SCIENTIFIC COMMITTEE
NINETEENTH REGULAR SESSION

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PROGRESS TOWARDS A CLOSE-KIN-MARK-RECAPTURE APPLICATION TO SOUTH PACIFIC ALBACORE (PROJECT 100C)

WCPFC-SC19-2023/SA-WP-13

SPC-OFP[1] and CSIRO[2]

[1] The Oceanic Fisheries Programme, the Pacific Community, Noumea, New Caledonia
[2] The Commonwealth Scientific and Industrial Research Organisation, Australia

Executive Summary

SC17 established a project to prepare western and central Pacific tuna fisheries for the application of close-kin mark-recapture (CKMR) methods to resolve key stock assessment uncertainties.

The project is co-funded between WCPFC and the European Union with additional support from SPC-OFP and CSIRO. The financial contribution of the European Union is sourced through their European Maritime, Fisheries and Aquaculture Fund. EMFAF funds became available in November 2022 (~10 months later than originally planned at SC17). To accommodate this delay, project milestones have been extended by 12 months (as per notification in WCPFC-SC18-SA-IP-10).

Project 100c delivers research across 3 broad themes to evaluate the feasibility of CKMR to WCPFC fisheries. These are:

- foundational research needed for efficient age estimation of individuals sampled from their DNA (this includes age validation and epigenetic age calibration) and genome resequencing for enhanced detection of kin-pairs.
- refinement and trials of Standard Operating Procedures for the cost effective and reliable collection of tissue samples necessary for CKMR applications to WCPFC stocks.
- completion of a CKMR feasibility and design study for South Pacific albacore and CKMR scoping studies for Pacific bigeye and Southwest Pacific Swordfish (samples collected during these trials to be used to also investigate and validate connectivity hypotheses via non-CKMR methods for South Pacific albacore in preparation for the 2024 stock assessment).

The foundation research is expected to be completed and presented to SC20. Sample collection trials for epigenetic age calibration has been completed to test quality of tissue collected for South Pacific Albacore under different sampling/storage protocols. Standard Operating Procedures for port sampling are currently being trialled. Results indicate that collection of the 25,000-30,000 tissue samples to allow for sufficient kin-pair identification is feasible over a 2 to 3 year period of sampling, the CKMR feasibility and design study for South Pacific Albacore is expected to be presented to SC20 along with scoping studies for Pacific bigeye and Southwest Pacific Swordfish at SC21.

Recommendations

SC19 is invited to:

- note the delay in commencement and progress that has been achieved to date.
- note that all proposed project milestones are delayed by 12 months (from that endorsed at SC17) due to the EMFAF grant not commencing until November 2022.
- consider the scheduling and resourcing for the inclusion of CKMR data in future stock assessments for South Pacific Albacore. Trials and protocols tested thus far indicate that there is unlikely to be logistics constraints that prevent the necessary number of tissue samples from being collected for CKMR application to South Pacific Albacore. Sequencing for samples for identification of kin-pairs could commence in 2024 if resources are available.
- thank the European Union for their continued support of this work and assistance with preparing the application to the European Maritime, Fisheries and Aquaculture Fund.

Background

A significant challenge for several WCPFC stocks assessments is estimating the absolute spawning biomass with the necessary accuracy and precision to assist management decision making. Close-Kin Mark-Recapture (CKMR) is likely the most practical solution to resolve this issue. Every animal is born with exactly one living mother and one living father, which it "marks" genetically. CKMR takes advantage of this and modern genotyping methods to identify pairs of close relatives (e.g. parent-offspring, half-brother-sister). The number of kin-pairs found, and the way they are distributed in space and time, can be embedded into a population dynamics model and used to estimate absolute adult abundance, as well as other important demographic parameters such as mortality rates, fecundity and connectivity. Unlike conventional mark-recapture, CKMR uses tissue biopsies taken from fishery catches. Other important information on fish age, fish sex and population structure can, potentially, also be obtained from the biopsies obtained and genotype information, providing significant efficiencies to fisheries monitoring programs.

The successful application of CKMR is dependent on adequate background understanding of a species' biology, fishery operation and consideration of sampling logistics. This includes the capacity to collect enough tissue samples, given the size of the stock, to identify sufficient kin pairs and the capacity to estimate the age of the individuals sampled. Validating our understanding of the species biology (e.g., reproductive biology, sexually dimorphism, spatial connectivity) and evaluating the logistical feasibility is a necessary first step for implementing CKMR. Project 100c was established by the scientific committee at SC17 to address these questions. The specified activities of the project include:

- Complete the foundational research needed for the application of CKMR methods to WCPFC stocks to reduce the uncertainty in stock assessments. This will include:
    i. epigenetic ageing for South Pacific albacore and Pacific bigeye using existing validated otolith age. At present there is no epigenetic age calibration or assay for South Pacific albacore.
    ii. evaluation of radio-carbon otolith age validation of swordfish and epigenetic age calibration.
    iii. genome resequencing of South Pacific albacore and Pacific bigeye for enhanced detection of kin-pairs.
- Complete CKMR feasibility and design study for South Pacific albacore.
- Complete CKMR scoping studies for Pacific bigeye and Southwest Pacific Swordfish.
- Develop and trial Standard Operating Procedures for the cost effective and reliable collection of tissue samples necessary for CKMR applications to WCPFC stocks.
- Use trial samples to investigate and validate connectivity hypotheses via non-close-kin methods for South Pacific albacore in preparation for the 2024 stock assessment.
- Develop capacity within WCPFC to implement and evaluate CKMR applications to WCPFC stocks.
- Provide advice to the Scientific Committee on what further research and data improvements are needed to enable best use of CKMR methods.

Project Administration

This project is supported by the European Union through its European Maritime, Fisheries and Aquaculture Fund with a budget of approximately Euro 270,000. WCPFC has allocated a further USD40,000 to support implementation. SPC-OFP and CSIRO are providing additional in-kind and operational support (to December 2025).

Project review and guidance is provided by the WCPFC Scientific Committee.

Progress to date

Activity	Progress
Project Financing	EMFAF Grant signed in November 2022
Complete the foundational research needed for the application of CKMR methods to WCPFC stocks to reduce the uncertainty in stock assessments:	
i. epigenetic ageing for South Pacific albacore and Pacific bigeye using existing validated otolith age. At present there is no epigenetic age calibration or assay for South Pacific albacore.	PMSB samples identified and extracted. Sequencing completed for SPA, trials for tissue collection evaluated. Additional sequencing to be undertaken to complete calibration for SPA Bigeye schedule to commence in October 2023
ii. evaluation of radio-carbon otolith age validation of swordfish and epigenetic age calibration.	Scheduled to commence in October 2023
iii. genome resequencing of South Pacific albacore and Pacific bigeye for enhanced detection of kin-pairs.	Samples collected and resequencing schedule for October 2023
Complete CKMR feasibility and design study for South Pacific albacore	Initial analyses completed to determine sampling requirements. Feasibility of collection 10,000 juveniles and 20,000 adults underway. Early trialling indicates that this volume of sampling is achievable over 2-3 year period.
Complete CKMR scoping studies for Pacific bigeye and Southwest Pacific Swordfish.	Scheduled to commence in October 2023
Develop and trial Standard Operating Procedures for the cost effective and reliable collection of tissue samples necessary for CKMR applications to WCPFC stocks.	SOP refined and currently being tested. Collected samples to test for DNA degradation in albacore. "DNA contamination risk" at point of sampling analyses completed

	Train the trainer workshop completed to upskill PIRFO observers
Use trial samples to investigate and test connectivity hypotheses via non-close-kin methods for South Pacific albacore in preparation for the 2024 stock assessment.	Samples collected and analyses commenced. Results will be available for the 2024 assessment
Develop capacity within WCPFC to implement and evaluate CKMR applications to WCPFC stocks.	Scheduled to commence in 2024 when feasibility studies are completed
Provide advice to the Scientific Committee on what further research and data improvements are needed to enable best use of CKMR methods.	Scheduled for project completion

Recommendations

SC19 is invited to:

- note the delay in commencement and progress that has been achieved to date.
- note that all proposed project milestones are delayed by 12 months (from that endorsed at SC17) due to the EMFAF grant not commencing until November 2022.
- consider the scheduling and resourcing for the inclusion of CKMR data in future stock assessments for South Pacific Albacore. Trials and protocols tested thus far indicate that there is unlikely to be logistics constraints that prevent the necessary number of tissue samples from being collected for CKMR application to South Pacific Albacore. Sequencing for samples for identification of kin-pairs could commence in 2024 if resources are available.
- thank the European Union for their continued support of this work and assistance with preparing the application to the European Maritime, Fisheries and Aquaculture Fund.