WCPFC Project 129 - Phase 1 six-month Progress Update

Pacific Community
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Building an Age-Length Data Stream for Tuna Stock Assessments

Scientific Committee 22
Apia, Samoa | 11-19 August 2026

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WHY THIS MATTERS

Current paucity of age data in tuna stock assessments

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A long-recognised gap

Age data remain extremely limited for tropical tunas across the WCPO.

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Assessments must infer age

Current tuna assessments rely on a single growth relationship to convert length data into age structure.

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Uncertainty affects the assessment

Uncertainty in growth and age structure propagates into estimates of mortality, recruitment and stock-status.

Currently conventional otolith ageing cannot provide age data at the scale required to routinely inform the assessment, creating a need for scalable rapid-ageing approaches

P129: a four-phase pathway to scalable ageing

Develop and validate rapid-ageing surrogates (otolith biometric modelling and epigenetic ageing) anchored to a robust, validated reference age-dataset

1 — 2 — 3 — 4

2026

Phase 1

- Refine & validate direct ageing methods
- Build reference datasets
- Develop rapid-ageing models

IN PROGRESS

2027

Phase 2

- Quantify ageing error
- Peer-reviewed validation of rapid methods
- Regional sampling protocols & training
- Establish sample/data pipeline

NEXT

2028

Phase 3

Trial implementation of the regional age–length sampling programme

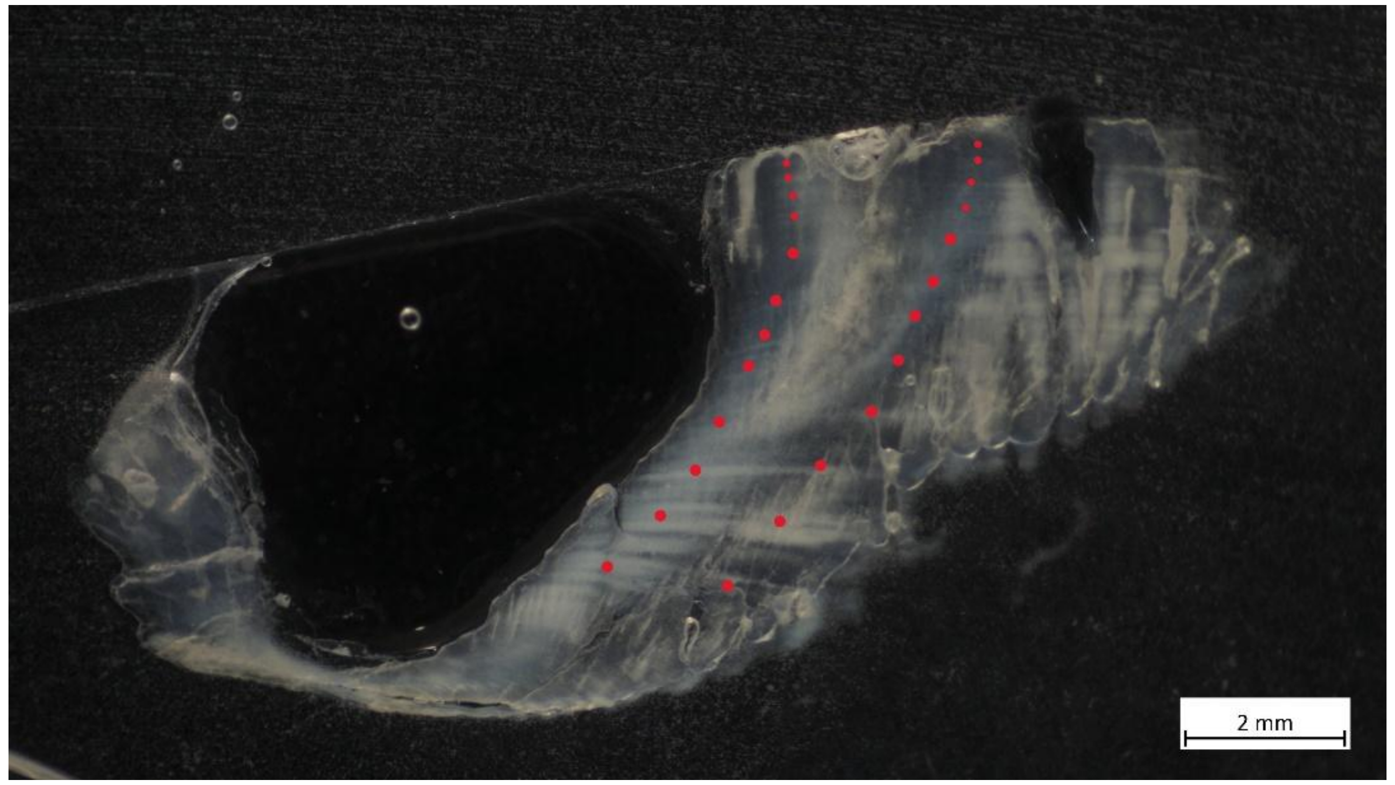
2029

Phase 4

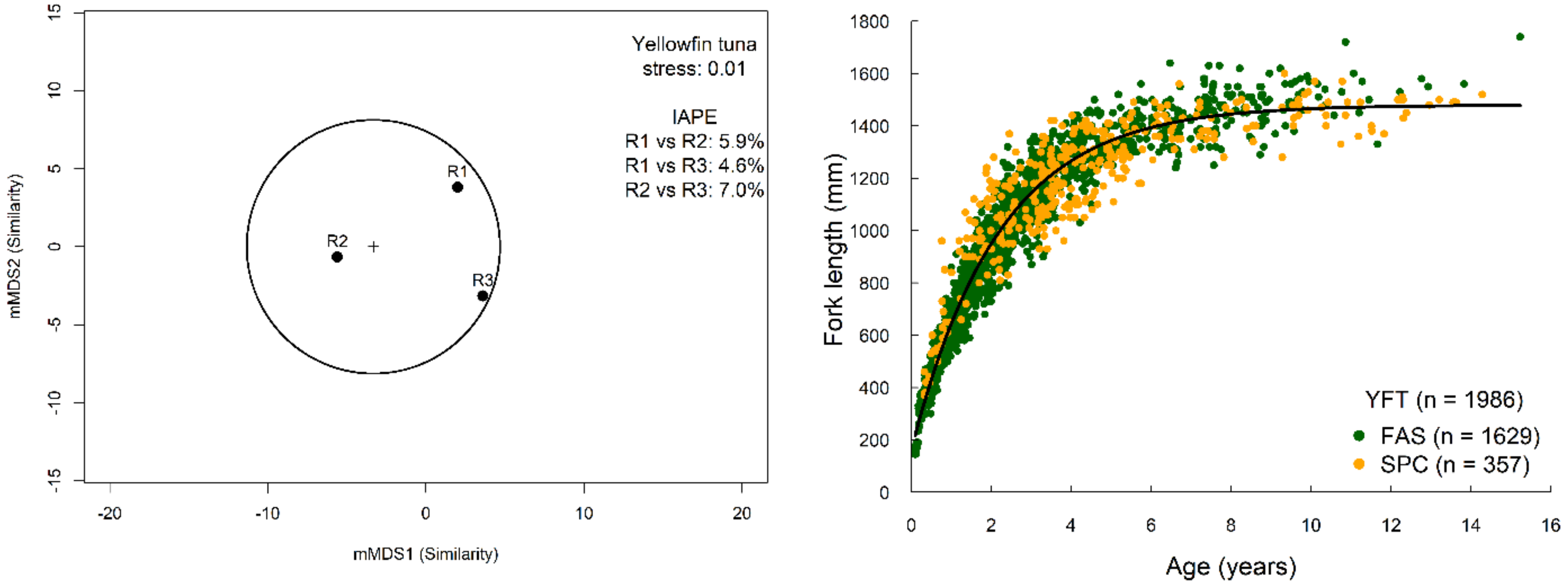
Refine the programme based on the trial and transition to full implementation

Refine and validate ageing methods for age prediction reference dataset

- Oblique sections give a longer and wider reading pane and improve annual growth zone clarity for Yellowfin and Bigeye
- Age reference sets for BET and YFT read by 3 experienced readers (SPC & FAS), precision assessed as acceptable (IAPE ≤ 5.5% threshold)
- Comparisons of oblique vs transverse sections of sister otoliths with sclerochemical validation for BET and YFT ongoing (n = 141).
- Annual opaque zone counts converted to decimal ages using the 'Jesstimation' fractional ageing approach for BET and YFT
- Oblique- and transverse-section ages combined into one standardized reference dataset for rapid age prediction models



Ventral-oblique otolith section, yellowfin tuna — 12 opaque (annual) zones visible along the broader ventral reading axis.



Age reader comparisons for oblique sections (left, ellipse = 5.5% IAPE) and age-length data derived from transverse (green circles, Farley et al. 2020) and oblique (orange circles) otolith sections for yellowfin tuna.

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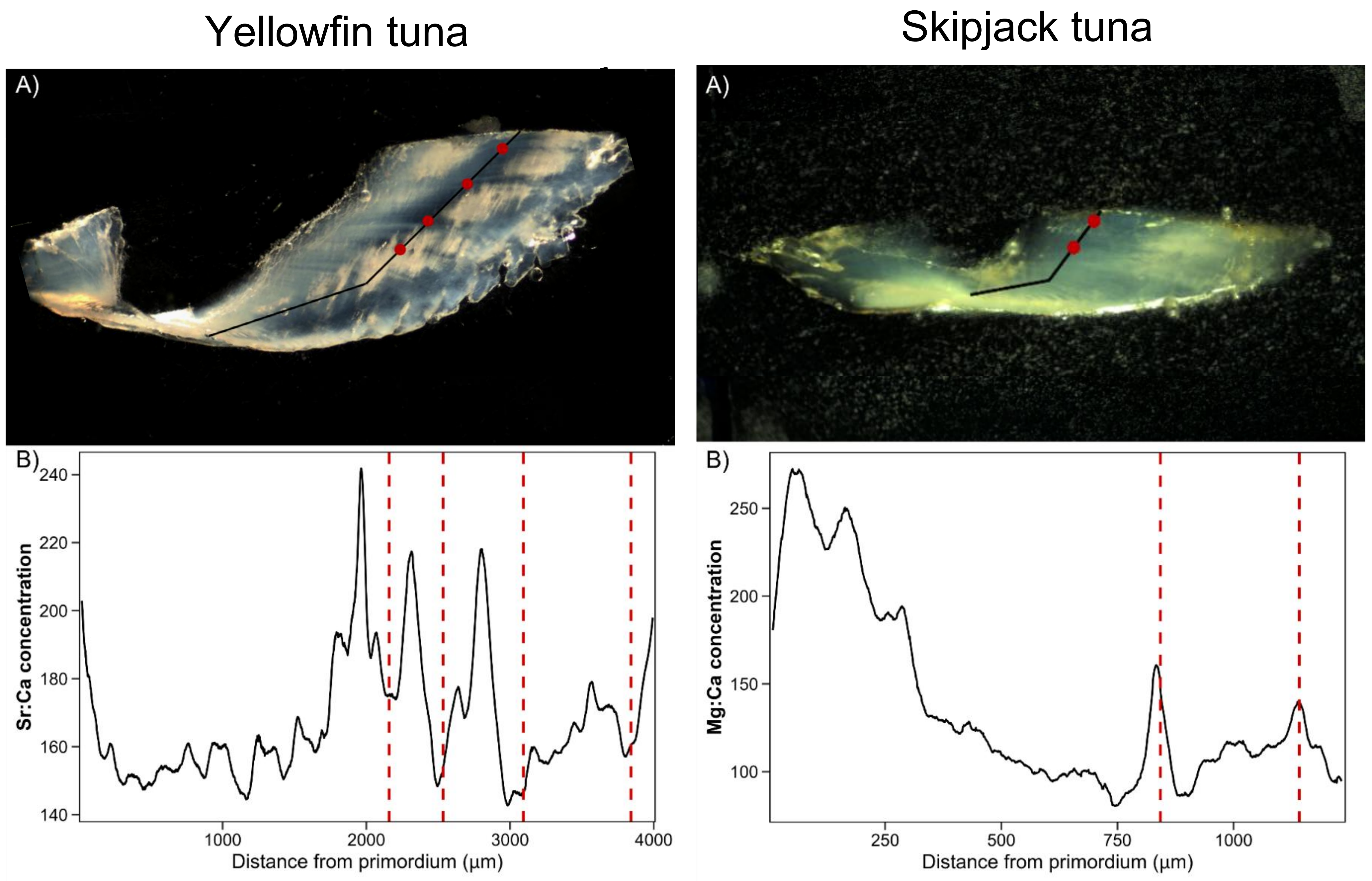
Sclerochemistry confirms annual growth zone interpretation

Laser ablation (LA-ICP-MS) transects reconstruct lifelong cyclical elemental variation (e.g. Mg, Sr, Ba, Ca) and align with visually interpreted annual growth zones for all three tuna species – including skipjack tuna, historically considered very difficult to age

391
Otolith sections analysed by LA-ICP-MS

164 / 153 / 74
Yellowfin / Bigeye / Skipjack

141
Oblique/transverse otolith comparisons (YFT+BET)



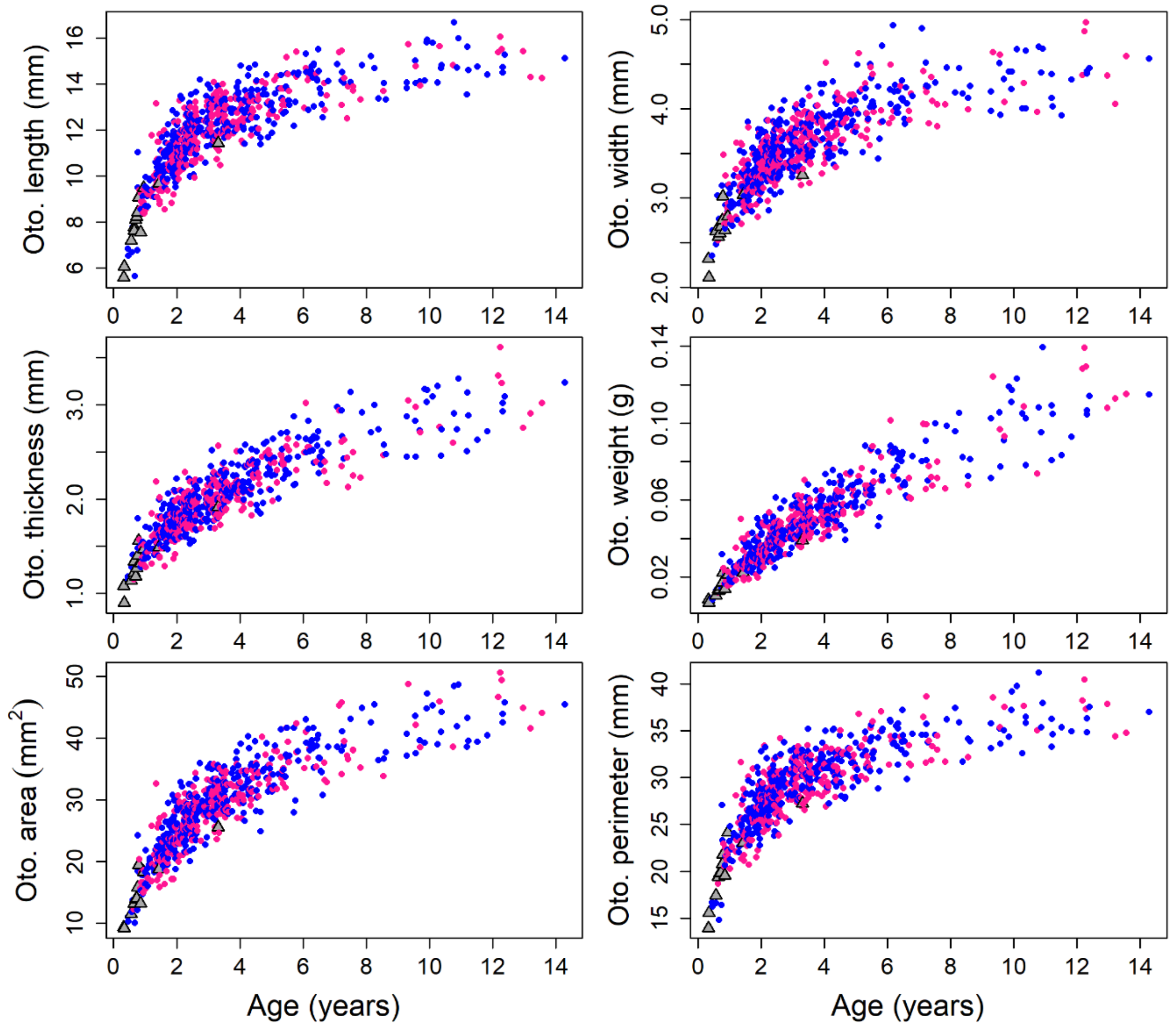
PHASE 1 – RAPID AGEING MODELS

Initial otolith biometric age prediction models with good precision

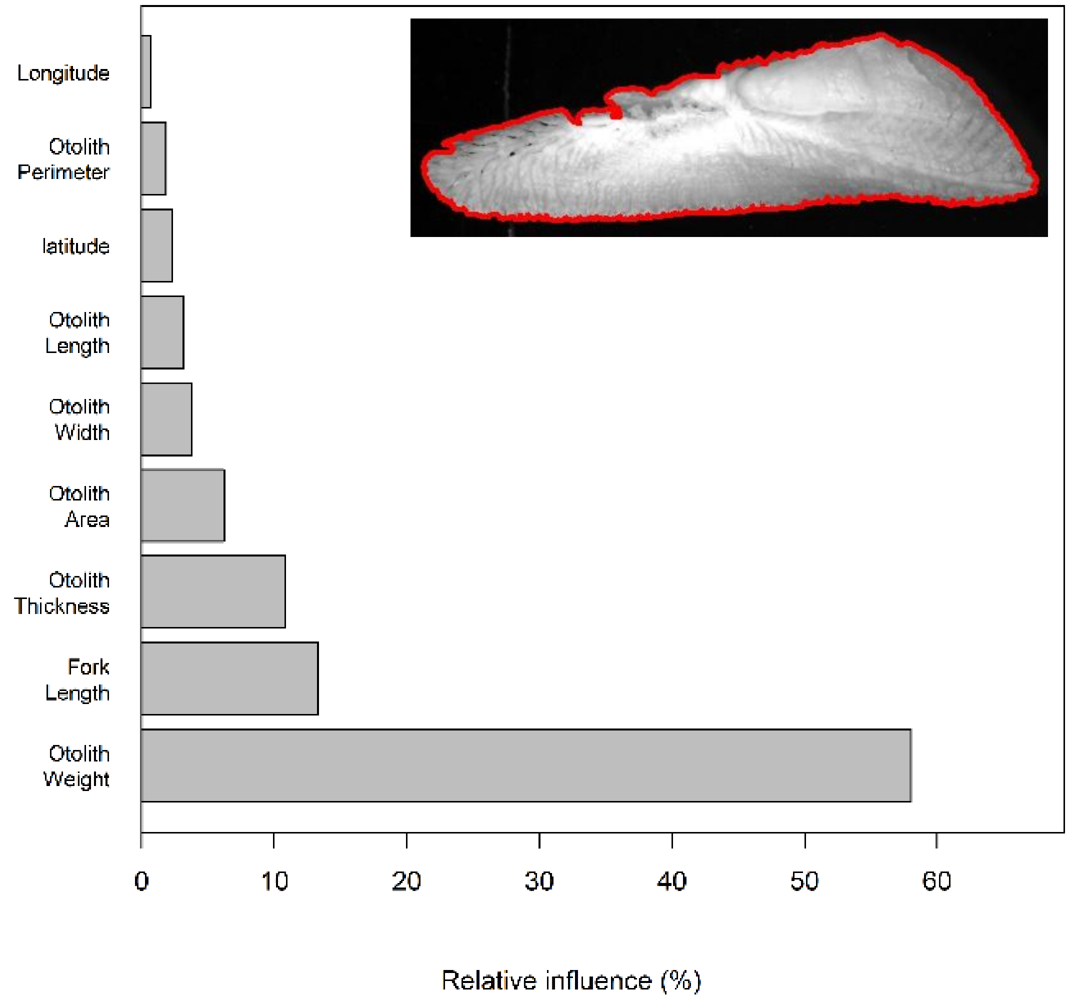
- Multivariate models using Gradient Boosting Machine (GBM) ensemble models.
- Currently, older fish (> ~6 years) are under-represented and need additional data for the training set.

670 / 416

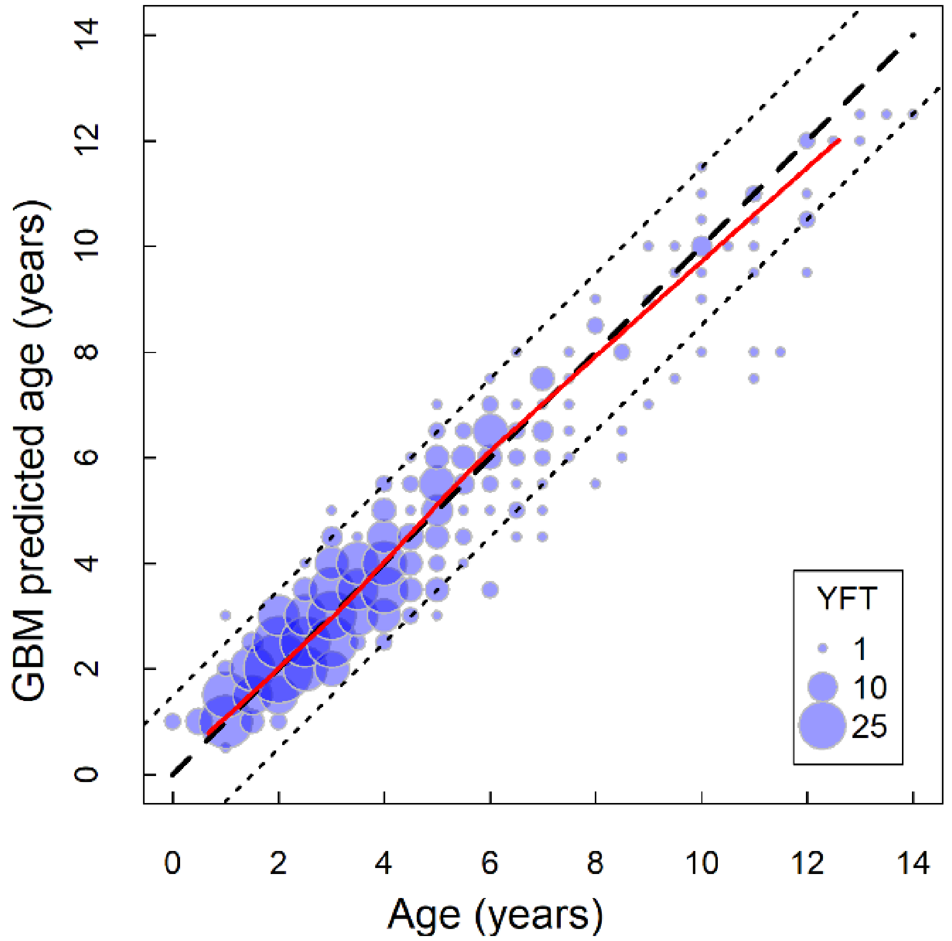
Yellowfin & Bigeye otoliths
(ages 0–14 & 0–12 yrs)



Univariate relationship between otolith biometrics and age



Relative influence of otolith biometric variables for age prediction



Age-bias plot, observed vs predicted age to half yearly increments (thick dashed line = 1:1, thin dashed lines ±1 year)

Epigenetic ageing: complementary, not duplicating

- Predicts age from muscle tissue samples — easier to collect at scale via observer & port-sampling than otoliths.
- Significant investment already underway: a published epigenetic clock for Indian Ocean albacore, and CSIRO work on South Pacific albacore / southern bluefin tuna (with DArT).
- P129's role is to complement, not duplicate, these efforts.

In the interim

SPC is collecting high-quality tuna muscle tissue (liquid-nitrogen & DESS preserved) with paired otoliths, so reference material is ready if a tuna clock is pursued.

~USD 75,000

Current indicative cost per species to develop a tuna epigenetic ageing approach

Not required under current P129 funding — a candidate for 2028/29 planning, subject to progress of external programmes.

Rest of Phase 1, and commencement of Phase 2

Finishing Phase 1 (2026)

- Complete LA-ICP-MS age validation of increment periodicity (YFT, BET, SKJ)
- Finalise a validated direct ageing protocol for skipjack tuna
- Finalise ageing-precision assessment between oblique & transverse sections
- Expand older age classes in YFT and BET reference datasets; refine GBM age prediction models

Commencing Phase 2 (2027)

- Collect 300-500 South Pacific albacore otolith samples per port across 4-5 ports, ahead of the 2027 assessment
- Develop GBM age-prediction models for South Pacific albacore to support rapid ageing ahead of the 2027 assessment
- Continue evaluating epigenetic ageing technologies
- Consult with Members, DWFNs, Observer Programme coordinators on a regional sampling programme
- Transition to Phase 2 (2027): protocols, training, sampling logistics

We invite SC22 to:

1. Note the progress achieved under Phase 1: standardised ageing protocols, LA-ICP-MS age validation, preliminary rapid age-prediction models, and the start of albacore and skipjack rapid ageing work.

2. Prioritise the continuation of Project P129 into Phase 2 to build on the scientific foundations in Phase 1

3. Note the planned increase in albacore otolith sampling ahead of the 2027 stock assessment, and to support the expanded sample collection across key ports and sectors.

4. Endorse the proposed 2027 budget of USD 90,000:
   - USD 60,000 project activities
   - USD 30,000 for two microscopes / digital cameras / associated equipment

Thank you

Questions and discussion welcome.

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