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Comparison of the species composition of purse-seine catches determined from logsheets, observer data, market data, cannery receipts and port sampling data

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COMPARISON OF THE SPECIES COMPOSITION OF PURSE-SEINE CATCHES DETERMINED FROM LOGSHEETS, OBSERVER DATA, MARKET DATA, CANNERY RECEIPTS AND PORT SAMPLING DATA

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Abstract

The species composition of purse-seine catches was determined from logsheets, grab samples and spill samples collected by observers, cannery receipts and port sampling data for ten trips by vessels from the Solomon Islands, and from logsheets, observer data and market data for four trips by vessels from Japan. For the Solomon Islands vessels, on average, the species compositions determined from the spill samples agree more closely with the cannery receipts than the logsheets and the grab samples. For the Japanese vessels, on average, the species compositions from each of the logsheets, grab samples, spill samples and market data are similar. Differences among the species compositions determined from each type of data are discussed in detail for each of the fourteen trips.

Introduction

The objective of WCPFC Project 60, *The Collection and Evaluation of Purse-Seine Species Composition Data*, is to improve the collection and representative nature of species composition data caught by purse-seine fisheries in the WCPO in order to improve the stock assessments of key target species. Under the project, paired grab and spill samples were successfully collected by observers onboard purse seiners during 54 trips from 2009 to 2013 (SPC 2014). Those data have been used to quantify the selectivity bias of grab samples and correct the historical data (Lawson 2012). For ten trips by vessels of the Solomon Islands, it was planned that *cannery receipts* — the record of sale from the fishing company to the cannery, which summarise the landings by categories of species and size class — would be obtained from the cannery at Noro and that port sampling of the landing categories would be conducted. For four trips by Japanese vessels, *market data* — the record of sale from the fishing company to the first buyer, which also summarise landings by categories of species and size class — were obtained; however, port sampling of the landing categories was not conducted. This study compares the species compositions determined from (i) logsheets, (ii) grab samples, (iii) spill samples, (iv) cannery receipts or market data, and, for the Solomon Islands, (v) cannery receipts adjusted with port samples of landing categories. The terms *cannery receipts* and *market data* are those used in Solomon Islands and Japan respectively; for the purposes of this study, both of these terms, as well as *container receipts* (see below), are referred to as *landings data*.

For this study, lengths (cm) were converted to weights (kg) using the length-weight parameters below, which were determined from data held by the SPC Oceanic Fisheries Programme:

Species	a	b
Skipjack	0.8639E-05	3.2174
Yellowfin	2.5120E-05	2.9396
Bigeye	1.9729E-05	3.0247

Species compositions for ten trips by Solomon Islands purse seiners determined from grab samples, spill samples, cannery receipts and port sampling

At the completion of a trip, the landings delivered to the cannery are usually sorted on a large metal table into bins, each containing a landing species and size category. Skipjack were sorted into three size categories of 1.3 to 1.8 kg, 1.8 to 3.4 kg and 3.4 to 10 kg. Yellowfin were sorted into five categories of 1.3 to 1.8 kg, 1.8 to 3.4 kg, 3.4 to 10 kg, 10 to 20 kg and > 20 kg. Bigeye represent a small proportion of the catch and were not sorted into separate categories; during the port sampling undertaken during this study, bigeye were found in categories of yellowfin. However, not all landings were delivered to the cannery; for certain trips, landings were also stored in containers, perhaps for transshipment or future delivery to the cannery.

The port sampling of the landing categories was done by first selecting the bins to be sampled, usually at least one of each landing category, and then each fish in the bin was sampled by the port sampler, so that there was no selectivity bias.

For the grab samples and spill samples, the species composition per trip in the tables presented below was determined by applying the proportion for each species (in terms of weight of the sampled fish) to the set weight (tonnes) to estimate the catch by species per set (tonnes). The weight of each sampled fish was estimated using the length-weight parameters given in the table in the Introduction. The estimated catches were then summed across all sets to obtain the catch by species for the trip. For a given set, the same set weight was used for both the grab sample and the spill sample, such that differences in the total catches per trip arise only if different sets have been sampled. For example, for Trip #1, the total catch per trip summed over sets from which grab samples were taken is 274 mt, whereas the total catch summed over sets from which spill samples were taken is 240 mt; this is because the latter include one less set.

The number of sets on the logsheets and recorded by the observers is given for unassociated schools (*Una*) and associated schools (*Ass*). The numbers of sets on the logsheets is sometimes greater than those recorded by the observer, usually because the observers have ignored skunk sets, for which a catch of one or two tonnes may have been recorded on the logsheet.

The species compositions (in terms of weight of the sampled fish) determined from the port samples of the landing categories were applied to the cannery and container receipts (tonnes) for the relevant landing category, so the same total catch appears in the tables below for landings and port sampling. If no port sample was taken for a particular category of species and size, then it was assumed that the landing category contained only fish of the correct species; e.g., if there was no port sample of the category of yellowfin, 10 kg to 20 kg, then all fish in the category were assumed to be yellowfin.

The criteria used to estimate the catches reported on the logsheets are unknown.

Trip #1 — Vessel A — 27 November to 13 December 2011

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	1	10	11		185	52.9%	165	47.1%	0	0.0%	350
Grab Samples	1	10	11	690	132	48.1%	139	50.9%	3	1.0%	274
Spill Samples	0	10	10	2,902	107	44.7%	132	54.9%	1	0.4%	240
Landings					146	44.7%	181	55.3%	0	0.0%	327
Port Sampling				2,301	146	44.7%	180	55.1%	1	0.2%	327

- The first trip consisted of 11 sets — with 10 on anchored FADs and one on an unassociated school — and caught both skipjack and yellowfin, and a small amount of bigeye.
- Grab samples were collected from all sets; spill samples were taken from all sets but one, a set of about 34 mt, skipjack and yellowfin, on the unassociated school.
- The landings consisted only of fish delivered to the cannery.
- The species composition determined from logsheets has a larger proportion of skipjack and a smaller proportion of yellowfin than the that determined from the cannery receipts, while that determined from the grab samples is intermediate. The grab samples contain more skipjack and less yellowfin than the spill samples. The species composition determined from the spill samples is almost identical to that from the cannery receipts, except that the cannery receipts showed no bigeye.
- The port sampling of the landing categories shows that 1,210 fish sampled in categories for skipjack contained no other species, while 1,091 fish sampled in categories for yellowfin contained 23 bigeye, or 2.1% (in terms of number of fish). The species composition (in terms of weight) determined from the landings data were therefore adjusted from 55.3% yellowfin and 0% bigeye to 55.1% yellowfin and 0.2% bigeye, while the percentage of skipjack remained unchanged.

- These results suggest that (i) the logsheets are probably the least accurate; (ii) the spill samples and the landings adjusted with port sampling are probably the most accurate; (iii) the grab samples are intermediate between the logsheets and spill samples; and (iv) the landings are only slightly less accurate than the spill samples because they contain no bigeye.

Trip #2 — Vessel B — 19 June to 12 July 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	15	15		194	55.5%	155	44.2%	1	0.3%	350
Grab Samples	0	15	15	671	163	55.9%	129	44.1%	0	0.0%	292
Spill Samples	0	14	14	6,719	183	64.9%	99	35.1%	0	0.0%	282
Landings					213	61.6%	132	38.3%	0	0.0%	345

- The second trip consisted of 15 sets — with all on drifting FADs — and caught both skipjack and yellowfin.
- Grab samples were collected from all sets; spill samples were taken from all sets but one, a set of about 10 mt, with skipjack but mostly yellowfin.
- The landings consisted of 132 mt of yellowfin that were delivered to the cannery and 213 mt of skipjack that were stored in containers. There was no port sampling of the landings categories.
- In contrast to Trip #1, the species composition determined from logsheets has a smaller proportion of skipjack and a larger proportion of yellowfin than that determined from the landings. The species composition from the grab samples is almost identical to the logsheets. In contrast to trip #1, the grab samples contain less skipjack and more yellowfin than the spill samples. The species composition determined from the spill samples is close to that from the cannery receipts. Both the logsheets and the landings showed a negligible amount of bigeye, whereas the grab and spill samples showed none.
- These results suggest that (i) the logsheets and grab samples are probably less accurate than the spill samples and the landings; and (ii) the spill samples and the landings would have been even closer if the missing set had been included in the spill samples.

Trip #3 — Vessel C — 28 August to 8 September 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	10	10		194	53.9%	166	46.1%	0	0.0%	360
Grab Samples	0	10	10	514	195	47.6%	214	52.4%	0	0.0%	409
Spill Samples	0	9	9	4,017	181	45.3%	218	54.7%	0	0.0%	399
Landings					207	54.0%	176	46.0%	0	0.0%	383
Port Sampling				778	207	54.0%	176	46.0%	0	0.0%	383

- The third trip consisted of 10 sets — with 9 on anchored FADs and one on a log — and caught both skipjack and yellowfin.
- Grab samples were collected from all sets; spill samples were taken from all sets but one, a set of about 10 mt, almost all skipjack.
- The landings consisted of 166 mt of yellowfin that were delivered to the cannery and 217 mt of skipjack and yellowfin that were stored in containers.
- For this trip, the species compositions from the logsheets and landings are almost identical. The species compositions for grab samples and spill samples are close, and probably would have been almost identical if the spill samples had included the missing set.
- The port samples were taken from bins containing categories of skipjack and categories of yellowfin, but also for mixed skipjack and yellowfin, whereas no mixed skipjack and yellowfin are reported in the landings data. The results for port sampling shown above therefore exclude the port samples of mixed fish. The samples excluding the mixed fish are highly accurate, with only one yellowfin in the skipjack categories and no other species in the categories of yellowfin.
- It is uncertain whether the species compositions from the logsheets and landings are more or less accurate than those from the grab and spill samples. Some of the landings were in bins of mixed skipjack and yellowfin, although each species was reported separately, which suggests a situation somewhat different from the previous trips. It may be that the species compositions from logsheets and landings are not independent. The large size of the spill samples suggests that there may have been less skipjack and more yellowfin than indicated by the logsheets and landings.

Trip #4 — Vessel C — 14 to 24 September 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	11	11		235	64.4%	128	35.1%	2	0.5%	365
Grab Samples	0	11	11	1,801	203	46.6%	228	52.3%	5	1.1%	437
Spill Samples	0	9	9	2,997	213	54.9%	173	44.5%	2	0.6%	388
Landings					208	54.8%	171	45.2%	0	0.0%	379
Port Sampling				2,073	208	54.8%	171	45.2%	0	0.0%	379

- The fourth trip consisted of 11 sets — with 10 on anchored FADs and one on a drifting FAD — and caught both skipjack and yellowfin.
- Grab samples were collected from all sets; spill samples were taken from all sets but two, a set of about 18 mt and another of about 31 mt, both on anchored FADs and neither containing all or almost all of one species.
- The landings consisted of 73 mt of yellowfin that were delivered to the cannery and 306 mt of skipjack and yellowfin that were stored in containers.
- The species composition from logsheets has a larger proportion of skipjack and a smaller proportion of yellowfin than from the landings. The species composition from the spill samples is almost identical to that from the cannery receipts, except that the cannery receipts showed no bigeye; however, it is possible that they would have been less close if the two missing sets had been included in the spill samples. The species composition from the grab samples shows less skipjack and more yellowfin than the spill samples.
- The port sampling of the landing categories shows that the categories for skipjack contained no other species and the categories for yellowfin also contained no other species. The port sampler for this trip was the same as for Trip #3, for which there was only one fish categorised incorrectly, a yellowfin mis-identified as a skipjack. However, there were no bigeye caught during Trip #3, whereas there was a small amount caught during this trip. A total of 782 yellowfin were sampled from four bins, including 573 small (1.3 – 1.8 kg) fish, which leads one to question whether the port sampler's discrimination of yellowfin and bigeye is reliable.
- These results suggest that the species compositions from the logsheets and grab samples are probably less accurate than from the spill samples and the landings.

Trip #5 — Vessel C — 28 September to 12 October 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	11	11		230	64.8%	125	35.2%	0	0.0%	355
Grab Samples	0	11	11	683	110	26.3%	297	70.8%	12	3.0%	420
Spill Samples	0	11	11	4,838	205	48.9%	215	51.1%	0	0.0%	420
Landings					231	63.9%	131	36.1%	0	0.0%	361

- The fifth trip consisted of 11 sets — with all on anchored FADs — and caught both skipjack, yellowfin and some bigeye.
- Grab samples and spill samples were collected from all sets.
- All of the landings were stored in containers. There was no port sampling.
- As for Trip #3, the species compositions from the logsheets and landings are almost identical. The species compositions from grab samples and spill samples both have much less skipjack and more yellowfin than from the logsheets and landings. The species composition from the grab samples shows less skipjack and more yellowfin than the spill samples. But the proportion of bigeye from the grab samples is positive, while from the spill samples, it is zero, even though the sample size was much larger. Bigeye were found in six of the eleven sets from which grab samples were taken; the numbers of bigeye are small, ranging from three to seven fish sampled per set. If not due to species mis-identification by either one of the two observers, the inconsistent results for bigeye may be related simply to the randomness of sampling.
- It is uncertain whether the species compositions from the logsheets and landings are more or less accurate than those from the grab and spill samples. The landings were all stored in containers, and there was no port sampling, which suggests that the catch was not sorted into landings categories. If so, it may be that the species compositions from logsheets and landings are not independent. Both the grab and spill samples suggest that there may have been less skipjack and more yellowfin than indicated by the logsheets and landings.

Trip #6 — Vessel A — 16 to 27 October 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	7	7		108	52.7%	83	40.5%	14	6.8%	205
Grab Samples	0	7	7	447	108	54.9%	75	37.8%	14	7.3%	197
Spill Samples	0	7	7	3,230	109	55.3%	78	39.7%	10	4.9%	197
Landings					93	52.5%	85	47.5%	0	0.0%	178
Port Sampling				1,405	93	52.5%	85	47.5%	0	0.0%	178

- The sixth trip consisted of 7 sets — with 5 on anchored FADs, one on a drifting FAD and one on a log — and caught skipjack, yellowfin and bigeye.
- Grab samples and spill samples were collected from all sets.
- All of the landings were stored in containers.
- The species compositions from the logsheets, grab samples and spill samples are close. The proportion of skipjack from the landings and port sampling are close to the logsheets, grab and spill samples, while the proportion of yellowfin is higher and the proportion of bigeye is zero.
- The port sampling of the landing categories for skipjack and yellowfin shows that the categories for skipjack contained no other species and the categories for yellowfin also contained no other species. However, there was a considerable amount of bigeye caught during this trip, according to the logsheets, grab and spill samples. Either (i) the bigeye were categorised, but not reported in the landings, or (ii) the port sampler, who was the same as for Trips #3 and #4, mis-identified the bigeye.
- The species compositions from the logsheets, grab samples and spill samples are close, while the proportions of yellowfin and bigeye from the landings and port sampling are almost certainly inaccurate.

Trip #7 — Vessel D — 2 to 22 November 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	17	17		215	59.6%	146	40.4%	0	0.0%	360
Grab Samples	0	17	17	995	313	67.9%	138	30.0%	9	2.1%	460
Spill Samples	0	16	16	5,928	307	66.9%	146	31.9%	6	1.2%	460

- The seventh trip consisted of 17 sets — with all on anchored FADs — and caught both skipjack and yellowfin.

- Grab samples were collected from all sets; spill samples were taken from all sets but one, a skunk set of only 1 mt.
- Landings data are unavailable. Port sampling was collected from mixed skipjack and yellowfin and combined categories of pure yellowfin; since the results from the port sampling could not be applied to the landings, they are omitted from the table above.
- The species compositions from the logsheets has a smaller proportion of skipjack and a larger proportion of yellowfin than from the grab samples and spill samples, and no bigeye, but the total catch from the logsheets is 100 mt less than from the observers. The species compositions from the grab and spill samples are close, although the grab samples have slightly more skipjack and bigeye, and slightly less yellowfin.
- The species compositions from the grab samples and spill samples are probably more accurate than the logsheets, which appear to underestimate the total catch, although, without landings data, this cannot be confirmed.

Trip #8 — Vessel D — 23 November to 10 December 2012

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	1	14	15		224	62.2%	132	36.5%	5	1.3%	360
Grab Samples	1	14	15	670	218	63.3%	120	34.9%	6	1.8%	345
Spill Samples	1	14	15	4,825	184	53.5%	153	44.3%	8	2.2%	345

- The eighth trip consisted of 15 sets — with 12 on anchored FADs, 2 on drifting FADs and one unassociated school — and caught skipjack, yellowfin and some bigeye.
- Grab samples and spill samples were collected from all sets.
- Landings data include only cannery receipts for skipjack, and neither cannery nor container receipts for yellowfin nor bigeye. Port sampling was collected from mixed skipjack and yellowfin and combined categories of pure yellowfin. Since the landings data are incomplete and the categories that were sampled in port did not correspond to the categories covered by the landings data, both were omitted from the table above.
- The species compositions from the logsheets and grab samples are close. The species composition from the spill samples has a smaller proportion of skipjack and a larger proportion of yellowfin than from the grab samples.
- It is uncertain whether the species compositions from the logsheets and grab samples is more or less accurate than from the spill samples, although the large spill sample size suggests the latter.

Trip #9 — Vessel C — 22 to 28 May 2013

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	0	7	7		180	70.4%	76	29.6%	0	0.0%	255
Grab Samples	0	7	7	553	225	75.9%	71	23.9%	1	0.2%	297
Spill Samples	0	7	7	3,511	182	61.4%	107	36.0%	8	2.6%	297
Landings					181	70.5%	76	29.5%	0	0.0%	257

- The ninth trip consisted of 7 sets — with 4 on logs and 3 on anchored FADs — and caught skipjack, yellowfin and some bigeye.
- Grab samples and spill samples were collected from all sets.
- Landings data include cannery receipts for categories of skipjack and yellowfin. There was no port sampling.
- As for Trips #3, #5 and #6, the species compositions from the logsheets and landings are almost identical, although the landings from those three trips were partly or fully stored in containers, which may be a factor, whereas all fish for Trip #9 were sorted into landing categories and delivered to the cannery.
- The species compositions from grab samples has more skipjack and less yellowfin than from the logsheets and landings. The species composition from the spill samples shows much less skipjack and more yellowfin than the other types of data. The proportion of bigeye from the spill samples is significant, whereas the proportion from the grab samples is negligible, and the proportion from logsheets and landings is zero.
- The total catch reported by the observers is somewhat greater than for the logsheets and landings; the weightings of the species compositions for each set therefore differs between the logsheets, on the one hand, and the observers, on the other, yet the results from the grab samples and spill samples are opposite.
- The almost identical species compositions from the logsheets and landings suggest that they may not be independent. It is uncertain which of the species compositions is the more accurate, although it is notable that the spill sample size is much larger than the grab sample size.

Trip #10 — Vessel C — 16 to 26 June 2013

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	3	11	14		132	37.6%	219	62.4%	0	0.0%	350
Grab Samples	3	11	14	1,180	171	45.1%	208	54.9%	0	0.0%	380
Spill Samples	2	11	13	3,382	151	40.1%	225	59.9%	0	0.0%	377

- The tenth trip consisted of 14 sets — with 10 on anchored FADs and 4 on unassociated schools — and caught skipjack and yellowfin.
- Grab samples were collected from all sets; spill samples were taken from all sets but one, a skunk set of only 3 mt.
- Landings data are not available. There was no port sampling.
- The species compositions from the logsheets has considerably less skipjack and more yellowfin than from the grab samples, while that from the spill samples is intermediate.
- Without landings data, it is uncertain which of the species compositions is the more accurate.

Summary

The table below summarises the results for the seven Trips #1, #2, #3, #4, #5, #6, #9; the remaining trips were ignored because of the lack of landings data.

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	1	71	72		1,326	59.2%	897	40.1%	17	0.8%	2,240
Grab Samples	1	71	72	5,359	1,136	48.9%	1,153	49.6%	35	1.5%	2,325
Spill Samples	0	67	67	28,214	1,181	53.1%	1,021	45.9%	20	0.9%	2,222
Landings					1,279	57.3%	952	42.7%	0	0.0%	2,231

- Port sampling was not conducted for Trips #2, #5 and #9 and so landings adjusted with port samples are not shown in the table above. The port sampling for Trip #1 showed that fish in the landings categories were almost perfectly sorted with respect to species. In retrospect, the accuracy of the landing categories is perhaps not surprising given that, at Noro, each fish is sorted by hand. The results of the port sampling for Trips #3, #4 and #6 are questionable, particularly since no bigeye were sampled for Trip #6, but they still show that skipjack and yellowfin are sorted with a high degree of accuracy.

- The spill samples show about 6% less skipjack and 6% more yellowfin than the logsheets, and about the same amount of bigeye. This result in regard to bigeye is somewhat surprising, given that bigeye made up only about 1% of the catch, yet were still reported on the logsheets.
- The grab samples show less skipjack and more yellowfin than the spill samples, which, though not necessarily the case for all sets or trips, is to be expected, since the selectivity bias of grab samples tends to result in fewer small fish and more large fish.
- The species compositions from the logsheets are close to those for landings, except for the lack of bigeye in the latter. However, for four trips — #3, #5, #6 and #9 — the species compositions were almost identical, which suggests that they may not be independent, perhaps because landings are based on the logsheets when the catch is stored in containers or logsheets are adjusted on the basis of landings when the catch is delivered to the cannery.
- The table below shows the results for the three trips for which landings are available, but the species compositions from the logsheets are not identical to those from the landings — #1, #2 and #4. For the 37 sets represented in this table, the results are similar to those in the table above, which represents 72 sets, except that the species composition from the landings is closer to the spill samples than to the logsheets.

Type of Data	Number of Sets			Number of Fish Sampled	Skipjack		Yellowfin		Bigeye		Total
	Una	Ass	Total		MT	%	MT	%	MT	%	MT
Logsheets	1	36	37		614	57.7%	448	42.0%	3	0.3%	1,065
Grab Samples	1	36	37	3,162	498	49.7%	496	49.5%	8	0.8%	1,002
Spill Samples	0	33	33	12,618	503	55.3%	403	44.3%	3	0.3%	910
Landings					567	53.9%	485	46.1%	0	0.0%	1,051

- The spill samples in the table above cover only 33 sets, with a total catch of 910 mt, compared to 37 sets and 1,002 mt for the grab samples. When the catch estimates based on the grab samples from the four missing sets — which total 39 mt of skipjack and 54 mt of yellowfin — are added to those based on the spill samples for the 33 sets, the resulting species composition is 54.1% skipjack, 45.6% yellowfin and 0.3% bigeye, which is even closer to that from the landings (although if the selectivity bias of the grab samples from the four sets was known, it would probably be slightly less close).

Species compositions for four trips by Japanese purse seiners determined from grab samples, spill samples and market data

Market data were provided for seven categories of skipjack — less than 1.0 kg, 1.0 to 1.8 kg, 1.8 to 2.5 kg, 2.5 kg to 4.5 kg, 4.5 kg to 6.0 kg, greater than 6.0 kg and 'wounded'; seven categories of yellowfin — less than 1.5 kg, 1.5 to 3.0 kg, 3.0 to 5.0 kg, 5.0 kg to 10 kg, 10 kg to 20 kg, greater than 20 kg and 'wounded'; and three categories of bigeye — less than 2.5 kg, 2.5 to 10 kg and greater than 10 kg.

The tables presented below are similar to those presented for the Solomon Islands vessels, except that no port sampling was conducted of landing categories.

Trip #1 — Vessel E — 29 January to 24 February 2012

Type of Data	Number of Sets			Number of Fish Sampled	Logsheets						
	Unassociated	Associated	Total		Skipjack		Yellowfin		Bigeye		Total
					MT	%	MT	%	MT	%	MT
Logsheets	19	0	19		1,094	99.5%	6	0.5%	0	0.0%	1,100
Grab Samples	16	0	16	1,465	1,109	97.6%	27	2.4%	0	0.0%	1,136
Spill Samples	12	0	12	3,205	1,024	98.8%	12	1.2%	0	0.0%	1,036
Market					1,152	98.3%	20	1.7%	0	0.0%	1,171

- The first trip consisted of 19 sets — with all on unassociated schools — and caught skipjack, with only a small amount of yellowfin.
- Grab samples were collected from 16 sets; the three sets not sampled were skunk sets of about 5 mt. Spill samples were taken from 12 sets; 3 skunk sets and 4 sets totalling 100 mt were not sampled.
- The species compositions from each type of data are consistent, as expected because the catch was almost entirely skipjack. However, the species composition from the spill samples is slightly closer to that from the market data than the grab samples and the logsheets.

Trip #2 — Vessel E — 2 March to 19 April 2012

Type of Data	Number of Sets			Number of Fish Sampled	Logsheets						
	Unassociated	Associated	Total		Skipjack		Yellowfin		Bigeye		Total
					MT	%	MT	%	MT	%	MT
Logsheets	27	3	30		534	56.2%	406	42.8%	10	1.0%	950
Grab Samples	22	3	25	1,313	549	49.7%	519	47.0%	36	3.3%	1,104
Spill Samples	24	3	27	3,736	581	54.5%	448	42.0%	38	3.6%	1,067
Market					469	50.5%	433	46.6%	27	2.9%	930

- The second trip consisted of 30 sets — with 27 sets on unassociated schools and 3 sets on logs — and caught skipjack and yellowfin, and a small amount of bigeye.
- Grab samples were collected from 25 sets; the 5 sets not sampled were skunk sets of about 5 mt. Spill samples were taken from 26 sets; one skunk set and two sets totalling 53 mt — with about 31 mt of skipjack, 22 mt of yellowfin and no bigeye — were not sampled.
- The species compositions from the logsheets and the spill samples show the largest proportion of skipjack and the lowest proportion of yellowfin. The logsheets show only 1% of bigeye while the other types of data have 2.9% to 3.6%. The grab samples are closest to the market data.

Trip #3 — Vessel F — 29 April to 31 May 2012

Type of Data	Number of Sets			Number of Fish Sampled	Logsheets						
	Unassociated	Associated	Total		Skipjack		Yellowfin		Bigeye		Total
					MT	%	MT	%	MT	%	MT
Logsheets	1	12	13		425	75.2%	38	6.7%	102	18.1%	565
Grab Samples	1	11	12	349	462	82.2%	47	8.4%	53	9.5%	562
Spill Samples	1	10	11	3,971	430	79.0%	44	8.1%	70	12.9%	544
Market					445	75.7%	63	10.7%	80	13.6%	587

- The third trip consisted of 13 sets — with 11 sets on drifting FADs, one on a log and one on an unassociated school — and caught mostly skipjack, followed by bigeye and yellowfin.
- Grab samples were collected from 12 sets; one skunk set of about 5 mt was not sampled. Spill samples were taken from 11 sets; one skunk set and one set totalling about 18 mt — with about 11 mt of skipjack, 5 mt of yellowfin and 2 mt of bigeye — were not sampled.
- The species compositions from the logsheets and market data show about the same amount of skipjack, while the logsheets show less yellowfin and more bigeye. The grab samples and the spill samples are close, showing more skipjack than the logsheets and market data, while the grab samples show the least amount of bigeye.

Trip #4 — Vessel F —7 June to 4 July 2012

Type of Data	Number of Sets			Number of Fish Sampled	Logsheets						
	Unassociated	Associated	Total		Skipjack		Yellowfin		Bigeye		Total
					MT	%	MT	%	MT	%	MT
Logsheets	12	5	17		504	88.0%	65	11.3%	4	0.7%	573
Grab Samples	9	5	14	525	481	94.1%	23	4.5%	7	1.4%	511
Spill Samples	10	5	15	4,091	460	84.1%	77	14.1%	10	1.8%	547
Market					510	86.3%	67	11.3%	14	2.3%	590

- The fourth trip consisted of 17 sets — with 12 sets on unassociated schools and 5 sets on drifting FADs — and caught mostly skipjack, with some yellowfin and a small amount of bigeye.
- Grab samples were collected from 14 sets; two skunk sets of about 5 mt and one set of about 36 mt of yellowfin were not sampled. Spill samples were taken from 15 sets; two skunk sets were not sampled.
- The species compositions from the grab samples show the largest amount of skipjack; however, if the set containing the 36 mt of yellowfin was included, the grab samples would show 87.9% skipjack, 10.8% yellowfin and 1.3% bigeye, and the logsheets, grab samples and market data would be close. The spill samples show less skipjack and more yellowfin.

Summary

The table below summarises the results for all four trips.

Type of Data	Number of Sets			Number of Fish Sampled	Logsheets						
	Unassociated	Associated	Total		Skipjack		Yellowfin		Bigeye		Total
					MT	%	MT	%	MT	%	MT
Logsheets	59	20	79		2,557	80.2%	515	16.2%	116	3.6%	3,188
Grab Samples	48	19	67	3,652	2,601	78.5%	617	18.6%	96	2.9%	3,314
Spill Samples	47	18	65	15,003	2,495	78.1%	581	18.2%	118	3.7%	3,194
Market					2,575	78.5%	583	17.8%	120	3.7%	3,278

- On average, the species composition from the logsheets shows slightly more skipjack and less yellowfin. The grab samples, spill samples and market data are almost identical, with all proportions within 1%, the grab samples showing slightly more yellowfin and slightly less bigeye.
- If the set during Trip #4 containing the 36 mt of yellowfin is included, the grab samples show an average of 77.6% skipjack, 19.5% yellowfin and 2.9% bigeye, which, when compared to the spill samples, suggests a slight effect due to the selectivity bias of grab samples.

Conclusion

The problems that became evident when comparing the results for the trips by the Solomon Islands vessels — such as the lack or incompleteness of cannery and container receipts, questions concerning the independence of the logsheets and the cannery and container receipts, the lack of port sampling data, and questions regarding the accuracy of the port sampling data — together with the lack of port sampling data for the Japanese vessels, suggest that if future studies of this kind are to be undertaken for these fleets, they would probably be best done by the national scientists. They would be closer to the activities and therefore better able to avoid the problems or to find answers to the questions.

Nevertheless, with certain assumptions discussed above, one can conclude that for the Solomon Islands vessels, on average, the species compositions determined from the spill samples agree more closely with the cannery and container receipts than the logsheets and the grab samples. For the Japanese vessels, on average, the species compositions from each of the logsheets, grab samples, spill samples and market data are similar.

For the Solomon Islands vessels, the average species composition was about 54% skipjack and 46% yellowfin, with a negligible amount of bigeye. For the Japanese vessels, the average was about 79% skipjack, 18% yellowfin and 3% to 4% bigeye. This difference in the species composition may partly, but not entirely, explain why the results for the Solomon Islands vessels were more variable among the types of data, compared to the results for the Japanese vessels, which were more consistent.

Regarding the results for the Japanese vessels, it should be noted that the impact of the selectivity bias of grab samples — due to which there is a relatively higher probability of selecting larger fish and a relatively lower probability of selecting smaller fish — depends on the distribution of sizes in the catch. That is, when all fish are of the same size, the selectivity bias has no impact and the species compositions determined from grab samples and spill samples will be similar. When there is a wide range of sizes, the species compositions will differ, with grab samples containing a smaller proportion of skipjack and a larger portion of yellowfin than spill samples. It may therefore be that the consistency of the average species compositions determined from the grab samples and spill samples is related to the sizes of skipjack and yellowfin in the catch. For Trip #1, for which the percentage of skipjack determined from the grab samples was slightly less than for the spill samples, and the percentage of yellowfin was slightly more, the average lengths of the skipjack and yellowfin were 51.7 cm and 98.6 cm respectively. These results are consistent with a selectivity bias, but the difference in the species compositions is small because of the catch was dominated by skipjack. For Trip #2, the average lengths of the skipjack and yellowfin were 49.5 cm and 97.0 cm respectively, which suggests that there should be a selectivity bias. Indeed, the bias is observed, and to a greater extent than for Trip #1 since the catch was not dominated by skipjack. For Trip #3, the average lengths of the skipjack and yellowfin were 46.4 cm and 55.9 cm respectively. The grab

samples show slightly more skipjack than for the spill samples, which is the opposite of the result expected from a selectivity bias, and this is probably related to the relative similarity in the average sizes of the skipjack and yellowfin. For Trip #4, the average lengths of the skipjack and yellowfin were 51.3 cm and 86.0 cm respectively, which suggests that the species compositions should reflect a selectivity bias, but the actual result is the opposite, with the grab samples showing considerably more skipjack and less yellowfin than for the spill samples. However, as noted above, when the set containing 36 mt of yellowfin, which is missing from the grab samples, is taken into account, the species compositions for this trip, while still inconsistent with a selectivity bias, is so to a much lesser degree. In summary, Trips #1, #2 and #3 are consistent with a selectivity bias, whereas Trip #4 is somewhat anomalous. Hence, the apparent consistency in the average species compositions for the four trips is due more to the anomalous results for Trip #4 than to a similarity in the average sizes of the skipjack and yellowfin.

Previous studies comparing grab samples and spill samples are based on purse-seine trips during which paired grab and spill samples were collected by observers (Lawson 2009, 2010, 2012) and on a simulation study (Lawson 2013). Those studies have shown that on the basis of both theoretical considerations and empirical data, species and size compositions determined from spill samples are more accurate than those determined from grab samples, primarily because spill samples are not subject to the selectivity bias and the sample sizes are much larger. The results from the current study go somewhat further and show that, on average, the species compositions determined from spill samples are consistent with those determined from cannery and container receipts in the Solomon Islands and from market data in Japan.

Samples collected by observers refer to the time, location and school association of each set, whereas the landings data refer only to the entire trip; samples collected by observers are therefore more informative. The research carried out under Project 60 shows that for the purse-seine fleets in the region, estimates of the species and size composition should be based on spill samples collected by observers. Doing so will result in estimates that can be given much greater confidence than by continuing to collect grab samples and subsequently correcting them for selectivity bias.

Project 60 has also shown that when crews are cooperative, the logistics of collecting spill samples are, in general, no more disruptive of the fishing operations than grab samples, given that grab samples are collected from each and every brail during a set, while spill samples are collected from a small number of brails. Regarding the potential transition from grab samples to spill samples, the following should also be noted:

- Observers that have been certified under the Pacific Island Regional Fisheries Observer (PIRFO) standards are easily trained to collect spill samples.
- The current observer data collection forms maintained by the SPC / FFA Tuna Fishery Data Collection Committee (DCC), which satisfy the WCPFC Regional Observer Programme (ROP)

standards and which are used by most sub-regional and national observer programmes, already allow for the recording of spill samples.

- The only additional sampling material that is required is the spill sample bin; see SC10–ST–IP–02 for the details of the spill sample protocol, including the dimensions of the standardised bin.

Future research

Future research on the estimation of the species composition of purse-seine catches will include the analysis of spill samples and port samples collected during five trips by vessels in Papua New Guinea, from March to June 2014; at the time of writing, the five trips were completed and the data were being processed. The port sampling protocol used in Papua New Guinea is not used elsewhere; hence, the analysis will have primarily local relevance.

Under WCPFC Conservation and Management Measure (CMM) 2008–01, the rate of coverage by observers on purse seiners has been 100% since January 2010. All observers have collected species and size samples as part of their regular duties; however, complete coverage of all sets during all trips is not necessarily required for the purposes of estimating the species and size compositions of the catch. If WCPFC was to consider decreasing the percentage of trips from which species and size samples were collected, and if spill samples were widely implemented, then future research could include studies of the sub-sampling of spill sample data to determine the relationship between the accuracy and reliability of estimates of the species and size compositions and the level of coverage by spill sampling, with a view to making recommendations regarding the appropriate level of coverage and the sampling design.

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