



▶ Pelagic AC

Western Horse Mackerel Focus Group

25 May 2020
14:00-17:00 hrs
WebEx

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Participants

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|----|-------------------------|--|
| 1 | Sean O'Donoghue, chair | Killybegs Fishermen's Organisation |
| 2 | Martin Pastoors | Pelagic Freezer-trawler Association |
| 3 | Claus Reedtz-Sparrevohn | Danish Pelagic Producer Organisation |
| 4 | Andrew Campbell | Marine Institute Ireland |
| 5 | Michaël Gras | Marine Institute Ireland |
| 6 | Gerard van Balsfoort | Pelagic Freezer-trawler Association |
| 7 | Laurens van Balsfoort | Pelagic Freezer-trawler Association |
| 8 | Edward Farrell | UCD |
| 9 | Angela Fuentes Pardo | Uppsala University |
| 10 | Steven Mackinson | Scottish Pelagic Fishermen's Association |
| 11 | Anne-Marie Kats | Pelagic AC |

1. Opening of the meeting by the chairman, Sean O'Donoghue

The chairman opened the meeting at 14:00 hrs.

2. Adoption of the agenda

The chairman explained the Focus Group meeting could not be held physically due to the current covid-19 circumstances. The key focus of today's meeting was the progress around the Western horse mackerel MSE work and establishing a timeframe for its completion. The chairman hoped to be able to finalize a draft to feed into the ICES system in time for WGWIDE.

The agenda was adopted without amendments.

3. Follow-up on action items

The chairmen went through the action items from the previous meeting, which took place almost one year ago. One outstanding action item was to find out why Spain and France had not collected samples in recent years. Martin Pastoors explained that this action item referred to sampling in the area 8a of the Bay of Biscay. Samples had been collected but they were not the same age-based samples. France doesn't have a directed fishery, but samples length, which isn't used. Spain is collecting lots of data on



horse mackerel but the catches are lower. That explains why no age-based samples for horse mackerel were seen in in 8a. The chairman asked if further actions were required on this.

Martin Pastoors clarified that in the context of WGWIDE, it would be interesting to look at length sampling to see if they are consistent in the different areas where horse mackerel is harvested. Analysis of length distribution is on the WGWIDE agenda. Martin Pastoors indicated he would make an inventory of length data and update the July PELAC meeting (**action 1**).

All the other action items on the list had been completed. This included circulating the TOR for the Western horse mackerel benchmark, updating Working Group II at the July 2019 meeting on the ad hoc rebuilding work and submitting the outcome of this work to WGWIDE in August 2019.

4. Update horse mackerel genetics work by Edward Farrell and Angela Fuentes Pardo

Edward Farrell gave an update on the state of play of the genome sequencing work in collaboration with Upsala University, and started with a brief background reminder of the work that had been carried out over the last few years. Angela Fuentes Pardo would then go over further details of from the genome sequencing outcomes.

The horse mackerel stock ID project was started in 2015 to get a better grasp on the different horse mackerel populations. The Southern horse mackerel stock is confined to area 9a, but certain times a year the divisions between the Western and North Sea stocks change. ICES division 4a the Western part of 3a are considered to be part of the North Sea stock in quarters one and two but are part of the Western stock in quarters three and four. Horse mackerel covers a huge area but how the stocks are broken up may not be entirely accurate in terms of population structure and how it changes over the year and areas.

Despite these issues in stock-ID, two of the stocks (Western and Southern) are category 1 assessments. The Western stock is not in good shape, but the Southern stock is apparently increasing. The North Sea stock is category 3, so data limited. If the populations these stocks belong to are identified, a lot of the issues in the assessments can be cleared up as the input data to the assessments will at least be divided on the population level.

A pilot study was initiated in 2015 by the PFA and IMARES, using genetic methods to try and differentiate samples and catches of North Sea and Western horse mackerel. At the time, there were almost no genetic markers for horse mackerel at all except for four microsatellites developed as part of the HOMISIR project. New genetic markers (microsatellites) were developed and tested for both the Western and NS stock. Some sequencing issues were encountered, so the industry funded a second phase with a more robust sampling collection over a period of multiple years. During this phase, samples from mackerel egg surveys were gathered as well and further work was done on the marker development. The sampling over multiple years allowed testing of temporal stability within the sampling areas as well. The study used novel methods and identified 50 microsatellite markers which were used to screen over 2,000 fish. Results revealed that the Southern NS stock was the most differentiated from all other stocks. The relationship between the Western and the Southern stock was much less clear. North African samples were expected to stand out, as well as Portuguese samples to stand out from samples from Ireland, however only a low level of differentiation was detected.

Attempts were made to try and assign mixed samples from the Western English channel (ICES division 7e) and the Northern NS back to either NS or the Western stock. An accuracy of 60% was realized which was wasn't considered robust enough. One of the recommendations from that project was to use the experience with herring genome sequencing on horse mackerel and determine if that information could be used to further refine the assignment. This led to a follow-up project carried out in 2019 in collaboration with Upsala University, where a draft genome for horse mackerel was



developed and pooled genome sequencing was undertaken in order to identify informative SNP markers.

Angela Fuentes Pardo explained that the main difference in the approach compared to previous stages of the work was that in previous methods only a small fraction of the genome was looked at to see if informative regions could be identified. In this case, a whole genome sequencing approach was applied so the entire genetic material of horse mackerel was searched for informative markers for discriminating between the populations.

A subset of the same samples, representing each potential population group, from the previous phase of the project were used, the DNA extracted, and mixed in a single tube, building libraries for sequencing. It provided millions of sequences, and as such overall population level information was obtained. DNA building blocks were read against the genome to map the differences, with a focus on single nucleotide polymorphisms (SNPs), i.e. single base changes. Samples from phase two were used and analyzed.

In terms of results, about 10 million SNPs were identified, which overall indicated a low genetic differentiation among the sampling locations. Overall, the genetics differences were low (max 4%).

Martin Pastoors asked how this finding compared to the genetic work being done on 6a, 7bc herring. Angela Fuentes Pardo replied that like herring, the genetic difference is very low. In herring the differentiation is more like 2%, this is applied genome-wide. When particular comparisons are made, the differences are bigger. Particular sites of the DNA have changes.

Pairwise comparisons between samples were conducted to identify markers of interest. Thanks to this technique, it could be seen that the North Sea population is distinct from other samples. These samples stand out from other sites at a number of SNPs on different chromosomes.

The draft genome was useful in distinguishing the populations. Angela Fuentes Pardo is finalizing a panel of markers and refining them to test what is further needed. Across all population samples, the level of genetic differentiation was relatively low and some areas stand out. The observed patterns broadly agree with the findings in the phase 2 project: the North Sea samples stand out from all other populations, while the samples from the northeast Atlantic samples seem a lot more mixed.

Finally, the main observation was a North/South genetic break in area 9a, suggesting a possible genetic barrier or mixing zone between two populations. When looking at temporal replicates in the NS, a low genetic differentiation is observed, suggesting temporal stability. There might be more mixing in the Southern Portugal area, as no temporal match was found. This finding is similar to what is observed in boarfish, and suggests that the Southern stock doesn't constitute one single population. In order to determine the level of mixing and whether it comprises more populations, more detailed analysis would be needed.

Some mixed samples were collected from area 7e, raising the question how the borders of the Western stocks could accurately be determined. This is still not clear and it will impact the data going into the assessments.

Ed Farrell went on to present a possible follow-up phase to this work: using the large number of identified SNPs in this project to further investigate the fine scale population structure of the species and to develop a panel of markers for stock identification and assignment of mixed samples back to their stock of origin. In order to advance to this stage, the results of the pooled sequencing analysis would need to be validated by genotyping a subsample of the individual fish included in the pools.

He proposed to have Identigen carry out the genotyping, since they have a massive capacity for rapidly and cost effectively processing this amount of markers. Once the marker panel is finalized, the samples



can be sent to Identigen and results could be ready within two months. The proposal was initially put together for the NPWG, but the Pelagic AC will look into the possibility of funding this project.

The chairman praised Ed Farrell and Angela Fuentes Pardo for their impressive work and progress in terms of genome sequencing. He was a firm believer in the need to carry out this intermediate step in order to reach the level now seen with 6a herring: taking a mixed sample and being able to assign it to its stock of origin. In terms of the management area of the Western, North Sea and Southern stock, he asked how this can be taken into account when developing a rebuilding plan for Western horse mackerel. If incorrect assumptions on the stock-ID are made, how can this then be taken onboard when developing a management plan? Would it be a waste of time to work on a plan for this stock?

Martin Pastoors explained that HCRs or MSEs are currently being developed on the basis of the current definition of the stock areas. Both the Southern and the Western stocks are conditioned on the current assessment. Including mis-identification into an MSE will not be straightforward. It needs to be specified how often the identification is wrong.

The chairman asked if a factual assessment is not possible, should the assessments be left separate or should this be highlighted as an issue to address?

According to Gerard van Balsfoort, the key question is trying to find the definite horse mackerel stocks in EU waters through genetic work. The work was started because the current layout of the management areas wasn't certain. We are now getting a first glimpse that stocks are structured quite differently than the way they are divided now. It remains key to understand how many stocks there are and where their boundaries lie. More importantly, what level of certainty would be acceptable for managers? That all influences the way forward. The key question is what the best timing would be for developing the management strategy. When looking at the NS stock component, he asked Ed Farrell whether areas 4b and 4c are standing out genetically.

Ed Farrell replied that the North Sea is the most differentiated, based on the baseline of spawning fish from areas 4b and 4c. Fish from these areas can be separated from the Western and other areas. There is an uncertainty in area 7d as there are no samples from there at the moment. The further North, the bigger the fish. More small fish are found in the Channel.

Gerard van Balsfoort asked if there could be more different stocks, and if so, how many. The more stocks, the more complicated it all becomes. Ed Farrell agreed it looked complicated, potentially there could be lots of mixing areas. He couldn't indicate at this stage how many populations there were. One of the main difficulties is obtaining spawning samples for the baselines. More samples are needed to define the populations at a fine level of detail. It can then be seen if there's justification for splitting the stocks for the stock assessment. It becomes more complicated to delineate mixed catches in the Western and Southern areas. Once more is known, it becomes possible to estimate how many years of sampling are needed for more certainty. But it will take years to better understand the population structure.

The chairman asked whether working on a MSE would be a waste of time. If it takes years to get a finer picture, there's no choice but to develop a MSE. Managers and scientists need to be informed that genetic research is being carried out. He asked whether the Northern area would need refining or the Southern border?

Gerard van Balsfoort replied that looking at the industry, the Southern part is more relevant for management, as well as the border between the Southern and the Western stock. Ed Farrell added that sampling in the Bay of Biscay needed to be improved.

With regard to establishing temporal stability, Martin Pastoors asked whether samples compared between years, are from the same season (and thus comparable). Ed Farrell replied that roughly this



was indeed the case, but spawners are difficult to catch. The 9a 2016 samples were caught in March/April while in 2017 they were caught in July. There is a slight time difference between them.

Michaël Gras asked whether the break between the two stocks in the Portugal area was similar to the 6a herring situation. Ed Farrell thought that this could potentially be the case. He indicated the area differentiation was similar to that observed in boarfish. The biology of horse mackerel is similar to herring and boarfish in terms of quick reproduction. In addition, there are oceanographic features and currents in the area that might be the driving force behind the split, similar to boarfish.

Michaël Gras asked if the oceanographic features were something to look into to identify which area belongs to which stock, on a yearly basis? Ed Farrell replied that if enough years are sampled, the oceanographic features could indeed be tested. In Atlantic herring, genotyping revealed differentiation related to ocean temperature. By collecting samples from that area and performing a time series analysis with oceanographic conditions, an oceanographic proxy can be established. Unlike herring, horse mackerel don't have particular types of spawning grounds. Horse mackerel are therefore more likely to tackle a certain temperature regime for spawning, instead of grounds. By that movement, the border might become slightly blurred. In the North Sea, the two-year samples seem to stay in place but in the Western shelf edge more spawning variation is seen, which is dynamic from year to year.

The chairman concluded from this discussion that being able to split samples into the different populations, if they exist as such, is a few years away. From that point of view, there is no choice but to continue with the development of the rebuilding plan, even though the situation could be different in a few years' time.

The chairman asked the Focus Group for a mandate to carry out the follow-up work on genetics. The samples need to be allocated to different stocks, so this interim piece of work is needed to advance to that stage. The Focus Group agreed to carrying out the validation work.

For the PELAC to fund this work, the Executive Committee needs to be consulted to sign-off on funding the €10,000 contract from the PELAC budget, following a positive recommendation from the Focus Group. Gerard van Balsfoort underlined his positive advice for continuing this project. The industry has been investing on this work for years and firmly believes carrying on would be money well spent.

Claus Reedtz-Sparrevohn highlighted his experience in area 3a, where a sample from the fishery could be assigned back its stock of origin, thus knowing if the sample related to North Sea herring. This is key to understanding the spread of the stock.

The PELAC secretariat will carry out the administrative requirements for funding the contract and will consult the Executive Committee for approval. The chairman noted it would be important to indicate that no Working Group meeting could be held on this before seeking ExCom approval. The Working Group members should therefore also be informed (**action 2**).

5. State of play since the last meeting in June 2019 by Martin Pastoors

The chairman invited Martin Pastoors to give the Focus Group an update on the state of play regarding the work on the rebuilding plan.

Martin Pastoors started by giving a historical overview of the work done on rebuilding plans for horse mackerel since 2015. This work has been subject to lots of changes, either relative to the assessment or the reference points.

In 2015, the Marine Institute (MI) and Cefas were commissioned to update the agreed management plan of 2007, which was no longer considered precautionary. There was a change in perception of the stock due to perceived changes in the egg survey. The perception of the assessment changed as well.



The MI and Cefas conducted two evaluations. The analysis found that even with no fishing, the risk of falling below Blim was more than 5%. The SSB appeared to increase, but the uncertainties were still so high that it increased slowly. The uncertainty in the assessment was too large for a meaningful MSE.

In 2017, a benchmark meeting led to the inclusion of new data sources resulting in a new assessment approach. New reference points were estimated from that assessment. A lesson learned here is to never take the last point from an assessment, because it will start to change everything. In 2018, an advice came out for a large TAC increase, close to MSY Btrigger. Landmark Fisheries was commissioned in 2018 to carry out some work to look at potential management plans. Landmark had done some MSE work on sablefish, and their approach looked promising. Landmark looked at different types of HCRs. In most of the scenarios, the stock was expected to increase. The fishing mortality was around 0.1. However, it didn't take into account the right types of uncertainty in the starting conditions. Landmark was not available for a follow-up for the required timeframe. This led to the setup of the collaboration between scientists working on different rebuilding methods for the herring stocks. However, the capacity to carry out the work was overestimated.

In 2019, the inter-benchmark resulted in less retrospective bias, indicating the stock was just above Blim. Formally, the stock is not in the rebuilding phase, but it could potentially happen at any moment because of revisions in the assessment.

During the meeting with the ad-hoc working group on rebuilding plans one year ago, other rebuilding techniques were looked at used in other stocks subject to a zero catch advice, such as WBSS herring, Celtic Sea and 6a herring. The aim was to look at simpler techniques to evaluate HCRs for Western horse mackerel. The SAM model was looked at with an HCR forecast used for WBSS herring. Also the SimpSIM was looked at used for Celtic Sea herring.

Some progress was made, but not enough. There is still some work to be done. Hopefully during this meeting a timeframe can be decided for its finalization. In 2019, the progress on the SAM assessment package was presented to WGWIDE, and it appears promising. It hasn't been followed up yet with an HCR evaluation in the SAM model. It is not a big job, but somebody needs to be assigned to carry it out.

In February 2020, the ICES workshop on rebuilding plans (WKREBUILD) took place. The workshop stemmed from the lack of criteria within ICES to evaluate rebuilding plans, making it difficult to develop rebuilding plans and get them through the ICES system. Martin Pastoors presented the work on Western horse mackerel as a case study, and there were other contributions on herring stocks. It was a useful and insightful workshop. There was more focus on how reference points are calculated. A recommendation was made to ICES to organize a workshop on estimating reference points. In addition, an estimation rebuilding timeframe was recommended, as opposed to the current ACOM rule stating that rebuilding needs to take place within 1 year. This timeframe is linked to generation time.

That's where we are at now. The goals outlined during the last Focus Group meeting in 2019 have not been achieved, but hopefully some deadlines can be set to fulfill them before the July PELAC meeting.

The chairman thanked Pastoors for his update. He asked if the recommendations made at the WKREBUILD workshop had gone through the ICES process and were they accepted by ACOM. Martin Pastoors agreed to check with ACOM whether a decision has been made on them (**action 3**).

6. Presentation MSE model by Andy Campbell

The chairman invited Andy Campbell to present the work on the development of an MSE for Western horse mackerel, based on an adaptation of the EqSim software.



Andy Campbell described that he had created a Github repository for WKREBUILD related work.

The code for this MSE exercise was originally adapted from the SimpSim software which itself was an adaptation of EqSim. A similar approach was taken recently for the development of an MSE for Celtic Sea Herring. However, significant additional code changes were required and it was decided to revert to the standard EqSim code (which itself had undergone further development by ICES in the meantime) and to implement additional functionality such that EqSim can be more readily used for MSE purposes.

Updates to the EqSim code were required in order that simulations can be appropriately initialized (e.g. a number of starting population replicates can be used), alternative harvest rules can be implemented and constraints such as min/max TAC levels and inter-annual variability can be tested. The base EqSim code is very limited in that it is designed to simulate at a constant fishing mortality or to apply the ICES advice rule. The code has been modified such that users can now define a harvest rule within a function which EqSim will use to derive a target fishing mortality. An implementation of the no further decline (NFD) rule as suggested by Dankert Skagen has been coded.

In order to parameterize the WHOM simulation, information from the stock assessment is required and help was provided by the stock assessor, Gwladys Lambert. The current stock assessment model is an implementation of Stock Synthesis. The most recent assessment parameter values were used to generate 1000 population vectors with which to initialize the MSE. The variability in the population vectors reflects the uncertainty in the assessment output, an element which was missing from the recent evaluation by Landmark.

A number of scenarios have been tested so far including no HCR, the ICES advice rule and the NFD rule whereby if the target F would lead to a decline in SSB, it is reduced to maintain SSB at current levels. The results presented are considered exploratory and further work is required, in particular in relation to the incorporation of appropriate levels of uncertainty. There is guidance available from the recent work of ICES which revised the guidelines for MSEs. The guidelines have raised the bar in terms of the requirements for successful evaluation of an MSE.

The chairman thanked Andy Campbell for this update and asked for the timeline to complete the work. Andy Campbell replied it could be done in a matter of weeks.

Martin Pastoors was impressed with the amount of the work and the results obtained in the margin of other meetings. He referred to the NFD rule, where the target cannot be exceeded. He asked if no big year classes were assumed for this evaluation. Andy Campbell confirmed but feared the amount of work that still needed to be done around the validation. The positive side to this approach was that it can be validated, which is more difficult to do with a full-feedback approach.

Gerard van Balsfoort remarked that when looking at the SSB from the latest benchmark, the level of uncertainty below the line is not seen here. Does this mean the chosen Fmsy and Blim are appropriate?

Andy Campbell clarified that the NFD prevents you from going below a certain level, so it is hard to say if the reference points are appropriate. That would require further validation.

The chairman asked Martin Pastoors to display the list of actions from the ad-hoc working group, which he did.

The first action on the list was to ask Dankert Skagen to investigate the role of age composition in SSB, to determine how long it takes to convert from recruitment to SSB. Martin Pastoors indicated Skagen would need to be commissioned as an independent expert to carry out this work, it would take around two days. The industry agreed to sort out the costing. Martin Pastoors agreed to follow-up with Dankert Skagen to ask for a timeframe and costing (**action 4**).



Martin Pastoors agreed to compare estimates of EqSim parameters F_{cv} and F_{phi} between different stocks by mid June (**action 5**). He would also check with ACOM on metrics for rebuilding, following from the recommendations from WKREBUILD (**action 3**).

The chairman asked if the parameters out of WKREBUILD are sufficiently precise to be incorporated into the horse mackerel MSE. Martin Pastoors said they weren't, they would need a bit more work. How much more work was unknown due to the lack of ICES criteria for evaluating rebuilding plans. Claus Reedtz-Sparrevohn added that the biggest problem is the lack of consensus from WKREBUILD for when you are in a rebuilding phase, making it difficult to proceed.

The next actions items were to set up a technical meeting on evaluation tools and for Vanessa Trijoulet and Andy Campbell to complete work on the SAM and EqSim HCRs (**actions 6 and 7**).

The chairman, Gerard van Balsfoort and the PELAC secretariat will work on the request to the Commission for submission of the draft rebuilding plan to ICES. They will work on formulating the request from the PELAC based on previous PELAC rebuilding plan/management plan submissions with input from the Focus Group (**actions 8 & 9**).

The evaluation will result in different options, the Focus Group will need to recommend on the preferred choice from these rules for the rebuilding plan.

Another Focus Group meeting was set for July 2nd at 15.00 hrs CET. Based on this meeting, the draft rebuilding plan can be finalised and proposed to Working Group II ahead of the meeting on July 9.

Martin Pastoors added that the PFA started on some work that touches the genetic work carried out by Ed Farrell. He wanted to start collecting samples to analyse mixed catches, to see if this could reveal information on spawning behaviour. Sampling for horse mackerel has already started. He agreed to coordinate this work together with Ed Farrell, as it would be good to involve him in the sampling (**action 10**).

7. AOB

There was no other business.

8. End of meeting

The chairman closed the meeting at 17:05 hrs and thanked the participants for their contributions.

9. Next WHOM FG meeting

The next Focus Group meeting would be held on 2nd July; 15:00 hrs Amsterdam time.



List of agreed action items

1. Make an inventory of WHOM length data and update the July PELAC meeting (Martin Pastoors)
2. Carry out the administrative requirements for funding the follow-up genetics contract and consult the Executive Committee for approval for funding out of PELAC budget (secretariat)
3. Check with ACOM on its decision with regard to the WKREBUILD recommendations and the resulting metrics for rebuilding (Martin Pastoors – early June).
4. Ask Dankert Skagen to investigate the role of age compositions in SSB: how long does it take to convert from recruitment to SSB; ask for the work to be done + timeframe + cost (Martin Pastoors – late May)
5. Compare estimates of Eqsim parameters F_{cv} and F_{phi} between different stocks (Martin Pastoors – mid June)
6. Plan for an Ad hoc technical meeting on evaluation tools and actions (Martin Pastoors – late May/early June)
7. Finalize evaluation work (SAM HCR, EqSIM HCR) (Andy Campbell, Vanessa Trijoulet, Martin Pastoors – end of June)
8. Develop draft rebuilding plan based on previous examples such as Celtic Sea herring; 6a herring; (southern horse mackerel – management plan) (Chairman, Gerard van Balsfoort, secretariat – mid June)
9. Develop request to ICES on evaluation of rebuilding plan for WHOM / WBSS (WHOM Focus Group)
10. Coordinate the mixed samples for genetics [Ed Farrell, Martin Pastoors; End of June]

