JRC Scientific and Technical Reports

Scientific, Technical and Economic Committee for Fisheries (STECF)

Impact Assessment of Bay of Biscay sole (STECF-11-01)

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This report was adopted by the STECF during its 36th plenary meeting held from 11-15 April, 2011 in Barza, Italy

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

Impact Assessment of Bay of Biscay sole (STECF-11-01)

THIS REPORT WAS ADOPTED DURING THE 36ᵗʰ PLENARY MEETING HELD IN Ispra 11-15 APRIL 2011

Request to the STECF

STECF is requested to review the report on Impact Assessments for the new management plan for Bay of Biscay sole from the **EWG-11-01** Working Group of February 28 to March 4, 2011 (Copenhagen) meeting, evaluate the findings and make any appropriate comments and recommendations.

STECF Introduction

A joint ICES / STECF meeting was held in Copenhagen 28 February to 4 March 2011, to prepare an impact assessment for Bay of Biscay sole, scope the Impact Assessment for Baltic Cod, and the historic evaluations of existing plans for Kattegat, North Sea, West of Scotland and Irish Sea cod. The meeting involved STECF, ICES scientists dealing with Economy and Biology and included Observers (Commission staff, Managers, Stakeholders). Two separate reports to the STECF were prepared by the EWG-11-01, one on the Impact Assessment of Bay of Biscay sole[1] and another on the Scoping for Impact Assessments for Baltic cod and Evaluation of Cod in Kattegat, North Sea, West of Scotland and Irish Sea[2]. Both reports were reviewed by the STECF during its 36ᵗʰ plenary meeting held from 11 to 15 April 2011 in Ispra, Italy. The following observations, conclusions and recommendations represent the outcomes of that review for Bay of Biscay sole report.

STECF observations

STECF commends the EWG-11-01 WG for its excellent work with the Impact Assessment of fisheries on Bay of Biscay sole and the report provided. STECF considers that this study is of a high standard and would particularly like to thank the group who carried out the work for their efforts in providing comprehensive and relevant biological and economic analyses.

Biological Modelling: STECF considers the biological modelling was appropriate. It was developed to include a large range of different stock dynamics incorporating uncertainty in stock recruitment function and measurement error. Several alternatives were tested and under the scenarios investigated the long term trends in stock development and TAC did not show any

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[1] This report

[2] Scientific, Technical and Economic Committee for Fisheries and International Council for Exploration of Seas (ICES). Scoping for Impact Assessments for Baltic cod and Evaluation of Cod in Kattegat, North Sea, West of Scotland and Irish Sea (STECF-11-02). 2011. Publications Office of the European Union, Luxembourg, EUR 24812 EN, JRC64951, 70 pp.

notable differences. A range of management scenarios examined the likely impacts of option for a multi-annual plan on the stocks and the fishery. These included different candidates for F targets, increasing the allowable annual TAC change, testing several $B_{trigger}$ values (the biomass at which exploitation rates are reduced) and the use of a fixed TAC strategy.

Long term Objectives: The simulations carried out show that given the probability of SSB< B_{lim}[1] for sole a target F of 0.26 (F_{msy}) can be accepted as precautionary in the long term. With levels of estimation precision assumed and no misreporting, exploiting the Bay of Biscay sole stock at F_{msy} (0.26) can be considered precautionary. An F target of 0.26 does not produce significantly higher long term yields relative to Fs in the range of 0.15-0.35. Target Fs between 0.15 and 0.35 will give yields higher than 95% of yield at F=0.26. Furthermore, for all F values below 0.35, the risk on SSB falling below B_{lim} is low. Fishing at F higher than F_{msy} would however result in a lower long term biomass and therefore a potential higher risk to the stock. A higher target F would also potentially result in higher ecosystem impact of the fishery.

Robustness to collapse: The simulations also show that the choice of $B_{trigger}$ for Bay of Biscay sole has little impact on the management as all plausible candidate values are lower than the current SSB which is expected to increase under all recommended strategies. Variability in TAC in the near future (5 years) or the longer term (20 years) is expected to be similar and the probability of SSB below B_{lim} is also expected to be the same. Taking the above into consideration, a $B_{trigger}$ of 11,000t (above B_{lim} and compatible with CV on estimation error derived from ICES quality sheets) may be a valid candidate.

STECF further notes that both types of options tested by the group (Gradual F reduction and Fixed TAC) are likely to give similar results on the short (2015) and longer term (2020) for yields, F level and risk on SSB. The main difference between these two approaches to management would be inter-annual variability in TAC, this variability would be greater for the F reduction strategy and lower for the constant TAC. This is an important point to consider as a constraint on the inter-annual variability in TAC would be advantageous to fishermen in planning future strategies and investments.

Gradual annual reductions in F towards achieving F_{msy} in 2015: Under a strategy of gradual annual reductions in F towards achieving F_{msy} in 2015, the current 15% constraint in inter-annual variation in TAC is considered acceptable from a biological perspective.

Fixed TAC strategy: Under a Fixed TAC strategy, TACs in the range of 3500t to 4500t appear to be precautionary and are predicted to give F_{msy} = 0.26 in 2015 with different probabilities. There is some uncertainty regarding the catch in 2010 and 2011 due to uncertainties in the way the fleet will utilise fishing opportunities during this period, however, irrespective the catch assumptions in 2010 and 2011, with a constant TAC of 4100t from 2012 onwards, F_{msy} could be reached with a 50% probability by 2015 with a 90% confidence interval in F in the range of [0.21,0.32] (assuming a change from constant TAC strategy to F_{msy} strategy once F_{msy} is reached).

This constant TAC approach is robust to the kind of reduction in mean recruitment seen in the past, (a reduction of 15% in the mean was observed between the periods before and after 1993). Simulations, beginning in 2012, indicate that a TAC of 4100 t shows low probability (<1%)| of

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[1] As no B_{lim} has been defined for the Bay of Biscay sole stock, the STECF Working Group used Bpa/1.4 = 9,300t as a proxy. In all text, B_{lim} should be interpreted as the proxy for B_{lim} defined by the group

reducing SSB below B_{lim} (9300 tonnes) under the existing recruitment regime or with up to 15% reduction in mean recruitment. Under the assumption of a 20% reduction in average recruitment a TAC of 4100 tonnes showed a low probability of reducing SSB below B_{lim} before 2017, but an increased probability thereafter.

Economic considerations. In 2008 the vessels exploiting Bay of Biscay sole consisted of 400 vessels in total which generated total gross revenue of €168million. Dependency on sole is presented as proportion of revenues generated by sole. Sole gillnetters have highest economic dependency on sole, around 60% for the various length classes. Other metiers have dependency of around 10 – 20%. Operating profit margins are presented for the 12 fleet sub-segments and the sole gillnetters had segment average operating profit ratios of around 15% for the larger vessels, 20% for the under 10m vessels.

Economic impact assessment suggests that compared to the status quo, implementation of any of the options examined under the management plan could be expected to create slight long term gains and short term negative economic impacts for fleet segments involved in the sole fishery. The short term negative impact is not considered to be severe. However, the negative impact is an outcome of the model assumption that if Bay of Biscay sole TAC declines, vessels will not exploit other fishing opportunities. In reality however, it is believed that there are other legitimate fishing opportunities (albeit not quantified) that owners would exploit and therefore the modelled decline in earnings might not occur, or might not be as marked as the model output implies, if the management plan were implemented.

The proportion of vessels in each segment is assumed to be constant over the simulation period.

Management options tested are based on TAC controls. Total effort deployed by the fleets was modelled to match the permitted fishing opportunities which lead to decreases in effort. This is the consequence of both a reduced fishing mortality towards Fmsy and an increase in catch rate as stock levels and density increase. The simulation analysis shows that there are important differences to outcomes for the vessels depending on whether the total effort reduction is achieved by making a reduction in the total number of vessels or by retaining the number of vessels and having each vessel spend less time, but more profitably, at sea. Reducing the number of vessels would also reduce the likelihood of effort reallocation to other species. However, this would have a direct effect on fleet size and employment. On the other hand, if the existing vessels are able to allocate more effort to other fishing opportunities, the management plan would have only a small effect on fleet performance and employment. However such displaced effort might impact other species and as a consequence may affect the performance of other fleets.

The fully coupled bio-economic modelling approach had some advantages over separate modules and STECF considers that the use of this approach has improved the relevance of the results. The modelling of the fleet response was limited to only total effort (days) or fleet size (vessels) and did not include a mixed response or a response related to the level of profit. However as most of the fleets remain in profit for all of the simulation period STECF considers that for the options evaluated the modelling is sufficient to rank the relative advantages or disadvantages of the options compared.

In order to provide management advice in the absence of an accepted assessment, STECF considers that Annex IV (rules 4 and 5) of COM(2010)241 final (fishing opportunities for 2011), would be a reasonable candidate for action. France has been carrying out a new survey for a number of years and it is anticipated that it will soon be able to provide an index of abundance for sole, if this or any other survey can provide adequate information on the status of the stock, information from such a survey should be taken into account for setting a TAC in the

following year. Using this survey in accordance with Annex IV (rules 4 and 5), a 15% increase in TAC could be applied if the average estimated abundance in the last two years exceeds the average estimated abundance in the three preceding years by 20% or more. A 15% decrease in TAC could be applied if the average estimated abundance in the last two years is 20% or lower than the average estimated abundance in the three preceding years.

Where abundance information, is not available or does not adequately reflect changes in stock abundance (ie. The survey is not informative), an unchanged TAC would apply unless the TAC is above 4100t. In that case the TAC should be reduced by 15% per year until it reaches 4100t (the fixed TAC value which has been evaluated as safe under the assumption of normal recruitment and safe for at least 7 years under reduced recruitment assumptions).

STECF conclusions

STECF endorses the findings of the STECF EWG report on the Impact Assessment for Bay of Biscay sole EWG 11-01a which forms an excellent basis for an Impact Assessment for fisheries on Bay of Biscay sole.

STECF recommendations

STECF notes that the use of an integrated bio-economic model used by the STECF EWG 11-01 on the Impact Assessment for Bay of Biscay sole, gave very useful additional information to assess the economic impact of a future management plan on the sole fishery in the Bay of Biscay. STECF recommends further development of the type of modelling approach described in the Annex to that report.

REPORT TO THE STECF

EXPERT WORKING GROUP ON IMPACT ASSESSMENT OF BAY OF BISCAY SOLE (EWG-11-01a)

Copenhagen Denmark, 28 February 4 March 2011

1. EXECUTIVE SUMMARY

THE SGMOS 10-06a met Copenhagen in June 2010 and produced a scoping plan for the Impact Assessment of the Bay of Biscay sole along with two other scoping reports on sole fisheries, North Sea and Western Channel. In October 2010 SGMOS 10-06b met in Vigo Spain to carry out Impact Assessments of NS sole and plaice fisheries and the Western Channel sole fishery. During this period a bioeconomic model was developed to assist with the Bay of Biscay Impact Assessment and ICES carried out a benchmark of the assessment for Bay of Biscay sole stock. Taking these into account STECF EWG 11-01 met from 28 February to 4 March 2011 and prepared this report for the April 2011 plenary of STECF.

Biological modelling was developed to include a range of different stock dynamics incorporating uncertainty in stock recruitment function and measurement error. Several alternatives were tested these included different candidates for F targets, increasing the allowable annual TAC change, testing several Btrigger values (the biomass at which exploitation rates are reduced) and the use of a fixed TAC strategy. An integrated bio-economic model was developed which permitted to assess the impact of several management strategy on the sole fishery in the Bay of Biscay.

The simulations carried out show that a target F of 0.26 (Fmsy) can be accepted as precautionary in the long term. Target Fs between 0.15 and 0.35 will give yields within 5% of yield at F=0.26.

Both types of short term options tested by the group (Gradual F reduction and Fixed TAC) can give similar results on the short (2015) and longer term (2020) for yields, F level and risk on SSB. The main differences between those options would be the allowed inter-annual variability in TAC. This is an important point to consider as constraint on the inter-annual variability in TAC would be advantageous to fishermen in planning future strategies and investments.

Under a strategy of gradual reduction in F towards F_{msy} in 2015 the current 15% constraint in inter-annual variation in TAC is considered acceptable from a biological perspective.

Under a Fixed TAC strategy, TAC in the range of 3500t to 4500t appears to be precautionary and will give F_{msy} = 0.26 in 2015 with different probabilities. Depending on the catch assumptions in 2010 and 2011 with a constant TAC of 4100t, F_{msy} could be reached with a 50% probability by 2015 with a 90% confidence interval in F in the range of [0.21,0.32] (assuming a change from constant TAC strategy to F_{msy} strategy once F_{msy} is reached).

Economic considerations suggest that the implementation of the management plan is expected to have slight long term gains and short term negative economic impacts for all the fleets involved in the sole fishery. The economic viability of fleets is not endangered and effort reallocation is expected to offset losses although it is difficult to predict such reallocation. The simulation analysis shows that the method by which the fleet adjusts to reach a given level of TAC or F is important. On one hand, if the adjustment is carried out by changing the number of vessels, this would likely lead to economic gains for remaining vessels and to a larger resource rent. This would also prevent effort reallocation to other species. However, this would have side effects on fleets and employment. On the other hand, if vessels reduce their effort directed to sole and allocate more effort on other metier, management plan would only slightly affect fleets performances and employment. However effort reallocation might impact other species and as a consequence reduce performances of other fleets through technical interactions.

The report provides details of approaches that could be used if the ICES assessment fails.

2. CONCLUSIONS OF THE EXPERT WORKING GROUP

The WG considers that this report forms an excellent basis for an Impact Assessment for fisheries on Bay of Biscay sole. The conclusions to the study are provided in Section 12 and are not repeated here.

3. RECOMMENDATIONS OF THE EXPERT WORKING GROUP

The WG notes that the use of an integrated bio-economic model provided for this Impact Assessment gave very useful additional information to assess the economic impact of a future management plan on the sole fishery in the Bay of Biscay. The WG would like to recommend further development of this type of modelling approach.

4. INTRODUCTION

THE SGMOS 10-06a met Copenhagen in June 2010 and produces a scoping plan for the Impact Assessment of the Bay of Biscay sole along with two other scoping reports on sole fisheries, North Sea and Western Channel. In October 2010 SGMOS 10-06b met in Vigo Spain to carry out Impact Assessments of NS sole and plaice fisheries and the Western Channel sole fishery. During this period a bioeconomic model was developed to assist with the Bay of Biscay Impact Assessment and ICES carried out a benchmark of the assessment for Bay of Biscay sole stock. Taking these into account STECF EWG 11-01 met from 28 February to 4 March 2011 and prepared this report for the April 2011 plenary of STECF.

4.1. Terms of Reference for EWG-11-01

Hold a meeting 28 February to 4 March in Copenhagen, for scoping and preparation of Impact Assessments for new management plans, and historic Evaluations of existing plans. The meeting should involve Observers (Commission staff, Managers, Stakeholders) and Scientists dealing with Economy and Biology and should prepare for work on the following stocks:

Impact Assessments for new plans for

- Bay of Biscay sole

Scoping for Impact Assessments for new plans

- Eastern and Western Baltic Cod

Scoping for historic Evaluations of existing plans

- North Sea cod,

- Kattegat cod

- West of Scotland cod

- Irish Sea cod

Clarification of ICES advice on NS whiting

For the Scoping the meeting should to determine the workload required and to reconcile this with available resources, to arrive at an effective detailed plan of what is needed to carry out the technical work that will underpin the required Impact Assessments and Evaluations. For North Sea cod the review should take account of any specific request from Norway (either relayed by the European Commission or submitted to ICES), and STECF guidelines. For the Baltic cod the meeting should concentrate on Impact Assessment for Western Baltic Cod, only amending the Eastern Baltic Cod plan if it is thought to need amendment in context of combined management with the Western Stock. Separate reports will be prepared the Impact Assessment on Bay of Biscay sole and scoping for all other cod plans. Reports should taking into account of the generic ToR from STECF report SG-MOS 10-01 and annex from SG –MOS 09-02.(See docs below)

For the Evaluation of NS cod plan the meeting should consider the reporting requirements of STECF and ICES and the information required by Commission and Norway (see below) and propose the best approach to provide the reporting requirement for all concerned. As a deliberate policy, in addition of scientists to be invited by the STECF to join this meeting as external experts, this EWG 11-01 will be open to scientists appointed or nominated by ICES.

The meeting should also examine work requirements and the appropriate expert group to answer the request to ICES from Norway (see below) concerning clarification of ICES advice on exceptions to 0.3 as the target fishing mortality rate for whiting in subarea IV (North Sea) and division VIId (Eastern Channel) specifically: the level and number of years for which recruitment is considered poor to trigger action; the lower level to which fishing mortality should be reduced when required; and the rate of reduction to the lower level in the event of poor recruitment.

4.2. Participants

The full list of participants at EWG-11-01 is given in section 13.

5. PROBLEM STATEMENT

The ICES advice for 2002 for the Bay of Biscay sole stock was for a recovery plan or no fishing. After consultations, the Commission presented a proposal to the Council in December 2003 (EC 2003). The European Parliament's opinion was reported in 2005 (EC 2005a), the plan eventually adopted in 2006 was Council Regulation (EC) No 388/2006 establishing a multi-annual plan for the exploitation of the stock of sole in the Bay of Biscay (EC 2006a, Appendix I). Council Regulation (EC) No 388/2006 requires that new biological targets be fixed once the stock has recovered to its precautionary biomass level. These targets are proposed by the Commission based on scientific and economic advice after considering various alternatives and their economic, environmental and social impacts.

In its last advice, ICES estimates that the stock of Bay of Biscay sole had reached safe biological limits (stock above $B_{PA} = 13,000$ and exploited below $F_{PA} = 0.42$), and consequently that the first objective of the plan had been met. The next step is now to decide a long-term fishing mortality rate for the stock and a rate of reduction in the fishing mortality rate until this target is reached. An STECF Study Group met in November 2009 to review the plan (SGMOS 09-02). The group concluded that F_{msy} would be a feasible long-term fishing mortality target for the stock.

A scoping meeting (SGMOS 10-06) selected a limited number of harvest rules to be tested. STECF is now requested to carry out an impact assessment to assess biological, social and economic consequences of implementing the various rules selected during the scoping meeting and evaluate the capacity of those rules in delivering improved environment, economic or social outcomes.

6. OBJECTIVES : GENERAL / SPECIFIC / OPERATIONAL

The objectives of plan can be categorised into biological, environmental and economic.

The principle biological objectives should be to fish the stock at mortality rate consistent with F_{MSY} by 2015, and to maintain this rate in subsequent years with a low risk that the stocks will move outside safe biological limits in the medium term.

The environmental objectives should be that the plan is consistent with the achievement of good environmental status by 2020.

The economic objectives should be to maintain viability of the fleets involved in the fishery and provide stability by constraining inter-annual variations in TAC. Another economic objective could be to move towards maximum economic yield, though this would require a clear definition of the group or groups for which the economic benefits are maximised.

7. CHOICE OF TACTICAL METHODS

Both TAC and effort controls are tested for this impact assessment of management plan as decided during the scoping meeting by the stakeholders.

The impact assessment presented here only assesses impacts of conservation measures of TAC or effort controls. Impacts of access regulation tools dedicated to selection of operator and determination of each operator's share (license system, individual quotas or taxes based on administrative methods or economic incentives through taxes or right based methods) are not assessed as no option was proposed in the scoping meeting on these aspects.

8. OVERRIDING CONSIDERATIONS OF THE OPTIONS

The group did not identify any aspects from TAC and effort control that can be unnecessary.

9. ENVIRONMENTAL EFFECTS OF THE OPTIONS

The most recent estimates of SSB have been provided by the ICES WKFLAT held in February 2011. The revised assessment, adding of two new commercial fleets in the tuning files, has resulted in slight increase in historic SSB and a slightly lower SSB in recent years. However, the general perception of the stock was unchanged, remaining flat, but SBB is now estimated to be slightly below Bpa, in contrast to the 2010 assessment. The trend in F was unchanged, showing a decrease in recent years which have reduced F to values below Fpa since 2007. Recruitment has been variable with stable mean since 1993.

A preliminary analysis of the stock-recruitment data for Bay of Biscay sole has been carried out in order to select the stock recruitment relationship to be used in subsequent analysis. A description of the methodology used to obtain stock recruitment function fits is presented in WD 1 "*Choice of Stock-Recruit model and equilibrium evaluations for Bay of Biscay sole*" that includes an evaluation of Stock-Recruitment (S-R) fits using a Bayesian approach to multiple model selection.

There is little sign of any clear relationship between spawning biomass and recruitment at age 2 for the stock of sole in the Bay of Biscay and there is little basis for selecting one functional form of stock and recruitment relationship over another. Ricker, Beverton Holt and segmented regression models fitted to the data all provided similar fits in terms of negative log-likelihood, although the segmented regression model performed slightly better. From this analysis it was concluded that a simple Hockey-Stick model with a breakpoint at lowest observed biomass would give sufficiently similar exploitation response near Fmsy that more elaborate methods were considered unnecessary.

The time series of recruitment for the stock shows a general decline in recruitment over the time series with a greater proportion of lower recruitment values in the more recent time period. There is little evidence that this decline in recruitment is a direct consequence of stock size. The reason for reduced recruitment in recent years is not clear but may be related to some environmental driver. To account for the observed change in recruitment, only data from the recent time series (1993 to 2008) were considered for stock and recruit modelling used in the simulations.

Recruits were generated, in the subsequent simulation analyses, using a stock and recruitment model based on a segmented regression in which the change point was fixed to the lowest observed SSB (Figure 9.1). Random deviates were generated using the standard deviation about this model fit.
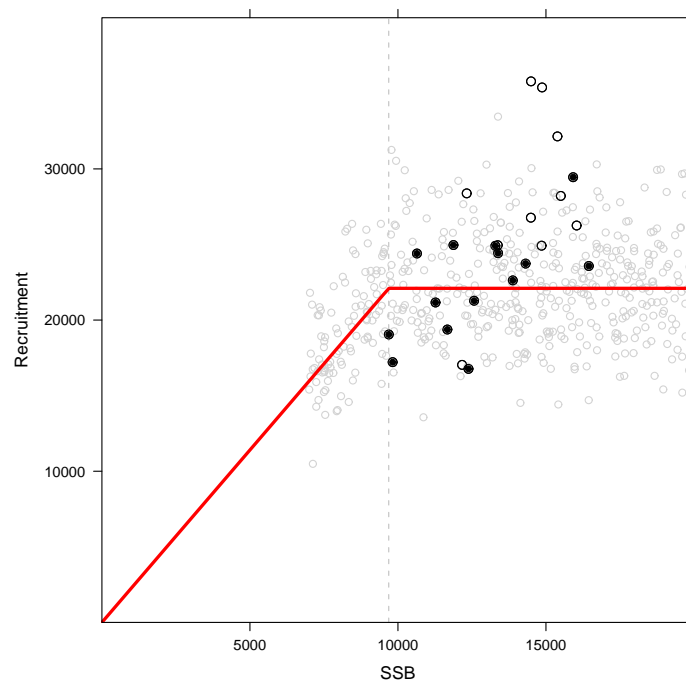
Figure 9.1. Stock recruitment relationship used in the simulations (red). Black dots: recent time series of recruitment at SSB level (1993-2006). White circles: older time series (prior to 1993). Grey dots: random series of recruitment generated using standard deviates about the model fit.

The sensitivity of the resulting estimates of F_{MSY} to the assumed stock and recruitment relationship were investigated over numerous options for fitting the segmented regression model (see Table 9.1). The estimate of F_{MSY} was found to be very robust to these alternative assumptions, with consistent estimates of around 0.25.

The curve of equilibrium yield at varying levels of fishing mortality (Figure 9.2) shows the long term yield that can be taken from the stock under the assumption of constant, and unvarying conditions. The curve is very flat topped and indicates that relatively high levels of yield can be taken over a wide range of fishing mortality levels.
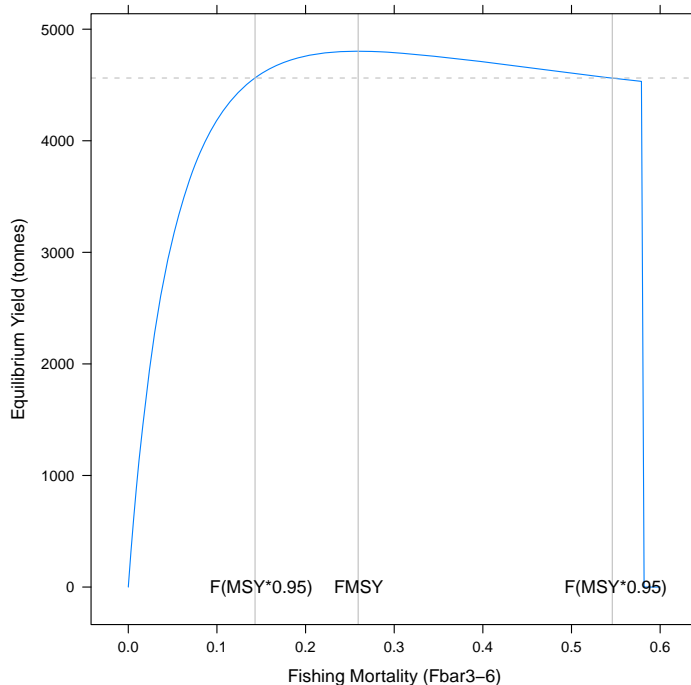
Figure 9.2. Equilibrium yield at varying levels of fishing mortality

The range of fishing mortalities over which at least 95% of the maximum sustainable yield can be achieved is from approximately 0.15 to at least 0.35 in all cases, and sometimes higher (table 9.1). However fishing at the higher levels of F over a continued period results in a high probability of depleting the stock to levels below the lowest observed spawning biomass.

A large range of harvest control rules, based on the management options selected during the scoping meeting have been tested in order to select the main region for exploitation to be used in subsequent bio-economic simulations. A detailed description of the analyses is presented in WD 2"*Basic evaluation of options for exploitation of Bay of Biscay sole"*.

All simulations are carried out using an HCR software (HCS programs for simulated harvest rules developed by Dankert Skagen (ver 3.01)).

Table 9.1. FMSY values (to nearest 0.05) with F limits (low and high) where yield reduces to 95% of yield at Fmsy and risk of SSB<Bpa under various stock-recruitment relationship assumptions based on stochastic simulations (WD 2)

SRR Assumptions	F_{MSY}	Flow for 95%MSY	Fhigh for 95%MSY	Probability SSB < Bpa at Fhigh
Hockey Stick 1984:2006 breakpoint at Bloss	0.25	0.15	0.55	0.5
Hockey Stick 1984:2006 breakpoint estimated by model	0.25	0.15	0.45	0.05
Hockey Stick 1993:2006 breakpoint at Bloss	0.25	0.15	0.35	0
All ICES sole stocks Hockey Stick, Beverton Holt & Ricker	0.25	0.15	0.35	0

The starting point of the simulations comes from the most recent ICES assessment (2011 ICES benchmark). Recruitment is generated using the estimated model fits and uncertainty for segmented regression (hockey stick) with a breakpoint at Bloss obtained from the stock recruitment analysis presented above. The weights at age are calculated as the mean of the last 3 years with variability based on CVs from the full data-series. Selection pattern is the mean over the last three years (variability from last 6 years – 10-20% by age). Assessment errors were taken from an analysis of ICES quality sheets giving CV of 11% with correlation coefficient between years of 0.37.

Two management strategies "Target F" and "constant TAC" have been evaluated (Table 9.2). All these evaluations show that exploitation at F_{msy} has a low risk of depleting the stock.

Table 9.2: Harvest control rules tested (WD 2)

Management Strategy	Harvest control rules
Target F	- F target from 0.15 to 0.65 in steps of 0.05 (F_{msy} is 0.26) - $B_{trigger}$ 10000t to 16000t in steps of 1000t (B_{lim} is 9286t and B_{pa} 13000t) - % constraint on TAC 10,15,20% - F rule : F = target F for SSB > $B_{trigger}$ and F = target F*SSB/$B_{trigger}$ for SSB < $B_{trigger}$
Target TAC	- Fixed TAC 3500t to 4500t in steps of 250t - $B_{trigger}$ 10000t to 16000t in steps of 1000t - Fixed TAC rule : TAC = target TAC for SSB > $B_{trigger}$ and TAC = target TAC*SSB/$B_{trigger}$ for SSB < $B_{trigger}$

9.1. Evaluation of the effects of the multi-annual plan options on the fishery

In 2007-2009, the mean catch has been about 4100t. A constant reduction in fishing mortality option (Figure 9.3) as well as a constant TAC option (Figure 9.4)should imply annual yield at about the same level (4000-4200 t) in 2013-2015 to reach Fmsy in 2015, depending on the

assumed catch in 2011. Indeed, this catch may vary according to possibility of quota swaps and consecutively simulations were carried out for 3 catch options in 2011 : 1) agreed TAC, 2) status quo F and 3) agreed TAC increased by quota swaps (9% of 2010 TAC, according to available consumption of the TAC in 2010). The difference in expected F in 2015 between these three options for 2011 are negligible (details are given in WD 3 Simulation of Catch and SSB.doc).

In the long term, TAC in the range 3500 to 4500 t appear to be precautionary but will give Fmsy in 2015 with differing probabilities, assuming recruitment follows historic range.

The reduction of fishing mortality by 25 % to reach F_{msy} should impact the fishing in the first quarter, when the fishery is targeting sole on spawning grounds. The corresponding decrease in effort will likely be dedicated to other species (hake, seabass, monk, cuttlefish…). The abundance increase associated with fishing at F_{msy} might imply larger discards, depending on the use the fishery makes of available effort.

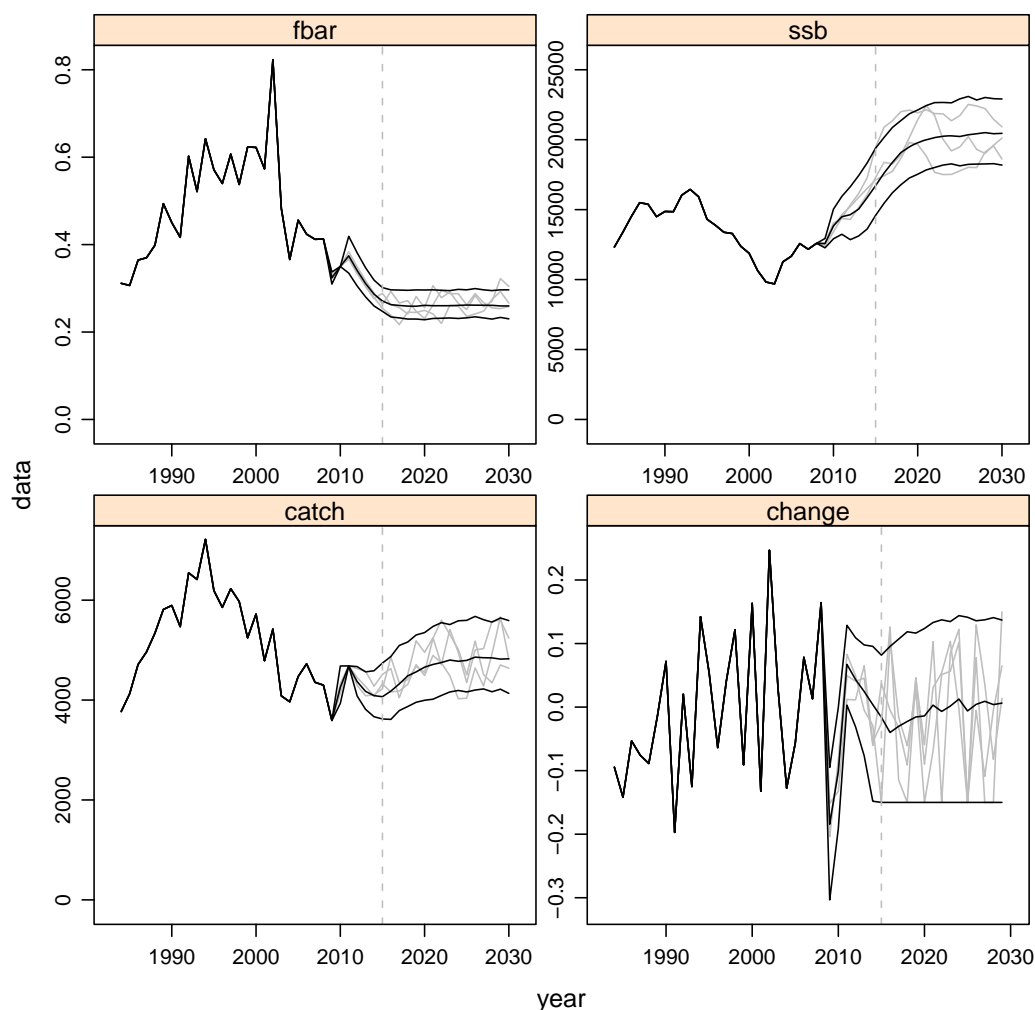**Figure 9.3.** Fishing mortality, ssb, landings and proportion change in landings (TAC) for a progressive 9% reduction in fishing mortality until F=Fmsy (0.26) with 15% limit to annual change in TAC, applied over the period 2012 to 2030. solid lines show 5th, 50th and 95th percentiles, light grey lines show a small random selection of actual trajectories. Vertical dotted line drawn at 2015.

Figure 9.4. Fishing mortality, ssb, landings and proportion change in landings (TAC) for constant TAC (minimum TAC=4100 tonnes) until $F=F_{msy}$ (0.26) then F target $F=F_{msy}$ with 15% limit to annual change in TAC, applied over the period 2012 to 2030. solid lines show 5th, 50th and 95th percentiles, light grey lines show a small random selection of actual trajectories. Vertical dotted line drawn at 2015. 50% probability of F=0.26 in 2015.
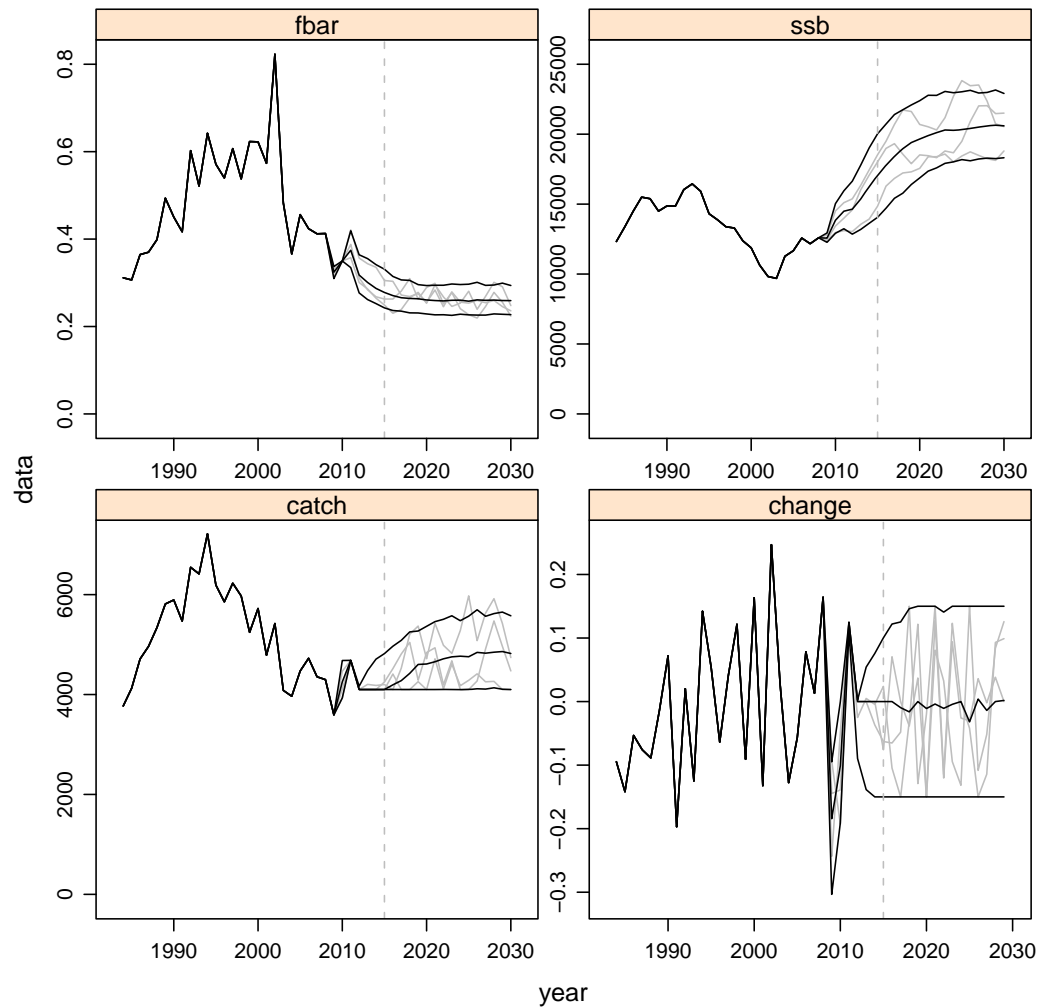
9.2. Evaluation of the effects of the options on the stock

ICES has estimated F_{msy} to 0.26, the F_{max} value. The basis is the lack of strong stock-recruitment relationship, the limited variations of recruitment and a fishing exploitation pattern (with age) known with low uncertainty. All evaluations using a variety of S-R and exploitation pattern assumptions give similar values (WD1).

The decrease of fishing mortality to F_{msy} in 2015 should bring the SSB to 17-18000 t, i.e. above the higher historical SBB in the 1984-2009 time series, and to 20000 t in 2020 (Figure 9.3).

Exploration of the sensibility of F_{msy} to S/R relationship shows that F_{msy} does not depend on the S/R relationship (WD 1). Risk evaluations for different assumptions of S/R were shown to be the same for exploitation below F=0.35. Consequently the simplest S/R relationship (hockey stick with breakpoint a lowest observed SSB) was used to carry out a comparison of exploitation according to different F targets (for risk B_{lim} set to Bpa/1.4). This full comparison shows that at F below 0.35, the risk is low (WD 1). Consequently, to exploit the stock at about

F_{msy} is safe, even though there is some uncertainties in the F_{msy} determination because of the flat-toped shape of Y/R curve. Setting the target to 0.26 appears consistent with the present knowledge of the dynamic of the stock to reach MSY.

Two possible transition strategies from current F to 0.26, both with a 50% probability of reaching F_{msy} in 2015, have been tested. Reduction in target F in steps to reach F=0.26 in 2015 (Figure 9.3) and a constant TAC of 4100 until F is estimated as Fmsy=0.26. The constant TAC transition has a wider range of F in 2015, however both strategies have a high probability of realised F between 0.15 and 0.35.

The sensitivity of the F_{msy} to changes in the exploitation pattern (fraction of the stock caught by age or size) was investigated using limited available information on the effect of changes in mesh size. Four possible changes were examined to stay in a range of likely acceptable proposals: 10 mm increase in mesh size of trawl, associated or not with an equivalent effect on catch length distribution of gillnetters, and a twice large effect on catch length distribution of all the fleets (WD 4). This investigation shows that the F_{msy} is only slightly changed by such possible changes in sole length distributions.

In the first phase of the previous management plan, B_{pa} was set as the precautionary reference point to respect. According to the simulations which were carried out (WD 2), a $B_{trigger}$ of 11,000t (above B_{lim} and compatible with CV on estimation error derived from ICES quality sheets) may be a valid candidate to define an harvest control rule which may guarantee a limited risk of having SSB at values for which the dynamic of the stock is unknown. This rule should guarantee to keep the fishing mortality below F_{pa} (0.42), which is a precautionary limit that the long term simulations have demonstrated to be well founded.

The options are based on simulations assuming recruitment in line with the historic series (1993-2006). One or two low recruitments may impede the reach of F_{msy} in 2015. However, given the limited variation in recruitment that the Bay of Biscay sole stock exhibits, the risk appears to be likely limited. As long as the fishing mortality is below 0.35, the scenarios may be considered safe according to the simulations carried out.

9.3.   Evaluation of the effects of the multi-annual plan on the ecosystem.

The group did not carry out any analysis permitting to assess and quantify the effect of the multi-annual management plan on the ecosystem. However, a decrease in F level (and the associated effort required to land the TAC) is likely to reduce the overall ecosystem impact if effort (and associated fishing mortality) is not re-allocated on one or more other stocks. It is also expected that a reduction of effort of the trawl fisheries would also reduce their environmental impact in terms of fuel consumption.

10.   SOCIAL AND ECONOMIC EFFECTS OF THE PLAN

Details of the description of the fishery, the fleets characteristics and their evolution and of the bio-economic evaluation, including a full description of simulation methodology and complete results, can be found in WD 5 (Bio-economic Impact Assessment sole Bay of Biscay management plan).

10.1. Short description of the Impact Assessment Model for fisheries (IAM)

The model is an integrated model coupling the biological dynamics of fish stocks with the economic dynamics. It can be used to inform an impact assessment for management plans and provide results on transition phases and cost benefit analysis. It is a stochastic model (for recruitment only for the moment). The model is age structured, has yearly time steps and is spatially aggregated. It is multi species, multi fleet and multi-métier. The model is based on a modular structure Figure 10.1.
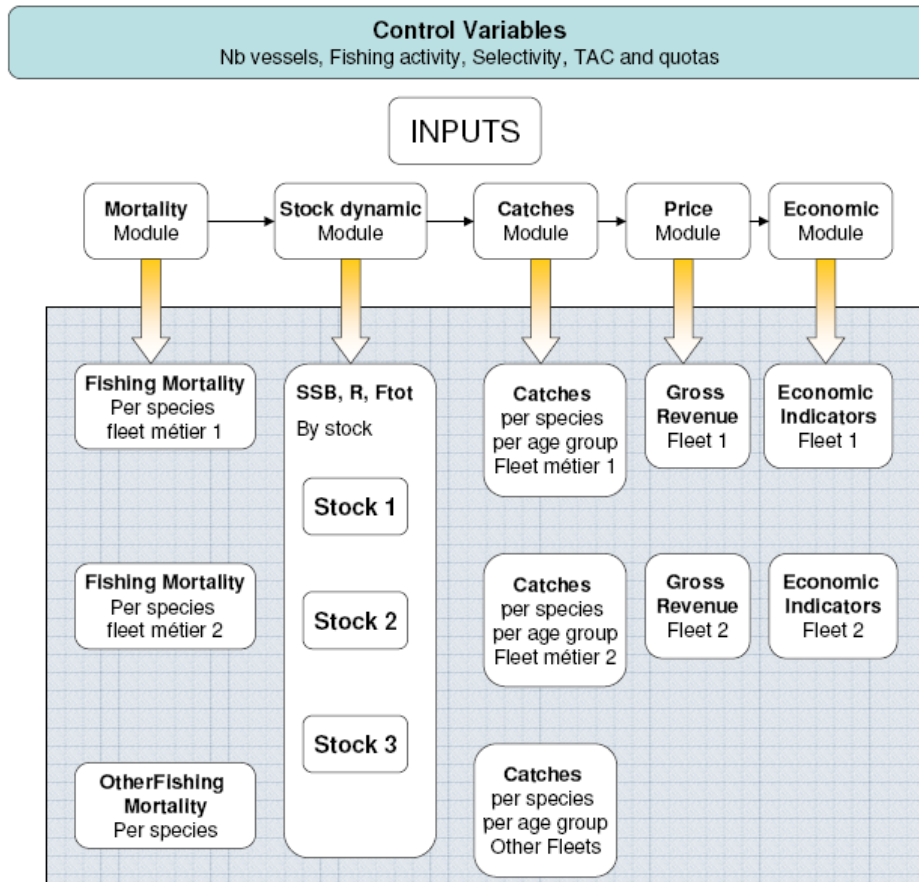
Figure 10.1 It is multi species, multi fleet and multi-métier model is based on a modular structure (Merzéréaud et al, 2011).

The model is described in Merzéréaud et al, 2011[1]. The bio-economic model applied to perform impact assessment for sole of the Bay of Biscay management plan takes into account sole stock

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[1] Merzéréaud, M., Macher, C., Bertignac, C., Frésard, M., Le Grand, C., Guyader, O., Daurès, F., Fifas, S., (2011) [on line] " Description of the Impact Assessment bio-economic Model for fisheries management (IAM)", Amure Electronic Publications, Working Papers Series D-29-2011, 19 p. Available : http://www.umr-amure.fr/electro_doc_amure/D_29_2011.pdf.

[2] Scientific, Technical and Economic Committee for Fisheries (STECF) Report of the Scoping meeting for Evaluation and Impact Assessments (SGMOS-10-06a) EUR 24532 EN - 2010 https://stecf.jrc.ec.europa.eu/c/document_library/get_file?p_l_id=53314&folderId=44892&name=DLFE-3643.pdf

dynamics. Hake and Nephrops stock dynamics are also included as it is expected that sole management impacts these species through technical interactions in these mixed fisheries.

As described in the scoping meeting report (SGMOS 10-06a[2]), the Bay of Biscay sole is fished by mainly three different fleet segments: a French trawler segment, a French gill-netters segment and a Belgium beam trawler segment. Among these segments several strategies can be distinguished according to their contribution to sole fishing mortality and to their dependence on this species (in terms of part of their gross revenue formed by sole). Segmentation is based on fleet segment (trawlers, gill-netters or beam-trawlers), dependence on sole (percentage of sole in the total value of landings) and vessel length structure enables to differentiate several groups of vessels (or sub-fleets) for which management plan's impacts are expected to be different. Among vessels of the Bay of Biscay that catch more than 1 ton of sole per year, the following sub-fleets can be identified:
-   gill-netters directed on sole the main part of the year and that are therefore highly dependant on this species (more than 30% of the GR[1])
-   other gill-netters catching sole and other fishes (hake, monkfish)
-   trawlers targeting Nephrops most of the year and by-catching sole (Nephrops counts for more than 40% of the GR)
-   other trawlers catching a mix of species of which sole, hake, monkfish, cephalopod etc.
-   beam-trawlers

The four main strategies developed by French demersal fleets in the Bay of Biscay have been defined in collaboration with the fishing sector. Belgium beam-trawlers 24-40 m are active in the English Channel and the North Sea and in the Bay of Biscay during summer.

Five main fleets were thus distinguished (plus a group aggregating fishing mortality of all other vessels catching less than 1 tonne of sole). These fleets were split into length classes and 12 fleets were distinguished. It represents 400 vessels, 914 employment on board and a total gross revenue of 168 M€ in 2008.

Main fleets' characteristics and evolution are detailed in the WD 5.

Twelve fleets and 6 métiers are modeled according to the three species exploitation pattern and the main strategies developed by the demersal vessels operating in the Bay of Biscay on sole.

10.2.   Parameterization of the application of the model

The vessels fishing for sole have been classed in 12 fleets according to metiers and vessel length (Table 10.1) Fleets' dependence to sole (as a percentage of the Gross Revenue made by sole) and contribution to fishing mortality (as a percentage of the total catches of sole by fleet) are represented in the Figure 10.2.

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[3] Threshold were defined by analyses of the distribution of vessels by dependence

Table 10.1 Fleets used in economic model.

Fleets	Fleets-length classes	Métiers
Nephrops Trawlers	Nephrops trawlers 12-16 m	Nephops trawling
	Nephrops trawlers 16-20 m	Nephops trawling
Mixed Bottom Trawlers	Mixed Bottom trawlers <12m	Inshore mixed bottom trawling
	Mixed Bottom trawlers 12-16m	Off_shore mixed bottom trawling
	Mixed Bottom trawlers 16-20m	Off_shore mixed bottom trawling
	Mixed Bottom trawlers > 20m	Off_shore mixed bottom trawling
Mixed gillnetters	Mixed gillnetters <12m	Inshore mixed gillnet
Sole gillnetters	Sole gillnetters <10 m	Inshore Sole gillnet
	Sole gillnetters 10-12 m	Inshore Sole gillnet
	Sole gillnetters 12-18 m	Offshore Sole gillnet
	Sole gillnetters 18-24 m	Offshore Sole gillnet
Beam Trawlers	Belgium beamtrawlers 24-40 m	Beam trawling
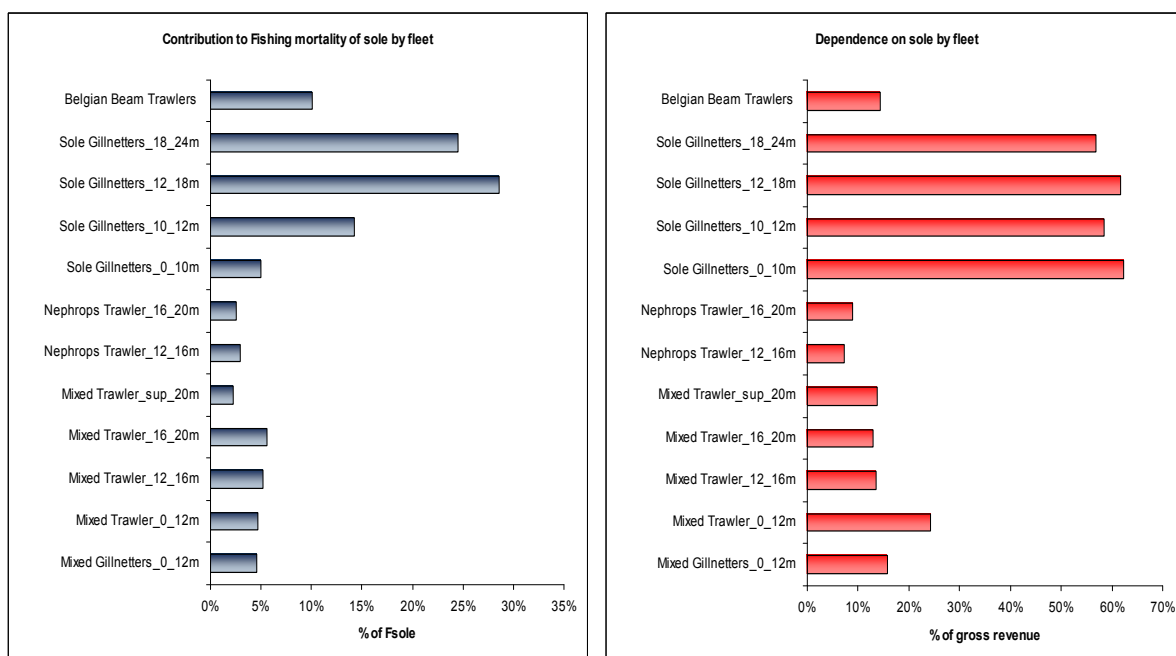
Figure 10.2 : Contribution to total catches of sole by fleet and dependence on sole in percentage of the gross revenue, sources: IFREMER/Fisheries Information System/DPMA, 2009, Belgian Administration 2008, ICES 2010.

Fleets contributing to the main part of the fishing mortality are sole gillnetters over 10 meters and Belgian beam-trawlers. These gillnetters are also very dependent on sole as sole represents more than 50% of their gross revenue. Among low contributing fleets, Sole gillnetters below 10 m have a small contribution to fishing mortality but are very dependant on sole, and mixed trawlers below 12 m depend on sole for more than 20% of their gross revenue. Impacts of regulation on sole are expected to be important for high dependent fleets. In the longer term high contributing fleets are also expected to benefit from overall reduction of fishing mortality.

Input parameters used to perform the analyses are given in Table 10.2

Table 10.2 : Synthesis of the data sources for each kind of parameters by stock, fleet and market

Parameter level	Detail	Data sources
Stock dynamic parameters	Sole	Benchmark 2011
	Nephrops	ICES, WGHMM 2010
	Hake	New xsa from ICES, WGHMM 2009
Fleet production and effort parameters	French fleets	IFREMER/Fisheries Information System/French Ministry data sources 2006-2009
	Belgian Fleet	Belgian administration data sources 2006-2008
Fleet economic data	French fleets	French ministry data sources (from Ifremer, RICEP, PWHC data collection) 2006-2008
	Belgian Fleet	Belgian administration data sources 2006-2008
Market	French price	IFREMER/Fisheries Information System/French Ministry data sources 2008/2009
	Belgian price	Belgian administration data sources 2006-2008

The main assumptions in the model are given here in summary and detailed in the WD 4.

Recruitment assumptions:
A Hockey-Stick stock-recruitment relationship (S-R 1993-2006).

Fishing mortality- fishing effort relationship assumptions:
Proportional relationship between fishing mortality and nominal effort is assumed and coefficient of catchability (tonnes/stock biomass) linking this variables is assumed to remain constant which means that the fleet keeps on targeting species in the same way and do not change their strategies of effort allocation between metiers and that fishing capacity does not evolve over the simulation period.

Other species gross revenue evolution assumptions:
Other species gross revenue is assumed to vary proportionally with effort variation (linear variation). This is a strong assumption for scenarios that adjust number of days at sea to reach TAC as it is assumed that gross revenue from other species will decrease proportionally to effort decrease needed to catch the TAC. No effort reallocation likely to offset losses on other species caught with sole is modelled. As a consequence, impacts assessed for scenarios adjusting needed number of days at sea to catch the TAC correspond to worst impacts expected.

Fleets dynamics assumptions:
Fleet structure and mean characteristics are assumed to be constant over the simulation period

Price and market of sole assumptions
Prices by grade are assumed to be constant over the simulation period

10.3.   Scenarios

In line with scenarios proposed by the Managers and RAC at the scoping meeting, impacts of two kinds of scenarios were assessed and results are presented in the WD:

- Impacts of gradual reduction of F to reach F_{msy} in 2015 with response in the number of vessels or of the of the number days at sea

- Impacts of various fixed TAC (traduced as well in terms of nb of days at sea reduction or in terms of number of vessels reductions such that TAC is reached according to the state of the stock).

    o TAC 3500 nbdays/nb vesssels

    o TAC 4000 nbdays/nb vesssels

    o TAC 4250 nbdays/nb vesssels

    o TAC 4500 nbdays/nb vesssels

Two options are considered according to cost structure:
- Economic cost structure based on data 2008
- Economic cost structure based on data 2006-2007

10.4. Results

The scenario of long term exploitation at F_{msy} reaching F_{msy} in 2015 conforms to the objectives of the CFP. The scoping meeting identified options compatible with this and that took into account the stakeholders suggestion of managing through fixed TAC. This corresponds to two types of scenario: a gradual reduction of F; or a fixed TAC of 4100 tons; during the transition period to F_{MSY} and an adaptive management of TAC to remain at F_{msy} after reaching that value.

Results of these scenarios obtained with the IAM bio-economic model are thus detailed in this section. F_{msy} value is 0.26 for this application. Other fixed TAC scenarios have similar trends and distribution of impacts between fleets. Higher stock recovery is expected for lower TAC value. Where the adjustment by the fleets to the changes in made is by reducing the number of vessels, greater benefits are observed for lower TAC but where the adjustment is by the number of days at sea by fleet reduced negative impacts are observed for higher TAC (WD5).

Following a gradual reduction of fishing mortality as a consequence of a fixed TAC implemented the SSB increases up to around 20000 tons in 2020 (well above the B_{lim}) with a low probability of being below B_{pa} and a negligible probability of being below B_{lim}. After the fixed TAC period up to 2015, average catches increase up to 5000 tons in 2020.

These results are similar to those obtained using the HCR analysis presented above (section 9.1).

Economic impacts of gradual F reduction and fixed TAC scenarios are analyzed following two fleet adjustment scenarios: adjustment of the effort (expressed as number of days at sea) needed to reach the fixed TAC and remain at F_{msy} after 2015; or adjustment of capacities (expressed as number of vessels). The same rate of variations of days at sea or vessels is applied to all the fleets. Mean number of days at sea by fleet (Table 10.3) and number of vessels by fleet (Table 10.4) needed to catch the TAC and to remain at F_{msy} after 2015 are presented.

Table 10.3 Model Estimates of mean number of days at sea by fleet needed to catch the TAC (WD 5).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Nephrops Trawl. 12-16m	196	188	178	167	156	145	145	145	145	145	145
Nephrops Trawl. 16-20m	201	193	182	171	160	149	149	149	149	149	149
Mixed Trawl. <12m	162	156	147	138	129	120	120	120	120	120	120
Mixed Trawl. 12-16m	204	196	185	174	163	152	152	152	152	152	152
Mixed Trawl. 16-20m	184	177	167	157	147	137	137	137	137	137	137
Mixed Trawl. >20m	220	212	200	188	175	163	163	163	163	163	163
Sole Gillnetters <10m	141	135	128	120	112	104	104	104	104	104	104
Sole Gillnetters 10-12m	183	177	167	156	146	136	136	136	136	136	136
Sole Gillnetters 12-18m	213	205	194	182	170	158	158	158	158	158	158
Sole Gillnetters 18-24m	210	202	191	179	167	156	156	156	156	156	156
Mixed Gillnetters <12m	200	192	181	170	159	148	148	148	148	148	148
Belgian Beam Trawl.	238	229	216	203	190	177	177	177	177	177	177
% variation compared to 2011			-6%	-11%	-17%	-23%	-23%	-23%	-23%	-23%	-23%

Table 10.4 Model Estimates of mean number of vessels by fleet needed to catch the TAC (WD 5).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Nephrops Trawl. 12-16m	36	36	34	32	30	28	28	28	28	28	28
Nephrops Trawl. 16-20m	21	21	20	19	17	16	16	16	16	16	16
Mixed Trawl. <12m	49	49	46	43	41	38	38	38	38	38	38
Mixed Trawl. 12-16m	34	34	32	30	28	26	26	26	26	26	26
Mixed Trawl. 16-20m	31	31	29	27	26	24	24	24	24	24	24
Mixed Trawl. >20m	9	9	8	8	7	7	7	7	7	7	7
Sole Gillnetters <10m	24	24	23	21	20	19	19	19	19	19	19
Sole Gillnetters 10-12m	37	37	35	33	31	29	29	29	29	29	29
Sole Gillnetters 12-18m	41	41	39	36	34	32	32	32	32	32	32
Sole Gillnetters 18-24m	24	24	23	21	20	19	19	19	19	19	19
Mixed Gillnetters <12m	21	21	20	19	17	16	16	16	16	16	16
Belgian Beam Trawl.	14	14	13	12	12	11	11	11	11	11	11
% variation compared to 2011			-6%	-11%	-17%	-23%	-23%	-23%	-23%	-23%	-23%

Mean number of days at sea or number of vessels needed to catch the TAC in 2015 are 23% lower than in 2011 given the stock increase (WD 5).

Economic impacts of scenarios have been assessed in terms of impacts on the gross revenue, the return to be shared, the gross cash flow. Cost benefit analysis was performed and impacts of scenarios were estimated through the net present value of the gross cash flow for each scenario compared to status quo (on 2010-2020 with a discount rate of 4%) (see WD5). For each indicator, mean vessel performances by fleet and total fleet performances are calculated. Detailed results are presented in WD 5 and the main results are summarised below. As there was no formal economic objective, economic impacts of scenarios on the viability of fleets are evaluated without reference to a specific objective such as maximising resource rent. Gross cash flow is used as an indicator of short term viability of fleets. When this indicator is below 0, short term viability of fleet is threatened. The results of the scenarios are compared with fishing at the current F (0.35) which is higher than the target F and implies very slightly lower long term yields, small stock size and slightly higher risk of SSB declining below B_{lim}.

In the scenario with days at sea response, impacts are over-estimated as the model assumes no effort reallocation whereas it is expected to occur. Besides it is assumed that all the species are caught together with sole which overestimates the impacts of days at sea reductions as other species gross revenue decreases proportionally with effort for each fleet. Results presented are an estimation of the most important negative impacts likely to occur. Mean performances by vessel by fleet and total fleet performances have the same trends when adjusting number of

days at sea for a constant number of vessels (Figures 10.3 and 10.4). Compared to status quo over the same period, economic performances are lower for all the fleets for the scenario tested and the cost-benefit analysis performed shows negative impacts compared to status quo (WD5)[1]. Compared to initial situation however, depending on fleets, economic performances are either stable or lower during a short term transition phases before a recovery phase. Viability of fleets is not endangered in any case. For the Belgian beam trawlers and mixed fleets, negative impacts observed are an artefact due to assumptions of the model that overestimates impacts for these fleets. It is thus expected that for the Belgian beam trawlers fleet economic impacts would be much smaller than those shown as they have other sources of earnings and they only fish for sole in the Bay of Biscay in summer. Viability of large mixed trawlers (>20m) is also endangered as this fleet had already negative GCF and situation is not getting better.
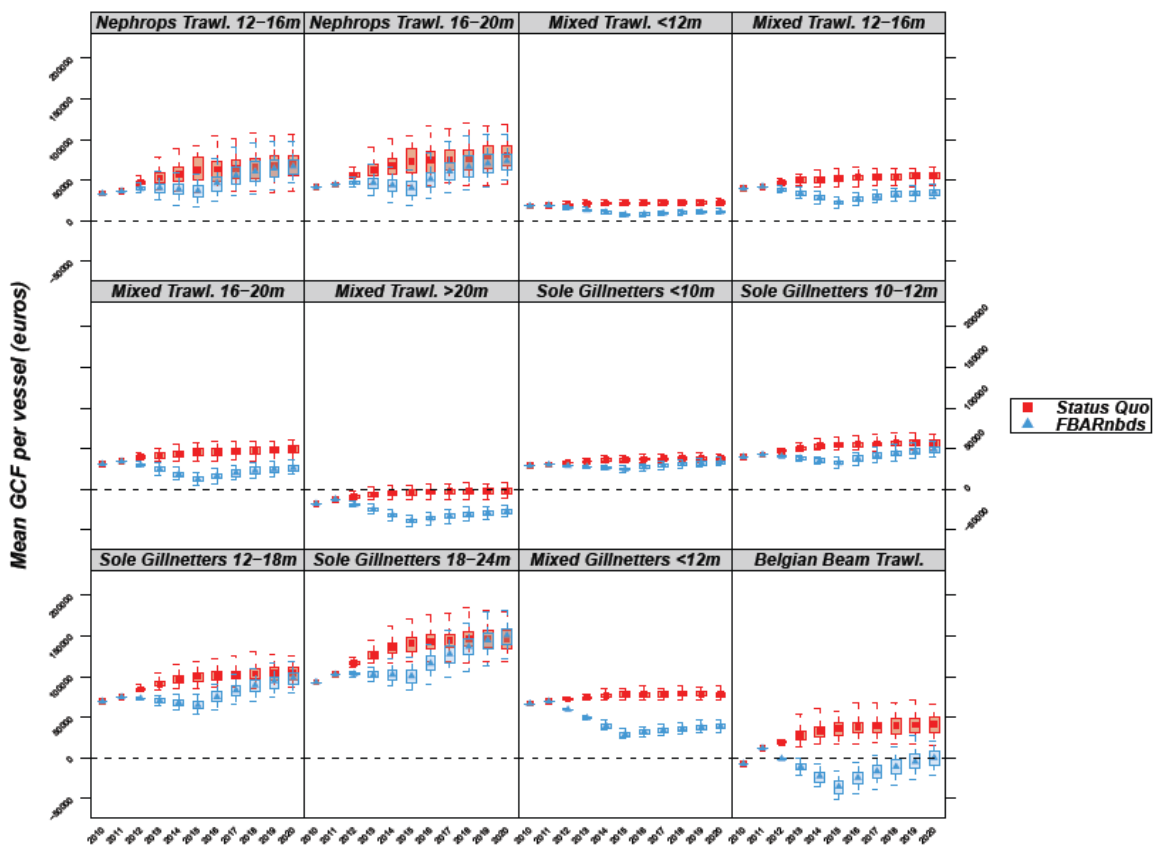

Figure 10.3: Evolution of the mean gross cash flow by vessel by fleet for scenario status quo and F_{bar}, : response by varying the number of days at sea, (WD5).

In the scenario with vessel number response, as expected, mean gross cash flow of remaining vessels are increasing when number of vessel in the fleet decreases. Positive impacts on mean vessels vary according to fleets (Figure 10.5).

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[1] The net present value of the total gross cash flow for the fleets is lower for this scenario than for the status quo.
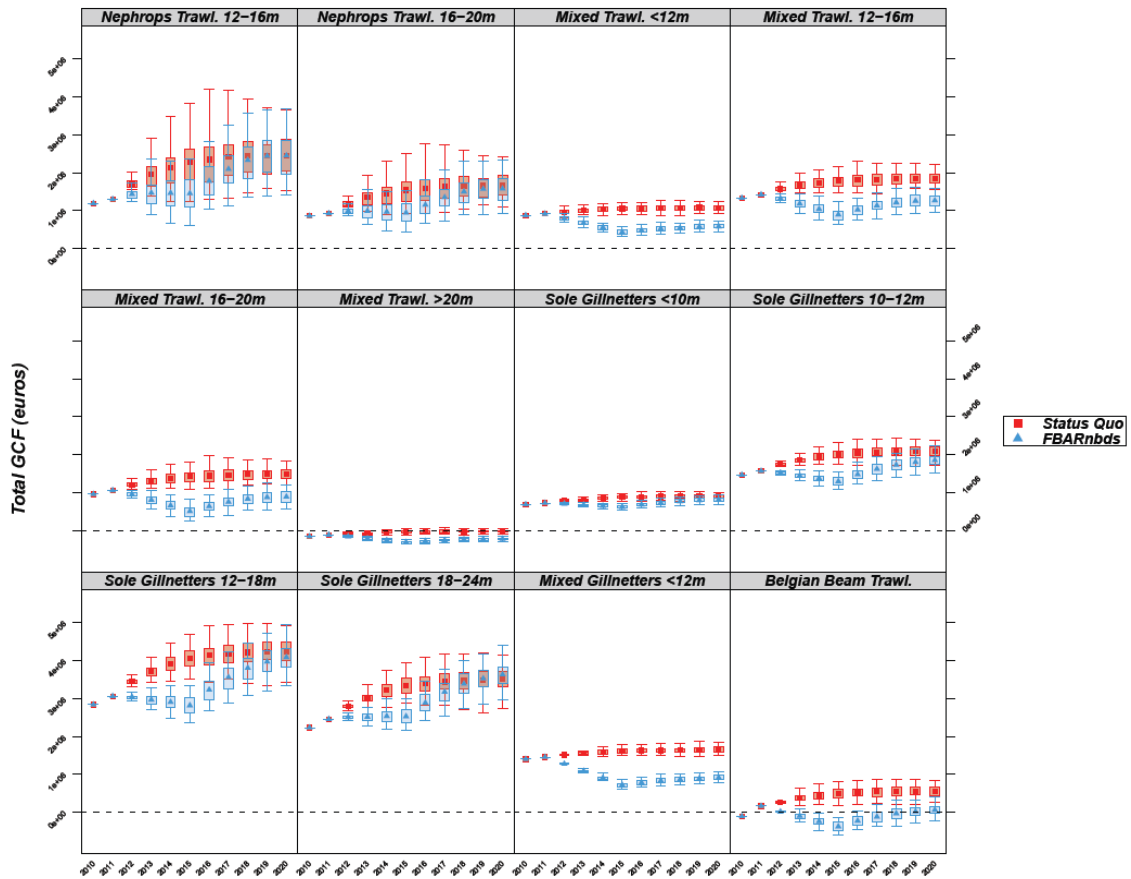
Figure 10.4 Evolution of the total gross cash flow by fleet for scenario status quo and F_{bar}, : response by varying the number of days at sea, (WD5)
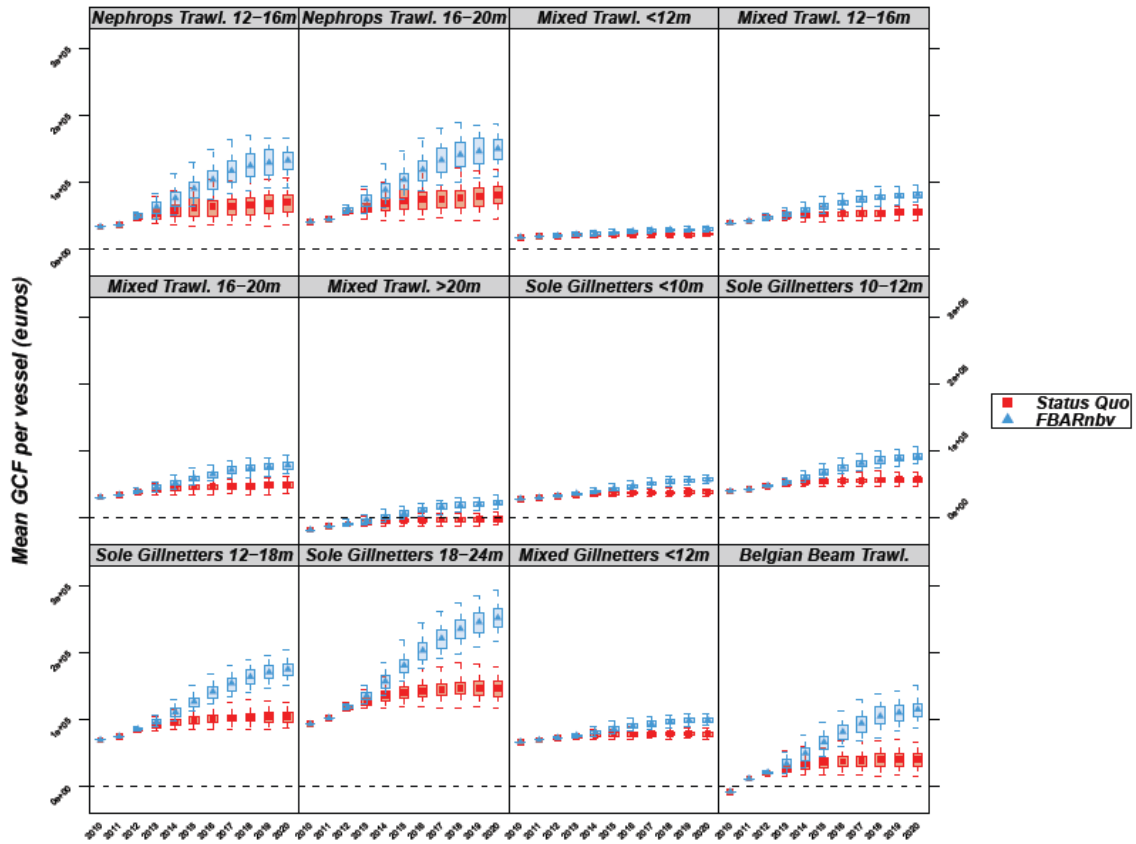
Figure 10.5: Evolution of the mean gross cash flow by vessel by fleet for scenario status quo and Fbar : response by varying the number of days at sea, (WD 5).

Total impacts on fleets compared to status quo is positive for Belgian fleet, large gillnetters and Nephrops trawlers and negative for other fleets (Figure 10.6) but less than in the scenario with adjustment of number of days at sea due to assumptions of absence of reallocation of effort (see detailed results in WD 5).
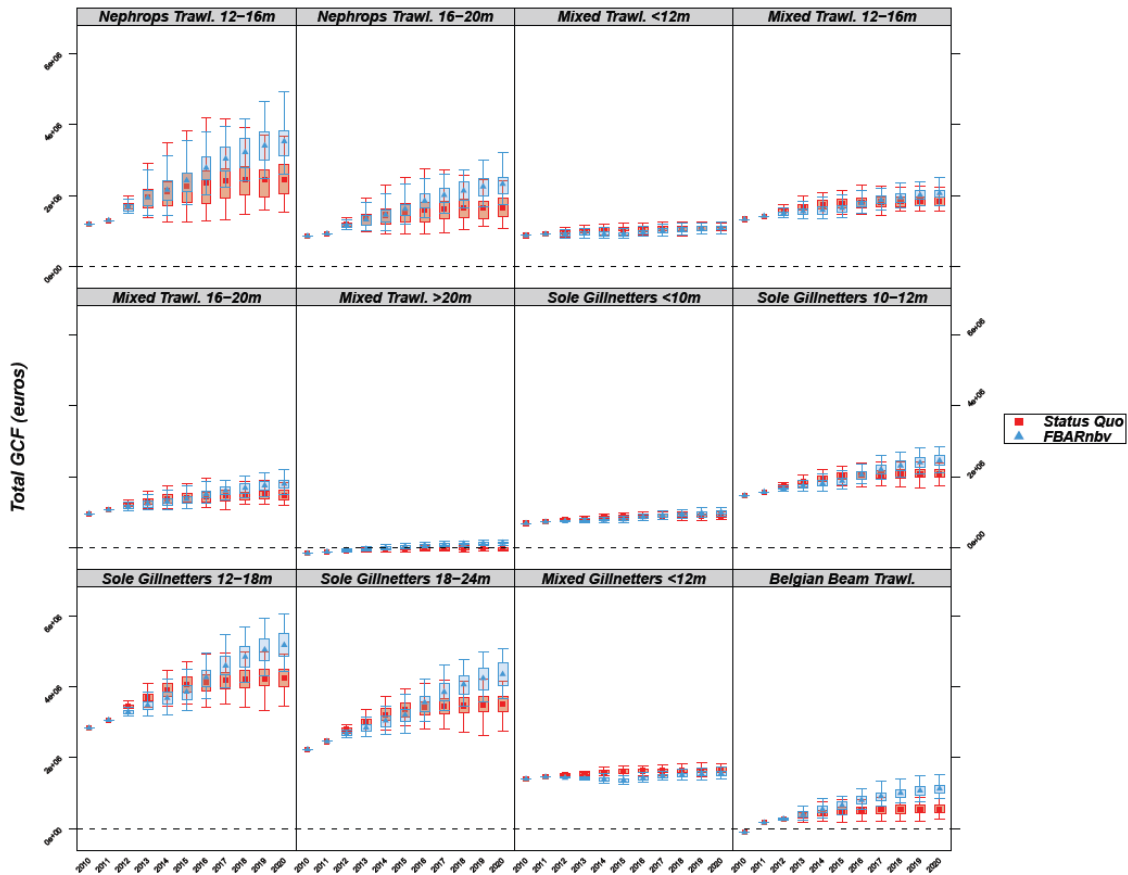
Figure 10.6 : Evolution of the total gross cash flow by fleet for scenario status quo and F_{bar} : response by varying the number of vessels, (WD 5).

The results do not include impacts of fleet dynamics (fleet's change and redistribution of effort in other fisheries) or costs of any decommissioning schemes that might be proposed.

The distribution of impacts of the scenarios between fleets varies according to fleets and response variables. Impacts by fleet show that lower impacted fleets would be Nephrops trawler fleets, Belgian fleet and sole gillnetters.

Response to change by reducing the number of vessels has positive impacts compared to status quo whereas variation of number of days at sea gives negative impacts (see cost-benefit analysis in WD5). These results however do not take into account expected reallocation of effort in case of variation of number of days which will likely occur although it is difficult to predict such reallocation. They do not include either the costs of variation of number of vessels in case adjustment of the number of vessels would correspond to a decommissioning scheme and not to fleet change.

When change is achieved by adjusting the number of vessels it is expected that this will have impacts on employment. Mean crew wages are expected to increase however for remaining vessels. When change is achieved by adjusting number of days at sea, the number of vessels remains stable and impact on employment is difficult to assess as it would induce changes in behaviours.

The catch restriction on sole tested are expected to decrease the number of vessels or the number of days at sea (effort) dedicated to sole. It is to be expected that vessels will change

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activity, allocate effort to another metier in case of catch constraints on sole or will exit the fleet if incentives are created. If vessels keep on fishing for sole according to catch restriction, effort reallocation is to be expected as gross revenue is expected to decline otherwise. There are therefore incentives to reallocate effort to other species. If a part of the vessels exit the fishery either because they move to other fishery or because they stop fishing, the remaining vessels are expected to benefit from these exits.

Management options tested in this impact assessment concerns conservation measures dedicated to productive and reproductive capacities of the stock. Options of TAC management were tested and the number of vessels or the number of days at sea needed to catch the TAC were adjusted. A UMS (Universal Measurement System for Tonnage) management system is also implemented in the fishery, however no data were available to assess or discuss the impacts of options on this management system.

Economic impacts of these options have been assessed in terms of impacts on the viability of fleets and in terms of resource rent. No economic objective has been defined explicitly in the scoping meeting however it is to be noticed that a regulation access to fisheries is needed to prevent from rent dissipation. Regulation access tools already exist as the fishery is managed (i) through a PPS system implemented since 2006 to select operators allowed to fish and (ii) through a system of quota allocation to define operator's share. Individual quotas are enforced in Belgium and a system of quota management by POs is implemented in France with strategies of allocation that vary according to POs (individual allocation, seasonal allocation…).

These tools are pertinent and should be used to give a link between fleet capacity and catching opportunities from the stock to prevent poor economic performance from overcapacity.

11.   COST EFFECTIVENESS OF CONTROL AND ENFORCEMENT

There is no information on cost of enforcement for this fishery so no cost-effectiveness analysis is possible.

12.   CONCLUSIONS TO THE IMPACT ASSESSMENT

Preliminary remark: As no B_{lim} as been defined for the Bay of Biscay sole stock, the group used Bpa/1.4 = 9,300t as a proxy. In subsequent text, B_{lim} should be interpreted as the proxy for B_{lim} defined by the group. This choice is only a minor consideration as fishing at F_{msy} has a very low risk of SSB<B_{lim}

12.1.   Exploitation Targets

With levels of estimation precision assumed and no misreporting, exploiting the Bay of Biscay sole stock at F_{msy} (0.26) can be considered precautionary.

An F target of 0.26 does not produce significantly higher long term yields relative to Fs in the range of 0.15-0.35. Target Fs between 0.15 and 0.40 will give yields within 5% of yield at F=0.26. Furthermore, for F values below 0.35, the risk on SSB falling below B_{lim} is low. Fishing at F higher than F_{msy} would however result in a lower long term biomass and therefore a potential higher risk to the stock. A higher target F would also potentially result in higher ecosystem impact of the fishery.

The choice of $B_{trigger}$ for Bay of Biscay sole has little impact on the variability of the level of yield in the near future (5 years) or the longer term (10 years) and on the probability of SSB below B_{lim}. Taking the above into consideration, a $B_{trigger}$ of 11,000t (in the vicinity of B_{lim} compatible with CV from ICES quality sheets) may be a valid candidate.

12.2.   Management in the absence of an assessment

Consideration has been given to management of Bay of Biscay sole in the absence of an agreed assessment. Based on the analyses presented above and on line with COM(2010)241 final (fishing opportunities for 2011), and in case no analytical assessment is available, the following action could be taken.

Currently a new survey has been developed, if a survey can provide adequate information on the status of the stock, information of such a survey should be taken into account for setting a TAC in the following year. Using this survey in accordance with Annex IV (rules 4 and 5), a 15% increase in TAC could be applied if the average estimated abundance in the last two years exceeds the average estimated abundance in the three preceding years by 20% or more. A 15% decrease in TAC could be applied if the average estimated abundance in the last two years is 20% or more lower than the average estimated abundance in the three preceding years.

Where abundance information is not available or does not adequately reflect changes in stock abundance (ie. The survey is not informative), an unchanged TAC would apply unless the TAC is above 4100t. In that case the TAC should be reduced by 15% per year until it reaches 4100t (the fixed TAC value which has been evaluated as safe for at least 7 years, Figure 12.1).
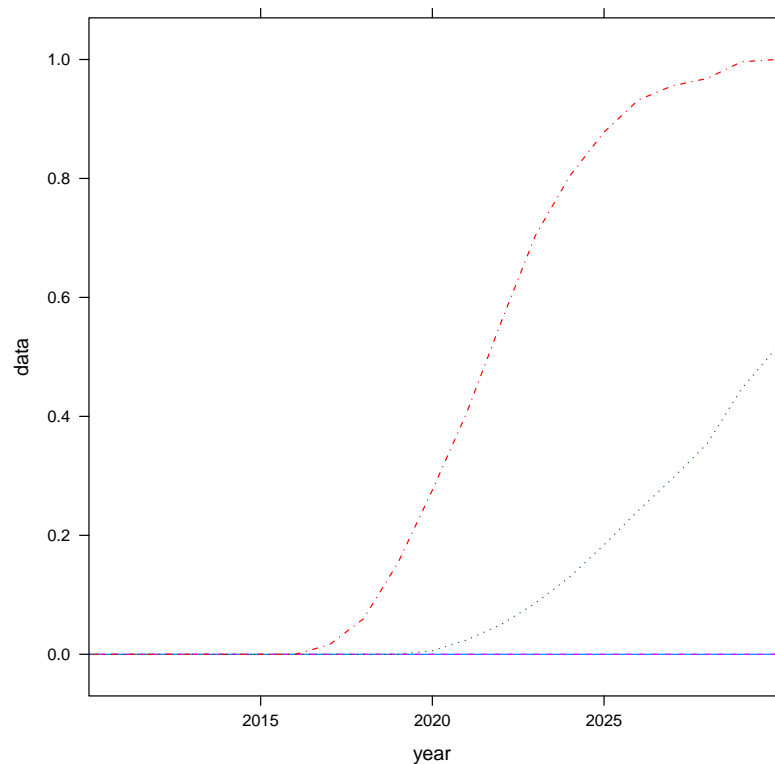

Figure 12.1 Risk of SSB< B_{lim} by year given reduced mean recruitment of 0,5,10, 15 and 20% and a constant TAC of 4100 t. Only with a continued 20% reduction in mean recruitment are risks of SSB<Blim above zero (dotted red line).

12.3.   Comparison of Options

Both types of options tested by the group (Gradual F reduction and Fixed TAC) can give similar results on the short (2015) and longer term (2020) for yields, F level and risk on SSB. The main differences between those options would be the allowed inter-annual variability in TAC. This is an important point to consider as constraint on the inter-annual variability in TAC would be advantageous to fishermen in planning future strategies and investments.

Gradual F reduction to F_{msy} by 2015

For this option, simulations show that constraint to inter-annual variability in TAC generally had little effect on risks. Although simulations indicate that a 10% constraint would be a possible value, a 15% constraint would be preferable because the risks are lower and it would allow more flexibility in obtaining the necessary level of exploitation for any given year.

Option 2: Fixed TAC

Fixed TAC strategy: Under a Fixed TAC strategy, TAC in the range of 3500t to 4500t appears to be precautionary and will give F_{msy} = 0.26 in 2015 with different probabilities. Depending on the catch assumptions in 2010 and 2011 with a constant TAC of 4100t, F_{msy} could be reached with a 50% probability by 2015 with a 90% confidence interval in F in the range of [0.21,0.32] (assuming a change from constant TAC strategy to F_{msy} strategy once F_{msy} is reached).

This is robust to some possible changes in stock dynamics. Simulations, beginning in 2012, indicate that a TAC of 4100 t shows low probability of reducing SSB below B_{lim} (9300 tonnes) under the existing recruitment regime or with up to 15% reduction in mean recruitment. Under the assumption of a 20% reduction in average recruitment a TAC of 4100 tonnes showed a low probability of reducing SSB below B_{lim} before 2017, but an increased probability thereafter. Historically mean recruitment has been seen to decline by about 15% between the periods before and after 1993.

12.4.   Sensitivity analysis

Sensitivity analyses of the F_{msy} to exploitation pattern shows that for reasonable selectivity increases, the trade off between effort and selectivity are not significant. Effort reduction to reach a new F_{msy} value obtained when selectivity increases would not be very different from effort reduction needed to reach the F_{msy} for the current exploitation pattern. Options tested in this impact assessment do not include socio-economic impacts of selectivity measures.

12.5.   Effectiveness: best placed to achieve the objectives (select appropriately just to relate to the objectives given above)

In the period of transition to F_{msy}, catches are expected to be relatively constant and it is expected that market will therefore not be affected. After 2015, the increase of catches predicted in the simulations could lead to a limited decrease in mean price due to price-quantity relationship. However this would not affect the viability of the sole market.

12.6.   Efficiency: cost-effectiveness

The implementation of the management plan is expected to have slight long term gains and short term negative economic impacts for all the fleets involved in the sole fishery. Cost-benefit analysis shows that overall economic impacts of the plan are positive when adjusting the number of vessels needed to catch the TAC and negative when adjusting the fishing time without considering likely effort reallocations.

The economic viability of fleets is not endangered and effort reallocation is expected to offset losses although it is difficult to predict such reallocation. It is anticipated that the stock status will improve.

Management options tested concerns conservation measures. Existing regulation access tools need to be maintained or further developed to avoid rent dissipation.

12.7.   Consistency: limiting trade-offs across the economic, social and environmental domains

From the socio-economic point of view, the main trade-offs are linked to the adjustment in fleets to reach a given level of TAC or F. On one hand, if the adjustment is carried out on the number of vessels, this would likely lead to economic gains for remaining vessels and to a larger resource rent. This would also prevent from effort reallocation to other species. This would however have side effects on fleets and employment. On the other hand, if vessels reduce their effort directed to sole and allocate more effort on another metier, the management plan would only slightly affect fleets performances and employment. However effort reallocation might impact other species and as a consequence reduce performances of other fleets through technical interactions.

12.8.   Forward look to Evaluation

There are no specific issues identified for evaluation

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14. LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:

https://stecf.jrc.ec.europa.eu/meetings/2011?p_p_id=62_INSTANCE_9gxN&p_p_lifecycle=0&p_p_stat e=maximized&p_p_mode=view&p_p_col_id=column-
2&p_p_col_count=1&_62_INSTANCE_9gxN_struts_action=%2Fjournal_articles%2Fview&_62_INST ANCE_9gxN_groupId=43805&_62_INSTANCE_9gxN_articleId=76341&_62_INSTANCE_9gxN_ver sion=1.0

List of background documents:

1. STECF EWG 11-01 Working Document 1 Choice of Stock-Recruit model and equilibrium evaluations for Bay of Biscay sole. E J Simmonds.
2. STECF EWG 11-01 Working Document 2 Basic evaluation of options for exploitation of Bay of Biscay sole E J Simmonds.
3. STECF EWG 11-01 Working Document 3 Simulations of catch and SSB in 2015 at constant TAC or decreasing F simulations, R. Scott.
4. STECF EWG 11-01 Working Document 4 Sensitivity if Fmsy to different assumptions on exploitation pattern in the fishery. Gerard Biais
5. STECF EWG-11-01 – Working Document 5 Bio-economic Impact Assessment sole Bay of Biscay management plan Claire Macher, Mathieu Merzereaud, Michel Bertignac, Christelle Le Grand, Gérard Biais And Olivier Guyader

Working documents 1 to 3 are summarized in:

Simulations for STECF Impact Assessment of Bay of Biscay sole - 3 Working Documents in support to the STECF Expert Working Group 11-01. E. J. Simmonds & R. Scott, 2011, Publications Office of the European Union, Luxembourg, EUR 24813 EN, JRC64931, 32 pp.

European Commission

Abstract

This report is one of two reports to the STECF of EWG 11-01 of the STECF Expert Working Group on management plans, (28 February to 4 March 2011) and provides an Impact Assessment report on the Bay of Biscay sole fisheries. It summaries biological modelling of a range of different stock dynamics incorporating uncertainty in stock recruitment function and measurement error. The results from an integrated bio-economic model showing economic impact on the sole fishery in the Bay of Biscay are presented. The simulations carried out show that a target F of 0.26 (Fmsy) can be accepted as precautionary in the long term. Target Fs between 0.15 and 0.35 will give yields within 5% of yield at F=0.26. Economic considerations suggest that the management plan is expected to have slight long term gains and short term negative economic impacts for all the fleets involved in the sole fishery. The economic viability of fleets is not endangered and effort reallocation is expected to offset losses although it is difficult to predict such reallocation. The report provides details of approaches that could be used if the ICES assessment fails. The report has been endorsed by the STECF during its 36th plenum in April 2011.

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