Guyana Seabob HCR 2013/14

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1 Introduction

This report outlines an evaluation of the harvest control rule (HCR) proposed by the Trawler Association to apply to the seabob fishery. This information was used to inform the discussions over an appropriate level of fishing and the response when fishing might be reduced. The evaluation is based on the 2013 stock assessment configured as required by the CRFM Shrimp and Groundfish Working Group (CRFM 2013).

2 Issues Discussed

The meeting discussed the following issues:

- Overview of the stock assessment in 2013. This included the data provided for the assessment and the results of the stock assessment. This stock assessment provided the basis for evaluation of HCRs.
- What harvest control rules are and why they are considered "best practice" in fisheries management
- The basic design of the empirical harvest control rules, which have been proposed for this fishery.

Two options were identified as possible harvest controls. They are a total catch quota (implemented as an export limit) and a total effort quota (days-at-sea). It is believed that other types of control could not be implemented at this time in Guyana, but other conservation measures could be implemented (such as a longer closed season and closed areas).

The abundance index used in the stock assessment was identified as the most useful index for the harvest control rule. The index would be based upon the trawl catch rate measured as the catch per standardised day at sea. Appropriate reference points for the index were discussed, and useful consideration was given to the effect of catch rates on earnings per trip. Reference points would be used to define when management action would be taken.

In deliberations on the HCR, consideration was given to fisher earnings, political acceptability and the level of precaution required. It was noted that any proposed HCR would undergo further evaluation through future stock assessments, which it was hoped would include improvements on the 2013 assessment. However, it is not anticipated that this would dramatically change any results.

3 Proposed Harvest Control

3.1 Harvest Control Rule Attributes

A harvest control rule should have the following attributes:

- Accountability: The control rule application and implementation should be transparent, so that all stakeholders can see that the agreed rule is being applied appropriately.
- Testability: It should be possible to test the harvest control rule using the best science available.
- Participation: All stakeholders should be involved, or at least have the opportunity to be involved, in developing the harvest control rule. For effective involvement, stakeholders will need to understand the proposed HCRs.
- Timeliness: The harvest control rule should lead to rapid management response when the fishery resource is put at unacceptable risk.

Most modern harvest control rules used in fisheries are based on the estimated output from stock assessments. This usually takes the form of controlling fishing mortality based on estimates of spawning stock biomass. In contrast, the proposed harvest control rule for Guyana seabob is based on an empirical index which is treated as a simple random variable that contains some information on stock status.

The main reasons for using an empirical harvest control rule are that it is within the capacity of the management authority to implement it without outside support, it is easy to test through computer simulation (otherwise such simulations would not be available) and it is easier for stakeholders to understand and therefore participate in its design and, ultimately, support it. The disadvantage is that the index may not use all information available to track stock status. This disadvantage could lead to a more sophisticated HCR in future, but it was agreed to implement an empirical HCR at this stage.

The type of empirical rule proposed for Guyana seabob is the same as that used in Suriname, which is a very similar fishery.

3.2 Trawler Association Proposed Rule

A decision was reached on a harvest control rule which would be applied over the next 5 years, notwithstanding ongoing evaluation which would be undertaken within this period. The full rule is described in Annex 1: Procedure for Setting the Total Allowable Effort (TAE) for Guyana Seabob. The following decisions on the attributes of the rule were made:

- An overall control would be placed on the days-at sea, which should be linked to the number of seabob licences issued, so that each vessel is allocated a fixed number of operational days.
- An overall days-at-sea limit was proposed of 87 licences each with an allocated 225 days at sea. This limit was acceptable to industry, because it would not limit current fishing activity as long as indicators remained high, and would allow the fishery to take advantage of strong recruitments. Members of the fishing industry believe that the stock is currently in good condition, based on current high catch rates. This is consistent with determinations of the stock assessment. However, current fishing effort is lower than the maximum set here because 11 licences are inactive.
- The most appropriate stock status indicator would be the annual catch rate calculated as kilos per day fishing. Days fishing are estimated on a per trip basis based on statistical analysis of the catch-per-trip data. Using standardised effort as part of the index makes its calculation a little more complicated, but it should increase the accuracy of the abundance index.
- An empirical HCR should be within the capacity of the processors and Department of Fisheries to assemble the necessary data and to calculate the index within the appropriate time frame.

- The first trigger, rebuilding trigger and limit reference points would be approximately 19000lb, 17000lb and 10000lb whole seabob weight per trip (i.e. 600, 540, 315 respectively of kilograms processed tail weight per standardised day at sea, as agreed at the 9th CRFM Scientific Meeting in 2013). 19000 lbs / trip (or greater) would represent a desirable, target catch rate, whereas 10000 lbs / trip represents the limit, below which the fishery should, as far as possible, be closed. 17000 lbs / trip represents the trigger point, where managers would intervene, reducing the exports as well as considering other actions to encourage the stock size to increase. The catch rates were decided based on the stock assessment reference points and bioeconomic assessment of earnings required to make fishing a viable livelihood.

The index reference points will need to be re-evaluated in the future and may be subject to change based on results from updated stock assessment.

3.3 HCR in the Fishery Management Plan

Appropriate text for the management plan is suggested in Annex 1. The HCR needs to be clearly written so that it is transparent and can be understood by the fishing community and other stakeholders. In particular, the implications of the reduction in fishing need to be understood, since the HCR testing assumes its timely implementation, should a reduction in harvest be necessary. Any prevarication at this time would lead to possible depletion of the resource and almost certain suspension of the MSC certification, if this has been achieved.

3.4 Effort Standardization

The only standardization used was to adjust effective days fishing from the days-at-sea. There was a clear diminishing returns in catch based on trip length (Figure 1), so nominal days-at-sea (the sum of all days at sea by all vessels) may not be the best determinant of fishing effort. For the stock assessment, a standard number of days-at-sea (estimated fishing days) was calculated for each trip (Table 1).

For the calculation of the harvest control rule index either the standardized effort can be calculated based on each trip length (Table 1), or an adjustment made to the total days-at-sea based on the ratio between mean trip length and equivalent estimated fishing days (Table 2). The former is the preferred method, but the adjustment based on the mean trip length is simpler and should be work well enough as long as vessel operations do not change substantially. This latter method is proposed for the initial implementation of the HCR (Annex 1: Procedure for Setting the Total Allowable Effort (TAE) for Guyana Seabob).

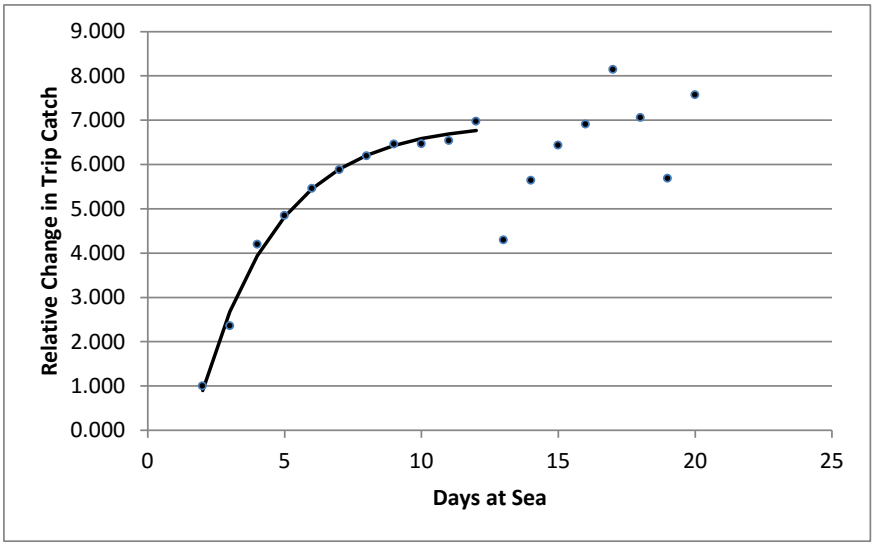

Figure 1 Estimated relative mean catch (●) dependent on trip length (days-at-sea) and fitted logistic model for trips up to 12 days length (–).

Table 1 Standardised days-at-sea (i.e. the estimated fishing days) based on nominal trip length.

Nominal Days at Sea	Relative Mean Days-at-sea	Logistic Estimate Smoothed
3	2.358	2.681
4	4.196	3.938
5	4.847	4.826
6	5.458	5.452
7	5.882	5.894
8	6.193	6.206
9	6.460	6.426
10	6.466	6.582
11	6.533	6.692
12	6.975	6.769
13	4.296	6.824
14	5.641	6.862
15	6.434	6.890
16	6.905	6.909
17	8.144	6.923
18	7.056	6.932
19	5.682	6.939
20	7.572	6.944

Table 2 Mean trip length and equivalent days-at-sea interpolated from the estimates (Table 1), used to estimate the factor converting nominal days-at-sea to standardised days-at-sea.

Observed Average Days per trip	8.148
Equivalent Standard Days per trip	6.244
Conversion Factor	0.766

3.5 Main Risks to the HCR and MSC Certification

Some catches may not be recorded. IUU catch may occur, but is not thought to be significant. The most significant unrecorded catch may be discards of sour seabob and seabob bycatch in the main penaeid shrimp fishery. A well implemented Total Allowable Effort quota should be robust to this problem.

A system for the allocation and management of the DaS quota will need to be developed. The approach proposed here is to allocate each licence 225 days at sea (Return date-time – departure date-time). It may be considered desirable to allow vessels to transfer DaS between them, or alternatively DaS may not be transferrable, which may be easier to administer.

The projection uses standardised boat days as the measure of fishing effort. This adjusts DaS for the trip length.

The Fisheries Department will be required to calculate the HCR index, but will not be required to complete frequent stock assessments. Nevertheless, some expansion in the technical capacity of the Department is still required to accept and manage the data. Furthermore, it is important that the data that are used for the index remain consistent and valid. Changes to the way fishing is conducted, particularly improvements in fishing technology, will invalidate the index and the HCR.

Many of these risks should be considered in an updated stock assessment.

4 HCR Evaluation

The HCR was evaluated using the 2013 assessment (CRFM 2013). The evaluation procedure is to apply a simplified management strategy evaluation. This is possible because the HCR is simple and does not require sophisticated stock assessments. The harvest control rule was applied as it would be implemented in the projection (see Annex 1: Procedure for Setting the Total Allowable Effort (TAE) for Guyana Seabob).

A range of harvest control rules were considered (Table 3) so that a HCR consistent with Maximum Sustainable Yield and the precautionary approach could be identified. Two types of controls were tested: overall effort control (as a fixed quota for each licensed vessel) and an overall catch limit (most probably enforced as an export limit).

For the HCR index, three reference points were proposed (Table 4). These were based around the observation that approximately 15000 standardized days-at-sea (approximately 20000 nominal days-at-sea) achieve an average SSB of 40% of the unexploited SSB, a proxy for B_{MSY}. The average catch rate at this level of depletion was 630kg processed tail weight per fishing day.

Consultations with the industry suggested the lowest acceptable of 315kg processed tail weight per fishing day was an acceptable limit reference point (i.e. 50% B_{MSY}). That is, if catch rates fell to this level, a moratorium would be acceptable for economic reasons.

Finally, two trigger points were suggested. Firstly, the main trigger for stock rebuilding at 540kg per standardized day-at-sea, which is approximately 70% of the range between the limit and target reference points. Secondly, a reasonable catch rate based on economic considerations suggested by industry was 19000lb whole weight per trip, which was approximately 600 kg per standardized boat day, a little below the target. It was felt this might be useful to apply small reductions in effort to encourage the stock to remain at the target level and avoid rebuilding, and therefore some harvest control rules were tested using this approach (Table 3; Figure 4).

The HCR index is here reported as kilograms per standard day-at-sea. However, there are equivalent expected landings per trip has been used in discussions (Table 4), although the official index will be maintained as kilograms per standard day-at-sea.

From the simulation testing, the following general results were found:

- The effort based controls (Figure 2) was more stable and more precautionary than catch based controls (Figure 3) and as a result would be able to maintain a higher long-term yield. This is primarily because the population dynamics for seabob operate on a time scale of months rather than years, and a catch based control would not react rapidly enough.
- The long term target biomass (40% B_0) would be attained at around 15000 fishing days (20000 days-at-sea).
- Small departures from the proposed target reference point and effort level are unlikely to make much difference to the outcome (Figure 4). This allowed the fishing industry representatives to choose reasonable HCR within a reasonable range around the target and limit reference points to achieve social and economic objectives.

The HCR chosen by the industry (225pv_DaS) was consistent with attaining MSY and maintaining the stock above the limit reference point.

Table 3 Range of harvest control rule configurations considered, also represented in Figure 2 to Figure 4.

Name	Control Type	Trigger Control	Target Index	Target Control	Figure
5000_DaS	DaS	75 DaS / Vessel	NA	75 DaS / Vessel	Figure 2
10000_DaS	DaS	150 DaS / Vessel	NA	150 DaS / Vessel	Figure 2
15000_DaS	DaS	225 DaS / Vessel	NA	225 DaS / Vessel	Figure 2
20000_DaS	DaS	300 DaS / Vessel	NA	300 DaS / Vessel	Figure 2
5000_Catch	Export	5000t Catch	NA	5000t Catch	Figure 3
7500_Catch	Export	7500t Catch	NA	7500t Catch	Figure 3
10000_Catch	Export	225 Catch	NA	225 Catch	Figure 3
12500_Catch	Export	300 Catch	NA	300 Catch	Figure 3
225pv_DaS	DaS	205 DaS / Vessel	600	225 DaS / Vessel	Figure 4
Target_20000lb	DaS	205 DaS / Vessel	630	225 DaS / Vessel	Figure 4
215pv_DaS	DaS	215 DaS / Vessel	600	215 DaS / Vessel	Figure 4
225pv_DaS _Target_20000lb	DaS	225 DaS / Vessel	630	225 DaS / Vessel	Figure 4

Table 4 HCR index reference points used in developing a precautionary HCR.

	Index Value (kilograms processed tail weight per standardised day at sea)	Equivalent per trip landings (Approx. pounds whole weight per average trip)
Target Reference Point (TRP)	600	19000
Alternative TRP	630	20000
Trigger Point	540	17000
Limit Reference Point	315	10000

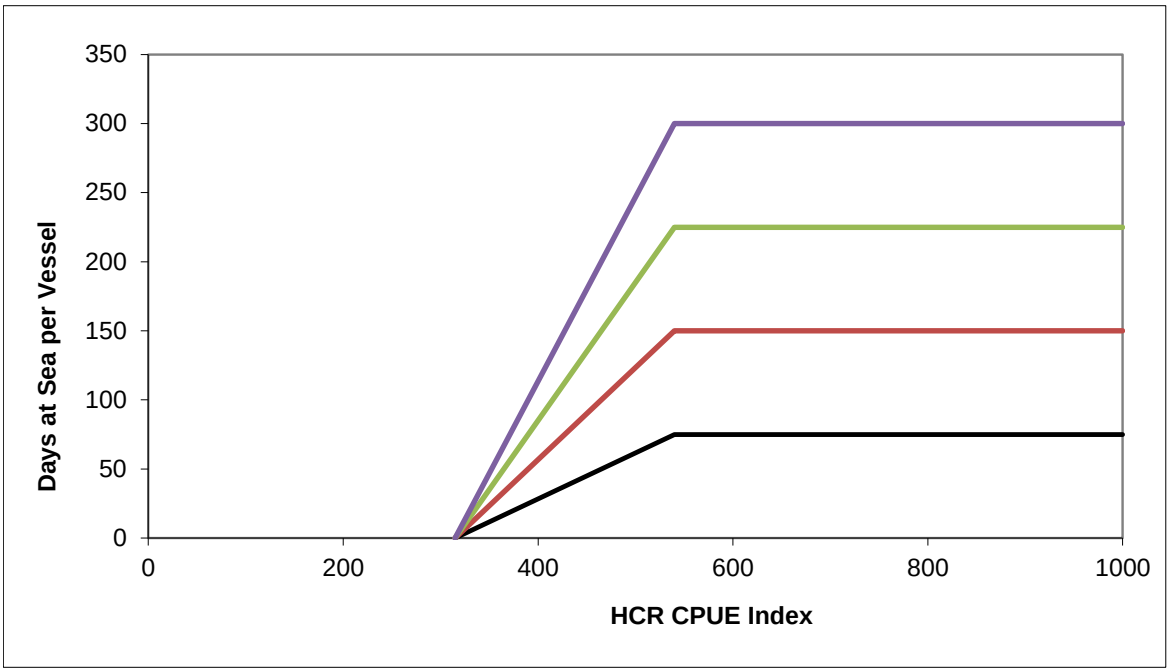

Figure 2 Alternative harvest control rules (HCR) based on effort control

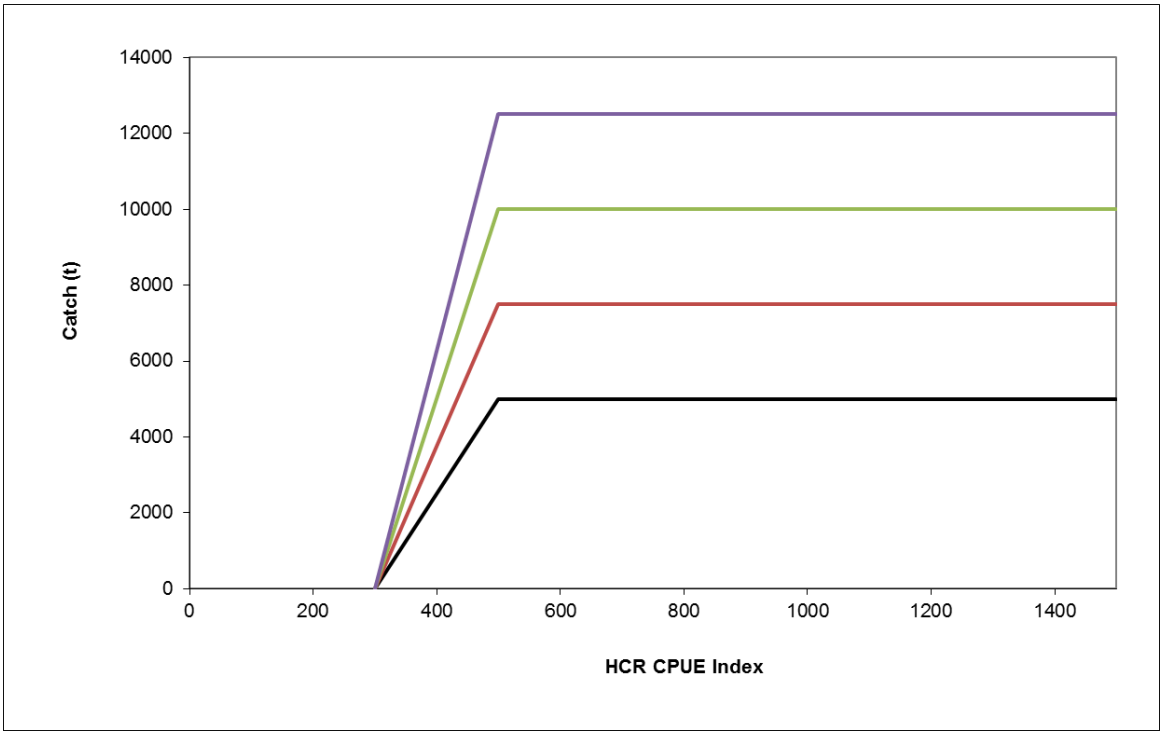

Figure 3 Alternative harvest control rules (HCR) based on catch control

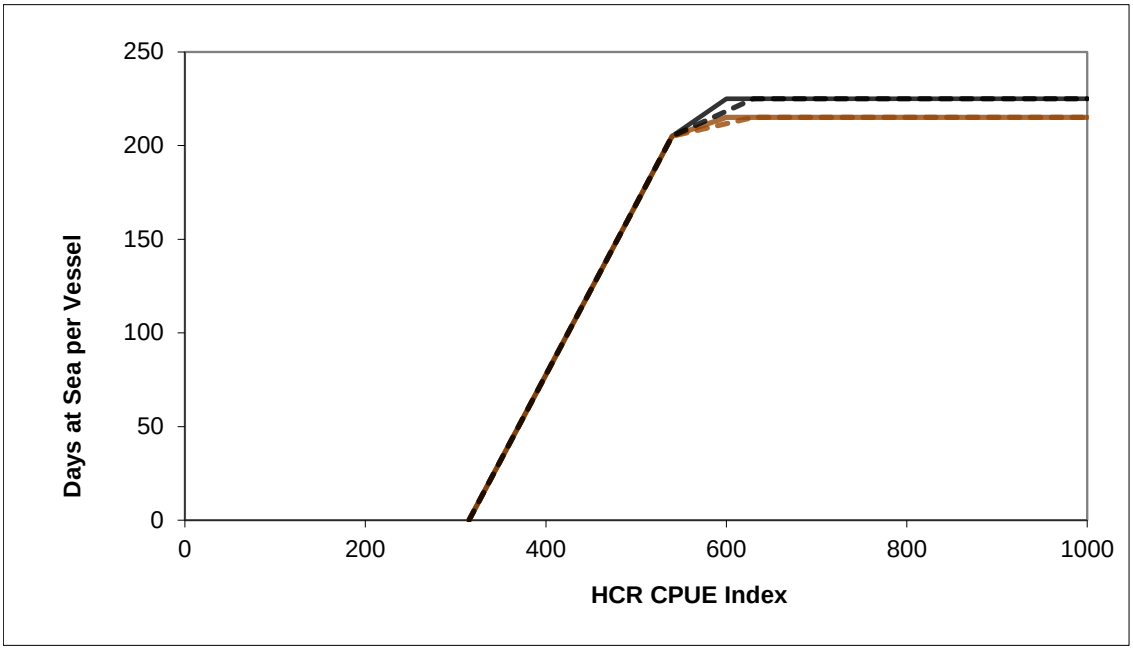

Figure 4 Alternative harvest control rules (HCR) based on effort control with alternative target controls and reference points.

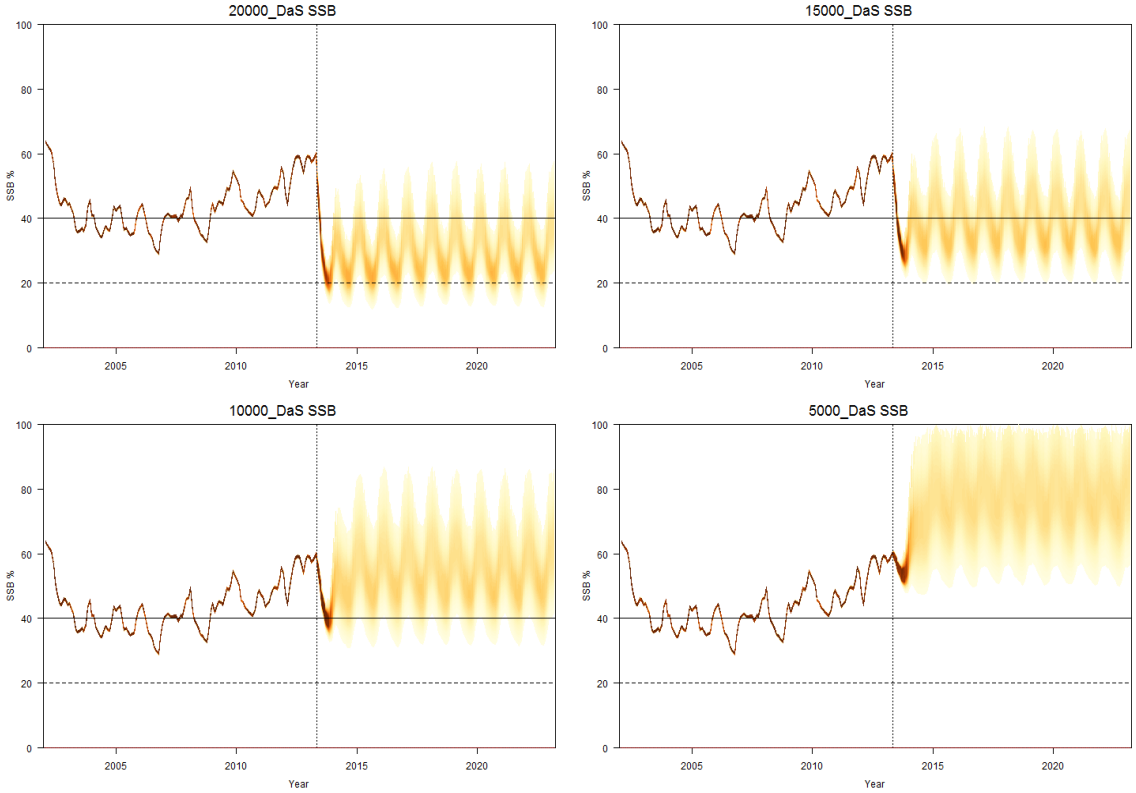

Figure 5 Estimated spawning stock biomass (SSB) as percentage of the unexploited SSB to 2011 estimated in the 2013 stock assessment, and applying alternative HCR based on effort to 2023 (Table 3). The colour density represents the certainty in the estimates, where darker colours indicate greater certainty. The 40% and 20% SSB_0 default reference points are shown as horizontal lines.

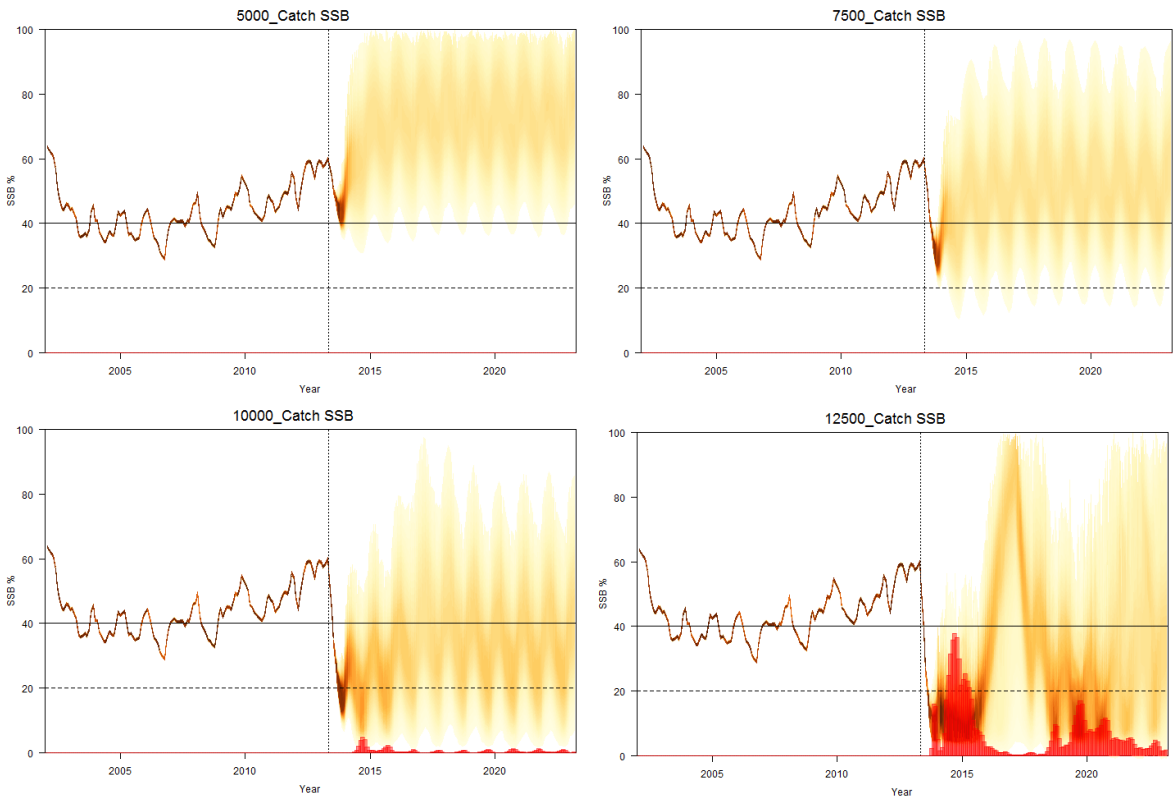

Figure 6 SSB as a proportion of unexploited state for alternative HCR based on catch (see Figure 5; Table 3). The red histogram represent the proportion of simulations where the stock has collapsed (SSB/B_0 < 2%).

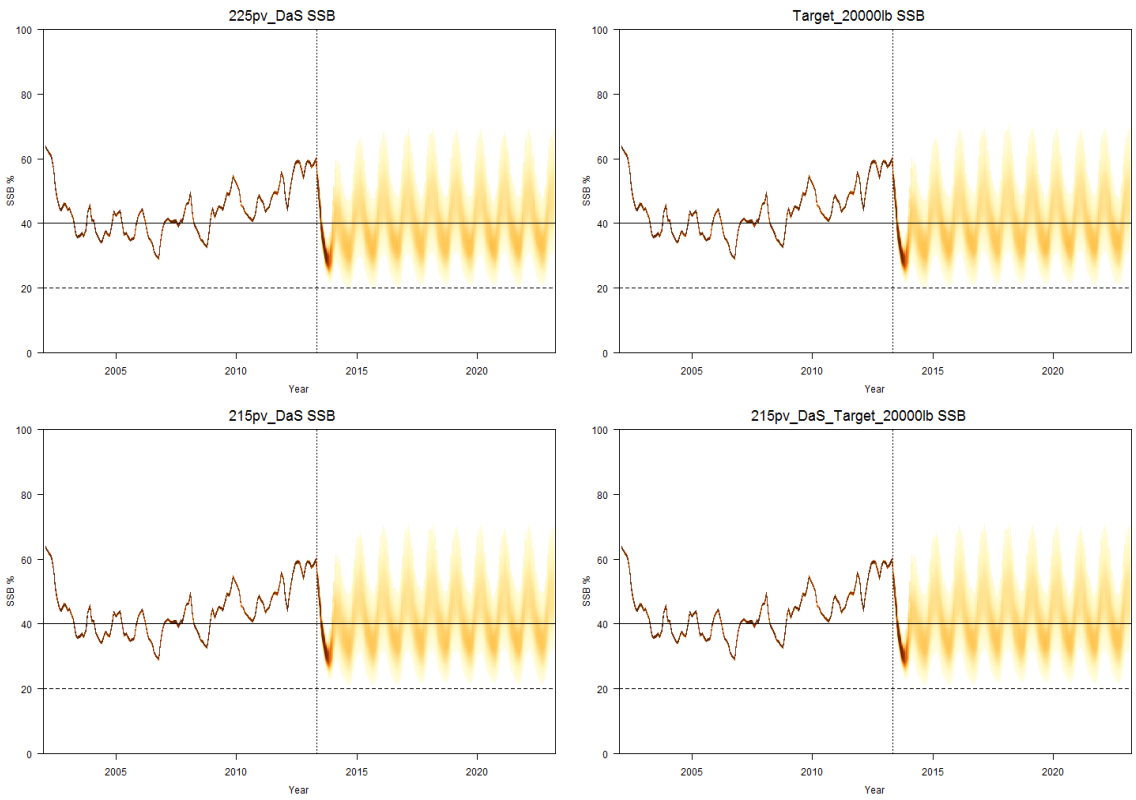

Figure 7 Estimated spawning stock biomass (SSB) as percentage of the unexploited SSB to 2011, and applying the proposed HCR to 2023. The colour density represents the certainty in the estimates, where darker colours indicate greater certainty. The 40% and 20% SSB_0 default reference points are shown as horizontal lines.

5 Conclusion

The Trawler Association has chosen a HCR which they think will be accepted. This is a major step forward for the fishery, and while it still needs to be accepted and implemented, establishing such a rule in principle greatly reduces the risks of overfishing. That is, the industry accepts that there is a limit to the amount that they can extract sustainably and they have chosen a sensible limit on exploitation.

Overall, the evaluation suggests that the HCR should sustain the fishery. Preventing further increases in effort should protect the stock and ensure future recruitment. However, it should be noted that changes in productivity are possible, and unforeseen circumstances (e.g. climate change) may still require management intervention to protect the stock. Nevertheless, seabob is a robust species that should be able to support a substantial fishery with low risk.

The HCR should be safe if implemented correctly. As long as the HCR CPUE is a valid abundance index, the HCR should act to stop excessive depletion. Most importantly, for the HCR to work, there should be no further uncontrolled changes in gear or expansion in fishing capacity before conducting a full scientific stock assessment to ensure that any such change will be sustainable.

6 References

CRFM 2013. Report of Ninth Annual Scientific Meeting – Kingstown, St. Vincent and the Grenadines, 14 - 20 June 2013. CRFM Fishery Report - 2013. Volume 1. In prep.

7 Annex 1: Procedure for Setting the Total Allowable Effort (TAE) for Guyana Seabob

The Total Allowable Effort days-at-Sea (DaS) Quota shall be set at:

- Maximum 87 licences to fish seabob
- Maximum 225 days at sea per licenced vessel when the indexed catch index is <u>at or above</u> the target index.
- a linearly declining value when the current index is <u>above</u> the trigger index, but <u>below</u> the target index, according to the calculation (TAE in days at sea per vessel):

  TAE = 205 + 20*(Current Index – Trigger Index) / (Target Index – Trigger Index)
- a linearly declining value when the current index is <u>above</u> the limit index, but <u>below</u> the trigger index, according to the calculation (TAE in days at sea per vessel):

  TAE = 205*(Current Index – Limit Index) / (Trigger Index – Limit Index)
- zero (there is an export moratorium) if the current index is <u>at or below</u> the limit index.

The current index for each year shall be calculated as the average between the previous year's index value and the catch rate of the previous year (i.e. a moving average). The catch rate will be based on reported catch and effort data for all vessels. The catch rate is calculated as the total landings of seabob processed (peeled tail) weight in kilograms divided by the total number of standardised days-at-sea.

The HCR Index in any given year *t* (I_t) is calculated as:

$$I_t = 0.5\left(I_{t-1} + \frac{C_{t-1}}{0.766\, D_{t-1}}\right)$$

Where C_{t-1}=catch (kg processed tail weight) in the year *t-1* and D_{t-1} = total nominal days-at-sea required to catch C_{t-1}. The index calculation should include all observed reliable catch and effort data.

Table 5 Reference points used in the harvest control rule and approximate equivalent average trip landings.

	Index Value (kilograms processed tail weight per standardised day at sea)	Equivalent per trip landings (Approx. pounds whole weight per average trip)
Target Reference Point	600	19000
Trigger Reference Point	540	17000
Limit Reference Point	315	10000

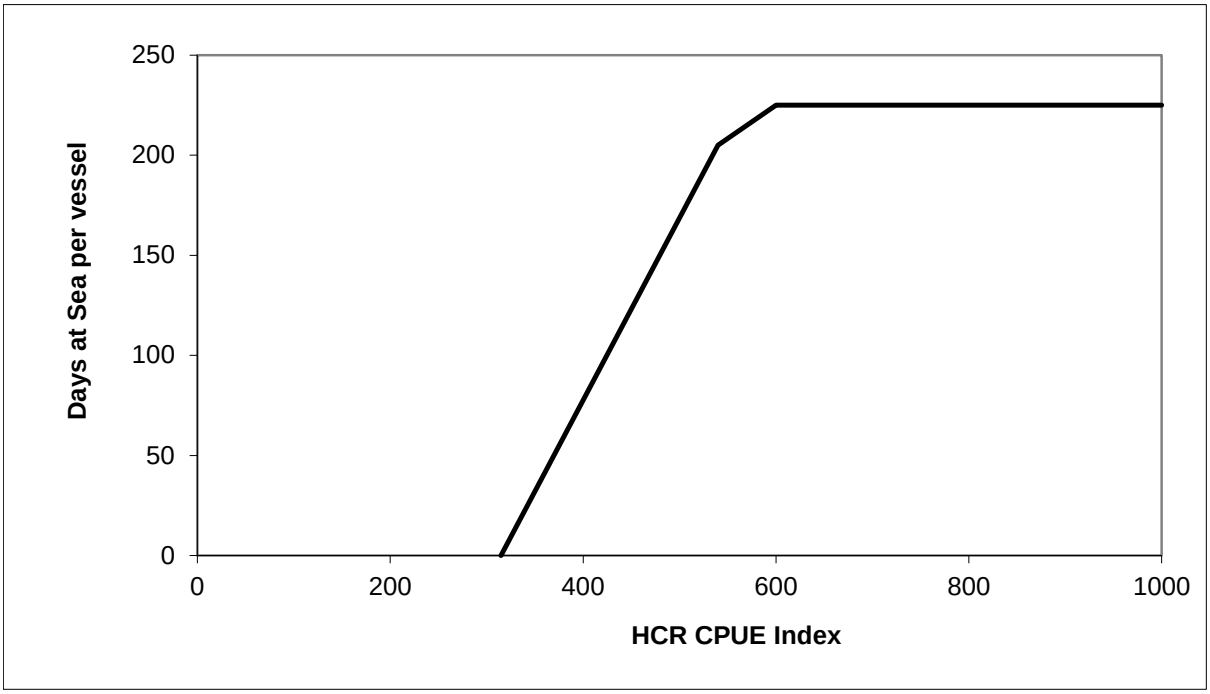

Figure 8 Graphical representation of the proposed harvest control rule, with the nominal days-at-sea per vessel based on a maximum of 87 vessels. The HCR index is in kilograms of seabob processed tail weight per standardised day at sea.