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Comparison of PFA self-sampling with EU observer data

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Abstract

The pelagic freezer-trawler fleet (PFA) has been carrying out a self-sampling program on the freezer-trawler fleet since 2015, within the northeast Atlantic, West Africa and the South Pacific. The pelagic freezer-trawler fisheries are characterized by a high level of sampling being carried out for commercial purposes. The self-sampling programme expanded on the ongoing sampling programme by standardizing the sampling methodology and the recording formats. During self-sampled trips, the crew member will generally take a random sample of around 20 kg from the catch of each haul (or the majority of hauls), separate them into the different species and measure the length compositions of each of the subsamples. During some of the self-sampled trips, the vessel was also joined by a scientific observer. For those trips the species and length compositions from the scientific observer have been compared to the self-sampling data.

Within the fishery for jack mackerel in the South Pacific, the PFA self-sampling program has been carried out on all trips. The scientific observer program for that fishery is targeted to cover at least 10% of the effort. Over the years 2015-2017 the analysis has shown that around 35% of the catch has been covered by scientific

observers. Over these years, 8 trips were covered by both self-sampling and scientific observes.

The overal number of length measurements between the self-sampling and observer trips is comparable, but self-sampling samples fewer fish per trip but more (all) trips while the observer program measures more fish but on fewer trips. Comparisons of the cumulative catch per trip show close correspondence between the two sampling programs, as does the species compositions.

Length compositions per sampled trips and hauls are generally comparable. However, during three out of the eight trips, differences were observed in the overall length compositions. They have been further investigated and were shown to derive from either problems in the sampling method employed by one of the scientific observers or by the lower number of measurements in the self-sampling program. A comparison of the overall length compositions by year derived from all self-sampled trips or derived from the raised observer trips, demonstrates that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources. Thus self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programs while being able to assure a wide coverage of the fishing season.

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1 Introduction

1.1 Self-sampling in the Pelagic freezer-trawler fisheries

The pelagic freezer trawler fishery targets small pelagic species. In the Northeast Atlantic, the most important species are: herring (*Clupea harengus*), blue whiting (*Micromesistius poutassou*), horse mackerel (*Trachurus trachurus*), mackerel (*Scomber scombrus*), greater argentine (*Argentina silus*) and sardine or pilchard (*Sardina pilchardus*). There is also a fishery for sardine (*Sardina pilchardus*) and sardinella (*Sardinella aurita*) in the waters west of Africa and for jack mackerel (*Trachurus murphyi*) in the South Pacific.

The Pelagic Freezer-trawler Association (PFA) is an association that has nine member companies that together operate 19 (in 2018) freezer trawlers in five European countries (www.pelagicfish.eu). The PFA initiated a research and knowledge strategy in 2014 with the aim to "initiate, develop, contribute and sustain knowledge development that is needed for sustainable management and exploitation of fish stocks in all areas where PFA members are active." As part of this ambition a self-sampling program has been initiated that extended and harmonized the already ongoing sampling activities on the vessels for commercial reasons. The extension in the self-sampling programme consists of recording of haul information, recording the species compositions per haul and regularly taking random length-samples from the catch. The self-sampling is carried out by the vessel quality managers on board of the vessels, who have a long experience in assessing the quality of fish, and by the skippers/officers with respect to the haul information. The scientific coordination of the self-sampling programme is carried out by Martin Pastoors (PFA chief science officer) with support of Floor Quirijns (contractor). A self-sampling manual is used to provide instructions to the crews (Pastoors 2018a). Results of the self-sampling program are published in annual reports (Pastoors & Quirijns 2017, 2018) and in dedicated reports for species expert groups (e.g. Pastoors 2017a, 2018b)

1.2 Scientific observer program

In the European Union, the collection and management of fisheries data is regulated through the Data Collection Framework (DCF) of the European Commission (EC).

The observer program in the South Pacific was initially carried out by Corten Marine Research (CMR). In 2015 this observer program became embedded into the

European Data Collection Framework even though the coordination was still carried out by CMR. From 2017 onwards the coordination has been taken over by the ational Marine Fisheries Research Institute in Poland. Around 10% of the trips in the South Pacific are covered by scientific observers. Scientific observers have a wider objective than the self-sampling program by also focussing on potential bycatch of birds and seamammals or other protected species.

1.3 Aim of this paper

While many have reacted positively to the ambition and execution of the PFA self-sampling program in the different areas, there have also been sceptical voices that suggested that self-sampling cannot really be trusted because there is no inde-pedent quality control of the data that is generated. Fortunately, the presence of the scientific observer programs does provide us with the possiblity of comparing self-sampling with scientific observer data for those trips where both self-sampling was carried out and where a scientific observer was on board. This paper documents the comparisons between self-sampling and scientific observer trips in the northeast Atlantic and in the South Pacific.

2 Material and methods

Data from the PFA self-sampling program has been made available from the PFA database system. Data from the official observer programs could only be released for this analysis after written consent of the vessel-owners because by definition the observer data will not be released in a form that can be attributed to specific vessels. The aim of the analysis was to present a haul-by-haul comparison of observer data and self-sampling data. Given the time available for preparing this paper/presentation, this could only be achieved for the trips in the SPRFMO area in 2015 - 2017. For the Northeast Atlantic, the comparison had to be restricted - due to time available - to a comparison on a trip level. Although a similar analysis could in principle be carried out for the CECAF area (West Africa), the information to carry out such a comparison was not available when preparing this presentation.

Comparisons will be focussed on catch compositions and length compositions.

3 Results

The European fishery in the South Pacific is targeted as Jack mackerel (*Trachurus murphyi*) and has been carried out by one or two vessels per years. All trips of vessels by PFA members are covered by self-sampling and at least 10% of the effort is covered by observer trips. In 2016 one of the European vessels fishing in the South Pacific did not belong to the PFA membership and was not covered by the self-sampling program.

An overview of the key-characteristics of the self-sampling and scientific observer trips between 2015 and 2017 is shown in Table 3.1. Of the close to 70 000 tonnes of catch during those years, around 24 000 tonnes were covered by the scientific observer programme (~ 35%). The number of length measurements in the self-sampling and the observer program are more or less similar. This means that the self-sampling covers a larger part of the fishery at a more extensive rate, while the observer program targets fewer trips but with higher sampling rate.

year	ntrips_ss	nhauls_ss	nlength_ss	catch_ss
2015	9	379	7,299	27,921
2016	4	169	6,845	10,284
2017	10	615	20,829	29,652
(all)	23	1,163	34,973	67,857

year	ntrips_obs	nhauls_obs	nlength_obs	catch_obs
2015	3	176	18,810	13,935
2016	2	50	5,594	2,694
2017	3	183	14,533	7,429
(all)	8	409	38,937	24,058

Table 3.1: Summary of self-sampling and scientific observer trips in the Northeast Atlantic: number of vessel, trips, days, hauls, catch (tonnes) and number of fish measured

A direct comparison of the trips that were both self-sampled and that had a scientific observer on board is shown in table 3.2. Generally, these will give very similar values, except when a trip was not fully covered by an observer as was the case in 2016 for example.

When making these direct comparisons we encountered some difficulties in the labelling of trips and hauls. The SPRFMO haul database does not record the trip number or the haul number so that matches can only be generated on the basis of haul datetime fields and position fields. If there are (small) errors in either of these fields in the self-sampling data or in the scientific observer data, it becomes rather difficult to match up the two.

year	nvessels_ss	nhauls_ss	nlength_ss	catch_ss
2015	2	167	2,703	13,061
2016	1	85	2,620	4,664
2017	1	183	5,493	7,429
(all)	.	435	10,816	25,154

year	nvessels_obs	nhauls_obs	nlength_obs	catch_obs
2015	2	176	18,810	13,935
2016	1	50	5,594	2,694
2017	1	183	14,533	7,429
(all)	.	409	38,937	24,058

Table 3.2: Summary of trips where both self-sampling and scientific observations was carried out in the South Pacific: number of vessels, trips, hauls, catch (tonnes) and number of fish measured

Cumulative catch per trip

A comparison between the cumulative catches per trip from self-sampling and scientific observers is shown in figure 3.1.There is generally a very close correspondance between the two sampling programs. Where there is a mismatch, this is mostly due to misallocations in haulnumbers and haul datetimes. A process of manually checking the haul numbers and associated datatimes and positions has been carried out but it has not been possible to reallocate catches accordingly.

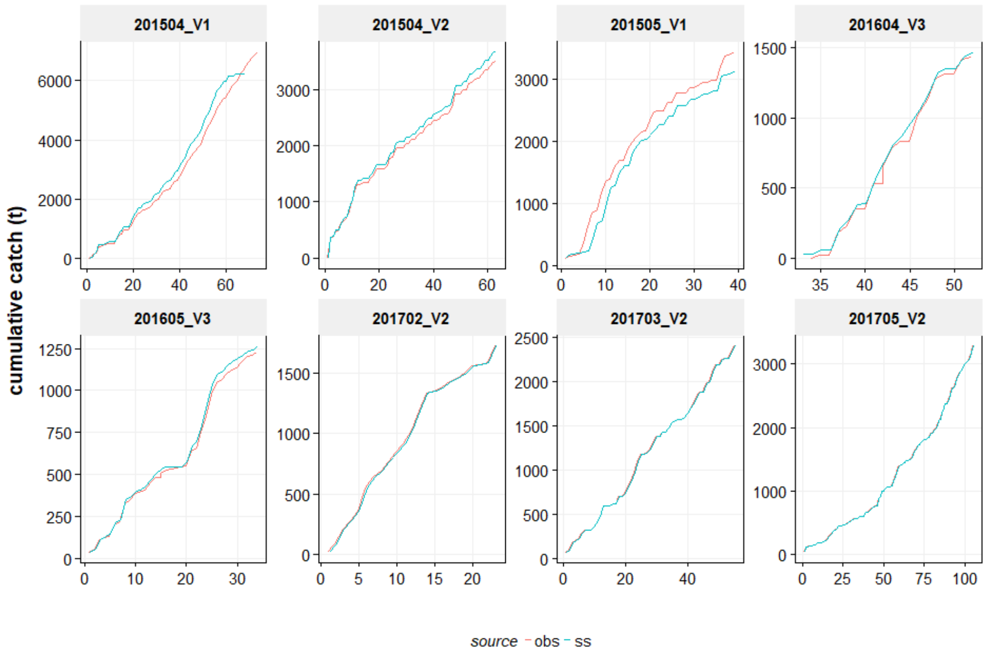

Figure 3.1: Overlap between catch per haul for observer trips (red) and self-sampling trips (bluegreen)

Catch by species

A comparison of the total catch by trip and species for the hauls in common between the self-sampling and the observer program is shown in figure 3.2. This shows a good correspondence in the estimated quantities for the main species. Figure 3.3 has the same information, but leaving out the catches of jack mackerel, so that the smaller quantities of species like chub mackerel, fatheads and tuna-like species can be better compared. Again there is a close correspondence between the estimated quantities of each of the species per trip.

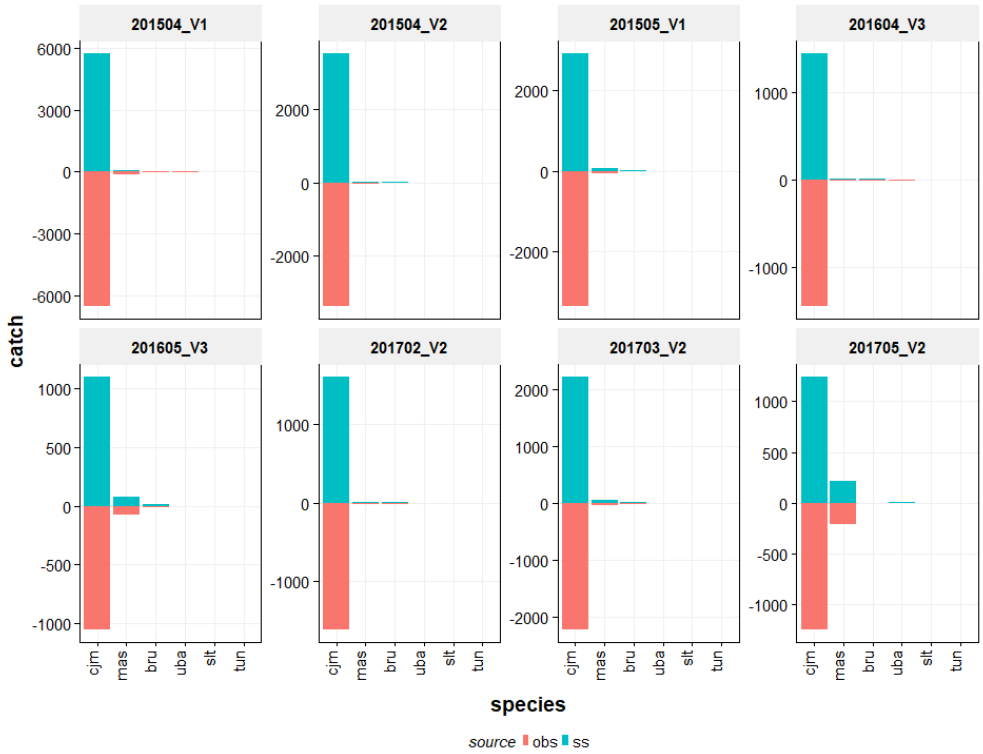

Figure 3.2: Comparison of catch per species for hauls in common in observer trips (red) and self-sampling trips (bluegreen)

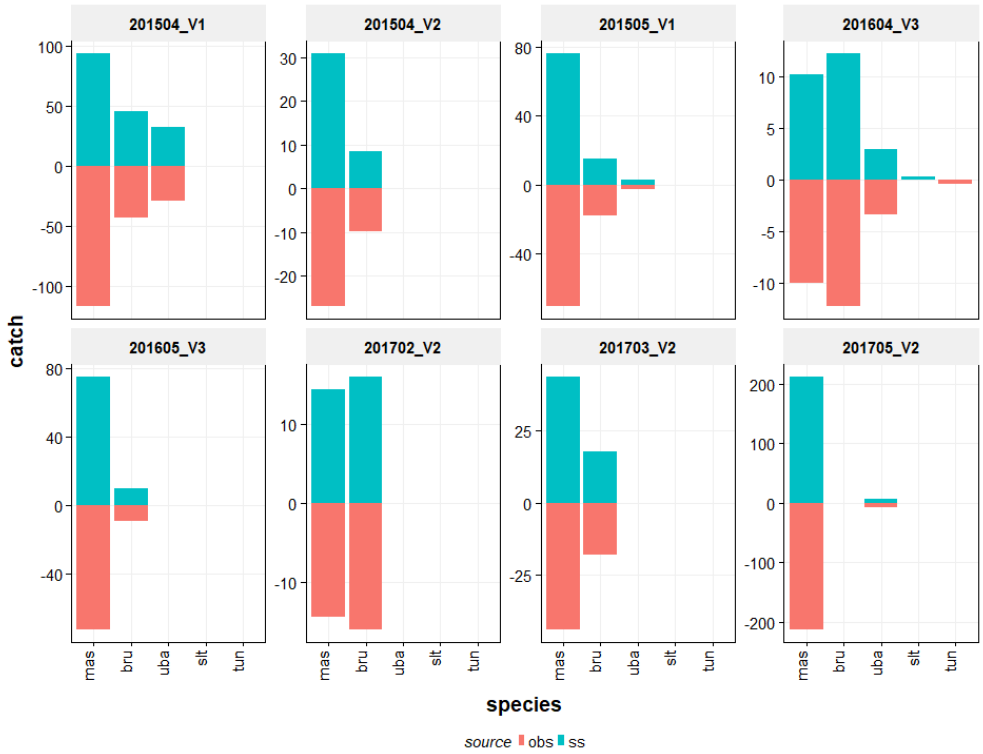

Figure 3.3: Comparison of catch per species (except Jack mackerel) for hauls in common in observer trips (red) and self-sampling trips (bluegreen)

Length distributions

The length distributions of Jack mackerel (in proportion at length calculated from raised catchnumbers) by trip for the hauls that are in common between the self-sampling and observer program are shown in figure 3.4. There is generally a close correspondence between the length distributions from the self-sampling and the observer program, with the only exceptions trips 201504_V2, 201604_V3 and 201705_V2 where some discrepancies are observed. These will be explored in more detail below.

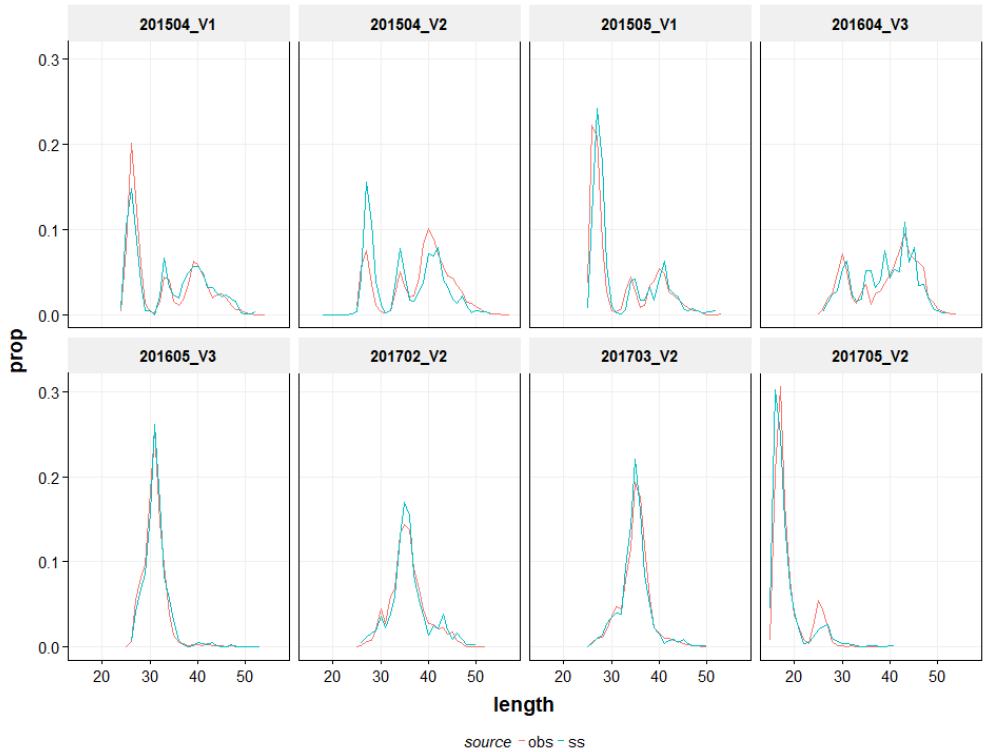

Figure 3.4 Jack mackerel length distributions by trip only for hauls that are in common between self-sampling and observer trips

Trip 201504_V2

Trip 201504_V2 demonstrated a pattern whereby the scientific observer measured relatively less small fish and more larger fish compared to the self-sampling data. Trip 201504_V2 was in fact a special case, because it was closely linked with trip 201505_V1. The two vessels were fishing in the same area and each of the vessels was carrying out the self-sampling program and had a scientific observer on board. This provided a unique opportunity to evaluate the consistency of the self-sampling and the observers on board of the vessels. Unfortunately the time of the fishing activities did not closely align as one of the vessels was probably offloading during part of the trip. There were only 6 days in which both vessels were fishing on the same dates. Figure 3.5 shows the comparison for the 2 vessels (V1 and V2), the 6 dates and the self-sampling (solid line) and the observer data (dashed line). These comparisons confirm that the length compositions of the self-sampling and scientific observer on V1 and the self-sampling on V2 was very consistent but that the scientific observer on V2 had a tendency to sample relatively more larger fish. This has been confirmed afterwards as being due to the sampling method being used by the scientific observer on V2 who created samples by manually picking fish from the conveyor belt instead of taking an appropriate random sample.

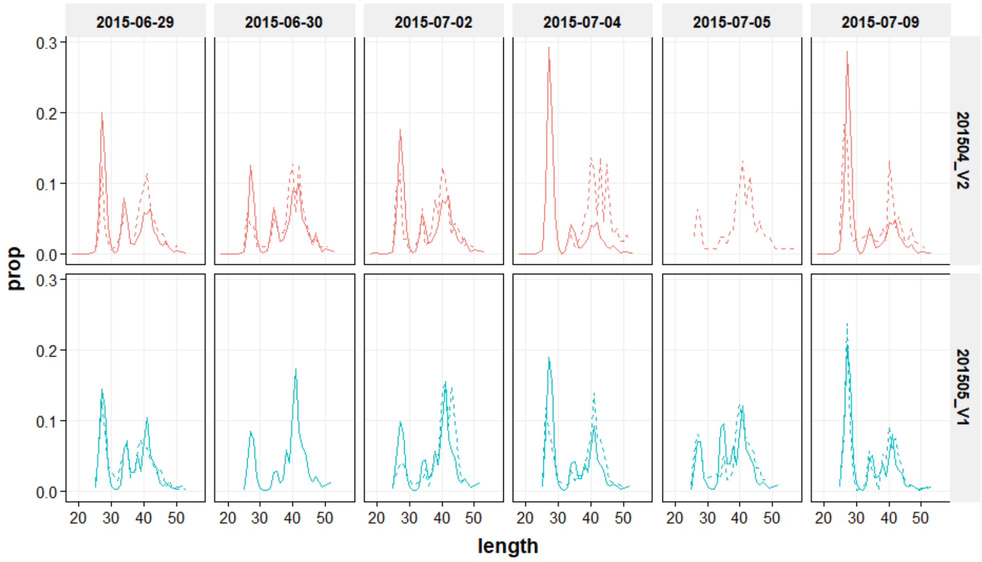

Figure 3.5 Jack mackerel length distributions for trips 201504V2 and 201505V1 for dates where self-sampling (solid lines) and observer trips (dashed lines) where available for both vessels.

Trip 201604_V3

In trip 201604_V3, the self-sampling length compositions showed a more 'spikey' character than the scientific observer data. When looking at the length compositions per day, for which both self-sampling and scientific observer data was available (figure 3.6).Also shown are the number of fish measured in the self-sampling and the observer program. From this comparison, it is clear that the spikey nature of the self-sampling data derives from the too small sample size (too few fish measured).

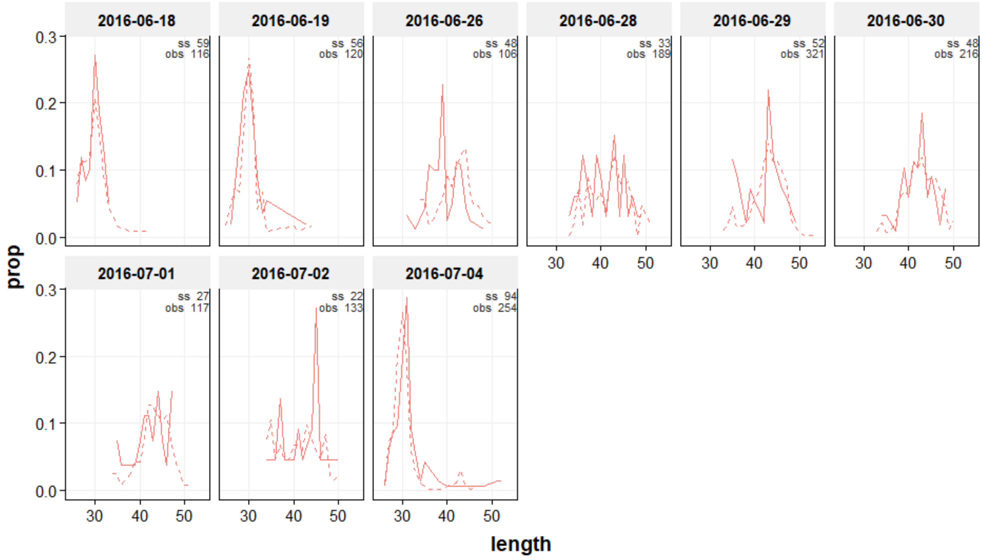

Figure 3.6 Jack mackerel length distributions for trip 201604V3 for dates where self-sampling (solid lines) and observer trips (dashed lines) where available.

Trip 201705_V2

The last trip that will be compared between self-sampling and observer data is trip 201705_V2. Here there were many dates for which both self-sampling and observer data was available. Sample size on the self-sampling turned out to be somewhat variable with sometimes good coverage and sometimes insufficient coverage. The main difference between the length compositions seems to be derived from the lack of the second peak on some dates in September which was picked up in the observer program but not in the self-sampling program. It is unclear what has created this difference.

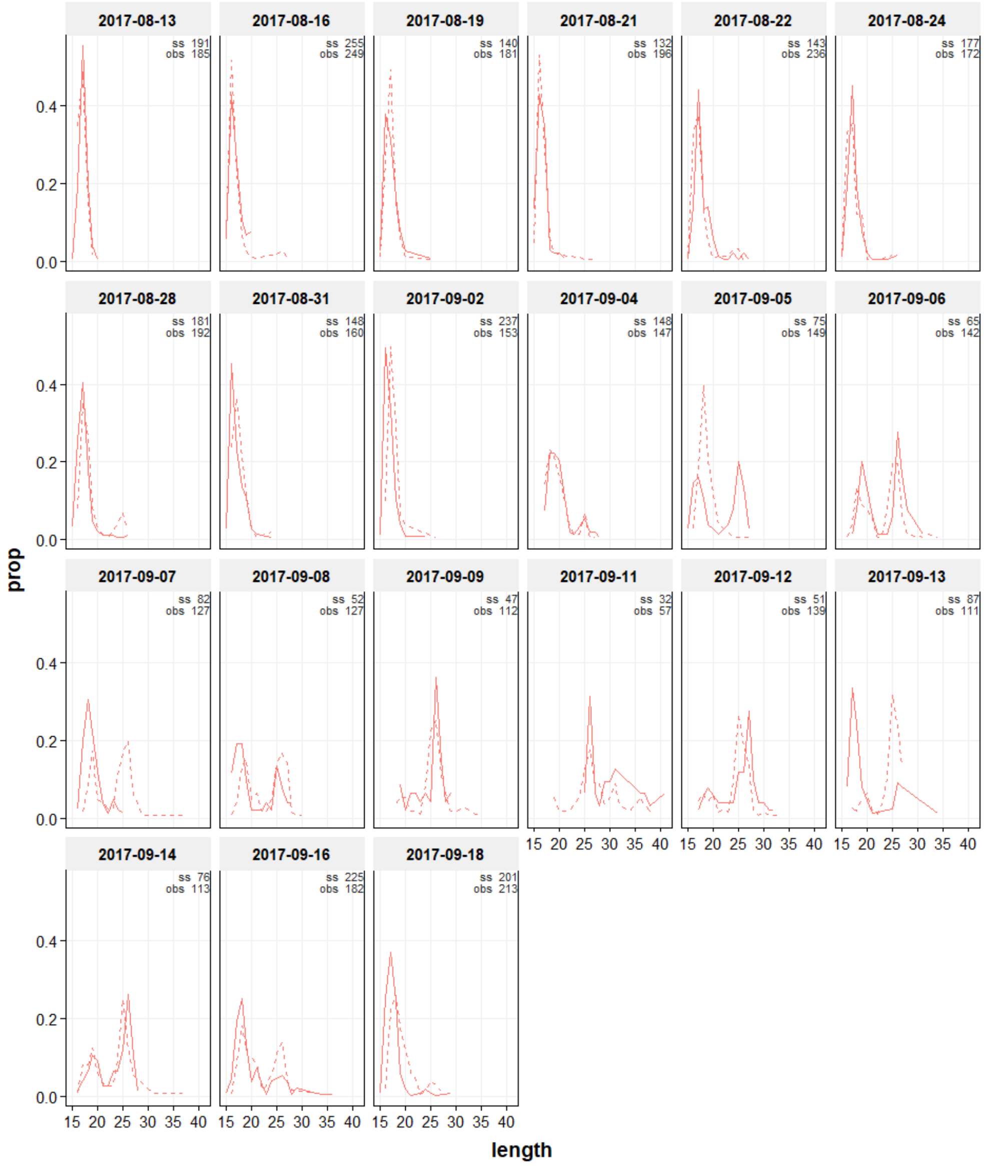

Figure 3.7 Jack mackerel length distributions for trip 201705V2 for dates where self-sampling (solid lines) and observer trips (dashed lines) where available.

Comparison of length distributions of sampled and unsampled trips

The scientific observer program aims to cover at least 10% of the fishing effort in the area. In practice, the observer program in the years 2015-2016 has covered around 35% of the total catch by PFA vessels. However, that still means that a substantial part of the catch has not been covered by the scientific observers. The self-sampling program, because it covers all trips in the area at a somewhat lower intensity, could be used as a way to expand the results of the observer program to the whole fishing season.A comparison of the proportions at length (calculated from raised number at length) by year is shown in Figure 3.8 and the same information by quarter in Figure 3.9. There are substantial differences in the overall annual length compositions based on the coverage (or not) of certain trips in certain quarters, or even parts of trips (e.g. quarters 2 and 3 in 2016). This is also evident from the spatial maps by years and quarter (Figure 3.10).

Overall, this demonstrates that using self-sampling on the basis of full coverage of trips even if not all hauls are sampled, does provide a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel.

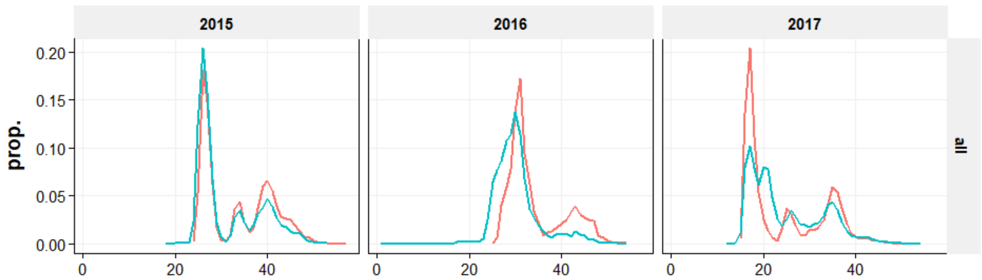

Figure 3.8 Jack mackerel overall relative length distributions from all trips where self-sampling (bluegreen) and observer trips (red) where available.

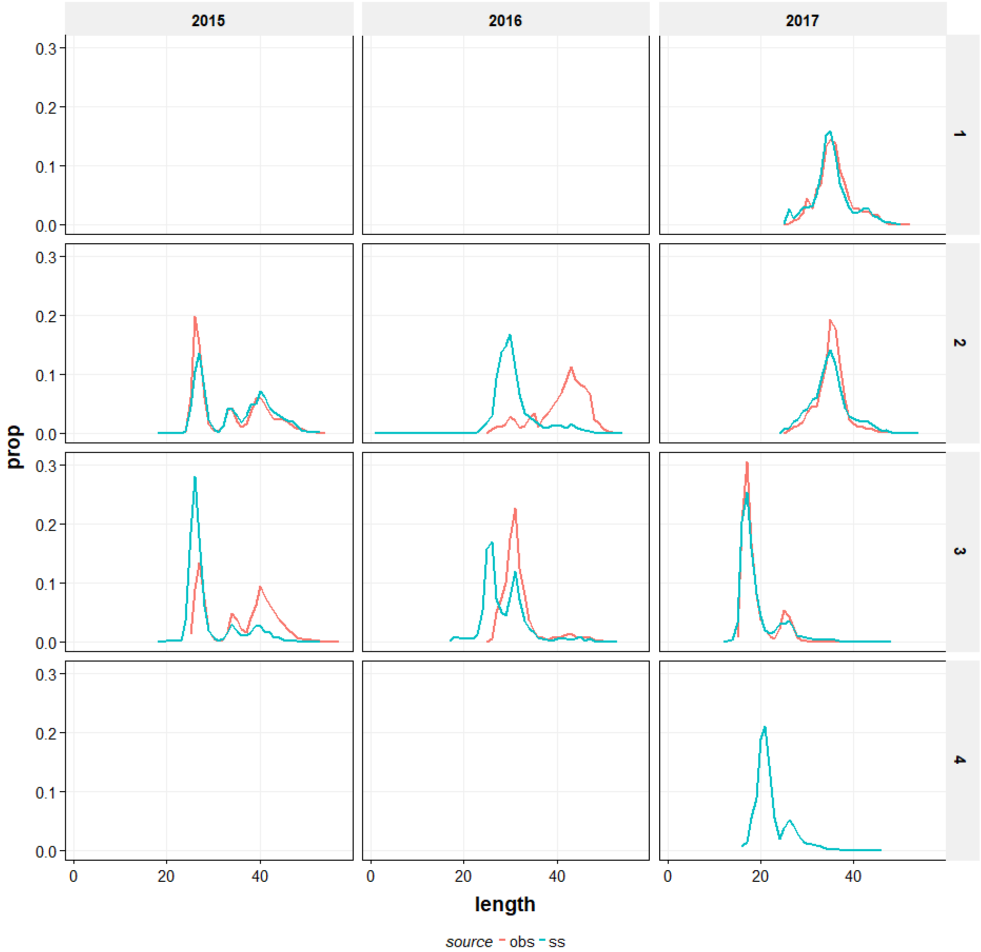

Figure 3.9 Jack mackerel overall relative length distributions by quarter from all trips where self-sampling (bluegreen) and observer trips (red) where available.

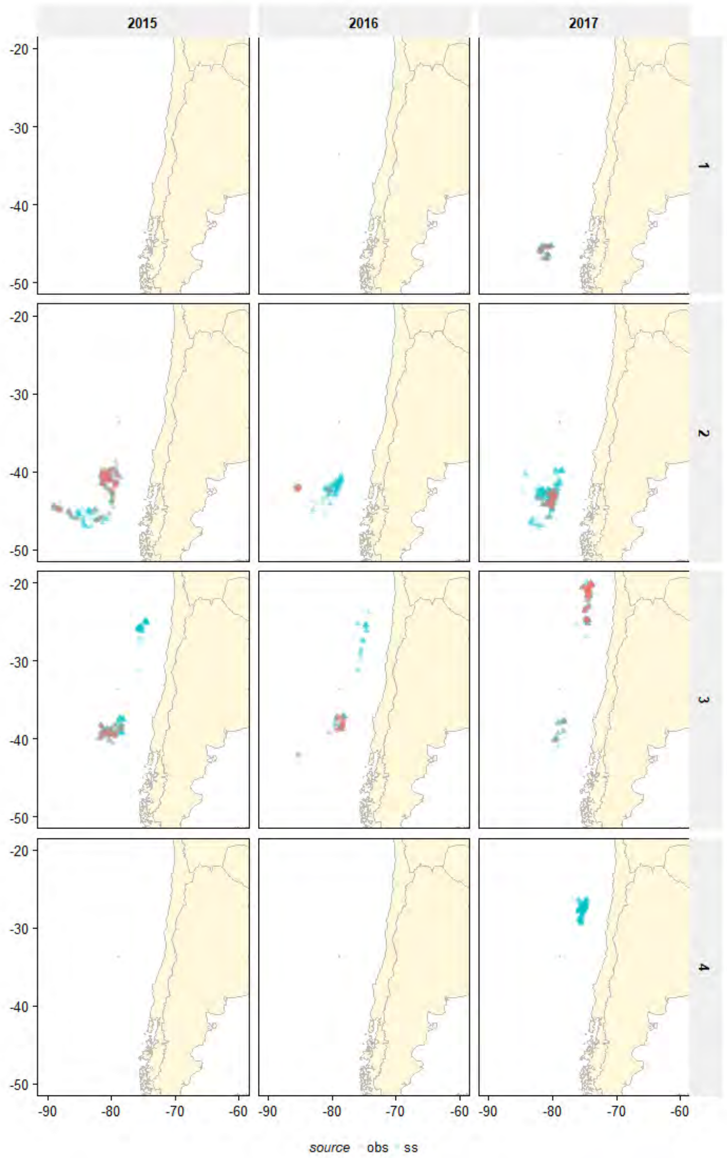

Figure 3.10 mapping of self-sampling hauls (bluegreen) and observer hauls (red) by year and quarter.

Discussion

The pelagic freezer-trawler fleet (PFA) has been carrying out a self-sampling program on the freezer-trawler fleet since 2015, within the northeast Atlantic, West Africa and the South Pacific. In the fishery for jack mackerel in the South Pacific, the PFA self-sampling program has been carried out on all trips. The scientific observer program in that for that fishery is targeted to cover at least 10% of the effort. Over the years 2015-2017 the analysis has shown that around 35% of the catch has been covered by scientific observers. Over these years, 8 trips were covered by both self-sampling and scientific observes.

While working with the data from the self-sampling and from the observer trips, we found that there were a large number of small issues with the consistency of the data. This was largely due to three reasons: 1) the absence of vessel, trip and haul identifiers in the SPRFMO observer database, 2) an apparent lack of consistency checking in the database (e.g. haul dates being prior to the shoot dates), difficulties in the time conversions (according to the protocols, time should be reported in UTC, but this has not always been the case in the self-sampling program). Due to these inconsistencies it has not been possible to create an exact one-on-one match between hauls in the self-sampling and observer program, although we could get very close. We reccoment to include vessel, trip and haul identifiers in the SPRFMO database and to include timezone in the self-sampling template.

The PFA self-sampling program has been initiated in 2015 while the observer program has been carried out for many more years already. Because this was the first time that self-sampling has been applied in this fleet, there was a learning process involved in finding out the best way to measure and record the relevant parameters on board of the vessel. This has also meant that the method of measurement has developed over time which in turn generated challenges for the methods of raising. Initally the sampling was carried out by 'batch' (i.e. a production unit of a certain species and size and quality). By also recording the share of batches within a haul, it has been possible to redistribute the length measurements by batch to length estimates per haul. During the later years of the self-sampling program, this approach has been abandoned, and the sampling was simply carrid out by haul. One of the immediate and very important consequences of the comparison between self-sampling and the observer program has been to critically review the data storage and raising methods employed for the self-sampling program. Several (small) errors have been removed from the code because of the comparisons that could be carried out.

The overal number of length measurements between the self-sampling and observer trips is comparable, but self-sampling samples fewer fish per trip but more (all) trips while the observer program measures more fish but on fewer trips. Comparisons of the cumulative catch per trip show close correspondence between the two sampling programs, as does the species compositions.

Length compositions per sampled trips and hauls are generally comparable. However, during three out of the eight trips, differences were observed in the overall length compositions. They have been further investigated and were shown to derive from either problems in the sampling method employed by one of the scientific observers or by the lower number of measurements in the self-sampling program. For the design of the self-sampling program, this means that when not all hauls will be sampled, that the hauls that are sampled would require a larger sample size (e.g. 50 kg).

A comparison of the overall length compositions by year derived from all self-sampled trips or derived from the raised observer trips, demonstrates that the self-sampling covers a wider part of the fishery (season, area) which explains some of the differences between the two data sources. Thus self-sampling provides a substantial improvement in the coverage of the fishery and thereby a more realistic length composition to be used in the assessment of jack mackerel. The combination of self-sampling and observer trips allows for quality control of both programs while being able to assure a wide coverage of the fishing season.

Of course it should be recognized that scientific observers have a wider objective than the self-sampling program by also focussing on potential bycatch of birds and seamammals or other protected species. While the self-sampling program appears to provide useable and validated data on the composition of the commercial catches, it is unlikely, in the near future, to provide such information on bycatches of protected species. That is therefore an important element of the scientific observer program.

4 Acknowledgements

We would like to acknowedge the crews of the PFA vessels and the scientific observers who have been on board of the vessels. We would like to thank the coordinators of the scientfic observer program for allowing acces to the observer data for this analysis.

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