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PROJECT 42: PACIFIC TUNA TAGGING PROJECT REPORT AND WORKPLAN FOR 2016-2017

WCPFC-SC12-2016/RP-PTTP-02

SPC-OFP

1 Introduction

The steering committee report for the Pacific Tuna Tagging Programme (PTTP) for 2016 reports upon the tagging activities undertaken in 2015 under the banner of the PTTP, tag recoveries, and tag seeding activities. The objectives of the PTTP are specified in SC6-GN-IP-04. Funding support for the PTTP has been provided by the PNG National Fisheries Authority, New Zealand Aid Agency, the Government of the Republic of Korea, Australian Centre for International Agricultural Research, European Community 8th European Development Fund, European Community 9th European Development Fund, European Community 10th European Development Fund, the French Pacific Fund, the Government of Taiwan, Heinz Australia and the Global Environment Facility. In 2011, SPC and the PNG National Fisheries Authority (NFA) began a three-year tag release programme in the PNG EEZ, funded by NFA. This project, referred to here as the PNG Tagging Project (PNGTP) is considered under the umbrella of the PTTP and is reported in this annual report.

The overall operational structure of the PTTP is as follows (with planned work for 2016-17 shown in red):

	Time period	**Operational area**	**Tagging vessel**
Phase 1	Aug – Nov 2006	PNG	*Soltai 6*
	Feb – May 2007	PNG	*Soltai 6*
	Oct – Nov 2007	Solomon Islands	*Soltai 6*
	Feb – Mar 2008	Solomon Islands	*Soltai 6*
	Apr 2008	Solomon Islands	*Soltai 105*
Phase 2 (to date)	May – Jun 2008	Central Pacific (CP1)	*Double D*
	Jun – Nov 2008	Western Pacific (WP1)	*Soltai 105*
	Mar – Jun 2009	Western Pacific (WP2)	*Soltai 105*
	May – Jun 2009	Central Pacific (CP2)	*Double D*
	Jul – Oct 2009	Western Pacific (WP3)	*Soltai 105*
	Oct – Nov 2009	Central Pacific (CP3)	*Aoshibi Go*
	May – Jun 2010	Central Pacific (CP4)	*Aoshibi Go*
	Oct – Nov 2010	Central Pacific (CP5)	*Pacific Sunrise*
	Oct 2011	Central Pacific (CP6)	*Pacific Sunrise*
	Nov – Dec 2011	Central Pacific (CP7)	*Aoshibi Go*
	Sep – Oct 2012	Central Pacific (CP8)	*Pacific Sunrise*
	Nov – Dec 2013	Central Pacific (CP9)	*Pacific Sunrise*
	Aug 2014	Central Pacific (CP10)	*Pacific Sunrise*
	Sep - Nov 2015	Central Pacific (CP11)	*Gutsy Lady4*
	Sep-Oct 2016	Central Pacific (CP12)	*Gutsy Lady4*
	Sep 2017	Central Pacific (CP13)	to be determined
PNGTP	Apr – Jul 2011	PNG (PNGTP1)	*Soltai 105*
	Jan – Mar 2012	PNG (PNGTP2)	*Soltai 105*
	Aug 2012	PNG (TAO trial)	*FTV Pokajam*
	Apr – Jun 2013	PNG (PNGTP3)	*Soltai 101*
	July 2016	PNG (TAO trial)	*FTV Pokajam*

The report provides a review of work undertaken in 2015-16, an update of the overall programme results to date and the proposed work plan for the PTTP for 2016-2017.

2 Summary of PTTP Activities in 2015-2016

Since SC11, PTTP activities comprised one troll/handline cruise, CP11, in the tropical central Pacific, continued implementation and refinement of tag recovery processes and tag seeding, and data preparation for use in the 2016 skipjack stock assessment.

CP11 was a cruise of 56 days duration conducted in Sep-Nov 2015 targeting bigeye tuna aggregations associated with the TAO oceanographic moorings (Figure 1) located along the longitudes 170°W, 155°W and 140°W and between the 8°N and 5°S Latitudes, and drifting fish aggregations devices (dFADs) in this area. CP11 was designed to include data collection on tuna movements, exploitation rates and dFAD association dynamics. This work is the result of collaborations between SPC, IATTC, Tri Marine and ISSF and is detailed in the Acoustic tagging section of this report. We are grateful to these organisations for their support of this cruise.

The Hawaii-based multipurpose vessel *Gutsy Lady 4* was chartered for the cruise. A total of 2,959 fish (1953 bigeye, 773 yellowfin, 228 skipjack, 3 trigger fish and 2 silky sharks) were tagged (Figure 2, Table 1). A majority (62%) of the total tagged fish were released in association with dFADs and the rest in association with TAO moorings. Within these releases, 95 archival tags were deployed on bigeye tuna and 70 on yellowfin tuna. Three dFADs were equipped with a satellite communicating acoustic receiver manufactured by Vemco. These types of units utilize Iridium satellite communication and eliminate the need to retrieve the receiver to download information.

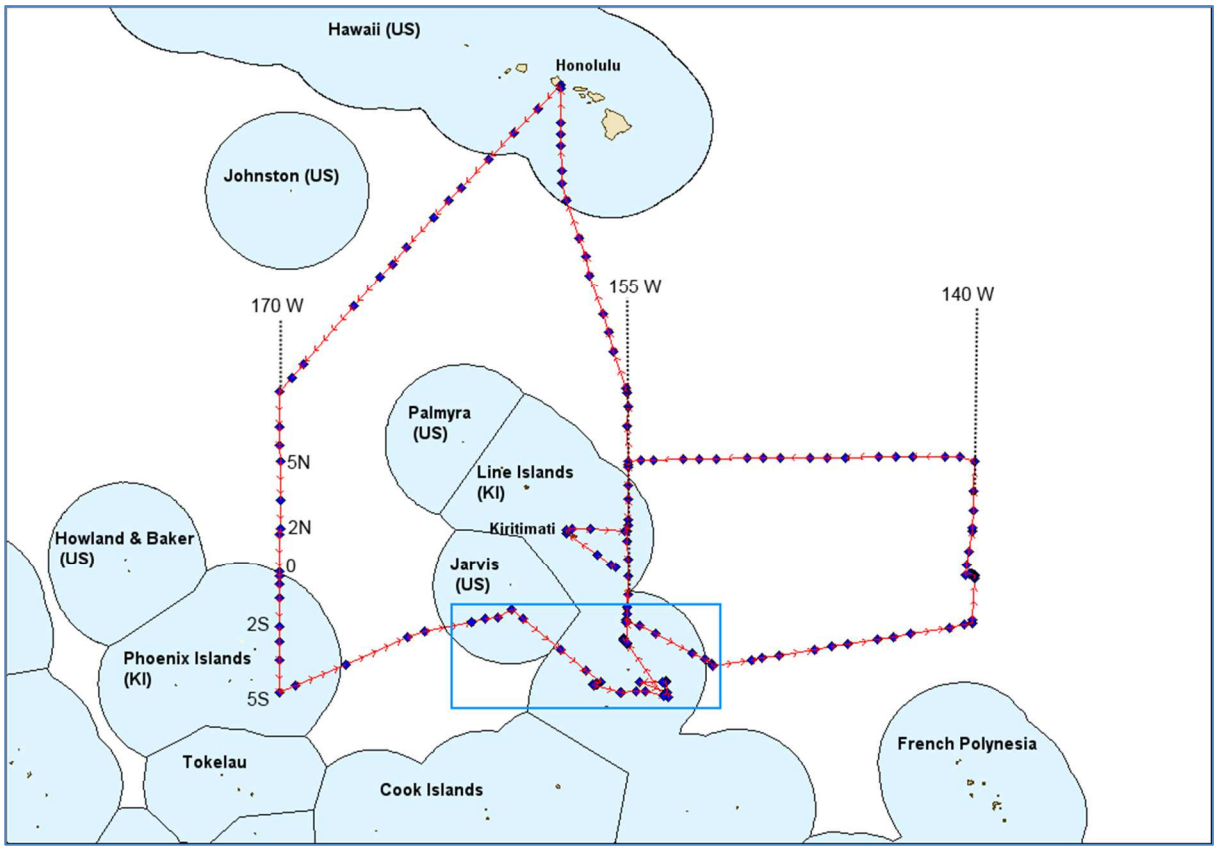

Figure 1: CP11 cruise trajectory over 56 days during Sep-Nov 2015 targeting bigeye tuna aggregations associated with the TAO oceanographic moorings located along the longitudes 170°W, 150°W and 140°W and between the 8°N and 5°S Latitudes. The blue rectangle delimits the dFAD research area.

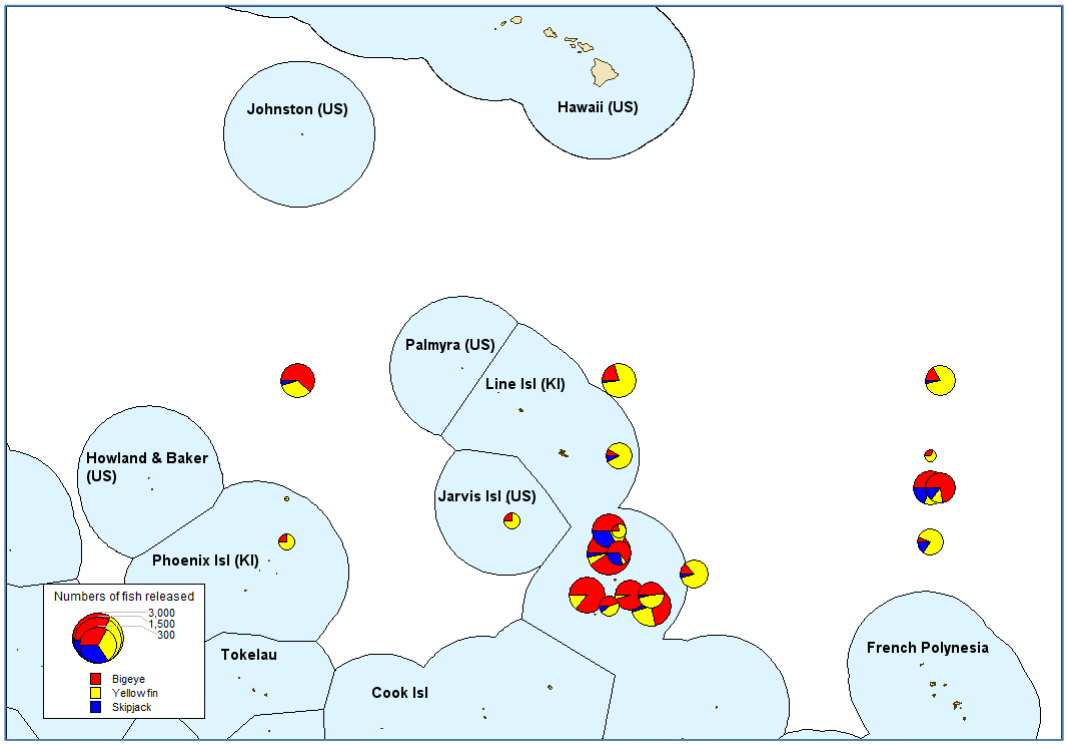

Figure 2. Distribution of tag releases during CP11 cruise.

Table 1: Number of fish tagged per species and tag type during CP11. 7 YFT and 2 BET were double tagged with sonic and archival tags.

Tag type	BET	YFT	SKJ	other	Total
Sonic	23	21	10	5	**59**
Archival	95	70	0	0	**165**
satellite	0	1	0	0	**1**
Conventional Y13	1837	688	218	0	**2743**
Total fish tagged	**1953**	**773**	**228**	**5**	**2959**

2.1 Acoustic tagging

The acoustic tagging component of the CP11 cruise consisted of instrumenting 3 dFADs with VR4 Global satellite communicating acoustic receivers manufactured by Vemco. Tagging of the main species associated with the dFADs was done with coded, pressure sensitive acoustic tags (maximum 23 per dFAD) to investigate:

1. Vertical behaviour of species at dFADs to improve processing of echo sounder buoy data, in order to better distinguish different species from echo sounder buoy data, and
2. The behaviour of tuna and non-tuna species at dFADs to better understand the effects of dFADs on these species, including residency, vertical behaviour, and daily presence/absence patterns.

A total of 9 different dFADs were visited (see Figure 3) and tagged fish were released in association with 8 of them. Fifty nine fish were implanted with acoustic tags across the 3 equipped dFADs. Details of acoustic tagged species are displayed in Table 2.

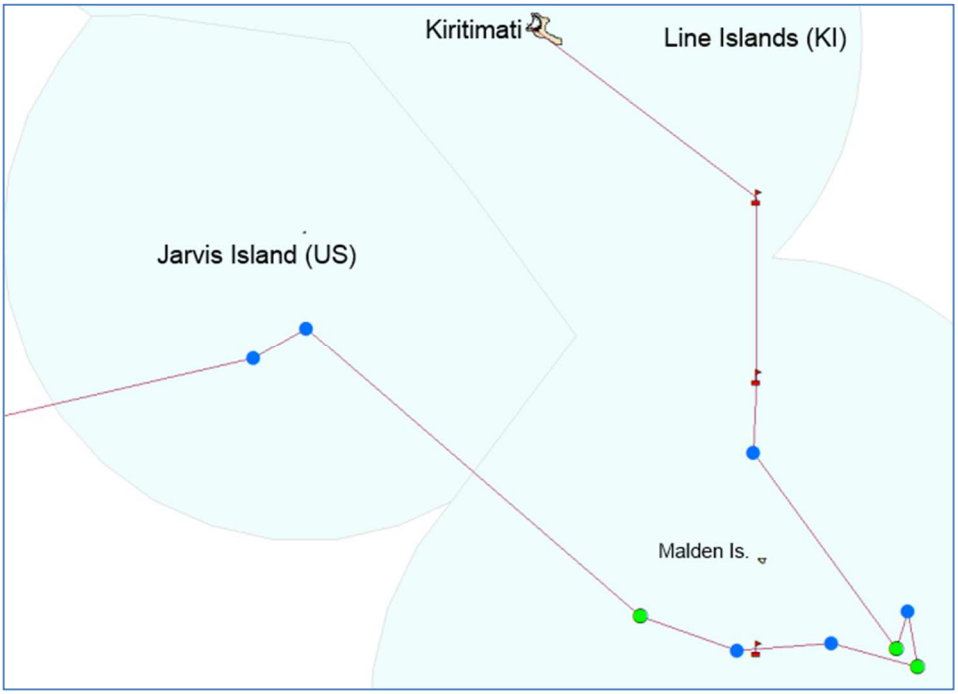

Figure 3. Positions of the 9 visited dFADs. The green coloured circles are the FADs where acoustic tagging occurred. Red flags are TAO mooring positions.

Table 2: Summary of animals implanted with acoustic tags during CP11. In brackets, number of fish that also received an archival tag.

Species	Exp1	Exp2	Exp3	Total
Yellowfin	10 (3)	6 (1)	5 (3)	21
Skipjack	0	36	7	10
Bigeye	8	8 (1)	7 (1)	23
Silky shark	2	0	0	2
Triggerfish	1	0	2	3
Total	**21**	**17**	**21**	**59**

3 PTTP Results

The release numbers and recovery percentages to date of conventional and archival tags made during the 11 Central Pacific (CP) cruises, the PNGTP and Phase 1 and 2 of the PTTP are detailed in Table 3.

Table 3. CP, PNGTP and total PTTP releases numbers and % of recoveries to date (May 2016) of conventional and archival tags.

Project	Tag type	RELEASE NUMBERS				RECAPTURES PERCENTAGES			
		Skipjack	Yellowfin	Bigeye	Total	Skipjack	Yellowfin	Bigeye	Total
CP	**Conventional**	652	2,191	37,044	**39,887**	4.4	11.9	28.9	**27.6**
	Archival	30	229	651	**910**	0.0	4.4	13.5	**10.8**
PNGTP	**Conventional**	80,439	27,070	2,915	**110,424**	20.0	18.4	21.0	**19.6**
	Archival	0	68	12	**80**	NA	25.0	58.3	**30.0**
Total PTTP	**Conventional**	246,861	106,446	46,376	**399,683**	17.3	16.7	27.3	**18.3**
	Archival	127	639	837	**1,603**	3.1	10.2	14.7	**12.0**

3.1 Biological sampling during tagging cruises

A total of 5923 stomach samples have been collected since the beginning of the PTTP, mainly from skipjack, yellowfin, bigeye and albacore tuna (Table 4). The examination of the stomachs is an ongoing process and is conducted in the laboratory at SPC headquarters. A total of 5492 stomachs, representing 93% of the samples collected, have been examined and the corresponding data entered into a dedicated database (Table 4).

Table 4. Total number of stomach samples collected and analysed to date (May 2016).

PREDATOR SPECIES		COLLECTED	ANALYSED	% ANALYSED
SKJ	SKIPJACK	2645	2474	94%
YFT	YELLOWFIN	2127	2014	95%
BET	BIGEYE	447	357	80%
ALB	ALBACORE	245	245	100%
KAW	KAWAKAWA	124	118	95%
RRU	RAINBOW RUNNER	126	112	89%
FRI	FRIGATE TUNA	95	95	100%
DOL	MAHI MAHI / DOLPHINFISH / DORADO	71	45	63%
SWO	SWORDFISH	6	6	100%
WAH	WAHOO	11	6	55%
MSD	MACKEREL SCAD / SABA	5	5	100%
FAL	SILKY SHARK	4	4	100%
BUM	BLUE MARLIN	3	3	100%
BRZ	POMFRETS AND OCEAN BREAMS	3	3	100%
CFW	POMPANO DOLPHINFISH	2	2	100%
NXI	GIANT TREVALLY	1	1	100%
YTL	AMBERJACK (LONGFIN YELLOWTAIL)	1	1	100%
PLS	PELAGIC STING-RAY	1	1	100%
	TOTAL	**5923**	**5492**	**93%**

3.2 Conventional and archival tag recoveries for the PTTP

As at 24 May 2016, a total of 73,367 tagged tuna had been recaptured and the data reported to SPC. The numbers of conventional tag recoveries by species and by main tagging cruise are given in Table 5. Tag recoveries have occurred over the duration of the project, and are expected to continue for several years. Tag attrition follows the expected declining pattern (Figure 4) with the rate of decline in skipjack tag returns indicating their shorter expected lifespan and higher natural mortality when compared to yellowfin and bigeye tuna. The recovery rates of yellowfin and bigeye tagged with archival tags and conventional tags vary depending on cruise (Table 6). Initial observations of this data suggest increased tag rejection/fish mortality with archival tagging on some cruises.

There is a notable reduction in bigeye conventional tag recovery rate from CP9 onwards (from ~30+% up to cruise CP8, down to 13% for CP9 and to 2-3% for CP10-11, Table 5).

For CP10 and CP11 there are significant changes in the distribution of tag release and subsequent fishing activity which readily explain the differences. During these cruises the release method changed with 45-60% of the releases being done on dFADs, as opposed to 100% at TAO in previous cruises. This also changed the species composition of tagging with ~30% less bigeye being tagged on dFADs compared to tagging on TAOs. Further, the dFADs were not fished in the following month as it was FAD closure period (previously many fish were recaptured during this period, Figure 4). The assumption is that fish had more time to disperse before fishing recommenced, thus reducing the tag recapture rate. Also no large school aggregations were found around the TAOs during those two cruises with maximum releases on one buoy being around 200 fish, whereas 1000-4000 fish have been released on at least one TAO buoy during the previous CP cruises.

The observed reduction in bigeye recovery rate for the CP9 cruise (13% c.f. 30%+) is less readily explained. Possibly some of the fleets that increased their effort in the Phoenix and Line Islands EEZ after CP9 cruise have not reported all their tag recoveries. This needs further investigation.

Table 5. Tag releases and recaptures for the PTTP to date (24/05/2016).

Cruises	Releases				Number recovered (% recovered)			
	SKJ	YFT	BET	Total	SKJ	YFT	BET	Total
PG1 Aug-Nov 2006	13,948	7,806	562	**22,316**	2,645 (19%)	1,806 (23.1%)	229 (40.7%)	**4,680** **(21%)**
PG2 Feb-May 2007	26,493	12,845	129	**39,467**	2,501 (9.4%)	1,717 (13.4%)	8 (6.2%)	**4,226** **(10.7%)**
SB1 Oct-Nov 2007	7,479	3,565	139	**11,183**	1,975 (26.4%)	784 (22%)	18 (12.9%)	**2,777** **(24.8%)**
SB2 Feb-Apr 2008	15,327	14,405	414	**30,146**	1,765 (11.5%)	2,419 (16.8%)	62 (15%)	**4,246** **(14.1%)**
CP1 May-Jun 2008	57	116	1,736	**1,909**	4 (7%)	25 (21.6%)	574 (33.1%)	**603** **(31.6%)**
WP1 Jun-Nov 2008	37,691	17,647	1,467	**56,805**	6,378 (16.9%)	2,058 (11.7%)	362 (24.7%)	**8,798** **(15.5%)**
WP2 Mar-Jun 2009	34,207	13,919	3,145	**51,271**	4,608 (13.5%)	2,352 (16.9%)	488 (15.5%)	**7,448** **(14.5%)**
CP2 May-Jun 2009	169	205	2,309	**2,683**	5 (3%)	26 (12.7%)	569 (24.6%)	**600** **(22.4%)**
WP3 Jul-Oct 2009	30,722	7,340	735	**38,797**	6,695 (21.8%)	1,430 (19.5%)	197 (26.8%)	**8,322** **(21.5%)**
CP3 Oct-Nov 2009	66	237	4,802	**5,105**	2 (3%)	62 (26.2%)	1,755 (36.5%)	**1,819** **(35.6%)**
CP4 May-Jun 2010	7	120	2,284	**2,411**	1 (14.3%)	13 (10.8%)	510 (22.3%)	**524** **(21.7%)**
CP5 Nov-Dec 2010	40	228	6,090	**6,358**	7 (17.5%)	46 (20.2%)	1,954 (32.1%)	**2,007** **(31.6%)**
PNGTP1 Apr-Jul 2011	28,730	11,571	355	**40,656**	5,767 (20.1%)	2,473 (21.4%)	60 (16.9%)	**8,300** **(20.4%)**
CP6 Oct-Oct 2011	2	123	3,804	**3,929**	0 (0%)	27 (22%)	1,023 (26.9%)	**1,050** **(26.7%)**
CP7 Nov-Dec 2011	52	245	4,212	**4,509**	1 (1.9%)	20 (8.2%)	1,442 (34.2%)	**1,463** **(32.4%)**
PNGTP2 Jan-Mar 2012	28,312	9,607	2,008	**39,927**	7,219 (25.5%)	1,688 (17.6%)	519 (25.8%)	**9,426** **(23.6%)**
CP8 Sep-Oct 2012	20	140	6,014	**6,174**	2 (10%)	32 (22.9%)	2,287 (38%)	**2,321** **(37.6%)**
PNGTP3 Apr-Jun 2013	23,397	5,960	564	**29,921**	3,082 (13.2%)	836 (14%)	40 (7.1%)	**3,958** **(13.2%)**
CP9 Nov-Dec 2013	29	135	4,296	**4,460**	1 (3.4%)	9 (6.7%)	595 (13.9%)	**605** **(13.6%)**
CP10 Aug-Aug 2014	12	98	195	**305**	0 (0%)	5 (5.1%)	1 (0.5%)	**6** **(2%)**
CP11 Sep-Nov 2015	228	773	1,953	**2,954**	6 (2.6%)	5 (0.6%)	84 (4.3%)	**95** **(3.2%)**
Total	**246,988**	**107,085**	**47,213**	**401,286**	**42,664** **(17.3%)**	**17,833** **(16.7%)**	**12,777** **(27.1%)**	**73,274** **(18.3%)**

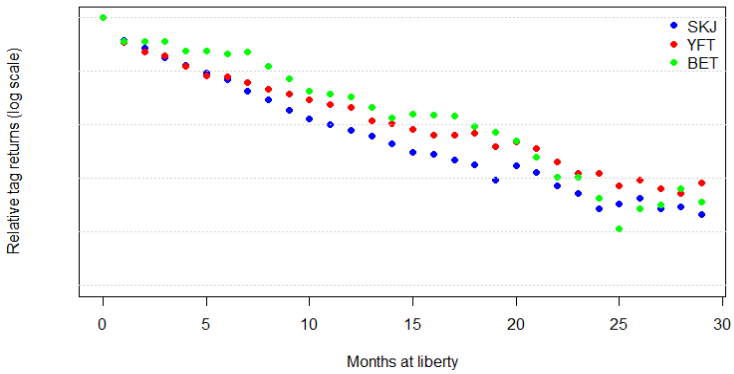

Figure 4. Tag recoveries by time at liberty for skipjack, yellowfin and bigeye tuna. Note that the values on the y-axis are uninformative and thus omitted. At the top-left the points (overlaid so as only BET shows) are the (species) specific maximum logarithm of recoveries, standardised so that the attrition curves all start at the same value. The gradient is a proxy for total mortality.

Table 6. Comparison of archival and conventional tag recoveries by species and cruise.

	Archival Recoveries (%) (Number tagged)				Conventional Recoveries (%) (Number tagged)			
Cruises	**SKJ**	**YFT**	**BET**	**Total**	**SKJ**	**YFT**	**BET**	**Total**
PG1	100%	37%	44%	**40.3%**	19%	23.1%	40.6%	**20.9%**
Aug-Nov 2006	(1)	(46)	(25)	**(72)**	(13,947)	(7,760)	(537)	**(22,244)**
PG2	0%	8.6%	0%	**7.6%**	9.4%	13.4%	7.5%	**10.7%**
Feb-May 2007	(1)	(187)	(23)	**(211)**	(26,492)	(12,658)	(106)	**(39,256)**
SB1		0%	0%	**0%**	26.4%	22%	13.6%	**24.9%**
Oct-Nov 2007		(5)	(7)	**(12)**	(7,479)	(3,560)	(132)	**(11,171)**
SB2		13.6%	0%	**13%**	11.5%	16.8%	15%	**14.1%**
Feb-Apr 2008		(22)	(1)	**(23)**	(15,327)	(14,383)	(413)	**(30,123)**
CP1		40%	22.2%	**24%**	7%	20.7%	33.4%	**31.8%**
May-Jun 2008		(5)	(45)	**(50)**	(57)	(111)	(1,691)	**(1,859)**
WP1		0%	38.9%	**28.6%**	16.9%	11.7%	24.3%	**15.5%**
Jun-Nov 2008		(13)	(36)	**(49)**	(37,691)	(17,634)	(1,431)	**(56,756)**
WP2	0%	1.8%	3.7%	**2.3%**	13.5%	17%	15.8%	**14.6%**
Mar-Jun 2009	(39)	(56)	(81)	**(176)**	(34,168)	(13,863)	(3,064)	**(51,095)**
CP2		0%	12.3%	**11.1%**	3%	13.3%	25.1%	**22.8%**
May-Jun 2009		(9)	(81)	**(90)**	(169)	(196)	(2,228)	**(2,593)**
WP3	5.4%	7.7%	0%	**5.7%**	21.8%	19.5%	26.8%	**21.5%**
Jul-Oct 2009	(56)	(13)	(1)	**(70)**	(30,666)	(7,327)	(734)	**(38,727)**
CP3		14.3%	20.6%	**19.3%**	3%	27.8%	36.9%	**36.1%**
Oct-Nov 2009		(28)	(107)	**(135)**	(66)	(209)	(4,695)	**(4,970)**
CP4		10%	5.1%	**6.8%**	14.3%	11%	22.6%	**22.1%**
May-Jun 2010		(20)	(39)	**(59)**	(7)	(100)	(2,245)	**(2,352)**
CP5			15.5%	**15.5%**	17.5%	20.2%	32.2%	**31.7%**
Nov-Dec 2010			(58)	**(58)**	(40)	(228)	(6,032)	**(6,300)**
PNGTP1		15.8%	0%	**13.6%**	20.1%	21.4%	17%	**20.4%**
Apr-Jul 2011		(19)	(3)	**(22)**	(28,730)	(11,552)	(352)	**(40,634)**
CP6		0%	13.7%	**13.2%**	0%	22.3%	27.1%	**26.9%**
Oct-Oct 2011		(2)	(51)	**(53)**	(2)	(121)	(3,753)	**(3,876)**
CP7	0%	0%	10.9%	**4.8%**	4.5%	12.5%	34.8%	**33.8%**
Nov-Dec 2011	(30)	(85)	(92)	**(207)**	(22)	(160)	(4,120)	**(4,302)**
PNGTP2		36.8%	87.5%	**51.9%**	25.5%	17.5%	25.6%	**23.6%**
Jan-Mar 2012		(19)	(8)	**(27)**	(28,312)	(9,588)	(2,000)	**(39,900)**

Table 6. (Continued)

CP8 Sep-Oct 2012			44.4% (18)	**44.4% (18)**	10% (20)	22.9% (140)	38% (5,996)	**37.6% (6,156)**
PNGTP3 Apr-Jun 2013		23.3% (30)	0% (1)	**22.6% (31)**	13.2% (23,397)	14% (5,930)	7.1% (563)	**13.2% (29,890)**
CP9 Nov-Dec 2013		0% (1)	17.1% (41)	**16.7% (42)**	3.4% (29)	6.7% (134)	13.8% (4,255)	**13.5% (4,418)**
CP10 Aug-Aug 2014		12.5% (8)	0% (24)	**3.1% (32)**	0% (12)	4.4% (90)	0.6% (171)	**1.8% (273)**
CP11 Sep-Nov 2015		1.4% (71)	3.2% (95)	**2.4% (166)**	2.6% (228)	0.6% (702)	4.4% (1,858)	**3.3% (2,788)**
Total	**3.1% (127)**	**10.2% (639)**	**14.7% (837)**	**12%(1,603)**	**17.3% (246,861)**	**16.7% (106,446)**	**27.3% (46,376)**	**18.3% (399,683)**

The majority of recoveries have come from purse-seine vessels (92%), followed by pole and line and other gear types (5%), unknown (4%) and longline recoveries <1% (216 in total). Table 7 shows the number of recoveries by gear type for yellowfin and bigeye that have been at liberty for at least 1 year before recapture. After 1 year at liberty, the fish should be approximately 80cm-100cm in length and available to purse-seine and longline fleets. The same trend is observed if the analysis is restricted to just the spatial domain of the purse-seine fleet (10°N to 10°S). The accuracy of information returned from tags recovered on fishing vessels remains higher than that received from canneries or via transhipment (Figure 5). The information from transhipment on date and location of recovery is typically reported as unknown. To improve understanding of tag recovery patterns the number of fish caught by purse seine needs to be compared with the numbers caught by longline to explore whether tag recoveries are really disproportionate or not between the fleets.

3.3 Tag Recovery staff

Across the region the previously full-time Tag Recovery Officers (TROs) have now taken on other duties at their respective local fisheries agencies, however they generally continue to act as TROs. Staff working on tag recovery continue in Wewak, Madang, Lae, Honiara, Rabaul, Tarawa, Thailand and the Philippines. The TRO in Manta is still employed as full-time officer until 30 September 2016 (after which date the contract will be discontinued due to the low rates of recovery now through that port). A new fisheries officer in Kiritimati is now acting as TRO. This network of tag recovery officers are monitored by the central TRO at SPC. These TRO (except for those in Rabaul and Thailand) are entering data in a specialized database that allows importation of recovery information directly into an SPC database. This database has been improved to incorporate more data control systems and to capture information regarding transhipment if tags are reported from carriers unloading at port and Canneries. Recovery information is received at SPC on a monthly basis. The establishment of these TRO positions has provided greater opportunity for collection of tags during unloading, transhipments and processing in canneries with more complete and reliable capture information (Table 8). Major unloading and processing facilities as well as transhipping vessels in port have been visited by TROs over the last 12 months.

In Bangkok canneries, a lottery was organised in May 2016, to collect the remaining tags and to promote the tagging project.

3.4 Tag Seeding

From February 2007 to May 2016, a total of 504 tag seeding kits (consisting of seeding tags, applicators, guide books and data forms) for a total of 8,649 tags have been given to observer coordinators and TRO in PNG, Solomon Islands, Fiji, FSM, Marshall Islands, Kiribati, New Zealand and American Samoa for deployment on purse seine vessels by senior observers.

Since 2011, kits have been modified to contain a mix of steel head and plastic barb tags to test the effect of tag type. When a kit is not completely deployed during a trip, the kit is either kept aside or used in another kit for deployment. Table 9 details the number of seeded tags deployed per EEZ to date.

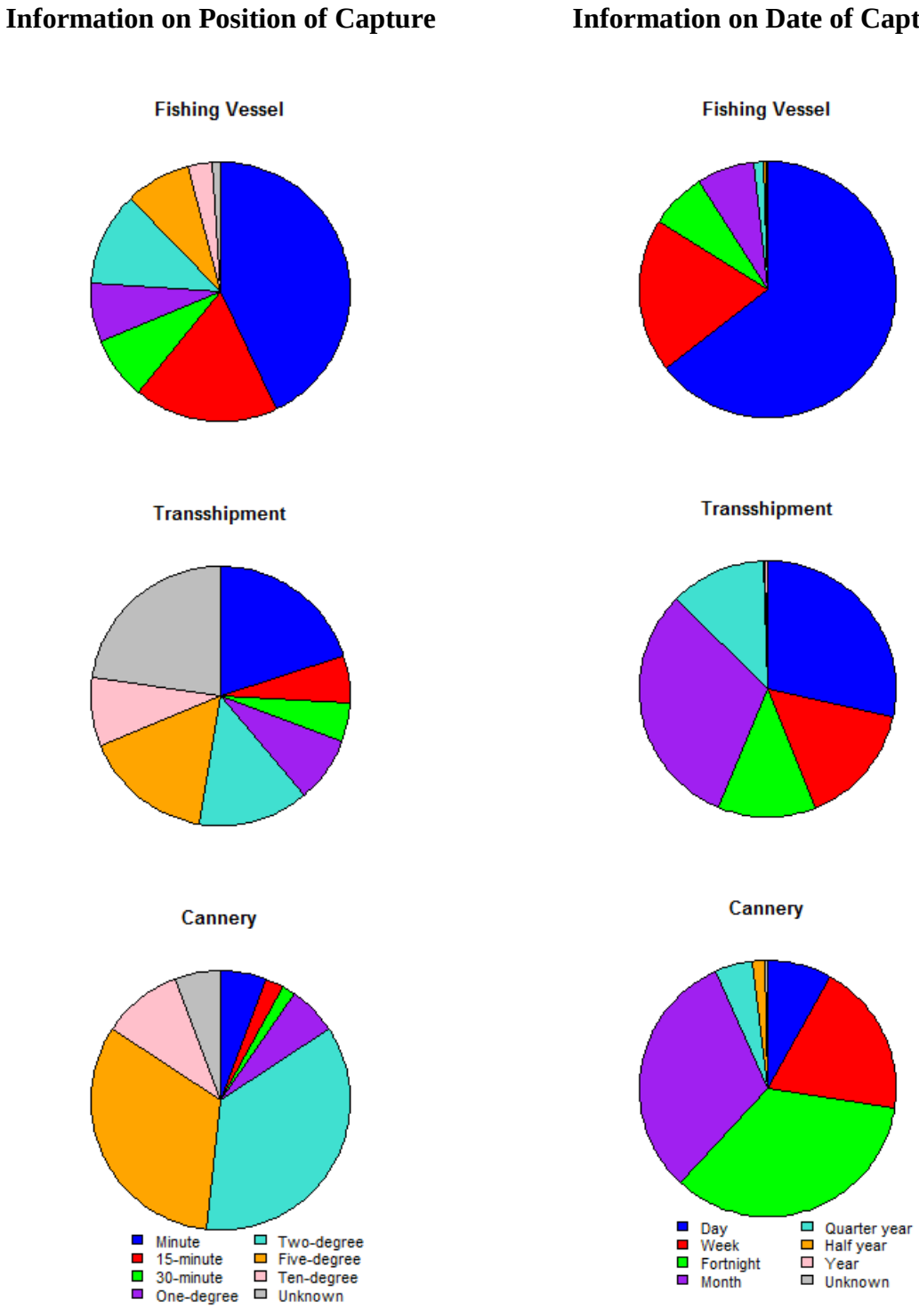

Figure 5. Location and date of tag recovery accuracy information for recoveries on fishing vessels, during transhipment and at canneries.

To aid in the implementation of tag seeding experiments, training is provided as part of the PIRFO observer training courses. Tag Recovery Officers in the ports of Pohnpei, Honiara, Lae, Madang, Wewak and Tarawa continue to liaise closely with observer coordinators, observer debriefers and observers to implement tag seeding experiments and to recover the tag seeding logs for deployed kits. Tag seeding debriefing materials are used by both TROs and local debriefers.

Of the 504 kits distributed to observer coordinators, 348 have been given to observers for deployment, of which 328 tag seeding datasheets have been received for observer trips. Currently, SPC is holding returned seeded tags from one additional kit for which the datasheets have not yet been provided. It is worth noting that it can take 6 months or more for datasheets to be returned. Since June 2015, 19 kits have been deployed, using a total of 516 tags. This is a higher rate of deployment in comparison to last year's (13 kits for 226 tags). As at 24th May 2016, there have been 6768 reported tags that have been seeded and 3,715 of these have been returned to SPC. In addition to allowing estimation of tag reporting rates, the tag seeding data also allow the error rate in tag return information to be determined (Peatman et al. 2016). Tables 10 and 11 detail the reporting of vessel name by location and cannery, respectively. The accurate reporting of vessel name is particularly important for validation of location and time of recapture using VMS and log book data. Vessel name was reported incorrectly for 637 tags, was absent from the recovery information for 170 tags and was correct for 2908 tags.

For the first time in 2015-16, a tag seeding trial was attempted on a PS vessel intending fishing within the IATTC area. That vessel fished in Kiribati waters and not the EPO. The recent events regarding the treaty with US fleets, the lack of effort from other flags in the central Pacific, and a lack of unloadings there, all combined to make this a particularly challenging exercise.

Table 8. Tag recoveries by source and validation.

Source	Recov.	% Valid.	% VMS	% Logsheet	% Archival	% Buffer	% Other	% None	% No vessel name	% Vessel but no date	% Vessel but no position	% No length
American Samoa	1,953	96.31	92.72	0.21	0.21	0.00	0.37	6.49	3.48	1.48	27.14	24.78
China	19	78.95	20.00	0.00	0.00	0.00	0.00	80.00	68.42	0.00	5.26	63.16
Fishing vessel	545	92.29	80.12	1.79	0.00	0.00	15.31	2.78	1.83	0.73	3.67	3.85
FSM	546	86.81	97.47	0.42	0.00	0.00	0.00	2.11	2.56	0.73	10.07	30.40
FSM (SPC)	182	40.11	91.78	2.74	1.37	0.00	0.00	4.11	1.10	0.00	5.49	3.30
IATTC	9,516	24.95	47.01	4.04	1.31	0.00	14.32	33.32	22.67	11.41	15.87	71.26
Indonesia	5,984	81.23	0.12	0.00	0.00	95.19	3.25	1.44	2.07	0.00	5.01	5.60
IOTC	10	30.00	0.00	0.00	0.00	0.00	0.00	100.00	70.00	0.00	30.00	20.00
Japan	3,024	74.57	92.15	3.81	0.00	0.00	0.71	3.33	3.67	4.79	20.07	4.86
Kiribati (Kiritimati)	340	63.24	91.63	0.00	2.33	0.00	0.00	6.05	4.41	5.88	20.59	23.53
Kiribati (Tarawa)	1,004	85.26	71.61	0.12	0.47	0.00	0.47	27.34	22.21	3.49	17.63	8.86
Korea	610	68.69	16.23	1.19	0.24	0.00	0.48	81.86	82.30	0.00	4.10	9.84
Marshall Islands	944	89.41	87.56	9.60	0.36	0.00	0.47	2.01	1.48	2.01	12.29	27.33
Nauru	2	100.00	0.00	0.00	0.00	0.00	0.00	100.00	50.00	0.00	50.00	50.00
Philippines (direct)	8,404	55.75	66.87	4.44	0.06	0.00	7.79	20.83	16.50	4.52	26.48	65.74
Philippines (Frabelle)	351	51.57	97.79	0.55	1.66	0.00	0.00	0.00	7.12	3.13	0.85	27.35
Philippines (NFRDI)	175	49.71	59.77	4.60	0.00	0.00	4.60	31.03	10.29	0.00	10.29	13.71
PNG (China Fisheries Association)	7	14.29	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.71	85.71
PNG (Dologen ltd)	1	100.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PNG (Fairwell Fishery)	28	53.57	60.00	20.00	0.00	0.00	0.00	20.00	3.57	10.71	39.29	32.14
PNG (Fong Seong Fishery)	7	100.00	85.71	14.29	0.00	0.00	0.00	0.00	0.00	28.57	28.57	0.00
PNG (Frabelle)	6,772	82.06	88.45	10.02	0.05	0.02	0.04	1.42	1.74	1.30	3.51	8.06
PNG (Japanese Far Sea Tuna Association)	2	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00
PNG (Korean Overseas Association)	3	66.67	100.00	0.00	0.00	0.00	0.00	0.00	0.00	33.33	33.33	33.33
PNG (Luminar Fishing)	12	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	8.33	16.67	0.00
PNG (NFA)	515	85.63	70.07	5.22	0.45	0.00	2.27	22.00	17.28	1.55	11.84	22.91
PNG (other)	1,076	79.65	71.30	0.82	0.12	0.00	0.12	27.65	6.13	2.23	14.78	12.45
PNG (Pacific Blue Sea Fishing)	274	70.44	95.34	4.66	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00
PNG (RBL Fishing)	962	72.14	99.71	0.14	0.00	0.00	0.00	0.14	0.52	2.18	7.59	6.76
PNG (RD)	9,516	93.51	80.07	17.97	0.06	0.00	0.03	1.87	1.77	0.51	2.30	3.94
PNG (RR Fishing)	30	83.33	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PNG (Sepik Coastal Agencie)	10	100.00	90.00	0.00	0.00	0.00	0.00	10.00	10.00	0.00	10.00	10.00
PNG (SST)	1,438	43.53	62.94	13.58	0.00	0.00	11.98	11.50	36.16	1.39	29.62	34.49

Source	Recov.	% Valid.	% VMS	% Logsheet	% Archival	% Buffer	% Other	% None	% No vessel name	% Vessel but no date	% Vessel but no position	% No length
PNG (Taiwan Deep Sea Association)	19	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	5.26	15.79	5.26
PNG (TPJ Fishing)	1,861	69.05	89.18	4.36	0.08	0.00	0.39	5.99	4.25	2.31	4.35	6.34
PNG (TSP Marine)	457	83.81	99.48	0.00	0.00	0.00	0.00	0.52	0.00	1.09	7.22	2.41
Solomon Islands (Global Investment)	1,081	97.59	78.77	12.61	0.00	0.00	0.00	8.63	8.60	0.93	1.85	55.87
Solomon Islands (Korean Deep Sea Association)	355	59.15	100.00	0.00	0.00	0.00	0.00	0.00	0.28	10.14	14.08	7.32
Solomon Islands (MFMR)	280	83.57	75.21	3.85	2.56	0.00	0.00	18.38	15.00	0.36	14.64	10.00
Solomon Islands (NFD)	4,000	88.82	62.26	37.32	0.03	0.00	0.00	0.39	0.20	0.15	3.72	3.25
Solomon Islands (other)	179	86.03	86.36	2.60	0.00	0.00	0.00	11.04	16.76	2.79	11.17	28.49
Solomon Islands (Soltai)	3,070	92.74	79.87	10.89	0.00	0.00	0.56	8.68	7.13	0.16	1.53	2.70
Solomon Islands (Taiwan Deep Sea Association)	559	95.35	100.00	0.00	0.00	0.00	0.00	0.00	0.00	1.79	1.97	1.07
Solomon Islands (Western Solomon ventures limited)	11	63.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00	27.27	27.27	9.09
Tagging vessel	217	51.61	2.68	0.00	0.00	0.00	95.54	1.79	0.46	0.00	10.14	1.38
Taiwan	67	91.04	95.08	0.00	0.00	0.00	0.00	4.92	0.00	0.00	23.88	0.00
Thailand	10,375	64.06	93.64	3.70	0.11	0.00	0.05	2.51	1.30	0.06	95.39	1.20
Vanuatu	30	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	259	62.16	59.01	1.86	13.04	0.00	4.97	21.12	15.06	0.00	11.97	28.19

Table 9: Number of seeded tags deployed per EEZ since the beginning of the project.

EEZ	Releases
Not known yet	2,897
American Samoa	2
Cook Islands	44
Federated states of Micronesia	212
Fiji	7
Gilbert Islands	347
Howland & Baker	4
Indonesia	7
International waters H4	56
International waters H5	45
International waters I2	109
International waters I5	4
International waters I6	15
International waters I9	5
Jarvis	5
Marshall Islands	45
Nauru	98
Other international waters	4
Papua New Guinea	1,706
Phoenix Islands	267
Samoa	4
Solomon Islands	479
Tokelau	134
Tuvalu	272
Total	**6,768**

Table 10: Vessel reported per locations of recovery.

Recovery location	All tag recoveries	Tag seeding recoveries (TSR)	Wrong vessel reported (TSR)	No vessel reported (TSR)	Correct vessel reported (TSR)	% correct vessel
GENERAL SANTOS, Philippines	8,518	230	81	22	127	55.2
HONIARA, Solomons	1,144	469	12	2	455	97.0
LAE, PNG	5,454	192	27	5	160	83.3
LONDON, Kiribati	160	2	0	0	2	100.0
MADANG, PNG	2,879	300	59	0	241	80.3
MAJURO, Marshalls	1,119	202	21	0	181	89.6
MANTA, Ecuador	1,403	44	9	0	35	79.5
NORO, Solomons	8,308	52	20	1	31	59.6
Noumea, New Caledonia	317	15	1	2	12	80.0
PAGO PAGO, A. Samoa	1,939	522	40	22	460	88.1
POHNPEI, FSM	841	73	6	0	67	91.8
PORT MORESBY, PNG	524	80	14	0	66	82.5
RABAUL, PNG	396	133	29	0	104	78.2
SAMUTSAKOM, Thailand	10,371	551	208	6	337	61.2
SAN DIEGO, USA	8,207	166	38	70	58	34.9
SHIMIZU, Japan	2,996	7	2	1	4	57.1
TARAWA, Kiribati	1,008	176	6	4	166	94.3
VIDAR, PNG	7,149	192	13	1	178	92.7
WEWAK, PNG	6,984	253	65	1	187	73.9

Table 11: Vessel reported per cannery (Thailand).

Cannery Name	Tag seeding recoveries	Wrong vessel reported	No vessel reported	Correct vessel reported	% correct vessel reported
Asian Alliance International	11	0	1	10	90.9
CHOTIWAT	15	6	0	9	60.0
EKSAKHON COLD STORAGE CO., LTD	30	4	0	26	86.7
ISA VALUE	6	1	0	5	83.3
PATAYA FOOD INDUSTRIES LTD.	129	93	0	36	27.9
R.S. Cannery Co., Ltd.	35	8	0	27	77.1
RS CANNERRY CO LTD	1	1	0	0	0.0
Songkla Canning PLC.	62	42	0	20	32.3
SOUTHEAST ASIAN PACKAGING	50	8	0	42	84.0
Thai Union Manufacturing Co.	33	3	0	30	90.9
TROPICAL	6	0	0	6	100.0
TROPICAL CANNING (THAILAND)	9	2	0	7	77.8
Unicord Public Co., Ltd.	86	16	1	69	80.2

3.5 Analysis of Tag Seeding data

Data from tag seeding experiments have been used to estimate prior distributions for reporting rates for use in MULTIFAN CL assessments of tuna stocks in the Western Central Pacific Ocean. These prior distributions are used to minimise bias in assessments resulting from the non-reporting (or detection) of tag recoveries, and as such are a critical input to the MULTIFAN-CL models.

The methodology used to estimate reporting rates requires the implicit assumption that tags seeded in tag seeding experiments were no more likely to be detected than recoveries of PTTP tag releases, i.e. that tag seeding experiments are not compromised by fishing vessel crew or potential tag finders. There are now sufficient tag seeding data to test that assumption. Peatman et al. (2016) developed statistical models to test whether tag seeding experiments are likely to have been compromised, based on the proportion of reported tag recoveries that were detected on fishing vessels. No evidence was detected for tag seeding experiments having been systematically compromised. However, reporting rates on fishing vessels were significantly higher for individual tag seeding experiments where observers thought it likely that crew had seen tag seeding take place. Additionally, due to sample sizes, the statistical power of the models may have been insufficient to detect small but significant differences given the large variability in observations.

Peatman et al. (2016) also present a modified approach to estimating reporting rate priors that substantially improves fits to observations, resulting in reporting rate prior distributions that more accurately reflect underlying variability in flag-specific reporting rate estimates.

All tag recoveries reported to SPC are cross-validated using available additional datasets, e.g. VMS data and vessel logbook data, to determine the accuracy of recovery information reported to SPC. Peatman et al. (2016) develop statistical models that use tag seeding data to determine how accurately the cross-validation process estimates the reliability of tag recovery information, and the variables that influence the accuracy of these estimates. The results indicated that the cross-validation process provides estimates of accuracy that are both appropriate on a relative and absolute scale. Furthermore, the analyses suggest that the efficacy of the cross-validation process has increased with time. This is encouraging given the time and resources that are spent on cross-validation of tag recoveries.

Specific recommendations from Peatman et al. (2016) are:

- Tag seeding should be continued, targeted to fleets and regions where recoveries are most likely;

- The tag recovery cross-validation process should be continued, with due consideration of the resources required;
- A maximum of one tag seeding experiment per vessel per year should be implemented where possible, with a focus on sampling multiple vessels within fleets;
- Reporting rate prior distributions for MULTIFAN-CL assessments should be generated from flag-specific reporting rates based on beta-binomial models. This will ensure that fits to tagging data are not excessively penalised;
- The estimated reporting rate priors for regions 1 (all species), region 4 (skipjack) and region 7 (yellowfin and bigeye) should not be used. The uninformative prior distribution used for other tagging programmes (mean reporting rate = 0.5, penalty = 1) would be more appropriate for these regions;
- Data from recent tag seeding programmes in the Central Pacific should be included, once available; and,
- Future analysis of errors in recovery position and/or date should include exploration of the potential for experimental duplicates to result in correlated residuals, and therefore underestimation of uncertainty in the effects of explanatory variables.

3.6 Analyses of Movement

Movement trends observed from both conventional and archival tags are consistent with expectations for highly migratory species with larger movements positively related to time at liberty (Figure 6).

3.7 TagEst analyses

Development of spatially explicit advection-diffusion-reaction models of skipjack and yellowfin is ongoing, using TagEst (Sibert et al., 1999). The models were fitted to conventional tagging data from the RTTP and PTTP, building on earlier work (e.g. Sibert & Hampton, 2003). The models allow estimation of movement and mortality, taking in to account the spatial and temporal distribution of both tag releases and fishing effort. There are a wide range of potential uses for TagEst models, including: testing for size dependent movement dynamics; providing solely tagging data-derived estimates of movement for comparison with movement dynamics in Multifan CL assessments. Advective and diffusive movement parameters, fleet catchabilities and natural mortality were estimated, with fleet-specific reporting rates fixed based on analyses of tag seeding experiments. Release numbers were corrected for tag induced mortality, shedding and tagger effects and conditioned on the proportion of total recoveries that were used in the model, to better estimate the relative contributions of natural and fishing mortality to tag attrition. The models fitted well to the observed spatial distribution of tag recoveries. There was a tendency for recoveries shortly after release to be underestimated due to violation of the assumption that tagged fish were fully mixed at the spatial resolution of the model (1 x 1 degree) immediately after release.

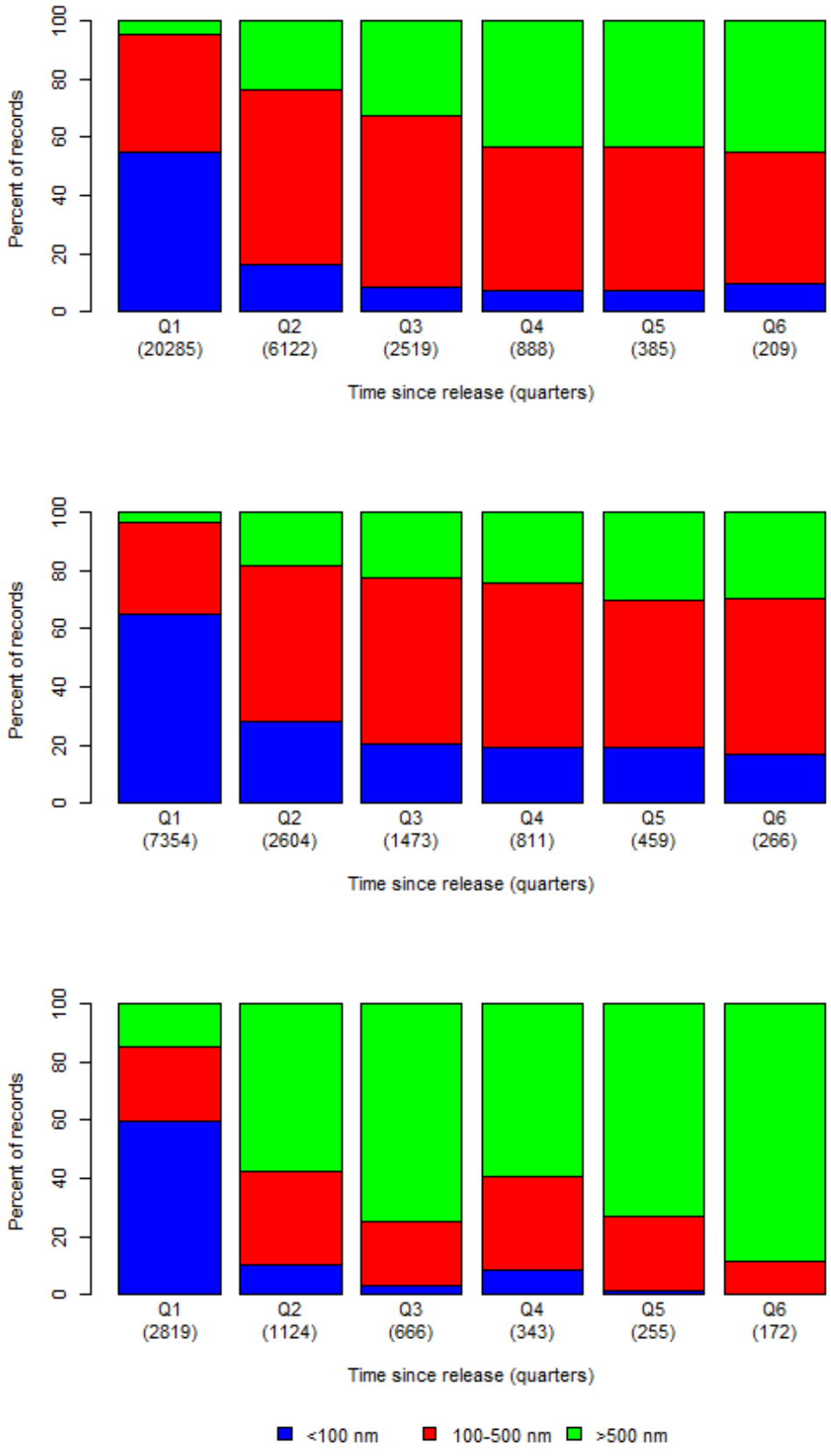

Figure 6. Reported recoveries within 100 nm, 100-500 nm and >500 nm in the first 6 quarters (18 months) since release for skipjack (upper graph), yellowfin (middle graph) and bigeye (lower graph). The sample size for each quarter is provided in the parentheses below the quarter label on the x-axis.

4 Albacore tagging

A description of albacore tagging activities was outlined previously in SC6 GN IP-06 and SC5 GN IP-16. Since SC11, no new tag recaptures have been reported with the total of 29 recoveries (1%) for the project. Movements of recaptured fish for which we received accurate recovery position are displayed in Figure 7.

Figure 7. Release-recovery arrow map for albacore tags reported to SPC.

5 PTTP 2016-2017 work plan

	Task	2016	2017
TAGGING			
1.	**CP12** *Background*: 5 week cruise focusing upon the NOAA TAO Oceanographic Buoys along the 165° and 156˚E meridian (waters of Nauru, Marshall Islands, FSM, PNG, Solomon Islands and High Seas). This is the twelfth Central Pacific cruise designed to improve overall spatial coverage of PTTP tag releases in areas difficult to access to pole and line vessels and investigate movement parameters and vertical habitat utilization of tuna in the central Pacific region. This cruise will be undertaken in collaboration with ISSF and Trimarine to study residential time of tuna and bycatch around drifting fads. The cruise will charter the *FV Gutsy Lady4*, a multi-purpose pelagic handline/longline vessel which is based in Honolulu, HI/USA. *Target*: BET 3,000 conventional tags; BET & YFT 75 Archival Tags, equip 3 drifting fads with sonic listening station. **PNG TAO trial** *Background*: It is planned to equip the NFC training vessel with the appropriate fishing gears to assess in PNG the possibility of fish and tag bigeye tuna in the same way than the CP cruises. The vessel is based in Kavieng which is conveniently situated not too far from and in between the longitudes 147E and 156E where TAO are anchored. A trial cruise has been implemented in August 2012, targeting the 2 TAO situated north of Manus island on the 147E longitude. Unfortunately no bigeye schools were seen during this trial cruise. It is proposed this time (July 2016) to do a second attempt to release some tagged bigeye on the 2 TAO anchored in the PNG EEZ on the 156E longitude (see Map1). If a tuna aggregation is present we plan to release a minimum of 500 conventional tags and 20 archival tags on bigeye tuna. *Target*: BET 500 conventional tags; BET 20 Archival tags.		
2.	Additional CP cruise(s) subject to funding Note that it is strongly recommended that the tagging programme be normalized into the ongoing science programme of WCPFC. For logistical reasons and for cost efficiency it is preferable to have a tagging event every year – especially due the cost and time involved in establishing the tag recovery network (maintaining the network is much more cost effective). SC12 may wish to recommend that a skipjack tagging programme occur every second year starting 2017 and a bigeye/yellowfin tagging programme over every second year starting 2018.		
TAG RECOVERY			
1.	Support of TRO in Ecuador (to 30 September 2016)		
2.	Support of TROs in PNG, Philippines, Thailand and key Pacific Island locations.		
DATA MANAGEMENT			
1.	PTTP data verification with VMS and Logbook		
2.	Consolidation of the web tagging framework		
DATA ANALYSES			
1.	Tag reporting and seeding Purpose: Estimation is a direct scalar for fishing mortality. Tasks: (1) Routine update of analyses;		
2.	Fishing and natural mortality Purpose: Provide external validation to estimates from within MFCL and identify fishing mortality changes in response to expansion of the WCPO fisheries. Tasks: (1) Routine update of analyses.		
3	Movement Purpose: Provide external validation to estimates from within MFCL and SEAPODYM. Tasks: (1) Routine update of analyses.		

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