NOT TO BE CITED WITHOUT PRIOR
REFERENCE TO THE AUTHOR(S)

Northwest Atlantic Fisheries Organization

Serial No. N5399 **NAFO SCR Doc. 07/47**

SCIENTIFIC COUNCIL MEETING – JUNE 2007

An XSA Based Assessment of Beaked Redfish (*S. mentella and S. fasciatus*) in NAFO Division 3M

by

A. Ávila de Melo [1] , F. Saborido-Rey [2] and R. Alpoim [1]

[1] Instituto de Investigação das Pescas e do Mar, Av. Brasília 1400 Lisboa, Portugal.
[2] Instituto de Investigaciones Marinas, Eduardo Cabello 6, Vigo, Spain.

Abstract

The 3M beaked redfish stock is regarded as a management unit composed of two populations from two very similar species (*Sebastes mentella* and *Sebastes fasciatus*). 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. 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. An Extended Survivor Analysis (Shepherd, 1999) was performed using the previous XSA framework and the revised EU survey abundance's at age as the tuning input file.

Very high fishing mortalities until 1996 forced a rapid and steep decline of abundance, biomass and female spawning biomass of the 3M beaked redfish stock. With low fishing mortalities since then the stock decline was halted and the survival and growth of the existing cohorts allowed a discrete but continuous growth of 4+ biomass and female SSB from 1998 onwards. Meanwhile the income of a sequence of weak year classes (1991-1997) kept the 4+ abundance stable at a low level till 2001. However on the most recent years (2003-2006) a sequence of above average year classes from 1998 to 2002, each one greater than the previous, recruit each year to the 4+ stock, pumping abundance and biomass at the beginning of 2006 to a maximum and a second high of the 1989-2006 interval, respectively. At the same time the stock reproductive potential has increase substantially and above average year classes are being generated by parental female stock with biomass sizes well bellow the ones that produced the previous abundant 1989-1990 cohorts. Nevertheless these results of the present XSA assessment don't change the perception of previous assessments, that this is still an unbalanced stock strongly leaning to the younger age groups and that female spawning stock biomass should be allowed to recover to the former 1989-1990 level, in order to stabilize the stock and the fishery at a safe zone.

Short and medium term projections of female spawning stock biomass under a gradient of *F status quo* percentages, as well as SSB and yield medium term probability profiles under *F status quo* were obtained with the *Mterm* program of the CEFAS laboratory (Lowestoft/UK). In order to low the impact of retrospective bias on the *Mterm* projections, the XSA 2006/2005 average abundance and fishing mortality at age ratios estimated in the retrospective analysis were used to get a proxy of a retrospective-corrected population at age at the beginning of 2007 and of *F status quo* at age. The results of the present *Mterm* projections showed that the recent population growth and the survival of the abundant year classes that meanwhile joined the exploited stock will drive SSB over the 40,000 tons target in the short term if fishing mortality is kept at its present low level. Taking into account the recent biomass increase, a medium term constant fishing mortality at *F status quo* will imply in the near future a catch level not exceeding 10,000 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 beaked redfish populations is supported by recent morphometric studies (Saborido Rey, 1998).

The 3M redfish assessment is focused on the beaked redfish, regarded as a management unit composed of two populations from two very similar species: the Flemish Cap *S. mentella* and *S. fasciatus*. The reason for this approach is the historical dominance of this group in the 3M redfish commercial catch. During the entire series of EU Flemish Cap surveys (1988-2006) beaked redfish also represents the majority of redfish survey biomass (77%). But at present this majority is down to 61% due to the rise of golden redfish survey indices on most recent years (2003-2006).

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 of age (Saborido Rey, 2001). Redfish are viviparous with the larvae eclosion occurring right before or after birth. Mean length of female first maturation varies from 26,5cm (at age 8) for Acadian redfish to 30.1cm (at age 10) for deep-sea redfish (Saborido Rey, *pers. comm.* 2000). Spawning on Flemish Cap occurs through February till the first half of April for deep-sea redfish while for Acadian redfish spawning reach its maximum in July – August (Saborido Rey, 1994).

Description of the fishery

The 3M redfish stocks have been exploited over the past both by pelagic and bottom trawl. Due to the similarity of their external morphology the commercial catches of 3M redfish are reported together. The majority of the bottom commercial catches are composed of beaked redfish. The species composition of the pelagic redfish catches, which dominated the fishery in the early nineties, remains unknown. However, taking into account that from survey results, *S.mentella* and *S.fasciatus* together represent the major proportion of the abundance and biomass of 3M redfish, it is assumed that these pelagic catches were also dominated by beaked redfish.

The redfish fishery on Division 3M increased from 20,000 tons in 1985 to 81,000 tons in 1990, falling continuously since then till 1998-99, when a minimum catch around 1,000 tons has been recorded most as by-catch of the Greenland halibut fishery (Table 1a, Fig. 1a). The drop of the 3M redfish catches from 1990 onwards is related with the quick decline of the stock biomass followed by an abrupt decline of fishing effort deployed in this fishery.

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

From July 2004 to July 2006 Flemish Cap EU survey showed an important increase in bottom biomass of both golden and beaked redfish by 3.5 times (Casas, 2007). As regards golden redfish this increase justified a new directed fishery pursued by Portugal and Russia from September to mid November 2005 and from June till the end of October 2006. TAC was overshoot in November 2005 (6,550 ton) and 2006 (6,228 ton, from NAFO Circ. Letters), with an estimated catch of beaked redfish of 3,784 ton and 4,154 ton respectively. For the 2005 estimate of beaked redfish catch the Portuguese monthly catch between September and November was split to golden and beaked redfish using the golden redfish biomass proportion on the July 2005 EU survey, while the Russian and Baltic states catch was split using the golden redfish proportion in weight on the Russian commercial redfish sampling data from the fall of 2005 (Vaskov, 2006). For the 2006 estimate the Portuguese monthly catch between July and November , together with the Russian and Baltic states catch, was split to golden and beaked redfish using the golden redfish biomass proportion on the July 2006 EU survey. The rest of the 3M redfish nominal catches were assigned to beaked redfish in 2005 and 2006 (Table 1a, Fig. 1a).

The boom in 1993 and further settlement of a shrimp fishery in Flemish Cap lead to high levels of redfish by-catch in 1993-94. From 1995 onwards by-catch in weight fell to apparent low levels but since 2001 increase again, reaching 1006 tons in 2003. That increase does not reflect any recent expansion of the 3M shrimp fishery and was supported by above average year classes occurring since late 1990's (Ávila de Melo *et al.*, 2004 and 2005). From Canadian observer data, the redfish by-catch on the 3M shrimp fishery declined to 471 ton in 2004 and again to 80 ton in 2005 (Table 1b), reflecting an important reduction of the 3M shrimp catch observed in recent years (Skúladóttir and Pétursson, 2006). The level of the 2006 redfish by-catch remains unknown. Length sampling of this by-catch for 2005 and 2006 is also unavailable.

Translated to numbers recent redfish by-catch increased from 3.4 millions (1999-2000) to 29.1 millions in 2001 and declined continuously since then: in 2002-2003 to 21 millions, in 2004 to 9.9 million and finally in 2005 was estimated to be at 1.8 millions, the lowest redfish by-catch level since the beginning of the 3M shrimp fishery in 1993. 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 1c, Fig. 1b). The present dynamics of the Flemish Cap beaked redfish stock is driven by the commercial catch and associated fishing mortality.

Length composition of the commercial catch and by-catch

Most of the commercial length sampling data available for the 3M redfish came, since 1989, from the Portuguese fisheries and has been annually included in the Portuguese research reports on NAFO SCS Document series. Most of these data referred to beaked redfish, and, taking into account that the majority of the length sampling was from depths greater than 400m, they should represent *S. mentella* catches. Length sampling data from Russia, Japan and Spain were also available for several years and used to estimate the length composition of the commercial catches for those fleets in those years. The annual length composition of the Portuguese trawl catch was applied to the rest of the commercial catches (Vargas *et al*, 2007). The 1998-2006 3M beaked redfish commercial length weight relationships from the Portuguese commercial catch (Alpoim and Vargas, 2004; Vargas *et al*, 2007) were used to compute the mean weights of all commercial catches and correspondent catch numbers at length.

Modal lengths of the annual commercial catch gradually shift towards larger sizes from 1996 to 1999 and were kept within 27-30cm the next coming years, 2000-2003 (Table 3a). Mean length in the catch generally increased to a higher level, being in 2003 again above the maturity L_{50} of *S. mentella* females (Saborido-Rey pers. comm., 2000). However in 2004, the most abundant length groups were pulled back to smaller sizes, 20-23cm, and mean length drop almost 6cm, to a minimum of 24.4cm (Table 3a, Fig. 2). From the 2004 age-length key and mean lengths at age, this dramatic shift reflects the gradual recruitment to the commercial fishery of the above average 1998 year class, as well as of the 1999 year class, after passing through 2001-2003 the redfish by-catch of the 3M shrimp fishery. Model lengths were pulled to the former larger sizes (27-29cm) in 2005 and mean length raised to 28.1 cm, but in 2006 they return to smaller sizes (21-24cm) and mean length to a new minimum level. According to the 2006 age-length key this return to previous small lengths reflects the recruitment of the again abundant 2000 year class and the still ongoing recruitment process of the 1999 year class (Table 3a, 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 EU survey length weight relationships (Table 2b: Troncoso and Casas, *pers. comm.* 2007) were used to compute the mean weights of the by-catch and correspondent by-catch numbers at length. The sum of the absolute length compositions of the 1989-2006 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 3b).

Age composition of the catches

Age composition of the total catch was obtained using the *S.mentella* age length keys from the 1990-2006 EU surveys. On the first years of the assessment, before 1993, age group 8 was the most abundant and consecutive 1981-1984 cohorts were the most important in the commercial catch when passing through this age. The lack of sorting grades on shrimp trawl at the beginning of the 3M shrimp fishery justified that the most abundant age group in the catch (including redfish by-catch) moved back to age 4 and 5, targeting prematurely the above average 1989 and 1990 cohorts in 1993-1995. The implementation of that escape device and a large scale shrimp fishery lead to even younger modal age groups: between 1996 and 2004 ages 1 and 2 were the most abundant on the redfish catch. Finally the drop of the shrimp catch to a low level over the last couple of years allowed the most abundant age group of the redfish catch to grow older again, to age 6. The above average year classes of 1999 and 2000 were the most abundant in 2001-2002 (still from the redfish by-catch) and again in 2005 and 2006 (already as commercial catch) (Table 3c).

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 3d).

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 (1988-2006). An earlier bottom trawl survey series has been carried out by Canada from 1979 till 1985. This series was discontinued since then, despite an isolated Canadian bottom trawl survey conducted again on 1996.

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

EU survey

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

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

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

Length weight relationships from EU survey

Annual length weight relationships for *S. mentella* and *S. fasciatus* (1992-2006) and for the two species combined (1988-2006) were available from survey data (Troncoso and Casas *pers. comm.*, 2005 and 2007) (Table 2b). In each category all pairs of length-weight observations from the sampling of the survey catch were included in the fit, regardless sex and size. *S. mentella* and *S. fasciatus* length weight relationships were used to get 1992-2006 *SOP* survey biomass and *SSB* for each species. The *Sebastes sp*. length weight relationships were used to get the 1988-91 *SOP* survey biomass and *SSB* for beaked redfish, as well as the 1989-2006 mean weights at age for the stock and mature females.

Beaked redfish survey abundance at length

Each of the redfish categories included in the beaked redfish assemblage had their own survey abundance at length original series (beaked redfish including juveniles, 1988-1989; beaked redfish, 1990-1991; *S. mentella*, 1992-2002; *S. fasciatus*, 1992-2002 and juveniles, 1990-2002) converted to the new RV units using the conversion framework described in the previous assessment (Ávila de Melo *et al*, 2005). The transformed *S. mentella, S. fasciatus* and juvenile survey abundance at length series were then updated with the 2003-2006 *RV Vizconde de Eza* length distributions. For each year and redfish category abundance at length is re-scaled in order to fit the correspondent swept area survey biomass estimate. Finally the matrices of length distributions from all redfish categories were combined in order to give for beaked redfish a single 1988-2006 survey abundance at length series (Table 4a) and a single 1988-2006 survey female spawning abundance at length series.

Age composition of the beaked redfish survey stock and mature female beaked redfish stock

The EU survey abundance at age for the 1989-206 3M beaked redfish stock and mature female component (Table 4b and 4c) were obtained using the *S.mentella* age length keys from the 1990-2006 EU surveys, with both sexes combined. Dr. Fran Saborido-Rey (Instituto de Investigaciones Marinas,Vigo, Spain) has carried out age reading of 3M redfish otoliths since 1990 (Saborido-Rey, 1994). Due to the fact that the 1989 *S.mentella* age length key was based on scale readings, the 1990 *S. mentella* age length key was also used in 1989. The ageing criteria of 3M redfish otoliths have been first revised in 1995 (Saborido-Rey, 1995) and 1998 (Saborido Rey *pers. comm*., 1998) and survey age length keys were then standardized accordingly. The purpose of these revisions was to get a clearer consistence on the tracking of the 1990 cohort, a strong year class that showed a density dependent growth (Saborido-Rey, 2001). Due to the scarcity of redfish larger than 40cm either in the survey and commercial catch a plus group was considered at age 19.

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

Maturity ogive

An observed maturity ogive for 3M beaked redfish was calculated as the mean proportion of mature females in the survey stock abundance at age (Table 4d) and used in the Extended Survival Analysis to get female spawning biomass estimates. At each age this mean proportion is given by the ratio between the 1989-2006 sum of survey mature females and the correspondent total survey stock abundance.

Survey biomass and abundance, 1988-2006

The 1989-2006 EU survey biomass index for 3M beaked redfish is first presented as mean catch per tow and associated standard errors (Table 5a, Fig. 3a). From 1992 onwards this mean catch is the sum of the mean catch per tow for *S. mentella, S. fasciatus* and beaked redfish juveniles (Casas and Troncoso, 2007). The mean catch per tow for beaked redfish juveniles is estimated with the proportion of beaked redfish found in the sum of products biomass for small redfish up to 21cm length, applied to the juvenile mean catch per tow. The standard error of the beaked redfish mean catch per tow is given by the square root of the sum of squares of the standard errors associated to each mean catch per tow category.

The 1988-2006 interval covered by the EU Flemish Cap survey, started with a continuous decline of bottom biomass till 1991, followed by a period of biomass fluctuation with no apparent trend between 1992 and 1996. A further decline occurred in 1997 and 1998, when the lowest survey biomass was recorded. The index increased in 1999 and 2000, recovering to the 1992 level, but between 2001 and 2003 returned to wide oscillations. Since 2004 survey biomass rise continuously to an historical maximum in 2006, three times above the level at the beginning of the survey series in 1988 (Table 5b, Fig. 3b). Sharp increases on both exploited biomass (age 4 and older) and juvenile biomass (ages up to 3 years old) contributed to this peak in 2006 of the survey biomass index. Female spawning biomass is also growing though at a slow pace, being its present level half way the average low of the mid 1990's and the high level that produce the abundant year classes from the beginning of the time series (1989 and 1990) (Table 5b, Fig. 3b).

A similar pattern is observed on survey abundance. After falling by half from the 1988-1989 level, reaching in 1990 the minimum of the series, the index was pushed up to a local peak in 1992 by the strong 1990-year class, recruiting then to the survey gear. Abundance was kept at a low level between 1993 and 2000, with a minimum recorded in 1998 and the 1990 year-class as the most abundant cohort in the survey catch for seven consecutive years. From 2001 onwards a sequence of abundant year classes (2000-2003) and generalized high survival rates through the age spectrum supported a rapid increase in stock (and exploited stock) survey abundance: historical high have also been attained in 2006 (Table 4b and 5b, Fig. 3c). Female spawners component showed a widespread and balanced age composition during the first years of the interval, despite its continuous fall from 1989 to 1993. By that time a sequence of cohorts (1981-1985) was most abundant on consecutive years, always at age 8. Since 1996 till 2004 the 1990 year class was dominant, with older ages loosing their importance on this stock component. The increasing number of maturing females from the 1990 year class was responsible for the rise of the survey index on 1999-2000 but it quickly fell afterwards till 2004, with the shrinkage in the size of this cohort. In 2005 and 2006 the portion of young maturing females at age 6 from the 1999 and 2000 year classes, together with an increasing number of mature female survivors from the previous cohorts, pull up again this survey index to the vicinity of its high level on 1989-1990 (Table 4b and 5b, Fig. 3d).

XSA Assessment

Bottom trawl survey indices for Div. 3M redfish presented until recently large inter-annual variability, too drastic to be only explained by changes in stock size from one year to the next. These fluctuations are caused not only by vertical migrations of redfish, all species with both demersal and pelagic behaviour, but also by a wide and variable distribution within the division, as pointed out by the beaked redfish commercial catches from the north eastern slopes of Flemish Pass, near the border of Div. 3M with Div. 3L.

The wide inter annual fluctuations of survey abundance at age have been considered a strong handicap on the performance of VPA tuning methods such as the Extended Survivor Analysis (XSA) (Shepherd 1999), due to the likelihood of its reflection on high variability of catchabilities through ages, years or cohorts that relate survey indices at age with VPA abundance. Nevertheless the existence of the EU survey time series of abundance at age indices urged the authors to frame the 3M beaked redfish assessment with an Extended Survivors Analysis since 2000 (Ávila de Melo *et al*., 2000).

The XSA program used was based in the algorithm implemented by Shepherd (1999) and is included in the Lowestoft VPA Suite (Darby and Flatman, 1994). The model algorithms are presented in Appendix 8 of the respective user guide (Darby and Flatman, 1994) and have been summarized and adapted to this case study in 2003 assessment (Ávila de Melo *et al.*, 2003).

Input files

The input files for XSA analysis are presented in Table 6. Natural mortality was assumed constant at 0.1. The proportion of mature females at age is the one observed on the 1989-2006 period (Table 4d) and the month with a peak of spawning for 3M *Sebastes mentella*, February (Saborido-Rey, 1994), was the one adopted to the estimate of the proportion of F and M before spawning. The first age group considered was age 4 (the first age in the catch at age matrix with catches assigned every year) and age 18 was the last true age (from age 19 onwards both survey and commercial sampling data are scarce and so a plus group on age 19 has been considered). Landings were given by the 4+ *SOP* of the catch at age *x* commercial weight at age matrices.

The present Extended Survivor Analysis used as tuning file the 1989-2006 EU survey abundance at age matrix, with the 1989-2002 indices converted into the new *RV Vizconde de Eza* units.

The framework

In order to give a full use and equal importance to the sixteen years of input data, namely the former ones till 1993 when a full-scale redfish fishery occurred on Flemish Cap, no tapered time weighting was applied. Despite its (very) low level when compared to the first half of the 1990's catches have not been stable through the recent years, increasing from 1881 ton in 2003 to 4154 ton in 2006, and so fishing mortalities at age on the terminal year were not shrunken towards a mean. Fishing mortalities at oldest true age were not shrunk to an average of previous ages either. Survivors at age were not shrunk to a mean of each previous age abundance at the beginning of the last years of the assessment.

A run with catchability dependent of year-class strength on all ages till the penultimate true age (17) showed all ages with high regression standard errors, most of them with high *t* values of the slope as well. However the regression statistics of catchability for the younger ages considered (4 and 5) present *t* values of the slopes, that linearly relate the log abundance at age with the log survey index at age, not differing significantly from 1 (*Student's t* test with 16 degrees of freedom = No. points – 2, significance level of 0.05). This lack of a significant trend on the regression slopes for the younger ages led us to accept catchability independent with respect to year class strength and time through all the age spectrum of the assessment. Catchability was set constant with age only at age 17: after declining between age 4 and 12, catchability does not stabilize on older ages showing on the contrary some increase (Table 6, Fig. 4a). Exploratory runs have also shown that keeping the minimum standard error of the *log* catchability on the last true age (18) at 0.5 (in order to avoid overweight of the cohort's terminal population estimates by the last true age) improved the fitness of the model to the data. In summary the present XSA framework is the same of previous assessments: 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.

The diagnostics and results of this assessment are from the 30^{th} iteration and not from convergence that only occurred at the 61^{st} iteration: solutions at convergence tend to be (slightly) higher as regards population at age on the final year and survivors at age at the beginning of the present year and (slightly) lower as regards fishing mortality at age on the final year. The comparison of the diagnostics (Table 7) suggests that the fit of the model to data remains practically unchanged when the XSA stops at the 30^{th} iteration or at convergence, and so the more conservative picture was adopted.

Diagnostics

The diagnostics of the 2007 XSA are presented on Table 7. Survey catchability at age present a steep decline till age 11, followed by relative stability (ages 11-14) and a finally an increasing trend on older ages (ages 15-17) (Fig. 4a). Mean catchabilities are associated to high standard errors on most ages (Table 7 Mean *log* catchability and standard errors for ages with catchability independent of year class strength and constant w.r.t. time).

The *log q* residuals continue to present a clear pattern of year effects. There is a higher proportion of positive *log q* residuals during the intermediate years of 1994 to 2002, while on the first (1989-1991) and last (2003-2006) years of the interval most ages had negative residuals (Table 7/*log* catchability residuals; Fig. 4b and 4c). The higher residuals were negative and related to the catchability of age 5 on 1989 and 1990, and to catchability of age 12 in 2006 (Table 7/*log* catchability residuals; Fig. 4b and 4c). It was considered that the sum of the *log q* residuals for each year of the interval and its plot against time could illustrate both the magnitude and trends of year effects over the assessment interval (Fig. 4d): *log q* residuals resulted on strong negative year effects on 1989-1991, shifted sign and produce strong positive effects on 1995-1997 and 2000, and a strong negative effect exists again in the final year. Trends on catchability through the age spectrum never reaching a stage of apparent stability, together with temporal changes on beaked redfish concentration near the bottom of the survey swept area (amplifying the noise on the mean *log* catchabilities at age and introducing strong year effects) contributed to both high standard errors and residual year patterns that are distinctive of the survey mean catchability at age of the Flemish Cap beaked redfish.

Retrospective Analysis

A 2006-2003 retrospective analysis was carried out in order to determine the bias on the biomass, female spawning stock biomass (SSB), fishing mortality (mean F: ages 6-16) and recruitment (age 4) estimates from consecutive assessments back in time (Table 8a and Fig. 5a). This retrospective analysis was confined to the most recent years of surveys conducted by the new *RV Vizconde d'Eza*, covering both the passage of the abundant 1990 cohort trough the exploitable stock and female spawning stock, together with the recruitment of the more recent above average year classes to the 4+ component. The retrospective XSA present an over bias pattern on female SSB and (to a lesser extent) 4+ Biomass, most probably caused by the downwards revisions to the estimated recruitment of the 1990 year class, together with the recruitment of the subsequent weak year classes. However the most recent recruitments from the 1999-2001 year classes are revised upwards. This reversion of the recruitment retrospective pattern leads to an over bias pattern on average fishing mortality from 2005 to 2006.

For a population unit with the wide inter-annual oscillations of survey indices typical of redfish species, the retrospective biomass, spawning stock biomass, mean fishing mortality and recruitment ratios from the 2006/2005 XSA's shown a rather consistent estimate of stock parameters and stock trends between the two last assessments (Table 8b, Fig. 5a). In order to have an age disaggregated picture of retrospective patterns from one assessment to the next, the XSA 2006/2005 ratios of fishing mortality and abundance at age were calculated and averaged for 2005 back to 1995 interval (Table 8b and 8c; Fig 5b and 5c). Both abundance and fishing mortality retrospective biases are age dependent: under estimate of fishing mortality increase from age 4 till age 7, decrease since then and from age 13 onwards retrospective bias is reversed: for older ages fishing mortality is systematically over estimated. On the contrary young age groups are increasingly over estimated till age 7, this retrospective pattern decrease afterwards and for ages 14 and older abundance is under estimated.

From the possible causes of retrospective patterns – patterns of misreporting, patterns in catchability or misspecification of natural mortality (Sinclair *et al*., 1990) – the year patterns in catchability, translated in positive or negative *log* catchability residuals through most of the ages on several years, can be the main cause of bias in a redfish assessment. In long living stocks, cumulative biases over a large number of ages included in the assessment tend to inflate the retrospective pattern. However it seems clear as regards 3M beaked redfish that younger ages still not fully recruited to the exploited stock, but representing on average 70% of its total size in numbers, are the major contributors to XSA retrospective patterns on fishing mortality and biomass. If the sequence of recent above average year classes (1999-2002) confirms its size in future assessments and are able to pass through their cohorts with high survival rates, abundance will be more evenly spread on the age spectrum and not squeezed within young ages. Small bias or bias of reverse sign on rebuilt ages 8 and plus will be more effective in the reduction of the actual retrospective patterns caused by the young age groups.

The poor diagnostics of the XSA seem related both with redfish own biology and unpredicted changes of its spatial distribution. On top of that constraint fishing mortality dropped ten years ago to a level much lower than the one from the first half of the 1990's, when a direct fishery was responsible for most of the catch. But despite the high standard errors associated to the average catchability at age and the year patterns in catchability residuals, the low level of retrospective bias between the 2006/2005 XSA's support the results of the present assessment as the closest picture one can get of the 3M beaked redfish stock.

Results

Very high fishing mortalities until 1996 forced a rapid and steep decline of abundance, biomass and female spawning biomass of the 3M beaked redfish stock (Table 9, Fig. 6a 4+ Biomass *vs* 4+ Abundance and SSB *vs* FBar). With low fishing mortalities since then the stock decline was halted and the survival and growth of the existing cohorts allowed a discrete but continuous growth of 4+ biomass and female SSB from 1998 onwards. Meanwhile the income of a sequence of weak year classes (1991-1997) kept the 4+ abundance stable at a low level till 2001. However on the most recent years (2003-2006) a sequence of above average year classes from 1998 to 2002, each one greater than the previous, recruit each year to the 4+ stock, pumping abundance and biomass at the beginning of 2006 to a maximum and a second high of the 1989-2006 interval, respectively (Table 9, Fig. 6a and 6b).

The stock reproductive potential increase slowly from 1996 till 1998, was kept at the 1998 level in 1999 and 2000, and records a sharp increase in 2001-2002 (Fig. 6a, R/SSB). However in 2006 female spawning stock biomass was still far away from a SSB average level of 40,000 tons, beyond which two consecutive above average recruitments were observed, from the 1989 and 1990 year classes, this last one being the most abundant cohort within the 4+ stock throughout the nineties. Despite a stock/recruitment plot suggesting that no apparent relationship between the size of the year classes and the parental female stock biomass (Fig. 6a, SR plot), this former level of female SSB should continue to be regarded as a benchmark in terms of stock recovery of this stock.

Stock projections

Short and medium term projections of female spawning stock biomass under a gradient of *F status quo* percentages, as well as 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 each projection, abide to a measure of uncertainty and bootstraps recruitment (age 4) from the third to the tenth year of the projection. The program has been upgraded to allow projections for long living stocks with a large number of ages included in the analytical assessment (Smith and Darby, *pers. comm*. 2001). The input data are aggregated in two categories of files:

a. A *.srr* file (Table 10a, adopting as stock recruitment relationship a random recruitment around the geo-mean of the 1989-2004 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 1989-2004 recruitments, the strong 1989 and 1990 year classes at age 4 included: the most recent assessments showed that above average recruitments can be produced by a much lower level of female SSB than the one responsible for the production of the 1989-1990 year classes. The 2001 and 2002 recruitments were excluded from the average due to the greater uncertainty of their estimate by the 2007 XSA.

b. A *.sen* sensitivity file (Table 10b), including the usual vectors needed to forward projections, with uncertainty associated to the population at age at the beginning of the first year of the projection (2007). The XSA survivors, at age 5 and older, by the end of 2006, coupled with a recruitment given by the 1989-2004 geo-mean of the numbers at age 4, are the basis to get the starting population at the beginning of 2007 (the same level of recruitment is assumed for the second year of each projection). Being the internal and external standard errors from XSA diagnostics (Table 7/ 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 (these CV's are used to bootstrap the initial population at age). In order to low the impact of retrospective bias on the *Mterm* projections, the XSA 2006/2005 average abundance at age ratios estimated previously in the retrospective analysis (see bottom Table 8c) were used to get a proxy of a retrospective-corrected population at age at the beginning of 2007 (Table 10c). Fishing mortality was kept constant through projections at *F statusquo*, corresponding at each age to the product of 2006 *FBar* (6-16) by the average (last three years, 2004-2006) relative fishing mortality at age. In order to reduce retrospective pattern on *F* at age vector the same procedure as for initial 2007 abundance was adopted, using the average fishing mortality at age ratios from the 2006/2005 retrospective analysis (see bottom Table 8b) to get a proxy of a retrospective corrected *F status quo* at age (Table 10d).

On the previous assessment (Ávila de Melo *et al.*, 2005) exploratory *Mterm* projections were made from 100% *F statusquo*, descending -10% steps down. The goal was to find an average fishing mortality level for the next ten years that would allow female spawning biomass to reach a level of 40,000 tons (similar to the one that produced by the time the most abundant recruitments) with a 50% probability. Those exploratory *Mterm* runs concluded that, with a 50% reduction of the 2004 level of fishing mortality on the next coming years, female spawning biomass target could be reached by 2014.

The results of the present *Mterm* projections (Table 11a and 11b, Figures 7a and 7b, 8a and 8b) showed that the recent population growth and the survival of the abundant year classes that meanwhile joined the exploited stock will drive SSB over 40,000 tons by 2010, if fishing mortality is kept at its present low level. Taking into account the recent biomass increase, a medium term constant fishing mortality at *F status quo* will imply in the near future a catch level not exceeding 10,000 tons.

Status of the 3M beaked redfish stock

The 3M beaked redfish stock experienced a steep decline from the 1989 till 1996. High commercial catches, at an historical maximum level between 1989 and 1993, lead to fishing mortalities at the top through the first half of the 1990's. Between 1996 and 1997 fishing mortality dropped and since then has been kept at a low level that allowed the survival and growth of the remainders from all cohorts. The 1993-1994 high by-catches in numbers at age 4 at the beginning of the 3M shrimp fishery depressed too early the abundant cohorts of 1989 and 1990, reducing their contribution to stock recovery. The 4+ Biomass is growing since 1998 but at a slow rate until 2003, basically still supported by the biomass of those 1989 and 1990 cohorts and the biomass growth of incoming weak year classes (1991-1997), that despite their small size survived at much higher rates than their predecessors. Meanwhile, and for similar reasons, abundance was kept stable at low level between 1996 and 2001. Since 2002 recruitment to exploitable stock comes from year classes not only above the 1985-2002 average at age 4 but with their size increasing each year. Their impact was translated on a fast growth of both 4+ biomass and abundance over the most recent years, putting the stock size in numbers at the beginning of 2006 on the maximum of the assessment interval and exploitable biomass at a level only surpassed in 1989 and 1990.

Being 3M beaked redfish an ensemble of two long living and slow maturing species, the impact of these young and abundant cohorts on female SSB is yet to come: its continuous growth from 1998 onwards is still at a slow pace, though now at a higher speed due to females from the 1999 and 2000 year classes already reaching maturity over recent years (2005-2006). At the same time the stock reproductive potential has increase substantially and above average year classes are being generated by parental female stock with biomass sizes well bellow the ones that produced the previous abundant 1989-1990 cohorts. Nevertheless these results of the present XSA assessment don't change the perception of previous assessments, that this is still an unbalanced stock strongly leaning to the younger age groups and that female spawning stock biomass should be allowed to recover to the former 1989-1990 level, in order to stabilize the stock and the fishery at a safe zone.

With the recent growth of stock abundance and biomass, coupled with a significant decline of the 3M shrimp fishery, this goal becomes foreseeable in a closer future: it is now basically dependent on keeping fishing mortality stabilized at its present low level on the next coming years, and therefore allowing high survival rates through the 1998-2002 cohorts. Translated to the 3M beaked redfish fishery this would imply an annual catch not exceeding a 10,000 tons level.

Acknowledgements

This assessment is part of a EU research project supported by the European Commission (DG XIV, Program for the collection of data in fisheries sector), IPIMAR, CSIC, IEO and AZTI. The authors would like to thank to Diana González Troncoso and José Miguel Casas (Instituto Español de Oceanografia, Vigo, Spain) for the early submission of the results of the 2006 EU Flemish Cap bottom trawl survey. Also our acknowledgments to Alexander Vaskov (PINRO, Murmansk, Russia) for his early submission of the redfish length sampling data by species from the Russsian redfish (and shrimp) fishery in Div. 3M. Last but not least our thanks to our colleague Fatima Cardador (Instituto de Investigação das Pescas e do Mar, Lisbon, Portugal) for her support to the XSA and *MTerm* programs.

References

Alpoim, R., and J. Vargas, 2004. Length-weight relantionships of the Portuguese commercial catches in NAFO, 1998-2003. *NAFO SCR Doc.* 04/40 Ser. No N4991, 10pp.

Ávila de Melo, A.M., R. Alpoim and F. Saborido-Rey, 2000. A comparative assessment of redfish in NAFO Div. 3M based on beaked redfish data (*S. mentella and S. fasciatus*) commercial, by-catch and survey data . *NAFO SCR Doc.* 00/34 Ser. No N4263, 51pp.

Ávila de Melo, A.M., R. Alpoim and F. Saborido-Rey, 2003. An assessment of beaked redfish (*S. mentella and S. fasciatus*) in NAFO Div. 3M. *NAFO SCR Doc.* 03/45 Ser. No N4863, 72pp.

Ávila de Melo, A.M., R. Alpoim and F. Saborido-Rey, 2004. Interim monitoring report of beaked redfish (*S. mentella and S. fasciatus*) in NAFO Division 3M. *NAFO SCR Doc.* 04/31 Ser. No N4981, 9pp.

Ávila de Melo, A.M., R. Alpoim and F. Saborido-Rey, 2005. A revised assessment of beaked redfish (*S. mentella and S. fasciatus*) in NAFO Div. 3M using the original EU survey indices converted to the new RV Vizconde de Eza units. *NAFO SCR Doc.* 05/47 Ser. No N5133, 40pp.

Casas, J. M. and Diana González Troncoso, 2007. Results from Bottom Trawl Survey on Flemish Cap of June-July 2006. NAFO SCR Doc. 07/10, Serial Number N5353. 34 pp.

Bishop, C. A., 1994. Revisions and additions to stratification schemes used during research vessel surveys in NAFO Subareas 2 and 3. *NAFO SCR. Doc.* 94/43 (rev.). Ser. No N2413.

Darby, C. and S. Flatman, 1994. Virtual population analysis: version 3.1 (Windows/Dos) user guide. *Info. Tech. Ser., MAFF Direct. Fish. Res.*, Lowestoft, (1): 85pp.

Doubleday, 1981. Manual of groundfish surveys in the Northwest Atlantic. . *NAFO Sci. Coun. Studies* 2, 55pp.

Kulka, D. W., 1999. Update on the by-catch in the shrimp fisheries in Davis Strait to Flemish Cap. *NAFO SCR Doc.* 99/96 Ser. No N4168, 8pp.

Mahe, J.C. and C. Darby, 2000. Greenland Halibut in NAFO Subarea 2 and Divisions 3KLMNO – Short-term and Medium-term Projections from an Extended Survivor Analysis. *NAFO SCR Doc.* 00/54 Serial No. N4288.

Saborido-Rey, F., 1994. El género *Sebastes* Cuvier, 1829 (Pisce, Scorpaenidae) en el Atlántico Norte: identificación de espécies y poblaciones mediante métodos morfométricos; crescimiento y reproducción de las poblaciones en Flemish Cap. Universidad Autónoma de Madrid, Facultad de Biología, Departamento de Zoología, Madrid. Phd Thesis, xi, 276pp.

Saborido-Rey, F., 1995. Age and growth of redfish in Flemish Cap (Div. 3M). *NAFO SCR. Doc.* 95/31 Ser. No N2540, 16pp.

Saborido-Rey, F.,1998. Differences in weight and length of otoliths between populations of genus Sebastes in the North Atlantic. 2nd international symposium on Fish Otolith Research & application. Bergen, Norway, 20-25 July 1998. Poster no. 186.

Saborido-Rey, F., 2001. Age and growth of redfish (*Sebastes marinus*, *S. mentella* and *S. fasciatus*) in Flemish Cap (Northwest Atlantic). *NAFO SCR Doc.* 01/109. Ser. No. N4495, 19 pp.

Shepherd, J. G., 1999. Extended survivors' analysis: an improved method for the analysis of catch at age data and abundance indices. ICES Journal of Marine Science. Vol. 56, No. 5.pp. 584-591.

Sinclair, A., Gascon, D., O'Boyle, R., Rivard, D., and S.Gavaris, 1990. Consistency of some Northwest Atlantic groundfish stock assessments. *NAFO SCR. Doc.* 901/96 Ser. No N1831, 35pp (revised).

Skúladóttir, U. and G. Pétursson, 2006.Assessment of the international fishery for shrimp (Pandalus borealis) in Division 3M (Flemish Cap), 1993-2006. *NAFO SCR Doc.* 06/76 Ser. No N5326, 21pp.

Troncoso, D. G., and J. M. Casas, 2005. Calculation of the calibration factors from the comparative experience between the R/V *Cornide de Saavedra* and the R/V *Vizconde de Eza* in Flemish Cap in 2003 and 2004. *NAFO SCR Doc.* 05/29 Ser. No N5115, 8pp.

Vargas, J., Alpoim, R., E. Santos, and A.M. Ávila de Melo, 2005. Portuguese research report for 2004. *NAFO SCS Doc.* 05/6 Ser. No N5086, 54pp.

Vargas, J., Alpoim, R., E. Santos, and A.M. Ávila de Melo, 2007. Portuguese research report for 2006. *NAFO SCS Doc.* 07/9 Ser. No N5357, 54pp.

Vaskov, A. A., Gorchinsky, K. V., Igashov, T. M. and S. P. Melnikov, 2006. Russian research report for 2005. NAFO SCS Doc. 06/7, Serial No. N5223, 24 pp.

Vaskov, A. A., Gorchinsky, K. V, Lisovsky, S. F. and M.V. Pochtar, 2007. Russian research report for 2006. NAFO SCS Doc. 07/6, Serial No. N5350, 26 pp.

Table 1a: 3M Redfish nominal catches (ton) by country, 1989-2006.

Country	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000 (a)	2001 (a)	2002 (a)	2003 (a)	2004 (a)	2005 (a)	2006 (b)
CAN			2		10			2				5						
CUB	1765	4195	1772	2303	945													
DDR		4025																
GRL				1		26												
JPN	885	2082	1432	1424	967	488	553	678	212	440	321	31	80	67	98	210	472	383
SUN/RUS	13937	34581	24661	2937	2035	2980	3560	52		25	92	1808	1292	1155	115	5	1023	854
UKR																		1
LVA				7441	5099	94	304										48	250
LTU					2128								10	10	1	2	522	397
EST						47						632	167	5	23	61	1093	1249
E-SP	213	2007	6324	3647	100	610	0	0	252	196	409	433	157	499	633	327	696	498
E PRT	13012	11665	3787	3198	4781	5630	1282	332	83	259	96	916	1589	1512	1091	2501	2696	2593
EU	13225	13672	10111	6845	4881	6240	1282	332	335	455	505	1349	1746	2011	1724	2828		4987
FR-STP																		3
KOR-S	17885	8332	2936	8350	2962													
FAROE IS.				16										0.1				
NORWAY						8	3											
Total	47697	66887	40914	29317	19027	9883	5702	1064	547	920	918	3825	3295	3248	1961	3106	6550	6228
STACFIS Estimates of beaked redfish commercial catches from various sources.																		
Total	**58100**	**81000**	**48500**	**43300**	**29000**	**11300**	**13500**	**5789**	**1300**	**971**	**1068**	**3658**	**3224**	**2934**	**1881**	**2923**	**3784**	**4154**(c)

(a) Provisional
(b) From NAFO Circ. Letters
(c) From NAFO Circ. Letters overall redfish catch for 2006

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

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
By-catch in weight (ton) (b)	11970	5903	374	550	157	191	96	106	738	767	1006	471	80	

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

Table 1c: 3M Redfish catch in numbers(millions), 1989-2006.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Comm.	125.3	196.3	104.2	92.9	57.3	27.5	34.9	15.5	3.0	2.2	2.3	9.7	8.5	7.4	4.6	12.8	10.5	17.9
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	92.9	181.8	90.4	39.0	30.7	6.2	7.4	6.0	12.9	37.6	27.2	26.4	22.7	12.4	

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

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

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

	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

Table 3a: Length composition (absolute frequencies in'000s) of the 3M redfish commercial catch, 1989-2006.

Length	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
10	3				1	0								1				8
11														0		1		20
12	3				1	0						8		1				43
13	11				9	0						16		1		4		35
14	25	4			112	11						1		2		11		46
15	8	73			378	41				2		9	4	4		41	33	59
16	30	190			422	123	0	20				1	4	9		203	46	169
17	59	724			160	363		20	1	2		9	20	23	6	349	83	258
18	30	2489	156		97	783	118	20		1		25	58	46	6	455	157	410
19	11	5774	647	64	125	957	265	66	6	8	1	39	42	90	0	602	254	855
20	111	6179	1331	322	139	466	1142	360	8	13	2	66	43	148	0	**1157**	276	1304
21	383	2904	1234	1697	313	479	2874	964	14	28	1	52	63	153	2	**1524**	385	**1766**
22	1149	1205	1179	2843	929	556	5895	**2215**	41	52	2	118	117	150	4	**1511**	433	**2200**
23	3766	1927	945	2173	1815	680	5715	**1641**	104	94	1	123	197	172	30	**963**	475	**2100**
24	**8408**	5526	1697	1343	3232	1308	1691	**1324**	**263**	116	9	242	278	284	89	845	583	**1905**
25	**14733**	11932	3737	2523	3029	1857	1157	785	**325**	**222**	113	347	450	422	262	702	649	1484
26	**14793**	**19979**	6292	**7914**	3206	1863	793	513	**310**	**223**	108	741	890	523	363	533	765	1107
27	11148	**25688**	**10368**	**12159**	3141	1656	953	740	198	**207**	**212**	**1305**	**1241**	693	**516**	544	**873**	1011
28	7059	**26047**	**12852**	**12256**	**3857**	**2267**	1185	758	169	173	**294**	**1631**	**1451**	**883**	**535**	494	**928**	867
29	5773	**20113**	**15100**	**8786**	**3383**	**2404**	**1476**	855	210	168	**296**	**1413**	**1195**	**881**	**588**	387	**973**	638
30	7424	15200	**13056**	7423	**5042**	**2586**	**1506**	899	248	162	**195**	957	997	**854**	475	342	656	471
31	6972	10134	7456	5300	**4419**	**2347**	**1257**	954	223	172	**203**	659	537	661	390	265	665	319
32	7393	8308	7054	4685	**3478**	**2040**	**1304**	891	248	157	**237**	460	339	490	359	268	462	242
33	7030	6551	3519	4146	**3592**	1353	1219	689	268	112	172	353	209	395	331	276	457	177
34	6927	6397	3891	4362	2951	865	1008	672	107	74	82	318	146	237	258	158	448	128
35	6520	5486	3101	4402	3170	924	1035	281	76	54	140	203	77	117	200	69	438	105
36	4920	4398	2620	3178	2782	579	1041	198	43	47	75	160	38	76	94	53	343	73
37	4080	3047	2394	2381	2661	329	915	220	24	46	66	150	31	25	47	44	91	32
38	2441	2206	1672	1584	1472	282	749	103	27	33	8	127	37	20	16	46	21	26
39	1566	1557	1748	1269	1263	142	488	125	11	29	29	55	17	15	8	32	20	10
40	946	769	1024	890	666	93	469	45	3	16	2	35	10	8	2	31	5	8
41	504	581	640	533	376	72	346	38	12	11	4	24	5	1	0	42	28	10
42	341	345	201	213	325	24	164	46	5	8	1	16	6	2	0	14	0	6
43	289	264	283	250	143	14	69	18	1	3	1	21	3	5	2	18	0	5
44	135	130	19	182	425	25	50	3	6	2	0	14	2			12	0	2
45	143	73	14	41	52	15	34	2	1	0	2	3	1		1	6		2
46	75	32	8	9	43		7	4	1	1		7	1			5		2
47	46	16	0	0	35		19	1	1		0	4	0					1
48	28	12	8	18	61		4			0			1			1		1
49	4	12								0								0
50	11	4						27										0
51	4	12																
52	4																	
53	7	16																
54		8																
55		4																
56																		
57																		
58		4																
59																		
60																		
61									11									
mean weight (g)	464	413	465	466	506	411	386	374	438	435	474	377	379	397	410	243	359	232
mean length (cm)	30.1	28.8	30.2	30.2	30.9	28.6	27.6	27.6	29.5	29.4	30.9	29.6	28.6	28.8	30.2	24.4	28.1	24.4

Table 3b: Length composition (absolute frequencies in'000s) of the 3M redfish total annual catch, 1989-2006 (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
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				1		3	416	258	45	845	193	6537	879	1454	593		8
11	0						15	1056	569	391	390	593	6275	1607	913	1055		20
12	3				3	19	36	841	512	1830	313	1014	4996	2986	1368	1495		43
13	11				33	338	34	459	164	1721	286	766	2126	5087	2741	1229		35
14	25	4			329	986	64	488	120	340	97	182	746	4072	2546	1094		46
15	8	73			2257	2258	247	731	119	63	90	93	531	1775	1886	1022	33	59
16	30	190			7937	7370	430	1713	647	116	86	50	522	805	1994	1011	46	169
17	59	724			29485	17696	758	1182	184	85	62	25	453	399	2513	1006	83	258
18	30	2489	156		47480	21831	1105	758	61	32	41	35	339	300	1751	835	157	410
19	11	5774	647	64	30181	11975	1086	444	68	34	40	47	146	243	657	901	254	855
20	111	6179	1331	322	6882	2782	1569	428	85	19	14	76	90	226	224	1462	276	1304
21	383	2904	1234	1697	1305	796	3001	1058	75	39	7	56	91	190	183	1797	385	1766
22	1149	1205	1179	2843	1289	669	5922	2220	82	65	9	120	143	170	93	1681	433	2200
23	3766	1927	945	2173	1816	680	5722	1641	126	102	6	124	211	184	80	1049	475	2100
24	8408	5526	1697	1343	3232	1308	1694	1324	273	135	11	244	288	290	108	910	583	1905
25	14733	11932	3737	2523	3029	1857	1162	785	328	237	118	347	454	425	272	753	649	1484
26	14793	19979	6292	7914	3206	1863	798	513	311	243	108	742	891	525	364	569	765	1107
27	11148	25688	10368	12159	3141	1656	957	740	198	217	214	1305	1242	694	517	580	873	1011
28	7059	26047	12852	12256	3857	2267	1192	758	169	174	294	1631	1453	884	536	525	928	867
29	5773	20113	15100	8786	3383	2404	1483	855	210	169	296	1413	1195	881	589	411	973	638
30	7424	15200	13056	7423	5042	2586	1509	899	248	162	195	957	998	854	475	364	656	471
31	6972	10134	7456	5300	4419	2347	1258	954	223	172	203	659	538	662	390	282	665	319
32	7393	8308	7054	4685	3478	2040	1304	891	248	158	237	460	339	491	359	285	462	242
33	7030	6551	3519	4146	3592	1353	1219	689	268	112	172	353	209	395	331	293	457	177
34	6927	6397	3891	4362	2951	865	1008	672	107	75	82	318	146	237	258	168	448	128
35	6520	5486	3101	4402	3170	924	1035	281	76	54	140	203	77	117	200	74	438	105
36	4920	4398	2620	3178	2782	579	1041	198	43	47	75	160	38	76	94	56	343	73
37	4080	3047	2394	2381	2661	329	915	220	24	46	66	150	31	25	47	46	91	32
38	2441	2206	1672	1584	1472	282	749	103	27	33	8	127	37	20	16	49	21	26
39	1566	1557	1748	1269	1263	142	488	125	11	29	29	55	17	15	8	34	20	10
40	946	769	1024	890	666	93	469	45	3	16	2	35	10	8	2	33	5	8
41	504	581	640	533	376	72	346	38	12	11	4	24	5	1	0	45	28	10
42	341	345	201	213	325	24	164	46	5	8	1	16	6	2	0	15	0	6
43	289	264	283	250	143	14	69	18	1	3	1	21	3	5	2	19	0	5
44	135	130	19	182	425	25	50	3	6	2	0	14	2			13	0	2
45	143	73	14	41	52	15	34	2	1	0	2	3	1		1	6		2
46	75	32	8	9	43		7	4	1	1	0	7	1			5		2
47	46	16	0	0	35		19	1	1		0	4	0					1
48	28	12	8	18	61		4			0			1			1		1
49	4	12								0								
50	11	4						27										
51	4	12																
52	4	0																
53	7	16																
54		8																
55		4																
56																		
57																		
58		4																
59																		
60																		
61									11									
number ('000)	125310	196321	104246	92949	181803	90442	38979	30697	6180	7385	6037	12864	37623	27185	26441	22655	10546	17906
weight (ton)	58100	81000	48500	43300	40970	17203	13874	6339	1457	1162	1164	3764	3962	3701	2887	3577	3784	4154

Table 3c: Catch in numbers at age (' 000) of 3M redfish, 1989-2006, 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	308	3913	111450	11241	7987	6706	6787	3112	4903	4776	4538	3442	3692	3060	1452	1120	1718	1599	181803	1989
1994	0	759	5174	54165	6617	2876	4296	3376	3077	2788	2150	1523	1111	612	728	320	219	269	384	90442	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	2408	258	102	159	232	417	1023	1393	4145	647	179	75	644	64	39	35	41	569	12868	1990
2001	12984	13397	1805	828	337	387	842	1303	870	858	3232	381	116	61	65	59	19	29	61	37632	1999
2002	2536	10606	5543	1280	309	464	559	877	1044	555	678	1910	360	116	167	61	53	10	57	27185	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	4516	2990	994	4053	2578	1537	943	553	346	241	177	211	849	15	66	38	13	303	21905	2002
2005	0	19	106	354	452	1456	1140	1278	1306	981	703	733	362	352	1052	104	62	17	71	10546	1999
2006	8	208	304	1302	2296	5550	3342	2411	1050	272	315	21	251	101	37	228	32	92	84	17905	2000

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

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

Table 4a: 3M beaked redfish abundance at length ('000s) from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2006 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
5											2868								
6		73	239	1042				144			956			455	1091	779			
7	1203	160	1952	39644	4931	1102		31	2453		695	291		1240	9720	6940	286	499	304
8	8538	1890	15439	194701	117561	3160		594	12310	1359	3390	2417	1883	18643	14581	10410	12530	5985	94129
9	8327	2007	11861	90135	75875	1764		1816	6548	2887	6048	12420	6848	152327	44733	31940	69454	8679	410980
10	7082	2894	846	9088	57005	7812	274	1889	867	1615	1573	8840	5242	246451	53017	37818	181225	11172	569937
11	20338	8434	412	17232	332037	36153	1573	3397	1762	4312	2626	3052	4412	29300	52317	37322	178289	47283	83653
12	39345	20228	390	18877	381332	46734	2665	9269	5827	12810	13751	2976	15579	9424	115720	82575	306313	109207	93826
13	27472	21581	1062	5792	90012	29392	5209	4666	5993	14318	22307	4851	30605	16454	247642	176146	217455	305354	168066
14	4000	46259	1865	1177	16174	79964	25338	4768	8609	7064	11124	4639	18860	19286	292527	206425	109487	563721	368892
15	802	87282	2527	1708	27540	165019	58046	9835	16820	13161	14504	19442	6447	31061	99677	77233	59669	496389	570855
16	1034	71271	6765	8178	41045	138724	130198	24357	14379	23773	29969	39114	4277	71951	73453	105506	93021	321931	705579
17	1499	22119	15552	25999	9939	29763	219435	64809	23877	29710	20988	26097	8270	56570	59348	89286	130177	216267	1022408
18	1140	3665	17573	47125	7593	9245	230202	110934	54208	30013	13414	32861	19781	22594	72239	40677	155247	199060	785412
19	4032	2167	10349	74340	14615	4970	121884	144384	108902	36047	14029	29489	27898	12501	74283	28249	179357	182684	502187
20	7430	3097	2514	83901	24467	3328	33879	100682	153048	68928	13962	20335	29190	18149	55461	22778	156658	169721	357636
21	16559	4479	1078	40481	46504	3306	16450	38742	135158	101923	18530	14731	24042	24890	28013	18751	86575	163284	189268
22	33994	9816	3011	10577	70167	5125	8472	9863	83283	98256	33310	17528	21181	25754	23745	12635	48011	179265	120714
23	68369	18570	10028	3746	51568	7222	7632	3978	37902	62655	56319	29378	18209	17298	19916	8313	29273	132897	99950
24	102943	33229	13236	3852	23847	8078	9824	3261	17322	24171	57007	61585	29389	15498	21186	7521	18368	81899	76572
25	108959	50665	28825	7719	10049	5812	11309	3704	7875	9733	33609	75417	54137	14734	16263	7312	11706	41610	57766
26	79514	60423	42888	9637	12417	5431	9941	4600	4102	5921	14895	57490	76085	18293	14695	7561	11260	32227	25064
27	33899	49923	41939	9637	16819	4256	6971	4265	5830	4280	5807	20106	78418	17465	13793	7875	8280	18476	13672
28	13963	31600	28902	8406	18154	4326	8135	4642	4150	3998	2710	6614	54137	13151	12150	6742	7280	12570	8323
29	6818	17451	16287	5838	12743	3066	6925	4694	4325	2790	1258	2472	21494	7232	9235	4988	5204	8890	5072
30	9150	10747	9819	4832	11009	2882	4765	4493	2995	3195	828	804	4582	5003	5643	3945	3753	7874	5648
31	7567	8245	7209	3508	7557	2362	3995	3479	2489	1977	959	701	1715	1439	2210	2264	2651	3273	2394
32	8886	9234	6686	3032	4866	1882	3611	2792	2280	1514	762	652	890	782	818	1556	1835	2954	1723
33	8570	6908	5710	3283	4450	2012	2463	2304	2050	1291	619	470	1120	337	572	756	1132	1085	1340
34	7451	6529	6333	3283	4276	1660	1613	1897	1410	981	517	401	578	405	286	639	762	736	479
35	5646	6544	4312	2568	3486	1536	1468	1591	948	590	293	347	382	199	122	171	323	310	383
36	4929	5410	3975	2290	2635	1518	1039	1441	757	544	310	221	388	161	113	207	166	174	192
37	3631	3912	3065	1814	2014	1425	590	1205	568	305	194	134	357	67	68	135	108	29	
38	3166	2501	2223	1483	1620	904	549	717	402	212	142	81	67	80	54	117	98	29	96
39	3092	4145	2425	1734	2156	1392	520	932	471	212	168	78	131	67	27	117		19	
40	2090	2908	1634	1086	1410	831	379	493	266	143	65	39	87	27	14	45			
41	1499	1192	842	477	586	378	225	433	243	124	77	26	44	54	14	9	10		
42	665	742	421	371	426	362	84	313	162	37	26	26		13	14	9			
43	253	291	253	172	165	103	28	156	69		65	13	29	40	14				
44	84	87	51	53	165	168	28	36	23	25	26		15			9			
45	84	87	67	53	45	26	28	36	23		13	26							
46		58	17	53	30	26		36			13						10		
47			34	13		26		12											
48						39			12										
total	664025	638823	330614	748938	1509292	623284	935746	581692	730719	570876	400725	496163	566768	869393	1434771	1045762	2085973	3325555	6342519

Table 4b: 3M beaked redfish abundance at age ('000s) from EU bottom trawl survey series, 1989-2006.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+	Total	Most abundant year class
1989	4130	53137	219406	19357	8071	35188	89946	89433	43605	21698	12392	7202	6537	5939	5301	3013	2467	2189	9812	638823	1985
1990	29489	2710	33397	24565	2605	17585	56217	67444	36082	18378	10186	5630	5333	4816	4009	2318	1851	1730	6269	330614	1982
1991	325523	51145	5421	154995	127962	17655	20481	13300	8086	4187	3884	3393	3014	2479	952	1514	1139	653	3155	748938	1990
1992	198367	866124	59802	58014	144968	71881	30456	26346	16857	9630	6011	4452	4062	3082	2852	2072	1258	1028	2031	1509292	1990
1993	6025	151086	90620	306049	10455	21648	10476	6426	2189	2996	2596	2453	1910	2000	1589	859	874	1414	1619	623284	1989
1994	0	20065	76102	677611	79504	22080	22594	11375	7515	4950	3935	2808	2105	1122	1257	657	482	616	968	935746	1990
1995	2585	18672	63686	114762	332114	8381	8942	8765	4706	3963	4073	2322	1642	1441	1536	1045	605	732	1721	581692	1990
1996	21311	18163	34710	25262	190134	402615	11731	8653	5698	2783	2035	1950	991	1117	886	659	453	436	1132	730719	1990
1997	5861	28568	34939	86326	96940	78135	222658	4967	3731	2768	1494	1269	689	837	236	298	368	124	667	570876	1990
1998	15530	38427	62957	35093	32524	52330	30121	125511	3903	486	396	1990	257	249	77	156	343	28	347	400725	1990
1999	23967	12166	50006	79605	45976	38126	46333	39046	151887	5871	257	337	858	110	246	253	201	435	481	496163	1990
2000	13974	54195	27539	32860	61731	46285	47381	71096	35736	169492	2949	463	158	1548	152	81	83	52	992	566768	1990
2001	419116	55177	121788	86078	52309	42284	29268	20323	8954	5122	26935	853	304	174	198	156	57	64	234	869393	2000
2002	123142	480414	394558	235867	61369	46106	30279	22076	17766	4899	3033	13969	580	164	241	81	60	23	143	1434771	2000
2003	87887	395055	335930	65241	84103	24769	14624	10827	6967	3974	2233	1323	11068	465	53	248	274	52	669	1045762	2001
2004	263500	762669	301354	144943	430177	104125	34401	17198	8319	4654	2365	1301	1182	8772	72	230	248	39	490	2086038	2002
2005	26335	1244660	652407	425205	292846	467795	123484	47163	20489	10868	4939	3849	1663	655	3050	64	45	21	16	3325555	2003
2006	1075350	1210387	1175890	1507863	761946	418013	123430	48858	11126	2091	2276	80	1912	320	96	2033	80	424	345	6342519	2000

Table 4c: 3M beaked redfish mature female abundance at age ('000s) from EU bottom trawl survey series, 1989-2006.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+	Total	Most abundant year class
1989				43	156	1545	7734	11709	7329	4218	3366	2593	2910	2829	2722	1561	1440	1231	7823	59210	1981
1990				13	59	840	5392	9830	6743	3922	2988	2245	2655	2529	2300	1346	1110	1020	4432	47425	1982
1991				55	493	820	2102	2501	2086	1443	1634	1658	1619	1448	596	1054	769	446	2437	21161	1983
1992				18	1610	1817	2280	4334	4320	3147	2222	1829	1981	1668	1644	1413	818	811	1614	31525	1984
1993					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	1984
1995				86	418	360	910	1343	1005	1105	1269	720	525	523	568	498	296	425	1344	11394	1990
1996					1297	2557	1505	1754	1528	980	852	893	521	593	492	394	291	283	793	14731	1990
1997					147	2720	6144	2287	1841	1263	705	605	333	403	113	157	201	67	428	17415	1990
1998					133	924	1560	5282	785	120	119	647	86	96	26	61	155	9	231	10234	1990
1999					155	1129	3118	4737	15007	1341	102	153	340	41	101	99	103	199	307	26931	1990
2000					335	1052	3056	10012	9198	29716	1352	162	97	638	83	55	60	34	615	56465	1990
2001					554	1329	2140	2777	1922	1815	6695	335	108	65	71	57	20	24	175	18089	1990
2002				230	463	1547	1933	2574	3161	1826	1136	5364	308	82	113	28	26	9	62	18864	1990
2003				9	326	676	1012	1258	1342	1114	913	647	3199	281	36	173	156	39	502	11683	1990
2004				41	1431	2676	3028	2990	2112	1528	1100	749	785	3754	57	161	165	31	333	20942	1990
2005				147	1139	13060	11962	11076	7139	4410	2717	2266	921	469	1840	33	26	12	9	57226	1999
2006				338	1570	12723	11392	10474	4634	995	1385	54	1066	229	92	998	54	272	219	46494	2000

Table 4d: maturity ogive at age for 3M beaked reddish as the average proportion of mature females at age, from the EU survey abundance at age 1989-2006.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
Ogive	0.000	0.000	0.000	0.000245	0.004	0.025	0.071	0.137	0.183	0.220	0.332	0.406	0.425	0.481	0.528	0.596	0.605	0.626	0.742

Table 4e: Weights at age of the 3M beaked redfish stock (Kg) from EU surveys, 1989-2006.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1989	0.012	0.032	0.060	0.100	0.164	0.205	0.248	0.284	0.317	0.349	0.431	0.511	0.563	0.586	0.631	0.643	0.706	0.703	0.880
1990	0.011	0.028	0.082	0.097	0.171	0.212	0.261	0.299	0.331	0.361	0.443	0.524	0.582	0.602	0.652	0.668	0.731	0.727	0.920
1991	0.012	0.029	0.067	0.109	0.135	0.214	0.276	0.337	0.385	0.465	0.515	0.569	0.616	0.649	0.700	0.779	0.764	0.794	0.892
1992	0.013	0.032	0.070	0.096	0.171	0.208	0.292	0.354	0.396	0.452	0.525	0.571	0.635	0.680	0.704	0.807	0.769	0.879	0.933
1993	0.010	0.034	0.051	0.066	0.156	0.212	0.287	0.365	0.395	0.434	0.513	0.554	0.624	0.687	0.714	0.871	0.853	0.867	1.101
1994	0.000	0.045	0.076	0.090	0.130	0.226	0.276	0.348	0.395	0.464	0.493	0.530	0.549	0.673	0.659	0.719	0.816	0.852	0.912
1995	0.011	0.027	0.071	0.102	0.113	0.217	0.288	0.357	0.405	0.456	0.514	0.546	0.632	0.702	0.726	0.812	0.822	0.869	1.067
1996	0.011	0.036	0.062	0.079	0.138	0.141	0.270	0.328	0.384	0.443	0.480	0.533	0.580	0.600	0.649	0.697	0.756	0.794	0.956
1997	0.013	0.031	0.059	0.090	0.127	0.190	0.174	0.355	0.406	0.466	0.505	0.573	0.609	0.621	0.682	0.746	0.787	0.759	0.933
1998	0.010	0.034	0.062	0.089	0.138	0.181	0.229	0.222	0.371	0.422	0.490	0.550	0.624	0.687	0.714	0.809	0.832	0.729	1.103
1999	0.014	0.033	0.064	0.087	0.121	0.176	0.223	0.260	0.246	0.323	0.473	0.564	0.513	0.552	0.541	0.552	0.642	0.615	0.766
2000	0.016	0.037	0.060	0.097	0.132	0.174	0.234	0.285	0.329	0.297	0.418	0.528	0.668	0.564	0.497	0.673	0.718	0.718	0.750
2001	0.015	0.028	0.062	0.085	0.140	0.179	0.238	0.297	0.328	0.384	0.340	0.516	0.598	0.663	0.668	0.616	0.771	0.853	1.010
2002	0.013	0.034	0.052	0.101	0.132	0.184	0.227	0.282	0.323	0.390	0.408	0.398	0.561	0.595	0.629	0.719	0.644	0.894	0.952
2003	0.012	0.034	0.054	0.076	0.109	0.161	0.217	0.264	0.321	0.355	0.413	0.462	0.351	0.558	0.584	0.638	0.509	0.694	0.754
2004	0.015	0.030	0.066	0.094	0.120	0.163	0.221	0.278	0.343	0.378	0.444	0.498	0.553	0.426	0.635	0.684	0.541	0.756	0.755
2005	0.013	0.041	0.061	0.092	0.119	0.166	0.214	0.273	0.339	0.379	0.459	0.481	0.462	0.591	0.502	0.710	0.724	0.904	0.869
2006	0.013	0.043	0.067	0.086	0.107	0.155	0.209	0.262	0.356	0.409	0.501	0.597	0.483	0.675	0.836	0.441	0.597	0.516	0.497
mean	0.012	0.034	0.064	0.091	0.135	0.187	0.244	0.303	0.354	0.402	0.465	0.528	0.567	0.617	0.651	0.699	0.721	0.773	0.892

Table 4f: Weights at age of the 3M mature female beaked redfish stock (Kg) from EU surveys, 1989-2006.

Year\Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19+
1989				0.157	0.174	0.220	0.267	0.306	0.337	0.376	0.461	0.541	0.575	0.596	0.636	0.647	0.728	0.725	0.886
1990				0.160	0.181	0.228	0.283	0.323	0.352	0.390	0.474	0.553	0.594	0.615	0.658	0.671	0.749	0.746	0.926
1991				0.151	0.163	0.251	0.304	0.354	0.406	0.473	0.528	0.585	0.629	0.661	0.712	0.791	0.778	0.809	0.908
1992				0.157	0.185	0.225	0.310	0.372	0.412	0.459	0.534	0.593	0.656	0.706	0.732	0.828	0.800	0.889	0.947
1993				0.000	0.183	0.226	0.288	0.375	0.411	0.438	0.518	0.558	0.645	0.705	0.728	0.929	0.865	0.875	1.156
1994				0.153	0.169	0.244	0.286	0.357	0.402	0.470	0.502	0.539	0.569	0.702	0.684	0.750	0.824	0.874	0.952
1995				0.153	0.157	0.226	0.296	0.366	0.412	0.459	0.516	0.546	0.638	0.723	0.740	0.837	0.854	0.889	1.079
1996				0.000	0.176	0.187	0.281	0.337	0.389	0.449	0.483	0.536	0.583	0.606	0.658	0.702	0.757	0.799	0.959
1997				0.000	0.188	0.226	0.240	0.358	0.410	0.465	0.503	0.576	0.612	0.625	0.684	0.747	0.790	0.768	0.957
1998				0.000	0.159	0.195	0.266	0.243	0.384	0.436	0.493	0.554	0.626	0.707	0.712	0.815	0.844	0.729	1.128
1999				0.000	0.152	0.193	0.238	0.277	0.264	0.341	0.464	0.572	0.514	0.542	0.534	0.544	0.673	0.643	0.778
2000				0.000	0.162	0.192	0.270	0.304	0.344	0.327	0.424	0.519	0.681	0.574	0.494	0.695	0.724	0.728	0.770
2001				0.000	0.165	0.191	0.246	0.306	0.344	0.390	0.374	0.514	0.602	0.665	0.667	0.622	0.776	0.853	1.035
2002				0.151	0.174	0.209	0.238	0.305	0.340	0.399	0.453	0.408	0.557	0.587	0.616	0.715	0.643	0.888	0.968
2003				0.138	0.148	0.188	0.234	0.274	0.334	0.378	0.432	0.476	0.398	0.560	0.584	0.651	0.524	0.694	0.778
2004				0.149	0.160	0.195	0.243	0.288	0.352	0.399	0.466	0.518	0.566	0.460	0.635	0.675	0.550	0.756	0.718
2005				0.146	0.151	0.193	0.244	0.286	0.345	0.385	0.472	0.493	0.481	0.585	0.514	0.705	0.719	0.900	0.861
2006				0.146	0.154	0.205	0.247	0.302	0.375	0.437	0.534	0.628	0.532	0.702	0.881	0.471	0.628	0.543	0.522
mean				0.092	0.167	0.211	0.266	0.318	0.367	0.415	0.479	0.539	0.581	0.629	0.659	0.711	0.735	0.784	0.907

Table 5a: 3M beaked redfish survey mean catch per tow from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2006 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
mean weight per tow (Kg/tow)	199	159	109	85	147	68	125	90	125	104	74	103	146	78	129	57	196	296	532
SE	32	21	13	10	17	24	38	10	17	18	12	30	57	12	17	7	26	53	79
CV	16%	13%	12%	12%	12%	36%	30%	11%	14%	18%	16%	29%	39%	16%	13%	13%	13%	18%	15%

Table 5b: 3M beaked redfish abundance, stock and female spwanning biomass ('000 tons) from EU bottom trawl survey series (1988-2002 by RV Cornide Saavedra (CS), 2003-2006 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
abundance (millions)	664	639	331	749	1509	623	936	582	731	571	401	496	567	869	1435	1046	2086	3326	6343
4+abundance (millions)		362	265	367	385	376	840	497	657	502	284	410	471	273	437	227	759	1402	2881
female spawners (millions)		59	47	21	32	12	13	11	15	17	10	27	56	18	19	12	21	57	46
biomass ('000 ton)	160	128	89	72	119	78	105	73	100	84	60	82	118	64	107	66	157	302	485
4+ biomass ('000 ton)	155	113	86	67	92	45	100	71	101	82	56	81	116	51	69	34	106	209	337
spawning biomass ('000 ton)	28	28	23	12	16	8	6	6	6	6	3	8	18	6	6	4	7	17	13
ssb proportion	18%	22%	25%	16%	13%	10%	6%	9%	6%	8%	5%	9%	16%	9%	6%	7%	5%	3%	3%

Table 6: Input files for 2007 XSA assessment.

REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2007

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	2006
4	19
5	
58086	
80223	
48500	
43300	
43090	
17660	
13879	
6101	
1408	
1011	
1095	
3664	
3327	
3061	
2273	
3043	
3775	
4121	

REDFISH NAFO 3M CATCH NUMBERS thousands

1	2														
1989	2006														
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
111450	11241	7987	6706	6787	3112	4903	4776	4538	3442	3692	3060	1452	1120	1718	1599
54165	6617	2876	4296	3376	3077	2788	2150	1523	1111	612	728	320	219	269	384
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
102	159	232	417	1023	1393	4145	647	179	75	644	64	39	35	41	569
828	337	387	842	1303	870	858	3232	381	116	61	65	59	19	29	61
1280	309	464	559	877	1044	555	678	1910	360	116	167	61	53	10	57
1712	1946	281	391	546	565	423	365	311	1222	214	22	102	69	23	266
994	4053	2578	1537	943	553	346	241	177	211	849	15	66	38	13	303
354	452	1456	1140	1278	1306	981	703	733	362	352	1052	104	62	17	71
1302	2296	5550	3342	2411	1050	272	315	21	251	101	37	228	32	92	84

REDFISH NAFO 3M CATCH WEIGHT AT AGE kg

1	3														
1989	2006														
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	0.156	0.250	0.323	0.405	0.442	0.474	0.547	0.588	0.654	0.716	0.740	0.883	0.856	0.870	1.170
0.109	0.147	0.264	0.312	0.389	0.436	0.500	0.533	0.572	0.601	0.703	0.694	0.726	0.832	0.855	0.923
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
0.071	0.122	0.167	0.234	0.283	0.348	0.330	0.441	0.520	0.657	0.558	0.496	0.659	0.720	0.763	0.801
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	0.167	0.229	0.266	0.328	0.359	0.423	0.492	0.450	0.577	0.600	0.622	0.704	0.643	0.866	0.876
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	0.222	0.272	0.338	0.378	0.453	0.510	0.553	0.441	0.610	0.679	0.569	0.724	0.925
0.105	0.127	0.182	0.243	0.290	0.347	0.383	0.476	0.508	0.517	0.637	0.596	0.693	0.693	0.878	0.929
0.111	0.134	0.183	0.229	0.301	0.366	0.422	0.515	0.610	0.549	0.693	0.831	0.469	0.669	0.628	0.781

Table 6: Input files for 2007 XSA assessment (cont.).

REDFISH NAFO 3M STOCK WEIGHT AT AGE kg

1	4														
1989	2006														
4	19														
1															
0.100	0.164	0.205	0.248	0.284	0.317	0.349	0.431	0.511	0.563	0.586	0.631	0.643	0.706	0.703	0.880
0.097	0.171	0.212	0.261	0.299	0.331	0.361	0.443	0.524	0.582	0.602	0.652	0.668	0.731	0.727	0.920
0.109	0.135	0.214	0.276	0.337	0.385	0.465	0.515	0.569	0.616	0.649	0.700	0.779	0.764	0.794	0.892
0.096	0.171	0.208	0.292	0.354	0.396	0.452	0.525	0.571	0.635	0.680	0.704	0.807	0.769	0.879	0.933
0.066	0.156	0.212	0.287	0.365	0.395	0.434	0.513	0.554	0.624	0.687	0.714	0.871	0.853	0.867	1.101
0.090	0.130	0.226	0.276	0.348	0.395	0.464	0.493	0.530	0.549	0.673	0.659	0.719	0.816	0.852	0.912
0.102	0.113	0.217	0.288	0.357	0.405	0.456	0.514	0.546	0.632	0.702	0.726	0.812	0.822	0.869	1.067
0.079	0.138	0.141	0.270	0.328	0.384	0.443	0.480	0.533	0.580	0.600	0.649	0.697	0.756	0.794	0.956
0.090	0.127	0.190	0.174	0.355	0.406	0.466	0.505	0.573	0.609	0.621	0.682	0.746	0.787	0.759	0.933
0.089	0.138	0.181	0.229	0.222	0.371	0.422	0.490	0.550	0.624	0.687	0.714	0.809	0.832	0.729	1.103
0.087	0.121	0.176	0.223	0.260	0.246	0.323	0.473	0.564	0.513	0.552	0.541	0.552	0.642	0.615	0.766
0.097	0.132	0.174	0.234	0.285	0.329	0.297	0.418	0.528	0.668	0.564	0.497	0.673	0.718	0.718	0.750
0.085	0.140	0.179	0.238	0.297	0.328	0.384	0.340	0.516	0.598	0.663	0.668	0.616	0.771	0.853	1.010
0.101	0.132	0.184	0.227	0.282	0.323	0.390	0.408	0.398	0.561	0.595	0.629	0.719	0.644	0.894	0.952
0.076	0.109	0.161	0.217	0.264	0.321	0.355	0.413	0.462	0.351	0.558	0.584	0.638	0.509	0.694	0.754
0.094	0.120	0.163	0.221	0.278	0.343	0.378	0.444	0.498	0.553	0.426	0.635	0.684	0.541	0.756	0.755
0.092	0.119	0.166	0.214	0.273	0.339	0.379	0.459	0.481	0.462	0.591	0.502	0.710	0.724	0.904	0.869
0.086	0.107	0.155	0.209	0.262	0.356	0.409	0.501	0.597	0.483	0.675	0.836	0.441	0.597	0.516	0.497

REDFISH NAFO 3M NATURAL MORTALITY

1	5														
1989	2006														
4	19														
2															
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

REDFISH NAFO 3M PROPORTION MATURE AT AGE

1	6														
1989	2006														
4	19														
2															
0.0002	0.0038	0.0249	0.0715	0.1372	0.1832	0.2196	0.3324	0.4058	0.4255	0.4806	0.5281	0.5957	0.6051	0.6263	0.7416

REDFISH NAFO 3M F ON OLDEST AGE GROUP BY YEAR

1	9
1989	2006
4	19
5	
0.837	
1.086	
1.120	
0.849	
1.834	
0.509	
1.131	
0.355	
0.059	
0.057	
0.295	
0.541	
0.393	
0.290	
0.444	
0.263	
0.263	
0.263	

REDFISH NAFO 3M PROPORTION OF F BEFORE SPAWNING

1	7
1989	2006
4	19
3	
0.08	

REDFISH NAFO 3M PROPORTION OF M BEFORE SPAWNING

1	8
1989	2006
4	19
3	
0.08	

REDFISH NAFO 3M F AT AGE IN LAST YEAR

1	10														
1989	2006														
4	19														
2															
0.0154	0.103	0.0402	0.0774	0.0943	0.0511	0.0411	0.0278	0.0246	0.0358	0.0213	0.0664	0.4475	0.2208	0.2628	0.2628

Table 6: Input files for 2007 XSA assessment (cont.).

REDFISH NAFO 3M SURVEY TUNNING DATA

101																
EU BOTTOM TRAWL SURVEY																
1989	2006															
1	1	0.5	0.6													
4	19															
10555	19357	8071	35188	89946	89433	43605	21698	12392	7202	6537	5939	5301	3013	2467	2189	9812
10555	24565	2605	17585	56217	67444	36082	18378	10186	5630	5333	4816	4009	2318	1851	1730	6269
10555	154995	127962	17655	20481	13300	8086	4187	3884	3393	3014	2479	952	1514	1139	653	3155
10555	58014	144968	71881	30456	26346	16857	9630	6011	4452	4062	3082	2852	2072	1258	1028	2031
10555	306049	10455	21648	10476	6426	2189	2996	2596	2453	1910	2000	1589	859	874	1414	1619
10555	677611	79504	22080	22594	11375	7515	4950	3935	2808	2105	1122	1257	657	482	616	968
10555	114762	332114	8381	8942	8765	4706	3963	4073	2322	1642	1441	1536	1045	605	732	1721
10555	25262	190134	402615	11731	8653	5698	2783	2035	1950	991	1117	886	659	453	436	1132
10555	86326	96940	78135	222658	4967	3731	2768	1494	1269	689	837	236	298	368	124	667
10555	35093	32524	52330	30121	125511	3903	486	396	1990	257	249	77	156	343	28	347
10555	79605	45976	38126	46333	39046	151887	5871	257	337	858	110	246	253	201	435	481
10555	32860	61731	46285	47381	71096	35736	169492	2949	463	158	1548	152	81	83	52	992
10555	86078	52309	42284	29268	20323	8954	5122	26935	853	304	174	198	156	57	64	234
10555	235867	61369	46106	30279	22076	17766	4899	3033	13969	580	164	241	81	60	23	143
10555	65241	84103	24769	14624	10827	6967	3974	2233	1323	11068	465	53	248	274	52	669
10555	144943	430177	104125	34401	17198	8319	4654	2365	1301	1182	8772	72	230	248	39	490
10555	425205	292846	467795	123484	47163	20489	10868	4939	3849	1663	655	3050	64	45	21	16
10555	1507863	761946	418013	123430	48858	11126	2091	2276	80	1912	320	96	2033	80	424	345

Table 7: Comparative 2007 XSA diagnostics after 30 and 61 terations (=tuning convergence).
Log catchability residuals, regression statistics and terminal year survivor and F summaries for 30 iterations.

Lowestoft VPA Version 3.1 7/05/2007 16:34

Extended Survivors Analysis

REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2007
CPUE data from file red3mtun.txt

Catch data for 18 years. 1989 to 2006. Ages 4 to 19.

Fleet	First year	Last year	First age	Last age	Alpha	Beta
EU BOTTOM TRAWL SURV	1989	2006	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 had not converged after 30 iterations
Total absolute residual between iterations
29 and 30 = .00893

Tuning converged after 61 iterations

Comparative diagnostics after 30 and 61 terations (=tuning convergence).

Final year F values

Age	4	5	6	7	8	9	10	11	12	13
Iteration 30	0.002	0.012	0.063	0.055	0.058	0.082	0.052	0.053	0.006	0.061
Iteration 61	0.002	0.012	0.062	0.054	0.058	0.08	0.051	0.052	0.006	0.059

Age	14	15	16	17	18
Iteration 30	0.039	0.026	0.015	0.366	0.604
Iteration 61	0.037	0.024	0.014	0.346	0.581

Regression weights	1	1	1	1	1	1	1	1	1	1

Table 7: Cont.

XSA population numbers (Thousands)

	AGE									
YEAR 2006	4	5	6	7	8	9	10	11	12	13
Iteration 30	666000	203000	95500	65900	44700	14100	5610	6410	3650	4480
Iteration 61	676000	206000	97200	67100	45300	14300	5730	6520	3790	4600
Estimated population abundance at 1st Jan 2007										
Iteration 30	0	603000	182000	81400	56600	38200	11700	4830	5510	3300
Iteration 61	0	610000	184000	82700	57500	38700	11900	4930	5600	3410
Taper weighted geometric mean of the VPA populations										
Iteration 30	50900	34800	27100	21800	16300	11000	7870	5920	4180	2960
Iteration 61	51500	35200	27400	22100	16500	11200	7960	5990	4240	3000
Standard error of the weighted Log(VPA populations)										
Iteration 30	1.103	0.856	0.852	0.954	1.008	1.017	1.07	1.121	1.215	1.354
Iteration 61	1.102	0.855	0.851	0.952	1.007	1.016	1.07	1.122	1.216	1.356

XSA population numbers (Thousands)

	AGE				
YEAR 2006	14	15	16	17	18
Iteration 30	2800	1540	16700	110	213
Iteration 61	2920	1670	17500	115	219
Estimated population abundance at 1st Jan 2007					
Iteration 30	3830	2450	1370	15000	69
Iteration 61	3920	2550	1480	15600	74
Taper weighted geometric mean of the VPA populations					
Iteration 30	2090	1360	909	481	339
Iteration 61	2120	1380	921	490	348
Standard error of the weighted Log(VPA populations)					
Iteration 30	1.444	1.542	1.558	1.498	1.537
Iteration 61	1.445	1.542	1.558	1.492	1.531

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

	Age									
Mean Log q	4	5	6	7	8	9	10	11	12	13
Iteration 30	-8.394	-8.386	-8.472	-8.603	-8.682	-8.983	-9.375	-9.687	-9.852	-9.765
Iteration 61	-8.406	-8.398	-8.484	-8.614	-8.693	-8.995	-9.388	-9.7	-9.866	-9.779
S.E(Log q)										
Iteration 30	0.83	1.403	0.996	0.616	0.715	0.763	0.75	0.668	1.05	0.551
Iteration 61	0.828	1.398	0.988	0.608	0.708	0.756	0.747	0.667	1.057	0.553

	Age				
Mean Log q	14	15	16	17	18
Iteration 30	-9.739	-9.973	-9.632	-9.353	-9.353
Iteration 61	-9.754	-9.99	-9.649	-9.378	-9.378
S.E(Log q)					
Iteration 30	0.83	0.916	0.757	0.841	0.386
Iteration 61	0.837	0.929	0.761	0.839	0.386

Table 7: Cont.

Log catchability residuals, regression statistics and terminal year survivor and F summaries for 30 iterations.

Log catchability residuals. Fleet : EU BOTTOM TRAWL SURV

Age	1989	1990	1991	1992	1993	1994	1995	1996
4	-1.92	-1.35	0.76	0.03	0.96	0.83	0.97	-0.3
5	-3.01	-3.8	0.57	0.93	-1.18	0.74	0.48	1.77
6	-1.76	-1.99	-1.58	0.41	-0.41	0.29	-0.82	0.97
7	-0.81	-0.79	-1.31	-0.32	-0.87	0.39	0.01	0.17
8	-0.41	-0.39	-1.5	-0.15	-1	-0.13	0.16	0.62
9	-0.39	-0.35	-1.41	-0.17	-1.6	0.21	-0.22	0.75
10	-0.43	-0.28	-1.44	-0.13	-0.7	0.2	0.69	0.08
11	-0.36	-0.39	-0.9	-0.21	-0.33	0.66	1.17	1.1
12	-0.47	-0.54	-0.82	-0.01	-0.2	0.7	1.12	1.63
13	-0.36	-0.38	-0.79	-0.2	-0.12	0.24	0.87	0.95
14	-0.4	-0.06	-0.68	-0.26	-0.08	0	0.43	1.36
15	0.26	0.01	-0.95	0.32	0.22	0.47	1.59	0.71
16	-0.07	-0.22	-0.78	0.03	-0.43	-0.29	0.9	1.75
17	-0.4	0.01	-0.52	-0.78	-0.26	-0.75	-0.1	0.72
18	0	0.09	0.01	0.12	0.37	0.11	0.34	0.12
sum	**-10.53**	**-10.43**	**-11.34**	-0.39	-5.63	3.67	**7.59**	**12.40**

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4	0.7	0.09	0.66	-0.07	0.29	0.34	-1.21	-0.61	-0.17	0
5	1.2	-0.16	0.46	0.51	0.51	0.07	-0.58	0.81	0.19	0.51
6	1.22	0.78	0.18	0.66	0.34	0.6	-0.64	-0.14	1.11	0.77
7	0.64	0.54	0.89	0.65	0.49	0.27	-0.28	-0.03	0.3	0.05
8	-0.36	0.26	1.01	1.57	0.07	0.5	-0.53	0.14	0.55	-0.41
9	0.5	-0.09	0.87	1.45	0.03	0.45	-0.16	-0.33	0.88	-0.42
10	0.97	-0.94	0.94	1.53	0.2	0.03	-0.46	0.01	0.53	-0.79
11	0.08	-0.4	-1.11	0.92	0.2	0.27	-0.25	-0.52	0.61	-0.53
12	1.39	0.79	-0.17	-0.12	0.28	-0.12	-0.15	-0.46	0.33	-3.17
13	1.2	0.02	0.18	-0.77	-0.36	0.33	-0.28	-0.14	-0.12	-0.26
14	1.3	0.49	-0.65	1.54	-0.47	-0.71	0.72	-0.39	-0.51	-1.62
15	0.56	-0.59	1.17	0.2	0.43	0.56	-1.39	-0.53	-1.06	-1.99
16	-0.45	0.04	0.59	0.27	0.28	-0.4	1.01	-0.03	-0.51	-1.68
17	1.7	-0.41	0.44	-0.4	0.11	-0.42	1.18	1.49	-1.62	0.03
18	-0.2	-0.56	0.11	-0.33	-0.27	-0.41	-0.03	-0.23	-0.33	1.16
sum	**10.45**	-0.14	5.57	**7.61**	2.13	1.36	-3.05	-0.96	0.18	**-8.35**

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	1.11	-0.545	8.12	0.59	18	0.94	-8.39
5	1.82	-1.146	6.68	0.11	18	2.54	-8.39
6	1.56	-1.285	7.51	0.25	18	1.52	-8.47
7	1.45	-2.208	7.97	0.6	18	0.81	-8.6
8	1.46	-1.982	8.21	0.54	18	0.96	-8.68
9	1.33	-1.391	8.88	0.53	18	0.99	-8.98
10	1.12	-0.608	9.42	0.63	18	0.85	-9.38
11	1.19	-1.118	9.88	0.68	18	0.79	-9.69
12	1.51	-1.692	10.62	0.41	18	1.5	-9.85
13	1.26	-2.319	10.22	0.84	18	0.62	-9.77
14	1.28	-1.628	10.32	0.68	18	1.01	-9.74
15	1.12	-0.732	10.3	0.7	18	1.04	-9.97
16	1.36	-2.588	10.64	0.76	18	0.89	-9.63
17	1.39	-2.317	10.6	0.69	18	1.04	-9.35
18	0.89	2.176	8.97	0.96	18	0.31	-9.35

Table 7: Cont.

Terminal year survivor and F summaries :

Age 4 Catchability constant w.r.t. time and dependent on age
Year class = 2002

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	602977	0.853	0	0	1	1	0.002

Age 5 Catchability constant w.r.t. time and dependent on age
Year class = 2001

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	181510	0.734	0.299	0.41	2	1	0.012

Age 6 Catchability constant w.r.t. time and dependent on age
Year class = 2000

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	81375	0.596	0.442	0.74	3	1	0.063

Age 7 Catchability constant w.r.t. time and dependent on age
Year class = 1999

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	56623	0.434	0.462	1.06	4	1	0.055

1

Age 8 Catchability constant w.r.t. time and dependent on age
Year class = 1998

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	38233	0.374	0.174	0.46	5	1	0.058

Age 9 Catchability constant w.r.t. time and dependent on age
Year class = 1997

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	11750	0.338	0.177	0.52	6	1	0.082

1

Age 10 Catchability constant w.r.t. time and dependent on age
Year class = 1996

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	4834	0.313	0.231	0.74	7	1	0.052

Age 11 Catchability constant w.r.t. time and dependent on age
Year class = 1995

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	5513	0.284	0.179	0.63	8	1	0.053

1

Age 12 Catchability constant w.r.t. time and dependent on age
Year class = 1994

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	3301	0.277	0.37	1.33	9	1	0.006

Age 13 Catchability constant w.r.t. time and dependent on age
Year class = 1993

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	3831	0.251	0.145	0.58	10	1	0.06

Age 14 Catchability constant w.r.t. time and dependent on age
Year class = 1992

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	2452	0.243	0.256	1.06	11	1	0.038

Age 15 Catchability constant w.r.t. time and dependent on age
Year class = 1991

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	1372	0.248	0.275	1.11	12	1	0.025

1

Age 16 Catchability constant w.r.t. time and dependent on age
Year class = 1990

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	14999	0.225	0.25	1.11	13	1	0.014

Age 17 Catchability constant w.r.t. time and dependent on age
Year class = 1989

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	69	0.34	0.128	0.38	14	1	0.363

1

Age 18 Catchability constant w.r.t. time and age (fixed at the value for age) 17
Year class = 1988

Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
EU BOTTOM TRAWL SURV	106	0.239	0.269	1.12	15	1	0.601

Table 8a: XSA retrospective analysis, 2006-2003

Biomass

	2006	2005	2004	2003
1989	209	206	208	212
1990	179	176	178	180
1991	128	126	127	130
1992	95	93	94	95
1993	66	65	65	66
1994	45	45	50	54
1995	35	36	42	47
1996	25	27	34	40
1997	24	26	35	44
1998	27	30	40	53
1999	27	31	41	50
2000	32	37	48	59
2001	33	39	51	61
2002	40	49	60	73
2003	43	53	58	68
2004	61	70	73	
2005	85	93		
2006	145			

SSB

	2006	2005	2004	2003
1989	49	47	48	51
1990	42	40	41	42
1991	32	31	32	33
1992	25	24	25	25
1993	16	16	16	16
1994	8	7	8	8
1995	7	6	7	7
1996	4	3	4	4
1997	4	3	4	7
1998	4	4	6	10
1999	5	5	7	8
2000	6	7	9	11
2001	7	8	11	14
2002	8	10	14	17
2003	8	9	13	17
2004	10	12	17	
2005	11	15		
2006	13			

FBAR

	2006	2005	2004	2003
1989	0.34	0.35	0.35	0.34
1990	0.53	0.54	0.53	0.53
1991	0.40	0.40	0.40	0.40
1992	0.60	0.61	0.61	0.60
1993	0.73	0.75	0.74	0.70
1994	0.47	0.49	0.48	0.45
1995	0.75	0.78	0.75	0.63
1996	0.58	0.62	0.58	0.48
1997	0.16	0.17	0.16	0.15
1998	0.09	0.10	0.09	0.08
1999	0.15	0.16	0.15	0.12
2000	0.26	0.28	0.25	0.20
2001	0.17	0.17	0.15	0.13
2002	0.21	0.23	0.18	0.15
2003	0.17	0.18	0.12	0.09
2004	0.08	0.10	0.08	
2005	0.16	0.17		
2006	0.05			

REC

	2006	2005	2004	2003
1989	59	59	59	59
1990	48	48	48	49
1991	33	33	33	33
1992	25	24	24	24
1993	140	140	140	142
1994	165	181	226	252
1995	21	24	31	37
1996	16	19	25	30
1997	19	22	26	32
1998	14	20	21	25
1999	18	22	23	28
2000	16	20	19	20
2001	29	35	33	34
2002	75	97	92	104
2003	97	108	52	35
2004	118	87	71	
2005	224	205		
2006	666			

Table 8b: XSA 2006/2005 ratios

2006/2005 ratios	**Biomass**	**SSB**	**FBAR**	**REC**
1989	1.02	1.04	0.98	1.00
1990	1.02	1.04	0.98	1.00
1991	1.02	1.04	0.98	1.00
1992	1.02	1.05	0.98	1.03
1993	1.02	1.06	0.97	1.00
1994	0.99	1.07	0.97	0.91
1995	0.98	1.10	0.95	0.87
1996	0.94	1.11	0.93	0.84
1997	0.92	1.08	0.92	0.89
1998	0.89	0.99	0.94	0.72
1999	0.87	0.94	0.90	0.82
2000	0.86	0.93	0.94	0.77
2001	0.83	0.87	0.96	0.83
2002	0.81	0.84	0.93	0.77
2003	0.81	0.82	0.94	0.90
2004	0.87	0.82	0.80	1.35
2005	0.91	0.78	0.97	1.09

Table 8c: 2005-1997 fishing mortality at age ratios from the two last XSA assessments.

2006/2005 F@age ratios	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.88	0.77
1990	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.97	0.95	0.92	0.90	0.75
1991	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.99	0.98	0.97	0.95	0.93	0.85	0.75
1992	0.97	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.99	0.97	0.95	0.93	0.89	0.72
1993	1.00	0.95	1.00	1.00	1.00	1.00	0.99	0.99	0.96	0.99	0.98	0.94	0.89	0.85	0.70
1994	1.12	0.99	0.92	1.00	0.99	0.99	0.99	0.98	0.98	0.93	0.99	0.96	0.89	0.84	0.72
1995	1.16	1.15	0.98	0.88	0.99	0.99	0.98	0.99	0.96	0.97	0.88	0.97	0.91	0.82	0.70
1996	1.19	1.19	1.17	0.97	0.81	0.99	0.99	0.97	0.97	0.92	0.92	0.81	0.90	0.80	0.72
1997	1.13	1.22	1.22	1.18	0.97	0.74	0.99	0.99	0.95	0.94	0.88	0.88	0.78	0.80	0.73
1998	1.40	1.12	1.21	1.23	1.18	0.96	0.71	0.98	0.98	0.94	0.93	0.85	0.87	0.76	0.75
1999	1.23	1.40	1.10	1.20	1.24	1.18	0.96	0.69	0.98	0.98	0.93	0.90	0.82	0.82	0.71
2000	1.30	1.23	1.39	1.14	1.22	1.27	1.20	0.95	0.65	0.98	0.96	0.92	0.84	0.75	0.70
2001	1.21	1.30	1.23	1.42	1.15	1.26	1.33	1.22	0.93	0.59	0.97	0.92	0.89	0.77	0.67
2002	1.30	1.22	1.31	1.24	1.46	1.17	1.29	1.40	1.23	0.89	0.50	0.96	0.89	0.83	0.69
2003	1.11	1.30	1.22	1.33	1.25	1.51	1.18	1.32	1.46	1.25	0.81	0.43	0.93	0.82	0.73
2004	0.74	1.11	1.31	1.23	1.35	1.27	1.55	1.19	1.34	1.51	1.26	0.75	0.36	0.86	0.71
2005	0.94	0.74	1.12	1.33	1.25	1.41	1.30	1.62	1.21	1.37	1.59	1.27	0.63	0.19	0.76

averageF@age ratios (age 4-18, years 1997-2005)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.15	1.18	1.24	1.25	1.23	1.20	1.17	1.15	1.08	1.05	0.98	0.88	0.78	0.73	0.72

Table 8d: 2005-1997 abundance at age ratios from the two last XSA assessments.

2006/2005 N@age ratios	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1989	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.03	1.03	1.03	1.10	1.18
1990	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.01	1.02	1.02	1.04	1.06	1.06	1.17
1991	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.00	1.01	1.03	1.04	1.07	1.12	1.17
1992	1.03	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.00	1.01	1.02	1.04	1.05	1.10	1.23
1993	1.00	1.03	1.00	1.00	1.00	1.00	1.01	1.01	1.03	1.00	1.01	1.04	1.08	1.11	1.15
1994	0.91	1.01	1.07	1.00	1.00	1.01	1.00	1.01	1.01	1.06	1.01	1.03	1.11	1.17	1.29
1995	0.87	0.87	1.01	1.11	1.00	1.01	1.01	1.01	1.03	1.02	1.10	1.01	1.05	1.15	1.22
1996	0.84	0.86	0.86	1.02	1.17	1.01	1.01	1.02	1.02	1.06	1.05	1.19	1.06	1.18	1.31
1997	0.89	0.83	0.82	0.85	1.03	1.31	1.01	1.01	1.04	1.05	1.12	1.13	1.28	1.20	1.35
1998	0.72	0.88	0.83	0.81	0.85	1.03	1.39	1.02	1.02	1.06	1.07	1.17	1.14	1.29	1.31
1999	0.82	0.72	0.88	0.83	0.81	0.85	1.04	1.42	1.02	1.02	1.07	1.09	1.17	1.16	1.34
2000	0.77	0.82	0.72	0.88	0.83	0.80	0.84	1.05	1.46	1.02	1.03	1.08	1.14	1.28	1.29
2001	0.83	0.77	0.81	0.71	0.88	0.81	0.77	0.83	1.07	1.62	1.02	1.08	1.10	1.25	1.39
2002	0.77	0.82	0.77	0.81	0.70	0.87	0.79	0.73	0.82	1.09	1.81	1.03	1.10	1.16	1.35
2003	0.90	0.77	0.82	0.76	0.80	0.67	0.85	0.77	0.69	0.81	1.16	2.23	1.05	1.14	1.29
2004	1.35	0.90	0.76	0.82	0.75	0.79	0.65	0.84	0.75	0.67	0.80	1.33	2.39	1.11	1.33
2005	1.09	1.36	0.90	0.76	0.81	0.73	0.78	0.64	0.84	0.74	0.65	0.79	1.36	3.34	1.22

averageN@age ratios (age 4-18, years 1997-2005)

4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.90	0.87	0.81	0.80	0.83	0.87	0.90	0.92	0.97	1.01	1.08	1.21	1.30	1.44	1.32

Table 9: XSA results (at the 30th iteration) for 2007 assessment.

Run title : REDFISH NAFO DIVISION 3M INDEX OF INPUT FILES 2007

Terminal Fs derived using XSA (Without F shrinkage)

(Table 8) Fishing mortality (F) at age

YEAR / AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	0.008	0.2565	0.0404	0.01	1.8042	0.4225	0.1494	0.1132
5	0.0154	0.0569	0.1185	0.2157	0.7443	0.4049	0.1542	0.2586
6	0.084	0.0999	0.1764	0.3171	0.521	0.3746	0.5982	0.0663
7	0.2158	0.4354	0.4452	0.7394	0.501	0.5215	0.4003	0.2678
8	0.3106	0.7862	0.6476	0.9676	0.6604	0.4492	0.5564	0.5156
9	0.2906	0.7774	0.6422	0.7288	0.3699	0.6325	0.3404	0.6654
10	0.2553	0.6408	0.4181	0.5763	0.6883	0.5855	0.6278	0.3333
11	0.3167	0.4864	0.4316	0.4762	0.8082	0.6538	0.8908	0.6998
12	0.2922	0.3708	0.3367	0.5252	0.7886	0.5769	0.7752	0.9751
13	0.4006	0.4442	0.3532	0.5016	0.8913	0.3927	0.7921	0.593
14	0.4002	0.6244	0.3574	0.4938	0.9679	0.3322	0.5862	0.8173
15	0.5979	0.5298	0.2163	0.6641	1.0611	0.4397	1.4324	0.3133
16	0.6021	0.5841	0.3369	0.6404	0.7184	0.2464	1.1982	1.0946
17	0.5045	0.8704	0.576	0.3848	0.841	0.1926	0.6257	0.5353
18	0.772	0.9443	1.0044	0.7046	1.3837	0.4308	0.8853	0.3081
+gp	0.772	0.9443	1.0044	0.7046	1.3837	0.4308	0.8853	0.3081
0 FBAR 6-16	0.3424	0.5254	0.3965	0.6028	0.7251	0.4732	0.7453	0.5765

(Table 8) Fishing mortality (F) at age

YEAR / AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	FBAR **-**
4	0.0384	0.0081	0.0087	0.0069	0.0305	0.0181	0.0187	0.0089	0.0017	0.0021	0.0042
5	0.0118	0.0037	0.0035	0.0103	0.0256	0.0129	0.0311	0.0505	0.0045	0.012	0.0223
6	0.0563	0.0099	0.0011	0.0213	0.0282	0.0402	0.0131	0.0473	0.0208	0.063	0.0437
7	0.0132	0.0311	0.0071	0.0325	0.0904	0.0467	0.039	0.0831	0.024	0.0548	0.0539
8	0.0681	0.013	0.0321	0.1226	0.1212	0.1154	0.053	0.1119	0.0829	0.0584	0.0844
9	0.1647	0.1288	0.0122	0.2169	0.1308	0.1211	0.0911	0.0628	0.2	0.0818	0.1149
10	0.2679	0.0491	0.1417	0.0998	0.1801	0.1037	0.0594	0.0667	0.136	0.0523	0.085
11	0.1025	0.0835	0.0675	0.352	0.0948	0.1892	0.0828	0.0393	0.1683	0.0531	0.0869
12	0.333	0.2148	0.156	0.1871	0.321	0.0671	0.1116	0.0474	0.1446	0.0061	0.066
13	0.2797	0.1068	0.2184	0.131	0.1594	0.5029	0.0503	0.0927	0.1161	0.0607	0.0898
14	0.3159	0.2009	0.1143	1.0807	0.1344	0.2119	0.5609	0.0405	0.1973	0.0387	0.0921
15	0.098	0.0423	0.4839	0.2478	0.2448	0.5715	0.0507	0.06	0.0582	0.0257	0.048
16	0.0411	0.1498	0.3772	0.4214	0.3376	0.3393	0.7349	0.1894	0.6427	0.0145	0.2822
17	0.3949	0.1156	0.4675	0.2541	0.3316	0.5087	0.703	0.592	0.244	0.3661	0.4007
18	0.0597	0.074	0.2427	0.4966	0.3077	0.2597	0.3828	0.2387	0.5097	0.6038	0.4507
+gp	0.0597	0.074	0.2427	0.4966	0.3077	0.2597	0.3828	0.2387	0.5097	0.6038	
0 FBAR 6-16	0.1582	0.0937	0.1465	0.2648	0.1675	0.2099	0.1679	0.0765	0.1628	0.0463	

Table 9 Relative F at age

YEAR / AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	0.0233	0.4881	0.1019	0.0165	2.4881	0.8928	0.2004	0.1964
5	0.045	0.1083	0.299	0.3579	1.0265	0.8558	0.207	0.4487
6	0.2455	0.1901	0.4448	0.5261	0.7185	0.7916	0.8026	0.1149
7	0.6302	0.8287	1.1228	1.2267	0.691	1.1022	0.5371	0.4646
8	0.9072	1.4964	1.6334	1.6052	0.9108	0.9494	0.7466	0.8944
9	0.8489	1.4797	1.6198	1.2091	0.5101	1.3368	0.4567	1.1541
10	0.7456	1.2197	1.0545	0.9561	0.9493	1.2374	0.8423	0.5782
11	0.9251	0.9258	1.0884	0.7901	1.1146	1.3818	1.1952	1.2138
12	0.8536	0.7058	0.8493	0.8713	1.0876	1.2192	1.0402	1.6915
13	1.17	0.8454	0.8908	0.8322	1.2292	0.83	1.0629	1.0286
14	1.1688	1.1885	0.9013	0.8191	1.3349	0.702	0.7866	1.4177
15	1.7464	1.0084	0.5455	1.1017	1.4634	0.9291	1.922	0.5434
16	1.7586	1.1117	0.8496	1.0625	0.9907	0.5207	1.6078	1.8987
17	1.4736	1.6567	1.4528	0.6383	1.1598	0.4071	0.8395	0.9285
18	2.2549	1.7974	2.5331	1.1689	1.9083	0.9105	1.188	0.5344
+gp	2.2549	1.7974	2.5331	1.1689	1.9083	0.9105	1.188	0.5344
0 REFMEAN	0.3424	0.5254	0.3965	0.6028	0.7251	0.4732	0.7453	0.5765

Table 9: XSA results (at the 30th iteration) for 2007 assessment (cont.)

Table 9 Relative F at age

YEAR AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	MEAN **-**	
4	0.2426	0.086	0.0597	0.026	0.1822	0.086	0.1112	0.1161	0.0102	0.0444	0.0569	0.0569
5	0.0743	0.0394	0.0241	0.0388	0.1526	0.0613	0.1852	0.6609	0.0276	0.2591	0.3159	
6	0.3558	0.1062	0.0076	0.0805	0.1682	0.1916	0.078	0.619	0.1277	1.3625	0.7031	
7	0.0831	0.3324	0.0486	0.1228	0.5399	0.2224	0.2321	1.0864	0.1473	1.1839	0.8059	
8	0.4306	0.1388	0.2194	0.463	0.7232	0.5496	0.3156	1.4638	0.5095	1.2619	1.0784	
9	1.0412	1.3756	0.0834	0.8189	0.7809	0.5769	0.5426	0.8217	1.2285	1.7676	1.2726	
10	1.6934	0.5243	0.9674	0.3768	1.0753	0.4942	0.3537	0.8725	0.8352	1.1306	0.9461	
11	0.6477	0.8921	0.4609	1.329	0.5658	0.9014	0.4931	0.5137	1.034	1.1471	0.8982	
12	2.1047	2.2939	1.0648	0.7064	1.9159	0.3198	0.6647	0.6192	0.8883	0.1312	0.5463	
13	1.768	1.1405	1.4909	0.4946	0.9515	2.3956	0.2999	1.2121	0.713	1.3118	1.079	
14	1.9965	2.1451	0.7798	4.0808	0.8025	1.0096	3.3409	0.529	1.2118	0.8363	0.859	
15	0.6196	0.4515	3.3026	0.9358	1.4614	2.7228	0.3023	0.7851	0.3574	0.5546	0.5657	
16	0.2595	1.5996	2.5745	1.5914	2.0155	1.6162	4.3773	2.4774	3.9473	0.3124	2.2457	
17	2.4961	1.2346	3.1911	0.9593	1.9793	2.4235	4.1877	7.7424	1.4989	7.9124	5.7179	
18	0.3773	0.7906	1.6567	1.8753	1.8367	1.2371	2.2802	3.1217	3.1308	13.0497	6.434	
+gp	0.3773	0.7906	1.6567	1.8753	1.8367	1.2371	2.2802	3.1217	3.1308	13.0497		
0 REFMEAN	0.1582	0.0937	0.1465	0.2648	0.1675	0.2099	0.1679	0.0765	0.1628	0.0463		

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

YEAR AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	58714	48246	32629	25129	140252	165251	20989	16024
5	72752	52704	33779	28355	22512	20890	98002	16357
6	102896	64823	45051	27148	20678	9677	12608	76001
7	124473	85599	53080	34173	17889	11113	6021	6273
8	94711	90770	50114	30773	14761	9807	5969	3651
9	60470	62817	37418	23728	10581	6901	5663	3096
10	45334	40915	26123	17813	10359	6614	3317	3646
11	34045	31778	19505	15560	9057	4709	3332	1602
12	25774	22442	17679	11463	8745	3652	2216	1237
13	20276	17411	14015	11423	6134	3596	1856	924
14	18753	12291	10104	8908	6259	2276	2197	761
15	12144	11372	5956	6395	4919	2151	1478	1106
16	6891	6043	6058	4341	2979	1540	1254	319
17	5630	3415	3049	3914	2070	1314	1089	342
18	3848	3076	1294	1551	2410	808	981	527
+gp	9711	7785	5435	3574	2217	1149	2200	1142
0 TOTAL	696424	561489	361290	254248	281823	251449	169172	133009

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

YEAR AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	GMST 89-**	AMST 89-**
4	19317	14280	18229	15615	28950	75203	97349	118215	224223	666290	0	39535	55900
5	12947	16821	12818	16350	14032	25408	66829	86457	106020	202549	602977	29072	37313
6	11427	11578	15164	11557	14643	12376	22696	58618	74374	95501	181510	23516	32309
7	64360	9774	10373	13706	10237	12882	10757	20269	50587	65911	81375	19308	30686
8	4342	57474	8573	9319	12005	8462	11124	9362	16878	44689	56623	15279	26326
9	1973	3670	51333	7512	7459	9623	6822	9546	7574	14056	38233	11141	19288
10	1440	1514	2919	45884	5472	5922	7714	5635	8112	5611	11750	8022	14414
11	2364	997	1304	2292	37575	4135	4830	6578	4770	6406	4834	5969	11229
12	720	1930	830	1103	1459	30925	3096	4023	5722	3647	5513	4136	8581
13	422	467	1409	642	828	958	26165	2506	3472	4481	3301	2858	6815
14	462	289	380	1025	510	639	524	22513	2067	2797	3831	2052	5493
15	304	305	214	307	315	403	467	271	19563	1535	2452	1146	3007
16	732	249	264	119	216	223	206	402	231	16700	1372	825	1990
17	97	635	194	164	71	140	144	89	301	110	14999	543	1397
18	181	59	512	110	115	46	76	64	45	213	69	397	979
+gp	1377	765	715	1521	241	261	876	1496	186	194	202		
0 TOTAL	122466	120808	125231	127227	134127	187603	259676	346044	524124	1130692	1009043		

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

YEAR AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	12	9	6	5	24	32	4	3
5	274	198	126	105	80	76	365	60
6	2525	1589	1097	654	490	232	297	1867
7	8678	5864	3633	2285	1219	756	414	435
8	12574	11601	6476	3876	1906	1288	777	477
9	10737	10728	6460	4068	1867	1192	1002	534
10	9676	8468	5504	3706	2136	1375	687	773
11	10946	10079	6213	4939	2800	1474	1023	500
12	10136	8771	6928	4425	3305	1404	838	461
13	8289	7093	5751	4632	2411	1471	735	372
14	8659	5574	4682	4083	2762	1057	999	340
15	6065	5710	3067	3177	2367	1088	690	565
16	3881	3408	3485	2437	1662	893	673	173
17	3246	1912	1748	2278	1162	777	622	197
18	2248	1772	742	911	1341	485	568	320
+gp	6717	5310	3690	2485	1460	816	1508	820

Table 9: XSA results (at the 30th iteration) for 2007 assessment (cont.)

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

YEAR AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4	4	3	4	3	6	15	19	23	44	132
5	49	63	48	62	53	96	251	325	400	763
6	281	286	375	285	361	305	560	1442	1834	2347
7	4560	692	735	970	721	910	761	1428	3581	4655
8	588	7815	1164	1256	1618	1141	1508	1263	2282	6054
9	354	660	9320	1342	1341	1732	1231	1726	1355	2538
10	307	328	629	9916	1175	1279	1673	1221	1748	1217
11	773	327	428	735	12297	1343	1582	2162	1552	2104
12	282	764	330	437	572	12383	1235	1614	2277	1468
13	174	195	584	268	345	388	11000	1050	1452	1882
14	215	135	179	448	240	299	239	10699	970	1330
15	158	159	108	157	162	202	244	141	10201	803
16	431	146	152	68	125	128	115	234	129	9858
17	56	378	112	96	41	81	82	51	177	64
18	112	36	312	66	70	28	46	39	27	126
+gp	1009	560	516	1076	173	188	625	1080	131	136

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

YEAR AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	5871	4680	3557	2412	9257	14873	2141	1266
5	11931	9012	4560	4849	3512	2716	11074	2257
6	21094	13743	9641	5647	4384	2187	2736	10716
7	30869	22341	14650	9978	5134	3067	1734	1694
8	26898	27140	16888	10894	5388	3413	2131	1197
9	19169	20792	14406	9396	4179	2726	2293	1189
10	15822	14770	12147	8051	4496	3069	1513	1615
11	14674	14078	10045	8169	4646	2322	1713	769
12	13170	11760	10059	6545	4845	1936	1210	659
13	11415	10133	8633	7254	3828	1974	1173	536
14	10989	7399	6558	6057	4300	1532	1542	456
15	7663	7415	4169	4502	3512	1418	1073	718
16	4431	4037	4719	3503	2594	1108	1018	222
17	3975	2496	2329	3010	1766	1072	896	259
18	2705	2236	1027	1363	2090	688	852	419
+gp	8546	7162	4848	3335	2441	1048	2348	1092
0 TOTALBIO	209223	179195	128238	94966	66372	45147	35447	25065

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

YEAR AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4	1739	1271	1586	1515	2461	7595	7399	11112	20629	57301
5	1644	2321	1551	2158	1965	3354	7284	10375	12616	21673
6	2171	2096	2669	2011	2621	2277	3654	9555	12346	14803
7	11199	2238	2313	3207	2436	2924	2334	4479	10826	13775
8	1541	12759	2229	2656	3565	2386	2937	2603	4608	11708
9	801	1362	12628	2471	2447	3108	2190	3274	2567	5004
10	671	639	943	13628	2101	2309	2738	2130	3074	2295
11	1194	488	617	958	12775	1687	1995	2920	2189	3210
12	413	1062	468	582	753	12308	1431	2004	2752	2177
13	257	291	723	429	495	537	9184	1386	1604	2164
14	287	198	210	578	338	380	292	9590	1221	1888
15	207	218	116	152	210	254	273	172	9821	1283
16	546	202	146	80	133	160	131	275	164	7365
17	76	529	125	118	55	90	73	48	218	66
18	138	43	315	79	98	41	53	49	40	110
+gp	1285	844	548	1141	244	249	661	1130	162	96
0 TOTALBIO	24168	26561	27185	31764	32697	39660	42629	61102	84838	144919

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

YEAR AGE	1989	1990	1991	1992	1993	1994	1995	1996
4	1	1	1	0	2	3	0	0
5	45	34	17	18	12	10	41	8
6	518	337	235	136	104	52	64	263
7	2152	1530	1003	667	350	209	119	118
8	3571	3469	2183	1372	696	448	277	156
9	3404	3551	2487	1611	737	471	406	205
10	3377	3057	2559	1675	927	638	313	343
11	4718	4465	3200	2593	1436	727	526	240
12	5179	4596	3942	2526	1831	744	458	246
13	4667	4128	3543	2941	1505	808	465	216
14	5074	3356	3038	2776	1897	711	702	204
15	3827	3723	2147	2237	1690	717	501	367
16	2495	2277	2715	1967	1448	642	547	120
17	2292	1398	1335	1752	991	634	511	149
18	1580	1288	589	801	1162	413	493	254
+gp	5911	4886	3292	2319	1608	745	1609	784
0 TOTSPBIO	48810	42095	32284	25392	16396	7971	7033	3672

Table 9: XSA results (at the 30th iteration) for 2007 assessment (cont.)

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

YEAR / AGE	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
4	0	0	0	0	0	2	1	2	4	11
5	6	9	6	8	7	13	27	39	48	82
6	53	52	66	50	65	56	90	235	304	364
7	793	158	164	227	172	207	165	316	766	973
8	209	1735	303	358	481	322	398	351	623	1586
9	144	245	2293	441	440	559	395	592	459	903
10	143	139	203	2945	451	499	594	462	662	498
11	390	160	202	307	4181	548	653	960	712	1054
12	162	420	186	231	295	4928	571	804	1095	876
13	106	122	300	179	206	218	3861	581	671	909
14	133	93	99	253	159	178	133	4558	573	897
15	108	114	58	78	108	127	142	90	5121	671
16	322	118	84	46	77	92	73	160	92	4347
17	44	314	72	69	32	52	41	28	128	38
18	85	27	192	47	60	25	32	30	24	65
+gp	941	617	395	807	175	179	471	815	114	68
0 TOTSPBIO	3640	4322	4623	6047	6909	8004	7650	10021	11398	13343

(Table 16) Summary (without SOP correction)

	RECRUITS Age 4	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 6-16	ABUNDANCE
1989	58714	209223	48810	58086	1.19	0.3424	696424
1990	48246	179195	42095	80223	1.9058	0.5254	561489
1991	32629	128238	32284	48500	1.5023	0.3965	361290
1992	25129	94966	25392	43300	1.7053	0.6028	254248
1993	140252	66372	16396	43090	2.6281	0.7251	281823
1994	165251	45147	7971	17660	2.2156	0.4732	251449
1995	20989	35447	7033	13879	1.9733	0.7453	169172
1996	16024	25065	3672	6101	1.6615	0.5765	133009
1997	19317	24168	3640	1408	0.3868	0.1582	122466
1998	14280	26561	4322	1011	0.2339	0.0937	120808
1999	18229	27185	4623	1095	0.2369	0.1465	125231
2000	15615	31764	6047	3664	0.6059	0.2648	127227
2001	28950	32697	6909	3327	0.4816	0.1675	134127
2002	75203	39660	8004	3061	0.3824	0.2099	187603
2003	97349	42629	7650	2273	0.2971	0.1679	259676
2004	118215	61102	10021	3043	0.3037	0.0765	346044
2005	224223	84838	11398	3775	0.3312	0.1628	524124
2006	666290	144919	13343	4121	0.3089	0.0463	1130692
Arith. Mean	99162	72176	14423	18757	1.0195	0.3267	
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 10a: stock/recruitment srr file for MTerm projections

```
5               Nparams
5               Geometric mean model
39.535           1989-2004 age 4 XSA geomean in millions
0.00000E+000
0.00000E+000
0
0.00000E+000
16              Ndata
0.395            Residuals
0.199
-0.192
-0.453
1.266
1.430
-0.633
-0.903
-0.716
-1.018
-0.774
-0.929
-0.312
0.643
0.901
1.095
0               No extra data
```

Table 10b: An explanation of the red.sen file input data with an exploitation pattern corresponding to F*statusquo*

N4=1989-2004 age 4 XSA geometric mean

Name	Value	C.V.	Name	Value	C.V.	Name	Value	C.V.	Name	Value	C.V.
Initial population at age (2007)			Exploitation pattern (H - Human consumption)			Exploitation pattern (D - Discards)			Exploitation pattern (I - Industrials)		
N4	35769	0.85	sH4	0.0030	0.00	sD4	0.00	0.00	sI4	0.00	0.00
N5	527089	0.52	sH5	0.0173	0.00	sD5	0.00	0.00	sI5	0.00	0.00
N6	147470	0.52	sH6	0.0402	0.00	sD6	0.00	0.00	sI6	0.00	0.00
N7	65357	0.45	sH7	0.0468	0.00	sD7	0.00	0.00	sI7	0.00	0.00
N8	46855	0.27	sH8	0.0614	0.00	sD8	0.00	0.00	sI8	0.00	0.00
N9	33409	0.26	sH9	0.0705	0.00	sD9	0.00	0.00	sI9	0.00	0.00
N10	10608	0.27	sH10	0.0511	0.00	sD10	0.00	0.00	sI10	0.00	0.00
N11	4461	0.23	sH11	0.0479	0.00	sD11	0.00	0.00	sI11	0.00	0.00
N12	5333	0.32	sH12	0.0274	0.00	sD12	0.00	0.00	sI12	0.00	0.00
N13	3332	0.20	sH13	0.0524	0.00	sD13	0.00	0.00	sI13	0.00	0.00
N14	4139	0.25	sH14	0.0390	0.00	sD14	0.00	0.00	sI14	0.00	0.00
N15	2975	0.26	sH15	0.0230	0.00	sD15	0.00	0.00	sI15	0.00	0.00
N16	1789	0.24	sH16	0.0809	0.00	sD16	0.00	0.00	sI16	0.00	0.00
N17	19672	0.23	sH17	0.1942	0.00	sD17	0.00	0.00	sI17	0.00	0.00
N18	91	0.25	sH18	0.2143	0.00	sD18	0.00	0.00	sI18	0.00	0.00
N19	266	0.25	sH19	0.2143	0.00	sD19	0.00	0.00	sI19	0.00	0.00
Stock weight at age			Catch weight at age (H - Human consumption)			Catch weight at age (D - Discards)			Catch weight at age (I - Industrials)		
WS4	0.090	0.00	WH4	0.102	0.00	WD4	0.00	0.00	WI4	0.00	0.00
WS5	0.115	0.00	WH5	0.131	0.00	WD5	0.00	0.00	WI5	0.00	0.00
WS6	0.161	0.00	WH6	0.179	0.00	WD6	0.00	0.00	WI6	0.00	0.00
WS7	0.215	0.00	WH7	0.231	0.00	WD7	0.00	0.00	WI7	0.00	0.00
WS8	0.271	0.00	WH8	0.288	0.00	WD8	0.00	0.00	WI8	0.00	0.00
WS9	0.346	0.00	WH9	0.350	0.00	WD9	0.00	0.00	WI9	0.00	0.00
WS10	0.389	0.00	WH10	0.394	0.00	WD10	0.00	0.00	WI10	0.00	0.00
WS11	0.468	0.00	WH11	0.482	0.00	WD11	0.00	0.00	WI11	0.00	0.00
WS12	0.525	0.00	WH12	0.542	0.00	WD12	0.00	0.00	WI12	0.00	0.00
WS13	0.500	0.00	WH13	0.539	0.00	WD13	0.00	0.00	WI13	0.00	0.00
WS14	0.564	0.00	WH14	0.590	0.00	WD14	0.00	0.00	WI14	0.00	0.00
WS15	0.658	0.00	WH15	0.679	0.00	WD15	0.00	0.00	WI15	0.00	0.00
WS16	0.612	0.00	WH16	0.613	0.00	WD16	0.00	0.00	WI16	0.00	0.00
WS17	0.621	0.00	WH17	0.644	0.00	WD17	0.00	0.00	WI17	0.00	0.00
WS18	0.725	0.00	WH18	0.743	0.00	WD18	0.00	0.00	WI18	0.00	0.00
WS19	0.707	0.00	WH19	0.878	0.00	WD19	0.00	0.00	WI19	0.00	0.00
Natural mortality at age			Maturity								
M4	0.1	0.00	MT4	0.000	0.00						
M5	0.1	0.00	MT5	0.005	0.00						
M6	0.1	0.00	MT6	0.021	0.00						
M7	0.1	0.00	MT7	0.063	0.00						
M8	0.1	0.00	MT8	0.122	0.00						
M9	0.1	0.00	MT9	0.167	0.00						
M10	0.1	0.00	MT10	0.210	0.00						
M11	0.1	0.00	MT11	0.312	0.00						
M12	0.1	0.00	MT12	0.392	0.00						
M13	0.1	0.00	MT13	0.414	0.00						
M14	0.1	0.00	MT14	0.474	0.00						
M15	0.1	0.00	MT15	0.514	0.00						
M16	0.1	0.00	MT16	0.612	0.00						
M17	0.1	0.00	MT17	0.605	0.00						
M18	0.1	0.00	MT18	0.626	0.00						
M19	0.1	0.00	MT19	0.743	0.00						
Natural mortality multiplier in year			Effort multiplier in year (H - Human consumption)								
K2006	1	0.0	HF2006	1.0	0.0						
K2007	1	0.0	HF2007	1.0	0.0						
K2008	1	0.0	HF2008	1.0	0.0						

Table 10c: Initial population at age (2007)

gmean rec 1989-2004	XSA survivors end 2006	N@age av.retro XSA2006/2005	Retro-corrected N beginning 2007
N4	39535	0.90	**35769**
N5	602977	0.87	**527089**
N6	181510	0.81	**147470**
N7	81375	0.80	**65357**
N8	56623	0.83	**46855**
N9	38233	0.87	**33409**
N10	11750	0.90	**10608**
N11	4834	0.92	**4461**
N12	5513	0.97	**5333**
N13	3301	1.01	**3332**
N14	3831	1.08	**4139**
N15	2452	1.21	**2975**
N16	1372	1.30	**1789**
N17	14999	1.20	**17978**
N18	69	1.32	**91**
N19	202	1.32	**266**

Table 10d: Exploitation pattern (H - Human consumption)

	Relative F average 2004-2006	$F_{status\ quo}$ (Fbar .Relative F)	Fratios XSA2006/2005	Retro-corrected $F_{status\ quo}$ 2007-2016
sH4	0.0569	0.0026	1.1517	**0.0030**
sH5	0.3159	0.0146	1.1813	**0.0173**
sH6	0.7031	0.0326	1.2356	**0.0402**
sH7	0.8059	0.0373	1.2548	**0.0468**
sH8	1.0784	0.0499	1.2307	**0.0614**
sH9	1.2726	0.0589	1.1967	**0.0705**
sH10	0.9461	0.0438	1.1668	**0.0511**
sH11	0.8982	0.0416	1.1508	**0.0479**
sH12	0.5463	0.0253	1.0816	**0.0274**
sH13	1.079	0.0500	1.0488	**0.0524**
sH14	0.859	0.0398	0.9814	**0.0390**
sH15	0.5657	0.0262	0.8763	**0.0230**
sH16	2.2457	0.1040	0.7779	**0.0809**
sH17	5.7179	0.2647	0.7334	**0.1942**
sH18	6.434	0.2979	0.7195	**0.2143**
sH19	6.434	0.2979	0.7195	**0.2143**
$Fbar_{6-16,\ 2006}$	0.0463			

Table 11a: Short term (2009) and medium term SSB projections under a range of Fstatus quo multilpie

	Relative Fbar					Fsattus quo					
2009	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5
5th %ile	28824	28362	27950	27488	27042	26617	26157	25703	25313	24933	24562
10th %ile	29934	29405	28891	28402	27949	27525	27083	26659	26267	25873	25506
25th %ile	31433	30919	30419	29946	29467	29008	28559	28126	27699	27265	26873
50th %ile	35231	34663	34156	33629	33103	32577	32065	31553	31066	30585	30139
95th %ile	44609	43997	43399	42768	42186	41630	41085	40554	40011	39489	38978
	Fbar					Fsattus quo					
2016	0.025	0.029	0.034	0.039	0.044	0.049	0.054	0.059	0.064	0.069	0.074
5th %ile	75196	71723	68456	65386	62507	59798	57311	54910	52631	50432	48312
10th %ile	81593	77878	74437	71202	68164	65264	62452	59854	57351	54964	52718
25th %ile	89751	85676	81860	78269	74883	71669	68653	65768	63060	60462	57936
50th %ile	110195	105267	100715	96375	92208	88319	84616	81053	77663	74437	71390
95th %ile	172659	165400	158496	151923	145661	139490	133571	127963	122797	117821	112978

Final assessment data year	2006	
First year for populations in Sen	2007	
First SSB profile 3 years ahead	2009	SSB 2009
Last SSB profile 10 years ahead	2016	SSB 2016

Tab. 11b: SSB and yield 5th, 25th, 50th and 95% %ile probability profiles under Fstatusquo, 2007-2016

	5th %ile	10th %ile	25th %ile	50th %ile	95th %ile
Year	SSB				
2007	16355	17018	17792	19408	23342
2008	20455	21234	22213	24196	28879
2009	26617	27525	29008	32577	41630
2010	32913	34269	36653	**42525**	58951
2011	38140	40171	43527	51704	75075
2012	43741	45965	50399	60415	88987
2013	51371	55252	61375	75408	117157
2014	55726	60885	67374	83561	133982
2015	56578	61058	67251	82558	128221
2016	59798	65264	71669	88319	139490
Year	Yield				
2007	6035	6323	6690	7566	9760
2008	7729	8164	8748	**10286**	14681
2009	8581	9110	9936	11885	17623
2010	9264	9916	10997	13373	21197
2011	9262	10109	11136	13841	22843
2012	8381	8887	9765	11831	18078
2013	7947	8504	9417	11359	17597
2014	7384	8030	8720	10120	14171
2015	8820	9482	10351	12158	17956
2016	8898	9394	10143	11669	16014

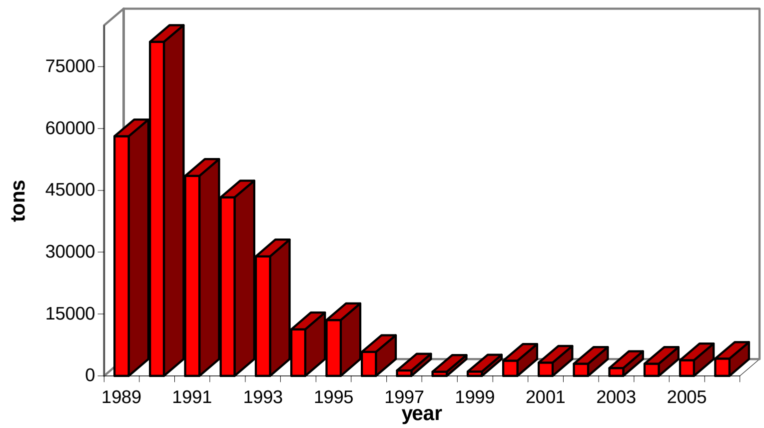

Fig. 1a: STACFIS estimates of beaked redfish commercial catch.

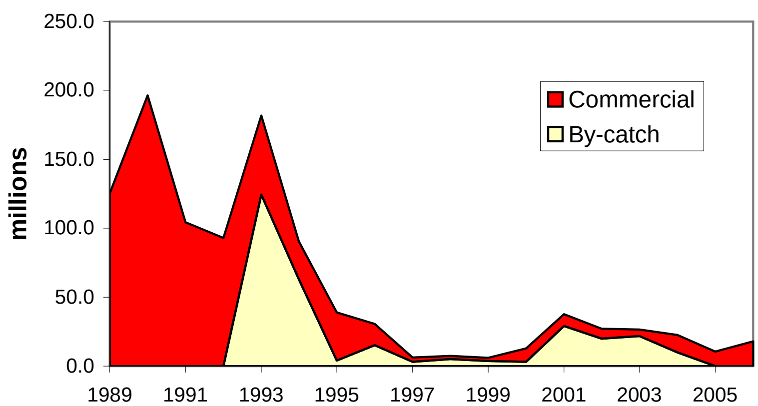

Fig. 1b: Beaked redfish commercial catch and by-catch in numbers

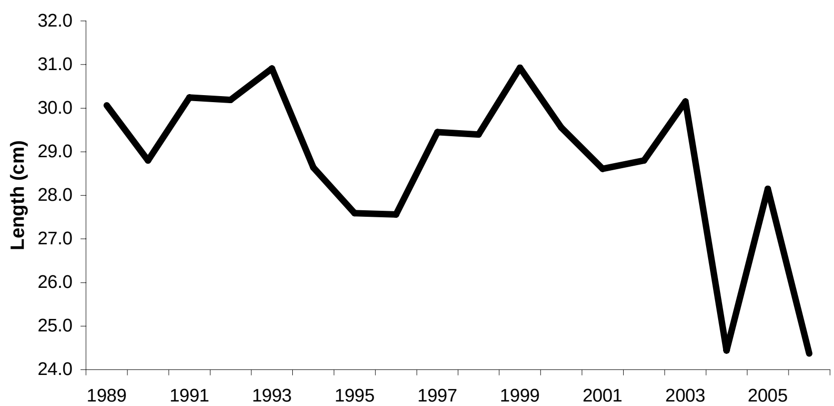

Fig. 2: Mean length in the commercial catch, 1989-2006

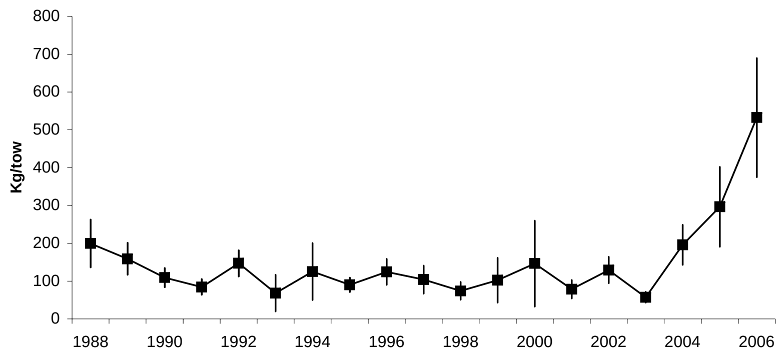

Fig. 3a: mean catch per tow for 3M beaked refish (EU survey, 1988-2006) with associated +/- 1.96 se

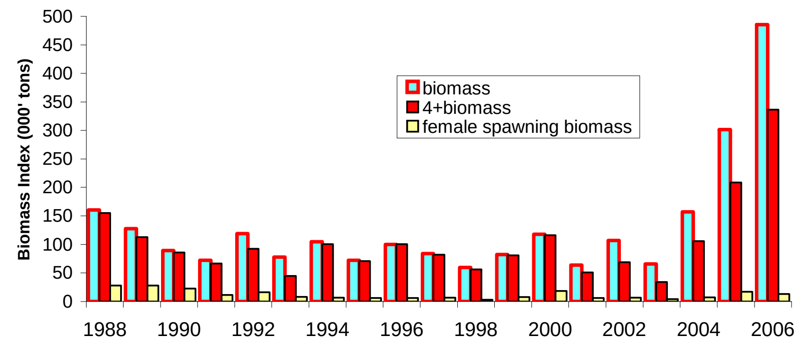

Fig. 3b: 3M Beaked redfish biomass, 4+ biomass and female spawning biomass and abundance (EU survey, 1988-2006)

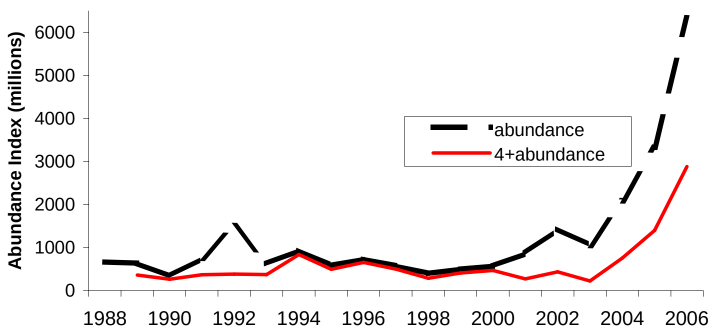

Fig. 3c: 3M Beaked redfish abundance and 4+ abundance (EU survey, 1988-2006)

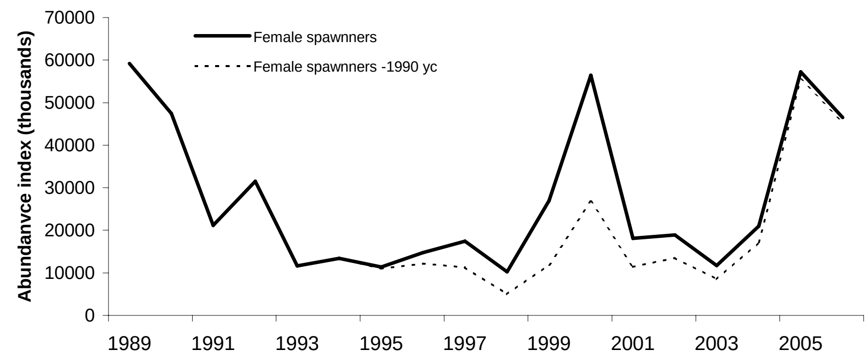

Fig. 3d: 3M Beaked redfish female spawners abundance (EU survey, 1988-2006)

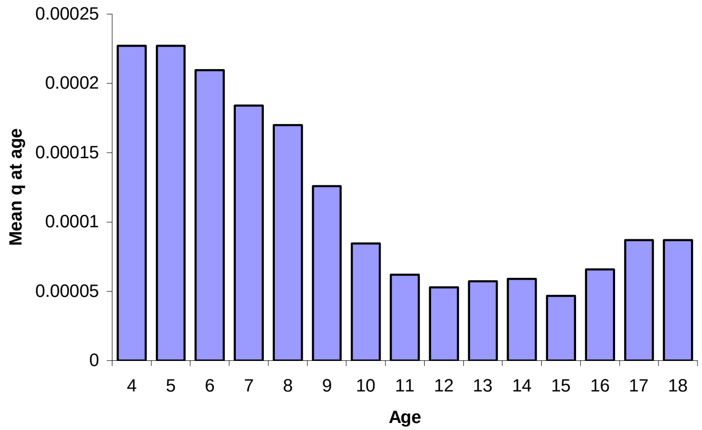

Fig. 4a : Mean survey q at age, ages 4-18

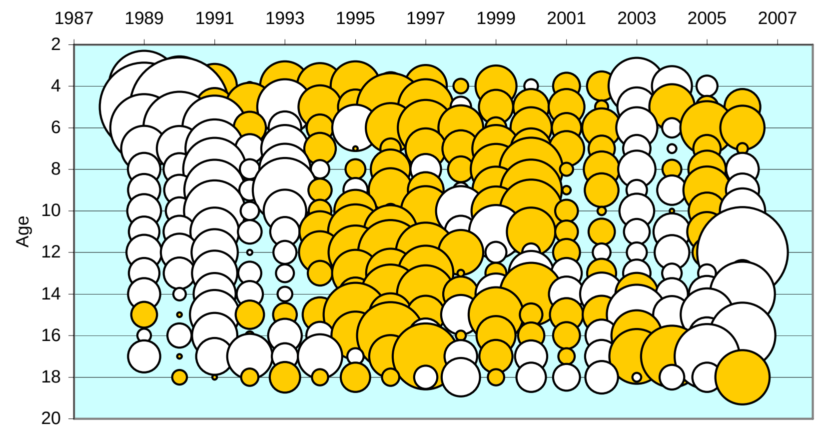

Fig.4b : Eu survey log q residuals by age and by year, 1989-2006

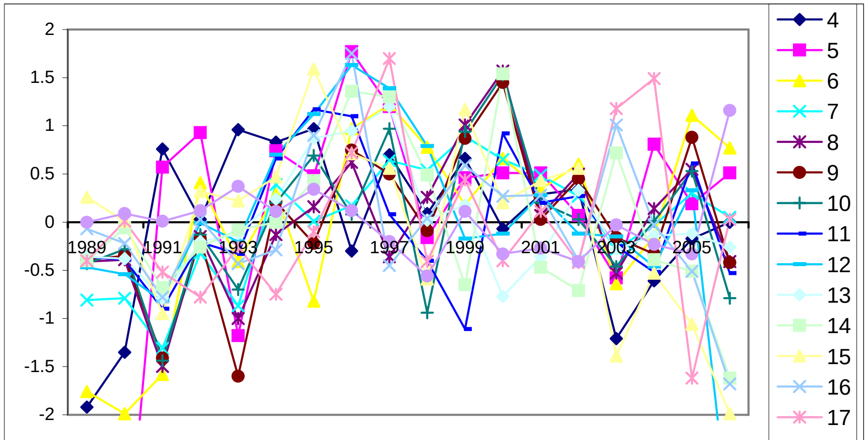

Fig 4c : EU survey log q residuals by age and by year, 1989-2006

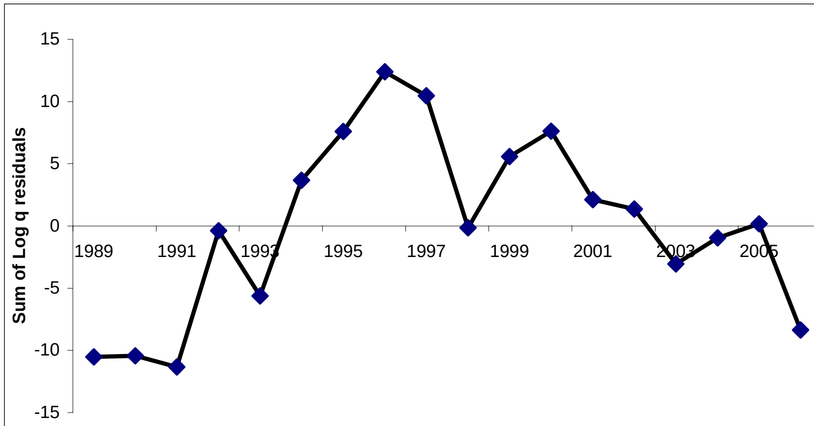

Fig 4d: Trends and "size" of year effects on Log q, 1989-2006

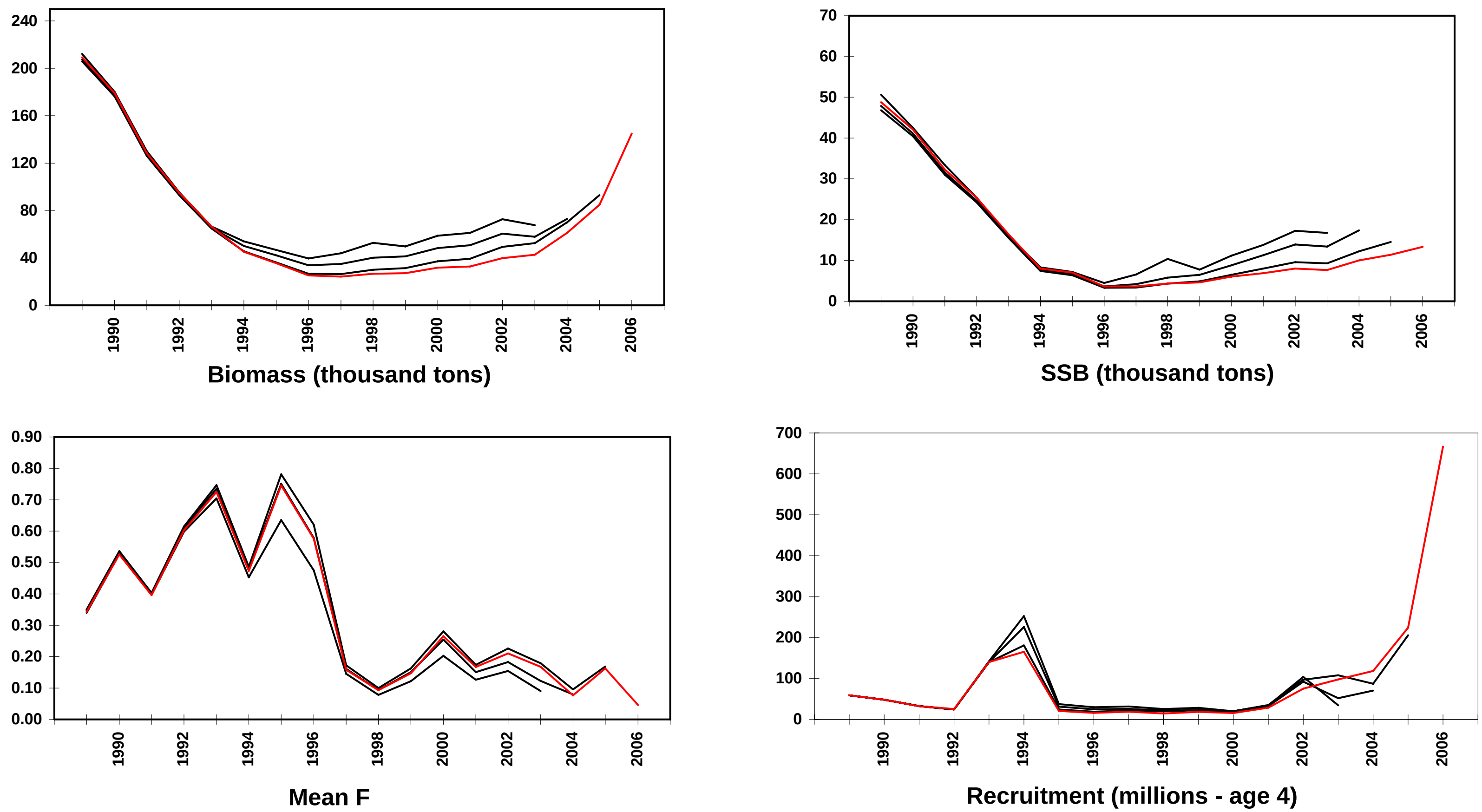

Fig. 5a: XSA retrospective analysis, 2006-2003

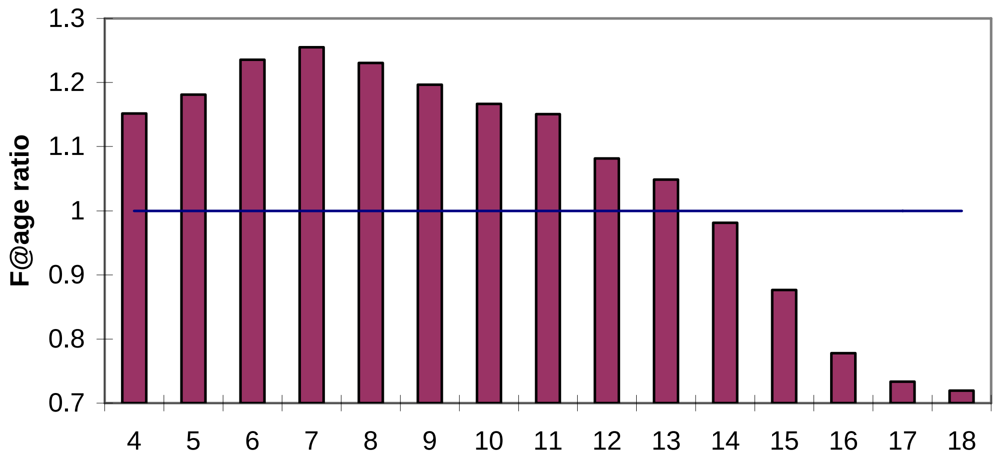

Fig. 5b: F@age ratio XSA 2006/2005

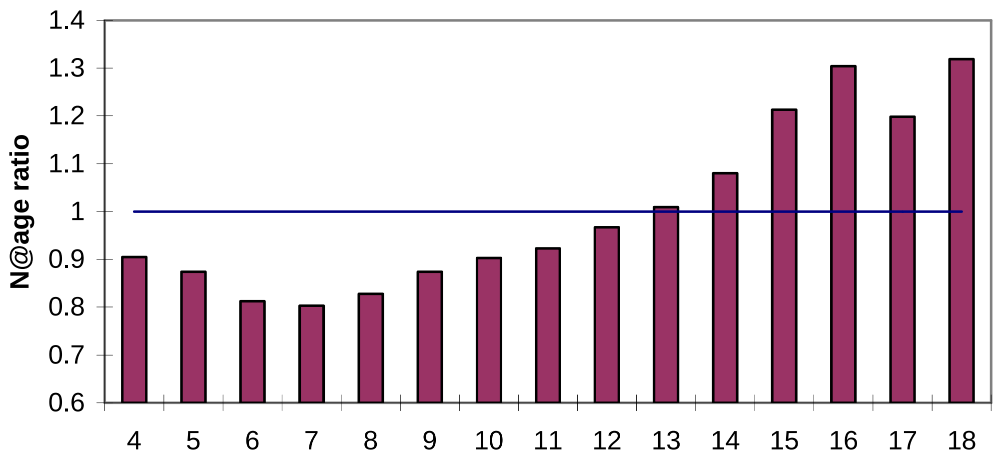

Fig. 5c: N@age ratio XSA 2006/2005

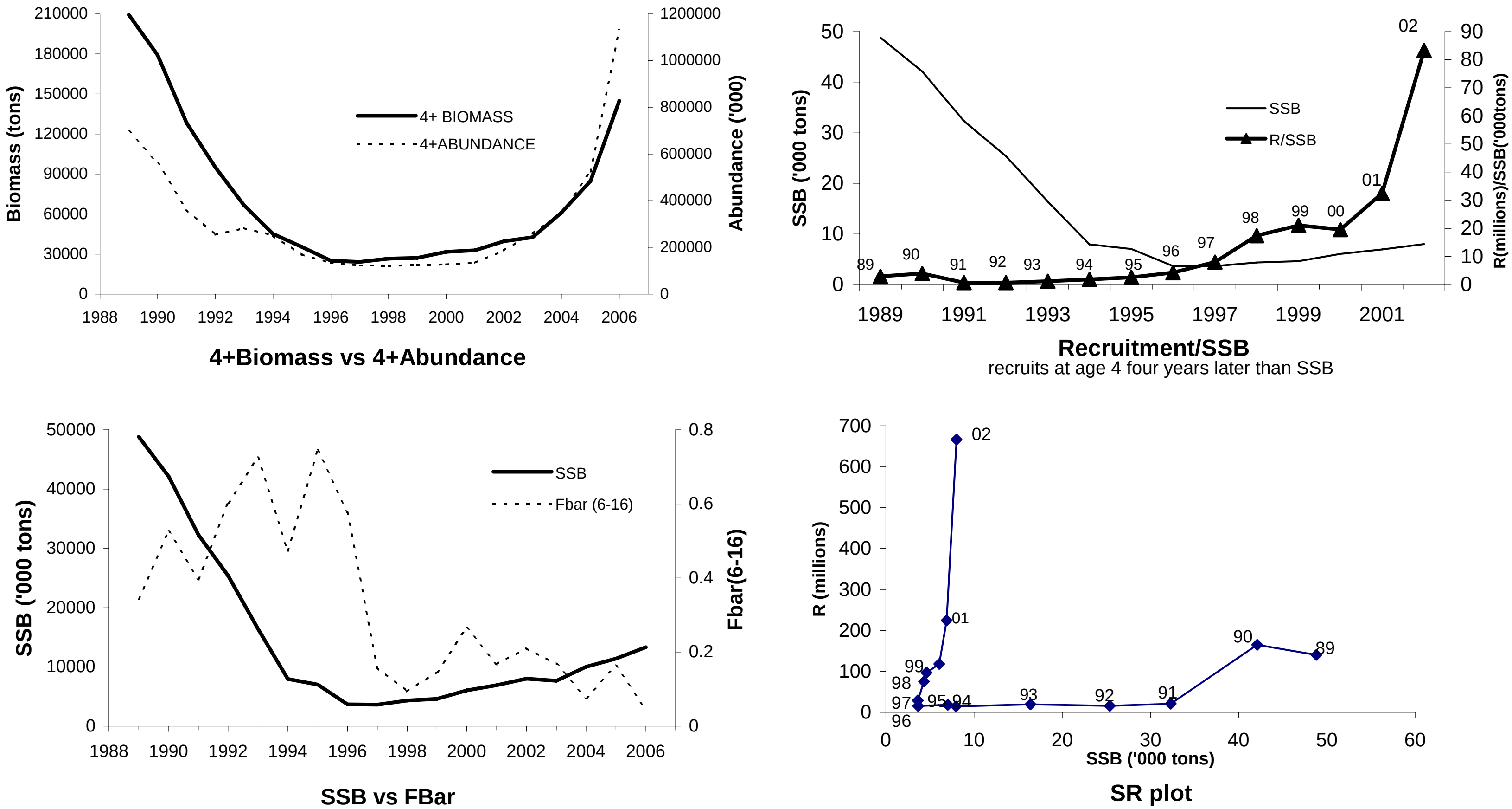

Fig. 6a: XSA results (at the 30th iteration) for 2007 assessment.

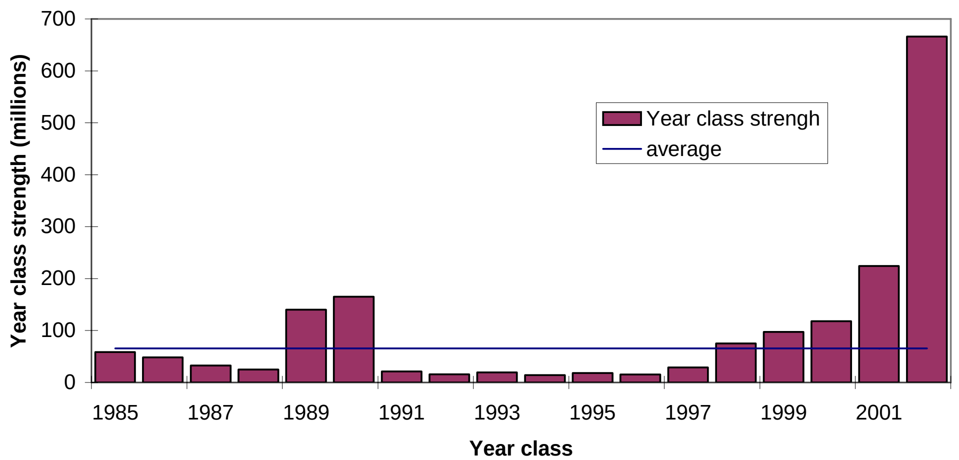

Fig. 6b: Year class strength at age 4, 1985-2002

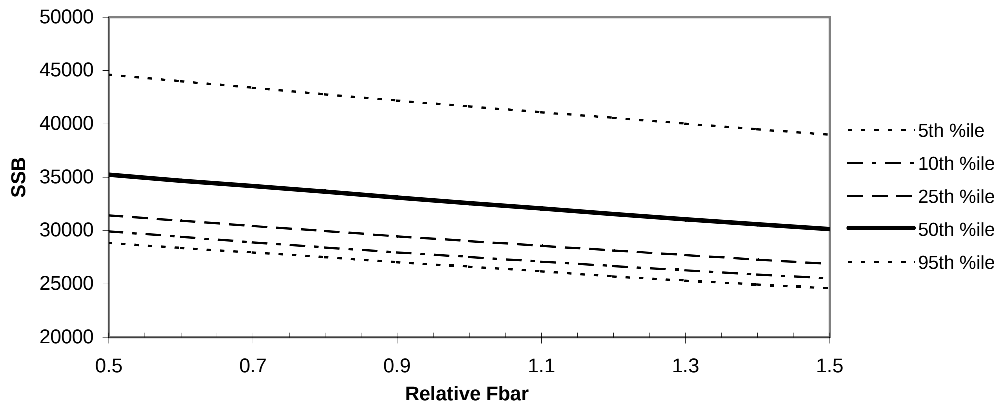

Fig. 7a: SSB 2009 projections under a range of relative F status quo multipliers

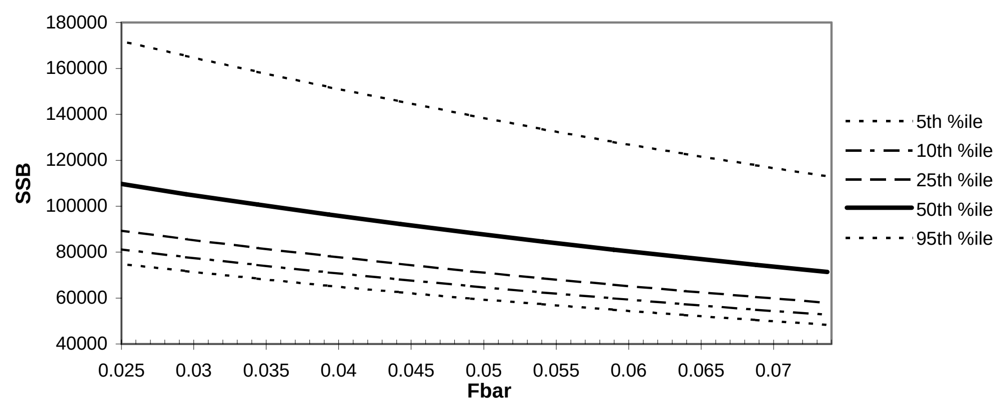

Fig. 7b: SSB 2016 projections under a range of F status quo multilpiers

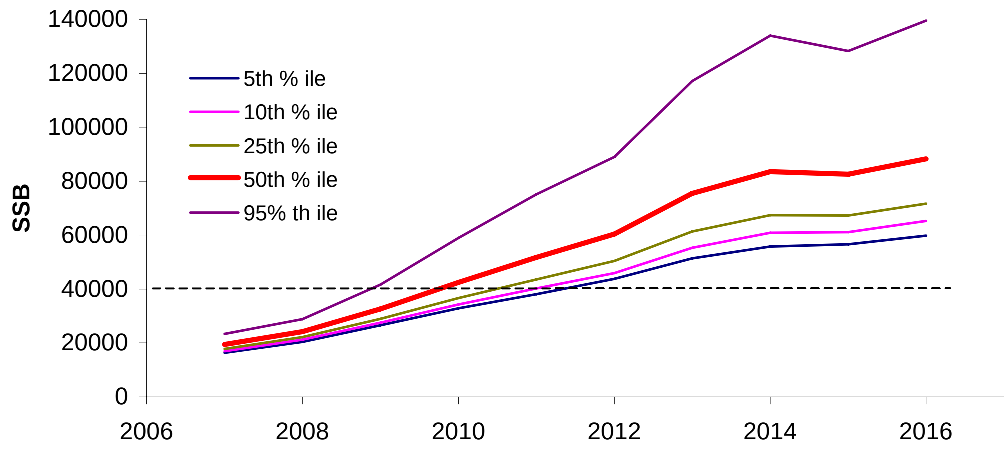

Fig. 8a: SSB probability profiles under Fstatus quo

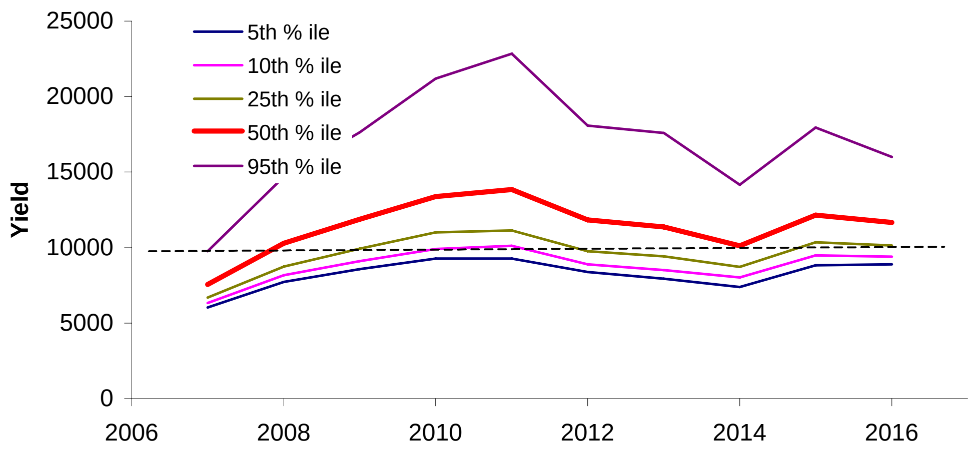

Fig. 8b: Yield probability profiles under Fstatusquo