Australian Government

Australian Fisheries Management Authority

Shark Resource Assessment Group (SharkRAG) Meeting 2 2021

Meeting minutes

November 15 and 16 2021

Teleconference

Agenda item 1. Preliminaries

1.1 Welcome and apologies

1. The Chair opened the meeting at 10am with an Acknowledgement of Country and welcomed members and observers.

2. Members and participants noted the meeting was being recorded.

3. **Membership**

Mr Sandy Morison	Chair
Robin Thomson	Scientific member
Ian Knuckey	Scientific member
Charlie Huveneers	Scientific member
Julian Morison	Economic member
Kyri Toumazos	Industry member
Leigh Castle	Industry member
Craig Harris	Industry member
Sally Weekes	AFMA member
Lou Cathro	Executive officer

4. **Invited Participants**

Fiona Hill	AFMA
Ross Bromley	SSIA
James Woodhams	ABARES

5. **Observers**

Miriana Sporcic	CSIRO
Paul Burch	CSIRO
Tim Emery	ABARES
Simon Boag	SSIA
Don Bromhead	ABARES
Rocio Noriega Tronloso	ABARES
Krystle Keller	ABARES
Mahdi Parsa	ABARES
Robert Curtotti	ABARES
Michael Dylewski	ABARES

6. Apologies

Jamie Papas	Industry

1.2 Declarations of interest

7. The Chair noted that a preliminary session was held for SharkRAG members to discuss attendee declarations of interest.

8. RAG members followed the declarations of interest procedure as outlined in Fisheries Administration Paper 12, updating the Table included at Attachment A.

9. The following conflicts of interest were declared with specific agenda items:
   - Industry members, Mr Harris, Mr Toumazos and Mr Castle noted conflicts of interest for agenda items 3, 7, 8 and 9.
   - Dr Thomson, Dr Sporcic and Dr Burch noted conflicts of interest for agenda items 3, 4, 7.1, 9, 10.
   - Observers from ABARES noted conflicts of interest with agenda items 8 and 10.
   - Dr Knuckey and Dr Morison noted conflicts with agenda item 10.

The participants were advised of and accepted the decision made at the preliminary meeting that consistent with the approach taken in previous meetings, that members with conflicts of interests were welcomed to be part of discussion but not take part in the formulation of advice.

1.3 Adoption of agenda

10. The RAG adopted the agenda (**Attachment B**) as final with the exception of Agenda Item 9, Discard estimates for shark species from EM to inform 2022-23 TAC calculations, which was deferred due to work ongoing.

1.4 Minutes of previous meeting

11. The RAG noted the final minutes of the SharkRAG meeting of March 2021 are available on the [AFMA website](#) .

1.5 Actions arising from previous meetings

12. The RAG noted the status of action items from previous meetings and the updates provided by relevant parties at **Attachment C**.

Agenda item 2 – Updates from Members

2.1 AFMA Update

13. The AFMA member provided a general update on activities relevant to the Gillnet Hook and Trap Fishery since the last meeting in March 2021. The RAG noted and discussed the following points:

   a) SharkRAG membership: Existing membership expires 30 June 2022 and a call for applications for the new term due to start 1 July 2022, will go out mid-December.

   b) Electronic monitoring and data transformation: The Australian Government announcement in April 2021 of funding that commits AFMA to expanding the EM program and further developing data collection systems. AFMA is looking to the expansion of EM coverage in the manual hook sector, supported by SEMAC in July 2021, in this program.

      o The RAG advised that the recommendations of the Strategic Monitoring and Review Project (SMARP) should be considered by the team administering the funding in the development of the work program.

   c) New sea lion closure: Consistent with AFMA's Australian Sea Lion Management Strategy, an 11nm gillnet closure is being implemented at Western Isles in South Australia due to the discovery of 10 pups at a previously undocumented colony in early 2020.

2.2 Industry Update

13. The RAG noted that across the fishery catches and price of gummy shark were very good but a number of operators are finding it difficult to get quota resulting in some boats fishing less.

2.3 Scientific Member Update

14. Dr Thomson provided an update on the school shark CKMR project progress on genetic sampling and ageing:

a) Any school shark vertebral samples collected by the SIDaC and ISMP programs and supplied to Fish Ageing Services are routinely provided to CSIRO. Samples are transported via freezer trucks to ensure high DNA quality. To-date, a little over 1,000 samples have been provided to CSIRO and DNA-extracted. An additional set of several hundred school shark samples have been provided recently, and will be catalogued and have DNA extracted over the coming months. The rate of sample collection is sufficient to reach the target of 3,000 samples by the middle of 2023.

b) Noting the uncertainties associated with vertebral ageing for both mature and juvenile sharks, a pilot project using epigenetic ageing for school shark is being undertaken and showing promising results. Subject to the outcomes of the pilot project, a decision informed by RAG advice, will be required to determine if this ageing approach is worth pursuing.

Agenda item 3 – Manual Longline ERA

15. Dr Sporcic presented the paper *"Ecological Risk Assessment for the Effects of Fishing: Draft Report for the Southern and Eastern Scalefish and Shark Fishery (Gillnet Hook and Trap Sector): Manual Longline Sub-Fishery 2015-2019".* The RAG was asked to adopt the ERA or provide advice regarding any methods or results that require further investigation by CSIRO or AFMA.

16. The RAG noted and discussed:

    a) A level 1 SICA (Scale, Intensity, Consequence Assessment) was undertaken.

    b) All ecological components were eliminated at Level 1 (there were no risk scores of 3 – moderate – or above for each component) for any internal hazard.

    c) Significant external hazards included other fisheries in the region which presented moderate risk to communities, major risk to key commercial species (gummy shark) and severe risk to byproduct/bycatch species (school shark); and to coastal development, which presented a moderate risk to protected species (Australian fur seal and New Zealand fur seal) and major risk to byproduct/bycatch species (school shark).

    d) Regarding Shy Albatross – the need to be explicit about what population of shy albatross was considered in the ERA given this species does not travel far. Any interactions that occurred are likely to be from a population close by, and evaluation of risk should be based on the number of breeding pairs on that island.

    e) The need to mention species that have been recently listed as protected species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and why they did not come out at high risk, such as Whitefin swell shark and scalloped hammerhead. The RAG noted that during the ERA reference period these species were not listed as protected species and hence not assessed as such however the risk posed to them as 'bycatch' was still assessed.

17. The RAG adopted the ERA for the manual longline sector of the GHAT, subject to Dr Sporcic including the following updates to the report:

a) Updated population estimates for shy albatross specific to the breeding island (Albatross Island) closest to where the interactions in the fishery occurred be included in the report for context.

b) The executive summary to be updated to clarify the risk rating for shy albatross.

c) The species table for whitefin swell shark and scalloped hammerhead be updated to acknowledge that they have been nominated for listing and listed, respectively, under the EPBC Act but those listings occurred outside of the reference period being assessed.

d) Update the table on page 44 of the report to include the white shark.

e) AFMA and CSIRO to consider simplifying the title of the ERA.

18. The RAG confirmed that once the above changes were made the ERA did not need to be re-circulated to the RAG before finalising.

Agenda item 4 – Gummy Shark Work plan

19. Dr Thomson presented the paper *"Proposed work to improve gummy shark stock assessment"* that she had prepared in response to a number of action items. The RAG was asked to note the proposed improvements identified and provide advice regarding the priority of the work to be completed and also the potential implications for RBC advice if improvements to the model are not made.

20. Dr Thomson highlighted the following key points:

a) All Tier 1 stock assessments in the SESSF for scalefish species are implemented using the Stock Synthesis package (SS). This means new assessment techniques are implemented by the SS developers and thereby automatically made available to assessment scientists. By contrast, the gummy shark assessment uses a bespoke model, written in AD Model Builder (ADMB) developed specifically for gummy shark in the SESSF.

b) The model cannot be implemented in SS as it deviates from the standard scalefish model in that the stock-recruitment relationship and associated density dependence for a shark is very different from that of a teleost, and the sophisticated tag-recapture component of the model cannot be replicated by SS.

c) The gummy shark assessment has fallen behind the current state-of-the-art for stock assessment and needs to be brought up-to-date. During SharkRAG's discussion in 2020 when the gummy shark assessment was last updated, a number of improvements to the model were identified with an action on CSIRO to develop a costed work plan for discussion by the RAG. Dr Thomson provided the RAG with a list of proposed work sourced from the "future work" sections of the previous two assessments. It is intended that any agreed improvements would be undertaken in 2022, prior to the assessment being updated in 2023.

21. The RAG discussed:

a) The first two items of work – "Likelihood profiles" and "Model-tuning/data weighting" – typically being considered standard work to update an assessment however there is an initial piece of work to write code that automates these updates for future assessments.

b) the importance of tracking the implications of the improvements as they are made and ground truthing the results, particularly given the gummy shark assessment is quite stable. Dr Thomson suggested this could be accomplished through a bridging analysis, adding each change incrementally to the model and assessing the impact sequentially.

c) The work requested by SharkRAG 7 in September 2020 to investigate a CPUE series combining the manual longline and automatic longline fleets should also be included in the work plan to be completed before the next gummy shark stock assessment.

22. The RAG recommended the completion of the work identified as high priority in the paper (**Attachment D)** be undertaken during 2022, before the next stock assessment. In addition, a CPUE series combining manual and automatic longline fleets is be investigated by Miriana Sporcic (SharkRAG7 2020 action item 7) and will also be provided to SharkRAG in 2022.

> **Action Item 1**: Dr Thomson to present the resultant diagnostics of the incremental improvements made to the gummy shark model to illustrate the impacts of the changes for SharkRAGs consideration at its October 2022 meeting. Dr Sporcic to present investigation of a CPUE series combining manual and autolongline to the same meeting.

Agenda item 5 – School Shark CKMR

23. The AFMA member outlined the purpose of this agenda item was to provide background information to assist RAG members understanding the relative new assessment method based on CKMR approach, addressing two main issues:

    a) Ongoing discussion in the RAG that suggested lingering concerns that there is a large biomass of school shark not picked up in the CKMR assessment because it could not reconcile large catches of in the 1990's. Further, that because fishers are no longer fishing in certain parts of the fishery where school shark are known to be in higher abundance, that the CKMR assessment is not accounting for that part of the stock.

    b) A recommendation from the Expert Panel review which was that *"prior to any future assessment that SharkRAG and researchers discuss assumptions to be used and what they mean for the sampling strategy to ensure there is a shared understanding", and "that a planning session precede the next assessment to identify the uncertainties to be address, the methods for doing that, the data to be collected and criteria for adopting the results."*

24. In relation to (a), AFMA presented a time series of maps of school shark catch by decade showing how the fishery developed from the 1930's to present day, and previous SharkFAG advice about how school shark catches during the 1990's were dealt with. SharkRAG noted in particular -

    i. SharkFAG 1998 (Punt et al. 2001 SharkFAG/01/D02) identified three reasons historical catches of school shark may be underestimates; the mercury ban in Victoria during 1975-85, general underreporting, and reporting of 'paper fish' in anticipation of possible

management actions. Consequently, an alternative series of historical catches was developed that attempted to account for these sources of error that involved catches being multiplied by a certain percentage for each of the respective time periods.

ii. What is not clear is if fishers were reporting 'paper' fish in anticipation of management action in the 1990's, i.e. implementation of quota, why catches were still considered an underestimate. The term 'paper' fish is generally used to suggest over-reporting of catches. Either way, it could explain why the CKMR assessment can not make sense of the large catches in the 1990's.

25. To address (b), Dr Thomson provided a presentation on the inputs and assumptions of the CKMR method to members (provided at Attachment F). Key points from the discussion included:

a) Essentially, that there is evidence that the school shark stock is well mixed which means that it does not matter if tissue sample collection is not from every part of the existing or historical area of the fishery. However, to be ultra-precautionary, sample collection is designed to be spread throughout the fishery.

b) Work undertaken in 2005 by Dr Terry Walker suggesting a three-year reproductive cycle for school shark. Based on this, one third of them should be in pup at any one time.

c) The final result of the CKMR assessment is the absolute number of mature reproducing adults in the population for the given year (but includes those females that are mature will not reproduce in that year). Regarding the relationship between the adult population and the total population, the CKMR model is only reporting on those animals contributing to the pool of juveniles.

Action item 2: AFMA to liaise with CSIRO (Dr Burch) to include a summary of previous SharkFAG advice regarding historical catches be included into a paper they are working on that captures historical decisions.

Agenda item 6 – SESSF Data Plan 2021-2023

26. The AFMA member presented the SESSF Data Plan 2021-2023, outlining that it was to update SharkRAG on the inclusion of RAG advice into the document.

27. SharkRAG noted that the plan has been updated to include SharkRAG's advice regarding sampling targets for school shark to support the CKMR assessment and length measurement targets for school and gummy shark to assist the interpretation of existing length data.

28. SharkRAG noted that the Plan does not include any economic data but that it could potentially be expanded in the future if necessary. However, AFMA's objective regarding net economic returns is implemented in the SESSF via economic reference point for target species and beyond that, no economic data is used to directly inform the TAC setting process and any that does exist, such as the ABARES economic survey work, is used for context.

Agenda item 7 – School Shark
7.1 Review of the School Shark Rebuilding Strategy

29. The AFMA member introduced this item, seeking RAG input into the Review of the School Shark Rebuilding Strategy (the Strategy), highlighting the following points:

    a) The performance of rebuilding strategies are reviewed annually as well as a broader review every five years to ensure that rebuilding is monitored and management arrangements remain appropriate. The outcomes of these reviews are reported to the Department of Agriculture, Water and the Environment (DAWR) to meet EBPC Act requirements.

    b) AFMA is undertaking both the annual and five-year review of the Strategy and has provided a draft assessment of its performance for the RAG's consideration (Attachment E to these minutes).

    c) Subsequent to SharkRAG providing advice, AFMA will consult the South East Management Advisory Committee (SEMAC), the SEMAC subcommittee and other stakeholders including the Department of Agriculture, Water and Environment (DAWE), the fishing industry and the public.

30. To inform the RAGs consideration of this item, AFMA stepped through the table at Attachment E and CSIRO presented the updated trawl CPUE series for school shark and updated bycatch (metier) and targeting analysis.

31. The RAG agreed:

    a) Available indicators, including the trawl CPUE and most recent CKMR assessment, suggest that school shark is rebuilding.
    b) There is no evidence of fishers targeting school shark.
    c) There is currently a disconnect between the outputs of the CKMR assessment and the approach outlined in the Commonwealth Harvest Strategy Policy 2018 (CHSP) to measure stock rebuilding. The CKMR provides an absolute estimate of abundance however the HSP and hence the stock rebuilding strategy, measure rebuilding relative to unfished levels.
    d) To this end, a project to develop a harvest strategy for alternative assessment approach where it is not possible to measure stock status relative to B0, has been identified as a high priority. In conjunction with this, clarity from the Department of Agriculture, Water and the Environment (DAWR) should be sought regarding rebuilding objectives that can be assessed consistent with the intent of the Commonwealth Fisheries Harvest Strategy Policy.
    e) The next CKMR assessment is due to be updated in 2024 which will provide more confidence in the trend in abundance.
    f) In light of the above, there is no evidence to suggest that the Strategy is not working and therefore no significant changes to management are justified at this point, noting that once the above work regarding harvest strategy objectives and the assessment is updated, another review of the Strategy will be required.

7.2 School Shark TAC

32. The purpose of this agenda item was for SharkRAG to recommend the incidental bycatch Total Allowable Catch (TAC) for school shark for the 2022-23 fishing season.

33. The AFMA member highlighted the following key points:

    a) The next Close Kin Mark Recapture (CKMR) assessment school shark is due to be updated in 2024 however a TAC is required to be set for the upcoming season.

    b) As school shark is a rebuilding species, the Recommended Biological catch (RBC) is zero but a TAC may be set to cover incidental bycatch.

    c) SharkRAG had agreed in March:

       • that updating the CKMR assessment with one more year of catch data would not produce substantially different results to the previous assessment.

       • The metier analysis could inform the minimal take of school shark based on the current catch of gummy shark and that in terms of sustainability, the recent metier analysis output was within 1 tonne of the model-based RBC which had been assessed as sustainable.

       • Trawl CPUE is another indicator that could be used to inform the TAC.

34. The RAG discussed the following points:

    a) In deciding a TAC methodology, the following principles be considered:
       i.   The primary aim remains to minimize the mortality of school shark.
       ii. If the school shark stock is increasing, it would be expected that the bycatch rate would increase.
       iii. As the gummy shark TAC is reduced, the unavoidable bycatch of school shark should also decrease (assuming effort directed at gummy shark also declines).
       iv. There is no benefit to the stock from discarding of dead school shark and the TAC should be sufficient to minimize the likelihood of this happening.
       v.   The total expected mortality should remain below the CKMR-estimated TAC, which should provide for rebuilding, noting the large amount of uncertainty associated with these predictions.

    b) Logbook data indicates a substantial level of discarding in recent years, ranging from 16% to 31% between 17/18 and 21/22. Industry members noted the primary reason for discarding was driven by lack of quota availability and that the mandated release of live school shark resulted in few animals being released. Industry also reported that quota-driven discarding of dead school shark was a source of strong dissatisfaction and stress among fishers that this had adverse impacts on them and their attitudes to management.

    c) There is no evidence of significant targeting based on the analyses presented by CSIRO.

d) Based on the results of the ABARES comparison of EM and logbook data, the RAG agreed that logbook reported discards from gillnet and hook methods can be used as the best estimate of discards for school shark.

35. The RAG agreed that the methodology to calculate the school shark bycatch TAC should be based on the best estimate of total, unavoidable mortality (both retained and discarded), but adjusted to take account of the reduction in gummy shark TAC, and the projected increase in biomass estimated from the CKMR model. *Note: The actual number was to be calculated by non-conflicted members after the meeting and the outcome of that discussion is provided as an addendum to these minutes.* Subsequently, the RAG recommended a school shark bycatch TAC of 225t.

Agenda item 8 - EM Logbook Data Comparison Analysis

36. Dr Tim Emery, ABARES, presented the preliminary results of the paper *"An evaluation of the reliability of electronic monitoring and logbook data for informing fisheries science and management in the GHAT sector of the SESSF".* The RAG was asked to consider the results and provide advice regarding any implications for the management of commercial, bycatch and protected species.

37. Dr Emery highlighted the following preliminary findings:

a) Logbook reporting of retained gummy and school shark is congruent. This data can be used in both fishery and shot-level analyses as representative of retained catches.

b) Logbook reporting of discarded gummy shark is slightly higher than EM but with some evidence of underreporting at the vessel-level. This data can be used in fishery-level analyses as representative of discarded catches and used in shot-level analyses with caveats.

c) Logbook reporting of discarded school shark is underreported by both logbook and EM on different shots, with minor evidence of underreporting at the vessel-level. This data can be used in fishery-level analyses as representative of discarded catches and used in shot-level analyses with caveats.

d) Logbook reporting of retained elephantfish is on average slightly underreported compared to EM. This is likely driven by a small number of vessels not reporting any retained catches. This data can be used in fishery-level analyses as representative of retained catches and used in shot-level analyses with caveats. Logbook reporting of discarded elephantfish is underreported compared to EM, with some vessels not reporting any discarded catches. The systemic bias towards underreporting means this data cannot be used in both fishery and shot-level analyses as representative of discarded catches

e) Logbook reporting of retained sawsharks (grouped) is on average slightly underreported compared to EM, with variation in reporting across vessels. The heterogeneity in reporting means this data cannot be used in either fishery and shot-level analyses as representative of retained catches. Logbook reporting of discarded sawsharks (grouped) is underreported compared to EM, with some vessels not reporting discarded catches.

The systemic bias towards underreporting means this data cannot be used in both fishery and shot-level analyses as representative of discarded catches. The variability in reporting of saw sharks is likely related to identification issues by the EM analyst.

f) Preliminary analysis indicates that logbook records of retained and discarded school and gummy sharks, as well as retained elephantfish are suitable to estimate the annual estimates of these species. Furthermore, boat is a significant factor in explaining variation in predicted EM catch.

g) Overall, the results of the study emphasis the important role that the EM program can play in informing scientific assessments and fisheries management decisions in the GHAT

38. RAG discussion focused on the flowing key points:

a) The data may be better presented as proportional differences in counts by species between EM and logbook, rather than the difference in just number of individuals. This is because depending on the quantity of catch in a shot, the difference in the recording of one individual between the logbooks and EM could be more of an issue for counts with a lower (e.g., 0 and 1) than higher number (e.g., 99 and 100) of individuals.

b) The RAG noted that data from EM, like other data sets, may be subject to biases or inaccuracies, but it does offer good spatial and temporal coverage, and can help identify vessels with higher bycatch levels.

c) Whether the Tucker's Congruence Index (TCI) was an appropriate statistical tool to measure congruence between the two data sets.

d) Even if there is a lower level of congruence between data sets, it doesn't preclude the logbook data from being used as a correction factor. For example, logbook retained catch typically tends to be 10 per cent lower than the verified weight on landing.

e) Unlike logbook data, EM provides for the ability to check for variability between EM reviewers which could be informative to do. Subject to the outcome, this could allow for reviews to be 'ranked'.

f) If logbook reported weights are to be used as inputs for things such as discard calculations, it would be helpful to explore the relationship between weights and piece counts. This would be to ensure that the relationship looks reasonable because it is ultimately the weights that get used when the analysis of similarity is based only on piece counts.

39. The RAG recommended the following updates to the ABARES analysis:

a) Presenting proportional data in the plots rather than numbers of individuals.

b) Reconsidering whether the TCI is the most appropriate statistical method to assess congruence.

c) Exploration of the relationship between catch weights reported in logbooks relative to piece counts for school and gummy shark to inform the RAG discussion regarding the use of retained and discarded weights.

d)   That the final report of this analysis be considered by SharkRAG once available.

40. Upon considering the outcomes of the preliminary results, SharkRAG agreed:

a)   Logbook reported discards for school and gummy shark could be used to estimate discard weights for gillnet and set longline (shark hook) methods in the 2022-23 TAC setting process.

b)   To inform how logbook reported discards are treated for gillnet and longline methods beyond the 2022-23 TAC setting process, that it would like to consider further analysis of the relationship between discarded weights and piece counts

c)   That a paper be prepared for the October 2022 SharkRAG meeting outlining options for the calculation of discards of quota species, including the use of logbook reported weights and EM piece counts (to which an average size of discards is applied).

Action Items:

(3) AFMA to provide SharkRAG advice to ABARES for its consideration in finalising the logbook/EM analysis.

(4) ABARES to present the final logbook/EM analysis to SharkRAG in 2022.

(5) CSIRO to include the logbook reported discards for school shark in the metier analysis for SharkRAG consideration in October 2022.

(6) CSIRO to finalise the analysis estimating discards for shark quota species using EM piece counts or consideration by SharkRAG in October 2022.

(7) AFMA to prepare a paper regarding options for accounting for discards for the October SharkRAG meeting.

Agenda item 9 – Discard estimates for shark species from EM to inform 2022-23 TAC calculations

41. This agenda item was postponed due to incomplete work. The RAG agreed that it would be considered at the October 2022 meeting.

Agenda item 10 – Research Priorities

42. This agenda item was postponed to a later date due to other more time critical agenda items running over the scheduled time.

Agenda item 11 – Other Business

43. Robert Curtotti noted that the Department will be running the economic survey of the Gillnet, Hook and Trap sector in 2022.

Agenda item 11 – Other Business

44. SharkRAG noted the proposed dates for the next meeting are likely Juen to consider research priorities and then October 2022. The SharkRAG EO will provide details when available.

Close of meeting

45. The Chair thanked the RAG for their contribution and closed the meeting at 5:00pm.

Table 2: Actions arising from SharkRAG 2 2021

Action	Agenda item		Responsibility
1	4	Dr Thomson to present the resultant diagnostics of the incremental improvements made to the gummy shark model to illustrate the impacts of the changes for SharkRAGs consideration at its October 2022 meeting. Dr Sporcic to present investigation of a CPUE series combining manual and autolongline to the same meeting	CSIRO (Dr Thomson)
2	5	AFMA to liaise with CSIRO (Dr Burch) to include a summary of previous SharkFAG advice regarding historical catches be included into a paper they are working on that captures historical decisions.	AFMA
3	8	AFMA to provide SharkRAG advice to ABARES for its consideration in finalising the logbook/EM analysis.	AFMA
4	8	ABARES to present the final logbook/EM analysis to SharkRAG in 2022	ABARES
5	7	CSIRO to include the logbook reported discards for school shark in the metier analysis for SharkRAG consideration in October 2022	CSIRO (Dr Burch)
6	9	CSIRO to finalise the analysis estimating discards for shark quota species using EM piece counts or consideration by SharkRAG in October 2022	CSIRO (DR Burch)
7	9	AFMA to prepare a paper regarding options for accounting for discards for the October SharkRAG meeting	AFMA

Signed (Chairperson):
Alexander Morison

Date: 21 February 2022

Attachment A – Declarations of Interest

Member	Position	Interest declared
Alexander (Sandy) Morison	Chair	Director of Morison Aquatic Sciences. Chair of SharkRAG. Contracted by government departments, non-government agencies and companies for a range of fishery related matters including research and for MSC assessments of AFMA managed and other Australian and international fisheries. Have undertaken work for SETFIA in 2021 reviewing a report on matters unrelated to the shark fishery. No pecuniary or other interest in the SESSF shark fishery.
Robin Thomson	Scientific Member	CSIRO, Assessment scientist. Acquiring funding for research purposes. PI of AFMA-CSIRO co-funded project 'Ongoing monitoring of school shark abundance and rebuilding in the SESSF using close kin mark recapture'. PI of AFMA-CSIRO co-funded project' Scoping study for application of Close-Kin-Mark-Recapture to blue-eye trevalla caught in the SESSF'.
Charlie Huveneers	Scientific Member	Associate Professor and research scientist. Potential interest in funding for research. No pecuniary interest or otherwise.
Ian Knuckey	Scientific Member	Director Fishwell Consulting Pty Ltd. Involved in SESSF and GAB Fishery Independent Survey (FIS). Range of research interests in relation to South East fisheries including the GHAT, GABTF, SESSF and auto-longline sector. This includes the project on using EM data for estimating discards and collecting length information. Principal Investigator of FRDC Project 2019-129 "Potential Transition of Shark Gillnet Boats to Longline Fishing in Bass Strait - Ecological, Cross-Sectoral, and Economic Implications". Involved in FRDC project 2018-021 "Development and

		evaluation of SESSF multi-species harvest strategies" and Traffic Project "Shark Product Traceability". Agent for Olfish Electronic Logbooks NPF RAG Chair, Scientific member on NORMAC. Provides research advice to various industry associations: SETFIA, GABIA and SSIA.
Dr Julian Morison	Economic member	Director, Kuti Co Pty Ltd – SA Pipi quota holder Economics member, SA Marine Scalefish Fishery MAC (PIRSA)Member, SA Snapper Management Advisory Committee (PIRSA) Economics member, Scallop RAG, Scallop MAC and Scallop Harvest Strategy Working Group (AFMA) Member, Economics Working Group (AFMA) Economics member, Spanner Crab and Trawl Whiting Harvest Strategy Working Groups (NSW DPI) Member, Human Dimensions Research subprogram (FRDC) Principal & co-investigator on several FRDC research projects
Kyri Toumazos	Industry Member	South Australia/Bass Strait shark fisher, boats fishing with hooks and gillnets. SESSF quota holder. Southern Rock Lobster Board CEO. Declared interests in RBCs.
Jamie Papas	Industry Member	Gillnet fisher and SFR holder. Board Director San Remo Fishermen's Co/Op
Craig Harris	Industry Member	Gillnet fisher and SFR holder.
Leigh Castle	Industry Member	Tasmanian shark hook, scalefish hook and tuna minor line fisher. Owns SESSF quota and vessel statutory fishing rights. Has a declared interest in shark hook interests and RBC recommendations
N/A	Conservation Member	
Sally Weekes	AFMA Member	AFMA member, manager of the Gillnet, Hook and Trap fishery. No interest pecuniary or otherwise.

Lou Cathro	Executive Officer	AFMA EO. No interest pecuniary or otherwise.
Ross Bromley	Invited Participant	Principal of Girella Fisheries Services

Engaged by Southern Shark Industry Alliance as project manager for Shark Industry Data Collection project (SIDaC) and Blue Eye Trevalla co-management

Engaged to provide advice on various SESSF MSC accreditation projects

Project manager of Western Orange Roughy Data Collection project (WORDaC)

Provide advice to various fisheries on EPBC Act accreditation. |
| James Woodhams | Invited Participant | Employed by ABARES – Section Manager. No pecuniary interest.

Co-investigator FRDC Project: 2019-036 Implementation of dynamic reference points and harvest strategies to account for environmentally-driven changes in productivity in Australian fisheries.

Steering committee – FRDC Project: 2018-021 SESSF Multi-species Harvest Strategy project

Steering committee – FRDC Project: 2019-010 Reviewing Biological Parameters |
| Paul Burch | Presenter/Observer | Employed by CSIRO, assessment scientist. Acquiring funding for research purposes. PI on data services contract.

CSIRO representative at the Fisheries Statistics and Information Working Group (a sub-committee of the Australian Fisheries Management Forum). |
| Fiona Hill | Invited Participant | AFMA Demersal and Midwater Senior Manager – AFMA SEMAC member – no interest pecuniary or otherwise. |
| Miriana Sporcic | Observer | Employed by CSIRO, Assessment scientist. Acquiring funding for research purposes |
| Tim Emery | Presenter/Observer | Employed by ABARES.

No interest, pecuniary or otherwise.

ABARES potentially may conduct shark research in the future |

Krystle Keller	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Mahdi Parsa	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Rocio Noriega Tonloso	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Don Bromhead	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Simon Boag	Observer	Non-beneficiary Director of two fishing companies in the SESSF. Industry member on SERAG. Executive Officers to SETFIA, SSIA and SPFIA. SETFIA receives funding from various bodies to complete projects. Undertakes contracts as an independent consultant.
Robert Curtotti	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Michael Dylewski	Observer	Employed by ABARES. No interest, pecuniary or otherwise. ABARES potentially may conduct shark research in the future
Ali McIlwain	Observer	AFMA Graduate. No interest pecuniary or otherwise.

Attachment B – SharkRAG 2 November 2021 Agenda

DAY 1: 9:45am – 3.15pm (Non-members required from 10am)

Agenda item	Purpose	Paper / presentation	Suggested time	Schedule
Conflicts of Interest - Pre-meeting **(SharkRAG members only)**	For information	Chair	15 min	9:45-10:00
Acknowledgement of country		Chair	5 min	10:00-10:05
1. Preliminaries				
1.1. Welcome and apologies	For information	Chair	5 min	10:05-10:10
1.2. Adoption of agenda	For action	Chair	5 min	10:10-10:15
1.3. Declarations of interest	For action	Chair	30 min	10:15-10:45
1.4. Minutes from previous Minutes	For information	AFMA	5 min	10:45-10:50
1.5. Status of action items	For information	AFMA	10 min	10:50-11:00
2. Updates from Members	For information			
2.1. AFMA Update		AFMA	10 min	11:00-11:10
2.2. Industry Update		Industry Members	10 min	11:10-11:20
2.3. Scientific Member Update		CSIRO	20 min	11:20-11:40
BREAK (1)			30 min	11:40-12:10
3. Manual Longline ERA	For advice	CSIRO	45 min	12:10-12:55
4. Gummy Shark Work Plan	For advice	CSIRO	45 min	12:55-13:40
BREAK (2)			15 min	13:40-13:55
5. School Shark CKMR Assessment	For discussion	AFMA/CSIRO/ RAG	1 hr	13:55-14:55
6. SESSF Data Plan 2021-2023	For information	AFMA	20 min	14:55-15:15

DAY 2: 10am – 4:30pm

Agenda item	Purpose	Paper / presentation	Suggested time	Schedule
7. School Shark				
7.1. Review of School Shark Rebuilding Strategy (including targeting analysis, metier analysis, trawl CPUE)	For advice	AFMA/CSIRO	1 hr 30min	10:00-11:30
7.2. School Shark TAC	For advice	RAG	30 min	11:30-12:00
BREAK (1)			45 min	12:00-12:45
8. EM Logbook Comparison Analysis	For advice	ABARES	2 hrs	12:45-14:45
BREAK (2)			15 min	14:45-15:00
9. Discard estimates for shark species from EM to inform 2022-23 TAC calculations	Advice	CSIRO	30 min	15:00-15:30
10. Research Priorities	For advice	AFMA	45 min	15:30-16:15
11. Other Business			5 min	16:15-16:20
12. Dates for Next Meeting			5 min	16:20-16:25

Attachment C - Action items

Complete/Redundant		Underway		Yet to start		Need further advice

	Agenda item	No.	Action	Agency/Person Responsible	Timeframe	Progress
	SharkRAG 1 2021	1	ABARES to provide an update on the scheduling of the next GHaT economic report	ABARES	October 2021	Economic survey of the GHAT fishery will be undertaken in 2022.
	SharkRAG 1 2021	2	AFMA to summarise existing sources of information on school shark and gummy shark discard rates for all sectors (trawl, gillnet, autolongline and manual longline) through time including interannual variability	AFMA		Revisit this action after the RAG has considered the final comparison analysis of logbook versus EM data to be presented by ABARES, and whether logbook discard data can be used to estimate annual discards from the gillnet and hook sectors.
	SharkRAG 1 2021	3	AFMA to summarise existing sources of information on school shark and gummy shark discard size composition for all sectors (trawl, gillnet, autolongline and manual longline) through time – including interannual variability	AFMA		Revisit this action after the RAG has considered the final comparison analysis of logbook versus EM data to be presented by ABARES, and whether logbook discard data can be used to estimate annual discards from the gillnet and hook sectors.

SharkRAG 1 2021	4	AFMA to work with SSIA and industry to review need for EM piece counts and review EM audit rate (currently 10%)	AFMA/SSIA		Underway – the ABARES logbook vs EM analysis preliminary results were present at SharkRAG2 2021. Final results will be presented to SharkRAG in 2022
SharkRAG 1 2021	5	AFMA to circulate the report from the EM trawl sector trial, confidentiality permitting.	AFMA		Complete – the report is available on the AFMA website here.
SharkRAG 1 2021	6	Dr Thomson to discuss with AFMA the specific school shark biological parameters to be collected from automatic longlines to support the close kin assessment.	AFMA/Dr Thomson		Complete – included in SESSF Data Plan
SharkRAG 1 2021	7	AFMA to create a comparison of EM data versus logbook data regarding sawshark composition including a summary table for the RAG to consider.	AFMA		Not complete
SharkRAG 1 2021	8	SIDaC to look at feasibility of including sawshark species composition in their data program	AFMA/SIDAC		Subject to outcomes of SharkRAG1 action item 7 "AFMA to create a comparison of EM data versus logbook data regarding sawshark composition including a summary table for the RAG to consider."
SharkRAG 1 2021	9	AFMA to consider observer data including trawl data in the	AFMA		Not complete, related to SharkRAG1 2021 action item 7.

			sawshark summary table for SharkRAG – related to SharkRAG1 2021 action item 7			
SharkRAG 1 2021	10	SharkRAG to provide any additional comments on the school shark panel report within two weeks of the SharkRAG March meeting.	RAG members		Complete
SharkRAG 1 2021	11	Dr Thomson to provide an update on the progress and viability of the DNA method of ageing to the SharkRAG October 2021 meeting.	Dr Thomson		Update provided under Agenda Item 2.
SharkRAG 2 2016	1	For the next gummy shark assessment, the assessment scientist to investigate estimating selectivity separately for the three regional stocks and allowing it to be flexible in form. This may allow the differing availability function to be removed from the assessment.	CSIRO Assessment Scientist	In time for the next stock assessment.	Complete – discussed under agenda item 4
SharkRAG 2 2016	3	The School Shark Rebuilding Strategy to be updated to reflect research showing there is some genetic connectivity between	AFMA	2019	The review of the School Shark (*Galeorhinus galeus*) Stock Rebuilding Strategy is underway and will include updating information concerning latest research relevant to the species.

			Australian and New Zealand school shark stocks.		
SharkRAG 1 2018	3	AFMA to investigate removing elephant fish as a quota species in the SESSF.	AFMA		Complete - AFMA has attempted to remove species from quota in the past, unsuccessfully. This action item is not priority for AFMA. AFMA recommends removing this action item from the list.
SharkRAG 2 2018	1	Dr Thomson to liaise with Dr Braccini to investigate the availability of further vertebrae samples taken during surveys	Dr Thomson/ Dr Braccini/FAS	TBC	Completed – provided under agenda item 2.
SharkRAG Teleconference 2020	3	AFMA and CSIRO to prepare a summary table of assumptions that went into the original close-kin assessment model.	AFMA/CSIRO	2021	Completed – provided under agenda item 5
SharkRAG 7 September 2020	4	Dr Althaus to incorporate elephantfish into the recreational catch report	CSIRO	Prior to finalization of gummy shark assessment	Complete
SharkRAG 7 September 2020	5	Dr Althaus to finalise the recreational catch report with the most recent available data from State agencies.	CSIRO	Prior to finalization of gummy shark assessment	Complete
SharkRAG 7 September 2020	6	Dr Sporcic to investigate a CPUE series which combines the manual longline and automatic longline fleets	Dr Sporcic	Before the next gummy shark stock	Complete – discussed under agenda item 4

					assessment (2023)	
	SharkRAG 7 September 2020	7	AFMA and CSIRO to discuss additional analysis to determine the relationship between net length and CPUE before the next meeting of SharkRAG	AFMA/CSIRO	Prior to October 2020 intersessional meeting of SharkRAG	Subject to funding - this project is in the annual research statement for the fishery and has been included in the 2022-23 call for research.
	SharkRAG 7 September 2020	12	SharkRAG to determine the weighting of each method to be included in the gummy shark assessment at the next meeting of SharkRAG	SharkRAG	November 2020	Included in the Gummy Shark work plan to be discussed under Agenda Item 4.
	SharkRAG 7 September 2020	13	AFMA to modify the contract with fish aging services to allow shark vertebrae to be sectioned on an annual basis	AFMA / FAS	December 2020	AFMA will discuss alterations to the contract with fish aging services and Robin Thomson.
	SharkRAG 8 November 2020	3	Dr Sporcic to include the justification for the reference period in the final Tier 4 assessment report for sawshark	Dr Sporcic	2021	Complete The updated report is available upon request.
	SharkRAG 8 November 2020	6	AFMA to examine justification for low sawshark TACs in 2009 and 2010	AFMA	SharkRAG 10	Complete – rationale circulated to SharkRAG via email.
	SharkRAG 8 November 2020	7	The RAG suggested that the inclusion of all shots that capture gummy shark in the CPUE series be	Dr Sporcic	Prior to the next gummy shark	Complete – all shots were included in the gummy shark assessment (2020).

			investigated for the next gummy shark Tier 1 Assessment	Stock assessment	
SharkRAG 8 November 2020	8	The RAG agreed that the next stock assessment should have a gear saturation factor that also considers the effects of longline effort	CSIRO Stock Assessment Scientist	Prior to the next gummy shark Stock assessment	Complete – discussed under agenda item 4
SharkRAG 8 November 2020	9	CSIRO to investigate why significant changes to pup depletion are occurring in the models where density dependence is affected by 0-2 and 0-4 year olds	CSIRO Stock Assessment Scientist	Prior to the next gummy shark Stock assessment	Complete – discussed under agenda item 4
SharkRAG 8 November 2020	10	SharkRAG to discuss the method of data weighting in the gummy shark Tier 1 model be examined for the next gummy shark assessment in 2023	SharkRAG	Prior to the next gummy shark Stock assessment	Complete – discussed under agenda item 4
SharkRAG 8 November 2020	11	Dr Thomson to include a Danish Seine fleet in the next gummy shark assessment in 2023	CSIRO Stock Assessment Scientist	Prior to the next gummy shark Stock assessment	Complete – discussed under agenda item 4
SharkRAG 8 November 2020	13	SharkRAG to discuss future work to be completed before the next gummy shark assessment	SharkRAG	December 2020	Complete – discussed under agenda item 4

SharkRAG9 December 2020	2	Dr Thomson to restrict projections to 2030, noting the long term RBC will still be calculated on the 50 year projection, this will be noted in the updated report.	Dr Thomson	To be included in the updated report	Complete
SharkRAG9 December 2020	3	AFMA to consider how new entrants to the fishery can be accounted for in the gummy shark assessment.	AFMA	2021	Complete - The impact of new entrants on shark CPUE is part of a research priority that has been included in the 2022-23 call for research and is subject funding.
SharkRAG9 December 2020	4	Dr Thomson to prioritise and cost the future work she proposes regarding the gummy shark assessment and provide this to the next meeting of SharkRAG.	Dr Thomson	SharkRAG March 2021	The Gummy Shark Workplan will be discussed under Agenda item 4.
SharkRAG9 December 2020	9	AFMA to discuss with ABARES regarding project to update the 2018 analysis comparing logbook and EM records of discards.	AFMA	2021	Complete – presented under agenda item 8
SharkRAG9 December 2020	10	AFMA to produce a summary of previous, current, and planned work that relates to the "Environmental drivers for stock abundance" project.	AFMA	2021	Not complete however SharkRAG agreed this can be removed.

Attachment D – Prioritised Gummy Shark Work Plan

No.	Improvement	Indicative time	Priority	Work Details	Priority justification
1	Likelihood profiles	3 days	High	Write re-useable code that will ease the calculation of likelihood profiles (LPs). LPs assess the support from each data source for the estimated parameters as well as the precision with which those parameters are estimated.	LPs are an important diagnostic tool that are routinely performed for other Tier 1s. They reveal data conflicts and indicate how well (or poorly) particular parameters are estimated.
2	Model-tuning / data weighting	10 days	High	Data weighting / model tuning is used for SESSF Tier 1 assessments implemented in SS, using software written by Malcolm Haddon for SS assessments. That code can be converted to work with the gummy assessment. Note that gummy model, but no teleost Tier 1s, has tagging data, so a modified method will need to be developed.	Sensitivity testing in 2020 revealed data conflicts, so data weighting is likely to be influential on model results.
3	Change the age of the plus group	2 days	High	The model implements a plus group at age 10, which was reasonable when most fishing used gillnets, but now that line fishing is more common, there are many more older animals caught. An older plus group for the population dynamics model should be used. A lower plus group can be used in the likelihood for gillnet (but not for line) age data. Exploration of the effect of changing the age of these plus groups is recommended. Currently, the fits to the plus group for length data for trawl and line are poor, this might be improved, or at least better understood, if the dynamics model uses a larger age plus group.	The current model does not make best use of the older samples collected by the line fishery; those can be very useful in estimating mortality rates for the population

4	Add port-collected length data	5 days	High	Currently only onboard collected data are used in the gummy shark model. Investigate the potential to use port-collected length data for the trawl fleet; it might also be possible to use port data for gillnets and line vessels if the assumption is made that collection across gillnet sizes and line depths are in proportion to catches.	Large data sets are currently not used; they could greatly improve model accuracy
5	Improve understanding of density dependence scenarios	4 days	High	Why do the data give greater support to density dependence (dd) for younger ages? The set of models that make dd a function of 1+ biomass differ greatly from those that are a function of mature biomass; both groups show less within than between group variance. Why is that choice more influential than the choice of the ages over which dd operate? Might it be possible to design an experiment that would indicate which assumptions are more correct?	The form of assumed density dependence greatly alters the results, but the reasons for the differences are little understood
6	Add a Danish seine fleet	3 days	High	Use onboard but not port-collected length frequency data, catch data, and age data. Most of the data processing was done in 2020 using re-useable code but the model code needs to be amended to allow a new fleet. Selectivity will ideally be estimated. The length frequency of the aged sample differed greatly from that of the length sample. The effect of this unbalanced sampling should be explored and advice given regarding future data collection.	Danish seine catch small sharks so this fleet could provide an earlier indication of recruitment strength
7	Retrospective analysis	3 days	High	Write re-useable computer code so that in future retrospective analyses (RA) can be performed quickly and easily.	RAs are important diagnostic tools for detecting model misspecification and resulting bias. They are performed routinely for other Tier 1s. They are likely to be particularly interesting wrt to the effort saturation parameters for each stock.

Attachment E
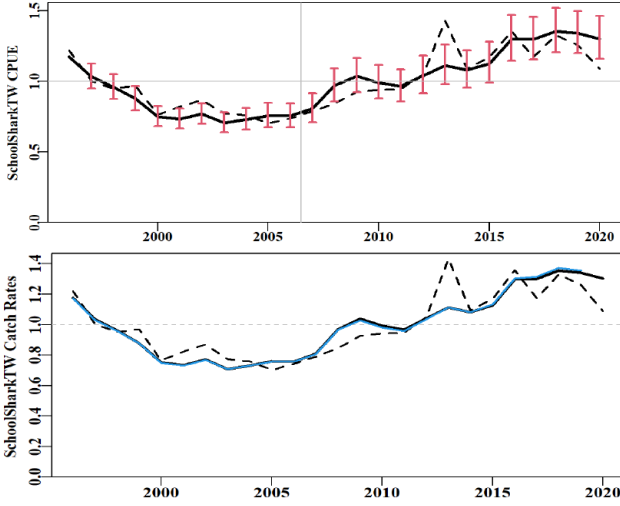
School Shark Stock Rebuilding Strategy Performance

Galeorhinus galeus (also eastern school shark, snapper shark, tope, soupfin shark)

Table 1. Summary of progress against the *School Shark Stock Rebuilding Strategy 2015*

Criteria	Actions
How is the stock tracking against strategy objectives, is rebuilding apparent?	Available indicators, including the 2018 close kin mark recapture (CKMR) assessment and the trawl CPUE series, suggest that school shark is rebuilding. It is not currently possible to determine if the objective of the School Shark Rebuilding Strategy (the Strategy) is strictly being met given the disjunct between the new CKMR assessment approach that does not estimate stock status relative to B0, and the Strategy objective that measures rebuilding relative to B0.
	The objective of the School Shark Rebuilding Strategy (2015) is to rebuild school shark in the area of the SESSF to the default limit reference biomass (BLIM) level of 20 percent of unfished levels within a biologically reasonable time frame (three generation times = 66 years).
	School shark was last assessed in 2018 using a new methodology known as close kin mark recapture (CKMR), for the first time. The CKMR assessment model provides an estimate of current absolute abundance with trend back to 2000. The assessment indicated that the stock was on a recovery trajectory between 2000 and 2017. SharkRAG accepted the assessment noting high confidence in the absolute estimate of abundance produced by the model, but accepting lower confidence in the estimates of trend. SharkRAG noted that confidence in trend will gradually improve over time with continued CKMR sampling and assessments. The next CKMR assessment is scheduled for 2024.
	The new CKMR assessment methodology however, does not provide an estimate of depletion relative to B0 which means it is not possible to interpret the recent results in the context of the current rebuilding objectives outlined in the Rebuilding Strategy.
	In light of the new assessment approach, a research priority has been identified "*Developing a Harvest Strategy for species where depletion can no longer be estimated against B0 – this project will investigate the development of a harvest strategy for species where depletion can no longer be estimated against B0 (absolute estimate is only available), using school shark as a case study.*"
	Catches
	School shark is a rebuilding species which means that no targeting fishing is permitted however a TAC is set annually to cover incidental catches while targeting other species, primarily gummy shark.
	Projections based on the 2018 CKMR assessment estimate a continued rebuilding of the school shark biomass by 3 per cent p.a., provided catches stay below a certain tonnage noting that the tonnage increases slightly each year as the biomass increases. In 2018 the required tonnage was less than 250 tonnes in 2018 and in 2022 it is 278 tonnes. The Commonwealth TAC has been and will continue to be set, lower than this level, in combination with measures to prevent targeting. What is evident, particularly in more recent years, is a large amount of discarding that is attributed to lack of quota availability and potentially reflects an increasing school shark stock that can not be avoided when targeting gummy shark. This issue was considered by SharkRAG when setting the 2022-23 incidental bycatch TAC.

Criteria	Actions
	A summary of TAC, retained and discarded catch for the last ten years is provided below.

Season	TAC	Retained Catch (CDR)	Discarded Catch (Logbook)
2015-16	215,000	181,278	16,660
2016-17	215,000	173,578	23,347
2017-18	215,000	205,987	38,295
2018-19	215,000	195,714	65,998
2019-20	189,000	184,029	83,413
2020-21	195,000	184,210	58,298
2021-22*	194,000	70,082	19,909

*Data extracted on 8/11/2021

Criteria	Actions
What management arrangements in the strategy have been implemented?	The primary mechanism available to AFMA to promote recovery is restricting Commonwealth commercial catch via the TAC.

Additional management measures focus on preventing targeting of school shark via a 20 per cent catch ratio limit with gummy shark, a requirement to release all live school shark, area closures, gear restrictions and selectivity.

Other measure include size limits, processing restrictions, limited entry and monitoring and enforcement programs. |
| Is the strategy meeting its performance measures? | The key performance measure in the strategy is to rebuild to 20 per cent of the unfished biomass within 66 years (By 2073). The new CKMR assessment approach does not provide a measure of biomass relative to unfished levels which means that it is not possible to interpret the new assessment results in the context of the existing objectives in the rebuilding strategy. However, the new assessment did indicate that the stock had recovered slightly during the period from 2000 to 2017.

Updating the CKMR assessment in 2024 will provide an additional data point that will provide a further indication of whether rebuilding is occurring and of recovery rate. In addition, a research priority to develop a harvest strategy based on alternative assessment methods such as the CKMR approach, using school shark as a test case, has been identified and is in FRDC's current call for research.

Catch per unit effort (CPUE) of school shark by the trawl sector of the SESSF is another data source that SharkRAG consider provides an indication of what the school shark biomass trend is doing given that it is generally assumed to be a non-targeted catch rate series. |

Criteria	Actions
	• SharkRAG 2 November 2021 noted the updated trawl CPUE series produced by CSIRO (Figure 1 below), indicated an increasing trend overall since around 2005 with a slight flattening in recent years. SharkRAG noted that the flattening in recent years may be attributed to discards not being included in the CPUE series, particularly given industry are of the view that they have increased recently due to lack of quota availability (the CPUE is based on retained catch). Figure 1. Updated trawl CPUE series presented by Dr Sporcic A secondary performance measure is whether there is any targeted fishing of school shark. As outlined above, the TAC for school shark is intended only to cover incidental catches while targeting other species and a number of management measures are aimed at further preventing targeted fishing. To assist in assessing whether targeting fishing is occurring. • SharkRAG 2 2021 considered CSIRO's updated metier and targeting analysis for school shark. SharkRAG noted the results of the updated metier and targeting analysis indicated no evidence of school shark targeting.
What changes, if any, have been made to the strategy since the last annual report?	There has been no change to the management measures under the Strategy since the last review.
Are any changes being proposed now?	No. AFMA is not proposing to make any significant changes to the Strategy at this point given available indicators suggest rebuilding is occurring, the next CKMR assessment is due to be updated in 2024, and work is required to resolve the disconnect between the outputs of the CKMR assessment and the way rebuilding is currently measured under the HSP and Strategy. SharkRAG 2 2021 supported this approach, agreeing: a) available indicators, including the trawl CPUE and most recent CKMR assessment, suggest that school shark is rebuilding b) there is no evidence of fishers targeting school shark. c) there is currently a disconnect between the outputs of the CKMR assessment and the approach outlined in the Commonwealth Harvest Strategy Policy 2018 (CHSP) to measure stock rebuilding. The CKMR provides an absolute estimate of

Criteria	Actions
	abundance however the HSP and hence the stock rebuilding strategy, measure rebuilding relative to unfished levels. d) To this end, a project to develop a harvest strategy for alternative assessment approach where it is not possible to measure stock status relative to B0, has been identified as a high priority. In conjunction with this, clarity from the Department of Agriculture, Water and the Environment (DAWR) should be sought regarding rebuilding objectives that can be assessed consistent with the intent of the Commonwealth Fisheries Harvest Strategy Policy. e) The next CKMR assessment is due to be updated in 2024 which will provide more confidence in the trend in abundance. f) In light of the above, there is no evidence to suggest that the Strategy is not working and therefore no significant changes to management are justified at this point, noting that once the above work regarding harvest strategy objectives and the assessment is updated, another review of the Strategy will be required.
Is there any relevant research or monitoring planned or underway?	The assessment report for the 2018 CKMR assessment is now completed and is available on the FRDC website. A further project has been approved for funding to continue CKMR sampling and analysis for school shark through the AFMA Research Fund (ending in 2024/25). Improving ageing techniques – This was identified as a key uncertainty to be addressed by the Expert panel review of the CKMR assessment. CSIRO are undertaking a pilot project investigating the feasibility of using DNA-ageing for school shark. Subject to the outcome of the pilot project, the expectation is that this will be the method used moving forward to inform the next update for the CKMR assessment in 2024. A targeting and companion species analyses is undertaken annually to understand the level of unavoidable bycatch across the fishery, including whether there is any evidence of targeting (the metier and targeting analysis discussed above), by the CSIRO. Developing a Harvest Strategy for species where depletion can no longer be estimated against B_0 using school shark as a case study is another research priority and has been included in FRDCs call for research for potential funding in 2022-23. School shark post release survival – this project will investigate the post release survival rates of school shark (with a focus on immediate and post- release mortality), and the application of survivability to discard estimates for this species. This project is in the annual priority list for the fishery however recent feedback from the AFMA Research Committee (ARC) was that the scope needed to be fleshed out and a cost effective methodology identified so as to ensure the cost does not blow out.
Other knowledge gaps still to be addressed.	Stock structure noting that this is not currently a high priority based on the outcomes of the Expert Panel review of the CKMR assessment but that improved understanding of stock structure would be helpful from a management perspective.

Calculations towards TAC for school shark
Addendum

SharkRAG

2 December 2021

The calculations described below were performed using a spreadsheet (Updated SHS TAC calcs.xlsx) which is provided along with this Word document.

During their November 2021 meeting, sharkRAG decided to minimise both catch and discarding of school shark by setting an TAC that reflects the minimum unavoidable bycatch and that includes the discards that been associated with that minimum catch, as well as reflecting the estimated 3% p.a. rate of increase in the population (Thomson et al 2018) and the reduction in the gummy shark TAC for 2022.

The decision was made to set the TAC at the past landings (L), plus past discards (D), multiplied by a 3% annual increase, and by a 13% reduction in the gummy quota:

$$TAC = (L + D) * (1-0.13) * (1 + 0.03)$$

Calculations are done by calendar year, as is the norm for the SESSF and also because discard calculations are available by calendar year only (Burch et al 2021).

1. Landings

The landed catches (CDRs) for the most recent 4 years are shown in Table 1

Table 1. Total landed catch of school shark by all SESSF sectors (in which school shark is under quota) calendar year from CDR database (Lou Cathro, AFMA, pers comm).

Year	Landed (kg)
2017	259,781
2018	177,006
2019	223,940
2020	136,686

2. Discards

Data collected onboard fishing vessels by ISMP observers are used to calculate fishery-wide discard estimates for SESSF quota species (Burch et al 2021). However, estimates for shark quota species typically fail the imposed validity criteria because onboard observers were withdrawn from GHAT vessels in mid-2015. The ISMP can, however, be used to calculate discards for the trawl sector, which does still carry observers.

GHAT vessels now carry EM and it has recently been shown that logbook records of discards for school shark are sufficiently accurate for use by management (Tim Emery, ABARES, pers comm).

Trawl discards

Here, I revisit the school shark discard calculation for 2017-2020 inclusive, calculating a trawl specific discard tonnage.

The validity criteria applied as part of the discard calculation is:

1. At least 5 observed shots in each ISMP stratum for that stratum to be used in the calculation
2. The strata that pass (1) must represent at least 50% of the total catch, or the total logbook reported shots (either one)
3. The estimated CV for the discard estimate must not exceed 100%

Using the Deng et al reports from SERAG meetings held in 2018, 2019, 2020 and 2021 the discard rates were calculated for calendar years 2017 to 2020 for the trawl sector only (Table 2). The estimate for 2020 was did not pass the validity criteria; the only trawl stratum that had more than 5 observations (TR_TAS_W) accounted for only 5% of the total landed catch and 23% of the total reported shots across all trawl strata.

Table 2. Discard rate estimates for calendar years showing discards (Disc (t)) and Landings (Landed (t)) for only those ISMP trawl strata (Strata used) that had at least 5 observations. Figures are given in tonnes, as they are in the discard reports.

Year	Disc (t)	Landed (t)	Discard rate	Valid?	Strata used
2017	10.92	12.41	0.468	Yes	TR_SW, TR_TAS_W
2018	10.84	21.11	0.339	Yes	TR_SW, TR_TAS_E, TR_TAS_W
2019	8.65	25.96	0.250	Yes	TR_SW, TR_EDL_OFF, TR_TAS_E, TR_TAS_W
2020	2.07	4.48	0.316	No	TR_TAS_W

I applied these discard rates to the total CDR landings for the trawl sector (Althaus et al 2021), Table 3. The invalid discard rate for 2020 is replaced by the most recent valid figure, in accordance with standard practice (Althaus et al 2021).

The discard rate (p) is defined as

p = Discard / (Discard + Landings)

Therefore the discard is

Discard = p * Landings / (1 – p).

Table 3. Trawl CDR total for school shark reported by Althaus et al, discard rate from Table 2, estimated discard tonnage from above formula. Figures are given in tonnes, as they are in Althaus et al 2021, but the discard estimate is given in kg..

Year	Trawl CDR (t)	Discard rate	Discard (kg)
2017	24.6	0.468	21,641
2018	27.9	0.339	14,309
2019	34	0.250	11,333
2020	24.7	0.250	8,233

Estimated discards from the trawl sector from Table 3 are now added to the logbook reported discards from the GHAT (obtained from Lou Cathro, AFMA, pers comm) (Table 4).

Table 4. Trawl discards (Table 2), GHAT discards reported in logbooks, and CDR landings from all SESSF sectors summed to give total catch which for which a weighted average is calculated. The final column give the weights used in the weighted average.

Year	Trawl discards (kg)	GHAT discards (kg)	Landed (kg)	Total catch (kg)	Weights
2017	21,641	22,269	259,781	303,691	1
2018	14,309	55,480	177,006	246,794	2
2019	11,333	70,095	223,940	305,368	4
2020	8,233	73,704	136,686	218,623	8
Wted mean				251,182	

3. TAC calculation

Applying the drop in the gummy shark TAC, and a presumed 3% increase resulting from school shark population size increase to the estimated total catch (the weighted mean from Table 4) gives 225,085 kg:

251,182 * (1-0.130) * (1 + 0.03) = 225,085kg.

4. Discussion

Sustainability: The median projection of the CKMR model using average exploitation rate over 2013-2017 resulted in a catch of 278t in 2022 that would allow the population to continue to increase at roughly 3% per annum. This seems ample 'room' to allow for state catches and discards in addition to a 225t TAC. State landings have been below 30t in recent years (Althaus et al 2021). Recreational catches are poorly known.

Logic: The average over the most recent 4 years of landings and discards was used to estimate a weighted average total catch. To this we added a 3% expected increase in population size to 2022 but the calculations inherently assume no such increase occurred over the most recent 4 years.

Rounding error: These calculations apply the logic used in the Discard Report (ie the Deng et al series) and the Catch Report (ie the Althaus et al series) but have been calculated from the tables in those report instead of from the raw data. Rounding error is an inevitable result, but is unlikely to be of great concern.

Report version: the most recent reports available were used, but it is possible that more updated versions exist.

State and recreational catches: Recreational catches and any state landed and discarded catches are ignored in the actual TAC calculation.

CKMR for school shark
How does it work and what assumptions were made?

Robin Thomson
SharkRAG 15-16 Nov 2021

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Close Kin ~~Genetics~~ Mark Recapture (CKMR)

- **Conventional Mark-Recapture refresher:**

  - How many fish are in the pond?

2 |
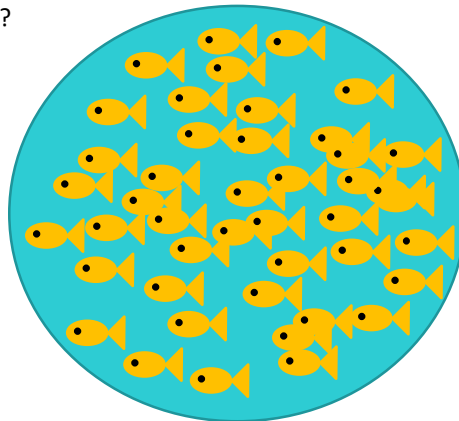
Close Kin ~~Genetics~~ Mark Recapture (CKMR)

- **Conventional Mark-Recapture refresher:**

  - How many fish are in the pond?
  - Catch and mark 10 fish
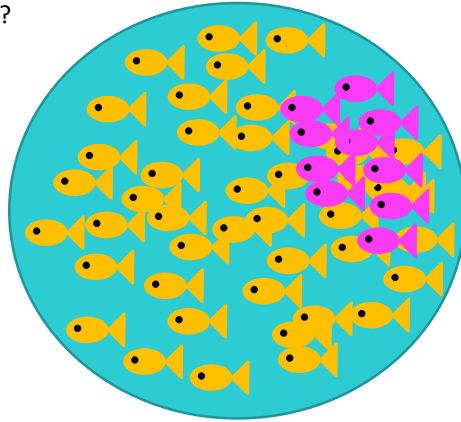
3 |

Close Kin ~~Genetics~~ Mark Recapture (CKMR)

- **Conventional Mark-Recapture refresher:**

  - How many fish are in the pond?
  - Catch and mark 10 fish
  - Release, and give them time to mix
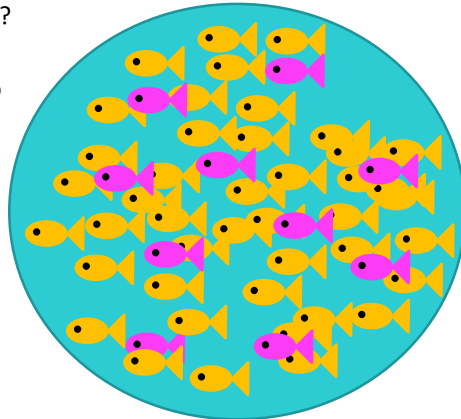
4 |

Close Kin ~~Genetics~~ Mark Recapture (CKMR)

- **Conventional Mark-Recapture refresher:**

  - How many fish are in the pond?
  - Catch and mark 10 fish
  - Release, and give them time to mix
  - Catch another 10 fish – what proportion are marked?

  $$\boxed{\frac{R_{tagged}}{R_{all}}} \sim = \frac{N_{tagged}}{N_{all}}$$

  $$N_{all}{}^{EST} = N_{tagged}\frac{R_{all}}{R_{tagged}}$$
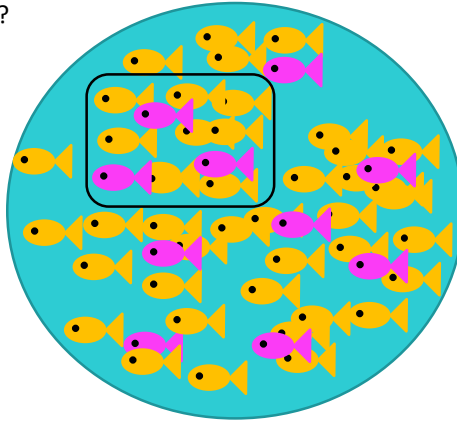
5 |

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  $$N_{all} = N_{tagged}\frac{R_{all}}{R_{tagged}}$$
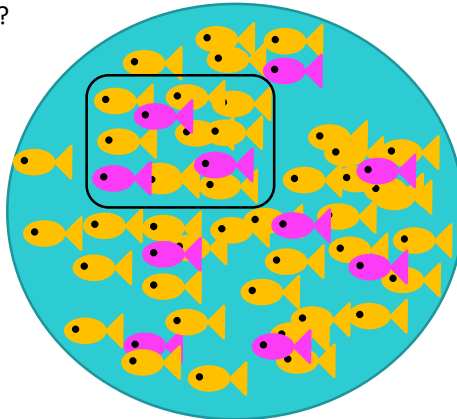
6 |

CKMR for a small country town

1 Supermarket, 1 School

- Speak to first 300 kids to arrive at school
  - ask their birthday
  - ask their Mum's full name
- Speak to first 300 women at Supermarket
 - ask their birthday
  - ask their full name
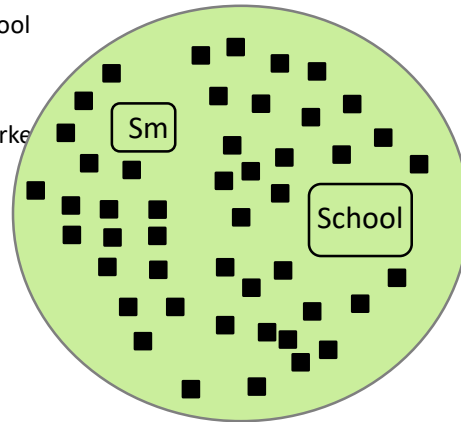
7 | 7 |

CKMR for a small country town

1 Supermarket, 1 School

- 30,000 adult women in town
- 60,000 school-going kids in town
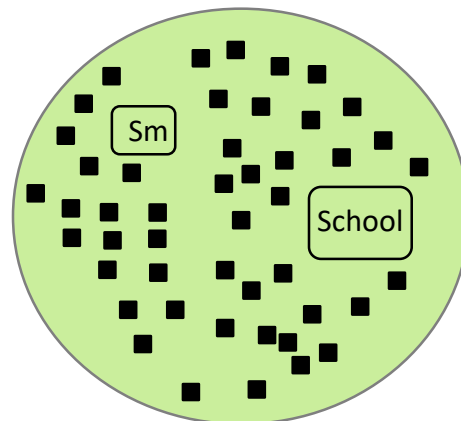
8 |

CKMR for a small country town

1 Supermarket, 1 School

- 30,000 adult women in town
- 60,000 school-going kids in town
- Every child has 1 Mum
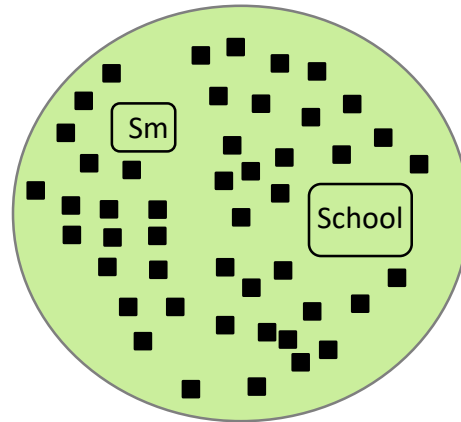
9 |

CKMR for a small country town

1 Supermarket, 1 School

- 30,000 adult women in town
- 60,000 school-going kids in town
- Every child has 1 Mum
- So every child has 1 "tag" in the population
- Find the "tag" (mother)
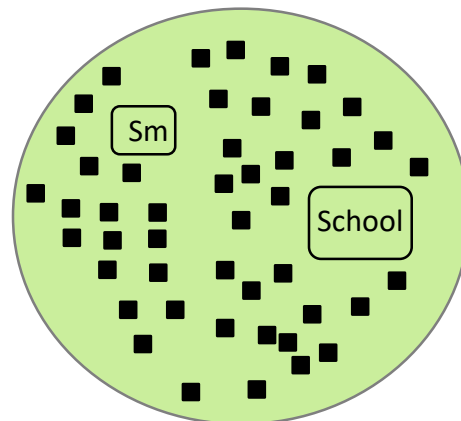
10 |

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- For each child: $1/N_{women}$ chance of speaking to their parent

Sm
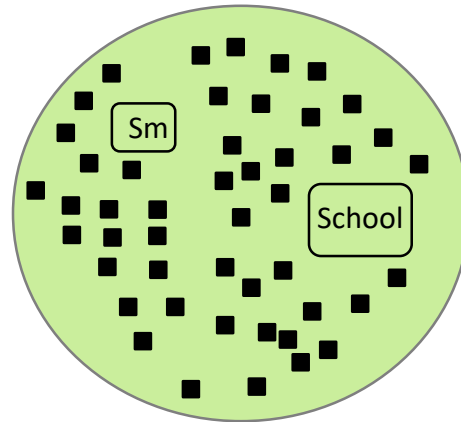
School

11 |

CKMR for a small country town

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- Every child has 1 Mum
- So every child has 1 "tag" in the population
- Find the "tag" (mother)
- For each child: $1/N_{women}$ chance of speaking to their parent

- Account for parental mortality
- Estimate population size from "hits" (pairs)

Sm

School
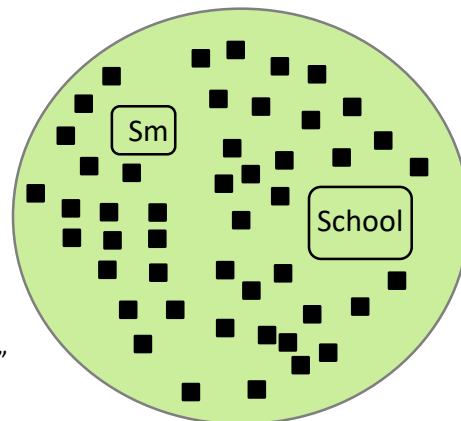
12 |

CKMR for a small country town

- From 300 kids and 300 women, (we already know 30k adults and 60k kids in town)

$$N_{all} = N_{tagged} \frac{R_{all}}{R_{tagged}}$$
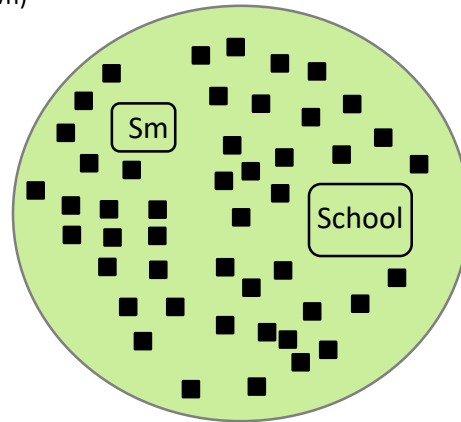
13 |

CKMR for a small country town

$$N_{all} = N_{tagged} \frac{R_{all}}{R_{tagged}}$$

- From 300 kids and 300 women, (we already know 30k adults and 60k kids in town)
- Expect n * p Mother-Kid pairs
- Where n = number of "trials"
- n=300*300 = 90k pairs interviewed
- p=P(success) = 1/30k
- np = 3 expected POPs
- Use stock assessment to "scope"
- ------------
- Given 3 POPs,
  - For each kid, p=1/N$_{women}$ chance of speaking to a parent
  - Estimated Parents = 300*300 / 3 = 30k

14 |

7
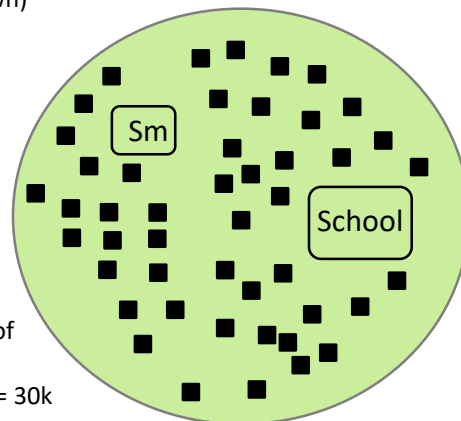
Why the birthdays?

- Parent's birthday
  - 20yo women won't be Mums of 8yo kids
    - Number of potential pairs sampled isn't really 300*300
  - $1/N_{Mum}$ might not be the same as $1/N_{dad}$

Sampling

- Does it matter that I sampled the first 300 kids to arrive at school?
- Does it matter that I sampled the first 300 women to arrive at the shop?

CKMR for a bigger country town

1 Supermarket, 2 Schools

- Sample only 1 school, and the Supermarket
- Will the answer be wrong?
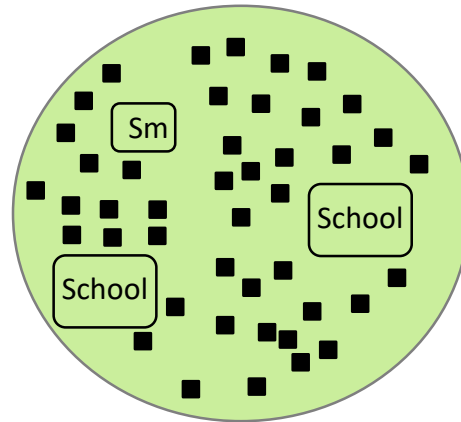
17 |

CKMR for an even bigger country town

2 Supermarket, 2 Schools

- Sample only 1 school, and 1 Supermarket
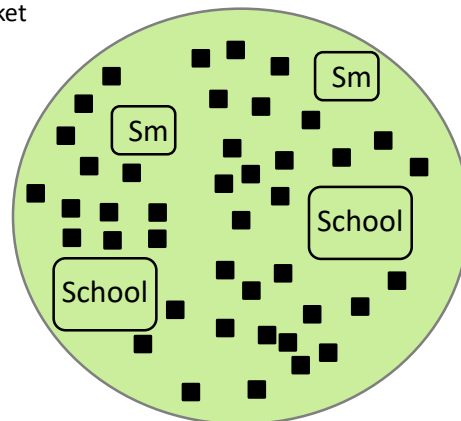
18 |

CKMR for an even bigger country town

2 Supermarket, 2 Schools

- Sample only 1 school, and 1 Supermarket
  - Which ones?

- Sample 1 school and 2 supermarkets?

- Sample 2 schools and 1 supermarket?
  - Maybe everyone tries to arrive early
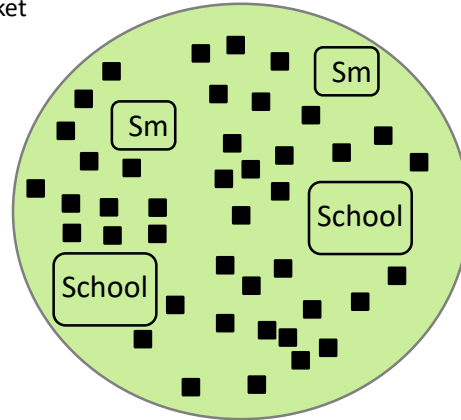
19 |

CKMR for two country towns

2 Towns, no intermingling
- Sample only first town
- Sample both towns – same rules apply as to split town
  - Eg sample all schools and just 1 shop

20 |

28/01/2022
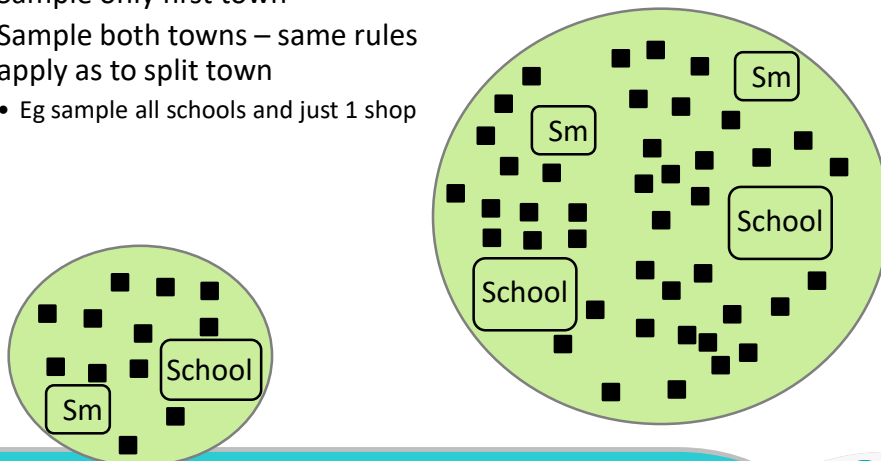
Siblings
- No sampling of adults, just siblings

21 |

Siblings
- No sampling of adults, just siblings

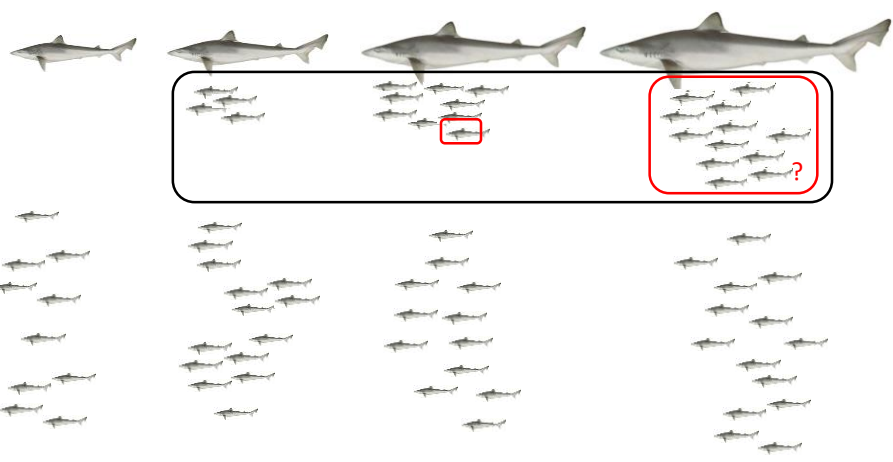22 |

11

Siblings

- No sampling of adults, just siblings

23 |

Siblings

- No sampling of adults, just siblings

24 |

Half sibling case

- The mother of the first pup sampled was Toothy, what is the probability that the mother of the pup born 3 years later was also Toothy?
  - $1/N_{females}$
  - Adjusted for whether Toothy is still alive
  - Adjusted for how fecund Toothy is now

- As for country town:
  - P(sample me) and P(sample my sibling) must be uncoupled
  - Ignore school shark caught in same shot (or trip)

Half sibling case

- P(sample me) and P(sample my sibling) must is uncoupled
  - Same as country town example: need not sample everywhere if nothing systematic

Half sibling case

- P(sample me) and P(sample my sibling) must is uncoupled
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- Female & Male fecundity is known
  - Compare male-only with female-only estimates

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- Lucky litters and same-cohort siblings: Some years are better than others
  - Estimate lucky litter effect, multiple paternity, 'lucky' males
  - Incorporate ageing error (perhaps not enough) – do better ageing

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- **Cross cohort full siblings are unlikely if mating is random**
  - $1/N_{females} * 1/N_{males}$

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  - Removed by age limit of 11y

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- Full Thiatic pairs (me and the offspring of my full-sibling) are like HSPs
  - Removed by age limit of 11y
- **One third breeding each year**
  - Need to explicitly incorporate breeding cycle (<= 16% over-estimate)

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AFMA review panel

- For assessment:
  - Account for skip breeding explicitly
  - Improve age estimation
  - (research the mating system of school sharks, sperm storage? – biological work)

- For management:
  - try to understand stock structure better – biological work

CSIRO

Thank you

Robin Thomson

t +61 3 6232 5133
e robin.thomson@csiro.au
w www.csiro.au

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