.3 |
| 7 | 1.2 | -1.259 | 8.09 | 0.66 | 22 | 0.76 | -8.43 |
| 8 | 1.48 | -2.381 | 8.11 | 0.56 | 22 | 0.96 | -8.67 |
| 9 | 1.38 | -1.948 | 8.81 | 0.57 | 22 | 0.95 | -8.99 |
| 10 | 1.18 | -1.017 | 9.41 | 0.63 | 22 | 0.86 | -9.37 |
| 11 | 1.17 | -1.236 | 9.78 | 0.73 | 22 | 0.68 | -9.63 |
| 12 | 1.53 | -3.055 | 10.29 | 0.62 | 22 | 0.9 | -9.63 |
| 13 | 1.27 | -2.557 | 10.32 | 0.82 | 22 | 0.59 | -9.82 |
| 14 | 1.25 | -1.772 | 10.2 | 0.72 | 22 | 0.83 | -9.7 |
| 15 | 1.09 | -0.754 | 10.3 | 0.78 | 22 | 0.76 | -10.06 |
| 16 | 1.17 | -1.257 | 10.14 | 0.72 | 22 | 0.88 | -9.67 |
| 17 | 1.6 | -3.634 | 11.54 | 0.65 | 22 | 1.13 | -9.65 |
| 18 | 0.92 | 1.912 | 9.43 | 0.96 | 22 | 0.32 | -9.73 |

Terminal year survivor and F summaries :

| **Age 4** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2006** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 55776 | 0.794 | 0 | 0 | 1 | 1 | 0.036 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 55776 | 0.79 | 0 | 1 | 0 | 0.036 | | |

| **Age 5** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2005** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 68801 | 0.677 | 0.03 | 0.04 | 2 | 1 | 0.058 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 68801 | 0.68 | 0.03 | 2 | 0.044 | 0.058 | | |

| **Age 6** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2004** | | | | | | | |
| | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 56595 | 0.551 | 0.101 | 0.18 | 3 | 1 | 0.055 |
| | | | | | | | |
| Weighted prediction : | | | | | | | |
| | | | | | | | |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 56595 | 0.55 | 0.1 | 3 | 0.184 | 0.055 | | |

| **Age 7** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2003** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 50113 | 0.421 | 0.05 | 0.12 | 4 | 1 | 0.053 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 50113 | 0.42 | 0.05 | 4 | 0.119 | 0.053 | | |

| **Age 8** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2002** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 47930 | 0.366 | 0.327 | 0.89 | 5 | 1 | 0.016 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 47930 | 0.37 | 0.33 | 5 | 0.894 | 0.016 | | |

| **Age 9** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2001** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 27546 | 0.329 | 0.218 | 0.66 | 6 | 1 | 0.02 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 27546 | 0.33 | 0.22 | 6 | 0.661 | 0.02 | | |

| **Age 10** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 2000** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 19662 | 0.302 | 0.215 | 0.71 | 7 | 1 | 0.039 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 19662 | 0.3 | 0.22 | 7 | 0.712 | 0.039 | | |

| **Age 11** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 1999** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 13509 | 0.272 | 0.216 | 0.79 | 8 | 1 | 0.076 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 13509 | 0.27 | 0.22 | 8 | 0.795 | 0.076 | | |

| **Age 12** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 1998** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 6520 | 0.255 | 0.128 | 0.5 | 9 | 1 | 0.064 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 6520 | 0.26 | 0.13 | 9 | 0.5 | 0.064 | | |

| **Age 13** Catchability constant w.r.t. time and dependent on age | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Year class = 1997** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 2587 | 0.233 | 0.172 | 0.74 | 10 | 1 | 0.141 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 2587 | 0.23 | 0.17 | 10 | 0.74 | 0.141 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Age 14** Catchability constant w.r.t. time and dependent on age | | | | | | | |
| **Year class = 1996** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 1043 | 0.229 | 0.102 | 0.45 | 11 | 1 | 0.169 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 1043 | 0.23 | 0.1 | 11 | 0.447 | 0.169 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Age 15** Catchability constant w.r.t. time and dependent on age | | | | | | | |
| **Year class = 1995** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 1039 | 0.218 | 0.161 | 0.74 | 12 | 1 | 0.051 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 1039 | 0.22 | 0.16 | 12 | 0.738 | 0.051 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Age 16** Catchability constant w.r.t. time and dependent on age | | | | | | | |
| **Year class = 1994** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 598 | 0.214 | 0.105 | 0.49 | 13 | 1 | 0.144 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 598 | 0.21 | 0.1 | 13 | 0.489 | 0.144 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Age 17** Catchability constant w.r.t. time and dependent on age | | | | | | | |
| **Year class = 1993** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 427 | 0.216 | 0.141 | 0.65 | 14 | 1 | 0.114 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 427 | 0.22 | 0.14 | 14 | 0.652 | 0.114 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Age 18** Catchability constant w.r.t. time and age (fixed at the value for age) 17 | | | | | | | |
| **Year class = 1992** | | | | | | | |
| Fleet | | Int | Ext | Var | N | Scaled | Estimated |
| | | s.e | s.e | Ratio | | Weights | F |
| EU BOTTOM TRAWL SURV | 227 | 0.212 | 0.157 | 0.74 | 15 | 1 | 0.134 |
| Survivors | Int | Ext | N | Var | F | | |
| at end of year | s.e | s.e | | Ratio | | | |
| 227 | 0.21 | 0.16 | 15 | 0.739 | 0.135 | | |

Table 9a: XSA retrospective analysis, 2010-2006

| **Biomass** | **XSA** | | | | | **SSB** | **XSA** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2011 | 2010 | 2009 | 2008 | 2007 | Year | 2011 | 2010 | 2009 | 2008 | 2007 |
| 1989 | 217 | 217 | 212 | 213 | 210 | 1989 | 51 | 51 | 48 | 48 | 47 |
| 1990 | 186 | 185 | 181 | 182 | 180 | 1990 | 44 | 44 | 42 | 42 | 41 |
| 1991 | 133 | 133 | 130 | 130 | 129 | 1991 | 37 | 37 | 35 | 35 | 35 |
| 1992 | 98 | 98 | 96 | 96 | 95 | 1992 | 36 | 36 | 34 | 34 | 33 |
| 1993 | 67 | 67 | 66 | 66 | 65 | 1993 | 21 | 21 | 20 | 20 | 20 |
| 1994 | 44 | 44 | 42 | 44 | 45 | 1994 | 9 | 9 | 9 | 9 | 8 |
| 1995 | 35 | 35 | 32 | 35 | 35 | 1995 | 7 | 7 | 7 | 7 | 6 |
| 1996 | 24 | 24 | 21 | 24 | 25 | 1996 | 4 | 4 | 3 | 4 | 3 |
| 1997 | 22 | 22 | 20 | 23 | 24 | 1997 | 5 | 5 | 4 | 4 | 4 |
| 1998 | 24 | 24 | 21 | 26 | 27 | 1998 | 8 | 8 | 7 | 8 | 9 |
| 1999 | 24 | 24 | 21 | 26 | 28 | 1999 | 4 | 4 | 3 | 4 | 4 |
| 2000 | 28 | 29 | 25 | 31 | 33 | 2000 | 5 | 5 | 5 | 5 | 6 |
| 2001 | 28 | 29 | 26 | 32 | 34 | 2001 | 7 | 7 | 6 | 8 | 9 |
| 2002 | 32 | 34 | 29 | 37 | 41 | 2002 | 6 | 7 | 6 | 8 | 8 |
| 2003 | 35 | 37 | 32 | 40 | 44 | 2003 | 7 | 7 | 6 | 8 | 9 |
| 2004 | 54 | 56 | 49 | 64 | 63 | 2004 | 17 | 18 | 15 | 19 | 21 |
| 2005 | 73 | 81 | 71 | 93 | 88 | 2005 | 12 | 12 | 10 | 15 | 17 |
| 2006 | 109 | 135 | 128 | 157 | 159 | 2006 | 13 | 14 | 12 | 16 | 17 |
| 2007 | 124 | 150 | 140 | 169 | | 2007 | 16 | 17 | 15 | 20 | |
| 2008 | 142 | 170 | 155 | | | 2008 | 33 | 36 | 29 | | |
| 2009 | 135 | 158 | | | | 2009 | 31 | 36 | | | |
| 2010 | 121 | | | | | 2010 | 25 | | | | |

| **FBAR** | **XSA** | | | | | **REC** | **XSA** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | 2011 | 2010 | 2009 | 2008 | 2007 | Year | 2011 | 2010 | 2009 | 2008 | 2007 |
| 1989 | 0.32 | 0.32 | 0.33 | 0.33 | 0.34 | 1989 | 54 | 54 | 54 | 54 | 54 |
| 1990 | 0.49 | 0.49 | 0.50 | 0.50 | 0.51 | 1990 | 42 | 42 | 42 | 42 | 42 |
| 1991 | 0.37 | 0.37 | 0.38 | 0.38 | 0.38 | 1991 | 24 | 24 | 24 | 24 | 24 |
| 1992 | 0.57 | 0.58 | 0.59 | 0.58 | 0.59 | 1992 | 22 | 22 | 22 | 22 | 22 |
| 1993 | 0.67 | 0.67 | 0.69 | 0.69 | 0.70 | 1993 | 139 | 139 | 139 | 139 | 140 |
| 1994 | 0.47 | 0.47 | 0.49 | 0.48 | 0.49 | 1994 | 145 | 145 | 136 | 158 | 169 |
| 1995 | 0.71 | 0.72 | 0.76 | 0.75 | 0.77 | 1995 | 26 | 27 | 22 | 25 | 23 |
| 1996 | 0.55 | 0.55 | 0.60 | 0.59 | 0.61 | 1996 | 13 | 13 | 13 | 16 | 17 |
| 1997 | 0.15 | 0.15 | 0.17 | 0.16 | 0.17 | 1997 | 14 | 15 | 14 | 17 | 18 |
| 1998 | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 1998 | 13 | 14 | 14 | 16 | 17 |
| 1999 | 0.13 | 0.13 | 0.15 | 0.15 | 0.16 | 1999 | 16 | 18 | 16 | 18 | 19 |
| 2000 | 0.25 | 0.25 | 0.27 | 0.26 | 0.27 | 2000 | 16 | 17 | 17 | 18 | 17 |
| 2001 | 0.17 | 0.17 | 0.19 | 0.17 | 0.17 | 2001 | 26 | 28 | 23 | 25 | 29 |
| 2002 | 0.20 | 0.20 | 0.22 | 0.20 | 0.20 | 2002 | 51 | 54 | 51 | 62 | 71 |
| 2003 | 0.16 | 0.16 | 0.17 | 0.16 | 0.15 | 2003 | 85 | 84 | 73 | 92 | 102 |
| 2004 | 0.12 | 0.11 | 0.13 | 0.11 | 0.11 | 2004 | 133 | 146 | 134 | 186 | 122 |
| 2005 | 0.19 | 0.18 | 0.21 | 0.17 | 0.16 | 2005 | 191 | 244 | 225 | 272 | 231 |
| 2006 | 0.09 | 0.09 | 0.10 | 0.08 | 0.08 | 2006 | 377 | 573 | 608 | 688 | 787 |
| 2007 | 0.17 | 0.15 | 0.26 | 0.15 | | 2007 | 267 | 288 | 252 | 274 | |
| 2008 | 0.08 | 0.07 | 0.08 | | | 2008 | 200 | 229 | 200 | | |
| 2009 | 0.06 | 0.05 | | | | 2009 | 163 | 171 | | | |
| 2010 | 0.08 | | | | | 2010 | 86 | | | | |

Table 9b: Compairision of the consistency of the most recent XSA assessments based on the retrospective ratios of biomass and fishing mortality.

**Biomass 4+** 1yr revision

| XSA's | 2011/2010 | 2010/2009 | 2009/2008 | 2008/2007 |
|---|---|---|---|---|
| Year 1989 | 0.0016 | 0.0237 | -0.0030 | 0.0105 |
| 1990 | 0.0013 | 0.0224 | -0.0032 | 0.0102 |
| 1991 | 0.0014 | 0.0230 | -0.0028 | 0.0100 |
| 1992 | 0.0013 | 0.0276 | -0.0037 | 0.0126 |
| 1993 | 0.0007 | 0.0233 | -0.0032 | 0.0107 |
| 1994 | 0.0000 | 0.0493 | -0.0476 | -0.0111 |
| 1995 | -0.0011 | 0.0852 | -0.0769 | -0.0091 |
| 1996 | -0.0048 | 0.1157 | -0.1268 | -0.0308 |
| 1997 | -0.0072 | 0.1475 | -0.1636 | -0.0411 |
| 1998 | -0.0115 | 0.1408 | -0.1791 | -0.0557 |
| 1999 | -0.0221 | 0.1355 | -0.1874 | -0.0597 |
| 2000 | -0.0217 | 0.1338 | -0.1829 | -0.0543 |
| 2001 | -0.0297 | 0.1426 | -0.1980 | -0.0710 |
| 2002 | -0.0390 | 0.1441 | -0.2092 | -0.0888 |
| 2003 | -0.0338 | 0.1562 | -0.2123 | -0.0895 |
| 2004 | -0.0461 | 0.1448 | -0.2345 | 0.0179 |
| 2005 | -0.0963 | 0.1294 | -0.2278 | 0.0567 |
| 2006 | -0.1923 | 0.0516 | -0.1871 | -0.0118 |
| 2007 | -0.1698 | 0.0720 | -0.1755 | |
| 2008 | -0.1626 | 0.0957 | | |
| 2009 | -0.1498 | | | |

**Biomass 4+** 2yr revision

| XSA's | 2011/2009 | 2010/2008 | 2009/2007 |
|---|---|---|---|
| Year 1989 | 0.0254 | 0.0206 | 0.0074 |
| 1990 | 0.0237 | 0.0191 | 0.0070 |
| 1991 | 0.0244 | 0.0201 | 0.0071 |
| 1992 | 0.0290 | 0.0238 | 0.0089 |
| 1993 | 0.0240 | 0.0200 | 0.0074 |
| 1994 | 0.0492 | -0.0007 | -0.0582 |
| 1995 | 0.0840 | 0.0017 | -0.0853 |
| 1996 | 0.1103 | -0.0258 | -0.1537 |
| 1997 | 0.1392 | -0.0403 | -0.1980 |
| 1998 | 0.1276 | -0.0636 | -0.2249 |
| 1999 | 0.1104 | -0.0772 | -0.2359 |
| 2000 | 0.1091 | -0.0736 | -0.2273 |
| 2001 | 0.1086 | -0.0836 | -0.2549 |
| 2002 | 0.0995 | -0.0953 | -0.2795 |
| 2003 | 0.1172 | -0.0892 | -0.2828 |
| 2004 | 0.0921 | -0.1236 | -0.2208 |
| 2005 | 0.0207 | -0.1278 | -0.1840 |
| 2006 | -0.1506 | -0.1451 | -0.1967 |
| 2007 | -0.1100 | -0.1161 | |
| 2008 | -0.0825 | | |

**Biomass 4+** 3yr revision

| XSA's | 2011/2008 | 2010/2007 |
|---|---|---|
| Year 1989 | 0.0223 | 0.0313 |
| 1990 | 0.0205 | 0.0295 |
| 1991 | 0.0215 | 0.0303 |
| 1992 | 0.0252 | 0.0367 |
| 1993 | 0.0206 | 0.0309 |
| 1994 | -0.0007 | -0.0118 |
| 1995 | 0.0006 | -0.0074 |
| 1996 | -0.0305 | -0.0558 |
| 1997 | -0.0472 | -0.0797 |
| 1998 | -0.0744 | -0.1158 |
| 1999 | -0.0977 | -0.1323 |
| 2000 | -0.0937 | -0.1239 |
| 2001 | -0.1109 | -0.1487 |
| 2002 | -0.1306 | -0.1756 |
| 2003 | -0.1200 | -0.1707 |
| 2004 | -0.1640 | -0.1079 |
| 2005 | -0.2118 | -0.0784 |
| 2006 | -0.3095 | -0.1552 |
| 2007 | -0.2662 | |

**SSB** 1yr revision

| XSA's | 2011/2010 | 2010/2009 | 2009/2008 | 2008/2007 |
|---|---|---|---|---|
| Year 1989 | 0.0043 | 0.0630 | -0.0080 | 0.0282 |
| 1990 | 0.0035 | 0.0603 | -0.0088 | 0.0283 |
| 1991 | 0.0030 | 0.0495 | -0.0061 | 0.0219 |
| 1992 | 0.0023 | 0.0510 | -0.0070 | 0.0238 |
| 1993 | 0.0008 | 0.0518 | -0.0077 | 0.0268 |
| 1994 | 0.0036 | 0.0892 | -0.0139 | 0.0411 |
| 1995 | 0.0029 | 0.1232 | -0.0212 | 0.0615 |
| 1996 | 0.0058 | 0.1521 | -0.0455 | 0.0431 |
| 1997 | 0.0117 | 0.1872 | -0.0938 | 0.0051 |
| 1998 | 0.0019 | 0.1556 | -0.1805 | -0.0743 |
| 1999 | -0.0063 | 0.1508 | -0.1746 | -0.0578 |
| 2000 | -0.0030 | 0.1727 | -0.1740 | -0.0515 |
| 2001 | -0.0170 | 0.1734 | -0.2488 | -0.0955 |
| 2002 | -0.0255 | 0.1944 | -0.2685 | -0.0968 |
| 2003 | -0.0313 | 0.2186 | -0.2849 | -0.0932 |
| 2004 | -0.0401 | 0.1862 | -0.2199 | -0.0710 |
| 2005 | -0.0436 | 0.2115 | -0.3009 | -0.1177 |
| 2006 | -0.0632 | 0.1957 | -0.2637 | |
| 2007 | -0.0694 | 0.1810 | -0.2729 | |
| 2008 | -0.0707 | 0.2176 | | |
| 2009 | -0.1252 | | | |

**SSB** 2yr revision

| XSA's | 2011/2009 | 2010/2008 | 2009/2007 |
|---|---|---|---|
| Year 1989 | 0.0676 | 0.0545 | 0.0199 |
| 1990 | 0.0640 | 0.0510 | 0.0193 |
| 1991 | 0.0526 | 0.0430 | 0.0156 |
| 1992 | 0.0534 | 0.0437 | 0.0166 |
| 1993 | 0.0526 | 0.0437 | 0.0189 |
| 1994 | 0.0931 | 0.0741 | 0.0266 |
| 1995 | 0.1265 | 0.0994 | 0.0390 |
| 1996 | 0.1588 | 0.0998 | -0.0043 |
| 1997 | 0.2011 | 0.0758 | -0.0893 |
| 1998 | 0.1578 | -0.0531 | -0.2415 |
| 1999 | 0.1435 | -0.0501 | -0.2223 |
| 2000 | 0.1692 | -0.0313 | -0.2165 |
| 2001 | 0.1535 | -0.1185 | -0.3205 |
| 2002 | 0.1639 | -0.1263 | -0.3393 |
| 2003 | 0.1805 | -0.1286 | -0.3516 |
| 2004 | 0.1387 | -0.0747 | -0.2754 |
| 2005 | 0.1586 | -0.1531 | -0.3832 |
| 2006 | 0.1201 | -0.1196 | -0.3276 |
| 2007 | 0.0991 | -0.1413 | |
| 2008 | 0.1315 | | |

**SSB** 3yr revision

| XSA's | 2011/2008 | 2010/2007 |
|---|---|---|
| Year 1989 | 0.0590 | 0.0842 |
| 1990 | 0.0547 | 0.0808 |
| 1991 | 0.0461 | 0.0658 |
| 1992 | 0.0461 | 0.0685 |
| 1993 | 0.0445 | 0.0717 |
| 1994 | 0.0779 | 0.1182 |
| 1995 | 0.1026 | 0.1670 |
| 1996 | 0.1061 | 0.1472 |
| 1997 | 0.0883 | 0.0812 |
| 1998 | -0.0513 | -0.1235 |
| 1999 | -0.0561 | -0.1051 |
| 2000 | -0.0343 | -0.0812 |
| 2001 | -0.1335 | -0.2027 |
| 2002 | -0.1486 | -0.2108 |
| 2003 | -0.1558 | -0.2098 |
| 2004 | -0.1118 | -0.1404 |
| 2005 | -0.1900 | -0.2528 |
| 2006 | -0.1753 | -0.1960 |
| 2007 | -0.2009 | |

**FBAR** 1yr revision

| XSAratios | 2011/2010 | 2010/2009 | 2009/2008 | 2008/2007 |
|---|---|---|---|---|
| 1989 | -0.0015 | -0.0296 | 0.0039 | -0.0133 |
| 1990 | -0.0010 | -0.0241 | 0.0036 | -0.0118 |
| 1991 | -0.0003 | -0.0149 | 0.0024 | -0.0071 |
| 1992 | -0.0009 | -0.0179 | 0.0029 | -0.0085 |
| 1993 | -0.0016 | -0.0357 | 0.0055 | -0.0175 |
| 1994 | -0.0026 | -0.0331 | 0.0037 | -0.0148 |
| 1995 | -0.0061 | -0.0525 | 0.0052 | -0.0203 |
| 1996 | -0.0098 | -0.0792 | 0.0105 | -0.0271 |
| 1997 | -0.0066 | -0.0869 | 0.0197 | -0.0379 |
| 1998 | -0.0067 | -0.0844 | 0.0189 | -0.0325 |
| 1999 | -0.0111 | -0.1230 | 0.0247 | -0.0536 |
| 2000 | 0.0000 | -0.0970 | 0.0498 | -0.0301 |
| 2001 | 0.0163 | -0.0959 | 0.1028 | -0.0092 |
| 2002 | 0.0144 | -0.0808 | 0.0852 | 0.0005 |
| 2003 | 0.0165 | -0.0871 | 0.0912 | 0.0207 |
| 2004 | 0.0338 | -0.1064 | 0.1425 | 0.0157 |
| 2005 | 0.0553 | -0.1074 | 0.2143 | 0.0820 |
| 2006 | 0.0797 | -0.1598 | 0.3571 | |
| 2007 | 0.0927 | -0.4130 | | |
| 2008 | 0.1465 | -0.1114 | | |
| 2009 | 0.1314 | | | |

**FBAR** 2yr revision

| XSAratios | 2011/2009 | 2010/2008 | 2009/2007 |
|---|---|---|---|
| 1989 | -0.0311 | -0.0258 | -0.0095 |
| 1990 | -0.0250 | -0.0206 | -0.0083 |
| 1991 | -0.0151 | -0.0125 | -0.0048 |
| 1992 | -0.0188 | -0.0151 | -0.0056 |
| 1993 | -0.0373 | -0.0304 | -0.0121 |
| 1994 | -0.0356 | -0.0295 | -0.0112 |
| 1995 | -0.0583 | -0.0476 | -0.0152 |
| 1996 | -0.0882 | -0.0695 | -0.0169 |
| 1997 | -0.0929 | -0.0689 | -0.0189 |
| 1998 | -0.0906 | -0.0672 | -0.0142 |
| 1999 | -0.1327 | -0.1013 | -0.0303 |
| 2000 | -0.0970 | -0.0521 | 0.0182 |
| 2001 | -0.0811 | -0.0029 | 0.0927 |
| 2002 | -0.0675 | -0.0025 | 0.0857 |
| 2003 | -0.0720 | -0.0038 | 0.1138 |
| 2004 | -0.0763 | 0.0209 | 0.1604 |
| 2005 | -0.0580 | 0.0840 | 0.3139 |
| 2006 | -0.0928 | 0.1403 | 0.3714 |
| 2007 | -0.3585 | 0.0305 | |
| 2008 | 0.0188 | | |

**FBAR** 3yr revision

| XSAratios | 2011/2008 | 2010/2007 |
|---|---|---|
| 1989 | -0.0273 | -0.0388 |
| 1990 | -0.0215 | -0.0321 |
| 1991 | -0.0128 | -0.0195 |
| 1992 | -0.0159 | -0.0234 |
| 1993 | -0.0320 | -0.0474 |
| 1994 | -0.0320 | -0.0439 |
| 1995 | -0.0534 | -0.0669 |
| 1996 | -0.0786 | -0.0947 |
| 1997 | -0.0751 | -0.1042 |
| 1998 | -0.0735 | -0.0975 |
| 1999 | -0.1113 | -0.1495 |
| 2000 | -0.0521 | -0.0806 |
| 2001 | 0.0134 | -0.0121 |
| 2002 | 0.0119 | -0.0020 |
| 2003 | 0.0127 | 0.0168 |
| 2004 | 0.0554 | 0.0369 |
| 2005 | 0.1439 | 0.1728 |
| 2006 | 0.2312 | 0.1522 |
| 2007 | 0.1260 | |

Table 10: XSA results for 2011 assessment

Run title : REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2011

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 | 1999 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | | |
| 4 | 0.0086 | 0.2988 | 0.0562 | 0.0114 | 1.8023 | 0.4959 | 0.117 | 0.1467 | 0.052 | 0.0087 | 0.0097 | 0.0057 |
| 5 | 0.0157 | 0.0616 | 0.1429 | 0.3173 | 0.8161 | 0.3914 | 0.1932 | 0.1931 | 0.0155 | 0.005 | 0.0038 | 0.0093 |
| 6 | 0.0847 | 0.102 | 0.1929 | 0.403 | 0.2765 | 0.2462 | 0.5902 | 0.0855 | 0.0403 | 0.0132 | 0.0015 | 0.0201 |
| 7 | 0.2129 | 0.4397 | 0.458 | 0.8594 | 0.3099 | 0.3224 | 0.4424 | 0.2625 | 0.0172 | 0.022 | 0.0095 | 0.0414 |
| 8 | 0.3012 | 0.7687 | 0.659 | 1.0282 | 0.517 | 0.3524 | 0.5529 | 0.6078 | 0.0665 | 0.017 | 0.0225 | 0.1658 |
| 9 | 0.2788 | 0.737 | 0.614 | 0.7548 | 0.2611 | 0.5424 | 0.3392 | 0.6576 | 0.2086 | 0.1255 | 0.0161 | 0.1509 |
| 10 | 0.2426 | 0.5997 | 0.3808 | 0.5315 | 0.5443 | 0.584 | 0.6145 | 0.3318 | 0.263 | 0.0641 | 0.1375 | 0.1361 |
| 11 | 0.3034 | 0.4518 | 0.3866 | 0.4129 | 0.7784 | 0.7176 | 0.8704 | 0.6716 | 0.1019 | 0.0817 | 0.0898 | 0.3449 |
| 12 | 0.2737 | 0.3491 | 0.302 | 0.4422 | 0.8102 | 0.6769 | 0.7405 | 0.9203 | 0.3115 | 0.2134 | 0.1522 | 0.2458 |
| 13 | 0.3726 | 0.4045 | 0.3242 | 0.4268 | 0.987 | 0.4545 | 0.7512 | 0.5431 | 0.2524 | 0.0984 | 0.2166 | 0.1201 |
| 14 | 0.3652 | 0.5546 | 0.3118 | 0.4343 | 1.0225 | 0.4311 | 0.5175 | 0.7286 | 0.2763 | 0.1766 | 0.1043 | 0.9622 |
| 15 | 0.5644 | 0.4595 | 0.1818 | 0.5332 | 1.041 | 0.5254 | 1.3643 | 0.2597 | 0.0825 | 0.0361 | 0.4051 | 0.2223 |
| 16 | 0.5664 | 0.5276 | 0.2729 | 0.4952 | 0.8023 | 0.3039 | 1.0689 | 0.9359 | 0.033 | 0.1235 | 0.3113 | 0.3133 |
| 17 | 0.4314 | 0.7683 | 0.4838 | 0.2879 | 0.9267 | 0.2333 | 0.5297 | 0.4193 | 0.2935 | 0.0913 | 0.362 | 0.1908 |
| 18 | 0.5826 | 0.6978 | 0.7504 | 0.5174 | 1.6637 | 0.5022 | 0.6876 | 0.2395 | 0.0436 | 0.0516 | 0.1841 | 0.3086 |
| +gp | 0.5826 | 0.6978 | 0.7504 | 0.5174 | 1.6637 | 0.5022 | 0.6876 | 0.2395 | 0.0436 | 0.0516 | 0.1841 | 0.3086 |
| 0 FBAR 6-16 | 0.3242 | 0.4904 | 0.3713 | 0.5747 | 0.6682 | 0.4688 | 0.7138 | 0.5459 | 0.1503 | 0.0883 | 0.1333 | 0.2475 |

(Table 8) Fishing mortality (F) at age

| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | FBAR **-** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AGE | | | | | | | | | | | |
| 4 | 0.0335 | 0.0302 | 0.0213 | 0.008 | 0.0034 | 0.0066 | 0.002 | 0.0015 | 0.0033 | 0.0365 | 0.0138 |
| 5 | 0.0242 | 0.016 | 0.047 | 0.0588 | 0.0027 | 0.035 | 0.0038 | 0.0049 | 0.0043 | 0.058 | 0.0224 |
| 6 | 0.0311 | 0.0392 | 0.0144 | 0.0732 | 0.0112 | 0.0995 | 0.0091 | 0.0193 | 0.0146 | 0.0548 | 0.0296 |
| 7 | 0.0974 | 0.0514 | 0.0368 | 0.0937 | 0.0289 | 0.1073 | 0.0703 | 0.0369 | 0.018 | 0.0528 | 0.0359 |
| 8 | 0.1713 | 0.1218 | 0.0592 | 0.1118 | 0.0918 | 0.0925 | 0.0498 | 0.0573 | 0.0316 | 0.0155 | 0.0348 |
| 9 | 0.1865 | 0.1743 | 0.0995 | 0.0784 | 0.2123 | 0.1111 | 0.0971 | 0.0653 | 0.0383 | 0.0197 | 0.0411 |
| 10 | 0.1135 | 0.1487 | 0.0923 | 0.0807 | 0.1811 | 0.0978 | 0.0677 | 0.0617 | 0.0532 | 0.0392 | 0.0513 |
| 11 | 0.1318 | 0.1049 | 0.1302 | 0.0701 | 0.2243 | 0.0804 | 0.1873 | 0.0755 | 0.0569 | 0.0763 | 0.0695 |
| 12 | 0.3065 | 0.0918 | 0.0611 | 0.0893 | 0.2979 | 0.0856 | 0.1968 | 0.1169 | 0.0802 | 0.0641 | 0.0871 |
| 13 | 0.2381 | 0.4317 | 0.0741 | 0.0585 | 0.2423 | 0.089 | 0.1527 | 0.0739 | 0.0587 | 0.1409 | 0.0911 |
| 14 | 0.1314 | 0.3241 | 0.4763 | 0.0686 | 0.1161 | 0.1372 | 0.1906 | 0.1234 | 0.142 | 0.1686 | 0.1447 |
| 15 | 0.2121 | 0.4993 | 0.0893 | 0.0617 | 0.1077 | 0.0666 | 0.2529 | 0.0968 | 0.0413 | 0.0507 | 0.0629 |
| 16 | 0.2982 | 0.26 | 0.6254 | 0.4931 | 0.6287 | 0.0763 | 0.5536 | 0.1685 | 0.1189 | 0.144 | 0.1438 |
| 17 | 0.2273 | 0.3857 | 0.5064 | 0.5675 | 1.012 | 0.9522 | 0.063 | 0.101 | 0.0712 | 0.1142 | 0.0955 |
| 18 | 0.2209 | 0.1434 | 0.2735 | 0.2239 | 0.4868 | 0.2643 | 1.2156 | 0.064 | 0.1676 | 0.1345 | 0.122 |
| +gp | 0.2209 | 0.1434 | 0.2735 | 0.2239 | 0.4868 | 0.2643 | 1.2156 | 0.064 | 0.1676 | 0.1345 | |
| 0 FBAR 6-16 | 0.1744 | 0.2043 | 0.1599 | 0.1163 | 0.1948 | 0.0948 | 0.1662 | 0.0814 | 0.0594 | 0.0751 | |

| | (Table 9) | Relative F at age | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 0.0266 | 0.6093 | 0.1513 | 0.0199 | 2.6972 | 1.0578 | 0.1639 | 0.2688 | 0.3463 | 0.0979 | 0.0726 | 0.023 |
| | 5 | 0.0484 | 0.1256 | 0.3849 | 0.5521 | 1.2213 | 0.8348 | 0.2707 | 0.3537 | 0.1033 | 0.0571 | 0.0285 | 0.0376 |
| | 6 | 0.2612 | 0.208 | 0.5196 | 0.7013 | 0.4138 | 0.5252 | 0.8268 | 0.1566 | 0.2681 | 0.1492 | 0.0114 | 0.0813 |
| | 7 | 0.6567 | 0.8967 | 1.2337 | 1.4954 | 0.4637 | 0.6878 | 0.6198 | 0.4809 | 0.1143 | 0.2491 | 0.071 | 0.1674 |
| | 8 | 0.9291 | 1.5675 | 1.7749 | 1.7891 | 0.7737 | 0.7517 | 0.7745 | 1.1135 | 0.4426 | 0.1929 | 0.1689 | 0.6699 |
| | 9 | 0.86 | 1.5029 | 1.6537 | 1.3134 | 0.3907 | 1.157 | 0.4752 | 1.2046 | 1.3882 | 1.4208 | 0.1206 | 0.6095 |
| | 10 | 0.7482 | 1.223 | 1.0256 | 0.9249 | 0.8146 | 1.2458 | 0.8609 | 0.6078 | 1.7502 | 0.7256 | 1.0318 | 0.5497 |
| | 11 | 0.9358 | 0.9214 | 1.0414 | 0.7185 | 1.1649 | 1.5308 | 1.2194 | 1.2304 | 0.6779 | 0.9254 | 0.6735 | 1.3935 |
| | 12 | 0.8444 | 0.7118 | 0.8135 | 0.7695 | 1.2126 | 1.4439 | 1.0374 | 1.6859 | 2.0724 | 2.4161 | 1.1417 | 0.9928 |
| | 13 | 1.1495 | 0.8248 | 0.8732 | 0.7426 | 1.4771 | 0.9694 | 1.0523 | 0.995 | 1.6797 | 1.1137 | 1.6249 | 0.4852 |
| | 14 | 1.1266 | 1.1309 | 0.8398 | 0.7557 | 1.5303 | 0.9195 | 0.7249 | 1.3348 | 1.8384 | 2 | 0.782 | 3.8873 |
| | 15 | 1.7412 | 0.9371 | 0.4897 | 0.9279 | 1.5579 | 1.1208 | 1.9112 | 0.4757 | 0.549 | 0.4089 | 3.0389 | 0.8979 |
| | 16 | 1.7472 | 1.076 | 0.735 | 0.8617 | 1.2008 | 0.6482 | 1.4975 | 1.7146 | 0.2193 | 1.3982 | 2.3354 | 1.2655 |
| | 17 | 1.3308 | 1.5666 | 1.3031 | 0.501 | 1.3868 | 0.4976 | 0.7421 | 0.7682 | 1.9527 | 1.034 | 2.7156 | 0.7709 |
| | 18 | 1.7972 | 1.4229 | 2.0212 | 0.9003 | 2.4898 | 1.0713 | 0.9633 | 0.4388 | 0.29 | 0.5839 | 1.3809 | 1.2466 |
| | +gp | 1.7972 | 1.4229 | 2.0212 | 0.9003 | 2.4898 | 1.0713 | 0.9633 | 0.4388 | 0.29 | 0.5839 | 1.3809 | 1.2466 |
| 0 | REFMEAN | 0.3242 | 0.4904 | 0.3713 | 0.5747 | 0.6682 | 0.4688 | 0.7138 | 0.5459 | 0.1503 | 0.0883 | 0.1333 | 0.2475 |

| | Table 9 | Relative F at age | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | MEAN **-** | |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 0.1919 | 0.1478 | 0.1334 | 0.0689 | 0.0173 | 0.0696 | 0.0122 | 0.0185 | 0.0549 | 0.4857 | 0.1863 | |
| | 5 | 0.1388 | 0.0784 | 0.2942 | 0.5055 | 0.014 | 0.3695 | 0.0229 | 0.0608 | 0.0721 | 0.7722 | 0.3017 | |
| | 6 | 0.1785 | 0.1917 | 0.0903 | 0.6295 | 0.0575 | 1.0489 | 0.0546 | 0.2365 | 0.2462 | 0.7293 | 0.404 | |
| | 7 | 0.5584 | 0.2518 | 0.23 | 0.8058 | 0.1482 | 1.1315 | 0.4231 | 0.4538 | 0.3032 | 0.7032 | 0.4867 | |
| | 8 | 0.9825 | 0.596 | 0.3704 | 0.9612 | 0.4715 | 0.9753 | 0.2994 | 0.7045 | 0.5322 | 0.2066 | 0.4811 | |
| | 9 | 1.0697 | 0.853 | 0.6222 | 0.6746 | 1.0901 | 1.1711 | 0.5843 | 0.8016 | 0.6446 | 0.2624 | 0.5695 | |
| | 10 | 0.6509 | 0.7281 | 0.5776 | 0.6939 | 0.9297 | 1.0309 | 0.4073 | 0.7575 | 0.8954 | 0.5211 | 0.7247 | |
| | 11 | 0.7561 | 0.5136 | 0.8143 | 0.6031 | 1.1519 | 0.8475 | 1.1274 | 0.9273 | 0.9567 | 1.0153 | 0.9664 | |
| | 12 | 1.7579 | 0.4495 | 0.3819 | 0.7682 | 1.5299 | 0.9024 | 1.1846 | 1.4364 | 1.3489 | 0.8529 | 1.2127 | |
| | 13 | 1.3656 | 2.1133 | 0.4634 | 0.5031 | 1.2442 | 0.9389 | 0.9189 | 0.9074 | 0.9875 | 1.8747 | 1.2565 | |
| | 14 | 0.7537 | 1.5864 | 2.9796 | 0.5897 | 0.596 | 1.447 | 1.1469 | 1.5161 | 2.39 | 2.2439 | 2.05 | |
| | 15 | 1.2164 | 2.4438 | 0.5583 | 0.5309 | 0.5528 | 0.7022 | 1.5218 | 1.1886 | 0.6947 | 0.6747 | 0.8527 | |
| | 16 | 1.7104 | 1.2728 | 3.9119 | 4.2401 | 3.2282 | 0.8044 | 3.3318 | 2.0703 | 2.0007 | 1.9159 | 1.9956 | |
| | 17 | 1.3033 | 1.8879 | 3.1675 | 4.8802 | 5.1962 | 10.0396 | 0.379 | 1.2406 | 1.1984 | 1.5193 | 1.3194 | |
| | 18 | 1.2668 | 0.7018 | 1.7106 | 1.9255 | 2.4996 | 2.7863 | 7.3159 | 0.7865 | 2.8197 | 1.7902 | 1.7988 | |
| | +gp | 1.2668 | 0.7018 | 1.7106 | 1.9255 | 2.4996 | 2.7863 | 7.3159 | 0.7865 | 2.8197 | 1.7902 | | |
| 0 | REFMEAN | 0.1744 | 0.2043 | 0.1599 | 0.1163 | 0.1948 | 0.0948 | 0.1662 | 0.0814 | 0.0594 | 0.0751 | | |

| | Table 10 | Stock number at age (start of year) | | | Numbers*10**-3 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | | |
| | | | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | | | |
| | 4 | 54397 | 42254 | 23659 | 21939 | 139451 | 144671 | 26377 | 12571 | 14345 | 13305 | 16484 | 16469 | | |
| | 5 | 71308 | 48798 | 28357 | 20238 | 19626 | 20810 | 79724 | 21232 | 9822 | 12322 | 11935 | 14772 | | |
| | 6 | 102148 | 63517 | 41516 | 22242 | 13334 | 7852 | 12732 | 59463 | 15839 | 8750 | 11093 | 10758 | | |
| | 7 | 125975 | 84922 | 51898 | 30974 | 13450 | 9150 | 5554 | 6384 | 49395 | 13766 | 7814 | 10022 | | |
| | 8 | 97234 | 92129 | 49501 | 29703 | 11867 | 8927 | 5997 | 3229 | 4443 | 43934 | 12185 | 7004 | | |
| | 9 | 62687 | 65100 | 38648 | 23174 | 9613 | 6403 | 5679 | 3122 | 1591 | 3762 | 39081 | 10780 | | |
| | 10 | 47423 | 42921 | 28189 | 18925 | 9857 | 6700 | 3368 | 3660 | 1464 | 1168 | 3002 | 34798 | | |
| | 11 | 35323 | 33668 | 21320 | 17429 | 10064 | 5175 | 3380 | 1648 | 2377 | 1018 | 992 | 2367 | | |
| | 12 | 27277 | 23598 | 19389 | 13105 | 10436 | 4181 | 2285 | 1281 | 762 | 1942 | 849 | 820 | | |
| | 13 | 21512 | 18771 | 15061 | 12970 | 7620 | 4200 | 1923 | 986 | 462 | 505 | 1420 | 660 | | |
| | 14 | 20215 | 13410 | 11335 | 9854 | 7659 | 2570 | 2412 | 821 | 518 | 325 | 414 | 1034 | | |
| | 15 | 12672 | 12695 | 6968 | 7509 | 5776 | 2493 | 1511 | 1301 | 358 | 356 | 246 | 338 | | |
| | 16 | 7208 | 6520 | 7255 | 5257 | 3986 | 1845 | 1334 | 349 | 908 | 299 | 310 | 149 | | |
| | 17 | 6366 | 3702 | 3481 | 4997 | 2899 | 1617 | 1232 | 414 | 124 | 795 | 239 | 206 | | |
| | 18 | 4688 | 3742 | 1554 | 1942 | 3390 | 1038 | 1159 | 656 | 247 | 84 | 657 | 150 | | |
| | +gp | 11849 | 9489 | 6539 | 4481 | 1937 | 1460 | 2604 | 1423 | 1872 | 1087 | 917 | 2203 | | |
| 0 | TOTAL | 708281 | 565237 | 354670 | 244741 | 270966 | 229094 | 157271 | 118542 | 104526 | 103415 | 107637 | 112529 | | |

| | (Table 10) | Stock number at age (start of year) | | | Numbers*10**-3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | GMST 89-** | AMST 89-** |
| | | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | | |
| | 4 | 26450 | 50718 | 85323 | 133488 | 190875 | 377254 | 267386 | 199635 | 162794 | 86298 | 0 | 52392 | 92852 |
| | 5 | 14817 | 23145 | 44526 | 75575 | 119821 | 172130 | 251218 | 178872 | 133618 | 108769 | 55776 | 37577 | 61952 |
| | 6 | 13242 | 13086 | 20610 | 38438 | 64479 | 108123 | 111409 | 167756 | 119310 | 89184 | 68801 | 28667 | 45319 |
| | 7 | 9540 | 11615 | 11386 | 18381 | 32325 | 57693 | 65614 | 74005 | 110306 | 78814 | 56595 | 22192 | 34493 |
| | 8 | 8700 | 7831 | 9983 | 9931 | 15144 | 28416 | 46891 | 55340 | 64534 | 72620 | 50113 | 16848 | 27420 |
| | 9 | 5369 | 6633 | 6274 | 8513 | 8035 | 12501 | 23441 | 40370 | 47283 | 41912 | 47930 | 11561 | 19039 |
| | 10 | 8388 | 4031 | 5042 | 5139 | 7122 | 5880 | 10122 | 19248 | 34220 | 30503 | 27546 | 7992 | 13322 |
| | 11 | 27481 | 6775 | 3144 | 4160 | 4290 | 5377 | 4825 | 8560 | 16374 | 21750 | 19662 | 5773 | 9969 |
| | 12 | 1517 | 21794 | 5520 | 2497 | 3509 | 3102 | 4489 | 3620 | 7182 | 10369 | 13509 | 4092 | 7599 |
| | 13 | 580 | 1010 | 17990 | 4699 | 2066 | 2357 | 2576 | 3336 | 2914 | 4443 | 6520 | 2930 | 6035 |
| | 14 | 529 | 414 | 594 | 15116 | 4010 | 1467 | 1951 | 2001 | 2804 | 1842 | 2587 | 2134 | 4832 |
| | 15 | 358 | 420 | 271 | 334 | 12771 | 3231 | 1158 | 1459 | 1600 | 1631 | 1043 | 1475 | 3611 |
| | 16 | 245 | 262 | 231 | 224 | 284 | 10376 | 2735 | 813 | 1198 | 1029 | 1039 | 1026 | 2529 |
| | 17 | 98 | 164 | 183 | 112 | 124 | 137 | 8699 | 1423 | 622 | 713 | 598 | 670 | 1851 |
| | 18 | 154 | 71 | 101 | 100 | 57 | 41 | 48 | 7391 | 1164 | 388 | 427 | 418 | 1363 |
| | +gp | 323 | 424 | 1166 | 1788 | 228 | 506 | 438 | 7909 | 6741 | 5230 | 3292 | | |
| 0 | TOTAL | 117791 | 148395 | 212341 | 318493 | 465141 | 788590 | 802999 | 771737 | 712664 | 555496 | 355437 | | |

| (Table 11) | Spawning stock number at age (spawning time) | | Numbers*10**-3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| | | | | | | | | | | | | |
| AGE | | | | | | | | | | | | |
| 4 | 324 | 82 | 23 | 0 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 |
| 5 | 1130 | 915 | 640 | 78 | 201 | 240 | 234 | 21 | 68 | 24 | 47 | 44 |
| 6 | 3623 | 2750 | 1947 | 983 | 323 | 351 | 554 | 2519 | 94 | 303 | 198 | 320 |
| 7 | 8355 | 6995 | 4765 | 2955 | 976 | 778 | 452 | 633 | 6264 | 382 | 403 | 664 |
| 8 | 10170 | 11259 | 6801 | 5102 | 1853 | 1352 | 842 | 467 | 890 | 20021 | 507 | 830 |
| 9 | 9731 | 10228 | 6826 | 5584 | 2391 | 1289 | 1102 | 626 | 416 | 1821 | 7783 | 1046 |
| 10 | 10059 | 7873 | 5778 | 6208 | 3061 | 1649 | 970 | 986 | 500 | 526 | 728 | 7786 |
| 11 | 11013 | 8762 | 6008 | 7043 | 3471 | 1454 | 992 | 484 | 977 | 474 | 294 | 912 |
| 12 | 10536 | 8196 | 7491 | 6136 | 3988 | 1218 | 684 | 366 | 338 | 903 | 270 | 362 |
| 13 | 9239 | 8023 | 7250 | 6678 | 3409 | 1487 | 575 | 300 | 236 | 240 | 462 | 257 |
| 14 | 9134 | 6057 | 5758 | 5514 | 3788 | 1027 | 978 | 279 | 267 | 153 | 157 | 353 |
| 15 | 6140 | 6227 | 3911 | 4468 | 3037 | 1008 | 550 | 468 | 196 | 168 | 78 | 135 |
| 16 | 3595 | 3212 | 4091 | 3489 | 2529 | 1958 | 635 | 153 | 537 | 154 | 118 | 56 |
| 17 | 3624 | 2017 | 1990 | 3270 | 1736 | 1077 | 736 | 195 | 77 | 427 | 104 | 103 |
| 18 | 2623 | 1973 | 856 | 1262 | 2323 | 689 | 714 | 371 | 158 | 45 | 204 | 67 |
| +gp | 8504 | 7095 | 4319 | 3293 | 1337 | 917 | 1679 | 1082 | 1295 | 690 | 596 | 1362 |

| (Table 11) | Spawning stock number at age (spawning time) | | Numbers*10**-3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| | | | | | | | | | | |
| AGE | | | | | | | | | | |
| 4 | 0 | 0 | 84 | 265 | 0 | 1461 | 777 | 773 | 473 | 1167 |
| 5 | 73 | 252 | 352 | 895 | 357 | 1496 | 1946 | 1212 | 1035 | 1153 |
| 6 | 301 | 401 | 694 | 2995 | 1662 | 3013 | 3342 | 2109 | 4155 | 4816 |
| 7 | 610 | 838 | 721 | 6407 | 2815 | 5504 | 6084 | 7686 | 14295 | 5777 |
| 8 | 1200 | 1054 | 1153 | 6815 | 2595 | 6576 | 9823 | 12132 | 20137 | 10396 |
| 9 | 1349 | 1395 | 1099 | 7260 | 1991 | 4277 | 8514 | 19003 | 22279 | 11267 |
| 10 | 1443 | 1399 | 1852 | 3921 | 2284 | 2350 | 4514 | 14953 | 20329 | 13429 |
| 11 | 12355 | 1660 | 1154 | 2462 | 1944 | 2915 | 2410 | 7309 | 10688 | 13713 |
| 12 | 514 | 8413 | 2093 | 1272 | 1958 | 1800 | 2065 | 3280 | 4886 | 4966 |
| 13 | 347 | 344 | 9421 | 3048 | 1335 | 1286 | 1426 | 3090 | 1992 | 3506 |
| 14 | 214 | 150 | 285 | 8888 | 1687 | 1031 | 1146 | 1836 | 1979 | 1243 |
| 15 | 190 | 144 | 125 | 223 | 9847 | 1922 | 816 | 1295 | 860 | 1051 |
| 16 | 162 | 93 | 75 | 254 | 186 | 5259 | 1254 | 606 | 504 | 774 |
| 17 | 69 | 57 | 75 | 48 | 75 | 72 | 5281 | 1198 | 243 | 639 |
| 18 | 97 | 26 | 41 | 129 | 41 | 23 | 41 | 4785 | 814 | 332 |
| +gp | 195 | 312 | 493 | 1866 | 147 | 280 | 343 | 6846 | 2924 | 3854 |

| | (Table 12) | Stock biomass at age (start of year) | | Tonnes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 5440 | 4099 | 2579 | 2106 | 9204 | 13020 | 2691 | 993 | 1291 | 1184 | 1434 | 1597 |
| | 5 | 11695 | 8344 | 3828 | 3461 | 3062 | 2705 | 9009 | 2930 | 1247 | 1700 | 1444 | 1950 |
| | 6 | 20940 | 13466 | 8884 | 4626 | 2827 | 1775 | 2763 | 8384 | 3009 | 1584 | 1952 | 1872 |
| | 7 | 31242 | 22165 | 14324 | 9045 | 3860 | 2525 | 1600 | 1724 | 8595 | 3152 | 1742 | 2345 |
| | 8 | 27614 | 27547 | 16682 | 10515 | 4332 | 3107 | 2141 | 1059 | 1577 | 9753 | 3168 | 1996 |
| | 9 | 19872 | 21548 | 14879 | 9177 | 3797 | 2529 | 2300 | 1199 | 646 | 1396 | 9614 | 3546 |
| | 10 | 16551 | 15495 | 13108 | 8554 | 4278 | 3109 | 1536 | 1621 | 682 | 493 | 970 | 10335 |
| | 11 | 15224 | 14915 | 10980 | 9150 | 5163 | 2551 | 1738 | 791 | 1200 | 499 | 469 | 990 |
| | 12 | 13938 | 12366 | 11032 | 7483 | 5782 | 2216 | 1248 | 683 | 437 | 1068 | 479 | 433 |
| | 13 | 12112 | 10925 | 9278 | 8236 | 4755 | 2306 | 1215 | 572 | 281 | 315 | 728 | 441 |
| | 14 | 11846 | 8073 | 7356 | 6701 | 5262 | 1729 | 1693 | 492 | 322 | 223 | 229 | 583 |
| | 15 | 7996 | 8277 | 4878 | 5286 | 4124 | 1643 | 1097 | 844 | 244 | 254 | 133 | 168 |
| | 16 | 4635 | 4356 | 5651 | 4242 | 3472 | 1327 | 1083 | 244 | 677 | 242 | 171 | 100 |
| | 17 | 4495 | 2706 | 2659 | 3843 | 2473 | 1319 | 1013 | 313 | 98 | 661 | 153 | 148 |
| | 18 | 3296 | 2721 | 1234 | 1707 | 2939 | 885 | 1007 | 521 | 187 | 61 | 404 | 108 |
| | +gp | 10427 | 8730 | 5833 | 4181 | 2133 | 1332 | 2778 | 1360 | 1747 | 1199 | 703 | 1652 |
| 0 | TOTALBIO | 217321 | 185729 | 133186 | 98313 | 67461 | 44078 | 34910 | 23732 | 22241 | 23784 | 23794 | 28264 |

| | (Table 12) | Stock biomass at age (start of year) | | Tonnes | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 2248 | 5122 | 6485 | 12548 | 17561 | 33198 | 29145 | 20163 | 19047 | 10183 | | |
| | 5 | 2074 | 3055 | 4853 | 9069 | 14259 | 19623 | 30146 | 23253 | 17771 | 16424 | | |
| | 6 | 2370 | 2408 | 3318 | 6265 | 10703 | 16975 | 15263 | 28183 | 21118 | 16231 | | |
| | 7 | 2271 | 2637 | 2471 | 4062 | 6918 | 12404 | 13451 | 16133 | 20958 | 17260 | | |
| | 8 | 2584 | 2208 | 2635 | 2761 | 4134 | 7530 | 11723 | 15218 | 14649 | 19099 | | |
| | 9 | 1761 | 2142 | 2014 | 2920 | 2724 | 4213 | 7360 | 13120 | 12294 | 12154 | | |
| | 10 | 3221 | 1572 | 1790 | 1943 | 2699 | 2358 | 4018 | 7102 | 10916 | 9914 | | |
| | 11 | 9344 | 2764 | 1298 | 1847 | 1969 | 2317 | 2205 | 3552 | 6484 | 7917 | | |
| | 12 | 783 | 8674 | 2550 | 1244 | 1688 | 1331 | 2335 | 1586 | 2341 | 4013 | | |
| | 13 | 347 | 567 | 6315 | 2598 | 955 | 1160 | 1396 | 1475 | 1582 | 2031 | | |
| | 14 | 351 | 246 | 331 | 6439 | 2370 | 782 | 1052 | 984 | 1223 | 831 | | |
| | 15 | 239 | 264 | 158 | 212 | 6411 | 1900 | 605 | 827 | 762 | 1014 | | |
| | 16 | 151 | 188 | 147 | 154 | 202 | 4379 | 1091 | 492 | 600 | 542 | | |
| | 17 | 76 | 106 | 93 | 61 | 90 | 75 | 4254 | 841 | 420 | 337 | | |
| | 18 | 131 | 63 | 70 | 75 | 52 | 34 | 35 | 3311 | 951 | 201 | | |
| | +gp | 326 | 404 | 879 | 1350 | 198 | 391 | 242 | 6082 | 3586 | 2704 | | |
| 0 | TOTALBIO | 28276 | 32422 | 35408 | 53547 | 72931 | 108670 | 124322 | 142324 | 134703 | 120856 | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Table 13) | Spawning stock biomass at age (spawning time) | | | Tonnes | | | | | | | | |
| | YEAR | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 32 | 8 | 3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | 5 | 185 | 157 | 86 | 13 | 31 | 31 | 26 | 3 | 9 | 3 | 6 | 6 |
| | 6 | 743 | 583 | 417 | 204 | 69 | 79 | 120 | 355 | 18 | 55 | 35 | 56 |
| | 7 | 2072 | 1826 | 1315 | 863 | 280 | 215 | 130 | 171 | 1090 | 87 | 90 | 155 |
| | 8 | 2888 | 3366 | 2292 | 1806 | 676 | 470 | 301 | 153 | 316 | 4445 | 132 | 236 |
| | 9 | 3085 | 3386 | 2628 | 2211 | 944 | 509 | 446 | 240 | 169 | 676 | 1915 | 344 |
| | 10 | 3510 | 2842 | 2687 | 2806 | 1329 | 765 | 442 | 437 | 233 | 222 | 235 | 2312 |
| | 11 | 4747 | 3882 | 3094 | 3697 | 1781 | 717 | 510 | 232 | 494 | 232 | 139 | 381 |
| | 12 | 5384 | 4295 | 4263 | 3504 | 2209 | 646 | 373 | 195 | 194 | 497 | 152 | 191 |
| | 13 | 5201 | 4669 | 4466 | 4240 | 2127 | 816 | 363 | 174 | 144 | 150 | 237 | 171 |
| | 14 | 5353 | 3647 | 3737 | 3750 | 2602 | 691 | 687 | 167 | 166 | 105 | 87 | 199 |
| | 15 | 3874 | 4060 | 2738 | 3146 | 2168 | 664 | 399 | 304 | 134 | 120 | 42 | 67 |
| | 16 | 2311 | 2146 | 3187 | 2815 | 2203 | 1408 | 516 | 107 | 401 | 125 | 65 | 38 |
| | 17 | 2559 | 1474 | 1520 | 2514 | 1481 | 879 | 605 | 147 | 61 | 356 | 67 | 74 |
| | 18 | 1844 | 1434 | 680 | 1109 | 2014 | 587 | 620 | 294 | 120 | 33 | 126 | 48 |
| | +gp | 7484 | 6528 | 3853 | 3072 | 1472 | 836 | 1792 | 1034 | 1209 | 761 | 457 | 1022 |
| 0 | TOTSPBIO | 51273 | 44301 | 36964 | 35752 | 21387 | 9314 | 7331 | 4014 | 4755 | 7867 | 3784 | 5301 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Table 13) | Spawning stock biomass at age (spawning time) | | | Tonnes | | | | | | | | |
| | YEAR | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | | |
| | | | | | | | | | | | | | |
| | AGE | | | | | | | | | | | | |
| | 4 | 0 | 0 | 6 | 25 | 0 | 129 | 85 | 78 | 55 | 138 | | |
| | 5 | 10 | 33 | 38 | 107 | 42 | 171 | 234 | 158 | 138 | 174 | | |
| | 6 | 54 | 74 | 112 | 488 | 276 | 473 | 458 | 354 | 735 | 876 | | |
| | 7 | 145 | 190 | 156 | 1416 | 602 | 1183 | 1247 | 1676 | 2716 | 1265 | | |
| | 8 | 357 | 297 | 304 | 1895 | 708 | 1743 | 2456 | 3336 | 4571 | 2734 | | |
| | 9 | 442 | 451 | 353 | 2490 | 675 | 1441 | 2673 | 6176 | 5793 | 3267 | | |
| | 10 | 554 | 546 | 657 | 1482 | 866 | 942 | 1792 | 5518 | 6485 | 4365 | | |
| | 11 | 4201 | 677 | 477 | 1093 | 892 | 1256 | 1101 | 3033 | 4232 | 4992 | | |
| | 12 | 265 | 3349 | 967 | 633 | 942 | 772 | 1074 | 1437 | 1593 | 1922 | | |
| | 13 | 207 | 193 | 3307 | 1686 | 617 | 633 | 773 | 1366 | 1081 | 1602 | | |
| | 14 | 142 | 90 | 159 | 3786 | 997 | 549 | 617 | 903 | 863 | 560 | | |
| | 15 | 127 | 91 | 73 | 142 | 4943 | 1130 | 427 | 735 | 410 | 654 | | |
| | 16 | 100 | 67 | 48 | 174 | 132 | 2219 | 500 | 367 | 252 | 408 | | |
| | 17 | 53 | 37 | 38 | 26 | 54 | 39 | 2582 | 708 | 164 | 302 | | |
| | 18 | 83 | 23 | 28 | 98 | 37 | 20 | 30 | 2144 | 665 | 172 | | |
| | +gp | 197 | 297 | 372 | 1409 | 128 | 217 | 190 | 5264 | 1556 | 1992 | | |
| 0 | TOTSPBIO | 6937 | 6412 | 7096 | 16949 | 11912 | 12918 | 16239 | 33252 | 31309 | 25423 | | |

| (Table 16) | Summary (without SOP correction) | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | Terminal Fs derived using XSA (Without F shrinkage) | | | | | | |
| | | | | | | | |
| | RECRUIT | TOTALBIO | ABUNDANCE | TOTSPBIO | LANDINGS | YIELD/SSB | FBAR 6- |
| | Age 4 | | | | | | |
| 1989 | 54397 | 217321 | 708281 | 51273 | 58086 | 1.1329 | 0.3242 |
| 1990 | 42254 | 185729 | 565237 | 44301 | 80223 | 1.8108 | 0.4904 |
| 1991 | 23659 | 133186 | 354670 | 36964 | 48500 | 1.3121 | 0.3713 |
| 1992 | 21939 | 98313 | 244741 | 35752 | 43300 | 1.2111 | 0.5747 |
| 1993 | 139451 | 67461 | 270966 | 21387 | 43100 | 2.0153 | 0.6682 |
| 1994 | 144671 | 44078 | 229094 | 9314 | 17664 | 1.8965 | 0.4688 |
| 1995 | 26377 | 34910 | 157271 | 7331 | 13879 | 1.8932 | 0.7138 |
| 1996 | 12571 | 23732 | 118542 | 4014 | 6101 | 1.5197 | 0.5459 |
| 1997 | 14345 | 22241 | 104526 | 4755 | 1408 | 0.2961 | 0.1503 |
| 1998 | 13305 | 23784 | 103415 | 7867 | 1011 | 0.1285 | 0.0883 |
| 1999 | 16484 | 23794 | 107637 | 3784 | 1095 | 0.2894 | 0.1333 |
| 2000 | 16469 | 28264 | 112529 | 5301 | 3665 | 0.6914 | 0.2475 |
| 2001 | 26450 | 28276 | 117791 | 6937 | 3327 | 0.4796 | 0.1744 |
| 2002 | 50718 | 32422 | 148395 | 6412 | 2964 | 0.4622 | 0.2043 |
| 2003 | 85323 | 35408 | 212341 | 7096 | 2273 | 0.3203 | 0.1599 |
| 2004 | 133488 | 53547 | 318493 | 16949 | 3260 | 0.1923 | 0.1163 |
| 2005 | 190875 | 72931 | 465141 | 11912 | 4039 | 0.3391 | 0.1948 |
| 2006 | 377254 | 108670 | 788590 | 12918 | 5936 | 0.4595 | 0.0948 |
| 2007 | 267386 | 124322 | 802999 | 16239 | 5131 | 0.316 | 0.1662 |
| 2008 | 199635 | 142324 | 771737 | 33252 | 4274 | 0.1285 | 0.0814 |
| 2009 | 162794 | 134703 | 712664 | 31309 | 3639 | 0.1162 | 0.0594 |
| 2010 | 86298 | 120856 | 555496 | 25423 | 4894 | 0.1925 | 0.0751 |
| | | | | | | | |
| Arith. | | | | | | | |
| Mean | 95734 | 79831 | 362298 | 18204 | 16262 | 0.782 | 0.2774 |
| 0 Units | (Thousands) | (Tonnes) | (Thousands) | (Tonnes) | (Tonnes) | | |

Table 11A

| | |
|---|---|
| 5 | Nparams |
| 5 | Geometric mean model |
| 52.392 | 1989-2008 age 4 XSA geomean in millions |
| 0.00000E+000 | |
| 0.00000E+000 | |
| 0 | |
| 0.00000E+000 | |
| 20 | Ndata |
| 0.038 | log residuals |
| -0.215 | |
| -0.795 | |
| -0.870 | |
| 0.979 | |
| 1.016 | |
| -0.686 | |
| -1.427 | |
| -1.295 | |
| -1.371 | |
| -1.156 | |
| -1.157 | |
| -0.684 | |
| -0.032 | |
| 0.488 | |
| 0.935 | |
| 1.293 | |
| 1.974 | |
| 1.630 | |
| 1.338 | |
| 0 | No extra data |

**Table 11b: An explanation of the red.sen file input data with an exploitation pattern corresponding to F*statusquo***

*N4=1989-2008 age 4 XSA geometric mean*

| Name | Value | C.V. | Name | Value | C.V. | Name | Value | C.V. | Name | Value | C.V. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Population at age in 2011 | | | Exploitation pattern | | | Exploitation pattern | | | Exploitation pattern | | |
| | | | (H - Human consumption) | | | (D - Discards) | | | (I - Industrials) | | |
| N4 | 52392 | 0.79 | sH4 | 0.01377 | 0.01971 | sD4 | 0.00 | 0.00 | sI4 | 0.00 | 0.00 |
| N5 | 55776 | 0.35 | sH5 | 0.0224 | 0.03083 | sD5 | 0.00 | 0.00 | sI5 | 0.00 | 0.00 |
| N6 | 68801 | 0.33 | sH6 | 0.02957 | 0.02198 | sD6 | 0.00 | 0.00 | sI6 | 0.00 | 0.00 |
| N7 | 56595 | 0.24 | sH7 | 0.0359 | 0.01742 | sD7 | 0.00 | 0.00 | sI7 | 0.00 | 0.00 |
| N8 | 50113 | 0.35 | sH8 | 0.0348 | 0.02108 | sD8 | 0.00 | 0.00 | sI8 | 0.00 | 0.00 |
| N9 | 47930 | 0.27 | sH9 | 0.0411 | 0.02293 | sD9 | 0.00 | 0.00 | sI9 | 0.00 | 0.00 |
| N10 | 27546 | 0.26 | sH10 | 0.05137 | 0.01136 | sD10 | 0.00 | 0.00 | sI10 | 0.00 | 0.00 |
| N11 | 19662 | 0.24 | sH11 | 0.06957 | 0.01098 | sD11 | 0.00 | 0.00 | sI11 | 0.00 | 0.00 |
| N12 | 13509 | 0.19 | sH12 | 0.08707 | 0.02706 | sD12 | 0.00 | 0.00 | sI12 | 0.00 | 0.00 |
| N13 | 6520 | 0.20 | sH13 | 0.09117 | 0.04374 | sD13 | 0.00 | 0.00 | sI13 | 0.00 | 0.00 |
| N14 | 2587 | 0.17 | sH14 | 0.14467 | 0.02272 | sD14 | 0.00 | 0.00 | sI14 | 0.00 | 0.00 |
| N15 | 1043 | 0.19 | sH15 | 0.06293 | 0.0297 | sD15 | 0.00 | 0.00 | sI15 | 0.00 | 0.00 |
| N16 | 1039 | 0.16 | sH16 | 0.1438 | 0.0248 | sD16 | 0.00 | 0.00 | sI16 | 0.00 | 0.00 |
| N17 | 598 | 0.18 | sH17 | 0.09547 | 0.02203 | sD17 | 0.00 | 0.00 | sI17 | 0.00 | 0.00 |
| N18 | 427 | 0.18 | sH18 | 0.12203 | 0.05291 | sD18 | 0.00 | 0.00 | sI18 | 0.00 | 0.00 |
| N19 | 3292 | 0.18 | sH19 | 0.12203 | 0.05291 | sD19 | 0.00 | 0.00 | sI19 | 0.00 | 0.00 |
| | | | | | | | | | | | |
| Stock weight at age | | | Catch weight at age | | | Catch weight at age | | | Catch weight at age | | |
| | | | (H - Human consumption) | | | (D - Discards) | | | (I - Industrials) | | |
| WS4 | 0.112 | 0.010 | WH4 | 0.130 | 0.022 | WD4 | 0.00 | 0.00 | WI4 | 0.00 | 0.00 |
| WS5 | 0.138 | 0.011 | WH5 | 0.143 | 0.010 | WD5 | 0.00 | 0.00 | WI5 | 0.00 | 0.00 |
| WS6 | 0.176 | 0.007 | WH6 | 0.188 | 0.021 | WD6 | 0.00 | 0.00 | WI6 | 0.00 | 0.00 |
| WS7 | 0.209 | 0.016 | WH7 | 0.224 | 0.007 | WD7 | 0.00 | 0.00 | WI7 | 0.00 | 0.00 |
| WS8 | 0.255 | 0.025 | WH8 | 0.268 | 0.008 | WD8 | 0.00 | 0.00 | WI8 | 0.00 | 0.00 |
| WS9 | 0.292 | 0.032 | WH9 | 0.308 | 0.019 | WD9 | 0.00 | 0.00 | WI9 | 0.00 | 0.00 |
| WS10 | 0.338 | 0.028 | WH10 | 0.341 | 0.022 | WD10 | 0.00 | 0.00 | WI10 | 0.00 | 0.00 |
| WS11 | 0.392 | 0.026 | WH11 | 0.401 | 0.045 | WD11 | 0.00 | 0.00 | WI11 | 0.00 | 0.00 |
| WS12 | 0.384 | 0.056 | WH12 | 0.398 | 0.038 | WD12 | 0.00 | 0.00 | WI12 | 0.00 | 0.00 |
| WS13 | 0.481 | 0.054 | WH13 | 0.477 | 0.070 | WD13 | 0.00 | 0.00 | WI13 | 0.00 | 0.00 |
| WS14 | 0.460 | 0.029 | WH14 | 0.488 | 0.013 | WD14 | 0.00 | 0.00 | WI14 | 0.00 | 0.00 |
| WS15 | 0.555 | 0.074 | WH15 | 0.525 | 0.010 | WD15 | 0.00 | 0.00 | WI15 | 0.00 | 0.00 |
| WS16 | 0.545 | 0.054 | WH16 | 0.540 | 0.035 | WD16 | 0.00 | 0.00 | WI16 | 0.00 | 0.00 |
| WS17 | 0.580 | 0.102 | WH17 | 0.589 | 0.108 | WD17 | 0.00 | 0.00 | WI17 | 0.00 | 0.00 |
| WS18 | 0.594 | 0.196 | WH18 | 0.537 | 0.085 | WD18 | 0.00 | 0.00 | WI18 | 0.00 | 0.00 |
| WS19 | 0.606 | 0.141 | WH19 | 0.647 | 0.121 | WD19 | 0.00 | 0.00 | WI19 | 0.00 | 0.00 |
| | | | | | | | | | | | |
| Natural mortality at age | | | Maturity | | | | | | | | |
| M4 | 0.4 | 0.00 | MT4 | 0.008 | 0.006 | | | | | | |
| M5 | 0.4 | 0.00 | MT5 | 0.012 | 0.005 | | | | | | |
| M6 | 0.4 | 0.00 | MT6 | 0.045 | 0.011 | | | | | | |
| M7 | 0.4 | 0.00 | MT7 | 0.113 | 0.041 | | | | | | |
| M8 | 0.4 | 0.00 | MT8 | 0.227 | 0.103 | | | | | | |
| M9 | 0.4 | 0.00 | MT9 | 0.361 | 0.110 | | | | | | |
| M10 | 0.4 | 0.00 | MT10 | 0.503 | 0.080 | | | | | | |
| M11 | 0.4 | 0.00 | MT11 | 0.646 | 0.023 | | | | | | |
| M12 | 0.4 | 0.00 | MT12 | 0.564 | 0.110 | | | | | | |
| M13 | 0.4 | 0.00 | MT13 | 0.756 | 0.058 | | | | | | |
| M14 | 0.4 | 0.00 | MT14 | 0.717 | 0.021 | | | | | | |
| M15 | 0.4 | 0.00 | MT15 | 0.696 | 0.159 | | | | | | |
| M16 | 0.4 | 0.00 | MT16 | 0.756 | 0.220 | | | | | | |
| M17 | 0.4 | 0.00 | MT17 | 0.761 | 0.266 | | | | | | |
| M18 | 0.4 | 0.00 | MT18 | 0.794 | 0.088 | | | | | | |
| M19 | 0.4 | 0.00 | MT19 | 0.765 | 0.181 | | | | | | |
| | | | | | | | | | | | |
| Natural mortality multiplier in year | | | Effort multiplier in year | | | | | | | | |
| | | | (H - Human consumption) | | | | | | | | |
| K2010 | 1 | 0.0 | HF2010 | 1.0 | 0.0 | | | | | | |
| K2011 | 1 | 0.0 | HF2011 | 1.0 | 0.0 | | | | | | |
| K2012 | 1 | 0.0 | HF2012 | 1.0 | 0.0 | | | | | | |

| Table 12a: Short and medium term SSB projections under a range of Fstatus quo multilpiers. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | Relative Fbar | | | | Fsattus quo | | | | | |
| 2013 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 |
| 5th %ile | 21891 | 21628 | 21370 | 21112 | 20850 | **20591** | 20337 | 20086 | 19839 | 19604 | 19375 |
| 10th %ile | 22582 | 22313 | 22042 | 21775 | 21516 | 21267 | 21016 | 20769 | 20529 | 20294 | 20059 |
| 25th %ile | 23370 | 23098 | 22830 | 22564 | 22302 | 22039 | 21776 | 21517 | 21269 | 21027 | 20788 |
| 50th %ile | 25281 | 24978 | 24682 | 24394 | 24114 | **23844** | 23575 | 23304 | 23039 | 22774 | 22516 |
| 95th %ile | 29797 | 29467 | 29142 | 28821 | 28505 | 28192 | 27883 | 27558 | 27235 | 26937 | 26642 |
| | Fbar | | | | | Fsattus quo | | | | | |
| 2020 | 0.036 | 0.043 | 0.050 | 0.058 | 0.065 | 0.072 | 0.079 | 0.086 | 0.094 | 0.101 | 0.108 |
| 5th %ile | 6728 | 6408 | 6121 | 5849 | 5597 | 5354 | 5111 | 4900 | 4694 | 4499 | 4318 |
| 10th %ile | 7418 | 7067 | 6750 | 6450 | 6196 | 5951 | 5703 | 5473 | 5265 | 5061 | 4873 |
| 25th %ile | 8357 | 8007 | 7679 | 7369 | 7079 | 6799 | 6530 | 6283 | 6036 | 5815 | 5628 |
| 50th %ile | 10723 | 10332 | 9953 | 9613 | 9285 | **8969** | 8680 | 8405 | 8134 | 7894 | 7663 |
| 95th %ile | 15737 | 15242 | 14774 | 14330 | 13930 | 13565 | 13220 | 12900 | 12595 | 12272 | 11955 |
| | | | | | | | | | | | |
| Final assessment data year | | | 2010 | | | | | | | | |
| First year for populations in Sen | | | 2011 | | | | | | | | |
| First SSB profile 3 years ahead | | | 2013 | | SSB 2013 | | | | | | |
| Last SSB profile 10 years ahead | | | 2020 | | SSB 2020 | | | | | | |

| Tab. 12b: SSB and yield 5th, 25th, 50th and 95% %ile probability profiles under 0.5Fstatusq | | | | | |
|---|---|---|---|---|---|
| | 5th %ile | 10th %ile | 25th %ile | 50th %ile | 95th %ile |
| Year | SSB | | | | |
| 2011 | 25542 | 26232 | 27161 | 29338 | 33993 |
| 2012 | 23491 | 24168 | 24980 | **26993** | 31627 |
| 2013 | 20591 | 21267 | 22039 | **23844** | 28192 |
| 2014 | 17315 | 17907 | 18540 | 20036 | 23792 |
| 2015 | 14421 | 14939 | 15623 | 16915 | 20294 |
| 2016 | 11475 | 12080 | 12726 | 14142 | 17808 |
| 2017 | 9137 | 9733 | 10312 | 11853 | 15959 |
| 2018 | 7337 | 7952 | 8709 | 10458 | 15097 |
| 2019 | 6085 | 6678 | 7579 | 9539 | 14273 |
| 2020 | 5354 | 5951 | 6799 | 8969 | 13565 |
| | | | | | |
| Year | Yield | | | | |
| 2011 | 3382 | 3455 | 3578 | 3822 | 4417 |
| 2012 | 2955 | 3040 | 3161 | **3392** | 4007 |
| 2013 | 2549 | 2626 | 2745 | **3012** | 3635 |
| 2014 | 2139 | 2234 | 2355 | 2665 | 3359 |
| 2015 | 1809 | 1915 | 2034 | 2332 | 3052 |
| 2016 | 1536 | 1631 | 1770 | 2061 | 2825 |
| 2017 | 1267 | 1364 | 1504 | 1836 | 2594 |
| 2018 | 1114 | 1224 | 1348 | 1677 | 2448 |
| 2019 | 981 | 1088 | 1230 | 1560 | 2360 |
| 2020 | 917 | 999 | 1145 | 1477 | 2350 |

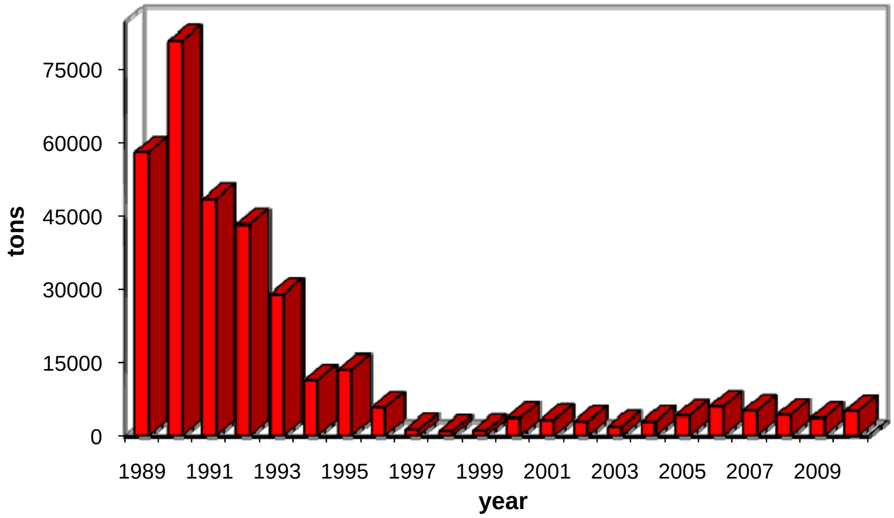



**Fig. 1a: STACFIS estimates of beaked redfish commercial catch.**

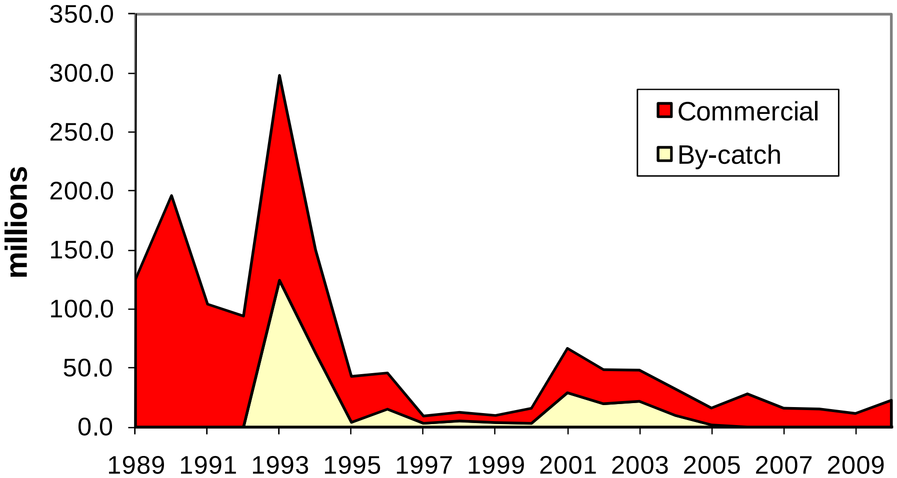



**Fig. 1b: Beaked redfish commercial catch and by-catch in numbers**

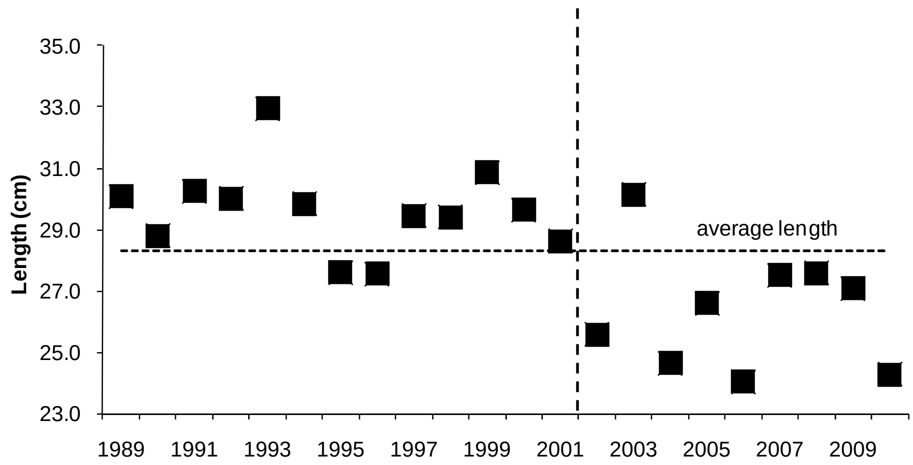



**Fig. 2: Mean length of the commercial catch, 1989-2010**

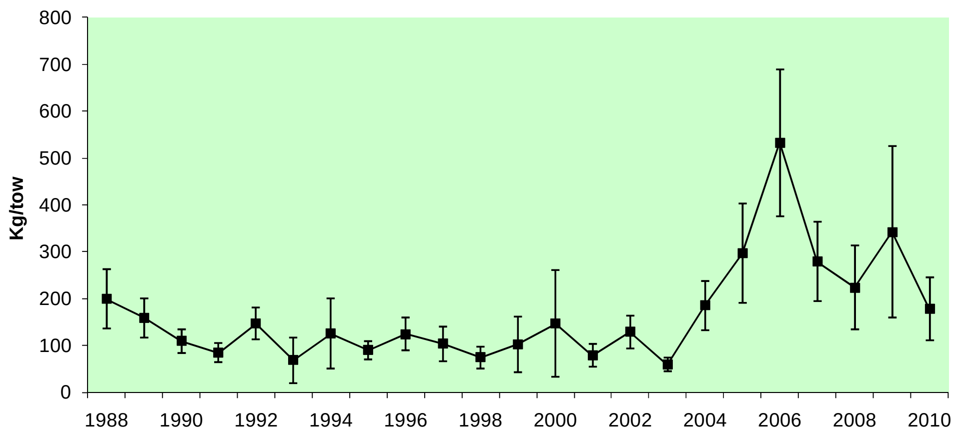



**Fig. 3a: mean catch per tow for 3M beaked refish (EU survey, 1988-2010) with associated +/- 1.96 se**

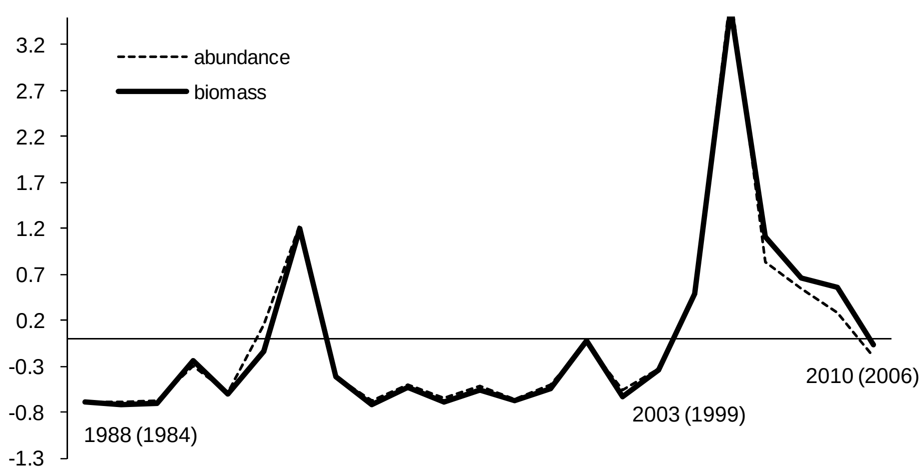



**Fig 3b : Standardized *year class strength at age 4* (in brakets) given by EU surveys, 1989-2010**

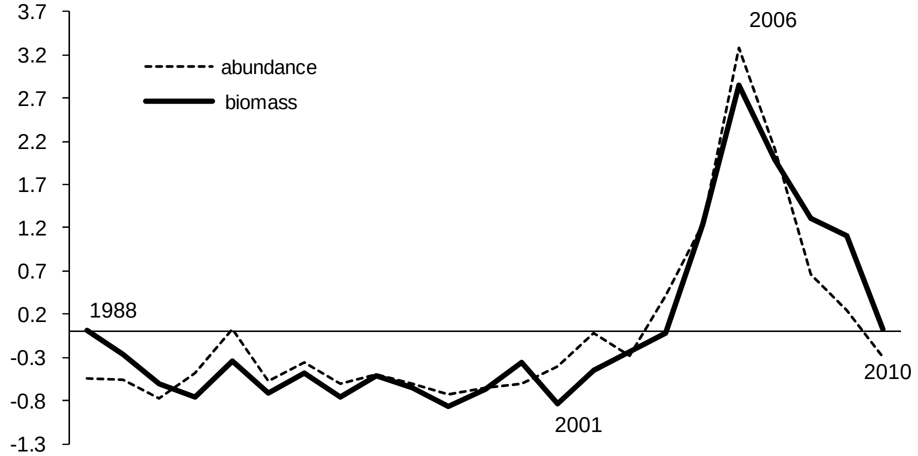



**Fig 3c: Standardized *total abundance and biomass* given by EU surveys, 1988-2010**

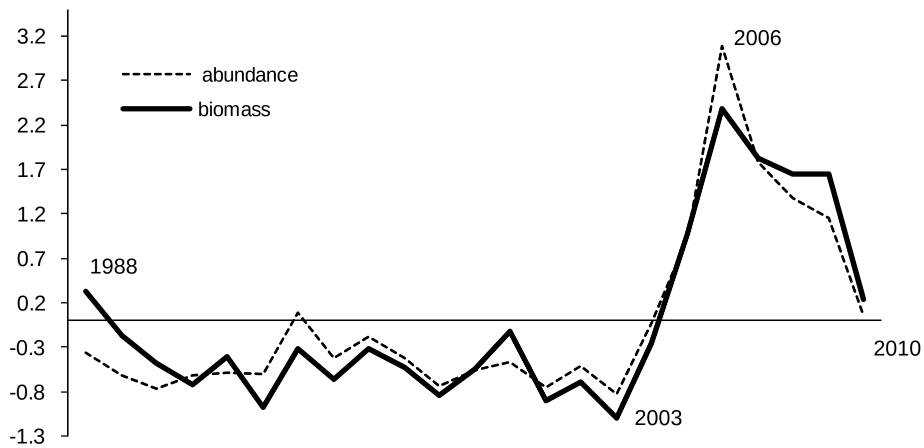



**Fig 3d: Standardized *4+ abundance and biomass* given by EU surveys, 1988-2010**

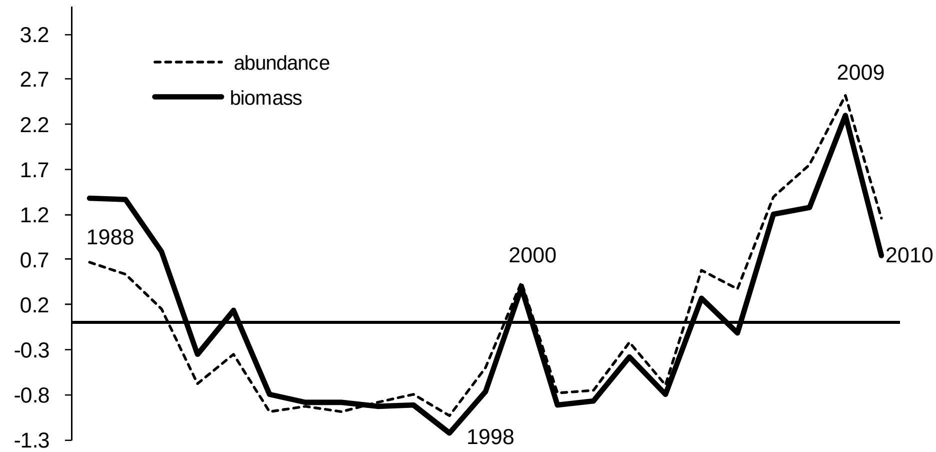



**Fig 3e: Standardized *female spawnning abundance and biomass* given by EU surveys, 1988-2010**

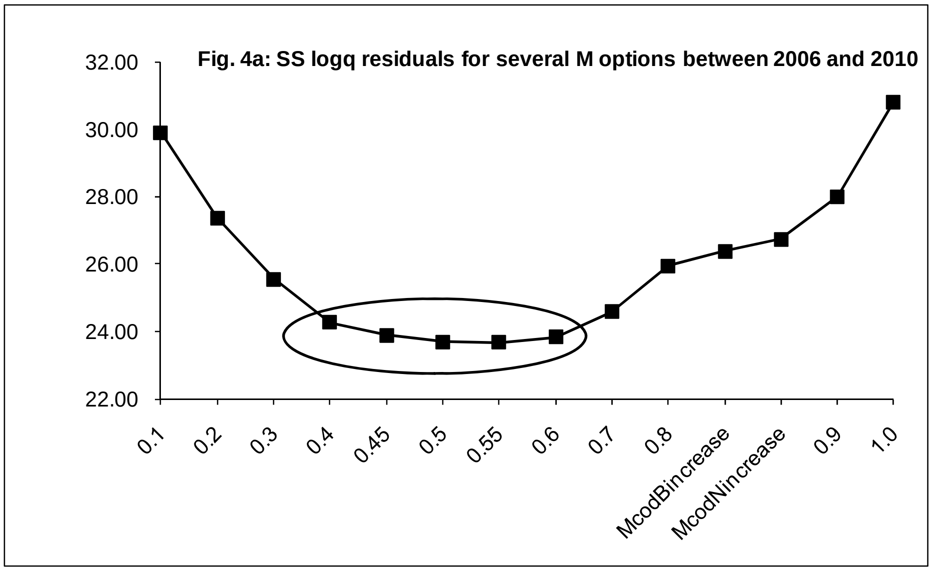



**Fig. 4a: SS logq residuals for several M options between 2006 and 2010**

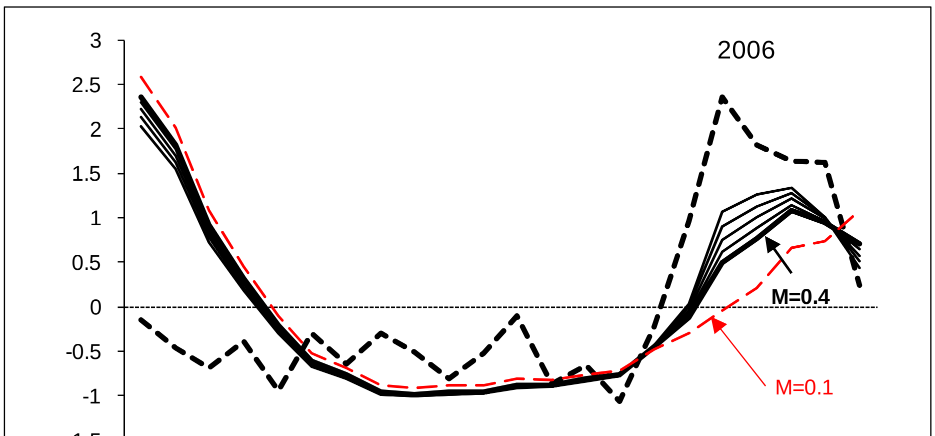



**Fig. 4b: Standized 4+ biomass given by XSA$_{M=0.4\ to\ 0.6}$ *versus* EU survey$_{1989\text{-}2010}$ and standard XSA$_{M=0.1}$**

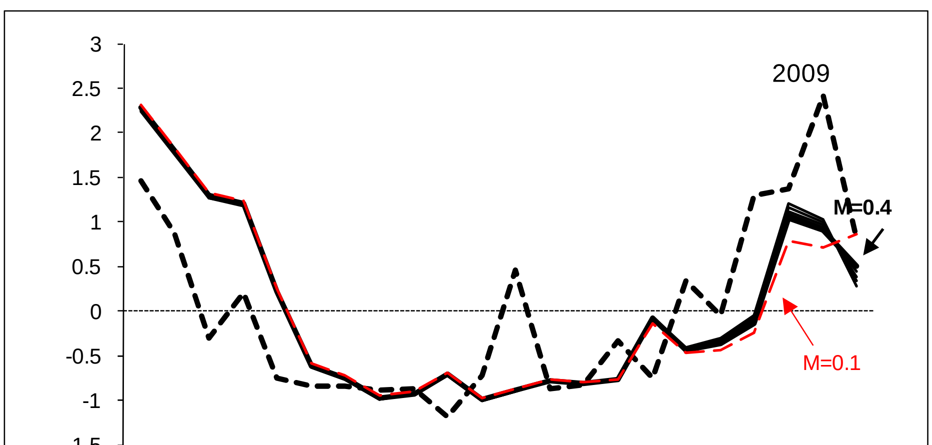



**Fig. 4c: Spawnning stock biomass given by XSA$_{M=0.4\ to\ 0.6}$ *versus* EU survey$_{1989\text{-}2010}$ standard XSA$_{M=0.1}$**

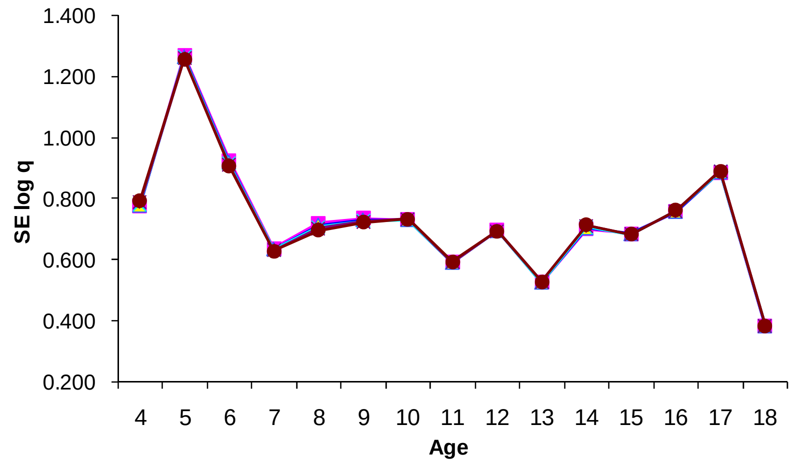



**Fig. 5a: SE Log q for five $XSA_{2010}$ runs with $M_{0.4-0.6}$**

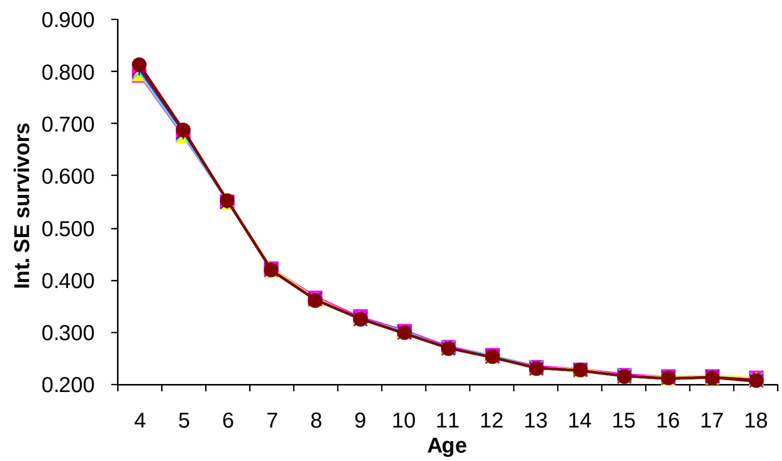



**Fig. 5b: Int. SE of survivors for five $XSA_{2010}$ runs with $M_{0.4-0.6}$**

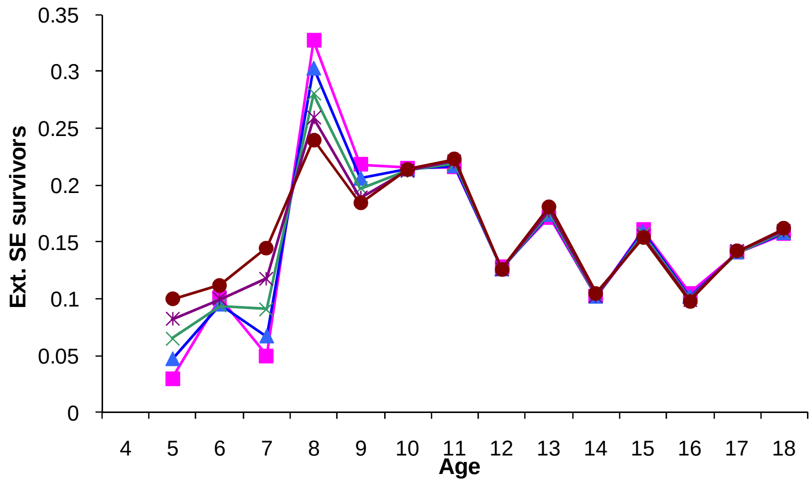



**Fig. 5c: Ext. SE of survivors for five $XSA_{2010}$ runs with $M_{0.4-0.6}$**

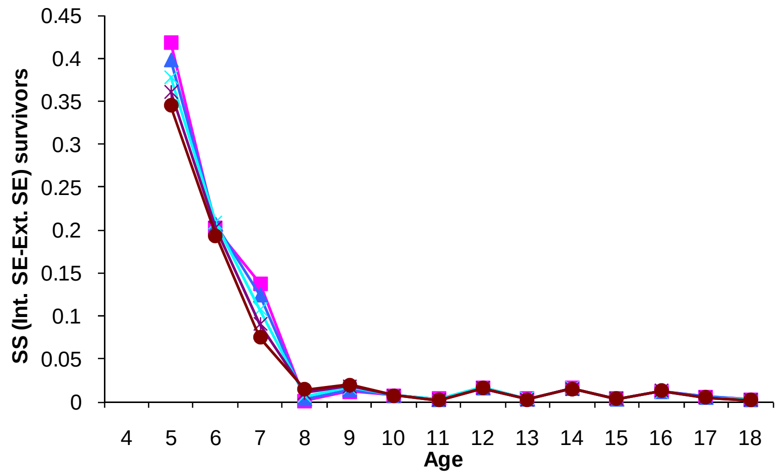
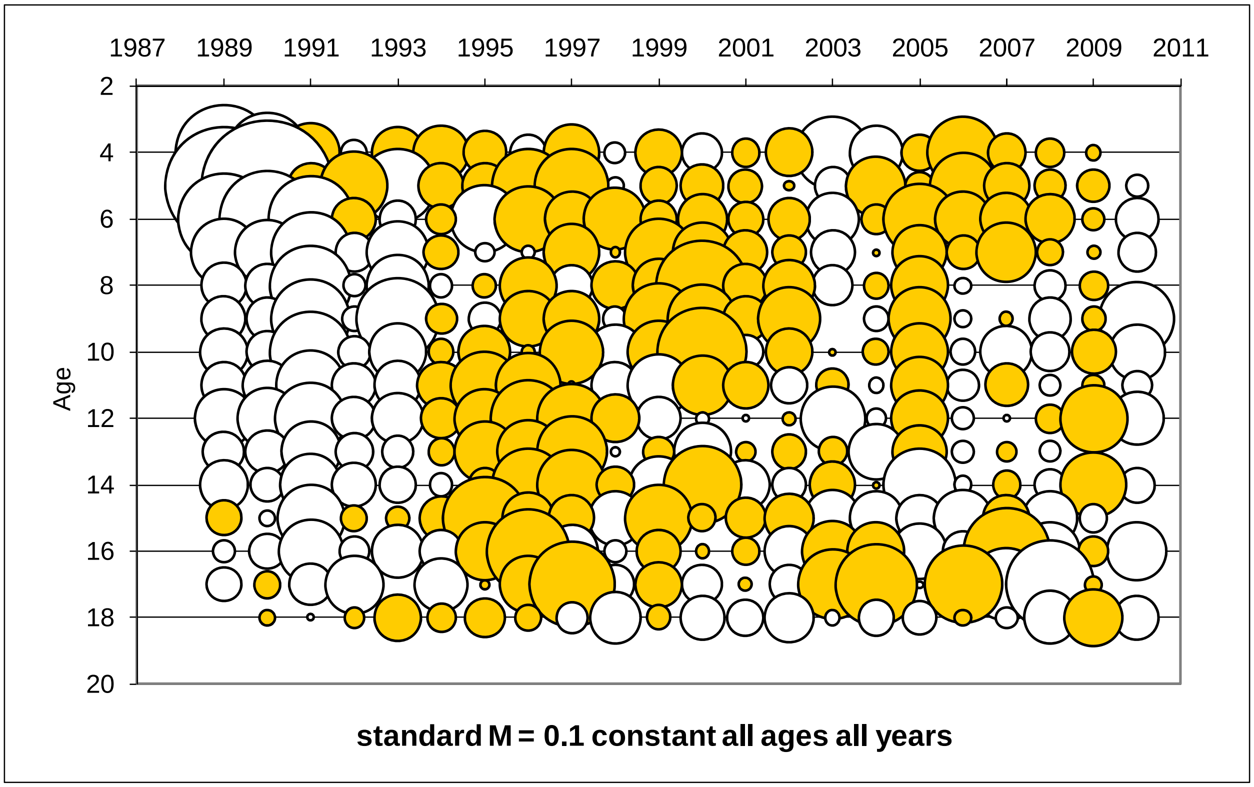



**Fig. 5d: SS (Int. SE-Ext. SE) of survivors for five $XSA_{2010}$ runs with $M_{0.4-0.6}$**



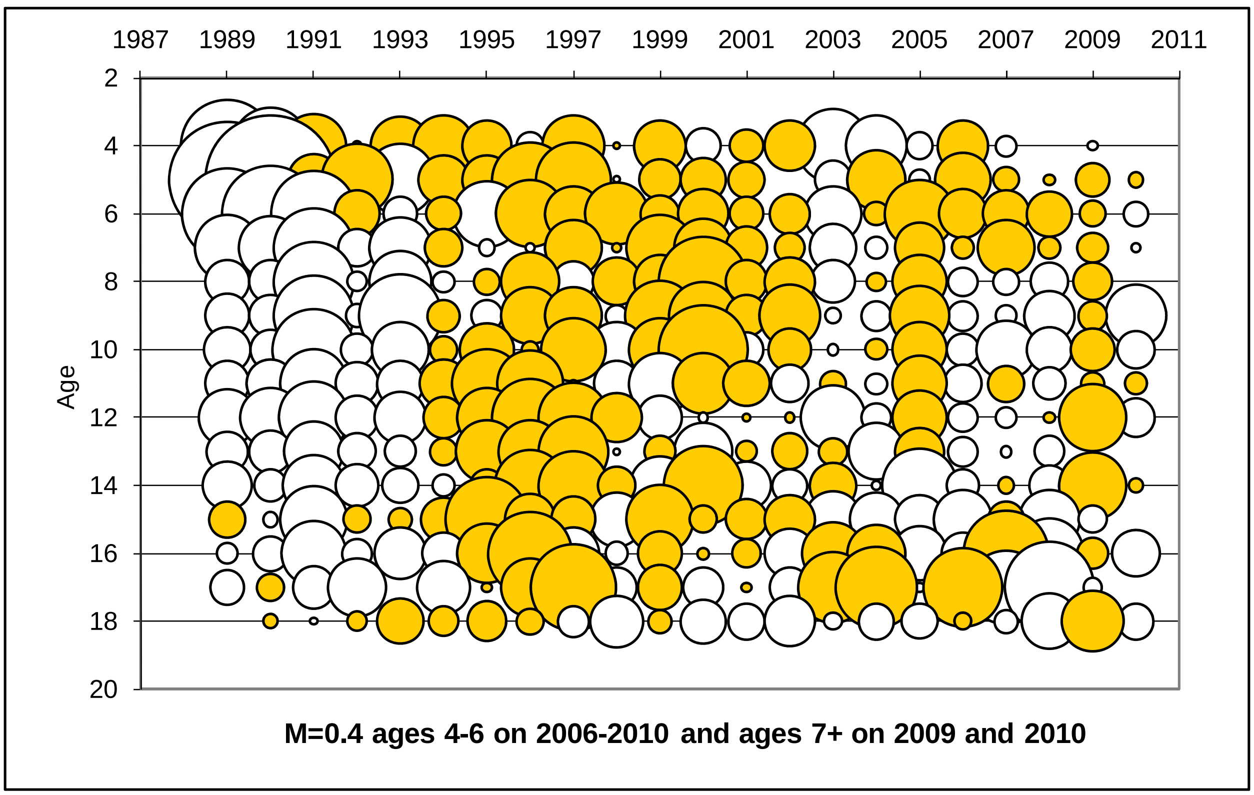
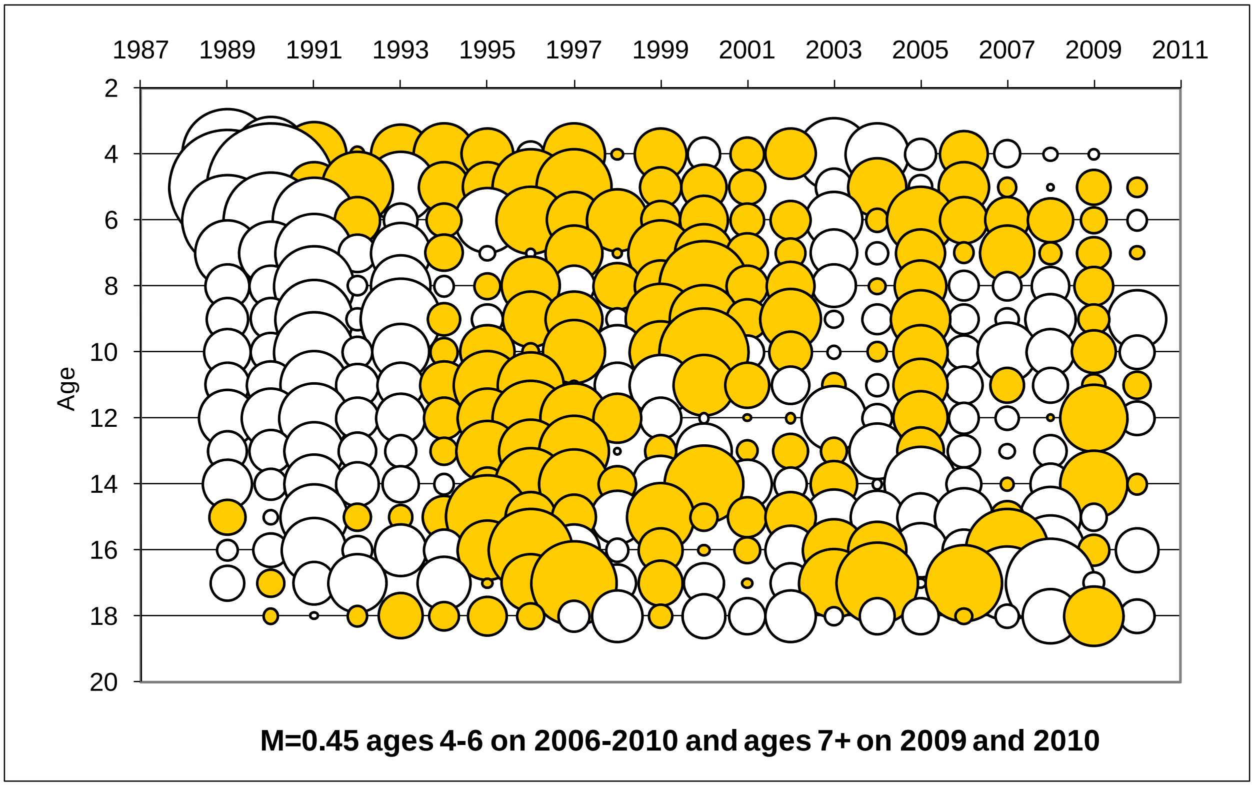




Fig. 6: Residual log q patterns of the XSA2010 for the standard M input (M=0.1 all ages all years) and several M options between 0.4 and 0.6 on 2006-2010 (ages 4-6) and 2009-2010 (ages 7+)



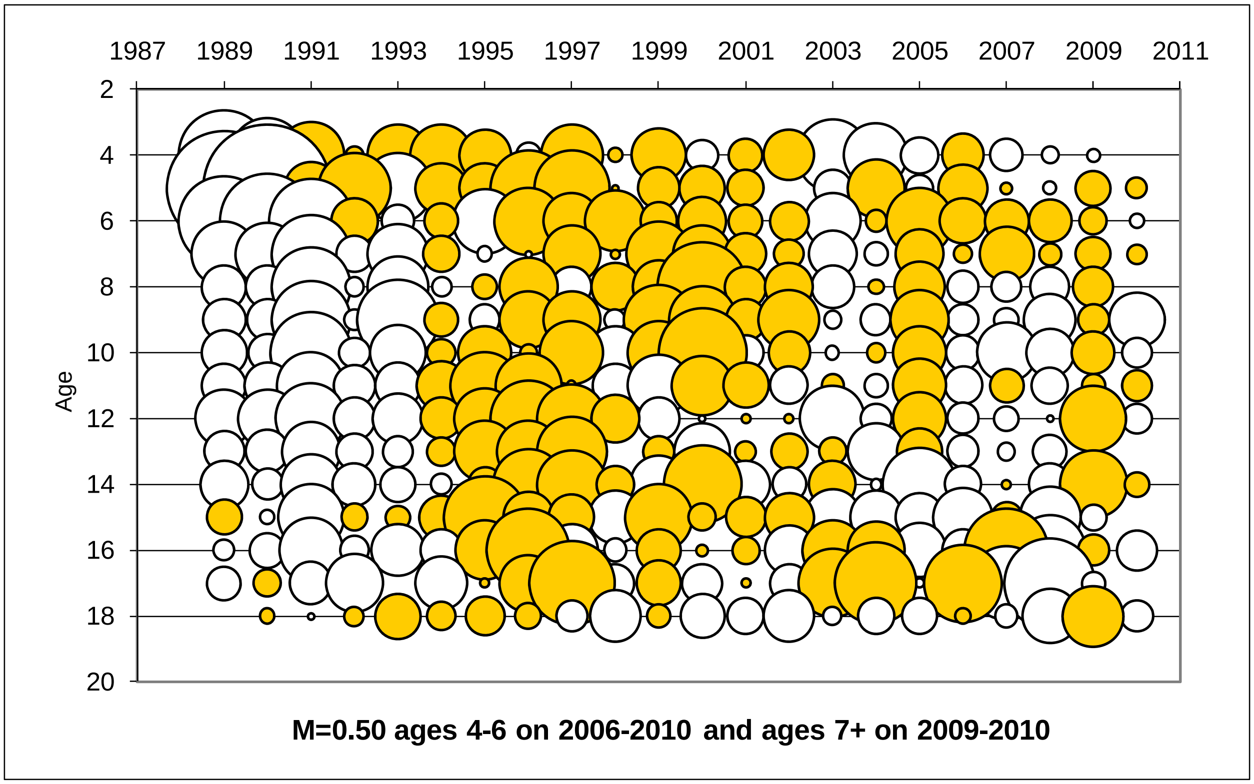
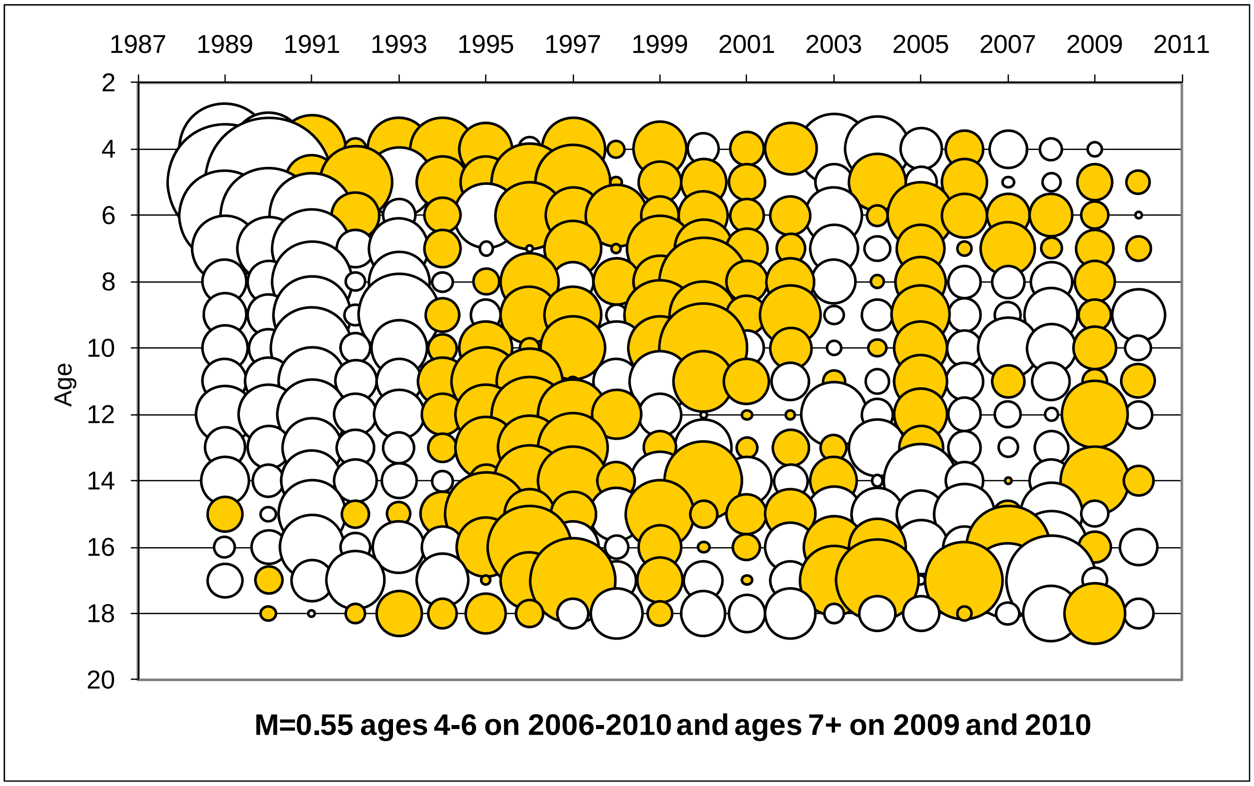




Fig. 6 (cont): Residual log q patterns of the XSA2010 for the standard M input (M=0.1 all ages all years) and several M options between 0.4 and 0.6 on 2006-2010 (ages 4-6) and 2009-2010 (ages 7+)



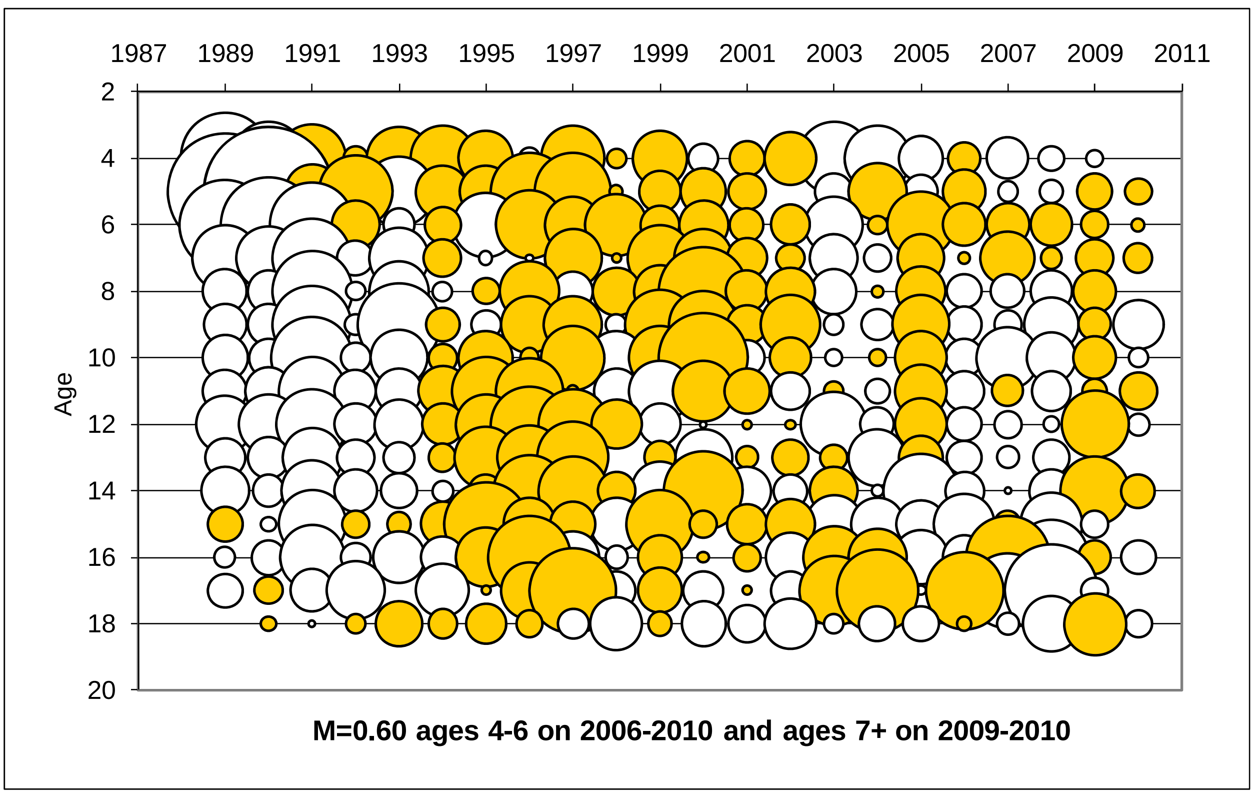




Fig. 6 (cont): Residual log q patterns of the XSA2010 for the standard M input (M=0.1 all ages all years) and several M options between 0.4 and 0.6 on 2006-2010 (ages 4-6) and 2009-2010 (ages 7+)

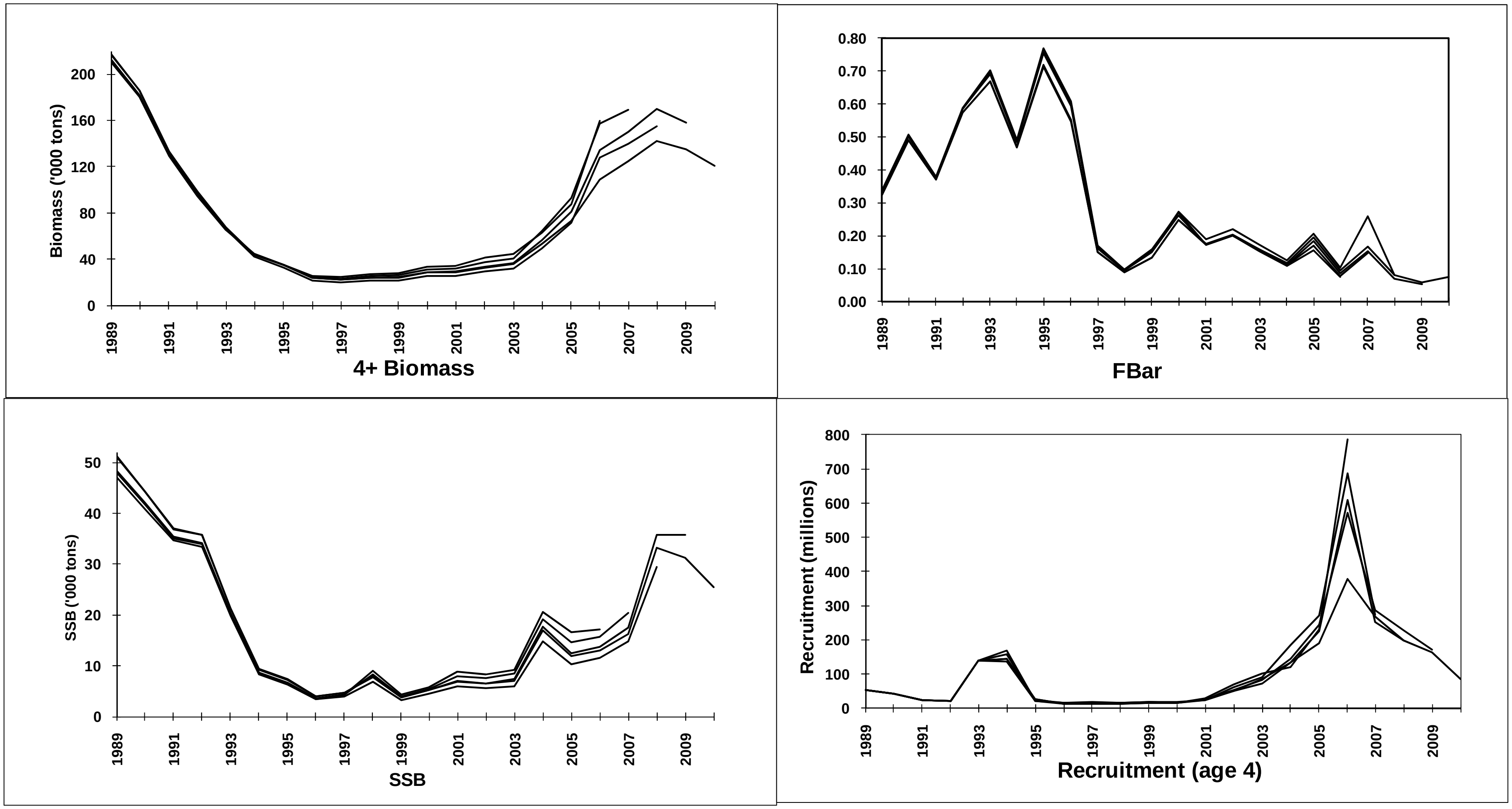



Fig. 7: XSA retrospective analysis, 2010-2006

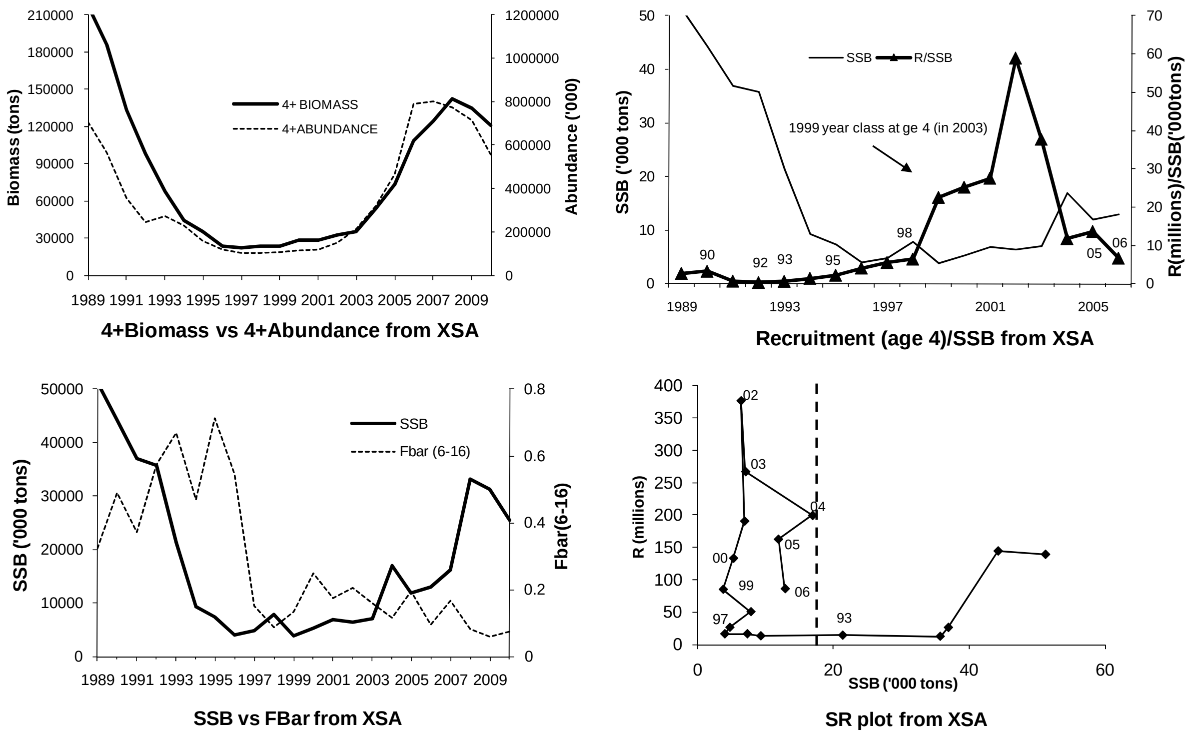



Fig. 8a: XSA results for 2011 assessment.

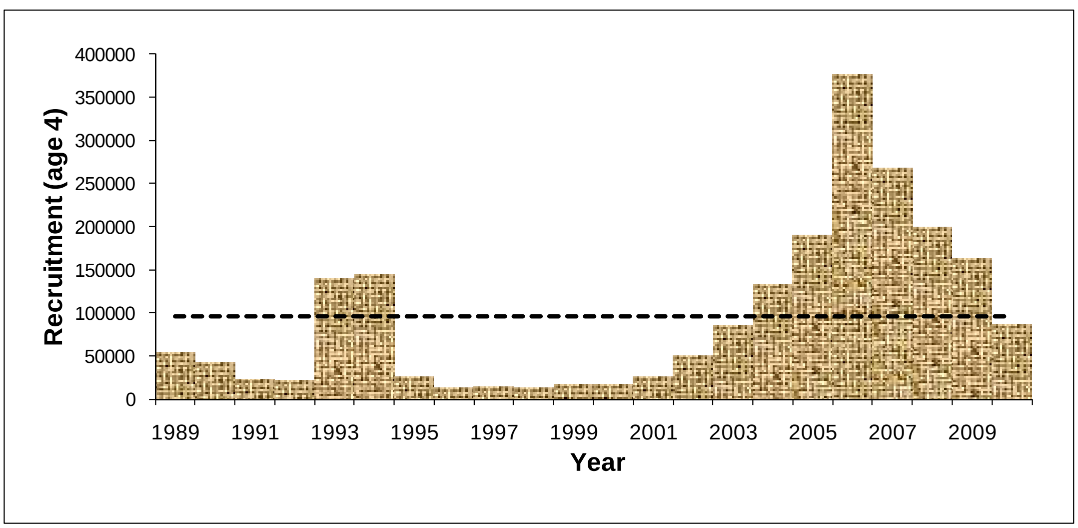



Fig. 8b: Year Class strength at recruitment from 2011 XSA.

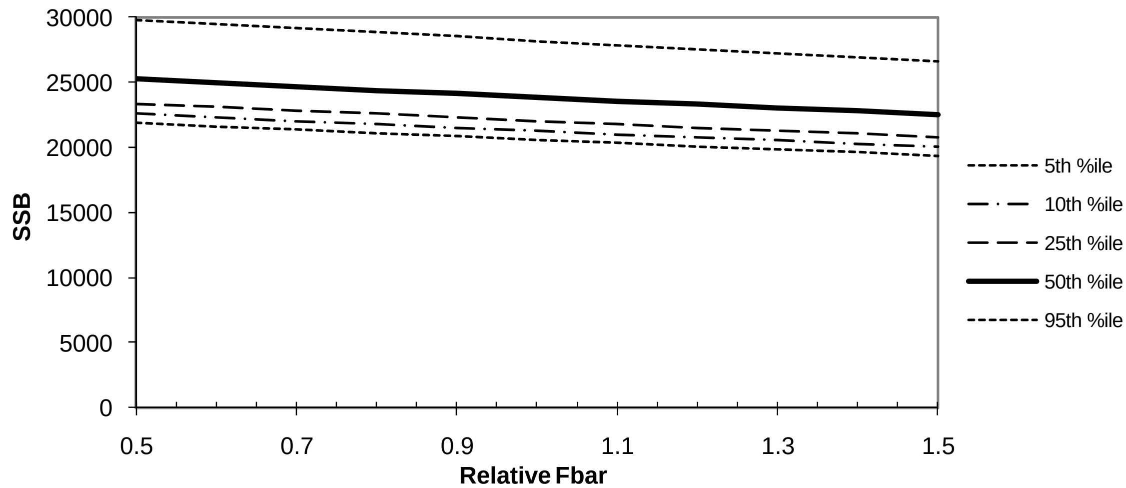



**Fig. 9a: 2013 SSB projections under a range of relative F status quo multipliers**

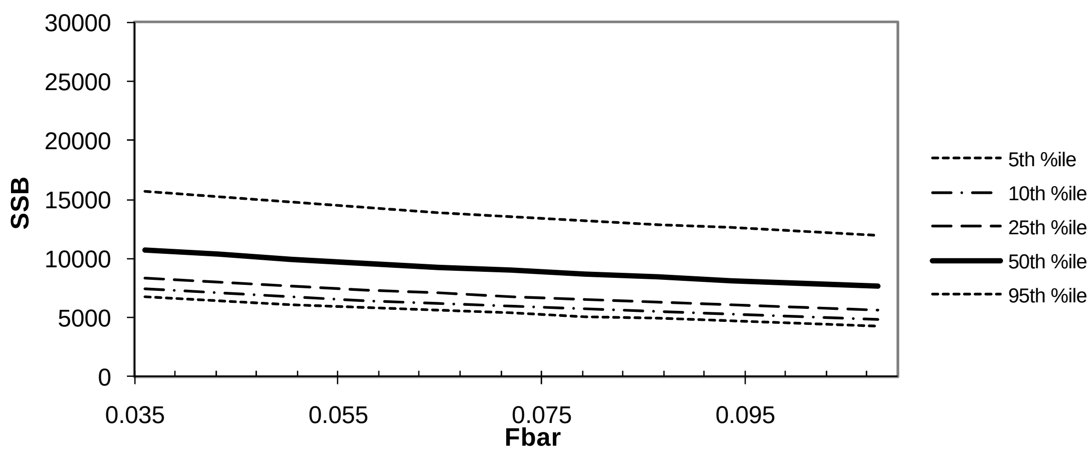



**Fig. 9b: 2020 SSB projections under a range of F status quo multilpiers**

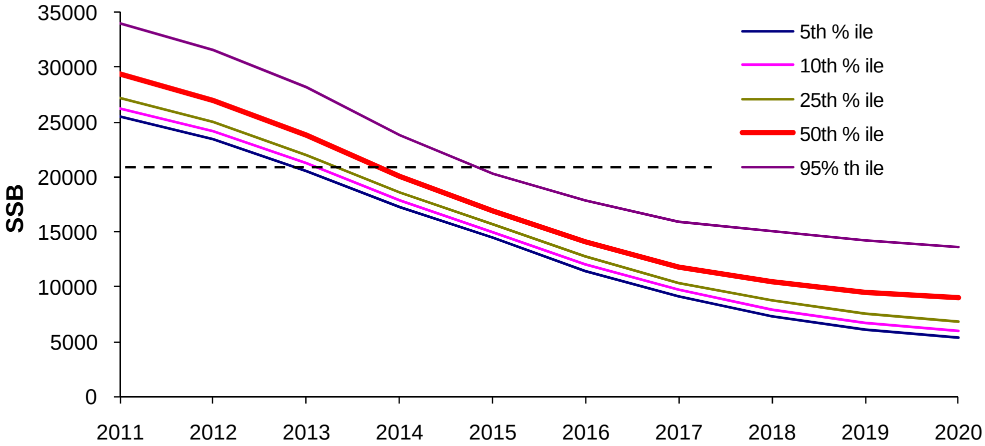



**Fig. 10a: SSB probability profiles under Fstatus quo**

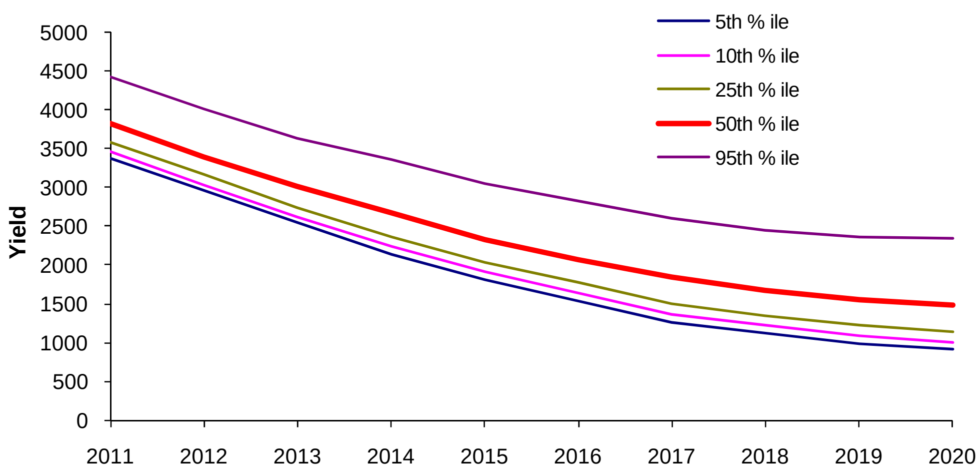



**Fig. 10b: Yield probability profiles under Fstatusquo**