TDW 2024

Pacific Community
Communauté du Pacifique

Close Kin Mark Recapture as applied to South Pacific albacore

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What is CKMR?

- A fisheries-independent assessment to estimate absolute population abundance/total reproductive output, and/or mortality

- A variation on mark-recapture studies that 'marks' fish genetically and 'recaptures' related individuals

- Basic concept: a ratio between fish sampled and kin found
  - the bigger the population, the less likely you are to randomly sample related individuals
  - the more samples you need to take to find 1 kin pair, the bigger the population must be
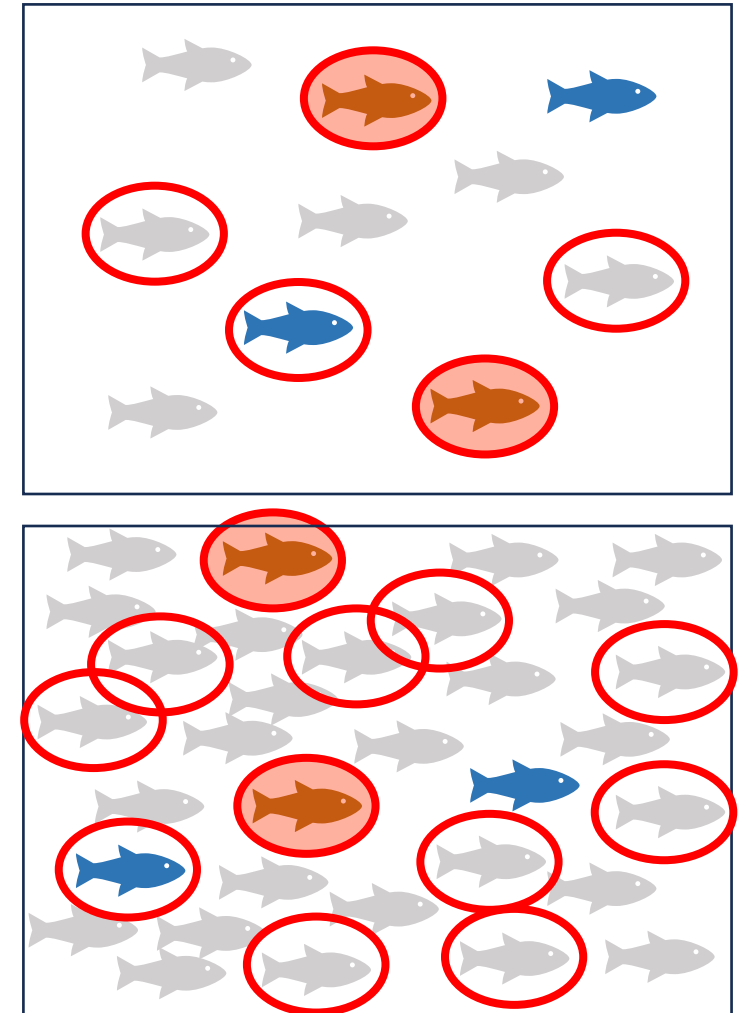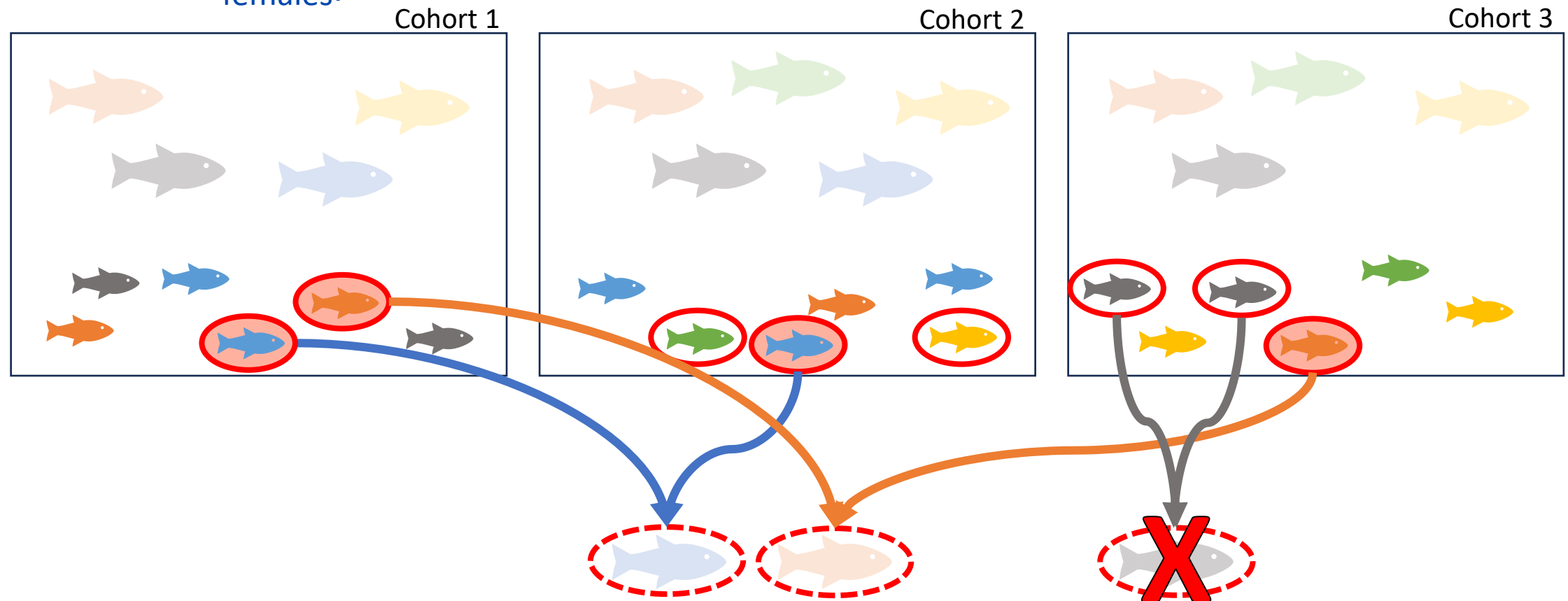
Some basics

Original concept used parent-offspring pairs

"Assumption": Every fish has just one mother (and one father)

Model: Pr [this pair is a POP] = 2/N
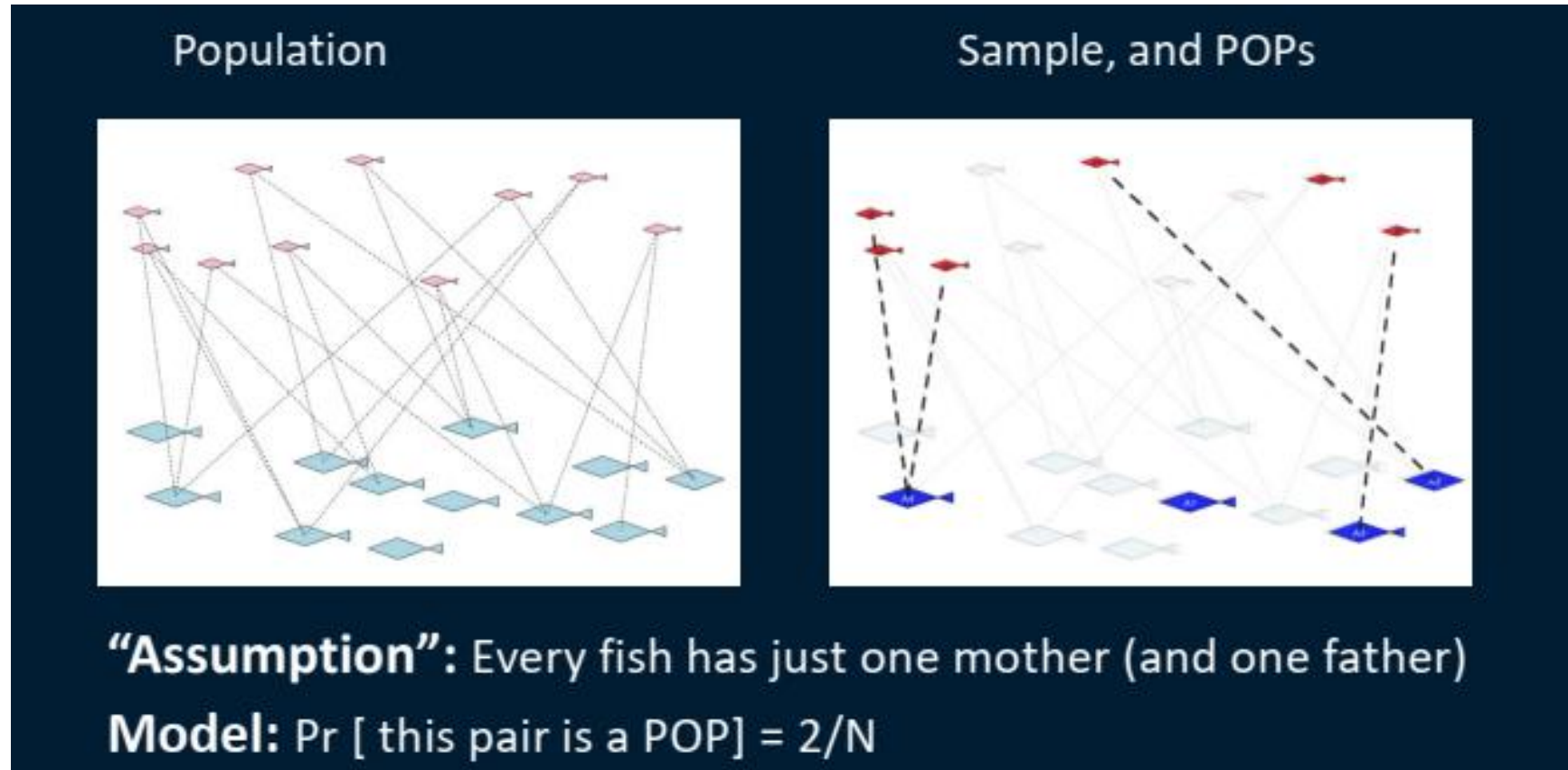
$$\frac{\text{Number of kin pairs found}}{\text{Number of possible pairs}} = \frac{2}{\text{Number of adults in pop}}$$

Some basics

Theory has been expanded to use cross-cohort half sibling pairs, since the ratio still holds (chances that two individuals have the same mother is still $1/N_{females}$)
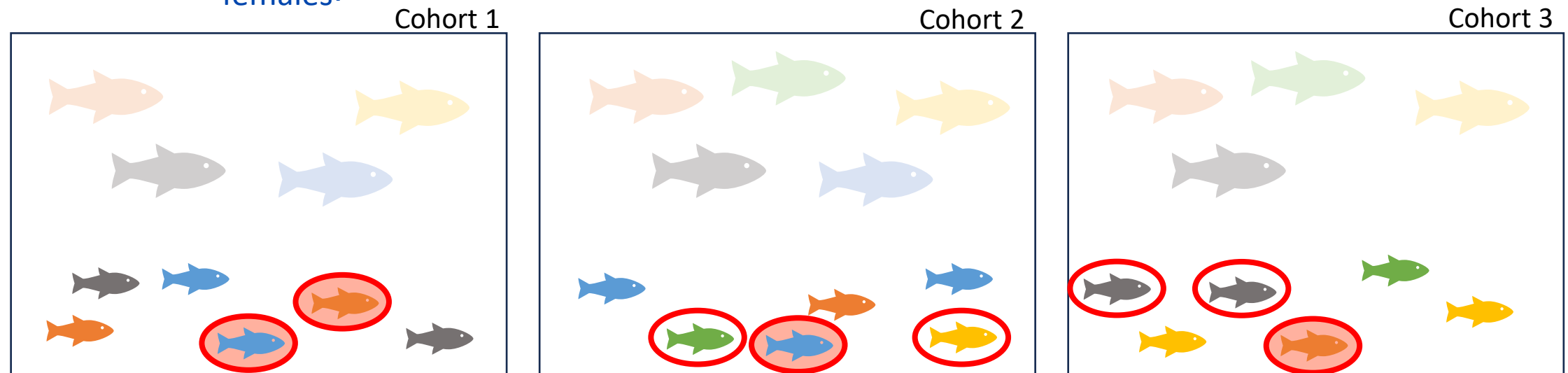
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But now with more covariates

- Mother's survival between offspring
- Growth/changing fecundity
- Range of probable genetic relatedness

More technical bits

- "CKMR is a new source of data provided to an integrated population model, which computes a likelihood that compares observations to expectations"

- Quality of result depends on accuracy of population model and biologically-appropriate sampling scheme
  - Distribute samples across ages, sexes, spatial range, population substructure

- Different kinship types inform different metrics
  - Parent-offspring presence informs total abundance
  - Half-sib presence informs mortality rate

- Precision of estimate improves by finding more kin pairs
  - Baseline of 50 kin pairs to reach CV of 15-20%
 - Estimates are relevant to the birth year of sampled offspring

Data to collect

- ## Muscle tissue
  - Tiny amount of tissue needed, taken with the CSIRO widget
  - Used for genetic relatedness analyses

- ## Age
  - Currently using length-to-age conversions
  - Hopefully soon to augment with higher confidence epigenetic age estimates

- ## Other metadata
  - Location and time of catch (low-precision data is okay)
  - Sex
  - Some details about sampling conditions (flagging if best practices couldn't be followed)

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Albacore goals

- Initial modelling says we need…

- ~30,000 individuals
- Sampled evenly across all size classes
- Sampled evenly across the geographic range

100% juvenile samples

Visual courtesy of Laura Tremblay-Boyer
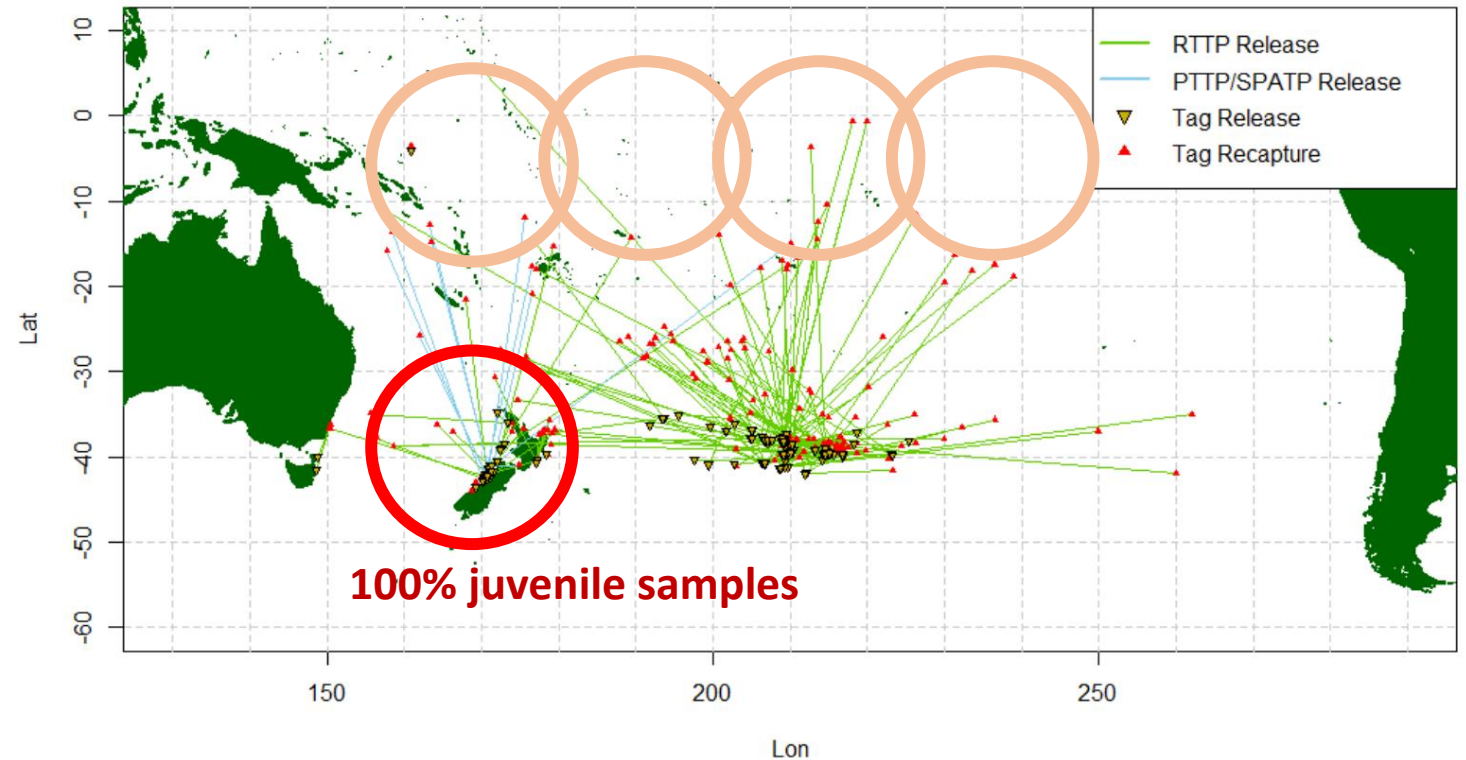
How are we doing?

- 10000+ samples collected so far
- CKMR training events in Fiji*, Tonga and Marshalls, Samoa, and Solomons later this month
    - 28 collaborators from 10 countries **fully** trained
    - Protocols specialized at 6 ports
- Sampling kits for 26000 fish distributed to 8 countries
- Countries can start sampling independently once staff are trained and LOAs in place
- Starting to sample other species, too

Other considerations

- Deciding how to transport samples out of each country will likely require port-by-port assessments

- Still establishing quality control protocols to help flag sample quality issues. This could impact number of samples needed, and/or flag samples that are already collected

- Still working to incorporate epigenetic aging. Once rolled out, sampling should get still faster/more inclusive, and results should be more confident

Outlook

- This is still the 'upfront investment' phase. Once all pieces are in place, CKMR sampling should be a low-maintenance system that can be maintained across years

- Will create incredibly powerful temporal datasets that only gets more valuable as they mature

- Most of the site-specific protocols established for albacore (sampling, transporting, etc) are directly applicable to other species flagged for future CKMR studies

Questions?