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Project 114 Update: Progress in improving CANNERY RECEIPT DATA for WCPFC scientific work

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Paper prepared by

Tiffany Vidal[1], Sebastien Gislard[1], Joe Scutt Phillips[1], Tom Peatman[2]

[1] Oceanic Fisheries Programme of the Pacific Community
[2] Shearwater Analytics

Executive Summary

This paper briefly describes the scientific needs that improved cannery data could support including improved precision of species composition for purse seine catch estimates and enhanced understanding of tuna movements for stock assessment modeling and tuna product flow for traceability. The purse seine fishery is the key fishery in the WCPFC, and yet reliably monitoring the catch compositions from it remain challenging. The current practice is to use species composition sampling conducted by observers to generated model-based adjustments to logbook-reported catch estimates. However, operational limitations for observer sampling mean that less than 0.2% of the catch is generally sampled due to the high volume. Improving the coverage of cannery receipt data would be provide an independent data source to improve species composition estimates and overall species-level catch estimates for the purse seine fishery.

Species composition has been the driver for the collection of cannery data, but using cannery receipt data as the basis to describe a physical network of the tuna supply chain for the WCPO could be used to improve the quality of reported tagging data as well as be tested against tag seeding to identify weak nodes for tag reporting and where traceability of product is particularly strong. Here we present preliminary results of building a tuna product flow network using a limited subset of the available cannery data, with the aim of highlighting its potential for such applications to enhance the work of the scientific Commission and to support industry initiatives (e.g., Fisheries Improvement Programs; see the Annex).

The priority remains to receive full cannery receipt data where WCPFC tuna resources are landed and processed; however, given the challenges encountered around improved cannery data submissions to the Commission, we have proposed a complementary initiative to work with members to develop WCPFC standards around the use of cannery receipt data, to address some of these scientific uncertainties. We are proposing the hold a workshop later this year with key CCMs to better understand the cannery data collected, how it is used, and to collectively work toward developing WCPFC standards and methodologies for using these data to improve species-level catch estimates. This intention of this proposal is to work within data sharing constraints some CCMs may have around cannery data, while still realizing benefits for the scientific work of the Commission. The remaining funds available through the no-cost extension of Project 114 (approximately USD 35K) could be used to support this initiative.

SC21 is invited to:

- Note this paper and the potential applications for cannery receipt data;
- Continue to support submission of cannery receipt data to support the scientific work of the Commission, where possible;
- Support the proposed workshop to review cannery data collections in-country and to work toward developing WCPFC standards for incorporating cannery receipt data to improve species

composition and catch estimates from the purse seine fishery (initially funded through Project 114 no-cost extension).

- Discuss the potential additional benefits for tuna tagging and industry initiatives such as traceability of tuna product flow, under the Commission, as detailed in the paper.

1 Background to this project

Project 114 to improve cannery receipt data for the scientific work of the Commission has made progress toward that end, but at a slower rate than anticipated. At the 21st regular session of the Western and Central Pacific Fisheries Commission (WCPFC) in December 2024, the cannery project was ranked relatively low among competing scientific projects. The need to prioritize activities with limited resources is fully acknowledged, however, given the perceived benefits of this work, we felt it was important to bring this topic to the attention of the Scientific Committee once again. In this year's update, we have expanded the scope to illustrate the breadth of work areas that improved cannery data collection would benefit.

Over the previous few years, the Scientific Services Provider (SSP) has tried to engage with Members, Cooperating Non-Members and Participating Territories (CCMs) around the provision of cannery receipt data for the key purposes of improving purse seine species composition estimates. Due in part to perceived sensitivity of these data, little progress has been made. However, given bilateral discussions with key CCMs, we are of the understanding that members may be receiving cannery receipts for their own in-country work, and that there may be an opportunity to pivot away from requesting these data to be submitted to the Commission, where data sharing constraints exist, and toward efforts to develop a standardized approach to using these data, at the CCM-level, to evaluate or adjust the species composition data reported to the Commission, as part of the extant Scientific Data to be Provided to the Commission (i.e., SciData) requirements.

2 Status of cannery receipt data

The SSP has been receiving and processing cannery receipt data for more than a decade now, with the number of receipts received annually generally increasing, from a little over 6,000 in 2013 to more than 14,000 in 2024, largely through International Seafood Sustainability Foundation (ISSF) companies. These data are managed through the TUFMAN2 system, with links to logbook and observer trip-level data relevant to an unloading event. This linking, although not perfect, enables comparisons between the catch volume and species composition reported in the different data streams.

Figure 1: Summary of number of cannery receipts received, by country, over the last five years

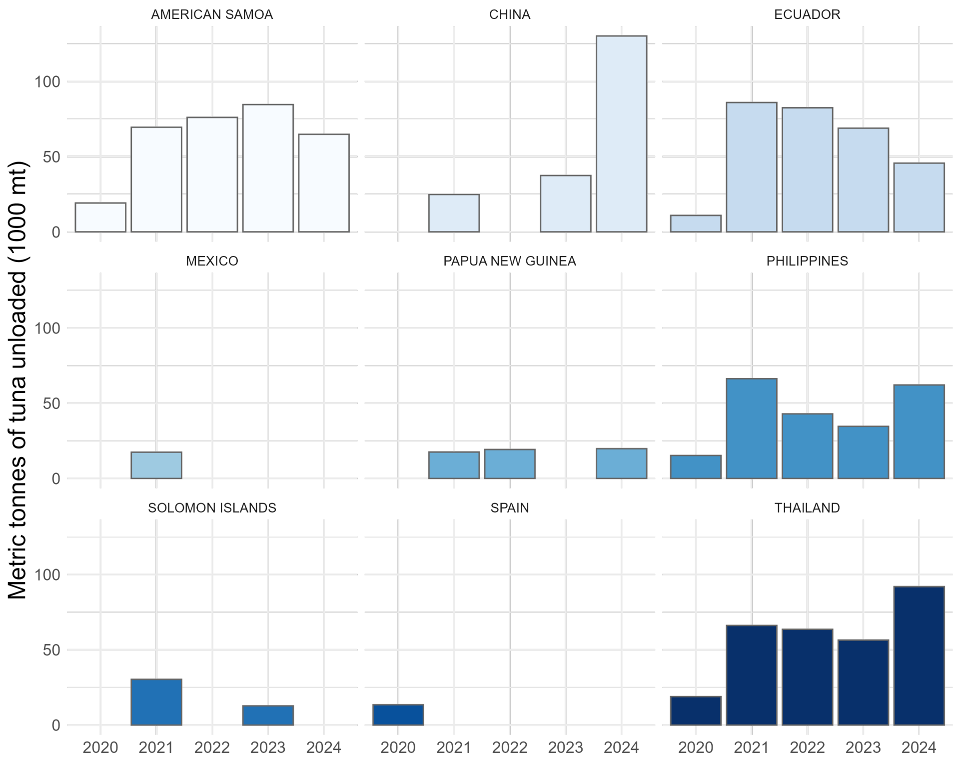

Figure 2: Summary of total tuna catch (SKJ, BET, YFT) reported in cannery receipt data received over the past five years

Cannery receipt data currently cover approximately half of all purse seine catches in the WCPFC (Table 1). Approximately 38% of the reported cannery data have been matched to logbook trips, and about 35% have been matched to observer data.

Table 1: Estimated purse seine tuna catch in the WCPFC compared against catch volumes reported to the Commission via cannery receipts, and the catch volumes and percentages that can be matched between cannery receipts and logbook and observer data

Year	**WCPFC estimate (mt)**	**Processor data (mt)**	**%**	**Matched cannery/logbook**	**%**	**Matched cannery/observer**	**%**
2019	1,821,164	658,271	36	519,581	28	475,699	26
2020	1,641,060	846,488	52	643,626	39	217,288	13
2021	1,584,353	839,877	53	633,383	40	35,859	2
2022	1,606,023	816,949	51	601,059	37	69,058	4
2023	1,598,902	875,906	55	674,399	42	549,056	34
2024	1,873,994	932,127	50	756,095	40	358,426	19

3 Cannery receipt data applications

3.1 Species composition

The WCPFC purse seine fishery represents the largest tuna fishery in the world. The ability to effectively monitor and assess the fish stocks that support the fishery, is paramount. Given the high-volume nature of purse seine catches, it can be very challenging, if not impossible, to obtain accurate information on the species composition of the catch during at-sea fishing operations. The species compositions of catches from the WCPFC purse seine fishery are currently adjusted based on sampling by at-sea observers. While there is a requirement for 100% coverage of observers on purse seine vessels in the tropical western and central Pacific Ocean (WCPO) purse seine fishery, recent species composition sampling can only feasibly sample less than 0.2% of the catch due to the high volume of catches and the need to avoid significant disruptions to fishing operations.

The activities associated with Project 60 have developed around correcting observer-based samples for bias, and obtaining model-based estimates for species composition using observer data. The resulting estimates of species compositions offer an improvement over the nominal reported catches (Peatman et al., 2017), but there remains uncertainty. In particular, the precision of the resulting estimates of species compositions at high resolutions are considered to be low given the low proportions of sampled catch. Cannery receipt data have been identified as a data source that could further improve upon species composition estimates, in providing an independent data source to verify observer-based estimates (e.g., Peatman, 2020). This comparison would be valuable to identify and address any potential biases in the data and in the approach to species composition estimation that is currently used.

Representative cannery data would also provide a precise estimate of species-level catch estimates at a trip level. Using these data to adjust purse seine catch compositions could result in a substantial reduction in uncertainty in the operational-level and fine-scale species composition estimates that underpin a variety of analyses (e.g., 'S-BEST' data). As such, more precise estimates of purse seine catch compositions would improve the quality of scientific work that supports the management of fisheries targeting tropical tuna in the WCPFC Convention Area, including stock assessments.

One of the challenges encountered during bilateral discussions on the WCPFC/SSP receiving cannery receipt data is industry concern around the privacy/sensitivity of these data. These data would be treated with the highest level of confidence, given the WCPFC Rules and Procedures for data dissemination; however, these concerns are understood. One proposal to advance this work, given the perceived concerns and potential data sharing constraints, is to organize a workshop during the second half of 2025 with relevant parties to understand the nature of these data and how, if at all, these data are currently being used to verify or adjust purse seine catch and species composition data (see para 28 in SPC-OFP, 2024; funding would come from the no-cost extension of Project 114 from 2024).

The low precision of estimated purse seine species compositions is considered to be most problematic for bigeye tuna. Bigeye represents a small proportion of the total catch from the WCPFC purse seine fishery, but purse seine accounts for a substantial proportion of the total catch of bigeye across all fisheries in the WCPFC Convention Area. As such, relatively small changes in the proportion of estimated bigeye catch in the purse seine fishery (in absolute terms) can result in large differences to the estimated total catch for the species. The use of cannery data to support species composition estimates, with a reduced reliance on sampling by at-sea observers, would also free up time of observers to focus on other work areas during brailing operations.

4 Summary

Here, we have briefly outlined some key scientific uncertainties that could be addressed, at least in part, with enhanced cannery receipt data provided to the Commission, ranging from increased precision of catch composition estimates to enhancing the tuna tagging programmes and improving our understanding of tuna product flow. Acknowledging the challenges faced in obtaining these data, we have proposed to leverage the value of cannery receipt data through alternative means. Specifically, we are proposing to organize a workshop with CCMs receiving cannery data, to work toward developing WCPFC standards for the use of these data (e.g., for species composition adjustments), for situations where cannery data are not provided to the Commission directly. The initial workshop could be funded by the remaining Project 114 funds that were carried forward to 2025. The Annex to this paper elaborates on one type of analysis using cannery data to bring added-value to the work of the Commission, and potentially the fishing industry.

5 References

Brandes, U. (2005). *Network analysis: methodological foundations*, volume 3418. Springer Science & Business Media.

Peatman, T. (2020). USA purse seine catch compositions. *WCPFC SC16 ST–IP–05, Online, 12-19 August.*

Peatman, T., Satoh, K., Matsumoto, T., Caillot, S., and Smith, N. (2017). Improving the quality of Japanese purse seine catch composition estimates: a Project 60 collaboration. *WCPFC SC13 ST–WP–03, Rarotonga, Cook Islands, 9-17 August.*

Rosvall, M. and Bergstrom, C. T. (2008). Maps of random walks on complex networks reveal community structure. *Proceedings of the national academy of sciences*, 105(4):1118–1123.

SPC-OFP (2024). Project 114 Update: Progress in improving CANNERY RECEIPT DATA for WCPFC scientific work. *WCPFC-SC20-2024/ST-IP-05, Manila, Philippines, 14-21 August.*

SPC-OFP (2025). PROJECT 42: PACIFIC TUNA TAGGING PROJECT REPORT AND WORK-PLAN FOR 2025-2028. *WCPFC-SC21-2025/RP-PTTP-01, Nuku'alofa, Tonga, 13-21 August.*

Syed, S., ní Aodha, L., Scougal, C., and Spruit, M. (2019). Mapping the global network of fisheries science collaboration. *Fish and Fisheries*, 20(5):830–856.

Annex

A1 Tuna product flow and traceability

A better understanding of the structure and flow of the tuna product supply network through the analysis of improved cannery receipt data, would also support several WCPFC science projects. Building models to describe such networks could be used to better understand the quality and reporting rate of tuna tagging data, as well as describe changes to product flow over time and support traceability for companies and Fisheries Improvement Programs.

A 1.1 Network approach

One quantitative approach to describing such systems is to use graph, or network, theory. This method describes the structure of the system using a ‘physical network’, and the way in which separate nodes (vessels, ports, processing facilities, etc.) are connected via weighted ‘edges’. Networks can be used to describe changes to edges over time or in response to variables, and can make probabilistic forecasts, estimating how disruptions, demand shifts, or policy changes may alter the flow of goods. Edges between nodes can be iteratively updated with new data and observations, and the likelihood of new observations tested on inference of hidden structure can be made against what is known about the network.

Using cannery receipt data as the basis to describe a physical network of the tuna supply chain for the WCPO could be used to improve the quality of reported tagging data, as well as be tested against tag seeding to identify weak nodes for tag reporting and where traceability of product is particularly strong. Here we present preliminary results of building a tuna product flow network using a limited subset of the available cannery data, with the aim of highlighting its potential for such applications.

This physical network represents the movement of caught tuna within a region of the Western and Central Pacific Ocean (WCPO), capturing its path from fishing vessels, through potential transhipment by carrier vessels, to its final destination at canneries (Figure A1). The full network (Figure A1; left) was constructed using cannery receipt data from a single year (i.e., 2014) and includes only skipjack tuna (SKJ) catch. Figure A1 (right) presents a focused subset of this broader network, illustrating the flow of tuna to a single cannery (‘Cannery 5’). Each node corresponds to a key entity in the supply chain—fishing vessels (red), carrier vessels (blue), canneries (green) and stock assessment region where fish were caught (purple). The edges, or connections between nodes, reflect the relative volume of tuna transferred from one entity to another. For example, in Figure A1 (right), fishing vessel 21 received ∼85% of its catch from stock assessment region 4 and ∼15% from region 5 and less than 1% from outside of the stock assessment region, unloaded all its catch on carrier 82 which unloaded all its catch to Cannery 5.

The presented network provides a simple representation of tuna product flow in a small part of the

WCPO system. While this network is relatively simple in terms of data complexity and coverage, it illustrates the approach effectively The methodology can be significantly enhanced to expand its scope, increase its complexity, and improve its overall utility.

Other data sources could be integrated to improve the accuracy, resolution, and potential applications of the network. In the current example, spatial context was incorporated by estimating edges between fishing vessels and stock assessment regions using vessel monitoring system (VMS) data from the fishing trip immediately prior to unloading. The distribution of catch across regions was assigned proportionally to the fishing effort within each region. While this approach offers a practical approximation, it carries certain caveats—particularly the assumption that fishing effort is a reliable proxy for spatial catch distribution. Incorporating additional data sources such as logbooks, observer records, or electronic monitoring could help reduce uncertainty, improve spatial allocation, and provide a more comprehensive and robust representation of tuna catch movement within the WCPO system.

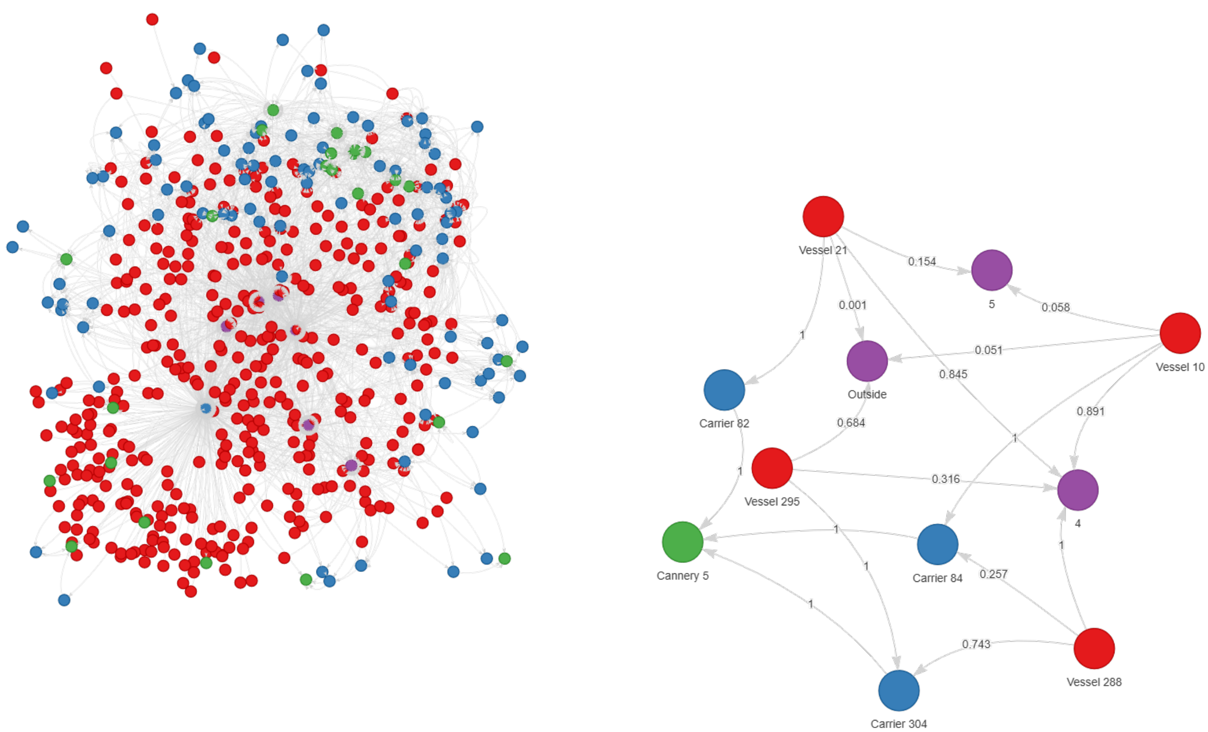

Figure A1: Network of tuna flow. Left: general network including skipjack from 2014. Right: subset of the tuna network focusing on a single cannery; the weighted edges represent the relative strength of the probability of interactions between nodes.

A 1.1.1 Industry benefits

The integration of improved cannery data and with greater coverage of the fishery into a network framework offers substantial operational benefits for the fisheries industry. Once established, the network can be queried to extract key performance indicators such as betweenness centrality (how often a node connects other parts of the network), in-degree (the number of connections coming *in* to a node), out-degree (the number of connections going *out* of a node), community clustering (communities of nodes that are more connected to each other than other parts of the network), providing valuable insights within the supply chain (Brandes, 2005; Syed et al., 2019). These data can streamline workflows, improve traceability across the production process, and enhance reporting procedures. Increased transparency not only boosts operational efficiency but also aids in securing industry certification.

Our example network presented here can reveal important structural patterns and performance indicators. Betweenness centrality, which highlights bottlenecks, points to Carrier 219 as a major hub with a betweenness centrality score of 150 approximately 1.7 times higher than the second node's score. Based on in-degree and out-degree metrics, Carrier 219 receives catch from 22 vessels and distributes it to 10 canneries, accounting for nearly 2% of the total catch flow through the network. While the majority of carriers contribute between 0% and 0.5% of the total catch, some show moderately higher contributions. In particular, the top 10 carriers each from 2% to 5% of the total catch, together accounting for around 25% of the overall total. On the processing end, three key canneries concentrate 40% of all landings, receiving catch from 14, 71, and 93 carriers, respectively, as indicated by their in-degree values. In contrast, the catch from fishing vessels is broadly distributed: the top vessel contributes only 2% of the total volume and vessels typically unload to between 1 and 13 carriers, with an average of 4.5. Community detection through random walk algorithms identified 30 communities, ranging in size from 2 to 318 nodes (Rosvall and Bergstrom, 2008). These include large integrated communities (more than 100 nodes; Figure A2 - left), medium (30-60 nodes) and small, isolated communities (fewer than 10 nodes; Figure A2 -right). The size of smaller communities may be slightly underestimated, as some nodes are pre-assigned to larger groups and cannot carry multiple labels.

Figure A2: Left: Large integrated communities; and Right: small, isolated communities

A 1.1.2 Support for the PTTP Program

Beyond these structural insights, the network framework provides practical support for tuna tagging programs by helping trace the likely origin of recovered tags (SPC-OFP, 2025). This enhances both the quality and quantity of recapture data available for stock assessment models.

For instance, consider a scenario where a tag is recovered on carrier Vessel 82. In the absence of transshipment records—but assuming cannery receipt data are complete—the network approach allows us to infer information that would otherwise be unavailable. The model would assign a probability of 100% that the tag originated from fishing vessel 21, offering valuable insight into the likely source of the recovery. This inference can then be further refined using complementary data sources such as VMS (Vessel Monitoring System) or logbook data to better understand the fishing event and recapture location.

In a more complex case, suppose a tag is found at Cannery 5 with no associated prior data—a common situation in real-world operations. Through a probabilistic framework, the model can estimate the likelihood of each possible source vessel by evaluating the entire set of plausible paths from the cannery back to the fleet, example of output in Table A1.

Table A1: Probability of a tag recovery originating from individual vessels

Cannery	**Vessel**	**Posterior probability**
Cannery 5	Vessel 288	0.638
	Vessel 21	0.148
	Vessel 10	0.134
	Vessel 295	0.080

From a scientific perspective, the network methodology serves as a robust tool for understanding the complex relationships within the tuna supply chain, enhancing the accuracy of research efforts like tagging program and ecosystem modeling. By tracking the movement of tagged caught tuna across the supply chain, the network enables precise identification of geospatial and temporal aspects of the products journey, including predictions on the specific vessel of capture of tagged fish, improving the quality of data integrated into stock assessment models. By incorporating this more complete and accurate information, we can refine our understanding of tuna population dynamics, facilitating better-informed decisions for sustainable stock management and marine ecosystem preservation. Tag seeding data can validate the accuracy of the network, further strengthening the traceability of tuna caught in the WCPO and providing deeper insights into supply chain dynamics.