Fisheries New Zealand
Tini a Tangaroa

Report from the 2019 Specialist Technical Workshop on the New Zealand hoki stock assessment model

New Zealand Fisheries Science Review 2020/2

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Cover Photography by Mary Livingston: Reflections and Abstractions 2015

Preface

Fisheries New Zealand and its predecessors, the Ministry for Primary Industries and the Ministry of Fisheries, have conducted fully-independent expert reviews of stock assessments, research methodologies, and research programmes since 1998. We also run specialist technical review workshops to further advance fisheries and other marine science methodologies and techniques. These fully-independent reviews and technical workshops are separate from, but complementary to, the annual Science Working Group processes that are used to ensure the objectivity and reliability of most of our scientific research and analyses.

A new publication series, Fisheries Science Reviews, was initiated in 2015 to ensure that reports from these reviews are readily accessible. The series will include all recent and new fully-independent reviews and technical workshop reports and will also incorporate as many historical reports as possible, as time allows. To avoid confusion about when the reviews were actually conducted, all titles will include the year of the review. They may also include appendices containing the Terms of Reference, a list of participants, and a bibliography of supporting documents, where these have not previously been incorporated. Other than this, there will be no changes made to the original reports composed by the independent experts or workshop participants.

Fisheries Science Reviews (FSRs) contain a wealth of information that demonstrates the utility of the processes the Ministry uses to continually improve the scientific basis for managing New Zealand's fisheries.

Mace, Pamela M.; Skea, Gretchen L. (2020). Report from the 2019 Specialist Technical Workshop on the New Zealand hoki stock assessment model. *New Zealand Fisheries Science Review 2020/2.* 13 p.

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EXECUTIVE SUMMARY

Mace, Pamela M.; Skea, Gretchen L. (2020). Report from the 2019 Specialist Technical Workshop on the New Zealand hoki stock assessment model. *New Zealand Fisheries Science Review 2020/2.* 13 p.

The Ministry for Primary Industries/Fisheries New Zealand convened a Specialist Technical Workshop to review the hoki stock assessment model and the data inputs used in the model. The workshop was held on 11–12 November 2019 in Wellington, New Zealand. The two-day workshop was attended by a number of hoki data and assessment analysts, Fisheries New Zealand scientists and fisheries managers, fishing industry members, and four external fish stock assessment experts with little direct experience with New Zealand hoki assessment to provide 'fresh eyes' for the assessment.

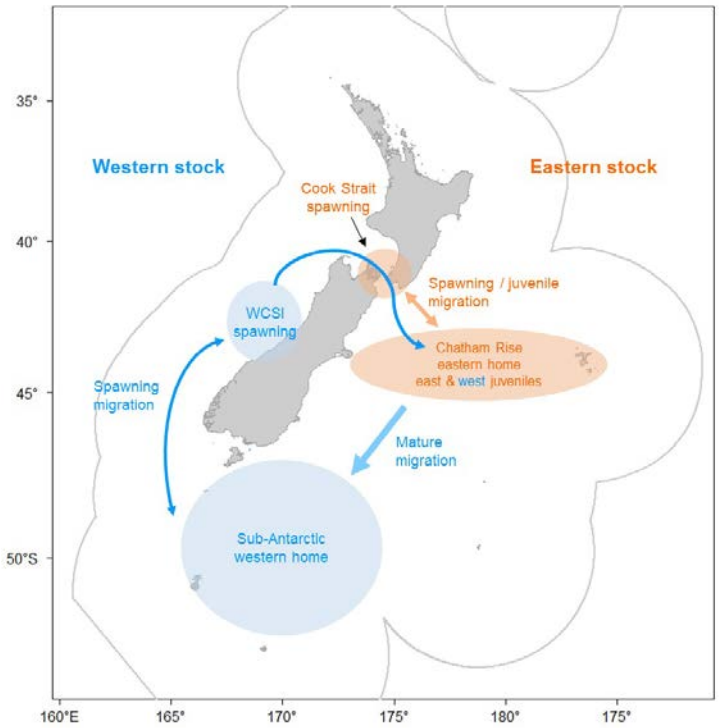
Hoki is the largest fishery by volume in New Zealand and a full Bayesian stock assessment is usually completed annually. The assessment undergoes regular reviews and updates but since approximately 2018, the model results have not appeared to be consistent with either the trawl survey time series or the experience of the fishing fleets, particularly for the western stock. This discrepancy has led to further investigation of data inputs as well as model structure.

This review workshop was designed to generate ideas and contribute to the review process currently underway by informing further data analyses and potential motel structure alterations that may be useful to undertake before the next full stock assessment.

The output from this workshop is a prioritised work plan in which specific objectives are rated in terms of urgency and feasibility. Because the stock assessment review is an ongoing process occurring throughout 2019–2020 some of these objectives are currently underway and many will be completed before the next full stock assessment in 2021.

1 INTRODUCTION

New Zealand hoki (*Macruronus novaezelandiae*) has a complex stock structure with multiple fisheries and correspondingly complex stock assessment model. There are believed to be two separate stocks (a western stock and an eastern stock) that share common juvenile nursey grounds on the Chatham Rise. As they mature, the western stock hoki leave the Chatham Rise area and move to their adult home grounds in the Sub-Antarctic. During the winter spawning season, they migrate from there to the west coast of the South Island (WCSI) to spawn. The eastern adult stock maintains its home on the Chatham Rise but migrates to Cook Strait to spawn. Fisheries operate in all parts of the range of both stocks.



Research trawl surveys using RV *Tangaroa* have taken place since about 1992 on the Chatham Rise and in the Sub-Antarctic. Trawl surveys have also been conducted, though less frequently, off the WCSI. Acoustic surveys have been conducted in Cook Strait and off the WCSI. Other input data include length and age frequencies from the observer programme, length and age frequencies from the research surveys, gonad stage data from both the observer programme and research surveys, and catch and CPUE data from the commercial fisheries.

The assessment model is a Bayesian age-structured model that attempts to mimic the migratory behaviour of the stocks and to integrate multiple sources of input data. Not all the available data are used in the model. Stock assessments occur on an annual basis.

The model has had a similar structure for about two decades although a number of refinements have occurred during that period. However, starting in about 2018, the model results did not appear to be consistent with either the trawl survey time series or the experience of the fishing fleets, particularly for the (larger) western stock. This led to a separate study that attempted to dissect the model to determine the source of the anomalies. The May 2019 assessment also attempted a few variations on the usual model structure and led to a range of results but did not resolve the issues. A further study continued the effort to dissect the model, including re-stratifying the age composition input data to finer scales for each fishing/survey area.

It is intended that the results from these studies will be used to inform a) further analyses that might usefully be attempted, either between now and the due date for the next assessment in May 2020, or later in 2020/2021, and b) the structure of the base model to be used in the May 2020 stock assessment.

A draft work programme for the period from mid-November 2019 until May 2020 is currently being developed and will be discussed during the Specialist Technical Workshop. The Terms of Reference for the workshop are given in Appendix 1, participants are listed in Appendix 2, and background references are given in Appendix 3.

2 HOKI STOCK ASSESSMENT MODEL REVIEW WORK PLAN: Short- and long-term priorities

Notes compiled from discussions held during the Hoki Model Review Workshop held 11-12 November 2019 in Wellington New Zealand
15 November 2019

2.1 Purpose

To outline further exploratory work that could usefully be done to address issues with the hoki stock assessment model. The primary focus of this work should be on activities that can usefully be undertaken between now and May 2020. However, the opportunity for such additional work is likely to be limited, and some of the work plan may need to be deferred beyond this timeframe.

Data for a new stock assessment will not be available until late February/early March 2020. The time between now and then, and possibly beyond, will be spent developing a new model without the additional year of data.

The components of the work plan should be prioritised in the following way:

Category	Symbol	Description
Urgency	U1	should be undertaken soon; likely to have a significant impact on the assessment
	U2	medium-term priority; likely to have a moderate impact on the assessment
	U3	longer-term priority; uncertain what impact it will have
Feasibility	F1	should be relatively easy to accomplish
	F2	moderate level of difficulty to implement
	F3	potentially difficult to implement

The idea behind the tasks listed below is to implement the useful changes that have been made in the Stock Synthesis (SS) model into CASAL, along with other analyses that the work undertaken to date has suggested may be useful. These tasks are presented in no particular order and are likely to be further prioritised, based on the estimated time available for continuing the exploratory work and insights that are gained as the work progresses.

2.2 Recommendations

1. Further explore the use of the re-stratified age composition data to include additional complexity in the Sub-Antarctic, WCSI, and Chatham Rise fisheries and fishery-specific selectivity functions to account for temporal changes in the spatial distribution of the regional catches. Initial model trials indicate that the spatial disaggregation has improved the it to the age composition data from the main fisheries. **[U1, F1]**

2. Develop age-length keys for use with datasets where direct ageing samples are too low. [U1, F1]

3. Fitting to multiple biomass components has enabled an increased understanding of the age-specific dynamics of the model. Trawl survey biomass indices should be incorporated into the model by partitioning by groups of age classes; in particular, ages 1 and 2 in the Chatham Rise survey need to be split off and treated as separate indices in the model, with their own q's and CVs. Ages 1 and 2 years should be excluded from the Chatham Rise trawl survey age compositions. In addition, consider removing 3-year-old fish from the Sub-Antarctic trawl survey biomass and age compositions. Consider the process error associated with the sets of trawl survey biomass indices. Use the CVs for the specific age component of the biomass to evaluate the reliability of the fit to the individual age components of the biomass and, therefore, determine whether these components would be expected to be fitted well. [U1, F1]

4. Explore the use of age-based rather than length-based selectivities and ensure that bounds are not unduly constraining. Most of the available composition data are provided as age compositions and configuring the age-based selectivity functions provides a more direct implementation, removing the need for the transition to length composition (with assumptions regarding growth and variance of length at age). [U1, F1]

5. Relax the constraints in movement/selectivity/catchability dynamics between the Chatham Rise and Sub-Antarctic to enable a more gradual transition in the movement of fish recruiting to the Sub- Antarctic (trawl survey) area. Trials with the SS model indicated that this could improve fits to some components of the Sub-Antarctic trawl survey. There is an indication that the assessment under-estimates the abundance of the strongest year classes sampled (as 2-year-old fish) by the Chatham Rise trawl survey. There is also an indication that the stronger year classes are more abundant in the Sub-Antarctic trawl survey area at a younger age. [U1, F1]

6. Also investigate the potential for density dependence juvenile migration, as well as sex-specific selectivities and sex-specific movement in the future, but this is probably not a priority for this year. [U3, F1]

7. The assessment model appears to be well-informed regarding the magnitude of the biomass for the western stock. However, the data do not appear to be as informative regarding the magnitude of the biomass of the eastern stock (presumably due to the correlation between the eastern biomass and the one-way movement from the Chatham Rise). The current assessment model constrains the overall relative distribution of biomass between the eastern and western stocks via a number of model priors (proportion of recruitment East vs. West and trawl survey and acoustic q's). Consider alternative constraints to specify the relative magnitudes of the East:West biomass split. [U2, F3]

8. Consider reinstating the data, or aspects of it, from the old Shinkai Maru surveys that were used to develop a prior for pE; consider also reinstating information from other surveys that have been excluded from the model. Also re-examine the early Sub-Antarctic survey series data to determine whether there is information on fish sizes beyond the current survey area.

9. There are some missing early length frequency and age data from WCSI (1987, 1988, and 1989) that should be included in the model. [U1, F1]

10. Further investigate the poor fit to the Sub-Antarctic old fish trawl survey biomass by applying additional spatial structure to the assessment model and/or differential age-based movement dynamics (from the Sub-Antarctic to the WCSI fishery). [U2, F1]

11. Examine liver condition data for evidence of spawning senescence. [U3, F2]

12. Conduct further examination of the effects of environmental variables on fish distributions, particularly for the Sub-Antarctic area. [U2-3, F2]

13. The Stock Synthesis models all set M at a constant value of 0.25 for females, and 0.30 for males, rather than using a U-shaped relationship. These values may be too high and use of M = 0.18 or 0.20 for females and M = 0.22 for males should be considered. This might result in a better fit to the 11- to 17-year-old group in the Sub-Antarctic. Also, consider estimating a constant M inside the model. [U1, F1]

14. Test other structural assumptions; for example, movement parameterisation (from the Chatham Rise to the Sub-Antarctic), juvenile natural mortality, terminal selectivity (logistic vs. double normal), and stock (and recruitment) dynamics. [U3, F2]

15. Further consider the technical merit of the time series of WCSI (and Cook Strait) acoustics biomass indices in the assessment model, and, if there are flaws, consider whether or how to incorporate them into the model. A review was undertaken in 2001–02, but it may be useful to conduct a new review based on updated knowledge about the acoustic surveys. To be done inter-sessionally post-2020. [U3, F2]

16. Cook Strait fishery age composition data – review the sampling data and reconfigure if appropriate. There is evidence to indicate that the changes in the composition of the fleet (catch by vessel size) has an influence on the proportion of female fish in the age composition samples. The misfit of the older ages in the eastern spawning age frequencies (which has previously led to the kill 'em or hide 'em assumptions) is still present in the revised model with constant M. It could be useful to investigate whether this is removed if a stratified eastern spawning fishery is fitted in the model. Annual trends in the selectivity of the fishery have not been investigated. It may be possible to account for changes in the selectivity of the fishery by incorporating a covariate associated with one or more of the selectivity parameters. [U1, F2]

17. Maintain the option for a West Only model for the 2020 assessment. The West Only model provides a useful comparison with the western stock component of the two-stock model and, thereby, enables the relative influence of the data from the eastern stock on the estimates of stock status for the western stock to be determined. This model should also use the newly-specified fisheries. No specific new work is needed beyond exploratory work as detailed above; just include in the usual Working Group meeting processes. [U1, F1]

18. Conduct exploratory analyses (to better understand fleet behaviour, but not to create new model input) of the composition data by generating standardised composition time series that are not affected by time-varying effects such as movement of the fleet. The model should account for factors such as depth and location. Similar analysis could also provide a better understanding of factors affecting the stock. VAST can be used for this. Using this approach to standardise the survey data would also be useful. Model-based analyses have some advantages over stratified approaches to analysis because they can account for known sources of variation within strata, such as depth. [U2, F2]

19. Review the base biological parameters (length-weight relationships – both spawning and non-spawning, growth, and variation of length-at-age and weight-at-age). [U2, F2]

20. Re-examine the stratification of the Sub-Antarctic survey. [U2, F2]

21. Consider the use of random effects to deal with the potentially time-varying aspects of movement rates, selectivities, and catchabilities. [U3, F2]

22. Consider developing a new model that doesn't include movements, but rather treats different areas as having different selectivities. Check whether this substantially affects stock status. To bound the structural uncertainty re movement/selectivity confounding, also consider a model having uniform selectivities (or at least selectivities that are shared between the areas), and therefore use movement to explain the differences in age composition between the Chatham Rise and Sub-Antarctic. [U1-U2, F2]

23. Move the model from CASAL to CASAL 2. [U3, F2]

24. Further explore appropriate methods for defining appropriate Effective Sample Sizes for age composition data, particularly when age compositions are partially decomposed. The relative weighting of individual annual observations may be defined by the number of otoliths or length samples included in the derivation of the composition. Review the utility of the length samples for years where there are insufficient age data to reliably determine the annual age composition of the catch from individual fisheries (especially for the Sub-Antarctic fisheries). [U3, F2]

2.3 Comments from External Reviewers

The four external reviewers, along with other participants, primarily contributed to the work plan as a whole, but they were invited to contribute additional comments if they wished.

John Hampton

On the model

- It's difficult to see from the presentations to date how the selectivity, mortality, and movement parameters might be confounded, so some model diagnostics on this would be useful. Information on parameters hitting bounds would also be useful.
- Same for priors – it's not clear how the combinations of priors may be pushing the model into a corner.
- I think the selectivity forms could be explored, particularly the shared *M*/*F* length-based selectivity for the surveys; e.g. as an alternative, just estimate separately as age-based parameters. Also, I wonder if an asymptotic (or even uniform) selectivity for the surveys should be tried, because from the description it seems that the survey is designed to sample all age classes in a representative way. (I may be wrong on this though.)
- It's a little surprising that we didn't see assessment results presented in a way that includes the uncertainty, e.g., the probability that the current biomass B/B0 is less than 20% is X. Perhaps this is done in other fora/reports. Also, it seems that a single "best" model formulation has been relied upon for the most part. Maybe a multi-model approach that better represents the range of uncertainty could be looked at.

Fishery monitoring

- Seems unfortunate that the surveys have become biennial, which means there is no power to follow cohorts from 1+ to 2+ in the Chatham Rise survey in particular, which makes up the bulk of the catch.
- The current model suffers from having no observations regarding movement generally or stock composition on the Chatham Rise fishery. I'll defer to Robin on this, but it would be useful to do a feasibility study for the application of close kin mark-recapture to see what the

sampling/cost requirements might be for this. This seems like the only way that direct observations of movements could be generated.

- Some of the experts have indicated that stock structure effectively doesn't matter for the assessment. However, it would seem that it is at least possible that you could have high depletion of one stock while maintaining the overall B/B0 within management limits. So an added benefit of genetics sampling would be to evaluate (potentially, if persistent genetic differentiation of the two main spawning stocks is detected) the stock mixture on the various non-spawning fishing grounds and possibly be able to classify catches to stocks in the future.

Simulation/MSE

- It may be useful to develop a suite of simulation (operating) models reflecting current understanding of the stocks in an MSE-type framework to test whether it is important to recognise stock structure in the assessment. Then of course if industry was interested, developing a management procedure approach to annual TACC setting might also be considered.

Nick Davies

My overall comment arises from the approach used in WCPO assessments where we step back from attempts to refine a single MPD and rather investigate a wide range of MPDs that explore uncertainty in the structural and statistical assumptions; known as an **uncertainty grid**. The hoki assessment, by comparison, appears to have explored only one area of statistical uncertainty – the relative importance of observations from the East stock on the integrated model fit, specifically in relation to the West stock estimates. This exploration could be expanded further given the range of issues raised during this review process, to more fully express the uncertainty in the assessment model. Specific areas of uncertainty that warrant attention include natal fidelity, stock mixing, fishery definitions, and migration and selectivity ogives. A key model structural assumption is **natal fidelity**, such that there is no possibility of stock mixing on the Sub-Antarctic foraging area, and the only area of stock mixing is that for juveniles in the Chatham Rise area. The effect of this assumption should be explored with alternative, perhaps, simpler models. Field studies to estimate the level of **stock mixing** in the various spawning and non-spawning areas should be undertaken, e.g., genetic identification using close kin mark-recapture. WCPO assessments typically have complex **fishery definitions** to deal with spatial heterogeneity in fisheries and stocks, for which evidence of this for hoki was presented during the review, and more fisheries could be defined to deal with this. A major source of uncertainty in the reference hoki model (that used for the basis of the assessment) was the potential **confounding in the age-specific processes** for: migration, selectivity, and natural mortality; especially in respect of the **Whome** migration ogive and selectivities on the Sub-Antarctic foraging area. This is reflected in the sensitivity of the model in fitting to the trawl survey abundance indices and age compositions from this area (data conflict). **Diagnostics** should be undertaken to identify correlations among these parameters, in particular, and alternative model assumptions (e.g., ogive functional forms) should be explored in the uncertainty grid (as suggested above).

Lastly, I recommend that **full MCMC calculations** be undertaken on all models comprising an uncertainty grid, and to use the posteriors rather than the MPD point estimates.

Rick Methot

The hoki model implemented in CASAL has a number of structural features designed to track the movement of two stocks among four areas and four seasons. It is largely successful in this, but some noticeable residuals remain. The most obvious is the non-random pattern of residuals for the fit to the survey abundance in the Sub-Antarctic. This is probably due to an, as yet, undiscovered environmental effect of the distribution of fish or the catchability of that survey. The CASAL implementation uses an

adjustment (increase) to the assumed standard error of these survey values which rationalises the lack of fit, but does not improve or explain the fit. An alternative approach is to adopt a stance that admits that random environmental effects are at play and that the time-varying value of the catchability, movement, and selectivity parameters are responsive to these random effects. A good example is the recently published work by Tim Miller and his colleagues in the Northeast of the US. An approach like this is worthy of future inclusion in CASAL and implementation in the hoki assessment.

Robin Thomson

I agree with the view that it would be better to estimate selectivity at age (sex segregated) rather than to convert selectivity at length into age. While in principal it would be best to model growth within the model, as is done in SS, and to fit to lengths to ALKs (as age conditional on length), I think that this would be a lot of work for little gain in that the current model faces greater problems, that would not be solved by that change. The East and West focused (or -only) models seem to show that the abundance of the east and west stocks are coupled in some way that is not intentional (or desirable) – the model seems to need to raise the abundance of the west stock to achieve higher abundance in the east, and similarly to lower that of the east to achieve lower abundance in the east. The data for the west seem to indicate a lower abundance and more depleted stock than can be achieved when the west is estimated within the two-stock model so that the data for the east are resulting in a larger stock in the west than is indicated by the data from the west. I would like to see more exploration of which parameters or assumptions are causing that. I would like to see that constraint relaxed, if possible. The Whome migration seems to be the culprit, but I would like to see that more clearly explored. I would also like to see the correlation matrix to see which parameters are confounded. Some parameters are hitting (or are close to) their bounds – those should all be relaxed. The model includes some influential assumptions and some strong priors – those should not be forgotten by the assessment team. I would be interested to see how a model that does not assume natal fidelity performs.

Comments on the potential for close kin mark-recapture to inform a hoki assessment model

Regarding close kin mark recapture (CKMR), a proper scoping study would be needed to (a) work out which parameters and assumptions could be informed by CKMR, and (b) what sample sizes would be required and, therefore, what the cost of such a project might be. Results from a full CKMR study would be some years away, so this would not help with your work plan for the next few months. Nevertheless, it would be worth considering because I believe it could greatly reduce the uncertainties in the current model. With the caveat that a design study would be needed to be sure of the claims that I am about to make, I think that a close kin study ought to be able to deliver the following:

- Separate absolute abundance estimates for the west and the east stocks (and therefore the ratio between the two stocks)
- A clear answer regarding natal fidelity; i.e., whether hoki that were spawned in the west will recruit to the west or whether they make a decision as juveniles regarding which stock to join
- Information on whether fish spawned in the east and the west co-occur on grounds other than the Chatham Rise
- Given sufficient parent-offspring pairs spanning the mature age range, CKMR is able to deliver a fecundity-at-age ogive; for hoki, if there is a descending tail to that ogive then that would be interpreted as ‘senescent fecundity’
- The age gap between half-siblings (mitochondrial DNA tells you whether they share a mother, or a father) gives information on the mortality rate of parents. Although the age of the parent is unknown, the width of the age gaps will be smaller for stocks that experience higher

mortality rates – that gives an estimate of *Z*, the absolute abundance estimate coupled with known catches given an estimate of *F*, so that the remainder is *M*.

3 ACKNOWLEDGMENTS

We would like to thank all participants in this workshop but, in particular, the international experts who agreed to participate: Rick Methot (National Oceanic and Atmospheric Administration – NOAA Fisheries), Nick Davies (New Zealand-based consultant), Robin Thomson (Commonwealth Scientific and Industrial Research Organisation – CSIRO), and John Hampton (Pacific Community – SPC). The workshop was funded by the Fisheries New Zealand budget for peer review.

APPENDIX 1: TERMS OF REFERENCE

Fisheries New Zealand
Tini a Tangaroa

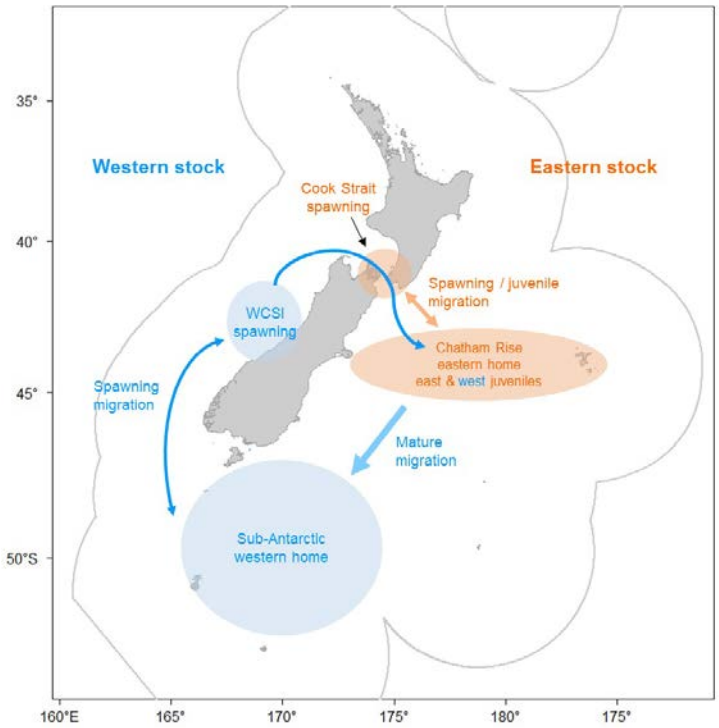
Draft Fisheries New Zealand Terms of Reference for a Specialist Technical Workshop on the Hoki Assessment Model: 11–12 November 2019

National Library of New Zealand, 70 Molesworth St, Thorndon, Wellington

9:30 am to approximately 5:00 pm each day

1. Background and overview

New Zealand hoki (*Macruronus novaezelandiae*) has a complex stock structure with multiple fisheries and correspondingly complex stock assessment model. There are believed to be two separate stocks (a western stock and an eastern stock) that share common juvenile nursey grounds on the Chatham Rise. As they mature, the western stock hoki leave the Chatham Rise area and move to their adult home grounds in the Sub-Antarctic. During the winter spawning season, they migrate from there to the west coast of the South Island (WCSI) to spawn. The eastern adult stock maintains its home on the Chatham Rise but migrates to Cook Strait to spawn. Fisheries operate in all parts of the range of both stocks.



Research trawl surveys using *RV Tangaroa* have taken place since about 1992 on the Chatham Rise and the Sub-Antarctic areas. Trawl surveys have also been conducted, though less frequently, off the WCSI. Acoustic surveys have been conducted in Cook Strait and off the WCSI. Other input data include

length and age frequencies from the observer programme, length and age frequencies from the research programmes, gonad stage data from both the observer programme and research surveys, and catch and CPUE data from the commercial fisheries.

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It is intended that the results from these studies will be used to inform a) further analyses that might usefully be attempted, either between now and the due date for the next assessment in May 2020, or later in 2020/2021, and b) the structure of the base model to be used in the May 2020 stock assessment.

A draft work programme for the period from mid-November 2019 until May 2020 is currently being developed and will be discussed during the Specialist Technical Workshop.

2. Participants

The technical workshop will consist of hoki data and assessment analysts who have been involved in data collection or preparation, developing hoki stock assessment models, or dissecting the results; Fisheries New Zealand scientists and fisheries managers, fishing industry members, and four external stock assessment experts who have little or no experience with New Zealand hoki assessments. The four external experts are:

Rick Methot (NOAA Fisheries)
Nick Davies (New Zealand-based consultant)
Robin Thomson (CSIRO)
John Hampton (SPC)

The workshop will be chaired by Pamela Mace (Fisheries New Zealand).

3. Terms of Reference

The primary purpose of the workshop is for participants to discuss, amend, delete, and add to the draft work plan for the period between mid-November 2019 and May 2020 (and possibly beyond). If there is sufficient time, participants may also be asked to roughly prioritise the elements of the work plan.

The main output of the workshop will be the agreed/endorsed, and possibly prioritised, work plan. The four external experts may also be requested to provide a short statement of their views of the work that has been undertaken, and alternative approaches that could be explored in subsequent work.

Leading up to discussions on the work plan, New Zealand analysts will provide background information on hoki biology and stock structure, hoki input data, the 2019 stock assessment, the reasons why the assessment results were questioned, and the exploratory analyses used to dissect the model in order to better understand it.

4. Background documents

Hoki chapter from the May 2019 Fisheries Assessment Plenary (Fisheries New Zealand 2019).
Hoki stock assessment for 2019 (McKenzie 2019).

5. Indicative Timetable

No times are given for the presentations because we want to make sure that all participants have ample opportunity to ask questions of the presenters and that discussions are not limited (within the constraint that we need an agreed/endorsed work plan by the end of the second day).

We may start the presentation of the model dissection prior to the end of the first day, if there is sufficient time.

Monday 11 November 2019	Welcome, introductions, objectives of the workshop Presentations and discussion on a) Brief background information on hoki biology and stock structure, and the hoki fisheries b) Length, age, stage and CPUE data c) Survey time series d) The 2019 hoki stock assessment e) Issues with the 2019 hoki stock assessment	Pamela Mace Rosie Hurst Sira Ballara Rosie Hurst Matt Dunn Alistair Dunn
Tuesday 12 November 2019	Model dissection: Presentations and discussion of the analyses and results that have been undertaken to better understand the dynamics of the hoki stocks and the extent to which the assessment model realistically models these dynamics Presentation and discussion of the proposed work plan for additional work	Adam Langley, Alistair Dunn, Matt Dunn Discussion led by Pamela Mace

Morning tea and lunch will be provided, and there will be a short afternoon break.

APPENDIX 2: LIST OF PARTICIPANTS

Independent Expert Review Panel

Rick Methot	NOAA
John Hampton	SPC
Robin Thomson	CSIRO
Nick Davies	SPC

Partipants

Sira Ballara	NIWA
Tiffany Bock	FNZ
George Clement	Deepwater Group
Patrick Cordue	Innovative Solutions Limited
Alistair Dunn	Ocean Environmental
Matt Dunn	NIWA
Jack Fenaughty	Sanford Ltd
Simon Hoyle	NIWA
Rosemary Hurst	NIWA
Adam Langley	Trophia
Pamela Mace	FNZ
Vidette McGregor	NIWA
Jeremy McKenzie	NIWA
Gretchen Skea	FNZ
Nathan Walker	FNZ

APPENDIX 3: BACKGROUND DOCUMENTS PROVIDED TO PARTICIPANTS

McKenzie, A. (2019). Assessment of hoki (*Macruronus novaezelandiae*) in 2019. *New Zealand Fisheries Assessment Report* 2019/68. 99 p.

Fisheries New Zealand (2019). Fisheries Assessment Plenary, May 2019: stock assessments and stock status. Compiled by the Fisheries Science and Information Group, Fisheries New Zealand, Wellington, New Zealand. 1641 p.