# **Preliminary** evaluation of Seychelles longline length, catch and effort data

Summary of Findings… so far

# Objectives

- Review the data
- Identify potential data errors and possible corrections
- Focus on length compositions, with the aim of considering these for use in stock assessment
- Preliminary results presented here focus on albacore, yellowfin and bigeye tunas

# Data Description

- Data consisted of individual pelagic set data 2007-2023 for Seychelles registered vessels.
- Landings generally do occur in the Seychelles, so the reports have not been verified.
- There is a vessel registry and 3 other main tables:
  - A3: Trip details consisting of a record for each longline set in a trip. TripLogID represents individual sets, but with more than one record where multiple baits are used.
  - A4: Logbook details consisting of a record for each catch species (weight and number).
  - A5: The lengths (cm) of retained fish caught up to 20 per set.
- Significant number of records from the 3 tables are currently orphaned.

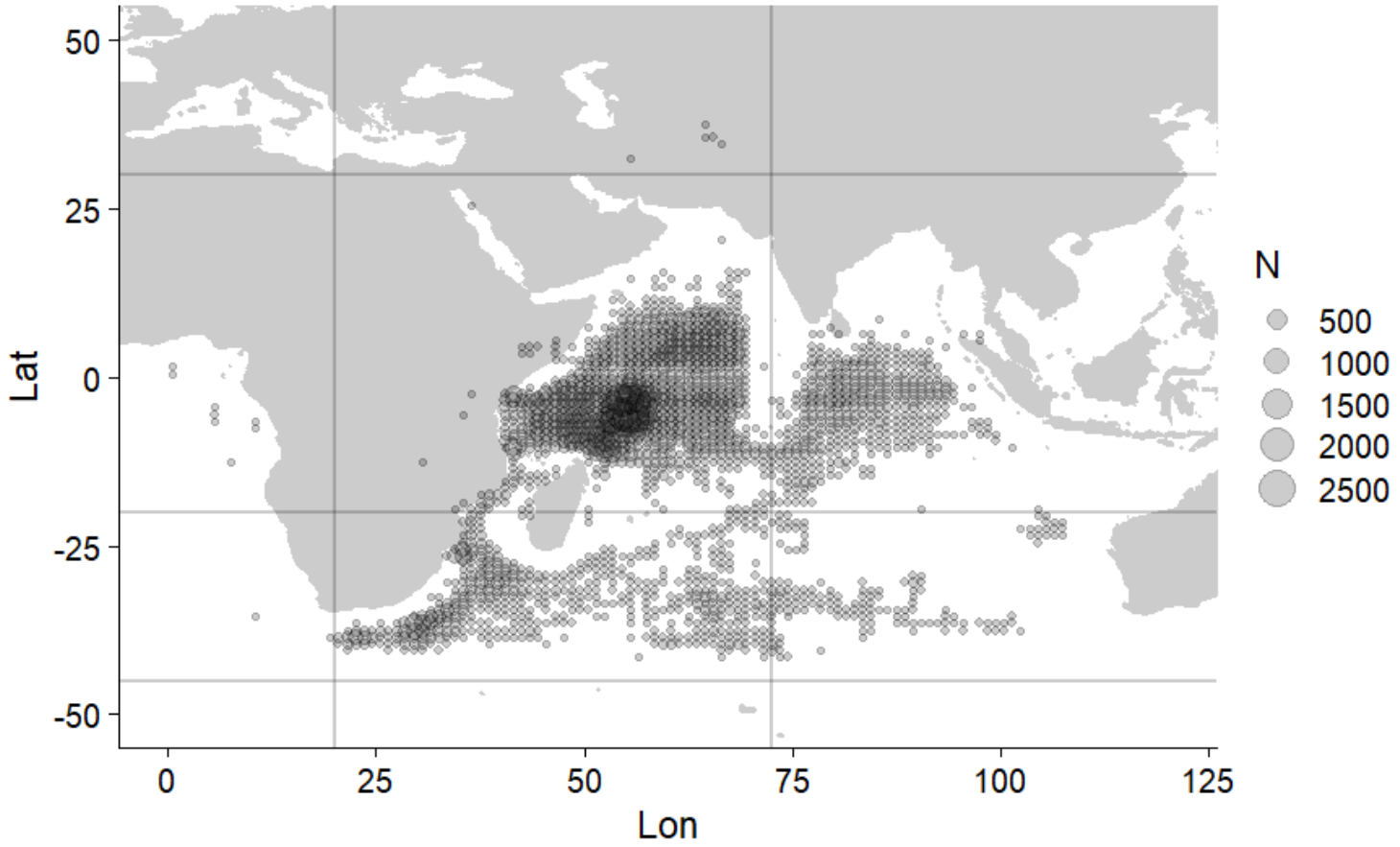
| Gear Variable | Min | Median | Max | NA % |
|---|---|---|---|---|
| Hooks | 20.0 | 3,000 | 6,080 | 0.8 |
| HooksBetweenFloats | 1.0 | 19 | 3,000 | 8.5 |
| LengthFloatLine | 0.9 | 15 | 660 | 87.8 |
| LengthSetLine | 1.0 | 27 | 1,350,000 | 78.7 |
| LengthBranchLine | 0.1 | 23 | 1,800 | 8.5 |

| Catch Variable | Min | Median | Max | NA % |
|---|---|---|---|---|
| RetainedWeight | 1.0 | 100.0 | 14,324 | 1.6 |
| DiscardWeight | 0.0 | 130.5 | 21,216 | 100.0 |
| RetainedPieces | 1.0 | 3.0 | 11,399 | 1.6 |
| DiscardPieces | 0.0 | 1.0 | 722 | 98.4 |

# Length records

| | | | Length | | | | Catch |
|---|---|---|---|---|---|---|---|
| ScientificName | CommonName | ACode | Min | Median | Max | Count | Retained Pieces |
| Alopias spp | Thresher sharks (Moro Sharks) | THR | 30 | 165.0 | 290 | 6,425 | 14 |
| Carcharhinus limbatus | Blacktip shark | CCL | 24 | 152.0 | 274 | 3,690 | 1,067 |
| Carcharhinus longimanus | Oceanic Whitetip shark | OCS | 69 | 129.5 | 168 | 34 | 92 |
| Makaira indica | Black Marlin (white marlin) | BLM | 119 | 174.0 | 312 | 16,904 | 36,564 |
| Makaira nigricans | Indo-Pacific blue Marlin | BUM | 143 | 180.0 | 295 | 1,318 | 37,686 |
| Makaira spp | Marlins nei | BXQ | 64 | 172.0 | 290 | 29,061 | 2,574 |
| Osteichthyes | Marine fishes nei | MZZ | 10 | 90.0 | 194 | 99,866 | 792,877 |
| Osteichthyes | Pelagic fishes nei | PEL | 42 | 77.0 | 135 | 143 | |
| Prionace glauca | Blue Shark | BSH | 67 | 157.0 | 325 | 44,825 | 96,851 |
| Selachimorpha (Pleurotremata) | sharks nei | SKH | 51 | 170.0 | 310 | 2,463 | 15,249 |
| Tetrapturus audax | Stripped Marlin | MLS | 104 | 168.0 | 231 | 5,217 | 32,126 |
| Thunnus alalunga | Albacore | ALB | 20 | 90.0 | 165 | 134,099 | 430,124 |
| Thunnus albacares | Yellowfin tuna | YFT | 31 | 130.0 | 190 | 401,267 | 1,011,130 |
| Thunnus obesus | Bigeye tuna | BET | 48 | 134.0 | 186 | 749,328 | 1,196,687 |
| Xiphias gladius | Swordfish | SWO | 50 | 147.0 | 260 | 129,409 | 257,574 |

# Longline set start positions



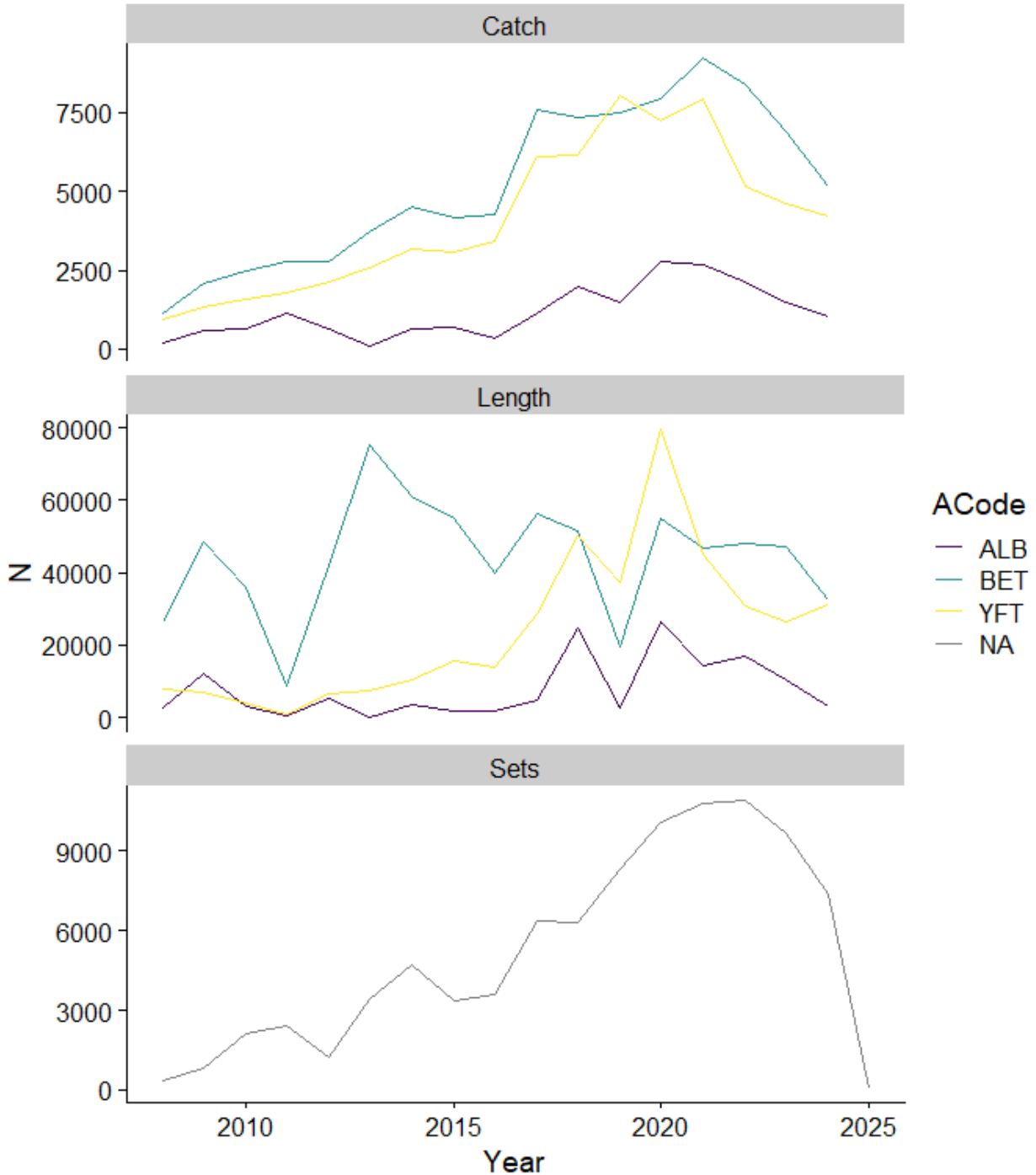

| Area | Count | Percent |
|---|---|---|
| Atlantic | 17 | 0.0% |
| NA | 5 | 0.0% |
| NE | 4,058 | 4.4% |
| NW | 77,941 | 84.9% |
| On Land | 44 | 0.0% |
| Outside | 5 | 0.0% |
| SE | 378 | 0.4% |
| SW | 9,310 | 10.1% |
| Total | 91,758 | 100.0% |

# Length Observations

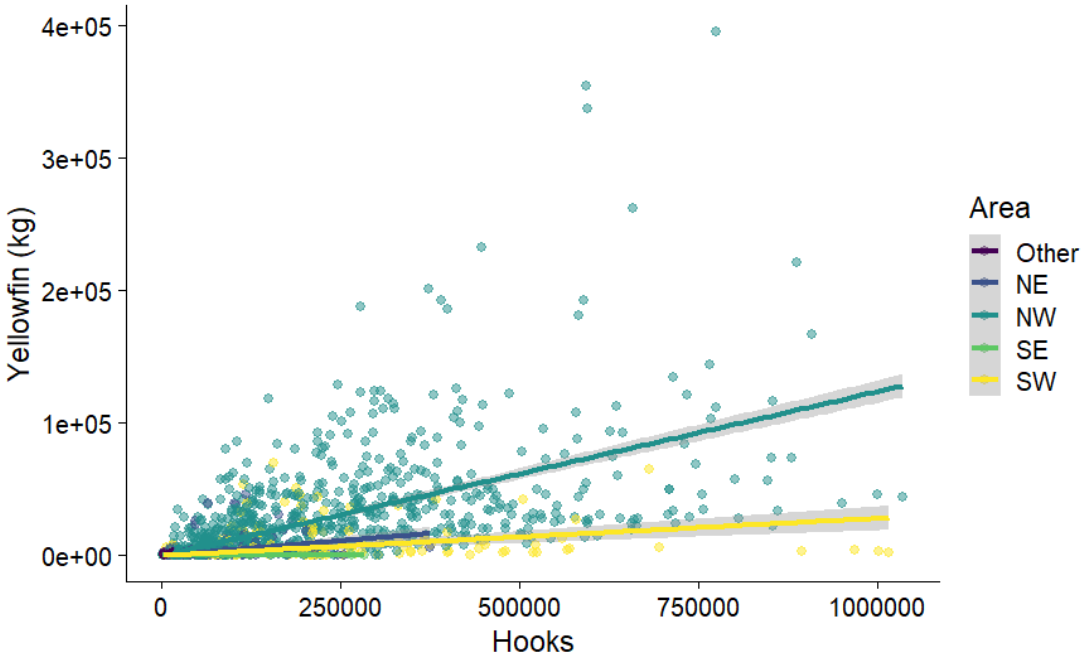
| Area | | ACode | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ALB | BET | BLM | BSH | BUM | BXQ | CCL | MLS | MZZ | OCS | PEL | SKH | SWO | THR | YFT | Total |
| Atlantic | Count | 300 (0.0%) | 1,057 (0.1%) | 47 (0.0%) | 86 (0.0%) | 3 (0.0%) | 42 (0.0%) | 1 (0.0%) | 1 (0.0%) | 111 (0.0%) | | | | 197 (0.0%) | 6 (0.0%) | 695 (0.0%) | 2,546 (0.2%) |
| | Mar. pct [1] | 0.2% ; 11.8% | 0.1% ; 41.5% | 0.3% ; 1.8% | 0.2% ; 3.4% | 0.2% ; 0.1% | 0.1% ; 1.6% | 0.0% ; 0.0% | 0.0% ; 0.0% | 0.1% ; 4.4% | | | | 0.2% ; 7.7% | 0.1% ; 0.2% | 0.2% ; 27.3% | |
| NE | Count | 2,037 (0.1%) | 68,278 (4.2%) | 2,230 (0.1%) | 5,717 (0.4%) | 158 (0.0%) | 1,288 (0.1%) | 424 (0.0%) | 344 (0.0%) | 1,823 (0.1%) | 4 (0.0%) | | 119 (0.0%) | 6,859 (0.4%) | 209 (0.0%) | 13,683 (0.8%) | 103,173 (6.4%) |
| | Mar. pct | 1.5% ; 2.0% | 9.1% ; 66.2% | 13.2% ; 2.2% | 12.8% ; 5.5% | 12.0% ; 0.2% | 4.4% ; 1.2% | 11.5% ; 0.4% | 6.6% ; 0.3% | 1.8% ; 1.8% | 11.8% ; 0.0% | | 4.8% ; 0.1% | 5.3% ; 6.6% | 3.3% ; 0.2% | 3.4% ; 13.3% | |
| NW | Count | 10,132 (0.6%) | 648,583 (39.9%) | 14,396 (0.9%) | 26,873 (1.7%) | 1,126 (0.1%) | 27,622 (1.7%) | 3,131 (0.2%) | 4,777 (0.3%) | 17,772 (1.1%) | 20 (0.0%) | 23 (0.0%) | 2,303 (0.1%) | 110,485 (6.8%) | 2,397 (0.1%) | 368,264 (22.7%) | 1,237,904 (76.2%) |
| | Mar. pct | 7.6% ; 0.8% | 86.6% ; 52.4% | 85.2% ; 1.2% | 60.0% ; 2.2% | 85.4% ; 0.1% | 95.0% ; 2.2% | 84.9% ; 0.3% | 91.6% ; 0.4% | 17.8% ; 1.4% | 58.8% ; 0.0% | 16.1% ; 0.0% | 93.5% ; 0.2% | 85.4% ; 8.9% | 37.3% ; 0.2% | 91.8% ; 29.7% | |
| On Land | Count | 124 (0.0%) | 785 (0.0%) | 47 (0.0%) | 41 (0.0%) | | 31 (0.0%) | 3 (0.0%) | 26 (0.0%) | 33 (0.0%) | | | 3 (0.0%) | 251 (0.0%) | 2 (0.0%) | 616 (0.0%) | 1,962 (0.1%) |
| | Mar. pct | 0.1% ; 6.3% | 0.1% ; 40.0% | 0.3% ; 2.4% | 0.1% ; 2.1% | | 0.1% ; 1.6% | 0.1% ; 0.2% | 0.5% ; 1.3% | 0.0% ; 1.7% | | | 0.1% ; 0.2% | 0.2% ; 12.8% | 0.0% ; 0.1% | 0.2% ; 31.4% | |
| Outside | Count | 2 (0.0%) | 182 (0.0%) | 8 (0.0%) | 4 (0.0%) | 1 (0.0%) | 5 (0.0%) | | | 5 (0.0%) | | | | 43 (0.0%) | 3 (0.0%) | 174 (0.0%) | 427 (0.0%) |
| | Mar. pct | 0.0% ; 0.5% | 0.0% ; 42.6% | 0.0% ; 1.9% | 0.0% ; 0.9% | 0.1% ; 0.2% | 0.0% ; 1.2% | | | 0.0% ; 1.2% | | | | 0.0% ; 10.1% | 0.0% ; 0.7% | 0.0% ; 40.7% | |
| SE | Count | 23,333 (1.4%) | 3,061 (0.2%) | | | | 6 (0.0%) | | | 417 (0.0%) | | | | 628 (0.0%) | | 1,378 (0.1%) | 28,823 (1.8%) |
| | Mar. pct | 17.4% ; 81.0% | 0.4% ; 10.6% | | | | 0.0% ; 0.0% | | | 0.4% ; 1.4% | | | | 0.5% ; 2.2% | | 0.3% ; 4.8% | |
| SW | Count | 98,171 (6.0%) | 27,382 (1.7%) | 176 (0.0%) | 12,104 (0.7%) | 30 (0.0%) | 67 (0.0%) | 131 (0.0%) | 69 (0.0%) | 79,705 (4.9%) | 10 (0.0%) | 120 (0.0%) | 38 (0.0%) | 10,946 (0.7%) | 3,808 (0.2%) | 16,457 (1.0%) | 249,214 (15.3%) |
| | Mar. pct | 73.2% ; 39.4% | 3.7% ; 11.0% | 1.0% ; 0.1% | 27.0% ; 4.9% | 2.3% ; 0.0% | 0.2% ; 0.0% | 3.6% ; 0.1% | 1.3% ; 0.0% | 79.8% ; 32.0% | 29.4% ; 0.0% | 83.9% ; 0.0% | 1.5% ; 0.0% | 8.5% ; 4.4% | 59.3% ; 1.5% | 4.1% ; 6.6% | |
| Total | Count | 134,099 (8.3%) | 749,328 (46.1%) | 16,904 (1.0%) | 44,825 (2.8%) | 1,318 (0.1%) | 29,061 (1.8%) | 3,690 (0.2%) | 5,217 (0.3%) | 99,866 (6.1%) | 34 (0.0%) | 143 (0.0%) | 2,463 (0.2%) | 129,409 (8.0%) | 6,425 (0.4%) | 401,267 (24.7%) | 1,624,049 (100.0%) |

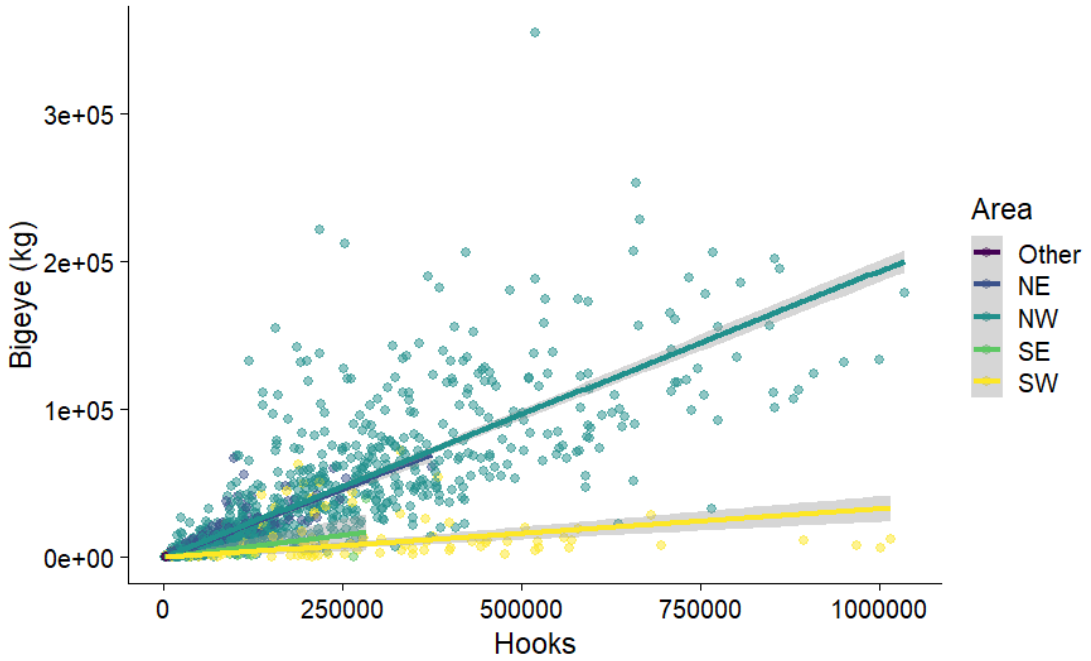
(1) Columns and rows percentages

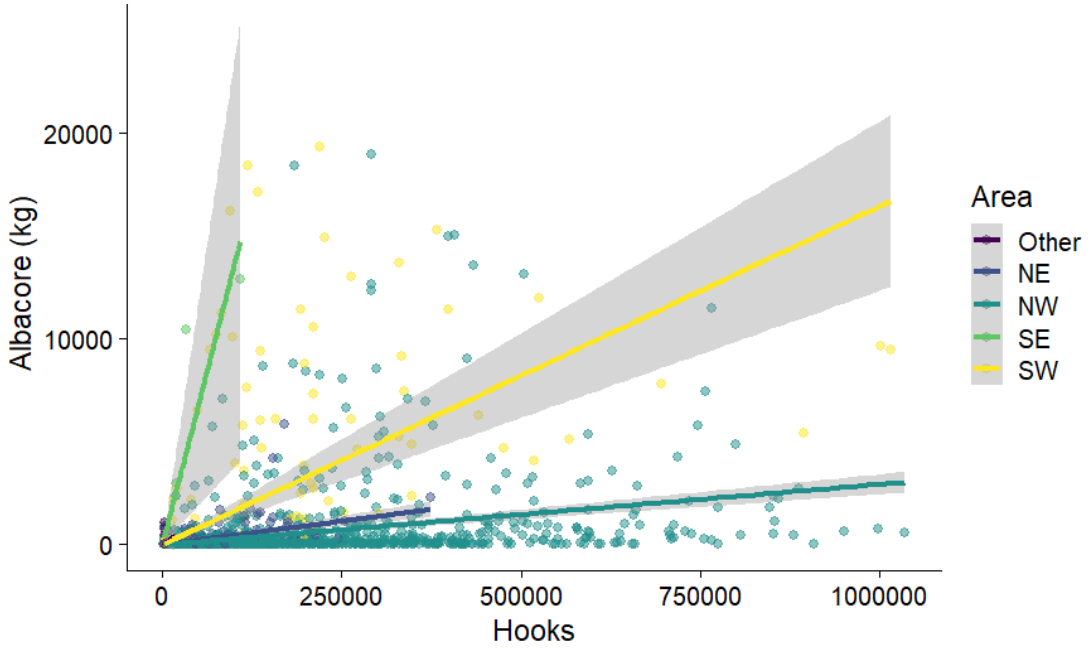
# Number of observations by year



# Catch (kg) and effort (hooks) - trips



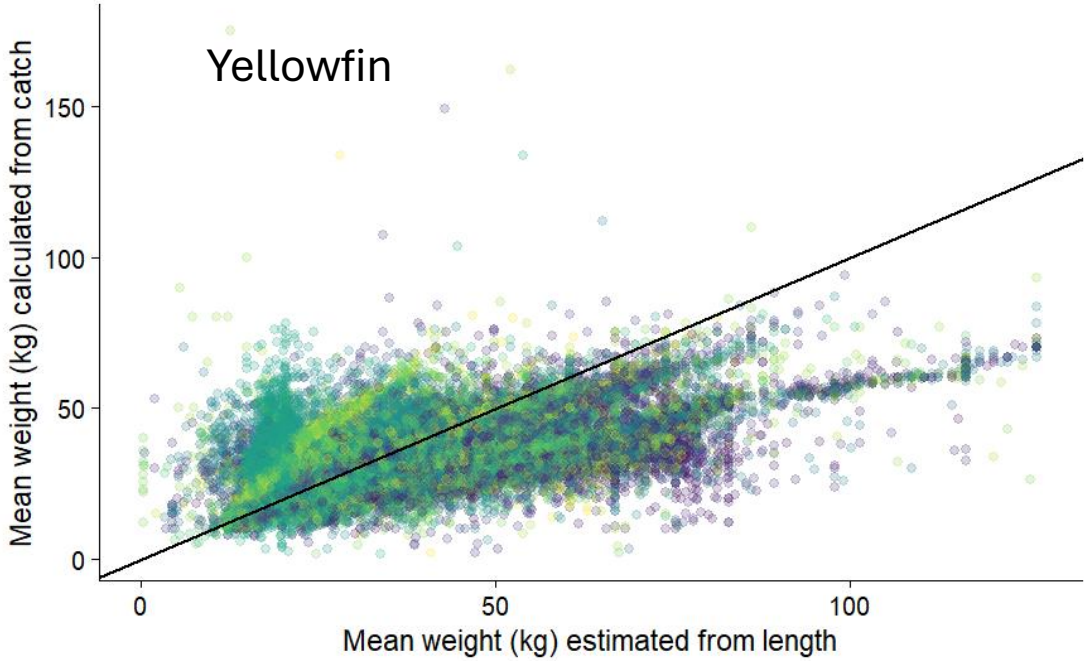



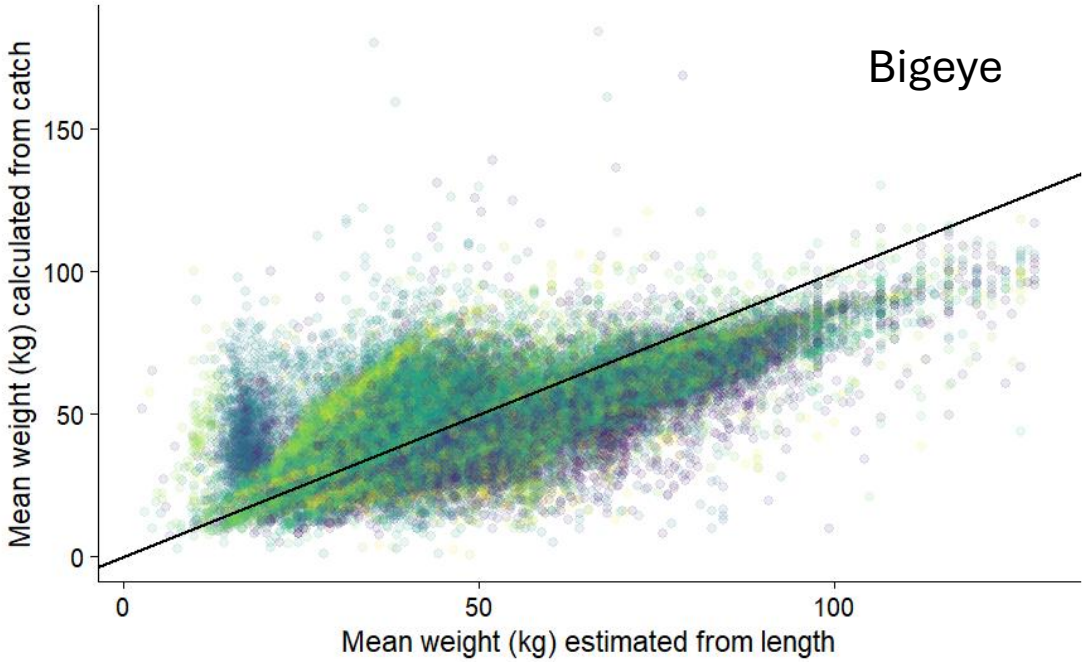
# Internal consistency

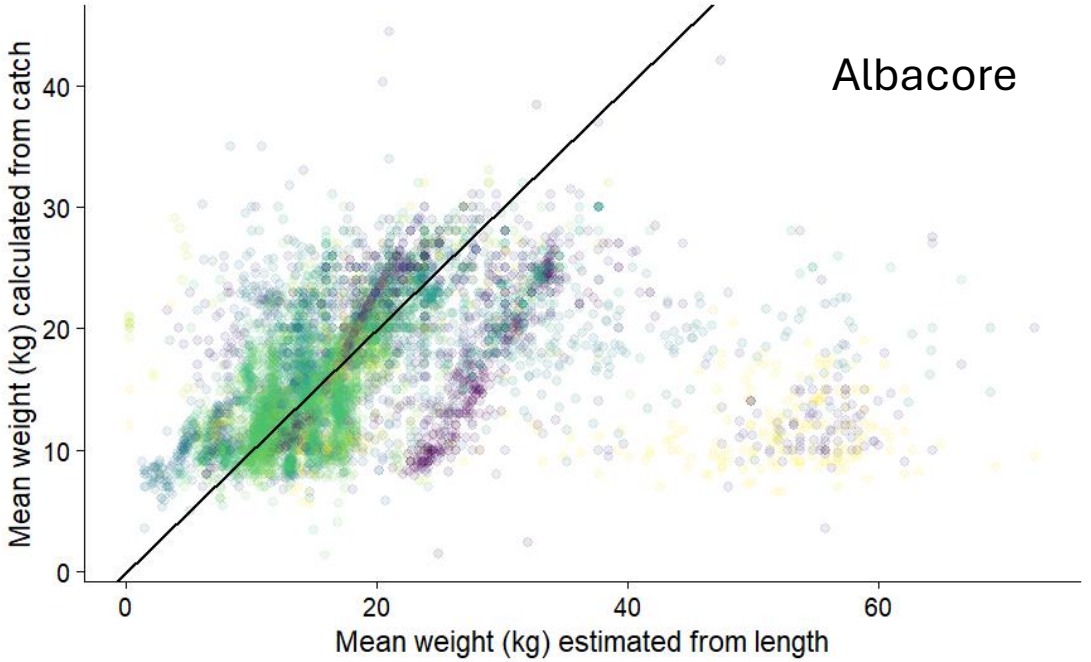
- For each longline set, the retained weight and retained pieces by species
- For the first 20 fish of each species, the lengths are recorded.
- The mean weight of fish can be calculated from the length
  - Mean weight = sum(a L^b) / N
- and from the recorded catch weight
  - Mean weight Retained weight / Retained species

These estimates can be used to identify inconsistencies.

# Catch-based vs Length-based mean weight: sets

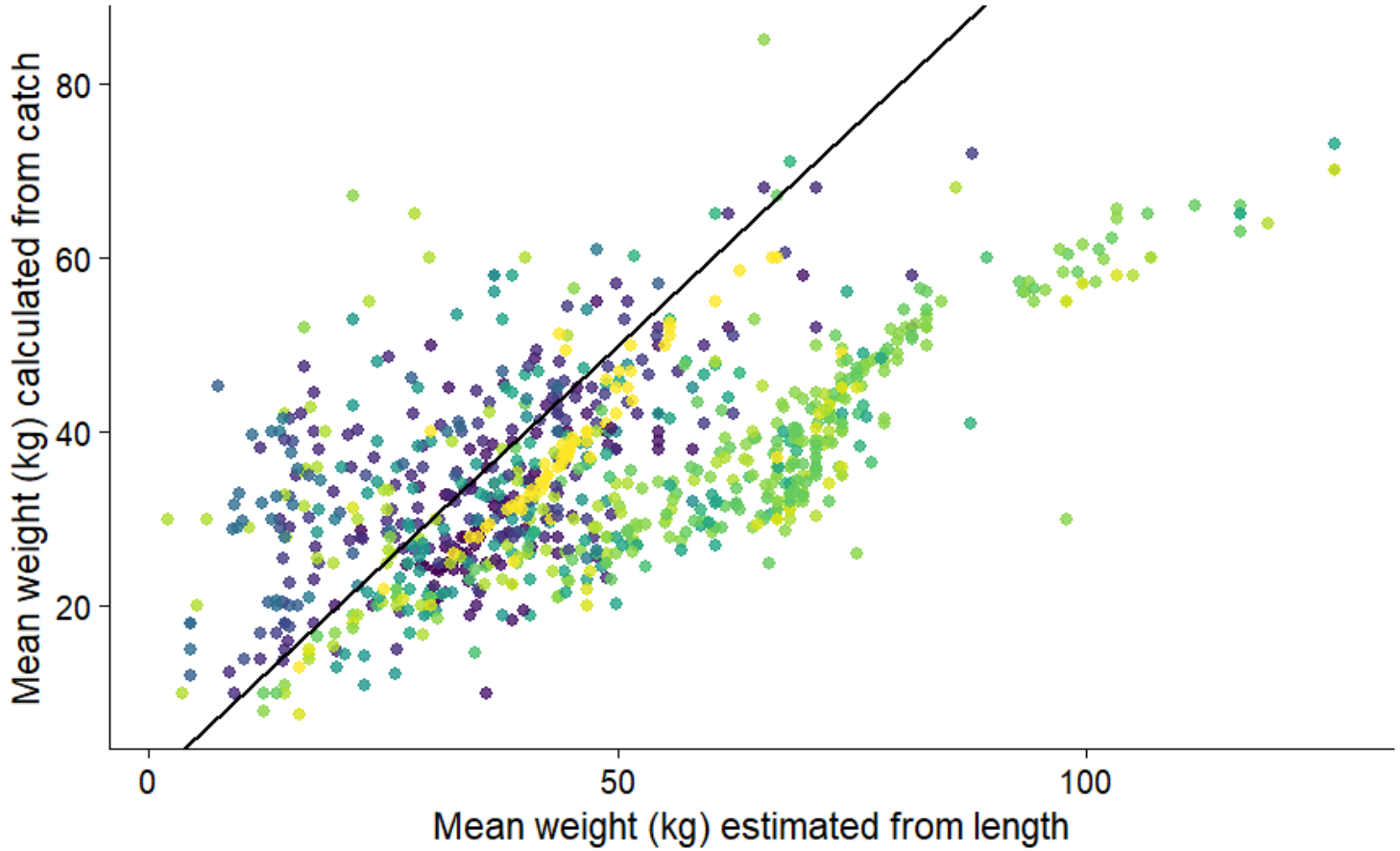



Only sets are used where the number of retained fish and the number of length measurements were equal

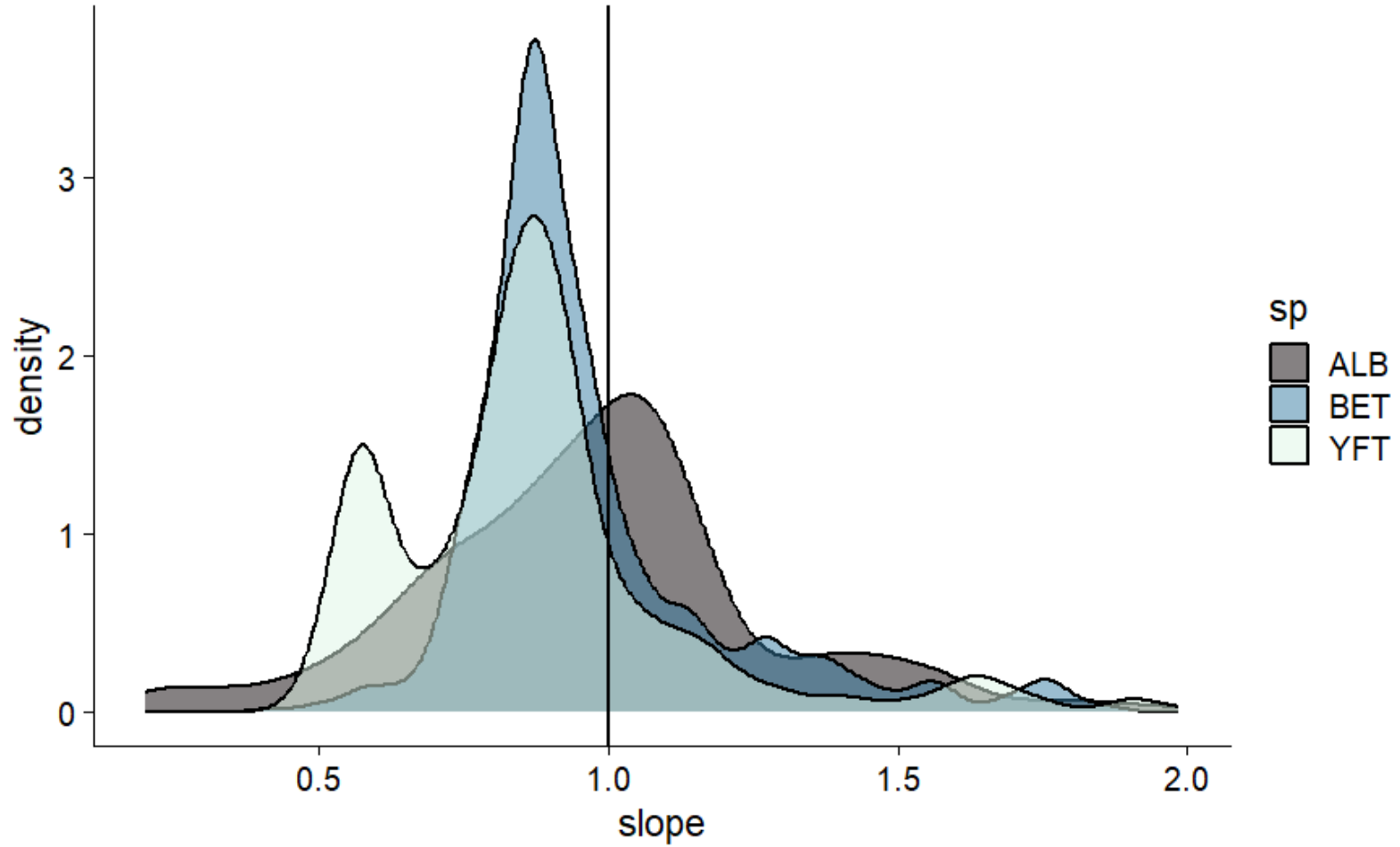
# Single vessel: yellowfin: sets



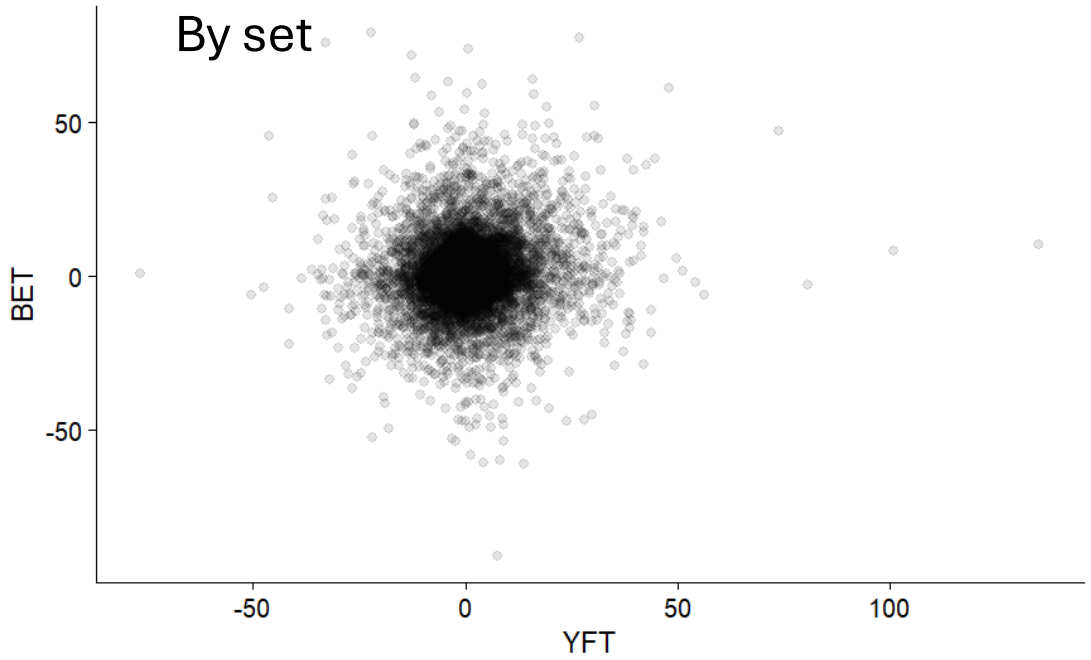

Each point is a single set
Colour by trip

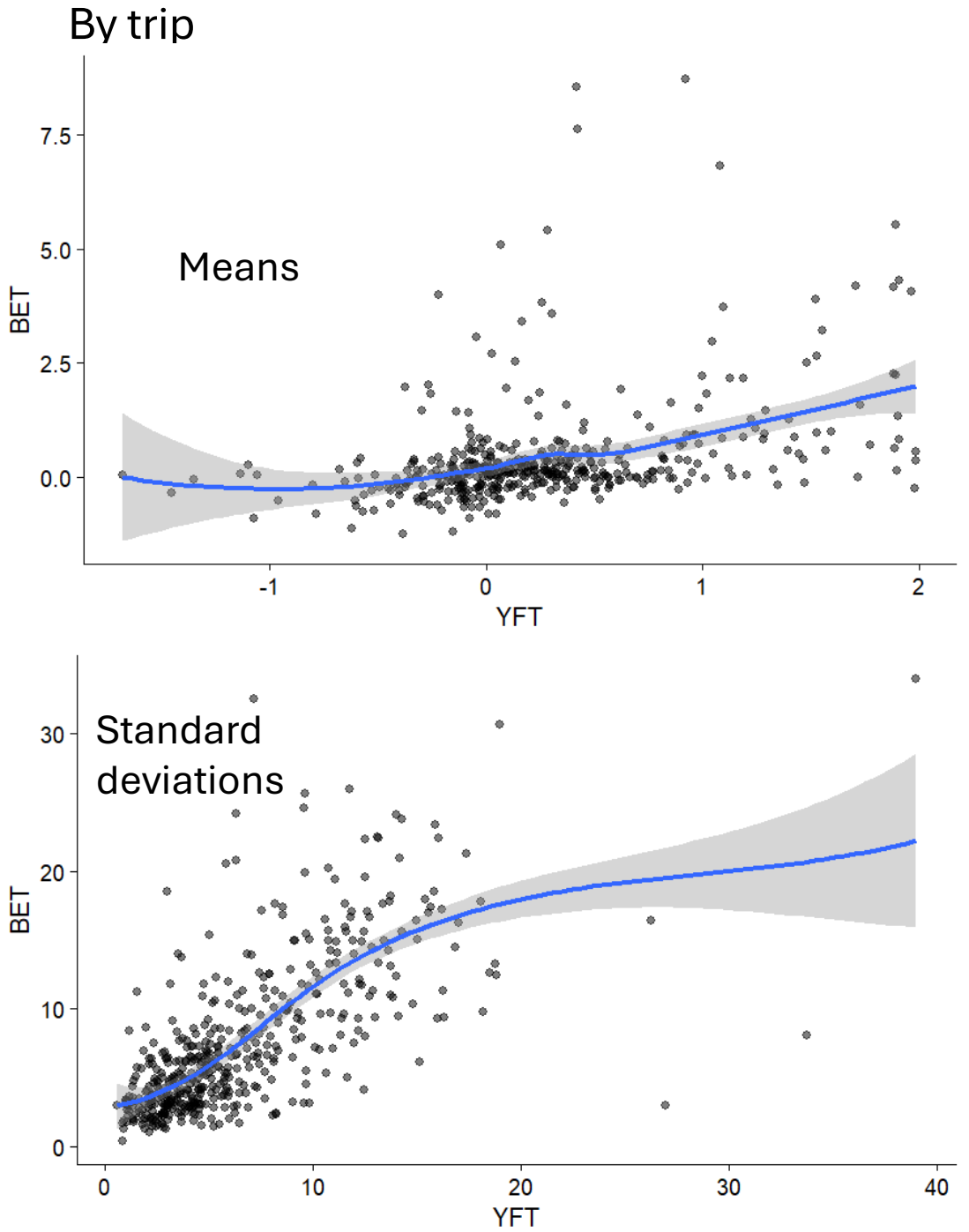
# Slope density for:

## ca_mwt ~ le_mwt : trip + 0



# Catch vs Length-based Mean Weight Slope Residuals



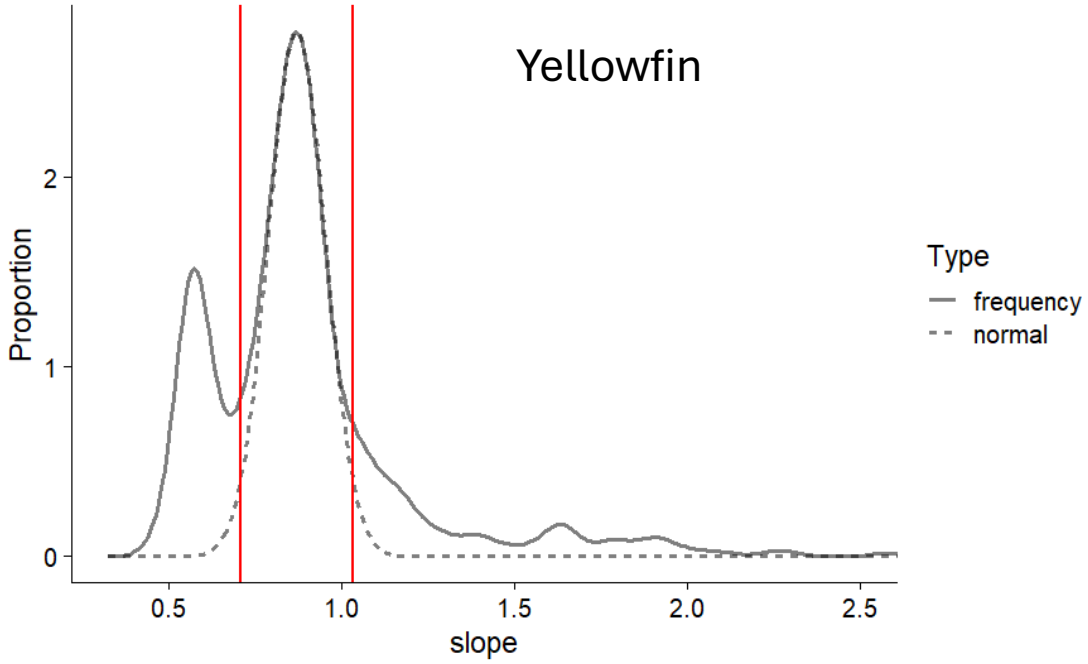



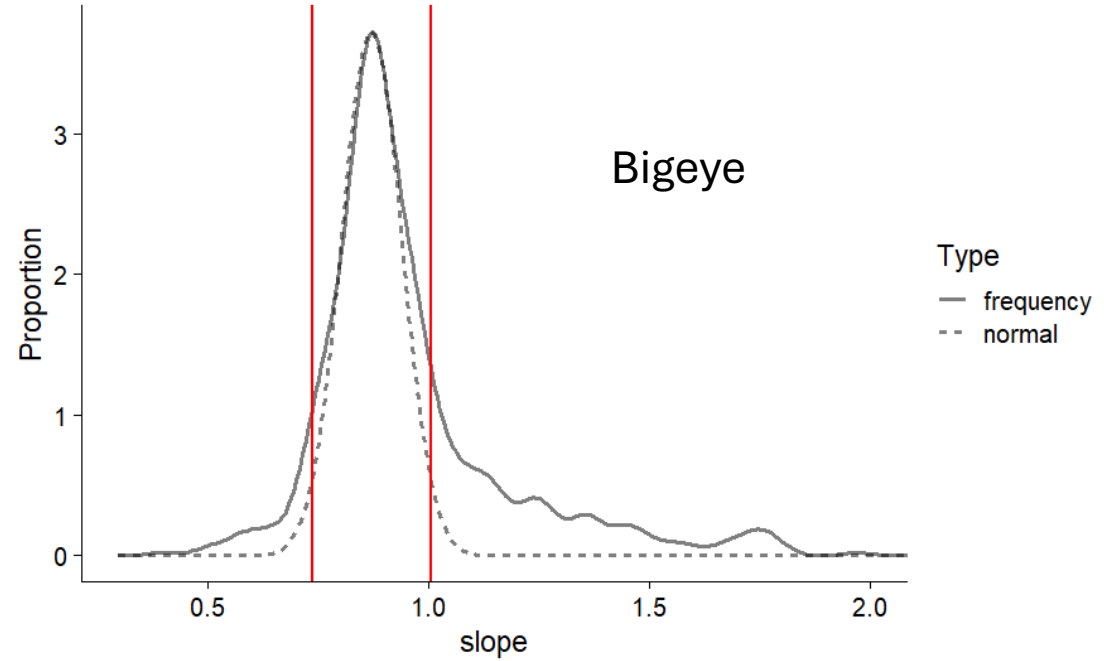
# Trial Data Filtering for Stock Assessment

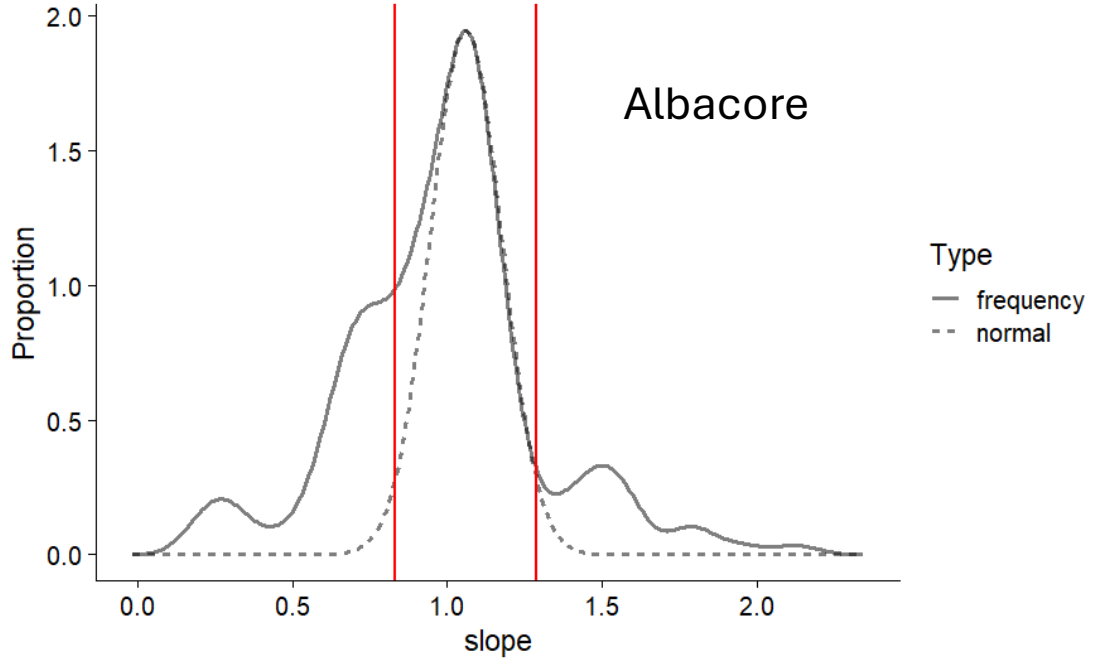
The fitted linear model has the form:- ca_mwt ~ le_mwt:TripID+0

1. Globally, filter out **individual sets** that are unlikely (< 50% chance) to be present in the sample if it was normally distributed. For example, for 1000 observations, observations would be removed where the absolute standardised residual is greater than 3.29.
2. Refit the linear model to the filtered data set and extract the slopes.
3. Fit the sd of a normal density to the mode (+/- 10 points around the mode) of the smoothed density of the slopes.
4. Filter out **trips** where the slopes are beyond the 95% quartile range of the normal density around the mode.
5. If no trips are removed in 4 exit, else goto 2.

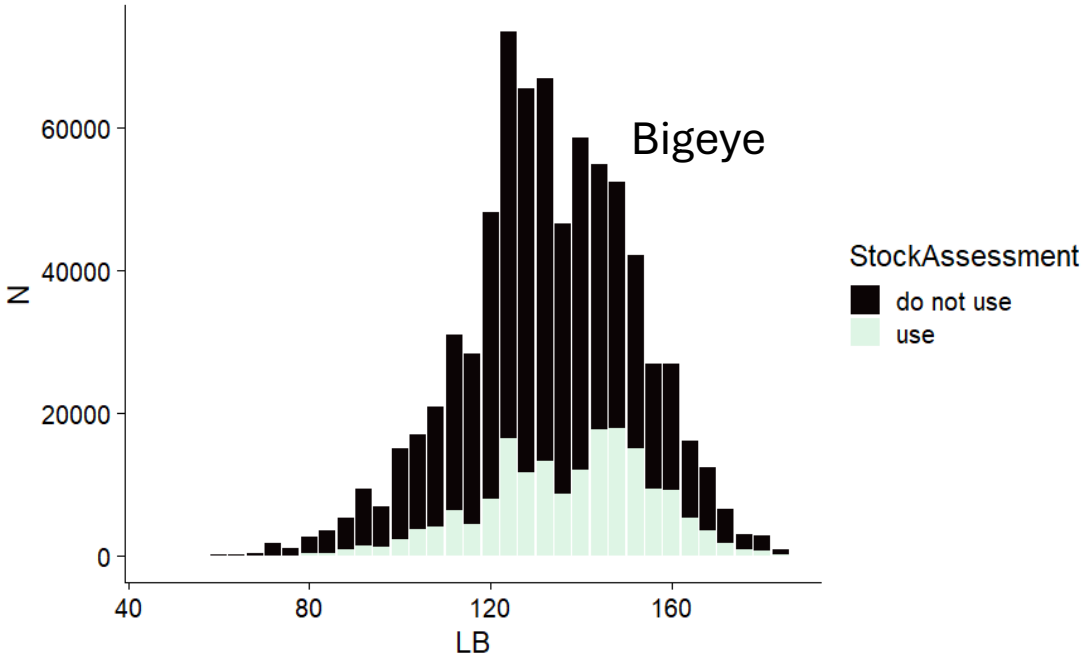
# Filtering

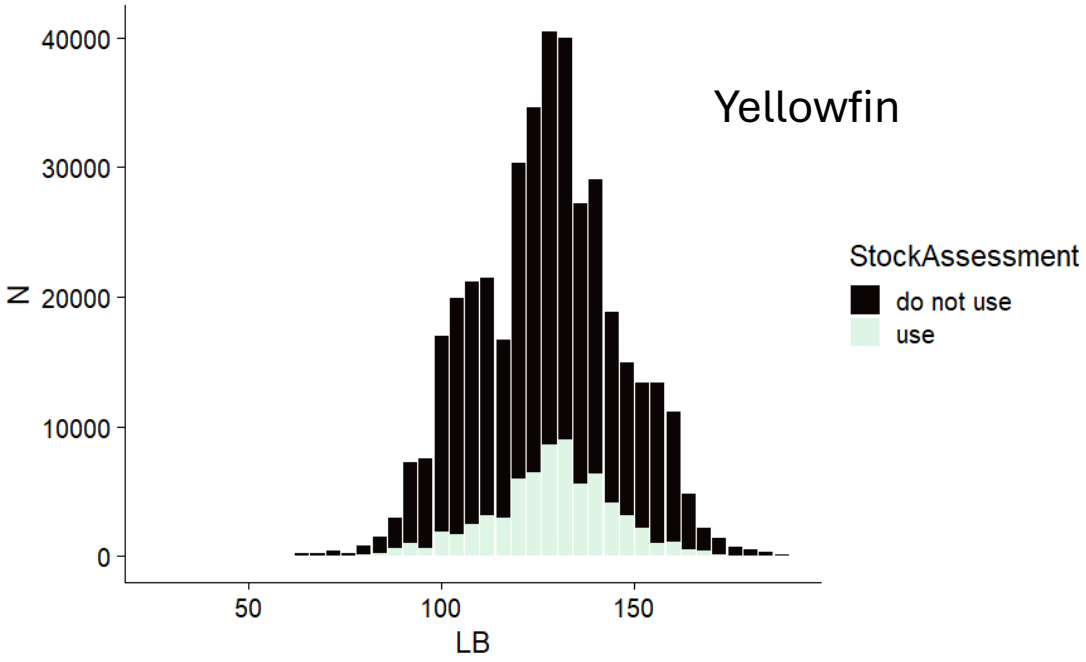

Yellowfin
Proportion
slope
Type
frequency
normal

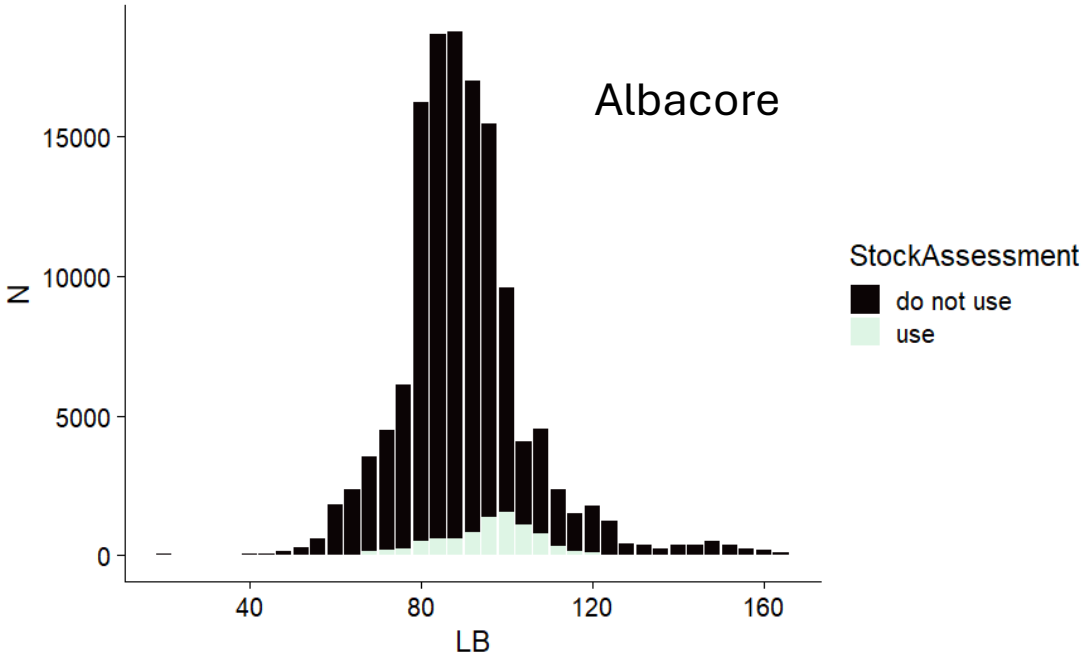

Bigeye
Proportion
slope
Type
frequency
normal


Albacore
Proportion
slope
Type
frequency
normal

# Filtering Impact

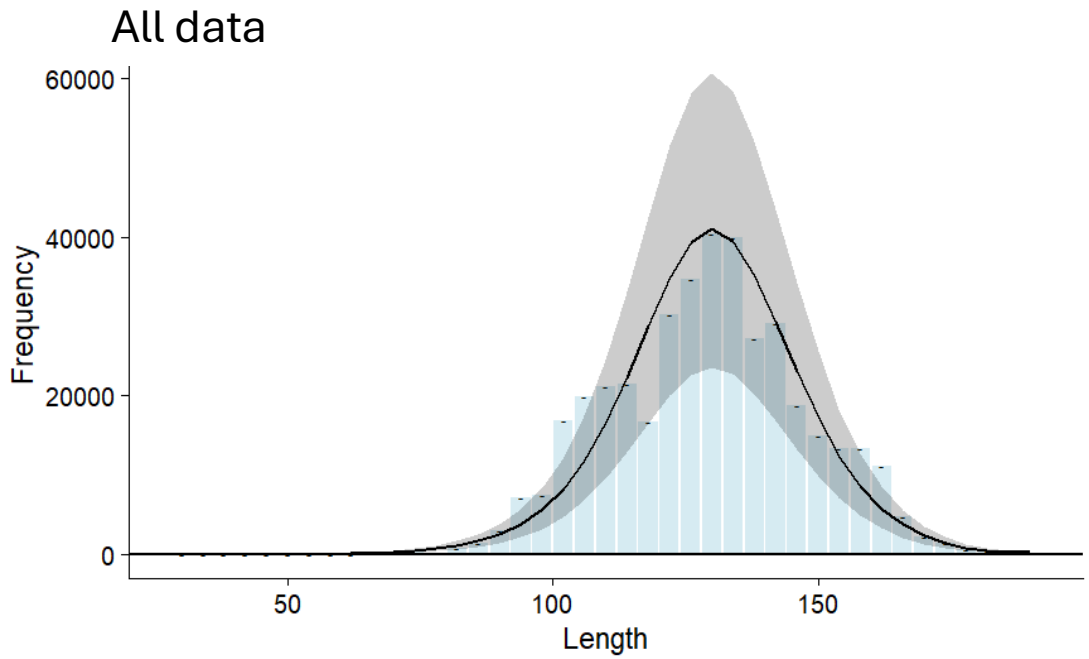


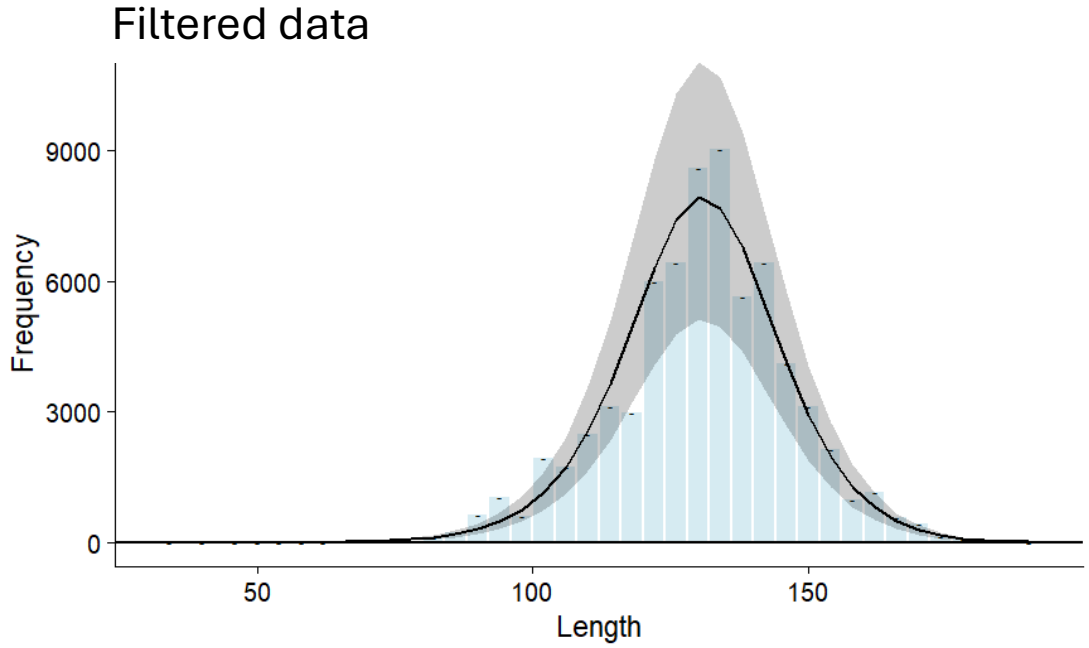



# Yellowfin catch curve comparison

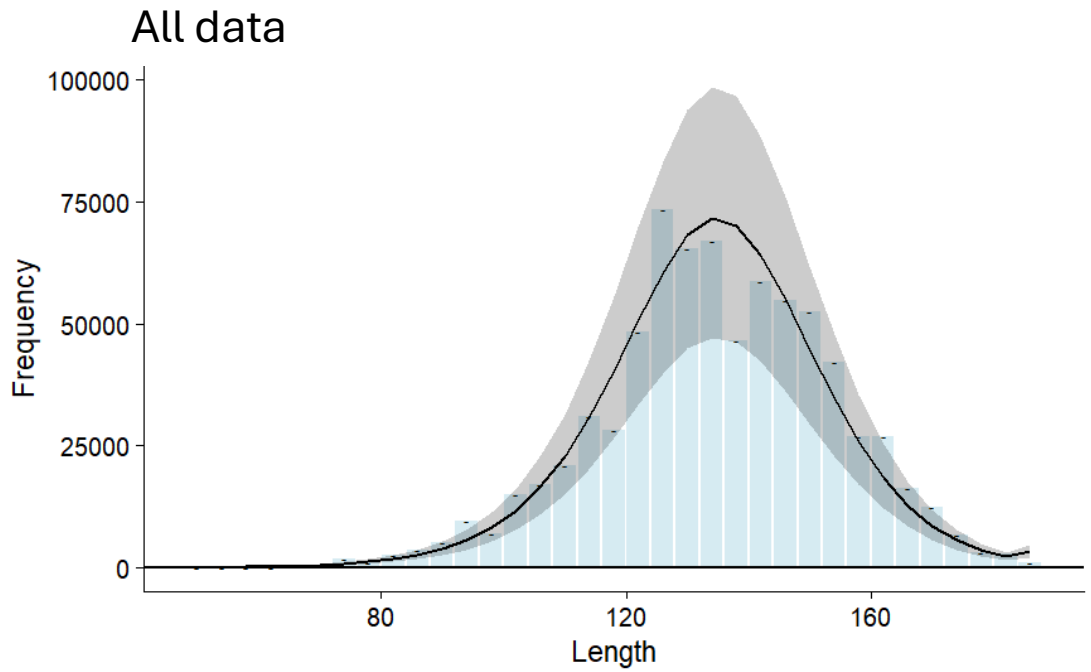
| Parameter | All Data | Filtered Data |
|---|---|---|
| Linf | 189.920 | 189.907 |
| M/K | 1.481 | 1.491 |
| F/K | 3.473 | 4.238 |
| Selectivity 50% | 126.754 | 128.470 |
| Selectivity slope | 0.108 | 0.117 |
| SPR | 0.203 | 0.184 |
| YPR | 7.956 | 8.321 |

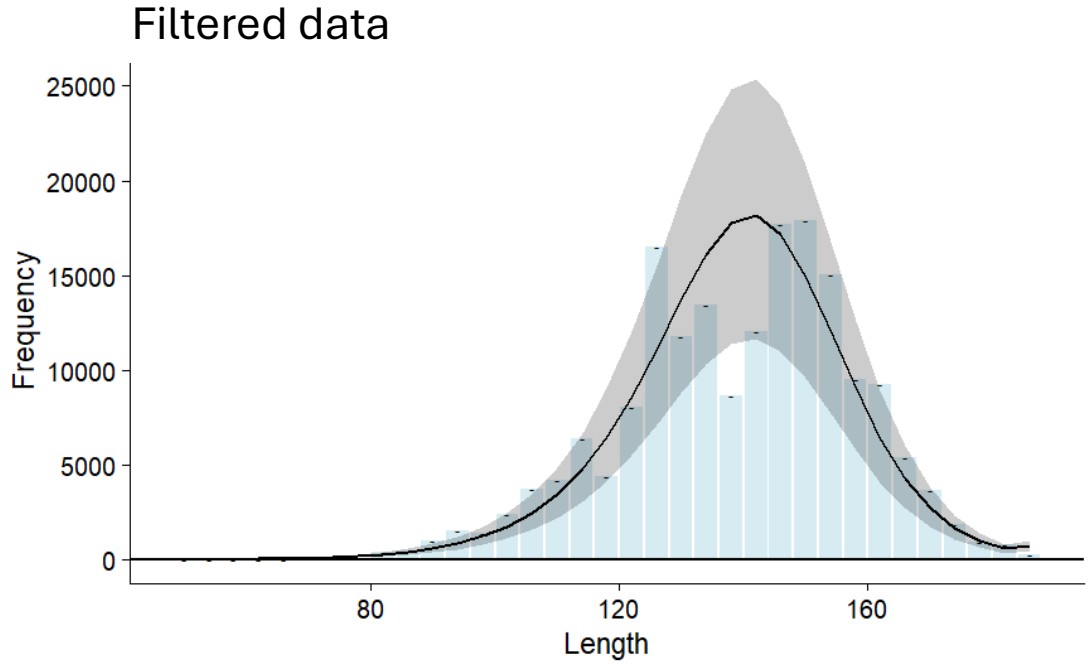


# Bigeye catch curve comparison

| Parameter | All Data | Filtered Data |
|---|---|---|
| Linf | 199.912 | 199.968 |
| M/K | 1.492 | 1.495 |
| F/K | 3.681 | 4.873 |
| Selectivity 50% | 131.808 | 142.421 |
| Selectivity slope | 0.099 | 0.095 |
| SPR | 0.188 | 0.218 |
| YPR | 12.230 | 12.172 |

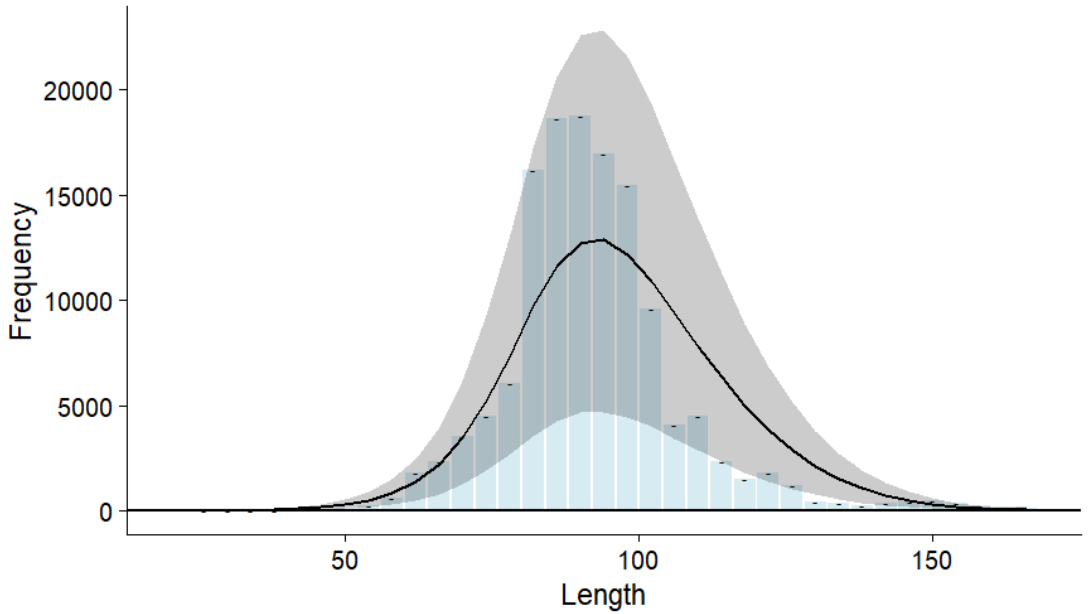


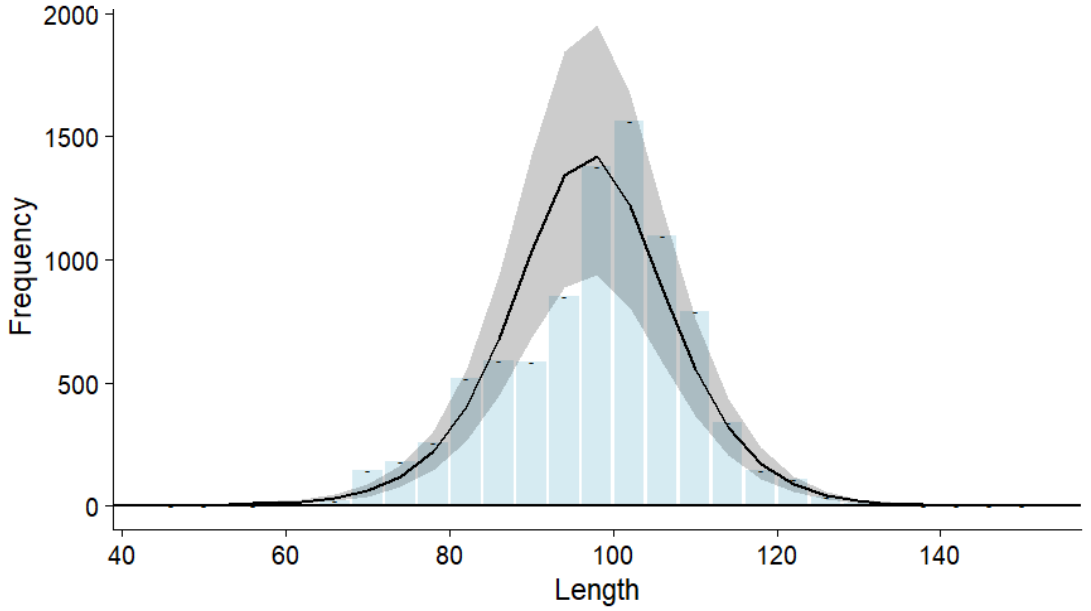
# Albacore catch curve comparison

| Parameter | All Data | Filtered Data |
|---|---|---|
| Linf | 125.323 | 124.990 |
| M/K | 1.479 | 1.501 |
| F/K | 0.360 | 2.488 |
| Selectivity 50% | 83.554 | 95.489 |
| Selectivity slope | 0.137 | 0.176 |
| SPR | 0.753 | 0.459 |
| YPR | 0.918 | 2.750 |

All data




Filtered data



# Conclusions and Suggestions

1. Catch and length data are most likely generally not biased but precision is low
2. Need to consider more explanations for observation error vs true change in catch (e.g. time period, location)