PHASE 2 REPORT

IMPLEMENTATION OF PILOT PROJECTS TO EXPLORE THE MARKET VIABILITY OF FULL RETENTION OF NON-TUNA SPECIES IN PURSE SEINE FISHERIES

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EXECUTIVE SUMMARY

This report represents Phase 2 of a study undertaken during 2015-2016 on the potential of full utilization of bycatch in tuna purse seine fisheries with the following activities completed:

> Monitored the implementation and reviewed outcomes of pilot projects suggested for consideration at six locations by the Phase 1 study (ISSF Technical Report 2014-12).
> Monitored retention policies at RFMOs, and developments with bycatch marketing, especially in the WCPO and the Indian Ocean.
> Evaluated pilots and prepared recommendations for the consideration of the ISSF SAC.

One pilot project has been successfully implemented (Noro, Solomon Islands) and another is in development (Seychelles/South Africa), whereas others have pursued improvements to bycatch marketing on their own account with varying success. The suitability of additional locations for possible pilot projects was also reviewed.

Available information suggests that bycatch utilization in the WCPO, both formally and informally, has been underestimated to some extent in the past, but that utilization of bycatch sorted and unloaded or discarded during transhipment in remote sparsely populated locations in the WCPO and Indian Ocean is limited, and this remains the biggest single challenge. Increased observer coverage is needed in some fisheries, to better document bycatch and inform the design of marketing pilot projects. Information is also needed on all aspects of post-harvest disposal of both bycatch and small/undersized tunas.

The following recommendations are tabled for consideration, with respect to ISSF work on full retention and possible future work on bycatch utilization.

- Based on the modest success achieved during the Phase 2 activity, it is recommended that pilot bycatch marketing projects should continue in additional locations if possible, along with efforts to monitor and encourage bycatch utilization generally. Priority should be accorded to WCPO and Indian Ocean locations

- As the biggest challenge will be to increase utilization of bycatch transhipped in remote locations with small populations, far from potential markets, and often with limited value-added processing capacity, implementing pilots in such locations with transhipment ports should be prioritized in future e.g. Majuro, Tarawa, Victoria.

- It is not recommended to seek mandatory total retention of bycatch by purse seine vessels supplying ISSF Participating Companies, particularly in the WCPO and IO, until such time as additional pilot bycatch marketing projects have been trialled.

- It is recommended that vessels supplying ISSF Participating Companies commit to improving bycatch handling and quality, in anticipation of possible marketing opportunities arising; guidelines for improved handling could become part of bycatch mitigation efforts within skippers' workshops and in handbooks.

- It is recommended that efforts be made to increase availability and timeliness of observer data on all aspects of bycatch and its utilization, including information on all aspects of the post-harvest disposal of both bycatch and small/undersized tunas.

- RFMOs that have target tuna species total retention policies in place, especially the WCPFC and IOTC, should review their compliance levels and evaluate their effectiveness as a disincentive to the catch of small tunas.

- In the medium term, and informed by project outcomes and reviews of target tuna total retention measures, advocate selected RFMOs (WCPFC, IOTC) for the introduction of

total bycatch retention measures. In the case of IATTC and ICCAT, it was determined previously that utilization of bycatch is already at high levels.

- Increase strategic financial and technical support from ISSF for future pilot projects e.g. trial shipments, market surveys etc., and increase efforts to work in tandem with Government and interested NGOs and agencies (e.g. CI and FFA/DevFish) in bycatch utilization efforts; consider broadening involvement to companies with vessels on the PVR.

1. BACKGROUND

Full retention and subsequent utilization of non-target species is one way in which the wasteful practice of discarding fish at sea can be reduced. This report corresponds to the second phase of a two-phase study contracted by ISSF to better understand the potential for bycatch utilization in tropical tuna purse seine fisheries.

The ISSF study has the ultimate objective to implement regional projects to understand market and other impacts of retained fish being landed, with special emphasis on avoiding conflicts with subsistence and artisanal fisheries and enhancing food security through the development of durable local markets for retained fish. For the period 2013-2015, the study aimed to identify two or three specific coastal countries for pilot projects, such as in the Western Pacific and Western or Eastern Africa, with the individual projects designed to explore the market viability of a retain-all strategy in different identified cases:

(i) Cases where the processing plants can utilize the bycatch (e.g. to make fishmeal or other products) without substantially impacting local fishers;

(ii) Cases where local markets can buy and re-sell the bycatch without significantly undermining subsistence fishers or coastal fishing communities;

(iii) Cases where reliable transportation options exist to market the bycatch outside of the port of landing, without undermining the viability of local businesses or fishers;

The overall study has been divided into two phases, with objectives as described below. This report records and discusses the outcomes of the Phase 2 study.

Phase 1 (2014)

- Review bycatch levels by ocean/fishery and by set type/species (finfish species and sharks, though little attention given to rays and sharks since not usually marketed).
- Review of all available information on current retention policies by RFMOs (and companies, if applicable); some will have non-retention/release policies, notably for shark species, and applicable conservation and management measures.
- Visit major landings sites/ports visits and profile landings/processing capability/market demand/existing artisanal fisheries and the supply chain at each site.
- Identify a minimum of two pilot site locations and design trials, with the cooperation of ISSF participating companies, associated purse seine fleets, local fisheries and resource management authorities, to test market viability with respect to the three identified marketing cases (see above) and any other scenarios as identified.

Phase 2 (2015-2016)

- Review pilot project outcomes after 6-9 month trials (early-mid 2015).
- Monitor and maintain dialogue during the trials (one visit to each pilot site).
- Monitor RFMO and national retention policies and developments during this time
- Evaluate pilots and prepare recommendations for the consideration of the ISSF SAC (September 2015).

The Phase 1 work was completed in 2014 and posted as an ISSF Technical Report 2014-12 in December 2014. The preliminary conclusions of that report are attached as Annex 1. For the Phase 2 work, the Indian Ocean (IO) and Western and Central Pacific Ocean (WCPO) were identified as the most logical sites for pilot projects, given the low current level of

utilization of bycatch in those two ocean areas, as estimated during the Phase 1 study. An attempt was made to set up at least one pilot project in each of these areas, whilst monitoring developments with bycatch marketing more generally.

This report provides a review of Phase 2 activities, reports on the implementation of pilot projects, outlines recommendations for consideration of the ISSF SAC and Board, and suggests future work that might be undertaken.

2. REVIEW OF PHASE 2 ACTIVITIES

The project proposal provided the following guidance for the Phase 2 work, as noted:

"*For the period 2013-2015[1], two or three specific coastal countries will be identified for pilot projects, such as in the Western Pacific and Western or Eastern Africa, with the individual projects designed to explore the market viability of a retain-all strategy in different cases:*

(i) Cases where the processing plants can utilize the bycatch (e.g. to make fishmeal or other products) without substantially impacting local fishers;

(ii) Cases where local markets can buy and re-sell the bycatch without significantly undermining subsistence fishers or coastal fishing communities;

(iii) Cases where reliable transportation options exist to market the bycatch outside of the port of landing, without undermining the viability of local businesses or fishers;

ISSF Participating Companies, environmental NGOs, and fleet partnerships will be essential to promoting and executing these pilot projects, as will active engagement with local fisheries resource management authorities and local and regional scientific bodies."

2.1 Selection of pilot project sites[2]

The process of "selecting a minimum of two pilot sites" was guided by the following considerations from the project outline/proposal:

1) Design trials with the cooperation with ISSF participating companies, associated purse seine fleets, local fisheries and resource management authorities.
2) Test market viability with respect to the three identified marketing cases (see above) and any other scenarios as identified.

Table 1 following lists the six pilot project possibilities that were under consideration at the conclusion of Phase 1. It was clear that the Indian Ocean and particularly the WCPO provided the most under-utilized bycatch situations, with the great majority of bycatch assumed discarded at sea and only minor amounts traded, formally or informally. In these areas, few companies have perceived, let alone seized, any economic opportunities in bycatch marketing

It therefore seemed appropriate to proceed as follows:

- Develop and implement well-designed bycatch pilot projects in the WCPO as the initial priority, involving ISSF participating companies wherever possible.
- Gather information on possible initiatives in the Indian Ocean, especially as the total retention policy (target tuna species now, and possibly bycatch in the future) may be implemented;

[1] timeframe later revised to 2015,following delayed start to the project

[2] Text partially taken from Phase 1report

involve ISSF participating companies and/or vessel-owning companies participating on the PVR where possible.

- Consider other possibilities eg Tema (Ghana), Tarawa (Kiribati), Rabaul (PNG) etc as they develop.

Noro (Solomon Islands) was selected as the most promising pilot location, with the enthusiastic cooperation of an ISSF participating company, with other WCPO possibilities and Indian Ocean prospects, especially in Seychelles, to be further investigated, and potential pilots in other areas to be scoped as time permitted.

2.2 Implementation of pilots

WESTERN AND CENTRAL PACIFIC OCEAN

2.2.1 Noro, Solomon Islands

An initial visit was made to National Fisheries Development (NFD) Honiara office in March 2014, when information was gathered on the current informal disposal of bycatch from the five NFD purse seine vessels and details of current bycatch markets and potential. NFD management was keen to develop a formal arrangement for the marketing of the considerable amount of bycatch[3] to the primary benefit of the crew, and had begun giving consideration to the formation of a credit union to market the fish, using NFD/Soltuna facilities, and receive and distribute revenue on behalf of the crew, in addition to discharging the usual credit union functions for staff.

In August 2014, a decision was taken that all bycatch would become the property of NFD and would be totally retained and landed, for marketing on behalf of the company, credit union and crew. Crew were, however, entitled to continue to take home two rice bags of fish (approximately 50 kgs, mostly bycatch) from each trip. Storage and marketing of the bycatch and undersized tunas, along with inventory and record keeping, began in August 2014. The credit union was established shortly after in September. NFD also received Government approval to market fish domestically and paid the requisite licence fee.

Under the arrangement, NFD is responsible for landing, sorting, storage and sale of the fish (bycatch and undersized tunas) from the Kitano cold storage. Small deductions are made from sales for the credit union (administration and welfare fund) and for NFD administration, with the majority reverting to crew members via accounts in the credit union e.g. SBD[4] 8 of the SBD 11 sale price per kg for rainbow runner. This was later revised to a 5/5/2 split for crew, company and credit union for an increased SBD 12 sale price.

After initial hesitancy on the part of some crew, and restricted bycatch availability during the free-school fishing season, landings and sales gradually picked up, such that by July 2015, NFD staff were confident that over 90% of the bycatch was being marketed and landed, along with undersized tunas (Pitanoe, pers. comm.).

Sales details as provided by NFD are shown in **Annex 2** but, in summary, approximately 680t of bycatch seems to have been sold over the 14 month period from September 2014 to early November 2015, or around 50t per month, on average; 209t were sold during the first 4 months (incomplete details of species breakdown) and 470t in the remaining period,

[3] The NFD fleet fishes mostly on aFADs, though with a significant free school catch seasonally. At a conservative 2% of the catch is bycatch, at minimum of 600t of fish might be expected to be landed annually from the 30,000t catch.

[4] Solomon Islands dollar

Table 1 Summary outline of possible pilot projects, mid- 2014

Location/company (bold if ISSF member)	Activity	Structure	Processing	Existing market	Market development	Local impact on fishers/vendors ?	Status of implementation
SOLOMON ISLANDS Noro (NFD/ Soltuna, **Tri Marine International** parent company)	Marketing quality bycatch species (and undersized tunas) in Honiara and Noro	Crew of 5 purse seiners join credit union to market bycatch (onboard responsibility for maintenance of quality)	Initially no – just whole fish; may process for value-added to higher end markets subject to good initial outcomes	Yes, Honiara – traders purchase in Noro so no transport needed; Year-round supply cf seasonal supply from t/sin Honiara; likely initial volume < 100t ?	Needed if move to value-adding and higher priced local markets	No direct impact Noro; strong local demand for small tunas /bycatch in Honiara; initial market target is < 25% of current leakage during Honiara t/shipment	Under discussion in NFD/Soltuna since late March 2014; hope to fully implement late 2014
KIRIBATI Tarawa; Central Pacific Producers Ltd (Govt), KFL; possible unloading/ t/s by **ISSF members;** increased t/s in recent years	Expanding the current marketing of bycatch by CPPL to involve KFL on > scale	CPPL has exclusive access to bycatch KFL has large processing plant which is currently underutilized	KFL already processing some target species and bycatch for local markets and export but longline b/c.	Well developed artisanal tuna fishery can't meet strong demand; export markets price sensitive, costs high	Not necessary for local; need to develop higher quality value-added by-catch product for export	Probably only moderate; low end of market for bycatch No impact of exports, more employment provided in plant	Further discussion required, product development and market trials; support of ISSF members for t/s
PAPUA NEW GUINEA Rabaul (n/a)	Providing formal market outlet for present leakage	Consultation needed to develop project [replace informal leakage ?)	Whole fish only; buyers may later smoke/salt for distant markets	Yes – unsure of size but large local population (>300,000)	Good market exists but prospects for expansion not well documented	Unlikely; strong demand and local supply of tunas etc limited	ENB PG/FFA working on b/c marketing ; more consultation needed.
SEYCHELLES Victoria	Sorting bycatch, small tunas in Victoria for container (FCL) export	Vessels unload to FCLs and shipped to identified market destinations	Some processing of small tunas for fish meal; modest local b/c sales and export	Small – low population (70,000) and preference for reef fish	Market identified in South Africa but others in E and W Africa	None, as primarily export	May depend on completion of new port and cold storage in Victoria
MAURITIUS Port Louis	Ship bycatch to Port Louis for processing/local sale; process bycatch in port	Transport from Victoria – processing, sale in Port Louis. Limited unloading in Port Louis	Sale of whole or processed fish in Mauritius	imports 20,000t of fish p.a, large population; high quality longline catch probably a better option	Probably not necessary – study of project economics for lower quality transported fish	Very little – current supply does not meet demand; no local artisanal fishery of any size	Economics of transport of sorted product to Mauritius to consider; assess competition with longline b/c
GHANA Tema	Observer coverage, info on retention and marketing of small tunas, bycatch (total retention trial)	Observers upgraded, working with ABNJ project under company supervision; ABNJ project; sales from existing cold store	Not necessary – buyers take whole fish from cold storage at port; fish from other fleets and in future maybe from IO	Strong demand in Accra & beyond; huge fish imports (180,000t); bycatch and tunas 500-800t from vessels plus other fleets	Not needed unless move to value–adding but no real incentive. to do so at this stage	Minimal – huge shortfall in fish supply and ongoing food security issues	Under discussion with company – might need to fit in with ABNJ project; possible supply of additional fish from IOT to be monitored

comprising 66% island bonito[5], 22% rainbow runner, and the balance mahi mahi (8%), mackerel scad[6] and leatherjackets/bubu[7]. Sale prices per kg ranged from SBD 6 (island bonito, mackerel, bubu) to SBD 8 for mahi mahi and SBD11 for rainbow runner. Under-sized tuna were also sold, mostly as mixed target species, and the value appeared to slightly exceed that of the by-catch species, based on sales value data for the 5 month period April-August 2015, when a total sales value of SBD 2.5 million was realized.

The sales value on an annual basis may therefore have reached SBD 6 million. All of the proceeds from the sale of undersized target tunas are retained by the company cf bycatch.

The fish is primarily sold to Honiara-based buyers in Noro who return by passenger ferry at scheduled times to Honiara with the frozen fish packed in over-filled chillers. Prices per kg realized in Honiara from sales at the Honiara market and other outlets may be up to 5 times the Noro purchase price. The quality of the Noro fish is recognized, coming from short trips (generally two weeks or less) with fish well handled on board, and prices are said to be intermediate between the low price of longer-term storage brined transhipment fish traded in Honiara ("leakage"), and the highly priced fresh fish landed by artisanal fishers. Supply from Noro is also year-round, unlike the supply of leakage fish from the highly seasonal/erratic transhipment operations in Honiara. El Niño events in particular strongly impact the amount and timing of transhipment in Honiara (see later).

Approximately 80% of the bycatch is sold in Honiara and the remainder in Noro where demand is also strong (Pitanoe, pers. comm.).The estimated crew take-home catch of possibly 50-100t per year, at one tonne per crew per year, would also be primarily consumed in Noro.

Although some financial arrangements are still evolving (e.g. tax payments for crew), bonus payments for target tuna sales, handling fees for crew etc, the project is mutually recognized as a success and most participants in the process are happy with the initiative.

The key elements of success in the Noro situation have been as follows:

- the formalization of the ownership, disposal and marketing of the bycatch, with strong and continuing administrative support from the parent company;
- formation of the credit union as a mechanism, albeit it at times cumbersome, for transparent sale and revenue sharing amongst members; this will ultimately bear all transactional costs and the mechanism continues to be refined;
- access (free) to cold storage facilities, and sales made from these accessible facilities;
- the good quality of the bycatch from short trips and onboard care is recognized in the market place;
- relatively assured bycatch levels from anchored FAD fishing and year-round availability of product;
- strong regular demand in Honiara (and locally) for bycatch species at good prices;
- transport costs to market and risk largely borne by middlemen (but vulnerable to the regularity of passenger services to Honiara);
- the belief of NFD in the project, and determination that it should succeed.

Conclusion: The project is fully operational and appears sustainable. It should be monitored as the business model continues to be refined, and particularly if value-added processing in Noro is to be considered as an additional option. It can be noted that the NFD aFAD purse seine fishery and the pole-and-line fishery have been granted MSC certification (early 2016).

[5] a mix of *Euthynnus affinis* (mackerel tuna) and *Auxis thazard* (frigate tuna)
[6] mostly ocean trigger fish (*Canthidermis maculatus*)
[7] ocean scad (*Decapterus macarellus)*

2.2.2 Tarawa, Kiribati

Tarawa, where a significant amount of transhipment occurs (120,000t per year, and often more in recent El Niño years e.g. 234,000t in 2014[8], but less in 2015), presents a different perspective for bycatch marketing. Some bycatch is landed voluntarily and is marketed exclusively by the Government arm Central Pacific Producers Ltd. This unloaded brined catch (bycatch and tunas) is of indifferent quality, and is marketed at low price through outlets around the atoll. The volume sold may reach 200t per year (CPPL data). There is some resistance to this product from the competing artisanal fisheries sector, but the needs of the lower socio-economic level consumers prevail and the products are well differentiated by the consumers.

Demand for fresh fish is strong, and per-capita fish consumption is amongst the highest in the world, but Tarawa has an estimated population of only 50,000 so local demand is ultimately limited, meaning that export markets would need to be sought for increased fish volumes.

In late 2012, the Kiribati Fish Ltd (KFL)[9] processing plant and cold storage was opened, primarily to process catch from 5-6 longliners operating from Tarawa, but also locally-caught tuna, reef fish and other seafood from Tarawa and outer islands. The catch of 5-6 longliners is processed at the KFL plant, and some value-added sold on local markets via CPPL – the volume is low, but quality high, and aimed at higher end markets (e.g. hotels).

Approaches were made to KFL and the Fiji partner about the possibility of trial marketing of bycatch sorted and removed during the transhipment process. Some small-scale trials of bycatch marketing in some Pacific Islands including Nauru have reportedly occurred, but this has mainly involved longline bycatch. KFL management were, and remain doubtful of the existence of suitable markets for lower quality brined fish, notably rainbow runner, the main component of the bycatch in the Central Pacific. There was less concern about freight costs as long as bycatch of suitable equality could be secured at a low price eg < US 50c per kg or free of charge. There was some interest in the utilization of small and damaged tunas for fish meal production. Currently, most bycatch would appear to be discarded during or after transhipment, even by Eastern Pacific Ocean (EPO) vessels unloading in Kiritimati which do market most of the bycatch taken closer to home and directly landed in their homeport.

There was considerable interest however in the landing of large yellowfin (> 15 kgs) from purse seine (and also longline) with mention of additional joint venture facilities in Tarawa and Kiritimati (see later) to handle this larger yellowfin for primarily the European canning market. it is not known what developments have since occurred.

The company did seem prepared to consider bycatch marketing trials provided markets could be found and quality concerns addressed. The best prospect would seem to be offered by the new generation of purse seine vessels, notably those of the Korean fleet, some of which store fish at -35^{0}C onboard. There are also concerns with the extent of bruising and damage of the purse seine fish relative to longline fish, rather than salt penetration in brine, but these concerns could possibly be overcome with onboard sorting, quality checking and storage in separate wells if the market demand justified such action. Attempts to interest the Korean fleet in trials have thus far been unsuccessful.

For a possible pilot project to proceed, more information on the volume of bycatch (and quality) per fleet, would be needed, as well as market surveys for whole and partially processed bycatch, by species. Support for such activity might be available eg ISSF if ISSF Participating

[8] SPC transhipment data–Korean vessels 129,000t (55%), Kiribati 36,413t, China 19,159t and Taiwan 17,170t.

[9] Joint venture amongst Golden Ocean Fish (Fiji) (40%),Kiribati Govt (40%) and Shanghai Deep Sea Fishing (China) (20%).

Companies are involved, and maybe the DevFish project in FFA. The Kiribati Government is also thought to be looking at requiring the landing of all suitable fish for processing (presumably yellowfin > 15 kgs and selected bycatch species). If so, this would add considerable impetus to any marketing bycatch trials, preferably for fish from newer purse seine vessels built with enhanced refrigeration quality.

Conclusion: Discussion amongst the Kiribati Government, KFL and joint venture partners, and ISSF, to design possible bycatch marketing trials, would be proposed as the first step.

Port London, Kiritimati (Christmas Island, Line Islands, Kiribati)
An increasing amount of transhipment has been occurring at Port London in the most easterly portion of the Kiribati EEZ (1^0N, 157^0W) in recent years, for longliners and purse seiners, especially those licensed to fish in both EPO and WCPO waters, i.e. EU, Ecuador and US vessels, especially in El Niño years. 30,000t of purse seine fish was transhipped during 2012, increasing to 54,000t in 2014, and over 150,000t in 2015. Most of the bycatch is assumed discarded during transhipment, especially for carriers returning to the EPO where little bycatch from vessels fishing in the WCPO appears to be landed. The local population is very small, with little demand for bycatch or small tuna. KFL has spoken of establishing a joint-venture cold storage in Kiritimati, mostly to buy larger (> 15 kg) yellowfin, as proposed for Tarawa, but this may have implications for bycatch.

Conclusion: Continue to monitor the situation with respect to cold storage development on the island.

2.2.3 Rabaul, PNG

Rabaul is the largest transhipment port in PNG, well positioned in the eastern part of the Bismarck Sea, and with around 160,000t of fish transhipped in some years[10]. There is much leakage and barter for supplies during transhipment, an informal trade which is not quantified but helps to meet the strong demand for fish in the densely populated Gazelle Peninsula (population 300,000+). Bartered fish are sold in the Kokopo local market and also hot-smoked in earth ovens for distribution to more remote parts of the Gazelle. No estimate is available for the annual volume of fish bartered (McCoy, 2012), but it may be 100t or more from the potentially 1,600t of bycatch available (1% of 160,000t) plus a potentially larger amount of undersized or damaged tuna. There is currently no processing of tuna in Rabaul and the disposal of bycatch and small/damaged trade remains informal. There have been several container shipments of bycatch/tunas as feed to crocodile farms in the Markham Valley, near Lae, but these appear have not to have continued on a regular basis (Ilakini, pers.com).

There is, however, potential scope for a pilot marketing project to formalize and expand the existing barter/leakage trade, or indeed work alongside it, in Rabaul. There has long been interest from the East New Britain Provincial Government (ENBPG), now ENB Administration, in the development of a wharf and associated (tuna) fishery facilities in the Rabaul area. A study was commissioned for Kurakakaul on the north side of Rabaul in 2013, and costed at close to K50million (Bostle Project Planners, 2013). More recently, interest has focussed on the development of a Rabaul Tuna Terminal/cold storage (RTT) and Rabaul Regional Fisheries Service Centre (RRFSC) probably on land at Malaguna now owned by NFA and the former Starkist pole-and-line base. It is intended that this facility, as well as storing target tunas prior to sale/export or even processing eventually, would include marketing of bycatch as an explicit part of the operational plan from the outset.

[10] 60,000t in 2014, presumably as a result of El Niño conditions and transhipment further east; similar in 2015 with El Niño continuing (SPC transhipment data).

Although the project is strongly supported by ENBA, and NFA, with additional support from FFA/Devfish and JICA, and apparently potential investors identified, there has however been little progress as at the end of 2015, following a planning meeting in October 2015, and the future of the project remains uncertain.

Conclusion: To continue to monitor possible development of the Rabaul Tuna Terminal (RTT) and associated developments eg wharves and other facilities at Kurakakaul and Kokopo relative to bycatch utilization.

Other PNG locations
Bycatch issues and marketing opportunities at other PNG locations where significant quantities of tuna are transhipped and/or unloaded to processing plants – Lae, Wewak, Madang, Kavieng - are discussed later in the report.

INDIAN OCEAN

2.2.4 Victoria, Seychelles

Port Victoria is one of two major tuna hubs in the western Indian Ocean, with over 80% of the Indian Ocean purse seine catch being unloaded there, and home to the largest tuna cannery in the region, processing up to 90,000t of tuna per year.

Although per-capita fish consumption in Seychelles is high (70 kg pa), the population is small – less than 90,000, albeit augmented continuously by a significant tourism industry. Some undersized tuna and bycatch is unloaded for human consumption and bait, with several companies[11] processing modest amounts of bycatch for export and some local consumption. The government has made available processing units for value-adding activity south of the main port. Nonetheless, this would account for only a small percentage of the 6,000-10,000t of bycatch (3-5% of 200,000t), including undersized tuna, that might potentially be available. As there is considered little or no chance of increasing local consumption, unloading bycatch for export, either whole or in value-added form, appears the only marketing possibility.

The major processing company which also operates a cannery in Ghana, expressed some interest in the exporting by container load of bycatch and small tuna to Ghana where the demand for fish is high and very much unsatisfied.[12] ISSF indicated some willingness to support the freight costs of trial shipments. The total costs of shipping a 20'container (20-25t of fish) were estimated at €450 exclusive of fish purchase price. Fishing companies approached seemed unwilling to provide fish for less than US 50c per kilo, which would raise the all-inclusive transport cost per container to €8,450 or US 53c per kg. This was considered to be uneconomic and was not pursued at the time.

At the initiative of the same processing company, a South African-based marine fish trader with existing markets for bycatch was contacted and expressed interest in the shipping of container loads (FCLs) of bycatch to South Africa. An initial shipment was planned for October 2015 with the cooperation of one of the larger fishing companies but did not work out because of a misunderstanding over timing of the shipment. A second ~ 30t shipment was scheduled for December and was landed in Cape Town on January 24th 2016, but consisted mostly of undersized target tunas rather than bycatch. Indications from an earlier monitored unloading

[11] One such company was recently showcased by Atuna (6th July 2015) "How one company is turning tuna bycatch into a money maker" – Amirante Fisheries, processing and vac-packing bycatch for export. At least two other companies are also operating eg Sea Harvest, Oceana Fisheries, but no data on export volumes.

[12] Seychelles and Ghana signed an administrative agreement in May 2014 to allow them to buy fish from each other, unencumbered, for potential export to Europe.

were that a typical bycatch composition was rainbow runner (10%), mahi, trigger fish, and wahoo (all 5-10%) and mixed fish ("island bonito", mackerel scad, etc.) up to 40-50% (Kaye, pers. comm.). The trader has indicated that, given this expected species composition of the bycatch, the business appears viable, with a potential volume of 5,000t per year or more, and alos that the salt content of the brined fish appears acceptable.

Conclusion: The first trial shipment of product, a 40" container comprised mostly under-sized target species, and did not meet market specifications. There were plans to continue the market trials during 2016 but not further information has been forthcoming. This activity should be monitored as well as the increasing value-adding shore-based activities in Victoria, Seychelles.

2.2.5 Port Louis, Mauritius

Port Louis, Mauritius, is the second largest tuna hub in the western Indian Ocean, after Victoria, with two canneries[13] processing close to 400t/day, a processing hub with two plants processing target tunas caught by purse seine vessels[14] (seven, of which two are Mauritius flag) and stored at -40^{0}C onboard. These processing plants have a capacity of 30,000t pa. Most fish destined for the two canneries (~ 100,000t pa) is transhipped in Victoria, the bycatch presumably removed and discarded for the most part, then the target tunas freighted by container to Port Louis.

There is also a large longline base supplied by over 1500 licensed longline vessels and accounting for nearly 40% of the Indian Ocean longline catch. Significant amounts of high quality bycatch – oilfish/escolar, mahi mahi, wahoo, butterfly tuna, opah, sailfish etc are unloaded.

Mauritius, with a population of 1.3 million, has a strong demand for fish, some of which is supplied by the longline by-catch, but Mauritius still imports up to 20,000t of fish per year.

Prospects for marketing purse seine bycatch in Mauritius might involve two possibilities:

- One company has traditionally frozen catch onboard its purse seiners at -35^{0}C or lower, then processed the fish into loins etc in Port Louis, at least for fish > 3.5kgs. If the fish was unloaded directly from the seiners in Port Louis, there would seem to be some prospect for bycatch recovery unless discarded during loading onboard which unfortunately seemed likely.
  With a reportedly different fishing strategy in 2015 following losses in 2014[15], the fleet was to target FAD fish more frequently, and loin only high quality fish (cf targeting large yellowfin in free schools previously, and with minimal bycatch). This was to be made possible with completion of a large new wharf in October 2015 with cold storage and other facilities in Ile du Port to which the fleet would have priority access; all catch would then be unloaded in Victoria, sorted and either freighted to Mauritius or sold to the local processor for canning. This would further underline the limited opportunities for bycatch marketing in Mauritius unless it was economical to ship fish there for sale, possibly after some basic processing e.g. vacpacked fillets/loins. In any case, no interest has been shown by the company in bycatch marketing.

- Similar comments apply to the new combined processing operation in Mauritius which obtains most of its fish from Victoria after sorting. Any bycatch marketing in Mauritius

[13] The companies merged in November 2014

[14] The fishing company and a large US processor formed a partnership in May 2014 to provide sashimi-quality frozen tuna for US markets, fish potentially processed in Mauritius from the purse seine vessels.

[15] Atuna 3rd August 2015 "How Sapmer plans to become profitable again".

would involve freighting sorted bycatch there from Victoria. Part of the conglomerate showed some interest in exploring this option further, but this became lost during the restructuring and merger, along with a failed MSC certification attempt by a major fishing company operating in the Indian Ocean. Renewed commitments to obtaining MSC certification for several components of the fishery have recently been made. This may have implications for bycatch utilization.

Conclusion: Maintain lines of communication with Mauritius players, to explore possibilities of marketing bycatch transhipped in Victoria, and the feasibility of marketing bycatch transported to Mauritius.

ATLANTIC OCEAN

2.2.6 Tema, Ghana

Ghana, with its population of 25 million, supports a sizeable purse seine (~17 vessels) and pole-and-line fishery (~20 vessels), and hosts one large cannery (180t/day), as well as two other smaller canneries, one of which may not be operational currently, whilst the other is committed to expanding.

Per capita fish consumption is modest (21.7- 24.3 kg pa) but demand is strong - the country imports over 200,00t of marine fish per year. Bycatch and small tunas are landed, notably by the largest company to its large cold storage for onward sale, but marketing arrangements are not clear.

The Ghana tuna fishery was yellow-carded by the EU during 2014 for alleged IUU irregularities, but the card was lifted in October 2015 after the good progress in limiting IUU fishing was recognized by the EU[16]. A possible pilot project would have looked at improved observer coverage on selected vessels initially to better characterize the nature and extent of bycatch, and to look at formalizing the landing and marketing of bycatch by those vessels. In the event, the FAO ABNJ project was launched in Tema in 2014, with a focus on e-monitoring and reducing IUU fishing. This largely obviated the immediate need for enhanced observer coverage; there was also little enthusiasm with the yellow card in place and various other activities ongoing for engaging in bycatch marketing and the project has not proceeded any further.

Other eastern Atlantic Ocean locations

Abidjan (Cðte d'Ivoire) has large well documented landings of bycatch and small tunas (collectively "faux poisson") which comprise around 20% of the catch, and are sold immediately on landing. There is no apparent need for assistance with marketing, as demand for the fish is high, in Côte d'Ivoire and neighbouring countries e.g. Burkina Faso, Mali. Local consumption mostly takes place in restaurants (garbadromes) which serve *faux poisson* utilized in the national dish (garba) (Amandè et al, 2016)

Dakar (Senegal) where a fleet of pole-and-line vessels (17) and EU purse seiners[17] unload in part to a foreign-owned cannery (SCA-SA, 80t/day capacity), was not visited. With pole-and-line catch dominant and probably limited bycatch, Dakar is not seen as a high priority for

[16] Atuna 22 December 2015 "How Ghana has become a role model"

[17] 28 Spanish and French purse seiners licensed to fish in the Senegal EEZ (Hickman, 2015)

establishing a pilot project. What bycatch there is available is probably in strong demand anyway, as everywhere in West Africa, and Senegal itself has a population of 15 million.

No other tuna landing locations in the Atlantic, particularly this involving purse seine landings or transhipment, were visited but these would be minor relative to Abidjan, Tema and Dakar. These other locations would include, for example Cape Verde, Madeira, Azores, Brazil, and Venezuela.

Summary of the pilot projects proposed in Phase 1 report

Table 2 below attempts to summarize the status of implementing pilot projects as proposed in the Phase 1 report, with slight subsequent modification to that list.

One project has been successfully implemented and seems sustainable (Noro), one awaits a commitment to a possible pilot project (Tarawa), another has made some progress with marketing trials underway (Seychelles), one has been overtaken by events, with much bycatch being utilized but not well documented (Tema), another awaits development of a major onshore tuna terminal (Rabaul) whilst one is probably no longer appropriate without economic stimulus, at least for purse seine bycatch (Mauritius).

Table 2. Summary outcomes at the six suggested pilot project locations

Location	Bycatch utilization	Status
Noro, Solomon Is	30,000t pa unloaded by five p/seiners; sorting, storing marketing bycatch and small tunas via company credit union; 680t bycatch marketed in first 14 months, plus under-sized tunas. Has replaced company leakage and captures > 90% of p/seine bycatch; Longline bycatch not involved in local marketing.	In full operation – rated a success
Victoria, **Seychelles**	200,000t pa transhipped, of which ~ 100,000t processed; trial container shipments of bycatch and small tuna to South Africa underway - recent progress unclear.	Work in progress - optimism
Tema, Ghana	17 purse seine vessels and ~ 20 pole-and-line vessels; One cannery processing 180t/day, another smaller; bycatch unloaded but marketing informal, observer coverage developing; demand strong from large Ghana population, and marine fish imports continue to be very large	Overtaken by ABNJ and yellow card issues
Rabaul, PNG (transhipment only)	160,000t pa transhipped in some years, less in El Niño years; no processing; considerable leakage/ barter but no formal marketing; plans to establish Rabaul Tuna Terminal to handle bycatch & tuna, but implementation has been slow	No formal marketing facilities as yet
Tarawa, Kiribati (KFL/CPP)	240,000t transhipment pa, less in recent years; large Kiribati flag p/s fleet, Tarawa-based longline fleet; large processing and cold storage facility; some brined bycatch unloaded and traded; economics and export markets for purse seine bycatch unproven and currently unattractive to companies.	Processors not yet OK re pilot viability
Port Louis, Mauritius	Tuna hub of western IO with two large canneries (now merged), 380t/day; cold storage and processing; some p/s fish unloaded for processing; most fish transhipped in	Little interest in pilot at present –

	Victoria then freighted to Port Louis; demand strong but partly supplied as high quality by large longline hub.	possibly in future

3. ADDITIONAL OBSERVATIONS ON BYCATCH SINCE PHASE 1

Bycatch and food security

Since the Phase I field work was completed in 2014, there have been various calls for the use of bycatch to address present and anticipated future food security uses, notably in the WCPO. Bell et al (2015) propose a role for undersized tuna and bycatch in alleviating food security issues in the Pacific Islands by "distributing small tuna and bycatch offloaded by industrial fleets at regional ports", and recommend extending the current total retention requirement for target tuna species to bycatch. They do identify some of the difficulties in doing so, *inter alia* the variable nature of transhipping activities (often influenced by El Niño events), the remote location of key transhipment ports and the need not to undermine the livelihood of artisanal tuna fishers with cheaper substitutes.

Proposed solutions of an interventionist nature included specifying the number and locations of transhipments under licence conditions, and arranging for all foreign fleets to offload small tunas, with a role for government envisaged in quality oversight during transhipping, and incentivizing small business distribution of bycatch and small tunas.

Pilling et al. (2015), drawing on material presented earlier in Pilling (2013), concluded that the utilization of non-target catch alone will not solve future PIN food insecurity, and that availability, stability and access with respect to the non-target catch needed to be taken into account. They also provide a reminder that formerly discarded undersized target tuna, now required to be landed, could be contributing more to food security under appropriate circumstances.

As important background to the volumes of bycatch potentially available, **Annex 3** shows the volume of **2014 transhipments and unloadings** in WCPO ports, as well as some outside the region, where WCPO fish is landed for processing, based on information in the SPC transhipment database. The database generally does not include unloadings and transhipment in Indonesia, Philippines, Vietnam and China, and may not cover all direct unloadings in some countries or for some flags, especially where at-sea transhipment is permitted e.g. PNG/Philippines. Incomplete unloadings data are also known to be the case for Japan. Nonetheless, data for 2014 include an estimated 1,366,148t of catch from 2048 unloadings, at an average of 667t per unloading, suggesting much unloading may be partial.

Four ports accounted for over 73% of the total catch volume transhipped/unloaded in 2014 - Majuro (36%), Tarawa, Pago Pago and Pohnpei, with Pago Pago mostly unloading for processing and the others transhipment with minimal onshore processing or sale. Rabaul, Kiritimati and Yaizu all had more than 50,000t recorded as transhipped/unloaded during 2014, with five other WCPO ports more than 20,000t. These transhipment ports would be the obvious focus for attempts to market bycatch currently being discarded at sea or during transhipment.

Transhipment and unloadings data for 2015 are incomplete (1832 unloadings, 1,203,734t, maybe representing ~ 90% of the total) but show some differences relative to 2014, possibly related to the ongoing El Niño event. Four ports again account for two thirds of landing volume, but Tarawa and Pohnpei dropped to 5th and 6th respectively, to be replaced by Kiritimati (158,000t) and Funafuti (124,000t), with Rabaul and Pago Pago showing similar volumes to 2014. Majuro remained the top port, with an estimated total of 450,000t in 704 unloadings, slightly down on the 2014 figure. The average volume transhipped/unloaded in WCPO ports remained similar at 656t per event cf. 667t in 2014.

Extent of utilization of bycatch

The Phase 1 study recognized two types of arrangements in dealing with purse seine bycatch during unloading, described as informal and formal (see **Annex 4** for description). It has become clear during subsequent field work that the informal consumption has probably not been fully accounted for, but as with formal arrangements as well, there are few data available on its extent to be able to quantify this utilization. It has also become clear that, particularly in the Indian Ocean and WCPO (exclusive of Indonesia and Philippines[18]), much bycatch is discarded by larger industrial vessels, either at sea, during transhipment or after leaving the transhipment port. Bycatch unloaded in home ports is much more likely to be utilized.

The following examples of bycatch usage, both informal and formal, are briefly discussed for the WCPO as an example where such practices re better known

- *crew consumption onboard*

This is normal practice in most fleets and involves both higher grade bycatch species such as mahi mahi and wahoo and damaged or selected tunas, for fresh consumption/sashimi etc. The quantity involved is unknown but for the 200+ industrial purse seine vessels fishing in the WCPO, this may easily exceed **250t** (say 5kg per day x 250 days x 200 vessels), of which half may be bycatch.

- *crew processing onboard*

On Philippine-crewed vessels in PNG, it is common practice for rainbow runner to be scored, salted and sun dried, and mackerel scad (*Decapterus macarellus*) to be cleaned, split and dried (McCoy, 2012), in both cases for ultimate transport back to Philippines. This is seen as separate from crew taking home whole fresh/unprocessed fish (see next paragraph) and may amount to **50t** net weight per year. No other such examples are known from other fleets but some onboard processing and packaging for home use presumably occurs if feasible to do so.

- *crew take home*

The amount of unloaded fish crew are allowed to take home (if in home port), can be significant. For example, NFD Solomons crew are allowed to take home 2 rice bags (approx 50 kgs) of fish, mostly bycatch, per trip. This amount has been estimated at 5t per month (Lewis, 2014b) for the 5 NFD p/seine vessels so say 50t per year in Solomons alone. It is not possible to extend this to the whole region, but with the growing number of domestically-based fleets eg PNG (Lae, Madang), FSM, Marshall Islands, and Kiribati, this practice may be increasing. A crude guesstimate including some informal sales suggest crew take-home could approach **150t** per year.

- *leakage*

Leakage is generally understood to be the exchange or barter of fish for goods or services, usually during transhipment but also during unloading to processing plants. Bycatch/non target species and undersized/damaged tunas are usually involved. It is almost impossible to document directly, as it is often clandestine, or even illegal in some jurisdictions. It can also involve prostitution as an exchange service in some situations. Whilst some leakage occurs in most ports or transhipment locations, it is best known in the WCPO in Honiara and Rabaul, and in Diego Suarez in the Madagascar, where it is almost institutionalized amongst the stevedores. Leakage is of course minimal during unloading where formal

[18] in these cases, and Vietnam, all catch is retained and marketed/consumed - bycatch becomes byproduct

arrangements for bycatch disposal, involving ownership of the bycatch by the vessel, are in place eg many of the EPO fleets, NFD Noro. The extent of leakage in WCPO might be **several hundred tonnes** pa of bycatch and small tunas, mostly in Honiara and Rabaul, with minor amounts in other ports e.g. Pohnpei, Majuro, Lae and Wewak (McCoy, 2012).

- *regularized disposal of bycatch*

This occurs in several *WCPO* locations – Tarawa (Kiribati) where transhipping vessels are required to land a portion of the bycatch and undersize tunas, as a goodwill understanding of their licence conditions, to the Government company CPPL which has the sole right to handle and market the fish. The amount involved is estimated at **200t** per year, as noted earlier. It is unknown how much of this is small/damaged target tunas and how much is bycatch. The regularized disposal of bycatch in Noro has been described elsewhere.

In the *EPO*, as noted, disposal of the bycatch is typically regulated by the captain or company, with high quality fish being exported, sold to local processors or utilized in the messes/dining room of processors who may have several thousand employees e.g. NIRSA, Salica in Posorja, others in Manta (Ecuador).

In the *Atlantic Ocean*, notably Abidjan, the small target tunas, minor tunas and other bycatch ("faux poisson"), which may comprise 20% of the total catch, are loaded into trucks for immediate carriage off-wharf and sale, sometimes in the distant interior regions and adjoining countries, but in the case of Abidjan, mostly utilized in a network of restaurants (garbadromes) which serve *faux poisson* routinely incorporated in the national dish (garba) (Amandè et al, 2016).

The relative rarity of such situations in the WCPO and IO underpins the attempts to prioritize appropriate pilot projects to increase bycatch utilization in those oceans.

- *cannery processing and disposal of bycatch and small tunas*

Canneries regularly receive unsorted catch if direct unloading occurs from company capture vessels or contract supply vessels. They may process small tunas for fish meal, to augment the normal use of offal from the processed target tunas, but bycatch species are not often used, reportedly because of the different protein/lipid/ash composition relative to tunas. In some plants, neritic/minor tunas[19] may be processed, as evidenced by the rapidly growing "chunk light" market in the US[20]; minor tunas might also be processed for petfood in some plants if the quality is acceptable. Other amounts of bycatch are distributed from the cold storage to staff or local communities in some processing plants eg Wewak, often in significant amounts.
There are often cannery receipts data on the quantities of bycatch received after sorting. In the case of Wewak, it is possible that close to 80t pa might be received. Extrapolating this to other WCPO canneries where unsorted fish are received direct from capture vessels (these are in the minority), it is conceivable that **500t** per year might be received by processors and utilized in some form. This should be checked if data are available.

- *micro-cannery processing of bycatch and small tunas to aid food security in PINs*

During 2016, PNA has proposed the use of table-top micro-canning of the abundant bycatch potentially available at various PIN ports[21] , to alleviate anticipated food security shortfalls in the future. A training course has been held for 13 representatives of four of the eight PNA member countries (PMG, Kiribati, FSM, RMI) with participants duly certified to operate micro-canneries[22]. It remains to be seen what impact this initiative will

[19] mostly *Auxis thazard* and *Euthynnus affinis*

[20] Atuna 6th July 2016 US market flooded with Euthynnus "

[21] Atuna 20th September "Canning tuna bycatch: a food security solution ?"

[22] Atuna 11th October "PNA trains micro-canners to boost food security from bycatch"

have but will likely be for limited specialist domestic consumption only, given the costs of materials.

In summary, the utilization of bycatch may be more widespread than generally realized. In the WCPO or more so the PNA area, this may currently exceed 1,500t per year as a conservative estimate (680t for Solomons, 100t onboard consumption, crew take home, unsorted catch received in processing plants, leakage, some regular disposal, cannery processing etc.) Even 1,500t is not a trivial amount - Pilling et al (2015)[23] estimate an average bycatch (selected finfish) volume in the PNA EEZs as 3,661t pa for the period 2000-2010[24]. Whilst catches have increased further over the past 5 years since then,1,500t of bycatch would represent a significant degree of utilization, albeit it with considerable uncertainty surrounding the utilization estimate.

Longline bycatch

Longline bycatch, usually of considerably higher quality than that of purse seine fisheries, is outside the concern of the study, but is mentioned only because in some situations where pilot projects might be considered, higher quality longline catch, frozen onboard at typically -35^{0}C or below, or chilled may be a strongly preferred alternative to brined purse seine bycatch, especially when the storage time has been months rather than weeks, and well temperatures may be around -15^{0}C or higher. This is the case in Tarawa, probably in Majuro, Port Louis (Mauritius) and Suva, Fiji. The quality (and value) of the longline bycatch is often sufficiently high for it to be exported to overseas markets, as happens in Noro, for example. Availability of alternative longline bycatch (and species) is a factor to consider when setting up pilot projects for marketing purse seine bycatch as it may provide better quality competition.

Availability of purse seine bycatch

Current bycatch estimates for the WCPO are now some years old (Pilling et al., 2015 use 2000- 2010 observer data) and need to be updated, especially now with 100% observer coverage of the industrial fleets in the WCPO since 2010. This leaves open to speculation an important issue ie whether the quantum of bycatch caught in the WCPO purse seine fishery is decreasing, despite increases in the total catch, in the face of bycatch mitigation efforts (escape panels etc), FAD closures, reduced proportion of FAD sets and other factors, especially as FAD sets are responsible for a disproportionate amount of the total bycatch.

As Pilling et al. (loc.cit) note however, the FAD closure in its early years has resulted in an increase in the total number of FAD sets annually and bycatch levels may not have changed significantly. This will remain the working assumption until more recent estimates become available. Shark bycatch levels, not considered in the Phase 1 report, should be an exception to this, with non-retention requirements under several CMMs for particular species, and the increasingly depleted stocks of these species.

Possible future pilots

In the light of additional information gathered during 2015 and part of 2016, a review of locations where significant amounts of by-catch are potentially available and where pilots maybe feasible/desirable follows, excluding those locations already discussed.

[23] this estimates refers only to catch taken in the PNA EEZs, and does not include all marketable finfish species.
[24] the Phase report estimated the total amount of bycatch in the WCPO (PNA waters, other PIN EEZS, high seas and SEA EEZs) as 20,698t, based on 1.18% of a total WCPO catch of around1,800,000t.This contrasts with the Pilling et al estimate, of which bycatch is 0.45% of the total catch.

WESTERN AND CENTRAL PACIFIC OCEAN (WCPO)

Honiara, Solomon Islands
No processing facility (several plans for canneries have not materialized) but significant seasonal transhipment, up to 200,000t pa but variable if not erratic, and strongly influenced by El Niño events. The volume of transhipment in 2014 and 2015, for example, was only ~ 30,000t. The strong demand in Honiara is partly supplied now by the Noro project, and also by the considerable leakage during transhipment. This leakage and concerns about food safety issues provides an incentive to at least improve marketing facilities.

Conclusion: A possible candidate for a pilot project, possibly taken up by other interested parties eg Conservation International. Government involvement may be necessary.

Lae, Papua New Guinea
Expanding processing facilities - three plants already in operation (Frabelle, Majestic, IFC/Besta), one about to open (Nambawan) and several others in the pipeline or proposed. None of the plants are operating at full capacity, and currently process around 150t/day in total. There is some transhipment activity in the port area, mainly unloading to the plants. With its large population (100,000 in the urban area) but importantly road access to the densely populated Highlands, Lae must be well placed for marketing of bycatch and small tunas.
None of the present and future processors are ISSF Participating Companies although GenTuna is one of three shareholders in the Majestic operation and Frabelle vessels are on the PVR.

Conclusion: Lae is seemingly an obvious prospect for bycatch marketing, with probable high home port landings of bycatch, and should be investigated.

Madang, Papua New Guinea
RD Tuna Canners were the first cannery in PNG (Siar near Madang in 1997), mostly supplied by its own vessels which generally catch surplus to the cannery requirements. The company has operated both small fish and bycatch sales to local consumers, and value-added tuna and bycatch from its Vidar shorebase (RD Fishing). Value-added bycatch sales, mostly from the RDex facility and including trigger fish fillets and rainbow runner skin-on fillets, reached over 100t in 2011, whilst 25t of small tuna were sold on average (2010-12) to local communities (McCoy, 2013)
Neither operations seem to have since prospered and their current status is unknown.

Conclusion: The RD Vidar operation seems a good candidate for further investigation, given the previous history of involvement in bycatch and small tuna marketing and value adding.
Not currently an ISSF Participating Company.

Adjacent to Vidar port is the **Pacific Marine Industrial Zone** (PMIZ) with ambitious plans for the construction of wharfage and several canneries, in a major industrial waterfront zone. The project has been plagued by disputes with local landowners and pressure groups, but wharf construction by a Chinese company was approved to commence in November 2015[25].Plans are to house up 10 processing plants with wharfage and other facilities within the industrial complex.

Conclusion: As these developments would provide bycatch marketing opportunities, progress of this ambitious potentially major project should be monitored over the coming years.

[25] Atuna November 2015 “PNG one of China’s largest investment destinations”,

Wewak, Papua New Guinea
Up to 100,000t of fish is transhipped annually here[26], and an existing plant, an ISSF Participating Company, processes up to 100t per day, with plans to double this in the near future. Production is now entirely loins for the European market. Some leakage undoubtedly occurs during transhipment in Wewak, considerable crew consumption of bycatch on company vessels is confirmed, and variable quantities are also unloaded to the plant. Much of this is "island bonito" and rainbow runner but mackerel scad are especially prized.

Conclusion: Bycatch is thus being already marketed/consumed to a large degree but could be better documented.

Kavieng, Papua New Guinea
Occasional and irregular transhipment by PNG-based vessels has occurred in Kavieng Harbour (usually not more than several thousand tonnes per year, and 3,330 t in 2014). A small processing plant operated there for some recent years and would have been able to process bycatch but is currently not operational. A katsuobushi plant operated during the 1970s.

Conclusion: Unlikely to attract attention but the National Fisheries College might be available to support any marketing or value-added processing trials.

Pohnpei, Federated States of Micronesia
One of the major transhipment ports in the region (120-160,000t pa recently but over 250,000t in the past), with a growing nationally flagged purse seine fleet and a longline base, Pohnpei would seem a logical site for a pilot bycatch marketing project. The small population (35,000) and the distance from any potential markets for low value bycatch provide familiar constraints, but some processing facilities are available.

Conclusion: To reconsider the possibility of a bycatch marketing project, probably export-oriented

Majuro, Marshall Islands
Majuro has a small tuna processing plant (30t/day)[27], a sizeable RMI flag fleet, but most notably is now the largest transhipment port in the region (450,000t pa). There is also a longline base, which exports most of the considerable bycatch along with the target tunas. As with Pohnpei, the local population is small (30,000), there is preference for consuming fresh reef fish rather than frozen brined tuna, and the distance to possible markets is great disadvantage. Several local operators e.g. KMI, Jane's Fishery have tried their hand at bycatch marketing, some for export, but have enjoyed limited success. Recently PNA hosted a demonstration[28] of small scale bycatch canning in Majuro for selected PNA members (see earlier). It is not yet clear if this is regarded as a serious option for bycatch processing and domestic utilization in future, or just a local curiosity.

Conclusion: Majuro remains the biggest challenge in the WCPO for bycatch utilization and should perhaps attract renewed efforts to develop a pilot bycatch project for bycatch sorted during transhipment, but only if the economics appear favourable.

[26] down to 25,000t in 2014, and maybe less than 20,000t in 2015
[27] there are reportedly plans to considerably to considerably expand plant production by the Chinese owners
[28] Atuna 28th October 2015 "Micro canning tuna bycatch the answer to food security ?"

INDIAN OCEAN

Diego Suarez, Madagascar
Not visited during 2015 but probably no change since 2014. Diego Suarez, now Antsiranana, continues to function as a seasonal transhipment and slipping port for parts of the European Indian Ocean fleet, but is reportedly in decline (now 15,000t transhipment pa or less) and slipping calls at the Secren slipway have become less frequent. The long-established cannery - Conserverie PFOI (Peche et Froid Ocean Indien), now CDCO (Conserveries de Cinq Oceans,TOG), processes up to 150t/day but currently probably less. Large quantities of bycatch ("*prises accessories*") are landed and taken ashore at the end of each day's unloading. The activity is controlled by stevedores, and is very lucrative; Bycatch traded in this way may be 750t pa, comprising typically 41% small target tunas, 53% minor tunas and the balance other finfish, representing around 3% of the total catch (ACP Fish II, 2013).

Conclusion: There seems little incentive to become involved in this trade which is already partly formalized and may be utilizing most of the available bycatch and small tunas.

Mombasa, Kenya
The Wananchi Marine Products plant which previously produced loins for the EU market in a partnership with a major trader and with a processing capacity of up to 100t/day, has been up for sale since late 2015[29]. Its future is uncertain, and any bycatch from IO purse seine landings which supplied the plant are probably being marketed anyway in densely populated East Africa,

Conclusion: Not visited but seems unsuitable for pilot project consideration. Bycatch if available would be in high demand by the large local population (46 million).

ATLANTIC OCEAN

Dakar, Senegal
A fleet of 17 large pole-and-lie and several handline vessels fish out of Dakar, and EU purse seine vessels (28) are licensed to fish in the EEZ under an SFP. The SCA-SA cannery potentially processes around 80t/day, or 20,000t per year. Disputes with suppliers have disrupted production in recent times. The pole-and-line catch totalled 14,500t in 2013 (Hickman, pers. comm.) and supplies most of the cannery input, supplemented by purse seine landings. The pole-and-line catch contains very little bycatch (<0.5%). If purse seine bycatch was landed, it would presumably be in strong demand amongst the 15 million population of Senegal, as elsewhere in West Africa.

Conclusion: There would seem to be little opportunity or need to encourage the marketing of the small amount of bycatch which is landed and presumably already finds a ready market.

EASTERN PACIFIC OCEAN (EPO)

There may be possible opportunities for bycatch market intervention in the EPO in countries not visited during Phase 1, but given that total retention of tunas has been in place since 2000, 100% observer coverage of larger vessels has been in place for 22 years, along with excellent bycatch and discard data coverage, landing of bycatch has long been encouraged (since 2004), and discards of bycatch species are much reduced, now involving only small individual/species less desirable for sale, possibilities for increased intervention seem very

[29] Atuna 21st December 2015 "TriMarine's ex- partner puts operations up for sale"

limited. In addition, most high quality bycatch is assumed actively marketed, consumed domestically and even exported

Conclusion: Seeking to identify bycatch pilot projects in the EPO would seem to be low priority.

4. DISCUSSION

General comments

By the end of 2015, one successful pilot scheme had become established in Noro (Solomon Islands) trading nearly 700t of good quality bycatch on domestic markets in its first 14 months of full operation, plus undersized target tunas Another is in progress in Seychelles, shipping containerized bycatch form the large scale unloadings in Seychelles to South Africa. Several others have yet to be implemented either because required infrastructure is not in place or concerned parties have yet to be convinced of the economic viability of the projects.

Bycatch marketing continues to be a challenge, particularly in the western Indian Ocean and the central part of WCPO where much of the under-utilized bycatch originates from, but it is presently mostly discarded at various points along the supply chain. The combination of small local populations creating limited domestic demand, the remote location of key transhipment ports, far from any potential markets, and questions in some cases about the quality of the fish after lengthy periods in brine, often at less than optimal temperatures, as well as damage and bruising during handling and storage, all combine to present formidable marketing difficulties. Few economically viable opportunities stand out, otherwise they would presumably have been seized by entrepreneurs, as has been the case in other ocean areas. On the other hand, it has become clear that more bycatch is already being utilized in the WCPO in various ways, both formally and informally, than was previously thought.

Much remains to be done and there are lessons to be learned from the successful Noro example, mostly in the creation of an enabling environment for the project (easier in vertically integrated companies where at least some steps in the supply chain are under central control). There will be no uniform approach, with the marketing strategy and project design tailored to fit the particular circumstances prevailing.

One of keys to successful bycatch marketing will be improved fish quality, taking steps to ensure the fish quality meets the expectations of the market targeted. Brine freezing is probably acceptable on short trip vessels (or where partial unloading occurs), whereas other vessels may initially brine fish then store separately in dry wells if the economic return justifies this extra care, expense and effort. With much partial unloading these days - McCoy (2012) records the average amount per transhipment of < 800t on average and the transhipment/unloading data for WCPO ports for 2014/2015 consistently averaging ~ 600t per transhipment (see earlier), this seems to have continued - so with spare wells, this could become a feasible option.

The project so far has prioritized to work with ISSF Participating Companies since the potential adoption of a bycatch retention measure by the ISSF would be binding on them alone. If that were to continue to be the case, then more active consideration should be given to active financial and technical support of initial involvement in pilot projects e.g. covering freight costs for initial trial shipments, assistance with market surveys in potential locations, support for value-adding trials etc. This might also involve other interested like-minded NGOs e.g.

Conservation International Tuna Initiative[30] and domestic development agency initiatives such as the FFA DevFish project.

Associated with this, the key question is whether the introduction of a total retention measure of bycatch species (by ISSF or as attempted in the IOTC in 2014) would assist the process of enhancing the extent of bycatch utilization. In the WCPO and IO, this may be premature in a situation where much bycatch is currently legally discarded and there are too few examples of successful marketing interventions, especially involving bycatch sorted/discarded during or after transhipment. Transhipped fish accounts for the majority of the target tuna processing receipts in both ocean areas. Strategically, it would be desirable to have another successful example of bycatch market in each ocean area, preferably involving transhipped bycatch to demonstrate that it can be done. This should presumably be a priority if pilot projects are to be continued.

Notwithstanding this priority for transhipped fish projects, bycatch unloaded in home ports probably provide marketing opportunities with the best chance of success, as in the Noro pilot, provided local/domestic markets exist. Bycatch marketing in such situations should be encouraged and pilots implemented where appropriate.

Total retention and marketing of small target tunas vis à vis finfish bycatch

As noted in the Phase 1 study, the issue of marketing small/undersized tuna cannot be entirely separated from the bycatch marketing issues. The two categories are often not distinguished in the market place, and depending on the ocean area, the amount of small/undersized tuna may often be larger than that of the finfish bycatch eg *faux poisson* in the eastern Atlantic. This represents direct competition where the market is limited.

There may also be onboard issues if well space is limited, and small target tunas are required to be retained (total retention measure) whereas bycatch is currently not required to be retained, other than in the EPO.

In the WCPO, numerous anecdotal reports suggest that small target tunas are routinely discarded in small numbers throughout the loading process, and bycatch is often discarded after recording, the latter being both reasonable and legal. It is however unreasonable to expect that already heavily burdened observers will have time to record these minor multiple events of small tuna discards, though legitimate larger scale discards under circumstances prescribed in the CMM will be faithfully recorded.

The difficulty in assessing this small tuna/bycatch situation is that data on the ultimate disposal of the catch, both small tuna and bycatch, is lacking. Tracking small tunas beyond mandatory landing is not required and certainly not occurring. There is a need for an evaluation of the effectiveness of the total retention measure for target tunas, both in compliance terms and as an incentive to reducing the catch of small tunas, as originally envisaged.

[30] The Conservation International (Pacific) Tuna Initiative identifies Improving Food Security as an investment opportunity, with increasing access to tuna in urban areas through marketing of bycatch and tunas as a key activity.

5. RECOMMENDATIONS

- Based on the modest success achieved during the Phase 2 activity, it is recommended that pilot bycatch marketing projects should continue in additional areas if possible, along with efforts to monitor and encourage enhanced bycatch utilization generally.

- As the biggest challenge will be to increase utilization of the large amounts of bycatch transhipped in remote locations in the WCPO and IO, with small populations, far from potential markets, and often with limited value-added processing capacity, implementing pilots in such locations should be prioritized in future e.g. Tarawa, Majuro, Pohnpei, Victoria.

- It is not recommended to seek total retention of bycatch for ISSF Participating Companies, particularly in the WCPO and IO, until such time as additional successful pilot projects have been achieved. It does not seem necessary to implement this measure either for the Atlantic Ocean, where bycatch utilization is already at high levels. In the Eastern Pacific total retention for all catch has long been in place.

- It is recommended that vessels owned by ISSF Participating Companies commit to improving bycatch handling and quality, in anticipation of possible marketing opportunities arising; guidelines for improved handling could become part of bycatch mitigation efforts within skippers' workshops and handbooks.

- It is recommended that efforts be made to increase availability and timeliness of observer data on all aspects of bycatch and utilization, including information on the post-harvest disposal of both bycatch and small/undersized tunas where possible. E-monitoring may assist in this regard.
  [This would inform the fate of retained target tuna, since there is currently no supply chain information after fish is transhipped or unloaded; it may also anticipate the growing need for traceability, CDS, etc.]

- RFMOs that have target tuna species total retention policies in place, especially WCPFC and IOTC, should review their compliance and evaluate their effectiveness as a disincentive in reducing the catch of small tunas.

- In the medium term, and informed by project outcomes and reviews of target tuna total retention measures, advocate RFMOs (WCPFC, IOTC) for the introduction of total bycatch retention measures if appropriate.

- Increase strategic financial & technical support from ISSF for future pilot projects e.g. trial shipments, market surveys et, and increase efforts work in tandem with Government and interested NGOs and agencies e.g. CI and FFA/DevFish in bycatch utilization; consider broadening this involvement to companies with vessels on the PVR.

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ANNEXES

Annex 1

Preliminary Conclusions of the Interim Report

- Bycatch is defined in this study as marketable non-target species (byproduct and discards), but it is recognized that in many cases, catches/landings of small damaged tunas need to be considered, especially in situations where total retention of target species applies, as they are part of the market and may often compete with bycatch.
- Levels of bycatch, even when combined with small/damaged tunas, are low by the standards of other fisheries, and mostly < 5% with the exception of the eastern Atlantic where the special situation of *faux poissons* occurs.[31]
- Bycatch/small tunas is largely but not entirely a FAD issue in tropical purse seine tuna fisheries, and needs to considered alongside the suite of FAD-related issues.
- There are considerable differences amongst ocean areas/fisheries in marketing bycatch, with a high level of bycatch utilization in the EO and Eastern Atlantic. No single approach addresses the marketing potential in each ocean area ie "no one size fits all" – different factors influence marketing viability in each ocean area, with the demand generated by large population in unloading/transhipment the main factor to consider in the first instance.
- The main challenge to dealing with bycatch issues, specifically reducing wastage and achieving at least 80% utilization, lies in two ocean areas, the western Indian Ocean and the WCPO, where bycatch utilization may be less than 20% and 5% respectively.
- In all ocean areas, there are significant data gaps - complete observer data (100% coverage) is available for just two oceans and even those are not fully available in one case (WCPO – data entry backlog). Many aspects of at-sea procedures, from discarding to retention, sorting and storage are not well documented. Despite promising trials with e-monitoring, it is unlikely that it will be able to completely replace observer coverage, at least in the near term, and especially with issues such as species identification (small tunas, bycatch).
- There is a need to begin to collect supply chain information if bycatch marketing issues are to be scoped and understood. This seems an inevitable step for tRFMOs in the light of other parallel developments in catch monitoring and traceability.
- WCPO remains the ultimate challenge for bycatch utilization, with largest amount of bycatch (and even that probably under-estimated) - this is despite the low bycatch rate relative to other ocean areas, and comes about simply because of the volume of the catch (> 50% of the global catch). WCPO bycatch is discarded for the most part at present and there appears to be no ready and obvious solution – the situation is subject to the tyranny of transhipment points widely dispersed over a vast fishing area, and in ports with low populations, and far from alternative markets.

[31] Catch rates of minor tunas are close to 5% of the target tuna catch (Restrepo, 2011) and may be related to a combination of targetting minor tunas inshore areas by at least part of the fleet and a ready market available for the minor tuna catch.

Annex 2 Noro bycatch data

NFD unloading data (t)

Period	I/ bonito	R/runner	Mahi	Mackerel	L/jacket	Other	TOTAL
2013 - One vessel						44.8	
2014 Sept-Dec	(39.9)	(55.4)	n/a	n/a	n/a	114.8+	209.1*
2015 Jan-Nov (part)	307.9	104.3	35.6	12.9	9.1	0.3 (shk)	470.3

* one value for island bonito(IB) of 925t – assume error and changed to 9.25 rather than 0.925
Some large single IB unloadings seem to be normal - one of 55t in 2015, others > 20t ,> 30t
+ for this initial period, complete species composition data are not available

NFD sales data (SI$)

4 month sales data (April-July), rounded to nearest SI$

	April	May	June	July	August	5 mo total
U/S SJ	7,210	5,221	7,274	4,070	278	23,775
U/S YF	7,337	4,350	8,510	4,724	3,225	24,921
U/S Mix	215,502	247,033	481,916	378,317	159,193	1,322,768
I/bonito	32,984	11,422	77,707	78,795	16,879	217,787
R/runner	31,086	81,399	227,221	175,055	118,889	633,650
Mahi			1,646	13,700	33,944	49,290
Mackerel		3,762	4,552	7,486	3,102	18,902
Bubu	42	1,884	850	1,294	4,488	8,558
	294,161	**355,071**	**809,676**	**663,441**	**340,801**	**2,463,150**

Undersized (U/S) fish = 65 % of receipts - SI$ 1.371 million for April-July

Annex 3 Estimated distribution of WCPFC purse-seine vessel transhipments and unloadings in 2014, based on available data.

PORT	Vessel tranship/ unloading (no.)	Estimated tuna catch (mt) transhipped/ unloaded	Disposal
MAJURO	619	490,875	Tranship for export
TARAWA	294	244,113	"
PAGO PAGO	156	146,969	Processing at plants
POHNPEI	210	120,254	Tranship for export
RABAUL	101	59,768	"
KIRITIMATI	56	53,569	Tranship to EPO
YAIZU	135	51,526	Processing at plants
FUNAFUTI	36	32,507	Tranship for export
WEWAK	61	24,840	Tranship/processing
NORO	73	23,801	Tranship/processing
MADANG	90	21,234	Processing at plant
HONIARA	33	20,481	Tranship for export
POSORJA	14	18,289	Processing at plant
MAKURAZAKI	48	18,069	Processing at plants
LAE*	39	15,724	Processing at plants
YAMAGAWA	32	14,527	Processing at plants
KAVIENG	6	3,313	Tranship for export
KAOHSIUNG	20	2,206	Processing at plant
MANTA	4	1,745	Processing at plant
BUSAN	6	1,360	Processing at plant
GENERAL SANTOS*	14	585	Processing at plant
ISHINOMAKI	1	395	
	2048	1,366,148	

* data known to be incomplete; tuna catch for Japan port unloadings also incomplete

Annex 4 Bycatch procedures and arrangements

(modified slightly from Phase 1 report)

	Informal /unregulated	Formal /regulated
Bycatch ownership	Crew given tacit ownership of bycatch and small/damaged tunas; may process (salt/dry) onboard in some cases	Captain/fishing master retains control over bycatch storage onboard and disposal/sale in port
Sorting	Minimal sorting until transhipment or unloading, when most sorting occurs; some preferred species set aside for salting/drying in some cases	May be high grading and sorting below deck; live releases (sharks etc) on deck
Storage	Typically mixed in brine wells with target tunas; in some cases may be stored in wells above brine pound boards after initial chilling in brine for better quality;	Stored in separate wells or even dry wells for larger high value bycatch species eg mahi mahi, wahoo. Crew consumption (small amounts) may be stored in food freezers
Unloading/ transhipment	Bycatch/small tunas put to one side and often not sold/transferred to trader until late in day, after hours in the sun	Bycatch unloaded when buyers/receivers available; longer time taken to unload dry freezers/wells
Cost to buyers/traders	Usually provided free (by vessel) with only scavenging/retrieval costs involved for buyers; crew retain sales or traded goods as traditional "bonus" entitlement; often unable to trade the whole of bycatch & small tunas available ; sold on the spot	Usually sold at agreed price, possibly on pre-arranged sales contract; proceeds distributed amongst officers and crew, according to captain's judgment; can be stored onboard until sold or transferred to cold storage onshore
Quality	Often poor with high salt content, but depends on time in brine, temperature etc; usually receives low price unless demand very strong eg Diego Suarez	Generally good; moderate-high price if dry freezer; may be brined initially to reduce temperature; Sapmer example of ~ total retention, high quality at -35^0C
Utilization	Where alternatives eg processing plants, may be used for fish meal, animal food, bait, and not often for human consumption unless very strong demand, fish supply is short or the low price is attractive for low income earners	Sold as whole fish or may be processed onshore for export and/or local consumption. A viable stand-alone business in some ports