

# Sea turtle interactions with WCPO fisheries

1st Informal Intersessional Meeting for the Review of  
CMM 2018-04 Sea Turtles  
STIIWG01  
8-10 April 2026

Tom Peatman<sup>1</sup>, Simon Nicol<sup>2</sup>

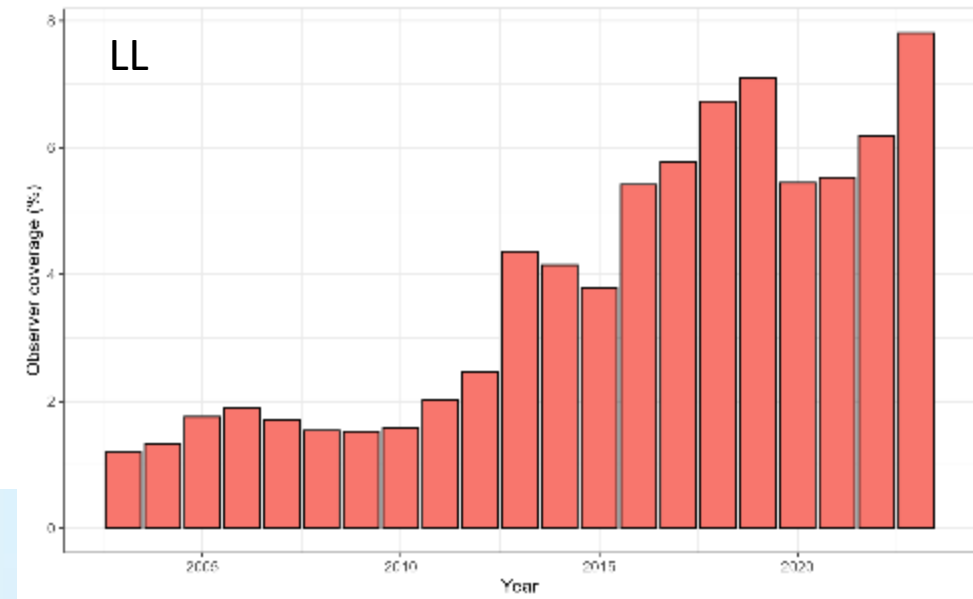
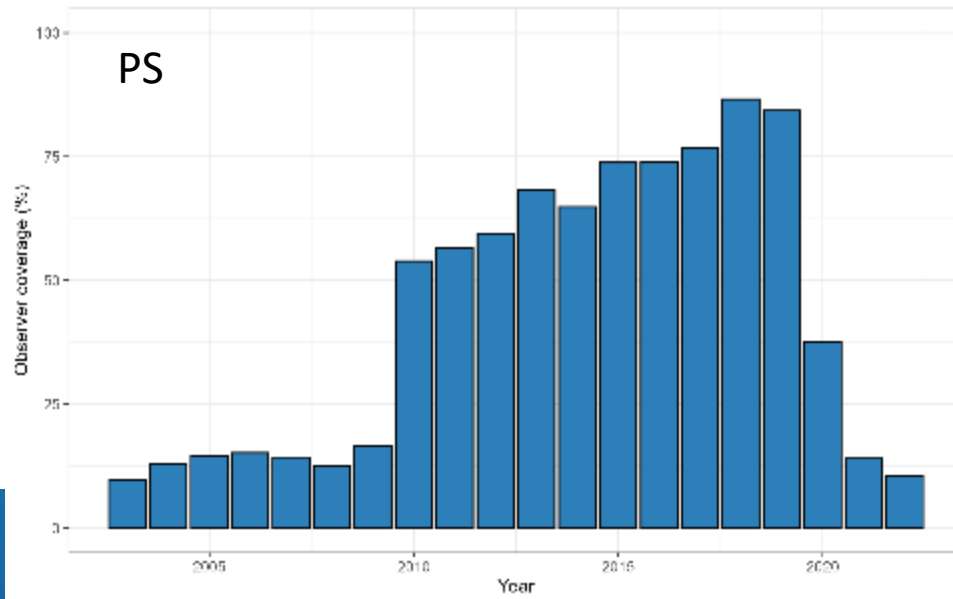
<sup>1</sup> Shearwater Analytics Ltd, Frome, UK

<sup>2</sup> Pacific Community, Noumea, New Caledonia



# Estimation of sea turtle interactions

- Overall approach:
  - Fit statistical models to observed sea turtle interactions
    - Covariates include when, where and how fishing took place
  - Apply these models to reported effort data
    - Estimate interaction rates, then raise to total interactions using total effort
- Complexity of interaction rate models tailored to available observer data
  - More complex modelling approaches possible for purse seine given high coverage rate



# Estimation of interactions - PS

- SC20-ST-WP-07
- Analysed dataset covers 2003-2022, including:
  - WCPFC ROP data (and other observer data held by SPC)
  - Aggregate effort data (S BEST data)
- Geostatistical catch rate models (implemented in sdmTMB package), with effects for:
  - Negative-binomial error structure
  - Year and month – temporal and seasonal variation
  - Flag and set-type
  - Depth of 20C isotherm, ENSO
  - Random spatial field to account for spatial variation
- Continuous variables included as splines to allow for non-linear effects on interaction rates
- For species that are infrequently observed, necessary to simplify model (dropping terms)
- Where possible, tested more complex treatment of spatial effects
  - E.g. reflecting seasonal shifts in distribution, ENSO etc.
  - Green turtle, hawksbill & olive ridley



# Estimation of interactions - LL

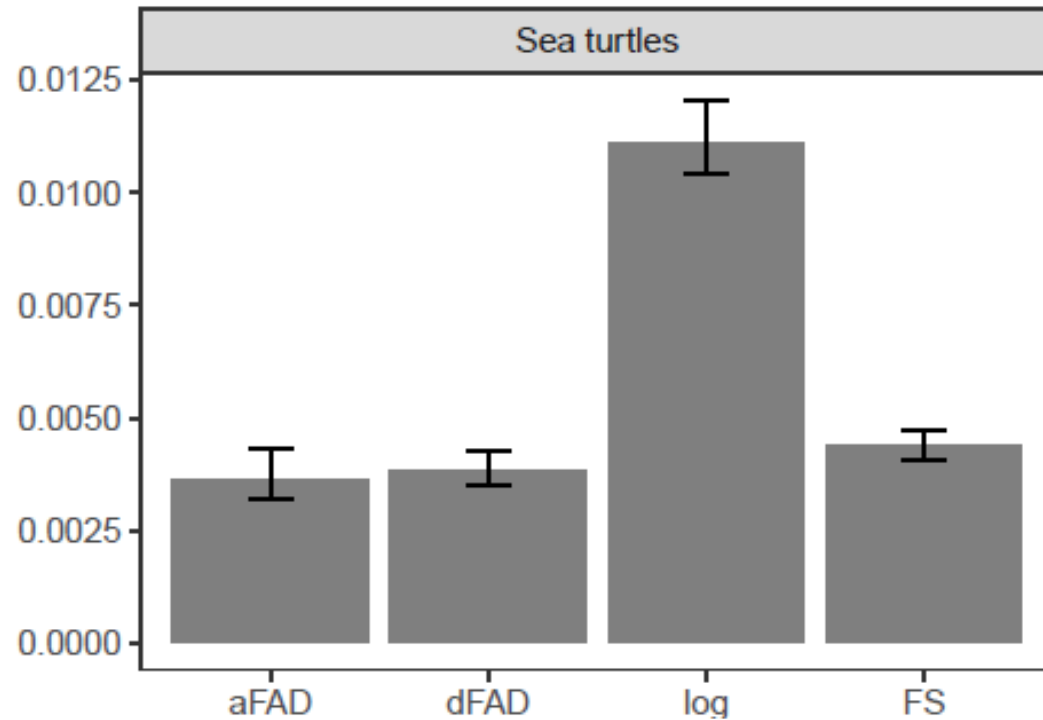
---

- [SC21-ST-WP-09](#)
- Analysed dataset covers 2003-2023, including:
  - WCPFC ROP data, and other observer data held by SPC
  - Reported longline effort data (L BEST data), and reported effort disaggregated by HBF
- Simpler modelling approach (Generalised estimating equations) with effects for:
  - Year – temporal variation
  - Flag, catch composition cluster and hooks-between-float
  - Sea surface temperature – indirectly accounts for spatial variation
- Continuous variables included as splines to allow for non-linear effects on interaction rates
- (Quasi) Poisson model to account for overdispersion
- ‘Exchangeable’ correlation structure to account for structure of observer data
  - Residuals within an observer trip are correlated
  - Mitigates against downwards bias in uncertainty

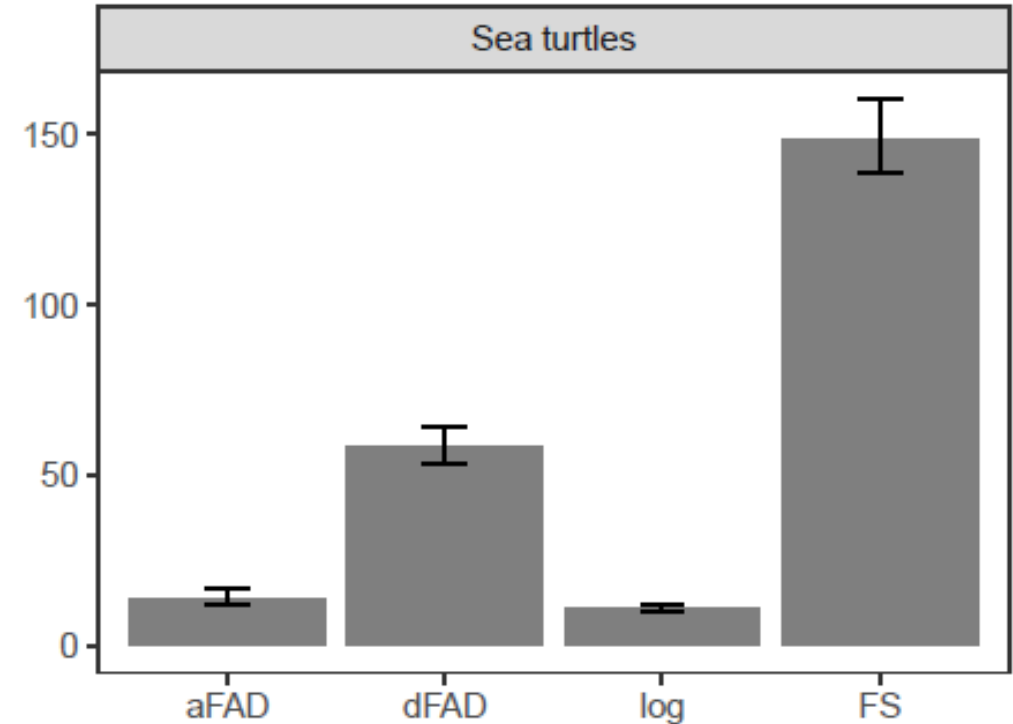


# Estimated PS interactions by set-type

Estimated interaction rate (n per set) – 2018 to '22

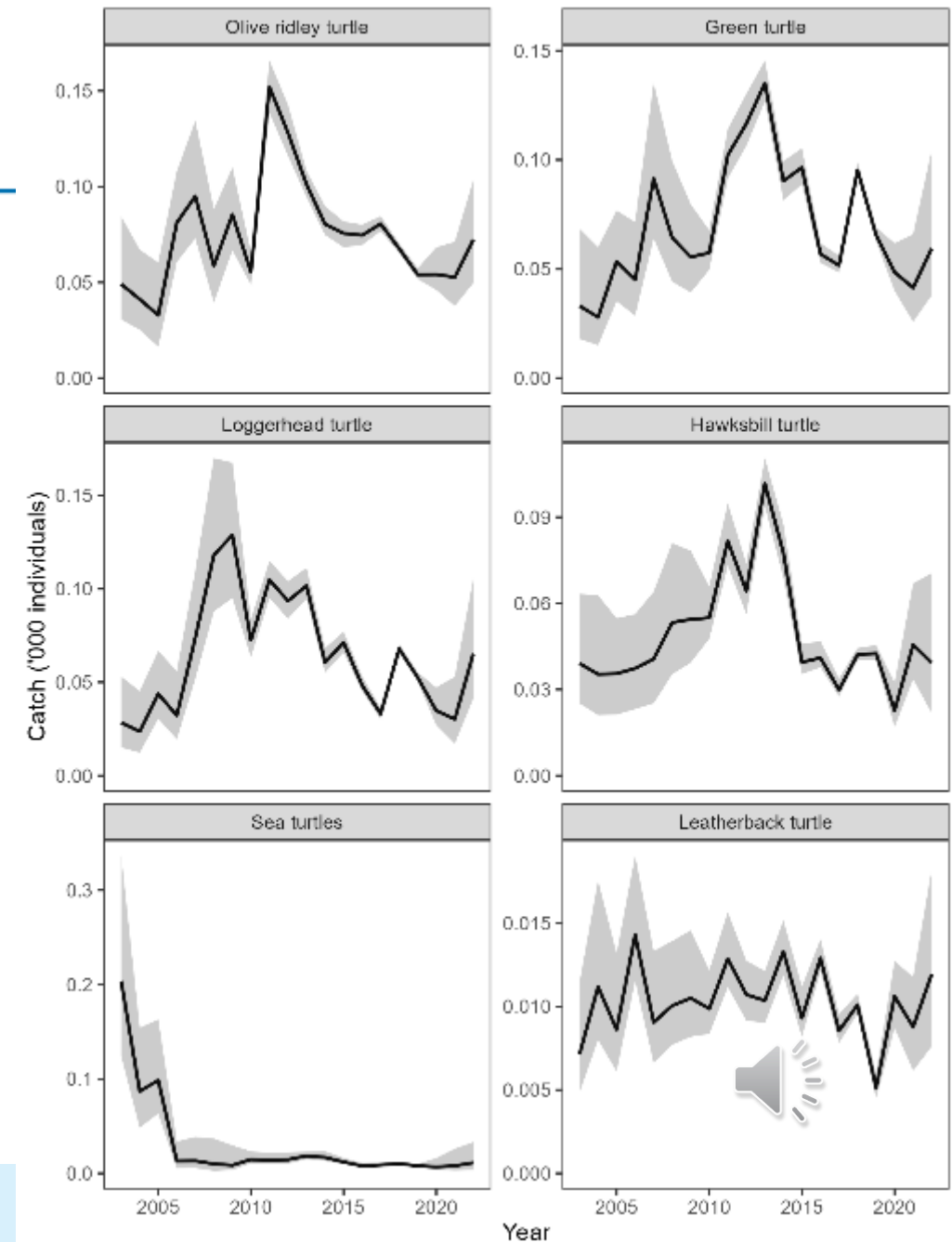


Estimated avg. annual interactions (individuals) – 2018 to '22



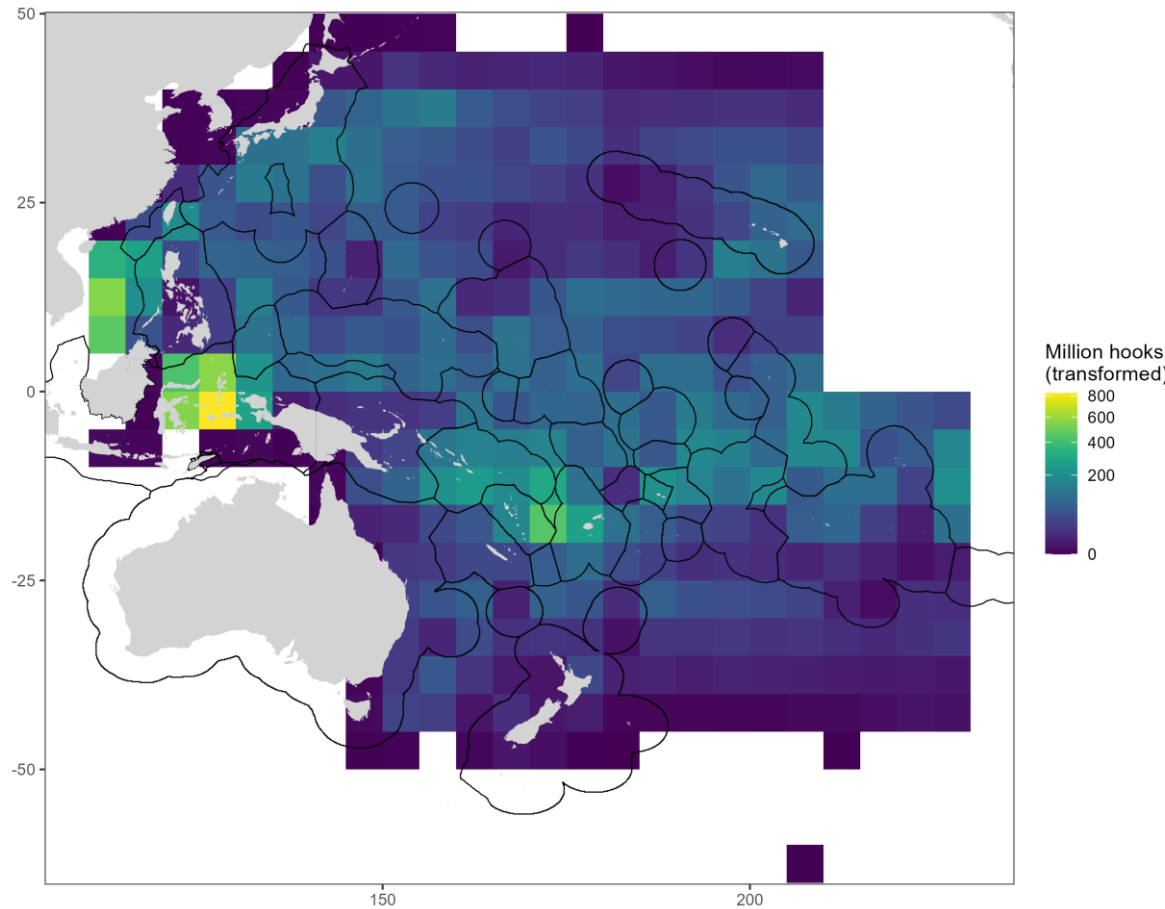
# Estimated PS interactions

- Low levels of estimated interactions
  - Strong variation between years
- Relatively high interactions of sea turtles (unspecified) early in time series
  - Lower taxonomic resolution early in time series
- Total sea turtle interactions predominantly olive ridley (25%), green and loggerhead (ca. 22% each) and hawksbill turtle (17%)

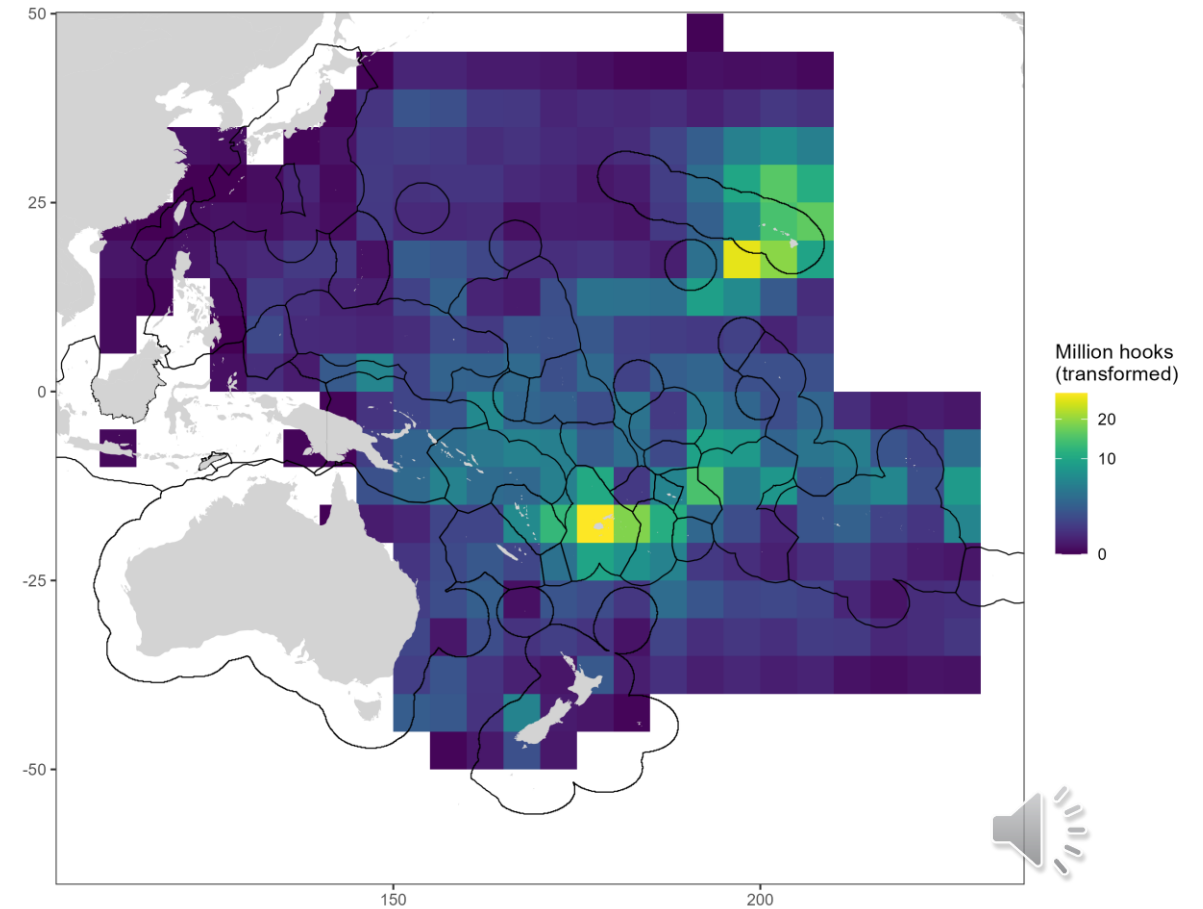


# LL observer coverage (2003 – 2023)

Total reported effort

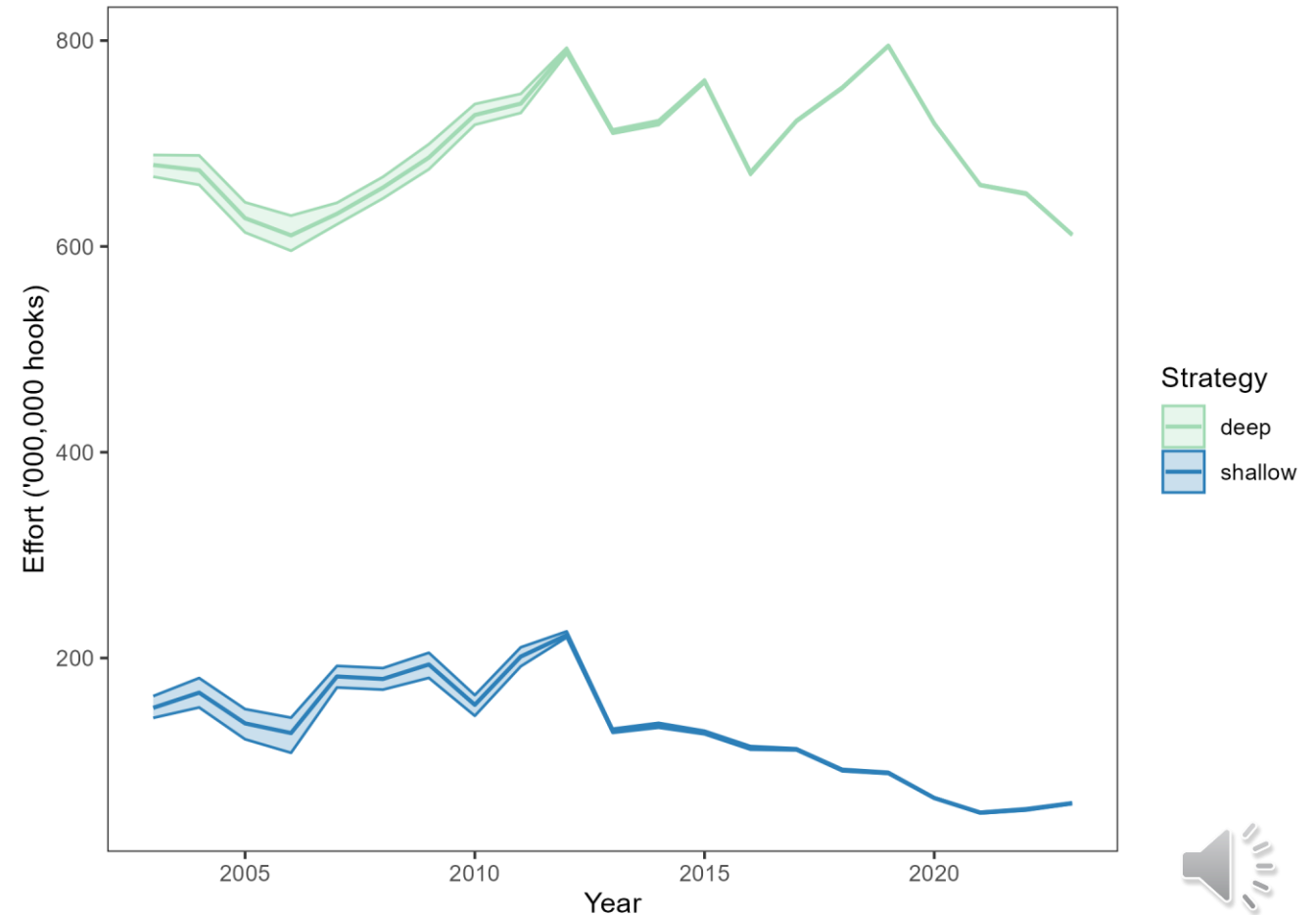


Total observed effort



# (Estimated) LL effort by set-type

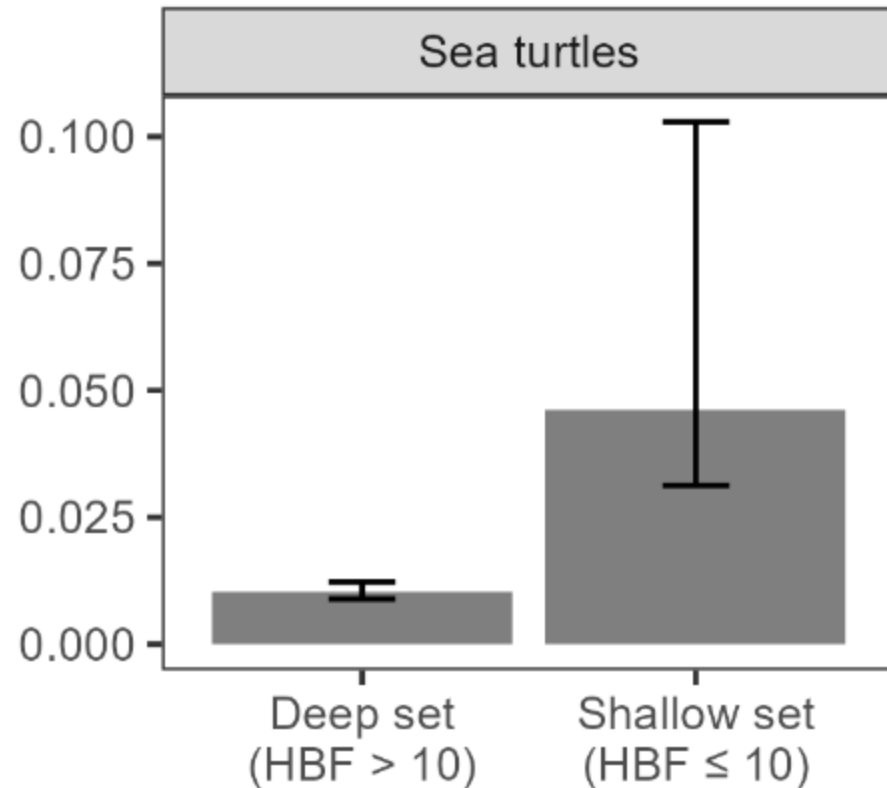
- Shallow-set effort ( $\leq 10$  HBF) accounted for 16% of total effort from 2003 – 2023
- Proportion of shallow set effort declined from 2013 onwards
  - 20% for 2003-2012
  - Decreasing to 9% in 2023



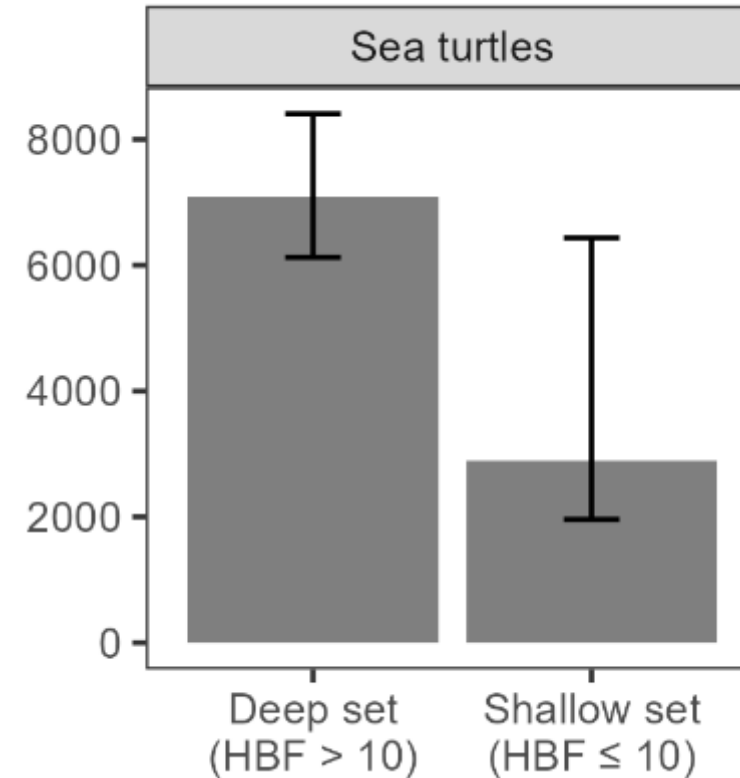


# Estimated LL interactions by set-type

Estimated interaction rate (n per set) – 2019 to '23

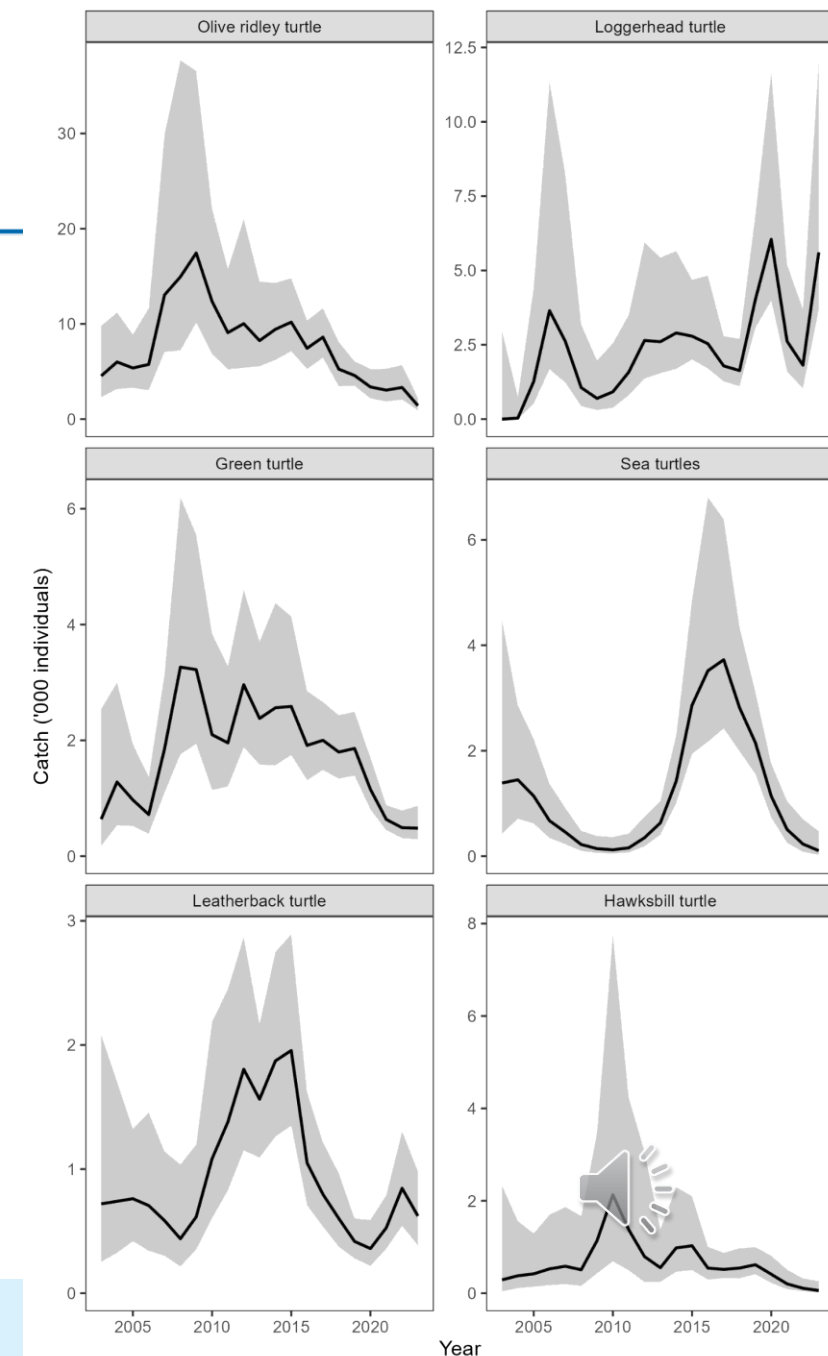


Estimated avg. annual interactions (individuals) – 2019 to '23



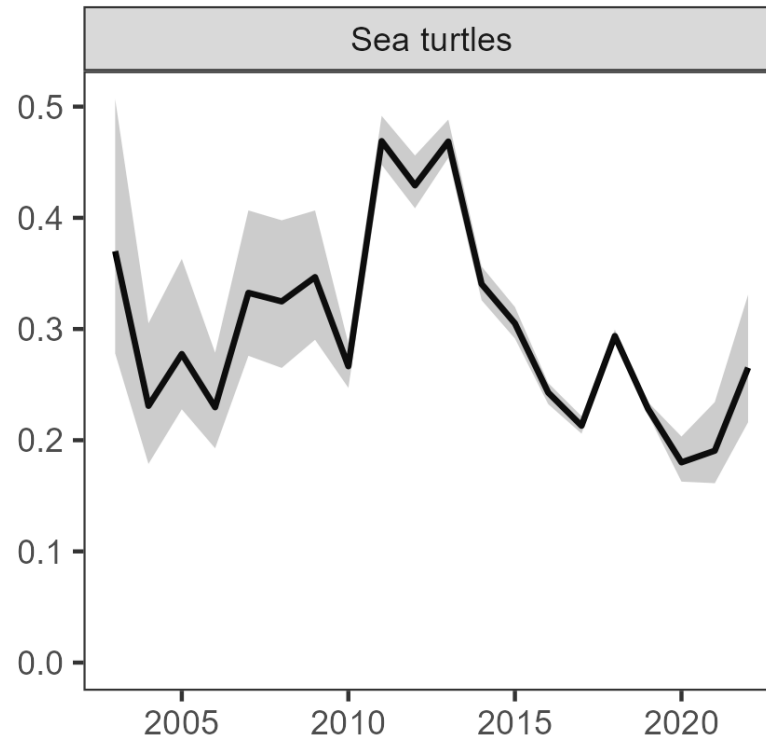
# Estimated LL interactions

- High uncertainty in estimated interactions
- Majority of sea turtle interactions accounted for by olive ridley (ca. 50% of total), loggerhead and green turtle
- Apparent decline in sea turtle interactions from 2015 onwards
  - Though assessing temporal trends complicated by high uncertainty in interactions

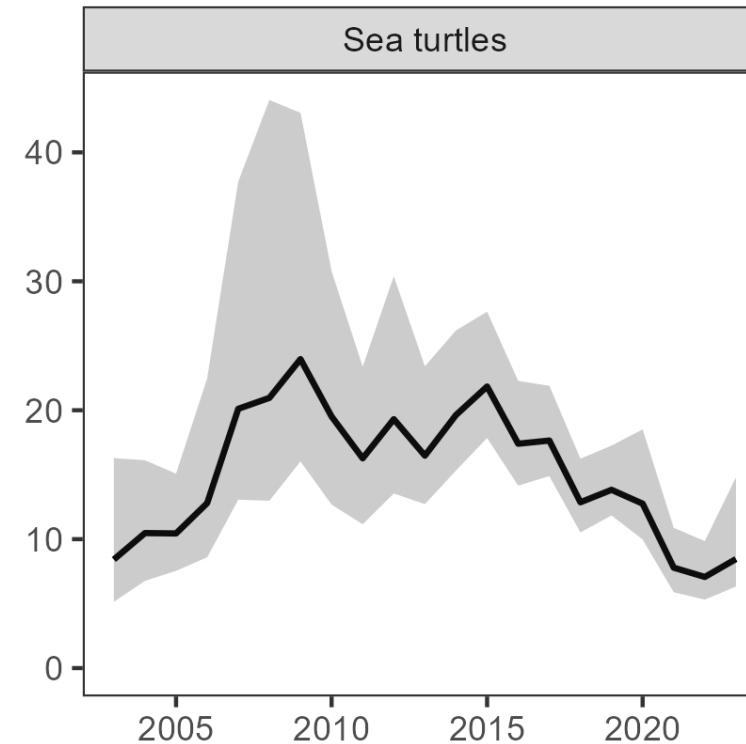


# Total estimated interactions

*Purse seine ('000s)*



*Longline ('000s)*



# Interpretation of estimates

---

- Estimated interactions are what would have been observed with 100% observer coverage
- Evidence of under-estimation of shark catch by purse seine observers
  - Not clear to what extent this may occur for other taxa
- For longline, low rates of observer coverage, and limited (spatio-temporal) observer coverage for key longline fleets
  - Estimated interactions are unlikely to be accurate
  - Comparisons of estimates with reported catches of tuna and billfish species suggests trends in interactions are more reliable
  - But limited sea turtle interactions compromises our ability to monitor temporal trends
  - Considerable model uncertainty – confidence intervals underestimate uncertainty
- Observer forms for SSI interactions have evolved through time
  - Potential for these changes to be driving apparent temporal changes in estimated sea turtle interactions



# Leatherback turtle

---

- Limited observed interactions in analysed datasets
  - LL – 437 individuals (2003 – 2023)
  - PS – 95 individuals (2003 – 2022)
  - (No year-effects in PS catch rate model)
- Exercise (more) caution when interpreting results for longline...



# Final remarks

- Estimates of longline interactions of sea turtles unlikely to be reliable
  - Limitations of observer coverage, coupled with relatively low interaction rate
  - Trends in estimated interactions should be viewed with extreme caution
  - More monitoring required to address this
  - Previous simulation work suggests 10% minimum (20% preferred) for most species, though more required for species that are rarely caught
- Estimates of purse seine interactions more reliable (but limited)
- Estimates cover large-scale longline and purse seine fisheries
  - Do not include interactions in domestic fisheries in the western sector of the WCPFC Convention Area
- Analyses for ABNJ sea turtle project still represent most detailed investigation of sea turtle interactions for longline fleet
  - Consideration of effects on catch rates (and at-vessel) status of gear configuration
  - Inclusion of non-ROP observer data for key fleets
  - Unfortunately does not include estimated catches



# Thank you!

---

