

**ECOREGION** Bay of Biscay and Atlantic Iberian waters  
**SUBJECT** EU request for the evaluation of the harvest control rule for sole in the Bay of Biscay

**Advice summary**

The evaluated harvest control rule (HCR; defined in Point 1, clauses 1–6) is considered to be precautionary when the fixed TAC is set at less than or equal to 4500 tonnes (Item (a) of the request).

ICES has no specific criteria for selecting what constitutes a high probability of reaching  $F_{MSY}$  in a specific year (Item (b) of the request). Instead, ICES provides the probability of having achieved the change from the fixed-TAC to the  $F_{MSY}$ -target regime of the HCR in each year (Table 7.3.5.2.1). This occurs when  $F$  is estimated to have reached  $F_{MSY}$ . Managers should draw their own conclusions on what constitutes a sufficiently high probability of achieving  $F_{MSY}$  as a target.

The simulations show that the year when  $F$  is estimated to have reached  $F_{MSY}$  is particularly sensitive to the combination of the selected fixed TAC in the HCR and the realised recruitment. The probability of reaching  $F_{MSY}$  with a fixed TAC increases with time. Within the requested range of fixed TACs the simulations show that none of the fixed TAC regimes have >50% probability of reaching  $F_{MSY}$  in 2015, but all fixed TAC targets  $\leq 4500$  tonnes have >50% probability of reaching  $F_{MSY}$  by 2020. However, it takes longer for higher fixed TAC options to reach  $F_{MSY}$  with some probability of failing to reduce  $F$  sufficiently to move from the fixed TAC target to the  $F_{MSY}$  target for a few years beyond 2020 (Table 7.3.5.2.1).

ICES has not evaluated the HCR defined in Point 2 of the request. When no analytical assessment is available, ICES recommends that the advice should comply with the ICES data-limited stocks framework, utilizing the existing survey-based methodology (ICES, 2012).

**Request** (the following is the interpretation of the French request in English)

*For a harvest control rule based on a fixed TAC and safeguard mechanisms as described below, ICES is requested to:*

- (a) advise on whether these management provisions are consistent with ICES precautionary approach in the long-term, and
- (b) to give the year at which  $F_{msy}$  is reached with high probability for each of the TAC values in point 2 below.

*Point 1: Fixed TAC*

1. Rules for setting the TAC for the stock of sole in the Bay of Biscay are defined with the objective to reach  $F_{MSY}$  (i.e.,  $F = 0.26$ ) by 2020,;
2. The TAC is set at a constant value until the fishing mortality is equal to  $F_{MSY}$ . TAC levels in a range of 3500 to 4500 tonnes (by 100 tonne steps) are tested;
3. When fishing mortality is equal to  $F_{MSY}$ , the TAC is set to give a forecast fishing mortality at  $F_{MSY}$  (0.26);
4. When the rule of paragraph 3 applies, the TAC set for a given year shall not correspond to a variation of less than or more than 10% compared to the TAC of the preceding year;
5. Notwithstanding paragraph 2, if fishing mortality increases during the two years preceding the advice on the status of the stock, the TAC is reduced by 10% compared to the previous year. The TAC level set in this way becomes the reference TAC fixed for the application of the rule in paragraph 2;
6. If the spawning stock biomass is estimated to be less than the biomass limit ( $B_{lim} = 13,000$  tons), the TAC is set at a level corresponding to  $F_{MSY}$ .

*Point 2: In the absence of validated analytical assessment*

1. If the analytical assessment of the stock of sole in the Bay of Biscay is not available or is not validated by ICES and / or STECF, the setting of the TAC is based on the trend in abundance indices;
2. Based on the index of abundance derived from the scientific campaign ORHAGO, the TAC is increased by 15% if the average stock abundance of the two preceding years is at least more than 20% compared to the average abundance of the previous three years. The TAC is otherwise reduced by 15% if the index indicates a decline in abundance of 20% or more on the same basis.

See Annex 1 for the original request, as written by the European Commission.

### **Elaboration on ICES advice**

#### Item (a) of the request

The standard ICES criteria to consider a plan as precautionary is that the probability of  $SSB < B_{lim}$  must be less than 5% per year. Clause 6 of the HCR is applied when SSB is below 13 000 tonnes. This SSB value is  $B_{pa}$  and not  $B_{lim}$ , which is not defined for this stock (incorrectly stated in the request). Simulations show that clause 6 rarely applies (< 0.2% of occasions) because in all the scenarios, SSB remains above 13 000 tonnes with a high probability (Table 7.3.5.2.2). Consequently, the probability of SSB being less than any candidate value for  $B_{lim}$  is much less than 0.2%; therefore, ICES considers the HCR to be precautionary.

#### Item (b) of the request

The evaluation is based on simulating hundreds of stocks and using the following criteria:

- a) The probability of changing from the fixed-TAC (Clauses 2, 5 and 6) to the  $F_{MSY}$ -target regime (Clauses 3 and 4) is the percentage of simulated stocks that have changed from the fixed TAC to the  $F_{MSY}$  target by any year. The change occurs when  $F$  is estimated to have reached  $F_{MSY}$ . This is the increasing probability with time displayed in Table 7.3.5.2.1.
- b) A simulated stock is considered by ICES as being exploited at  $F_{MSY}$  if the HCR target is  $F_{MSY}$ . This means that clauses 3 or 4 of the HCR are implemented.

The request is 'to give the year at which  $F_{msy}$  is reached with high probability for each of the TAC values'. ICES has no specific criteria to define what is meant by a high probability. Table 7.3.5.2.1 shows the increasing probability of the the HCR changing to the  $F_{MSY}$  target by year. The probability given indicates the percentages of the simulated stocks estimated to have reached  $F_{MSY}$  by year.

In considering the transition of exploitation to  $F_{MSY}$  it may be helpful to compare this HCR with the ICES transition method to the MSY approach, applied since 2010, which has an  $F_{MSY}$  target for the advice for 2015. Under this approach the target is selected directly year by year so that at each year the target is defined exactly. Under the proposed HCR, the stock of Bay of Biscay sole will change to the  $F_{MSY}$  exploitation target more unpredictably only in the year when  $F$  is estimated to have reached  $F_{MSY}$ . This year will depend on both the selected fixed TAC and the recruitment that occurs in practice. Because the recruitment will be unpredictable, only the probability that the transition will occur can be provided; the different outcomes are based on many possible recruitment scenarios. As indicated above ICES cannot advise on the probability (or certainty) that managers will wish to use for ensuring transition to  $F_{MSY}$ , Table 7.3.5.2.1 provides the full range of options; here we draw out two examples:

- 1) with a fixed TAC of 3800 there is a 60% chance of changing to  $F_{MSY}$  target by 2017 and only a 4% chance of not achieving transition by 2020 (Table 7.3.5.2.1);
- 2) with a fixed TAC of 4300 there is a 27% chance of changing to  $F_{MSY}$  target by 2017 and a 28% chance of not achieving transition by 2020.

The simulations are conditional on the assumed stock–recruitment relationships fitted to the observed historical data. Recent recruitment since 2004 has been 9% lower than the long-term mean and this period also contains a run of five years with mean recruitment 18% below the long-term mean. While these differences are not substantial they can influence the results. The simulations show that the year when  $F$  is estimated to be less than or equal to  $F_{MSY}$  is particularly sensitive to the combination of the selected fixed TAC and the realised recruitment. The probability of reaching  $F_{MSY}$  with a fixed TAC increases with time. However, it takes longer for higher fixed TAC options to reach  $F_{MSY}$ , extending well beyond 2020 for the highest TAC options. If recruitment in 2012 and onwards is low (similar to the 18% reduction seen from 2004–2008) then the high fixed TACs can result in short-term decline in SSB and possibly also increases in  $F$  (see intervals on the scenario with fixed TAC = 4500 in Figure 7.3.5.2.1). If managers wish to avoid these possibilities with a high probability, the lower fixed TAC options give increased certainty of reaching  $F_{MSY}$  by 2020 (Table 7.3.5.2.1).

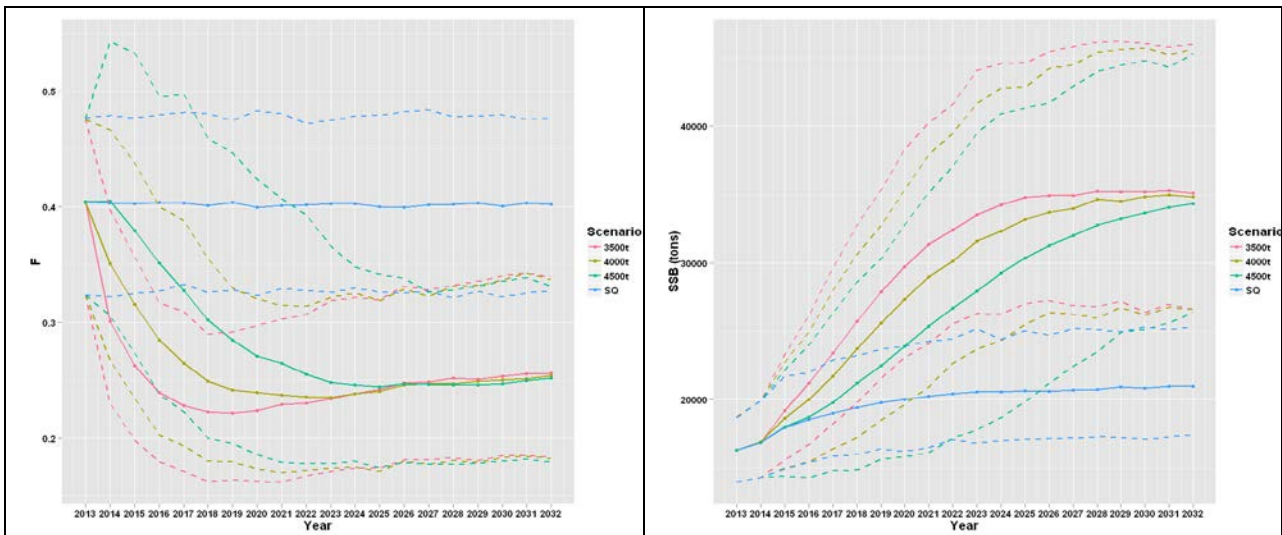
**Table 7.3.5.2.1** The probability (in %) of changing from the initial fixed TAC (Clauses 2 and 5) to the  $F_{MSY}$  target (Clauses 3 and 4), for initial fixed TAC values between 3500 and 4500 tonnes. Shaded values have >50% probability of making the change to Clauses 3 and 4 (i.e.  $F$  estimated to have reached  $F_{MSY}$ ). The simulations include the implementation of all clauses of the HCR.

Fixed TAC	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
3500	0	0	24	54	81	93	98	100	100	100	100	100	100	100
3600	0	0	20	49	75	89	96	99	100	100	100	100	100	100
3700	0	0	16	42	67	84	93	98	99	99	100	100	100	100
3800	0	0	13	36	60	79	90	96	99	99	100	100	100	100
3900	0	0	11	31	53	72	86	93	97	99	100	100	100	100
4000	0	0	9	26	46	64	80	90	95	98	99	100	100	100
4100	0	0	7	20	38	56	73	84	91	94	97	98	100	100
4200	0	0	6	16	33	49	66	78	86	92	95	97	98	99
4300	0	0	5	12	27	42	58	72	81	88	93	96	97	99
4400	0	0	3	9	22	33	49	62	72	81	88	93	96	98
4500	0	0	2	8	18	29	41	53	64	74	81	87	91	95

**Table 7.3.5.2.2** The probability (in %) of  $SSB \leq 13\ 000$  t for a fixed TAC between 3500 and 4500 tonnes.

Fixed TAC (tonnes)	2013	2014	2015	2016	2017	2018	2019	2020	2021
3500	0	0.2	0	0	0	0	0	0	0
3600	0.1	0.2	0	0	0	0	0	0	0
3700	0.1	0.2	0	0	0	0	0	0	0
3800	0.1	0.2	0	0	0	0	0	0	0
3900	0.1	0.2	0	0	0	0	0	0	0
4000	0.1	0.2	0.1	0	0	0	0	0	0
4100	0.1	0.2	0.1	0	0	0	0	0	0
4200	0.1	0.2	0.1	0	0	0	0	0	0
4300	0.1	0.2	0.2	0.1	0	0	0	0.1	0
4400	0.1	0.2	0.2	0.1	0	0.1	0	0	0
4500	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0	0

In all the scenarios, mean (or median) SSB increases largely in the short term to converge to about 34 000 to 36 000 tonnes by 2032 (Figure 7.3.5.2.1). The starting point of the simulations in 2013 is the second highest observed SSB in the historical time-series, which provides a good opportunity for either direct transition to  $F_{MSY}$  with little reduction in catch or the potential for fixed TACs with a low risk of stock decline. All the scenarios provide mean SSB above all past estimated values because the  $F$ s that result from following the HCR are lower than any of the historical  $F$ s in the time-series. In the long term the 95% interval of  $F$  is from 0.18 to 0.33, the upper limit being then far below  $F_{pa}$  (0.42). The variability in  $F$  comes from uncertainty in the assessment and the effect of the stability constraints (clauses 4 and 5). All of these outcomes are conditional on full compliance with the HCR.



**Figure 7.3.5.2.1** Trends in F and SSB for three values of fixed TAC (3500, 4000, and 4500 tonnes) and *status quo* F. The solid line is the median, and the dotted lines show the 95% CIs for each scenario. Note that the highest TAC scenario implies an increase in F in the short term.

### Point 2 of the HCR

No specific simulations have been carried out to address this part of the request.

When no analytical assessment is available, ICES has defined data-limited stock categories and an advice basis for each of them (ICES, 2012). If such a situation should occur, ICES could refer to this framework to provide advice. Currently, abundance indices are available from the ORHAGO survey; therefore, the ICES framework could provide TAC advice using this survey.

### Suggestions

Although simulations indicate that  $SSB < B_{pa}$  has a very low probability, currently the plan does not include any provision for reducing F if SSB does fall below  $B_{pa}$ . ICES considers that it would be prudent to replace clause 6 in the request with a clause to reduce F linearly from  $F = F_{MSY}$  at  $SSB = B_{pa}$  to  $F = 0$  at  $SSB = 0$  if  $SSB < B_{pa}$ . This approach would be in accordance with the standard ICES MSY harvest control rule.

### Basis of advice

The document by Merzèreaud *et al.* (Merzèreaud *et al.*, 2013) contains a description of the simulations and the overall results which form the basis of the advice given above.

### References

ICES. 2012. ICES Implementation of Advice for Data-limited Stocks in 2012 in its 2012 Advice. ICES CM 2012/ACOM 68. 42 pp.  
 Merzèreaud, M., Biais, G., Lisardy, M., Bertignac, M., and Biseau, A. 2013. Evaluation of proposed harvest control rules for Bay of Biscay sole. ICES CM 2013/ACOM:75. 16 pp.

## Annex 1

The original text of the request as received from the European Commission:

*For a harvest control rule based on a fixed TAC and safeguard mechanisms as described below, ICES is requested to:*

- (a) advise on whether these management provisions are consistent with ICES precautionary approach in the long-term, and
- (b) to give the year at which Fmsy is reached with high probability for each of the TAC values in point 2 below.

### *Point 1 : TAC fixe*

1. *Des règles de fixation du TAC du stock de sole du golfe de Gascogne sont fixées de manière à conduire à l'objectif du FMSY d'ici 2020, soit  $F=0,26$ ;*
2. *Le TAC est fixé à une valeur constante jusqu'à ce que la mortalité par pêche soit égale à FMSY. Différents niveaux de TAC sont testés dans un intervalle de 3500 à 4500 tonnes (par 100 tonnes);*
3. *Lorsque la mortalité par pêche est égale à FMSY, le TAC est fixé afin de maintenir la mortalité par pêche au niveau du FMSY (0,26);*
4. *Lorsque la règle du paragraphe 3 s'applique le TAC fixé pour une année ne doit pas correspondre à une variation inférieure ou supérieure de plus de 10% par rapport au TAC de l'année précédente;*
5. *Par dérogation au paragraphe 2, si la mortalité par pêche augmente au cours des deux années précédant l'avis sur l'état du stock, le TAC est réduit de 10% par rapport à celui de l'année précédente. Le niveau du TAC ainsi déterminé devient la référence du TAC fixe pour l'application de la règle du paragraphe 2;*
6. *Si la biomasse féconde est évaluée inférieure au niveau de biomasse limite ( $Blim = 13.000$  tonnes), le TAC est fixé à un niveau correspondant au FMSY.*

### *Point 2 : Absence d'évaluation analytique validée*

1. *Si l'évaluation analytique du stock de sole du golfe de Gascogne n'est pas disponible ou n'est pas validée par le CIEM et/ou le CSTEP, la fixation du TAC s'appuie sur l'évolution des indices d'abondance;*

*Sur la base de l'indice d'abondance issu de la campagne scientifique ORHAGO, le TAC est augmenté de 15% si la moyenne d'abondance du stock des deux années précédentes est supérieure ou égale de plus de 20% par rapport à l'abondance moyenne des trois années précédentes. Le TAC est au contraire réduit de 15%, si l'indice indique une baisse d'abondance de 20% ou plus selon les mêmes critères.*