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Scientific, Technical and Economic Committee for Fisheries (STECF)

Evaluation /Scoping of Management plans -
Data analysis for support of the impact assessment for the
management plan of Bay of Biscay anchovy
(COM(2009)399 final).
(STECF-14-05)

Edited by Ernesto Jardim

This report was reviewed by the STECF during its' 45th plenary meeting
held from 24 to 28 March 2014 in Brussels, Belgium

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**SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES
(STECF)**

Evaluation/scoping of Management plans

Data analysis for support of the impact assessment for the management plan of Bay of Biscay anchovy (COM(2009)399 final).

THIS REPORT WAS REVIEWED DURING THE PLENARY MEETING HELD IN BRUSSELS, BELGIUM, 24-28MARCH 2014

Background

In July 2009 the Commission adopted a proposal for a Council Regulation establishing a long-term plan (herein referred to as 'the 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. The plan's harvest control rule has been provisionally implemented since 2010. After four years of provisional implementation it is appropriate to evaluate the plan and possibly implement relevant measures taking into account recent scientific developments as well as stockholders' views.

Request to the STECF

STECF is requested to review the three reports of the STECF Expert Working Group, evaluate the findings and make any appropriate comments and recommendations.

Observations of the STECF

STECF reviewed the work of the EWG 14-03 concerning the impact assessment of management plan for anchovy in the Bay of Biscay.

To carry out the analysis the EWF 14-03 used Management Strategies Evaluation (MSE) model, implemented in the FLBEIA R package. Data used for conditioning the MSE model came from a DGMARE data call to the Member States involved in the fishery, Spain and France. Most of the data provided were very useful for the EWG. However, the data submitted by Spain did not contain the required level of disaggregation, and the data from France was submitted only one week before the meeting. As a result, the EWG was unable to include any economic components in the MSE.

STECF notes that the provision of the economic information would have allowed the analysis of fleet dynamics, which would provide additional indications of the economic performance of each fleet involved in this fishery for the whole range of TACs. Additionally, it would provide the necessary methodology to simulate and test for undershoot of the TAC, which has been observed in recent years.

Conclusions of the STECF

The EWG-14-03 addressed the terms of reference to the extent possible with the available resources, data and information. STECF endorses the findings and conclusions presented in the EWG 14-03 report and wishes to emphasise the following:

- The range of alternative HCR formulations (scenarios) assessed by the EWG 14-03 provide a sound base for developing options for fisheries management.
- The current HCR is confirmed to remain within the same precautionary limits of risks as assessed originally in 2008. It proved to be robust to low recruitment scenarios and limited changes in the quota uptake between semesters. Hence STECF considers that the current HCR remains appropriate as a basis for advising on TACs.

- The HCR proposed by the SWWRAC, modified to avoid large inter-annual changes in TAC arising from minor changes in SSB, predicted lower catches (by about 1,000 t - 1,500 t per year) compared to the current HCR but higher stability of annual TACs, while maintaining a similar level of risk of the stock falling below Blim.
- The HCRs that consider a continuous increase of the catches between the minimum and maximum TAC levels, resulted in higher TACs (by about 1,000 t) when compared to the current HCR, while showing similar level of risk of the stock falling below Blim and inter-annual variability of catches.
- Changing the management period to January-December (for all HCR options) considerably reduces the risks of the stock falling below Blim, and leads to a small increase in quantity and stability of catches, as compared to presently applied management period July-June.
- Reducing the maximum TAC from 33,000 t to 25,000 t reduces the risk of the stock falling below Blim by 1-2% and is predicted to give rise to increased catch stability, while average catches decrease by 2,000 t-4,000 t per year.
- Mid-year revisions of TACs were not tested by the EWG due to lack of time. Following the discussions by the EWG and the STECF in plenary, STECF acknowledges that performing a second, within-year stock assessment, to provide updated information for a mid-year revision of the TAC, may be a desirable option especially if the realised recruitment is lower than originally assumed for advising the TAC. In such circumstances it is conceivable that the risk of the stock biomass falling below Blim may become unacceptably high.

REPORT TO THE STECF

**EXPERT WORKING GROUP ON
Evaluation/Scoping of Management plans
Data analysis for support of the impact
assessment for the management plan of Bay
of Biscay anchovy (COM(2009)399 final).
(EWG-14-03)**

Varese, 10-14 March, 2014

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

STECF was requested to assess the management plan of anchovy in the Bay of Biscay and the fisheries exploiting that stock (COM(2009)399 final). The evaluation should address the biological and socio-economic impacts of options scoped with stakeholders in October 2013 in relation to changes to the harvest control rule, in-year TAC revisions and TAC period. The long-term biological and economic objectives established in the plan should guide this assessment.

In July 2009 the Commission adopted a proposal for a Council Regulation establishing a long-term plan (herein referred to as 'the 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. The plan's harvest control rule has been provisionally implemented since 2010, although the regulation supporting the management plan was not yet formally approved by the Council.

To carry out the analysis required to support the evaluation of the options agreed, the EWG used Management Strategies Evaluation, implemented in the FLBEIA R package. To condition the model, DGMARE issued a data call to the Member States involved in the fishery, Spain and France. Both administrations replied positively to the request, and the data provided was of major relevance for the work carried out. However, the data submitted by Spain didn't have the level of disaggregation required, while France submitted data one week before the meeting. As such, it was not possible to include the economic analysis in the MSE.

The EWG main conclusions were:

- The current HCR (COM(2009) 399 final) delivers the objectives of the plan, showing a biological risk ~7%, an average TAC of ~19900t and a median SSB of ~67700t.
- The current HCR applied to a management period of January to December, results in lower biological risks, ~3%, higher average catches,

~21900t, and higher stability in the catches, than when applied to the management period July to June.

- The current HCR proved to be robust to poor recruitment, as well as to limited mis-specifications of the quota share between semesters.
- The HCR proposed by the SWWRAC showed, in both management periods, lower catches than the current HCR (1000-1500t), higher stability of catches (~15%) and similar levels of biological risk.
- For all HCR tested by the EWG, changing the management period from July-June to January-December reduces biological risks and the probability of closing the fishery, by ~40%; while it leads to higher average catches (~5%) and higher stability in the catches (~12%).
- For all HCR tested by the EWG, decreasing the maximum TAC from 33000t to 25000t leads to a reduction in the levels of risks of 1-2% and an increase in catch stability of ~15%, while average expected catches decreased by 2000-4000t per year, depending on the scenario.
- All HCRs tested by the EWG were able to recover the SSB after the recruitment failure in less than two years.
- Having a stable TAC in a region of low biomasses, set by the minimum TAC, generates lower risks with similar levels of TACs, than not having such plateau of catches.
- Considering the trade-offs between biological risk and average TAC, a continuous HCR in Btrigger 2 with a maximum TAC of 33000t, tends to give similar or slightly better performance statistics than the current HCR. In the case of changing the management period to January to December, this HCR allows higher TAC, ~1000t, than the current HCR applied over the same management period, while still showing levels of biological risks below 5% and similar levels of inter-annual variability of TACs, although with a higher probability of closures, ~7%.

2 INTRODUCTION

In July 2009 the Commission adopted a proposal for a Council Regulation establishing a long-term plan (herein referred to as 'the 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. The plan's harvest control rule has been provisionally implemented since 2010. After four years of provisional implementation it is appropriate to evaluate the plan and possibly implement relevant measures taking into account recent scientific developments as well as stakeholder's views.

2.1 Terms of Reference for EWG-13-03

Following ICES advice updating stock dynamics as well as the methodology underlying the assessment of the anchovy stock in the Bay of Biscay, the STECF is requested to assess the biological and socio-economic impacts of options scoped with stakeholders in October 2013 in relation to changes to the harvest control rule, in-year TAC revisions and TAC period. The long-term biological and economic objectives established in the plan should guide this assessment.

2.2 Data call

To pursue the analysis proposed by STECF (2013) a data call was issued by DGMARE with the aim of building the required knowledge base to condition the MSE model, in particular the economic submodel.

Both administrations replied positively to the request, and the data provided was of major relevance for the work carried out. Unfortunately, due to lacks of data and late submission of data, it was not possible to carry out the work foreseen.

Nevertheless, the step forward on the analysis was relevant and the conditions to carry out the full analysis are loosely met, if it becomes necessary in a near future.

The terms of the data call are in Annex 5.

3 THE FISHERY OF ANCHOVY IN THE BAY OF BISCAY

The following section describes the evolution for the fishery regarding landings, effort, income, etc. The descriptions are based on datasets provided to the EWG as a response to the data call issued late last year (See annexes 1-3), as well as data from ICES and the SWWRAC.

The fishery is managed through TACs and Between 2007 and 2009 the fishery was closed due to a period of low recruitments. The anchovy fishery reopened during the second half of 2010, with a management plan agreed between France and Spain, although not yet approved by the EU.

3.1 Landings

Landings of anchovy have suffered a high variability along the years. As Figure 3.1 shows, in some years landings were larger than TAC. In recent years, after the reopening of the fishery, the TAC has not been taken, having reached 41% and 64% in the management periods 2010/2011 and 2012/2013, respectively.

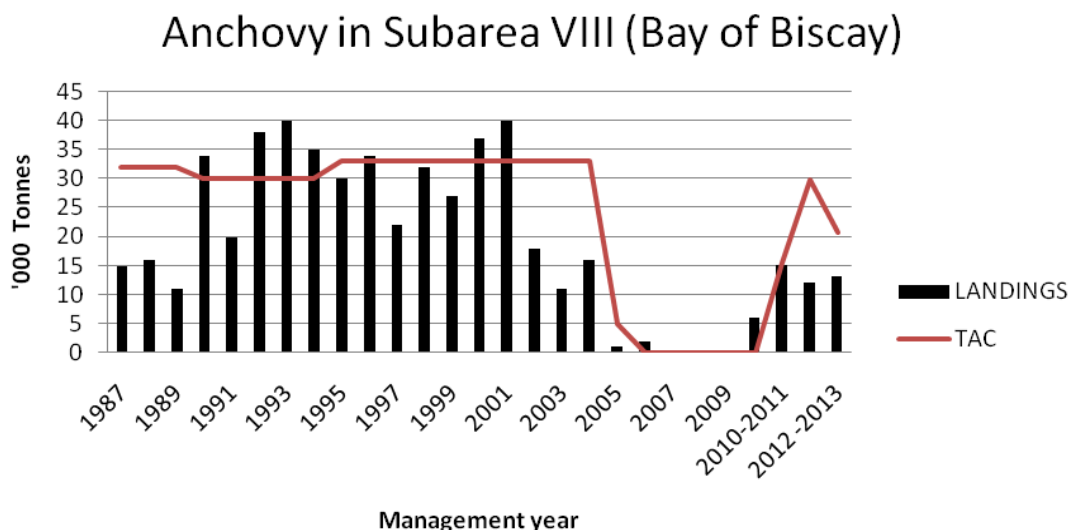


Figure 3.1: Landings and TACs of anchovy. Source: ICES

Currently, the MSE of the anchovy of the Bay of Biscay assumes that entire TAC is caught, but as the historic data shows that it is not necessary true. Quota overtake does not occur these last years. We observe however a quota-

undertake. This fact can drive to a lower level of biomass, lower level of TAC and thus lower income for the fishermen than they actually could get.

3.1.1 Spanish fleet

The Spanish fleet involved in the anchovy fishery are mainly purse seiners. The fleet is composed by 149 vessels and employs (direct employment) around 1 900 persons. The total income in 2012 was around 102.5 million of euros. The anchovy fishery alone generated around 18.7 million euros.

The Spanish fishery takes place during the first half of the year. Historically about 95% of the total landings of anchovy occur during the first semester. Currently, individual day limits by vessel are established by the Producer Organization (PO), in order to restrict daily landings and avoid saturating the market, with the consequent decrease in prices.

As Figure 3.2 shows, the Spanish landings of anchovy have been decreasing over the years. After the anchovy fishery closure, landings have been much lower than in 50's or 60's. Since 2011 the fleet hasn't caught its quota.

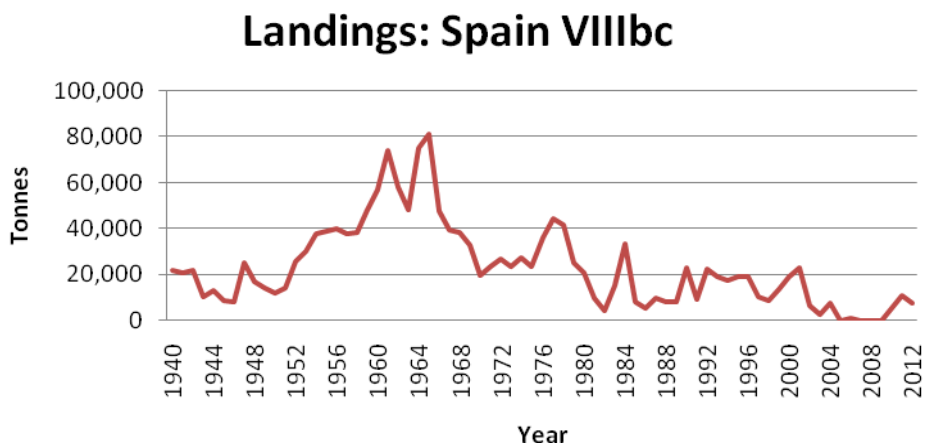


Figure 3.2: Anchovy landings of Spain. Source: ICES.

3.1.2 French fleet

French vessels operating in the anchovy fishery belong to 3 main segments pelagic trawlers (12-18 m and 18-24 m), purse seiners (12-18 m) and bottom trawlers (12-18 m). They represented in 2011 around 50 vessels, more than 200 Full Time Equivalents and a total income of around 34 million euros. **Error! Reference source not found.** shows the evolution of the French catches of

anchovy and highlights the development of the fishery during the 90s until the 2000s. The catches tended to decrease after 2001 until the closure and reached around 5 000 tons these last years after the reopening.

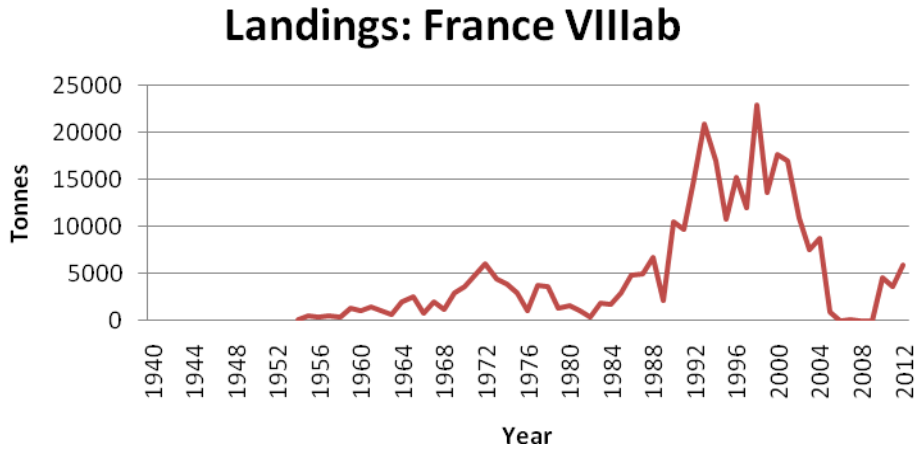


Figure 3.3: Anchovy landings of France. Source: ICES

French fleets mainly fish in the second semester. As highlighted in Figure 3.4, catches of anchovy in the second semester can represent more than 80% of the total catch of the year and almost 100% in 2011.

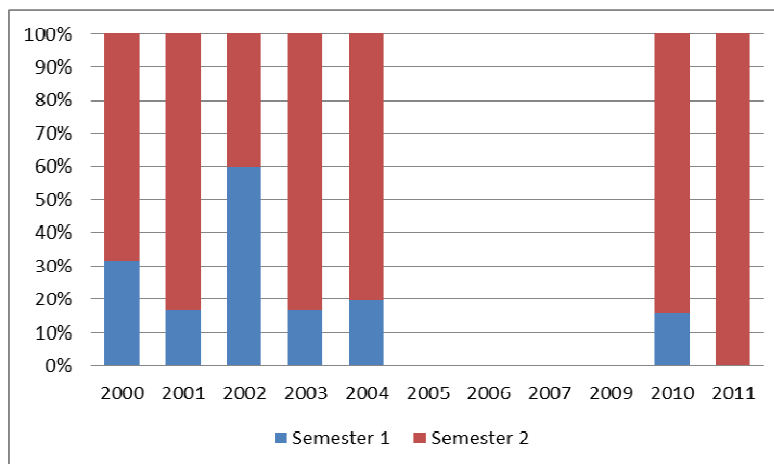


Figure 3.4: Evolution of the distribution of the total catches of anchovy in weight by French fleets between semesters. Source French Administration data call.

3.2 Effort.

Evolution of capacity, total effective effort and effort directed to anchovy is described in this section for the Spanish and French fleets operating in the fishery. Annual capacity is defined as the total number of vessels operating in the fishery in the given year multiplied by the maximum number of days at sea

observed by vessel. Total effort is the effective total effort in days at sea observed for the vessels of the fishery (all metiers included) and effort on anchovy corresponds to the effort in days at sea corresponding to trips with catches of anchovy (a limit of 1 kg and 10kg are applied to defined trips targeting anchovy for the French and Spanish fleets, respectively). The allocation of total effort between anchovy and other species is based on the allocation of each trip to anchovy or to other species (if less than 1 kg of anchovy landed).

3.2.1 Spanish fleet

The number of vessels involved in the Spanish fishery shows a decreasing trend, especially since 2000. The Basque fleet, that represented about 33% of the whole Spanish fleet, has also a decreasing trend. From 2001 to 2012 the Spanish fleet decreased 32% and the Basque 42% (Figure 3.5).

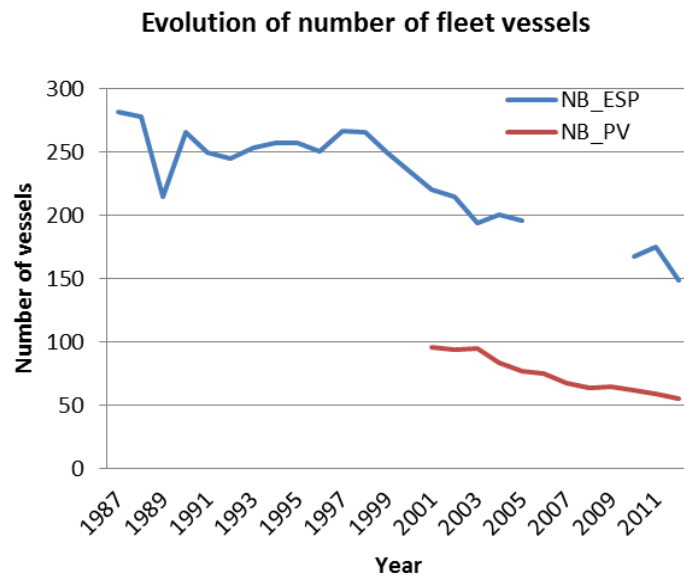


Figure 3.5: Evolution of the number of Spanish and Basque vessels selected in the anchovy fishery, Source: Data call, AZTI - Tecnalia.

The evolution of capacity and effort are represented in Figure 3.6 for the Spanish fleet. It shows a decreasing trend in capacity and effort until the fishery closure in semester one. After the anchovy fishery reopened the effort and capacity increased. Given the fact that the number of vessels has a decreasing trend, the number of days fishing has increased after the anchovy closure. In the second semester, the capacity and effort have been decreasing along the time series.

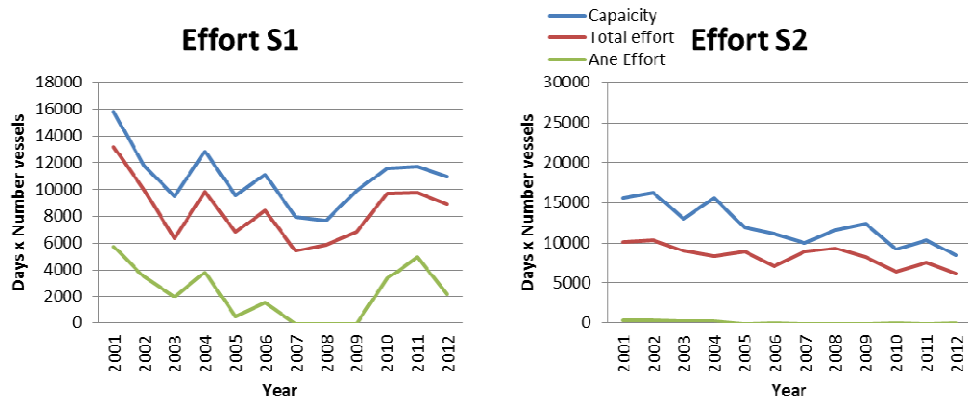


Figure 3.6: Capacity and effort (estimations) of Spanish fleet. Source: AZTI and data call.

3.2.2 French fleet

The number of vessels and total days at sea of the French fleets involved in the anchovy fishery, decreased since 2000 until the fishery closure (Figure 3.7 and Figure 3.8).

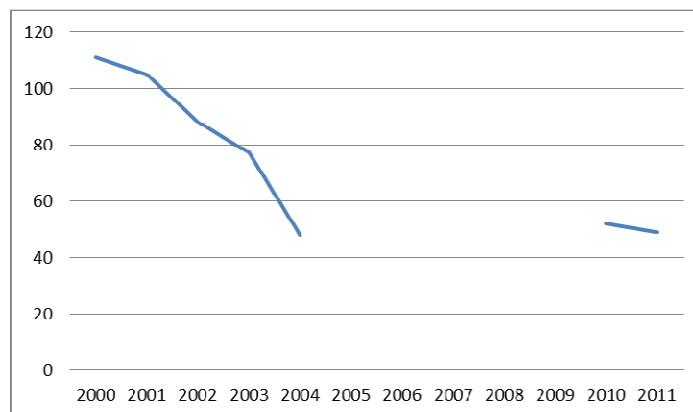


Figure 3.7: Evolution of the number of French vessels selected in the anchovy fishery (vessels catching more than 1 ton of anchovy). Source: Data call.

In recent years, the effort level was an half of 2000's levels, with 50 vessels cumulating 10 000 days at sea by year. The effort allocated to anchovy followed the same trend but its proportion in total effort in recent years was around 15%, instead of the 40% observed in 2000, with less than 2 000 days at sea by year (Figure 3.8).

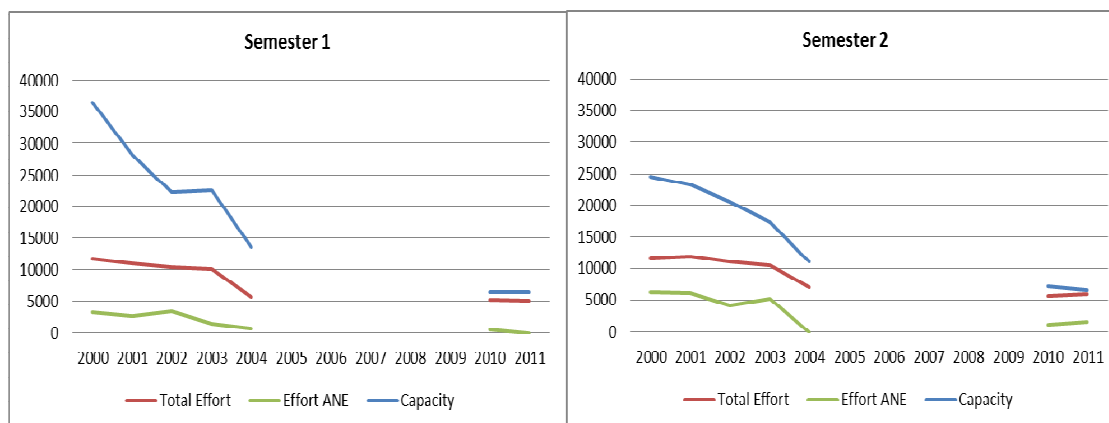


Figure 3.8: Capacity and effort (estimations) of French fleets operating in the anchovy fishery. Source: Data call.

The capacity of the French fleets decreased due to the decrease of vessels. In recent years, total effort nearly reached the maximum capacity whereas at the beginning of the period the total capacity was not used by the vessels operating in the fishery.

3.3 Prices

In general terms, the prices of anchovy suffered a strong decrease after the anchovy fishery closures (STECF 13_20), which affected the market. When the fishery reopened the prices didn't get back to the previous levels.

3.3.1 Spanish fleet

The price of anchovy has suffered a strong increase from 2001 to 2005, when the fishery was closed. After the closure, prices did not recover to the previous levels, although the prices of other species have remained stable (Figure 3.9).

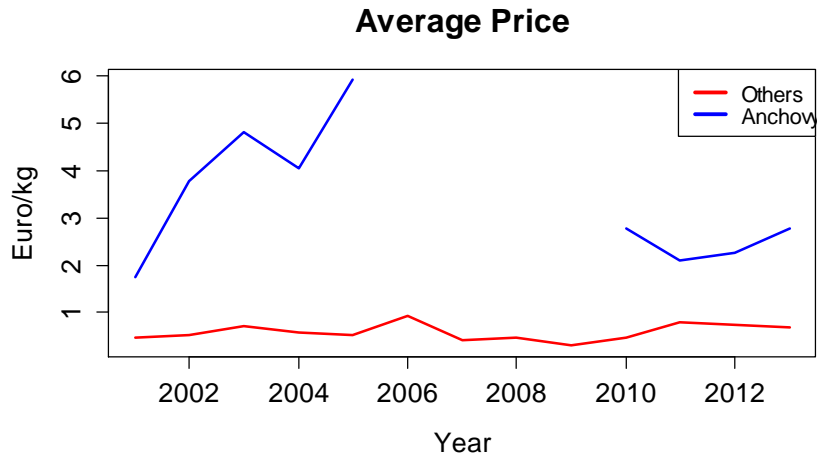


Figure 3.9: Price of anchovy and other species and landings (average by vessel) of other species (semester 1). Source: AZTI and STECF 13_20.

3.3.2 French fleet

Evolutions of the price of anchovy and of the price of other species are illustrated in Figure 3.10 by fleet.

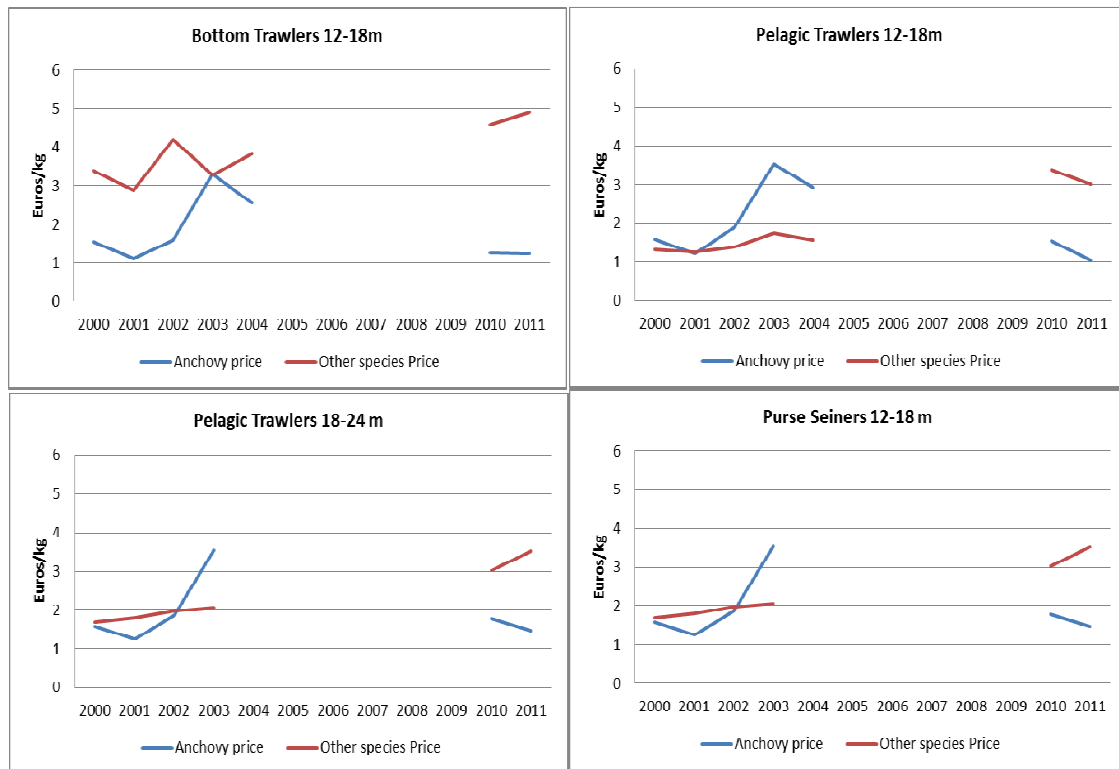


Figure 3.10: Evolution of the current price of anchovy and of the current price of other species by French fleets by year. Source French Administration data call.

Analyses of the evolution of the prices show that the anchovy price decreased after the closure and the prices of other species increased due to modifications in catch composition and targeting of high valued species.

3.4 Dependency and income.

In the specific case of fisheries closures, the response of fishers to management actions through changes in fishing effort allocation is important when developing effective regulations (Powers and Abeare 2009). When the fishery is closed, the fleets can change the effort profile (Andrés and Prellezo, 2012), and the dependency on one or other species can change significantly.

The dependency on the anchovy fishery was analysed according to the following indicator:

$$\text{ANE_DEP}_{y,f} = \text{Landing of anchovy (euros)}_{y,f} / \text{Total landing}_{y,f}$$

The indicator shows how important anchovy is for different fleets and how this dependency has changed over time. The subscripts y and f correspond to year and fleet respectively.

3.4.1 Spanish fleet

The fleet is a multispecies fleet that traditionally distributes its activity across three seasons: mackerel; anchovy and tuna. The fleet is composed basically of purse seiners, which can shift fishing gear to pole & line (using live bait), hand lines and trolling, depending on the species and fishing season. The main target species are anchovy (*Engraulis encrasicolus*), albacore (*Thunnus alalunga*), mackerel (*Scomberscombrus*), bluefin tuna (*Thunnus thynnus*) and horse mackerel (*Trachurus trachurus*).

According to the Spanish administration, the dependency of the Spanish purse seine fleet on anchovy in 2012 was 38% in the first semester and 2% in the second semester.

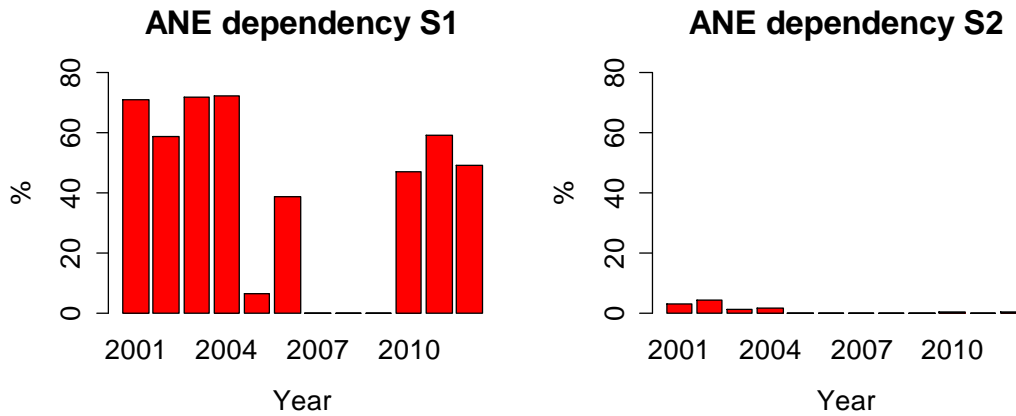


Figure 3.11: Dependency on the anchovy fishery by semester and year. Basque purse seiner. Source: AztiTecnalia.

Looking at the dependency of the Basque fleet on anchovy (Figure 3.11), showed that, before the fishery closure it was 68% (average of years 2001:2004) in the first semester, decreasing to 50% afterwards (average years 2010:2012).

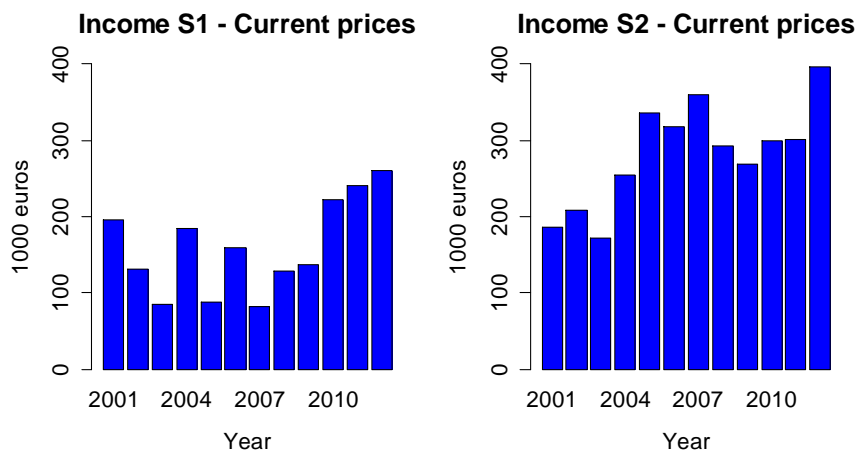


Figure 3.12: Income (average by vessel) by semester and year. Basque purse seiner. Source: AztiTecnalia.

Nevertheless, the general income increased, which may indicate a change in fishing strategies (Figure 3.12), for example due to daily restrictions on landings of anchovy. The income of the Spanish fleet in the second semester is larger than in the first, due to shifting the target species to large pelagics, which in general have higher prices.

The impact of the fishing closure was not the same for all vessels, once that the Spanish purse seine fleet is not homogeneous.

3.4.2 French Fleet

Figure 3.13 shows the dependency of the French fleet on anchovy from 2000 to 2011, highlighting that has been decreasing over time. Anchovy represented about 40% of the income before the closure, and less than 20% in 2010 and 2011, after the re-opening.

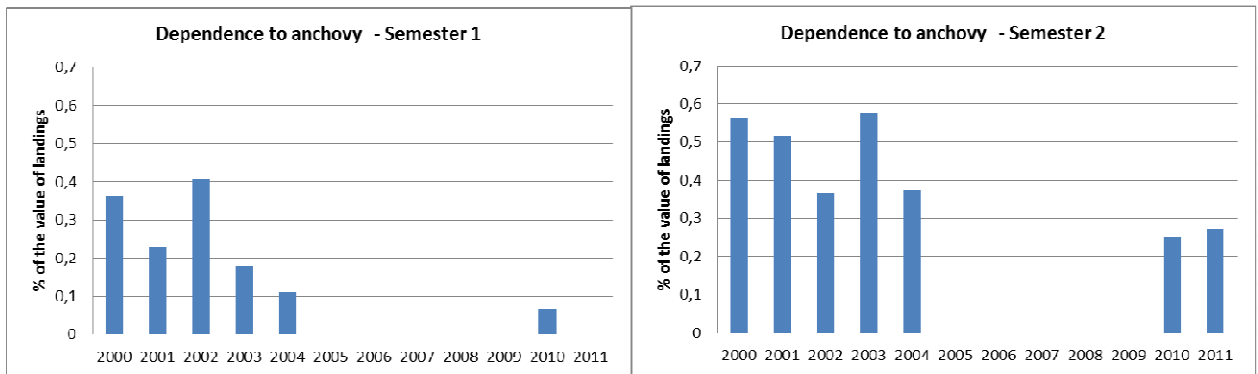


Figure 3.13: Dependency on anchovy by year. French Fleets. Sources: French Administration data -data call

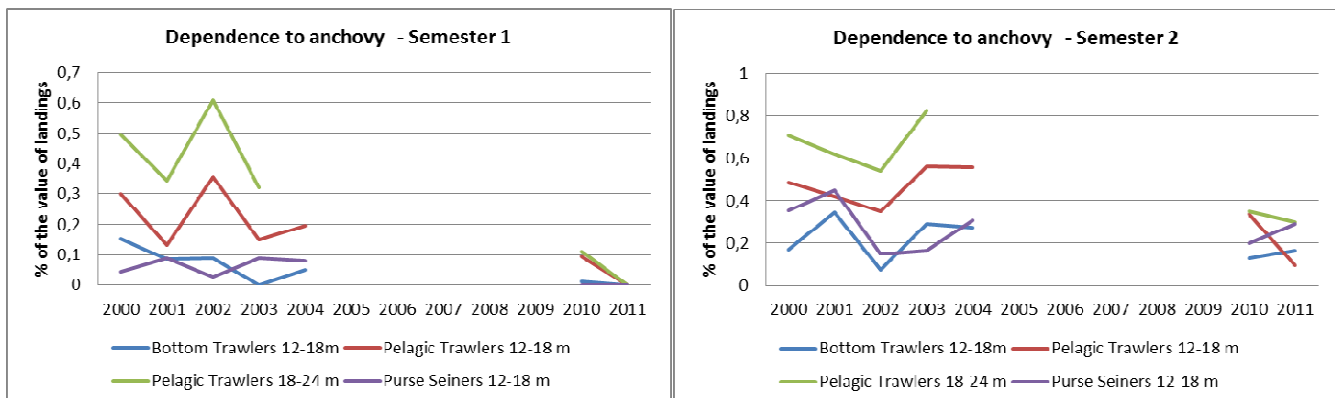


Figure 3.14: Dependency on anchovy by year by French Fleet. Sources: French Administration data -data call.

Moreover, after the closure, the French fleets also concentrated their activity on anchovy in the second semester, in particular purse seiners as highlighted in Figure 3.14.

The analysis of the evolution of the dependency to anchovy by fleet and of the catch composition (Figure 3.15) shows that the decrease in dependency is mainly explained by pelagic trawlers, which allocated their activity to other fisheries during the closure, and catch proportionally more tuna and seabass after the closure.

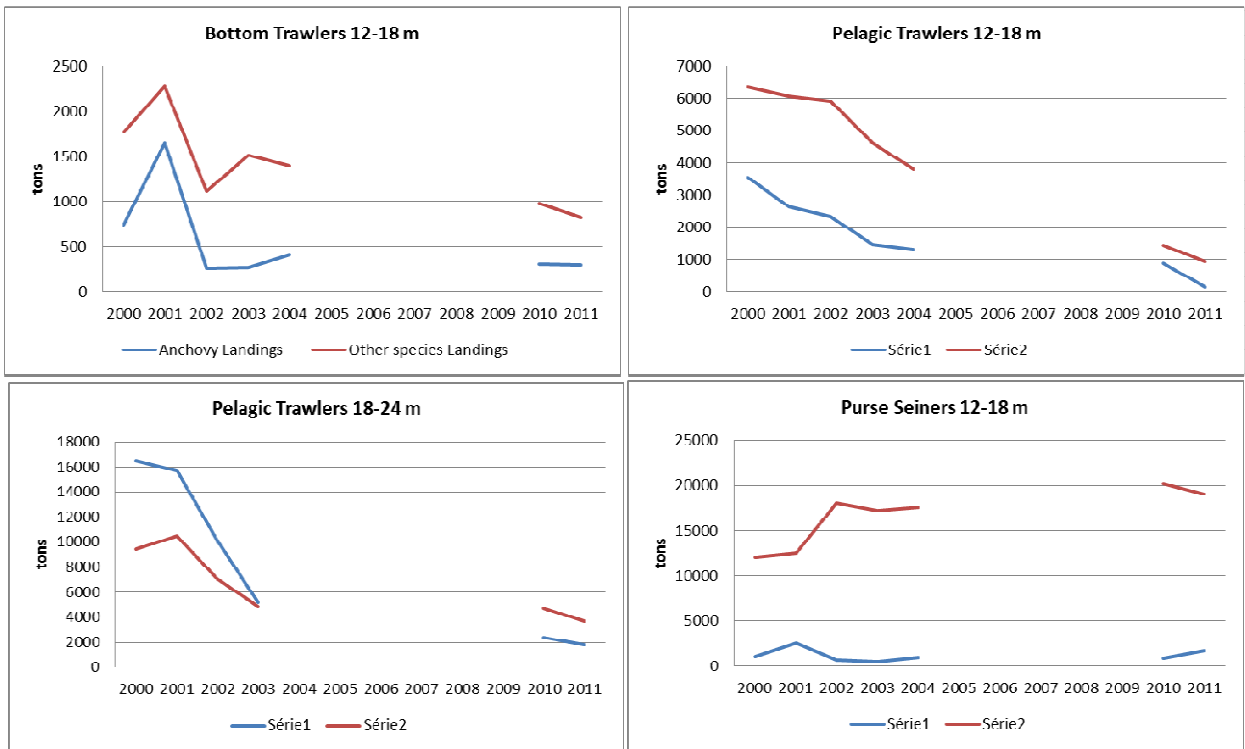


Figure 3.15: Evolution of the tonnage of anchovy and other species by French fleets. Sources: French Administration-data call.

The evolution of income along the studied period also showed a decrease (Figure 3.16).

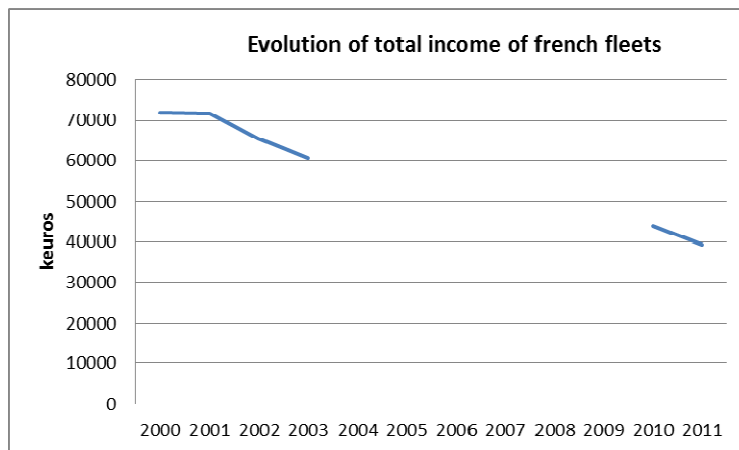


Figure 3.16: Evolution of the total income of French fleets. Sources: French Administration-data call

Detailed data of income by fleet show the same tendency (Figure 3.17) and in particular the strong decrease in total income due to the decrease in the number of pelagic trawlers 18-24 m in the fishery. Evolution of

the average income by vessel highlights an increase by vessel of bottom trawlers and purse seiners after the closure, while the pelagic fleets, despite the decrease in anchovy dependency previously observed, show a stable income.

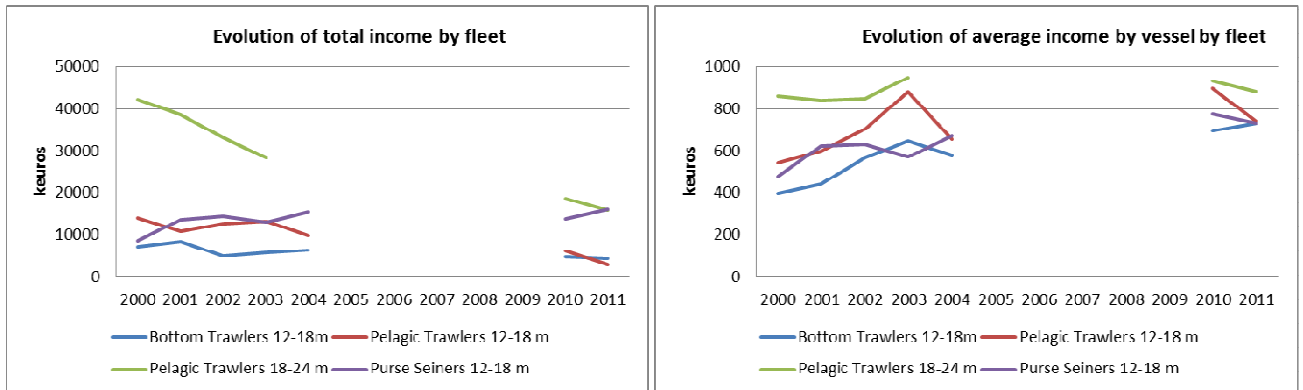


Figure 3.17: Evolution of the total income by French fleets and of mean income by vessel by fleet. Sources: French Administration-data call.

4 METHODS – MANAGEMENT STRATEGIES EVALUATION

The evaluation of the current harvest control rules and possible alternatives (Section5) was performed by simulation using an MSE approach. The analysis were carried out with FLBEIA (García *et al*, 2013), 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.

4.1 Operating Model

The population dynamics is described in terms of numbers at age (with age groups 0, 1, 2 and 3plus) by semesters (i.e. on half year basis). 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 Ricker stock recruitment model. It is known that all individuals are mature at age 1 (with conventional birthdate at first January). So at spawning time all existing age groups (from age 1 to 3+) are mature and equally contribute to the spawning. Natural mortality is constant across years but different for each age class and semester (see section 4.5.2).

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 according to historical rates of catches by semesters. An alternative is set up corresponding with the different quota assigned to France and Spain and the percentage of catches by country corresponding to each semester (see below section 4.5.6). Total catches by semester are separated by age groups according to the selectivity by semesters. As the effort dynamics is not included, there isn't a capital model implemented.

4.2 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 a juveniles' abundance index.

The estimate of SSB that will feed the MP/HCR is generated depending on the management periods which will be tested in the current report:

a) For the Management year going from July of year y to June of year $y+1$, the biomass of reference for setting the TACs refer to the previously assessed SSB in May of year y . In this case, the estimate of SSB_y that will feed the MP/HCR is

generated from a lognormal distribution with mean (in log scale) equal to the OM SSB in May year y and a standard deviation based on the coefficient of variation of the biomass estimates provided by 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). It should be noticed that this value is slightly larger than the coefficient of variation of the biomass estimates from the CBBM (which vary between 0.15 and 0.21), to account for under-estimation of the uncertainty surrounding the stock assessment model.

b) For the management year going from January to December of year y , the biomass of reference for setting the TACs refer to the next coming (expected and not yet assessed) SSB during the management year (in May of year y). The next coming expected SSB is to be deduced from an assessment carried out at the end of the previous year which provides estimates of the January Biomass at age 2+ (survivors from the previous year) and of the Biomass at age 1 (recruits from the age 0 happening in year $y-1$). Both estimates of biomasses are simulated independently in the MSE loop as a random observation of the biomasses at age 1 and at age 2+ respectively, both taken from lognormal distribution with mean (in log scale) equal to the OM Biomass by age in January of year y and a standard deviation corresponding to a $CV=0.25$ (as for the June assessment). The reason for drawing independent observations for the two age groups is that in practice the assessment of January biomasses is informed separately for the recruits from a survey (JUVENA) in Autumn on juveniles (age 0) and for age 2+ by the two surveys on the spawners in May of the previous year (which are to become the age 2+ survivors in January subject to the stock dynamics and the fishery during the previous year).

The major assumption is that the assessment carried out either in June or in December is subject to the same observation error (of a $CV=0.25$).

4.3 Management procedure

The assessment process is considered together with the observation process in the MSE loop. This is so because the stock assessment process could not be included in the MSE loop. Following a suggestion of EWG 13-24, a Maximum likelihood assessment model was developed and implemented in R (([27](http://www.r-</p></div><div data-bbox=)

project.org) (Sanchez et al. 2014WD). However this MLE Assessment showed convergence problems and the results were not always comparable to its Bayesian counterpart. In addition, the computation time took around 15 minutes, which could slow down greatly the MSE computation. Therefore, this MLE assessment was not included into the MSE algorithm. This situation limits the analysis by not accounting for estimation uncertainty.

4.4 Implementation Error and quota borrowing or banking

In order to test the different rules, all the TAC is assumed to be taken (no implementation error is included). As such TAC undertaken is not included, though it has happened in recent years.

TAC borrowing or banking from one year to the next (according to Article 4(2) of Regulation (EC) No 847/96)) was also omitted. In the last years movements of quota fractions between countries and from year to year have been quite common. Given that these quota fractions are small, its effect is expected to be small. We considered this of secondary priority and we decided to postpone its implementation until the economic sub-model is fully parameterized and tested.

4.5 Conditioning

The operating model was conditioned using the results obtained from applying the most recent assessment 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.

4.5.1 Initial population and mean weights

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).

4.5.2 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 also set to 0.4.

4.5.3 Growth parameters

The annual growth rates are taken from the output of the last assessment.

When generating the observed abundance indices at the end of the year (for recruits and adults) the average weights at age at the beginning of the year are 0.0129 and 0.0275 kg respectively for ages 1 and 2+. This is based on the average weights at age at spawning for years 1990-2012 (0.01589, 0.02847 and 0.03389 kg for ages 1, 2 and 3+ respectively), given the growth rates taken from the medians of the last assessment ($G_1 = 0.54$, $G_{2+} = 0.24$) and assuming that 68% of the individuals at age 2+ correspond to age 2.

4.5.4 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 to 1 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).

For the January-December calendar, when estimating the expected SSB the selectivity by ages used for the first semester are $s(\text{sem}_{1,1}) = 0.48$ and $s(\text{sem}_{1,2}) = 1$, which correspond to the medians of the last assessment.

4.5.5 Recruitment process

As it was decided by STECF (2013) a Ricker model of the stock recruitment relationship was used. The differences between fits of different models (Beverton and Holt, Hockey stick and Ricker, Figure 4.1) were small, SSB and recruitment exhibited strong variations over the years with no clear relationship, but the Ricker relationship was more stable.

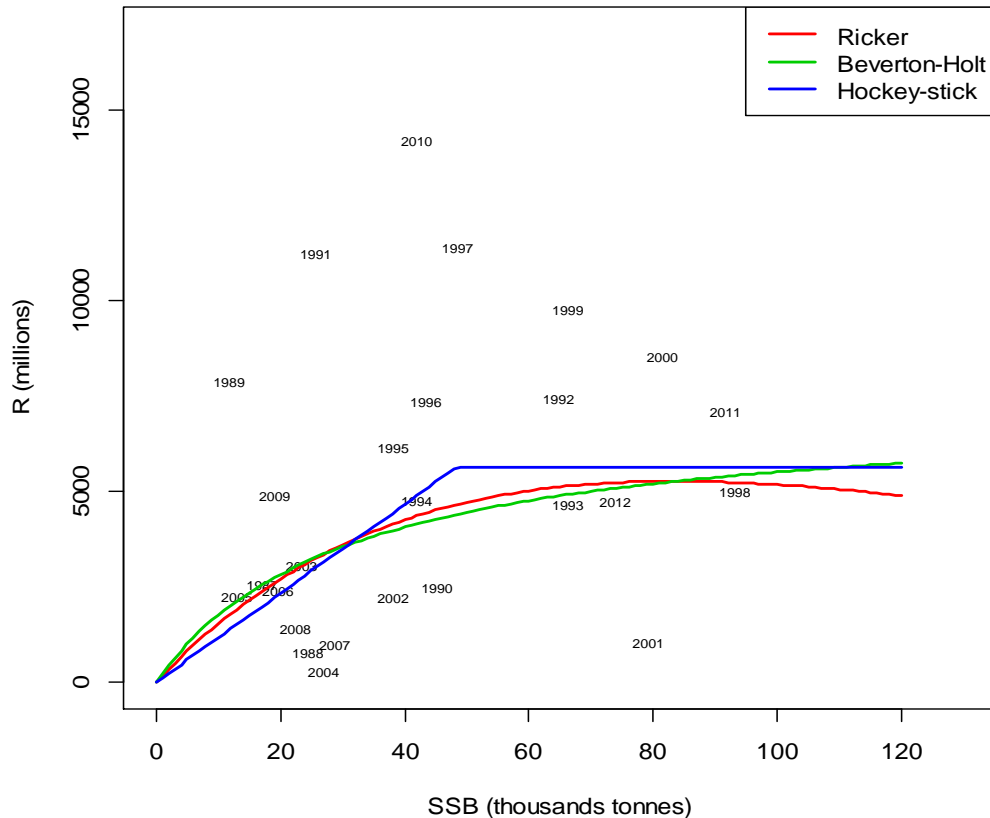


Figure 4.1: Scatter plot of SSB in thousand tons and recruitment in million individuals (both at mid-year) and stock recruitment relationships fitted with the values estimated using the CBBM median output values.

A scenario of poor recruitment was constructed in order to test the robustness of the HCRs to possible failures in recruitment, which have happened in the past and are well known to happen in small pelagics, and to periods of low productivity, largely dependent on environmental conditions. In this scenario three consecutive recruitment failures (3 years cover a whole life cycle of anchovy) were introduced. The low recruitments are sampled randomly from the 1/3 lowest recruitments of the time series, which correspond to years 1988, 1990, 2001-2002, 2004-2008. The minimum, maximum, mean and the standard deviation of these recruitment are respectively 332, 2528, 1586 and 814. Given that for the MSE simulations the projection period is from 2014 to 2033, these 3 years are assumed to occur in 2023-2025, so that after these induced failures there will be still 8 years to allow the population to recover and for the rule to show that it allows such a recovery. For the rest of the years recruitment is generated according to the Ricker model.

4.5.6 Partition of catches on half year basis

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.

4.6 Projections

The dynamics were simulated for 20 management periods (July 2014 – June 2024 or January 2014 – December 2023) and run for 500 iterations. The projection period was considered sufficient given the short-lived nature of the stock. In comparison to the EWG 13-24, the WG has extended in 10 years the projections. This was done in order to cope with the scenarios forcing recruitment failures (as described above), in order to give enough time for the population to recover after such perturbation.

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 errors affecting the assessments of the SSB used to set the TAC according to the HCRs.

Currently the coefficient of variation for the SSB 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.

4.7 Changing management periods

When applying HCRs on the period January to December, an estimate of SSB_y in May based on previous January's estimate must be made. The process is circular once that to compute TAC_y (the advice for year y being given in year y-1) one must know SBB_y, which is the indicator feeding the HCR. Currently, the estimate is made iteratively to account for the mortality that will occur until mid May. In each loop the catches at age for the first semester would be derived according to the selectivities at age for the first semester (provided above).

4.8 Sensitivity

Due to time constraints the EWG didn't run a thorough sensitivity analysis, and relied on the analysis performed by STECF (2013).

STECF (2013) made 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.

The results about the sensitivity of the coefficient of variation of the SSB observation (cv.ssb), were made by comparing alternative cases of lower CVs (more in line with the current assessment outputs of about CV=0.15). The results showed very limited sensitivity to alternative CV.

Regarding the seasonal share of the TAC, the assumption in the base cases is that the historical share is maintained, 60%:40% for the first and second half of the year respectively. While a justified alternative was 75%:25% (see EG 13-24). The results also showed very limited sensitivity to this factor.

The alternative S/R models showed little impact on the performance of the different harvest rules: "In terms of risks and expected TACs and its variations along the years and iterations the differences are negligible."

The EWG did tested the sensitivity of the MSE to mis-matches between the quota share by semesters, assumed in the projections and the quota share in the true population (operating model). The test used a scenario where the decision to set the TAC is made assuming that 60% of the

catches are taken in the first semester, while the operating model uses a catchshare of 75% in the first semester. This scenario was tested for cases G0, G1 and G2 (as described below) and allowed testing the robustness of the rule to a wrong assumption on semester share of future catches.

However, in the future, major changes outside this range could be explored, as they may affect the performance of the HCR and the fisheries. The same applies for borrow and banking (according to Art. 4.2 of Reg EC 847/96).

4.9 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) Median Spawning Stock Biomass across years and iterations.
- b) Probability of SSB being below B_{lim} in any randomly chosen year of the projection period. Sometimes also referred to as biological risk:

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

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

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

- d) Mean number of years in which SSB is below B_{lim} in the projection period

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

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

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

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

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

- g) Expected average TAC (in biomass) across the projection years:

$$\overline{TAC} = \frac{\sum_{iter,y} TAC_{iter,y}}{N_{iter} N_y}$$

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

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

- i) Mean number of years to get SSB above Blim in the projection period

5 MANAGEMENT SCENARIOS TESTS

5.1 Current HCR (COM(2009) 399 final).

The base case is the harvest control rule defined in the long term management plan proposal for the Bay of Biscay anchovy (COM(2009) 399 final). This HCR (Figure 5.1) has a Btrig1=24000 t, Btrig2=33000 t, Btrig3=110000 t, TACmin=7000 t and TACmax at 33000 t with a harvest rate (γ)=0.3 (note that the average harvest rate of the HCR is different from 0.3).

This rule was already tested for a range of harvest rates, between 0.2 and 0.5, in the previous meeting (STECF, 2013). The exercise showed that for the same harvest rates, the current HCR resulted in similar

levels of risks, with slightly higher catches, as when tested by the first time in 2008. For this reason it was concluded that the rule is still within the same precautionary limits of risks and consequently still operative under current new assumptions on stock status, providing similar levels of risks for the same management calendar.

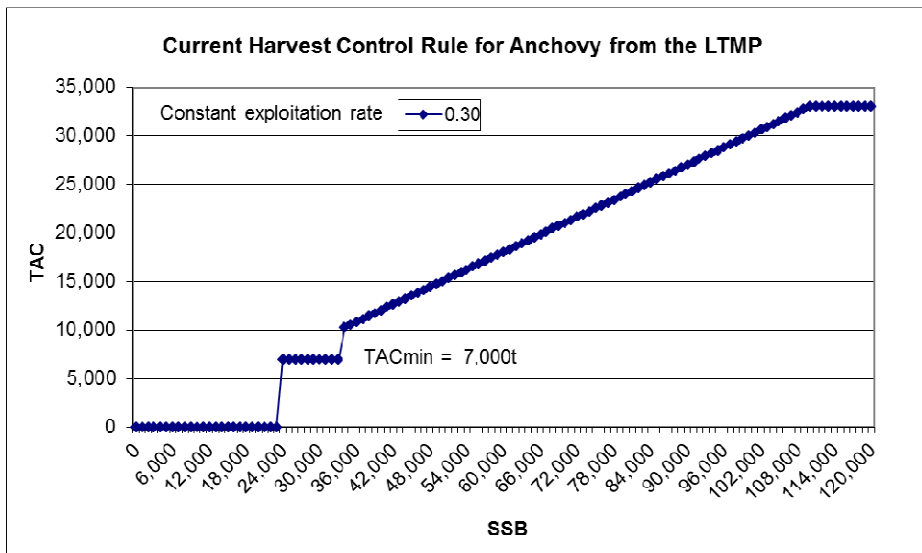


Figure 5.1: Current Harvest Control Rule from the draft LTMP for Bay of Biscay anchovy ((COM(2009) 399 final).

5.2 Alternative HCR proposed by the SWWRAC

The alternative suggested by the SWWRAC (Figure 4.1.2) has a Btrig1=24000 t, Btrig2=33000 t, Btrig3=58000 t, TACmin=7000 t and TACmax at 25000 t, implying a higher harvest rate than the current HCR. The proposal was tested by STECF (2013), for the management period July-June (Figure 4.1.2 for $\gamma = 0.3$).

The application for the period January-December generates a strong discontinuity and ambiguity around Btrig3 (see Sánchez *et al.* WD for more details). The group considered this to be an undesirable situation due to the instability it creates in the TAC, when the biomass is in the region of the Btrigger points.

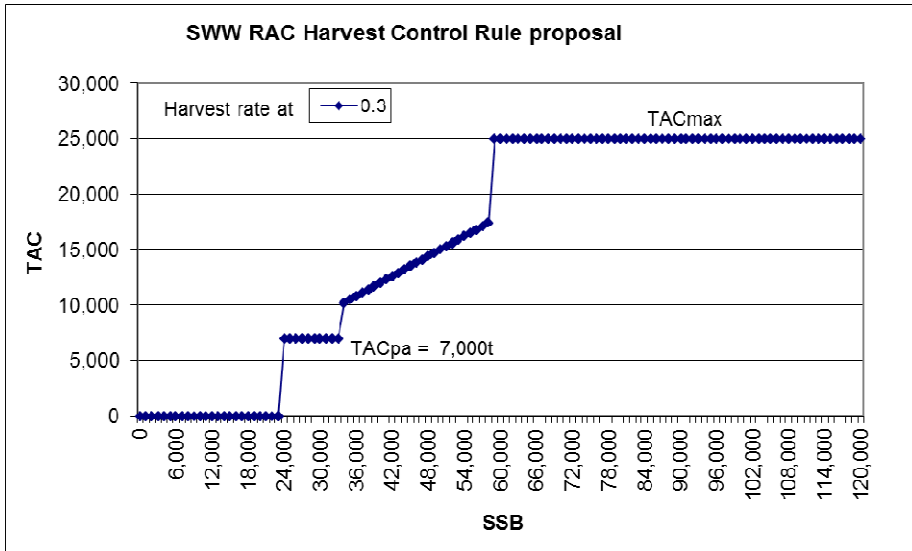


Figure 5.2: Proposal of HCR from the SWWRAC for $\alpha_y = 0.3$.

5.3 Reformulating HCRs

As stated before, any discontinuity in the HCR will create instability in the TAC when the biomass is in the region of the Btrigger points, which is undesirable. The extent of such instability will depend on the harvest rate parameter and how far from TACmax and TACmin it will set the TAC (see Sánchez *et al.* WD for more details). The jumps in TAC occur in a very limited range of biomasses. In theory a single kg of biomass can position it above or below the trigger, resulting in large differences in fishing opportunities.

For this reason the EWG considered a re-formulation of the HCRs that assure continuity across all range of potential SSB above Btrig1. The new formulation makes at Btrig2 (=33000 t) the TAC to be at TACmin, and thereafter the TAC is allowed to increase continuous and linearly as the biomass increases, up to reaching TACmax at Btrig3. The rule can be defined as a HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax (or simply continuous after Btrig2). The rule can be defined as:

$$TAC = \begin{cases} 0 & \text{"if" } (SSB)_y \leq B_{1trig1} \\ [TAC]_{min} & \text{"if" } [B_{1trig1} < (SSB)]_y \leq B_{1trig2} \\ \text{Linear increase} & \text{if } B_{1trig2} < (SSB)_y < B_{1trig3} \\ TAC_{max} & \text{if } (SSB)_y \geq B_{1trig3} \end{cases}$$

(Eq 4.3.1)

Where y is the subscript for “year”, Btrigger values represent biomass reference points against which the Spawning Stock Biomass (SSB) is

compared each year to deduct the catches (TAC). This HCR depends on seven parameters at most: the minimum and maximum TAC (TAC_{min} and TAC_{max}), the trigger points (B_{trig1} , B_{trig2} and B_{trig3}), the harvest rate (γ) and the intercept (α), where:

$$B_{lim} \leq B_{trig1} \leq B_{trig2} \leq B_{trig3},$$

$$0 \leq TAC_{min} \leq TAC_{max}$$

$$\frac{TAC_{min} - \alpha}{B_{trig2}} \leq \gamma \leq \frac{TAC_{max} - \alpha}{B_{trig3}}.$$

This rule is valid for either a $TAC_{July-June+1}$ where the TAC depends on the estimate of the SSB in May of year y for a management period going from July (y) to June ($y+1$), or for a $TAC_{Jan-Dec}_y$ where the TAC is set according to the expected SSB during the management period January-December of the year y .

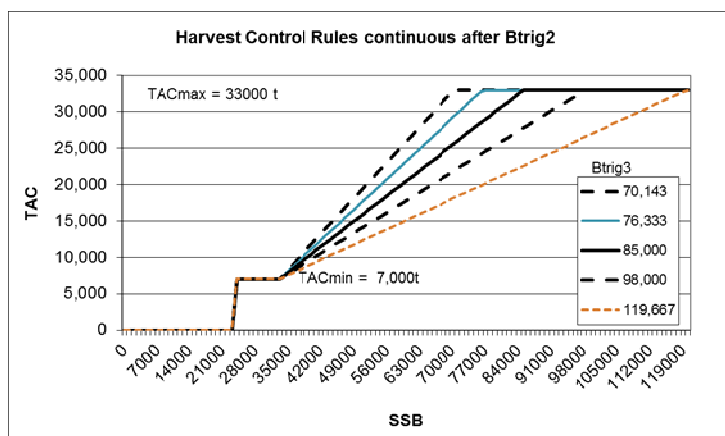
The harvest rate is defined by γ and α values and B_{trig2} , forcing continuity at (B_{trig2}, TAC_{min}) and (B_{trig3}, TAC_{max}) , which corresponds

$$\text{to } B_{trig3} = B_{trig2} + \frac{TAC_{max} - TAC_{min}}{\gamma} \text{ from which follows that } \alpha = TAC_{min} - \gamma B_{trig2}.$$

Note that this formulation can be further simplified.

5.4 Scenarios

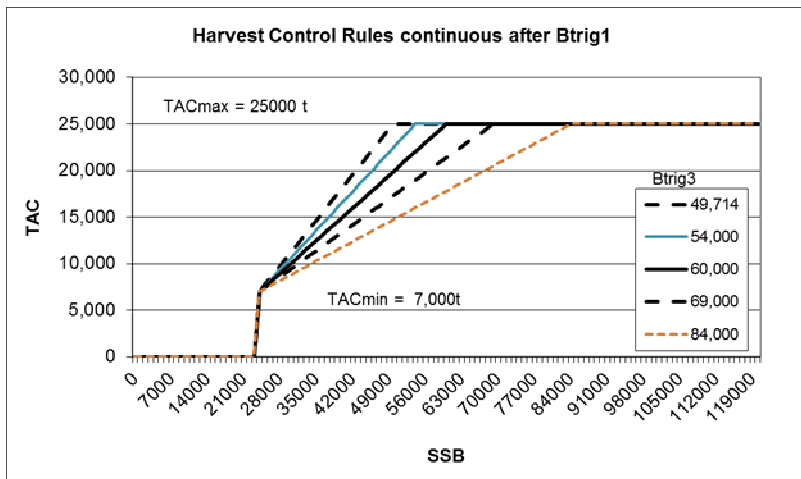
The HCR described above was tested for slopes (γ) ranging between 0.3 and 0.7 (Figure 5.3).



Btrig1	Bclosing	24000	24000	24000	24000	24000
Btrig2	BTACmin	33000	33000	33000	33000	33000
Btrig3	BTACmax	70,143	76,333	85,000	98,000	119,667
	TACmax	33000	33000	33000	33000	33000
	viableTACmin	7000	7000	7000	7000	7000
	Slope	0.70	0.60	0.50	0.40	0.30
	Intercept	-16,100.0	-12,800.0	-9,500.0	-6,200.0	-2,900.0

Figure 5.3: Examples of the HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax (or simply *continuous after Btrig2*).

An alternative of removing TACmin was considered. Using the formulation above it refers to situations where Btrig2 is equal to Btrig1 (=24000 t), for an initial TAC equal to TACmin, which grows afterwards depending on the harvest rate. This rule was tested for slopes (γ) ranging between 0.3 and 0.7 (example in Figure 4.1.4).



Btrig1	Bclosing	24000	24000	24000	24000	24000
Btrig2	BTACmin	24000	24000	24000	24000	24000
Btrig3	BTACmax	49,714	54,000	60,000	69,000	84,000
	TACmax	25000	25000	25000	25000	25000
	viableTACmin	7000	7000	7000	7000	7000
	Slope	0.70	0.60	0.50	0.40	0.30
	Intercept	-9,800.0	-7,400.0	-5,000.0	-2,600.0	-200.0

Figure 5.4: Examples of the HCR with continuous exploitation after Btrig1, up to a TACmax (or simply *continuous after Btrig1*).

Both HCRs were tested for two different values of TACmax (25 000 and 33 000t), the two management periods (Jul-Jun and Jan-Dec) and the two recruitment scenarios (Ricker with and without a low recruitment regime) (check annex 6 for all results). Table 5.1 presents the details of these scenarios.

Table 5.1: Anchovy HCRs Cases tested by the EWG

Cases	B_{trig1}	B_{trig2}	B_{trig2}	TAC_{min}	TAC_{max}	α	γ	Calendar	In year revision?	Recruitment
G0 - Base case	24000	33000	$\frac{TAC_{max}}{\gamma}$	7000	33000	0	0.3	Jul-Jun	No	Ricker
								Jan-Dec		Low
G1 - Continuous at Btrig2	24000	33000	$B_{trig2} + \frac{TAC_{max} - TAC_{min}}{\gamma}$	7000	33000	$TAC_{min} - \gamma B_{trig2}$	0.3	Jul-Jun	No	Ricker
							-0.7	Jan-Dec		Low
G2 - Continuous at Btrig2	24000	33000	$B_{trig2} + \frac{TAC_{max} - TAC_{min}}{\gamma}$	7000	25000	$TAC_{min} - \gamma B_{trig2}$	0.3	Jul-Jun	No	Ricker
							-0.7	Jan-Dec		Low
G3 - Continuous at Btrig1	24000	24000	$B_{trig2} + \frac{TAC_{max} - TAC_{min}}{\gamma}$	7000	33000	$TAC_{min} - \gamma B_{trig2}$	0.3	Jul-Jun	No	Ricker
							-0.7	Jan-Dec		Low
G4 - Continuous at Btrig1	24000	24000	$B_{trig2} + \frac{TAC_{max} - TAC_{min}}{\gamma}$	7000	25000	$TAC_{min} - \gamma B_{trig2}$	0.3	Jul-Jun	No	Ricker
							-0.7	Jan-Dec		Low

5.5 Results:

5.5.1 Case G0: The Current HCR (July-June vs Jan-Dec)

Table 5.2 presents summary results for the current HCR(G0).

The management period going from January to December (JD) seems to halve the risks of falling below Blim in any year compared with a management period going from July to June (JJ) and reduces the number of years below Blim and the number of closures, as well as the time to recover in case of falling below Blim. In terms of catches the JD results in higher catches (with a bit larger inter-annual variability 0.48) than with JJ by about 2000 t (and variability around 0.42). Summary results can be seen in Figure 5.5.

Table 5.2 also shows the assessment of the impact of a variation in the actual share between semesters (to 75% instead of default case of 60%, maintaining the assumption of 60% share within the management procedure) for the base case applied from January to December (last line compared with the second line). The results show that the increase in risk induced by setting the TACs assuming that catch share will be 60%/40% while actually being of 75%/25% would be less than 1% for catches slightly reduced but with similar stability.

Table 5.2: Summary results for the current harvest control rule G0 for the two calendar of management, also assessing the impacts of low recruitment scenario on the time to recover the population above Blim (Years to recover) and assessing the impact of a variation in the actual share between semesters (to 75% instead of default case of 60%). JJ=Management going from July to June. JD= Management going from January to December.

Case	Calendar	Recruitment	TACmax	Gamma	MedianSSB	P(SSB<Blim)	P(SSB<Blim).once	Years<Blim	P(Closure)	P(Closure).once	TAC ('000t)	P(TAC _{dir} <5000t)	Years to Recover
G0+Share60%	JJ	rick	33000	0.3	67.663	0.067	0.576	1.416	0.098	0.708	19.903	0.422	0.962
G0+Share60%	JD	rick	33000	0.3	69.980	0.034	0.352	0.676	0.051	0.454	21.850	0.484	0.550
G0+Share60%	JJ	ricklow	33000	0.3	56.732	0.130	0.852	2.73	0.167	0.914	17.298	0.402	1.820
G0+Share60%	JD	ricklow	33000	0.3	56.685	0.090	0.704	1.79	0.126	0.8	18.373	0.452	1.323
G0Share75%	JD	rick	33000	0.3	66.330	0.037	0.336	0.74	0.060	0.482	21.176	0.468	0.556

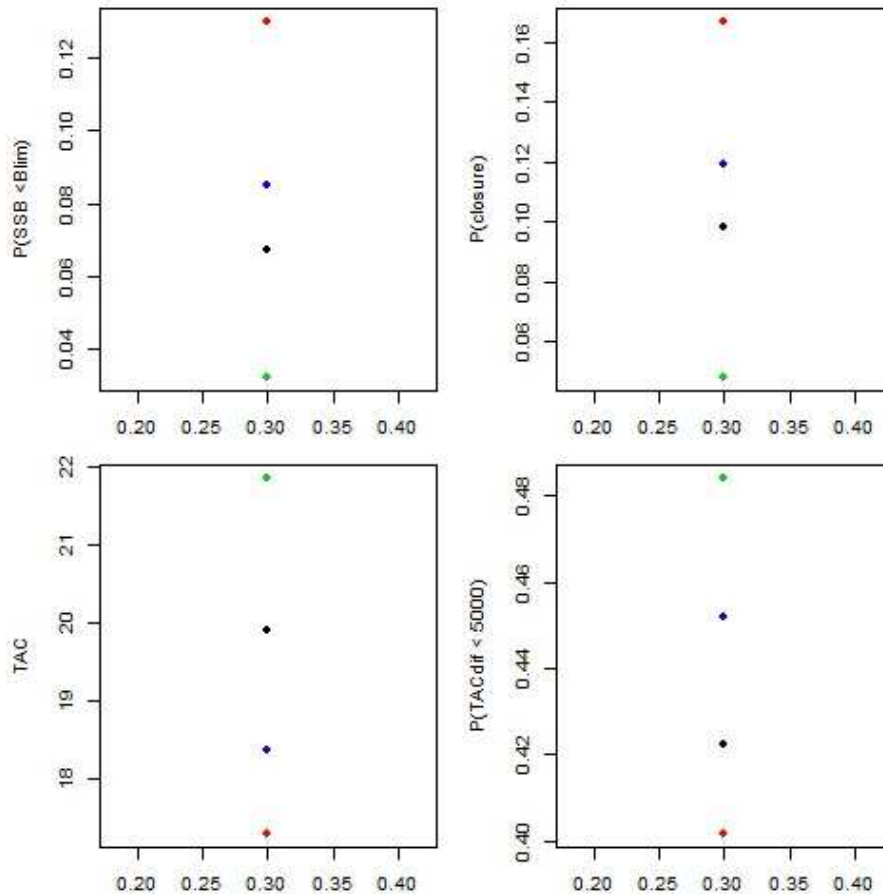


Figure 5.5: Summary indicators of the performance of the current harvest control rule. From top to bottom and from left to right probability of SSB being below Blim, probability of closure, the average TAC and the inter-annual variation in the TAC. Each of the points corresponds with: Black July June calendar under the Ricker model, Green January-December calendar under the Ricker model, Red July-June with Ricker+LowRecruits and Blue JD with Ricker+LowRecruits).

5.5.2 Cases G1 & G2: TACmin + Continuous exploitation from Btrig2 onwards.

Table 5.3 provides the summary results for the HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax (or simply *continuous after Btrig2*), which are cases G1 for a TACmax of 33000 t and G2 for a TACmax of 25000 t in Table 5.1. Figure 5.6 and Figure 5.7 show a summary of some statistics across different slopes for the two TACmax values respectively.

The management period going from January to December (JD) reduces biological risks in any year by 30-50%, provides larger catches (~1500t higher) and slightly reduces the inter-annual variability in catches (Figure 5.6). The calendar JD also reduces the probability of closing the fishery and the time to recover, in the case of SSB falling below Blim. The advantages in

moving the management period to JD, apply for both TACmax levels, 33000t (G1, Figure 5.6) and 25000t (G2, Figure 5.7), with slightly lower benefits in terms of catches when TACmax is 25000t.

Regarding the alternative TACmax, 25000t (Table 5.3), it leads to a reduction in the levels of risks of about 1-2% and gains in catch stability of ~14%. Although the average expected catches are reduced by 2000-3500t per year. The effect is similar for both management periods.

Regarding recruitment, imposing three poor consecutive recruitments (rick low scenarios, Figure 5.6 and Figure 5.7) almost doubles biological the risk and consequently of fishing closures and inter-annual variability. Catches decrease on average ~3000t. Similar patterns are found for both calendars (blue -JD- and red -JJ- lines in those figures) and TACmax setting (G1 and G2). In all scenarios, in cases where SSB falls below B_{trig1}, it recovers in less than two years on average.

All rules seemed to be robust to periods of low recruitment.

Table 5.3: Summary results for the HCR with continuous exploitation after the SSB range for TAC_{min}, up to a TAC_{max} (or simply Continuous after B_{trig2}) (G1 for a TAC_{max} of 33000 t and G2 for a TAC_{max} of 25000 t) for the two calendar years for management. JJ=Management going from July to June. JD= Management going from January to December.

Case	Calendar	Recruitment	TACmax	Gamma	MedianSSB	P(SSB<Blim)	P(SSB<Blim).once	Years<Blim	P(Closure)	P(Closure).once	TAC ('000t)	P(TAC _{min} <5000t)	Years to Recover
G1	JJ	rick	33000	0.3	71.013	0.049	0.454	1.038	0.078	0.62	18.921	0.405	0.774
G1	JJ	rick	33000	0.35	70.794	0.053	0.468	1.106	0.080	0.668	19.825	0.405	0.789
G1	JJ	rick	33000	0.4	67.723	0.060	0.512	1.256	0.092	0.686	19.988	0.421	0.940
G1	JJ	rick	33000	0.45	65.724	0.070	0.572	1.472	0.101	0.746	20.311	0.424	1.047
G1	JJ	rick	33000	0.5	65.660	0.072	0.592	1.51	0.104	0.742	20.952	0.439	1.063
G1	JJ	rick	33000	0.55	67.293	0.067	0.556	1.4	0.101	0.722	21.698	0.464	0.982
G1	JJ	rick	33000	0.6	63.130	0.084	0.624	1.768	0.121	0.768	21.238	0.456	1.151
G1	JJ	rick	33000	0.65	64.372	0.081	0.622	1.696	0.114	0.776	21.862	0.475	1.140
G1	JJ	rick	33000	0.7	62.018	0.087	0.662	1.834	0.124	0.8	21.697	0.471	1.206
G1	JD	rick	33000	0.3	70.102	0.030	0.316	0.594	0.051	0.444	19.855	0.463	0.476
G1	JD	rick	33000	0.35	70.112	0.032	0.308	0.636	0.054	0.482	21.096	0.464	0.499
G1	JD	rick	33000	0.4	67.512	0.036	0.362	0.718	0.054	0.464	21.742	0.476	0.549
G1	JD	rick	33000	0.45	65.267	0.042	0.416	0.83	0.063	0.548	21.887	0.481	0.653
G1	JD	rick	33000	0.5	64.626	0.039	0.39	0.784	0.057	0.504	22.549	0.484	0.585
G1	JD	rick	33000	0.55	64.153	0.042	0.39	0.842	0.061	0.532	22.974	0.508	0.650
G1	JD	rick	33000	0.6	63.523	0.039	0.402	0.788	0.063	0.542	23.389	0.518	0.623
G1	JD	rick	33000	0.65	62.094	0.047	0.418	0.934	0.068	0.54	23.430	0.524	0.682
G1	JD	rick	33000	0.7	62.302	0.053	0.5	1.058	0.067	0.57	23.831	0.542	0.843
G2	JJ	rick	25000	0.3	72.513	0.058	0.46	1.218	0.083	0.642	16.914	0.531	0.887
G2	JJ	rick	25000	0.35	72.391	0.049	0.458	1.034	0.080	0.67	17.531	0.541	0.792
G2	JJ	rick	25000	0.4	70.545	0.060	0.518	1.26	0.089	0.668	17.743	0.546	0.935
G2	JJ	rick	25000	0.45	71.307	0.056	0.522	1.17	0.084	0.676	18.223	0.571	0.858
G2	JJ	rick	25000	0.5	70.110	0.063	0.536	1.322	0.092	0.672	18.282	0.579	0.967
G2	JJ	rick	25000	0.55	70.234	0.065	0.536	1.368	0.093	0.712	18.583	0.594	0.951
G2	JJ	rick	25000	0.6	69.743	0.064	0.526	1.342	0.093	0.708	18.878	0.603	0.963
G2	JJ	rick	25000	0.65	69.662	0.065	0.544	1.364	0.095	0.696	18.830	0.601	0.967
G2	JJ	rick	25000	0.7	69.855	0.066	0.512	1.386	0.099	0.692	19.074	0.627	0.969
G2	JD	rick	25000	0.3	72.153	0.032	0.304	0.642	0.051	0.458	17.913	0.599	0.501
G2	JD	rick	25000	0.35	70.381	0.037	0.348	0.748	0.057	0.484	18.346	0.600	0.567
G2	JD	rick	25000	0.4	70.996	0.038	0.366	0.756	0.055	0.466	18.850	0.617	0.561
G2	JD	rick	25000	0.45	68.939	0.034	0.354	0.688	0.054	0.482	19.084	0.620	0.525
G2	JD	rick	25000	0.5	70.981	0.033	0.34	0.662	0.050	0.462	19.637	0.657	0.520
G2	JD	rick	25000	0.55	68.182	0.037	0.394	0.748	0.056	0.502	19.563	0.646	0.607
G2	JD	rick	25000	0.6	67.203	0.044	0.408	0.87	0.062	0.514	19.579	0.648	0.680
G2	JD	rick	25000	0.65	67.003	0.046	0.42	0.912	0.063	0.526	19.840	0.666	0.677
G2	JD	rick	25000	0.7	66.459	0.043	0.414	0.864	0.063	0.528	19.892	0.666	0.656

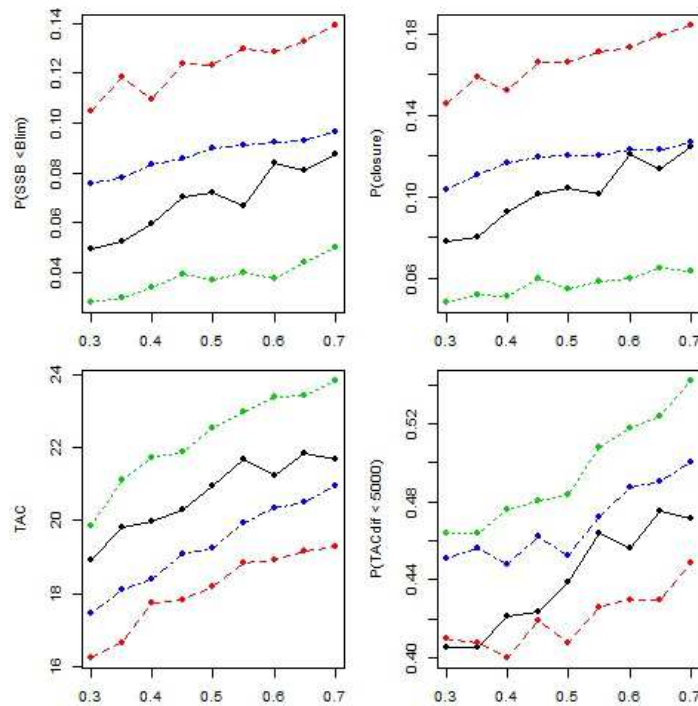


Figure 5.6: Summary indicators of the performance of the HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax=33000 t (G1) for the two managementcalendars (JJ July-June and JD January December) and for the two scenarios of recruitment (Ricker and Ricker low): Black: JJ & rick; Red: JJ & ricklow; Green: JD & rick; Blue: JD & ricklow. From top to bottom and from left to right four indicators versus the slope (gamma) of the HCR: probability of SSB being below Blim and probability of having a closure in any year, average TAC probability of the inter-annual TAC change being less than 5000t.

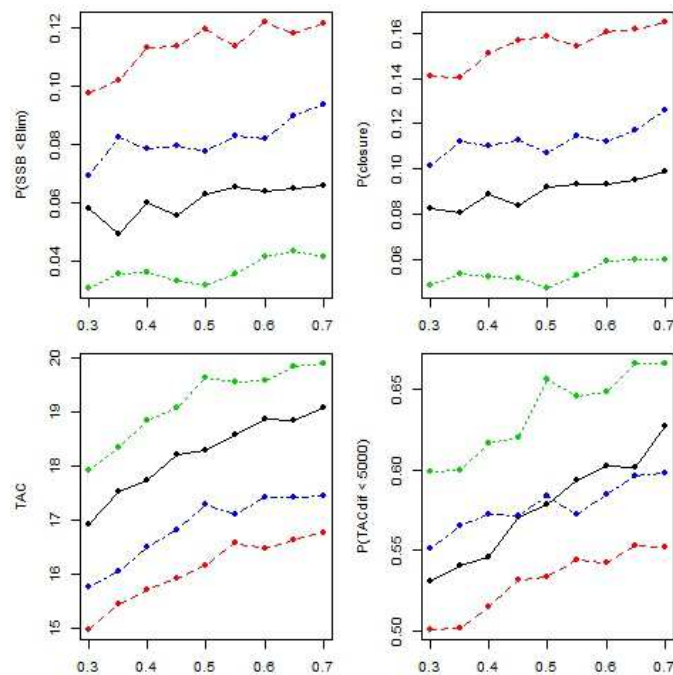


Figure 5.7: Summary indicators of the performance of the HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax=25000 t (G2) for the two management calendars (JJ July-June and JD January December) and for the two scenarios of recruitment (Ricker and Ricker low): Black: JJ & rick; Red: JJ & ricklow; Green: JD & rick; Blue: JD & ricklow. From top to bottom and from left to right four indicators versus the slope (gamma) of the HCR: probability of SSB being below Blim and probability of having a closure in any year, average TAC probability of the inter-annual TAC change being less than 5000t.

Table 5.4 shows the results of the sensitivity to a mismatch between the catch share (see section 4.8 for details), applied to the HCRs G1 and G2. In the case of a management period January-December (which can be compared with summary results in Table 5.3), the risk shows variations smaller than 1%, while catches would not differ by more than 200t and showing similar stability in catches.

Table 5.4: Summary of the sensitivity analysis of a wrong assumption on the share by semesters of catches when setting TACs for the HCR with continuous exploitation after the SSB range for TACmin, up to a TACmax (or simply Continuous after Btrig2)(G1 for a TACmax of 33000 t and G2 for a TACmax of 25000 t) for the management calendar year JD= Management going from January to December. (The assumption is a share 60%/40% while actual catches would be shared 75%/25% by semesters).

Case	Calendar	Recruitment	TACmax	Gamma	MedianSSB	P(SSB<Blim)	P(SSB<Blim).once	Years<Blim	P(Closure)	P(Closure).once	TAC ('000t)	P(TAC _{int} <5000t)	Years to Recover
G1	JD	rick	33000	0.3	71.332	0.024	0.274	0.488	0.042	0.444	20.353	9.028	0.405
G1	JD	rick	33000	0.35	69.053	0.030	0.314	0.590	0.049	0.454	21.051	9.304	0.494
G1	JD	rick	33000	0.4	67.163	0.035	0.344	0.690	0.055	0.482	21.519	9.516	0.557
G1	JD	rick	33000	0.45	66.052	0.033	0.320	0.664	0.055	0.492	22.282	9.536	0.535
G1	JD	rick	33000	0.5	62.529	0.044	0.402	0.888	0.067	0.540	22.088	9.889	0.720
G1	JD	rick	33000	0.55	62.752	0.038	0.368	0.766	0.064	0.548	22.751	9.891	0.584
G1	JD	rick	33000	0.6	61.781	0.045	0.420	0.902	0.066	0.548	23.132	9.831	0.648
G1	JD	rick	33000	0.65	59.727	0.054	0.466	1.072	0.077	0.592	23.024	10.191	0.805
G1	JD	rick	33000	0.7	60.593	0.043	0.406	0.854	0.064	0.544	23.771	10.007	0.651
G2	JD	rick	25000	0.3	72.149	0.030	0.322	0.596	0.054	0.492	17.825	6.810	0.515
G2	JD	rick	25000	0.35	70.753	0.028	0.294	0.558	0.048	0.460	18.499	6.676	0.434
G2	JD	rick	25000	0.4	68.836	0.031	0.330	0.628	0.050	0.452	18.818	6.745	0.527
G2	JD	rick	25000	0.45	69.603	0.032	0.326	0.630	0.052	0.480	19.257	6.777	0.530
G2	JD	rick	25000	0.5	68.204	0.033	0.326	0.656	0.055	0.508	19.323	6.827	0.501
G2	JD	rick	25000	0.55	69.057	0.034	0.342	0.676	0.053	0.466	19.816	6.634	0.535
G2	JD	rick	25000	0.6	65.218	0.040	0.372	0.796	0.063	0.508	19.489	6.762	0.626
G2	JD	rick	25000	0.65	66.827	0.040	0.380	0.792	0.063	0.530	19.709	6.857	0.637
G2	JD	rick	25000	0.7	65.585	0.044	0.416	0.878	0.065	0.538	19.764	6.798	0.636

5.5.3 Cases G3 & G4: continuous exploitation from Btrig1 onwards

Table 5.5 provides summary results for the HCR with continuous exploitation after Btrig1 (=24000 t), up to TACmax, which are called G3 for a TACmax of 33000t and G4 for a TACmax of 25000t). Figure 5.8 and Figure 5.9 provide a summary of some statistics for different harvest rates.

The relative behaviour between management calendars is similar to HCRs G1 and G2. In absolute terms these rules show higher TACs, higher times to recover SSB, higher probabilities of closure, higher biological risks and lower median SSB than HCRs G1 and G2.

Table 5.5: Summary results for the HCR with continuous exploitation after Btrig1 (=24000 t), up to a TACmax (or simply Continuous after Btrig1)(G3 for a TACmax of 33000 t and G4 for a TACmax of 25000 t) for the two calendar years for management. JJ=Management going from July to June. JD= Management going from January to December.

Case	Calendar	Recruitment	TACmax	Gamma	MedianSSB	P(SSB<Blim)	P(SSB<Blim).once	Years<Blim	P(Closure)	P(Closure).once	TAC ('000t)	P(TAC<5000t)	Years to Recover
G3	JJ	rick	33000	0.3	67.172	0.072	0.578	1.52	0.105	0.74	19.663	0.424	1.077
G3	JJ	rick	33000	0.35	66.289	0.072	0.568	1.504	0.104	0.728	20.660	0.432	1.053
G3	JJ	rick	33000	0.4	64.241	0.079	0.612	1.656	0.114	0.768	21.278	0.446	1.107
G3	JJ	rick	33000	0.45	62.077	0.085	0.618	1.778	0.121	0.8	21.485	0.451	1.146
G3	JJ	rick	33000	0.5	62.488	0.100	0.706	2.098	0.140	0.83	22.108	0.475	1.322
G3	JJ	rick	33000	0.55	60.147	0.103	0.7	2.16	0.139	0.816	22.194	0.487	1.364
G3	JJ	rick	33000	0.6	58.835	0.109	0.746	2.29	0.146	0.854	22.370	0.497	1.376
G3	JJ	rick	33000	0.65	59.226	0.118	0.764	2.474	0.156	0.854	22.531	0.516	1.573
G3	JJ	rick	33000	0.7	59.348	0.114	0.748	2.396	0.151	0.852	23.058	0.528	1.462
G3	JD	rick	33000	0.3	68.144	0.038	0.374	0.76	0.056	0.498	21.466	0.475	0.572
G3	JD	rick	33000	0.35	65.002	0.046	0.424	0.916	0.067	0.544	21.929	0.492	0.676
G3	JD	rick	33000	0.4	63.338	0.051	0.46	1.026	0.067	0.524	22.787	0.519	0.743
G3	JD	rick	33000	0.45	61.238	0.051	0.456	1.024	0.071	0.576	23.208	0.523	0.761
G3	JD	rick	33000	0.5	61.520	0.056	0.51	1.124	0.069	0.542	23.970	0.545	0.810
G3	JD	rick	33000	0.55	58.630	0.067	0.578	1.344	0.078	0.622	24.021	0.544	0.932
G3	JD	rick	33000	0.6	58.347	0.068	0.532	1.36	0.080	0.586	24.334	0.560	0.952
G3	JD	rick	33000	0.65	55.102	0.083	0.62	1.668	0.098	0.656	23.908	0.569	1.114
G3	JD	rick	33000	0.7	55.536	0.080	0.634	1.602	0.092	0.646	24.379	0.571	1.103
G4	JJ	rick	25000	0.3	71.043	0.059	0.506	1.236	0.089	0.67	18.014	0.566	0.908
G4	JJ	rick	25000	0.35	70.573	0.062	0.528	1.306	0.091	0.692	18.589	0.599	0.951
G4	JJ	rick	25000	0.4	67.359	0.073	0.584	1.542	0.104	0.746	18.614	0.603	1.079
G4	JJ	rick	25000	0.45	68.365	0.072	0.588	1.51	0.104	0.74	19.126	0.620	1.012
G4	JJ	rick	25000	0.5	65.583	0.085	0.612	1.776	0.119	0.78	19.009	0.625	1.152
G4	JJ	rick	25000	0.55	65.392	0.088	0.602	1.858	0.120	0.748	19.256	0.642	1.242
G4	JJ	rick	25000	0.6	65.656	0.091	0.616	1.912	0.122	0.752	19.435	0.660	1.212
G4	JJ	rick	25000	0.65	65.613	0.089	0.658	1.868	0.121	0.8	19.637	0.658	1.194
G4	JJ	rick	25000	0.7	64.761	0.100	0.68	2.106	0.135	0.812	19.436	0.675	1.322
G4	JD	rick	25000	0.3	69.951	0.037	0.372	0.748	0.054	0.488	19.004	0.645	0.587
G4	JD	rick	25000	0.35	67.883	0.045	0.422	0.902	0.063	0.512	19.317	0.659	0.704
G4	JD	rick	25000	0.4	69.482	0.044	0.418	0.87	0.060	0.532	20.055	0.673	0.669
G4	JD	rick	25000	0.45	68.794	0.045	0.424	0.892	0.059	0.504	20.352	0.688	0.685
G4	JD	rick	25000	0.5	65.491	0.056	0.494	1.118	0.069	0.528	20.223	0.687	0.821
G4	JD	rick	25000	0.55	64.319	0.062	0.556	1.238	0.079	0.604	20.183	0.693	0.891
G4	JD	rick	25000	0.6	66.025	0.055	0.466	1.092	0.067	0.512	20.728	0.716	0.777
G4	JD	rick	25000	0.65	63.730	0.068	0.554	1.36	0.083	0.604	20.504	0.717	0.956
G4	JD	rick	25000	0.7	65.099	0.061	0.52	1.216	0.069	0.558	20.974	0.729	0.857

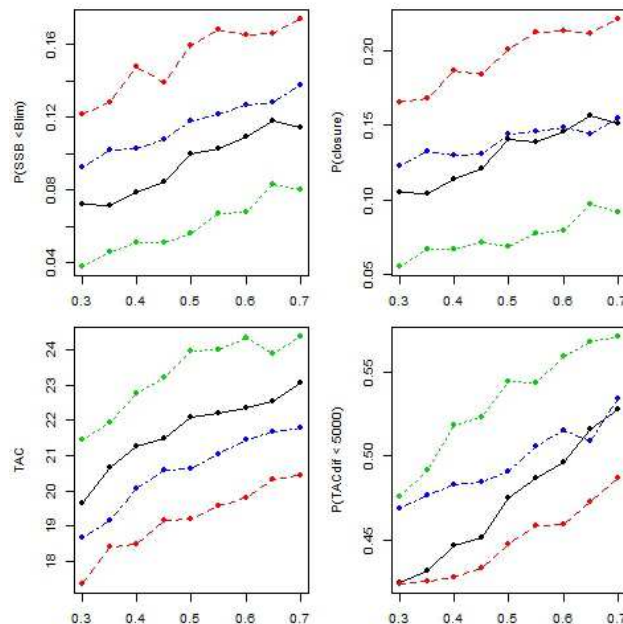


Figure 5.8: Summary indicators of the performance of the HCR with continuous exploitation after Btrig1, up to a TACmax=33000 t (G3) for the two management calendars (JJ July-June

and JD January December) and for the two scenarios of recruitment (Ricker and Ricker low): Black: JJ & rick; Red: JJ & ricklow; Green: JD & rick; Blue: JD & ricklow. From top to bottom and from left to right four indicators versus the slope (γ) of the HCR: Top: probability of SSB being below Blim and probability of having a closure in any year, average TAC probability of the inter-annual TAC change being less than 5000t.

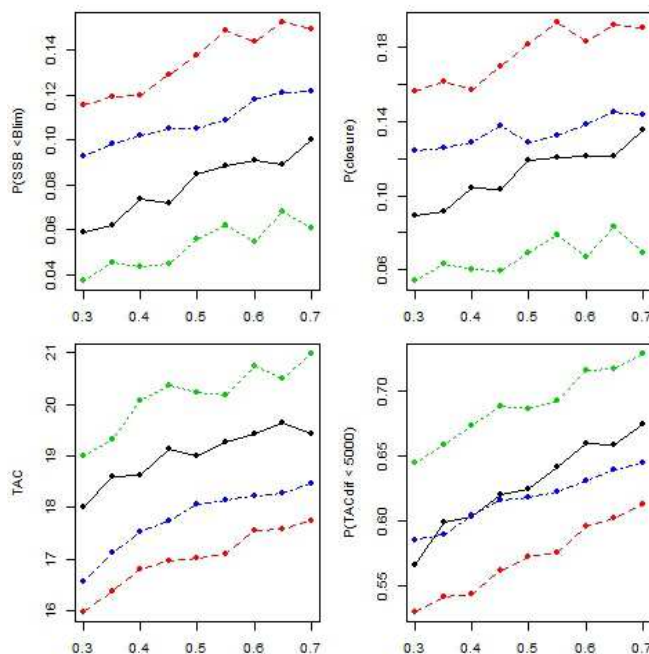


Figure 5.9: Summary indicators of the performance of the HCR with continuous exploitation after Btrig1, up to a TACmax=25000 t (G4) for the two management calendars (JJ July-June and JD January December) and for the two scenarios of recruitment (Ricker and Ricker low): Black: JJ & rick; Red: JJ & ricklow; Green: JD & rick; Blue: JD & ricklow. From top to bottom and from left to right four indicators versus the slope (γ) of the HCR: Top: probability of SSB being below Blim and probability of having a closure in any year, average TAC probability of the inter-annual TAC change being less than 5000t.

5.6 Summary

Both types of HCRs (continuous either at Btrig2 or Btrig1) showed similar relative performance to the changes in Calendar year, the effect of TACmax and the sensitivity to the poor recruitment scenario, in summary:

Moving to management from January to December (JD) reduces the risks of falling below Blim substantially (~40%) and shows similar probability of closures, while showing larger catches and slightly lower inter-annual variability in catches.

Decreasing the TACmax from 33000 t to 25000 t leads to a reduction in the levels of risks of about 1-2% and to a gain in the stability of catches of about 15% at the expenses of

decreasing the average expected catches by about 2000-4000 t. per year (whereby the larger the slope-gamma, the larger the reduction).

All rules were robust to low recruitment scenarios, being able to recover SSB in less than two years.

5.7 Discussion

5.7.1 *Is the current HCR robust to low recruitment regimes?*

The HCR in the current long term management plan proposal shows different performances depending on the recruitment scenario assumed. Having a low regime period of 3 years doubles the probability of the SSB being below B_{lim} from 0.07 to 0.13 and increases the average number of years to recover SSB above B_{lim} from 0.96 to 1.82. The HCR reacts to the low levels of the population by increasing the number of years in which the fishery is closed (the probability of the fishery being closed increases from 0.1 to 0.17) and by decreasing the average catches by almost 3000t. However, at the end of the projection period (9 years after the low regime period) the median SSB of the population is almost at the same level (around 65000t) for both low recruitment scenarios.

The robustness of the HCR to low recruitment regimes is defined as the capability of the population to recover from a low recruitment period. Therefore, the expert group considers the above results as indicative of the HCR being robust to low recruitment regimes.

5.7.2 *How does the HCR proposed by the SWWRAC compare with respect to the current HCR?*

In the STECF expert working group 13-24, the SWWRAC proposed to test the current HCR with a lower maximum TAC (TAC_{max} at 25000t instead of 33000t) and a lower trigger point from which this TAC_{max} would apply ($B_{trig3}=58000t$ instead of $B_{trig3}=110000t$). The aim of this proposal was to have more stable catches. In the current generic HCR this proposal corresponds either to HCR G2 with $\alpha = -16760$ and $\gamma = 0.72$ or to HCR G4 with $\alpha = -5706$ and $\gamma = 0.53$ when the biomass range in which TAC_{min} applies is removed (i.e. $B_{trig2}=B_{trig1}=24000t$). Although these exact

cases have not been tested, very similar ones, corresponding to $\gamma = 0.7$ in HCR G2 and $\gamma = 0.55$ in HCR G4, were tested. In general the SWWRAC proposal (both G2 and G4) leads to slightly lower level of catches than the current HCR (differences are less than 1000t) but with higher stability, since the probability of the inter-annual TAC variation being below 5000t increases from 0.4 to 0.6. The median SSB and the probability of SSB being below B_{lim} are similar for the current HCR and the SWWRAC proposal G2. However, the median biomass levels are lower and the probability of SSB being below B_{lim} increases from 0.07 to 0.09 for G4 in comparison with the other two due to the removal of the range of biomasses in which TAC_{min} applies.

The SWWRAC proposal with TAC_{min} (G2) in comparison with the current HCR provides more stability on catches but at a lower level of catches, with similar biological risks levels.

5.7.3 Management calendar: how does it affect the current HCR? Do all the other HCRs behave in the same way?

The HCR in the current LTMP proposal establishes the TAC as a function of the SSB estimate in year y for a management period from July in year y to June in year $y+1$. According to ICES the assessment for the Bay of Biscay anchovy stock can be conducted or updated at the end of the year when the latest juvenile abundance index from the JUVENA surveys is available. This would allow obtaining estimates of incoming recruitment and survivors at the beginning of January that could be used to set the TAC for a management period from January to December. The performance statistics indicate that if the current HCR would be applied on a management period from January to December it would have lower probability of SSB being below B_{lim} , slightly higher average catches and higher stability in the catches (with larger probability of the inter-annual TAC varying less than 5000t) (Figure 5.5). This pattern occurs also for all the HCRs evaluated (G1, G2, G3 and G4) for almost all the values of the γ parameters as it is shown by the ratio between the performance indicators in the management period January-December with respect to the ones in July to June (Figure 5.10). The ratios for the probability of SSB being below B_{lim} and the probability of closure are in general lower than 1 (around 0.6), whereas

the ratios for the average catch and the probability of the inter-annual TAC difference being less than 5000t are larger than 1 (of about 1.05 for catches and about 1.12 for the stability indicator). There is not a clear pattern in the changes in the relative performance statistics due to the management calendar depending on the HCR and the slope parameter γ . So the benefits of moving the calendar year from July to June to January-December apply to all harvest control rules tested rather similarly.

In general a management period from January to December has lower probability of SSB being below B_{lim} , slightly higher average catches and higher stability in the catches than a management period from July to June.

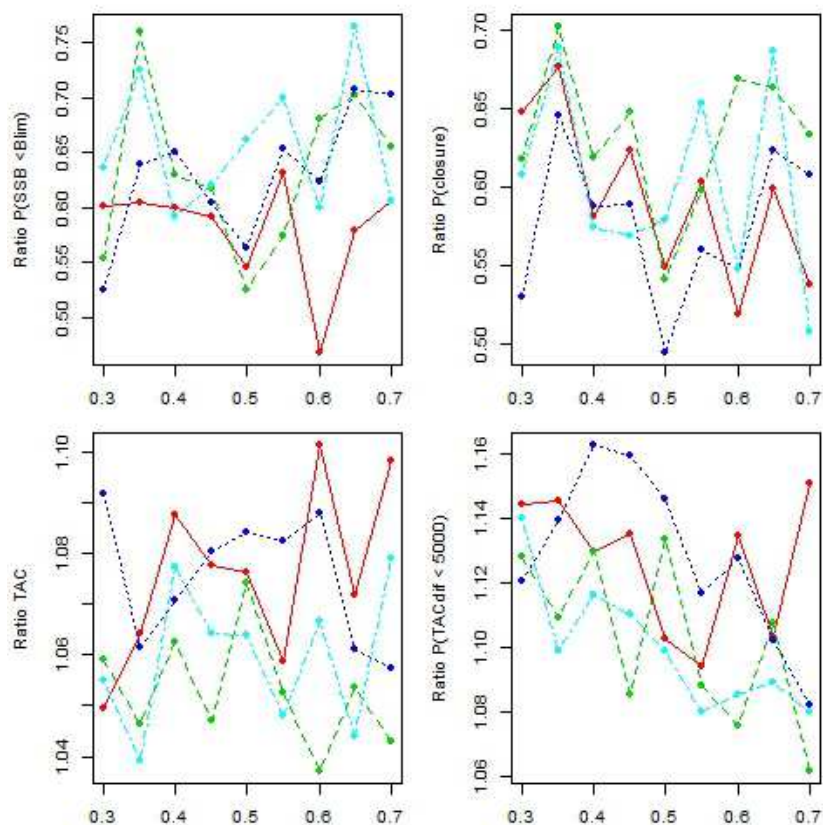


Figure 5.10: Ratios between the performance indicators in the management period January-December with respect to the ones in July to June (in the y-axis) as a function of the slope of the HCR (in the x-axis). When the ratio is above 1 the performance statistics are larger for the January-December than for the July-June calendar, whereas when the ratio is below 1 the performance statistics are smaller for the January-December than for the July-June calendar. From top to bottom and from left to right the performance statistics are the

probability of SSB being below Blim, the probability of closure, the average TAC and the inter-annual variation in the TAC. Each of the lines represents a HCR (G1 in red TAC_{max}=33000 t, G2 in green TAC_{max}=25000 t, G3 in blue TAC_{max}=33000 t and G4 in light blue TAC_{max}=25000 t).

5.7.4 Precautionary considerations regarding each management period

Regardless of the choice of management calendar, from an operational point of view, two stock assessments could be necessary each year.

Currently, under the July to June management period, the assessment is carried out in June (advice) during ICES WGHANSA working group. However, ICES recognizes that in November, when the information from the latest JUVENA survey is available, the assessment could be updated. Moving to a January to December management calendar would not change the timing of both assessments but the one done in November would provide the advice while the June one would act as an update. From the point of view of the timing of the assessments, a change of calendar would not affect the process. The update assessments provide information that could be used to reopen the advice or adjust the TAC if needed in exceptional circumstances. These cases are not discussed and evaluated here because of their secondary priority and limitations in time, but they should be considered or evaluated explicitly at some stage if desired to be implemented either in the ICES advice or in the management plan.

Under any management calendar, the consistency of the assessment and management options are dependent on the availability and capability of the spring and autumn survey indices (BIOMAN, PELGAS, JUVENA) to reflect the actual state of the stock. In a July to June management calendar, the assessment in June benefits from the biomass estimates of the recent spring PELGAS and BIOMAN surveys and thus is appropriate to advise for the proportion of the TAC for the first semester (July-December) before the recruitment occurs. Although a projection is made in June to assess the risk associated with the advised TAC regarding uncertainty on recruitment, the HCR does not take into account any information about the likely level of the upcoming recruitment. This unknown may lead to a substantial mismatch in the fishing opportunities (e.g. overfishing during the second semester –

January/June--with a high biological risk in case of recruitment failure, underfishing if the autumn survey spots a strong upcoming recruitment). The update assessment in November could be used as a checkpoint or for taking into account the upcoming recruitment.

In a January to December management calendar, the assessment in November would act as the advice assessment. In that case, information on the upcoming recruitment is integrated into the assessment which allows advice to be consistent with the strength of the upcoming recruitment (e.g. reducing the risk of overfishing the new year-class). However, JUVENA does not provide an index for the SSB. In addition, the reference points for the population apply to the SSB levels in May. Consequently, the biomass (both recruitment and SSB) has to be projected 4.5 month ahead in order to apply the HCR. Those projections require assumptions on natural mortality and the expected catch level for the upcoming semester, when the major proportion of the TAC is taken. As such the upcoming TAC is based on assumptions about the upcoming level of catches for the first semester, creating circularity. The solution so far provided is an optimization procedure where the biomass and TAC level are estimated together. This approach has been used for the current MSE and it is the common practice in most stocks in ICES.

One alternative would be to define rules setting TACs on the biomass assessed for 1st of January, rather than projected to May. In that setting, assumptions on catches during the first semester would not be required to set the TAC. However, such change might imply an estimation of reference points adapted to the biomass in January as well as the adaptation of the HCR to these new reference points. The assessment in June would still be used as a checkpoint in any cases. The methodology to estimate reference points in the 1st of January is not clear, once that the population is largely composed of recruits at that time of the year.

5.7.5 Which one is the best rule?

In the management period from July to June (Figure 5.11), the HCR G1 gives lower probability of SSB being below B_{lim} than the base case up to $\gamma = 0.6$, whereas G2 gives very similar values (around 0.07). The HCRs G3 and G4 without a biomass range in

which TAC_{min} is applied give larger probability of SSB being below B_{lim} than the current HCR (G0) for most of the γ values. Similar results are obtained for the probability of the fishery being closed. In terms of average TAC, the HCRs G2 and G4 (with TAC_{max} set at 25000t) result in lower TACs than the current HCR (G0), whereas G1 and G3 give higher TAC than the current HCR for γ values above 0.45 and 0.35. Stability of the TAC, which is measured as the probability that the inter-annual TAC variability is less than 5000t, is larger for G1 for γ values above 0.55 than the current HCR and for G2, G3 and G4 for any of the γ values.

In the management period from January to December (Figure 4.3.4.3) the HCRs G1 and G2 give similar or slightly higher probability of SSB being below B_{lim} than the base case (also for the management period January-December), whereas G3 and G4 without a biomass range in which TAC_{min} is applied give larger probability of SSB being below B_{lim} than G0 for all the γ values. In terms of average TAC, the HCRs G2 and G4 (with TAC_{max} set at 25000t) result in lower TACs than the current HCR (G0), whereas G1 and G3 give higher TAC than the current HCR for γ values above 0.5 and 0.4 respectively. Stability of the TAC, which is measured as the probability that the inter-annual TAC variability is less than 5000t, is larger for G1 and G3 than the current HCR for γ values above 0.55 and 0.35 respectively and for G2 and G4 for any of the γ values.

For any of the management periods the HCRs G1 show performance statistics very similar or slightly better than G0 (which is the base of the current HCR). These rules have the advantage of being continuous for all biomass levels above B_{trig1} , avoiding instability problems. The current HCR (G0), for biomass estimates $\sim 33000t$, establishes TACs that differ in almost 3000t, with slight changes in SSB.

There is no HCR that clearly outperforms the performance of the current HCR when compared over the same management year. The rules that have TAC_{max} set at 25000t instead of 33000t give higher stability but with lower TACs for similar levels of biological risk (probability of SSB being below B_{lim}). Alternatively, having a region in which TAC_{min} is applied (i.e. $B_{trig2} > B_{trig1}$) gives lower probability of SSB being below B_{lim} .

for similar levels of TACs. Overall, comparing the trade-offs between the probability of SSB being below Blim and the average TAC, G1 tends to give similar or slightly better performance statistics than G0 for some cases. However the differences are small and it is not possible to evaluate whether they are significant or not.

It is worth mentioning that if the management period is moved to January to December, it reduces the risks of falling below Blim. In this situation, HCRs which have TACmax at 33000t outperform the current HCR (G0) from July to June, both in terms of lower risks and higher and more stable catches (Figure 5.12 compared with the asterisk there), though at the expenses of closing a bit more often (1+2% more often). Compared to the G0 from January to December the improvement is less evident. Nonetheless, the fact that G1 rule results in higher catches than G0 (January to December) and lower levels of risks than 0.05 (for a range of gamma between 0.35 and 0.65) (and higher stability) suggest that this HCR should be passed to the consideration of managers as it would result in higher catches than the current HCR while still complying the standards on allowable levels of risks (below 0.05), and hence, they would be aligned to the general objectives of LTMP of maximizing catches while assuring sustainability of the resource and the fishery (long term sustainable yields).

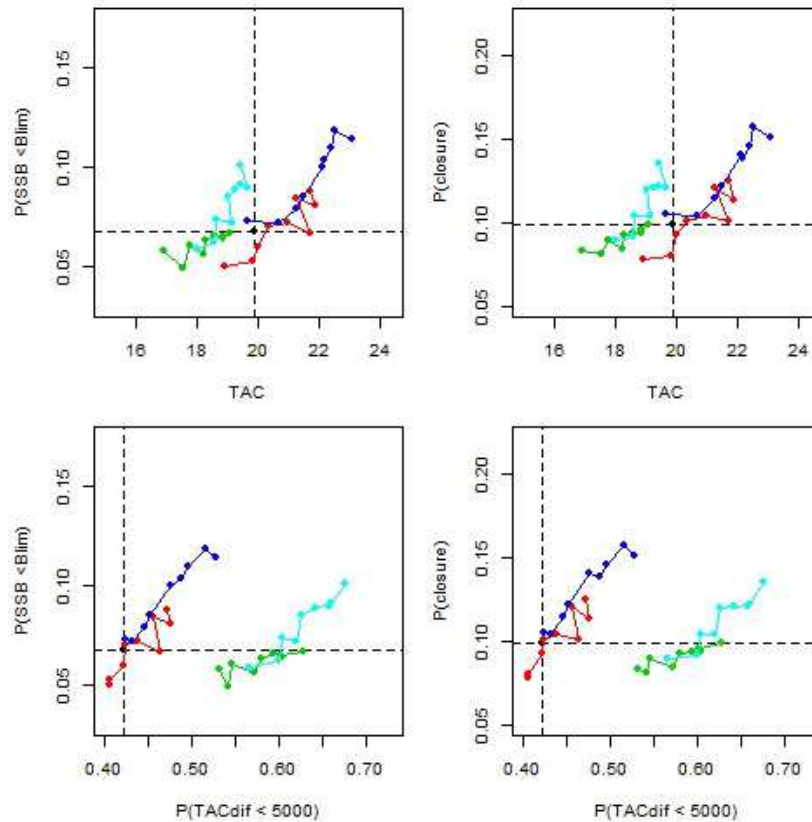


Figure 5.11: Cross plots between performance indicators in the management period from July to June under the Ricker stock recruitment scenario. From top to bottom and from left to right probability of SSB being below Blimvs TAC, probability of SSB being below Blimvs probability of the inter-annual TAC change being less than 5000t, probability of closure vs TAC and probability of closure vs probability of the inter-annual TAC change being less than 5000t. Each line represents a different HCR (G1 in redTACmax=33000 t, G2 in greenTACmax=25000 t, G3 in blue TACmax=33000 t and G4 in light blueTACmax=25000 t).The horizontal and vertical black dashed lines represent the performance statistics for the base case which is the current HCR (G0).

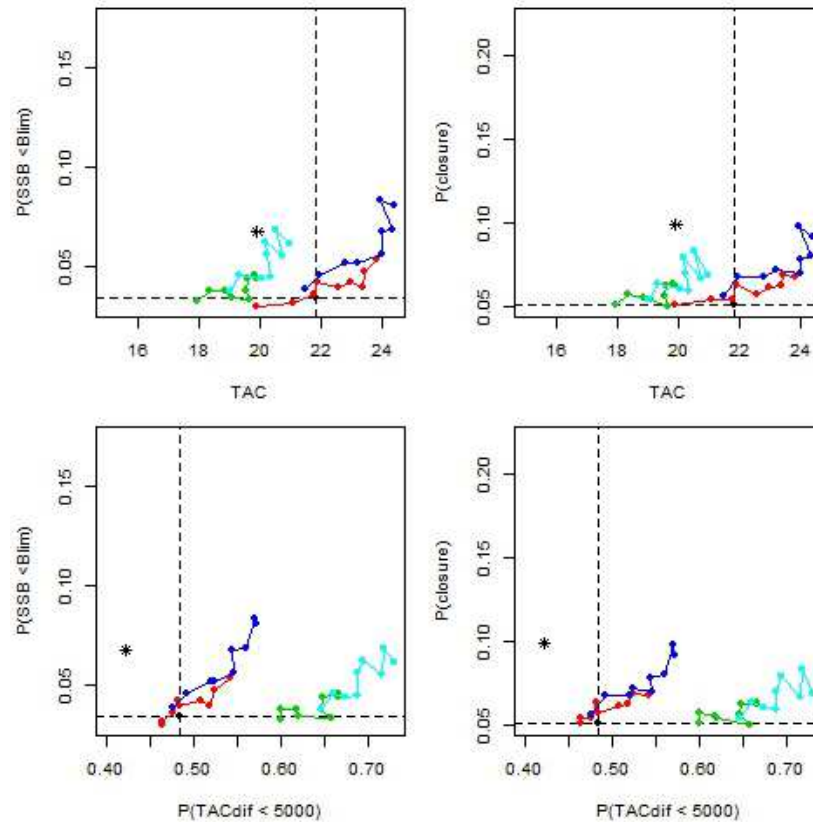


Figure 5.12: Cross plots between performance indicators in the management period from January to December under the Ricker stock recruitment scenario. From top to bottom and from left to right probability of SSB being below Blim vs TAC, probability of SSB being below Blim vs probability of the inter-annual TAC change being less than 5000t, probability of closure vs TAC and probability of closure vs probability of the inter-annual TAC change being less than 5000t. Each line represents a different HCR (G1 in red TACmax=33000 t, G2 in green TACmax=25000 t, G3 in blue TACmax=33000 t and G4 in light blue TACmax=25000 t). The horizontal and vertical black dashed lines represent the performance statistics for the base case which is the current HCR (G0) for the same calendar (January to December) while the asterisk represent the performance the current HCR for the calendar July to June.

6 ECONOMICS

6.1 Data Call

In order to include an economic sub-model in the MSE, it was agreed in STECF expert group EWG 13-24 to make a data call to Member States (MS). The requested data were transversal variables (effort, landing and price) and economic variables (costs, wage, etc.). In response to the data call, Spanish administration sent to the group data of effort, catches and price data of one year (2012) and no economic data. The

French authorities sent the required data but just one week before the meeting, which didn't allow its inclusion in the MSE simulation.

6.1.1 Spanish data

Spanish authorities provided data (ANNEX 1) of only one year (2012). Spanish data contained landing (in tonnes and euros) of anchovy (by age) and other species by month. Spanish authorities also provided effort data (number of days and number of vessels) by month for all purse seine fleet combined. Economic data was not available.

6.1.2 French data

The French data referred to landings, effort and economics for the subset of the fleets that target anchovy. The vessels were selected by identifying those that landed at least one ton of anchovy by year, which were posteriorly classified into 6 segments (Table 6.1). For each year, we selected vessels that really fished for anchovy and not all the vessels holding a license (from 2009) and able to fish for anchovy. We thus take into account effective effort and not potential effort.

Table 6.1: number of French vessels landing at least one ton of anchovy in the Bay of Biscay (VIII) by segment from 2000 to 2011 (DPMA/IFREMER-Fisheries Information System).

Years	2000	2001	2002	2003	2004	2005	2006	2007	2009	2010	2011	Total
Demersal trawlers	19	19	9	9	11	6	7	3	1	12	6	102
[12-18[m	18	19	9	9	11	6	6	2		7	6	93
[18-24[m	1						1	1	1	5		9
Pelagic trawlers	75	64	57	45	16	11	44	19	1	27	22	381
[12-18[m	26	18	18	15	15	10	9	3		7	4	125
[18-24[m	49	46	39	30	1	1	35	16	1	20	18	256
Seiners	22	26	24	25	23	5	1		7	19	23	175
[12-18[m	18	22	23	23	23	5	1		6	18	22	161
[18-24[m	4	4	1	2					1	1	1	14
Total	116	109	90	79	50	22	52	22	9	58	51	658

6.1.2.1 Transversal data

French authorities provided all the transversal data required in the data call for the 6 fleet segments identified above from 2000 to 2011. Those data include monthly landings for anchovy and other species (in volume and in value), monthly effort allocated for anchovy and for other species (in days at sea and in hours) and number of vessels fishing anchovy and

other species by year, by semester and by month. The calculations are explained in the excel file that was provided: for instance the number of days at sea is estimated as defined in the DCF regulation ("*Any continuous period of 24 hours (or part thereof) during which a vessel is present within an area and absent from port*"). The allocation of effort is based on the allocation of each vessels 'trip to anchovy (if at least 1 kg of anchovy landed) or to other species (if less than 1 kg of anchovy landed).

6.1.2.2 Economic data

French authorities also provided annual economic data for 2010 and/or 2011 for 4 of the 6 fleet segments identified above: Incomes (from landings, subventions, others), costs (crew costs, fuel costs, repair and maintenance costs variable costs and fixed costs), and also employment (full time equivalent), fuel consumption, investments and maximum days at sea. Economic indicators were estimated from sampled data collected via surveys or accounts under the DCF regulation. The availability of data for each fleet segment depended on the number of vessels in each sample. Sampling rate varied from 35% to 100%. For each variable, the average was estimated on sampled data and then extrapolated at fleet segment level using a simple rule of three.

6.2 Discrepancies between the data requested and the data provided

Some discrepancies have been found between data call and the data provided. In ANNEX 3 we can see details of these discrepancies.

6.2.1 Spanish data

The main discrepancies in case of Spanish fleets are:

- As the Spanish administration reported, they are restructuring and improving the entire data base regarding to the fisheries. For this reason, they can provide only one year (2012). The time series requested goes from 2000 to 2012.
- The Spanish administration didn't provided economic data.

6.2.2 French data

Globally, the French administration provided nearly all the data required, but failed to do so within the deadline, having submitted the data one week before the meeting. The discrepancies found were:

- Economic data were reported only on years 2010 and 2011: indeed they were not enough sampled vessels in 2009 to estimate indicators for the fleet segments involved in the anchovy fishery. Moreover, French administration only has aggregated DCF economic data before 2009. It would have required too much time to get individual data to do the work before the working group;
- Among economic variable requested, no data was available for annual depreciation neither for crewshare (variable not required in DCF regulation).

6.3 Operating Model Conditioning

Data from the data call and from other data sources used in this report have enabled to present analyses of the evolution of the fishery in terms of evolution of the income, dependency to anchovy or prices (see introduction section). These data were also computed to parameterize the economic module of FLBEIA in order to be able to provide a comparison of socio-economic consequences of the different HCR tested (see biological section). However, French data was made available one week before the meeting and it was thus not possible to run complete simulations including the economic module during the meeting. All the inputs parameters have however been prepared (Annex 4). This section presents the model conditioning, which can be used in future analysis.

6.3.1 Price dynamics.

The market of anchovy is included in the model through the inverse demand function or price function, that gives information about the income by fleet segment, and thus allows the analyse (together with costs) of the profitability of each harvest control rule tested.

6.3.1.1 Spanish Fleet

From both the data provided in the STECF EWG 13 24 meeting by the SWWRAC and Basque data (source: Basque Government and AZTI-Tecnalia), a price function for the Spanish fleet has been estimated. However, the price seems to have undergone a strong change after the fishery closure (STECF EWG 13 24). Therefore there are two options to project the income of the fishery:

- The average price of the last 3 years (2010 – 2012): 2.16 €/kg (constant euros with 2012 as base year) in semester one, and 2.46€/kg in the second semester.
- Price function: The price function that is already implemented in FLBEIA is the price function used in Kraak et al. (2004):

$$P_{a,y,s,f} = P_{a,0,s,f} * \left(\frac{L_{a,0,s,f}}{L_{a,1,s,f}} \right)^{e_{a,s,f}}$$

Where $P_{a,0,s,f}$ is the base price (2012), $L_{a,0,s,f}$ is the total landings in the base year (2012) and $e_{a,s,f}$ is the elasticity parameter, with $e \geq 0$. If landings in the base year are higher than current landings the price increases and vice-versa (Garcia *et al.*, 2014). The price function estimated for the first semester is shown in Table 6.2.

Table 6.2: Elasticity parameter estimation for the Spanish fleet in the first semester.

Residuals:				
Min	1Q	Median	3Q	Max
-0.15510	-0.03908	0.12224	0.71053	0.87088
Coefficients:	Estimate	Std Error t	t value	Pr(> t)
Elasticity	0.02818	0.01126	2.504	0.0408
Residual standard error: 0.5177				
Multiple R-squared: 0.4724				

Adjusted R-squared: 0.397

F-statistic: 6.268 on 1 and 7 DF, p-value: 0.04078

This estimation regards to the first semester, in the second semester the price function has not been calculated because prices present high variability, and therefore a fixed price should be assumed.

6.3.1.2 French fleet

Exploratory analyses of price-quantity relationship were performed but show that the closure may have changed the price formation. Only 2 years of reopening are available in the data and do not enable further analysis. Mean prices by fleet and semester for years 2010-2011 are represented in Table 6.3 and can be used in the model.

Table 6.3: Mean price by fleet segment and semester.

French Fleet	Mean Price 2010-2011 (euros/kg)	
	Semester 1	Semester 2
Bottom Trawlers 12-18m	2,64	1,25
Pelagic Trawlers 12-18m	1,95	1,26
Pelagic Trawlers 18-24 m	0,96	2,04
Purse Seiners 12-18m		2,19
All fleets	1,31	1,69

6.3.2 Effort dynamics and catch model.

The cornerstone of the effort dynamic is the production function that links the biomass, the effort and the catches. This part of the model mimics the tactical behaviour of the fleet every season and iteration. In each time step and iteration, the effort exerted by each individual fleet and its effort-share among métiers is

calculated depending on the stock abundance, management restrictions or other constraints. Afterwards, the catch produced by each metier is calculated.

The catch model estimates the production (i.e. catch) given effort and biomass (aggregated or at age). At the moment two production functions have been implemented: Cobb Douglas at biomass level, and at age level. The Cobb Douglas production function (Cobb and Douglas, 1928) is widely used by economists to describe production in industry in general and in fisheries in particular. The production function will be estimated by season, fleet, stock and age.

$$C_{f,stk,s,age} = q_{f,stk,s,age} * E_{f,stk,s}^{\alpha} * B_{f,stk,s,age}^{\beta}$$

Where C denotes catch, B biomass, both in weight, q the catchability, E the effort and α and β are the elasticity parameters associated to labour and capital respectively. Regarding the subscripts: f refers to the fleet, stk the stock, s the season and age the age class. α and β should have the same subscripts as E and B, but they have not been included in the formula for clarity.

6.3.2.1 Production function parameters

Cobb-Douglas function parameters have been estimated using historical information on effort, landings and biomass. In the case of the Spanish fleet, Cobb-Douglas function parameters have been estimated for each age class. The results are in Table 6.4.

Table 6.4: Production function parameters for anchovy.

	Anchovy	AGE0	AGE1	AGE2	AGE3+
SEM1	q, (Intercept)		0,0140764	5,497076	0,02066848
	alpha		1	1	1
	beta		1	0,7204381	1
SEM2	q, (Intercept)		0,08525549	0,04093752	0,009650448
	alpha		1	1	1
	beta		1	1	1

We can also estimate an artificial Cobb Douglas production function for the rest of the species captured by the fleet. However, the biomass values are not available and

therefore the function parameters will be estimated using an ‘artificial’ biomass; in this case, the biomass is a constant of 1e+09 tonnes.

Table 6.5: Production function parameters for the other species.

Other Species		
SEM1	q, (Intercept)	0,004773373
	alpha	1
	beta	1
SEM2	q, (Intercept)	0,003506628
	alpha	1
	beta	1

Table 6.6: Production function parameters of anchovy. French fleet

Fleet	Semester	Cobb Douglas Parameters	Ages			
			0	1	2	3
bottom_tractors_12_18m	Semester 1	Alpha		0,646	0,368	0,470
		Beta		0,731	0,840	1,020
		q		7,488	21,304	3,767
	Semester 2	Alpha	0,585	1,008	0,957	1,061
		Beta	1,116	0,972	0,529	1,405
		q	0,043	1,359	2,807	0,090
pela_tractors_12_18m	Semester 1	Alpha		0,641	0,352	0,793
		Beta		0,759	0,711	0,732
		q		12,285	76,727	1,931
	Semester 2	Alpha	0,218	1,262	1,284	1,086
		Beta	0,966	1,140	0,444	1,102
		q	1,433	0,340	0,930	0,188
pela_tractors_18_24m	Semester 1	Alpha		1,377	1,420	0,699
		Beta		0,434	0,205	2,092
		q		0,423	0,458	0,315
	Semester 2	Alpha	0,367	1,332	1,535	1,011
		Beta	3,558	1,093	0,151	1,180
		q	0,000	0,160	0,192	0,275

Parameters for the segment “purse_seiner 12_18” are missing because it wasn’t possible to compute realistic values.

6.3.3 Capital dynamics.

The capital dynamics updates the capacity of the fleets according to their economic performance, each fleet independently from the others. This module is intended to simulate the strategic behaviour of the fleets, namely, the investment and disinvestment dynamics (Garcia *et al.*, 2014). The model is applied at fleet level in an annual basis and affects fleet

capacity and catchability. Catchability could be modified through investment in technological improvements and capacity as a result of an increase (investment) or decrease (disinvestment) in the number of vessels. For example, changes in fleets' capacities could produce a variation in quota share among fleets. The capital dynamics that is already implemented in FLBEIA is the Simple Capital Dynamics (SCD). In SCD the investment depends on the revenues and break-even revenues.

The investment (number of vessels) or disinvestment takes place proportionally to the ratio between break-even revenues and the realised revenues, which is adapted by the share of profit dedicated to investments.

The inclusion of the capital dynamics in the model provides information, season by season, about the maximum effort that the fleet can exert on the stock. Additionally, makes data for socio - economic analysis also available.

As profitability of the fleet depends not only on the income but also on costs, it is important to analyse the cost structure. Income minus costs will inform about the real economic situation of the fleet. The costs that are going to be included in FLBEIA model are:

- FxC: Fixed cost by unit of capacity.
- Cac: Capital costs by unit of capacity.
- CrS: The simple capital dynamics (SCD) will estimate this value itself.
- FuC: Fuel costs by unit of effort.
- VaC: Variable cost by unit of effort.

6.3.3.1 Spanish Fleet

The economic data for vessels operating in the anchovy fishery was not available. Therefore, economic data of Basque purse seiner fleet was used to parameterize the costs (Table 6.7), assuming that the cost structure is the same for the whole Spanish fleet as for the Basque Fleet.

Table 6.7: Cost structure of average vessel (`000 euros). Source: Elaborated by the author from Basque authorities data.

Average cost by vessels					
.000 euros	FxC	CaC	CrS	VaC	FuC
2010	163	68	278	200	97
2011	189	44	286	233	109
2012	255	31	350	302	109

Relating cost with income, shows how the main percentage of operative costs is allocated to crew costs, then variable costs (fuel costs are separated because of its the importance), and fixed costs.

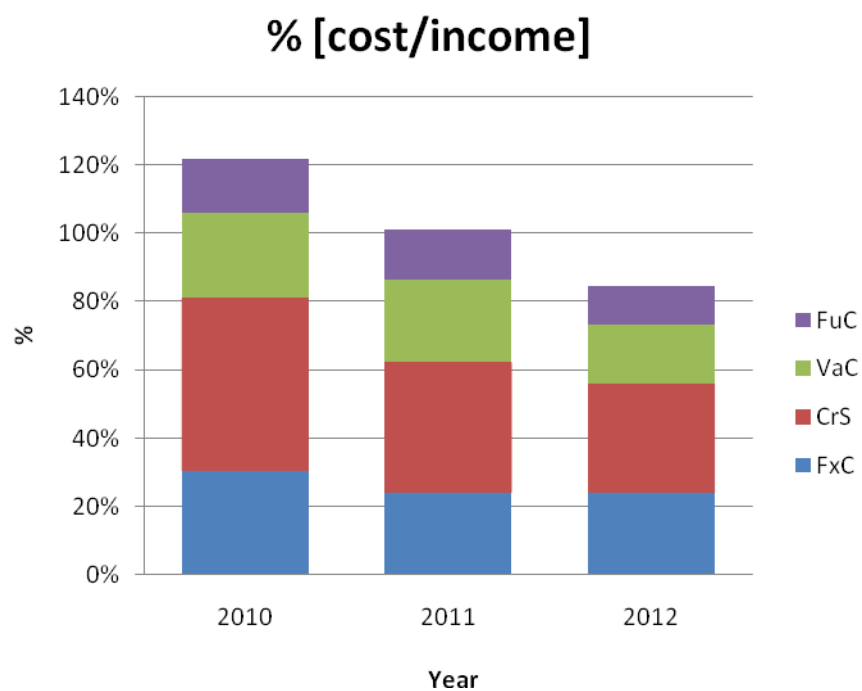


Figure 6.1: Cost structure by Basque fleet. Source: Basque authorities.

Figure 6.1 presents the distribution of costs in terms of income. Income includes income of landings, other incomes and operating subsidies. The sum of percentages of costs has been decreasing over the years. In 2010 the costs were higher than income, in 2011 the income and costs were more or less equal and in 2012 the revenues exceeded costs.

6.3.3.2 French Fleet

The costs structure of French fleets is illustrated in the following Table 6.8 and Figure 6.2.

Table 6.8: Costs structure of average vessel by fleet (keuros). Sources: French Administration Data Call

	FxC	CrS	VaC	FuC
2010				
PelagicTrawlers 12-18m	151	242	89	123
PelagicTrawlers 18-24m	142	273	71	227
PurseSeiners 12-18m	92	281	46	29
2011				
BottomTrawlers 12-18m	129	255	97	166
PelagicTrawlers 12-18m	185	190	136	95
PelagicTrawlers 18-24m	211	255	145	119
PurseSeiners 12-18m	92	294	63	42

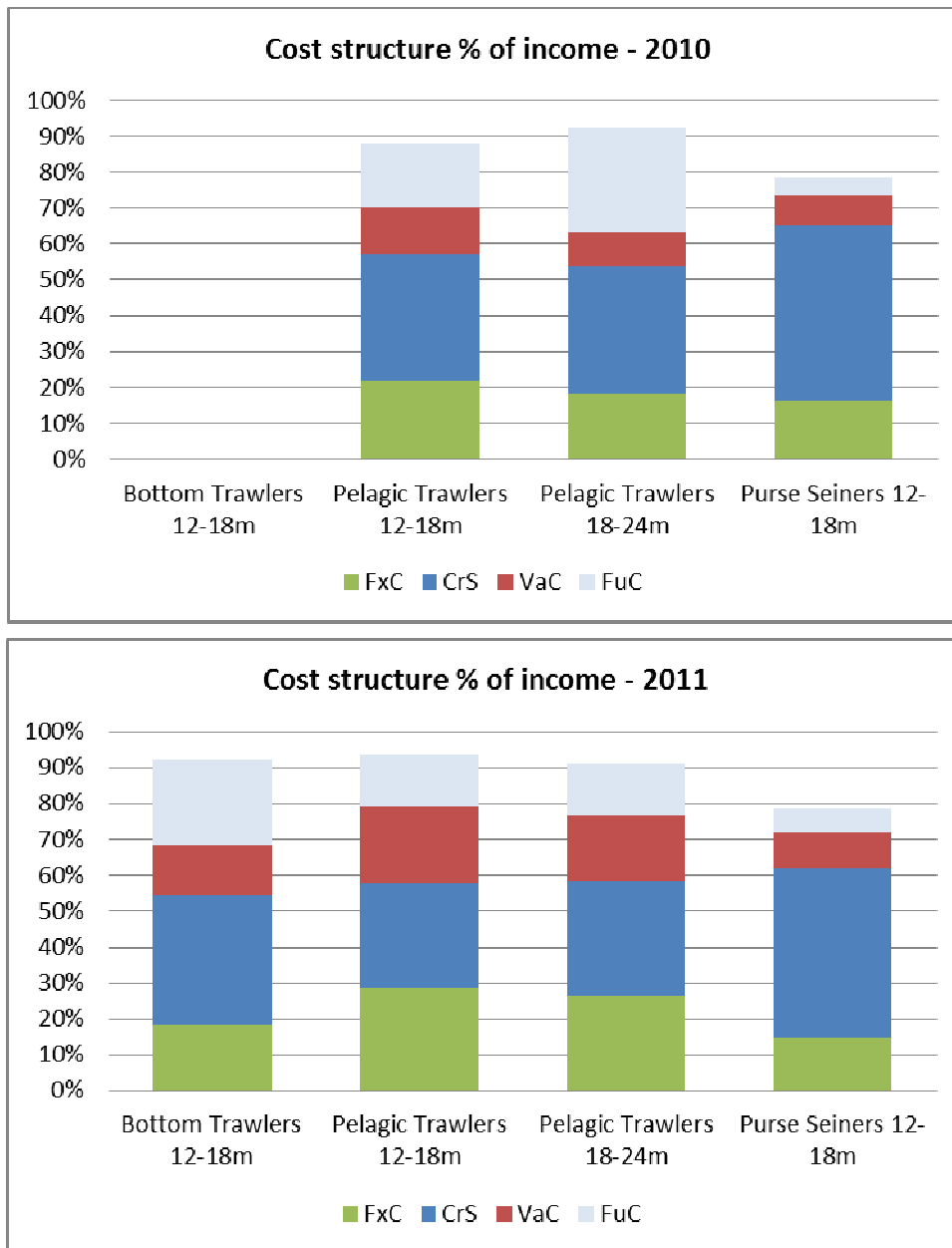


Figure 6.2: Cost structure by French fleets. Sources: French Administration-data call

The cost structure, represented as a percentage of the total income, highlights differences between fleets, in particular in terms of fuel costs. As expected bottom trawlers allocate a higher percentage of their costs to fuel than pelagic trawlers or purse seiners, which allocate the lower percentage of the three.

Crew costs are higher for purse seiners, while fixed costs and variable costs are higher for pelagic trawlers.

Capital costs data were not available for French fleets at this stage.

6.4 Expected outputs of the economic model.

This section presents the expected added value of running the complete model and the expected outputs from including the economic module of FLBEIA.

The system has three dimensions, biological, economic and social one, which have to be taken into account when managing the system. Despite the fact that what are directly managed are the fisheries, historically, most of the attention has been paid to the biological dimension, and management advice has been based solely in the output of biological models. However, in recent years driven by the Ecosystem-Based Approach for Fisheries Management (Curtin and Prellezo, 2010), it has been recognized the need to incorporate the economic and social factors into the management process. Consequently, management advice should be based not only on biological considerations, but also on economic and social (Garcia *et al.*, 2014). Within FLBEIA, the socio - economic performances of the fleets represented in the model depend on three processes related to fleet dynamics: the effort model, the price model and the capital model.

According to the status of the biomass, the expected marginal profit as a function of price, costs and yields per unit of effort, and the investment/disinvestment dynamics, the economic module of FLBEIA enables to assess the mean effort by vessel dedicated to anchovy and the potential reallocation of effort expected. By running the economic module of FLBEIA, the effort dynamics is included, and effort drives the landings.

Thus the assumption that all TAC will be taken (which actually doesn't occurs) is not needed anymore, because landings will depend on the historical effort allocation and on the fleet capacity. The socio-economic consequences of each management option can thus be analysed, for each fleet segment, in terms of expected impacts on the management scenario, income, gross value added or profit, as a result of the effort allocation. Distribution of the costs and benefits of the options tested between fleets (that can be impacted differently) can be assessed together with their viability and

the risk of not being viable during a transition period. Different options of quotas allocation by fleet and their impacts in terms of socio-economic viability can be tested through the model. The capital dynamics also enables the simulation of investment dynamics and consequently the variations on the size of the fleet segments in the long term. The variation of the fleet segment size has a direct effect on the capacity of the fleet (and consequently on the effort and the catches) as well as on the direct employment.

7 OTHER OUTSTANDING ISSUES

7.1 Mid-year revisions of the TAC

Potential mid-year revisions of the TAC were discussed by the EWG, including stakeholders. The option of having a mid-year revision to adjust the TAC every year was rejected. Alternatively the option of an alarm revision triggered by a drastic stock deterioration was considered relevant to test, but of lower priority. Mid year revision could not finally be considered during the EWG due to the lack of time. However, the group acknowledges that two assessments could be conducted per year, and therefore the updated information could be used to revise the TAC, particularly in exceptional circumstances of drastic deterioration of the stock status with a major risk of being below Blim at spawning time (in May) of the management year (SSBy) (as perceived through the mid year update assessment).

8 LIMITATIONS OF THE ANALYSIS

- Full feedback

So far the MSE framework does not include the assessment model used for anchovy, this is due to technical problems to combine the Bayesian framework of the assessment model with the operational model. The CV of the assessment model is used instead to add noise to the biomass simulated by the operational model and to produce an observed biomass to be used in the HCR. The analysis is thus closer to a regular impact assessment based on an operation model than to a complete MSE as usually understood (with explicit description and inclusion of the observation and assessment processes).

- Operational model

The operational model itself, is conditioned to the assessment model, with few processes included (bi-annual dynamics, stock-recruitment relationship, and selectivity by semester). So far it does not include fishing fleet and tactics (other than selectivity) dynamics, and thus relies on hypotheses regarding catch share between semesters. Not having the economic data available in time to condition the operating model made it impossible to explore these dynamics. This issue has been highlighted by the group as a limitation in terms of carrying out the economic, social and fleet impact assessment (See section on economics for the details of the advantages brought by the inclusion of the economic model).

- Uncertainty analysis

The group acknowledges the fact that the uncertainty included in the analysis is limited to the noise around the stock-recruitment relationship and the assessment error on biomass, the starting population and fishing selectivities at age by semester, although it would have been convenient the inclusion of other uncertain parameters in order to provide a better assessment of risk (see section on sensitivity analysis).

9 CONCLUSIONS

- The Current Harvest Control Rule (coded G0) from the draft LTMP for anchovy ((COM(2009) 399 final) is again confirmed to behave similarly as assessed originally in 2008, for a management period going from July to June. It has a risk of falling below Blim in any year of about 0.067 (and a probability of closure of 0.098) for an average TAC of about 19900 t and a median SSB of about 67700 t.
- The current HCR (for both potential management years) proved to be robust to the poor recruitment scenario as it allowed the population to recover above Blim in about two years. It also proved robust to limited mis-specifications of the quota share between semesters. More generally, all HCRs tested were able to recover the SSB after the recruitment failure.
- Changing the management period from July-June to January-December, in the case of the current HCR, resulted in a lower probability of SSB being below

Blim (of about 0.034), slightly higher average catches (21900t) and higher stability in the catches (with larger probability of the inter-annual TAC varying less than 5000t).

- The HCR proposed by the SWWRAC showed slightly lesser catches than the current HCR (by about 1000–1500 t) but higher stability of catches (about 15% higher), while keeping the similar levels of risk. This finding applies to both management periods.
- For all HCR tested by the EWG, changing the management period from July–June to January–December reduces the risks of falling below Blim by ~40% and similar probabilities closing the fishery; while it leads to slightly higher average catches (~5%) and higher stability in the catches (~12%).
- For all HCR tested by the EWG decreasing TAC_{max} from 33000t to 25000t leads to a reduction in the levels of risks of 1–2% and a gain in catch stability of ~15%, while average expected catches will decrease by 2000–4000t. per year, depending on the scenario.
- Having a stable TAC in a region of low biomasses (rules G1 and G2), TAC_{min}, generates lower risks with similar levels of TACs, when compared with G3 and G4.
- The EWG notes that comparing the trade-offs between the probability of SSB being below Blim and the average TAC, G1 (continuous HCR with TAC_{max} in 33000t) tends to give similar or slightly better performance statistics than the current HCR. Nevertheless, the differences are small and it is not possible to evaluate whether they are significant or not.
- The WG highlights that rule G1 (continuous HCR with TAC_{max} in 33000t) by assuring continuity at B_{trigger2} avoids the discontinuity step on setting TACs of the current HCR at this B_{trigger}. In addition, for a management going from January to December, G1 allows slightly bigger TAC levels of catches (by about 1000 t) than current HCR applied over the same management period, while still having allowable levels of biological risks below 0.05 and resulting in very similar levels of inter-annual catch variability at the expenses of slightly increased in the probability of closures to about 0.065.

- Description of the evolution of the fishery provided thanks to data from the data call and other data sources show the evolution of the fishery after the closure and highlight that fleets shifted towards other species (tuna, mackerel and sea bass in particular) and that the dependency to anchovy decreased.
- The last two years landing represented only 41% and 64% of TAC in management period 2010/1011 and 2012/2013 respectively.
- The price of anchovy was not able to reach the levels prior to closing.

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11 ANNEXES

ANNEX 1 (Data provided by Spanish authorities)

Table A1.1: Spanish fleet: Effort, landings and number of vessels of Spanish fleet involved in the anchovy fishery.

Effort, landings and price data by month									
YEAR	MONTH	Ld_Ane_Tn	Ld_Ane_Eu	Ld_oth_Tn	Ld_oth_Eu	Eff_Ane (days)	Eff_Oth (days)	NV_Ane	NV_Oth
2012	1	0,000	0,000	1.395,247	1.819.238,467	0	278	0	41
2012	2	0,000	0,000	9.481,561	10.611.465,657	0	1113	0	144
2012	3	32,568	173.881,602	9.963,398	6.351.415,666	30	1332	17	145
2012	4	1.016,888	3.564.807,568	3.367,456	2.489.727,386	228	442	110	138
2012	5	5.222,842	11.687.487,202	3.313,100	2.722.445,332	1035	457	138	148
2012	6	1.126,758	2.141.772,592	3.166,521	4.266.159,640	318	613	92	135
2012	7	328,343	722.270,288	3.690,270	10.227.589,831	244	1669	75	129
2012	8	12,087	61.076,855	5.211,155	13.760.589,334	70	1759	51	135
2012	9	121,130	367.013,570	4.017,157	10.537.002,174	75	1518	46	121
2012	10	90,643	57.578,570	12.807,350	13.154.923,574	33	1876	29	135
2012	11	0,000	0,000	7.754,437	6.285.293,924	1	799	1	123
2012	12	0,000	0,000	1.135,524	1.545.901,779	0	223	0	52
		7.951,259	18.775.888,247	65.303,175	83.771.752,764	2.034,000	12.079,000		

Table A1.2: Spanish fleet: Number of vessels fishing anchovy and other species by semester.

Number of vessels by semester		
SEMESTER	NV_Ane	NV_Oth
1	143	149
2	96	140

Table A1.3: Spanish fleet: Number of vessels by year.

Number of vessels by year	
YEAR	NV_T
2012	149

Table A1.4: Spanish fleet: landing, effort and number of vessels by month.

YEAR	MONTH	Ld_Ane_Tn	Ld_Ane_Eu	Ld_oth_Tn	Ld_oth_Eu	Eff_Ane_days	Eff_Oth_days	NV_T	NV_Ane_M	NV_Oth_M	NV_Ane_S	NV_Oth_S
2012	1	0,000	2.323,275	1.991,067	3.317.941,781	0	488	149	0	70	143	196
2012	2	0,000	37.312,125	10.444,720	12.410.576,694	1	1402	149	1	187	143	196
2012	3	32,568	236.497,912	10.539,818	7.878.064,466	30	1643	149	17	169	143	196
2012	4	1.016,888	3.571.367,108	3.579,936	3.293.641,928	228	513	149	110	50	143	196
2012	5	5.222,842	11.716.977,886	3.893,564	4.561.102,751	1035	696	149	138	41	143	196
2012	6	1.126,758	2.180.581,762	3.625,139	6.959.780,713	318	904	149	90	88	143	196
2012	7	328,343	731.505,776	4.312,844	13.180.136,570	244	2164	149	75	96	96	193
2012	8	12,087	74.970,975	5.790,546	16.901.999,363	70	2208	149	51	128	96	193
2012	9	121,130	369.550,785	4.585,015	12.949.977,633	75	1816	149	46	118	96	193
2012	10	90,643	83.711,816	13.837,697	15.687.426,686	33	2374	149	29	150	96	193
2012	11	0,000	0,000	8.234,995	7.788.936,421	1	968	149	1	154	96	193
2012	12	0,000	0,000	1.586,902	2.228.325,645	0	361	149	0	85	96	193

Table A1.5: Spanish fleet: Landings of anchovy by age and by month.

YEAR	MONTH	Ld_Ane_Age 1_No_thous ands	Ld_Ane_Age 1_Weight_T n	Ld_Ane_Age 1_Mean- weight_kg	Ld_Ane_Age 1_Mean- lenght_cm	Ld_Ane_Age 2_No_thous ands	Ld_Ane_Age 2_Weight_T n	Ld_Ane_Age 2_Mean- weight_kg	Ld_Ane_Age 2_Mean- lenght_cm	Ld_Ane_Age 3_No_thous ands	Ld_Ane_Age 3_Weight_T n	Ld_Ane_Age 3_Mean- weight_kg	Ld_Ane_Age 3_Mean- lenght_cm
2012	1												
2012	2												
2012	3	2228,84	30,2613	0,0135771	12,4712	116,139	2,30703	0,0198644	14,168				
2012	4	4621,29	85,3924	0,018478	13,9885	28178,4	894,591	0,0317474	16,5651	900,503	36,9031	0,0409805	17,9345
2012	5	23735,4	438,584	0,018478	13,9885	144727	4594,71	0,0317474	16,5651	4625,08	189,538	0,0409805	17,9345
2012	6	5120,6	94,6187	0,018478	13,9885	31223	991,249	0,0317474	16,5651	997,798	40,8903	0,0409805	17,9345
2012	7	13424,7	296,981	0,022122	14,6896	757,332	31,3619	0,0414111	17,5453				
2012	8	494,172	10,9321	0,022122	14,6896	27,8778	1,15445	0,0414111	17,5453				
2012	9	4952,57	109,561	0,022122	14,6896	279,39	11,5698	0,0414111	17,5453				
2012	10	1983,22	71,2144	0,0359085	16,8618	463,555	19,4286	0,0419121	17,5982				
2012	11												
2012	12												

ANNEX 2 (Data provided by French authorities).

Table A2.1: Annual economic data of French fleet involved in the anchovy fishery.

YEAR	FLEET	Vessel length	NUMBER_VESSELS	CREWCOST_WAGE		FUELCOST	TOTAL_FIXEDCOST		VARCOST		FTE_NAT	FUELCONS (L)	MAX_SEA_DAYS
				TOTAL_INCOME (€)	(% of TOTAL_INCOME)	(% of TOTAL_INCOME)	(% of TOTAL_INCOME)	(% of TOTAL_INCOME)					
2011	Demersal trawlers	[12-18[m	6	4 203 235	36%	24%	18%	14%	26	1 510 813	260		
2010	Pelagic trawlers	[12-18[m	7	4 808 983	35%	18%	22%	13%	32	1 661 867	256		
2011	Pelagic trawlers	[12-18[m	4	2 587 143	29%	15%	29%	21%	17	572 829	267		
2010	Pelagic trawlers	[18-24[m	20	15 435 874	35%	29%	18%	9%	92	8 783 143	237		
2011	Pelagic trawlers	[18-24[m	18	14 367 168	32%	15%	26%	18%	89	3 134 732	283		
2010	Seiners	[12-18[m	18	10 278 701	49%	5%	16%	8%	67	1 029 425	190		
2011	Seiners	[12-18[m	22	13 683 113	47%	7%	15%	10%	84	1 454 605	211		

Table A2.2: Effort, landings and number of vessels of French fleet involved in the anchovy fishery by semester.

Year	Semester	Fleet	Fleet_vessel_length	Ld_Ane_Tn	Ld_Ane_Eu	Ld_Oth_Tn	Ld_Oth_Eu	Eff_Ane_DAS	Eff_Ane_h	Eff_Oth_DAS	Eff_Oth_h	NV_T	NV_S_Oth	NV_S_Ane
2000	1	Demersal trawlers	[12-18[m	360	557	938	3 122	181	2 817	1 723	37 727	18	18	10
2000	2	Demersal trawlers	[12-18[m	385	597	834	2 864	212	4 314	1 456	30 840	18	18	12
2001	1	Demersal trawlers	[12-18[m	301	355	1 297	3 785	252	5 132	1 717	37 639	19	19	9
2001	2	Demersal trawlers	[12-18[m	1 351	1 474	983	2 796	492	7 482	1 311	28 625	19	19	19
2002	1	Demersal trawlers	[12-18[m	181	212	515	2 237	96	2 201	946	21 292	9	9	7
2002	2	Demersal trawlers	[12-18[m	80	200	597	2 437	73	1 564	957	21 416	9	9	3
2003	1	Demersal trawlers	[12-18[m	1	3	835	2 795			1 203	27 575	9	9	1
2003	2	Demersal trawlers	[12-18[m	270	891	679	2 148	513	11 380	841	19 401	9	9	9
2004	1	Demersal trawlers	[12-18[m	57	157	762	3 041	89	1 981	1 300	28 984	11	11	6
2004	2	Demersal trawlers	[12-18[m	346	873	637	2 294	364	7 497	945	20 721	11	11	11
2005	1	Demersal trawlers	[12-18[m	47	322	452	2 047	145	2 978	747	16 380	6	6	6
2005	2	Demersal trawlers	[12-18[m			469	1 614			624	13 244	6	6	
2006	1	Demersal trawlers	[12-18[m	37	205	265	1 339	71	1 219	565	11 593	6	6	6
2006	2	Demersal trawlers	[12-18[m	4	9	268	1 287	13	182	501	9 875	6	6	2
2007	1	Demersal trawlers	[12-18[m	6	7	113	557	6	90	246	5 262	2	2	2
2007	2	Demersal trawlers	[12-18[m			121	383			164	3 429	2	2	
2010	1	Demersal trawlers	[12-18[m	21	28	503	2 149	21	385	811	16 913	7	7	2
2010	2	Demersal trawlers	[12-18[m	280	351	476	2 347	87	1 256	787	16 215	7	7	7
2011	1	Demersal trawlers	[12-18[m	0	2	410	2 153	2	37	740	15 672	6	6	2
2011	2	Demersal trawlers	[12-18[m	300	373	410	1 861	626	8 367	578	12 217	6	6	6
2000	1	Demersal trawlers	[18-24[m	7	14	80	348			137	3 094	1	1	1
2000	2	Demersal trawlers	[18-24[m	94	152	93	292	21	390	98	2 272	1	1	1
2006	1	Demersal trawlers	[18-24[m	13	92	57	303	15	58	107	2 109	1	1	1
2006	2	Demersal trawlers	[18-24[m	3	7	112	305	8	68	111	1 874	1	1	1
2007	1	Demersal trawlers	[18-24[m	12	40	59	334	8	147	141	2 934	1	1	1
2007	2	Demersal trawlers	[18-24[m			103	354			97	2 000	1	1	
2009	1	Demersal trawlers	[18-24[m			40	216			94	1 787	1	1	
2009	2	Demersal trawlers	[18-24[m	1	3	44	165	4	73	85	1 660	1	1	1
2010	1	Demersal trawlers	[18-24[m	63	101	450	1 774	63	1 191	580	11 828	5	5	4
2010	2	Demersal trawlers	[18-24[m	184	271	523	2 181	72	1 254	627	12 891	5	5	4
2000	1	Pelagic trawlers	[12-18[m	1 195	1 919	3 499	4 513	655	11 194	1 620	29 343	26	26	21
2000	2	Pelagic trawlers	[12-18[m	2 352	3 714	2 853	3 942	1 030	18 233	1 386	25 285	26	26	25
2001	1	Pelagic trawlers	[12-18[m	350	621	3 242	4 082	239	4 259	1 218	22 775	18	18	16
2001	2	Pelagic trawlers	[12-18[m	2 295	2 567	2 828	3 523	678	12 224	1 153	22 450	18	18	16
2002	1	Pelagic trawlers	[12-18[m	1 419	2 078	2 836	3 771	669	10 891	1 370	27 819	18	18	18
2002	2	Pelagic trawlers	[12-18[m	915	2 367	3 074	4 437	492	7 789	1 438	28 451	18	18	13
2003	1	Pelagic trawlers	[12-18[m	207	798	2 457	4 552	173	3 039	1 729	36 099	15	15	13
2003	2	Pelagic trawlers	[12-18[m	1 255	4 386	2 157	3 452	1 020	20 836	1 078	22 006	15	14	15
2004	1	Pelagic trawlers	[12-18[m	247	866	2 288	3 584	318	5 690	1 392	24 485	15	15	15
2004	2	Pelagic trawlers	[12-18[m	1 079	3 016	1 506	2 394	729	12 475	825	13 143	15	15	15
2005	1	Pelagic trawlers	[12-18[m	89	612	1 238	2 978	297	5 675	956	19 327	10	10	10
2005	2	Pelagic trawlers	[12-18[m			1 282	2 501			916	18 770	10	10	
2006	1	Pelagic trawlers	[12-18[m	152	1 186	580	2 819	210	3 798	707	13 901	9	9	9
2006	2	Pelagic trawlers	[12-18[m	20	74	950	2 177	46	860	647	12 443	9	9	6
2007	1	Pelagic trawlers	[12-18[m	17	49	261	777	26	517	278	5 515	3	3	3
2007	2	Pelagic trawlers	[12-18[m			228	622			200	3 851	3	3	
2010	1	Pelagic trawlers	[12-18[m	143	279	481	2 743	115	2 075	674	14 078	7	7	7
2010	2	Pelagic trawlers	[12-18[m	741	1 096	970	2 161	206	3 703	551	10 145	7	7	7
2011	1	Pelagic trawlers	[12-18[m			348	1 420			466	9 635	4	4	
2011	2	Pelagic trawlers	[12-18[m	140	147	587	1 393	41	745	465	9 288	4	4	4

Year	Semester	Fleet	Fleet_vessel_length	Ld_Ane_Tn	Ld_Ane_Eu	Ld_Oth_Tn	Ld_Oth_Eu	Eff_Ane_DAS	Eff_Ane_h	Eff_Oth_DAS	Eff_Oth_h	NV_T	NV_S_Oth	NV_S_Ane
2000	1	Pelagic trawlers	[18-24[m	5 256	8 222	5 682	8 434	2 124	40 847	2 750	56 490	49	48	48
2000	2	Pelagic trawlers	[18-24[m	11 269	17 990	3 755	7 498	3 885	73 666	1 206	22 727	49	47	45
2001	1	Pelagic trawlers	[18-24[m	3 007	5 239	6 374	10 004	1 900	37 731	2 797	54 710	46	46	45
2001	2	Pelagic trawlers	[18-24[m	12 719	14 520	4 118	8 944	3 709	72 062	1 753	36 523	46	45	46
2002	1	Pelagic trawlers	[18-24[m	6 471	10 034	3 592	6 434	2 577	52 967	1 867	39 899	39	39	39
2002	2	Pelagic trawlers	[18-24[m	3 691	9 040	3 497	7 642	2 344	47 217	1 879	40 454	39	37	36
2003	1	Pelagic trawlers	[18-24[m	837	3 161	3 430	6 708	925	19 892	2 920	63 510	30	30	30
2003	2	Pelagic trawlers	[18-24[m	4 346	15 256	1 445	3 314	2 859	59 776	850	17 843	30	30	30
2004	1	Pelagic trawlers	[18-24[m	2	6	79	134	22	469	81	1 753	1	1	1
2004	2	Pelagic trawlers	[18-24[m									1	1	
2005	1	Pelagic trawlers	[18-24[m	20	118	34	168	54	1 128	96	2 109	1	1	1
2005	2	Pelagic trawlers	[18-24[m			87	213			88	1 964	1	1	
2006	1	Pelagic trawlers	[18-24[m	658	5 022	4 759	10 149	746	12 571	2 668	54 841	35	35	35
2006	2	Pelagic trawlers	[18-24[m	68	209	4 354	9 224	134	2 088	2 634	54 372	35	35	26
2007	1	Pelagic trawlers	[18-24[m	125	573	1 306	4 145	114	2 180	1 620	34 280	16	16	16
2007	2	Pelagic trawlers	[18-24[m			1 154	2 938			924	18 643	16	15	
2009	1	Pelagic trawlers	[18-24[m			145	584			135	2 830	1	1	
2009	2	Pelagic trawlers	[18-24[m	3	8	108	273	2	28	90	1 866	1	1	1
2010	1	Pelagic trawlers	[18-24[m	519	1 055	2 556	8 432	392	7 208	1 780	37 452	20	20	20
2010	2	Pelagic trawlers	[18-24[m	1 881	3 229	2 194	5 963	711	12 417	1 785	37 778	20	20	20
2011	1	Pelagic trawlers	[18-24[m	13	8	1 613	6 842	16	331	2 101	44 219	18	18	2
2011	2	Pelagic trawlers	[18-24[m	1 809	2 693	2 111	6 307	588	10 585	1 732	36 420	18	18	18
2000	1	Seiners	[12-18[m	79	114	4 017	2 550	318	7 558	2 294	53 121	18	18	9
2000	2	Seiners	[12-18[m	973	2 094	8 049	3 854	1 169	27 006	1 388	29 158	18	18	18
2001	1	Seiners	[12-18[m	174	375	4 956	3 867	273	6 172	2 597	57 454	22	22	10
2001	2	Seiners	[12-18[m	2 336	4 261	7 518	5 248	1 309	29 824	1 611	33 967	22	22	22
2002	1	Seiners	[12-18[m	60	133	4 835	4 774	140	3 135	2 631	58 614	23	22	6
2002	2	Seiners	[12-18[m	638	1 462	13 217	8 154	1 284	29 662	2 634	57 456	23	23	23
2003	1	Seiners	[12-18[m	198	530	5 416	5 590	414	9 656	2 612	57 830	23	23	9
2003	2	Seiners	[12-18[m	307	1 153	11 841	5 832	812	18 321	2 431	52 857	23	23	22
2004	1	Seiners	[12-18[m	219	383	4 111	4 519	214	4 412	2 246	48 818	23	21	5
2004	2	Seiners	[12-18[m	714	3 242	13 464	7 281	1 262	29 120	2 938	66 191	23	23	23
2005	1	Seiners	[12-18[m	12	22	366	464	230	5 333	481	10 559	5	5	5
2005	2	Seiners	[12-18[m			397	555			361	7 880	5	5	
2006	1	Seiners	[12-18[m	1	6	254	208	40	923	119	2 186	1	1	1
2006	2	Seiners	[12-18[m			145	170			74	1 003	1	1	
2009	1	Seiners	[12-18[m			2 969	1 600			532	4 728	6	6	
2009	2	Seiners	[12-18[m	49	213	5 014	1 897	6	92	424	3 533	6	6	6
2010	1	Seiners	[12-18[m	0	0	6 984	4 950	1	18	1 397	12 442	18	18	1
2010	2	Seiners	[12-18[m	834	1 787	13 194	7 216	143	1 485	1 454	13 051	18	18	18
2011	1	Seiners	[12-18[m			6 101	4 752			1 711	15 352	22	21	
2011	2	Seiners	[12-18[m	1 706	3 298	12 904	8 061	412	4 184	1 512	14 403	22	22	22
2000	1	Seiners	[18-24[m	85	87	280	179	101	2 351	119	2 849	4	4	3
2000	2	Seiners	[18-24[m	16	28	622	854	40	873	185	4 184	4	4	3
2001	1	Seiners	[18-24[m	34	42	308	363			195	4 613	4	3	3
2001	2	Seiners	[18-24[m	224	285	1 029	1 218	47	1 023	236	5 446	4	4	3
2002	1	Seiners	[18-24[m			567	898			124	2 751	1	1	
2002	2	Seiners	[18-24[m	121	392	680	788	14	264	128	2 843	1	1	1
2003	1	Seiners	[18-24[m	3	7	634	842	45	1 090	179	4 020	2	2	1
2003	2	Seiners	[18-24[m	26	103	1 301	1 111	40	869	216	4 809	2	2	1
2009	1	Seiners	[18-24[m			764	620			109	959	1	1	
2009	2	Seiners	[18-24[m	2	12	1 334	583	1	17	102	976	1	1	1
2010	1	Seiners	[18-24[m			413	280			86	627	1	1	
2010	2	Seiners	[18-24[m	35	75	1 030	515	5	45	129	1 538	1	1	1
2011	1	Seiners	[18-24[m			330	325			91	751	1	1	
2011	2	Seiners	[18-24[m	134	303	781	595	29	258	71	676	1	1	1

ANNEX 3. Discrepancies between the data requested and the data provided

1. Effort, landings and price data				Discrepancies between data required and data provided	
Period:	From 2000 to 2012			Spain	France
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				
Data time step:	By month or year				
Data	Unit	Name	Disaggregation		
Landing of anchovy - Tonnes	Tonnes	Ld_Ane_Tn	By fleet, month.	Only year 2012	2000 - 2011
Landing of anchovy - Euros	Euros	Ld_Ane_Eu	By fleet, month.	Only year 2012	2000 - 2011
Landing of all other species -Tonnes	Tonnes	Ld_oth_Tn	By fleet, month.	Only year 2012	2000 - 2011
Landing of all other species -Euros	Euros	Ld_oth_Eu	By fleet, month.	Only year 2012	2000 - 2011
Effort allocated to anchovy	Days or Trips length (hours)*	Eff_Ane	By fleet, month	Only year 2012	2000 - 2011

Effort allocated to all other species	Days or Trips length (hours)*	Eff_Oth	By fleet, month	Only year 2012	2000 - 2011
Total number of vessels operating in the anchovy fishery**	Number	NV_T	By fleet, year	Only year 2012	2000 - 2011
Number of vessels catching anchovy**	Number	NV_Oth	By fleet, month	Only year 2012	2000 - 2011
Number of vessels catching other species**	Number	NV_Ane	By fleet, month	Only year 2012	2000 - 2011
Number of vessels catching anchovy**	Number	NV_Oth	By fleet, semester	Only year 2012	2000 - 2011
Number of vessels catching other species**	Number	NV_Ane	By fleet, semester	Only year 2012	2000 - 2011
*for French vessels, estimation of the duration of the trip in hours					
**based on the selection of vessels involved in the anchovy fishery					
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				
Selection of vessels per fleet	Spain : Pelagic Purse Seiner operating in the Cantabric Sea				
Data time step:	By year			Spain	France

Data	Unit	Disaggregation	Acronym DCF		
Income from landings	1000 euros	By fleet	totLandgInc		2010 - 2011
Direct subsidies	1000 euros	By fleet	totDirSub	No data	2010 - 2011
Other income	1000 euros	By fleet	totOtherInc	No data	2010 - 2011
Wages and salaries of crew	1000 euros	By fleet	totCrewWage	No data	2010 - 2011
Imputed value of unpaid labour	1000 euros	By fleet	totUnpaidLabour	No data	2010 - 2011
Energy costs	1000 euros	By fleet	totEnerCost	No data	2010 - 2011
Repair and maintenance costs	1000 euros	By fleet	totRepCost	No data	2010 - 2011
Other variable costs (not including energy cost)	1000 euros	By fleet	totVarCost	No data	2010 - 2011
Non-variable costs	1000 euros	By fleet	totNoVarCost	No data	2010 - 2011
Annual depreciation	1000 euros	By fleet	totDepCost	No data	No data
Investments in physical capital	1000 euros	By fleet	totInvest	No data	2010 - 2011
FTE (national)	Number	By fleet	totNatFTE	No data	2010 - 2011
Energy consumption	Litres	By fleet	totEnerCons	No data	2010 - 2011
Crew share	%	By fleet		No data	No data

ANNEX 4. Data to be included in the model (per fleet).

File Name	Details on contents
flX.met1.stk1_alpha	Parameter alpha (Cobb-Douglas) for anchovy production function fleet, semester, age
flX.met1.stk1_beta	Parameter beta (Cobb-Douglas) for anchovy production function fleet, semester, age
flX.met1.stk1_catch.q	Parameter q (Cobb-Douglas) for anchovy production function fleet, semester, age
flX.met1.stk1_discards.n	Discards = 0
flX.met1.stk1_landings.n	Landings (in numbers) of anchovy by year, fleet, semester, age on 2000-2011 in numbers.
flX.met1.stk1_landings.wt	Landings (average weight at age) of anchovy by year, semester, age on 2000-2011, in tonnes.
flX.met1.stk1_price.n	Average price for anchovy by year, fleet, semester (euros/kg).
flX.met1_effshare	Total effective effort / efective effort allocated to anchovy , by fleet, year and semester .
flX.met2.stk2_discards.n	NO DATA
flX.met2.stk2_landings.n	NO DATA
flX.met2.stk2_landings.wt	Landings (total weight) of other species by year, semester, age in tonnes.
flX.met2.stk2_price.n	Average price for other species by year, semester (not age) on 2000-2011 (euros)
flX.met2_effshare	Total effective effort / efective effort allocated to other species , by fleet, year and semester .
flX_CaCcost	Capital costs by fleet and by year / Capacity. (1000 euros).
flX_capacity	Maximum numever of days multiply by maximun number of vessel operating in the fishery by fleet and year.
flX_Crewcost	Crew costs by fleet and by year (1000 euros).
flX_crewshare	Crewshare by fleet and by year (%).
flX_effort	Effective effort allocated by fleet and year (number of days with landing x number of vessels).
flX_fcost	Fixed costs by fleet and by year (1000 euros).
flX_fuelcost	Fuel costs / unit of effort (1000 euros).
flX_vcost	Variable costs /unit of effort (1000 euros).

ANNEX5. Data call.



EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR MARITIME AFFAIRS AND FISHERIES
ATLANTIC, OUTERMOST REGIONS AND ARCTIC
FISHERIES CONSERVATION AND CONTROL ATLANTIC AND OUTERMOST REGIONS

Brussels,
MARE.C2/RAD/Ares(2013)

E-MAIL

To: M. Cardenas Gonzalez
M. de Lambert des Granges
Mme Peyrat

Copy: M. Larranaga
M. Chatelus
STECF

From: Fuensanta CANDELA **Telephone:** +32 (2) 29 57753
CASTILLO

Number of pages: 1

Subject: Data call in relation to STECF impact assessment of management
measures for anchovy in the Bay of Biscay

Message:

The STECF has concluded its advice on the harvest control rule and evaluation of the management plan for anchovy in the Bay of Biscay proposed by the Commission in 2009 (COM(2009) 399 final). Please find the STECF final report online under:

http://stecf.jrc.ec.europa.eu/documents/43805/622860/2013-11_STECF+13-24+-+Advice+on+HCR+and+evaluation+anchovy+plan_JRCxxx.pdf

Pages 44 and 45 of the aforementioned report describe a set of data needed for the STECF impact assessment of measures scoped with stakeholders in October 2013. This impact assessment is foreseen for March 2014. In this context we would be grateful if you could provide the missing data to the JRC STECF SECRETARIAT (stecf-secretariat@jrc.ec.europa.eu), copy Ernesto.JARDIM@jrc.ec.europa.eu, by 1st January 2014. Please include a table explaining any codes you may use and be free to send your data via excel or csv files.

Best regards,

Fuensanta CANDELA CASTILLO

ANNEX6. Complete results.

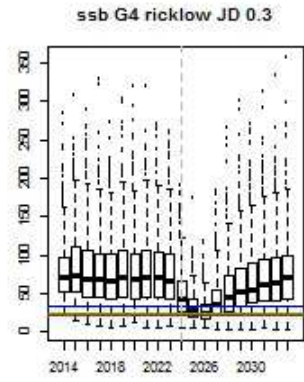
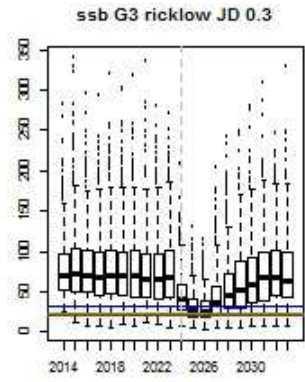
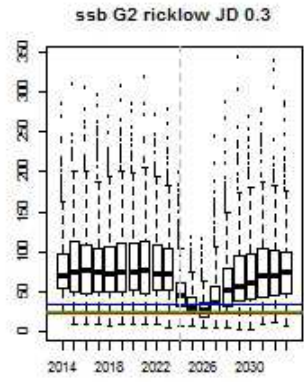
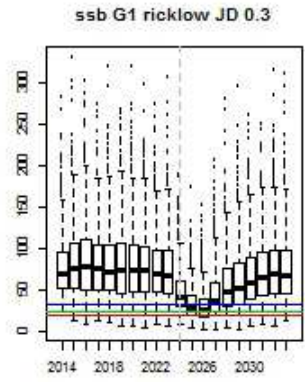
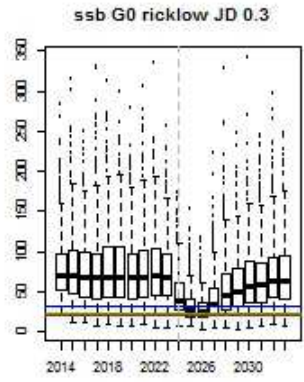
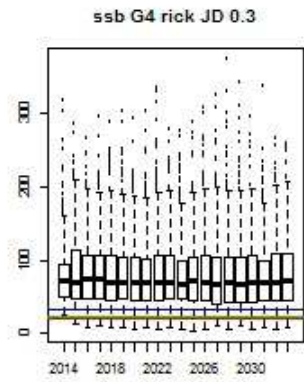
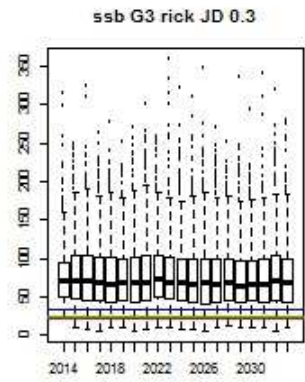
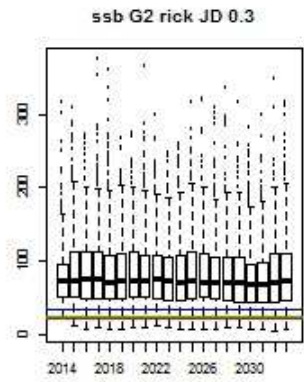
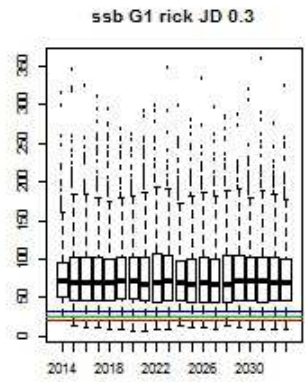
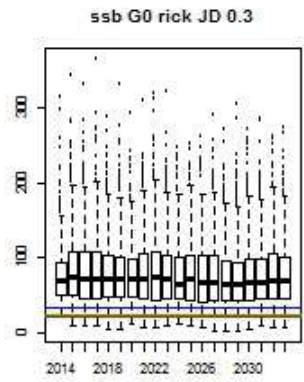


Figure A6.1: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) when the slope parameter $\gamma = 0.3$ for a management period from January to December. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

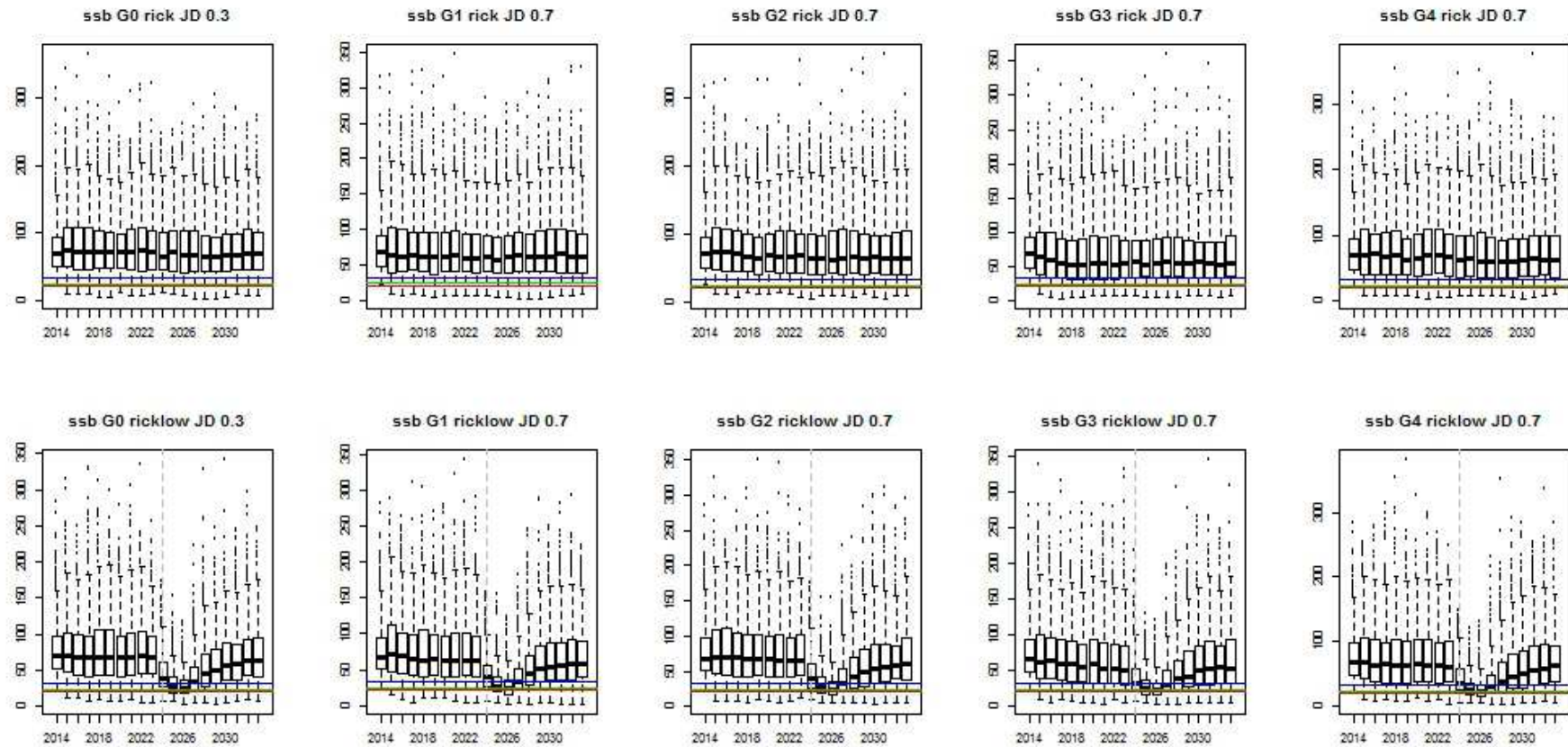


Figure A6.2: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) when the slope parameter $\gamma = 0.7$ for a management period from January to December. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

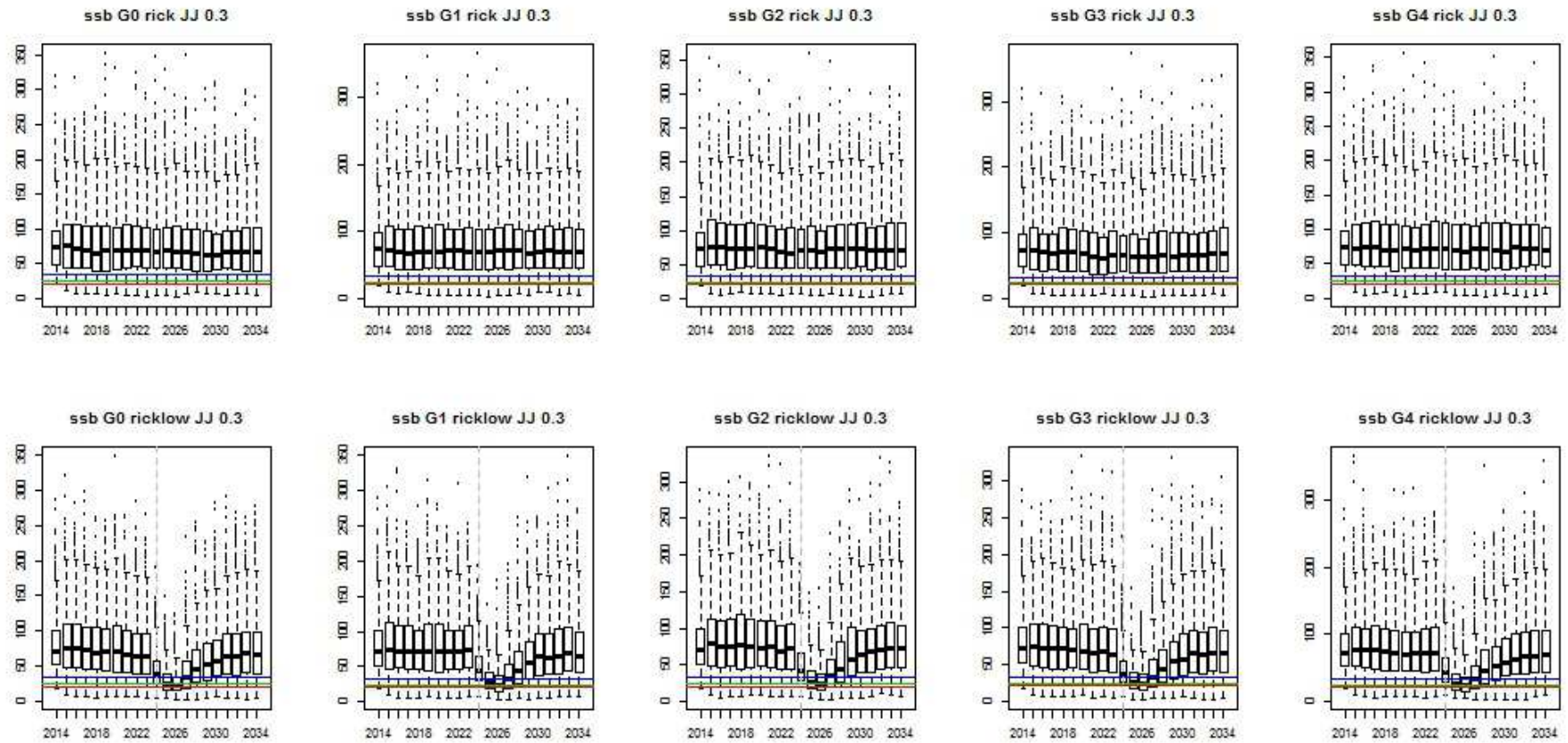


Figure A6.3: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) when the slope parameter $\gamma = 0.3$ for a management period from July to June. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitmentscenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

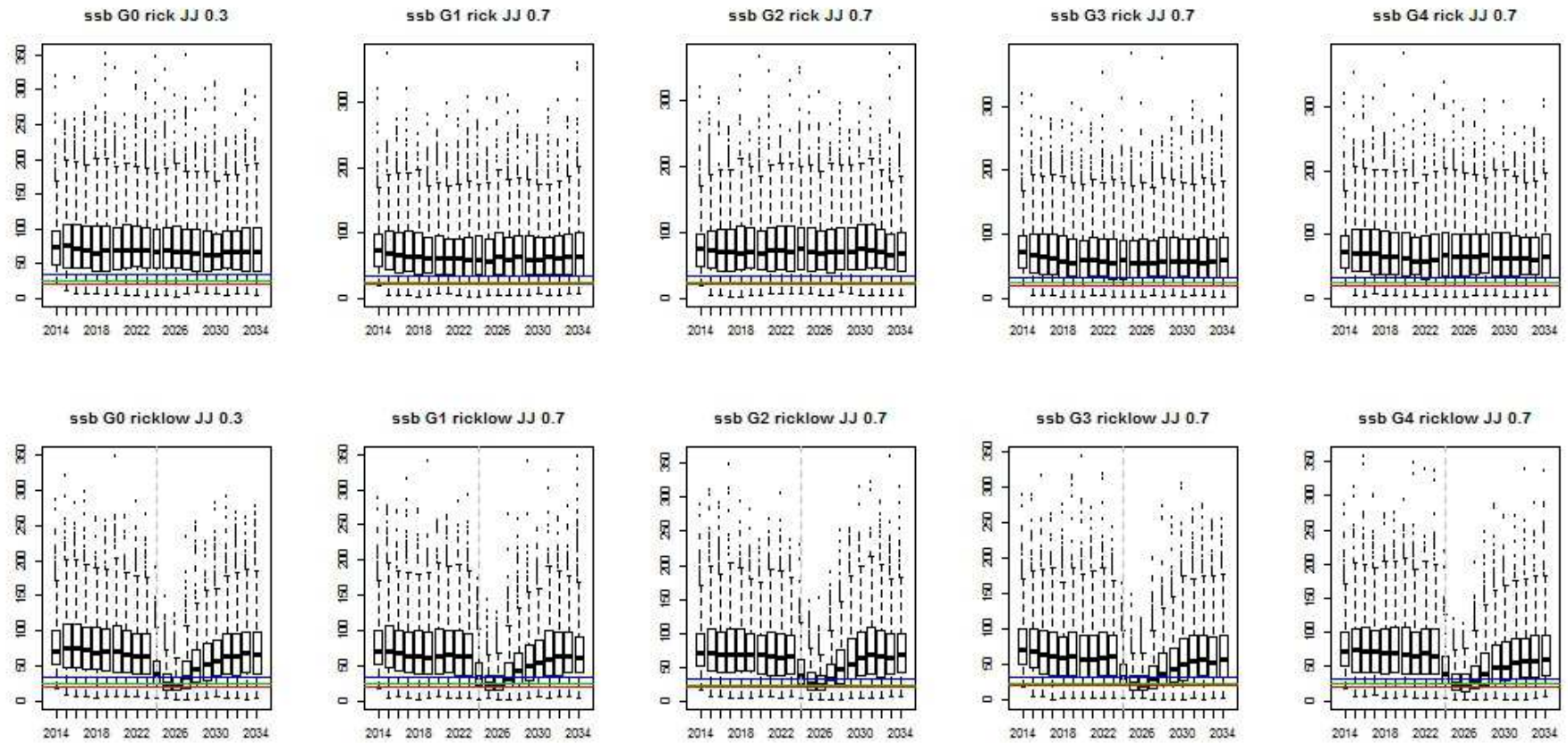


Figure A6.4: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) when the slope parameter $\gamma = 0.7$ for a management period from July to June. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

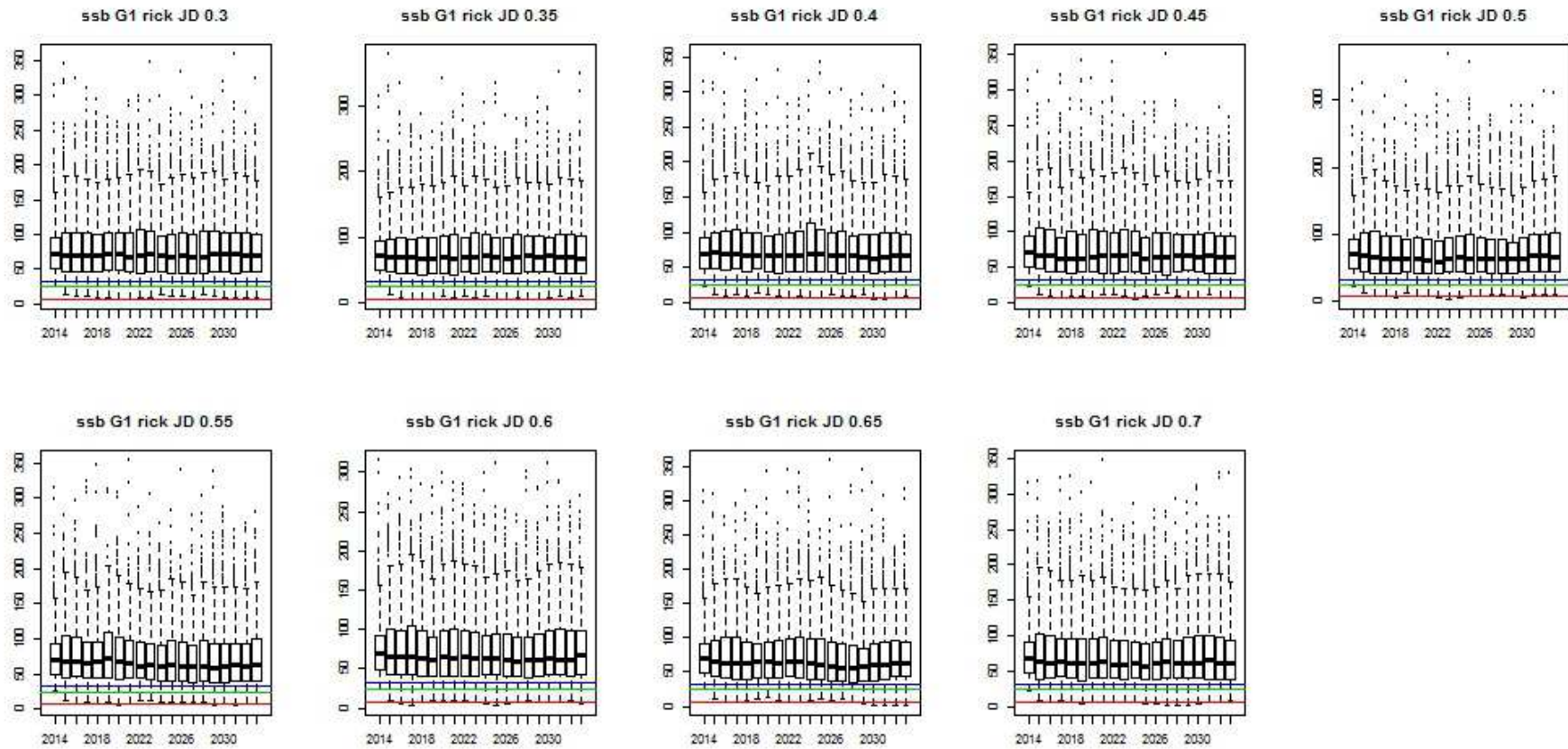


Figure A6.5: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G1 in a management period from January to December under the Ricker recruitment scenario.

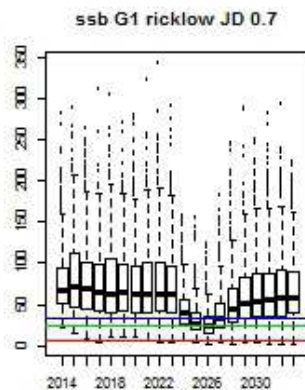
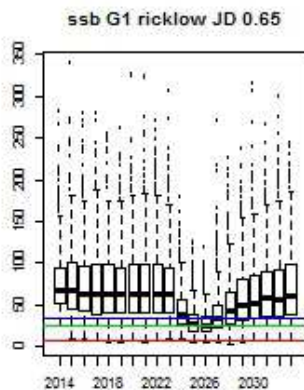
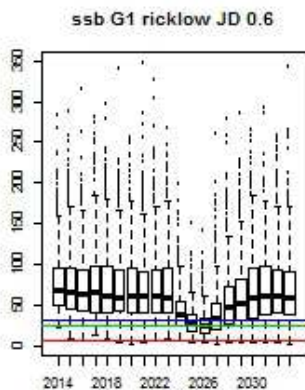
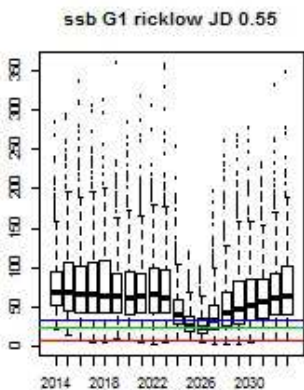
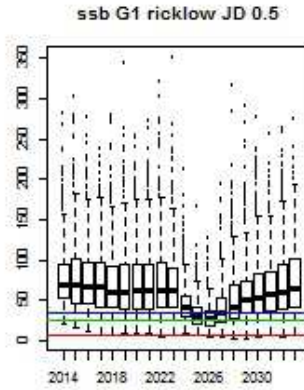
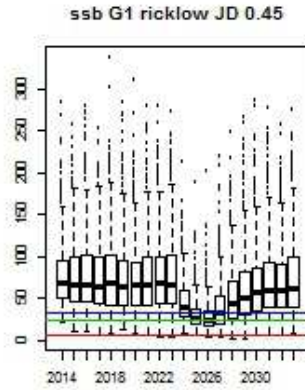
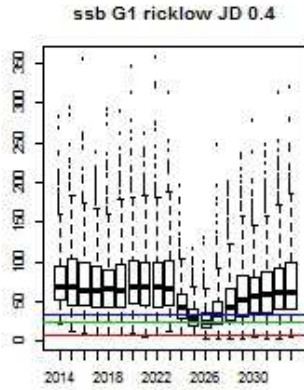
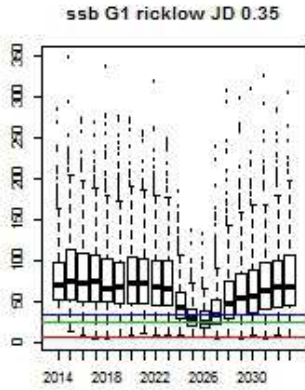
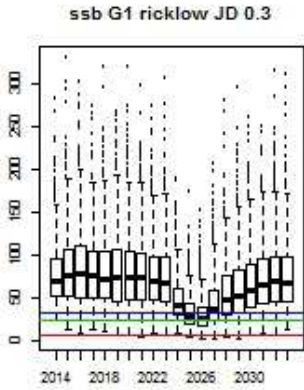


Figure A6.6: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G1 in a management period from January to December under the low regime recruitment scenario.

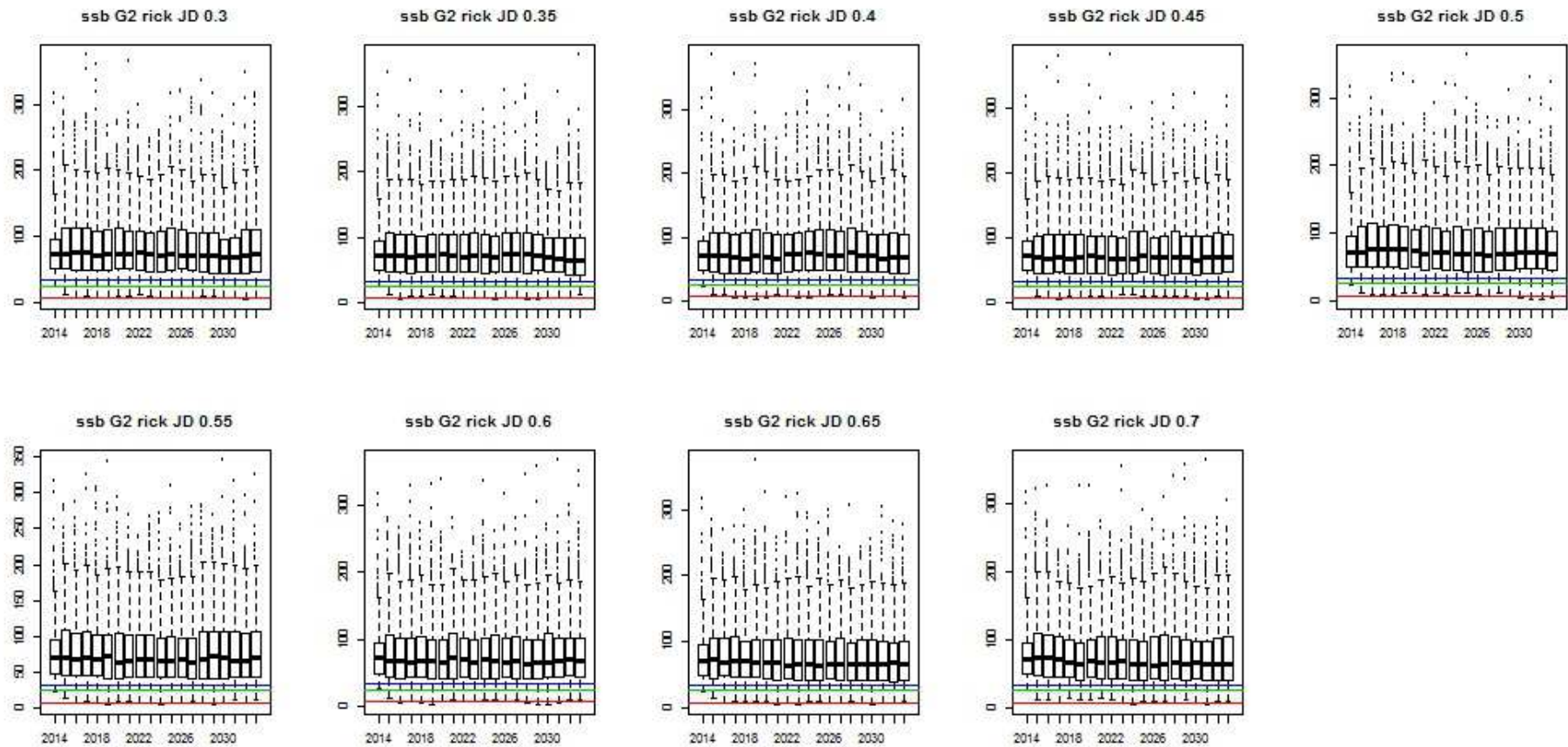


Figure A6.7: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G2 in a management period from January to December under the Ricker recruitment scenario.

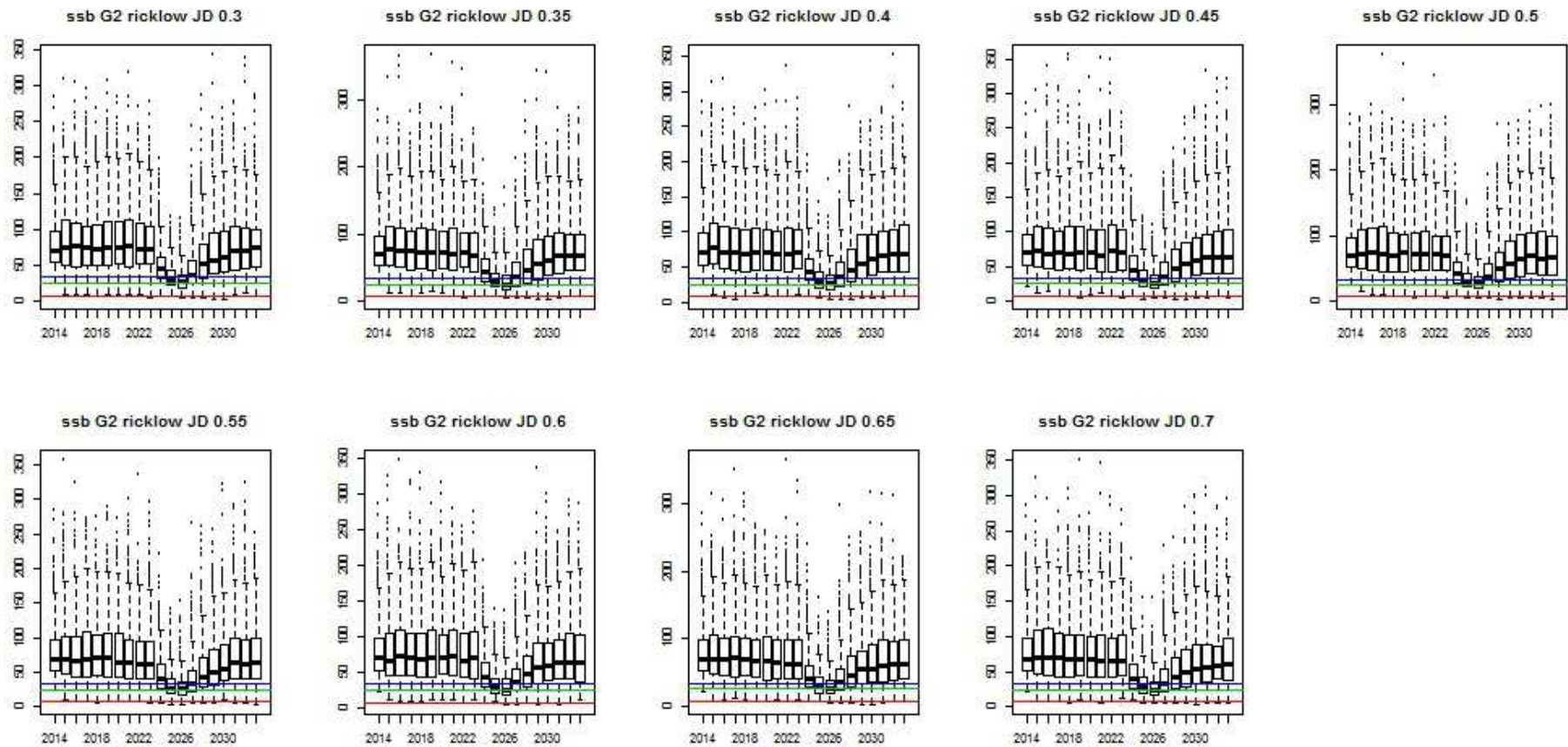


Figure A6.8: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G2 in a management period from January to December under the low regime recruitment scenario.

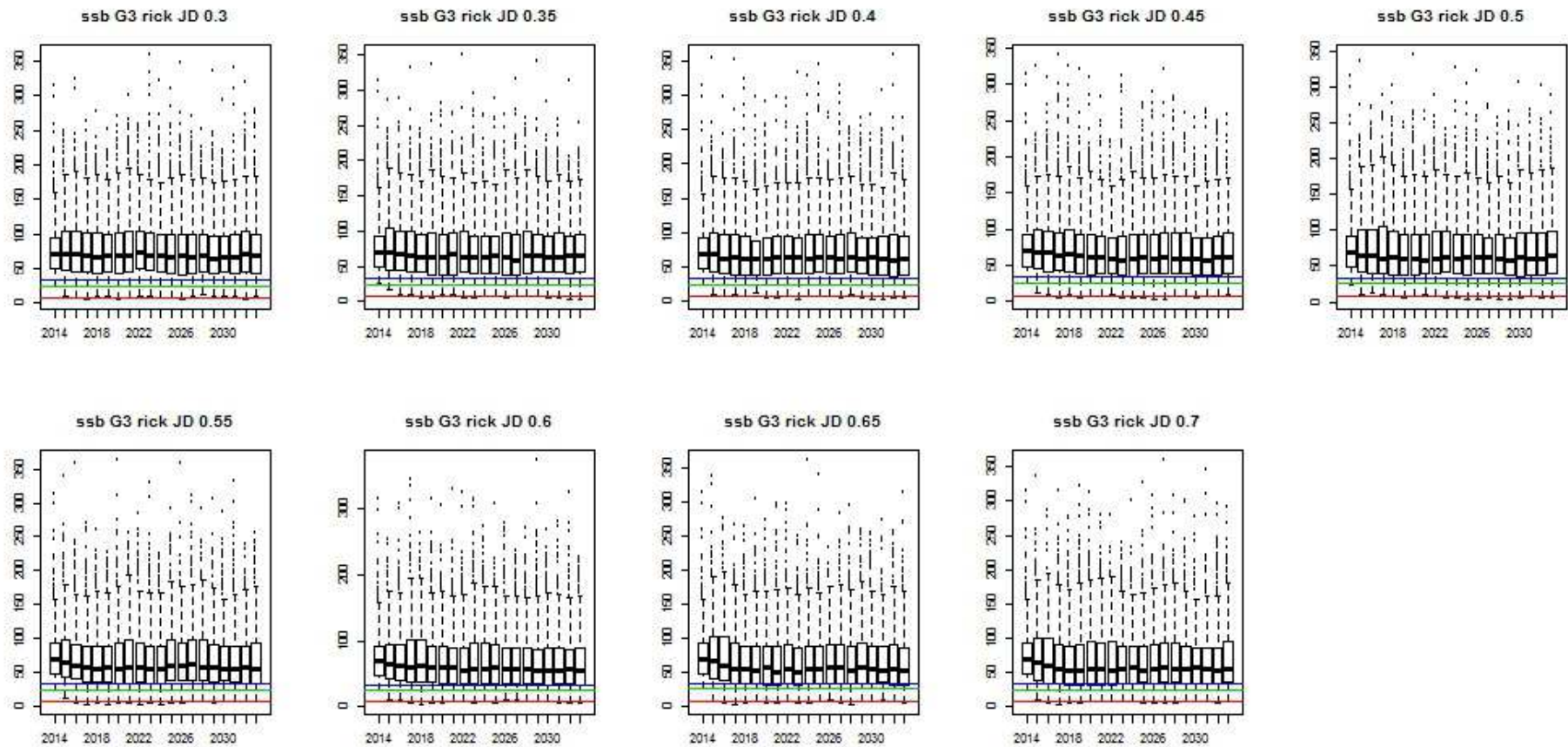


Figure A6.9: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G3 in a management period from January to December under the Ricker recruitment scenario.

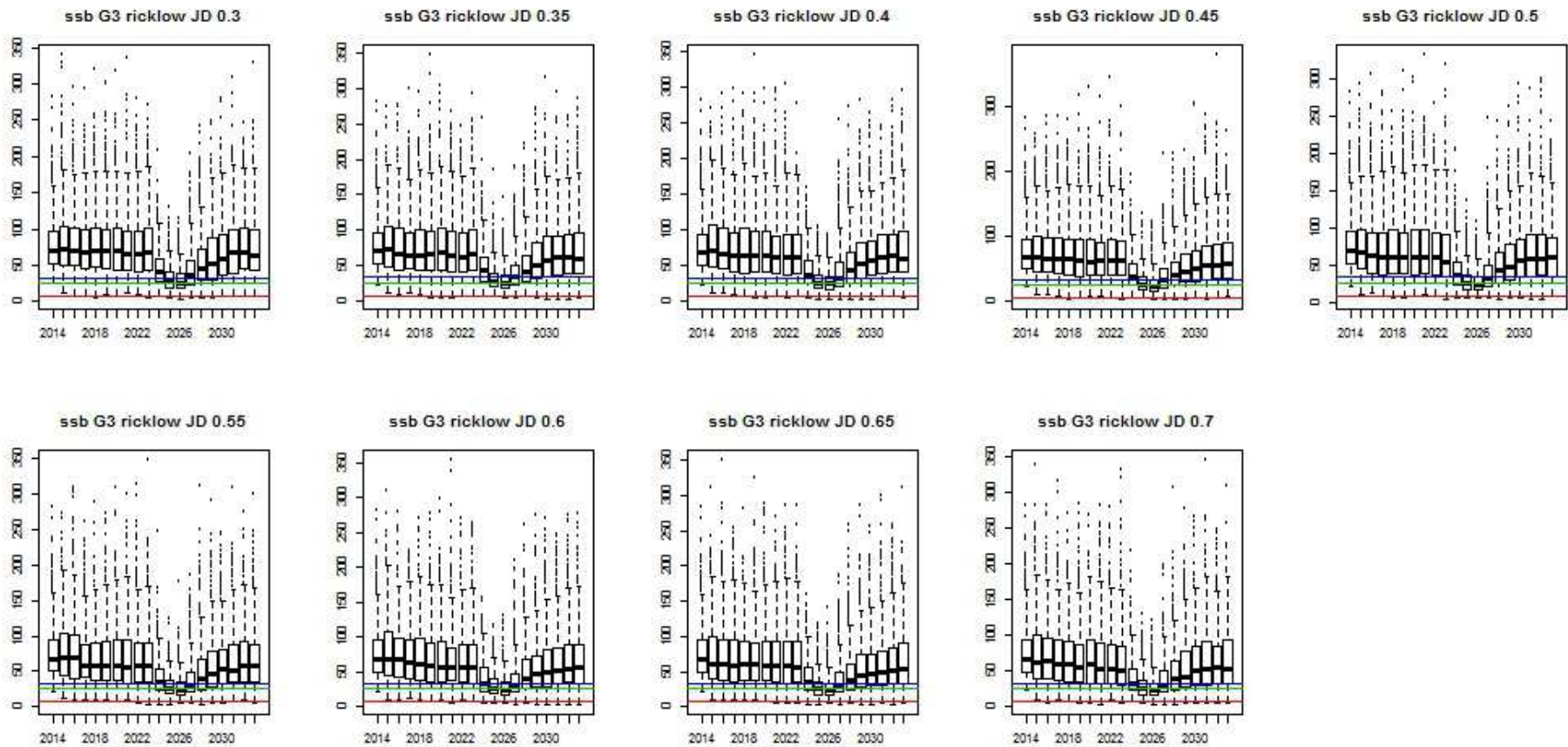


Figure A6.10: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G3 in a management period from January to December under the low regime recruitment scenario.

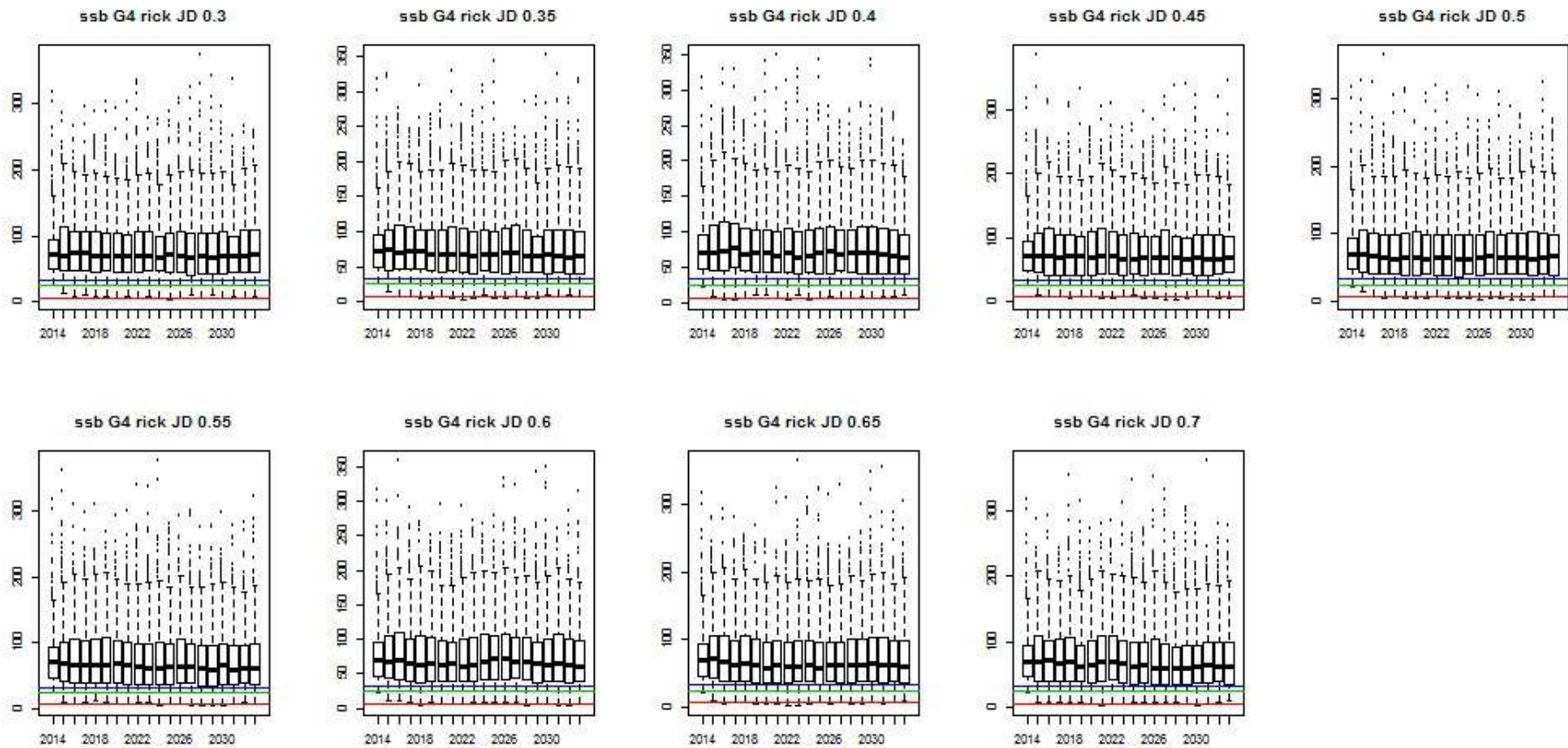


Figure A6.11: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G4 in a management period from January to December under the Ricker recruitment scenario.

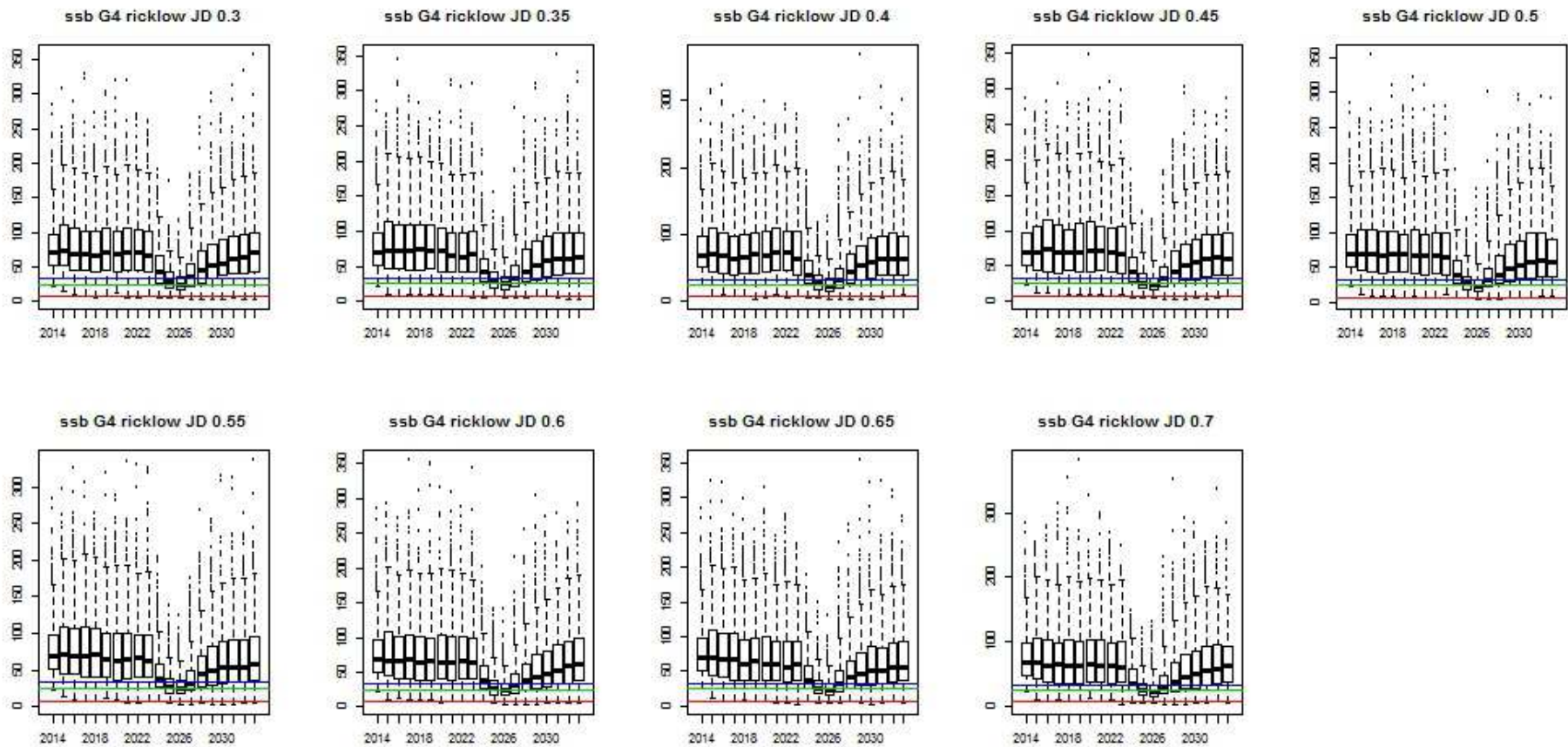


Figure A6.12: Boxplots of spawning stock biomass (SSB) for the projection period (2014-2034) depending on the slope parameter γ for HCR G4 in a management period from January to December under the low regime recruitment scenario.

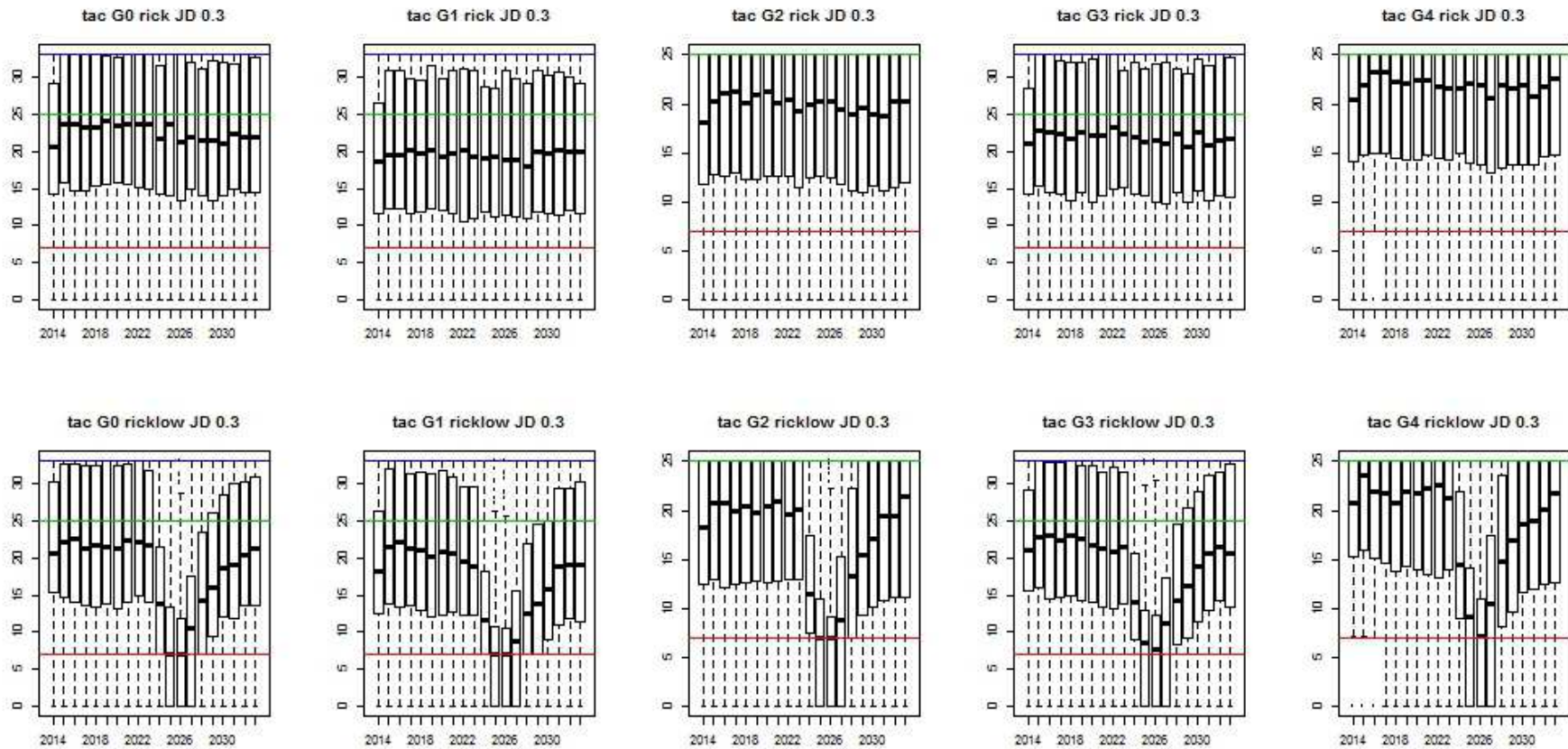


Figure A6.13: Boxplots of TAC for the projection period (2014-2034) when the slope parameter $\gamma = 0.3$ for a management period from January to December. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

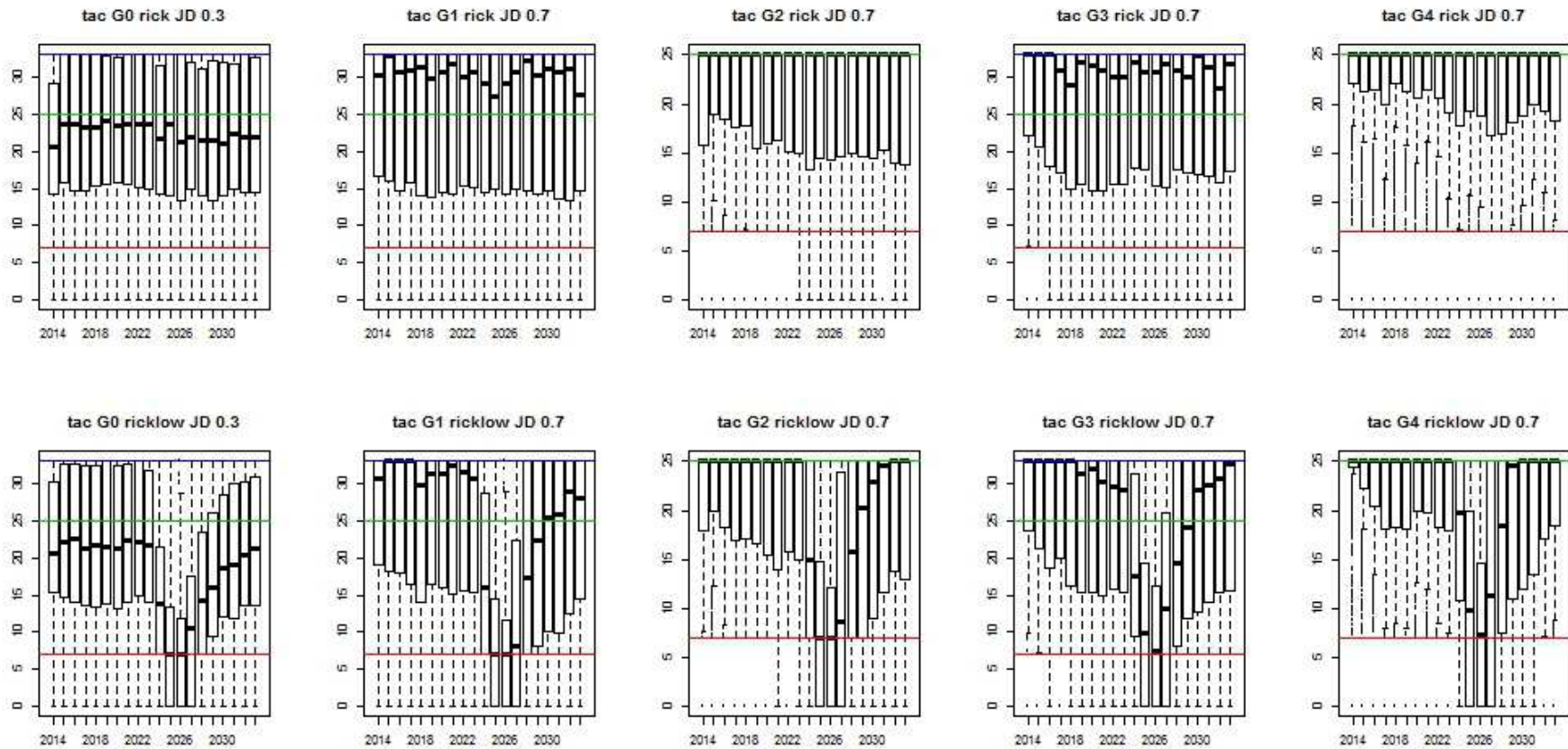


Figure A6.14: Boxplots of TAC for the projection period (2014-2034) when the slope parameter $\gamma = 0.7$ for a management period from January to December. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

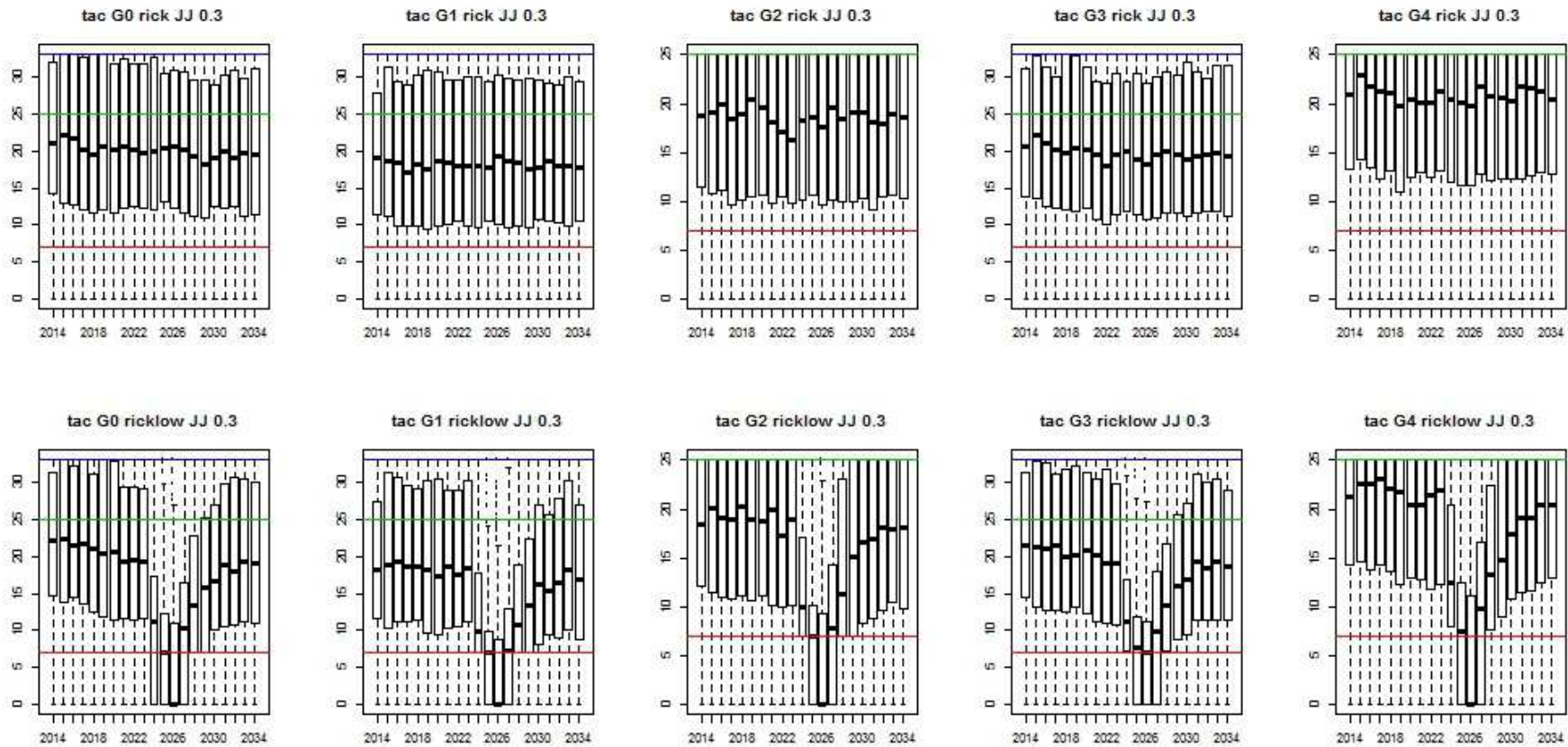


Figure A6.15: Boxplots of TAC for the projection period (2014-2034) when the slope parameter $\gamma = 0.3$ for a management period from July to June. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

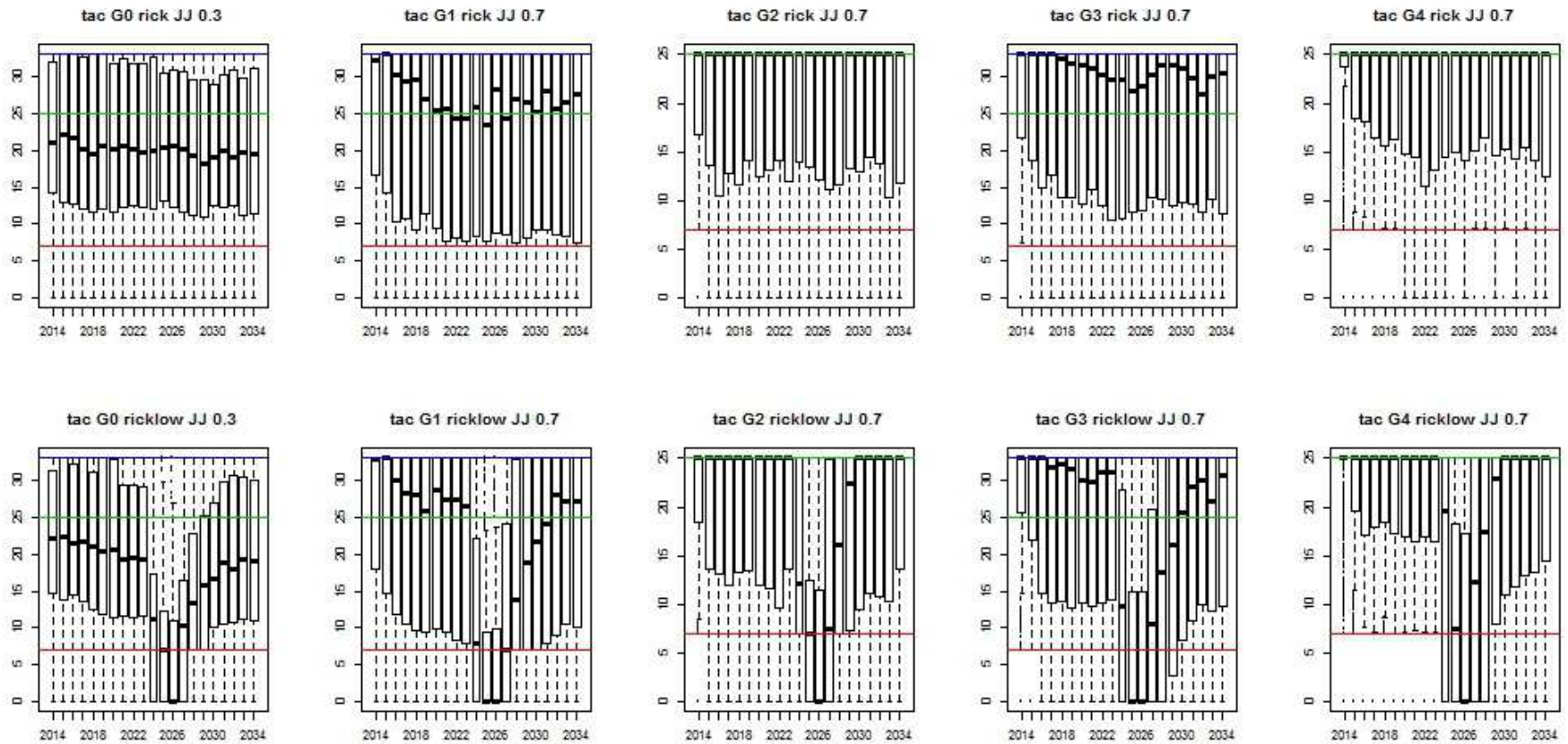


Figure A6.16: Boxplots of TAC for the projection period (2014-2034) when the slope parameter $\gamma = 0.7$ for a management period from July to June. The top row corresponds to the Ricker stock-recruitment model and the bottom row to the low regime recruitment scenario. Each column is a different HCR (G0, G1, G2, G3 and G4).

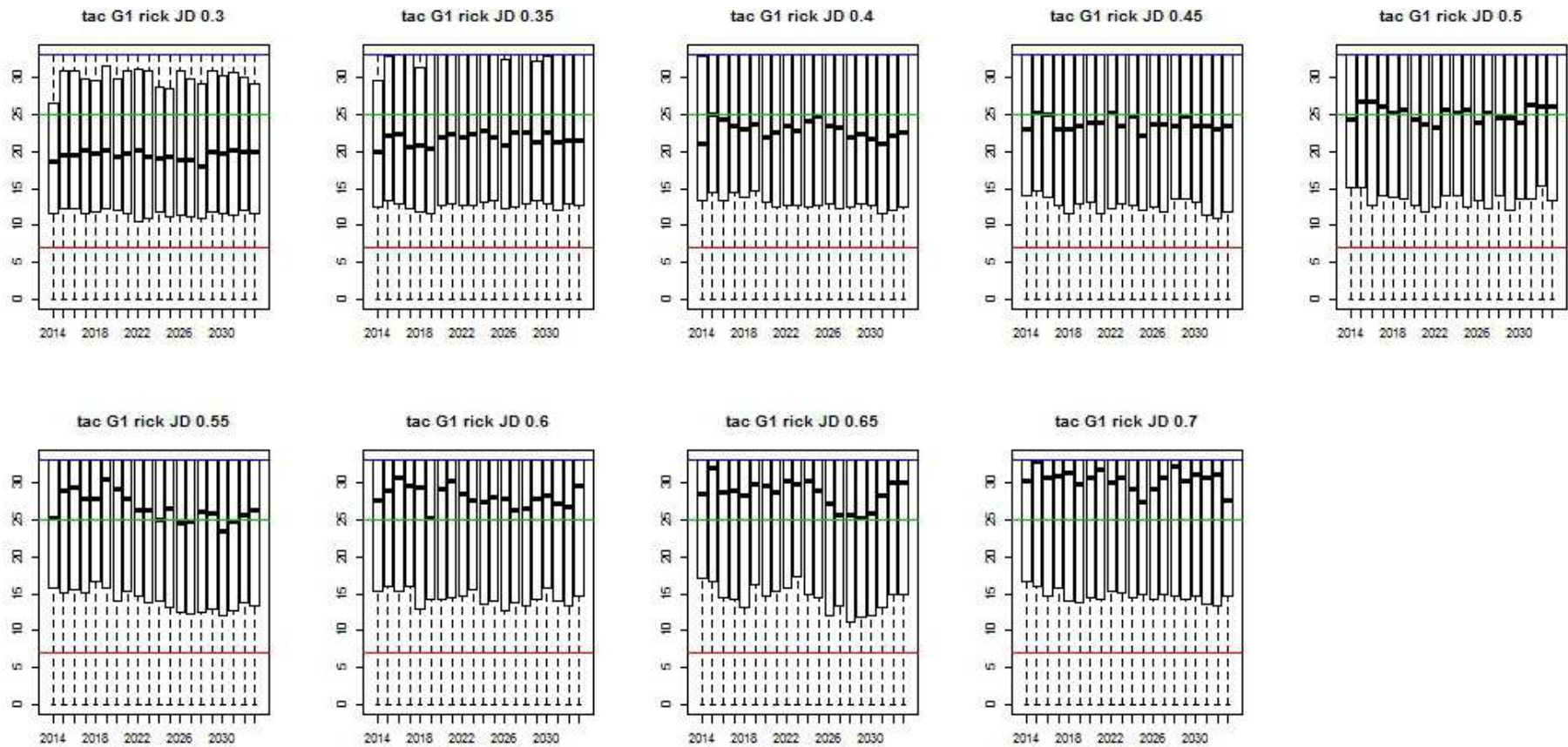


Figure A6.17: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G1 in a management period from January to December under the Ricker recruitment scenario.

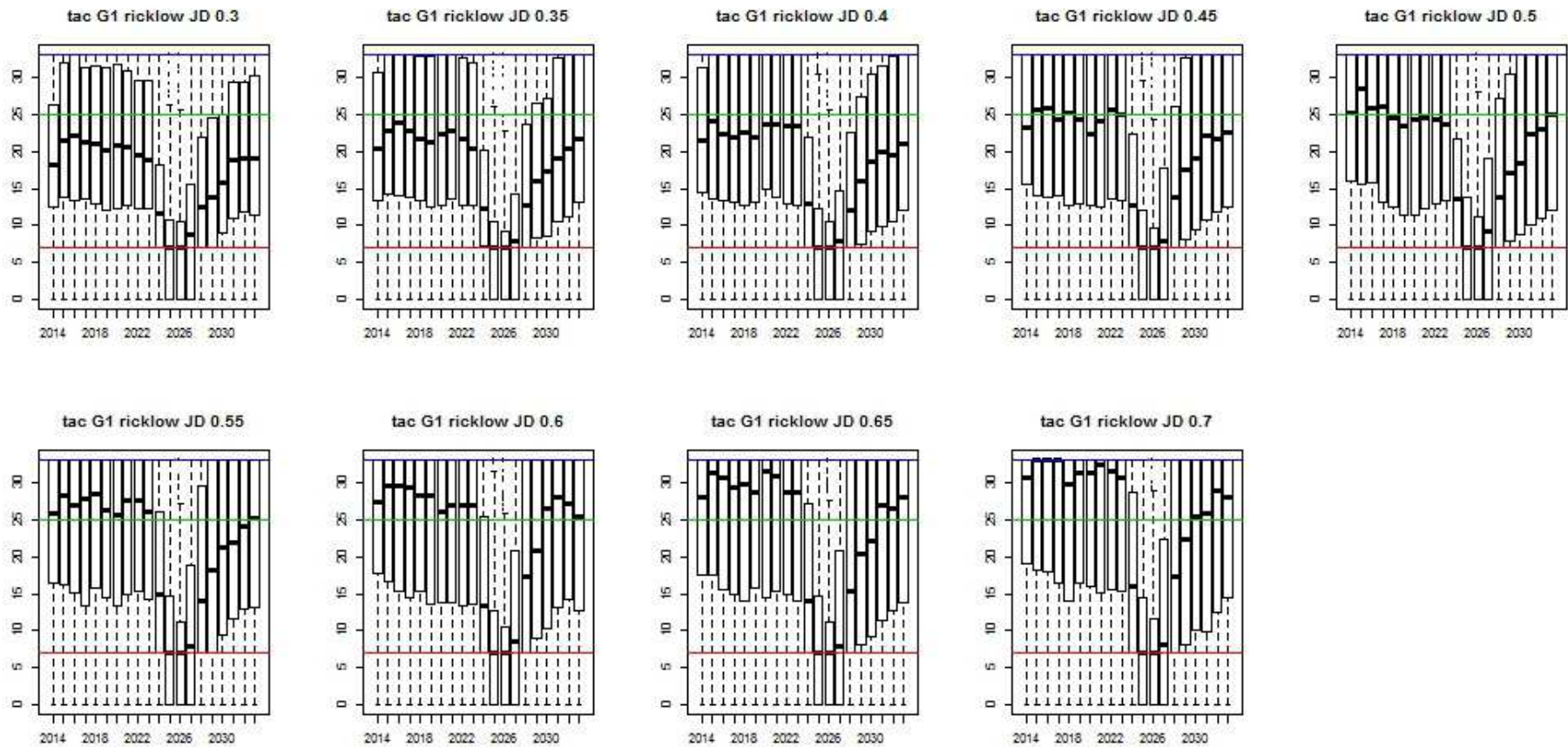


Figure A6.18: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G1 in a management period from January to December under the low regime recruitment scenario.

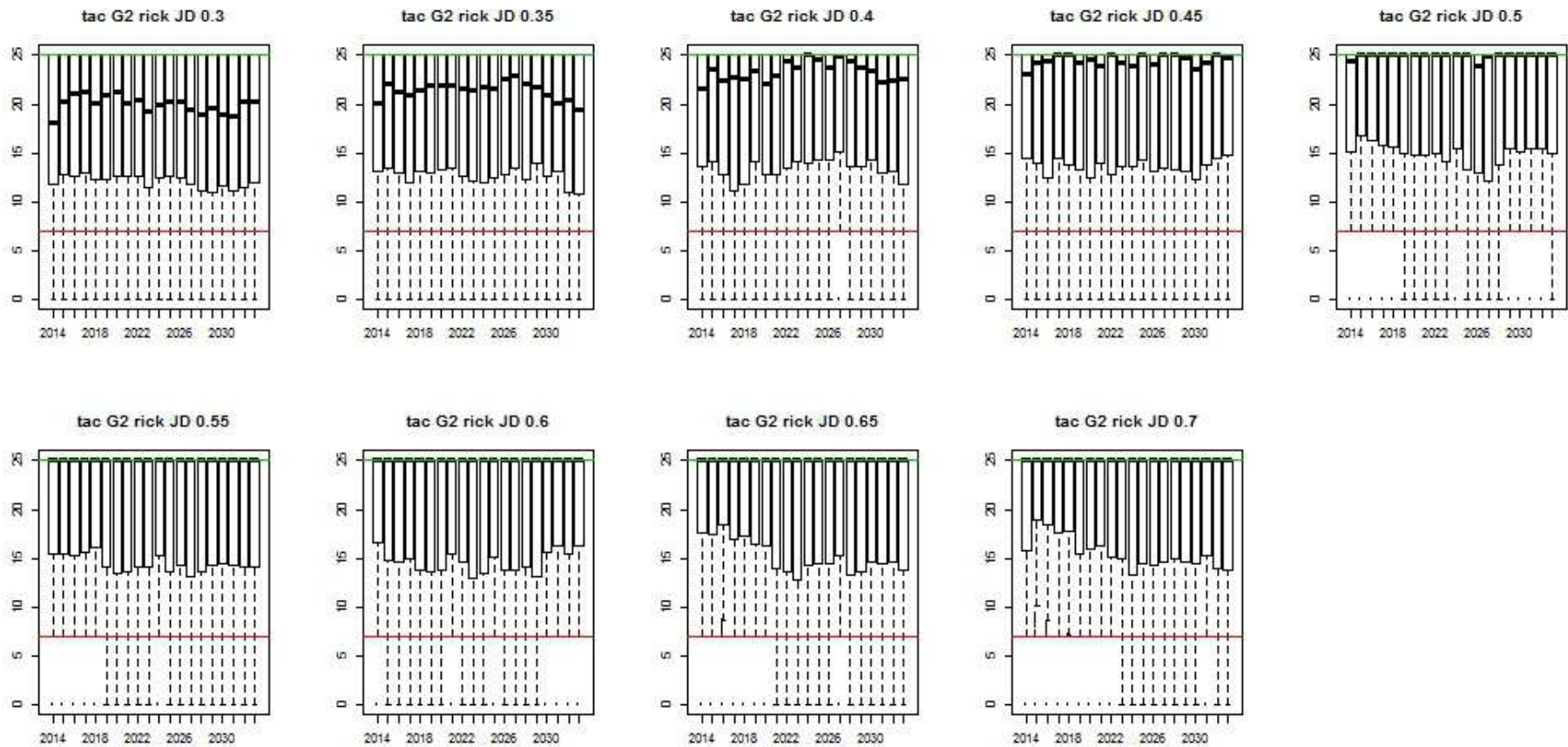


Figure A6.19: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G2 in a management period from January to December under the Ricker recruitment scenario.

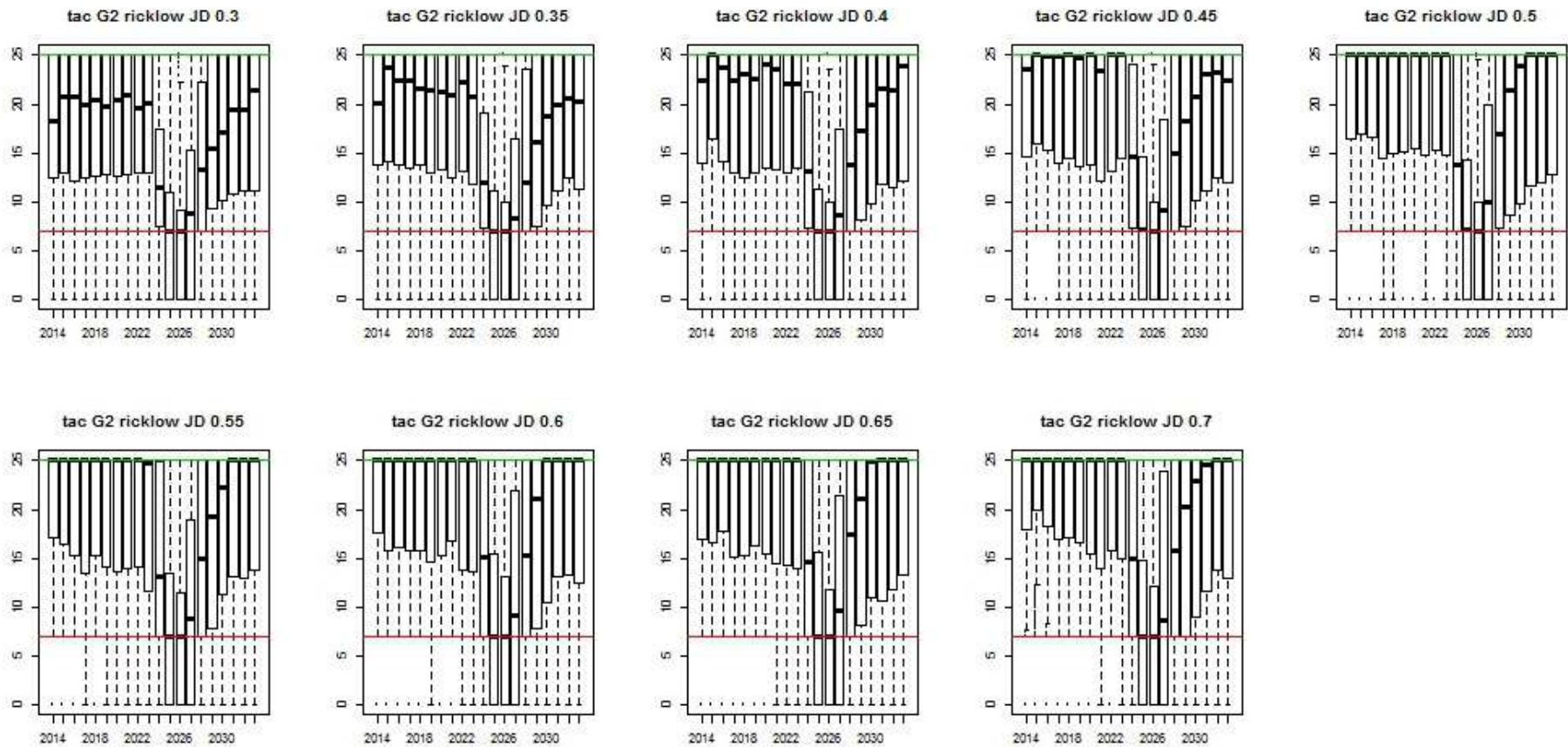


Figure A6.20: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G2 in a management period from January to December under the low regime recruitment scenario.

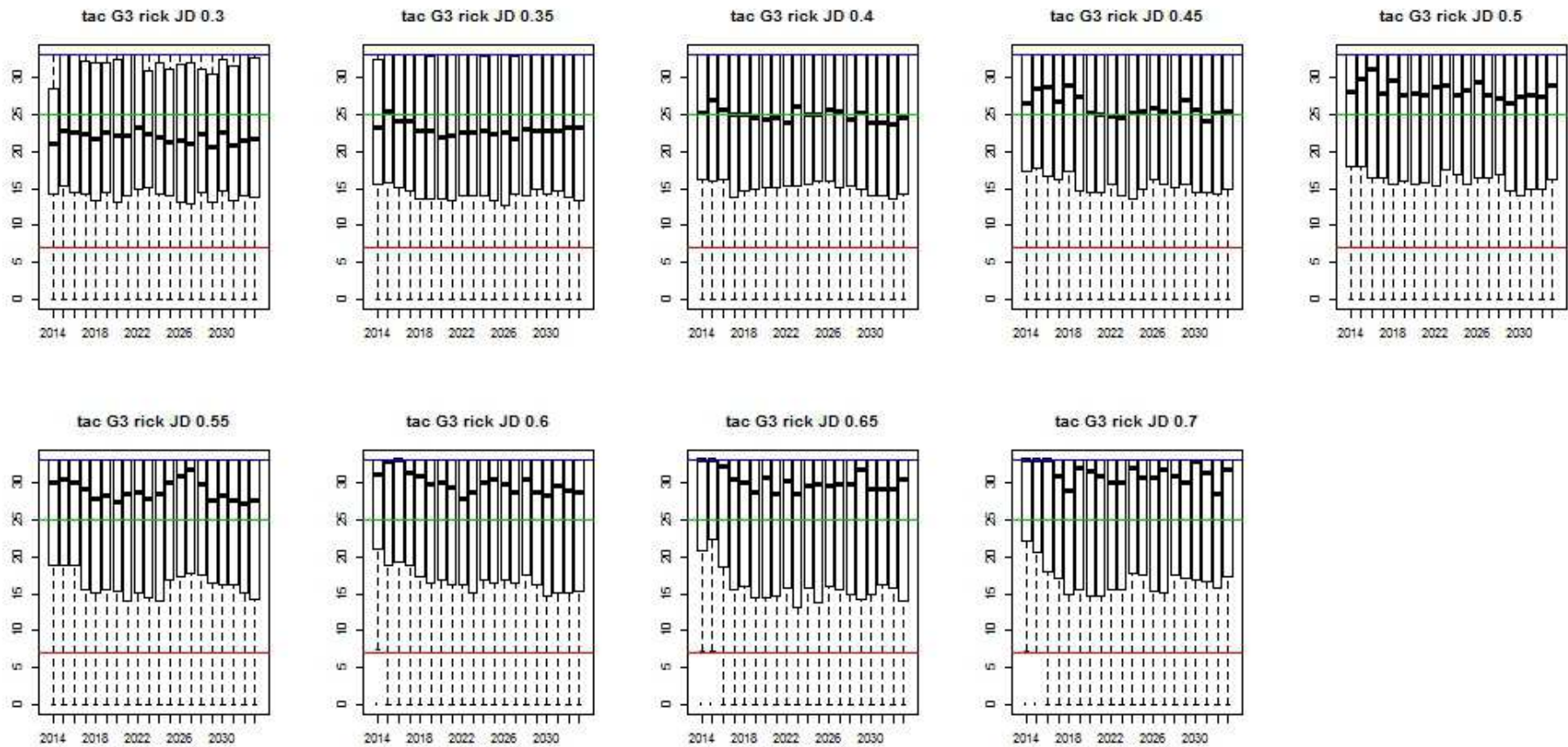


Figure A6.21: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G3 in a management period from January to December under the Ricker recruitment scenario.

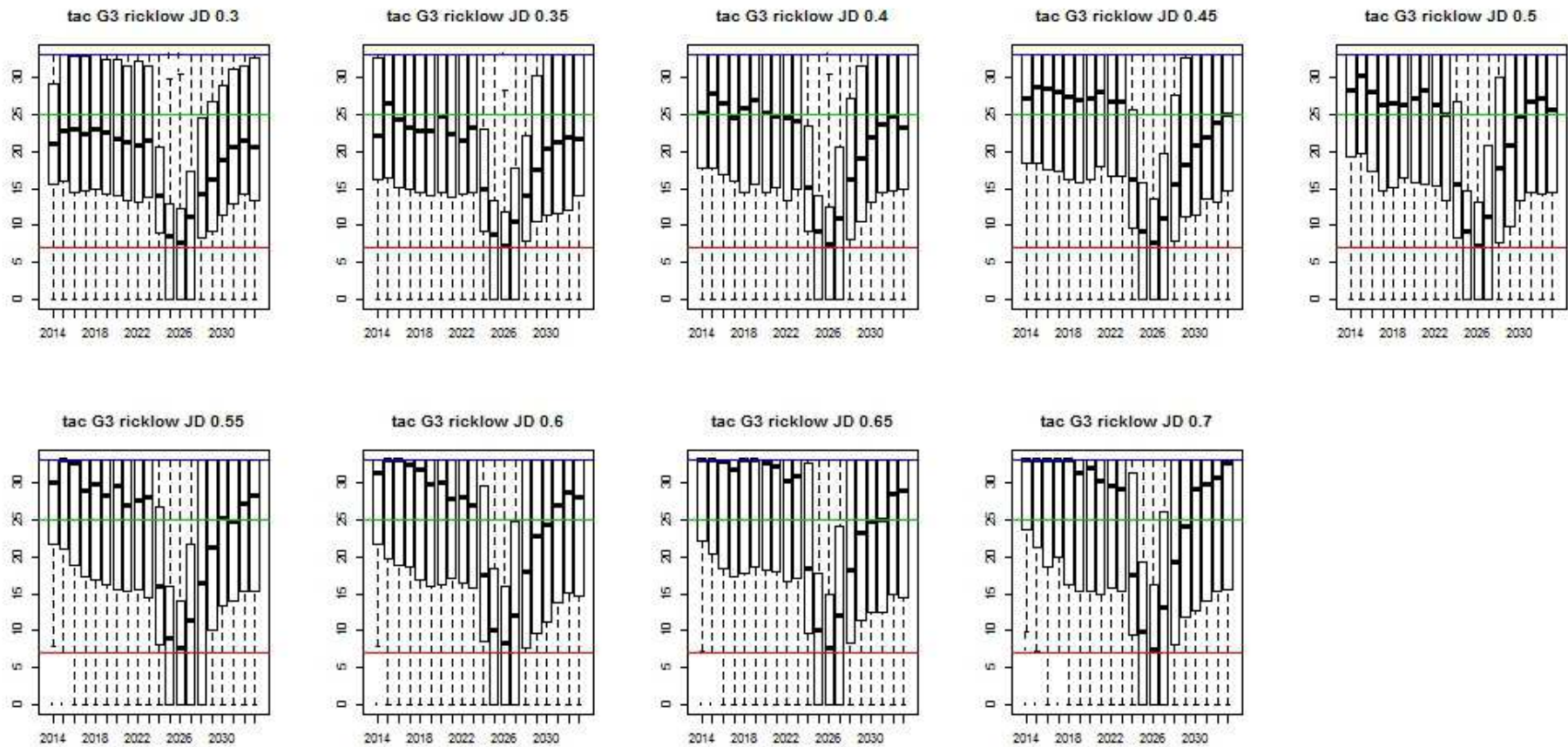


Figure A6.22: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G3 in a management period from January to December under the low regime recruitment scenario.

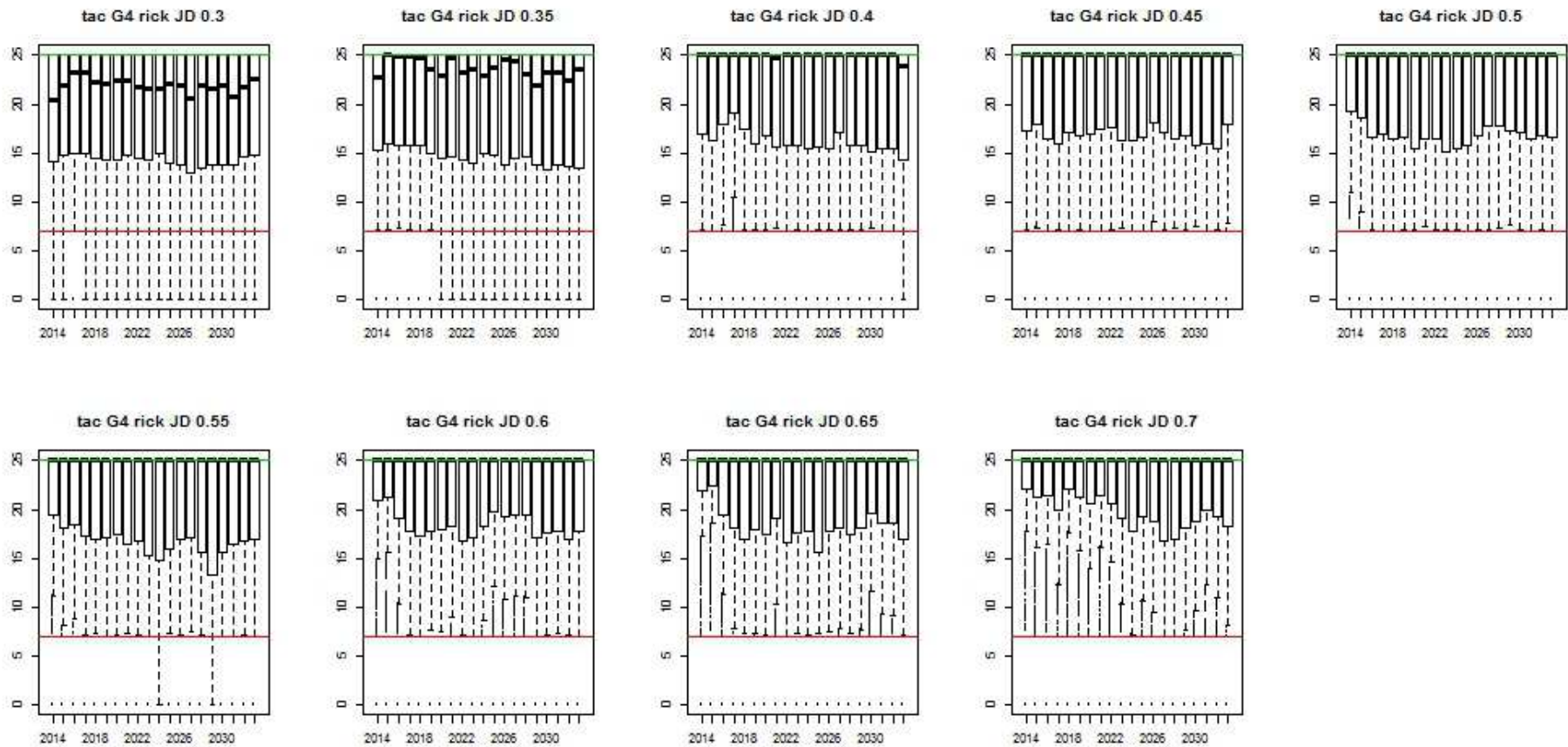


Figure A6.23: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G4 in a management period from January to December under the Ricker recruitment scenario.

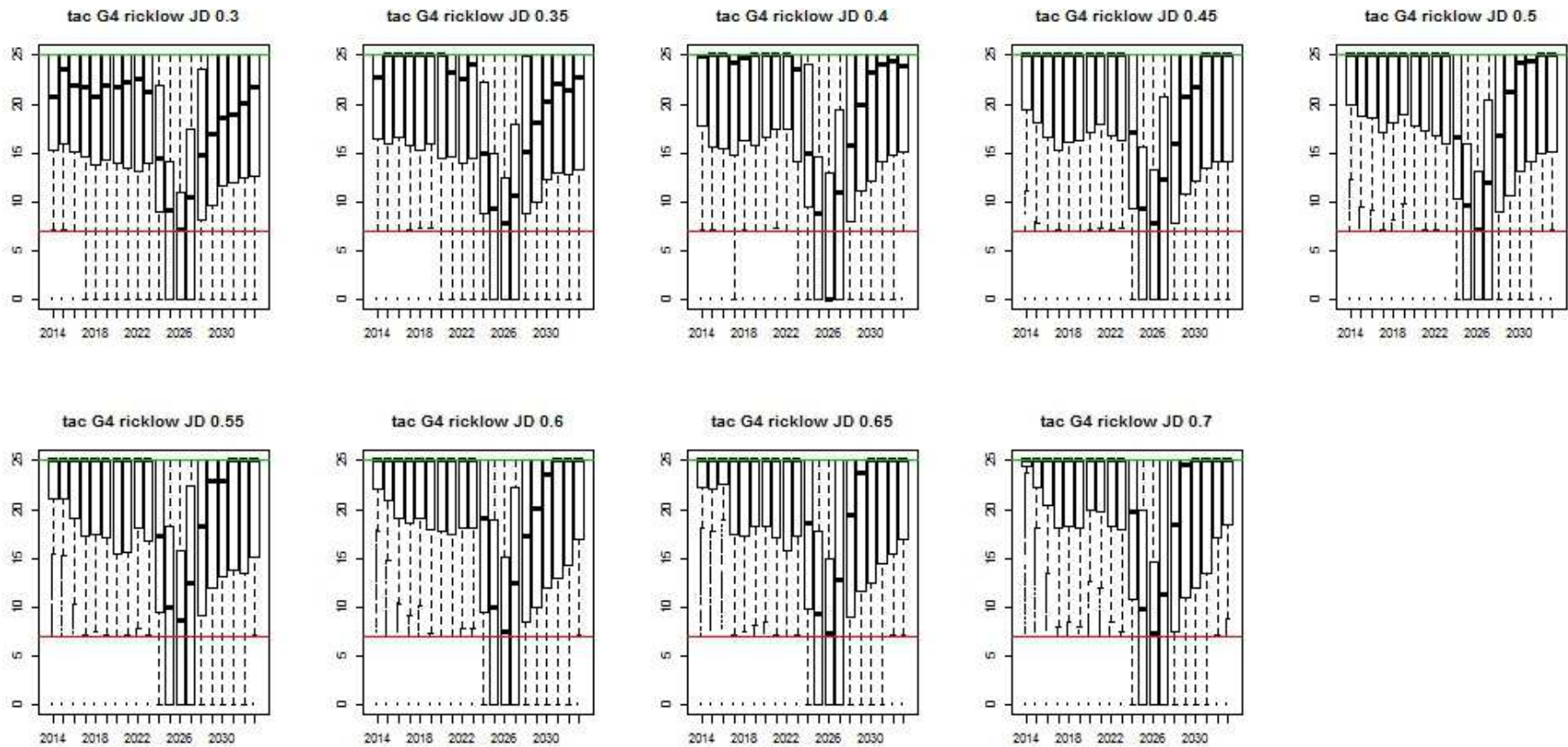


Figure A6.24: Boxplots of TAC for the projection period (2014-2034) depending on the slope parameter γ for HCR G4 in a management period from January to December under the low regime recruitment scenario.

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

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

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

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

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

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

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

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

- Mean number of years in which SSB is below B_{lim} in the projection period

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

- Mean number of years to get SSB above B_{lim} in the projection period
- Average TAC (in tonnes) across years and iterations

$$\overline{TAC} = \frac{\sum_{iter,y} TAC_{iter,y}}{N_{iter} N_y}$$

- Average standard deviation of the TAC

$$\frac{\sum_{iter} sd_y(TAC_{iter,y})}{N_{iter}} = \frac{\sum_{iter} \sqrt{\frac{\sum_y (TAC_{iter,y} - \overline{TAC}_{iter})^2}{N_y - 1}}}{N_{iter}}$$

- 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:

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

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

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

In the above equations $SSB_{iter,y}$ 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.

Table A6.1: Summary statistics for HCR G0.

Case	Calendar	Recruitment	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 _{dir} <5000)	P(TAC _{dir} <0.15 Rge)
G0	JJ	rick	0.3	67.663	66.300	0.067	0.576	1.416	0.962	0.098	0.708	2.066	19.903	9.870	0.422	0.475
G0	JJ	ricklow	0.3	56.732	65.118	0.130	0.852	2.730	1.820	0.167	0.914	3.504	17.298	10.781	0.402	0.458
G0	JD	rick	0.3	69.980	68.923	0.034	0.352	0.676	0.550	0.051	0.454	1.010	21.850	8.779	0.484	0.486
G0	JD	ricklow	0.3	56.685	64.560	0.090	0.704	1.790	1.323	0.126	0.800	2.510	18.373	10.146	0.452	0.468

Table A6.2: Summary statistics for HCR G1.

Case	Calendar	Recruitment	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 _{diff} <5000)	P(TAC _{diff} <0.15 Rge)
G1	JJ	rick	0.3	71.013	70.027	0.049	0.454	1.038	0.774	0.078	0.620	1.640	18.921	9.846	0.405	0.461
G1	JJ	rick	0.35	70.794	70.518	0.053	0.468	1.106	0.789	0.080	0.668	1.682	19.825	10.148	0.405	0.471
G1	JJ	rick	0.4	67.723	65.346	0.060	0.512	1.256	0.940	0.092	0.686	1.938	19.988	10.514	0.421	0.492
G1	JJ	rick	0.45	65.724	62.217	0.070	0.572	1.472	1.047	0.101	0.746	2.118	20.311	10.851	0.424	0.505
G1	JJ	rick	0.5	65.660	64.581	0.072	0.592	1.510	1.063	0.104	0.742	2.190	20.952	10.965	0.439	0.520
G1	JJ	rick	0.55	67.293	63.077	0.067	0.556	1.400	0.982	0.101	0.722	2.122	21.698	11.015	0.464	0.552
G1	JJ	rick	0.6	63.130	60.558	0.084	0.624	1.768	1.151	0.121	0.768	2.532	21.238	11.292	0.456	0.546
G1	JJ	rick	0.65	64.372	64.898	0.081	0.622	1.696	1.140	0.114	0.776	2.386	21.862	11.360	0.475	0.563
G1	JJ	rick	0.7	62.018	62.550	0.087	0.662	1.834	1.206	0.124	0.800	2.614	21.697	11.605	0.471	0.570
G1	JJ	ricklow	0.3	59.754	65.311	0.105	0.776	2.206	1.508	0.145	0.908	3.050	16.240	10.350	0.409	0.464
G1	JJ	ricklow	0.35	56.757	66.099	0.118	0.816	2.488	1.588	0.159	0.900	3.330	16.634	10.824	0.408	0.479
G1	JJ	ricklow	0.4	59.109	71.177	0.110	0.810	2.306	1.583	0.152	0.938	3.200	17.743	11.314	0.400	0.491
G1	JJ	ricklow	0.45	56.113	65.973	0.124	0.820	2.604	1.681	0.166	0.914	3.478	17.831	11.646	0.419	0.512
G1	JJ	ricklow	0.5	55.376	65.276	0.123	0.832	2.584	1.642	0.166	0.938	3.484	18.198	11.842	0.407	0.506
G1	JJ	ricklow	0.55	56.358	66.066	0.130	0.834	2.722	1.683	0.171	0.928	3.584	18.849	12.010	0.426	0.529
G1	JJ	ricklow	0.6	55.093	60.689	0.129	0.884	2.704	1.711	0.174	0.946	3.644	18.909	12.282	0.429	0.535
G1	JJ	ricklow	0.65	54.330	62.731	0.133	0.872	2.790	1.738	0.179	0.944	3.760	19.172	12.365	0.430	0.548
G1	JJ	ricklow	0.7	54.100	60.225	0.139	0.890	2.922	1.768	0.184	0.962	3.864	19.267	12.580	0.449	0.564
G1	JD	rick	0.3	70.102	70.186	0.030	0.316	0.594	0.476	0.051	0.444	1.012	19.855	9.043	0.463	0.476
G1	JD	rick	0.35	70.112	68.608	0.032	0.308	0.636	0.499	0.054	0.482	1.084	21.096	9.245	0.464	0.482
G1	JD	rick	0.4	67.512	66.716	0.036	0.362	0.718	0.549	0.054	0.464	1.072	21.742	9.532	0.476	0.508
G1	JD	rick	0.45	65.267	63.697	0.042	0.416	0.830	0.653	0.063	0.548	1.258	21.887	9.737	0.481	0.511
G1	JD	rick	0.5	64.626	66.245	0.039	0.390	0.784	0.585	0.057	0.504	1.144	22.549	9.679	0.484	0.524
G1	JD	rick	0.55	64.153	64.299	0.042	0.390	0.842	0.650	0.061	0.532	1.218	22.974	9.813	0.508	0.544
G1	JD	rick	0.6	63.523	66.736	0.039	0.402	0.788	0.623	0.063	0.542	1.250	23.389	9.849	0.518	0.562
G1	JD	rick	0.65	62.094	63.457	0.047	0.418	0.934	0.682	0.068	0.540	1.360	23.430	9.998	0.524	0.575
G1	JD	rick	0.7	62.302	62.579	0.053	0.500	1.058	0.843	0.067	0.570	1.338	23.831	10.120	0.542	0.587
G1	JD	ricklow	0.3	60.797	67.705	0.079	0.618	1.588	1.226	0.109	0.762	2.176	17.473	10.030	0.451	0.471
G1	JD	ricklow	0.35	58.418	67.126	0.082	0.682	1.642	1.224	0.116	0.790	2.324	18.108	10.368	0.456	0.487
G1	JD	ricklow	0.4	56.264	63.125	0.087	0.694	1.746	1.253	0.123	0.818	2.452	18.388	10.655	0.448	0.490
G1	JD	ricklow	0.45	55.559	62.914	0.090	0.712	1.800	1.282	0.125	0.820	2.506	19.066	11.005	0.463	0.517
G1	JD	ricklow	0.5	53.639	64.776	0.095	0.712	1.892	1.309	0.126	0.804	2.526	19.249	11.067	0.452	0.514
G1	JD	ricklow	0.55	54.145	64.812	0.096	0.724	1.920	1.392	0.126	0.816	2.528	19.926	11.173	0.472	0.529
G1	JD	ricklow	0.6	54.066	60.198	0.097	0.730	1.938	1.367	0.129	0.812	2.582	20.343	11.340	0.487	0.552
G1	JD	ricklow	0.65	52.782	60.345	0.097	0.744	1.948	1.348	0.129	0.826	2.586	20.487	11.424	0.490	0.555
G1	JD	ricklow	0.7	53.073	58.717	0.101	0.740	2.026	1.426	0.133	0.822	2.658	20.932	11.590	0.500	0.571

Table A6.3: Summary statistics for HCR G2.

Case	Calendar	Recruitment	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 _{diff} <5000)	P(TAC _{diff} <0.15 Rge)
G2	JJ	rick	0.3	72.513	70.730	0.058	0.460	1.218	0.887	0.083	0.642	1.740	16.914	7.485	0.531	0.511
G2	JJ	rick	0.35	72.391	68.960	0.049	0.458	1.034	0.792	0.080	0.670	1.690	17.531	7.629	0.541	0.530
G2	JJ	rick	0.4	70.545	71.789	0.060	0.518	1.260	0.935	0.089	0.668	1.864	17.743	7.735	0.546	0.547
G2	JJ	rick	0.45	71.307	73.643	0.056	0.522	1.170	0.858	0.084	0.676	1.762	18.223	7.693	0.571	0.575
G2	JJ	rick	0.5	70.110	74.748	0.063	0.536	1.322	0.967	0.092	0.672	1.936	18.282	7.822	0.579	0.588
G2	JJ	rick	0.55	70.234	65.589	0.065	0.536	1.368	0.951	0.093	0.712	1.960	18.583	7.815	0.594	0.602
G2	JJ	rick	0.6	69.743	68.577	0.064	0.526	1.342	0.963	0.093	0.708	1.960	18.878	7.810	0.603	0.617
G2	JJ	rick	0.65	69.662	69.590	0.065	0.544	1.364	0.967	0.095	0.696	1.998	18.830	7.849	0.601	0.614
G2	JJ	rick	0.7	69.855	66.350	0.066	0.512	1.386	0.969	0.099	0.692	2.080	19.074	7.805	0.627	0.643
G2	JJ	ricklow	0.3	61.378	72.366	0.098	0.758	2.054	1.513	0.141	0.888	2.966	14.976	8.303	0.501	0.495
G2	JJ	ricklow	0.35	61.078	73.835	0.102	0.784	2.146	1.515	0.140	0.902	2.944	15.451	8.507	0.502	0.500
G2	JJ	ricklow	0.4	60.262	71.051	0.113	0.802	2.380	1.602	0.151	0.904	3.170	15.707	8.742	0.515	0.526
G2	JJ	ricklow	0.45	59.442	72.193	0.114	0.818	2.390	1.612	0.156	0.918	3.286	15.925	8.966	0.532	0.542
G2	JJ	ricklow	0.5	58.677	68.092	0.120	0.802	2.512	1.709	0.158	0.894	3.324	16.149	9.017	0.534	0.555
G2	JJ	ricklow	0.55	59.750	67.395	0.114	0.804	2.394	1.569	0.154	0.922	3.236	16.582	9.043	0.545	0.569
G2	JJ	ricklow	0.6	58.312	69.933	0.122	0.848	2.564	1.678	0.160	0.930	3.366	16.484	9.215	0.542	0.569
G2	JJ	ricklow	0.65	57.788	73.632	0.118	0.832	2.484	1.647	0.162	0.940	3.396	16.644	9.208	0.553	0.585
G2	JJ	ricklow	0.7	57.473	68.545	0.122	0.854	2.552	1.622	0.165	0.928	3.460	16.776	9.240	0.552	0.583
G2	JD	rick	0.3	72.153	73.250	0.032	0.304	0.642	0.501	0.051	0.458	1.024	17.913	6.695	0.599	0.537
G2	JD	rick	0.35	70.381	63.961	0.037	0.348	0.748	0.567	0.057	0.484	1.130	18.346	6.819	0.600	0.552
G2	JD	rick	0.4	70.996	68.488	0.038	0.366	0.756	0.561	0.055	0.466	1.098	18.850	6.722	0.617	0.577
G2	JD	rick	0.45	68.939	68.757	0.034	0.354	0.688	0.525	0.054	0.482	1.086	19.084	6.879	0.620	0.593
G2	JD	rick	0.5	70.981	69.133	0.033	0.340	0.662	0.520	0.050	0.462	0.996	19.637	6.585	0.657	0.622
G2	JD	rick	0.55	68.182	69.803	0.037	0.394	0.748	0.607	0.056	0.502	1.116	19.563	6.767	0.646	0.626
G2	JD	rick	0.6	67.203	67.961	0.044	0.408	0.870	0.680	0.062	0.514	1.248	19.579	6.864	0.648	0.630
G2	JD	rick	0.65	67.003	64.380	0.046	0.420	0.912	0.677	0.063	0.526	1.262	19.840	6.697	0.666	0.651
G2	JD	rick	0.7	66.459	64.123	0.043	0.414	0.864	0.656	0.063	0.528	1.254	19.892	6.869	0.666	0.657
G2	JD	ricklow	0.3	61.073	73.050	0.073	0.602	1.458	1.097	0.107	0.754	2.132	15.770	7.816	0.551	0.516
G2	JD	ricklow	0.35	59.844	66.825	0.087	0.650	1.734	1.326	0.118	0.758	2.354	16.052	8.021	0.566	0.527
G2	JD	ricklow	0.4	58.338	67.681	0.082	0.670	1.646	1.244	0.116	0.794	2.310	16.490	8.150	0.572	0.549
G2	JD	ricklow	0.45	57.737	62.855	0.084	0.634	1.670	1.225	0.118	0.750	2.366	16.809	8.191	0.572	0.558
G2	JD	ricklow	0.5	58.929	65.695	0.081	0.638	1.624	1.191	0.112	0.786	2.242	17.303	8.315	0.584	0.574
G2	JD	ricklow	0.55	55.561	63.885	0.087	0.694	1.740	1.311	0.120	0.812	2.404	17.096	8.462	0.573	0.569
G2	JD	ricklow	0.6	56.470	63.587	0.086	0.694	1.726	1.266	0.118	0.792	2.350	17.435	8.377	0.585	0.588
G2	JD	ricklow	0.65	55.861	62.244	0.094	0.742	1.882	1.383	0.123	0.816	2.460	17.425	8.591	0.597	0.598
G2	JD	ricklow	0.7	54.763	61.120	0.098	0.726	1.968	1.419	0.132	0.808	2.642	17.456	8.553	0.598	0.596

Table A6.4: Summary statistics for HCR G3.

Case	Calendar	Recruitment	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 _{diff} <5000)	P(TAC _{diff} <0.15 Rge)
G3	JJ	rick	0.3	67.172	67.696	0.072	0.578	1.520	1.077	0.105	0.740	2.208	19.663	9.748	0.424	0.465
G3	JJ	rick	0.35	66.289	66.241	0.072	0.568	1.504	1.053	0.104	0.728	2.184	20.660	10.130	0.432	0.479
G3	JJ	rick	0.4	64.241	63.354	0.079	0.612	1.656	1.107	0.114	0.768	2.392	21.278	10.334	0.446	0.505
G3	JJ	rick	0.45	62.077	59.139	0.085	0.618	1.778	1.146	0.121	0.800	2.542	21.485	10.693	0.451	0.516
G3	JJ	rick	0.5	62.488	61.109	0.100	0.706	2.098	1.322	0.140	0.830	2.946	22.108	10.986	0.475	0.542
G3	JJ	rick	0.55	60.147	58.469	0.103	0.700	2.160	1.364	0.139	0.816	2.910	22.194	10.964	0.487	0.550
G3	JJ	rick	0.6	58.835	56.285	0.109	0.746	2.290	1.376	0.146	0.854	3.058	22.370	11.233	0.497	0.563
G3	JJ	rick	0.65	59.226	58.101	0.118	0.764	2.474	1.573	0.156	0.854	3.286	22.531	11.410	0.516	0.579
G3	JJ	rick	0.7	59.348	58.835	0.114	0.748	2.396	1.462	0.151	0.852	3.174	23.058	11.303	0.528	0.588
G3	JJ	ricklow	0.3	56.998	64.901	0.122	0.820	2.556	1.624	0.165	0.916	3.466	17.365	10.533	0.424	0.468
G3	JJ	ricklow	0.35	57.740	64.883	0.128	0.830	2.694	1.660	0.168	0.924	3.532	18.431	11.115	0.425	0.481
G3	JJ	ricklow	0.4	53.601	60.292	0.148	0.852	3.108	1.840	0.186	0.944	3.912	18.476	11.419	0.428	0.492
G3	JJ	ricklow	0.45	53.683	62.432	0.139	0.838	2.914	1.718	0.184	0.946	3.868	19.177	11.609	0.433	0.504
G3	JJ	ricklow	0.5	51.450	57.151	0.159	0.900	3.348	1.904	0.200	0.956	4.210	19.192	11.950	0.448	0.518
G3	JJ	ricklow	0.55	51.338	57.184	0.168	0.906	3.538	2.007	0.212	0.962	4.462	19.587	12.247	0.458	0.531
G3	JJ	ricklow	0.6	49.981	57.075	0.165	0.904	3.474	1.982	0.214	0.958	4.484	19.820	12.476	0.459	0.539
G3	JJ	ricklow	0.65	50.676	59.383	0.166	0.928	3.484	1.965	0.212	0.976	4.446	20.321	12.483	0.473	0.551
G3	JJ	ricklow	0.7	50.076	57.095	0.174	0.938	3.652	1.966	0.221	0.982	4.644	20.455	12.847	0.487	0.568
G3	JD	rick	0.3	68.144	67.460	0.038	0.374	0.760	0.572	0.056	0.498	1.114	21.466	8.799	0.475	0.477
G3	JD	rick	0.35	65.002	65.933	0.046	0.424	0.916	0.676	0.067	0.544	1.342	21.929	9.175	0.492	0.503
G3	JD	rick	0.4	63.338	63.079	0.051	0.460	1.026	0.743	0.067	0.524	1.338	22.787	9.083	0.519	0.528
G3	JD	rick	0.45	61.238	61.014	0.051	0.456	1.024	0.761	0.071	0.576	1.426	23.208	9.291	0.523	0.545
G3	JD	rick	0.5	61.520	64.401	0.056	0.510	1.124	0.810	0.069	0.542	1.386	23.970	9.228	0.545	0.564
G3	JD	rick	0.55	58.630	56.165	0.067	0.578	1.344	0.932	0.078	0.622	1.552	24.021	9.506	0.544	0.570
G3	JD	rick	0.6	58.347	54.837	0.068	0.532	1.360	0.952	0.080	0.586	1.594	24.334	9.324	0.560	0.578
G3	JD	rick	0.65	55.102	51.734	0.083	0.620	1.668	1.114	0.098	0.656	1.950	23.908	9.773	0.569	0.601
G3	JD	rick	0.7	55.536	55.164	0.080	0.634	1.602	1.103	0.092	0.646	1.836	24.379	9.638	0.571	0.599
G3	JD	ricklow	0.3	57.655	63.623	0.093	0.688	1.852	1.338	0.123	0.794	2.466	18.674	10.003	0.468	0.475
G3	JD	ricklow	0.35	54.835	59.806	0.102	0.744	2.044	1.440	0.133	0.828	2.662	19.152	10.457	0.477	0.497
G3	JD	ricklow	0.4	54.446	60.447	0.103	0.780	2.058	1.458	0.130	0.844	2.594	20.084	10.583	0.483	0.515
G3	JD	ricklow	0.45	52.383	59.037	0.108	0.784	2.156	1.507	0.131	0.838	2.626	20.577	10.888	0.485	0.519
G3	JD	ricklow	0.5	50.646	59.956	0.118	0.820	2.364	1.544	0.144	0.868	2.888	20.645	11.100	0.491	0.528
G3	JD	ricklow	0.55	49.712	56.959	0.122	0.800	2.432	1.590	0.146	0.836	2.918	21.048	11.138	0.506	0.548
G3	JD	ricklow	0.6	49.343	55.983	0.127	0.844	2.532	1.659	0.149	0.866	2.978	21.449	11.255	0.516	0.563
G3	JD	ricklow	0.65	47.996	52.922	0.128	0.828	2.560	1.588	0.144	0.874	2.878	21.681	11.411	0.509	0.558
G3	JD	ricklow	0.7	47.562	52.678	0.138	0.846	2.754	1.632	0.154	0.846	3.088	21.803	11.232	0.534	0.587

Table A6.5: Summary statistics for HCR G4.

Case	Calendar	Recruitment	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 _{dir} <5000)	P(TAC _{dir} <0.15 Rge)
G4	JJ	rick	0.3	71.043	69.294	0.059	0.506	1.236	0.908	0.089	0.670	1.870	18.014	7.182	0.566	0.539
G4	JJ	rick	0.35	70.573	70.189	0.062	0.528	1.306	0.951	0.091	0.692	1.920	18.589	7.246	0.599	0.589
G4	JJ	rick	0.4	67.359	63.330	0.073	0.584	1.542	1.079	0.104	0.746	2.190	18.614	7.500	0.603	0.598
G4	JJ	rick	0.45	68.365	66.616	0.072	0.588	1.510	1.012	0.104	0.740	2.178	19.126	7.438	0.620	0.623
G4	JJ	rick	0.5	65.583	61.103	0.085	0.612	1.776	1.152	0.119	0.780	2.504	19.009	7.676	0.625	0.634
G4	JJ	rick	0.55	65.392	61.302	0.088	0.602	1.858	1.242	0.120	0.748	2.526	19.256	7.510	0.642	0.653
G4	JJ	rick	0.6	65.656	64.951	0.091	0.616	1.912	1.212	0.122	0.752	2.554	19.435	7.603	0.660	0.665
G4	JJ	rick	0.65	65.613	66.771	0.089	0.658	1.868	1.194	0.121	0.800	2.540	19.637	7.628	0.658	0.674
G4	JJ	rick	0.7	64.761	64.158	0.100	0.680	2.106	1.322	0.135	0.812	2.844	19.436	7.839	0.675	0.692
G4	JJ	ricklow	0.3	59.467	68.676	0.115	0.798	2.424	1.650	0.156	0.904	3.280	15.975	8.360	0.530	0.526
G4	JJ	ricklow	0.35	58.645	71.172	0.119	0.828	2.500	1.671	0.162	0.916	3.400	16.379	8.653	0.541	0.547
G4	JJ	ricklow	0.4	57.503	70.885	0.120	0.828	2.514	1.655	0.157	0.914	3.296	16.799	8.648	0.543	0.552
G4	JJ	ricklow	0.45	57.061	65.649	0.129	0.806	2.706	1.650	0.170	0.898	3.572	16.957	8.761	0.562	0.578
G4	JJ	ricklow	0.5	55.775	65.758	0.138	0.844	2.894	1.772	0.182	0.932	3.816	17.023	8.959	0.572	0.595
G4	JJ	ricklow	0.55	54.475	60.399	0.149	0.864	3.124	1.811	0.194	0.942	4.068	17.108	9.265	0.576	0.603
G4	JJ	ricklow	0.6	55.955	64.967	0.144	0.888	3.024	1.868	0.183	0.938	3.848	17.549	9.088	0.596	0.623
G4	JJ	ricklow	0.65	55.579	68.066	0.152	0.876	3.202	1.825	0.192	0.946	4.038	17.576	9.223	0.602	0.630
G4	JJ	ricklow	0.7	54.609	59.440	0.150	0.888	3.142	1.836	0.191	0.938	4.008	17.728	9.246	0.613	0.637
G4	JD	rick	0.3	69.951	71.390	0.037	0.372	0.748	0.587	0.054	0.488	1.082	19.004	6.288	0.645	0.569
G4	JD	rick	0.35	67.883	65.306	0.045	0.422	0.902	0.704	0.063	0.512	1.260	19.317	6.377	0.659	0.595
G4	JD	rick	0.4	69.482	62.639	0.044	0.418	0.870	0.669	0.060	0.532	1.198	20.055	6.285	0.673	0.626
G4	JD	rick	0.45	68.794	67.775	0.045	0.424	0.892	0.685	0.059	0.504	1.180	20.352	6.125	0.688	0.657
G4	JD	rick	0.5	65.491	66.195	0.056	0.494	1.118	0.821	0.069	0.528	1.380	20.223	6.217	0.687	0.651
G4	JD	rick	0.55	64.319	60.660	0.062	0.556	1.238	0.891	0.079	0.604	1.572	20.183	6.578	0.693	0.675
G4	JD	rick	0.6	66.025	60.909	0.055	0.466	1.092	0.777	0.067	0.512	1.332	20.728	6.106	0.716	0.694
G4	JD	rick	0.65	63.730	60.702	0.068	0.554	1.360	0.956	0.083	0.604	1.660	20.504	6.417	0.717	0.706
G4	JD	rick	0.7	65.099	63.215	0.061	0.520	1.216	0.857	0.069	0.558	1.374	20.974	6.113	0.729	0.713
G4	JD	ricklow	0.3	57.790	70.261	0.093	0.704	1.862	1.357	0.124	0.810	2.488	16.571	7.876	0.585	0.546
G4	JD	ricklow	0.35	56.807	63.973	0.098	0.700	1.966	1.354	0.126	0.800	2.514	17.136	7.915	0.589	0.561
G4	JD	ricklow	0.4	56.529	64.326	0.102	0.758	2.038	1.504	0.129	0.806	2.576	17.520	8.008	0.604	0.582
G4	JD	ricklow	0.45	55.171	59.922	0.105	0.758	2.108	1.459	0.138	0.832	2.752	17.734	8.217	0.616	0.610
G4	JD	ricklow	0.5	53.514	57.189	0.105	0.806	2.098	1.477	0.129	0.850	2.578	18.054	8.215	0.618	0.611
G4	JD	ricklow	0.55	52.611	58.421	0.109	0.784	2.180	1.432	0.133	0.830	2.656	18.153	8.153	0.622	0.620
G4	JD	ricklow	0.6	52.007	61.913	0.118	0.782	2.366	1.552	0.139	0.824	2.770	18.221	8.211	0.631	0.627
G4	JD	ricklow	0.65	50.337	56.367	0.121	0.810	2.424	1.555	0.145	0.872	2.904	18.267	8.360	0.639	0.640
G4	JD	ricklow	0.7	51.239	62.780	0.122	0.786	2.438	1.549	0.143	0.862	2.868	18.470	8.337	0.645	0.647

Table A6.6: Summary statistics for HCRs G0, G1 and G2 under the Ricker recruitment scenario and for a management period from January to December depending on the actual quota share by semester. The quota share assumed for establishing the TAC when projecting from January to mid-May is always 60% and 40% for semesters 1 and 2 respectively.

Case	Calendar	Recruitment	Harvest Rate	Share	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 _{dir} <5000)	P(TAC _{dir} <0.15 Rge)
G0	JD	rick	0.3	0.6	69.980	68.923	0.034	0.352	0.676	0.550	0.051	0.454	1.010	21.850	8.779	0.484	0.486
G0	JD	rick	0.3	0.75	66.330	65.009	0.037	0.336	0.740	0.556	0.060	0.482	1.200	21.176	8.928	0.468	0.478
G1	JD	rick	0.3	0.6	70.102	70.186	0.030	0.316	0.594	0.476	0.051	0.444	1.012	19.855	9.043	0.463	0.476
G1	JD	rick	0.3	0.75	71.332	70.946	0.024	0.274	0.488	0.405	0.042	0.444	0.846	20.353	9.028	0.463	0.476
G1	JD	rick	0.35	0.6	70.112	68.608	0.032	0.308	0.636	0.499	0.054	0.482	1.084	21.096	9.245	0.464	0.482
G1	JD	rick	0.35	0.75	69.053	72.558	0.030	0.314	0.590	0.494	0.049	0.454	0.974	21.051	9.304	0.461	0.483
G1	JD	rick	0.4	0.6	67.512	66.716	0.036	0.362	0.718	0.549	0.054	0.464	1.072	21.742	9.532	0.476	0.508
G1	JD	rick	0.4	0.75	67.163	68.175	0.035	0.344	0.690	0.557	0.055	0.482	1.098	21.519	9.516	0.470	0.500
G1	JD	rick	0.45	0.6	65.267	63.697	0.042	0.416	0.830	0.653	0.063	0.548	1.258	21.887	9.737	0.481	0.511
G1	JD	rick	0.45	0.75	66.052	66.600	0.033	0.320	0.664	0.535	0.055	0.492	1.100	22.282	9.536	0.482	0.517
G1	JD	rick	0.5	0.6	64.626	66.245	0.039	0.390	0.784	0.585	0.057	0.504	1.144	22.549	9.679	0.484	0.524
G1	JD	rick	0.5	0.75	62.529	63.410	0.044	0.402	0.888	0.720	0.067	0.540	1.340	22.088	9.889	0.487	0.530
G1	JD	rick	0.55	0.6	64.153	64.299	0.042	0.390	0.842	0.650	0.061	0.532	1.218	22.974	9.813	0.508	0.544
G1	JD	rick	0.55	0.75	62.752	59.569	0.038	0.368	0.766	0.584	0.064	0.548	1.274	22.751	9.891	0.493	0.540
G1	JD	rick	0.6	0.6	63.523	66.736	0.039	0.402	0.788	0.623	0.063	0.542	1.250	23.389	9.849	0.518	0.562
G1	JD	rick	0.6	0.75	61.781	58.660	0.045	0.420	0.902	0.648	0.066	0.548	1.328	23.132	9.831	0.513	0.554
G1	JD	rick	0.65	0.6	62.094	63.457	0.047	0.418	0.934	0.682	0.068	0.540	1.360	23.430	9.998	0.524	0.575
G1	JD	rick	0.65	0.75	59.727	59.246	0.054	0.466	1.072	0.805	0.077	0.592	1.542	23.024	10.191	0.523	0.574
G1	JD	rick	0.7	0.6	62.302	62.579	0.053	0.500	1.058	0.843	0.067	0.570	1.338	23.831	10.120	0.542	0.587
G1	JD	rick	0.7	0.75	60.593	60.171	0.043	0.406	0.854	0.651	0.064	0.544	1.270	23.771	10.007	0.531	0.585
G2	JD	rick	0.3	0.6	72.153	73.250	0.032	0.304	0.642	0.501	0.051	0.458	1.024	17.913	6.695	0.599	0.537
G2	JD	rick	0.3	0.75	72.149	72.839	0.030	0.322	0.596	0.515	0.054	0.492	1.074	17.825	6.810	0.578	0.517
G2	JD	rick	0.35	0.6	70.381	63.961	0.037	0.348	0.748	0.567	0.057	0.484	1.130	18.346	6.819	0.600	0.552
G2	JD	rick	0.35	0.75	70.753	70.631	0.028	0.294	0.558	0.434	0.048	0.460	0.956	18.499	6.676	0.598	0.552
G2	JD	rick	0.4	0.6	70.996	68.488	0.038	0.366	0.756	0.561	0.055	0.466	1.098	18.850	6.722	0.617	0.577
G2	JD	rick	0.4	0.75	68.836	66.793	0.031	0.330	0.628	0.527	0.050	0.452	1.004	18.818	6.745	0.611	0.569
G2	JD	rick	0.45	0.6	68.939	68.757	0.034	0.354	0.688	0.525	0.054	0.482	1.086	19.084	6.879	0.620	0.593
G2	JD	rick	0.45	0.75	69.603	70.196	0.032	0.326	0.630	0.530	0.052	0.480	1.046	19.257	6.777	0.634	0.602
G2	JD	rick	0.5	0.6	70.981	69.133	0.033	0.340	0.662	0.520	0.050	0.462	0.996	19.637	6.585	0.657	0.622
G2	JD	rick	0.5	0.75	68.204	68.054	0.033	0.326	0.656	0.501	0.055	0.508	1.102	19.323	6.827	0.633	0.612
G2	JD	rick	0.55	0.6	68.182	69.803	0.037	0.394	0.748	0.607	0.056	0.502	1.116	19.563	6.767	0.646	0.626
G2	JD	rick	0.55	0.75	69.057	67.909	0.034	0.342	0.676	0.535	0.053	0.466	1.050	19.816	6.634	0.654	0.638
G2	JD	rick	0.6	0.6	67.203	67.961	0.044	0.408	0.870	0.680	0.062	0.514	1.248	19.579	6.864	0.648	0.630
G2	JD	rick	0.6	0.75	65.218	63.981	0.040	0.372	0.796	0.626	0.063	0.508	1.258	19.489	6.762	0.648	0.630
G2	JD	rick	0.65	0.6	67.003	64.380	0.046	0.420	0.912	0.677	0.063	0.526	1.262	19.840	6.697	0.666	0.651
G2	JD	rick	0.65	0.75	66.827	68.516	0.040	0.380	0.792	0.637	0.063	0.530	1.264	19.709	6.857	0.667	0.652
G2	JD	rick	0.7	0.6	66.459	64.123	0.043	0.414	0.864	0.656	0.063	0.528	1.254	19.892	6.869	0.666	0.657
G2	JD	rick	0.7	0.75	65.585	69.749	0.044	0.416	0.878	0.636	0.065	0.538	1.304	19.764	6.798	0.664	0.651

12 CONTACT DETAILS OF STECF MEMBERS AND EWG-14-03 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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13 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting's web site on:
<http://stecf.jrc.ec.europa.eu/web/stecf/ewg1403>

List of background documents:

1. EWG-14-03 - Doc 1 - Declarations of invited and JRC experts (see also section 12 of this report - List of participants)
2. EWG-14-03 - Doc 2 - Sanchez,S.,Ibaibarriaga,L. and Uriarte, A. 2013. Developments of the MSE methodology for the Bay of Biscay anchovy. Final Report for the European Commission, Directorate General for Maritime Affairs and

Fisheries. 44p.

3. EWG-14-03 - Doc 3 - HCR trajectories.
4. EWG-14-03 - Doc 4 - MSE code

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Abstract

The Expert Working Group meeting of the Scientific, Technical and Economic Committee for Fisheries EWG-14-03 on Evaluation/scoping of Management plans. Data analysis for support of the impact assessment for the management plan of Bay of Biscay anchovy (COM(2009)399 final) was held from 10-14 March 2014 in Varese, Italy. The report was reviewed and endorsed by the STECF during its plenary meeting held from 24 to 28 March 2014 in Brussels (Belgium).

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how with the Member States, the scientific community and international partners.

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.

