BETTER PURSE SEINE CATCH COMPOSITION ESTIMATES: PROJECT 60

WCPFC-SC14-2018/ST-WP-02

T. Peatman, N. Smith, S. Caillot, S. Fukofuka and T. Park

14th Regular Session of the Scientific Committee
9-16 August
Busan, Republic of Korea

OVERVIEW

- Brief summary of work undertaken in 2017/18
- Proposed work plan for 2019 to 2020
- Recommendations to SC14

SUMMARY OF WORK DONE IN 2017/18

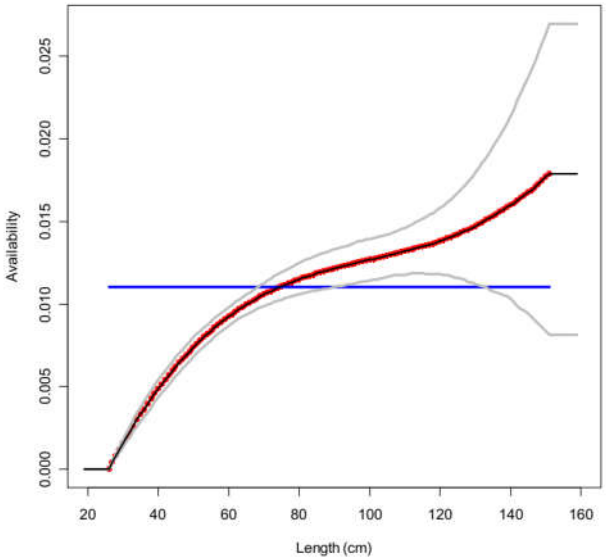
- Negotiating paired spill/grab sampling trips
- Grab sample bias (GSB) – availability vs. correction factors
- Revisiting models of species compositions (SC)

GSB: MODEL-BASED AVAILABILITY

- Availability defined as (Lawson, 2013):

  the probability of grab sampling a fish from individuals from the same length bin

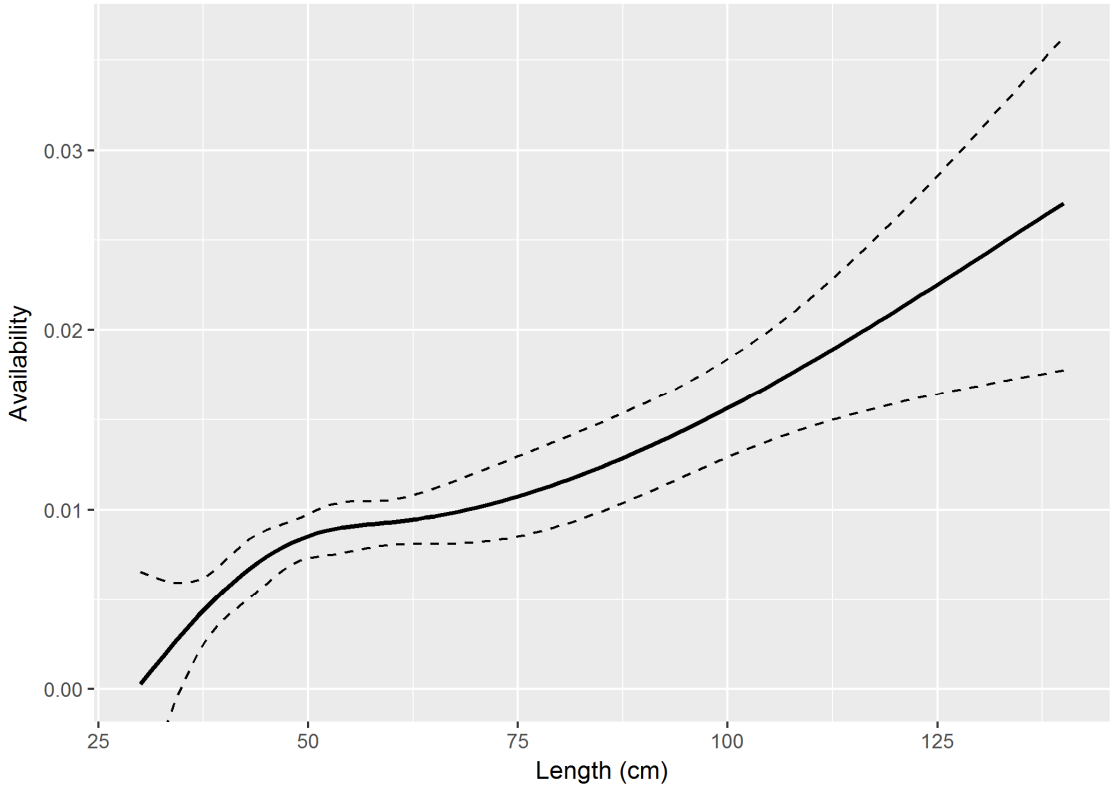
$$A_{jk} = \frac{n_{jk}\bar{w}_j}{W_k T_{jk}}$$



- If grab samples are unbiased:
  - availability should be size (and species) invariant
- Estimates of availability have demonstrated increasing availability with size
  - I.e. smaller individuals are under-represented in grab samples
  - Larger individuals are over-represented

GSB: UPDATED AVAILABILITY ESTIMATES

- Limited changes to model:
  - Included an intercept
  - Slight increase in flexibility of cubic spline
  - Simplification of length bins at large sizes
- Assumptions of error distribution violated (as with previous models)



GSB: SIMPLE MULTINOMIAL MODEL

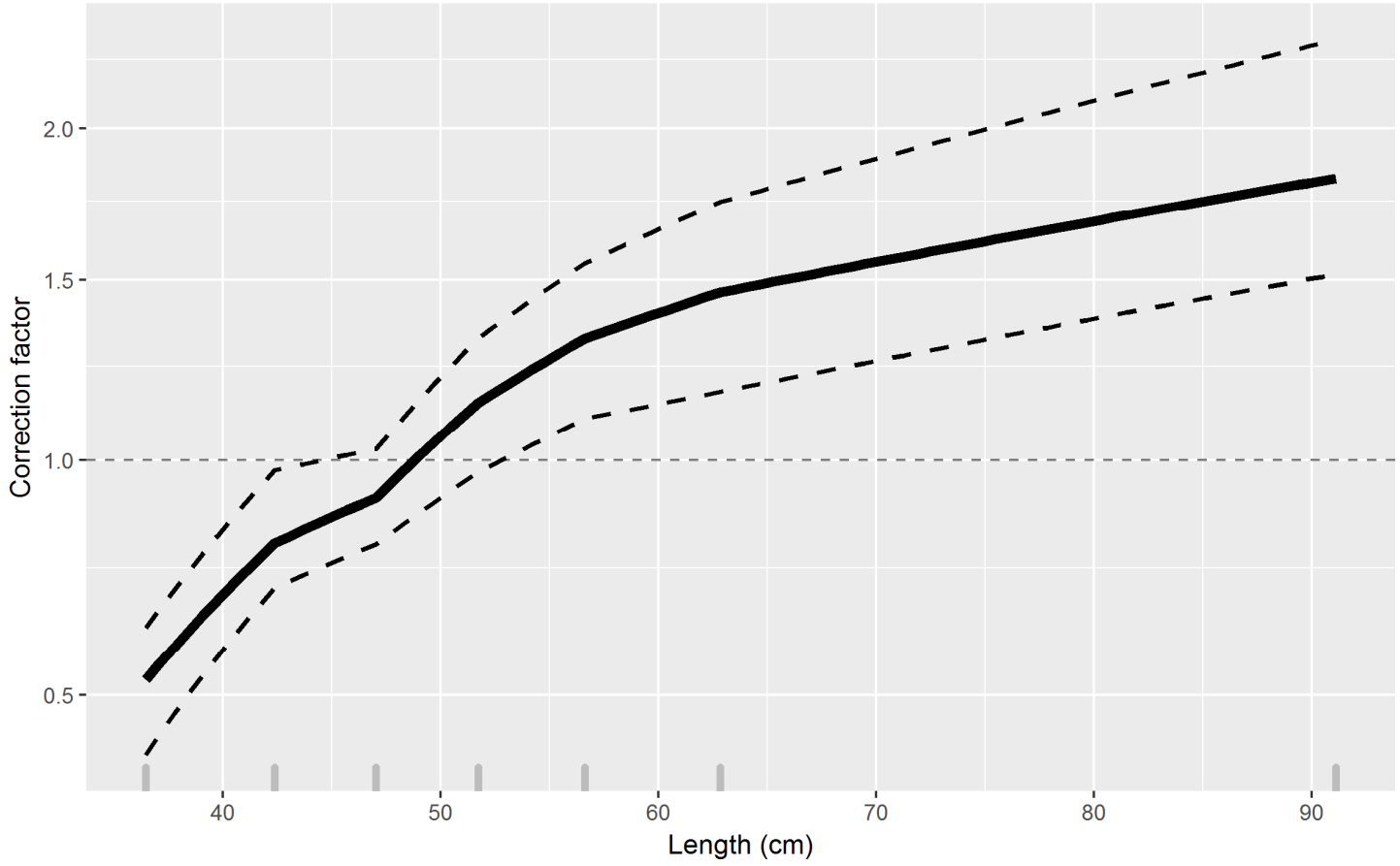
- The simple multinomial model was proposed by Cordue (2013), and implemented by McCardle (2013)
- Grab sample bias is the ratio of grab sample and spill sample proportions by length

$$r_j = \frac{\sum_k n_{jk} \Big/ \sum_k n_k}{\sum_k N_{jk} \Big/ \sum_k N_k}$$

- Uncertainty incorporated by bootstrapping observations
- Refer to estimates of r_j as 'correction factors' – as per Lawson (2013)
- Note used same (simplified) length bins as for the availability model

GSB: CORRECTION FACTORS

- Broadly similar to estimates of availability
- Grab samples under-represent fish ≤ 50 cm and over-represent fish > 50 cm



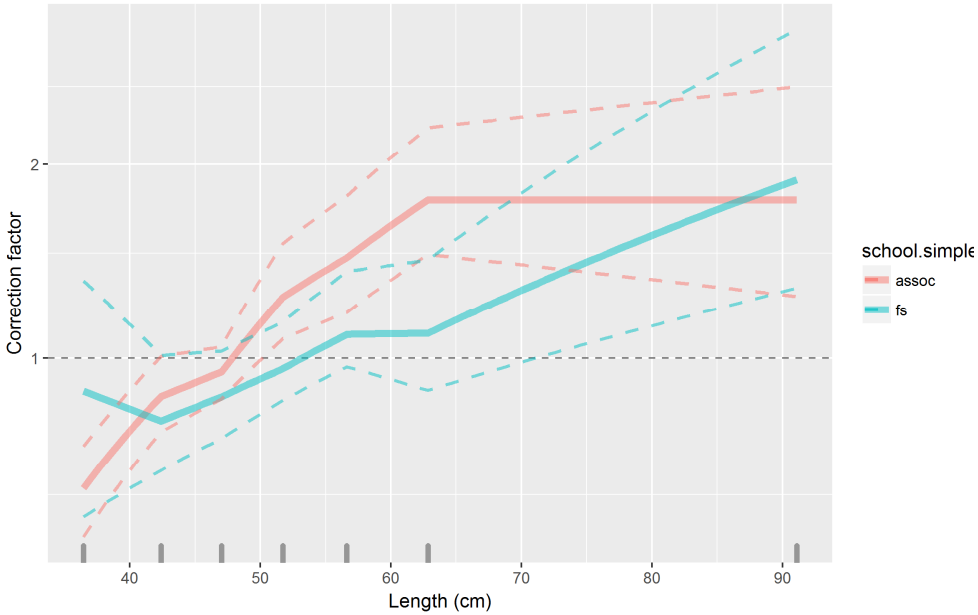
SPECIES COMPOSITION COMPARISONS

- Compared grab sample derived estimates of species compositions against (corrected) landing slips data for Japanese purse seiners, 2010 – 2015 (~ 780 trips)
  - (Updated model of availability slightly increased bias compared to 2013 availability model)
  - Correction factors, applied at a set-level, gave:
    - Similar estimates of species compositions to availability based estimates
    - Least biased estimates of species compositions based on species compositions

Source	BET %	SKJ %	YFT %	ΔBET	ΔSKJ	ΔYFT
Corrected landings	2.68	79.4	17.9			
Visual estimates	2.78	79.2	18.0	3.73	-0.25	0.56
Uncorrected grab	3.11	77.6	19.3	16.05	-2.3	7.7
Corrected grab - 2013 availability	2.76	79.9	17.3	2.97	0.6	-3.1
Corrected grab - new availability	2.80	80.0	17.2	4.60	0.7	-3.7
Corrected grab - correction factors (set level)	2.73	80.0	17.3	1.94	0.8	-3.7
Corrected grab - correction factors (trip-school strata)	2.62	82.0	15.4	-2.36	3.2	-13.9

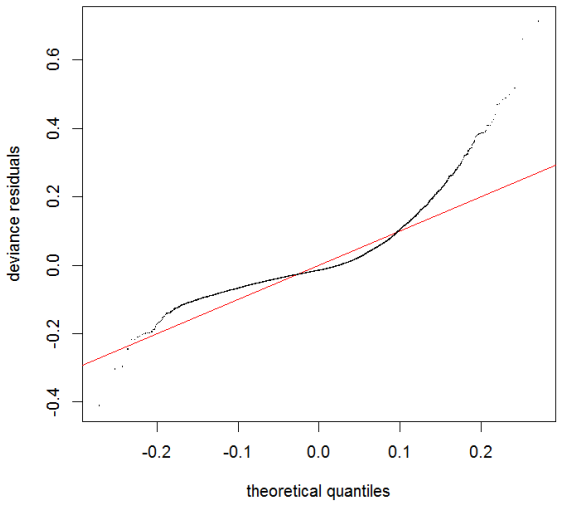
GRAB SAMPLE BIAS - EDA

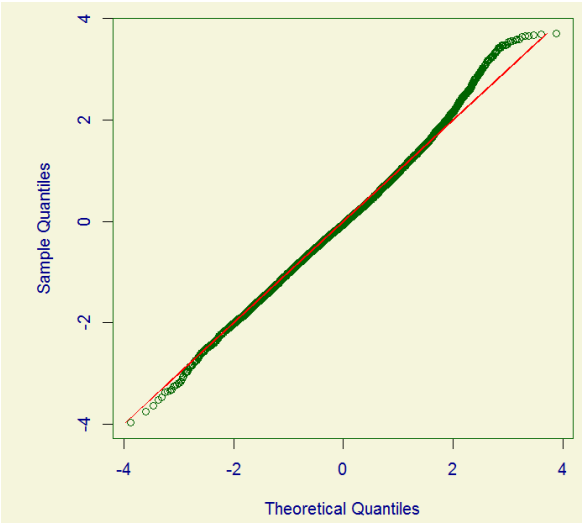
- Used the simple multinomial model to explore variables influencing grab sample bias
- No clear evidence for differences in bias between species
- Some suggestion of increased bias for sets on associated schools compared to sets on free schools
  - Appears to be driven by skipjack
  - Meaningful comparisons for YFT & BET hampered by available data
  - Simulation modelling should explore this in more detail



SC: MODELS OF SPECIES COMPOSITIONS

- Models currently used to estimate species compositions when observer coverage is limited
  - Fitted to (corrected) grab sample based estimates of species compositions
  - Aggregated to trip level and free school vs. associated sets
- Models assume Gaussian errors:
  - Problematic for proportional responses when observations are frequently close to (or equal to) 0 and 1 – i.e. models of bigeye
- (Zero and one) Inflated beta models a more robust approach
  - We fitted preliminary models
  - Substantially improved fits (particularly bigeye)





KEY RECOMMENDATIONS

- (The revised spill sampling protocol be used in future paired grab / spill trips)
- Multinomial model based correction factors be used to correct existing and future grab sample data (rather than estimates of ‘availability‘)
- Existing models of species compositions be replaced with inflated beta-response models
- Consider the proposed work plan for 2019 and 2020

PROPOSED WORK PLAN 2019-20

Pacific Community
Communauté du Pacifique

Activity	2019	2020	Priority
1. Paired grab-spill trips • Targeting fleets with likely availability of comprehensive landings slips data	X	X	High
2. Simulation model • Exploration of potential bias from between-brail variability in sizes • Inform need for set type and/or species specific correction factors	X		High
3. Finalise inflated beta-response models of species composition	X		Medium
4. Revisit stratification of aggregated grab samples used to estimate species composition estimates with > 20 % observer coverage • i.e. need for stratification by flag	X		Medium
5. Report species composition estimates to SC15 with step-wise changes from the existing approach, including: • Grab sample bias correction using correction factors • Beta response models of species compositions • (Potential) Stratification by flag for strata with > 20% observer coverage	X	X	High
6. Continue to explore opportunities for collaboration with members	X	X	High
7. Cost-benefit analysis of alternative sampling approaches for long-term estimation of species compositions (i.e. at-sea sampling vs port sampling)		X	Medium

ACKNOWLEDGEMENTS

- Project 60 funding comes from the WCPFC Commission
- We thank the observers, and those supporting the regional observer programme, for the collection and processing of the grab and spill sampling data that we have analysed. We thank our colleagues in Japan, the US and the Solomon Islands for useful discussions. Finally we thank Tim Lawson for all of his earlier work, which has laid strong foundations for Project 60 moving forward.

Pacific Community
Communauté du Pacifique

Thanks for listening!

REFERENCES

1. Cordue, P.L. 2013. Review of species and size composition estimation for the western and central Pacific purse seine fishery. WCPFC-SC9-2013/ST-IP-02.

2. Lawson, T.A. 2013. Update on the estimation of the species composition of the catch by purse seiners in the Western and Central Pacific Ocean, with responses to recent independent reviews. WCPFC-SC9-2013/ ST-WP-03.

3. McArdle, B. 2013. To improve the estimation of species and size composition of the western and central Pacific purse seine fishery from observer based sampling of the catch. WCPFC-SC9-2013/ST-IP-04.