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Scientific, Technical and Economic Committee for Fisheries (STECF)

Advice on the Harvest Control Rule and Evaluation of the Anchovy Plan COM(2009) 399 Final (STECF-13-24)

Edited by Ernesto Jardim & Colin P. Millar

This report was reviewed by the STECF during its 44th plenary meeting held from 4 to 8 November 2013 in Brussels, Belgium

Report EUR 26326 EN

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JRC 86109

EUR 26326 EN

ISBN 978-92-79-34619-4

ISSN 1831-9424

doi:10.2788/35653

Luxembourg: Publications Office of the European Union, 2013

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How to cite this report:

Scientific, Technical and Economic Committee for Fisheries (STECF) – Advice on the Harvest Control Rule and Evaluation of the Anchovy Plan COM(2009) 399 Final (STECF-13-24). 2013. Publications Office of the European Union, Luxembourg, EUR 26326 EN, JRC 86109, 71 pp.

Printed in Italy

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

Advice on the Harvest Control Rule and Evaluation of the Anchovy Plan COM(2009) 399 Final(STECF-13-24)

THIS REPORT WAS REVIEWED DURING THE PLENARY MEETING HELD IN BRUSSELS, BELGIUM, 4-8 NOVEMBER 2013

Background

Following new scientific information from ICES, in October 2014 the STECF expert group EWG 13-20 held a meeting to (i) assess and possibly revise the harvest control rule (HCR) in the proposed plan for anchovy in the Bay of Biscay (COM(2009)399 final), (ii) evaluate the results of implementing the HCR since 2010, and (iii) scope the impact assessment of management measures discussed with stakeholders.

Request to the STECF

STECF is requested to review the report of the STECF Expert Working Group, evaluate the findings and make any appropriate comments and recommendations. In particular advise on an appropriate harvest control rule and calculate the corresponding TAC for the fishing season 2013/2014 and plan for an impact assessment of management measures discussed with stakeholders.

Observations of the STECF

STECF notes that the 2009 proposal for a long-term plan for the anchovy fishery in the Bay of Biscay (COM(2009) 399 final)has, although not formally adopted, formed the basis for setting the TAC for anchovy since 2010. The plan was developed based on advice from STECF (STECF, 2008. *Working Group Report on the long term management of Bay of Biscay anchovy).*

STECF furthermore notes that the EWG-13-20 addressed the ToR by analysingfour tasks:

1. *Assess options in relation to the current harvest control rule.*
2. *Advise on a possible revision of the HCR.*
3. *Evaluate the long-term plan (scoping).*
4. *Assess impacts of possible changes to the long-term plan (scoping).*

Regarding 1,assess options in relation to the current harvest control rule, the expert group concluded that a change in 2013 in the assessment model used by ICES in assessing the Bay of Biscay anchovy, had not affected the usefulness of the HCR in the present long-term plan. The rule remains within the same precautionary limits of risks.STECF notes that it remains appropriate to use the current HCR to set the TAC for the fisheries exploiting anchovy in the Bay of Biscay.

The EWG computed the TAC for 2013-2014 based on the new assessment. The SSB used by ICES for the June 2013 advice, based on the old model, was 56 055 t, leading the EC to set a TAC of 17,100 t (as stated in Annex 1 of (COM(2009) 399 final)). The estimate of SSB in 2013 with the new model is 58 475t, which in accordance with Annex 1 of (COM(2009) 399 final), gives rise to presecribes catches for the period July 2013 to June 2014 of 17,700 t.

Regarding 2, advice on a possible revision of the HCR, STECF notes that the EWG in addition to possible revision of the harvest control rule also addressed change of the management year from the current July to June set up to a management year following the calendar year (January to December) and a possible mid-year revision of the TAC.

Two HCR modifications were evaluated: i) Modification of the parameters of the current HCR, such as the harvest rate, the maximum TAC, the minimum TAC or the biomass trigger points and ii) Adding an additional upper biomass trigger point, $B_{trigger3}$ above which a constant maximum TAC would be set. This HCR modification was proposed by the South Western Waters RAC (SWWRAC).

The analysis carried out by the EWG showed that the two HCR perform well, each giving a low risk of SSB falling below B_{lim} and high yields. The HCR proposed by the SWWRAC showed, for the same harvest rates,biological risks similar to the current HCR, while showing lower average catches and higher stability in yield.

The EWG discussed the possible impacts of changing the management year from July – June to January – December and the introduction of a mid-year revision of the TAC,on the quality of the stock assessment and the TAC advice. The assessment model to be used will depend on the management period chosen. The quality of the stock assessment and thereby the TAC advice is very dependent on the estimate of the recruiting year class and STECF notes that an assessment conducted in support of a January to December management period, is estimated to a have better quality than an assessment conducted in the spring because recruitment is observed by the JUVENA survey which is carried out in the autumn. If the management period were to be changed to follow the calendar year, the HCR would need to be revised.

The option of having a mid-year revision to adjust the TAC every year based on new information resulted in increased variability in TACs, would be scientifically/technically difficult to compute and legally complex to implement.

Regarding 3, evaluating the long-term plan, the EWG considered that an evaluation of the long-term plan will be of limited value, given the short time series. The implementation of the HCR started in 2010. Furthermore, since 2010 the fleets catches have been less than the agreed TACs, which suggest that the TAC may not be controlling the fishery, thereby making it more difficult to evaluate the effect of the HCR. The EWG therefore decided not to conduct a full evaluation of the plan.

Regarding 4, assess impacts of possible changes to the long-term plan (scoping), the EWG discussed the possibility of carrying out, in the future, a set of analysis to support an impact assessment for the Bay of Biscay Anchovy long-term plan regulation. The EWG identified the candidate HCRs, a list of performance statistics, MSE developments and data requirements.

The EWG suggested that a pragmatic procedure is used to call for the data required. The data can be managed by the chair of the EWG, avoiding the regular data-call management procedures.

Conclusions of the STECF

STECF commended the EWG for the comprehensive work carried out during the meeting and endorses the findings in the report as an appropriate basis on which to base management decisions including a possible revision of the long-term management plan.

In terms of possible revision of the HCR, the STECF advises that the current HCR and the HCR proposed by the SWWRAC are both consistent with the long-term objectives of the plan.

REPORT TO THE STECF

EXPERT WORKING GROUP ON
Advice on the Harvest Control Rule and Evaluation of the Anchovy Plan COM(2009) 399 Final
(EWG-13-20)

Barza, Italy, 14-18October 2013

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1 EXECUTIVE SUMMARY

In July 2009 the Commission adopted a proposal for a Council Regulation establishing a long-term plan for the anchovy stock in the Bay of Biscay and the fisheries exploiting that stock(COM(2009) 399 final). The objective of this plan is to keep the biomass of anchovy in the Bay of Biscay at sustainable levels and maintain levels of exploitation consistent with the maximum sustainable yield while ensuring stability to the fishing sector. Its main element is a harvest control rule prescribing annual TAC levels. Despite being a Commission proposal, the plan's harvest control rule has been implemented since 2010.

In 2013 ICES revised the stock assessment method used for advice. Consequently STECF was requested to assess the harvest control rule and possible alternatives scoped with the stakeholders, and provide advice taking into account the long-term biological and economic objectives established in the plan. AdditionallySTECF was requested to scope the evaluation of the long-term plan for the anchovy stock in the Bay of Biscay and the fisheries exploiting that stock.

To address this request the EWG-13-20 analysed four tasks:

1. *Assess options in relation to the current harvest control rule.*
2. *Advise on a possible revision of the HCR.*
3. *Evaluate the long-term plan (scoping).*
4. *Assess impacts of possible changes to the long-term plan (scoping).*

All the analyses were carried out using a Management Strategies Evaluation algorithm implemented as an R package, FLBEIA, using the FLR routines.

Regarding 1, assess options in relation to the current harvest control rule, the expert group concluded that a change in 2013 in assessment model used by ICES in assessing the Bay of Biscay anchovy had not affected the usefulness of the HCR in the present long-term plan. The rule is still within the same precautionary limits of risks.

The EWG concluded that the HCR described in the EC proposal for a long-term plan for anchovy in the Bay of Biscay (COM(2009)399 final), can still be applied to set the TAC for the fisheries exploiting that stock. The analysis carried out by the EWG showed that the current HCR:

- performs well (Sec.3.1), showing low biological risk (P[SSB<Blim] = 7%), a small probability of having a closure during the study period (9%), an average TAC during the study period of 20 300t;
- performs slightly better when compared with the previous evaluation, which also showed low biological risk (P[SSB<Blim] = 7%), but a slightly larger probability of having a closure during the study period (12%), and lower average TAC, 17 400t (Sec.3.1);
- presents 42% probability of having a 5 000t change in the TAC between consecutive years, which the EWG considered acceptable in terms of stability for this species;
- is robust to the major assumptions made during this exercise (Sec.3.2).

The EWG computed the TAC for 2013-2014 based on the new assessment. The SSB used by ICES for the June 2013 advice, based on the old model, was 56 055t, leading the EC to set a TAC of 17 100t (as stated in Annex 1 of (COM(2009) 399 final)). The estimate of SSB in 2013 with the new model is 58 475t, which in agreement with Annex 1 of COM(2009) 399 final, leads to catches for the period July 2013 to June2014 of 17 700t.

Regarding 2, advice on a possible revision of the HCR, the EWG in addition to possible revision of the harvest control rule also addressed change of the management year from the current July to June set up to a management year following the calendar year (January to December) and a possible mid-year revision of the TAC.

Two HCR modifications were evaluated: i) Modification of the parameters of the current HCR, such as the harvest rate, the maximum TAC, the minimum TAC or the biomass trigger points and ii) Adding an additional upper biomass trigger point, $B_{trigger3}$ above which a constant maximum TAC would be set. This HCR modification was proposed by the South Western Waters RAC (SWWRAC).

The analysis carried out by the EWG showed that the two HCR perform well, giving low biological risk of SSB falling below B_{lim} and high yields. The HCR proposed by the SWWRAC showed, for the same harvest rates, biological risks similar to the current HCR, while showing lower average catches and higher stability in yield.

The EWG discussed the possible impact on the quality of the stock assessment and the TAC advice of changing the management year from July – June to January – December and the introduction of a mid-year revision of the TAC. The assessment model to be applied will depend on management period. The quality of the stock assessment and thereby the TAC advice is very dependent on the estimate of the recruiting year class and STECF notes that an assessment conducted in support of a January to December management period is estimated to a have better quality than an assessment conducted in the spring because recruitment is observed by the JUVENA survey which is carried out in the autumn. If the management period is changed to follow the calendar year the HCR should be updated accordingly.

The option of having a mid-year revision to adjust the TAC every year based on new information was considered to increase the variability in TACs, would be scientifically/technically difficult to compute and legally complex to implement.

Regarding 3, evaluating the long-term plan, the EWG considered that an evaluation of the long-term plan will be limited given the short time series. The implementation of the HCR started in 2010. Furthermore, the fleets have not caught all their fishing opportunities, which suggest that the TAC may not be controlling the fishery, making it more difficult to evaluate the effect of the HCR. The EWG therefore decided not to conduct a full evaluation of the plan.

Regarding 4, assess impacts of possible changes to the long-term plan (scoping), the EWG discussed the possibility of carrying out, in the future, a set of analysis to support an impact assessment for the Bay of Biscay Anchovy long-term plan regulation. The EWG identified the candidate HCRs, a list of performance statistics, MSE developments and data requirements.

The EWG suggested that a pragmatic procedure is used to call for the data required. The data can be managed by the chair of the EWG, avoiding the regular data-call management procedures.

2 INTRODUCTION

In July 2009 the Commission adopted a proposal for a Council Regulation establishing a long-term plan for the anchovy stock in the Bay of Biscay and the fisheries exploiting that stock(COM(2009) 399 final). The objective of this plan is to keep the biomass of anchovy in the Bay of Biscay at sustainable levels and maintain levels of exploitation consistent with the maximum sustainable yield while ensuring stability to the fishing sector. Its main element is a harvest control rule prescribing annual TAC levels. Despite being a Commission proposal, the plan's harvest control rule has been implemented since 2010. After four years of implementation it is appropriate to evaluate the plan taking into account recent scientific developments as well as stakeholder's views.

2.1 Terms of Reference for EWG-13-20

Following ICES advice updating biological parameters as well as the methodology underlying the assessment of the anchovy stock in the Bay of Biscay the STECF is requested to assess options scoped with stakeholders in relation to the harvest control rule and advise on a possible revision of this rule taking into account the long-term biological and economic objectives established in the plan. In addition the STECF is requested to scope the evaluation of the long-term plan for the anchovy stock in the Bay of Biscay and the fisheries exploiting that stock(COM(2009) 399 final). Management options to be assessed should consider stakeholders' preferences, in particular regarding the definition of the management season. To this end, stakeholders, namely representatives from the South Western Waters RAC and the Member States concerned, should be associated to the evaluation process, especially during the scoping phase.

2.2 Addressing the Terms of Reference for EWG-13-20

The group addressed the ToR by identifying a set of four tasks. Addressing these tasks allowed the group to provide STECF's plenary with the analysis required to reply to DGMARE's request and move forward with issues that require further work and cooperation between experts. The tasks were:

5. *Assess options in relation to the current harvest control rule.*
6. *Advise on a possible revision of the HCR.*
7. *Evaluate the long-term plan (scoping).*
8. *Assess impacts of possible changes to the long-term plan (scoping).*

2.3 Interaction with Stakeholders

The SWWRAC, French Administration and Spanish Administration attended the meeting in the first 2 days to discuss their expectations and contribution to the EWG work.

Overall the contribution of these stakeholders was appreciated and contributed to the successful progress made by the EWG.

The SWWRAC contributed to the discussion of alternative HCR and helped the group setting the range of HCR to be explored. Furthermore, the SWWRAC required specific performance statistics to be computed, and contributed with data about the price and volume of landings of Anchovy between 2010 and 2013.

Both administrations, French and Spanish, contributed to the discussion about HCRs, performance statistics and technical details of the simulations. The administrations recognized their role in providing information to perform a thorough analysis of the long-term plan and showed availability to co-operate with the EWG.

Consequently, the EWG identified the data requirements (see section 7.4 for details) and informed both administrations so that a future request for data can be replied quickly.

2.4 Comparison between the assessment used for the 2008 evaluation and the current assessment

Up to June 2013 ICES has used an assessment methodology based on a Bayesian two-stage biomass-based model (BBM)(Ibaibbariaga, Fernandez, Uriarte, & Roel, 2008),where the population dynamics were described in terms of biomass with two distinct age groups: recruits or fish aged 1 year, and fish that are 2 or more years old. The biomass decreases exponentially on time by a factor accounting for intrinsic growth and natural mortality rates, which were assumed year and age invariant. The STECF evaluation in 2008 used this assessment as a basis for conditioning the simulations(STECF, 2008b).

In 2013 ICES adopted a new stock assessment model for the Bay of Biscay anchovy(ICES, 2013b). This model is based on the work by(Ibaibarriaga, Fernandez, & Uriarte, 2011), which is an extension of the previous model. In the new model growth and natural mortality are separated processes, which are assumed constant along time but distinct across age groups. Additionally, fishing is considered a continuous process in time and two stochastic observation equations are included for commercial catch by semester (one for total catch, the other for proportion by age class, in biomass). See Table 2.1 for more details or consult the new ICES stock annex (11).

Table 2.1Comparison of the major features of the previous assessment model (BBM) and current (CBBM)

MODEL	BBM (previous)	CBBM (current)
Estimation	Bayesian	Bayesian
Population dynamics	in Biomass	in Biomass

Age Groups	1 & 2+	1 & 2+
Catches observed?	Just as removals	Yes, as observations (total catch and age 1 mass proportion in the catch)
Growth	Constant parameter across ages and years	parameters varying across age groups. Observation equations based on weight at age data
Natural Mortality	1.2 (all ages)	0.8 (age 1) 1.2 (ages2+)
Fishery Selectivity	Flat selectivity (=1 all ages)	Sel1 (estimated by semester) Sel2+(=1)
Spring surveys observations	SSB and age 1 biomass proportion from the Spring (Acoustic + DEPM) surveys	SSB and age 1 biomass proportion from the spring surveys (Acoustic + DEPM revised series)
Autumn juvenile survey observations	None	Autumn Acoustic juvenile survey
Catchability of surveys	DEPM absolute ; AcousticRelative	Spring(DEPM & Acoustic) Relative ; Autumn (Acoustic) Power
Survey observation errors	Estimated	CV.observed + Estimated additional component

In terms of assessment outputs both models result in a rather concordant series of SSB, though the current CBBM points out towards a slightly lower average levels of biomass (Figure 2.1). Nevertheless, (ICES, 2013a) concluded that there was not enough evidence to revise the value of B_{lim}, which was kept at 21 000 t.

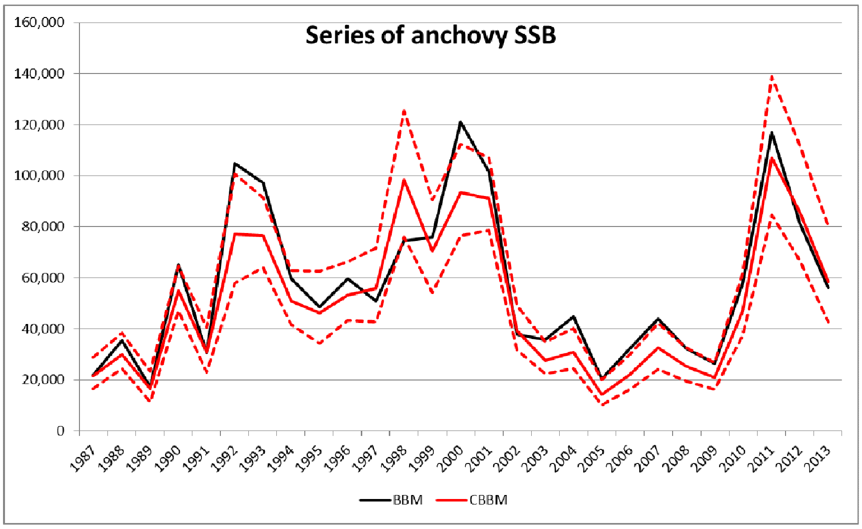


Figure 2.1Series of median SSB for the former (BBM, black line) and current (CBBM, red line, with +/- 95 confidence intervals) assessment models.

Regarding recruitment the new assessment shows lower levels than the previous model (Figure 2.2).

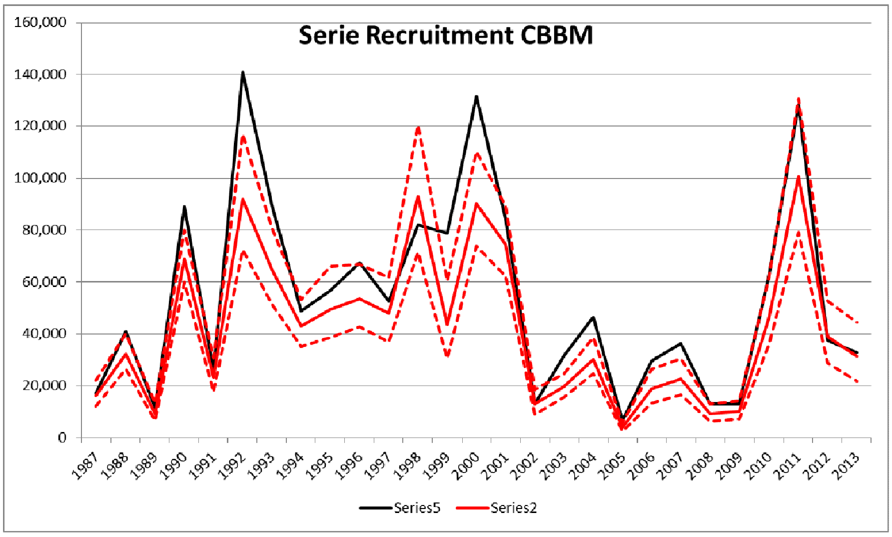


Figure 2.2Series of median recruitment at age 1 in mass from the BBM assessment (black line)and the new series from the CBBM (in red, with +/- 95 confidence intervals).

These results can be summarized in the fitting of the stock-recruitment (SR) relationships as shown in Figure 2.3. The SR scatter plots and the fittings reflect that recruitment (in numbers) in the BBM were on average higher than in the CBBM model. To a large extend this is due to the changes in population dynamics, particularly in the pattern of natural mortality by ages, and only partly to the new assessment model itself. The reason is that the reduced mortality at age 1 in the CBBM compared to the BBM implies that a lesser amount of recruits are required to obtain the same average biomass.

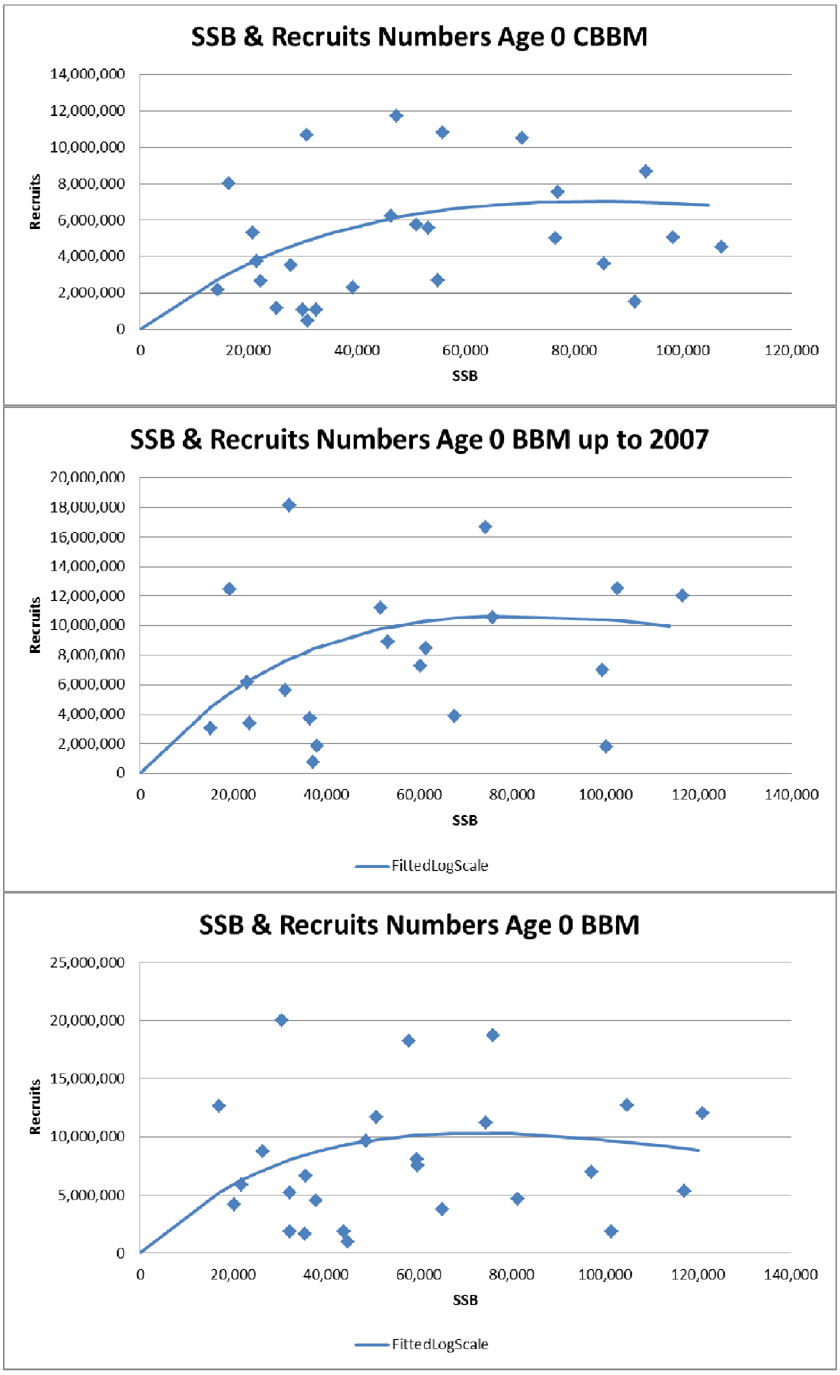


Figure 2.3SR relationships for the CBBM model (upper panel data up to 2013) and for the series available in 2008 (up to 2007 - mid panel - and 2013 – bottom panel). The fitting is made in log scale and the line corresponding to the expected mean value of recruit.

3 MANAGEMENT STRATEGIES EVALUATION (MSE)

The evaluation of the current harvest control rule (Section 4) and possible alternatives (Section 5) was performed by simulation using an MSE approach. The analysis were carried out with FLBEIA(García, Santurtun, Prellezo, Sánchez, & Andrés, 2012), which is a tool to perform bio-economic impact assessment of fisheries management strategies written in R (R Core Team, 2013) and using the FLR tools (Kell, et al., 2007).

The simulation algorithm has two major elements: the operating model (OM), representing the *real* world (i.e. the fish stocks and the fleets operating); and the management procedure (MP), representing the *perceived* system and the advice process (i.e. the assessment and the decision making algorithm or HCR). Both elements are connected through the observation error model (OEM) that feeds the MP with information from the OM, and the implementation error model (IEM) that acts on the OM based on the decisions taken by the MP.

The sections below describe the specifics of the implementation done for the anchovy fishery and long-term plan.

3.1 Operating Model

The population dynamics is described in terms of numbers at age (with age groups 0, 1, 2 and 3plus) by semester. Recruitment, which refers to number of individuals at age 0, enters the population at the beginning of the second semester. The population dynamics are modelled using an exponential mortality model with the Pope's approximation to F(Pope, 1972). Therefore, numbers at age decay exponentially according to natural mortality rate and catches are removed instantaneously in the middle of each semester. Recruitment is modelled as a function of the spawning stock biomass at the middle of the year, according to a stock recruitment model (e.g. Ricker, Beverton-Holt, Hockey-Stick). All individuals are mature at age 1. Natural mortality is constant across years but different for each age class and semester.

There is one fleet operating in each semester. As there was not data available to include the effort dynamics, it is assumed that all the TAC is taken. The TAC is split into semesters depending on the different quota assigned to France and Spain and the percentage of catches by country corresponding to each semester. Total catches by semester are separated by age groups according to the selectivity. As the effort dynamics is not included, there is not capital model implemented.

3.2 Observation Error Model

In the case of the anchovy, three surveys are carried out per year. Two of them take place in spring in order to observe the SSB and the age structure, and both are used in the assessment. Additionally, in autumn, an acoustic survey is performed to estimate juveniles' abundance.

The estimate of SSB that will feed the MP/HCR is generated from a lognormal distribution with mean (in log scale) equal to the OM SSB and standard deviation based on the coefficient of variation of the biomass estimated in the assessment. For this exercise the coefficient of variation was set at 0.25, the same that was used for the evaluation of the rule in 2008(STECF, 2008a)and (STECF, 2008b), but slightly larger than the coefficient of variation of the biomass estimates from the CBBM (between 0.10 and 0.20).

The recruitment index is not used in the MP currently implemented, but should be included in the future to cope with the inclusion of a stock assessment, changes in the management calendar or a TAC revision within current management calendar.

3.3 Management Procedure

The assessment process is considered together with the observation process. The OM SSB is observed as described in Section 3.2 and provided to the HCR without using a stock assessment model. This situation limits the analysis by not accounting for estimation and model uncertainty.

The harvest control rule is used to set the yearly TAC in the middle of the year. TAC is split between countries according to country shares. Semester share is calculated based on the country share and the average of catches of each country in each semester.

A generic harvest control rule has been implemented, in order to cover alternative HCRs for the management period from July to June:

$$TAC_{Jul_y - Jun_{y+1}} = \begin{cases} 0 & , \text{ if } SSB_y \le B_{trigger1} \\ TAC_{min} & , \text{ if } B_{trigger1} < SSB_y \le B_{trigger2} \\ \min\left(\max\left(\gamma \; SSB_y, TAC_{min}\right), TAC_{max}\right) & , \text{ if } B_{trigger2} < SSB_y \le B_{trigger3} \\ TAC_{max} & , \text{ if } SSB_y > B_{trigger3} \end{cases}$$

Where y is the subscript for "year", $B_{trigger}$ values represent biomass references against which the spawning stock biomass (SSB) is compared each year to deduct the catches (TAC) in the following year.

3.4 Implementation Error Model

All the TAC is assumed to be taken (no implementation error is included).

3.5 Conditioning

The operating model was conditioned using the results obtained from applying the most recent stock assessment model (CBBM) to 1987-2013 data, as agreed after WKPELA(ICES, 2013b)and WGHANSA(ICES, 2013a).

In order to account for all the uncertainty from the assessment when conditioning the model, the MCMC draws were used.

3.5.1 Initial population

The numbers at age 1 at the beginning of the year from 1987 to 2013 were taken as the biomass at age 1 at the beginning of the year divided by the stock weight at age 1 at the beginning of the year. The former were estimated in the assessment, whereas the later were derived from the stock weights in spring observed during the research surveys (PELGAS and BIOMAN) projected backwards according to the intrinsic growth by age class estimated in the assessment. The population structure of the 2 and older individuals in 1987 was calculated from the initial biomass (B_0, biomass of age 2+ at the beginning of 1987) estimated in the assessment. First, the weight at age 2+ was calculated as the mean of the weights at ages 2 and 3+ at the beginning of the year (projected backwards from the stock weights in spring according to the intrinsic growth by age class estimated in the assessment) weighted by the relative abundance in each age class. Then, B_0 was transformed into number of fish at age 2+ in 1987 by dividing it by the weight at age 2+ in that year. The numbers at age corresponding to the age 2 and age 3+ age classes were obtained according to the relative abundance in each age class. For these calculations the relative abundance in each age class (68% of the age 2+ corresponded to age 2) was taken from the results of the SICA (Seasonal Integrated Catch at Age) model in 2005(Uriarte, 2005).

3.5.2 Natural mortality

Natural mortality rates by semester were set as in the CBBM: 0.4 for age 1 and 0.6 for age 2+. The natural mortality rate for age 0 during the second semester was set to that of age 1 (0.4).

3.5.3 Fishing mortality

Year and age effects of fishing mortality were estimated for each of the semesters in the CBBM. For identifiability, the selectivity at age 2+ by semester is set equal to1 in the CBBM. So, selectivity at age 1 by semester represents the fishing mortality with respect to age 2+. Selectivity of age 0 was set equal to 0.05 in the second semester in accordance with previous age structured seasonal assessments on this stock (ICES 2005). This allowed the reconstruction of the whole matrix of numbers at age for both semesters according to the fish population dynamics defined in(Ibaibarriaga, Fernandez, & Uriarte, 2011) (note that in contrast to FLBEIA fishing is assumed to be a continuous process).

3.5.4 Recruitment

Different stock-recruitment (SR) relationships were fitted to the estimates of SSB (thousand tons in the middle of the year) and R at age 0 (in million numbers in mid-year). The SR models (Figure 3.1) show very similar fitting according to the AIC (Table 3.1). The SR model with the minimum AIC was the Beverton-Holt. However, the differences between fits are small and all of them have substantial or similar support from the data (because the difference between AIC_i and AIC_{min} is always < 2,(Mangel, 2006)). As both SSB and recruitment exhibit strong variations over the years with no clear relationship between those variables, the fact that AICs are very similar should be interpreted as a consequence of those variations: none of the tested SR models seems to adjust significantly better over the others as observations do not exhibit any particular trend. Analysing the fits to all the iterations (Figure 3.2) showed that the Ricker relationship was more stable. Moreover, the Ricker curve was used in the in the past for this stock, which made it simpler to use it for comparing the HCRs performance. As such, the group decided to use the Ricker relationship to condition the OM. Nevertheless a sensitivity analysis to the S/R model was carried out (Section 4.2)

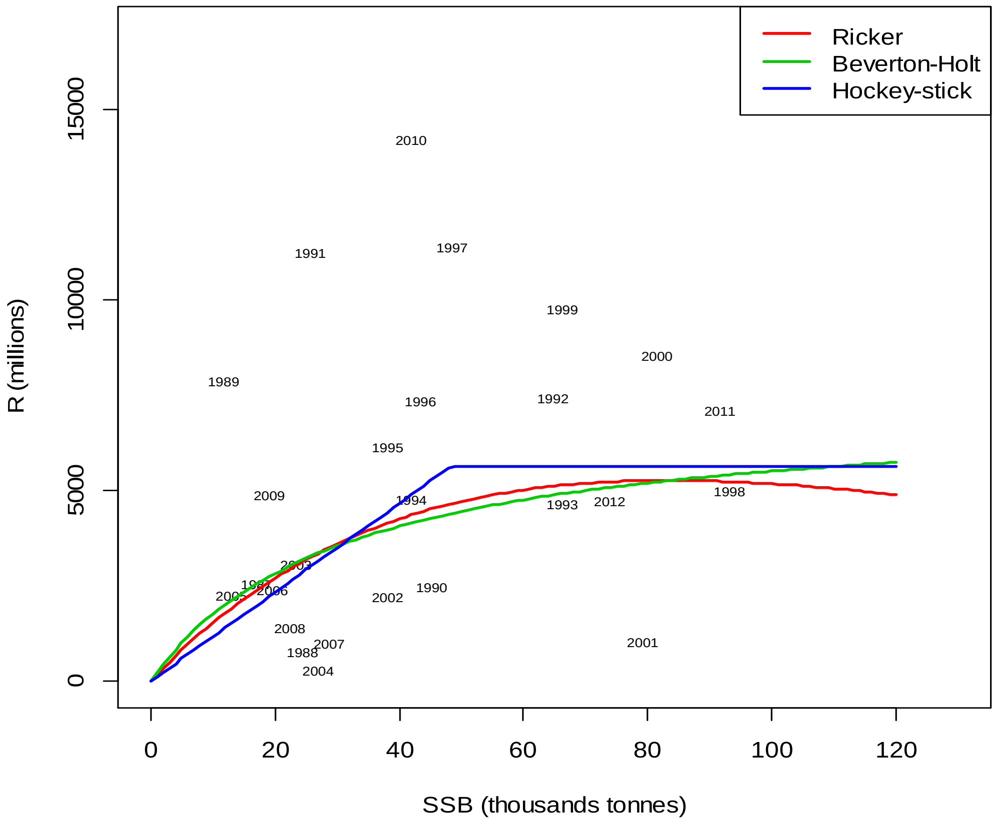


Figure 3.1Scatter plot of SSB in thousand tons and recruitment in million individuals (both at mid-year) and stock recruitment relationships fitted with the values estimated using the CBBM median output values.

Table 3.1AIC for the stock recruitment models fitted to the SSB and recruitment values estimated using the CBBM median output values.

SR model	Ricker	Beverton-Holt	Hockey-stick
AIC	12.1527	11.9693	12.43187

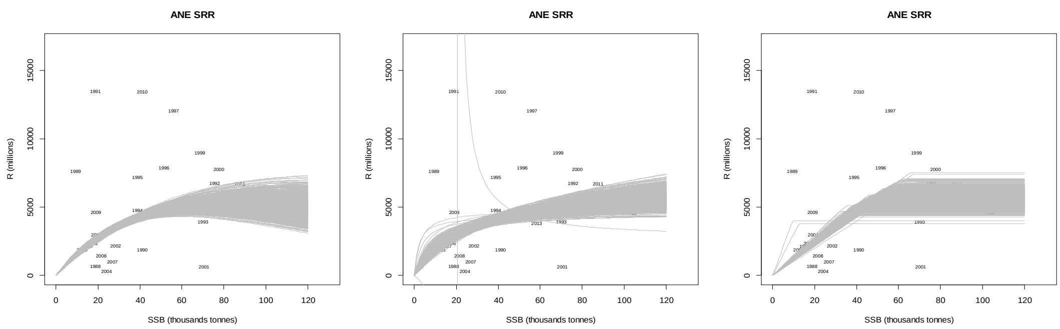


Figure 3.2Stock recruitment relationships fitted to 250 different iterations. From left to right: Ricker, Beverton-Holt and Hockey-stick.

3.5.5 Partition of catches within the year

The operating model implemented in the simulation loop allocates catches to each half of the year according to the actual historical mean values (from 1987-2004 and 2011-2012) which turns out to be 62% for the first half of the year. Therefore the WG adopted as the base case the 60% - 40 % sharing of catches for the first and second semester, respectively.

3.6 Projections

The dynamics were simulated for 10 management years (July 2014 – June 2024) and run for 1000 iterations. The projection period was considered sufficient given the short-lived nature of the stock.

Uncertainty in the projection period was introduced through (i) recruitment predictions derived from the model fitting including non-parametric bootstrap of residuals, and (ii) the lognormal observation error on the SSB used to set the TAC.

Currently the coefficient of variation for the assessment estimates, using the last agreed model CBBM, ranges from 0.10 and 0.20. However, the standard deviation value used for the estimation of the SSB was 0.25, the same value as used for the evaluation of the rule in 2008 (STECF, 2008a) and (STECF, 2008b).

As the TAC is already set for 2013, catches at age for the second semester are estimated according to the season share and the selectivity at age. Recruitment in 2013, is estimated according to the selected stock recruitment model for the projection period.

3.7 Performance statistics

Taking into account the objectives of the long-term plan and the interaction with stakeholders, the performance statistics used to evaluate the different HCRs were as follows:

a) Probability of SSB being below B_{lim} in any randomly chosen year of the projection period. Sometimes also referred to as biological risk:

$$P(SSB < B_{lim}) = \frac{\sum_{iter,y} I[SSB_{iter,y} < B_{lim}]}{N_{iter} N_y}$$

b) Probability of the fishery being closed (i.e. TAC=0) in any randomly chosen year of the projection period:

$$P(\text{closure}) = \frac{\sum_{iter,y} I[TAC_{iter,y} = 0]}{N_{iter} N_y}$$

c) Expected average catch (in biomass) across the projection years:

$$\overline{C} = \frac{\sum_{iter,y} C_{iter,y}}{N_{iter} N_y}$$

d) Probability of the inter-annual change of the catch being less than 5000 tonnes in any randomly chosen year of the projection period:

$$P(C_{y+1} < C_y \pm 5000t) = \frac{\sum_{iter,y} I\left[\left|C_{iter,y+1} - C_{iter,y}\right| < 5000\right]}{N_{iter} N_y}$$

e) Expected average standard deviation of the catch (in biomass) acrossthe projection years:

$$\frac{\sum_{iter,y} sd_y(C_{iter,y})}{N_{iter}}$$

f) Discounted present value of landings. This is estimated as the present value of the catches multiplied by the estimated price. The future amount value of landings has been discounted to reflect its current value.

$$DPV = \sum_{y=1}^{Y} \frac{\hat{P}_y . C_y}{(1+r)^y}$$

In the equations above, $SSB_{iter,y}$, $C_{iter,y}$, $TAC_{iter,y}$, $\hat{P}_y$ and r denote, respectively, the spawning stock biomass, catch (in biomass), TAC, average price and discount rate (fixed at 0.05), in year y and iteration $iter$, whereas N_y and N_{iter} are the number of years in the projection period and the number of iterations in the simulation. I[] is an indicator function that takes the value 1 if the condition within the brackets is fulfilled and 0 otherwise.

$\hat{P}_y$ was estimated using a price function which considers a linear relationship in the log scale between landing and prices in the first semester:

$$P_{sem1} = a + b * \log\ (L_{sem1})$$

where P_{sem1} is the average price corresponding to semester 1, and L_{sem1} is the total landings corresponding to semester 1 and b is the price elasticity. Table 3.2 shows the estimates obtained. In the case of the second semester a fixed price was adopted computed as the average price between 2010 and 2013, resulting in an average price of 1.5 euros/kg.

Table 3.2Estimated parameters for the demand function in the first semester.

Parameter	Value	Std. Error	t value	Pr(>|t|)	R
a	12.0040	1.7362	6.914	7.16e-06	0.6681
b	-0.6613	0.1246	-5.309	0.00011	

Other performance statistics that might also be considered of interest are described and given in Annex II.

4 ASSESS OPTIONS IN RELATION TO THE CURRENT HARVEST CONTROL RULE.

4.1 Base case description and comparison with previous evaluation

The base case uses the harvest control rule defined in the long term management plan proposal for the Bay of Biscay anchovy(COM(2009) 399 final). This rule was tested using distinct harvest rates between 0.2 and 0.5, both for comparison with the previous evaluation (this Section) and for testing alternatives to the current HCR, which is tackled in more detail on Section5.

$$TAC_{Jul_y - Jun_{y+1}} = \begin{cases} 0 & , \text{ if } SSB_y \leq 24\,000 \\ 7\,000 & , \text{ if } 24\,000 < SSB_y \leq 33\,000 \\ \min(\max(\gamma \;\; SSB_y, 7\,000), 33\,000) & , \text{ if } SSB_y > 33\,000 \end{cases}$$

Results of the previous evaluation are shown in Table 4.1 and those of the current evaluation in Table 4.2. Comparison of the performance of the rule within previous and actual evaluation is shown in Figure 4.1. It has to be noted that the results are not completely comparable as the models used for performing MSE are different. In the previous evaluation, two population dynamic models were used: a biomass model (based on the BBM assessment model) and an age-structured model (conditioned by a seasonal integrated catch-at-age analysis model**Error! Hyperlink reference not valid.**). In the current evaluation the population dynamics in the operating model is age-structured conditioned by the CBBM assessment outputs (in mass). In addition, the initial conditions, the stock-recruitment model and the projection years were also set up differently.

In spite of the previously mentioned differences, the trends of the main performance statistics for harvest rates of 0.2, 0.3, 0.4 and 0.5 are very similar in both evaluations. The probability of SSB being below B_{lim}, for a harvest rate of 0.2, was lower in the previous evaluation (3.8% while now is 4.2%). For the other harvest rates the current evaluation showed lower biological risks. For all the harvest rates the actual evaluation of the rule showed lower probabilities of fishery closure, ranging from 6% (harvest rate of 0.2) to 14% (harvest rate of 0.5). The previous evaluation values were 22% to 62% for the same harvest rates. Regarding average TACs, the present evaluation forecasts higher catches (~15% higher) than in the previous evaluation performed in 2009. The differences of the mean standard deviation of catches are also small, being 5% smaller for harvest rate 0.5, compared to the previous evaluation of the rule.

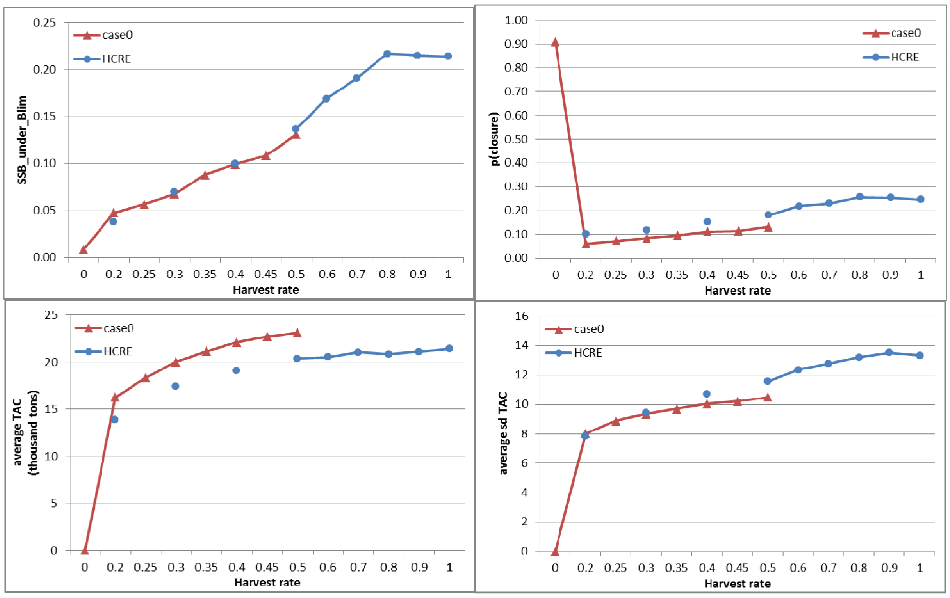


Figure 4.1Comparison of the performance statistics as a function of the harvest rate for the current evaluation of the long term management plan HCR (case 0, black line) and for the previous evaluation (rule E, red dashed line). From top to bottom and from left to right the performance statistics are: probability of SSB being below B_{lim}, probability of closure, average TAC and average standard deviation of the inter-annual TAC.

Table 4.1Probability of SSB being below B_{lim}, probability of closure, average TAC and mean inter-annual standard deviation of TACs for different harvest rates as assessed in the previous evaluation of the HCR currently in use - rule E in(Ibaibarriaga & Uriarte, 2009).

Case	Harvest Rate	P(SSB<B_{lim})	P(closure)	TAC ('000 t)	SD TAC ('000 t)
Rule E	0.2	0.038	0.217	13.900	7.863
Rule E	0.3	0.070	0.373	17.444	9.441
Rule E	0.4	0.100	0.498	19.073	10.732
Rule E	0.5	0.137	0.618	20.386	11.553

Table 4.2Probability of SSB being below B_{lim}, probability of closure, average TAC and mean inter-annual standard deviation of TACs for different harvest rates as estimated in the actual evaluation of the HCR currently in use (named as HCR 0).

Case	Harvest Rate	P(SSB<B_{lim})	P(closure)	TAC ('000 t)	SD TAC ('000 t)
case0	0.2	0.042	0.062	16.421	7.861
case0	0.3	0.066	0.089	20.332	8.998
case0	0.4	0.091	0.113	22.435	9.574
case0	0.5	0.115	0.137	23.464	10.043

As stated before, we obtain similar results in terms of risk and therefore we conclude that the rule is still within the same precautionary limits of risks and consequently still operative under current new assumptions on stock status. Despite the fact that due to the downward revision of the SSB value in the new assessment we would have expected an increase in the risks, those are maintained due to the new assumptions on selectivity and mortality. Currently assumed selectivity is smaller for age 1 in the first semester, where most of the catches are taken and natural mortality have decreased from 1.2 annual to 0.8 for ages 0 and 1 and has been maintained for the rest. Those assumptions lead to a greater stability of the population.

4.2 Sensitivity

The working group decided to make a sensitivity analysis to test the robustness of the base HCR to the assumptions about the coefficient of variation of the SSB observation (cv.ssb), the season share of the TAC (sh1) and the stock recruitment relationship used to predict future recruitment values. Once that it wasn´t possible to perform sensitivity analysis for all the cases studied, the EWG considered that testing the current HCR tookpriority.

In the base case definition, for consistency with previous assessment of the HCR performance, the coefficient of variation used for the SSB observation was 0.25. Nevertheless, as actually the assessment coefficient of variation ranges between 10 and 20%, the 0.15 value was tested (named BC_cv15).

Regarding the seasonal share of the TAC, the assumption in the base case is that the historical share is maintained. If the current TAC share by countries holds on at 80% (Spain) and 20% (France) and given the allocation of catches among semesters as follows:

IN percentage (Theoretical by Official Agreement)			
TOTAL CATCHES		1st Semeste	2nd Semeste
20%	France	0.1	0.9
80%	Spain	0.9	0.1

This will result in the following distribution of the international catches by semesters and countries:

Catches %	1st Semester	2nd Semester	Total
France	0.02	0.18	**0.2**
Spain	0.72	0.08	**0.8**
TOTAL	**0.74**	**0.26**	**1**

An alternative seasonal distribution of catches of 75% in the first semester (named BC_sh75) was also tested. Major changes outside this range should be explored as they may affect the performance of the HCR and the fisheries. In addition to alternative agreements that could be arranged between countries, the possibility of withholding and transferring part of the unutilised quota to the following fishing season (according to Article 4(2) of Regulation (EC) No 847/96) should be tested, as this right has been claimed in the last two years.

Finally, concerning the stock recruitment function used to predict future recruitment values, some of the SSB projected values are out of the range of the fitted values. Then, sensitivity of results to a stock recruitment model which does not assume density-dependence such as Beverton-Holt was explored (named BC_srBH), this was done because of there are not enough data at high SSB values (the right of the stock recruitment plot) to firmly support a decline in recruitment at high SSB which is an underlying assumption in the Ricker model.

In order to get comparable results within alternative cases, the same fixed random seed was used for the different alternative cases. Fixing the seed allows us to detect the differences due to the alternative assumptions, as we get the same values for the variables subject to uncertainty within the model in each case run. For the sensitivity testing, a 250 iterations simulation using the actual HCR in the long term management plan draft (with gamma 0.3) was performed. The SSB and catch projected values standardised to the base case ones are analysed (Figure 4.2).

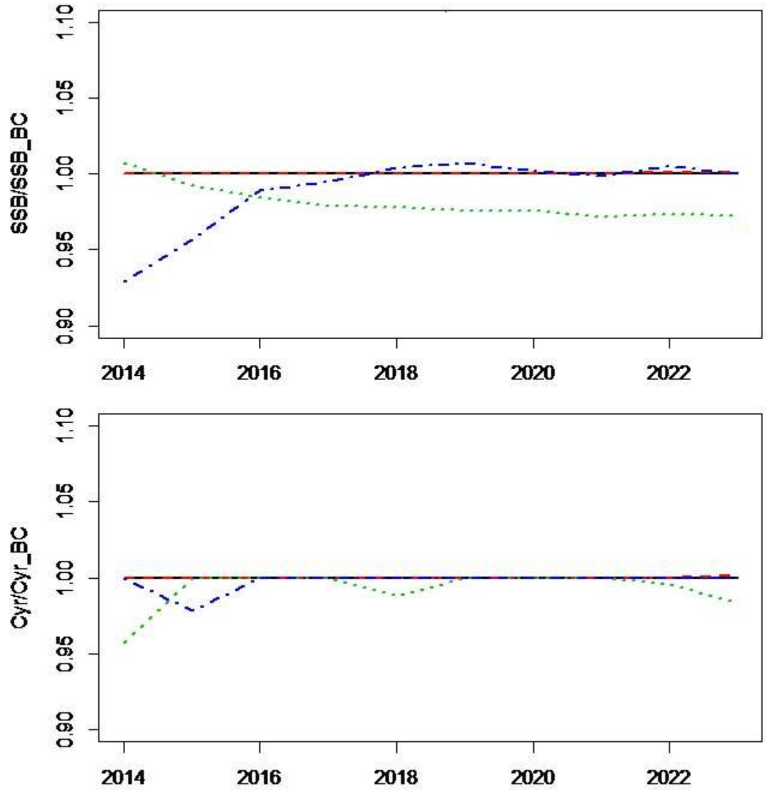


Figure 4.2Sensitivity analysis results to changes in the coefficient of variation for the SSB observation (cv.ssb), the season share of the TAC (sh1) and the stock recruitment relationship used to predict future recruitment values (sr). Top, SSB values relative to SSB in the base case and bottom, yearly average catches relative to those estimated in the base case. Cases: BC (cv.ssb=0.25, sh1=0.60, sr=Ricker), black solid line; BC_cv15 (as BC, with cv.ssb=0.15), red dashed line; BC_sh75 (as BC, with sh=0.75), green dotted line and BC_srBH (as BC, with sr=Beverton-Holt), blue dash-dotted line.

Table 4.3Probability of SSB being below B_{lim}, probability of closure, average TAC and probability of variability higher than 5000 tons for the current HCR under the following assumptions: BC (coefficient of variation for the SSB observation: cv.ssb=0.25, season share of the TAC: sh1=0.60, stock recruitment relationship used to predict future recruitment values: sr=Ricker), BC_cv15 (as BC, with cv.ssb=0.15), BC_sh75 (as BC, with sh=0.75), BC_srBH (as BC, with sr=Beverton-Holt).

Case	SSB ('000 t)	P(SSB<B_{lim})	P(closure)	TAC ('000 t)	P(TACdif<5000)
BC	67.217	0.067	0.081	20.193	0.396
BC_cv15	67.244	0.065	0.071	20.313	0.423
BC_sh75	66.170	0.076	0.086	19.976	0.398
BC_srBH	66.313	0.063	0.077	20.409	0.402

Changing the coefficient of variation for the SSB observation makes very little differences for the projected SSB values (<0.1%) and the expected yearly catches (<0.2%) for all the years. In terms of risks, the probability of closure is slightly smaller (1%) for the mean coefficient of variation estimated for the assessment (0.15), at the same time the probability of a TAC difference higher than 5000 tons is 2% higher. But the probability of SSB being bellow B_{lim} and the expected TACs are the same.

When we change the share by countries to the expected situation given the actual country shares and the agreements in place, the expected SSB values are smaller and those differences get increased along the years, reaching to a difference of 2.8% at the end of the 10 year period. The expected catches are also smaller, but differences are variable along the years. In terms of risks, the probabilities of SSB being bellow B_{lim} are slightly higher (<1%) and differences in the probability of fishery closure, expected TACs and TAC stability are negligible.

Finally, when considering a stock-recruitment relationship which is not density dependent (Beverton-Holt) the expected SSB values are smaller at the beginning of the projection period (7%), but stabilize at the same level at the end of the projection period. Differences in expected TACs are observed only in one of the projection years (2% smaller). In terms of risks and expected TACs and its variations along the years and iterations the differences are negligible.

To conclude, although some differences have been detected in the sensitivity analysis there are very small and they do not affect to the general performance of the rule.

4.3 Re-computation of the current TAC (Jul/13 – Jun/14) according to the new perception of the stock dynamics.

In September 2013 a new stock assessment method was adopted for anchovy by ICES (ICES, 2013a). The consistency between the biomass assessed for 2013 by the former and new stock assessment methods is very high, with differences smaller than 5% in the final years of the assessments (Section 2.4).

The 2013 ICES advice for anchovy in Subarea VIII given in June was based on the former methodology. This method was the basis to set up the current HCR, which is being used to set the TAC for anchovy since 2010. The SSB input for the HCR according to the ICES June 2013 advice was 56 055t leading the EC to set a TAC of 17 100t (as stated in Annex 1 of (COM(2009) 399 final)).

During the meeting the EC requested the experts to recompute the TAC value for the period July 2013 to June 2014, according to the estimates of SSB in May 2013 that resulted from the application of the new methodology. The median estimate for SSB in 2013 was 58 475t, which applying the HCR would allow catches for the period July 2013 to June2014 of 17 700t (in accordance with Annex 1 of(COM(2009) 399 final)).

It's important to note that the revised assessment (appearing in Annex 1 to the new anchovy stock annex -Table A.1, (11)), was not formally reviewed by ICES.

5 ADVISE ON A POSSIBLE REVISION OF THE HCR.

The HCR within the management plan proposed by the EC for the Bay of Biscay anchovy sets the annual TAC from July to June next year based on the latest spawning stock biomass estimate. While keeping the same type of HCR (i.e. TAC set as a function of some biomass estimate), the EWG considered that the HCR could be revised as follows:

1. Modify the parameters of the current HCR, such as the harvest rate, the maximum TAC, the minimum TAC or the biomass trigger points.

2. Add an additional upper biomass trigger point, $B_{trigger3}$ above which a constant maximum TAC would be set. This proposal was made by the SWWRAC.
3. Change the management period from July-June to January-December.
4. Include a mid-year revision of the TAC for any of the management periods considered.

The EWG evaluated options 1 and 2 using the management strategy evaluation (MSE) methodology described in Section 2.

This section presents the results obtained for options 1 and 2, and discusses the advantages and disadvantages of the alternatives regarding the management period and mid-year revisions of the TAC (options 3 and 4).

5.1 MSE evaluation of alternatives to the current HCR

The alternatives to the current HCR that were evaluated by MSE methods were a distinct set of harvest rates, between 0 and 0.5, that change the HCR parameterization (named CASE 0), and a HCR suggested by the SWWRAC that considers a maximum TAC lower than the current rule but to be applied at a lower value of SSB (named CASE 1).

5.1.1 Case 0 – current HCR with distinct parameterization

It consists on changing the harvest rate parameter (γ) to the current HCR. The annual TAC (in tonnes) is set for the period from July of year $y-1$ to June of year y (denoted by $TAC_{Jul_{y-1}-Jun_y}$) according to the spawning stock biomass estimate $\widehat{SSB}_{y-1}$ (corresponding to stock biomass on May 15th) as follows:

$$TAC_{Jul_{y-1}-Jun_y} = \begin{cases} 0 & , \text{ if } SSB_{y-1} \leq 24\,000 \\ 7\,000 & , \text{ if } 24\,000 < SSB_{y-1} \leq 33\,000 \\ \min(\gamma \; SSB_{y-1}, 33\,000) & , \text{ if } SSB_{y-1} > 33\,000 \end{cases}$$

The harvest rate values explored range from 0.2 to 0.5 with steps of 0.05. Harvest rates lower than 0.2 were not considered relevant given that for SSB_{y-1} values around 33000 tonnes would lead to TAC lower than the minimum economically viable TAC (TAC_{min}), which is set at 7000tonnes.

5.1.2 Case 1 – HCR suggested by the SWWRAC

This variation of the HCR was proposed by the SWWRAC. It consists on adding a new biomass trigger point in order to define a new biomass interval to which a constant TAC corresponds. Then, the annual TAC (in tonnes) is set for the period from July of year $y-1$ to June of year y (denoted by $TAC_{Jul_{y-1}-Jun_y}$) according to the spawning stock biomass estimate SSB_{y-1} (corresponding to stock biomass on May 15th).

$$TAC_{Jul_{y-1}-Jun_y} = \begin{cases} 0 & , \text{ if } SSB_{y-1} \le 24\,000 \\ 7\,000 & , \text{ if } 24\,000 < SSB_{y-1} \le 33\,000 \\ \gamma \ SSB_{y-1} & , \text{ if } 33\,000 < SSB_{y-1} \le 58\,000 \\ 25\,000 & , \text{ if } SSB_{y-1} > 58\,000 \end{cases}$$

As for case 0 (based on the formulation of the current HCR) harvest rates from 0.2 to 0.5 with steps of 0.05 were explored. The new biomass trigger point was set at 58 000 t and the maximum TAC TAC_{max} was equal to 25 000 tonnes.

5.1.3 Results

The main performance statistics for case 0 are given inTable 5.1andFigure 5.1. The probability of SSB being below B_{lim} in any year of the projection period increases from 0.04 for harvest rate of 0.2 to 0.12 for harvest rate of 0.5. The probability of the fishery being closed takes the value 0.06 when the harvest rate is 0.2, from which increases up to 0.13 when the harvest rate is 0.5. The average TAC also increases as the harvest rate increases, being between 16 400 and 23 500 corresponding to harvest rates 0.2 and 0.5 respectively. The probability of the inter-annual TAC difference being less than 5000 tonnes allows measuring the TAC stability. The larger the harvest rate, the larger the probability of the inter-annual TAC difference being less than 5000 tonnes.

Similar performance statistics were computed for the HCR variation proposed by the SWWRAC (Table 5.2 and Figure 5.1). The probability of SSB being below B_{lim} in any year of the projection period increases from 0.06 for harvest rate of 0.2 to 0.09 for harvest rate of 0.5. The probability of the fishery being closed increases from 0.08 for harvest rate of 0.2 up to 0.11 when the harvest rate is 0.5. Corresponding average TACs range between 18 100 and 20 100 for harvest rates between 0.2 and 0.5. The probability of the inter-annual TAC difference being less than 5000 tonnes increases as the harvest rate increases.

The performance statistics of the two HCRs (case 0 and case 1) are compared inFigure 5.1. The trends of the performance statistics (y-axis) depending on the harvest rate (x-axis) are similar for both cases. The probability of SSB being below B_{lim} and the probability of closure are lower for case 0 than for case 1 up to harvest rate 0.3. For harvest rates at and above 0.35 probability of SSB being below B_{lim} and the probability of closure are lower for case 1. The average TAC is higher for case 0 than for case 1 for all harvest rates except 0.2. The probability of the inter-annual TAC difference being less than 5000 tonnes is always larger for case 1 than for case 0, indicating a more stable TAC across years.

Table 5.1Probability of SSB being below B_{lim}, probability of closure, average TAC and probability of the inter-annual TAC difference being less than 5000 tonnes for different harvest rates for the current HCR (case0)

Case	Harvest Rate	P(SSB< B_{lim})	P(closure)	TAC ('000 t)	P(TAC_{dif}< 5000)
case0	0	0.013	1.000	0.000	1.000
case0	0.2	0.042	0.062	16.421	0.450
case0	0.25	0.054	0.073	18.685	0.424
case0	0.3	0.066	0.089	20.332	0.415
case0	0.35	0.078	0.100	21.545	0.428
case0	0.4	0.091	0.113	22.435	0.461
case0	0.45	0.104	0.128	23.005	0.498
case0	0.5	0.115	0.137	23.464	0.529

Table 5.2Probability of SSB being below Blim, probability of closure, average TAC and probability of the inter-annual TAC difference being less than 5000 tonnes for different harvest rates for the HCR proposed by the SWWRAC (case1).

Case	Harvest Rate	P(SSB< B_{lim})	P(closure)	TAC ('000 t)	P(TAC_{dif}< 5000)
case1	0	0.013	1.000	0.000	1.000
case1	0.2	0.057	0.079	18.108	0.638
case1	0.25	0.063	0.085	18.457	0.618
case1	0.3	0.068	0.089	18.796	0.592
case1	0.35	0.071	0.098	19.166	0.578
case1	0.4	0.077	0.102	19.503	0.642
case1	0.45	0.085	0.108	19.837	0.683
case1	0.5	0.091	0.113	20.050	0.710

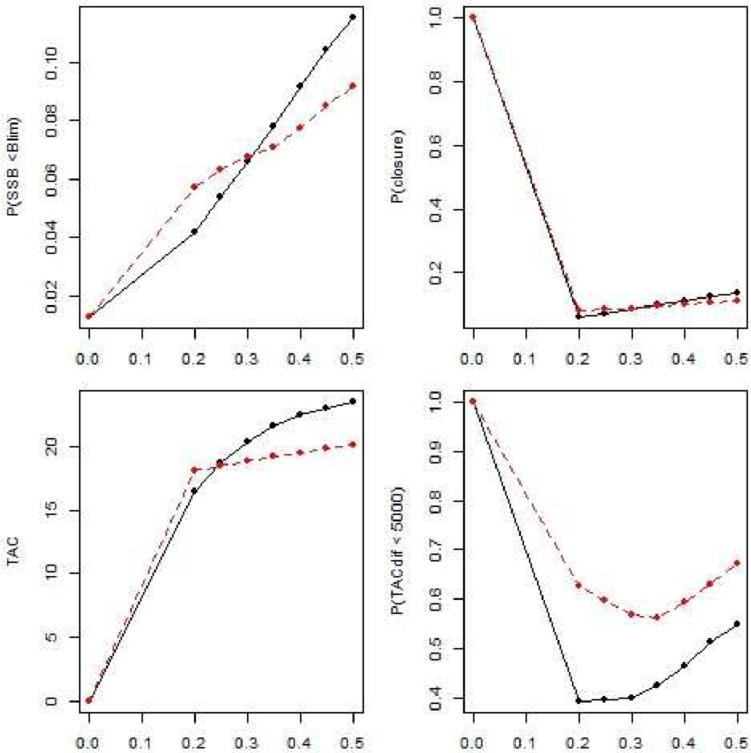


Figure 5.1Comparison of the performance statistics (y axis) as a function of the harvest rate (x axis) for the current HCR (case 0, in black) and the HCR proposed by the SWWRAC (case 1, in red). From top to bottom and from left to right the performance statistics are probability of SSB being below B_{lim}, probability of closure, average TAC and probability of the inter-annual TAC difference being less than 5000t.

To account for a minimum comparative economic analysis the net present value of future income was computed for each scenario using a discount rate of 0.05.

The value of landings was computed using the volume of landings projected between 2014 and 2024 by semester. The price function formulated in Section3.7 was used for the 1st semester, while for the second semester the average price of the period 2010-2013 was used.

Figure 5.2 shows the results by harvest rate for each HCR. The solid lines refer to the medians and dotted lines to the percentiles 0.05 and 0.95. The discounted present value of the landing income is lower in case 0 than in case 1 when the lambda parameter is lower than 0.4. After that, the value is higher in case 0 than in case 1. The maximum difference between both cases is reached when the lambda parameter is equal to 0.2. This means that in average the fleet will have higher incomes in case 1 but with case 0 the maximum income is larger.

Case 1 with a harvest rate of 0.3 showed biological risks similar to case 0 while showing higher catches in value. These results make the HCR proposed by the SWWRAC a promising alternative. Nevertheless, a thorough assessment is required to fully evaluate the performance of any alternative, which should be carried out in the next meeting, in the first quarter of 2014.

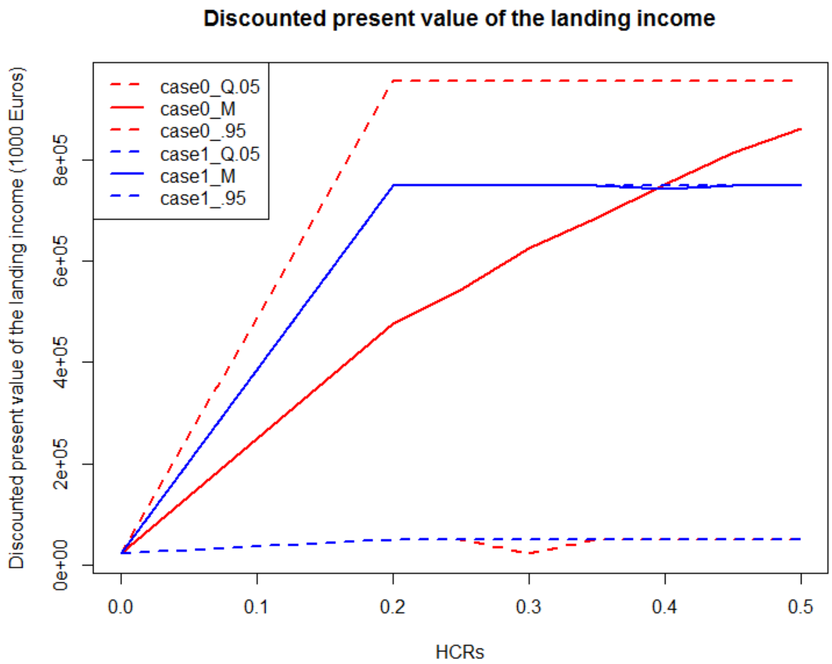


Figure 5.2Discounted present value of the landing income ('000 euros).

5.2 Changing the management period

A change in the management period from the current July to June calendar to a January to December calendar was considered under the view of practical implication in terms of assessment, advice and evaluation of management strategy.

Regarding the advice quality (Table 5.3), a January to December advice is estimated to a have better quality because recruitment is observed by the JUVENA survey, therefore no assumption has to be made about it. On the other hand projections may be needed if the advice is based on mid-year SSB.

The July to June advice is considered of lower quality because it requires robustness to the unknown recruitment level occurring during the management year. However the timing of the advice benefits from the fact that it is close from the spring PELGAS and BIOMAN surveys, which provide direct observation of the spring biomass on which to base the TAC and therefore do not need any projections of SSB.

For both calendars, the need for mid-year revisions was discussed. It was agreed that it might be necessary for monitoring purposes, especially if the spring or autumn observations reveal unexpected changes in the stock status.

For the July to June calendar, the mid-year (in December) revision of the TAC is of higher relevance because JUVENA brings new information of the magnitude of the upcoming recruitment for the next fishing season. The relevance of mid-year revision (in June) for the January to December calendar is lower than in the previous case because the magnitude of the recruitment is already informed by a survey when the initial TAC was set.

In order to accommodate changes in the period of the reference SSB for TAC settings, a revision of the HCR parameters may be required for the January to December calendar, while for the July to June calendar such revision is not needed.

If the HCR is based on the biomass in the 1st of January, the HCR parameters will have to be adjusted. Currently they're based on the SSB in May.The major advantage is that the biomass projection to the 1st of January will be informed by the recruitment estimates and the observed catches in year y, improving its precision.

Table 5.3Implications of a change in the calendar for assessment and advice.

Management period	Jul-Jun	Jan-Dec
Assessment time	In June (from May Surveys)	In Nov. (from Sept survey)
Assessment revision	Required if mid-year revisions are included in the HCR. May be necessary for monitoring purposes.	Required if mid-year revisions are included in the HCR. May be necessary for monitoring purposes.
Advice time	June	Dec
Projections	Not required	May be required if advice is based on mid-year SSB
Quality of advice	Lower. Will have a more timely estimation of biomass but not of R.	Higher. It includes the observation of R that will feed the fishery on the year after (advice year).
Relevance of mid-year revision of TAC	Higher. Need to assess impact of recruitment estimate from JUVENA.	Lower. Recruitment estimate from JUVENA included in the assessment revision.
Revision of HCR parameters to accommodate change in period of reference biomass.	Not required	May be required if advice is based on SSB or in the Biomass of 1st of January.

The group discussed the timing of assessment and advice in both cases, as well as the implementation of those calendars in terms of algorithms to be used for an MSE analysis.

With the current calendar going from July to June (Figure 5.3), the timing of assessment, advice and management requires to get at first biomass indices in May of year y. These indices come from the spring surveys. A second step is to apply the assessment model to estimate SSB in May from those indices, which is carried out in June. Then from the assessment of SSB, the harvest control rules are applied to provide a TAC for the management year which starts on the 1st of July of the current year until the end of June on the following year.

In November, an index of recruitment in year y (Ry) is generated. That index could be used as checkpoint. This would require some comparison of that index against some limits which could trigger a mid-year revision of the advice. Those limits and revision process are not discussed here.

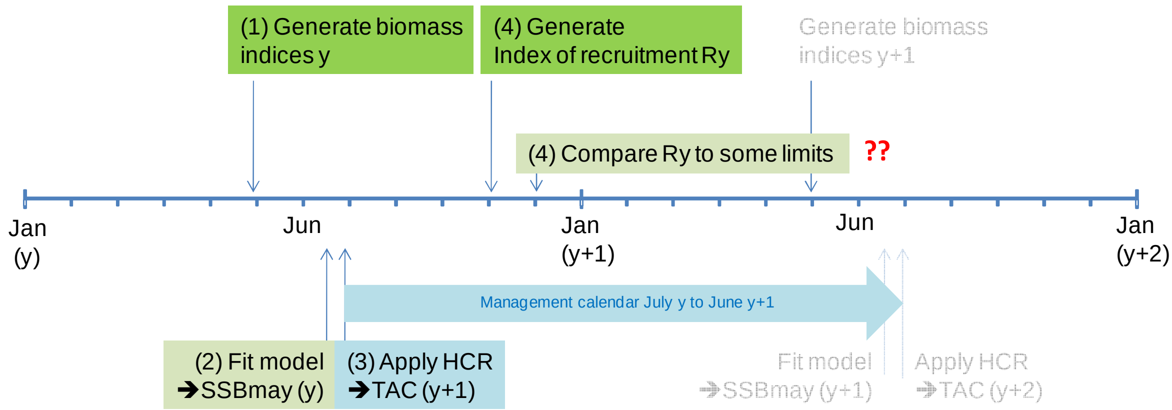


Figure 5.3Timing of assessment, advice and management for the July to June calendar.

In the case of the January to December management calendar (Figure 5.4), the assessment and advice for the upcoming year is carried out just before January of year y+1. It uses the information available from the spring survey (biomass indices) and autumn survey (index of recruitment) of year y. Since spring survey were already carried out 6 months before, the assessment model does not provide an estimate of biomass but a projection of the SSB to January of year y+1. However, the biomass projection is informed by the recruitment estimates and the observed catches in year y, which makes it more precise than a projection without either information. The HCRs are applied to the projected biomass in order to derive a TAC, that will be implemented in the following year. An alternative is to project SSB up to May y+1 and apply the HCR to this biomass, as it's currently done. Such projections would in addition act as a checkpoint to be compared with the spring survey indices afterwards. As before, this checkpoint could trigger if needed a mid-year revision of the SSB. The triggers and process of mid-year revision are not discussed here.

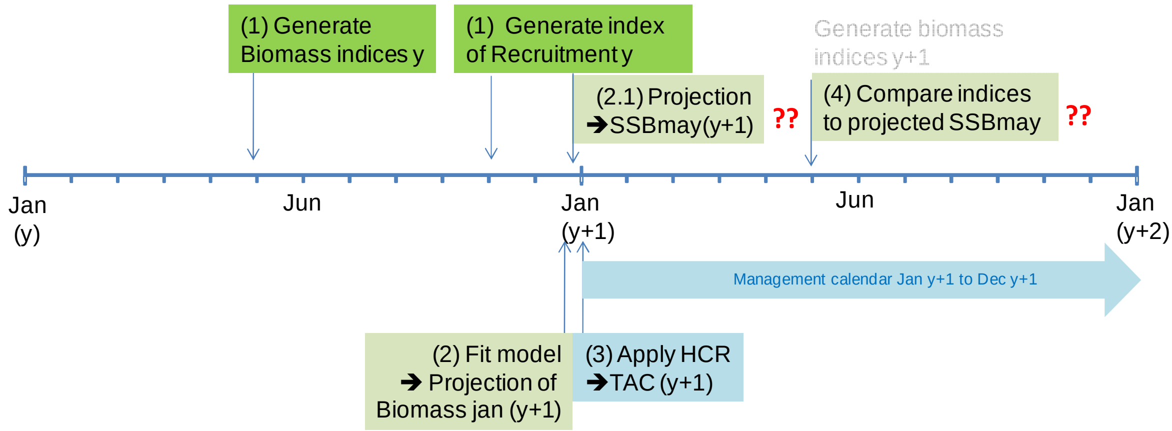


Figure 5.4Timing of assessment, advice and management for the January to December calendar.

5.3 Mid-year TAC revision

A potential mid-year revision of the TAC to be added to the candidate HCRs was discussed by the EWG, including the stakeholders present.

The option of having a mid-year revision to adjust the TAC every year based on new information was rejected. The group and stakeholders considered this option prone to create a large instability on the catches, scientifically/technically difficult to compute and legally too complex to implement.

The option of an alarm revision that could be triggered in case of a drastic deterioration of the stock status was considered relevant to test, although the technical details and the legal framework required to implement this option are still unclear.

The EWG considered these tests to be of lower priority than the tests about alternative HCR, alternative harvest rates and changes in the management period.

The rationale behind an alarm trigger for the HCRs being tested is a) to trigger a revision of the TAC in the current year if when re-assessed in light of within year information, it's found to create a large risk of SSB falling below B_{lim}; b) if the alarm is triggered reduced the TAC by the minimum amount required for the catches to still lead to the SSB at the end of the year to be above $B_{trigger1}$.

In the case of a July to June management period, the evaluation of risk is made adding the recruitment observation and volume in catches. Whereas In the case of a January to December management period this evaluation will be made including the output from the direct monitoring of the spawning population in the spring (Acoustic and DEPM surveys) which would produce the most up to date assessment of the spawning stock. In both cases the updated perception of the stock can be compared with the undesirable low levels of spawning biomass like $B_{trigger1}$.

6 Evaluate the long-term plan (scoping)

The group carried out a preliminary evaluation of the long term management plan using the data available. The objectives of this exercise were:

- to identify the most obvious patterns,
- to identify data and methods required for a full evaluation,

- to assess what can be expected from a full evaluation.

To support the analysis a dataset of landings (by country and by month), average prices (by countries and by month), number and technical characteristics of vessels was built during the meeting by the experts. The sources of data used were the SWWRAC (data provided to the meeting), ICES working groups (ICES, 2013a) and (ICES, 2011), STECF (STECF, 2008b) and the French Directorate for Sea Fisheries and Aquaculture (DPMA).

The dataset available through the Annual Economic Report is aggregated at the national level and it's not possible to disaggregate it at the level of vessel subgroups targeting anchovy in the Bay of Biscay. This disaggregation of the data is insufficient to allow an assessment of the fisheries on stocks that form only part of the fishery at the moment.

6.1 Landings of Anchovy

The landings volume has a high variability over the time series probably due to the variability of the resource (Figure 6.1). From year 2005 to 2009 landings were very small or none due to the fishery closure. After the anchovy closure landings recovered to levels similar to those in the period 2002-2004.

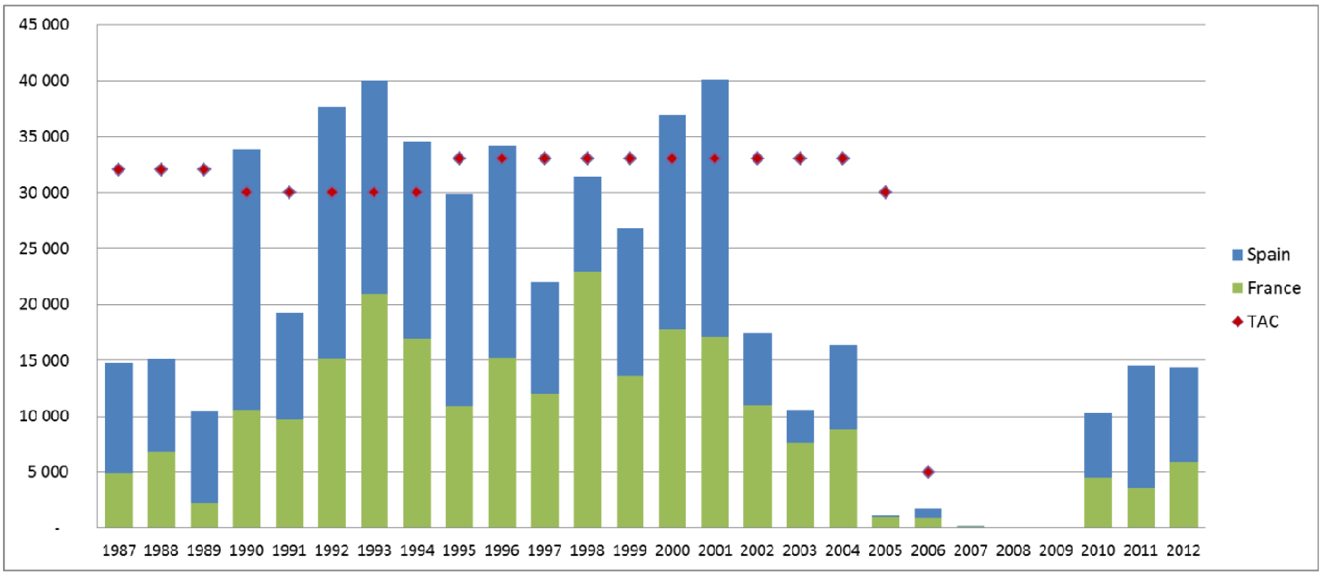


Figure 6.1- Landings and TAC for anchovy in the Bay of Biscay (tons) from 1987 to 2012 from French and Spanish vessels. Source:(ICES, 2013a)&(ICES, 2013c).

The volume of landings of Anchovy in the Bay of Biscay has followed a decreasing trend from more than 40 000 tonnes in 1993 to 14 500 tonnes in 2012 (after the fishery closure from 2005 to 2009 (Figure 6.1). The value of the landings after the fishery closure amounted to 13.6 million euros in 2012 (Table 6.1). After the closure, the Spanish fleet accounted for the biggest share of landings by weight (from 56% to 75%). In terms of value, the French fleet reached 34% of the total landings value in 2012.

Table 6.1Landings volume (tons) and value (1000€) of anchovy in the Bay of Biscay from 2000 to 2012 from French and Spanish vessels Source: 2000-2004(STECF, 2008b); 2010-2012 SWWRAC.

Year	2000	2001	2002	2003	2004	Closure	2010	2011	2012
Spain									
Landings(tons)	19 230	23 052	6 519	3 002	7 580		4 720	9 106	8 258
Value (1000 E)	30 768	36 883	19 557	14 109	23 725		12 812	21 015	18 375
France									
Landings(tons)	17 765	17 097	10 988	7 593	8 781		2 748	2 943	5 380
Value (1000 E)	28 424	27 355	32 964	35 687	27 485		2 508	4 595	9 569
Total									
Landings(tons)	36 995	40 149	17 507	10 595	16 361		7 468	12 049	13 638
Value (1000 E)	59 192	64 238	52 521	49 796	51 210		15 320	25 610	27 944

The landings profile by month has changed in the case of the French fleets (Figure 6.2). French vessels are fishing essentially at the end of summer with maximum landings reached in September. However, since the closure, French landings from January to June were reduced to a very low level. That can be due to both quota decrease and change of management calendar (from June Y to July Y+1), meaning that at the end of December the quota could have been exhausted. However, this could also be due to the agreements between Spanish and French fishermen organizations to close the fishery during the winter.

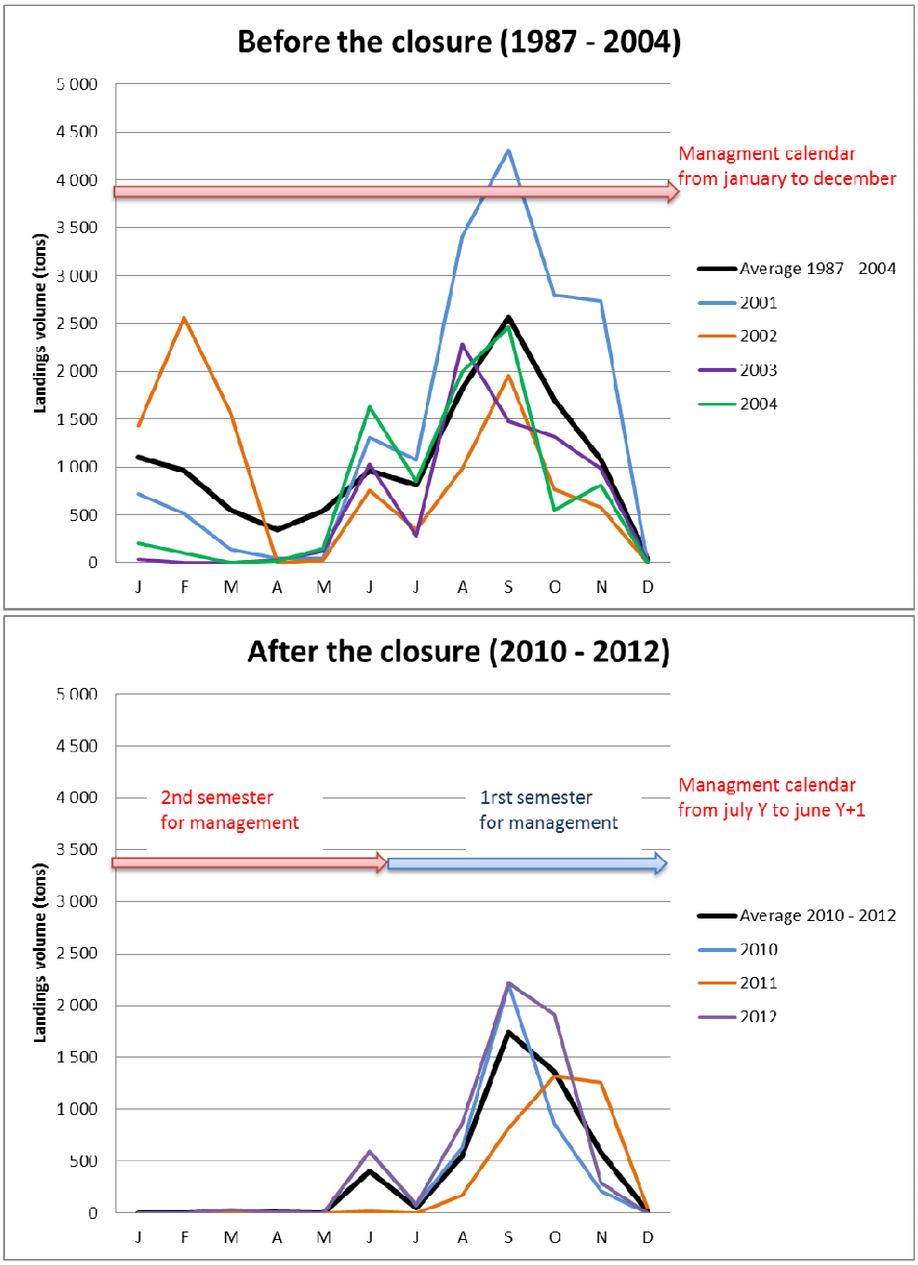


Figure 6.2Monthly landings of Bay of Biscay (VIII) anchovy by French vessels before and after the closure of the fishery. Source:(ICES, 2013a)

In the case of Spain, the fishing period still occurs during spring with maximum landings reached in May (Figure 6.3). However, after the closure, the Spanish fleet seems to begin its anchovy season a bit earlier with a bigger proportion of landings in March and April. This pattern could be due to the earlier ending of the mackerel fishery season, driving Spanish seiners to move to the anchovy fishery earlier.

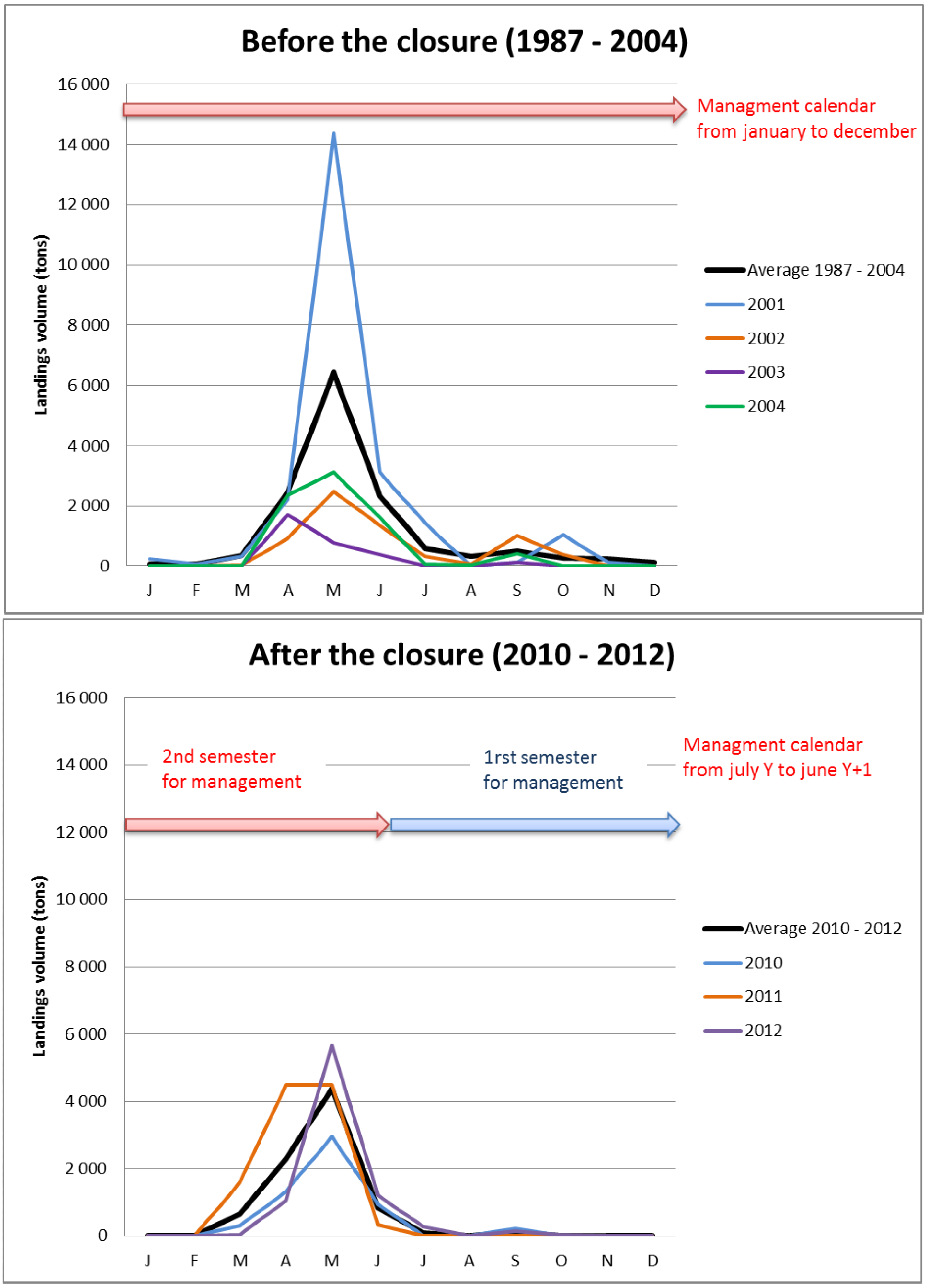
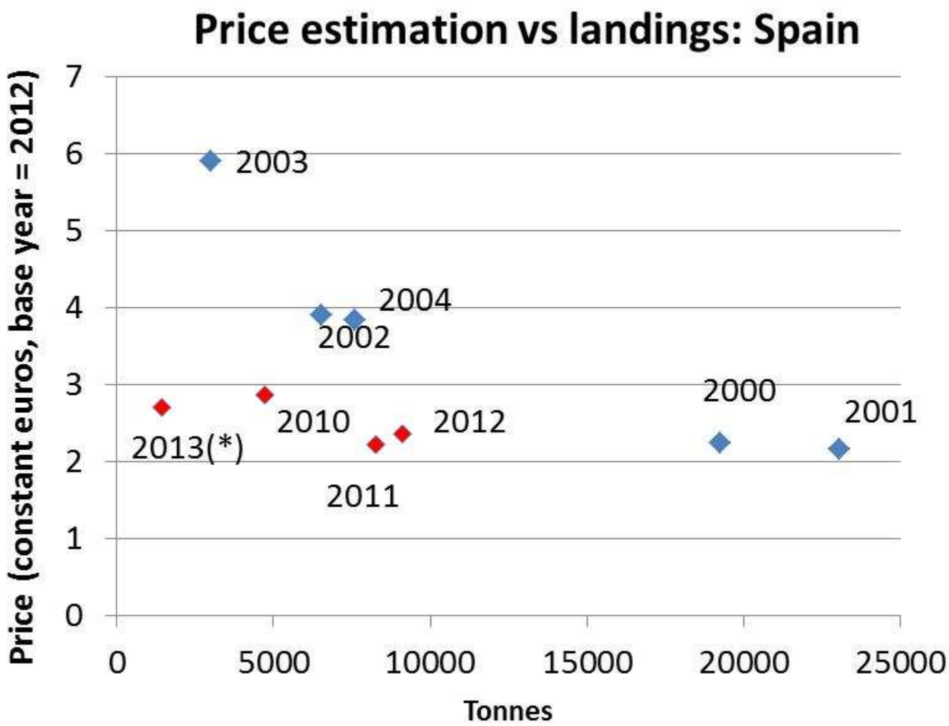


Figure 6.3Monthly landings of Bay of Biscay (VIII) anchovy by Spanish vessels before and after the closure of the fishery. Source:(ICES, 2013a).

6.2 Prices

Prices of anchovy have suffered a structural change after the fishery closure, asFigure 6.4 shows. One of the reasons that could have affected the price of anchovy in 2010 was the fact that the fishery was closed for approximately 5 years, and consequently, the closure has left a market niche. This market niche has been filled by anchovies from other places(Andrés M. , 2011), inducing a decrease in the Bay of Biscay anchovy prices.



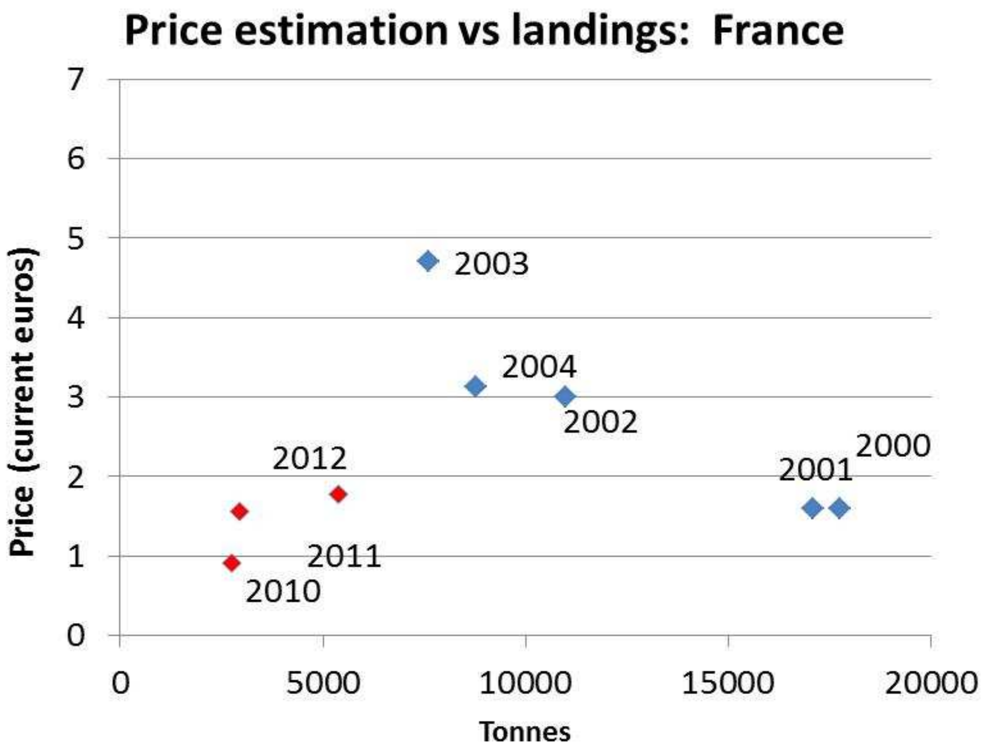


Figure 6.4Total landings and average prices of the anchovy. Source: STECF 2008b and data of SWWRAC.

Given the decrease of the price after the closure, it has to be taken into account that the stock collapse not only affected the landings, but also the market. Additionally, there are differences between prices achieved by each country, as Figure 6.5 shows. Price is apparently related to the amount of landings. In general terms, it can be said that the price in the first semester is higher than in the second semester.

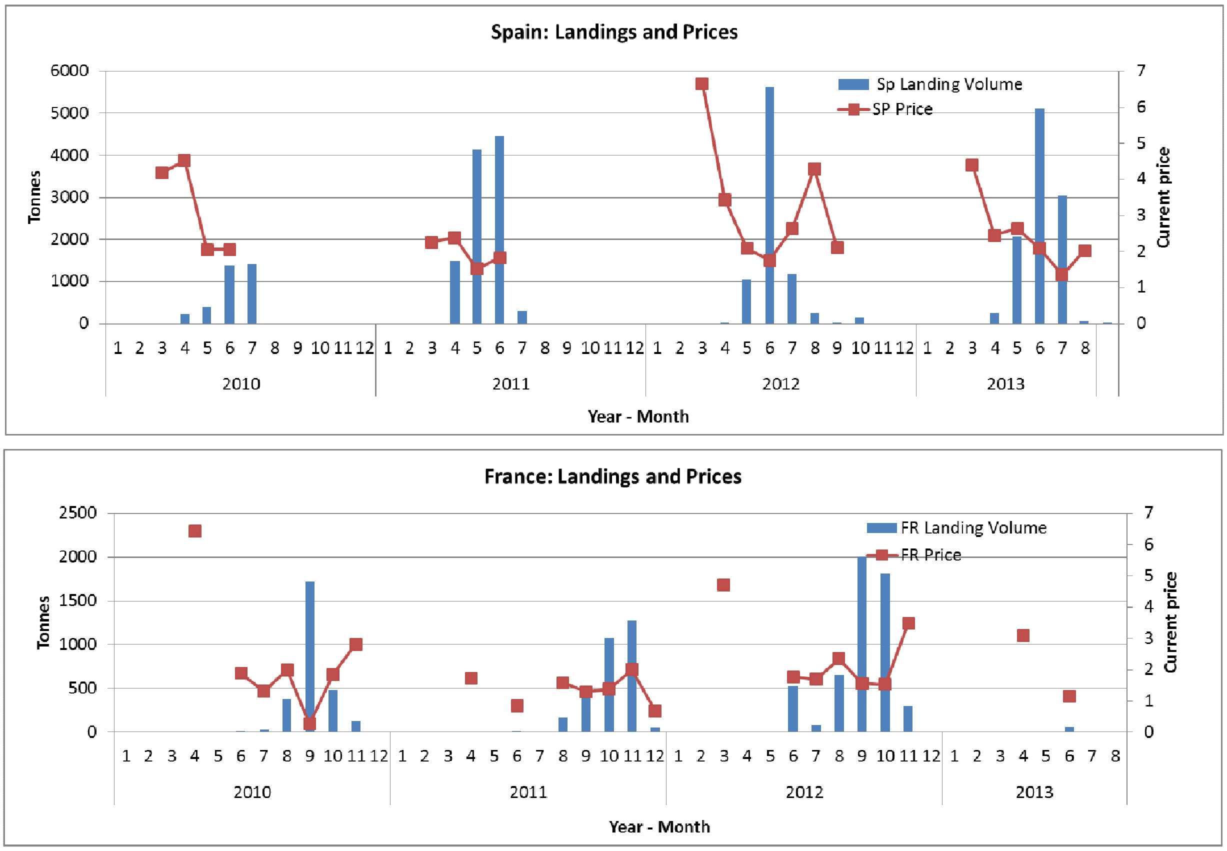


Figure 6.5Landings and average price by month. Source: SWWRAC.

6.3 Fleet Evolution

The total number of fishing licenses for anchovy in Spain increased from 159 in 2012 to 162 in 2013. The distribution by regions is as follow: País Vasco 38; Cantabria 40; Asturias 9 and Galicia 55(ICES, 2013a). The time series of the number of licenses has a decreasing trend in the case of the Spanish fleet (Figure 6.6). The decreasing trend started before the anchovy closure, especially from year 2000. This implies that the decrease in the fleet cannot be solely attributed to the closure of the anchovy fishery.

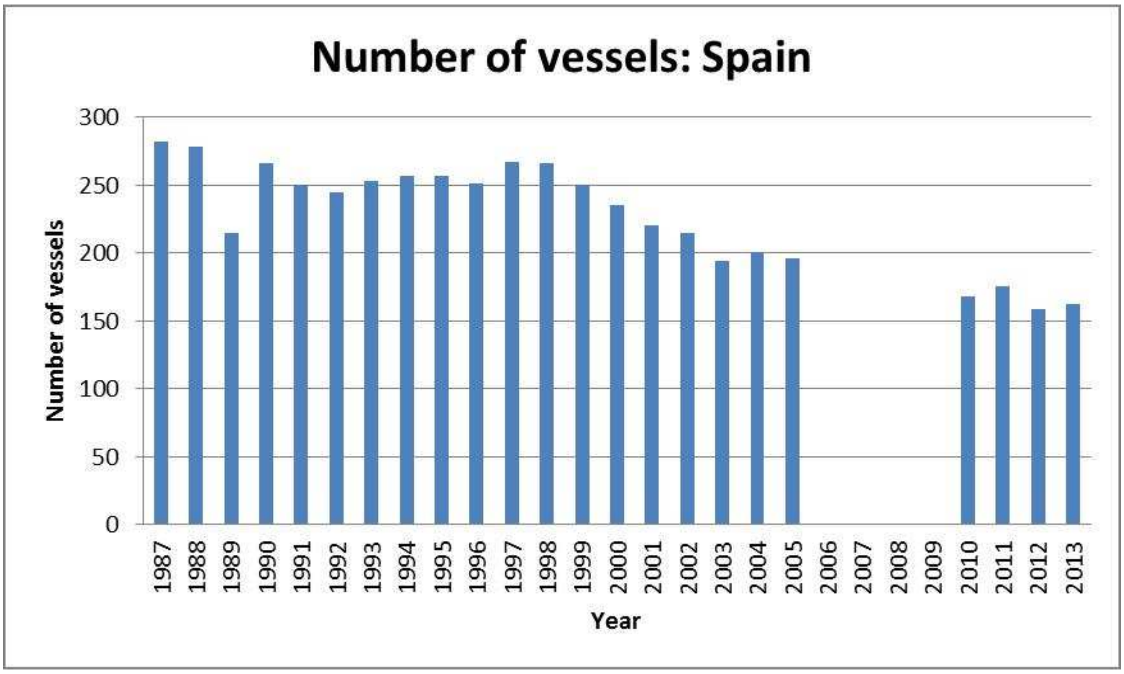


Figure 6.6Fishing licenses in Spain. Source:(ICES, 2013a).

In the case of the Spanish fleet, the technical characteristics of the fleet (Table 6.2) have been estimated from a sample of 144 vessels in 2012 (91% of the total).

Table 6.2Average technical characteristics of the Spanish vessels. Source: AZTI.

Year 2012	Average technical characteristics
Length (meters)	27
Engine power (CV)	425
Tonnage (GT)	125

The French anchovy fishery in ICES area VIII has been under license schemes since 2008 and decommissioning schemes were implemented, especially in 2007 to reduce the size of the fleet. The number of purse seiners allowed to catch anchovy in 2013 was around 30 (Figure 6.7). The exact number of vessels is not fixed, due to important movements in this fleet. Most of them are based in Brittany. The number of Basque purse seiners decreased progressively and some of them joined the North of the Bay of Biscay two years ago. The main target species of these vessels measuring 15 meters long in average is sardine, and fishing for anchovy is more opportunistic.

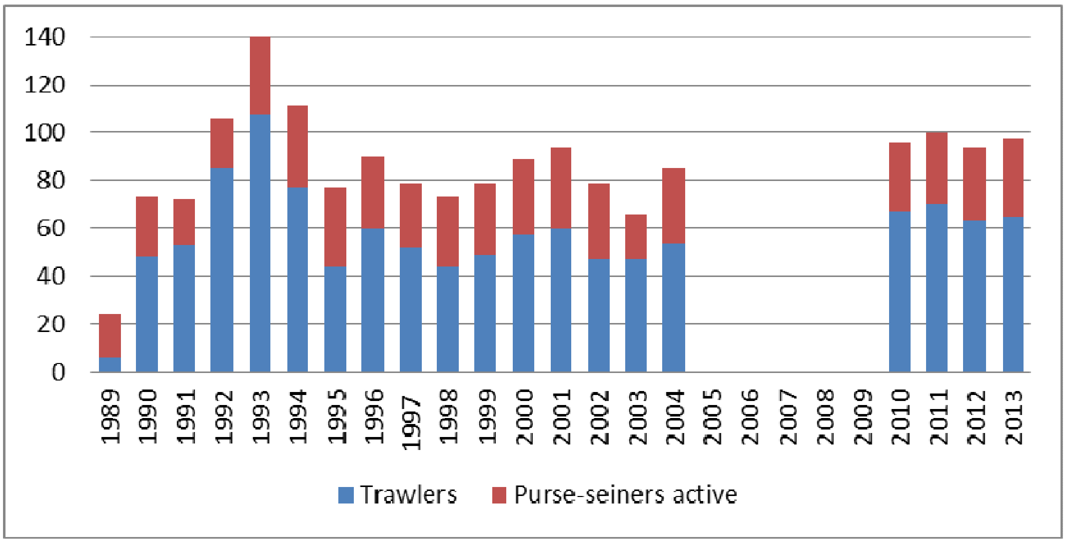


Figure 6.7Evolution of French vessels involved in the anchovy fishery. Sources: 1989-2004(ICES, 2013a); 2010-2013 French Directorate for Sea Fisheries and Aquaculture. Vessels selection for 1989-2004: (1) Only purse seiners having catch anchovy at least once a year but fishing sardine most of the time, and (2) Only trawlers that targeted anchovy (annual catch > 50 t). Vessels selection for 2010-2013: French vessels under the license scheme.

The number of French pelagic trawlers decreased drastically during recent years because they were anchovy dependent. In 2013, 65 trawlers operated under license on the anchovy Bay of Biscay fishery. 47 licenses were delivered to "active trawlers" that are mainly pairs of pelagic trawlers of around 20 meters long with an average engine power of 354 kW (Table 6.3). 18 licenses were delivered to "occasional trawlers": they are less anchovy dependent than the others and some of them are demersal trawlers targeting *Nephrops* as a main metier.

Table 6.3Number of vessels and average technical characteristics of French vessels under license scheme in 2013. Source:French Directorate for Sea Fisheries and Aquaculture.

	Purse-seiners	Active trawlers	Occasional trawlers
Number of vessels	32	47	18
Length (m)	15,4	18,8	13,7
Engine power (kW)	213	354	219
Tonnage (GT)	37	94	34

6.4 Conclusions

An evaluation of the plan will always be limited by the short time series since the implementation of the HCR and the fact that the fleet has not caught all their fishing opportunities, which means that TAC may not be controlling the fishery.

From the analysis done in the current report, there is evidence that the closure of the fishery affected the fleet, which is in agreement with(Andrés & Prellezo, 2012).

The French quota limitations may impact the way the French fleet organises their fishing activities.

To perform a full evaluation it's necessary to have information about effort, catches of other species than anchovy and economics by fleet.

7 ASSESS IMPACTS OF POSSIBLE CHANGES TO THE PLAN (SCOPING)

The EWG discussed the possibility of having to carry out in the future a set of analysis to support an impact assessment for the Bay of Biscay Anchovy long-term plan regulation.

A clear perspective of the tasks to be executed and the range of options to be tested were discussed among experts, with the RAC representatives and with the French and Spanish administrations.

It's important to note that the workload associated with these developments was not clearly assessed. However, the time needed to condition the MSE, including the economic component, it's considerable. This task will involve getting the data, integrate cases studies, made some improvements in the code and check the code.

To make progress the EWG identified the candidate HCRs, a list of performance statistics, model developments and data requirements.

7.1 Candidate HCR

Based on the analysis performed for the evaluation of the current HCR and the alternatives tested (Sections 4 and 5), the EWG agreed that the following set of HCRs should be included in the next round of tests:

- Current HCR with harvest rates between 0.2 and 0.5.
- HCR suggested by the SWWRAC with harvest rates between 0.2 and 0.5.
- HCR for a management period from January to December.
- HCRs subject to an in-year revision of the initial TAC according to an update assessment of the stock status (Basically alarm triggered revisions).
- HCR based on an escapement level of SSB.

A working document (11) presented to the EWG described a set of HCRs which can be taken as a starting point.

The practical implications of moving the management period from June to July to January to December and the introduction of a mid-year revision of the TAC are discussed in Sections 5.2 and 5.3. The discussions presented should be taken into account when designing the simulation study.

The new HCR should include a protocol with clear indications about how to react in the event that part of the knowledge base information for advice is missing, such as the failure of any of the direct monitoring surveys.

7.2 Performance statistics

The performance indicators used in the current report to assess the performance of the tested HCR were similar to those covered in the 2008 report and are listed in Section3.7.

The SWWRAC showed their interest for indicators on the probability of fishing closures linked to depletion of the stock, mean catches in 10 years and inter-annual variability.

All these indicators were included in this report and considered appropriated by the EWG. More indicators can be included if required or found necessary by the EWG.

7.3 MSE developments

The EWG discussed the MSE developments needed to run a thorough analysis of the management plan. It was considered that the same software platform should be kept (R/FLR/FLBEIA).

The developments identified were:

- Full feedback. It may be possible to mimic the assessment model by implementing the two stage model as a likelihood model instead of the current bayesian model. In this case the stock assessment model could be included within the management procedure.
- Model low recruitment periods. Small pelagics are subject to recruitment failures or periods of low productivity. As such it's important to test the HCRs robustness to low recruitment periods, e.g. using autocorrelation of residuals around the stock recruitment relationship or hypothesis of regime shifts.
- Parametrize the economic sub-model. The fleet component incorporated has four processes: (i) effort allocation (total effort and its allocation among metiers), (ii) catch – production (Cobb Douglas), (iii) price formation (fixed or elastic price), (iv) capital dynamics (investment and disinvestment in vessels or technology. For more details, see(García, Sánchez, Prelllezo, Urtizberea, & Andrés, submitted).
- Model TAC undertake. There are several reasons for the fleets not using their fishing opportunities fully. Anchovy is not the only source of revenues and the quotas and prices of alternative species will affect the effort allocated to anchovy. The capital dynamics affect the number of vessels, which will have an impact in the effort deployed and the catches of anchovy.
- Model “borrow and banking” of quota fractions.

7.4 Information required and source.

The EWG identified two sets of data needed to carry out a thorough analysis of the long-term plan.

The first one is based on transversal variables, effort, landings and price (Table 7.1). These are necessary to analyse the behaviour of the fleet, effort allocation and revenues of the fleets.

The second dataset (Table 7.2) is based in economic variables, costs, wages, employment, etc. These data are necessary to implement economic component to the FLBEIA model.

Table 7.1Data of effort, landings (volume and value), and price needed for the FLBEIA – economic model.

1. Effort, landings and price data			
Period:	From 2000 to 2012		
Selection of vessels per fleet			
	France : a list of vessels involved in the anchovy fishery will be communicated per fleet and per year		
	Spain : Pelagic Purse Seiner operating in the Cantabric Sea involved in the anchovy fishery		
Data time step:	By month or year		
Data	**Unit**	**Name**	**Disagregation**
Landing of anchovy - Tonnes	Tonnes	Ld_Ane_Tn	By fleet, month. * If it is avalible, also catches by size/length or age
Landing of anchovy - Euros	Euros	Ld_Ane_Eu	By fleet, month. * If it is avalible, also catches by size/length or age
Landing of all other species -Tonnes	Tonnes	Ld_oth_Tn	By fleet, month.
Landing of all other species -Euros	Euros	Ld_oth_Eu	By fleet, month.
Effort allocated to anchovy	Days or Trips length (hours)*	Eff_Ane	By fleet, month
Effort allocated to all other species	Days or Trips length (hours)*	Eff_Oth	By fleet, month
Total number of vessels operating in the anchovy fishery**	Number	NV_T	By fleet, year
Number of vessels catching anchovy**	Number	NV_Oth	By fleet, month
Number of vessels catching other species**	Number	NV_Ane	By fleet, month
Number of vessels catching anchovy**	Number	NV_Oth	By fleet, semester
Number of vessels catching other species**	Number	NV_Ane	By fleet, semester
*for French vessels, estimation of the duration of the trip in hours			
**based on the selection of vessels involved in the anchovy fishery			

Table 7.2Economic data needed for the BLBEIA – economic model.

2. Economic data			
Period:	From 2000 to 2012		
Selection of vessels per fleet			
	France : a list of vessels involved in the anchovy fishery will be communicated per fleet and per year		
	Spain : Pelagic Purse Seiner operating in the Cantabric Sea involved in the anchovy fishery		
Data time step:	By year		
Data	**Unit**	**Disagregation**	**Acronym DCF**
Income from landings	1000 euros	By fleet	totLandgInc
Direct subsidies	1000 euros	By fleet	totDirSub
Other income	1000 euros	By fleet	totOtherInc
Wages and salaries of crew	1000 euros	By fleet	totCrewWage
Imputed value of unpaid labour	1000 euros	By fleet	totUnpaidLab
Energy costs	1000 euros	By fleet	totEnerCost
Repair and maintenance costs	1000 euros	By fleet	totRepCost
Other variable costs (not including energy cost)	1000 euros	By fleet	totVarCost
Non-variable costs	1000 euros	By fleet	totNoVarCost
Annual depreciation	1000 euros	By fleet	totDepCost
Investments in physical capital	1000 euros	By fleet	totInvest
FTE (national)	Number	By fleet	totNatFTE
Energy consumption	Litres	By fleet	totEnerCons
Number of vessels	Number	By fleet	totVes
Maximun days at sea	Number	By fleet	MaxSeaDays
Crew share	%	By fleet	

8 CONCLUSIONS

The EWG concluded that the HCR described in the EC proposal for a long-term plan for anchovy in the Bay of Biscay (COM(2009)399 final), can still be applied to set the TAC for the fisheries exploiting that stock. The analysis carried out by the EWG showed that the current HCR:

- performs well (Sec.3.1), showing low biological risk (P[SSB<Blim] = 7%), a small probability of having a closure during the study period (9%), an average TAC during the study period of 20 300t;
- performs slightly better when compared with the previous evaluation, which also showed low biological risk (P[SSB<Blim] = 7%), but a slightly larger probability of having a closure during the study period (12%), and lower average TAC, 17 400t (Sec.3.1);
- presents 42% probability of having a 5 000t change in the TAC between consecutive years, which the EWG considered acceptable in terms of stability for this species;

- is robust to the major assumptions made during this exercise (Sec.3.2).

A set of alternative HCRs were identified in dialogue among experts, stakeholders and managers (Sec.6.1), as well as a set of performance statistics (Sec.2.7). From these a subset was tested (Sec.4.1) with simulations. The alternative proposed by the SWWRAC showed biological risks similar to the current HCR, while showing lower catches but higher stability. Changes in the management period and mid-year revisions of the TAC were discussed (Sec.4.2 and Sec.4.3, respectively), but it wasn't possible to perform simulation tests of these options. Nevertheless, a thorough assessment is required to fully evaluate the performance of any alternative, which should be carried out in the next meeting, in the first quarter of 2014.

The EWG discussed the possibility of carrying out, in the future, a set of analysis to support an impact assessment for the Bay of Biscay Anchovy long-term plan regulation. A clear perspective of the tasks to be executed and the range of options to be tested, were discussed among experts, with the RAC representatives and with the French and Spanish administrations. To make progress the EWG identified the candidate HCRs (Sec.6.1), a list of performance statistics (Sec.2.7), MSE developments (Sec.6.3) and data requirements (Sec.6.4).

The EWG suggests that a light procedure is used to call for the data required. The data can be managed by the chair of the EWG, avoiding the regular data-call management procedures involving database development, administration, data upload tools, coverage reports, etc.

The participation of stakeholder was highly appreciated and contributed to the successful progress made by the EWG, including setting the range of HCR to be explored, contributing with data and, in general, contributing to the discussions.

The EWG considered that an evaluation of the long-term plan will always be limited by the short time series. The implementation of the HCR started in 2010. Furthermore, the fleet have not caught all their fishing opportunities, which suggests that TAC may not be controlling the fishery, making it more difficult to evaluate the effect of the HCR.

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ANNEX I – AGENDA

Day 01

Intro (chair, MARE & STECF);

ToR 1: Presentation of the simulations (AZTI);

ToR 1: Discussion about the simulation and suggestions for more, if needed (group).

Day 02

ToR 2: Open discussion about alternative HCR. For now it seems to be focused on the management period and mid-year revisions of the TAC based on surveys (Andres will introduce this subject).

ToR 3: Evaluation of the plan (scoping). Set up a workplan and identify the analysis and information needed to evaluate the impact of the management plan. (Marga will present the economic part, Finlay will present methods being developed by JRC).

ToR 1: Run simulations and prepare outputs for discussion.

Day 03

ToR 1: Presentation of the simulations followed by discussion.

ToR 4: Open discussion about which HCR should be picked up from ToR 1 and 2 to prepare an impact assessment.

Day 04 and Day 05

Report drafting.

ANNEX II – SIMULATIONS

In this annex all the results of the evaluation of the different HCRs obtained during this meeting are given. The list of the HCRs considered and the names used throughout this annex are given in Table 0.1.

The performance statistics calculated for each of the HCRs are the following:

- Median Spawning Stock Biomass across years and iterations.

- Median of the SSB in the last year of the projection period across iterations.

- Probability of the SSB falling below B_{lim} in any year of the projection period

$$\frac{\sum_{iter,y} I\left[SSB_{iter,y} < B_{lim}\right]}{N_{iter} N_y}$$

- Probability of the SSB falling below B_{lim} at least once in the projection period

$$\frac{\sum_{iter} I\left[\left(\sum_{y} I\left[SSB_{iter,y} < B_{lim}\right]\right) \geq 1\right]}{N_{iter}}$$

- Probability of the fishery being closed (i.e. TAC=0) in any year of the projection period

$$\frac{\sum_{iter,y} I\left[TAC_{iter,y} = 0\right]}{N_{iter} N_y}$$

- Probability of the fishery being closed at least once in the projection period

$$\frac{\sum_{iter} I\left[\left(\sum_{y} I\left[TAC_{iter,y} = 0\right]\right) \geq 1\right]}{N_{iter}}$$

– Average catch (in tonnes) across years and iterations

$$\overline{C} = \frac{\sum_{iter,y} C_{iter,y}}{N_{iter} N_y}$$

– Average standard deviation of the catch

$$\frac{\sum_{iter} sd_y(C_{iter,y})}{N_{iter}} = \frac{\sum_{iter} \sqrt{\frac{\sum_y \left(C_{iter,y} - \overline{C}_{iter}\right)^2}{N_y - 1}}}{N_{iter}}$$

i) Probability of the inter-annual change of the TAC being within the 30% of the range across years in any randomly chosen year of the projection period:

$$\frac{\sum_{iter,y} I\left[\left|TAC_{iter,y+1} - TAC_{iter,y}\right| < 0.15\mathrm{Range}_y\left(TAC_{iter,y+1} - TAC_{iter,y}\right)\right]}{N_{iter} N_y}.$$

j) Probability of the inter-annual change of the TAC being less than 5000 tonnes in any randomly chosen year of the projection period:

$$\frac{\sum_{iter,y} I\left[\left|TAC_{iter,y+1} - TAC_{iter,y}\right| < 5000\right]}{N_{iter} N_y}.$$

In the above equations $SSB_{iter,y}$, $C_{iter,y}$ and $TAC_{iter,y}$ denote respectively the Spawning Stock Biomass, the catch and the TAC in year *y* and iteration *iter*, whereas N_y and N_{iter} are the number of years in the projection period and the number of iterations in the simulation. $I()$ is an indicator function that takes the value 1 if the condition within the brackets is fulfilled and 0 otherwise.

The performance statistics for the current HCR (case0) and for the variant proposed by the SWWRAC (case1) are given in Tables Table 0.2 and Table 0.3. Such of sensitivity analysis are given in Tables Table 0.4 and Table 0.5.

The dynamics of the population and the fleet for each case are shown in Figures A2.1-A2.16. Each of the figures summarises the recruitment (age 0 million of individuals at the beginning of the second semester), the spawning stock biomass (in thousand tonnes), the annual catch (tonnes from January to December) and the harvest rate (ratio between the annual catch and the spawning stock biomass) across years.

Table 0.1List of HCRs evaluated during this meeting.

Name	Type of HCR	Management calendar	Variation wrt the current HCR	HCRs parameters		
				harvest rate	biomass trigger points	TACmin, TACmax
Case 0	TAC is based on the last year SSB estimate	July-June (no mid-year revision)	Change in the harvest rate	from 0.2 to 0.5 with steps of 0.05	24000, 33000	TACmin=7000 t TACmax=33000 t
Case 1	TAC is based on the last year SSB estimate	July-June (no mid-year revision)	SWWRAC proposal: Include a new biomass trigger point with constant TAC	from 0.2 to 0.5 with steps of 0.05	24000, 33000, 58000	TACmin=7000 t TACmax=25000t

Table 0.2Performance statistics for the projection period (2014-2023) for the current HCR (case 0) depending on the harvest rate

Case	Harvest Rate	SSB ('000 t)	SSB_{2023} ('000 t)	$P(SSB<B_{lim})$	$P(SSB<B_{lim}$ once)	Nb yr $SSB<B_{lim}$	Nb yr get $SSB>B_{lim}$	P(closure)	P(closure once)	Nb years closure	TAC ('000 t)	SD TAC ('000 t)	$P(TAC_{dif}<5000)$	$P(TAC_{dif}<0.15$ Rge)
case0	0	93.241	95.632	0.013	0.079	0.129	0.119	1.000	1.000	10.000	0.000	0.000	1.000	1.000
case0	0.2	73.828	71.460	0.042	0.216	0.419	0.375	0.062	0.322	0.620	16.421	7.861	0.450	0.393
case0	0.25	70.399	67.385	0.054	0.271	0.541	0.471	0.073	0.376	0.729	18.685	8.540	0.424	0.395
case0	0.3	67.032	63.456	0.066	0.315	0.658	0.556	0.089	0.428	0.890	20.332	8.998	0.415	0.399
case0	0.35	64.741	58.762	0.078	0.373	0.780	0.653	0.100	0.469	0.997	21.545	9.314	0.428	0.426
case0	0.4	62.455	57.692	0.091	0.430	0.914	0.775	0.113	0.505	1.126	22.435	9.574	0.461	0.464
case0	0.45	60.796	55.010	0.104	0.464	1.043	0.859	0.128	0.557	1.280	23.005	9.906	0.498	0.514
case0	0.5	59.346	53.460	0.115	0.484	1.150	0.923	0.137	0.575	1.372	23.464	10.043	0.529	0.548

Table 0.3Performance statistics for the projection period (2014-2023) for the HCR proposed by the SWWRAC (case 1) depending on the harvest rate.

Case	Harvest Rate	SSB ('000 t)	SSB_{2023} ('000 t)	$P(SSB<B_{lim})$	$P(SSB<B_{lim}$ once)	Nb yr $SSB<B_{lim}$	Nb yr get $SSB>B_{lim}$	P(closure)	P(closure once)	Nb years closure	TAC ('000 t)	SD TAC ('000 t)	$P(TAC_{dif}<5000)$	$P(TAC_{dif}<0.15$ Rge)
case1	0	93.241	95.632	0.013	0.079	0.129	0.119	1.000	1.000	10.000	0.000	0.000	1.000	1.000
case1	0.2	70.043	66.525	0.057	0.274	0.573	0.494	0.079	0.395	0.794	18.108	7.733	0.638	0.627
case1	0.25	69.263	64.563	0.063	0.307	0.633	0.544	0.085	0.405	0.851	18.457	7.292	0.618	0.597
case1	0.3	68.643	64.783	0.068	0.322	0.676	0.574	0.089	0.409	0.887	18.796	6.865	0.592	0.568
case1	0.35	67.742	64.323	0.071	0.339	0.710	0.608	0.098	0.456	0.980	19.166	6.651	0.578	0.560
case1	0.4	66.912	61.539	0.077	0.353	0.772	0.633	0.102	0.467	1.020	19.503	6.485	0.642	0.593
case1	0.45	65.902	60.715	0.085	0.387	0.852	0.710	0.108	0.475	1.075	19.837	6.473	0.683	0.631
case1	0.5	65.105	59.862	0.091	0.414	0.913	0.747	0.113	0.498	1.125	20.050	6.514	0.710	0.671

Table 0.4Performance statistics for the projection period (2014-2023) for the current HCR under the following assumptions: BC (coefficient of variation for the SSB observation: cv.ssb=0.25, season share of the TAC: sh1=0.60, stock recruitment relationship used to predict future recruitment values: sr=Ricker), BC_cv15 (as BC, with cv.ssb=0.15), BC_sh75 (as BC, with sh=0.75), BC_srBH (as BC, with sr=Beverton-Holt).

Case	SSB ('000 t)	SSB_{2023} ('000 t)	$P(SSB<B_{lim})$	$P(SSB<B_{lim}$ once)	Nb yr $SSB<B_{lim}$	Nb yr get $SSB>B_{lim}$	P(closure)	P(closure once)	Nb years closure	TAC ('000 t)	SD TAC ('000 t)	$P(TAC_{dif}<5000)$	$P(TAC_{dif}<0.15$ Rge)
BC	67.217	68.269	0.067	0.368	0.736	0.624	0.081	0.444	0.896	20.193	9.167	0.396	0.383
BC_cv15	67.244	68.491	0.065	0.368	0.720	0.612	0.071	0.372	0.780	20.313	8.740	0.423	0.390
BC_sh75	66.170	67.087	0.076	0.384	0.836	0.696	0.086	0.452	0.948	19.976	9.250	0.398	0.387
BC_srBH	66.313	65.747	0.063	0.364	0.696	0.591	0.077	0.452	0.844	20.409	9.054	0.402	0.389

Table 0.5Performance of the SSB and yearly catches relative to the base case for the projection period (2014-2023) for the current HCR under the following assumptions: BC (coefficient of variation for the SSB observation: cv.ssb=0.25, season share of the TAC: sh1=0.60, stock recruitment relationship used to predict future recruitment values: sr=Ricker), BC_cv15 (as BC, with cv.ssb=0.15), BC_sh75 (as BC, with sh=0.75), BC_srBH (as BC, with sr=Beverton-Holt).

case	variable	percentile	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
BC_cv15	ssb	5th	0.999	0.971	0.955	0.957	0.951	0.954	0.956	0.943	0.961	0.954
		50th	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.001	1.001
		95th	1.001	1.046	1.055	1.062	1.085	1.099	1.114	1.092	1.111	1.098
	cyr	5th	0.950	0.926	0.894	0.894	0.874	0.873	0.892	0.901	0.883	0.867
		50th	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.002
		95th	1.078	1.130	1.151	1.149	1.254	1.159	1.177	1.177	1.231	1.235
BC_sh75	ssb	5th	1.003	0.967	0.952	0.939	0.931	0.932	0.923	0.923	0.913	0.908
		50th	1.007	0.992	0.984	0.979	0.978	0.976	0.976	0.972	0.973	0.972
		95th	1.014	1.002	0.996	0.996	0.994	0.994	0.996	0.996	1.006	0.997
	cyr	5th	0.898	0.877	0.795	0.777	0.603	0.625	0.774	0.604	0.625	0.597
		50th	0.957	1.000	1.000	1.000	0.988	1.000	1.000	1.000	0.996	0.983
		95th	1.116	1.178	1.240	1.222	1.217	1.134	1.213	1.222	1.210	1.229
BC_srBH	ssb	5th	0.336	0.417	0.542	0.646	0.702	0.791	0.773	0.833	0.839	0.807
		50th	0.929	0.957	0.989	0.995	1.004	1.007	1.002	0.999	1.005	1.000
		95th	3.145	2.591	1.782	1.585	1.452	1.429	1.504	1.464	1.581	1.480
	cyr	5th	0.707	0.397	0.392	0.528	0.713	0.724	0.769	0.682	0.806	0.853
		50th	1.000	0.978	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		95th	1.518	2.643	2.756	2.154	1.834	1.389	1.318	1.729	1.564	1.609

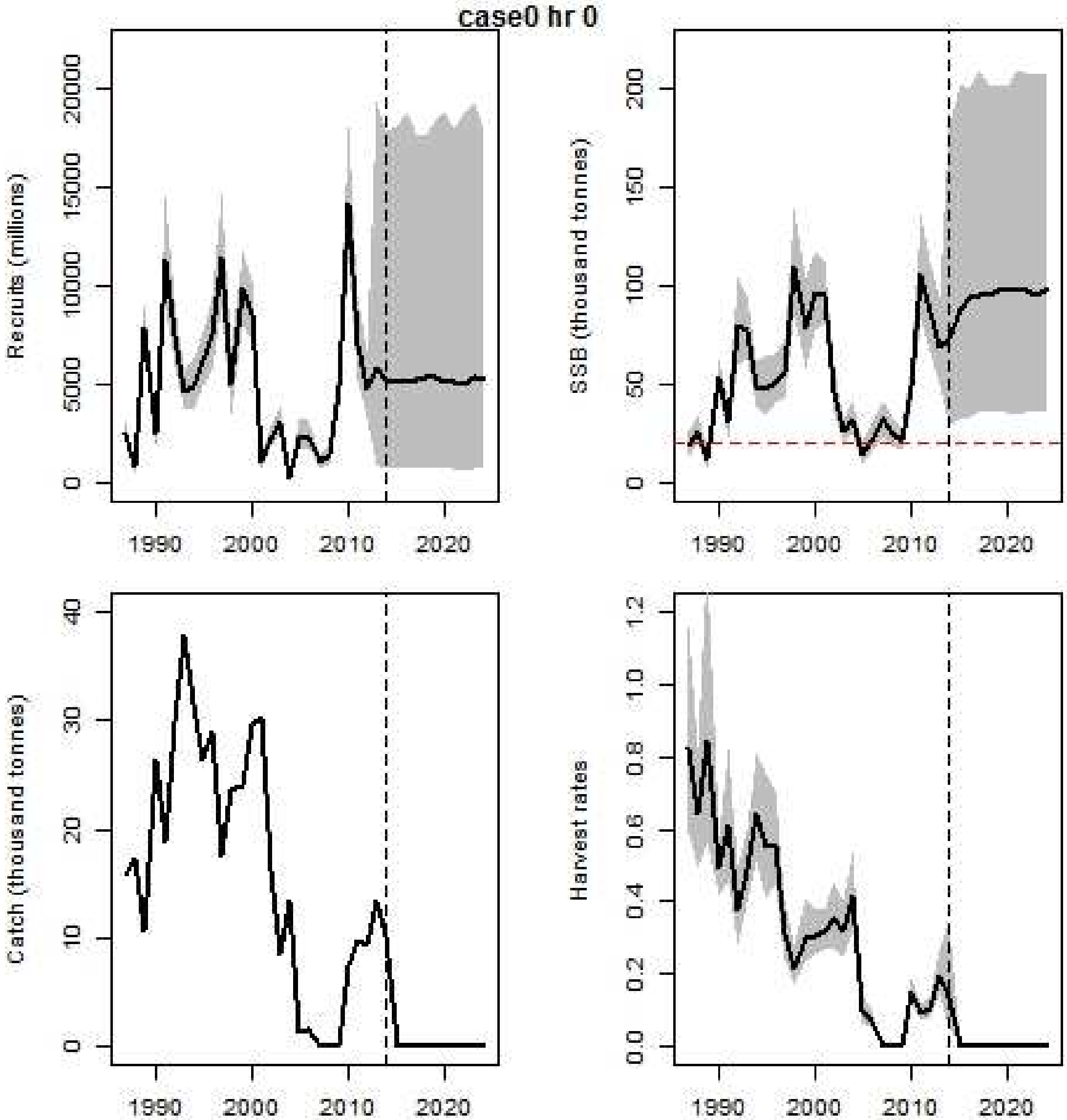

Figure 0.1From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

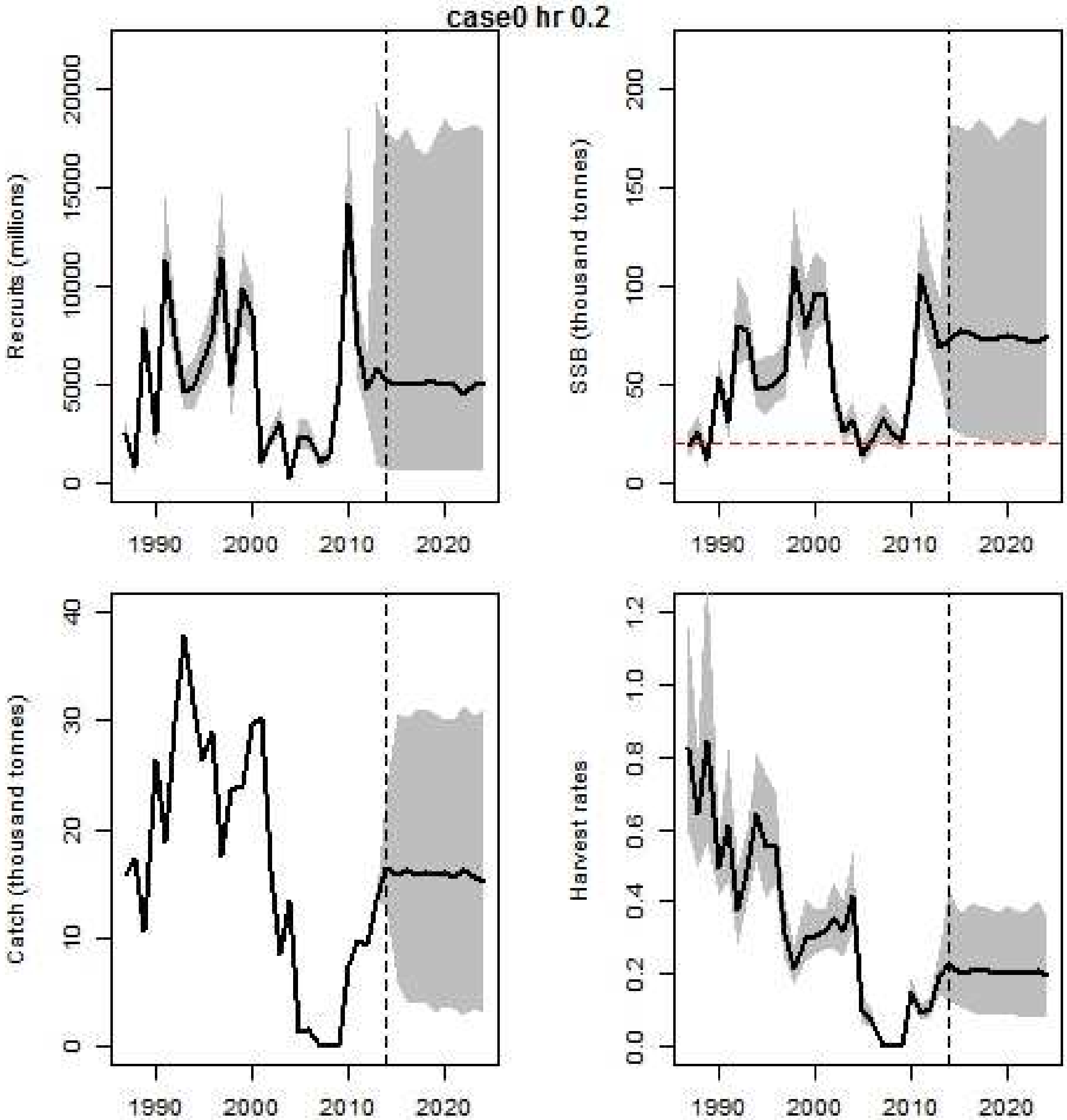

Figure 0.2From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.2. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

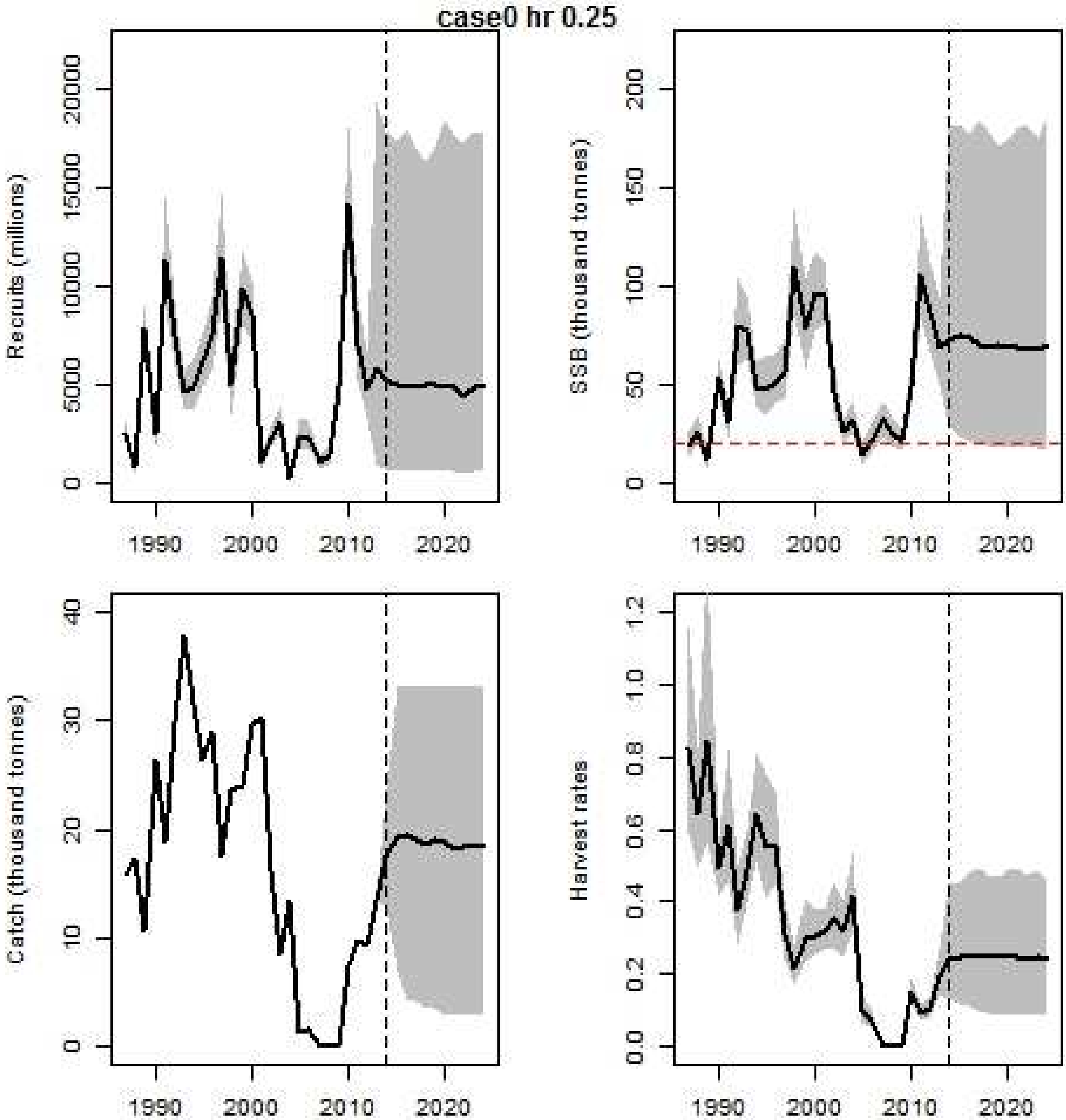

Figure 0.3From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.25. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

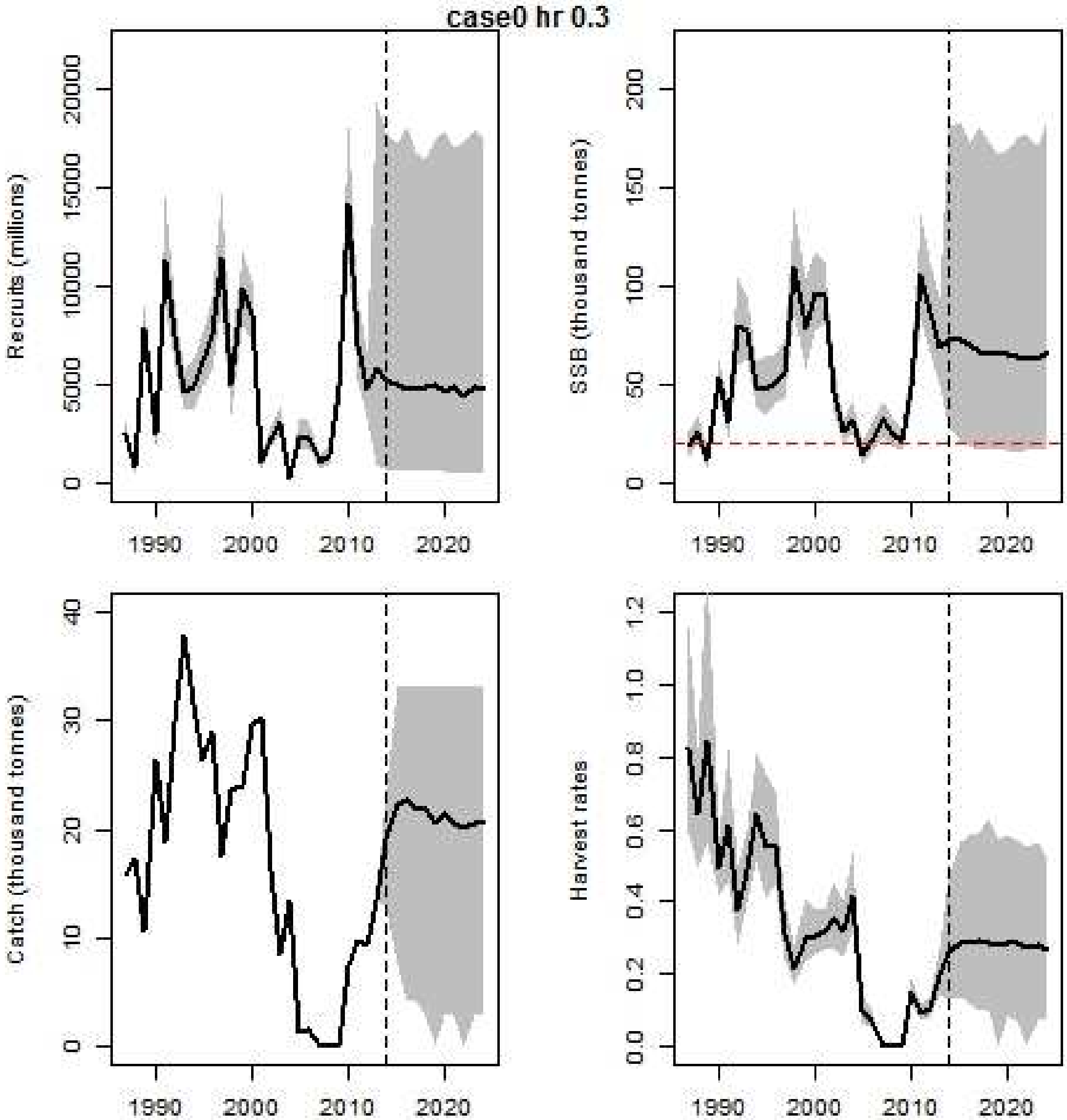

Figure 0.4From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.3. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

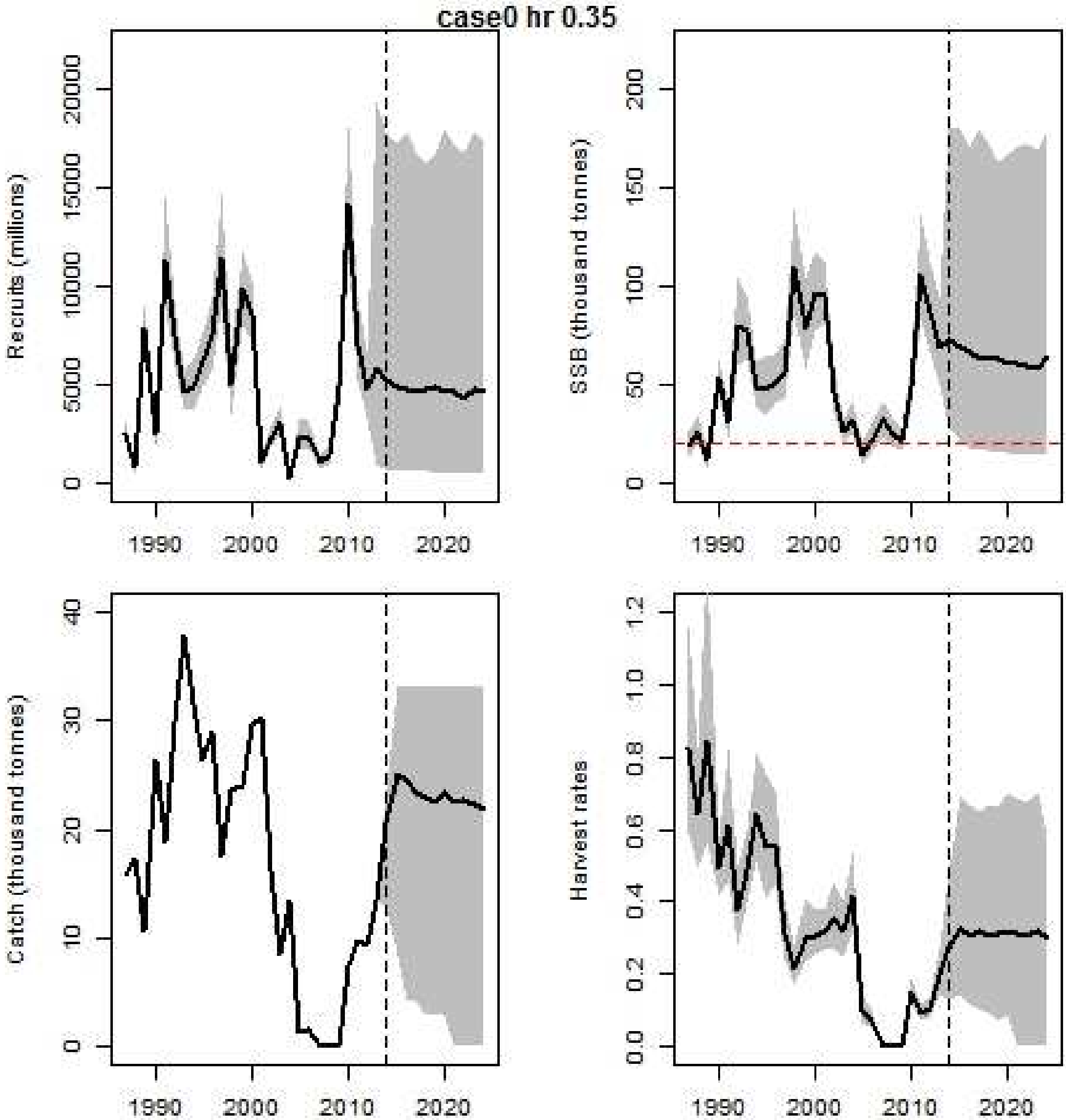

Figure 0.5From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.35. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

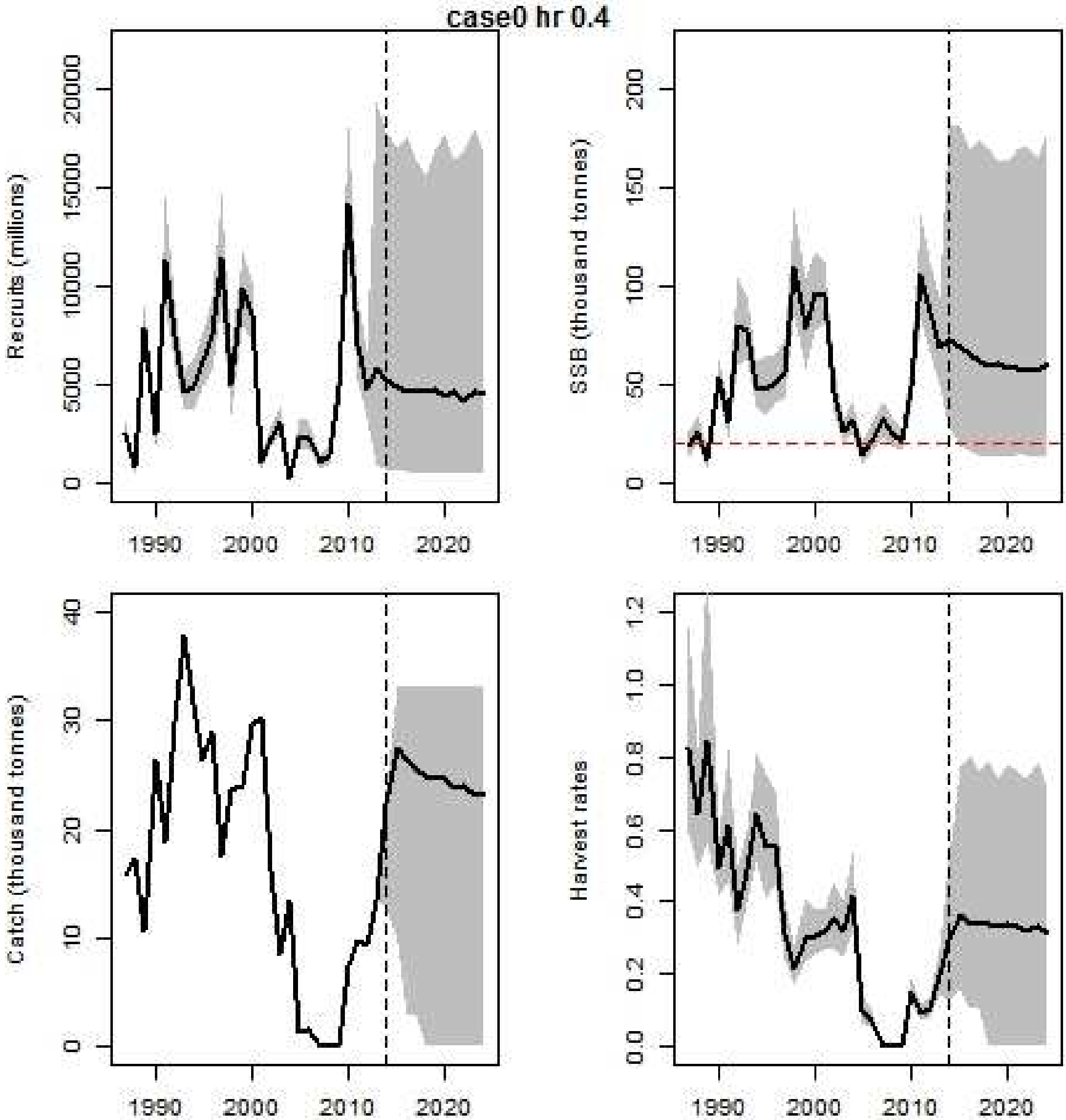

Figure 0.6From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.4. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

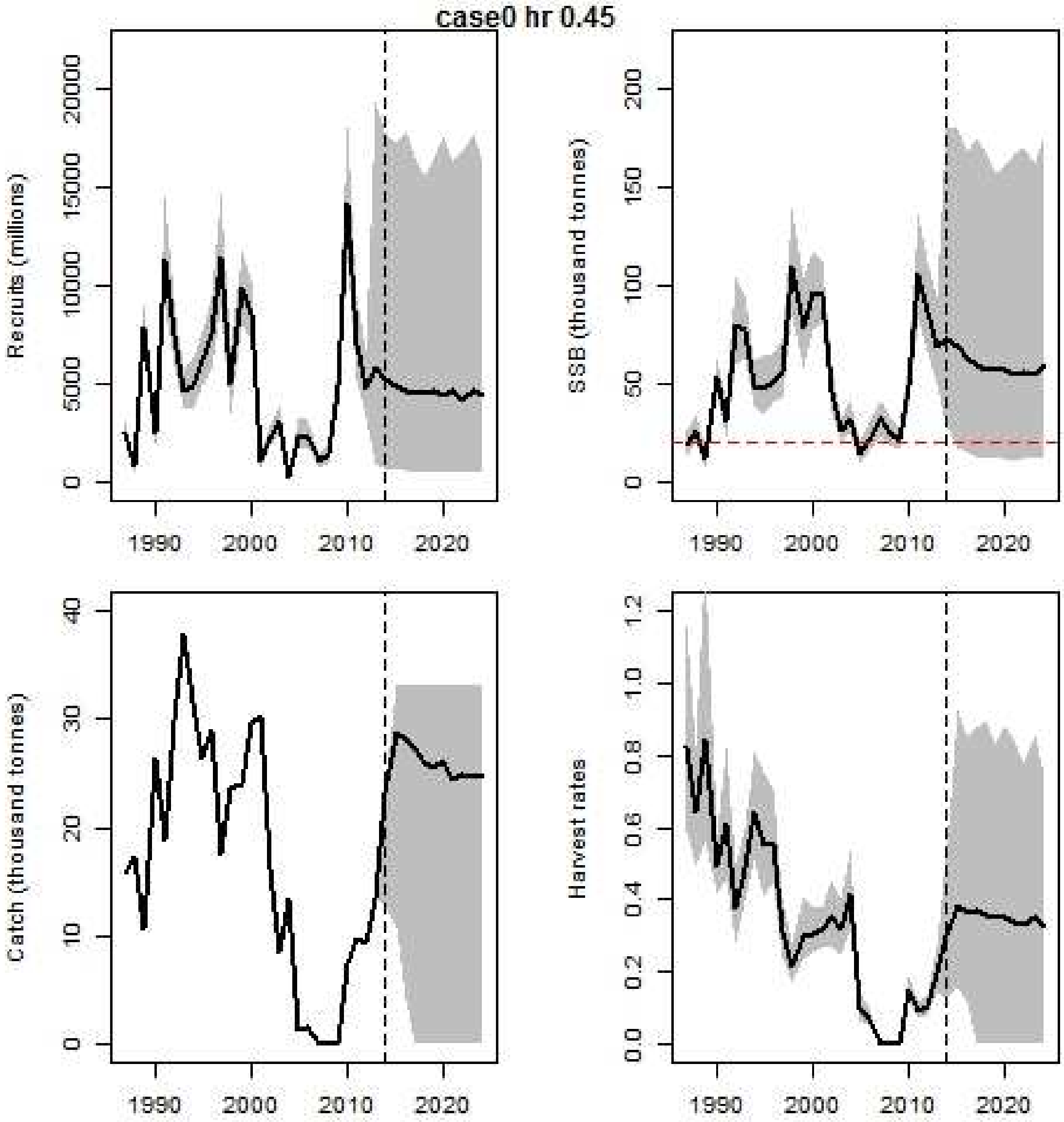

Figure 0.7From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.45. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

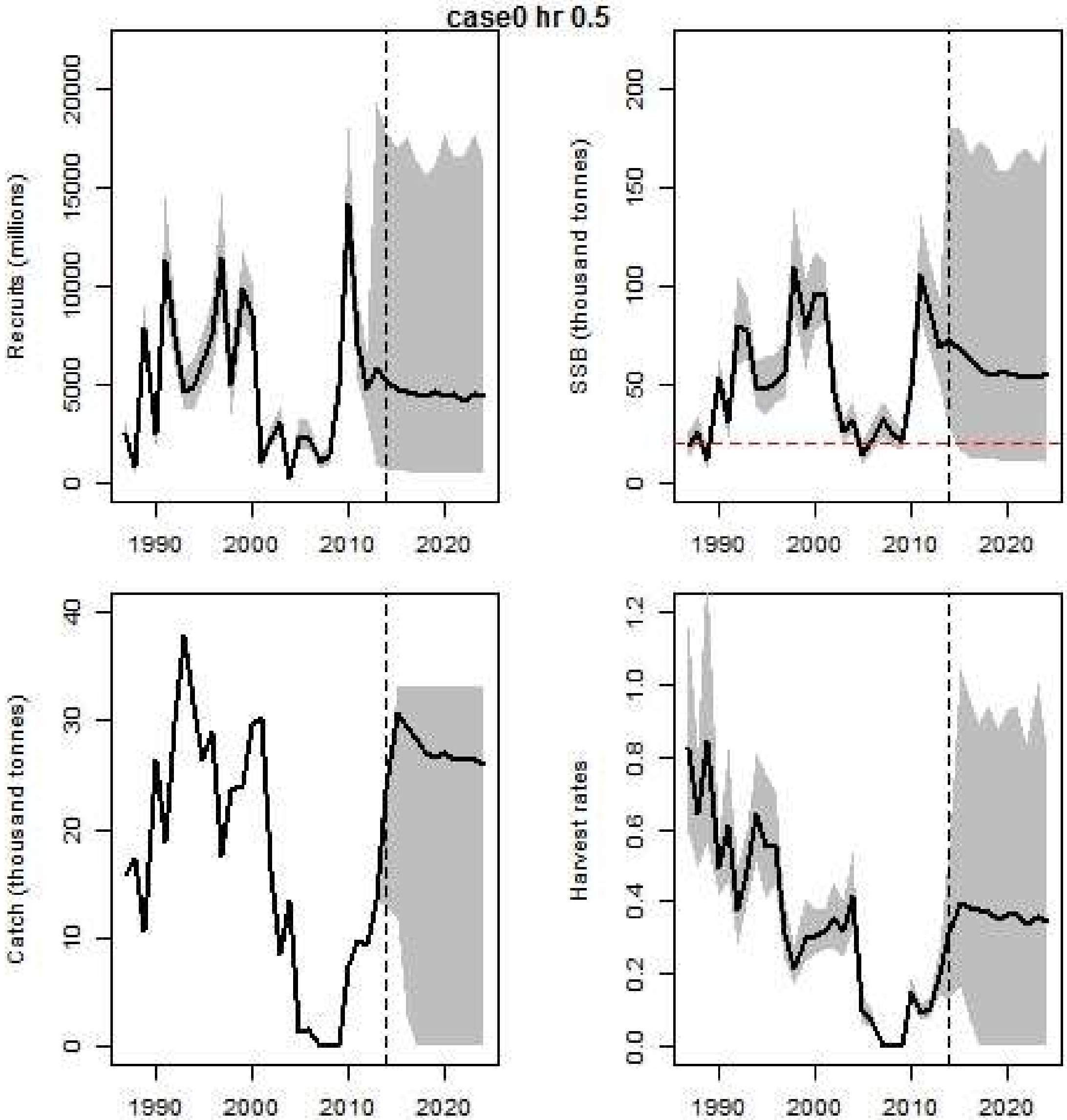

Figure 0.8From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the current HCR (case 0) with a harvest rate of 0.5. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

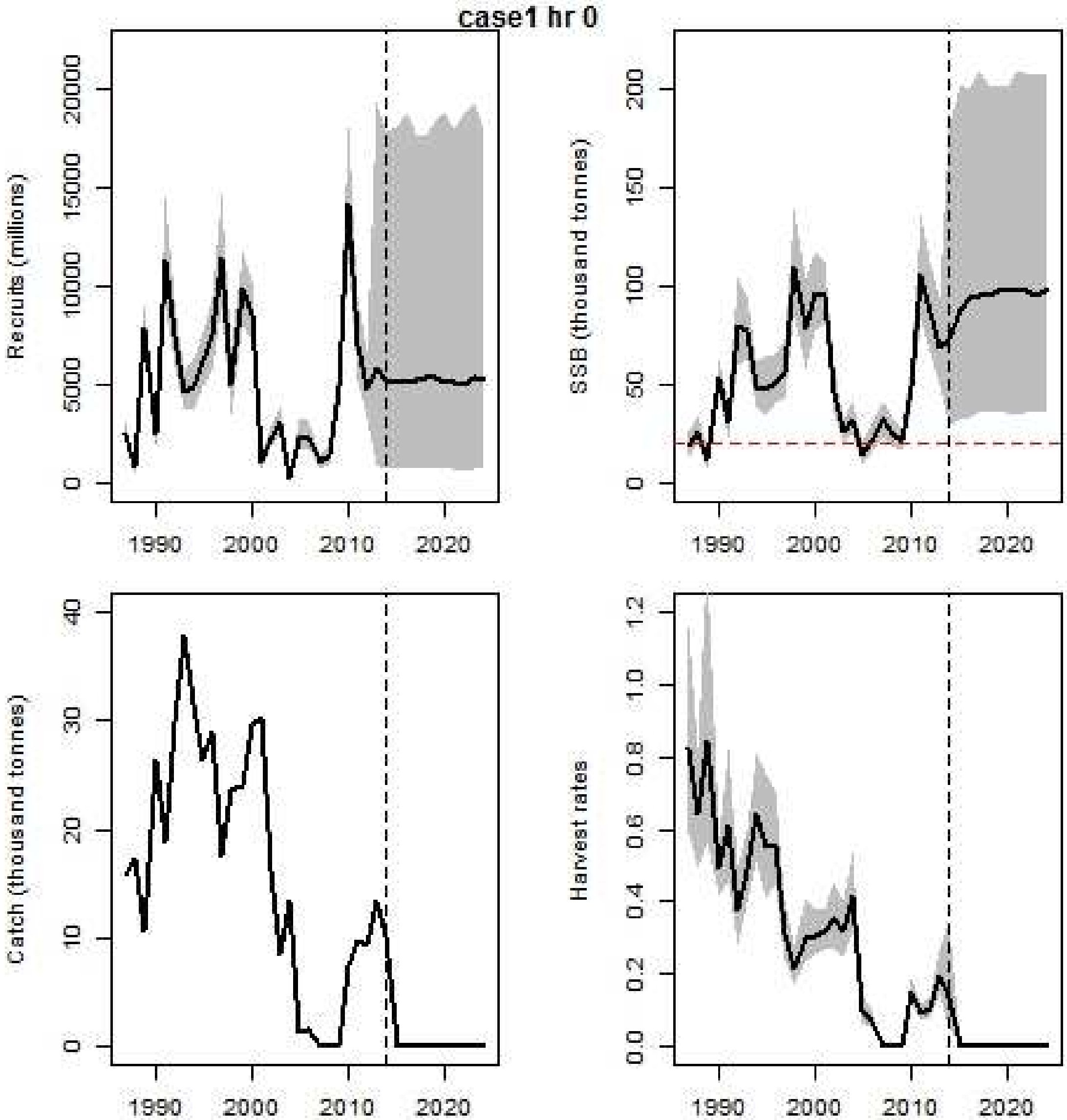

Figure 0.9From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5^{th} and 95^{th} percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

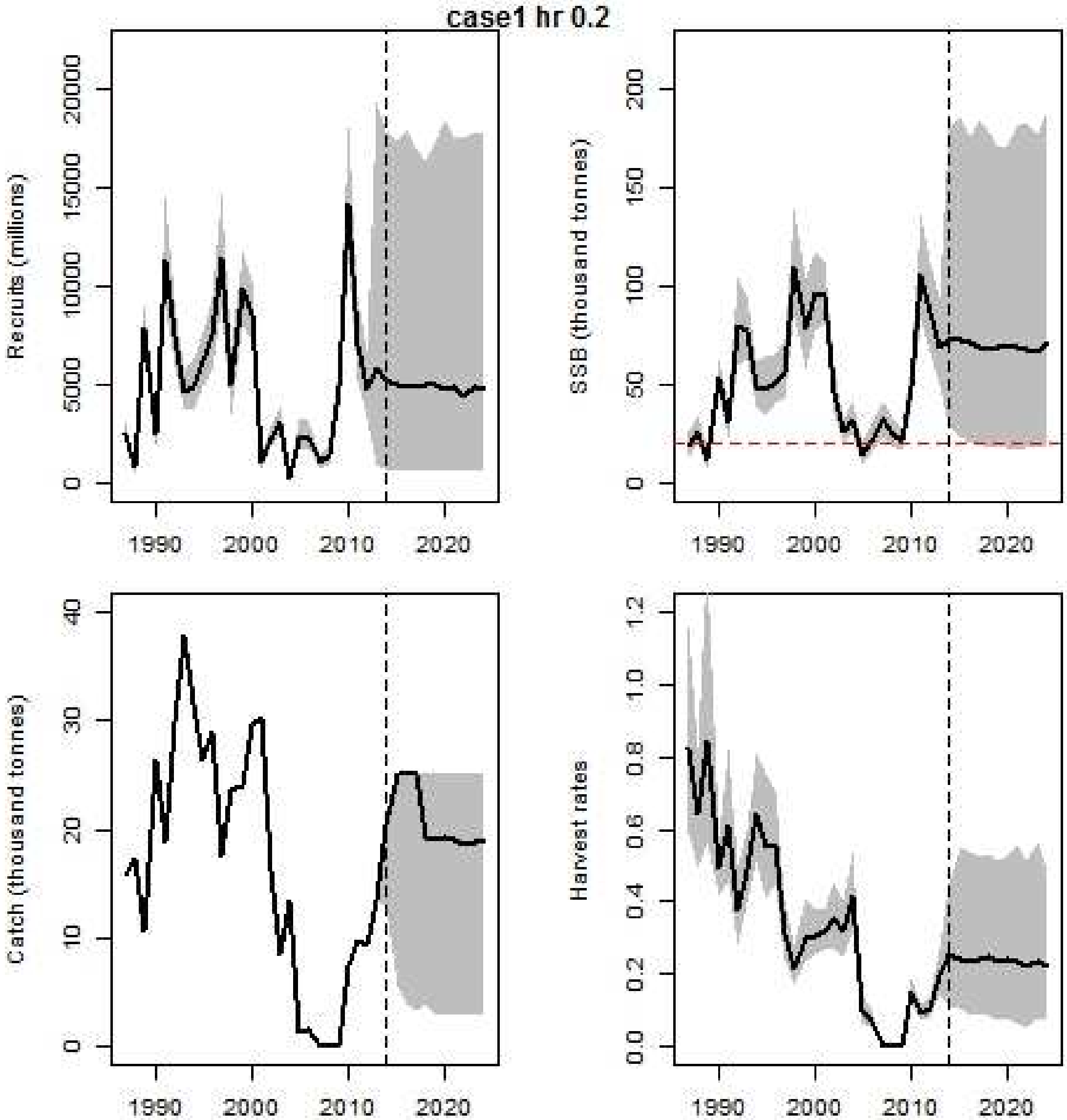

Figure 0.10From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.2. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

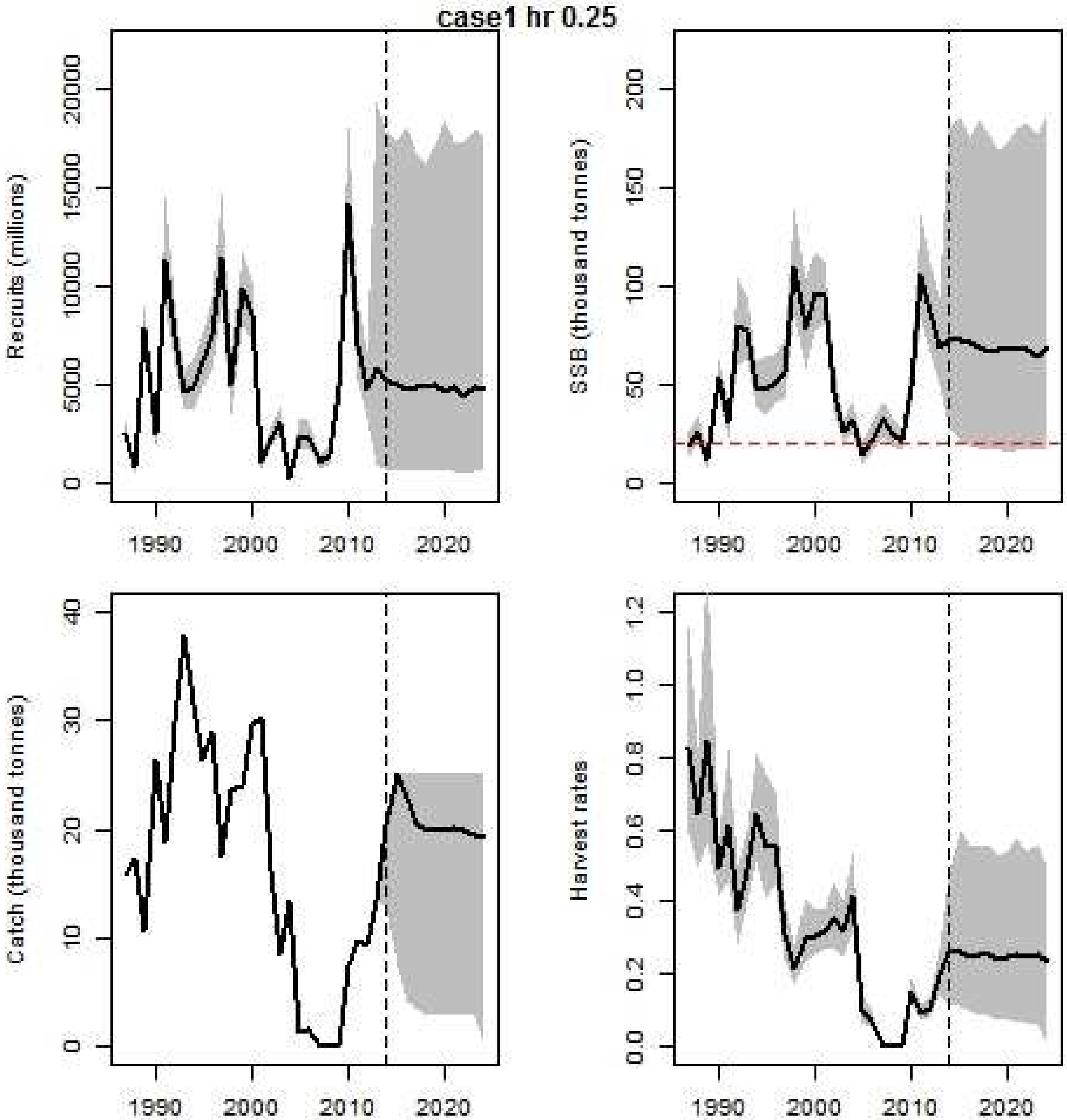

Figure 0.11From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.25. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

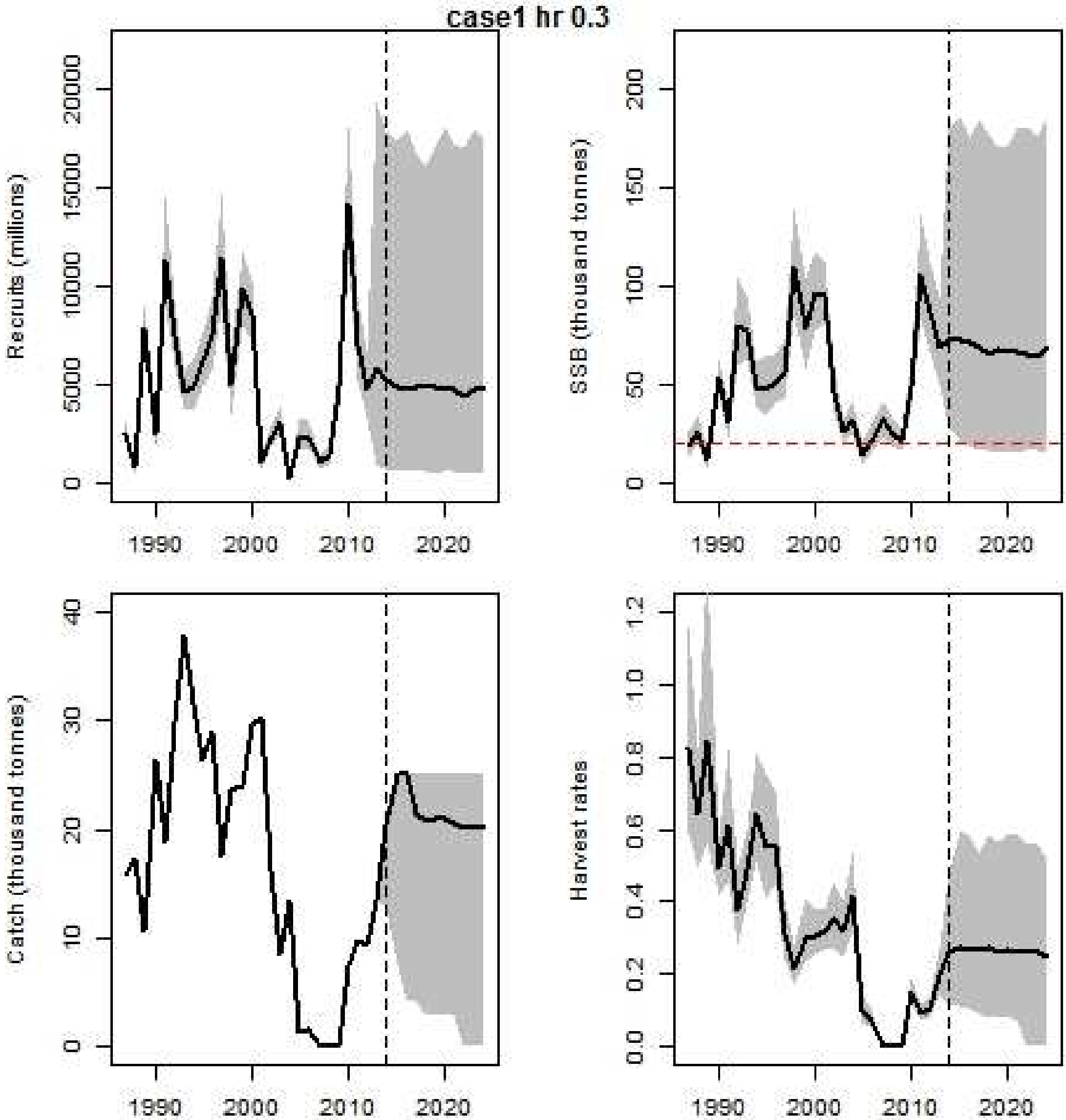

Figure 0.12From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.3. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

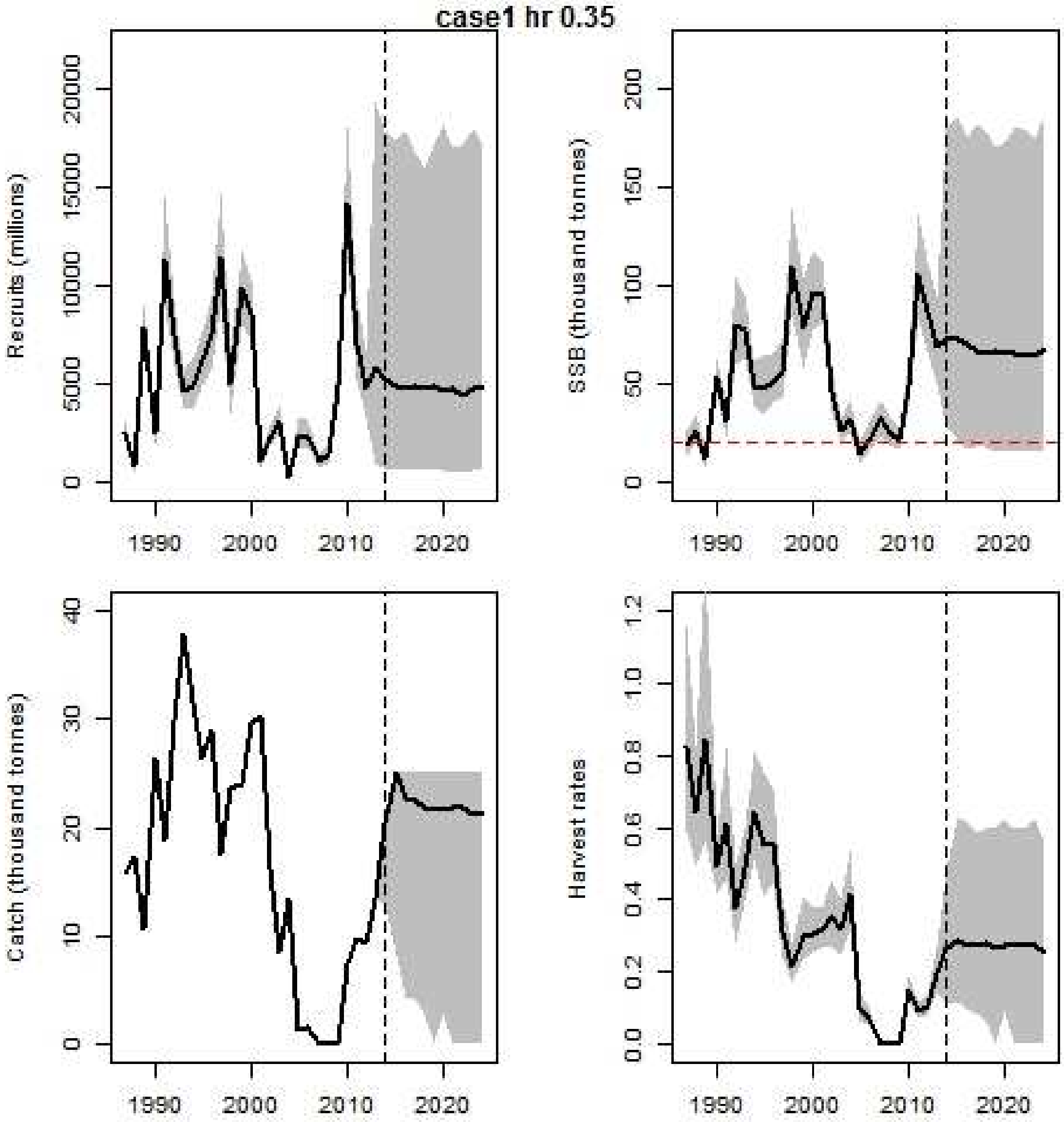

Figure 0.13From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.35. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

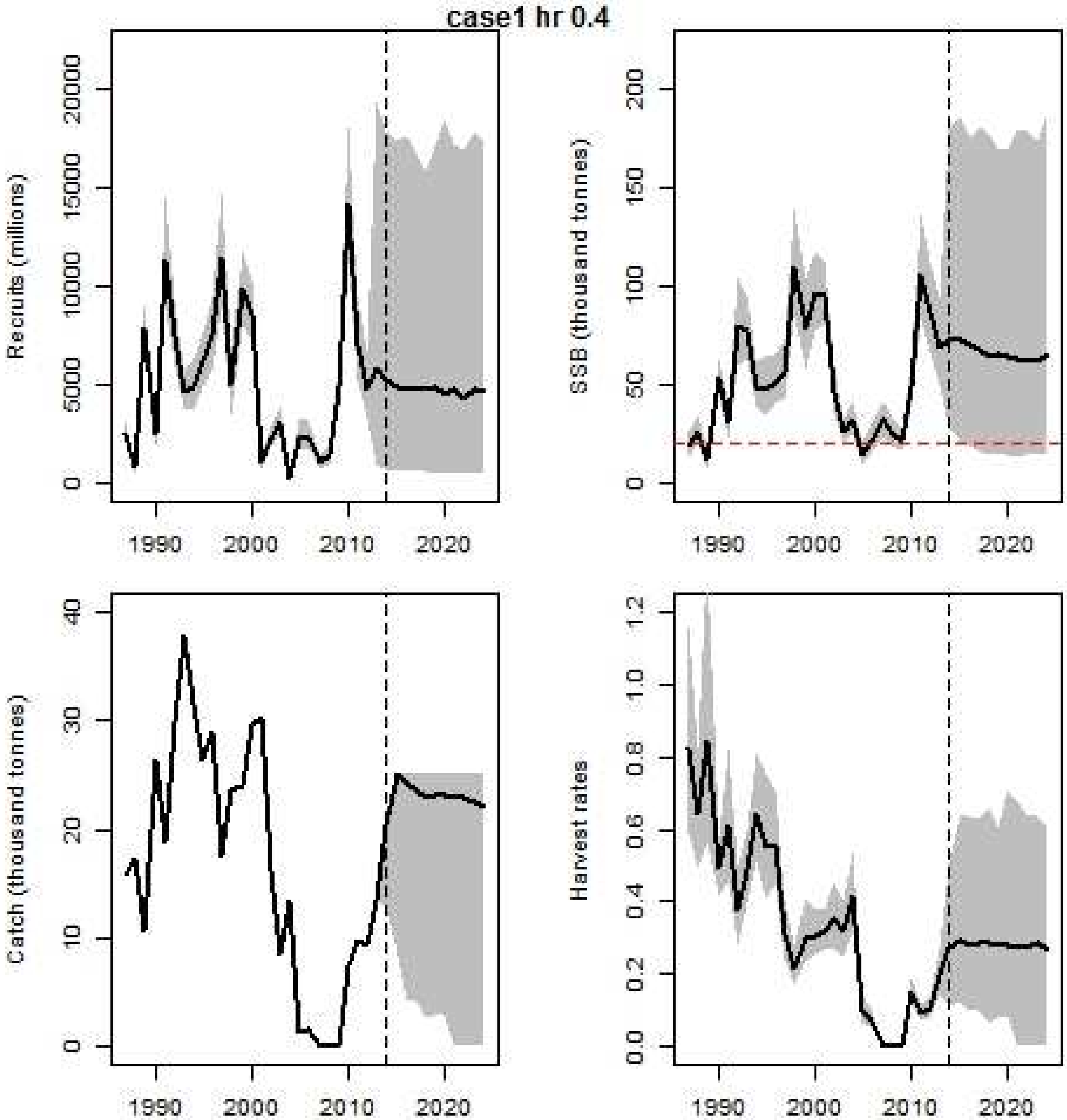

Figure 0.14From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.4. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

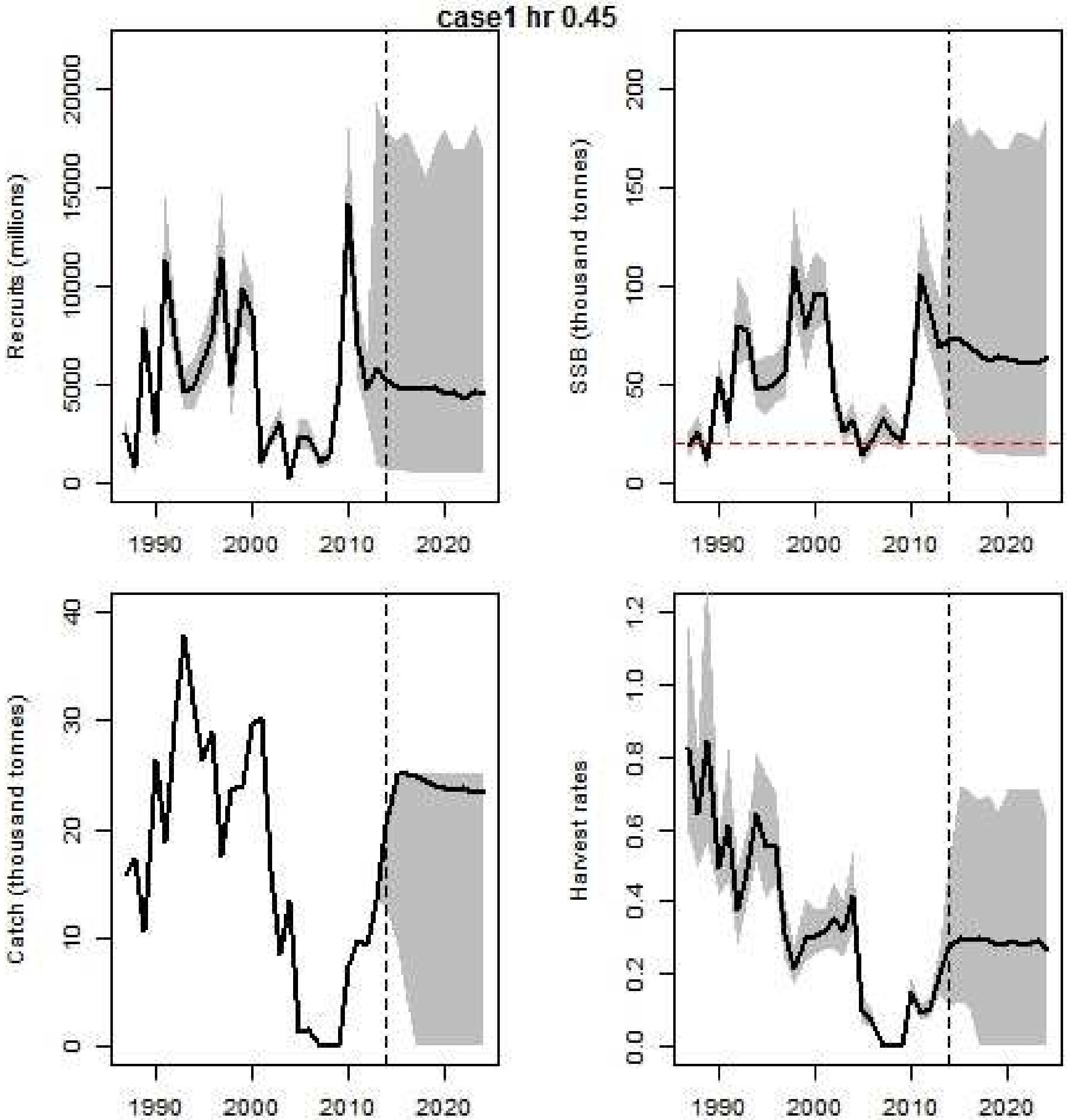

Figure 0.15From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.45. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

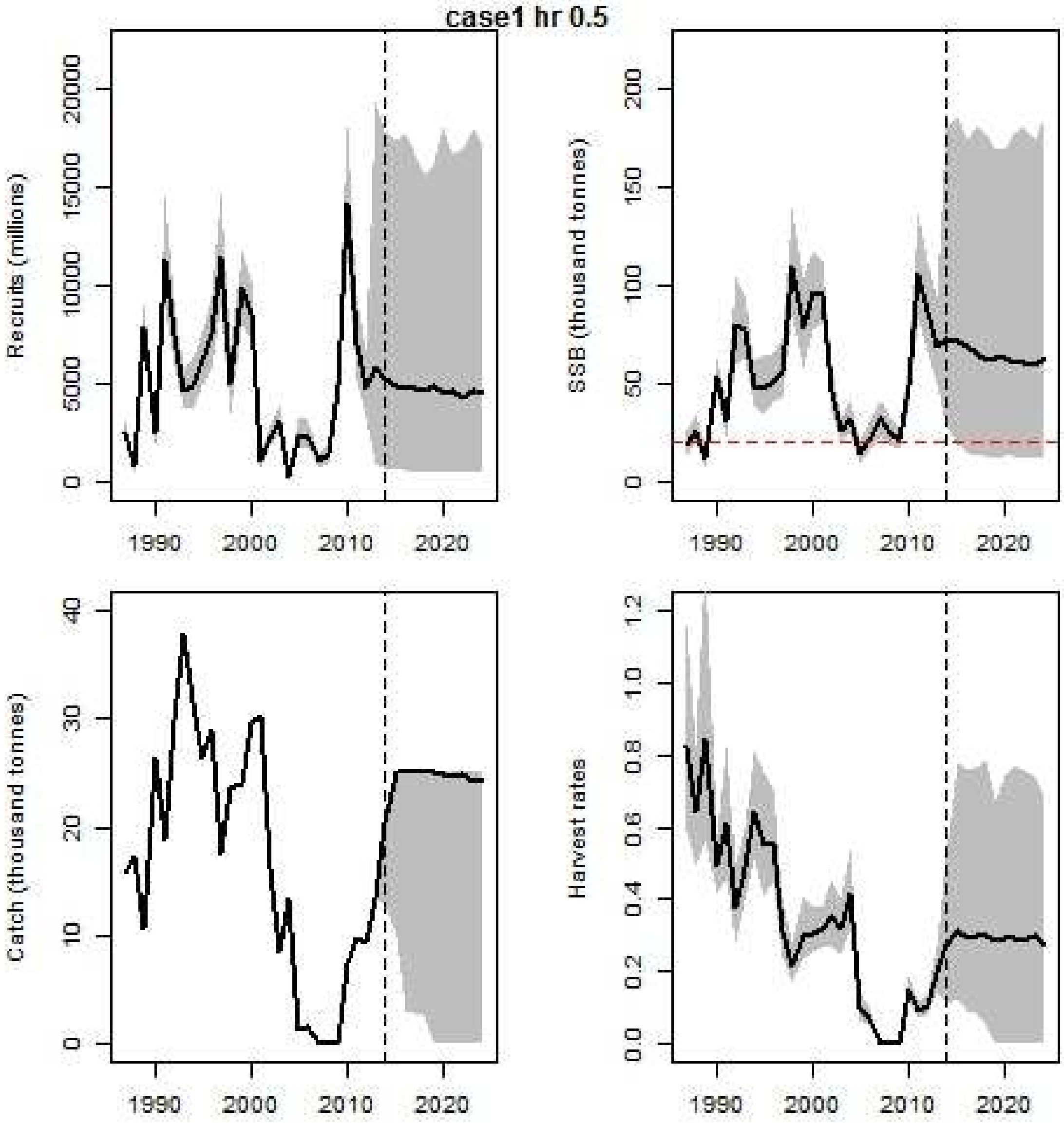

Figure 0.16From top to bottom and from left to right recruitment (age 0 million of individuals at the beginning of the second semester), spawning stock biomass (in thousand tonnes), annual catch (tonnes from January to December) and harvest rate (ratio between the annual catch and the spawning stock biomass) across years for the HCR proposed by the SWWRAC (case 1) with a harvest rate of 0.5. The solid line represents the median and the shaded area the 90 % confidence intervals computed from the 5th and 95th percentiles. The dashed vertical line is located at 2014, which is the first year of the projection period. The horizontal dashed red line in the second panel is the biomass reference point B_{lim} (set at 21 000 tonnes).

10 EWG-13-20 LIST OF PARTICIPANTS

1 - Information on STECF members and invited experts' affiliations is displayed for information only. In some instances the details given below for STECF members may differ from that provided in Commission COMMISSION DECISION of 27 October 2010 on the appointment of members of the STECF (2010/C 292/04) as some members' employment details may have changed or have been subject to organisational changes in their main place of employment. In any case, as outlined in Article 13 of the Commission Decision (2005/629/EU and 2010/74/EU) on STECF, Members of the STECF, invited experts, and JRC experts shall act independently of Member States or stakeholders. In the context of the STECF work, the committee members and other experts do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members and invited experts make declarations of commitment (yearly for STECF members) to act independently in the public interest of the European Union. STECF members and experts also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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11 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
http://stecf.jrc.ec.europa.eu/web/stecf/ewg1320

List of background documents:

1. EWG-13-20 – Doc 1 - Declarations of invited and JRC experts (see also Section10 of this report – List of participants)
2. EWG-13-20 Doc 2 ICES_Stock_Annex_VIII_30Sept2013.doc
3. EWG-13-20 Doc 3 com2009_0399en01.pdf
4. EWG_13_20 Doc 4 Proposed_HCR_Anchovy2013_Ibaibarriaga etal.docx

European Commission

EUR 26326 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: Scientific, Technical and Economic Committee for Fisheries. Advice on the Harvest Control Rule and Evaluation of the Anchovy Plan COM(2009) 399 Final (STECF-13-24).

STECF members: Casey, J., Abella, J. A., Andersen, J., Bailey, N., Bertignac, M., Cardinale, M., Curtis, H., Daskalov, G., Delaney, A., Döring, R., Garcia Rodriguez, M., Gascuel, D., Graham, N., Gustavsson, T., Jennings, S., Kenny, A., Kirkegaard, E., Kraak, S., Kuikka, S., Malvarosa, L., Martin, P., Motova, A., Murua, H., Nord, J., Nowakowski, P., Prellezo, R., Sala, A., Scarcella, G., Somarakis, S., Stransky, C., Theret, F., Ulrich, C., Vanhee, W. & Van Oostenbrugge, H.

EWG-13-20 members: Jardim, E., Ibaibarriaga, L., Sanchez, S., Uriarte, A., Andres, M., Leonardi, S., Pawlowski, L., Abaunza, P. & Millar, C.

Luxembourg: Publications Office of the European Union

2013 – 71 pp. – 21 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424 (online), ISSN 1018-5593 (print)

ISBN 978-92-79-34619-4

doi:10.2788/35653

Abstract

The EWG 13-20 took place between the 14th and the 18th of October of 2010, in Ispra, Italy, to carry out the necessary analysis for the STECF to give advice on the harvest control rule and evaluation of the Bay of Biscay anchovy management plan COM(2009) 399 Final. The report from the EWG was reviewed during the STECF plenary meeting held in Brussels, 4-8 of November of 2013. All the analyses were carried out using a Management Strategies Evaluation algorithm implemented as an R package, FLBEIA, using the FLR routines. STECF commended the EWG for the comprehensive work carried out during the meeting and endorses the findings in the report as an appropriate basis on which to base management decisions including a possible revision of the long-term management plan. In terms of possible revision of the HCR, the STECF advises that the current HCR and the HCR proposed by the SWWRAC are both consistent with the long-term objectives of the plan.

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LB-NA-26326-EN-N

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The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

Publications Office

ISBN 978-92-79-34619-4