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Dear Sean

We apologise for the delay in replying to your letter of the 13th November. It was our intention to reply immediately after the Herring Assessment Working Group meeting in March but as you know there was a problem with the natural mortality rates for herring and the Benchmark process was extended. This process has not been completed as yet, however, since there is a Pelagic AC meeting imminently we will respond to your letter now.

General issues of all three herring stocks

1. *The appropriateness and timing of the herring acoustic surveys.*

The survey is undertaken in conjunction with the survey for the North Sea and as such gives an assessment of the pre-spawning distribution and abundance of all herring stocks around the west, north and east of the British Isles. The consequence of this strategy is to standardise the methodology and optimise the use of resources for this survey.

Pre-spawning surveys are better for acoustic estimations of herring stocks for a variety of reasons such as a lack of dense aggregations and the exact timing of the survey is not critical for success. Spawning aggregation surveys for herring are notoriously difficult for quantification of biomass. The problems include the survey time in relation to the timing of spawning, the presence of 'spawning waves', variable locations and the necessity for multiple surveys to ensure the whole stock is covered. These latter points have logistical and cost implications.

2. *Stock components identities.*

The stock identification for VIaS and VIaN is based on characteristics (otolith shape and body morphometrics) that were characterised over 10 years ago. Some of these characters are most certainly not fixed over time so are likely to change somewhat (temporal variability). In recent years there has appeared to be problems with the classifications and assignments of individuals within the surveys to stocks being rather surprising. A new baseline set of samples to characterise VIaS and VIaN fish was obtained in 2014/15. These samples did not provide the level of classification required for a baseline and as such it was recommended that these should not be use, nor was the original baseline sufficient for determining stock identification in 2015. The only solution for these data sets would be a more comprehensive sampling programme of herring from a wider range of spawning locations.

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Other techniques, such as genetics, were used in the past, with little success for stock identification in this area. As such genetic techniques were not been pursued in the intervening time period. However, over the last 10years there have been significant advances in genetic techniques and technology so these methods may provide a reliable means of stock identification for this area, in the future. The Pelagic AC is pursuing this approach at present.

3. *Development of robust recruitment indices.*

In regard to predictive recruitment indices for e.g. 0 or 1 wr herring on the west coast, data do not exist at present. There is a possibility that 0-wr abundances in the North Sea (sampled during the 1st Quarter IBTS) may provide an index of recruitment for fish spawning in the VIaN management area. However, a lot more research is necessary and a commitment to funding for an investigation in to the IBTS data time series. In addition, without an analytical assessment of the VIaN spawning stock as a separate stock from area VIa, VIIb,c this cannot be fully investigated.

There are no current plans by national laboratories, as far as we are aware, to instigate specific surveys, or data gathering, to provide predictive recruitment indices for these stocks.

4. *The appropriateness of the limit reference points.*

With the assessment of the two spawning stocks as one VIa, VIIb,c complex the reference points for this assessment are appropriate. However, there are no new reference points for each of the two spawning stocks that occur in each of the two management areas (VIaS and VIaN). Due to an inability to assess the stocks separately we are uncertain as to the size of each or their recent trajectories. We suggest that the past perceptions are maintained until such time as information is available to change this view and/or provide new limit reference points.

5. *Incorporation of industry information into the assessments.*

The Benchmark acknowledged that industry does have valuable information about the stocks. It also acknowledged that this information can be used to guide the assessment where there is some doubt or the assessment appears to be in conflict with the perception from the fishery. However, the full incorporation of information can only be done using scientifically sound data. An example of which is acoustic data collected by fishermen with un-calibrated echo sounders can only be used to provide qualitative estimates of lower bound estimates of fish in an area. The assessments should take heed of this information in the final advice process.

6. *The contribution of seal predation to total herring mortality. ICES has identified that this may be significant, but data are limited and, the impact on the stock cannot be estimated accurately.*

The Benchmark, especially during the Data collation Workshop examined the contribution of seal predation to herring mortalities. Data do exist, however, it is not possible to quantify the mortality exerted by the seal population, either in the past or the present or how it has changed. Furthermore, it is not possible to accurately quantify the natural mortality of herring on the west cost of the British Isles, let alone quantify the interannual variability in mortality rates. The Benchmark chose to utilise a natural mortality rate that, whilst not specific for the west of the British Isles, reflects a best perception of the level of mortality. A similar natural mortality rate is used for all stocks in this vicinity. The rational etc are given in the Benchmark report.

The natural mortality level utilised the latest output from the North Sea multi-species model. It was an error in this model that was discovered in March 2015 that meant the VIa, VIIb,c assessments needed to be re-done and new reference points calculated. This resulted in an extension to the Benchmark process.

The following addresses the points raised about the individual stocks in VIa, VIIb,c.

Herring VIa North

'*The undefined reference points for herring in Division VIa (North) should receive the highest attention in order to derive values for all currently missing reference points. Clearly defining all reference points is a prerequisite for obtaining MSC certification. The transboundary issue as highlighted below in relation to herring VIaS and VIIbc could have an effect on defining these reference points.'*

Since there are problems with identifying the two stocks' contributions to the surveys and catches, the area is assessed as one stock for VIa, VIIb,c. An inability to determine the sizes of each or undertake an analytical assessment of either means that it is not possible to set reference points for either of the stocks. To a certain extent the transboundary nature of catches falls he the same problem, namely the origin of the fish are unknown at present.

Herring VIa (south), VIIbc

A major issues for the Pelagic AC over the last number of years is the herring stock in Divisions VIa (South) and VIIb,c. The Pelagic AC and the Irish fishing industry have invested both financial and other resources to develop a rebuilding plan for this stock. After several revisions STECF and ICES have concluded that this plan can rebuild the stock only if transboundary catches are eliminated. ICES States under its Management Considerations" in this year's advice that:

*"**Transboundary catches are likely to continue because the stock is not restricted to the TAC area, especially during the summer and autumn. This stock is expected to be caught in fisheries across the Malin Shelf. ICES welcomes the efforts of the Pelagic RAC and the Irish industry in the development of the proposed rebuilding plan. The plan implies a very low catch, only slightly above 0 t. Rebuilding will not be possible if transboundary catches are not eliminated (STECF, 2013). Given that the stock is not confined to the TAC area, outtake from the stock is not regulated by the TAC. Therefore, measures to reduce transboundary catch are required.**"*

This is a key issue that should be fully addressed during the benchmark process.

The Benchmark acknowledged that transboundary catches are an issue for the rebuilding plans. However, without a valid method of determining the stock origin of individuals it is difficult to determine the origin of outtake in catches near the management area boundaries. In addition, the lack of a 'splitting' method results in an inability to provide stock specific assessments thus the progress of the rebuilding plan cannot be monitored through assessment. Lastly, the problem of catches in this area is really a management issue that needs to be addressed in this forum.

Another important issue in relation to this herring stock is the setting of a TAC. ICES has concluded that outtake from the stock is not regulated by the TAC. In order to try

to address this the Pelagic AC has proposed a closed area in neighbouring Division VIaN, north to 57°30 N, and outside the UK 6 mile limits. However ICES has concluded that:

*"**Further work is required to evaluate if this closed area will be effective. Preliminary analyses suggest that Divisions VIaS and VIIb,c herring are present in Division VIaN beyond the limits of the proposed exclusion zone. These results also show that Division VIaN herring are present to a somewhat lesser extent in Division VIaS. Therefore the proposed exclusion zone would not be expected to eliminate the exploitation of Divisions VIaS and VIIbc fish in Division VIaN.**"*

The appropriateness or otherwise setting of a TAC for this management area in isolation or combined with another area and the extent and effectiveness of a closed area are important issues to be considered during the benchmark process.

Once again, the inability to assess these stocks separately or fully determine their spatial distribution (due to not having an appropriate method of identifying individuals to stocks) precludes providing any advice on this question.

*Finally the Pelagic AC noticed that the ICES advice for this stock published in June 2014 reads that "**this stock is heavily influenced by environmental factors, and its current low productivity is partly associated with unfavourable oceanographic conditions. The warm winter temperatures and stormy conditions that have been predominant in recent years are not favourable for herring in this area**." Unfortunately ICES does not present any form of scientific evidence in the advice, e.g. references to studies published in peer-reviewed scientific journals, which underline these claims. Therefore the Pelagic AC would like to encourage a literature review as part of the benchmark providing a summary of relevant scientific findings and possibly guidelines on how such environmental factors can be taken into account when formulating successful management strategies.*

The Benchmark undertook a review of the environmental conditions to the west of the British Isles using the limited resources that were available for this task. The findings are reported in the Benchmark report (Section 3.5). In summary (from the Benchmark report):

'Herring recruitment in VIaS, VIIb,c responds favourably to cooler temperatures. The influence of the environment on herring productivity means that the biomass will always fluctuate (...). Temperature trends are similar for the sea area to the west of Scotland and the North Sea. The broad trend in oceanic temperatures over the period 1900 – 2006 is warming. Oceanic temperatures around the Scottish coast for the period (1970-2006) have increased by ~ 0.5°C. Salinity and surface temperature of coastal waters around the Scottish coast also shows a slight increasing trend over the same time period.'

'Given the decline of the autumn spawning component, concomitant with environmental changes since the early 1990s, it would seem likely that spawning in late spring would be similarly attenuated.'
'In conclusion, there is no evidence of the various components (autumn, winter or spring) in VIaS, VIIb,c being separate stocks. However, there is a mechanism

allowing plasticity between autumn and winter/spring spawning. Autumn spawning used to be dominant, but a switch to winter spawning took place in the mid 1990s, concomitant with warmer temperatures. There is not enough information to judge the importance of spring spawning, but there is no evidence to suggest it is important at the present time. Judgment is reserved on differentiation of these sympatric temporal spawning variants.'

We hope the responses supplied here are what you were looking for. If you have any questions please do not hesitate to ask. The Benchmark report was passed on to the HAWG who were, and will, take up the task of dealing with the appropriate form of advice for these stocks.

Yours sincerely

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