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A preliminary comparison of length frequency and species composition using observer and port sampling data.

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L. Baje, T. Usu, B. Kumasi, L.Kumoru[1]

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[1] National Fisheries Authority, Papua New Guinea.

A PRELIMINARY COMPARISON OF LENGTH FREQUENCY AND SPECIES COMPOSITION USING OBSERVER AND PORT SAMPLING DATA.

By: Leontine Baje, Thomas Usu, Brain Kumasi, Ludwig Kumoru
National Fisheries Authority
Papua New Guinea

Abstract

The Papua New Guinea National Fisheries Authority (NFA) has been carrying out its own independent port sampling study. Unlike other port sampling protocols the NFA sampling technique constitutes sampling fish from the top, middle and bottom sections or layers of wells. This port sampling data has never been compared with data from other sampling protocols. Data from 8 vessels that were initially sampled by observers and then by port samplers were analyzed. Results show that port samplers are reporting higher proportion of skipjack. Observer grab-sampling showed higher compositions of larger Skipjack and Yellowfin than port sampling however there were no significant difference in the mean lengths for all species. This new port sampling technique is capable of producing data consistent with other sampling protocols and may also because of its design be able to cater for certain biases associated with port sampling.

Introduction

The tuna fisheries in the western and central Pacific Ocean (WCPO) produce approximately half of the world's tuna and are of high economic importance to Pacific island countries and territories. The purse-seine fishery operating in PNG waters is one of the largest in the WCPO, representing approximately 20% of recent purse-seine catches from the entire WCPO (Nicol et al, 2009).

The Papua New Guinea (PNG) National Fisheries Authority (NFA) observer program was initiated in 1996 recruiting over 200 personnel, to date there are 202 trained observers with 187 currently on active duty being deployed on fishing vessels. Regular observers are required to collect a variety of different types of scientific data relating to target catch, bycatch, species of special interest and discards (Hampton, 2009).

Port sampling is useful as a supporting sampling activity to observer based sampling (Hampton 2009). The PNGNFA has been conducting an independent port sampling program since 2008 in four major ports across the country employing 52 personnel. The design of this port sampling differs from others previously carried out across the Pacific as it involves taking samples from the top, middle and bottom layers of wells. The main reasons for this design are to ensure that a more representative portion of the catch was sampled and also to account for natural sorting of fish into size categories (i.e. larger fish sinking to the bottom of wells and smaller size fish at the top) that may be occurring especially in brine wells.

This form of port sampling is the first of its kind, its data has never been compared with data sets obtained from other sampling protocols such as the observer program. Here we present a preliminary comparison of size and species composition of port sampling and observer data.

Method

Sampling Protocol

Port samplers were required to sample a certain number of nets from the top, middle and bottom layers of each well which would in total constitute 20% of the catch. Samplers record the species and fork length measurement of every individual fish contained in each net.

Observers use the grab sampling method and also recorded species and fork length information of five fish selected at random from brails loading fish into storage wells on vessels at sea. A more detailed description of the grab sampling protocol is outlined in Lawson 2009.

Analysis

A total of 8 vessels positively identified as sampled by observers and then by port samplers were selected. Data from these vessels were collated to generate total species counts of target species and other non target species. (Lawson, Selectivity bias in grab samples and other factos affecting the analysis of species composition data collected by observers on purse seiners in the Western and Central Pacific Ocean, 2009)

An F-test was initially conducted to determine similarity in variances. Size composition data was subjected to a z-test to test for significant differences in mean lengths by species.

Given the large difference in size of data for observers and port samplers, the length frequencies were Asinh transformed for a clearer comparative representation.

Results

In total 179, 026 fish were sampled by port samplers and 9,969 fish by observers. Individual species compositions of both data sets are shown below (Fig 1).

Species Composition

Port sampling data showed 68% skipjack, 25% yellowfin, 2% bigeye and 5% other species. The observer data showed a lesser proportion of skipjack, 46% but all greater proportions of yellowfin 43%, bigeye 3% and 8% other species.

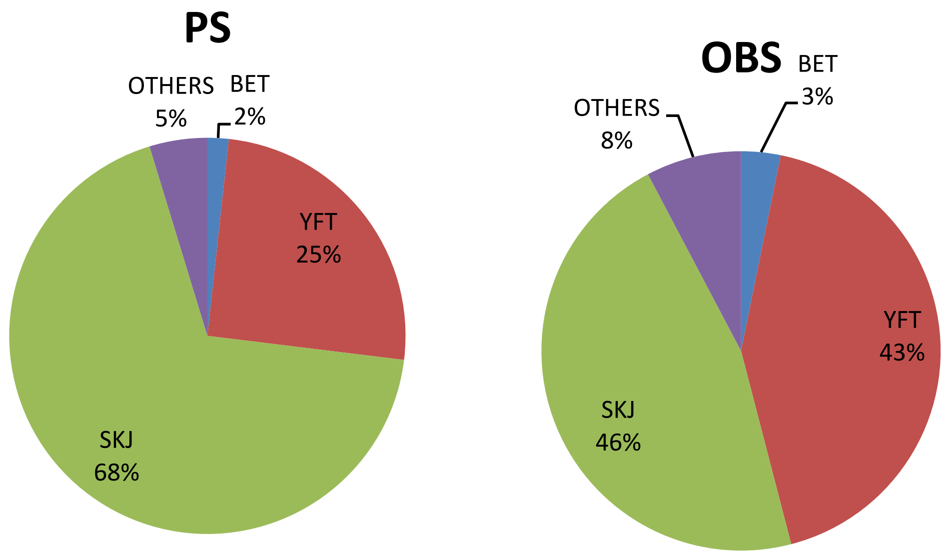

Figure 1. Species composition of Port Sampling and Observer data sets

Size Composition

Skipjack

22% more skipjack was sampled by port samplers than observers. Higher compositions of skipjack size 46-73 cm were detected in observer grab-sampling while higher compositions of size 32-45 cm were detected in port sampling (Figure 2). Length frequencies were slightly similar as illustrated in Figure 2 with the same modal length of 46 cm. Port sampling mean length for skipjack at 44 cm, while observers recorded a larger mean length of 47 cm. Skipjack lengths ranged from 11 cm -80 cm for port samplers and 28 cm -80 cm for observers.

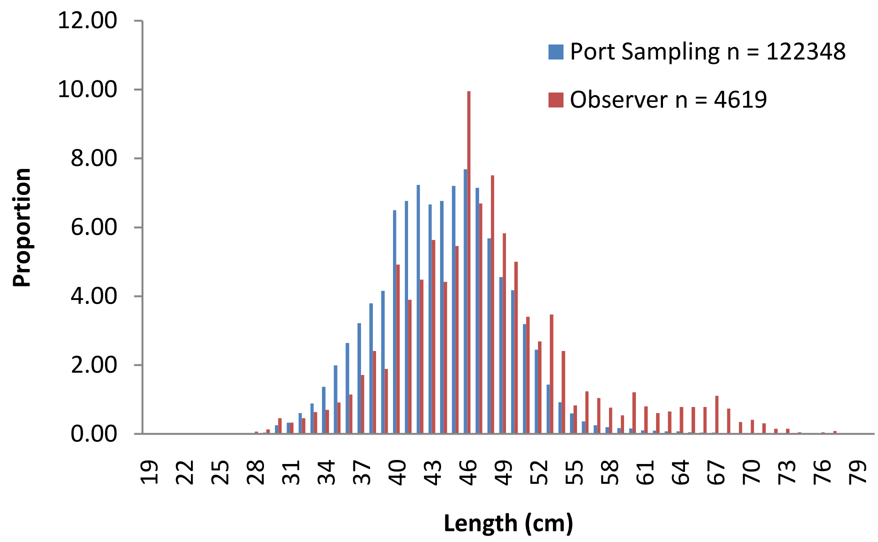

Figure 2. Proportion of length frequency of skipjack sampled

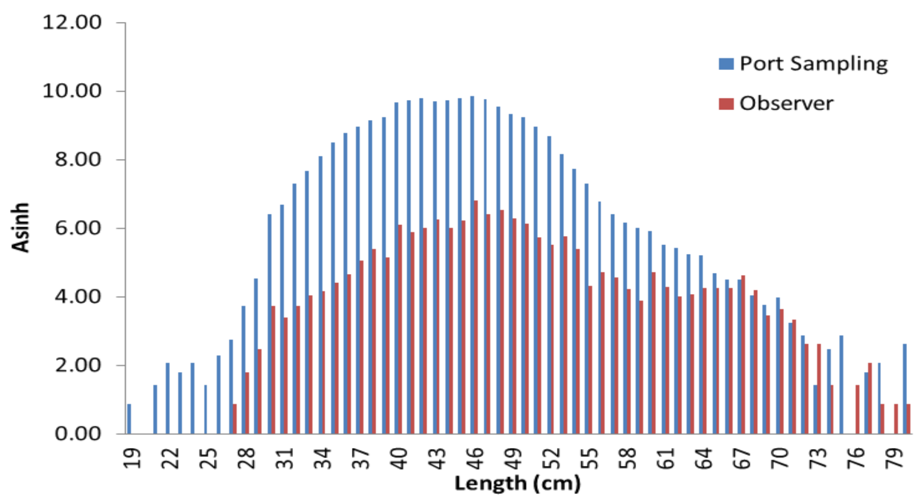

Figure 3. Skipjack Asinh transformed data

Yellowfin

Higher compositions of yellowfin size 63-122 cm were detected in observer grab-sampling while higher compositions of fish size 38-61 cm were detected in port sampling (Figure 4). The length frequencies were fairly similar (Figure 5) with the port sampling mode at 50cm and observer grab sampling at 53 cm. Port sampling showed a mean length for yellowfin to be 56 cm and while the observer data showed a larger mean length of 71 cm. Port sampling lengths ranged for 11 cm -150 cm, while observer data ranged from 21 cm – 150 cm.

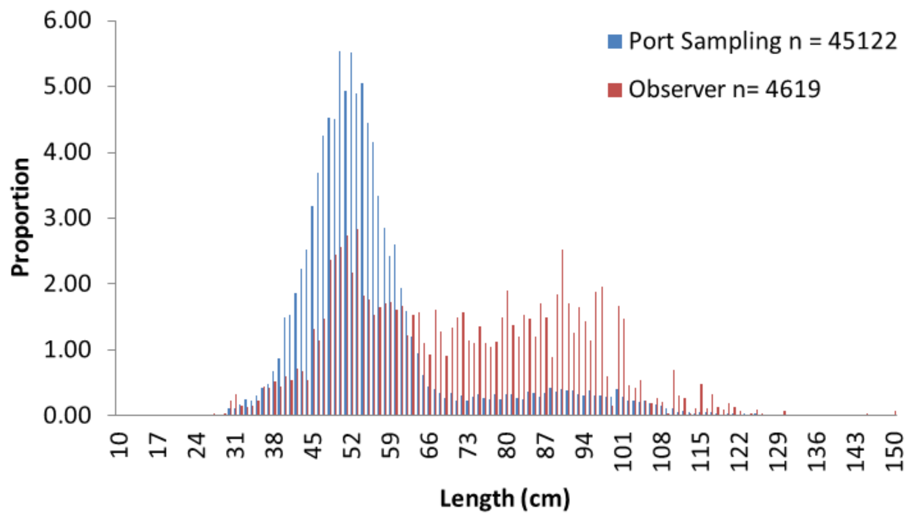

Figure 4. Proportion of Length Frequency of Yellowfin sampled

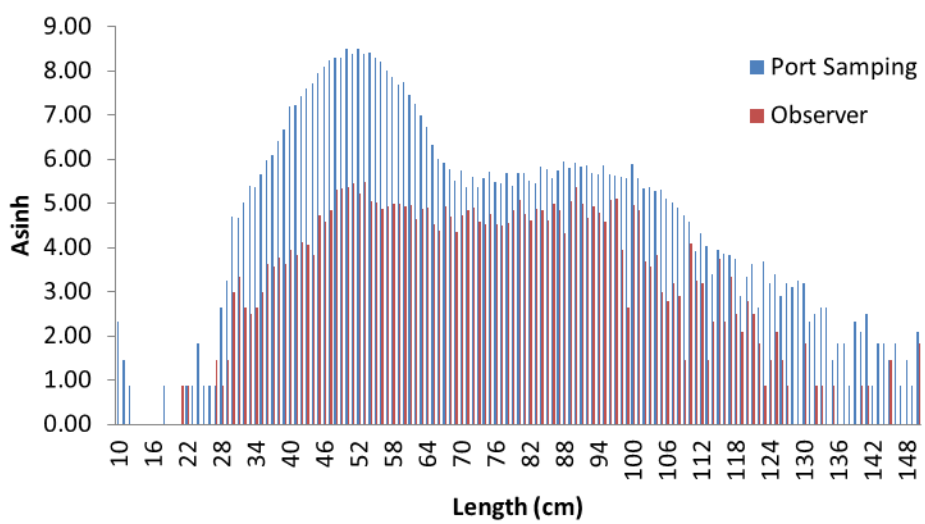

Figure 5. Yellowfin Asinh transformed data

Bigeye

Size composition of bigeye was variable between observer grab-sampling and port sampling over the size range. (Figure 6). Comparisons of Bigeye length data showed a port sampling mean length of 60 cm and modal length of 62 cm. Observer data indicated both a mean and modal length of 63 cm. Size range for Bigeye was 30 cm -112 cm for port samplers and 36 cm - 110 cm for observers.

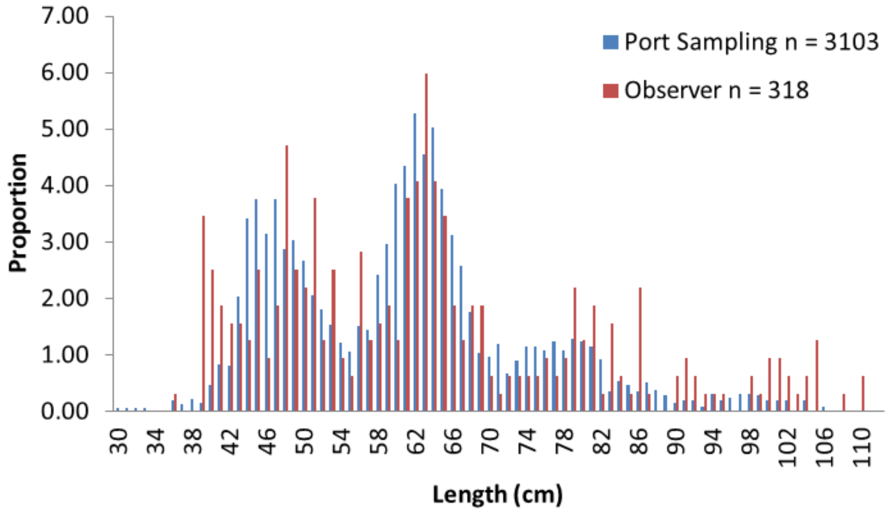

Figure 6. Proportion of length frequency of bigeye sampled

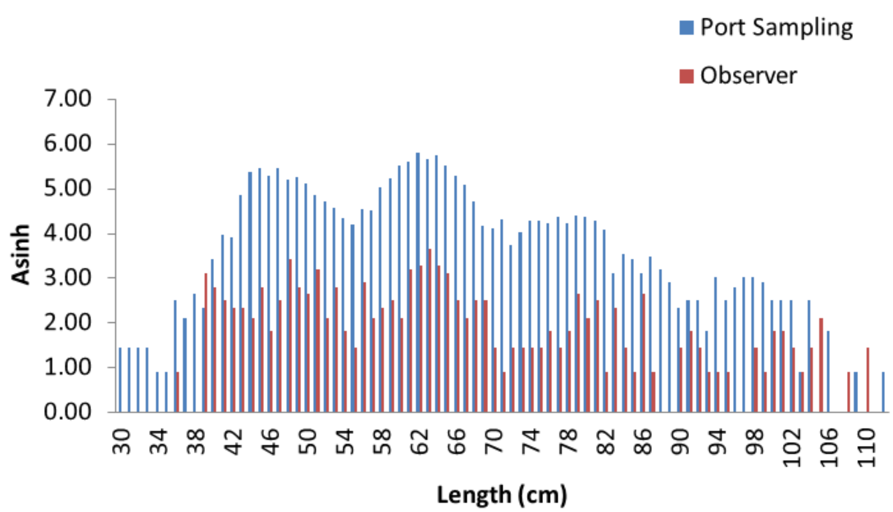

Figure 7. Bigeye Asinh transformed data

The F-test for difference in variance was not significant. The z-test also showed no significant difference in mean lengths for each species between port sampling and observer grab-sampling data. Refer to Appendix for actual results.

Discussion

The differences in estimation of the proportions of skipjack, yellowfin and bigeye by observers and other port sampling protocols have been noted by Lawson 2009. This data has shown observers to report almost equal amounts of skipjack and yellowfin while port samplers have sampled a greater proportion skipjack as opposed to yellowfin. The proportion of bigeye is consistent between observers and port samplers. Observers recorded a greater proportion of bycatch or other species compared to port samplers this may be attributed to sorting of fish before they are sampled in port.

Although higher compositions of large skipjack and yellowfin were detected in observer grab sampling than port sampling comparison of the means did not reveal any significant differences for all species. Analysis to test the mean differences between end tails of the size frequencies for each species was not done. Such an analysis would have been able to pint out if there were any significant differences between mean sizes of the smaller or larger ends of the size frequency of the three main species.

The port sampling size composition data for this study does agree with length composition summary for Papua New Guinea presented by Nicol et al, 2009 which was based on observer and SPC port sampling data. This shows that the PNG NFA port sampling protocol is compatible in producing results other sampling regimes are generating.

This method of port sampling may be able to cater for certain biases such as grab sampling bias, as samplers are not grabbing a certain number but are required to identify and measure the entire contents of a single net taken from either the top, middle or bottom layers of a well. Thus the sample size taken from each well is of a much greater magnitude. However certain biases still remain relating to set weight and well mixing as described by Lawson 2009, this may also account for the differences in species composition as noted above.

This has been a preliminary assessment of the large set of data collected by the NFA port samplers with the observer data. Further analysis that would include identification of what set types the data came from and location (archipelagic waters or exclusive economic zone (EEZ)) of sets can be included in future. This will enhance the comparability of the port sampling data especially to data held by SPC.

Conclusion

The tuna purse-seine fishery thrives in the waters of PNG because of high productivity of target species. Monitoring of this fishery requires a biological sampling program that can generate accurate information to adequately represent the biomass taken out as catch. The current port sampling activities initiated and implemented by the PNG NFA is producing size data consistent with length frequencies of fish sampled by the observer program. Such results for PNG alone provides the WCPO as a whole with an independent data set that will be valuable in making comparisons with other data sets and give a more accurate account of almost 20% of catch taken from the WCPO.

Acknowledgements

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Appendix

F-Test Two-Sample for Variances

BET	*Port Samping*	*Observer*
Mean	60.85	63.10
Variance	176.57	294.59
Observations	3103	318
df	3102	317
F	0.60	
P(F<=f) one-tail	0.00	
F Critical one-tail	0.88	

F-Test Two-Sample for Variances

YFT	*Port Sampling*	*Observer*
Mean	56.43	71.53
Variance	243.67	421.49
Observations	45122	4257
df	45121	4256
F	0.58	
P(F<=f) one-tail	0	
F Critical one-tail	0.96	

F-Test Two-Sample for Variances

SKJ	*Port Sampling*	*Observer*
Mean	44.00	47.51
Variance	29.06	60.42
Observations	122349	4619
df	122348	4618
F	0.481	
P(F<=f) one-tail	0	
F Critical one-tail	0.97	

z-Test: Two Sample for Means

Skipjack	*Port Sampling*	*Observer*
Mean	44.00	47.51
Known Variance	29.04	60.34
Observations	122349	4619
Hypothesized Mean Difference	0	
z	-30.44	
P(Z<=z) one-tail	0.00	
z Critical one-tail	1.64	
P(Z<=z) two-tail	0.00	
z Critical two-tail	1.96	

z-Test: Two Sample for Means

Yellowfin	*Port Sampling*	*Observer*
Mean	56.43	71.46
Known Variance	243.67	423.86
Observations	45122	4263
Hypothesized Mean Difference	0.00	
z	-46.42	
P(Z<=z) one-tail	0.00	
z Critical one-tail	1.64	
P(Z<=z) two-tail	0.00	
z Critical two-tail	1.96	

z-Test: Two Sample for Means

Bigeye	*Port Sampling*	*Observer*
Mean	60.85	63.10
Known Variance	176.57	294.59
Observations	3103	318
Hypothesized Mean Difference	0	
z	-2.28	
P(Z<=z) one-tail	0.01	
z Critical one-tail	1.64	
P(Z<=z) two-tail	0.02	
z Critical two-tail	1.96	