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REPORT OF THE WORKSHOP ON HERRING MANAGEMENT PLANS (WKHMP)

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Contents

Report of the ices Workshop on Herring Management Plans (WKHMP)

Executive summary

The ICES workshop on herring management plans met to consider the management plan of North Sea herring and continue the development of a management plan for western Baltic spring spawning herring. Whilst the purpose of the workshop was to answer the terms of reference, it also was an opportunity to further develop tools for testing management plans and for the exchange of expertise between scientists and other stakeholders.

The development of the North Sea herring management plan, a description of the relevance of understanding recruitment dynamics when testing management plans and a discussion on precautionary reference points and managing stocks in a precautionary manner are given in chapter 2.

Management plan of the North Sea autumn spawning herring

The simulations confirm the conclusion by ACFM in 2005 that the performance of the harvest rule is at marginal in the present situation of reduced recruitment. Using the rule will lead to an equilibrium biomass that is close to the Blim (<1.1 MT). A further reduction in recruitment, higher overfishing or less reliable assessments will all lead to a risk of falling below Blim that is incompatible with the precautionary approach. WKHMP considered a realised fishing mortality rate of 0.25 as too high and recommended that it be 0.20. Such a reduction could be achieved in one of three different ways: by directly reducing the target F, by increasing the trigger point or by reducing the fishing mortality on juveniles. The rule to constrain the interannual variation in TACs appears to work well, and 15% permitted change is within the acceptable range. WKHMP did not consider the application of limits on variation in the TAC for herring by-catches in the North Sea. Given the poor understanding of the reduced recruitment, the consequences for the stock are unknown if the stock falls below Blim.

Management plan of the western Baltic spring spawning herring

The present state the formulation of a management plan for WBSS is at an early stage and given the present knowledge of the biology and state of the assessment of WBSS, WKHMP emphasised that the results presented are preliminary.

[A] Simulations suggest that a target F should be set no higher than 0.25. Exploration of different juvenile selection pattern indicates that at high fishing mortalities the risk to Blim increases with increasing juvenile selection. [B] The limit on the year-to-year variation in TAC is recommended to be 15%. [C] All runs indicate a need for a high trigger level in SSB, however, as the state of the stock is not well defined, a specific recommendation on the level of [C] cannot be given by WKHMP.

1 Introduction

The ICES workshop on herring management plans met to consider the management plan of North Sea herring and continue the development of a management plan for western Baltic spring spawning herring (see terms of reference in appendix 2). The participation in the workshop (see appendix 1) included scientists and other stakeholders. This allowed an open and frank discussion of the functioning and utility of management plans for herring and proved a very creative and constructive process. Whilst the purpose of the workshop was to answer the terms of reference, it also was an opportunity to further develop tools for testing management plans and for the exchange of expertise between scientists.

The approach adopted by WKHMP is that proposed by the ICES Study Group on Management Strategies [SGMAS] and the ICES herring assessment working group [HAWG]. The assumptions made by HAWG about North Sea and western Baltic spring spawning herring were also accepted by WKHMP, unless otherwise stated.

The specific answers to the terms of reference are given in section 3.9 and 4.6.

2 Management plans and herring

2.1 A brief history

The origin of the present management plan was the plan developed in the negotiations between EU and Norway in 1997. The background for this development was the imminent stock collapse that was recognized in 1996 and led, following the advice from ICES, to a drastic reduction in the catches in the middle of 1996. The key elements in this plan was a fishing mortality set separately for adult and juvenile herring (at 0.25 and 0.12 respectively), and a trigger biomass (1.3 million tonnes) below which the fishing mortalities should be reduced. The target fishing mortalities were decided based on extensive simulations (Patterson et al., 1997) to find levels of adult and juvenile fishing mortalities with a low risk of bringing SSB below 800 000 tonnes, which was the MBAL at the time (Minimum Biological Acceptable Levels). The trigger biomass (1.3 MT) was decided mainly on political grounds, but with a value that also was thought to give some protection against falling below the MBAL.

When the rule was decided the SSB was well below 1.3 million tonnes. The rule did not specify mortalities for that situation, but in practice the TACs set were corresponding to an adult F of about 0.2. The industrial fishery on juvenile herring and sprat became heavily regulated and controlled, resulting in a fishing mortality around 0.05, well below the agreed level.

When ICES introduced precautionary reference points in its advisory practice, the MBAL level was adopted as B_{lim} and the trigger biomass of 1.3 million tonnes as B_{pa}. The target fishing mortalities in the harvest rule were adopted as F_{pa}.

The harvest rule was amended in 2004, to become the rule that is being evaluated at present (Annex 3). The amendments included specific rules to apply when SSB is below 1.3 million tonnes and a constraint on TAC change from year to year.

ICES examined the performance of this revised harvest control rule in 2005 (ACFM 2005) and considered the target F to be consistent with the precautionary approach. However, ICES considered that the strict application of the TAC change limit of 15% (rule number 5) may not be consistent with the precautionary approach. Assuming that para 6 (reducing the TAC more than 15%) would be invoked when TAC constraints would lead to SSB falling below B_{pa}, the

HCR (harvest control rule) was considered to be in accordance with the precautionary approach.

Previous evaluations of the rule were done assuming a recruitment at the historical average. Since 2001, the recruitment has been at about half the long term average. There are no indications that this is just a temporary change in stock behaviour. Hence, ICES has advised that management should adapt to a regime with reduced recruitment, noting that *'the performance of the present harvest rule is at best marginal in this situation, since it may easily break down if assessment and/or implementation and compliance are sufficiently biased. It is considered by ACFM that the present assessment may possibly be an overestimate, and that the TACs in the consumption fishery have been regularly over-fished. For this situation a HCR is required that is robust to errors in the assessment and implementation, the current one is not thought to be sufficiently robust.*' (ICES 2005).

2.2 The importance of the stock to recruit relationship

The dynamic of any fish stock is largely dependent on the form of the relationship between spawning biomass and recruitment and, in terms of biomass, on the changes of the individual growth in the population and removals from that stock. Therefore, the specification of the assumed stock productivity at different stock sizes is crucial in simulations of management plans. Many different approaches for recruitment modelling have been used in the past, but without conspicuous success (Needle 2002) and effective prediction of the central tendency and variability of future recruitment. Despite this, recruitment models are widely used because strategic fishery management demands an assessment of the likely future response of fish populations to exploitation. Medium-term (5- to 10-year) projections should be based on the best available data (usually the most up to date) but are also going to incorporate some assumptions about recruitment. A robust evaluation of any management plan is highly dependent on the specification of the recruitment algorithms used in the simulations. The key task for recruitment modelling is to characterise appropriately the probable variation in future recruitments and hence, the likely fluctuations in stock sizes under all feasible combinations of environmental conditions and fishing mortality (Needle 2002).

The ICES SGRECVAP (2007) considered a range of recruitment relationships for North Sea herring, and further work within the EU project INEXFISH has also investigated this further. It is clear that depending on the time series used and the models fitted, the dynamics of the stock recruitment relationship can be varied. With this in mind, WKHMP agreed to use the stock to recruitment relationship used by HAWG and proposed by SGRECVAP (2007), that is the segmented regression (also known as the hockey stick). While it is clear that apparently stochastic environmental fluctuations will be the principal determinant of future recruitment variation, it is not so obvious how environmental information should be incorporated into short and medium-term forecasts (see ICES WKEFA 2007). SGRECVAP reported that there was no indication that the current series of poor recruitments was likely to change, therefore this poor recruitment was built into all the simulations on North Sea herring described in this report.

2.3 Precautionary reference points and management plans considered precautionary

The 1998 Study Group on (ICES 1998a) estimated reference point values that were adopted by ACFM in giving advice (ICES 1999a). This framework was developed after the adoption of the first harvest rule (management plan) for herring.

Conceptually, precautionary reference points (PA) are different from parameters in a harvest control rule. In the PA approach, as interpreted by ICES, the function of the reference points is to ensure that the SSB is above the range where recruitment may be impaired or the stock dynamics is unknown. The limit is represented by Blim, while the Bpa takes assessment uncertainty into account, so that if SSB is estimated at Bpa, the probability that it really is below Blim shall be small. The Flim is one that corresponds to Blim in a deterministic equilibrium. The Fpa is related to Flim the same way as Bpa is related to Blim (ICES Study group on the precautionary approach 2002b). In the advisory practice, Fpa has been the basis for the advice unless the SSB has been below Bpa, where a reduction in F has been advised. Furthermore, Fpa and Bpa are used to classify the stock relative to 'safe biological limits'.

In a harvest rule, parameters serve as guidance to actions according to the state of the stock (ICES Study group on the precautionary approach 2002a) . These should be chosen according to management objectives, one of which should be to have a low risk of bringing the SSB to unacceptably low levels. In the evaluation of a harvest rule, one will use simulations with a 'real stock' which as far as possible resembles the stock in question, and the risk is evaluated as the probability of the 'real' SSB being below the Blim value. Within the constraints needed to keep the risk to Blim low, parameters of the rule will be chosen to serve other management objectives, e.g. to ensure a high long term yield and stable catches over time. ICES has accepted that a harvest rule as such is in accordance with the precautionary approach as long as it implies a low risk to Blim, even if other reference points may be exceeded occasionally. When a rule is regarded as precautionary, and the rule is followed, ICES gives its advice according to the rule. Within this framework, other precautionary reference points generally will be redundant. However, the precautionary reference points are also used to classify the stock with respect to 'safe biological limits', which may lead to a conflict that is still unresolved.

For the North Sea herring, the Blim was set at a level below which the recruitment may become impaired. The other precautionary reference points were taken from the already existing harvest rule, which in turn may have been political in origin. The target fishing mortalities there were intended as targets and not as upper bounds,. The inflection point in the rule (1.3 million tonnes) was derived largely as a political compromise, reflecting an ambition to maintain the stock at a high level, by reducing the fishing mortality at an early stage of decline.

In the present situation, with a reduced recruitment, the stock may be expected to be below 1.3 million tonnes most of the time. The rule will reduce fishing mortality accordingly. The outstanding question is if this reduction is sufficient. If needed, a reduction in the effective fishing mortality can be achieved by reducing the target F's, by moving the inflection point upwards or by reducing fishing mortality on juveniles. In some of these cases, it will be contradictory to regard the inflection point as a target SSB. **Hence, the WKHMP has considered the parameters of the rule independently of any link to Fpa or Bpa.**

2.4 Tools used

Four tools were used in this workshop to simulate various management plans: STPR3a (Skagen 2008a), HCS (Skagen 2008b), FLhms, and a deterministic manage-ment tool evaluation package implemented in SAS. The majority of the analysis was performed using STPR3a, with the other packages being used to complement and extend this work where appropriate.

STPR3 is a general tool designed for making medium term projections of the dynamics of two fleets fishing the same stock. It performs projections up to 10 years in length, and derives catches for each fleet according to specified management decision rules. The program simulates “true” year-classes within a stock and projects them forward in time by removing individuals as determined by the simulated implementation of a management decision rule. The rule specifies fishing mortalities corresponding to the SSB. If those fishing mortalities lead to a larger change in TAC than the constraint allows for, the TAC is set according to the constraint, unless the derogation from the constraint applies. The SSB used for decisions is always the SSB in the TAC year. Since the North Sea herring spawns late in the year, this SSB is sensitive to the TAC. Therefore, the decision rule includes an iterative process to achieve consistency between TAC and SSB. New individuals are introduced into the simulated stock through the use of a user-specified stock-recruitment relationship. Natural mortality and selection at age by fleet are treated as fixed parameters. Recruitment, weights and maturity at age, and initial stock numbers are treated as stochastic variables, and their values determined by the generation of appropriately distributed random numbers. Observation (assessment) error and implementation error are also modelled in a stochastic manner. The program works as a bootstrap simulation, per-forming 1000 projections with each stochastic variable being redrawn as appropriate. Key parameters (e.g. SSB, catches by fleet, fishing mortality) are determined for each of these trajectories and their distribution characterised: an example of 20 such individual trajectories are shown in figures 2.4.1. a-c, with the range of values clearly apparent. The efficacy of a given management rule can therefore be evaluated based on parameters derived from these distributions (e.g. risk of falling below B_{Lim}). STPR3a is implemented in the FORTRAN language. The detailed conditioning of the model is described in Section 3.1.

The FLR herring management simulator (FLhms) is ideologically similar to STPR, but focuses solely on North Sea herring and is implemented in the open-source R language using the FLR toolbox (Kell 2007). FLhms simulates the A fleet according to the current management plan with $B_{Trigger}$ and B_{lim} at respectively 1.3 and 0.8 million tons, while having the B fleet fixed at an F_{bar} of 0.05. The model was parameterized using stock characteristics determined by the herring assessment working group (ICES HAWG CM 2007/ACFM:11). Assessment and implementation error were modelled as log-normally distributed stochastic variables. Initial stock numbers were modelled as stochastic variables with log-normal co-variation between the age groups. Recruitment to the stock was treated using the Hockey stick relationship, centred on the mean recruitment of the past five years, with a log-normal distribution of the slope and position of the plateau. Inter-annual TAC constraints can be applied, while constraints are not applied when SSB drops below B_{lim}, in accordance with paragraph 6 of the management plan.

A deterministic tool, developed in SAS, focuses only on North Sea Herring as well. It is used to check for serious discrepancies in the responses (outputs) of the alternative rules on a purely deterministic ad hoc basis. The conditions in this tool were kept the same without specifying any errors, biases or other natural variations. To specify stock regeneration a stock-recruitment function of hockey stick type (segmented regression) has been applied to all approaches. The method has also been used to compare different management strategies that are currently operating in demersal fisheries. All input data (initial numbers per age, stock weight per age, catch weight per age, selection pattern, maturity ogive, natural mortality per age, etc) used for specifying the population dynamics of this stock were taken from the HAWG 2007 report (ICES 2007).

The “harvest control simulation” (HCS) package has been developed independently of STPR3a and FLhms, with different objectives in mind, but is built on a very similar ideological foundation. Rather than focusing on the details of a specific management plan, HCS is used here to characterise and explore the parameter space describing a family of management plans. As an example, HCS can be used to scan through a range of biomass trigger points to allow comparison of individual management rules employing each level: while such a task could be undertaken manually using STPR3a or FLhms, HCS provides a fast and efficient method to examine the effect of each parameter. However, HCS is only capable of dealing with the exploitation of a stock by a single fleet (as opposed to the two fleets of STPR3a or FLhms). HCS is implemented in FORTRAN.

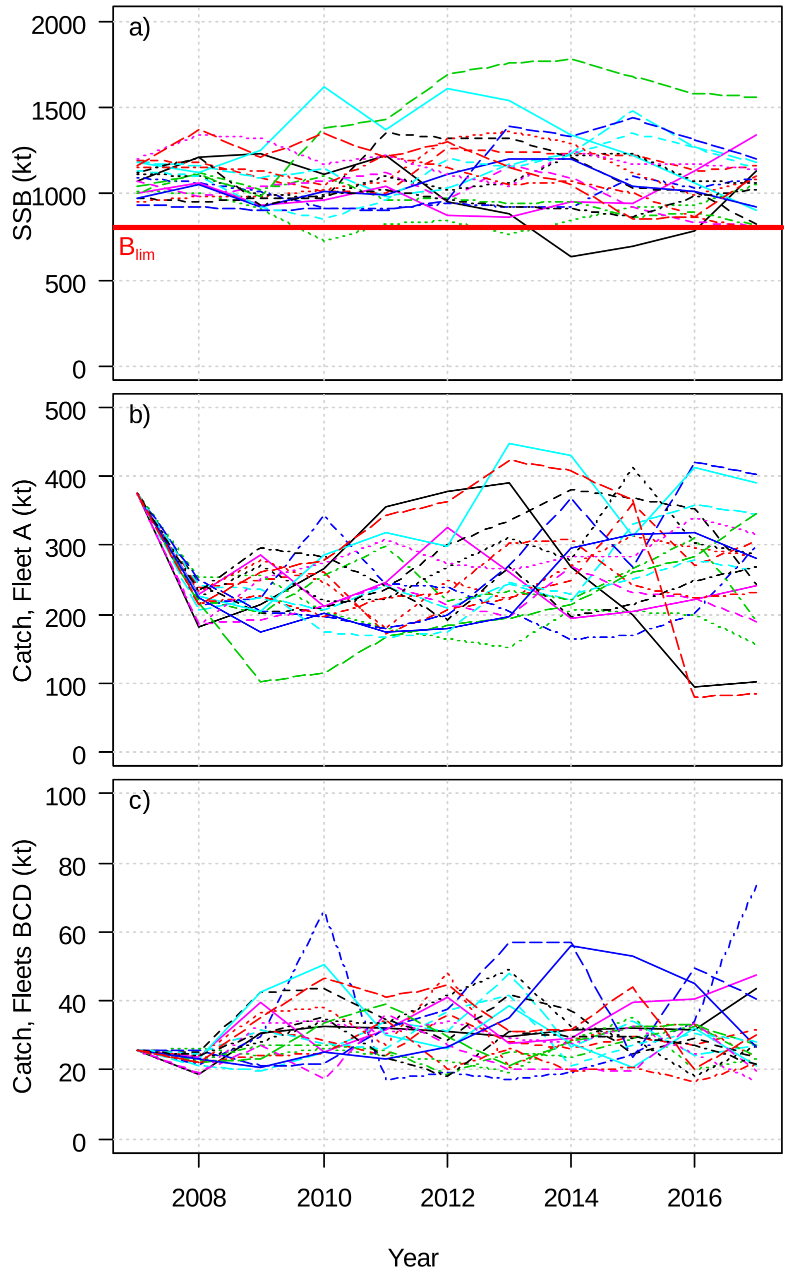


Figure 2.4.1 North Sea herring. Example of 20 individual stock trajectories produced by the STPR3a software for a given management scenario. a) Spawning stock biomass (kilotonnes). The B_{lim} of 800 kilotonnes is shown as a heavy red horizontal line. b) Realised catch of Fleet A (kilotonnes). c) Realised catch of Fleets B, C and D (kilotonnes). The formatting of each line is consistent and constant between the three panels, allowing a single realisation to be followed in each of the three dimensions shown.

3 North Sea Herring

WKHMP decided to approach the terms of reference by a range of explorations of settings for management simulations of North Sea herring. These are described in the sections below. The tools used are described above (section 2.4) and the conditioning of the STPR scenarios in section 3.1. A synthesis of the findings is then given in 3.10, along with the responses to the terms of reference.

3.1 Baseline scenarios

Two scenarios were initially examined to provide a baseline against which to compare other, alternative management scenarios. The first scenario (Figure 3.1.1) simulates the current management plan, as described in the agreement between the EU and Norway (Annex 3), whilst the second, "baseline", scenario (Figure 3.1.2) also describes the EU-Norway agreement, but uses a reduced fishing mortality on the juveniles of 0.05. The current management plan between Norway and the EU was agreed in 2004 with a limit on the fishing mortality of juvenile herring in the North Sea of 0.12. However, the fishing has only rarely reached that limit, and in recent years the average value has been 0.05. The opinion of WKHMP was that using the juvenile mortality observed in recent years was more appropriate, and this has been used as the baseline throughout the rest of this study.

All of the scenarios tested using STPR by WLHMP are based on the baseline scenario (see table 3.1.1). Conditioning of STPR3a was as follows:

The program was run with the same conditions as used by the HAWG in 2007, as far as that applies. The version used by WKHMP had some amendments compared to that used by the HAWG:

1) The TAC could be specified for year 1 (2008.)
2) The constraint on TAC variation could be abandoned if the constraint on a reduction led to SSB below a treshold SSB (the §6 rule)
3) Inter-annual variation was included in the printout.

The input data was as follows:

- Age range: 0 - 9
- One year delay between spawning and recruitment
- Initial stock numbers and their variance-covariances were derived from the assessment by HAWG in 2007, representing stock numbers at the start of 2007.
- Weights at age and maturities at age were drawn from data for 2001-2006, by drawing a year randomly each time such data are needed and using data for all ages from that year.
- Recruitment was modelled as a hockey stick function with a lognormally distributed random multiplier. The breakpoint was at 800 000 tonnes and the CV at 0.35. This function is assumed to represent the current poor recruitment regime.
- Selections at age were as used by HAWG for a fleet exploiting adults (Fleet A) and a fleet exploiting juveniles (Fleet B-B-D)
- Catches for 2007 were constrained to values used by the HAWG, to 375000 tonnes for fleet A and 25500 for fleet B-C-D.

- TACs for 2008 were derived from the agreed record of consultations between EU and Norway, assuming that 3000 tonnes of the Norwegian TAC in IIIa that Norway is permitted to take in the North Sea would actually be taken in the North Sea and consist of North Sea autumn spawners.
- A-fleet: 203300 tonnes
- B-C-D-fleet: 30900 tonnes.
- Unless stated otherwise, an observation bias of 10% was assumed with a CV of 10%, representing assessment uncertainty, and an implementation bias of 10% was assumed with a CV of 10%, representing assumed ovedrfishing of the TACs.

Simulations based on the "as-agreed" management plan (i.e. with F target=0.12 on juveniles, Figure 3.1.1) show a spawning stock biomass (SSB) that fluctuates around 1.0 million tonnes, with a probability of 5-10% of being below the B_{lim} of 800 thousand tonnes. Realized fishing mortalities (F) are slightly lower than the target Fs; according to the management rule, they should be lower, but assessment bias and implementation bias act to lift the values. Catches in the A fleet fluctuate around the 2008 level, with no time trend. Catches by the B-C-D fleet double in the first year, and remain at that level, but also show a high degree of variability. The 15% rule on inter-annual variability in the TAC limits the TAC compared to what the basic rule would give in about three-quarters of the cases, and therefore paragraph 6 of the agreement (*i.e.* disregarding the inter-annual variation limitation under appropriate circumstances) is rarely invoked.

The "baseline" scenario (Figure 3.1.2) gives an SSB fluctuating around 1.1 million tonnes, with a probability of 2-3% of being below B_{lim}. Realized Fs are slightly below the target values, but again are lifted by the effect of assessment bias and implementation error. Catches in the A-fleet show a slightly increasing trend over time, with an increasing range of fluctuations. Catches by the B-C-D fleet increase slightly in the first year, and remain constant within a narrow range after that point. The 15% rule limits the year-year variation in the TAC effectively, limiting the change in TAC in around three-quarters of the cases. Again, paragraph 6 is rarely invoked.

Comparing the "baseline" and "as-agreed" scenarios, it can be seen that there is a greater risk of falling below B_{lim} . The effect of a higher juvenile F (*i.e.* in the "as-agreed" management plan) is higher and more variable catches for the B-C-D fleets, and lower catches for the A-fleet, especially in the later years. The median SSB is also seen to be lower.

Table 3.1.1. Overview of runs with STPR3a for North Sea herring. Parameters that deviate from the baseline run are highlighted.

Run number NSH	Figure number	Target F2-6 A-fleet	Target F0-1 B-C-D fleet	% con-straint on TAC change (A-fleet)	SSB limit for applying §6	Upper trigger SSB in harvest rule	Obs error	Implem-entation error	Mean recruit-ment above breakpt.	CV recruit-ment	Assumed TAC for 2008 (A-fleet)
1	3.1.1	0.25	**0.12**	15	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
2 **(base line)**	3.1.2	0.25	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
3	3.2.3	**0.20**	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
4	3.4.1	0.25	0.05	**10**	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
5	3.4.2	0.25	0.05	**20**	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
6	3.6.1	0.25	0.05	15	**1000**	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
7	3.6.2	0.25	0.05	15	**1300**	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
8	3.8.1	0.25	0.05	15	800	**1000**	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
12	3.8.2	0.25	0.05	15	800	**1500**	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
13	3.3.1	0.25	0.05	15	800	1300	**0.1+-0.2**	0.1+-0.1	22963	0.35	203.3
14	3.3.2	0.25	0.05	15	800	1300	0.1+-0.1	**0.2+-0.1**	22963	0.35	203.3
15	3.2.4	0.25	**0**	15	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	203.3
16	3.3.3	0.25	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	**18370**	0.35	203.3
17	3.3.4	**0.20**	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	**18370**	0.35	203.3
18	3.3.5	0.25	**0**	15	800	1300	0.1+-0.1	0.1+-0.1	**18370**	0.35	203.3
19	3.3.6	0.25	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	22963	**0.6**	203.3
20	3.3.7	0.25	0.05	15	800	1300	0.1+-0.1	0.1+-0.1	22963	0.35	**300**

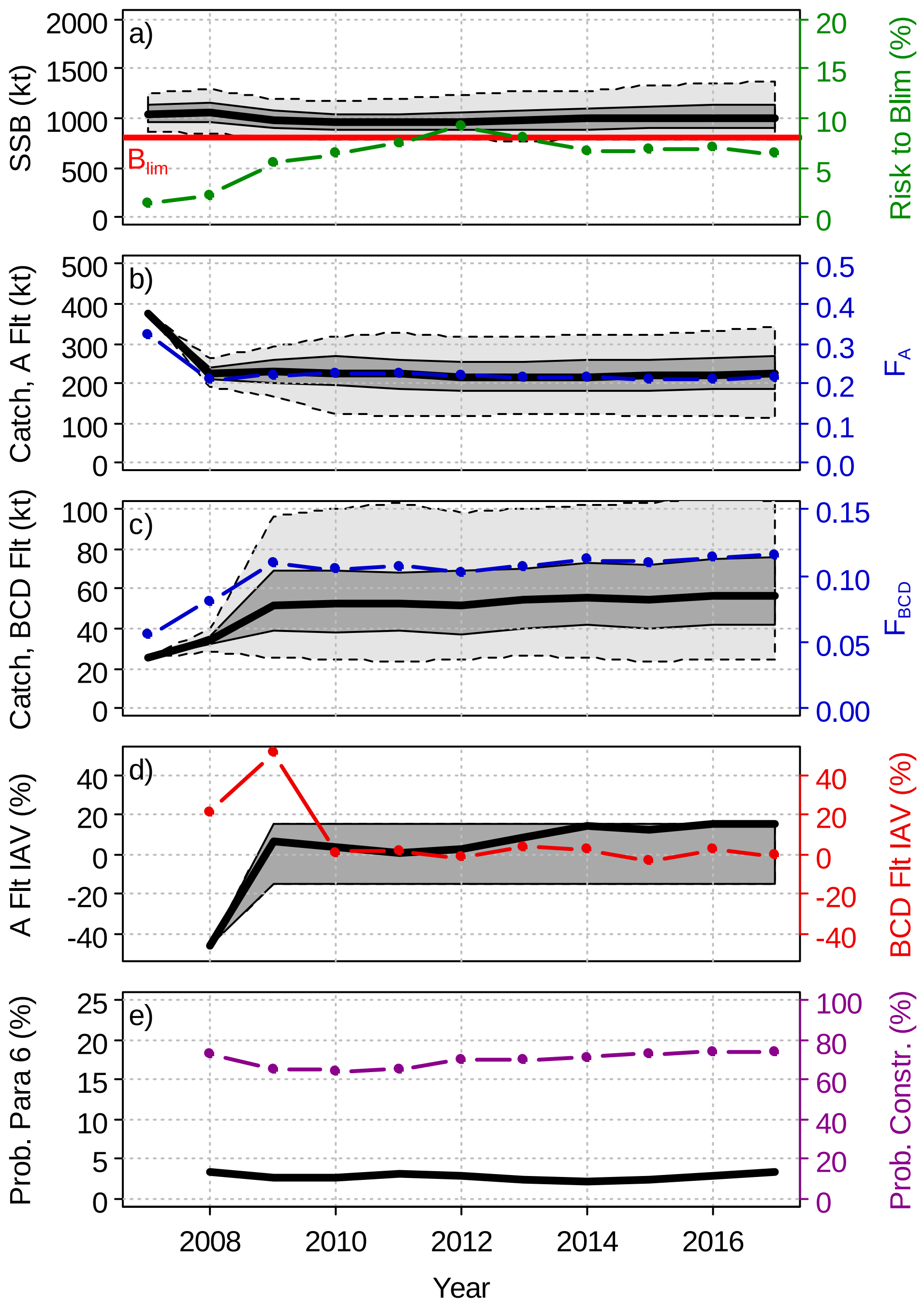


Figure 3.1.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN AS WRITTEN IN THE EU NORWAY AGREEMENT. Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with confidence intervals as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with confidence intervals as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above, and fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH01-in table 3.1.1.

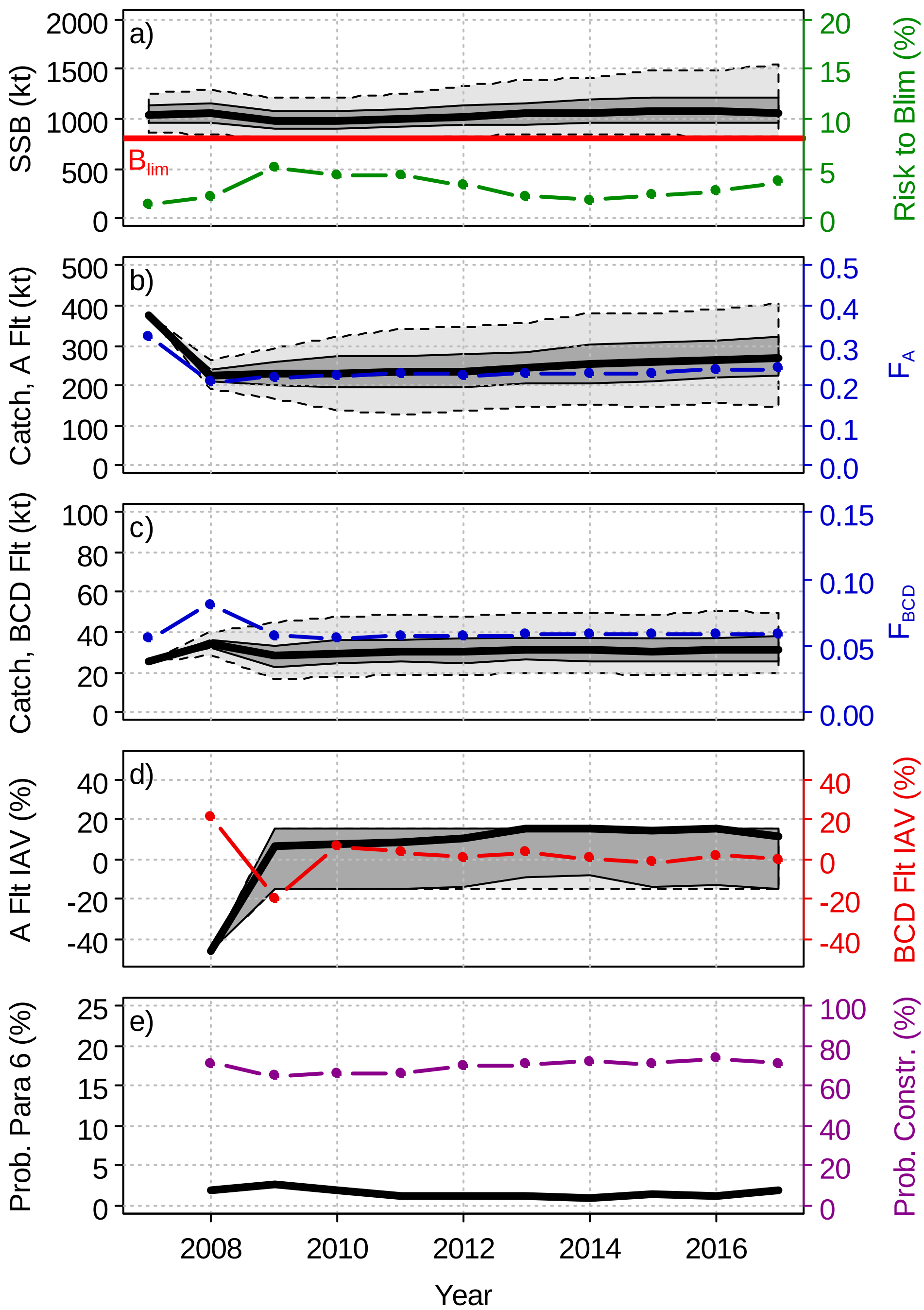


Figure 3.1.2 THE BASELINE CASE. Simulation of North Sea herring management plan as written in the EU Norway agreement but with the fishing mortality on the juveniles = 0.05 the recent average. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with confidence intervals as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with confidence intervals as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above, and Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 02 in table 3.1.1

3.2 Changing Target fishing mortalities

Two sets of simulations were performed examining the effect of varying the fishing mortality of the two sets of fleets. The first of these scenarios examined the effect of setting the target fishing mortality of the A fleet to 0.2. In the second scenario, the B, C and D fleet catches were eliminated as a proxy to investigate the effect of eliminating the juvenile fishery.

Reducing the target F for the A-fleet to 0.2 (figure 3.2.1) gave a long-term SSB of 1.2 million tonnes, approximately 100,000 tonnes higher than that in the baseline scenario. Catches from the A-fleet were approximately 15 000 tonnes lower in the first years of the simulation, but in later years the difference became insignificant. Catches from this fleet were slightly more stable, and therefore required the 15% rule to be invoked less often. The realized F was slightly above the target F, but lower than the baseline case. The risk of falling below Blim was generally lower than in the baseline scenario, showing a peak of around 5% in 2009, but then reduced in later years to less than 1%.

Simulations examining the effect of removing the catches in the B, C and D fleets (figure 3.2.2) gave SSBs 100 000 tonnes higher than in the baseline case. Catches in the A-fleet showed an appreciable long-term trend, increasing to a level about 20% higher than the baseline in the last years of the simulation period. These catches were also somewhat more stable than the baseline, with the 15% TAC constraint being in-voked less frequently. Again, the risk of falling below Blim was reduced relative to the baseline scenario.

These two scenarios, together with the baseline scenarios, show that reducing fishing mortality increases SSB and marginally improves the stability of the catches. Reduc-ing the fishing mortality on the juveniles gives better fishing opportunities on the adults, with one ton of juvenile catch “costing” approximately 2-3 tonnes of adult catch. Reducing the fishing mortality on adults does not lead to a loss in catches in the longer term, but does give a reduction of approximately 7% in the first years. Re-ducing the fishing mortality, either on adults or on juveniles (via the B-C-D fleet catches), generally reduces the risk of falling below Blim. Catches of juveniles are vir-tually independent of the fishing mortality on adults, and variation in the TACs is effectively constrained by the 15% rule.

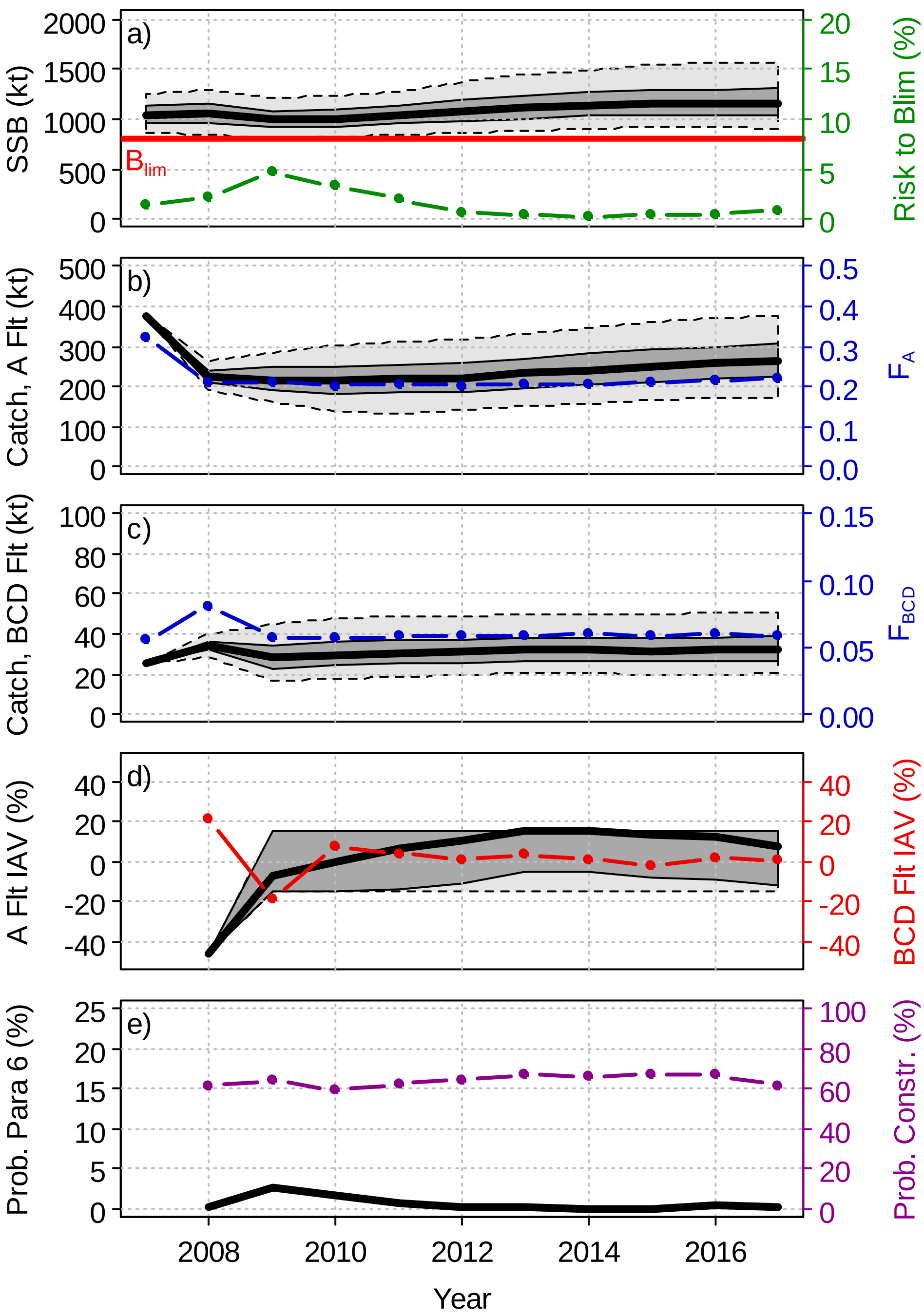


Figure 3.2.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT TARGET FISHING MORTALITY OF THE A FLEET = 0.2. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 03 in table 3.1.1.

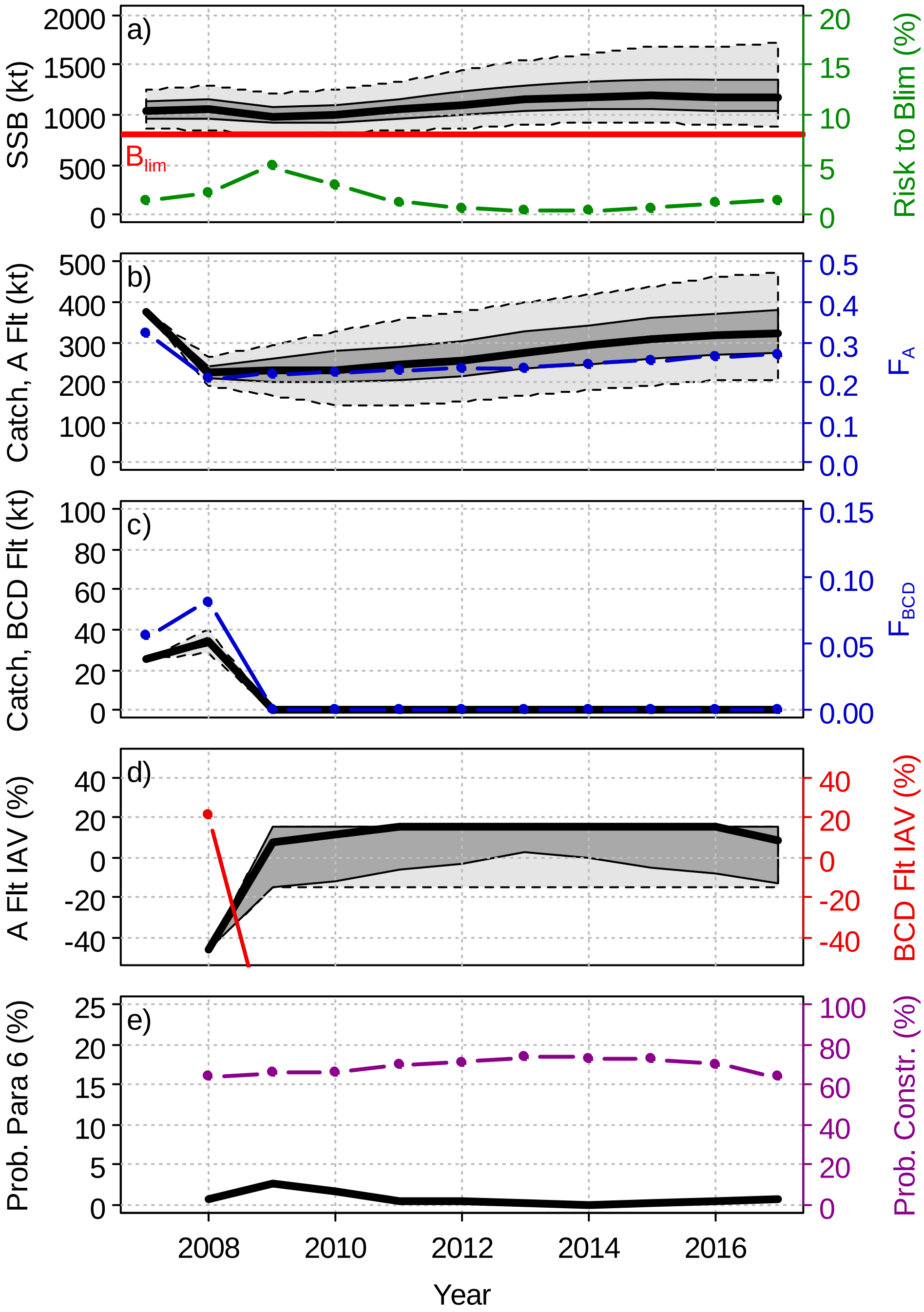


Figure 3.2.2 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT THE CATCH OF FLEETS B, C AND D = 0. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 15 in table 3.1.1

3.3 Sensitivity to assumptions

The results presented are conditional on assumptions that have been made when setting up the simulations. In this section WKHMP explores the sensitivity of the results to some potentially important assumptions, by making the following changes to the baseline scenario:

- Assessment quality, CV of the observation error increased from 0.1 to 0.2
- Implementation bias increased from 0.1 to 0.2
- Mean recruitment reduced by 20%, from 22963 to 18730
- CV of recruitment increased from 0.37 to 0.6.
- TAC in 2008 increased from 203.3 to 300.

The results are shown in Figures 3.3.1 to 3.3.7.

A higher assumed uncertainty in the assessments leads to more variable catches, and in some cases to very low catches. This is because the assessment at times may indicate that the stock is very low, which allows for derogation from the TAC constraint and a drastic reduction in catch. Due to the TAC variation constraint, it takes several years to increase the catches to a 'normal' level. The result is a generally lower fishing mortality and a larger SSB. The risk to Blim is slightly higher (Figure 3.3.1).

A greater overfishing of the TAC leads to a higher median fishing mortality, but not to higher median realized catches. The risk to Blim becomes higher, in the order of 5-10% with an overfishing at 20% (Figure 3.3.2).

A 20% reduction in the average recruitment leads to a risk to Blim in the order of 10%, and a reduction in mean SSB of about 10% (Figure 3.3.3). The median catches are reduced by approximately 30%. Hence, the rule, with its reduced F at lower SSB compensates partly for the reduced recruitment. A lower target fishing mortality for either the A-fleet or the B-C-D-fleet will reduce the risk to Blim (Figures 3.3.4, and 3.3.5). An F of 0.2 for the A-fleet reduced the risk to about 5%, without reducing the catches except for the first 2-3 years. Stopping the fishery by the B-C-D-fleet leads to a lower risk. Changing the variability in the recruitment has little impact (Figure 3.3.6)

Increasing the assumed catch for 2008 has two effects (Figure 3.3.7). It reduces the stock in 2009, and it lifts the reference TAC from which a 15% reduction is derived. The result is a decline in SSB in the first part of the simulation period, leading to a risk to Blim about 30%. However, in the subsequent years, the SSB will rise faster, because the catches have now been reduced and can only increase slowly.

These results are in accordance with what ICES has advised previously, indicating that the present harvest rule is borderline with respect to ensuring that SSB remains above Blim. The largest problems can be expected if the TACs are overfished more than in the recent period, or if the recruitment is further reduced.

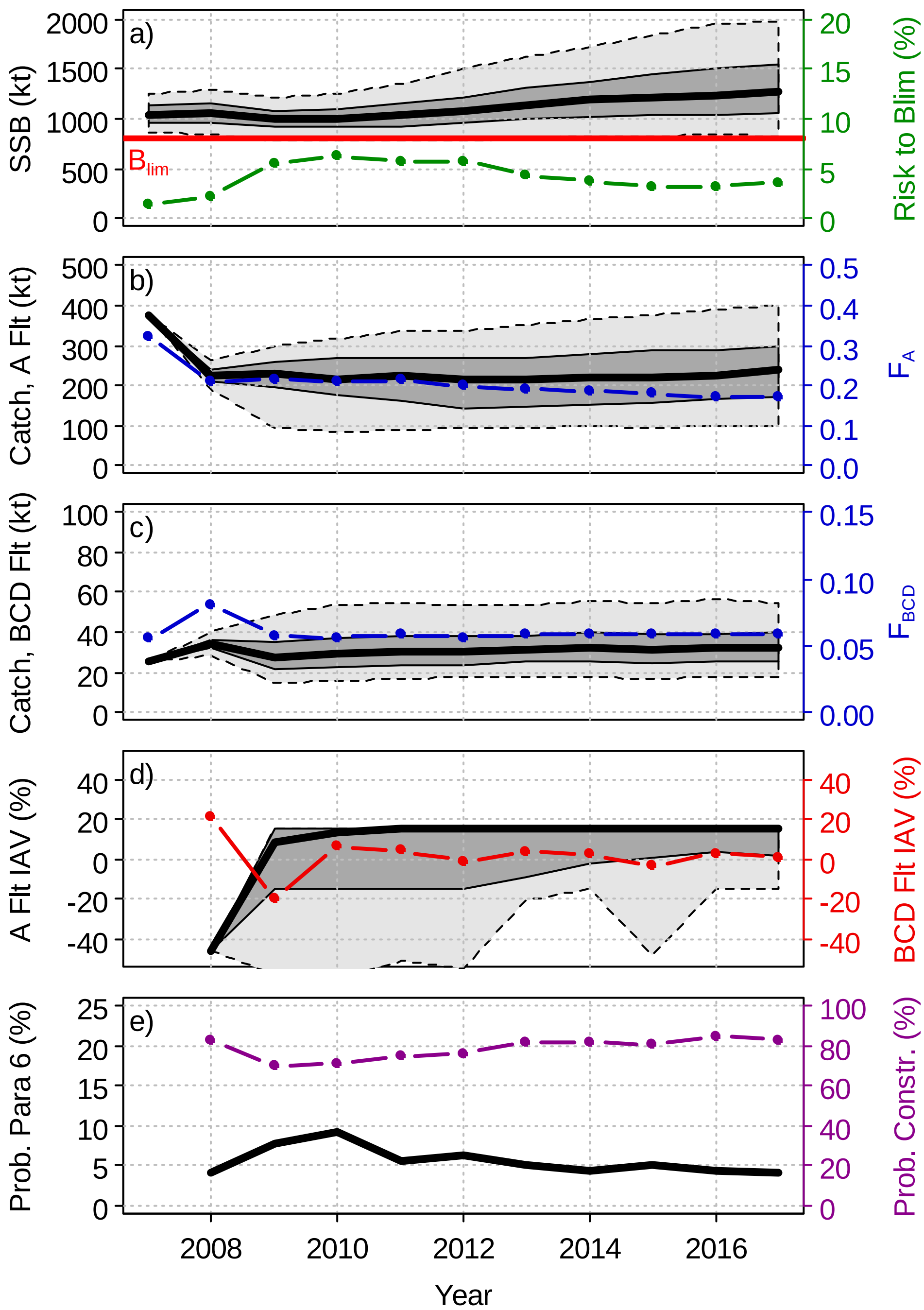


Figure 3.3.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT NOISE IN ASSESSMENT INCREASED 0.1 → 0.2. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 13 in table 3.1.1.

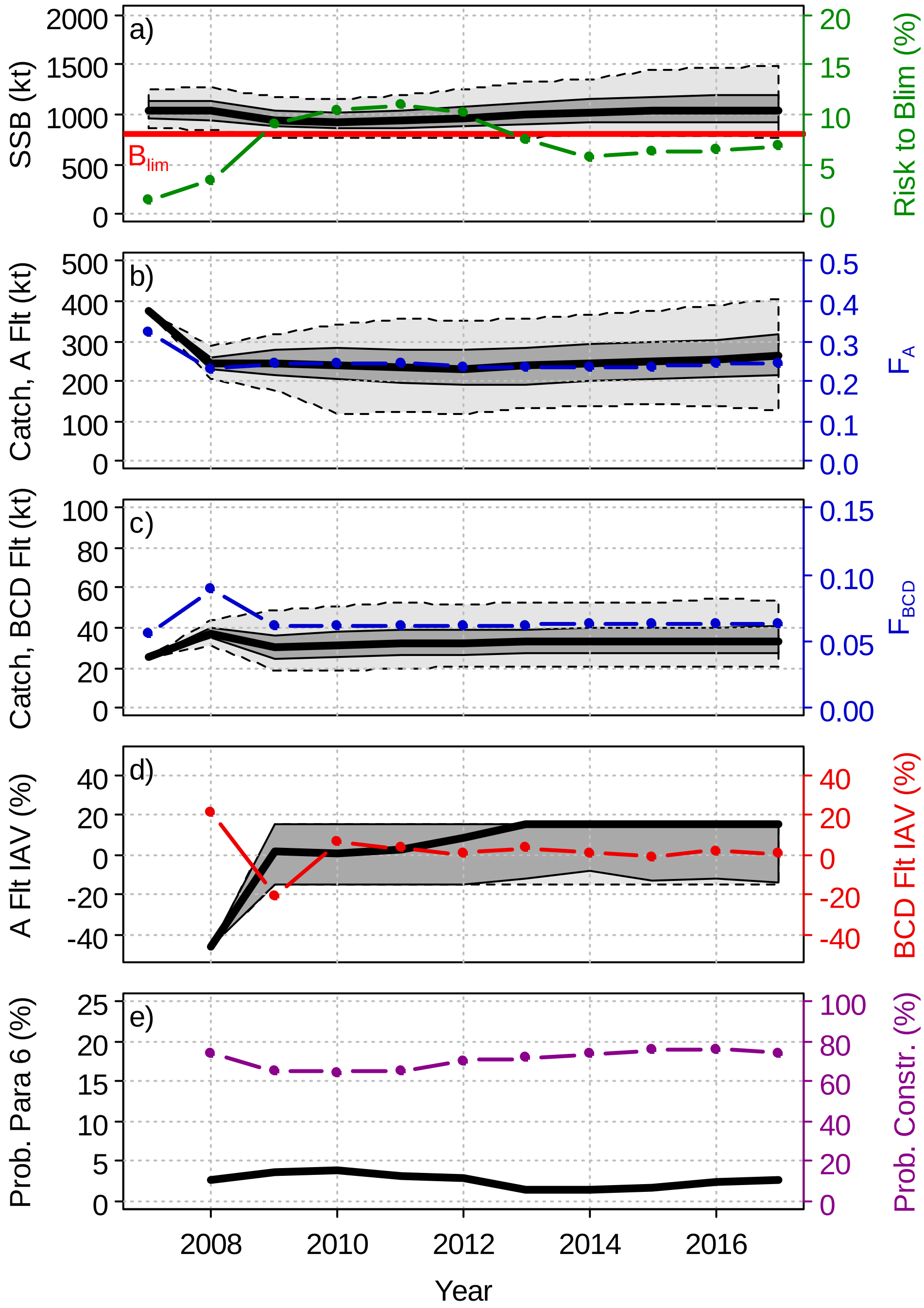


Figure 3.3.2 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT BIAS IN IMPLEMENTATION INCREASED 0.1 → 0.2. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 14 in table 3.1.1.

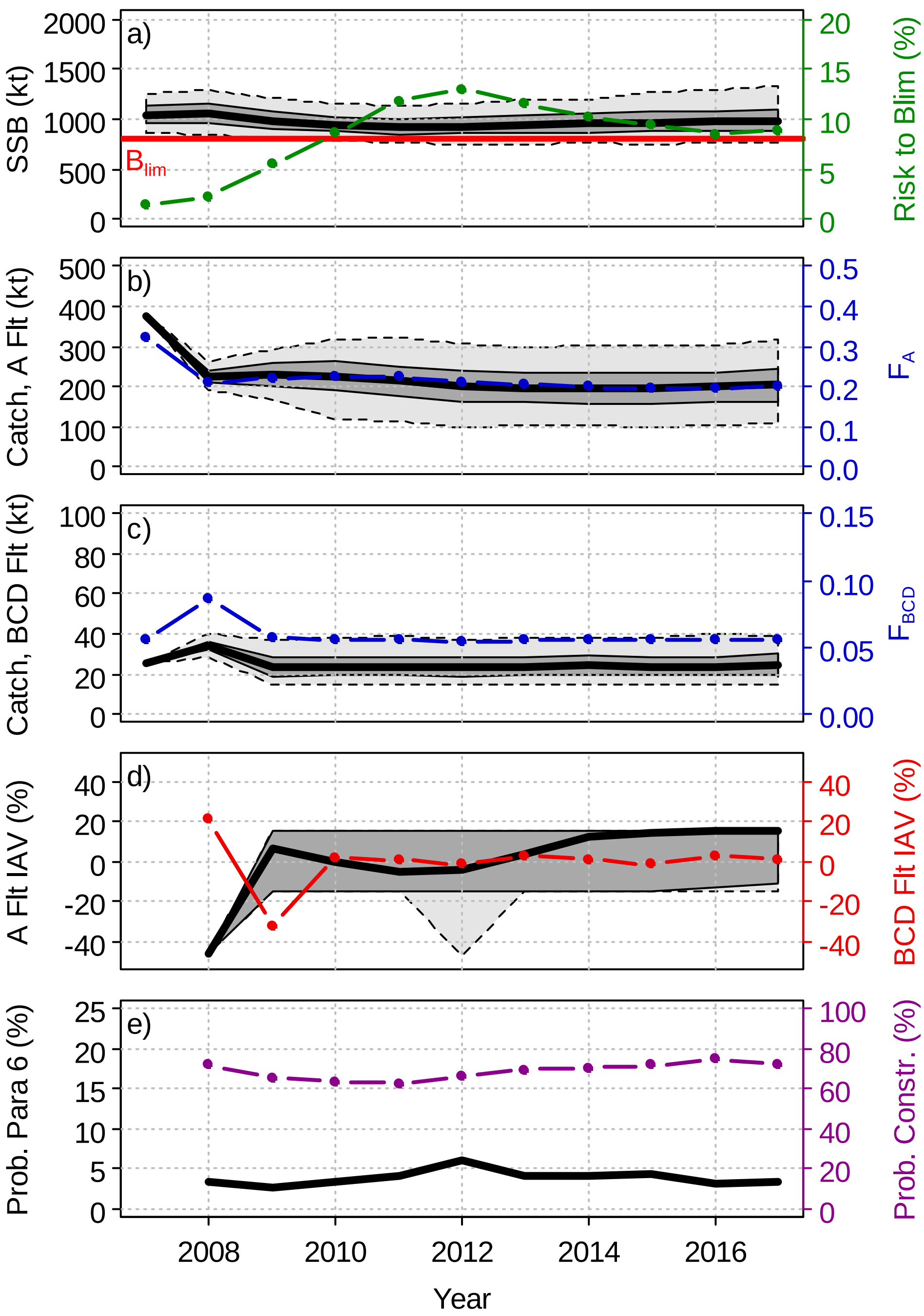


Figure 3.3.3 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT RECRUITMENT REDUCED BY 20%. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 16 in table 3.1.1.

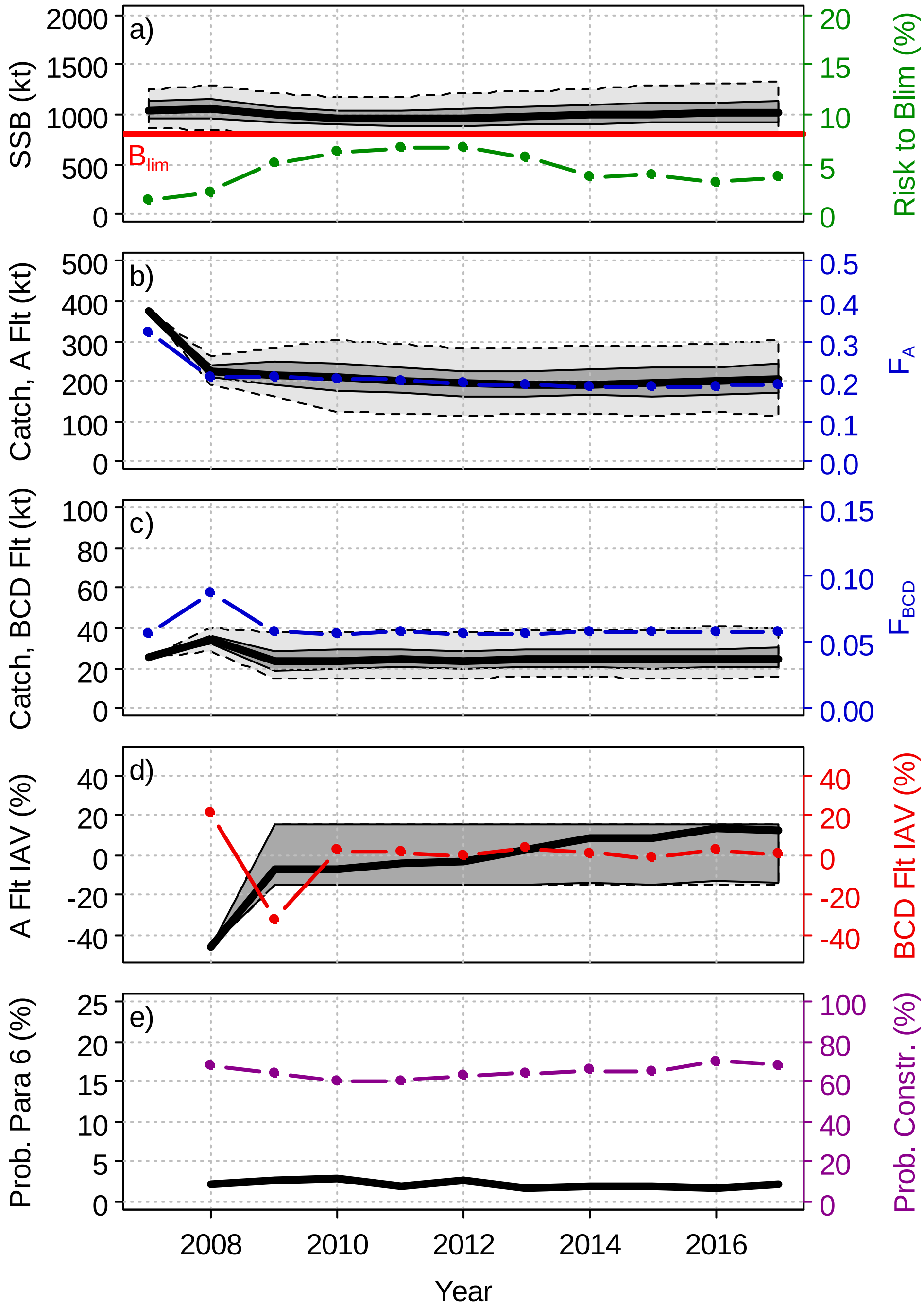


Figure 3.3.4 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT WITH RECRUITMENT REDUCED BY 20% AND TARGET F ON THE ADULTS OF 0.2. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 17 in table 3.1.1.

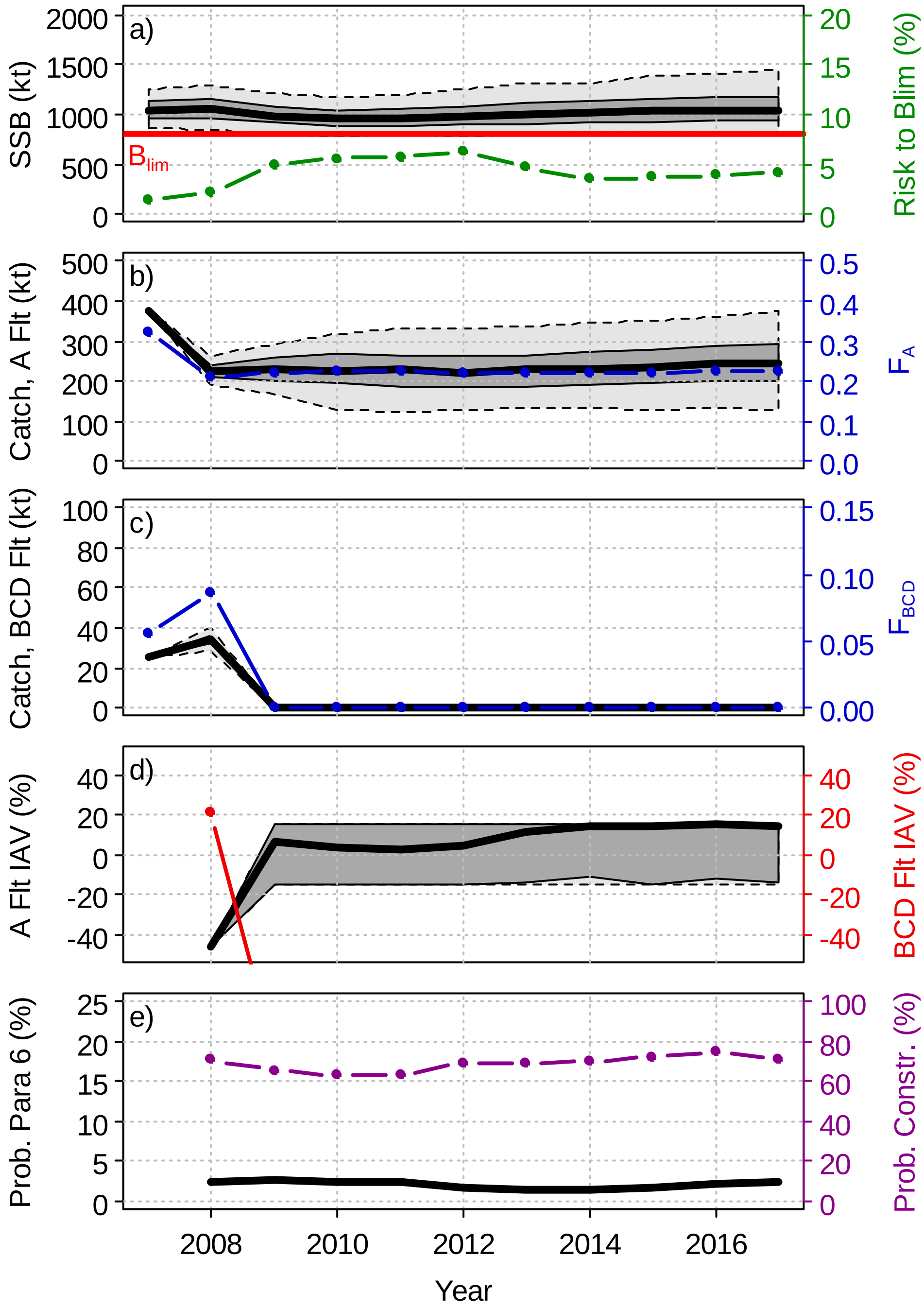


Figure 3.3.5 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT RECRUITMENT REDUCED BY 20% AND ZERO CATCH IN FLEETS B, C, D. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 18 in table 3.1.1.

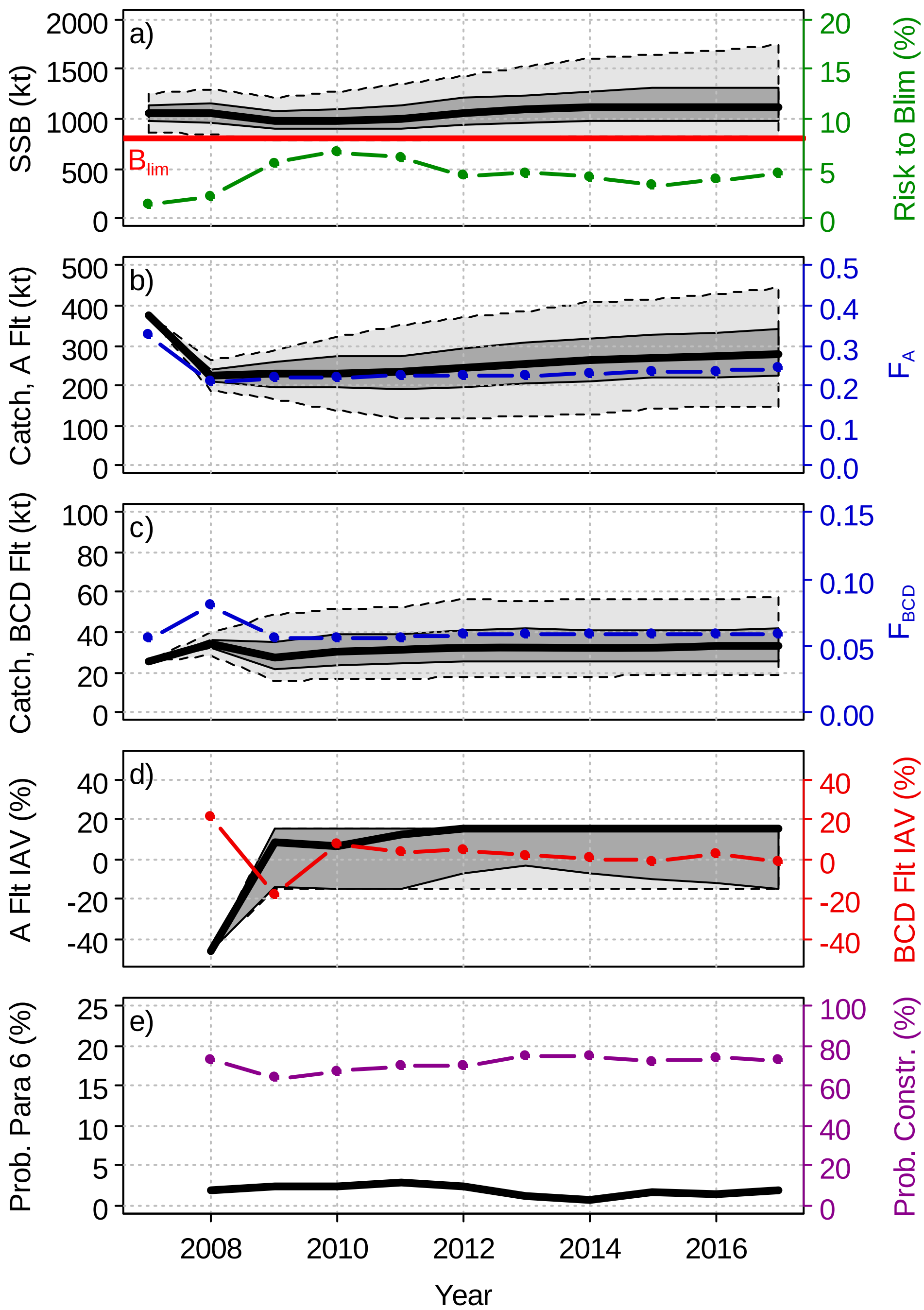


Figure 3.3.6 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT RECRUITMENT VARIABILITY INCREASED TO CV = 0.6. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 19 in table 3.1.1.

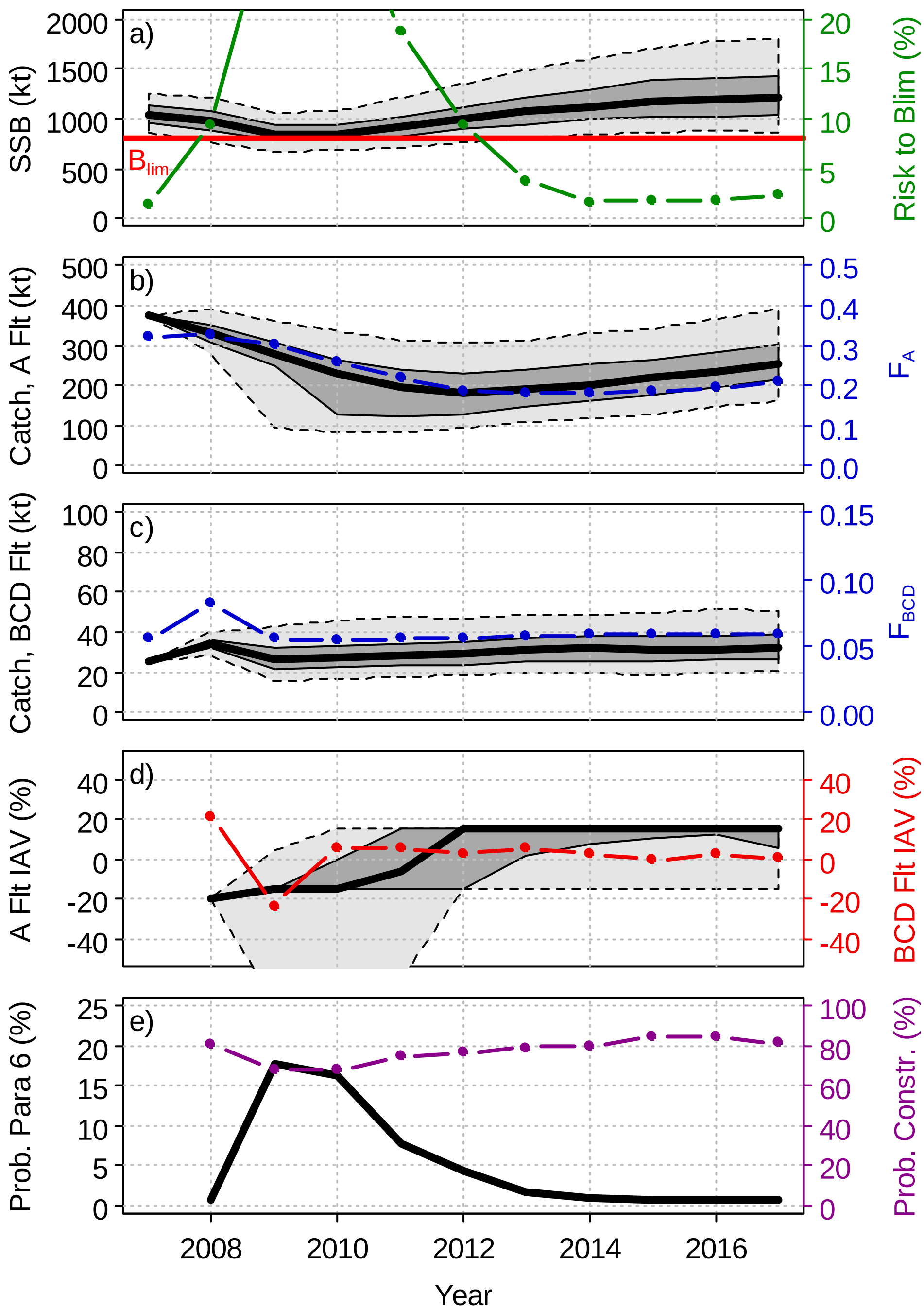


Figure 3.3.7 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT TAC IN 2008 AT 300 KT. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 20 in table 3.1.1

3.4 Stability of TACs for herring for human consumption

Simulations were performed to examine the effect of varying the inter-annual con-straint on the variability in TACs. Two different scenarios were examined, one tight-ening the constraint from the 15% in the management plan to 10%, whilst the other relaxed the constraint to a limit of 20% inter-annual variability.

Tightening the inter-annual variability constraint (figure 3.4.1) did not have a large effect, and the SSBs and catches did not vary greatly from the baseline scenario. The tighter constraint has the intended effect of stabilising TACs, which were observed to stay within the imposed bounds. The risk of falling below Blim increased from the baseline scenario, but did not rise above 5%. The TAC variability constraint was invoked more often than in the baseline scenario.

Loosening the variability constraint (figure 3.4.2) permitted greater variation in the TAC, but otherwise the SSB, catches and risk of falling below Blim were very close to that of the baseline run.

Generally, it appears that the dynamics of the system are not greatly influenced by the constraint on inter-annual variability, within the range of values examined here and for the given starting point. The importance of these final two caveats, however, should be strongly emphasised, and extrapolation beyond these limitations is not necessarily valid.

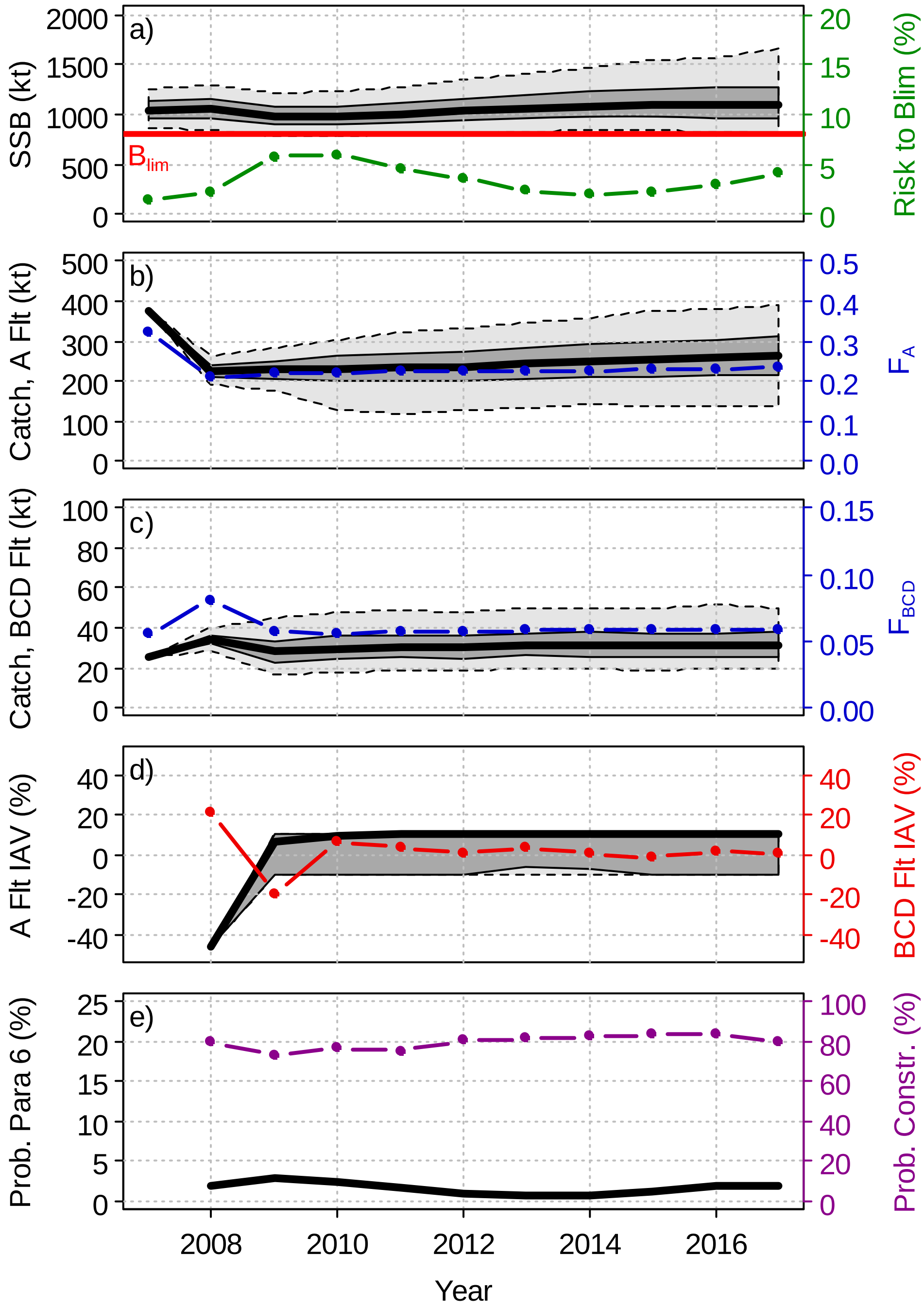


Figure 3.4.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT LIMIT ON TAC VARIABILITY REDUCED TO 10%. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 04 in table 3.1.1.

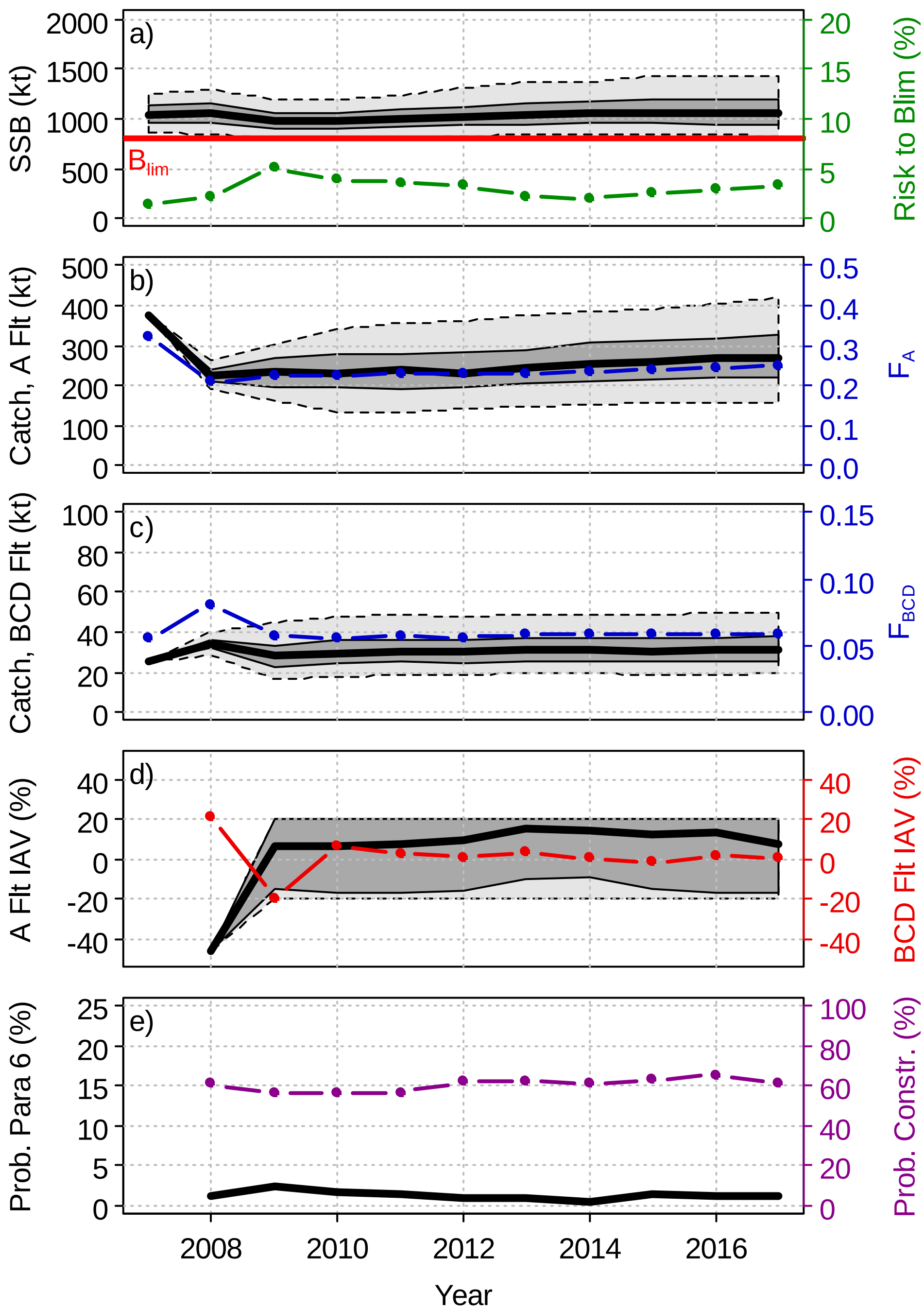


Figure 3.4.2 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT LIMIT ON TAC VARIABILITY INCREASED TO 20%. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 05 in table 3.1.1

3.5 Stability of TACs for herring for by-catch

The by-catch quota is in its nature different from other quotas as it is set to cover unintentional catches of juvenile herring in fisheries that target other species (mostly sprat or sandeel) and therefore does not relate to a directed fishery. Under the current by-catch regulations, the fishery has neither the possibility nor motivation to fully utilise this quota: indeed, in recent years, the by-catch ceiling has not been reached. In this context WKHMP considers it difficult to address item a) iii (stability in the by-catch TAC) in the terms of reference and this item has therefore not been explored explicitly. Other scenarios analysed here suggest that this by-catch should be as low as possible (*c.f.* figure 3.2.2) to minimise the risk of falling below B_{lim}.

3.6 Paragraph 6

Paragraph 6 of the management plan provides a mechanism whereby the inter-annual constraint on variations in the TAC can be disregarded when appropriate. Specifically, the text states:

> *6. Not withstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15% compared to the TAC of the preceding year.*

The meaning of "appropriate" is not clearly defined, and in practice, the application of this paragraph is left to the discretion of the Parties to the agreement. However, simulating this type of discretionary behaviour within a computer program is not practical, and it is therefore necessary to define a fixed rule for the invocation of this paragraph. The simulations employed in this work invoke paragraph 6, and therefore disregard the constraint on inter-annual variation, if the TAC produced by the basic management rule implies a larger reduction than the constraint allows for and will cause the SSB in the coming year to fall below some threshold value. In the baseline scenario, this threshold was chosen as 800 000 tonnes (B_{lim}): here we examine the effect of altering this value.

Increasing this threshold to 1.0 million tonnes (figure 3.6.1) and further to 1.3 million tonnes (figure 3.6.2) generally leads to increased invocation of paragraph 6 and subsequent increases in the inter-annual variation in the TAC, with more frequent drastic reductions in the TAC., while the resulting SSB is somewhat higher than the baseline scenario. The fishing mortalities and median catches are virtually unchanged, but the catch probability distribution is different, with increases in the threshold leading to a greater probability of larger catches in particular towards the end of the simulation period.. The risk of falling below B_{lim} slightly decreases.

Besides a rule for decisions based on predictions of SSB in the TAC year several further circumstances of applying the TAC max variation rule in the management plan could be envisaged:

- A series of low recruitment years that with a degree of confidence when applying paragraph 5 will lead to an SSB below Blim in the short to medium term (see section 5.2).
- A realised regime shift that has lead to a different carrying capacity/productivity or higher level of natural mortality would need a fast shift to a lower harvest level

Simulations of risk to Blim with and without constraints to TAC variation at different levels of assessment error show that increased uncertainty about the state of the stock is not necessarily a valid reason for applying paragraph 6.

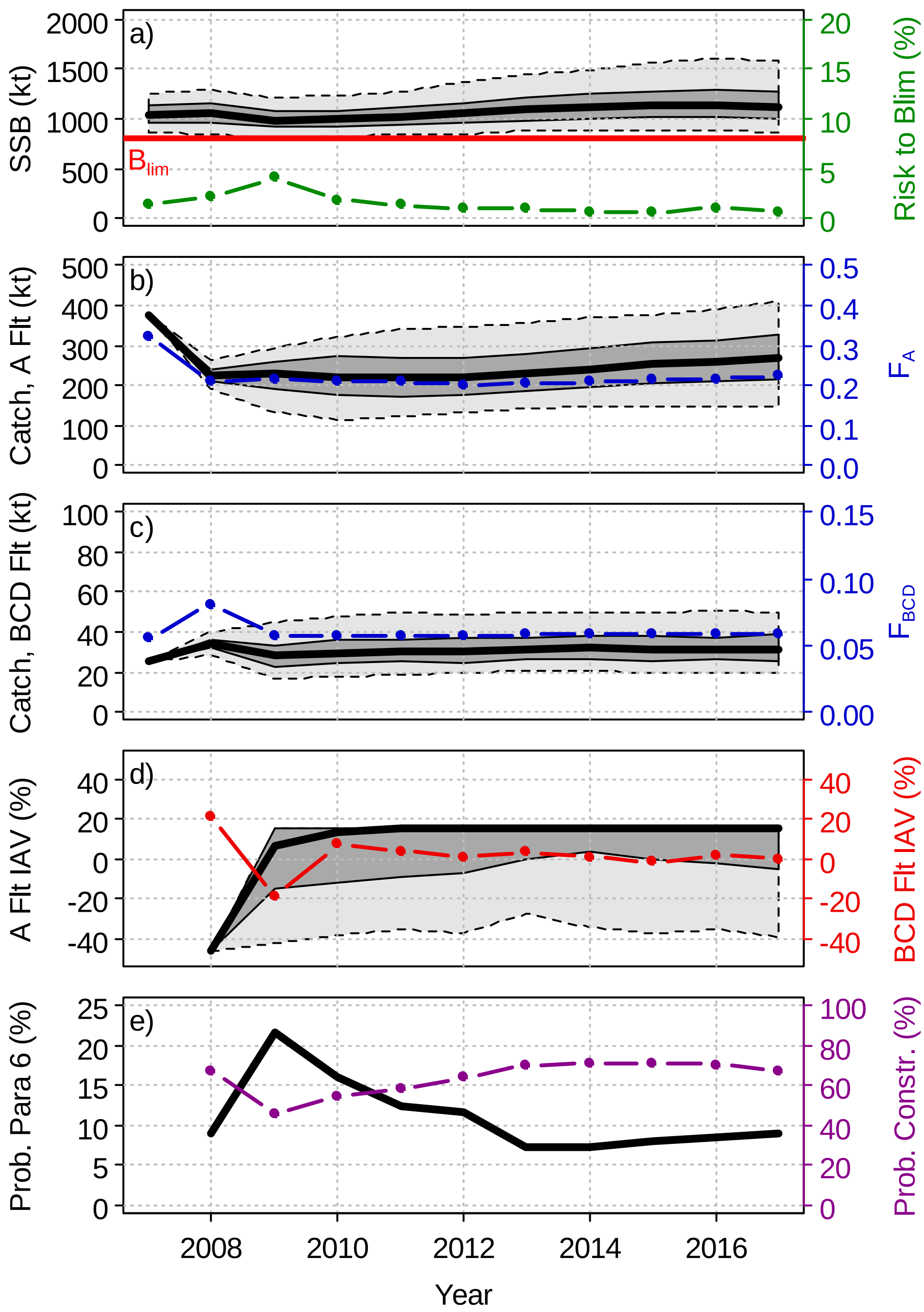


Figure 3.6.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT BIOMASS TRIGGER OF PARAGRAPH 6 INCREASED TO 1000 KT. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 06 in table 3.1.1.

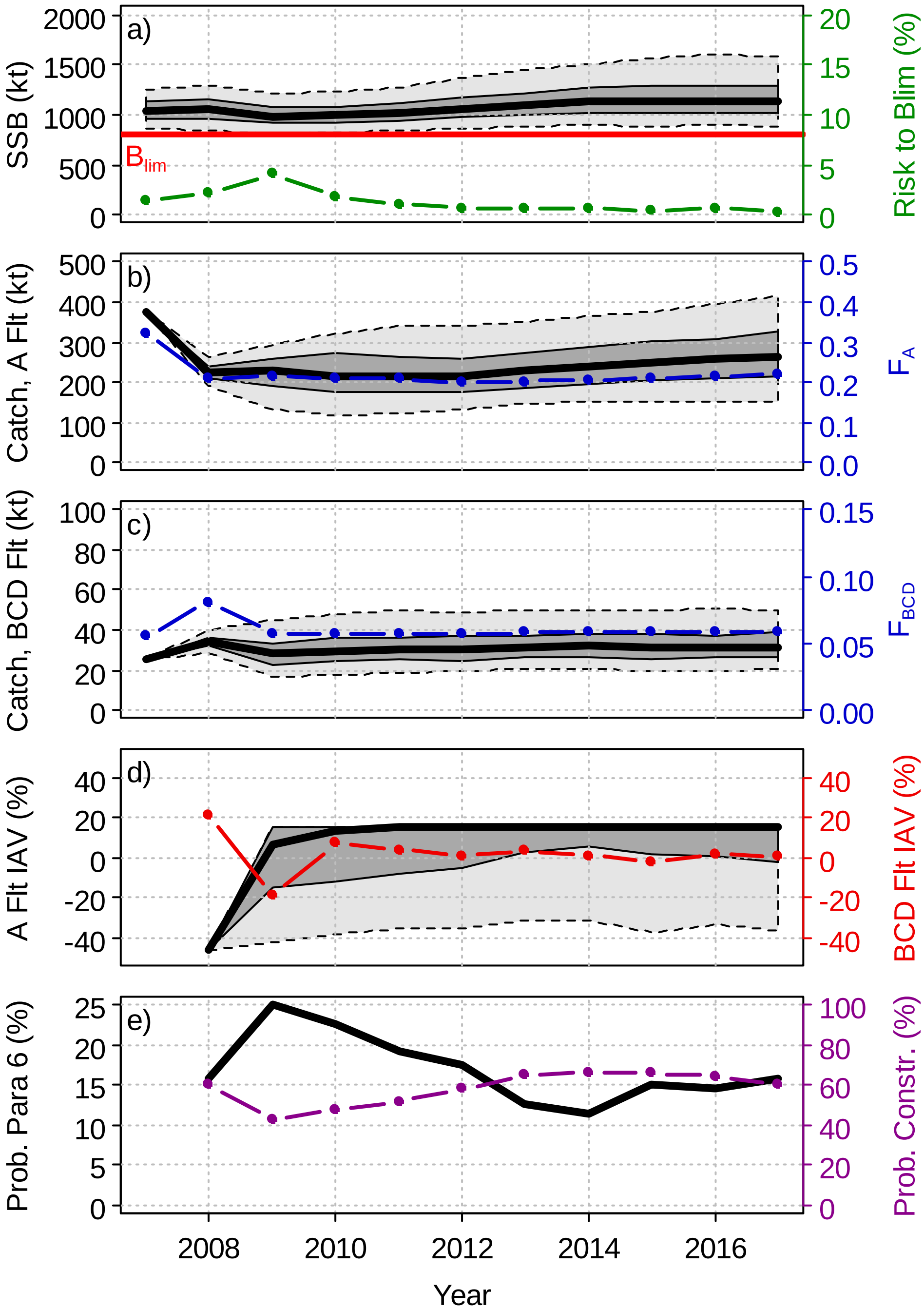


Figure 3.6.2 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT BIOMASS TRIGGER OF PARAGRAPH 6 INCREASED TO 1300 KT. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 07 in table 3.1.1.

3.7 The apparent discrepancy with previous ICES advice

ICES in 2005 said that applying a limit of TAC change between years of 15% was not precautionary for North Sea herring (rule number 5 of the management agreement). This advice may now appear to contradict the results described above. However it is important to realise that an impact of limiting TAC change is dependent on the relative size of catches and the starting point of enforcing the rule. WKHMP carried out simulations to illustrate this phenomenon. The tool used (FLR management simulator) was different from that used above, and is described in section 2.4. Only a broad cross comparison of the tools has taken place, thus studies can only be carried out that compare results from one tool, rather than across tools. A simple approach of simulating the management of North Sea herring with the existing rule (including 15% limit on TAC change), from 2003, 2005 or 2007 onwards was carried out. The recruitment was assumed to be poor, as seen over that period. The known quotas for 2004, 2006 and 2008 were applied to each simulation for the 2003, 2005 and 2007 studies respectively (Table 3.7.1).

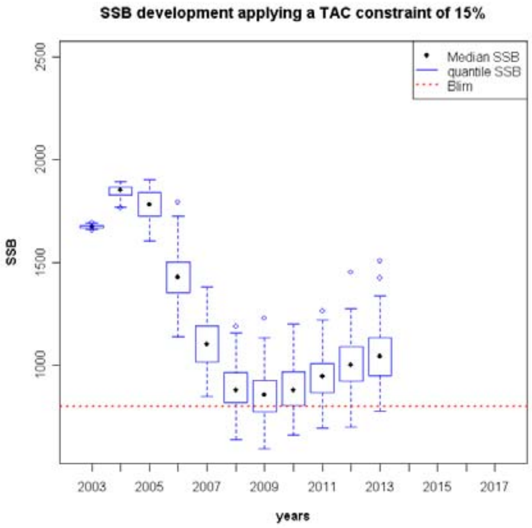
The simulations of population starting in 2003 (Figure 3.7.1) show that with the 15% limit on TAC change the population declines rapidly, this also occurs in 2005 simulation. The risk of dropping below B_{lim} was 35% in 2009 (Figure 3.7.2) if the rule had been applied in 2003. The TACs would have been too high to be precautionary if a limit on TAC change of 15% would have been applied. Due to the low recruitment, the limit on TAC change would also have had an impact from 2005 advice onwards (3.7.1). The risk of being below B_{lim} was 23% in 2009. This contrasts with starting the rule of 15% limitation on TAC change in 2007 when by 2009 that TACs are relatively small and the risk is low. This of course is dependent on the assumptions within the model.

This study demonstrates that it is important to account for the starting point (in terms of catch and SSB size) when applying a limit on TAC change.

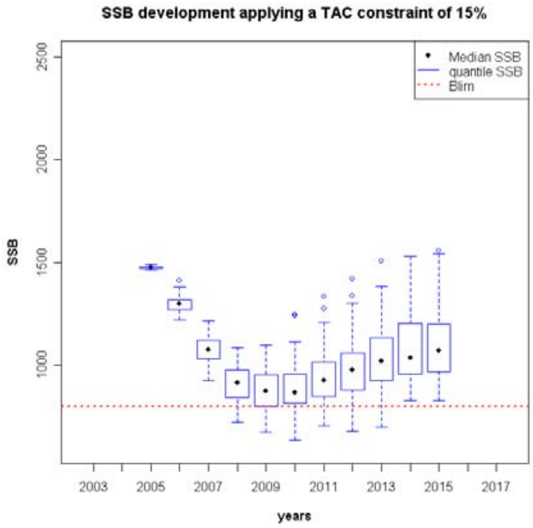
Table 3.7.1. Assumptions within the simulations to investigate the dynmics of the 15% limit on TAC rule.

	Fleet A	Fleet B
F on each fleet	0.12 SSB <= 0.8 MT 0.25 SSB > 1.3 MT Linear in between	0.05
TAC2004 for simulating 2003	460	According to F
TAC2006 for simulating 2004	455	According to F
TAC2008 for simulating 2007	202	According to F
Limit on TAC change	15%	-

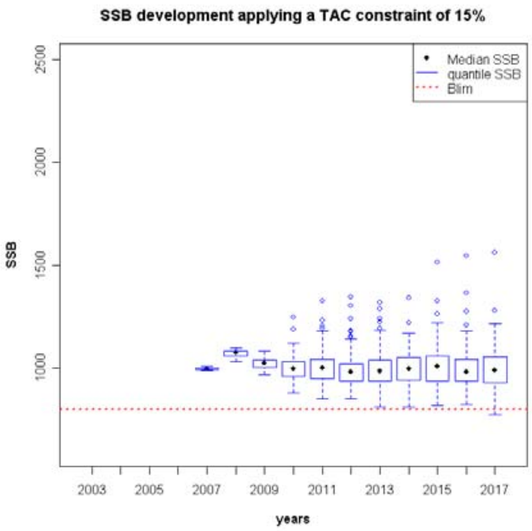
Implementation error	Lognormal distributed around 1.1, cv 0.1
Assessment error	Lognormal distributed around 1.1 , cv 0.1
Variance to initial numbers 2003 – 2005 – 2007	Lognormal distributed around 1 cv per age 0.0339, 0.0198, 0.0106, 0.0089, 0.0082, 0.0090, 0.0113, 0.0161, 0.0224, 0.01
Recruitment	Hockey stick: α= 62.23, cv 0.2 β= 0.3041, cv 0.12
Iterations	100
Trigger point	1.3 million tons
Blim	0.8 million tons
Catch weight, natural mortality, F patterns, catch weights, time of spawning, stock weights, SSB in starting year	According to HAWG reports in starting year



2003 onwards



2005 onwards



2007 onwards

Figure 3.7.1. Simulated population development of North Sea herring from 2003, 2005 and 2007 onwards with the management rule including 15% limit on TAC change. Recruitment as seen since 2002. Box plots are standard FLR outputs expressing medians and quartiles.

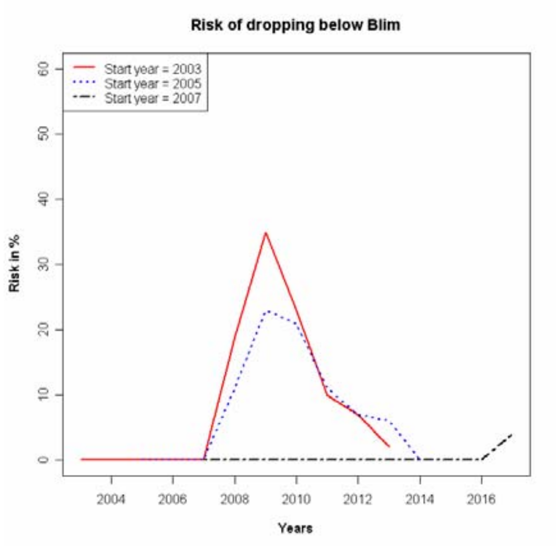


Figure 3.7.2. Risks of dropping below B_{lim} from simulated populations of North Sea herring from 2003, 2005 and 2007 onwards with the management rule including 15% limit on TAC change. Recruitment characterised as seen since 2002.

3.8 Exploration of trigger points

WKHMP is aware that the reference points for North Sea herring have long been questioned by the fishing industry: this was specifically addressed in 2007 by ICES WKREF (2003). In sections 2.1 and 2.3 of this report, the background and current thinking about the pertinence of reference points for this stock, which is being managed by a precautionary management rule, are discussed. However, the question of the target fishing mortality in relation to the trigger points is still a pertinent one, and is addressed here.

The current trigger biomass in the harvest rule is set at 1.3 million tonnes, reflecting an ambition to keep the stock large. However, given the recent string of poor recruitment in this stock, this level may no longer be appropriate: the reduced productivity implies that we should expect the stock to be below this trigger more frequently. A range of alternative values were explored.

The lowest value of the trigger biomass examined was 1.0 million tonnes (figure 3.8.1) and lead to a much higher risk of falling below B_{lim}. The median catches are similar to the baseline scenario, but there is an increased probably of small catches. The median SSBs are smaller, and the probability of low values is greater.

A high trigger biomass of 1.5 million tonnes (figure 3.8.2) lead to a median catch that is virtually unchanged from the baseline scenario. SSB is increased but realized fishing mortality decreased because the SSB is almost always below the trigger value. The stability of the catches is ensured by the constraint on TAC variation. The risk of falling below B_{lim} is comparable to that in the baseline scenario.

Generally, a biomass trigger that is too close to B_{lim} increases the risk of falling below B_{lim}, while the actual value of the trigger becomes less significant as the distance between the trigger and B_{lim} increases.

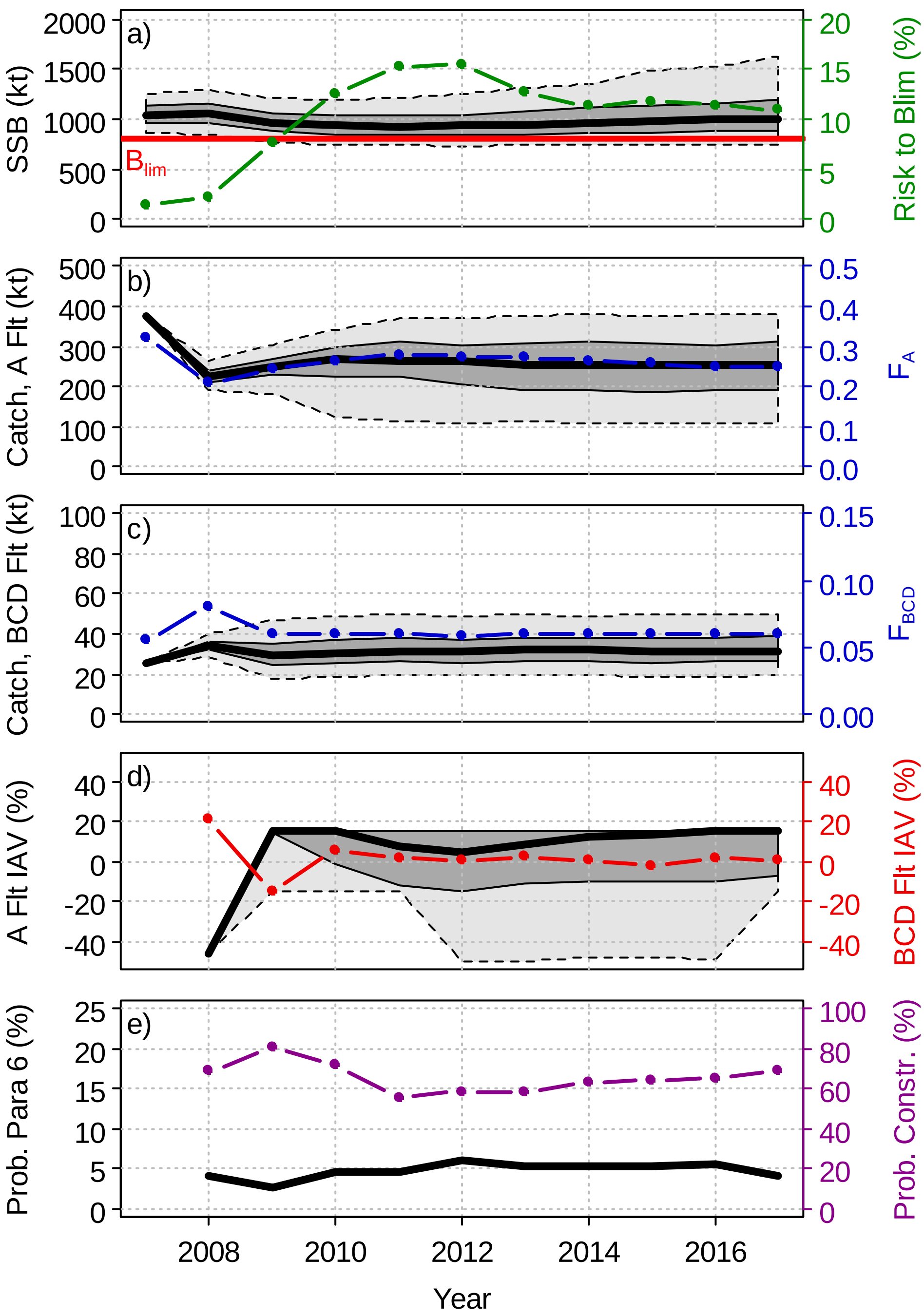


Figure 3.8.1 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT BIOMASS TRIGGER OF TARGET F REDUCED TO 1000 KT. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 08 in table 3.1.1.

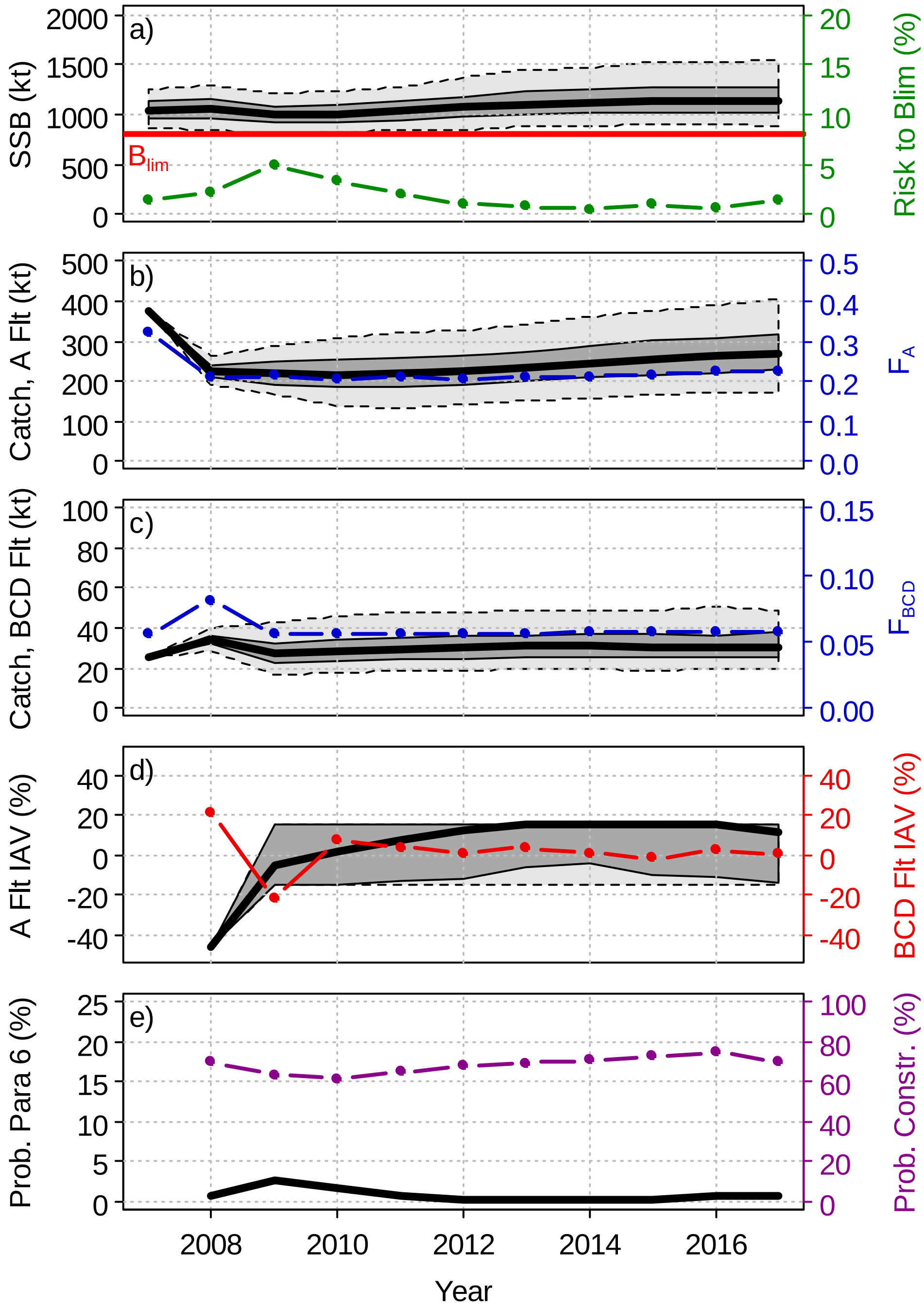


Figure 3.8.2 SIMULATION OF NORTH SEA HERRING MANAGEMENT PLAN BASELINE CASE BUT BIOMASS TRIGGER OF TARGET F INCREASED TO 1500 KT. a) Median spawning stock biomass (SSB; heavy black line) with estimated 50% (dark grey) and 90% (light grey) confidence intervals. B_{lim} (heavy horizontal red line at 800 kt). Risk of SSB falling below B_{lim} (green dotted line, right-hand axis). b) Median realised catch of Fleet A (heavy black line), with uncertainties as above. Median fishing mortality of Fleet A (blue dotted line, right-hand axis). c). Median realised catch of Fleets B, C, and D (heavy black line), with uncertainties as above. Fishing mortality of these fleets (blue dotted line, right-hand axis). d). Interannual variability in the TAC (IAV) for Fleet A (heavy black line), with confidence intervals as above. Fleets B, C and D (red dotted line, right-hand axis). e). Probability of Paragraph 6 of the management rule being invoked (black line, left-hand axis). Probability of the limitation on interannual variability constraining the catch (dotted magenta line, right-hand axis). NSH 12 in table 3.1.1.

3.9 North Sea herring summary and response to TOR a

The simulations confirm the conclusion by ACFM in 2005 that the performance of the current harvest rule is at best marginal in the present situation of reduced recruitment. The key issue is that even the relatively low fishing mortalities prescribed in the rule lead to an equilibrium biomass that is close to the Blim. A further reduction in recruitment, a higher overfishing or less reliable assessments all lead to a risk of falling below Blim that is incompatible with the precautionary approach. A better protection requires a reduction in the realized fishing mortality, which can be achieved by a reduction in target Fs or (less effectively) by a higher trigger biomass in the harvest rule. Neither of these will lead to substantial loss of catch for the A-fleet in the longer term, while the catch of the B-C-D feet will change according to the target fishing mortality for that fleet. A reduction in the F for the B-C-D fleet will lead to substantial increase in the catch for the A-fleet. Stability of TACs may improve with lower fishing mortalities.

The key criteria employed for judging the efficacy of a management plan were the long-term yields from the stock, conformity with the precautionary approach (specifically the risk of falling below Blim) and the stability of the yields.

The rule to constrain the interannual variation in TACs appears to work well, and 15% permitted change is within the acceptable range. The rule in paragraph 6 in these simulations has only been used as an additional protection below the Blim. Lifting the trigger biomass for the paragraph 6 rule has not been explored in depth, but would offer a further protection if the conditions deviate from what has been assumed here. The current value of Blim has not been considered by WKHMP.

Specific to the Terms of reference

The workshop considered the realised fishing mortality rate of 0.25 as being too high and recommended that it be 0.20. Such a reduction could be achieved in one of three different methods: by directly reducing the target F, by increasing the trigger point or by reducing the fishing mortality on juveniles. The rule concerning the stability of TACs (para. 5 of the management plan) was found to be appropriate under current circumstances.

The workshop did not consider the application of limits on variation in the TAC for herring by-catches in the North Sea. In recent years, the fishery has not taken up this quota fully and therefore it was felt that the implementation of such measures would not have a significant effect.

Scenarios examined in this workshop suggest that the application of paragraph 6 of the management plan is appropriate when the stock falls below Blim: in such situations, reversion to the basic management plan (without the constraint on interannual variation) appears to be appropriate. However, the application of this paragraph needs further development, especially in relation to the response to serial poor recruitment.

The workshop considers the current management plan to be borderline under the current low recruitment scenario. Simulations performed here show that it can just manage the stock in a precautionary manner under the current assumptions. However, the plan is sensitive to any negative deviations from the assumptions and such changes can lead to significantly increased risks of falling below Blim. Given the poor understanding of the ongoing reduced recruitment, it is not possible to say what the consequences are if the stock falls below Blim.

3.10 Exploration of other management rules

Under the Point 4 “A Consistent Basis for Decision-Making Concerning TACs” of the 2006 Communication from the Commission to the Council (COM(2006) 499) which is part of the

"Policy Statement from the European Commission" the Commission installed a set of rules to stabilise the fishing opportunities in 2007. Here various approaches with specific but not exclusive focus on demersal species are listed other than that what is commonly known as the "Agreed Harvest Control Rule for North Sea Herring" of the EU-Norway agreement of November 2004.

WKHMP picked up two of them which were then compared with a baseline approach and that of the current herring management procedure as being described in the EU-Norway agreement of November 2004. The idea is to check for serious discrepancies in the responses (outputs) of the alternative rules on a purely deterministic ad hoc basis. Thus, in all four cases the conditions were kept the same without specifying any errors, biases or other natural variations. A stock-recruitment function of hockey stick type (segmented regression) has been applied to all approaches with given parameter estimates. The other general conditions specified were:

$F_{start,\ adults}$ in 2007: 0.35

F_{adults}: 0.25 (where appropriate as targets)

$F_{juveniles}$: 0.12 (where appropriate as targets)

Planning horizon: 10 years

Data year: 2007

Intermediate year: 2008

First year of projection: 2009

Upper SSB trigger point: 1.3 Mio t

Lower SSB trigger point: 0.8 Mio t

TAC_{2007}: 341000 t

All input data (initial numbers per age, stock weight per age, catch weight per age, selection pattern, maturity ogive, natural mortality per age, etc) used for specifying the population dynamics of this stock were taken from the HAWG 2007 report (ICES 2007). The rules were named Rule 0 to 3 with

Rule 0. Baseline approach: This rule can stays with the initial F data for juveniles and adults without any further algorithmic restrictions such as constraining the catch flexibility. This basically forms a baseline for the other three rules 1 to 3.

Rule 1. Catch control approach: This rule mainly constrains the inter annual catch flexibility to ± 15% only (i.e. extreme changes). The first year, if the application of +15% in catches will result in rules not being fulfilled, then a 15% reduction in catches will apply. The algorithm will then check for the possibility of applying the +15% in catches for each subsequent year and again if rules are not fulfilled, a 15% reduction in catches will apply.

Rule 2. F control approach: This rule mainly constrains the effective F to be applied to a maximum inter annual reduction of 10% leaving the catch unconstrained until the target F (0.25) is reached.

Rule 3. The current herring management rule as specified by the EU-Norway agreement of November 2004 but without constraining the catch flexibility (i.e. invoking paragraph 6).

The results are illustrated by the diagrams in Figures 3.10.1 to 3.10.3 which basically show deterministic trajectories of SSB (for January and September) and total catch (Fig. 3.10.1), annual catch flexibilities and SSB flexibilities (Fig. 3.10.2) as well as annual F values (for adults and juveniles separately) (Fig. 3.10.3). In general the SSB and catch trajectories are not very different showing a similar pattern independent of the strategy used, made exception for Rule 1. However, because of the different control strategies, the patterns in terms of SSB fluctuations and catch flexibilities but also the F values differ somewhat between scenarios. Interestingly, even without any further control but only by keeping a constant initial F values for adults and juveniles, Rule 0 will not provide largely different results compared with the other control rules (except for Rule 1). In terms of the total catches summed up over the entire time series, Rule 3 is doing best while in terms of the final SSB (January and September) Rule 1 is maximising the SSB but at the cost of reducing the catches to almost nil. Nevertheless, it should be again stressed that this study is based on purely deterministic assumptions and thus these results can only give a very rough indication on how the various time trajectories may develop under the different control regimes applied.

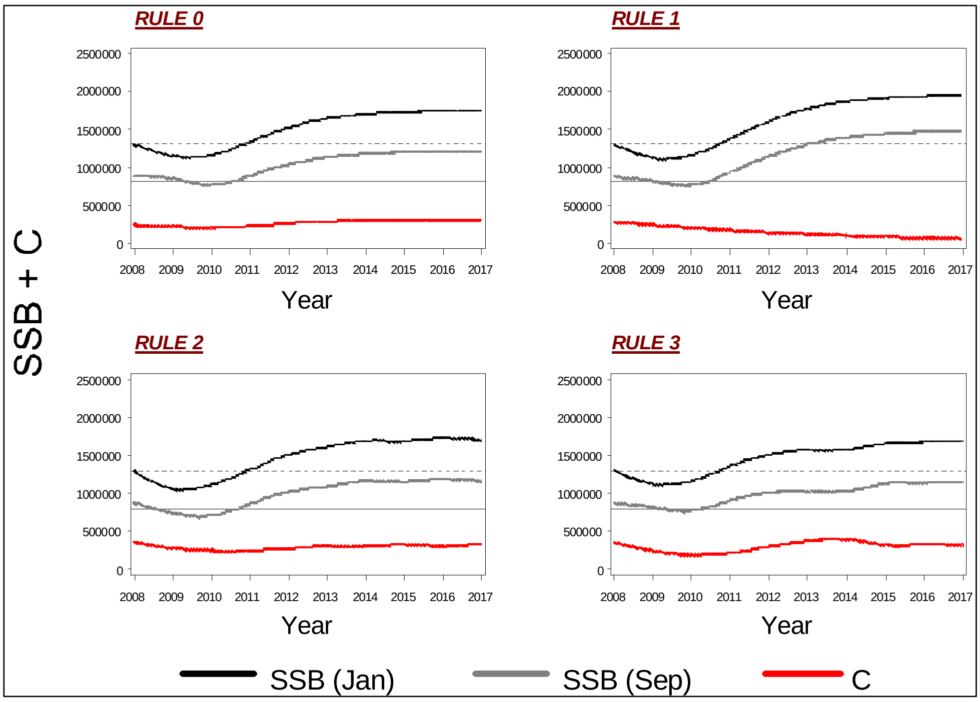


Fig. 3.10.1 Deterministic time trajectories of annual SSB values for January (black curve) and September (grey curve) as well as for the catches (red curve), given the different constraints of the four rules compared. The two horizontal lines in each of the four panels show the upper (broken black line) and lower (continuous black line) trigger point levels.

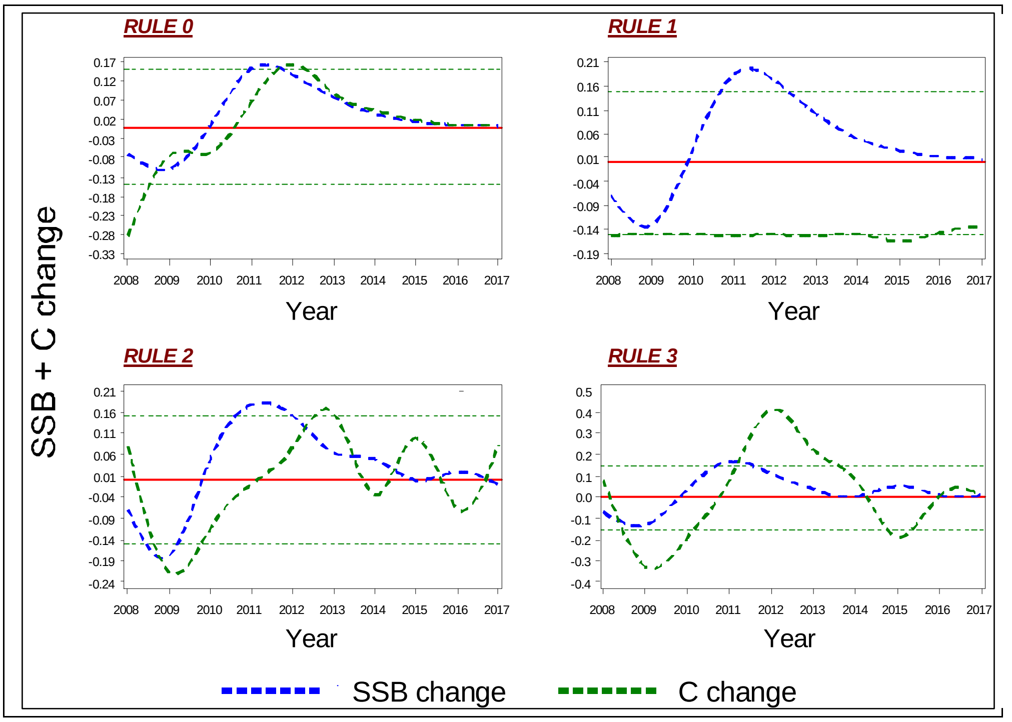


Figure 3.10.2 Deterministic time trajectories of annual SSB (broken blue curve) and catch (broken green curve) flexibilities, given the different constraints of the four rules compared. The two broken horizontal lines (black) in each of the four panels indicate the upper and lower 15% change levels while the continuous horizontal lines (red) in each of the panels indicate the no-change level.

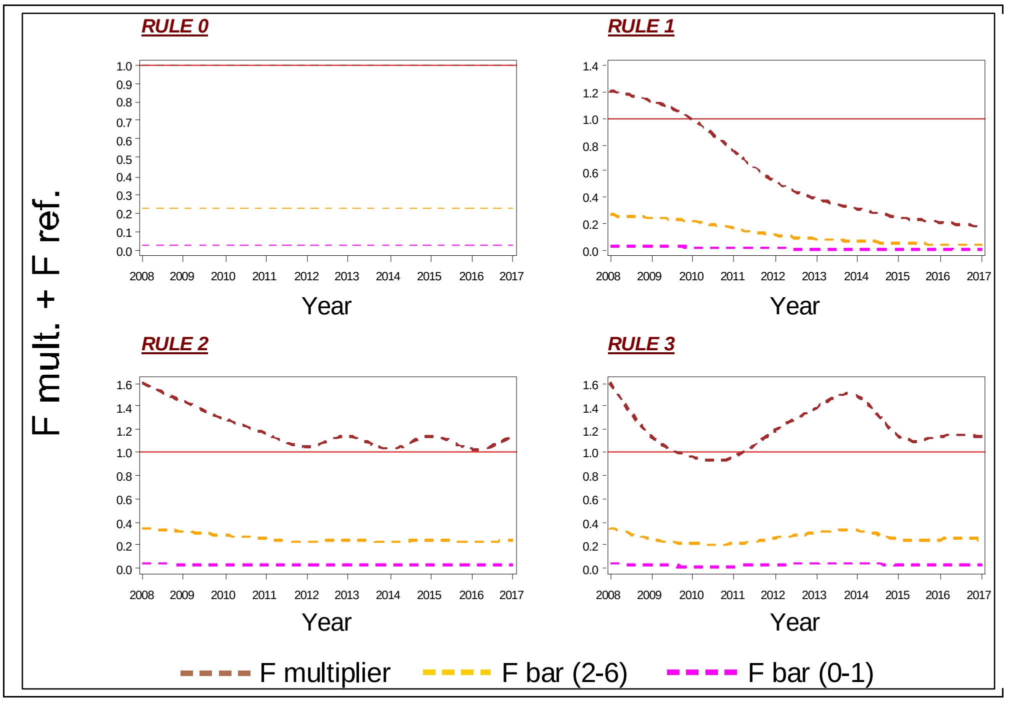


Figure 3.10.3 Deterministic time trajectories of annual F values for juveniles (broken magenta curve; means with respect to ages 0 and 1) and adults (broken orange curve; means with respect to ages 2 to 6), given the different constraints of the four rules compared. The third broken trajectory (broken brown curve) displays the F multiplier associated. The continuous horizontal lines (red) in each of the panels indicate the baseline for the F multiplier.

4 Western Baltic Spring Spawning Herring

4.1 Approach of the WKHMP

Following the TOR's set in b) WKHMP carried out simulations to identify multi-annual plans for WBSS aiming for a definition of a fishing mortality giving sustainability in the long term and ensure conformity with the precautionary approach with various combinations of the A, B and C.

The present state the formulation of a management plan for WBSS is at an early stage and given the present knowledge of the biology and state of the assessment of WBSS as described in sections 4.2 and 4.3, it should be emphasised that the results presented in section 4.4 are only preliminary. Therefore they are not final recommendations of the values for A, B and C. The end results should thus be regarded as indicative for what a management plan for WBSS should include.

4.2 WBSS stock background

The WBSS stock is comprised of several genetically distinct populations spawning in IIIa and subdivisions 22-24 (Bekkevold et al., 2005), of which the Rügen spawning component is assumed to be the largest and other components of relatively lesser significance. All components are considered to be highly migratory and particular the adults of Rügen origin migrate into IIIa where they feed in mixed stocks.

For WBSS the HAWG has advocated the need for better indicators of recruitment. At present, geometric mean recruitment has to be assumed for age 0 in the intermediate year and for later years. Stock and recruitment data for WBSS are available from 1991 and onwards. SSB declined since the early 1990s, while recruitment fluctuated and was low since the be-ginning of the 2000s. WBSS decreasing biomass was accompanied by stable individual weights and a decline of the proportion of older fish in the population. The results from a recent analysis carried out within WKHRPB (Workshop on Recruitment Processes of Baltic Sea herring stocks) in 2007 and further analysis (Cardinale et al., in prep) showed that the relationship between stock and recruitment was indistinguishable from a random process and therefore recruitment success could not be used as response in the models. For that reason, recruitment (in number of individuals; R) was used as response for modelling recruitment processes. After forward stepwise process, the only predictor in the final model was the BSI (Baltic Sea Index). This explained around 34% of the recruitment variance. However, the available time series is likely too short and the contrast in stock size not large enough to make firm conclusion on the recruitment dynamic. In addition, time series on food availability and predation by cod were not available.

4.3 Benchmark assessment on WBSS

The herring assessment working group will carry out a benchmark assessment of Western Baltic spring spawners in March 2008. This will result in a critical analysis of the availability, derivation and quality of input data. It also involves scrutiny of the data used in the assessment process, model choice and settings, and methods for projection of stock. Such benchmark assessment might change the perception of the stock dynamic as well as the current status of the stock. In this context, simulations and derived conclusions presented in the present report may need revision once the results of HAWG will be available.

4.4 Exploring the potential management plan

Comparable to the simulations for the NSAS herring the dynamics of the WBSS herring stock was examined under influence of target fishing mortality F[A] when the stock is above a trigger SSB [C] with maximum inter annual variation in TAC[B], expressed as interannual variation (%IAV). When the SSB was lower than [C] a linear decrease in F was applied according to the following relationship:

$F = (F_A - F_{low}) \times (SSB_{TAC} - SSB_L)/(SSB_C - SSB_L) + F_{low}$

F is estimated by iteration of TAC levels and subsequent SSB to the TAC; SSB_L is a limit spawning stock level below which a F_{low}= 0.1 is expected.

The HCS simulation tool was used to explore the effect of harvest rule parameters and model conditions. In each of several scenario runs a range of levels of target F[A] and trigger SSB [C] and levels of maximum TAC variation %IAV [B] were explored. The different scenarios differed in the recruitment level, the selectivity pattern for juveniles, and the assessment error.

Initial numbers at age, weight at age in the catch, weight at age in the stock, natural mortality, maturity at age and proportions of F and M taken before spawning were all applied as in the 2006 estimates from the HAWG 2007 report (table 3.7.1 in ICES HAWG 2007). Different selection patterns were modelled based on patterns estimated for different years (see e.g. fig. 3.9.3 in ICES HAWG 2007). Stock recruitment was assumed to follow a lognormal distribution around a hockey stick model with a SSB break point of 112 000 t, geometric mean recruitments and CVs were estimated from different periods of the time series. SSB_L was set at 110 000 t equal to the lowest observed SSB in the time series 1991-2006.

4.4.1 Simulations giving F for sustainable harvest applying standard settings

A run with a geometric mean recruitment over the time series 1991-2006 (3681 million, CV=44%) was performed with different levels of %IAV[B]. The yield per recruit curve levels out approaching a plateau at fishing mortalities above 0.3 (Figure 4.4.1.1). As with yield per recruit from the other scenarios the recruitment level only affects the level of the plateau not the curvature with F.

F values above 0.4 increase risks to B_{lim} somewhat (1-3%) independent of imposed maximum TAC variation (%IAV: 5-20%) (Figure 4.4.1.2).

Catches approach a maximum level at target fishing mortalities F[A] above of 0.25 and with the most restrictive levels of %IAV the catches decrease again at high target fishing mortality (Figure 4.4.1.3).

The realised median Fs are lower than F[A] at restrictive IAVs (5-10%) but similar at less restrictive IAVs (15-20%) (Figure 4.4.1.4).

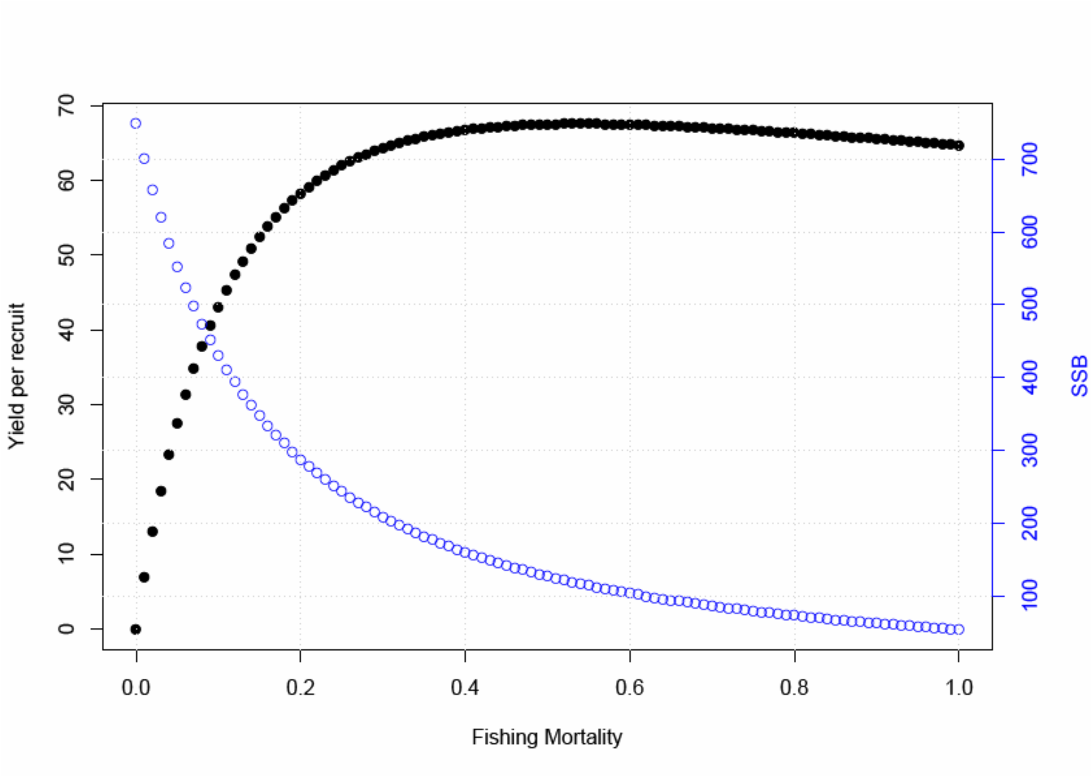


Figure 4.4.1.1. Yield per recruit curve for the WBSS herring stock at low recruitment (2002-2006 geometric mean) and recent exploitation pattern (2006)

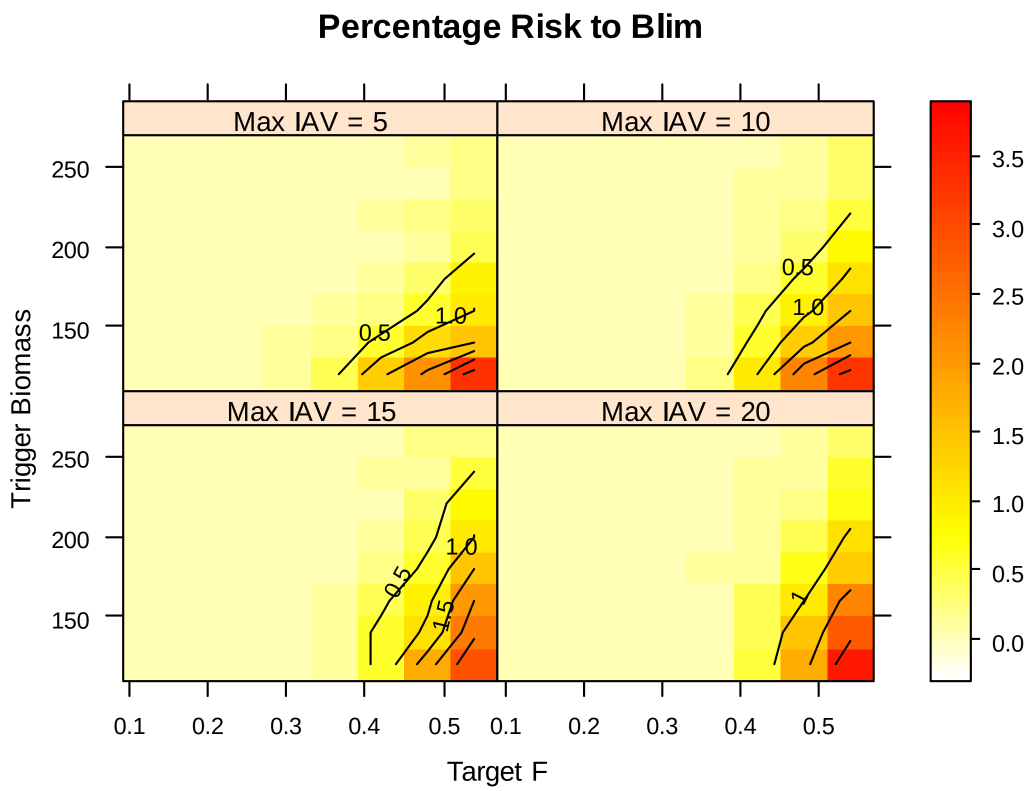


Figure 4.4.1.2. Risk to B_{lim} at scenarios of high recruitment (1991-2006 geometric mean) and low assessment error (CV=10%)

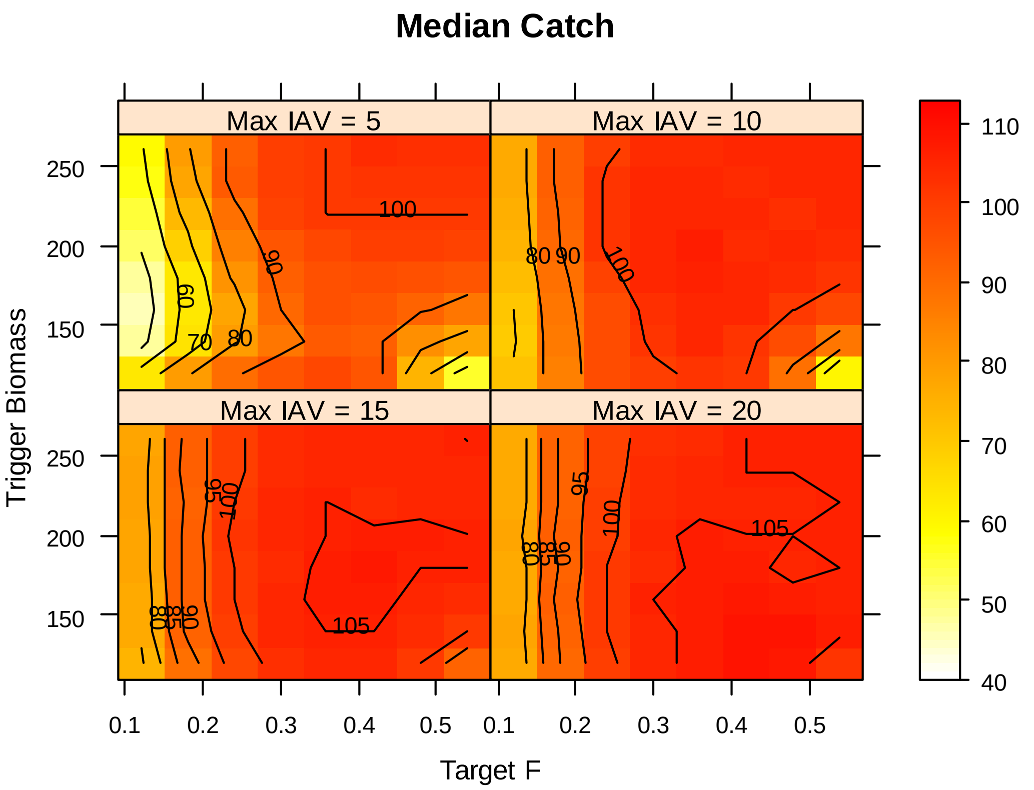


Figure 4.4.1.3. Median catches at scenarios of high recruitment (1991-2006 geometric mean) and low assessment error (CV=10%)

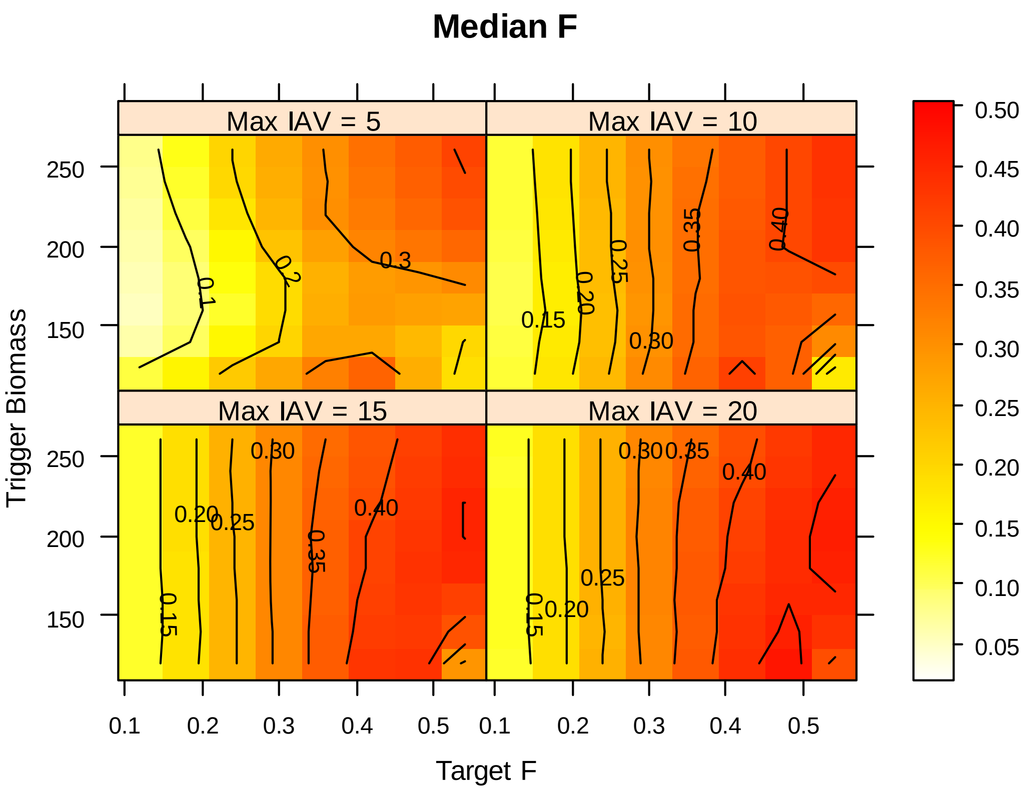


Figure 4.4.1.4. Realised F at scenarios of high recruitment (1991-2006 geometric mean) and low assessment error (CV=10%)

4.4.2 Variability in recruitment

A run with a geometric mean recruitment over the recent five years 2002-2006 (2487 million, CV = 44%) was compared with the runs using a higher recruitment described in section 4.4.1. The IAV was set at 15%.

At the recent years' lower recruitment and comparable target Fs, risks to B_{lim} were a little higher than at the high recruitment level. Risks further increased with increasing assessment error (10-50%) (Figure 4.4.2.1).

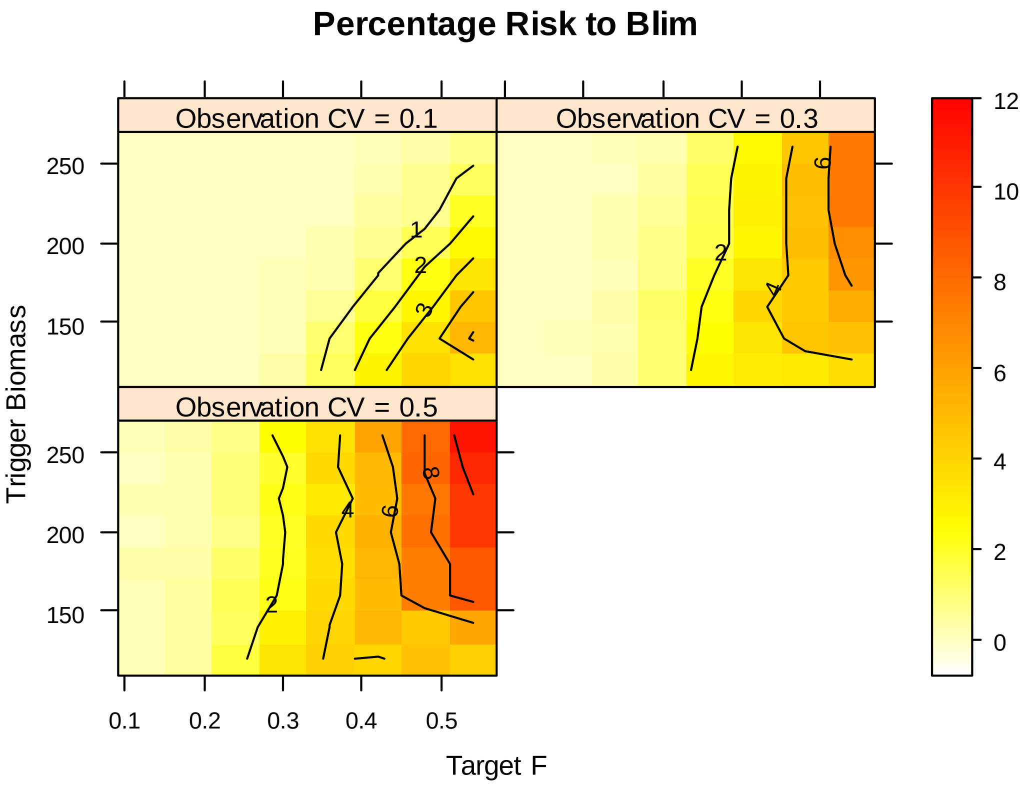


Figure 4.4.2.1. Risk to B_{lim} for different assessment error at scenarios of low recruitment and max 15% TAC variation

4.4.3 Variable selectivity at age and the role of the D fleet

Runs with a geometric mean recruitment over the recent five years 2002-2006 (2487 million, CV = 44%) were the basis for comparing different selection patterns on the juveniles. A selection pattern with relatively high juvenile fishing mortality similar to the years 1999-2001 was compared to one with relatively low juvenile F (about half of recent 2006 values for the 0-2 group). The IAV was varied between 5-15% (Figures 4.4.3.1 and 4.4.3.2).

Risk to B_{lim} increase (e.g. from 0.5 to 5% at 15% IAV, 200kt and F=0.4) with increasing proportion of juveniles selected. For the situation with a low juvenile selection there is slightly higher risk at lower trigger SSB, whereas for the high juvenile selection no such pattern is apparent.

The realised F is lower than the target F for the combination of low trigger SSB (<200' t) and low maximum variation in TAC (5%) for both scenarios of high and low juvenile selection (Figures 4.4.3.3 and 4.4.3.4).

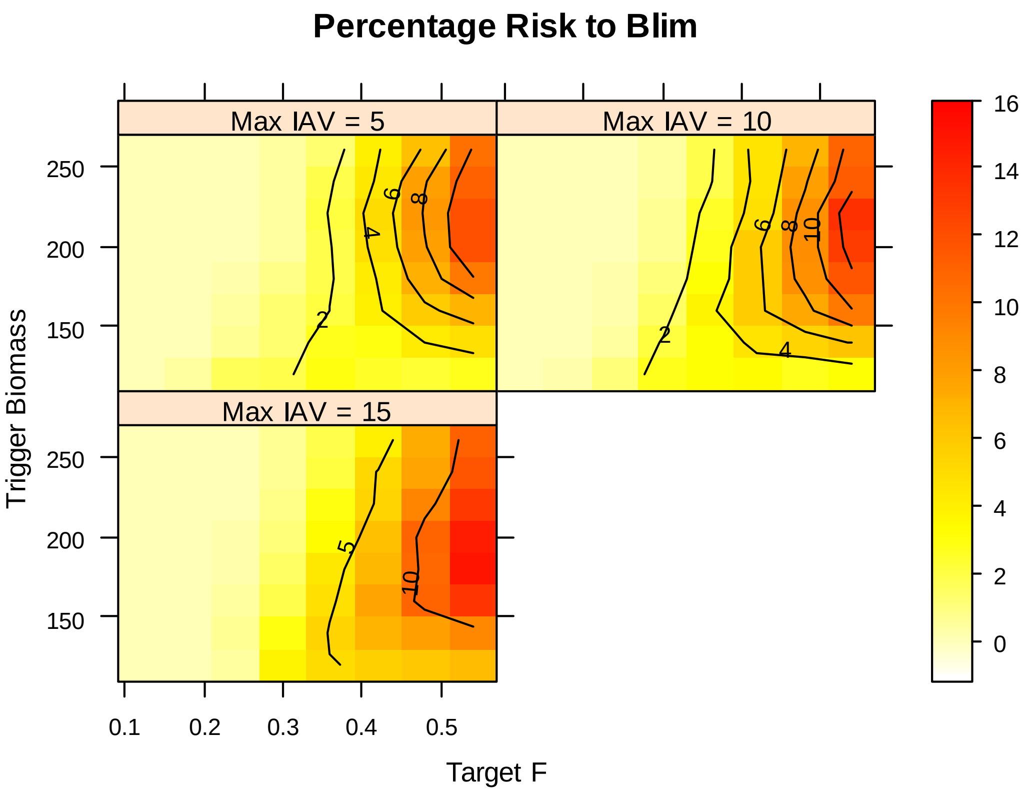


Figure 4.4.3.1. High juvenile selection (risk levels 0-16%)

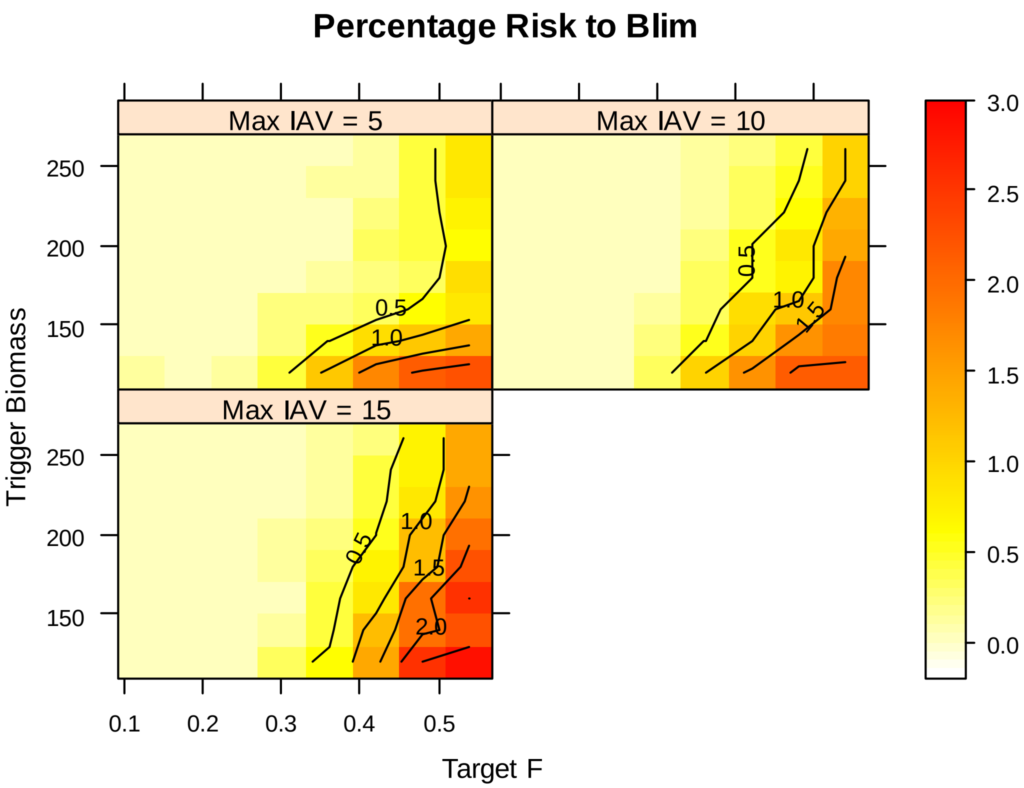


Figure 4.4.3.2. Low juvenile selection (risk levels 0-3%)

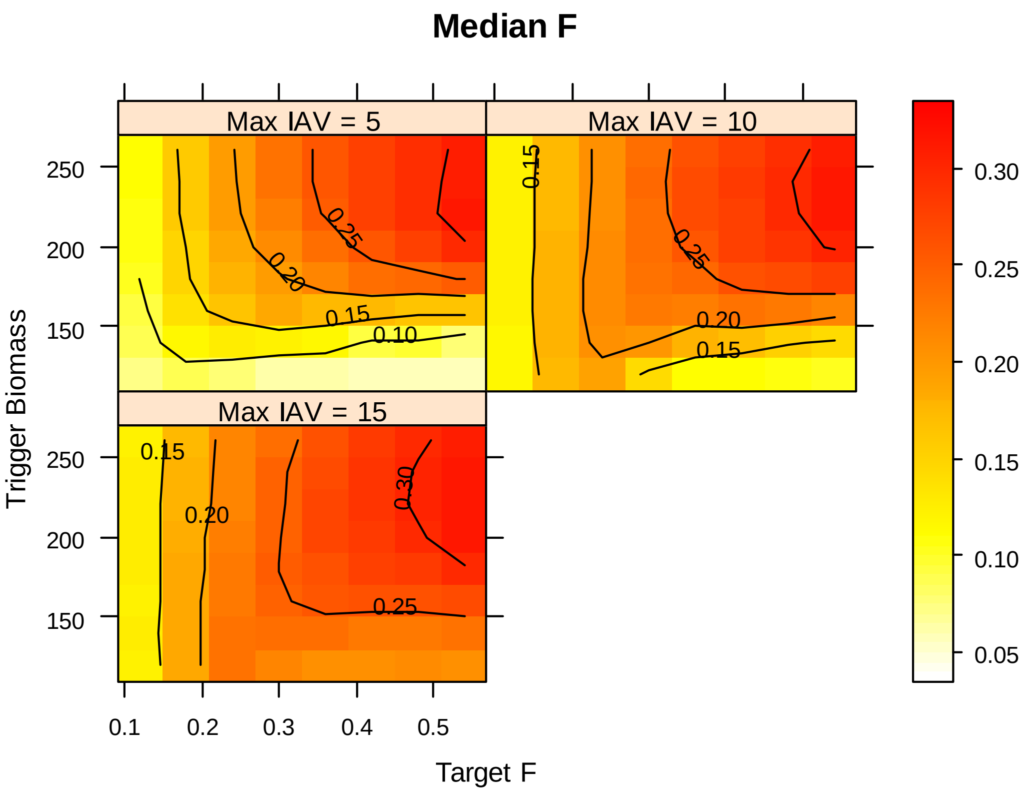


Figure 4.4.3.3. High juvenile selection (realised Fs)

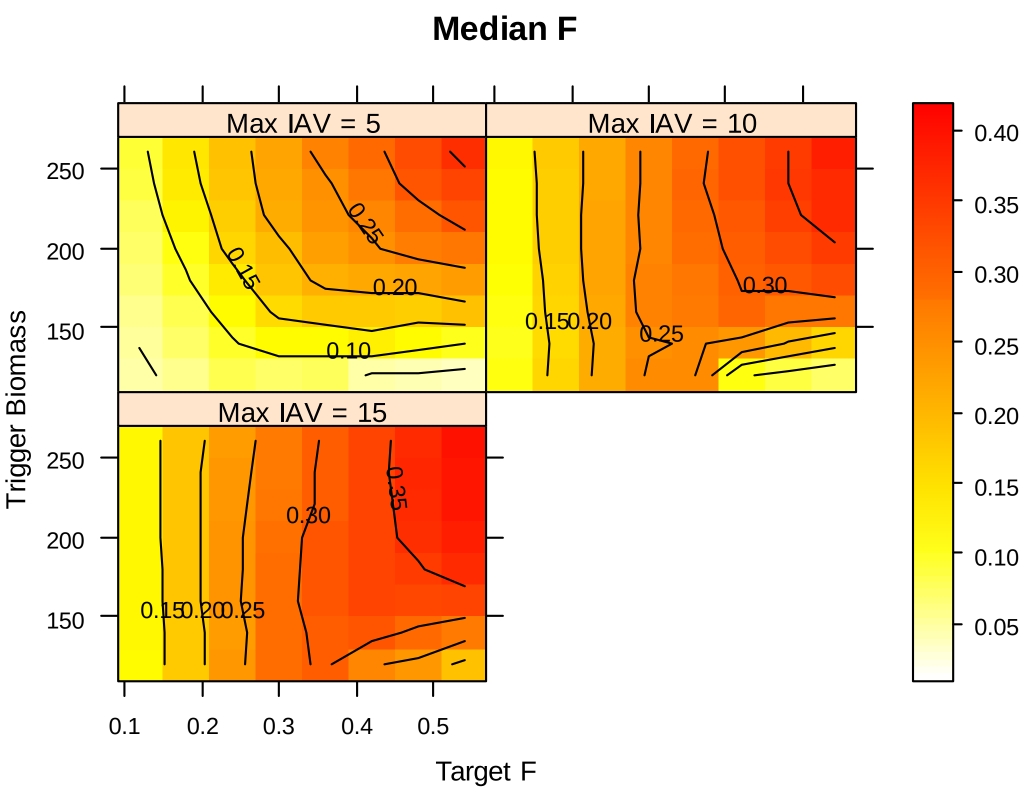


Figure 4.4.3.4. Low juvenile selection (realised Fs)

4.4.4 Variable accuracy of the assessment

Keeping trigger SSB constant at 160 000t the effects of assessment error at different target Fs was evaluated at no TAC restraint and at a 15% TAC variation restraint. Not surprisingly, the risk to B_{lim} increases with increasing assessment error at high target Fs, and in addition, in the current setup, risks are apparently much higher with no restraint to TAC variation than with the max. 15% limit. A run with a different perception of the stock hockey-stick SSB break point at 220 000 t instead of the 110 000 t gave qualitatively the same results (Figure 4.4.4.1).

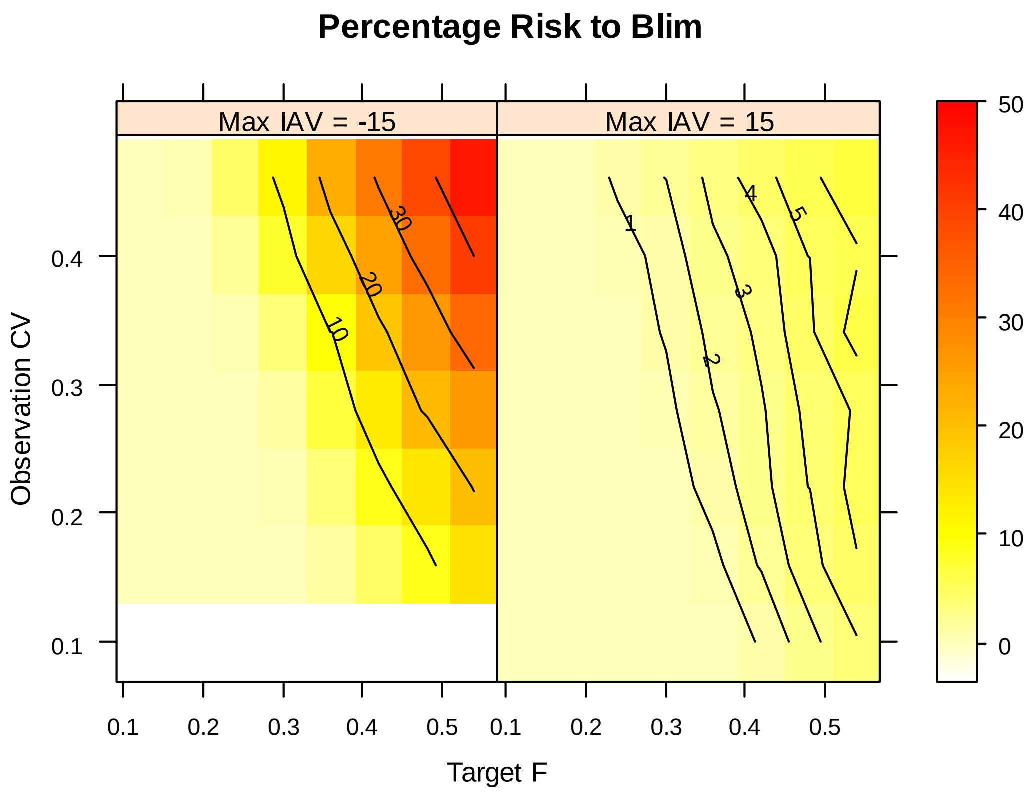


Figure 4.4.4.1. Risks at no TAC restraint (left) and max. 15% TAC restraint (right)

4.5 Looking forward

4.5.1 Further work required for the development of a management plan for WBSS

As pointed out in Section 2.2 a good understanding of the stock-recruitment relationship is a prerequisite for a robust simulation of a long term management plan. For WBSS such a relationship between stock and recruitment is not well established, and as it is unknown were the breakpoint is, the simulations presented here are based on the current understanding of the stock-recruitment relationship, which is poor. The major factor scaling the simulation output is the level of the expected mean recruitment under various circumstances and as the recruitment estimation for WBSS is not well established, the prediction of recruitment is based on quite sensitive assumptions. An improvement of the recruitment estimate for WBSS has been advocated by the HAWG that suggests to investigate procedures that give a better predictive power of the recruitment by reducing the impact of outliers and to analyse within survey variances. The upcoming benchmark assessment of WBSS is dealing with this subject by including new indices and testing a new recruitment estimate based on application of the split factor on the total North sea autumn spawners and western Baltic spring spawning herring (1wr) to get an estimate of the within-year WBSS 1-group as a recruitment index.

The simulation of management plan effects is sensitive to the selection pattern chosen in particular for the juveniles. Preliminary analysis suggests that the current selectivity pattern in both catch and indices as identified in the benchmark process by analysis of log-catch ratios are not appearing to be the same as used in the current settings in ICA and a recent decrease in F is not shown in the assessment. The outcome of trial assessments with a lower F the final years and runs with a somewhat shorter timeseries (1999-2007) should show a change in the catchability and thus give a better estimate of the selectivity pattern.

To achieve a more robust simulation of the effect of management plans for WBSS the stability of the growth and maturity index of WBSS need to be examined. The robustness of the maturity ogive was checked for the benchmark assessment by examining the year-to-year variation in percentage mature at age 3 and 4 in quarter 1. This revealed a large variation within those age-groups, though with an average not diverging from the ogives used by HAWG. The growth parameters for WBSS may also be worthwhile to look further into to get a better estimate of the rate of which the recruited individuals grow into the SSB.

4.5.2 Area based exploitation pattern for WBSS

A detailed analysis of log-books data from Danish vessels has demonstrated some spatial structure in the fleet exploitation pattern of WBSS showing the existence of two major groups of trawler vessels (fleets), one in the North (IIIa) and one in the South (Subdivisions 22-24). These fleets shift between mesh sizes (industrial trawling and human consumption trawling) throughout the year, and have to some extent distinct fishing patterns and fishing grounds. A management plan for WBSS is setup for the stock, however the stock is exploited in 2 different management areas and as the profile of the exploited stock is different between the areas it could be of importance to have a clear rule allocating fishing opportunities between the two areas. The historical pattern has been an allocation close to 50/50 between IIIa and subdivisions 22-24 as a result of informal allocation.

Current knowledge of the migration patterns of WBSS is that maturing individuals perform feeding migrations into the IVaE and IIIa during summer and return to the southern Kattegat and the sound where they over-winter before they, from March to May, move into the spawning areas at Rügen on the German Baltic coast (Bekkevold et al, 2007, Nielsen et al, 2001). Considering this life-stage spatiality over season and the fact that the stock is exploited in 2 different management areas it is recommended that a specific rule be incorporated in the management plan for WBSS that gives a fixed allocation between IIIa and Subdivisions 22-24 – i.e. 50/50 percent in each area.

4.5.3 Comparison with previous exploration of management plans for WBSS

The findings of the 2008 Workshop on Herring Management Plans (WKHMP) are consistent with the stochastic simulation based results of the Herring Assessment Working Group (HAWG) in 2007 (ICES 2007). This is striking as in contrast to the scenarios carried out during 2008 WKHMP, the scenarios of the optimization process during 2007 HAWG intended to directly regulate the WBSS fishery by generating optimum F values along with optimum catches. In the simulations carried out in HAWG 2007, the catches calculated were considered optimum once the optimum F values were found, and thus may have been used as TAC recommendations directly. Given this the outcome in terms of F and TAC values is anticipated to reflect the best management strategy with respect to the assessment conditions as specified by HAWG. The core of this approach was to maximize the following objective function:

$$\begin{aligned}\text{Objective Function} = \text{total herring catch} \\ - \lambda_1 \times \max(0, SSB_{\text{lower limit}} - SSB_{\text{estimated}}) \\ - \lambda_2 \times (1 - 0.15) \times \max(0, (\text{catch} - \text{catch}_{\text{mean}})^2)\,.\end{aligned}$$

This equation consists of three components in which the latter two are penalizing either an undercut of the lower SSB limit or a change of resulting catches that fall outside a symmetrical ± 15% interval being the current catch variation allowance suggested by the EU commission. The two λ values are weight factors that can be used for strengthening or relaxing the penalties associated with them. Beyond this the other equations describing the underlying population dynamics are given in detail in Gröger *et al.* (2007). However, although settings and concept of the methods used by HAWG (ICES 2007) and WKHMP are different, the HAWG results similarly indicated that an overall F value should be around F = 0.27 as the expected risk of SSB falling below the long term mean of SSB is negligibly small (around 1.5 on average). Risk in this context means, a probability of occurrence of 1.1% times an average (future) loss of SSB of 137 tons per year. The loss addresses the fact that lost SSB will be missing in the next year's SSB budget which in this case does affect regeneration potential and future catches only marginally. The HAWG simulations were carried out using SAS 9.1.3.

4.5.4 Interaction with stakeholders

The development of long- and medium term management plans needs science at the early stage to be open-minded, working together with managers and stakeholders to get some understanding of needs and preferences, and communicate possibilities, limitations and trade-offs. In order to agree upon a optimal management plan the rule for exploitation may often has to be part of a broader agreement, which for example includes the sharing of the resource between parties. The science contribution at this early stage should be to get an overview of opportunities and limitations, rather than coming up with detailed proposals (ICES 2007).

Stakeholders have been involved in the formulation of the management plan for WBSS right from the beginning initiating the request for the formulation of a management plan, based on the wish for stability in the TAC from year-to-year by allowing for a maximum change of 15% in TAC between years. Ultimately stakeholders have been active participants in the WKHMP. Such participatory decision-making processes in terms of both tools and practices has proven very fruitful and the WKHMP strongly recommends further inclusion of the stakeholders in the formulation of management plans, i.e. in terms of a risk assessment approaches to resource management as being developed in WKHMP. These use qualitative, semi-quantitative and quantitative methods and include stakeholder consultation and expert opinion to arrive at their determination of risk. Risk is then used to determine appropriate management responses.

4.6 Western Baltic spring spawners summary and response to TOR b

The simulations performed resulted in the below preliminary recommendations of the values for A, B and C. The end results should be regarded as indicative for what a management plan for WBSS should include.

[A] Simulations of yield per recruit and analysis of risks to Blim at different fishing mortalities (based on F-bar at ages 3-6 y) suggests that a target F should be set no higher than 0.25.

Exploration of different juvenile selection pattern indicates that at high fishing mortalities the risk to Blim increases with increasing juvenile selection.

[B] The constraints on the year-to-year variation in TAC is recommended to be kept at 15% as when adding uncertainty to the assessment accuracy, this IAV of 15% acts as a stabilizing factor reducing the risk to Blim.

[C] All exploratory runs indicate a recommendation for a higher trigger level in SSB, however, as the state of the stock is not well defined, a specific recommendation on the level of [C] cannot be given by WKHMP.

WKHMP recommends that fleet based management plans are analysed including options of partial Fs for juvenile and adult fishing mortalities. The analyses should be based on the best available information of the WBSS stock (HAWG bench mark assessment in March 2008).

5 Other approaches and potential future developments

In the future development and testing of management rules for herring the following issues should be considered:

5.1 Between year flexibility in catches.

It has been a longstanding recommendation from the fishing industry, and the Pelagic RAC, that the management plan should incorporate the possibility of transferring quota from one year to the next. This would allow the fishing industry the chance of optimizing the planning of their fishing activities. The suggested proportion that could be transferred between years is +/- 10% of the TAC. In effect this would mean that a state could overshoot its quota in one year by up to 10% and count the overshoot against the quota of the following year – or bring up to 10% of the quota in one year forward till the next year.

To test this, further development of the management simulation framework need is needed. At present the effect of this proposed flexibility is unclear.

5.2 Accounting for population dynamics more than one year in advance.

In 2004, ICES recommended an increase in the TAC for 2005 despite knowledge of the incoming poor year classes of recruitment from 2003 and 2004. This was because ICES gave advice in accordance with the existing management plan which only looks forward one year. The advice to increase the TAC for 2005 was then followed in 2006, 2007 and 2008 with advice to reduce the TACs as a result of the poor recruitment.

This caused problems for all stakeholders. At present the management plan does not account for poor recruitment until those year classes progress into the SSB. The 2005 advice also did not conform to the 15% limitation in TAC change. Further work is required (and recommended) to produce a management plan that prevents the phenomenon of advice being given for an increase in TAC in one year knowing that the TAC must be reduced the year after. An example of such a plan would be that used for north east Arctic cod where the decision rules are based on a three year forward projection.

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Annex 1: List of participants

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Annex 2: Terms of Reference

2007/2/ACOM27 The **Workshop on Herring Management Plans [WKHMP]** (chair: Mark Dickey-Collas, The Netherlands) will be established and will meet at ICES HQ, 4–8 February 2008 to:

α) evaluate the management plans agreed between Norway and the European Community concerning herring of North Sea origin:

- i) With particular respect to :
  - 1) achieving the highest yields long-term from these stocks;
  - 2) ensuring conformity with the precautionary approach;
  - 3) achieving yields as stable as possible, consistent with achieving a high yield from the stocks and achieving conformity with precautionary principles.
- ii) provide recommendations on any appropriate alterations to the target fishing mortality rate(s) (para. 2), the rule concerning stability of TACs (para 5), or the degressive rate of fishing mortality at lower stock sizes (para. 3).
- iii) Consider what (if any) limits on TAC variations could be applied to the TAC for herring by-catches in the North Sea
- iv) Advise on the circumstances in which para. 6 should apply, and the action to be taken in such circumstances.
- v) comment on any other pertinent aspect of the management plan.

β) identify multi-annual plans for Herring Western Baltic, Kattegat, Skagerrak (Sub-Div 22-24) :

- i) Of the following form
  - 1) the sum of the regulated catches for the stock of spring-spawning herring in the Western Baltic, the Skagerrak and the Kattegat ("the stock") shall be set according to a fishing mortality of [A].
  - 4) notwithstanding paragraph 1 above, the sum of the regulated catches shall not be altered by more than [B] % with respect to the sum of the regulated catches for the previous year.
  - 5) Notwithstanding paragraphs 1 and 2, in the event that the spawning stock size for the stock is estimated at less than [C tonnes / appropriate model-specific units], the sum of the regulated catches for the stock shall be adapted to assure rebuilding of the spawning stock size to above [C] without incurring the restriction referred to in Paragraph 2. ICES should propose a TAC-setting calculation in such cases.
- ii) ICES is asked to identify combinations of values for A, B and C that would assure management of the stock that would conform to the precautionary approach, i.e. a low risk of stock depletion, stable catches and sustained high yield.
- iii) ICES should explore other relevant scenarios on its own initiative, but should include at least scenarios where A = fishing mortality = 0.25 (by analogy with North Sea and West Scotland herring) or $F_{0.1}$= 0.22 and B = limit on TAC changes = 15%.
- iv) ICES is also invited to suggest other approaches to the multi-annual management of this stock on its own initiative.

WKHMP will report by 1 February 2008 for the attention of ACOM

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Annex 3: Existing Management plan for North Sea herring

According to the EU-Norway agreement (November 2004): -

1. Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the 800,000 tonnes (Blim).

2. Where the SSB is estimated to be above 1.3 million tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries , reflecting a fishing mortality rate of no more than 0.25 for 2 ringers and older and no more than 0.12 for 0-1 ringers.

3. Where the SSB is estimated to be below 1.3 million tonnes but above 800,000 tonnes, the Parties agree to set quotas for the direct fishery and for by-catches in other fisheries, reflecting a fishing mortality rate equal to:

   0.25 – (0.15*(1,300,000-SSB)/500,000) for 2 ringers and older, and

   0.12 – (0.08*(1,300,000-SSB)/500,000) for 0-1 ringers.

4. Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and less than 0.04 for 0-1 ringers.

5. Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC of the preceding year the Parties shall fix a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.

6. Not withstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15% compared to the TAC of the preceding year.

7. By-catches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.

8. The allocation of TAC for the directed fishery for herring shall be 29% to Norway and 71% to the Community. The by-catch quota for herring shall be allocated to the Community.

9. A review of this arrangement shall take place no later than 31 December 2007.

Annex 4: WKHMP terms of reference for the next meeting

There is no proposal for a further meeting of this workshop, as this workshop was held to address specific questions from customers.

However WKHMP acknowledges that the development and testing of management plans is an ongoing process within ICES and thus will expect further refinements and questions in the future.

Annex 5: Recommendations

We suggest that each Expert Group collate and list their recommendations (if any) in a separate annex to the report. It has not always been clear to whom recommendations are addressed. Most often, we have seen that recommendations are addressed to:

- Another Expert Group under the Advisory or the Science Programme;
- The ICES Data Centre;
- Generally addressed to ICES;
- One or more members of the Expert Group itself.

RECOMMENDATION	FOR FOLLOW UP BY:
1. **Recommendation**: WKHMP recommends that fleet based management plans are analysed for WBSS including options of partial Fs for juvenile and adult fishing mortalities. The analyses should be based on the best available information of the WBSS stock (HAWG bench mark assessment in March 2008). **Scientific justification:** The WBSS stock is comprised of several genetically distinct populations spawning in IIIa and subdivisions 22-24 (Bekkevold et al., 2005), of which the Rügen spawning component is assumed to be the largest and other components of relatively lesser significance. All components are considered to be highly migratory and particular the adults of Rügen origin migrate into IIIa and IVa east where they feed in mixed aggregations of NSAS and WBSS. Different age groups and stock components are caught by different fleets within its geographical distribution. Optimal management of this stock should consider characteristic migration patterns and mixing of different stock components when calculating effects of differential fishing mortality on juveniles taken as by catches and adults caught for human consumption respectively.	HAWG, RMC and ACOM
2.	
3.	
4.	
5.	
6.	

After submission of the report, the ICES Secretariat will follow up on the recommendations, which will also include communication of proposed terms of reference to other ICES Expert Group Chairs. The "Action" column is optional, but in some cases, it would be helpful for ICES if you would specify to whom the recommendation is addressed.

Annex 6: Output files from North Sea Herring scenario simulations

Run NSH1 – see figure 3.1.1

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	5.5	93.4	1.1	0.0	0.0
2010	6.4	92.4	1.2	0.0	0.0
2011	7.5	91.4	1.1	0.0	0.0
2012	9.2	88.2	2.6	0.0	0.0
2013	8.0	88.3	3.7	0.0	0.0
2014	6.7	89.8	3.5	0.0	0.0
2015	6.8	85.9	7.3	0.0	0.0
2016	7.0	86.1	6.9	0.0	0.0
2017	6.4	84.6	9.0	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.9	0.0	3.7
2010	4.9	0.0	1.0	3.9	0.0	0.9
2011	5.9	0.0	0.6	5.1	0.0	0.7
2012	7.1	0.0	2.1	5.3	0.0	0.6
2013	8.6	0.0	1.8	5.0	0.0	0.7
2014	7.3	0.0	1.2	3.5	0.0	1.4
2015	5.9	0.0	4.4	4.2	0.0	0.6
2016	5.7	0.0	2.7	3.6	0.0	3.1
2017	6.1	0.0	4.4	3.7	0.0	2.3

Percent prob. of level 2,3 => level 1 at least once: 35.1

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	797.3	907.8	979.8	1068.2	1200.3
2010	789.9	888.8	961.7	1042.0	1176.4
2011	782.2	879.6	953.3	1046.5	1183.9
2012	780.6	883.3	962.1	1057.6	1227.7
2013	771.6	889.0	980.9	1084.6	1270.8
2014	785.4	891.1	997.5	1105.7	1273.3
2015	778.8	902.4	996.1	1120.0	1334.0
2016	780.4	904.2	1007.3	1131.0	1342.6
2017	791.5	904.2	1006.9	1138.6	1376.6

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22339.9	28018.6	40625.1
2011	12526.1	17945.8	22854.8	29988.6	40381.3
2012	12853.1	18235.8	23150.8	29239.5	41575.3
2013	12534.1	18087.5	22650.3	28474.1	41715.3
2014	12440.8	17894.0	23150.7	29449.6	40277.6
2015	12994.9	18061.8	22924.3	28710.7	40143.7
2016	12522.4	17955.0	22430.2	28328.8	41077.3
2017	12729.0	17911.5	23432.7	29526.6	42157.8

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	167.5	200.2	231.0	257.2	291.3
2010	124.4	194.7	225.6	267.2	318.5
2011	117.1	185.6	225.1	260.3	326.0
2012	118.8	179.3	215.9	254.5	319.4
2013	122.5	180.0	216.8	253.4	317.8
2014	123.1	179.9	216.1	259.4	323.2
2015	118.3	181.5	219.9	259.3	324.0
2016	116.5	184.1	221.7	261.8	330.4
2017	112.0	185.8	227.0	268.6	339.7

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	25.1	38.8	51.5	68.8	96.4
2010	24.5	38.0	52.2	68.8	100.4
2011	23.9	39.1	52.3	68.7	103.7
2012	24.9	37.5	51.8	69.6	98.1
2013	26.5	40.4	54.2	70.4	100.3
2014	25.1	41.9	55.5	73.0	102.0
2015	23.8	39.6	54.6	72.3	103.3
2016	24.4	41.8	56.5	74.8	106.3
2017	24.5	41.6	56.7	75.7	103.9

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	6.0	15.0	15.0
2010	-15.0	-15.0	3.2	15.0	15.0
2011	-15.0	-15.0	0.4	15.0	15.0
2012	-15.0	-15.0	2.5	15.0	15.0
2013	-15.0	-15.0	8.7	15.0	15.0
2014	-15.0	-14.5	13.8	15.0	15.0
2015	-15.0	-15.0	12.6	15.0	15.0
2016	-15.0	-15.0	15.0	15.0	15.0
2017	-15.0	-15.0	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-24.7	13.5	50.9	99.6	177.2
2010	-53.1	-27.0	1.1	37.9	112.8
2011	-53.9	-26.7	1.2	36.8	115.8
2012	-51.9	-28.0	-1.7	35.8	126.6
2013	-50.7	-22.7	4.0	40.5	114.7
2014	-51.6	-23.6	2.3	38.6	108.8
2015	-54.4	-29.5	-3.2	31.5	113.8
2016	-50.9	-24.1	2.3	35.5	131.9
2017	-54.4	-26.1	-0.6	34.8	117.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	73.3	3.3
2009	65.0	2.7
2010	64.5	2.7
2011	64.8	3.1
2012	69.7	2.9
2013	69.9	2.3
2014	71.0	2.2
2015	73.2	2.4
2016	73.6	3.0
2017	73.4	3.3

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	165.6	204.7	225.3	246.1	277.0
2	33.5	42.9	50.3	58.2	73.5

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	152.7	195.3	223.6	246.9	285.1
2	18.6	24.4	28.8	33.9	41.8

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.161	0.198	0.221	0.248	0.294
2010	0.132	0.194	0.224	0.255	0.311
2011	0.116	0.190	0.226	0.263	0.320
2012	0.112	0.184	0.218	0.256	0.319
2013	0.112	0.178	0.217	0.250	0.318
2014	0.112	0.178	0.214	0.253	0.319
2015	0.108	0.171	0.212	0.254	0.322
2016	0.110	0.171	0.212	0.252	0.317

2017	0.110	0.174	0.214	0.261	0.334

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.058	0.087	0.109	0.137	0.175
2010	0.055	0.082	0.105	0.133	0.176
2011	0.054	0.082	0.107	0.132	0.175
2012	0.054	0.079	0.103	0.132	0.172
2013	0.058	0.084	0.107	0.135	0.173
2014	0.056	0.086	0.112	0.139	0.178
2015	0.055	0.086	0.110	0.138	0.174
2016	0.054	0.089	0.114	0.144	0.184
2017	0.057	0.086	0.115	0.144	0.180

Run NSH2 (baseline) – see figure 3.1.2

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	5.2	93.7	1.1	0.0	0.0
2010	4.3	94.1	1.6	0.0	0.0
2011	4.3	93.0	2.7	0.0	0.0
2012	3.4	89.9	6.7	0.0	0.0
2013	2.2	88.0	9.8	0.0	0.0
2014	1.9	86.1	12.0	0.0	0.0
2015	2.4	83.4	14.2	0.0	0.0
2016	2.7	80.7	16.6	0.0	0.0
2017	3.7	79.9	16.4	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.6	0.0	3.7
2010	4.6	0.0	1.4	2.5	0.0	0.9
2011	4.1	0.0	1.9	3.0	0.0	0.8
2012	4.2	0.0	4.7	2.0	0.0	0.8
2013	3.2	0.0	5.6	1.5	0.0	2.5
2014	2.0	0.0	5.3	1.3	0.0	3.1
2015	1.6	0.0	6.3	1.7	0.0	4.1
2016	2.3	0.0	6.2	1.6	0.0	3.8
2017	2.5	0.0	5.5	2.9	0.0	5.7

Percent prob. of level 2,3 => level 1 at least once: 19.5

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	799.1	910.3	983.8	1071.9	1208.9
2010	803.4	905.5	981.5	1067.2	1206.6
2011	811.2	913.0	998.7	1093.5	1248.3
2012	819.2	934.7	1022.9	1134.4	1322.8
2013	836.3	948.0	1049.8	1163.5	1381.7
2014	839.3	960.2	1065.3	1189.7	1406.7
2015	834.3	960.8	1069.9	1211.5	1485.1
2016	827.7	956.4	1072.3	1219.1	1491.2
2017	820.9	952.0	1066.8	1219.3	1539.6

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22346.6	28018.6	40625.1
2011	12526.1	17959.4	22854.8	29988.6	40381.3
2012	12853.1	18263.2	23192.3	29308.3	41575.3
2013	12534.1	18158.7	22681.2	28562.4	41670.6
2014	12562.1	17937.2	23168.2	29520.3	40361.5
2015	13037.0	18096.1	22946.9	28710.7	40424.9
2016	12554.3	18050.1	22520.3	28267.5	41135.3
2017	12729.0	18026.6	23456.0	29542.9	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	167.5	200.7	232.0	257.4	291.3
2010	138.7	197.5	227.9	272.7	322.6
2011	129.8	195.2	235.1	274.4	341.1
2012	136.8	197.6	234.1	278.9	347.7
2013	144.7	204.4	244.3	285.3	358.0
2014	150.0	207.0	252.2	301.9	379.3
2015	149.2	212.6	258.1	309.7	382.7
2016	156.4	218.5	265.1	312.2	390.7
2017	146.8	223.1	266.9	319.9	404.5

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.1	22.6	27.9	33.4	44.9
2010	17.7	24.1	29.0	35.7	47.6
2011	18.7	25.1	30.0	36.4	49.0
2012	19.0	24.6	30.3	36.7	48.0
2013	20.0	26.0	31.2	37.0	49.3
2014	19.6	25.7	31.4	37.5	49.3
2015	18.9	25.2	30.7	37.4	49.2
2016	19.1	25.6	31.0	37.0	50.7
2017	19.5	25.5	31.1	38.2	49.6

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	6.7	15.0	15.0
2010	-15.0	-15.0	7.3	15.0	15.0
2011	-15.0	-15.0	8.1	15.0	15.0
2012	-15.0	-13.9	10.7	15.0	15.0
2013	-15.0	-9.0	15.0	15.0	15.0
2014	-15.0	-8.3	15.0	15.0	15.0
2015	-15.0	-13.8	14.2	15.0	15.0
2016	-15.0	-12.8	15.0	15.0	15.0
2017	-15.0	-15.0	11.4	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.3	-33.5	-19.4	-3.4	29.0
2010	-34.1	-11.6	6.5	28.9	68.6
2011	-37.2	-15.0	3.4	25.3	60.2
2012	-33.5	-16.4	0.4	21.0	57.1
2013	-34.0	-14.3	3.4	22.3	56.9
2014	-37.1	-16.4	0.3	22.0	53.6
2015	-37.6	-18.2	-1.7	17.5	52.6
2016	-35.5	-15.6	1.6	22.0	64.3
2017	-39.3	-16.4	0.1	20.6	56.5

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	70.9	2.0
2009	65.1	2.7
2010	66.3	2.0
2011	66.3	1.3
2012	69.7	1.1
2013	70.5	1.2
2014	71.8	0.9
2015	71.0	1.4
2016	73.8	1.3
2017	71.0	2.0

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	170.1	210.5	233.2	256.6	285.8
2	23.7	27.7	30.8	34.2	40.2

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	175.4	223.9	258.4	290.5	339.9
2	12.0	14.0	16.0	18.0	21.2

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.161	0.198	0.221	0.248	0.294
2010	0.140	0.194	0.223	0.256	0.308
2011	0.124	0.195	0.230	0.267	0.321
2012	0.121	0.191	0.227	0.263	0.327
2013	0.119	0.192	0.228	0.267	0.331
2014	0.116	0.194	0.232	0.273	0.343
2015	0.119	0.192	0.232	0.278	0.342
2016	0.123	0.197	0.239	0.279	0.360
2017	0.122	0.199	0.242	0.288	0.371

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.050	0.057	0.064	0.076
2010	0.042	0.050	0.056	0.064	0.076
2011	0.042	0.050	0.057	0.064	0.077
2012	0.042	0.050	0.057	0.064	0.075
2013	0.043	0.052	0.058	0.065	0.077
2014	0.043	0.051	0.058	0.066	0.078
2015	0.042	0.051	0.058	0.065	0.077
2016	0.043	0.052	0.058	0.065	0.079
2017	0.044	0.051	0.058	0.065	0.078

Run NHS3 – see figure 3.2.3

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	4.8	94.0	1.2	0.0	0.0
2010	3.3	94.7	2.0	0.0	0.0
2011	2.0	94.0	4.0	0.0	0.0
2012	0.7	89.1	10.2	0.0	0.0
2013	0.5	83.8	15.7	0.0	0.0
2014	0.3	78.3	21.4	0.0	0.0
2015	0.4	75.9	23.7	0.0	0.0
2016	0.5	75.5	24.0	0.0	0.0
2017	0.9	72.9	26.2	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.2	0.0	3.6
2010	4.1	0.0	1.8	2.0	0.0	1.0
2011	3.2	0.0	3.0	1.2	0.0	1.0
2012	1.8	0.1	7.3	0.4	0.0	1.2
2013	0.7	0.0	8.6	0.4	0.0	3.1
2014	0.5	0.0	10.6	0.2	0.0	4.9
2015	0.2	0.0	9.6	0.3	0.0	7.3
2016	0.4	0.0	7.2	0.3	0.0	6.9
2017	0.4	0.0	9.1	0.6	0.0	6.9

Percent prob. of level 2,3 => level 1 at least once: 8.4

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	801.0	915.7	993.9	1079.5	1209.0
2010	816.0	925.4	1003.8	1092.1	1229.9
2011	842.5	950.5	1038.3	1131.9	1279.7
2012	859.7	985.7	1077.8	1189.2	1374.1
2013	889.1	1008.5	1114.0	1238.9	1447.0
2014	906.6	1030.6	1137.9	1270.9	1479.7
2015	913.4	1040.8	1149.7	1284.3	1534.5
2016	914.6	1041.6	1161.7	1291.8	1561.2
2017	899.0	1036.5	1163.5	1308.1	1563.5

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22346.6	28018.6	40625.1
2011	12526.1	17959.6	22861.0	29988.6	40381.3
2012	12853.1	18263.2	23210.7	29308.3	41575.3
2013	12579.1	18158.7	22725.6	28585.6	41715.3
2014	12562.1	17937.2	23175.6	29685.2	40611.4
2015	13037.0	18115.4	22972.2	28732.6	40424.9
2016	12554.3	18077.3	22575.7	28380.8	41135.3
2017	12735.3	18026.6	23468.8	29553.1	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	163.9	190.6	216.9	248.8	285.0
2010	136.0	181.2	213.1	250.8	303.4
2011	130.6	183.8	218.3	256.0	314.5
2012	140.0	187.4	220.2	258.3	317.8
2013	151.4	196.1	233.3	269.8	329.8
2014	158.2	207.5	239.4	284.7	345.6
2015	164.6	212.3	249.8	293.8	358.9
2016	170.6	220.3	260.7	298.5	369.1
2017	173.3	226.2	265.1	309.1	377.6

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.1	22.8	28.1	33.8	45.2
2010	18.0	24.4	29.5	36.1	47.9
2011	19.1	25.6	30.5	37.1	49.2
2012	19.4	25.2	31.0	37.2	48.7
2013	20.6	26.6	32.0	37.9	50.2
2014	20.3	26.5	32.2	38.4	49.6
2015	19.5	26.2	31.2	38.1	50.0
2016	19.9	26.4	31.8	37.7	51.1
2017	20.3	26.4	31.9	38.9	51.1

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	-6.9	15.0	15.0
2010	-15.0	-15.0	-0.6	15.0	15.0
2011	-15.0	-13.9	6.3	15.0	15.0
2012	-15.0	-11.5	10.6	15.0	15.0
2013	-15.0	-5.0	15.0	15.0	15.0
2014	-15.0	-4.8	15.0	15.0	15.0
2015	-15.0	-8.2	13.3	15.0	15.0
2016	-15.0	-9.4	12.7	15.0	15.0
2017	-15.0	-12.2	7.4	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.1	-33.0	-18.9	-2.6	30.2
2010	-33.6	-11.1	7.2	29.0	68.6
2011	-36.9	-14.8	3.9	26.2	61.6
2012	-33.0	-16.1	0.8	21.6	57.7
2013	-33.5	-13.8	3.3	21.6	56.3
2014	-36.0	-15.9	0.9	21.2	52.6
2015	-36.7	-18.2	-2.0	17.1	50.8
2016	-34.9	-14.7	1.6	21.4	61.5
2017	-37.7	-16.1	0.4	19.9	54.7

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	61.6	0.3
2009	63.8	2.7
2010	59.7	1.8
2011	62.3	0.6
2012	64.1	0.3
2013	67.0	0.3
2014	66.3	0.1
2015	67.3	0.1
2016	66.8	0.5
2017	61.7	0.3

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	170.1	200.3	222.0	242.0	271.2
2	24.0	28.1	31.1	34.6	40.5

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	180.9	220.3	248.4	276.7	318.0
2	12.3	14.5	16.4	18.4	21.5

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.156	0.187	0.210	0.235	0.280
2010	0.137	0.178	0.203	0.234	0.282
2011	0.126	0.177	0.207	0.236	0.285
2012	0.126	0.172	0.203	0.231	0.278
2013	0.128	0.174	0.204	0.235	0.285
2014	0.133	0.178	0.206	0.237	0.289
2015	0.133	0.182	0.210	0.244	0.293
2016	0.140	0.185	0.216	0.247	0.298
2017	0.141	0.190	0.221	0.253	0.310

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.051	0.057	0.064	0.076
2010	0.042	0.050	0.057	0.064	0.076
2011	0.043	0.051	0.058	0.065	0.077
2012	0.043	0.051	0.058	0.065	0.076
2013	0.045	0.053	0.059	0.066	0.078
2014	0.044	0.053	0.060	0.067	0.078
2015	0.043	0.052	0.059	0.066	0.077
2016	0.044	0.053	0.060	0.066	0.079
2017	0.045	0.053	0.059	0.066	0.078

Run NHS4 – see figure 3.4.1

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	5.8	92.9	1.3	0.0	0.0
2010	6.0	91.6	2.4	0.0	0.0
2011	4.5	91.9	3.6	0.0	0.0
2012	3.6	88.4	8.0	0.0	0.0
2013	2.4	84.4	13.2	0.0	0.0
2014	2.0	83.0	15.0	0.0	0.0
2015	2.2	79.4	18.4	0.0	0.0
2016	2.9	75.5	21.6	0.0	0.0
2017	4.1	73.5	22.4	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.3	4.2	0.0	3.6
2010	5.0	0.0	2.0	3.0	0.0	0.9
2011	5.7	0.0	2.3	3.0	0.0	1.1
2012	4.3	0.0	5.1	2.2	0.0	0.7
2013	3.5	0.0	7.1	1.6	0.0	1.9
2014	2.3	0.0	6.0	1.3	0.0	4.2
2015	1.8	0.0	7.2	1.5	0.0	3.8
2016	2.0	0.0	6.8	2.0	0.0	3.6
2017	2.6	0.0	6.7	2.3	0.0	5.9

Percent prob. of level 2,3 => level 1 at least once: 20.0

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	790.3	907.7	985.4	1077.7	1217.0
2010	792.5	903.4	987.0	1079.2	1233.2
2011	804.3	913.6	1007.0	1111.0	1279.3
2012	809.5	943.4	1035.3	1153.2	1353.2
2013	830.9	955.7	1064.9	1186.6	1415.6
2014	845.8	972.4	1080.3	1233.5	1471.5
2015	834.2	971.7	1094.8	1247.1	1550.4
2016	831.0	964.0	1097.5	1271.8	1569.6
2017	812.1	961.0	1097.8	1274.3	1664.0

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22339.9	28018.6	40625.1
2011	12526.1	17933.0	22854.8	29988.6	40381.3
2012	12853.1	18235.8	23192.3	29308.3	41575.3
2013	12534.1	18158.7	22668.5	28562.4	41817.0
2014	12562.1	17937.2	23175.6	29518.8	40611.4
2015	13037.0	18096.1	22972.2	28710.7	40245.6
2016	12554.3	18050.1	22556.7	28328.8	41135.3
2017	12729.0	18026.6	23456.0	29526.6	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	176.0	205.2	228.7	250.9	282.7
2010	129.3	201.0	227.7	261.9	301.1
2011	119.1	199.1	233.1	269.1	321.6
2012	126.8	199.3	235.6	272.9	333.0
2013	131.6	205.9	244.0	282.3	344.2
2014	140.0	210.2	249.0	292.9	355.6
2015	138.5	211.2	255.4	299.6	373.3
2016	139.8	214.1	260.0	303.5	382.9
2017	137.3	216.6	264.7	312.6	388.9

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.0	22.6	27.9	33.5	44.9
2010	17.7	24.1	29.0	35.7	47.7
2011	18.7	25.1	30.1	36.6	49.0
2012	19.0	24.7	30.4	36.6	48.1
2013	20.0	26.0	31.3	37.1	49.7
2014	19.9	25.8	31.4	37.7	49.5
2015	19.0	25.5	30.8	37.4	49.3
2016	19.3	25.8	31.1	37.1	51.3
2017	19.8	25.8	31.3	38.4	49.8

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-10.0	-10.0	6.7	10.0	10.0
2010	-10.0	-10.0	9.0	10.0	10.0
2011	-10.0	-10.0	10.0	10.0	10.0
2012	-10.0	-10.0	10.0	10.0	10.0
2013	-10.0	-5.9	10.0	10.0	10.0
2014	-10.0	-6.9	10.0	10.0	10.0
2015	-10.0	-10.0	10.0	10.0	10.0
2016	-10.0	-9.7	10.0	10.0	10.0
2017	-10.0	-10.0	10.0	10.0	10.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.4	-33.5	-19.4	-3.3	29.0
2010	-33.8	-11.6	6.5	29.1	67.9
2011	-37.0	-14.8	3.6	25.3	59.5
2012	-33.3	-16.1	0.4	21.3	57.1
2013	-33.9	-14.1	3.5	21.9	56.4
2014	-37.1	-16.4	0.5	21.3	53.6
2015	-37.5	-18.4	-1.7	17.5	52.3
2016	-35.3	-15.1	1.9	22.5	63.7
2017	-38.7	-16.3	0.5	20.2	54.9

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	79.7	1.9
2009	73.2	2.8
2010	76.3	2.4
2011	75.3	1.7
2012	80.2	1.0
2013	81.2	0.8
2014	82.3	0.6
2015	83.1	1.2
2016	83.8	1.9
2017	79.8	1.9

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	166.8	211.9	231.3	252.2	273.1
2	23.7	27.8	30.8	34.3	40.2

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	156.9	220.9	253.6	285.8	337.5
2	11.9	14.1	16.0	18.1	21.3

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.164	0.197	0.219	0.244	0.291
2010	0.140	0.197	0.219	0.249	0.291
2011	0.117	0.196	0.226	0.257	0.301
2012	0.110	0.191	0.223	0.254	0.307
2013	0.103	0.190	0.223	0.259	0.315
2014	0.104	0.191	0.226	0.264	0.324
2015	0.101	0.189	0.228	0.266	0.336
2016	0.100	0.187	0.229	0.273	0.345
2017	0.095	0.189	0.235	0.277	0.373

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.050	0.057	0.064	0.076
2010	0.042	0.050	0.056	0.064	0.076
2011	0.042	0.050	0.057	0.064	0.077
2012	0.043	0.050	0.057	0.064	0.075
2013	0.044	0.052	0.058	0.065	0.077
2014	0.043	0.052	0.058	0.066	0.078
2015	0.042	0.051	0.058	0.065	0.077
2016	0.043	0.052	0.058	0.065	0.079
2017	0.044	0.052	0.058	0.065	0.078

Run NHS5 – see figure 3.4.2

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	5.1	93.8	1.1	0.0	0.0
2010	3.9	94.8	1.3	0.0	0.0
2011	3.6	94.6	1.8	0.0	0.0
2012	3.3	91.4	5.3	0.0	0.0
2013	2.3	89.0	8.7	0.0	0.0
2014	2.0	88.7	9.3	0.0	0.0
2015	2.6	84.9	12.5	0.0	0.0
2016	2.9	85.1	12.0	0.0	0.0
2017	3.3	85.2	11.5	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.5	0.0	3.7
2010	4.5	0.0	1.1	2.4	0.0	0.9
2011	3.6	0.0	1.3	2.7	0.0	0.8
2012	3.4	0.0	4.3	2.2	0.0	0.9
2013	3.1	0.0	5.2	1.8	0.0	1.8
2014	2.2	0.0	4.1	1.3	0.0	3.5
2015	1.8	0.0	6.3	2.0	0.0	3.1
2016	2.4	0.0	4.6	1.7	0.0	5.1
2017	2.7	0.0	5.2	2.2	0.0	5.7

Percent prob. of level 2,3 => level 1 at least once: 18.8

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	795.2	911.1	981.7	1066.7	1200.7
2010	807.4	904.5	975.3	1058.9	1200.0
2011	812.6	913.2	990.9	1086.7	1232.8
2012	823.1	932.2	1012.1	1120.4	1306.8
2013	834.9	946.0	1042.6	1153.9	1365.9
2014	847.7	954.1	1051.5	1175.5	1363.5
2015	836.9	957.1	1052.1	1185.6	1428.3
2016	836.9	947.9	1059.6	1185.2	1420.4
2017	824.5	947.6	1056.7	1189.3	1418.5

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17756.4	22339.9	28018.6	40625.1
2011	12526.1	17959.6	22854.8	29988.6	40381.3
2012	12853.1	18263.2	23157.5	29308.3	41575.3
2013	12579.1	18158.7	22668.5	28562.4	41670.6
2014	12562.1	17937.2	23175.6	29532.4	40361.5
2015	12994.9	18096.1	22946.3	28710.7	40245.6
2016	12554.3	18050.1	22474.4	28380.8	41135.3
2017	12729.0	18012.7	23446.6	29542.9	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	161.3	197.2	233.7	266.6	302.1
2010	133.4	193.7	227.5	279.9	342.1
2011	133.3	192.7	237.3	276.2	356.8
2012	141.7	195.0	231.7	281.0	359.6
2013	148.8	205.3	245.5	289.7	374.3
2014	154.2	210.3	255.7	306.9	384.5
2015	156.7	216.3	258.3	314.5	388.9
2016	154.5	220.2	267.1	318.3	405.5
2017	158.3	222.1	270.4	328.6	418.3

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.1	22.6	27.9	33.4	44.9
2010	17.7	24.1	28.9	35.7	47.5
2011	18.8	25.1	30.0	36.2	48.8
2012	18.9	24.5	30.2	36.6	48.2
2013	19.9	25.9	31.1	36.8	49.2
2014	19.6	25.7	31.3	37.4	49.1
2015	18.9	25.0	30.6	37.4	48.7
2016	19.1	25.5	30.9	36.9	50.2
2017	19.4	25.5	30.9	38.2	49.4

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-20.0	-15.3	6.7	20.0	20.0
2010	-20.0	-16.8	6.5	20.0	20.0
2011	-20.0	-16.8	7.2	20.0	20.0
2012	-20.0	-15.9	9.6	20.0	20.0
2013	-20.0	-10.3	14.9	20.0	20.0
2014	-20.0	-9.3	14.6	20.0	20.0
2015	-20.0	-15.2	12.6	20.0	20.0
2016	-20.0	-16.5	13.1	20.0	20.0
2017	-20.0	-16.8	7.9	20.0	20.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.3	-33.4	-19.4	-3.4	29.0
2010	-34.0	-11.7	6.6	29.0	69.3
2011	-37.5	-15.3	3.0	25.6	60.8
2012	-34.0	-16.6	0.6	21.4	57.7
2013	-34.1	-14.3	3.4	22.6	56.8
2014	-38.3	-15.7	0.3	21.9	54.2
2015	-38.3	-18.6	-1.8	17.5	53.7
2016	-35.4	-15.3	1.7	22.4	64.7
2017	-39.5	-16.7	0.2	20.8	56.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	60.9	1.3
2009	55.9	2.5
2010	56.5	1.6
2011	56.7	1.4
2012	61.9	1.0
2013	62.2	0.9
2014	61.0	0.5
2015	62.9	1.5
2016	65.5	1.1
2017	60.9	1.3

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	174.4	210.0	234.8	258.1	294.1
2	23.9	27.7	30.7	34.2	40.1

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	186.3	229.1	260.3	293.6	336.8
2	11.9	14.0	15.9	18.0	21.2

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.159	0.197	0.224	0.254	0.302
2010	0.140	0.192	0.225	0.263	0.332
2011	0.130	0.192	0.232	0.270	0.331
2012	0.129	0.189	0.228	0.268	0.339
2013	0.135	0.193	0.229	0.270	0.342
2014	0.135	0.198	0.235	0.279	0.350
2015	0.135	0.199	0.238	0.281	0.349
2016	0.143	0.201	0.245	0.284	0.364
2017	0.141	0.207	0.250	0.294	0.370

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.050	0.057	0.064	0.076
2010	0.042	0.049	0.056	0.064	0.076
2011	0.042	0.050	0.057	0.064	0.077
2012	0.042	0.050	0.056	0.064	0.075
2013	0.043	0.051	0.058	0.065	0.077
2014	0.042	0.051	0.058	0.065	0.078
2015	0.042	0.051	0.058	0.065	0.077
2016	0.043	0.052	0.058	0.065	0.079
2017	0.044	0.051	0.058	0.065	0.077

Run NHS6 – see figure 3.6.1

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	4.1	94.8	1.1	0.0	0.0
2010	1.9	96.4	1.7	0.0	0.0
2011	1.4	94.6	4.0	0.0	0.0
2012	1.0	90.2	8.8	0.0	0.0
2013	1.0	84.0	15.0	0.0	0.0
2014	0.7	80.6	18.7	0.0	0.0
2015	0.6	76.6	22.8	0.0	0.0
2016	1.1	75.6	23.3	0.0	0.0
2017	0.7	76.0	23.3	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	2.9	0.0	3.7
2010	3.9	0.0	1.5	0.6	0.0	0.9
2011	1.8	0.0	3.1	1.4	0.0	0.8
2012	1.3	0.0	5.9	0.5	0.0	1.1
2013	1.0	0.0	8.6	0.8	0.0	2.4
2014	0.9	0.0	8.2	0.5	0.0	4.5
2015	0.5	0.0	8.6	0.4	0.0	4.5
2016	0.6	0.0	6.8	0.7	0.0	6.3
2017	1.1	0.0	6.8	0.7	0.0	6.8

Percent prob. of level 2,3 => level 1 at least once: 8.2

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	806.8	917.4	987.0	1073.0	1208.9
2010	831.8	917.3	991.9	1073.5	1227.5
2011	841.0	940.9	1018.7	1107.9	1272.5
2012	850.1	966.5	1058.1	1164.1	1363.9
2013	875.9	988.3	1095.7	1216.5	1454.2
2014	889.7	1007.8	1119.6	1259.1	1489.3
2015	878.3	1009.6	1131.0	1279.2	1565.5
2016	886.6	1012.4	1130.3	1284.2	1593.2
2017	870.6	1008.2	1124.8	1280.7	1589.0

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17775.3	22346.6	28018.6	40625.1
2011	12526.1	17962.8	22873.5	30000.1	40381.3
2012	12853.1	18263.2	23269.6	29308.3	41575.3
2013	12579.1	18158.7	22725.6	28562.4	41817.0
2014	12562.1	17937.2	23175.6	29606.2	40611.4
2015	13037.0	18096.1	22972.2	28710.7	40424.9
2016	12554.3	18050.1	22561.5	28381.1	41135.3
2017	12735.3	18026.6	23468.8	29553.1	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	130.5	190.8	230.9	257.4	291.3
2010	115.5	175.9	218.4	272.6	322.6
2011	123.2	173.7	219.3	270.0	341.1
2012	132.6	177.6	218.1	267.3	346.1
2013	144.0	187.1	232.0	277.6	354.1
2014	147.3	197.0	239.7	291.1	371.6
2015	149.1	203.7	252.6	305.7	376.6
2016	149.3	210.9	261.0	311.6	392.5
2017	148.9	217.3	266.9	327.2	411.0

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.1	22.6	27.9	33.4	44.9
2010	17.8	24.2	29.1	35.9	47.8
2011	19.0	25.1	30.3	36.6	49.3
2012	19.3	24.9	30.6	37.0	48.3
2013	20.3	26.1	31.6	37.4	49.7
2014	20.3	26.2	31.9	38.2	49.3
2015	19.2	25.6	30.9	37.8	49.6
2016	19.4	26.1	31.4	37.2	50.7
2017	19.9	25.9	31.5	38.7	50.0

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-41.8	-15.0	6.7	15.0	15.0
2010	-37.9	-12.5	13.2	15.0	15.0
2011	-35.4	-9.0	15.0	15.0	15.0
2012	-37.5	-6.8	15.0	15.0	15.0
2013	-28.0	0.1	15.0	15.0	15.0
2014	-34.4	3.6	15.0	15.0	15.0
2015	-37.6	0.1	15.0	15.0	15.0
2016	-35.1	-2.2	15.0	15.0	15.0
2017	-39.5	-5.1	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.3	-33.4	-19.3	-3.3	29.0
2010	-33.8	-11.4	7.0	29.7	69.5
2011	-37.0	-14.6	4.0	26.3	62.0
2012	-33.3	-16.2	0.6	21.2	57.8
2013	-33.4	-14.0	3.4	22.3	56.6
2014	-37.0	-16.1	1.1	22.0	54.0
2015	-37.5	-18.4	-1.8	17.4	52.7
2016	-34.9	-15.4	1.9	21.7	61.8
2017	-38.6	-16.1	0.1	20.3	55.3

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	67.1	8.9
2009	46.1	21.7
2010	54.2	16.1
2011	58.0	12.4
2012	64.0	11.7
2013	70.2	7.3
2014	71.0	7.3
2015	71.0	8.1
2016	70.4	8.5
2017	67.2	8.9

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	159.3	197.3	224.1	251.0	284.3
2	24.0	27.9	30.8	34.3	40.2

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	182.0	216.7	247.8	283.5	328.2
2	12.2	14.4	16.2	18.2	21.4

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.134	0.188	0.215	0.244	0.291
2010	0.120	0.174	0.211	0.249	0.308
2011	0.118	0.169	0.210	0.257	0.318
2012	0.117	0.162	0.201	0.245	0.317
2013	0.120	0.164	0.206	0.251	0.319
2014	0.122	0.168	0.208	0.254	0.335
2015	0.121	0.169	0.213	0.258	0.329
2016	0.128	0.174	0.216	0.265	0.346
2017	0.129	0.179	0.224	0.277	0.362

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.050	0.057	0.064	0.076
2010	0.042	0.050	0.057	0.064	0.076
2011	0.043	0.051	0.057	0.065	0.077
2012	0.043	0.050	0.057	0.064	0.076
2013	0.044	0.052	0.058	0.065	0.077
2014	0.043	0.052	0.059	0.066	0.078
2015	0.043	0.052	0.059	0.065	0.077
2016	0.043	0.052	0.059	0.066	0.079
2017	0.045	0.052	0.059	0.066	0.078

Run NHS7 – see figure 3.6.2

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	4.1	94.8	1.1	0.0	0.0
2010	1.9	96.4	1.7	0.0	0.0
2011	1.1	94.9	4.0	0.0	0.0
2012	0.7	90.5	8.8	0.0	0.0
2013	0.7	83.7	15.6	0.0	0.0
2014	0.6	80.2	19.2	0.0	0.0
2015	0.5	75.5	24.0	0.0	0.0
2016	0.7	75.2	24.1	0.0	0.0
2017	0.3	75.7	24.0	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	2.9	0.0	3.7
2010	3.9	0.0	1.5	0.6	0.0	0.9
2011	1.8	0.0	3.1	1.1	0.0	0.8
2012	1.0	0.0	5.9	0.3	0.0	1.1
2013	0.7	0.0	8.9	0.7	0.0	2.1
2014	0.7	0.0	8.3	0.4	0.0	4.7
2015	0.5	0.0	9.4	0.4	0.0	4.6
2016	0.5	0.0	7.0	0.3	0.0	6.9
2017	0.7	0.0	6.8	0.3	0.0	6.9

Percent prob. of level 2,3 => level 1 at least once: 6.7

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	806.8	917.8	987.0	1073.1	1208.9
2010	831.8	919.3	993.1	1073.8	1227.5
2011	842.0	945.0	1019.9	1111.7	1277.8
2012	854.6	969.9	1063.3	1166.4	1368.8
2013	883.0	993.7	1101.1	1222.4	1454.2
2014	897.5	1012.4	1129.7	1266.2	1499.5
2015	890.1	1018.9	1137.0	1292.2	1569.6
2016	899.3	1021.6	1134.1	1292.4	1595.5
2017	891.5	1022.6	1133.3	1282.8	1589.0

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17775.3	22346.6	28018.6	40625.1
2011	12526.1	17962.8	22873.5	30000.1	40381.3
2012	12853.1	18263.2	23269.6	29308.3	41575.3
2013	12579.1	18158.7	22725.6	28562.4	41817.0
2014	12562.1	17937.2	23175.6	29606.2	40611.4
2015	13037.0	18096.1	22972.2	28710.7	40424.9
2016	12554.3	18050.1	22561.5	28381.1	41135.3
2017	12735.3	18026.6	23468.8	29553.1	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	130.5	190.5	230.9	257.4	291.3
2010	115.6	174.3	217.5	272.5	322.6
2011	123.6	174.0	216.1	265.1	341.1
2012	132.6	177.7	216.7	260.3	342.2
2013	144.7	187.8	229.1	275.3	351.5
2014	151.5	198.1	240.2	290.0	366.3
2015	150.8	204.3	249.5	303.9	373.9
2016	152.5	212.0	256.7	308.7	397.1
2017	154.1	216.8	264.5	325.2	415.7

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	17.1	22.6	27.9	33.4	44.9
2010	17.8	24.2	29.1	35.9	47.8
2011	19.0	25.2	30.3	36.6	49.3
2012	19.4	24.9	30.6	37.0	48.4
2013	20.4	26.2	31.7	37.4	49.7
2014	20.3	26.2	31.9	38.2	49.3
2015	19.2	25.6	31.0	37.8	49.6
2016	19.5	26.2	31.4	37.4	50.7
2017	20.1	26.1	31.6	38.7	50.1

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-41.8	-15.3	6.7	15.0	15.0
2010	-37.9	-12.5	13.2	15.0	15.0
2011	-35.4	-8.1	15.0	15.0	15.0
2012	-35.5	-5.2	15.0	15.0	15.0
2013	-31.0	2.5	15.0	15.0	15.0
2014	-31.7	5.9	15.0	15.0	15.0
2015	-37.2	1.3	15.0	15.0	15.0
2016	-33.7	0.6	15.0	15.0	15.0
2017	-35.9	-2.7	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-48.3	-33.4	-19.3	-3.3	29.0
2010	-33.8	-11.4	7.0	29.7	69.5
2011	-37.0	-14.6	4.0	26.3	62.1
2012	-33.3	-16.2	0.7	21.2	57.9
2013	-33.4	-14.0	3.4	22.2	56.6
2014	-37.1	-16.1	1.1	22.0	54.0
2015	-37.3	-18.5	-2.0	17.3	52.3
2016	-34.7	-15.2	1.9	21.7	62.0
2017	-38.6	-16.1	0.2	20.3	54.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	60.4	15.8
2009	42.8	25.0
2010	47.9	22.5
2011	51.8	19.2
2012	58.1	17.4
2013	64.9	12.7
2014	66.0	11.5
2015	65.7	15.0
2016	64.5	14.5
2017	60.5	15.8

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	159.3	197.3	223.0	249.2	282.5
2	24.0	27.9	30.9	34.3	40.2

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	182.0	217.4	247.9	281.4	324.7
2	12.2	14.4	16.2	18.3	21.5

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.134	0.187	0.215	0.244	0.291
2010	0.120	0.172	0.209	0.248	0.308
2011	0.118	0.168	0.208	0.254	0.315
2012	0.117	0.162	0.199	0.242	0.311
2013	0.120	0.164	0.203	0.245	0.311
2014	0.123	0.168	0.207	0.249	0.327
2015	0.124	0.169	0.210	0.253	0.324
2016	0.129	0.174	0.215	0.259	0.338
2017	0.131	0.180	0.220	0.271	0.352

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.042	0.050	0.057	0.064	0.076
2010	0.042	0.050	0.057	0.064	0.076
2011	0.043	0.051	0.057	0.065	0.077
2012	0.043	0.051	0.057	0.065	0.076
2013	0.044	0.052	0.058	0.065	0.077
2014	0.043	0.052	0.059	0.066	0.078
2015	0.043	0.052	0.059	0.065	0.077
2016	0.043	0.053	0.059	0.066	0.079
2017	0.045	0.052	0.059	0.066	0.078

Run NHS8 – see figure 3.8.1

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	32.4	66.2	0.0	0.0
2008	2.2	31.7	66.1	0.0	0.0
2009	7.6	50.5	41.9	0.0	0.0
2010	12.6	55.1	32.3	0.0	0.0
2011	15.2	54.0	30.8	0.0	0.0
2012	15.5	49.4	35.1	0.0	0.0
2013	12.7	49.2	38.1	0.0	0.0
2014	11.3	44.8	43.9	0.0	0.0
2015	11.8	42.9	45.3	0.0	0.0
2016	11.4	37.6	51.0	0.0	0.0
2017	10.9	37.9	51.2	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	1.5	0.0	1.4	5.7	0.0	25.6
2010	5.6	0.0	7.7	7.4	0.3	17.0
2011	8.9	0.7	10.9	8.4	0.4	12.9
2012	11.1	0.9	12.6	8.1	0.1	9.1
2013	10.1	1.2	13.0	6.2	0.6	10.7
2014	8.2	0.6	12.7	5.9	0.1	7.5
2015	8.3	0.7	11.3	6.0	0.2	10.6
2016	7.6	0.7	12.0	5.6	0.1	7.3
2017	7.6	0.5	10.5	5.8	0.1	10.9

Percent prob. of level 2,3 => level 1 at least once: 52.7

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	775.0	888.6	968.4	1063.0	1208.8
2010	753.7	852.1	937.9	1031.4	1190.9
2011	739.4	835.8	924.5	1031.1	1204.8
2012	731.4	846.9	931.4	1044.5	1250.7
2013	746.8	850.9	948.2	1070.7	1313.4
2014	752.5	863.3	962.5	1109.1	1346.7
2015	750.4	868.5	976.7	1130.7	1479.0
2016	749.3	873.9	1003.8	1164.3	1521.7
2017	754.2	879.7	1007.3	1185.0	1618.6

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13013.6	17739.8	22303.2	27838.7	40343.6
2011	12521.3	17815.0	22726.9	29905.9	40343.2
2012	12584.7	18101.0	22993.0	29066.9	41144.1
2013	12372.4	17808.3	22499.2	28460.1	41611.6
2014	12379.2	17881.2	23095.3	29414.3	40498.2
2015	12828.9	18008.6	22850.8	28575.3	40134.6
2016	12522.4	17868.0	22430.2	28169.6	41061.2
2017	12729.0	17844.1	23236.8	29431.1	42250.6

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	181.8	228.9	249.6	271.0	302.9
2010	122.3	225.1	267.3	299.5	341.1
2011	113.3	224.7	264.7	312.9	370.9
2012	108.7	205.1	262.5	303.1	370.4
2013	111.6	191.9	256.2	307.4	374.1
2014	110.6	189.6	254.5	312.1	379.5
2015	108.6	185.9	252.2	307.7	377.8
2016	109.6	191.4	251.7	304.6	380.6
2017	109.7	193.0	256.0	310.6	381.9

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	18.1	24.2	29.3	35.0	47.1
2010	18.6	25.2	30.4	36.9	49.1
2011	19.3	26.0	30.9	37.6	49.7
2012	19.3	25.2	31.0	37.2	48.8
2013	20.0	26.3	31.8	37.7	49.7
2014	19.6	26.4	31.8	37.9	48.7
2015	19.1	25.8	30.9	37.7	49.9
2016	19.1	26.1	31.5	37.6	50.0
2017	20.0	26.2	31.7	38.8	49.5

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	13.8	15.0	15.0	15.0
2010	-15.0	-1.2	15.0	15.0	15.0
2011	-15.0	-11.8	7.4	15.0	15.0
2012	-49.5	-15.0	4.1	15.0	15.0
2013	-49.7	-10.8	8.0	15.0	15.0
2014	-48.3	-9.9	12.0	15.0	15.0
2015	-47.6	-10.2	13.1	15.0	15.0
2016	-49.0	-9.8	15.0	15.0	15.0
2017	-15.0	-7.4	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-44.9	-28.7	-15.0	1.6	32.7
2010	-33.6	-12.5	5.4	26.7	64.7
2011	-37.7	-16.4	1.8	22.4	60.6
2012	-34.5	-17.8	0.4	19.6	56.7
2013	-34.9	-15.0	2.4	21.0	55.5
2014	-37.2	-16.6	0.6	21.3	53.8
2015	-37.3	-18.1	-2.1	17.8	52.3
2016	-35.4	-15.6	1.6	21.8	61.7
2017	-37.9	-16.3	0.7	19.9	57.6

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	68.6	4.2
2009	80.7	2.7
2010	71.6	4.7
2011	55.5	4.6
2012	58.6	6.0
2013	58.4	5.4
2014	62.9	5.3
2015	64.3	5.3
2016	64.9	5.5
2017	68.7	4.2

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	168.8	229.3	256.5	274.3	297.6
2	24.5	28.6	31.7	35.2	41.0

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	150.8	205.5	256.1	293.5	340.4
2	12.2	14.4	16.2	18.2	21.3

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.174	0.216	0.242	0.270	0.325
2010	0.125	0.229	0.264	0.298	0.357
2011	0.115	0.234	0.280	0.322	0.382
2012	0.110	0.220	0.275	0.318	0.378
2013	0.108	0.199	0.272	0.312	0.387
2014	0.105	0.178	0.266	0.316	0.389
2015	0.102	0.164	0.259	0.316	0.393
2016	0.103	0.157	0.248	0.309	0.385
2017	0.103	0.157	0.248	0.308	0.394

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.045	0.054	0.060	0.067	0.078
2010	0.043	0.053	0.060	0.067	0.078
2011	0.044	0.053	0.060	0.067	0.079
2012	0.043	0.052	0.059	0.066	0.077
2013	0.045	0.053	0.060	0.067	0.078
2014	0.044	0.053	0.060	0.067	0.079
2015	0.043	0.053	0.060	0.067	0.077
2016	0.044	0.053	0.060	0.067	0.080
2017	0.046	0.053	0.060	0.067	0.078

Run NHS12 – see figure 3.8.2

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	98.6	0.0	0.0	0.0
2008	2.2	97.6	0.2	0.0	0.0
2009	4.9	95.1	0.0	0.0	0.0
2010	3.3	96.5	0.2	0.0	0.0
2011	2.1	97.5	0.4	0.0	0.0
2012	1.0	98.1	0.9	0.0	0.0
2013	0.8	96.4	2.8	0.0	0.0
2014	0.5	95.1	4.4	0.0	0.0
2015	1.0	92.7	6.3	0.0	0.0
2016	0.6	92.1	7.3	0.0	0.0
2017	1.5	91.3	7.2	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.0	3.3	0.0	0.2
2010	4.3	0.0	0.2	1.9	0.0	0.0
2011	3.2	0.0	0.3	1.3	0.0	0.1
2012	2.0	0.0	0.7	0.7	0.0	0.2
2013	1.0	0.0	2.4	0.5	0.0	0.5
2014	0.8	0.0	2.1	0.4	0.0	0.5
2015	0.4	0.0	3.0	0.8	0.0	1.1
2016	1.0	0.0	2.4	0.3	0.0	1.4
2017	0.5	0.0	2.4	1.3	0.0	2.5

Percent prob. of level 2,3 => level 1 at least once: 10.2

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	801.1	915.3	992.9	1079.6	1209.1
2010	815.5	923.4	1001.3	1089.0	1226.2
2011	838.3	946.1	1033.8	1127.3	1277.9
2012	852.6	979.5	1068.5	1182.0	1367.4
2013	880.8	1002.3	1103.3	1224.4	1444.0
2014	892.0	1015.5	1122.2	1251.9	1464.4
2015	894.0	1028.0	1134.2	1269.6	1528.9
2016	892.7	1023.9	1140.2	1274.2	1529.0
2017	877.9	1015.1	1139.7	1277.7	1549.8

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22346.6	28018.6	40625.1
2011	12526.1	17959.6	22861.0	29988.6	40381.3
2012	12853.1	18263.2	23210.7	29308.3	41575.3
2013	12579.1	18158.7	22723.3	28585.6	41715.3
2014	12562.1	17937.2	23175.6	29685.2	40611.4
2015	13037.0	18115.4	22972.2	28732.6	40424.9
2016	12554.3	18077.3	22575.7	28380.8	41135.3
2017	12735.3	18026.6	23468.8	29553.1	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	166.3	192.0	218.7	250.8	285.8
2010	136.0	183.7	215.3	255.0	308.6
2011	131.3	185.9	222.0	260.0	323.5
2012	140.0	189.8	223.8	263.9	326.5
2013	151.3	198.4	235.8	273.4	339.7
2014	159.1	208.6	242.7	289.3	363.3
2015	164.7	215.4	252.0	300.8	375.8
2016	169.6	220.2	264.3	306.1	390.2
2017	171.3	227.6	269.2	317.3	405.1

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	16.7	22.1	27.0	32.4	43.3
2010	17.4	23.6	28.4	34.6	46.3
2011	18.6	24.7	29.3	35.6	48.1
2012	18.7	24.2	29.9	35.8	47.4
2013	19.7	25.6	30.8	36.4	48.5
2014	19.7	25.4	31.0	37.2	48.5
2015	18.9	25.1	30.1	37.0	48.5
2016	19.2	25.4	30.5	36.6	50.4
2017	19.5	25.2	30.6	37.6	49.1

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	-4.8	15.0	15.0
2010	-15.0	-15.0	1.2	15.0	15.0
2011	-15.0	-13.1	7.4	15.0	15.0
2012	-15.0	-11.6	12.5	15.0	15.0
2013	-15.0	-6.3	15.0	15.0	15.0
2014	-15.0	-4.5	15.0	15.0	15.0
2015	-15.0	-9.8	15.0	15.0	15.0
2016	-15.0	-11.1	15.0	15.0	15.0
2017	-15.0	-13.6	10.9	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-49.2	-35.1	-22.1	-6.3	24.6
2010	-33.1	-10.8	7.1	29.4	66.3
2011	-36.4	-14.2	3.7	25.7	59.6
2012	-33.7	-15.4	1.1	21.6	56.9
2013	-33.7	-13.6	3.7	22.2	57.2
2014	-37.3	-15.8	0.8	22.2	53.7
2015	-37.5	-18.2	-1.8	18.2	53.1
2016	-35.1	-15.0	2.1	22.8	63.1
2017	-39.2	-16.7	0.3	20.7	54.9

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	70.0	0.8
2009	63.6	2.7
2010	61.1	1.8
2011	64.9	0.7
2012	67.6	0.3
2013	69.3	0.3
2014	70.8	0.2
2015	72.7	0.3
2016	74.7	0.6
2017	70.1	0.8

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	170.1	202.9	224.1	245.2	277.4
2	23.5	27.2	30.2	33.5	39.5

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	182.0	222.5	252.0	283.1	332.6
2	11.8	13.9	15.8	17.8	21.1

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.157	0.189	0.213	0.237	0.282
2010	0.139	0.180	0.206	0.237	0.286
2011	0.127	0.179	0.210	0.241	0.294
2012	0.126	0.176	0.207	0.239	0.293
2013	0.129	0.177	0.209	0.241	0.300
2014	0.133	0.182	0.212	0.246	0.308
2015	0.133	0.185	0.216	0.253	0.313
2016	0.138	0.189	0.223	0.257	0.325
2017	0.139	0.193	0.227	0.268	0.342

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.041	0.049	0.055	0.061	0.074
2010	0.041	0.049	0.055	0.061	0.074
2011	0.042	0.049	0.056	0.062	0.075
2012	0.042	0.049	0.055	0.062	0.074
2013	0.043	0.051	0.056	0.063	0.075
2014	0.042	0.051	0.057	0.064	0.076
2015	0.042	0.050	0.057	0.064	0.075
2016	0.042	0.051	0.057	0.064	0.078
2017	0.043	0.051	0.057	0.064	0.077

Run NHS13 – see figure 3.3.1

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	5.6	93.0	1.4	0.0	0.0
2010	6.2	90.8	3.0	0.0	0.0
2011	5.7	86.7	7.6	0.0	0.0
2012	5.8	79.0	15.2	0.0	0.0
2013	4.4	70.5	25.1	0.0	0.0
2014	3.7	62.8	33.5	0.0	0.0
2015	3.2	58.4	38.4	0.0	0.0
2016	3.2	52.8	44.0	0.0	0.0
2017	3.6	49.7	46.7	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	1.8	0.0	0.4	4.2	0.0	3.6
2010	4.0	0.0	2.6	3.0	0.0	1.0
2011	5.2	0.0	5.5	3.6	0.0	0.9
2012	4.2	0.0	8.7	3.1	0.0	1.1
2013	4.2	0.0	12.0	2.2	0.0	2.1
2014	3.6	0.0	11.6	1.9	0.0	3.2
2015	2.9	0.0	9.5	1.6	0.0	4.6
2016	2.2	0.0	9.0	2.1	0.0	3.4
2017	2.2	0.0	8.1	1.7	0.0	5.4

Percent prob. of level 2,3 => level 1 at least once: 22.1

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	790.4	911.6	991.7	1079.1	1216.5
2010	784.5	912.2	1000.5	1096.2	1257.6
2011	793.7	928.3	1028.7	1153.0	1342.3
2012	788.6	955.7	1079.2	1221.0	1496.4
2013	811.0	990.0	1132.8	1301.0	1630.4
2014	830.1	1022.8	1186.4	1375.2	1713.6
2015	826.8	1035.3	1204.9	1443.0	1842.8
2016	842.8	1042.7	1234.9	1500.3	1945.7
2017	825.9	1047.8	1270.7	1547.4	1974.1

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13013.6	17755.9	22310.0	27838.7	40625.1
2011	12526.1	17881.3	22814.9	29962.7	40381.3
2012	12853.1	18263.2	23150.8	29211.9	41422.3
2013	12522.6	18078.7	22664.5	28471.9	41670.6
2014	12465.8	17937.2	23150.7	29507.7	40277.6
2015	12763.8	18035.4	22946.3	28698.5	40424.9
2016	12554.3	17955.0	22486.9	28328.8	41135.3
2017	12735.3	18012.7	23437.6	29526.6	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	93.6	193.8	229.4	258.5	295.5
2010	85.5	177.7	217.5	267.4	319.3
2011	88.5	161.9	224.0	268.0	338.8
2012	91.6	140.2	216.3	267.1	336.6
2013	94.6	146.0	217.3	270.1	350.7
2014	96.9	151.1	218.5	277.0	363.8
2015	92.4	156.8	222.3	285.8	376.5
2016	97.6	166.1	226.7	289.1	389.4
2017	99.0	170.6	239.6	299.8	398.9

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	14.9	21.4	27.7	35.5	48.6
2010	15.5	23.0	29.1	37.5	53.7
2011	16.5	23.6	30.6	38.4	54.5
2012	17.2	23.5	30.4	38.4	54.1
2013	17.6	25.1	31.5	38.5	53.4
2014	17.3	25.0	32.1	40.2	55.6
2015	17.1	24.5	30.9	39.2	54.7
2016	17.4	25.2	31.8	39.4	56.9
2017	17.5	25.2	31.9	40.3	54.9

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-58.2	-15.0	8.0	15.0	15.0
2010	-59.2	-15.0	13.0	15.0	15.0
2011	-51.2	-15.0	15.0	15.0	15.0
2012	-55.0	-15.0	15.0	15.0	15.0
2013	-20.5	-8.9	15.0	15.0	15.0
2014	-15.0	-2.2	15.0	15.0	15.0
2015	-47.9	0.5	15.0	15.0	15.0
2016	-15.0	4.0	15.0	15.0	15.0
2017	-15.0	1.3	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-54.9	-37.1	-19.6	4.2	41.8
2010	-46.8	-21.0	6.3	41.7	113.9
2011	-49.5	-22.5	4.1	39.8	107.5
2012	-47.6	-24.1	-1.1	32.9	102.8
2013	-47.0	-21.8	4.0	34.3	92.5
2014	-48.4	-22.5	2.3	33.0	88.2
2015	-49.1	-26.6	-3.5	27.5	92.3
2016	-45.8	-21.6	2.7	32.8	110.6
2017	-49.4	-24.5	0.9	30.6	87.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	82.5	4.2
2009	70.2	7.7
2010	70.6	9.2
2011	75.0	5.7
2012	76.1	6.2
2013	81.5	5.0
2014	81.6	4.4
2015	80.5	5.1
2016	85.0	4.4
2017	82.6	4.2

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	135.7	190.4	224.1	249.8	281.5
2	23.6	27.9	31.2	35.0	42.5

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	127.9	169.3	222.7	272.4	325.6
2	12.1	14.4	16.4	18.7	22.3

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.097	0.186	0.217	0.251	0.315
2010	0.081	0.172	0.211	0.256	0.316
2011	0.076	0.150	0.213	0.262	0.338
2012	0.074	0.118	0.199	0.254	0.333
2013	0.074	0.110	0.191	0.251	0.346
2014	0.073	0.106	0.187	0.247	0.343
2015	0.071	0.104	0.179	0.247	0.349
2016	0.074	0.106	0.171	0.252	0.356
2017	0.074	0.110	0.173	0.256	0.366

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.035	0.047	0.057	0.069	0.089
2010	0.035	0.046	0.056	0.069	0.090
2011	0.035	0.047	0.058	0.070	0.089
2012	0.035	0.047	0.056	0.069	0.086
2013	0.037	0.048	0.058	0.070	0.089
2014	0.036	0.048	0.059	0.071	0.090
2015	0.035	0.049	0.059	0.069	0.088
2016	0.036	0.050	0.059	0.071	0.092
2017	0.038	0.049	0.059	0.070	0.091

Run NHS14 – see figure 3.3.2

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	3.4	92.8	3.8	0.0	0.0
2009	9.1	90.2	0.7	0.0	0.0
2010	10.4	88.8	0.8	0.0	0.0
2011	10.9	87.9	1.2	0.0	0.0
2012	10.1	86.7	3.2	0.0	0.0
2013	7.4	86.3	6.3	0.0	0.0
2014	5.8	85.8	8.4	0.0	0.0
2015	6.3	81.9	11.8	0.0	0.0
2016	6.4	78.9	14.7	0.0	0.0
2017	6.8	78.2	15.0	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	3.1	0.0	0.2	6.7	0.0	3.3
2010	8.3	0.0	0.7	5.6	0.0	0.6
2011	10.0	0.0	0.9	6.5	0.0	0.5
2012	10.2	0.0	2.6	4.9	0.0	0.6
2013	9.4	0.0	3.9	4.7	0.0	0.8
2014	7.0	0.0	4.2	3.1	0.0	2.1
2015	4.9	0.0	5.6	4.3	0.0	2.2
2016	5.5	0.0	5.7	3.8	0.0	2.8
2017	5.8	0.0	4.8	3.7	0.0	4.5

Percent prob. of level 2,3 => level 1 at least once: 39.1

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	833.9	944.8	1036.4	1136.7	1278.7
2009	763.7	874.9	948.2	1032.0	1166.7
2010	759.6	857.7	930.1	1014.9	1149.2
2011	760.2	862.9	941.8	1036.3	1186.7
2012	769.8	885.0	967.2	1073.2	1252.8
2013	774.9	899.5	998.8	1116.0	1324.2
2014	795.0	911.8	1023.3	1148.1	1355.2
2015	784.3	916.1	1028.3	1170.7	1441.0
2016	785.6	915.7	1037.2	1188.2	1459.9
2017	774.0	918.2	1040.3	1188.6	1494.2

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17927.8	23045.8	28968.4	41326.3
2010	13040.0	17698.8	22291.2	27796.9	39810.5
2011	12521.3	17815.0	22750.0	29905.9	40343.2
2012	12769.7	18138.0	23041.6	29161.9	41575.3
2013	12534.1	18078.7	22612.6	28474.1	41649.3
2014	12465.8	17897.2	23150.7	29445.3	40277.6
2015	12994.9	18045.8	22924.3	28710.7	40143.7
2016	12522.4	17955.0	22414.3	28328.8	41135.3
2017	12728.5	18007.8	23405.3	29526.6	42317.1

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	205.6	228.4	244.2	260.6	287.1
2009	176.3	213.8	245.2	278.3	315.8
2010	117.7	203.2	238.4	284.2	342.8
2011	123.0	194.7	236.6	280.2	354.7
2012	119.9	189.0	231.5	277.2	350.9
2013	133.3	192.7	238.4	281.5	356.1
2014	138.2	199.0	242.3	292.4	367.0
2015	140.7	203.3	251.4	298.3	377.9
2016	138.3	210.9	256.5	305.0	388.1
2017	129.6	217.4	262.5	316.8	402.8

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	31.3	34.7	37.1	39.6	43.6
2009	18.3	24.3	30.0	36.0	48.5
2010	18.9	25.8	30.9	38.1	50.7
2011	19.8	26.8	31.9	38.8	52.4
2012	20.3	26.1	32.2	38.9	51.4
2013	20.8	27.6	33.2	39.3	52.7
2014	20.8	27.5	33.4	40.4	52.5
2015	20.3	27.2	32.8	39.9	52.9
2016	20.2	27.6	33.2	39.9	54.7
2017	21.0	27.3	33.4	41.4	53.6

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	1.5	15.0	15.0
2010	-15.0	-15.0	0.4	15.0	15.0
2011	-15.0	-15.0	2.2	15.0	15.0
2012	-15.0	-15.0	8.6	15.0	15.0
2013	-15.0	-12.0	15.0	15.0	15.0
2014	-15.0	-7.7	15.0	15.0	15.0
2015	-15.0	-13.2	15.0	15.0	15.0
2016	-15.0	-11.6	15.0	15.0	15.0
2017	-15.0	-13.5	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-49.0	-34.5	-20.5	-4.7	27.5
2010	-34.7	-12.5	6.0	28.1	66.8
2011	-37.5	-15.4	3.2	25.3	59.6
2012	-34.7	-16.6	0.3	21.5	59.6
2013	-34.6	-14.5	3.7	23.2	59.6
2014	-38.0	-16.0	1.0	22.9	56.4
2015	-38.2	-18.1	-1.3	18.5	53.5
2016	-36.3	-15.5	2.0	22.5	64.1
2017	-39.8	-16.6	0.3	21.2	55.0

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	74.0	2.7
2009	65.0	3.7
2010	64.5	3.9
2011	65.1	3.1
2012	70.2	3.0
2013	71.8	1.5
2014	73.5	1.4
2015	75.6	1.6
2016	75.9	2.3
2017	74.1	2.7

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	168.1	217.1	241.4	266.0	302.0
2	25.6	29.8	33.0	36.7	43.3

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	165.6	216.8	249.9	284.9	333.5
2	12.8	15.0	17.1	19.3	22.7

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.174	0.206	0.229	0.256	0.303
2009	0.175	0.218	0.245	0.276	0.327
2010	0.127	0.210	0.245	0.283	0.348
2011	0.124	0.203	0.246	0.288	0.355
2012	0.118	0.196	0.237	0.282	0.351
2013	0.117	0.190	0.235	0.279	0.352
2014	0.118	0.193	0.236	0.282	0.356
2015	0.116	0.189	0.237	0.283	0.360
2016	0.119	0.190	0.242	0.287	0.369
2017	0.122	0.195	0.245	0.295	0.387

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.063	0.078	0.089	0.102	0.123
2009	0.045	0.054	0.062	0.069	0.083
2010	0.045	0.054	0.061	0.069	0.083
2011	0.046	0.054	0.062	0.070	0.083
2012	0.045	0.054	0.061	0.069	0.082
2013	0.046	0.055	0.062	0.070	0.083
2014	0.046	0.055	0.063	0.071	0.084
2015	0.046	0.055	0.063	0.071	0.083
2016	0.046	0.056	0.063	0.071	0.086
2017	0.047	0.056	0.063	0.071	0.085

Run NHS15 – see figure 3.2.4

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.2	93.2	4.6	0.0	0.0
2009	4.9	93.9	1.2	0.0	0.0
2010	2.9	94.0	3.1	0.0	0.0
2011	1.3	91.0	7.7	0.0	0.0
2012	0.7	83.3	16.0	0.0	0.0
2013	0.5	76.4	23.1	0.0	0.0
2014	0.5	70.7	28.8	0.0	0.0
2015	0.7	68.3	31.0	0.0	0.0
2016	1.2	67.9	30.9	0.0	0.0
2017	1.4	69.5	29.1	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.3	0.0	3.6
2010	4.1	0.0	2.8	1.6	0.0	0.9
2011	2.8	0.0	5.7	1.2	0.0	1.1
2012	1.2	0.0	10.7	0.6	0.0	2.4
2013	0.7	0.0	11.6	0.4	0.0	4.5
2014	0.5	0.0	11.4	0.4	0.0	5.7
2015	0.3	0.0	10.3	0.6	0.0	8.1
2016	0.7	0.0	7.9	0.8	0.0	8.0
2017	1.2	0.0	8.3	1.2	0.0	10.1

Percent prob. of level 2,3 => level 1 at least once: 9.7

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	850.0	961.2	1052.2	1152.4	1295.6
2009	802.0	914.4	988.0	1076.1	1214.4
2010	820.7	921.0	1006.0	1093.3	1244.9
2011	850.7	955.5	1049.4	1157.5	1337.8
2012	867.4	1003.2	1102.2	1231.9	1453.7
2013	903.9	1030.7	1148.2	1285.2	1539.8
2014	915.1	1054.7	1172.9	1325.9	1597.5
2015	914.5	1052.0	1186.3	1347.9	1684.5
2016	903.3	1042.5	1171.6	1351.6	1683.7
2017	884.1	1032.5	1166.1	1341.5	1721.7

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12538.2	17949.4	23045.8	28968.4	41326.3
2010	13230.3	17771.7	22346.6	28018.6	40625.1
2011	12526.1	17962.8	22861.0	29988.6	40381.3
2012	12853.1	18235.8	23269.6	29308.3	41575.3
2013	12579.1	18158.7	22723.3	28585.6	41817.0
2014	12562.1	17937.2	23175.6	29685.2	40611.4
2015	13037.0	18115.4	22972.2	28710.7	40424.9
2016	12554.3	18077.3	22575.7	28380.8	41135.3
2017	12735.3	18026.6	23468.8	29542.9	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	168.2	201.6	232.2	257.8	291.3
2010	142.8	201.0	231.9	277.6	325.3
2011	141.7	205.8	244.4	288.2	356.4
2012	154.2	215.7	255.9	300.9	377.9
2013	168.2	232.4	275.2	324.8	398.1
2014	182.4	244.8	291.2	344.0	420.8
2015	190.0	258.2	306.2	359.8	437.9
2016	204.6	267.9	316.8	370.1	463.5
2017	204.2	272.3	323.0	381.1	471.7

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-14.8	7.3	15.0	15.0
2010	-15.0	-12.3	11.3	15.0	15.0
2011	-15.0	-6.2	15.0	15.0	15.0
2012	-15.0	-3.6	15.0	15.0	15.0
2013	-15.0	2.4	15.0	15.0	15.0
2014	-15.0	-0.7	15.0	15.0	15.0
2015	-15.0	-5.5	15.0	15.0	15.0
2016	-15.0	-8.5	15.0	15.0	15.0
2017	-15.0	-13.3	8.3	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-100.0	-100.0	-100.0	-100.0	-100.0
2010	nan	nan	nan	nan	nan
2011	nan	nan	nan	nan	nan
2012	nan	nan	nan	nan	nan
2013	nan	nan	nan	nan	nan
2014	nan	nan	nan	nan	nan
2015	nan	nan	nan	nan	nan
2016	nan	nan	nan	nan	nan
2017	nan	nan	nan	nan	nan

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	64.0	0.8
2009	65.6	2.7
2010	66.2	1.7
2011	69.6	0.5
2012	70.9	0.4
2013	73.9	0.2
2014	73.3	0.1
2015	72.7	0.3
2016	70.2	0.5
2017	64.1	0.8

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	181.1	216.2	240.6	266.3	295.8
2	5.7	6.4	6.8	7.3	8.0

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	208.6	262.7	300.9	336.0	385.1
2	0.0	0.0	0.0	0.0	0.0

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.161	0.198	0.221	0.248	0.295
2010	0.145	0.195	0.223	0.256	0.305
2011	0.136	0.197	0.231	0.268	0.323
2012	0.135	0.195	0.233	0.267	0.328
2013	0.128	0.200	0.237	0.276	0.340
2014	0.138	0.207	0.246	0.285	0.352
2015	0.138	0.210	0.254	0.296	0.363
2016	0.146	0.221	0.264	0.304	0.373
2017	0.141	0.228	0.269	0.315	0.395

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.057	0.071	0.081	0.093	0.112
2009	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000
2016	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000

Run NHS16 – see figure 3.3.3

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.3	93.1	4.6	0.0	0.0
2009	5.5	93.4	1.1	0.0	0.0
2010	8.6	90.6	0.8	0.0	0.0
2011	11.8	87.6	0.6	0.0	0.0
2012	13.0	86.2	0.8	0.0	0.0
2013	11.5	87.1	1.4	0.0	0.0
2014	10.2	87.9	1.9	0.0	0.0
2015	9.5	86.3	4.2	0.0	0.0
2016	8.5	86.7	4.8	0.0	0.0
2017	8.9	84.8	6.3	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.9	0.0	3.7
2010	4.7	0.0	0.6	5.3	0.0	0.9
2011	7.8	0.0	0.5	8.0	0.0	0.7
2012	10.4	0.0	0.6	6.8	0.0	0.4
2013	12.3	0.0	1.1	6.1	0.0	0.5
2014	9.9	0.0	0.9	4.1	0.0	0.4
2015	8.7	0.0	2.7	4.8	0.0	0.4
2016	8.4	0.0	2.0	4.4	0.0	1.4
2017	7.2	0.0	2.9	4.8	0.0	1.4

Percent prob. of level 2,3 => level 1 at least once: 42.7

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	849.4	960.4	1051.5	1151.5	1294.6
2009	797.3	909.3	981.8	1069.9	1206.6
2010	777.5	875.7	944.4	1023.7	1156.7
2011	757.5	852.5	924.1	1008.4	1128.5
2012	749.8	853.5	925.4	1011.0	1152.9
2013	749.7	855.4	939.9	1030.5	1199.4
2014	762.2	865.0	955.2	1052.3	1190.8
2015	754.6	874.6	963.6	1075.2	1268.3
2016	768.3	875.9	976.5	1084.6	1293.8
2017	771.3	883.6	981.8	1091.2	1328.4

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	10123.9	14628.0	18261.1	23438.9	32519.9
2009	10030.3	14359.2	18436.2	23174.2	33060.3
2010	10584.0	14217.1	17873.1	22414.4	32499.3
2011	10020.7	14346.1	18251.5	23924.2	32304.3
2012	10215.6	14527.9	18458.3	23354.1	33222.6
2013	9975.5	14504.7	18016.5	22761.4	33371.5
2014	9952.5	14314.9	18492.6	23505.8	32221.4
2015	10109.8	14428.0	18299.1	22954.3	32056.5
2016	10017.7	14363.7	17886.9	22596.6	32848.2
2017	10182.6	14328.9	18716.6	23620.8	33774.6

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	167.5	200.2	231.1	257.2	291.3
2010	116.5	190.7	222.5	265.4	317.4
2011	112.1	176.6	214.7	251.5	320.1
2012	97.7	162.3	201.4	239.2	308.4
2013	104.3	159.5	197.1	235.4	296.7
2014	102.5	157.1	194.8	236.7	302.7
2015	100.1	159.0	195.3	234.4	300.6
2016	104.4	160.4	198.3	236.3	303.8
2017	106.3	163.2	203.1	245.8	315.2

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	14.5	19.0	23.3	27.9	37.3
2010	14.3	19.4	23.3	28.6	38.2
2011	14.7	19.7	23.5	28.6	38.6
2012	14.7	19.0	23.4	28.2	37.5
2013	15.1	19.9	23.9	28.4	37.8
2014	14.9	19.7	24.2	29.1	38.2
2015	14.5	19.5	23.5	28.7	38.4
2016	14.6	19.8	23.8	28.7	39.7
2017	15.1	19.7	24.0	29.9	39.1

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	6.3	15.0	15.0
2010	-15.0	-15.0	-0.2	15.0	15.0
2011	-15.0	-15.0	-5.2	15.0	15.0
2012	-47.0	-15.0	-4.5	15.0	15.0
2013	-15.0	-15.0	3.3	15.0	15.0
2014	-15.0	-15.0	11.9	15.0	15.0
2015	-15.0	-15.0	14.4	15.0	15.0
2016	-15.0	-12.7	15.0	15.0	15.0
2017	-15.0	-11.4	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-56.2	-43.9	-32.6	-19.3	6.9
2010	-36.6	-15.3	2.0	23.5	60.6
2011	-38.6	-17.2	0.7	22.4	56.5
2012	-36.1	-17.7	-1.4	20.2	56.3
2013	-35.4	-15.2	2.8	21.4	56.2
2014	-38.1	-16.5	1.1	22.5	56.4
2015	-38.4	-18.8	-1.7	18.6	55.6
2016	-36.6	-14.9	2.7	24.1	66.0
2017	-40.0	-16.8	1.0	22.3	57.7

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	71.9	3.5
2009	65.5	2.7
2010	63.5	3.4
2011	62.5	4.1
2012	66.4	6.0
2013	69.3	4.2
2014	70.3	4.0
2015	71.7	4.3
2016	74.4	3.1
2017	72.0	3.5

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	161.1	198.0	219.8	241.1	272.5
2	20.4	23.6	26.0	28.7	33.5

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	134.7	172.5	201.7	227.3	268.8
2	9.2	10.9	12.3	13.9	16.5

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.161	0.198	0.221	0.248	0.294
2010	0.125	0.193	0.223	0.255	0.312
2011	0.115	0.185	0.223	0.259	0.318
2012	0.108	0.172	0.211	0.250	0.315
2013	0.108	0.162	0.205	0.242	0.309
2014	0.109	0.161	0.199	0.239	0.305
2015	0.102	0.154	0.195	0.238	0.301
2016	0.103	0.154	0.197	0.234	0.306
2017	0.105	0.154	0.199	0.241	0.316

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.062	0.077	0.087	0.100	0.120
2009	0.042	0.050	0.057	0.064	0.076
2010	0.041	0.049	0.055	0.063	0.075
2011	0.041	0.049	0.056	0.062	0.075
2012	0.041	0.048	0.054	0.061	0.073
2013	0.041	0.049	0.055	0.062	0.074
2014	0.041	0.049	0.056	0.063	0.075
2015	0.040	0.049	0.055	0.062	0.074
2016	0.041	0.049	0.056	0.063	0.078
2017	0.042	0.049	0.056	0.063	0.076

Run NHS17 – see figure 3.3.4

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.3	93.1	4.6	0.0	0.0
2009	5.1	93.7	1.2	0.0	0.0
2010	6.2	93.0	0.8	0.0	0.0
2011	6.6	92.6	0.8	0.0	0.0
2012	6.6	92.3	1.1	0.0	0.0
2013	5.8	91.6	2.6	0.0	0.0
2014	3.8	93.6	2.6	0.0	0.0
2015	3.9	91.1	5.0	0.0	0.0
2016	3.2	90.7	6.1	0.0	0.0
2017	3.7	89.7	6.6	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.0	0.0	0.2	3.5	0.0	3.6
2010	4.3	0.0	0.6	3.4	0.0	1.0
2011	5.6	0.0	0.7	4.1	0.0	0.7
2012	6.2	0.0	0.8	3.7	0.0	0.5
2013	6.4	0.0	2.2	3.8	0.0	0.7
2014	5.1	0.0	1.1	1.6	0.0	1.1
2015	3.4	0.0	3.1	2.4	0.0	0.7
2016	3.4	0.0	2.7	1.4	0.0	1.6
2017	3.0	0.0	3.0	2.4	0.0	2.5

Percent prob. of level 2,3 => level 1 at least once: 23.6

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	849.4	960.4	1051.5	1151.5	1294.6
2009	799.4	913.3	992.2	1077.6	1207.3
2010	788.4	897.8	968.7	1047.3	1173.3
2011	783.6	882.6	959.4	1043.4	1165.0
2012	781.8	891.1	968.1	1055.9	1210.3
2013	792.1	898.5	983.8	1076.3	1240.9
2014	813.2	911.0	1001.7	1092.5	1250.2
2015	813.2	918.4	1008.6	1111.8	1299.4
2016	822.8	921.6	1016.0	1118.5	1313.2
2017	812.2	924.0	1017.7	1137.5	1330.0

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	10123.9	14628.0	18261.1	23438.9	32519.9
2009	10030.3	14359.2	18436.2	23174.2	33060.3
2010	10584.0	14217.1	17876.9	22414.4	32499.3
2011	10020.7	14355.1	18283.4	23969.6	32304.3
2012	10282.3	14588.3	18498.8	23446.1	33259.5
2013	10031.8	14517.4	18134.4	22778.8	33335.8
2014	10049.5	14345.2	18523.6	23601.4	32221.4
2015	10395.7	14476.6	18357.1	22968.1	32339.2
2016	10043.3	14439.8	17999.6	22613.5	32907.5
2017	10188.1	14405.9	18764.4	23642.0	34037.6

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	163.9	190.4	216.4	248.1	285.0
2010	121.2	174.1	208.9	243.5	300.9
2011	119.4	169.3	201.8	235.3	291.5
2012	113.2	160.9	193.4	225.1	284.3
2013	117.2	162.0	192.2	225.2	281.1
2014	116.4	164.2	192.9	228.8	289.2
2015	113.1	164.1	196.2	232.3	288.6
2016	122.1	166.0	200.4	234.8	294.7
2017	114.1	170.6	203.7	243.5	305.0

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	14.5	19.1	23.5	28.2	37.7
2010	14.5	19.6	23.6	29.0	38.5
2011	15.0	20.1	24.0	29.1	39.0
2012	15.0	19.5	23.9	28.8	38.0
2013	15.6	20.3	24.5	29.0	38.8
2014	15.4	20.3	24.8	29.7	39.0
2015	14.8	19.9	24.0	29.7	39.0
2016	15.1	20.3	24.5	29.6	40.6
2017	15.6	20.2	24.6	30.5	39.6

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	-7.3	15.0	15.0
2010	-15.0	-15.0	-6.8	15.0	15.0
2011	-15.0	-15.0	-4.5	15.0	15.0
2012	-15.0	-15.0	-3.2	15.0	15.0
2013	-15.0	-15.0	2.7	15.0	15.0
2014	-15.0	-13.5	8.6	15.0	15.0
2015	-15.0	-14.8	8.7	15.0	15.0
2016	-15.0	-13.0	13.4	15.0	15.0
2017	-15.0	-14.1	12.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-55.9	-43.4	-32.1	-18.5	8.3
2010	-36.6	-15.2	2.2	24.0	61.7
2011	-38.4	-16.6	1.4	23.3	57.9
2012	-35.5	-17.7	-0.6	20.1	56.6
2013	-35.2	-15.1	3.6	22.0	58.0
2014	-38.4	-16.1	0.8	22.7	55.5
2015	-38.3	-18.8	-1.5	19.1	55.0
2016	-35.1	-14.9	2.2	23.5	65.8
2017	-39.9	-16.6	0.5	21.3	57.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	68.2	2.2
2009	63.9	2.7
2010	60.4	2.8
2011	60.2	2.0
2012	62.9	2.6
2013	64.0	1.8
2014	65.6	1.9
2015	65.2	2.0
2016	70.1	1.8
2017	68.3	2.2

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	158.1	191.7	210.4	230.1	257.8
2	20.5	23.8	26.3	29.0	33.9

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	141.1	174.9	198.6	222.9	258.9
2	9.4	11.1	12.7	14.2	16.9

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.157	0.187	0.211	0.235	0.280
2010	0.132	0.178	0.204	0.233	0.285
2011	0.118	0.172	0.203	0.234	0.283
2012	0.111	0.165	0.194	0.223	0.276
2013	0.112	0.161	0.189	0.219	0.276
2014	0.112	0.160	0.188	0.219	0.267
2015	0.113	0.158	0.186	0.219	0.270
2016	0.115	0.159	0.188	0.221	0.277
2017	0.111	0.161	0.191	0.228	0.284

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.062	0.077	0.087	0.100	0.120
2009	0.042	0.051	0.057	0.064	0.076
2010	0.042	0.049	0.056	0.064	0.076
2011	0.042	0.050	0.057	0.064	0.076
2012	0.041	0.049	0.055	0.063	0.074
2013	0.042	0.050	0.056	0.063	0.076
2014	0.041	0.050	0.057	0.064	0.076
2015	0.041	0.050	0.057	0.064	0.075
2016	0.042	0.050	0.057	0.065	0.078
2017	0.043	0.050	0.057	0.064	0.077

Run NHS18 – see figure 3.3.5

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	2.3	93.1	4.6	0.0	0.0
2009	4.9	94.0	1.1	0.0	0.0
2010	5.6	93.2	1.2	0.0	0.0
2011	5.7	92.9	1.4	0.0	0.0
2012	6.3	90.9	2.8	0.0	0.0
2013	4.7	90.1	5.2	0.0	0.0
2014	3.5	90.3	6.2	0.0	0.0
2015	3.7	86.1	10.2	0.0	0.0
2016	3.9	84.9	11.2	0.0	0.0
2017	4.2	82.8	13.0	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	2.1	0.0	0.2	3.3	0.0	3.7
2010	4.2	0.0	1.0	3.2	0.0	0.9
2011	5.0	0.0	0.9	4.0	0.0	0.7
2012	5.4	0.0	2.1	3.8	0.0	0.7
2013	6.2	0.0	3.2	3.4	0.0	0.8
2014	4.6	0.0	2.8	2.3	0.0	1.8
2015	3.2	0.0	5.9	2.6	0.0	1.9
2016	3.3	0.0	3.7	2.3	0.0	2.7
2017	3.4	0.0	5.0	2.6	0.0	3.2

Percent prob. of level 2,3 => level 1 at least once: 26.2

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	849.4	960.4	1051.5	1151.5	1294.6
2009	800.5	912.5	986.4	1074.3	1212.3
2010	793.1	892.0	962.4	1047.1	1182.7
2011	797.7	887.6	965.5	1055.0	1189.9
2012	788.6	903.4	983.0	1079.0	1248.3
2013	802.8	910.1	1006.4	1109.4	1301.8
2014	818.6	920.6	1021.1	1135.2	1317.7
2015	818.4	929.6	1029.6	1156.0	1393.3
2016	814.5	932.7	1041.1	1165.6	1411.2
2017	808.7	933.5	1040.8	1177.1	1438.6

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	10123.9	14628.0	18261.1	23438.9	32519.9
2009	10030.3	14359.2	18436.2	23174.2	33060.3
2010	10584.0	14217.1	17876.9	22414.4	32499.3
2011	10020.7	14346.1	18283.4	23990.3	32304.3
2012	10282.3	14588.3	18522.2	23446.1	33259.5
2013	10027.0	14517.4	18134.4	22849.4	33335.8
2014	10049.5	14332.9	18523.6	23601.4	32221.4
2015	10429.4	14476.6	18356.6	22968.1	32195.7
2016	10043.3	14426.0	17979.1	22703.2	32907.5
2017	10183.0	14421.0	18764.4	23633.8	34037.6

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	188.5	209.4	223.8	238.9	263.2
2009	167.9	200.9	232.1	257.4	291.3
2010	126.1	194.8	225.6	269.9	319.6
2011	121.0	187.8	228.4	264.7	333.1
2012	127.3	185.9	221.1	263.6	332.5
2013	130.3	186.2	227.5	265.0	336.1
2014	132.4	190.8	230.2	275.5	347.7
2015	129.8	193.9	235.5	280.8	351.9
2016	133.5	198.3	242.2	285.8	360.4
2017	130.1	201.2	243.4	293.2	375.2

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-15.0	6.8	15.0	15.0
2010	-15.0	-15.0	3.6	15.0	15.0
2011	-15.0	-15.0	2.1	15.0	15.0
2012	-15.0	-15.0	4.3	15.0	15.0
2013	-15.0	-14.0	10.9	15.0	15.0
2014	-15.0	-10.9	14.7	15.0	15.0
2015	-15.0	-14.8	14.0	15.0	15.0
2016	-15.0	-12.1	15.0	15.0	15.0
2017	-15.0	-14.2	14.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-100.0	-100.0	-100.0	-100.0	-100.0
2010	nan	nan	nan	nan	nan
2011	nan	nan	nan	nan	nan
2012	nan	nan	nan	nan	nan
2013	nan	nan	nan	nan	nan
2014	nan	nan	nan	nan	nan
2015	nan	nan	nan	nan	nan
2016	nan	nan	nan	nan	nan
2017	nan	nan	nan	nan	nan

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	70.7	2.5
2009	65.3	2.7
2010	63.1	2.5
2011	63.0	2.5
2012	69.2	1.6
2013	68.8	1.5
2014	69.8	1.5
2015	72.1	1.6
2016	74.8	2.2
2017	70.8	2.5

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	165.7	205.8	227.9	250.9	281.8
2	5.7	6.4	6.8	7.3	8.0

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	160.6	205.1	235.5	265.5	313.6
2	0.0	0.0	0.0	0.0	0.0

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.159	0.187	0.208	0.232	0.274
2009	0.161	0.198	0.221	0.248	0.295
2010	0.136	0.195	0.224	0.256	0.311
2011	0.119	0.191	0.227	0.263	0.317
2012	0.115	0.187	0.221	0.259	0.326
2013	0.116	0.183	0.222	0.257	0.322
2014	0.114	0.185	0.220	0.262	0.326
2015	0.113	0.182	0.219	0.260	0.325
2016	0.115	0.181	0.224	0.264	0.336
2017	0.115	0.184	0.227	0.270	0.348

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.062	0.077	0.087	0.100	0.120
2009	0.000	0.000	0.000	0.000	0.000
2010	0.000	0.000	0.000	0.000	0.000
2011	0.000	0.000	0.000	0.000	0.000
2012	0.000	0.000	0.000	0.000	0.000
2013	0.000	0.000	0.000	0.000	0.000
2014	0.000	0.000	0.000	0.000	0.000
2015	0.000	0.000	0.000	0.000	0.000
2016	0.000	0.000	0.000	0.000	0.000
2017	0.000	0.000	0.000	0.000	0.000

Run NHS19 – see figure 3.3.6

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.5	95.3	3.2	0.0	0.0
2008	2.3	93.4	4.3	0.0	0.0
2009	5.6	93.1	1.3	0.0	0.0
2010	6.7	89.5	3.8	0.0	0.0
2011	6.1	86.8	7.1	0.0	0.0
2012	4.3	83.3	12.4	0.0	0.0
2013	4.6	77.7	17.7	0.0	0.0
2014	4.2	74.2	21.6	0.0	0.0
2015	3.3	71.4	25.3	0.0	0.0
2016	3.9	69.4	26.7	0.0	0.0
2017	4.5	70.0	25.5	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	1.6	0.0	0.2	3.9	0.0	3.2
2010	5.5	0.0	3.0	4.5	0.0	0.5
2011	6.0	0.0	4.7	4.0	0.0	1.4
2012	5.3	0.0	7.8	2.4	0.0	2.5
2013	3.9	0.0	10.0	2.5	0.0	4.7
2014	4.1	0.0	8.9	2.5	0.0	5.0
2015	3.6	0.0	9.4	1.8	0.0	5.7
2016	2.6	0.0	7.6	2.7	0.0	6.2
2017	3.4	0.0	6.5	2.5	0.0	7.7

Percent prob. of level 2,3 => level 1 at least once: 25.0

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	860.2	977.4	1051.0	1134.2	1260.0
2008	842.4	963.9	1062.6	1151.6	1292.2
2009	794.3	900.2	982.7	1069.9	1216.7
2010	785.9	892.8	984.7	1095.8	1276.9
2011	788.7	907.4	1003.6	1130.7	1354.3
2012	807.3	940.3	1058.3	1206.2	1430.2
2013	803.4	962.8	1092.7	1237.8	1520.8
2014	814.5	979.8	1108.8	1269.3	1607.0
2015	823.8	984.8	1109.7	1301.7	1643.1
2016	818.1	977.0	1118.6	1314.3	1685.7
2017	805.9	978.9	1123.1	1306.5	1740.4

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8819.2	10602.4	12026.7	13652.5	16027.3
2008	10203.8	15395.4	22809.8	31106.2	49333.0
2009	10129.8	15811.7	22804.1	32679.8	49651.3
2010	10095.3	16332.6	23715.6	33293.4	49806.8
2011	10500.1	16411.3	23084.7	32436.9	51070.3
2012	10137.4	16598.6	24060.4	33189.6	50237.4
2013	10428.1	15774.7	23143.0	32830.4	50634.1
2014	10116.7	15855.7	22776.0	33633.9	51593.3
2015	10557.1	16078.4	23284.1	33131.0	52001.8
2016	10290.6	16385.7	23196.3	32795.2	51733.8
2017	10052.0	15963.4	23526.9	33464.3	52046.9

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	186.9	210.1	223.4	237.8	261.7
2009	165.4	197.8	229.6	257.3	289.1
2010	137.1	195.6	228.6	273.9	320.9
2011	118.9	193.2	232.6	273.9	349.6
2012	117.8	194.3	243.1	293.7	373.2
2013	124.5	205.3	255.6	307.0	384.2
2014	126.2	209.6	264.7	319.1	407.3
2015	140.0	217.8	268.3	326.7	416.1
2016	146.7	221.7	273.9	333.1	427.7
2017	148.4	223.4	280.4	342.7	441.4

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.4	31.9	34.0	36.2	39.8
2009	15.9	21.8	27.6	35.2	48.5
2010	16.4	23.3	30.3	38.6	52.0
2011	16.8	24.5	31.3	38.6	52.4
2012	17.6	25.4	32.3	40.7	56.2
2013	18.1	25.8	32.7	41.5	56.0
2014	18.0	25.5	32.3	40.8	56.3
2015	18.4	25.3	32.6	41.1	56.9
2016	18.3	25.9	33.2	41.4	56.7
2017	18.4	25.8	33.3	41.9	57.3

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-45.8	-45.8	-45.8	-45.8	-45.8
2009	-15.0	-13.7	8.1	15.0	15.0
2010	-15.0	-15.0	6.7	15.0	15.0
2011	-15.0	-15.0	12.1	15.0	15.0
2012	-15.0	-6.9	15.0	15.0	15.0
2013	-15.0	-3.0	15.0	15.0	15.0
2014	-15.0	-7.2	15.0	15.0	15.0
2015	-15.0	-10.1	15.0	15.0	15.0
2016	-15.0	-11.9	15.0	15.0	15.0
2017	-15.0	-14.5	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-53.3	-35.4	-17.8	1.8	38.8
2010	-36.7	-13.1	7.6	31.9	85.9
2011	-39.1	-16.0	3.5	27.2	73.3
2012	-39.4	-16.3	4.2	27.7	73.1
2013	-39.8	-15.6	2.0	24.8	65.6
2014	-41.2	-19.5	0.3	23.2	69.3
2015	-40.8	-19.7	-0.9	22.7	64.9
2016	-40.3	-16.8	2.4	25.5	73.9
2017	-39.8	-18.6	-1.1	21.0	62.3

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	73.0	2.0
2009	63.8	2.5
2010	66.9	2.3
2011	69.6	3.0
2012	70.4	2.4
2013	74.4	1.2
2014	75.0	0.8
2015	72.2	1.6
2016	73.5	1.5
2017	73.1	2.0

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	165.8	208.2	233.9	257.7	291.8
2	23.2	27.8	31.7	36.2	43.2

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	153.2	226.5	271.2	309.5	366.9
2	11.6	14.3	17.0	19.8	24.0

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.275	0.305	0.326	0.350	0.387
2008	0.156	0.185	0.208	0.230	0.274
2009	0.161	0.197	0.219	0.245	0.289
2010	0.142	0.192	0.222	0.255	0.304
2011	0.120	0.189	0.224	0.258	0.314
2012	0.112	0.185	0.224	0.265	0.324
2013	0.107	0.191	0.226	0.269	0.334
2014	0.106	0.193	0.230	0.275	0.342
2015	0.110	0.191	0.233	0.281	0.358
2016	0.114	0.193	0.237	0.282	0.360
2017	0.112	0.195	0.243	0.293	0.372

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.069
2008	0.053	0.068	0.080	0.095	0.118
2009	0.042	0.049	0.056	0.063	0.076
2010	0.041	0.049	0.056	0.063	0.076
2011	0.041	0.050	0.056	0.064	0.075
2012	0.042	0.051	0.058	0.065	0.078
2013	0.043	0.052	0.059	0.066	0.077
2014	0.043	0.052	0.058	0.066	0.078
2015	0.043	0.052	0.058	0.065	0.076
2016	0.043	0.052	0.059	0.065	0.077
2017	0.044	0.052	0.058	0.067	0.078

Run NHS20 – see figure 3.3.7

Probabilities of TRUE levels and limits:

Year	%Level 1	%Level 2	%Level 3	%>Max c1	%>Max c2
2007	1.4	96.4	2.2	0.0	0.0
2008	9.5	89.7	0.8	0.0	0.0
2009	32.3	67.6	0.1	0.0	0.0
2010	33.5	66.2	0.3	0.0	0.0
2011	18.8	79.5	1.7	0.0	0.0
2012	9.4	83.2	7.4	0.0	0.0
2013	3.8	81.3	14.9	0.0	0.0
2014	1.7	73.5	24.8	0.0	0.0
2015	1.8	66.2	32.0	0.0	0.0
2016	1.9	60.7	37.4	0.0	0.0
2017	2.4	59.4	38.2	0.0	0.0

Probabilities of shifts of TRUE level:
(from previous year to present year)

Year	%L 1=>2	%L 1=>3	%L 2=>3	%L 2=>1	%L 3=>1	%L3=>2
2009	6.8	0.0	0.0	23.7	0.0	0.7
2010	25.4	0.0	0.3	14.2	0.0	0.1
2011	29.7	0.0	1.6	6.7	0.0	0.2
2012	16.9	0.0	5.9	2.6	0.0	0.2
2013	9.0	0.0	8.5	1.5	0.0	1.0
2014	3.5	0.0	11.8	0.7	0.0	1.9
2015	1.5	0.0	10.5	1.4	0.0	3.3
2016	1.7	0.0	8.8	0.9	0.0	3.4
2017	1.8	0.0	7.0	1.6	0.0	6.2

Percent prob. of level 2,3 => level 1 at least once: 49.0

Fractiles for SSB:

Year	5%	25%	50%	75%	95%
2007	866.0	968.1	1047.6	1134.3	1254.1
2008	770.1	878.6	973.1	1071.1	1215.9
2009	674.3	775.6	847.5	931.0	1060.2
2010	691.5	775.6	851.0	946.1	1077.3
2011	716.8	823.4	913.9	1013.9	1206.4
2012	759.6	892.1	993.3	1115.1	1352.5
2013	813.2	948.1	1071.7	1210.2	1478.8
2014	852.4	998.1	1124.7	1296.7	1600.6
2015	864.7	1026.5	1166.2	1387.4	1695.2
2016	877.8	1027.2	1194.0	1413.0	1769.5
2017	864.6	1040.3	1216.5	1434.1	1803.8

Fractiles for Recruitment:

Year	5%	25%	50%	75%	95%
2007	8895.5	10666.0	12044.8	13631.6	16368.5
2008	12655.1	18285.5	22826.9	29299.2	40650.8
2009	12534.6	17901.6	22908.2	28724.4	41315.4
2010	12363.8	17280.4	21757.1	27513.8	39538.3
2011	12258.3	17443.8	22208.0	29540.9	39744.4
2012	12704.7	17967.7	22936.6	29007.9	41098.7
2013	12372.4	18077.5	22650.3	28460.1	41670.6
2014	12465.8	17937.2	23162.2	29632.7	40498.2
2015	13037.0	18115.4	22946.9	28710.7	40424.9
2016	12554.3	18050.1	22537.7	28379.7	41135.3
2017	12735.3	18026.6	23446.6	29542.9	42548.0

Fractiles for Catches, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	375.0	375.0	375.0	375.0	375.0
2008	278.1	308.9	330.3	352.5	388.4
2009	92.7	249.0	276.9	305.8	360.8
2010	83.5	125.5	230.9	266.1	335.2
2011	86.2	122.8	195.9	241.5	313.4
2012	94.6	128.8	179.4	230.4	306.2
2013	106.7	145.5	192.4	241.2	314.6
2014	117.7	160.6	202.0	252.8	330.9
2015	130.0	176.0	220.8	265.8	343.5
2016	148.2	194.5	236.8	282.8	363.8
2017	161.0	213.7	254.6	303.5	388.1

Fractiles for Catches, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	25.5	25.5	25.5	25.5	25.5
2008	28.6	31.8	34.0	36.3	40.0
2009	16.1	21.4	26.6	31.8	43.2
2010	16.6	22.4	27.4	33.6	45.5
2011	17.2	23.3	28.4	34.5	47.5
2012	18.2	23.6	29.1	35.5	46.9
2013	19.4	25.4	31.1	36.7	48.9
2014	19.7	25.8	31.8	38.0	49.2
2015	19.1	25.8	31.0	37.9	49.6
2016	19.7	26.6	31.6	37.7	51.3
2017	20.2	26.5	32.0	39.0	50.5

Fractiles for IAV on TAC, FLEET 1:

Year	5%	25%	50%	75%	95%
2008	-20.0	-20.0	-20.0	-20.0	-20.0
2009	-72.0	-15.0	-15.0	-15.0	4.6
2010	-69.5	-15.0	-15.0	0.0	15.0
2011	-60.0	-15.0	-6.6	15.0	15.0
2012	-15.0	-15.0	15.0	15.0	15.0
2013	-15.0	1.6	15.0	15.0	15.0
2014	-15.0	7.9	15.0	15.0	15.0
2015	-15.0	9.9	15.0	15.0	15.0
2016	-15.0	12.3	15.0	15.0	15.0
2017	-15.0	5.6	15.0	15.0	15.0

Fractiles for IAV on TAC, FLEET 2:

Year	5%	25%	50%	75%	95%
2008	21.2	21.2	21.2	21.2	21.2
2009	-50.5	-37.1	-23.5	-8.4	23.0
2010	-35.0	-12.9	5.7	28.3	67.9
2011	-37.9	-14.6	5.3	26.8	62.4
2012	-33.3	-14.6	2.8	24.3	63.2
2013	-32.4	-12.4	5.3	24.9	60.4
2014	-36.7	-14.9	2.8	24.0	58.9
2015	-36.6	-17.4	-0.6	18.4	52.8
2016	-34.0	-14.7	2.4	23.0	59.3
2017	-37.6	-15.6	0.3	20.5	53.8

Probabilities of applying catch constraint

Year	Prob. apply	Prob. abandon
2008	81.1	0.7
2009	68.0	17.8
2010	67.7	16.3
2011	74.6	7.8
2012	76.4	4.4
2013	79.1	1.6
2014	79.9	0.9
2015	84.4	0.8
2016	84.6	0.8
2017	81.2	0.7

Fractiles for mean catch (year 1-5)

Fleet	5%	25%	50%	75%	95%
1	156.8	194.9	246.9	268.8	306.8
2	22.9	26.7	29.7	32.9	38.9

Fractiles for mean catch (year 5-10)

Fleet	5%	25%	50%	75%	95%
1	138.3	177.6	221.9	258.7	310.9
2	12.2	14.2	16.1	18.3	21.3

Fractiles for realised fishing mortalities, FLEET 1:

Year	5%	25%	50%	75%	95%
2007	0.277	0.303	0.324	0.350	0.390
2008	0.244	0.291	0.325	0.366	0.436
2009	0.113	0.256	0.303	0.347	0.423
2010	0.099	0.139	0.258	0.307	0.372
2011	0.094	0.127	0.219	0.273	0.348
2012	0.092	0.121	0.186	0.242	0.314
2013	0.090	0.123	0.179	0.232	0.304
2014	0.093	0.124	0.180	0.230	0.309
2015	0.094	0.129	0.186	0.235	0.312
2016	0.100	0.142	0.195	0.244	0.322
2017	0.109	0.155	0.208	0.257	0.340

Fractiles for realised fishing mortalities, FLEET 2:

Year	5%	25%	50%	75%	95%
2007	0.043	0.050	0.055	0.060	0.068
2008	0.058	0.072	0.082	0.095	0.114
2009	0.041	0.048	0.055	0.061	0.074
2010	0.040	0.047	0.054	0.061	0.074
2011	0.041	0.049	0.055	0.062	0.075
2012	0.042	0.049	0.055	0.063	0.074
2013	0.043	0.051	0.057	0.065	0.076
2014	0.043	0.052	0.058	0.066	0.077
2015	0.043	0.052	0.058	0.065	0.077
2016	0.044	0.053	0.059	0.066	0.079
2017	0.045	0.053	0.059	0.066	0.078