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PTTP SUMMARY REPORT: REVIEW PHASE 2

WCPFC-SC5-2009/ GN-IP-13

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Executive Summary

The Pacific Tuna Tagging Programme is a WPCFC endorsed project being implemented by SPC. PTTP phase 2 is comprised of 3 Equatorial Western Pacific pole-and-line tagging cruises (WP1 to WP3) and 3 Central Pacific handline tagging cruises (CP1 to CP3).

WP1 was completed in November 2008 and involved 6 cruise legs covering the EEZs of FSM, Palau, Philippines, Indonesia and PNG. The pole and line FV Soltai 105 was chartered for all cruises after its suitability was assessed during phase 1.

Achievements of WP1 include:

- Successful implementation of 6 cruises.
- A total of 56,814 tuna were conventionally tagged
- A total of 49 tuna tagged with archival tags

With the same tagging platform, WP2 was completed in June 2009 and involved also 6 cruises covering the EEZ of South East PNG, East FSM, Marshalls, Kiribati (Gilberts), Tuvalu and South East Solomon.

Achievements of WP2 include:

- Successful implementation of 6 cruises.
- A total of 51,078 tuna were conventionally tagged
- A total of 176 tuna tagged with archival tags

The achievements of CP1 were reported to the Steering Committee at WCPFC SC4 (see GN IP-2). CP2, which was a collaborative exercise between SPC and IATTC, took place in May-June 2009, and visited the TAO buoys at 155°W and 140°W longitude. The achievements of CP2 included:

- 2,605 tuna (2,238 bigeye) tagged with conventional plastic dart tags
- 90 tuna (80 bigeye, 10 yellowfin) tagging with Lotek 2310 and Wildlife Computers MK9 archival tags

In excess of 25,000 conventional and 73 archival tags have been recovered to date, with recovery rates of the two tag types almost identical. Various descriptive analyses of the tag recoveries are presented to provide indications of potential tag reporting problems and to illustrate the nature of the data being accumulated.

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1 Background

The Pacific Tuna Tagging Programme (PTTP) is a joint research project being implemented by the Oceanic Fisheries Programme (OFP) of the Secretariat of the Pacific Community (SPC), the PNG National Fisheries Authority (NFA) and the members and participating nonmembers of the Western and Central Pacific Fisheries Commission. The goal of the PTTP is to improve stock assessment and management of skipjack, yellowfin and bigeye tuna in the Pacific Ocean. The specific objectives are:

> *1. To obtain data that will contribute to, and reduce uncertainty in, WCPO tuna stock assessments.*
>
> Conventional tagging data are an important component of tuna stock assessments, providing quasi-fishery-independent information on various biological and fishery processes, such as exploitation rates, natural mortality, movements and growth rates, and their spatial and temporal variability.
>
> *2. To obtain information on the rates of movement and mixing of tuna in the equatorial WCPO, between this region and other adjacent regions of the Pacific basin, and the impact of FADs on movement at all spatial scales.*
>
> This information is important for understanding the relationship of tuna stocks in the tropical WCPO with those in the sub-tropical WCPO and the EPO. Movement rates are particularly important for assessing the potential for interaction between fisheries operating in different areas. The comparison of tagged fish movements from areas of high FAD density with tagged fish movements from the same areas in the early 1990s (before extensive FAD deployment) will provide important new information on the meso-to large-scale effects on tuna movement of high-density FAD arrays. This will allow various hypotheses regarding the impact of FADs on the movements of small tuna, e.g. the "ecological trap" hypothesis (Marsac et al 2000), to be tested. The movement data will also provide critical information on appropriate spatial structuring of stock assessment models.
>
> *3. To obtain information on species-specific vertical habitat utilisation by tunas in the tropical WCPO, and the impacts of FADs on vertical behaviour.*
>
> Vertical habitat utilisation plays a large role in determining vulnerability to all major gear types operating in the fishery. This objective seeks to characterise the effect of FADs (anchored and drifting) and other possible impactors (e.g., seamounts) on tropical tuna vertical behaviour and habitat utilisation This information will allow better estimation of abundance indices and standardised effort for the main fisheries and possibly contribute directly to the design of management measures for FAD fishing.
>
> *4. To obtain information on local exploitation rates and productivity of tuna in various parts of the WCPO.*
>
> Knowledge of local exploitation rates, productivity and movements is important for understanding the impact of fishing at more local scales. In particular, it allows estimation of the extent to which current catch levels may reduce the standing stock of tuna and the catch-per-unit-effort of the fisheries, a phenomenon commonly known as "local depletion".

These objectives are being pursued through a tagging programme and associated data collection activities in the WCPO. Funding support for the project has been generously provided by the PNG National Fisheries Authority, New Zealand Agency for International Development, Australian Centre for International Agricultural Research, European Community 8th European

Development Fund (through the PROCFish Project), European Community 9th European Development Fund (through the SciFish Project), the French Pacific Fund, the Government of Taiwan, the Government of the Republic of Korea, and the Global Environment Facility (through the Pacific Oceanic Fisheries Management Project). The PTTP is a multi-phase programme that commenced in mid-2006. It has the following operational structure:

	Time period	Operational area	Tagging vessel
Phase 1	Aug – Nov 2006	Papua New Guinea	Soltai 6
	Feb – May 2007	Papua New Guinea	Soltai 6
	Oct – Nov 2007	Solomon Islands	Soltai 6
	Feb – Mar 2008	Solomon Islands	Soltai 6
	Apr 2008	Solomon Islands	Soltai 105
Phase 2	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)	To be determined

Phase 1 focused upon the waters of Papua New Guinea and the Solomon Islands with their large domestic fisheries and significant contribution to overall regional catches. Phase 2, approved in August 2007 aims to considerably extend the operational area of the PTTP, as well as broaden the scope and operations of the project. The first pole-and-line vessel tagging cruise of Phase 2 (WP1), undertaken in 2008, extended tagging activity to areas west of 160°E and north of the Equator (FSM and Palau), to the far west of the WCPO (Philippines and Indonesia), to the northern part of the PNG EEZ and waters east of Bougainville Island. The second pole-and-line vessel tagging cruise of Phase 2 (WP2), undertaken in 2009, further extended the coverage eastwards to 180°. A final pole-and-line vessel tagging cruise (WP 3) will fill the gaps in the coverage of the primary fishing area west of 165°E. This cruise commenced in July 2009 and will conclude in October 2009.

A different strategy has been adopted for the Central Pacific (140°W – 155°W) where pole-and-line operations are difficult, with a multipurpose handline vessel being used to tag and release primarily bigeye tuna associated with TAO moorings. The first one-month cruise (CP1) took place concurrently with WP1 and the second cruise (CP2) concurrently with WP2 in collaboration with the Inter-American Tropical Tuna Commission (IATTC). A third cruise (CP3) is scheduled for October to November 2009.

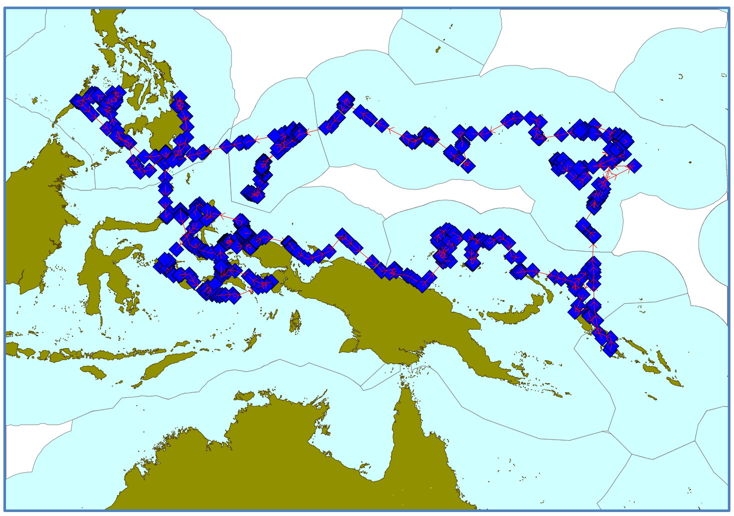
This report provides a review of WP1, WP2 and CP3, in addition to documenting tag recoveries to date (conventional and archival), data quality issues encountered and tag seeding activities. The work plan for future analysis is also outlined.

2 Conventional and electronic tag release update

2.1 Western Tropical Pacific (WP1 & WP2)

Western Pacific Cruise 1 (WP1) operated for five months beginning June 2008 in the EEZs of FSM, Palau, Philippines, Indonesia, Papua New Guinea and Solomon Islands. This area is an influential region in the stock assessment models for skipjack, yellowfin and bigeye. The warm pool of the western pacific has also been restricted to this region of the WCPO in conjunction with the strong La Nina event in 2008, providing an opportunity to sample during conditions when tuna numbers were expected to be high in the region. Western Pacific Cruise 2 (WP2) operated for three months beginning March 2009 in the EEZs of Papua New Guinea, FSM, Marshall Islands, Kiribati, Tuvalu and the Solomon Islands. This cruise was designed to complement WP1, tagging tuna in the boundary area of region 3 and region 4 of the stock assessment models for yellowfin and bigeye and regions 5 and 6 of the skipjack assessment model. The vessel tracks for WP1 and WP2 are shown in Figure 1.

Cruise WP1 – June-November 2008



Cruise WP2 – March-June 2009

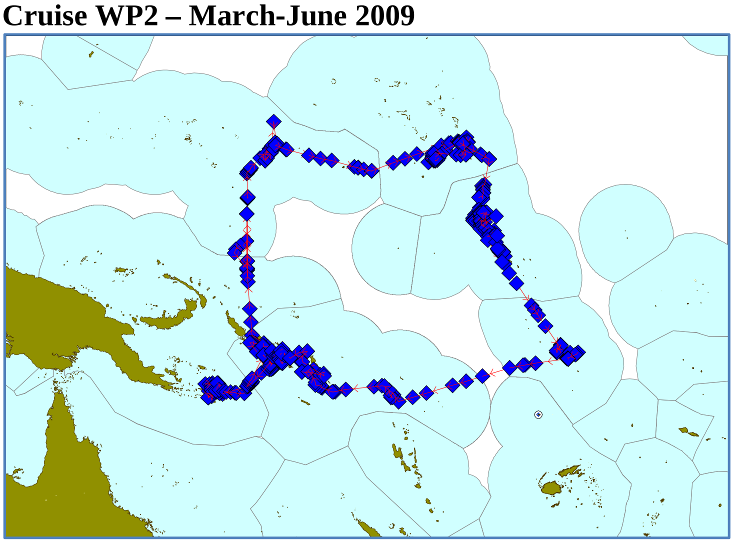


Figure 1. Cruise plot of FV Soltai 105 during WP1 and WP2.

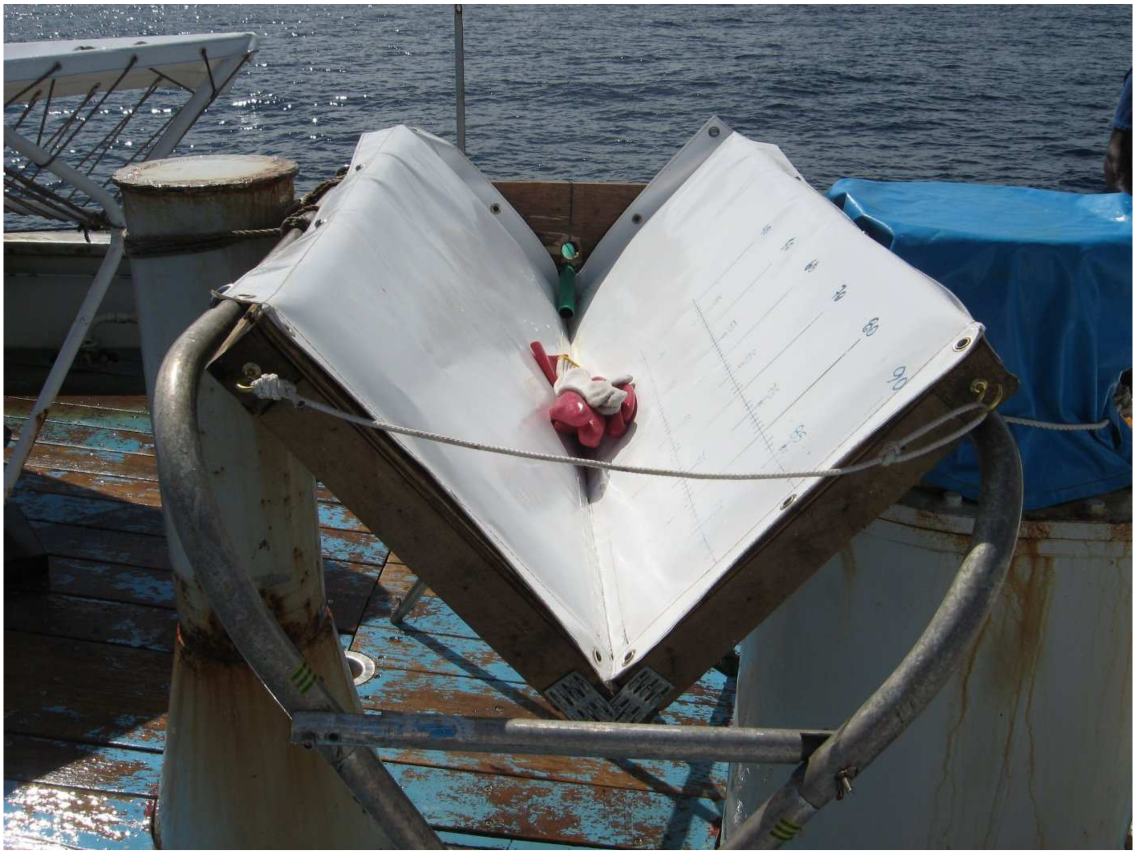
2.1.1 Methods and equipment

Methods and equipment used during WP1 and WP2 were the same as during Phase 1 (see WCPFC SC4-2008/ GN-IP-3) For WP1 and WP2 small modifications were made to the vinyl tagging cradle covers to allow for better water draining during tagging operation. (See picture 1).

Picture 1: Tagging cradle vinyl add in for water draining.

One of the two archival tagging cradles was re-designed prior to WP2 to better handle the easy to stress skipjack species (see Picture 2). This V-shaped cradle was also very efficient to restrain the medium size bigeye and yellowfin tagged with archival tags in Kiribati waters. WP1 and WP2 tagging operation were less focused upon anchored FADs in comparison to tagging during Phase 1. Subsequently fish were captured mostly during pole and line operations during the day rather using hand lines or rod and reel techniques at night when tie-up to a FAD.

Two different size classes of archival tag were used: (1) the larger LTD-2310 (Lotek Wireless, Newmarket, Canada) and the Mk9 (Wildlife Computers, Redmond, USA) which were surgically implanted into fish 55 cm and larger; and (2) the smaller LAT-2510 (Lotek Wireless, Newmarket, Canada) which was implanted into fish 40 cm and larger. Depth, fish and sea water temperatures and ambient light were recorded each minute for LTD-2310 and Mk9. The later versions of the Mk9 (with a 64 mb memory) were set to sample data every 30 seconds. The LAT-2510 has limited memory capacity (512 Kb) and to extend the period of sequential records of all data, the tag was programmed to record every 4 minutes.



Picture 2. V-shape tagging cradle re-designed for archival tagging.

2.1.2 Conventional tag releases

During WP1, a total of 56,801 tuna were conventionally tagged (skipjack 66.4%; yellowfin 31.1%; bigeye 2.5%). During WP2, a total of 51,254 tuna were conventionally tagged (skipjack 66.7%; yellowfin 27.1%; bigeye 6.1%). The numbers of conventional tag releases during WP1 and WP2 by species and school association is given in Table 1.

Table 1. All tag release by species and school association, for WP1 and WP2.

	Releases WP1				Releases WP2			
School association	**SKJ**	**YFT**	**BET**	**TOTAL**	**SKJ**	**YFT**	**BET**	**TOTAL**
Other	228	3	0	**231**	22	1	0	**23**
Free school	8,542	1,668	29	**10,239**	7,456	1,196	434	**9,086**
Log	2,551	1,973	81	**4,595**	2,266	3,072	9	**5,347**
Anchored Fad	22,150	8,161	1,130	**31,441**	12,862	5,787	196	**18,845**
Drifting Fad	2,952	5,146	219	**8,317**	1,085	395	298	**1,778**
Cetacean or Whale shark	838	18	0	**856**	305	773	32	**1,110**
Current line	279	357	6	**642**	23	1	0	**24**
Seamount	55	48	0	**103**	1,024	1,180	2,172	**4,376**
Island or reef	105	271	1	**377**	9,159	1,502	4	**10,665**
TOTAL	**37,690**	**17,645**	**1,466**	**56,801**	**34,204**	**13,907**	**3,145**	**51,254**

2.1.3 Spatial distribution of releases by school association

The spatial distribution of skipjack, yellowfin and bigeye releases, by species and school association, is shown in Figure 2. In combination, the two cruises have achieved a wide distribution of releases throughout the western equatorial Pacific.

2.1.4 Size distribution of conventional tag releases

The size distributions of tag releases during WP1 and WP2 are shown in Figure 3. During both cruises, skipjack and yellowfin 30-50 cm dominated the releases, although small numbers of larger yellowfin were also tagged during WP2. For bigeye, mostly smaller fish 30-55 cm were tagged during WP1; however, a mode of larger bigeye 60-100 cm associated with Maiana Seamount in Kiribati was successfully tagged in considerable numbers.

2.1.5 Archival tag releases

During WP1, 49 tuna (13 yellowfin, and 36 bigeye) were tagged with archival tags. The new small Lotek tag model (LAT2510) that allows the deployment in fish of size < 55 cm FL was only available during the last month of WP1. Fish of larger size that could handle Mk9 tag insertion were caught only occasionally and in small numbers. During WP2, 176 tuna (56 yellowfin, 81 bigeye and 39 skipjack) were tagged with archival tags. Our objectives were to release 50 skipjack and 24 bigeye tagged with the new small Lotek tag model (LAT2510) and to deploy 50 large tags (LTD2310 or Mk9) in bigeye and yellowfin. This objective was over-achieved due to the good quantity of suitable size fish found on Maiana Seamount in the Kiribati EEZ. The numbers of releases by species and school association for WP1 and WP2 are given below (Table 2).

2.1.6 Biological sampling

Biological sampling has been conducted as part of the tagging cruises to obtain information on the trophic status of tunas in different types of school association and different areas. A sampling design was developed and stratification included species, school association type, area (FSM, Palau, PNG, Marshall Islands, Kiribati, Tuvalu, Solomon Islands) and time of day. The sampling strategy was to sample 15 individuals from 1 morning school and 2 afternoon schools for each species, area and school type. For each individual, we recorded species, length and sex, and collected stomach and muscle and liver tissue sample. Although Philippines and Indonesia were visited during WP1, it was decided not to collect samples in these 2 areas as logistics for transportation of samples from there were too difficult.

In addition to stomach/muscle/liver sampling, measurements using a Fatmeter were undertaken. The Fatmeter is a non-destructive, non-invasive method that can be used on live fish. This electronic device measures the lipid content of the fish. The lipid content of fish is related to the water content of the sample; by measuring the water content using a micro strip sensor the amount of lipids can be inferred by conversion with the appropriate calibration (required for each species). Calibration for yellowfin was built in to the device but muscle samples have been collected for checking the calibration in the lab. More muscle samples were collected for skipjack to establish a proper calibration for this species. The sampling strategy was the same as for stomach sampling; however, because there is no further lab work after measurement, it was decided to conduct some measurements in Indonesia and Philippines in addition to the normal sampling strategy.

The total number of biological samples collected during WP1 and WP2 are detailed in Table 3. The stomach samples are currently awaiting analysis at OFP biological laboratory. Over both cruises, a total of 1,419 fish were examined with the Fatmeter including 820 skipjack, 530 yellowfin and 69 bigeye. Fillets for calibration were collected from 4 skipjack, 1 bigeye and 1 yellowfin.

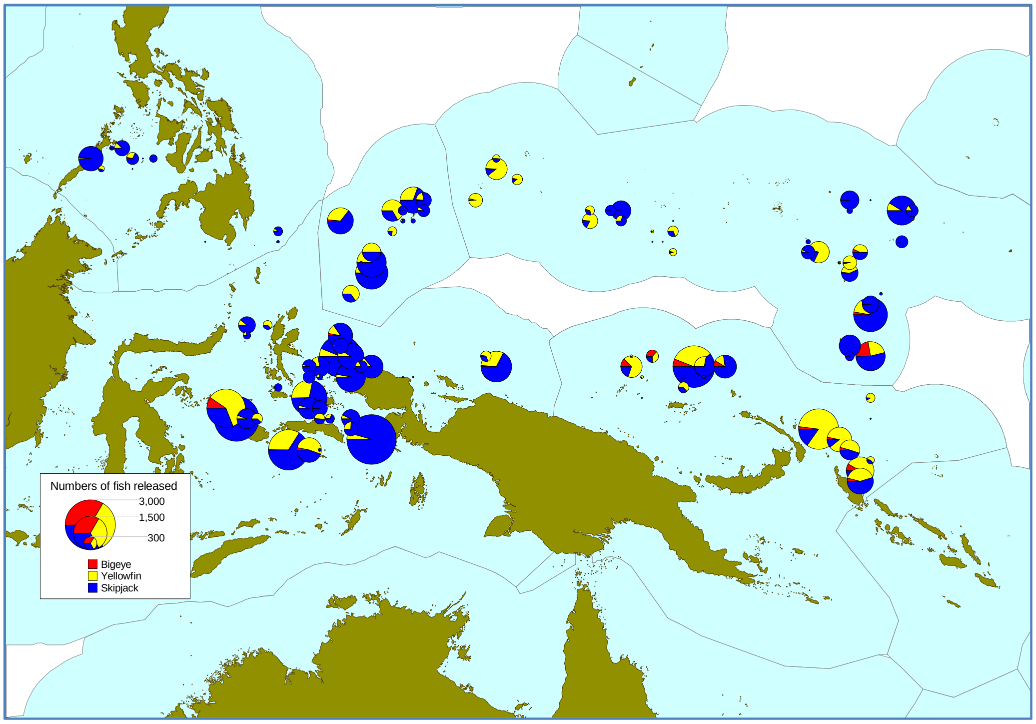
Table 2. Total archival tag releases during WP1 and WP2 by species and school association.

WP1	Bigeye			Yellowfin		Skipjack	TOTAL
Association	**LAT 2510**	**LAT 2310**	**MK9**	**LAT 2310**	**MK9**	**LAT 2510**	
Anchored FAD	24		8				32
Drifting FAD					5		5
TAO buoy			3		1		4
Free-school			1		5		6
Whale shark					1		1
Seamount					1		1
Island/reef							0
TOTAL	24	0	12	0	13	0	49
WP2	**Bigeye**			**Yellowfin**		**Skipjack**	**TOTAL**
Association	**LAT 2510**	**LAT 2310**	**MK9**	**LAT 2310**	**MK9**	**LAT 2510**	
Anchored FAD							0
Drifting FAD	3		3		1	2	9
TAO buoy	21				1		22
Free school						6	6
Whale shark			1				1
Seamount		21	32	29	24	7	113
Island/reef					1	24	25
TOTAL	24	21	36	29	27	39	176

Table 3. Number of biological samples taken during WP1 and WP2.

Association	WP1					WP2		
	Skipjack	**Yellowfin**	**Bigeye**	**Kawa**	**Frigate**	**Skipjack**	**Yellowfin**	**Bigeye**
Free-school	135	91	2			176	63	15
Drifting log	118	102	3			30	72	16
Anchored FAD	69	76	23			38	49	
Whale							15	
Seamount	1	2		10	3	3	29	35
TAO buoy						3	15	7
TOTAL	323	271	28	10	3	250	243	73

WP1



WP2

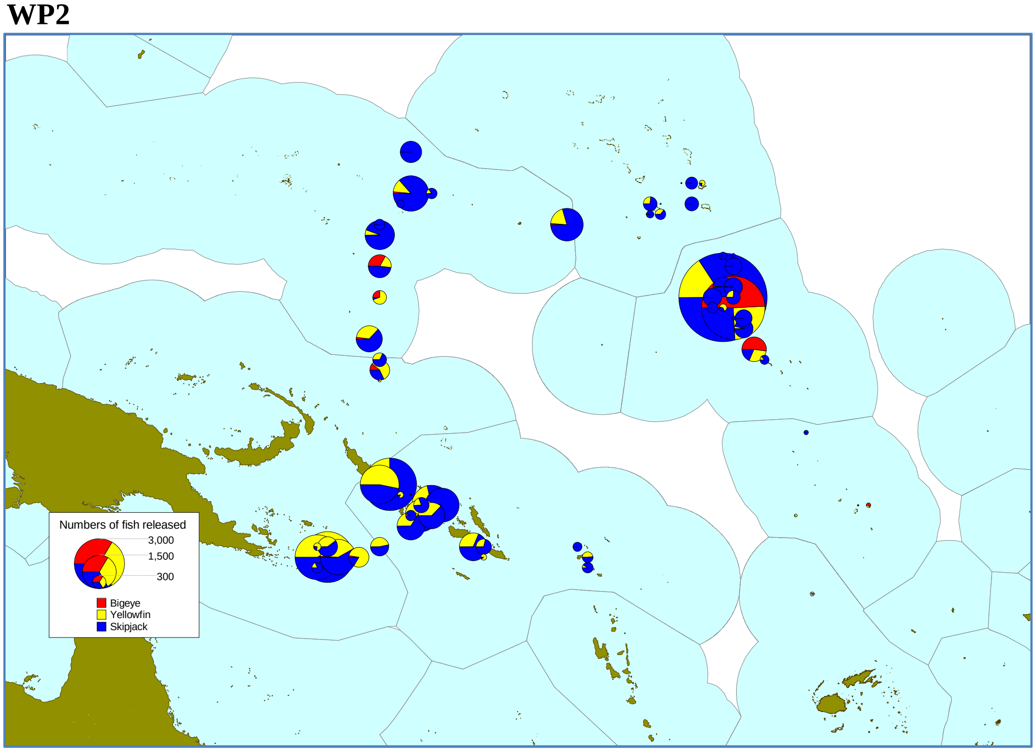


Figure 2. Spatial distribution of releases of skipjack (blue), yellowfin (yellow) and bigeye (red) during cruises WP1 and WP2.

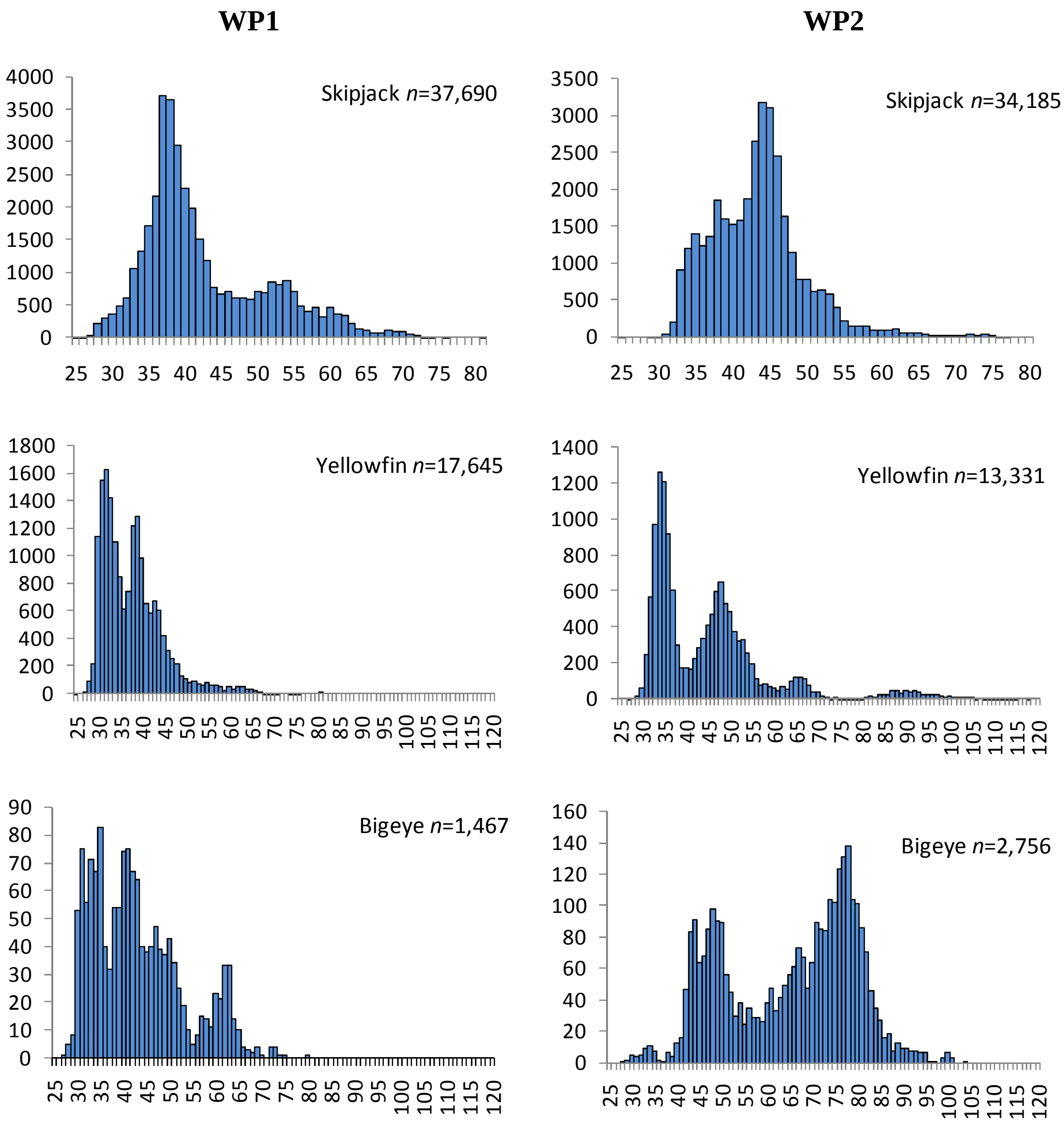


Figure 3. Distributions of the fish tagged during WP1 and WP2.

2.2 Central Tropical Pacific (CP2)

Following the successful deployment of tags in bigeye tuna during the first tagging cruise to the central Pacific in May 2008 (Itano, 2008), and the encouraging numbers of recovered conventional and archival tags, two additional six-week cruises were planned for the periods of May to June, and October to November, 2009. Those tagging cruises were designed to be carried out as a collaborative effort between the SPC and the Inter-American Tropical Tuna Commission (IATTC), with the proposed area of operation between 5°N and 5°S and 155°W and 140°W.

The second tagging cruise to the central Pacific (CP2) took place during a 38 day charter period of the Hawaii-based FV Double D from 12 May to 19 June, 2009. In addition to the Captain and one crew member, there were two IATTC scientists aboard the vessel to conduct fishing and tagging operations during CP2. The cruise track is shown as Figure 4. The track consisted of running from Hawaii to look for tuna aggregations associated with the National Oceanic and Atmospheric Administration Tropical Atmosphere-Ocean (TAO) moorings at the 8°N, 5°N, and 0°on the 155°W meridian, then east to the NOAA weather buoy no. 51028, eastward to the 140°W meridian to the TAO moorings at 2°S, 0°, 2°N, and 5°N, and then return to port in Hawaii.

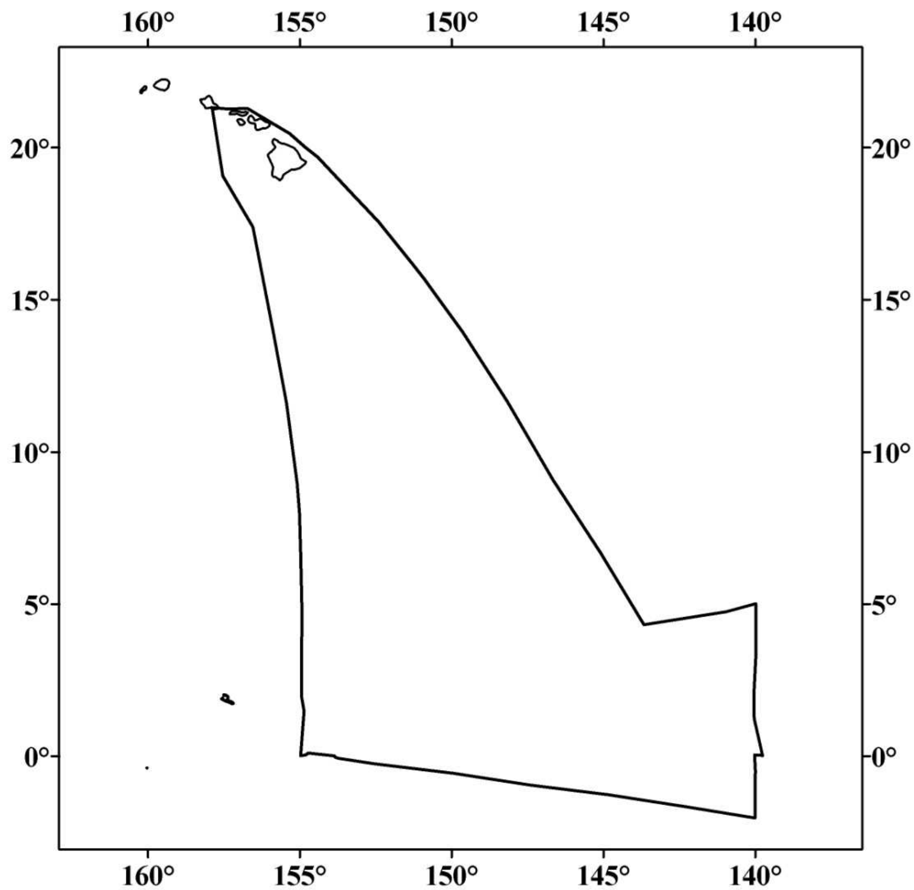


Figure 4. Cruise track for SPC/IATTC collaborative tagging cruise (CP2) during May 12 to June 19, 2009.

2.2.1 Methods and equipment

The cruise was supplied with SPC yellow plastic dart tags (PDTs), size Y-13, manufactured by Hallprint Ltd., Pty of Australia, as used throughout the PTTP. Fifty MK9 geolocating archival tags (ATs), manufactured by Wildlife Computers, Redmond, Washington, USA, and forty LTD2310 geolocating ATs, manufactured by Lotek Wireless, Inc. St. John's, Newfoundland, Canada, were allocated for deployments in bigeye tuna and a limited number in yellowfin tuna. The MK9 ATs (64 MB memory) were programmed to sample each of the four parameters at a frequency of every 30 seconds and the LTD 2310 STs (16 MB memory) at a frequency of every minute. Fish tagged with MK9 ATs were also tagged with SPC Y-13 orange PDTs, and fish tagged with LTD2310 ATs were also tagged with IATTC Y-12 green PDTs.

For CP2, two tagging stations were set up on the rear deck of the Double D. The tagging cradles used were rigid aluminum with v-shaped inserts, padded with closed cell foam, lined with a smooth white vinyl, and marked with 1-cm increments for obtaining fish lengths. Two aprons with a capacity of 100 PDTs each, and numerically coded with the corresponding tag numbers, were stacked on one another and attached to the side of the cradle where a tagger would stand. Fish greater than 80 cm length were brailed with a heavy-gauge aluminum rigid-framed net, of knotless webbing, and landed on a wet foam pad covered with smooth vinyl for tagging (Bayliff and Holland, 1986). The materials and methods used for tagging and releasing bigeye and yellowfin with surgically-implanted archival tags are described in detail by Schaefer and Fuller (2002).

2.2.2 Conventional tag releases

The daily tag releases by fishing location and species are given in Table 4. A total of 2,605 tunas were tagged and released with conventional tags during the cruise comprising 2,238 BET (85.9%), 200 YFT (7.7%), and 167 SKJ (6.4%). The majority of the releases were made at the NOAA weather buoy no. 51028 (55.9%), and the 0°N, 155°W TAO mooring (39.3%). The high percentage of BET associated with these moorings, tagged and released, is not surprising considering similar results during CP1 (Itano, 2008). There is no reason to assume that the TAO moorings on the 140°W meridian, in particular between 2°S and 2°N, should not also have large tuna aggregations occasionally associated, including high proportions of BET, providing excellent opportunities for tagging significant numbers of BET in this area.

Table 4. Daily tag releases by fishing location, species, and tag type.

Buoy		Species			
Latitude	Longitude	Skipjack	Yellowfin	Bigeye	Total
5.00 N	154.93 W			1	1
0.01 N	154.97 W	65	120	643	828
0.01 N	154.80 W	2		12	14
0.10 N	154.72 W	16	2	135	153
0.00 N	153.90 W		3	18	21
0.00 N	153.88 W	68	57	1,285	1,410
0.08 S	153.70 W	2	1	2	5
0.03 N	140.03 W	14	16	130	160

0.02 N	139.77 W			11	11
5.01 N	139.99 W		1	1	2
Total		167	200	2,238	2,605

2.2.3 Size distribution of conventional tag releases

The length distributions of the bigeye, yellowfin, and skipjack tagged with conventional tags during this cruise are shown in Figure 5. There appeared to be two relatively distinct modes of bigeye tagged during the cruise with the smaller around 40 to 45 cm and the larger around 47 to 60 cm.

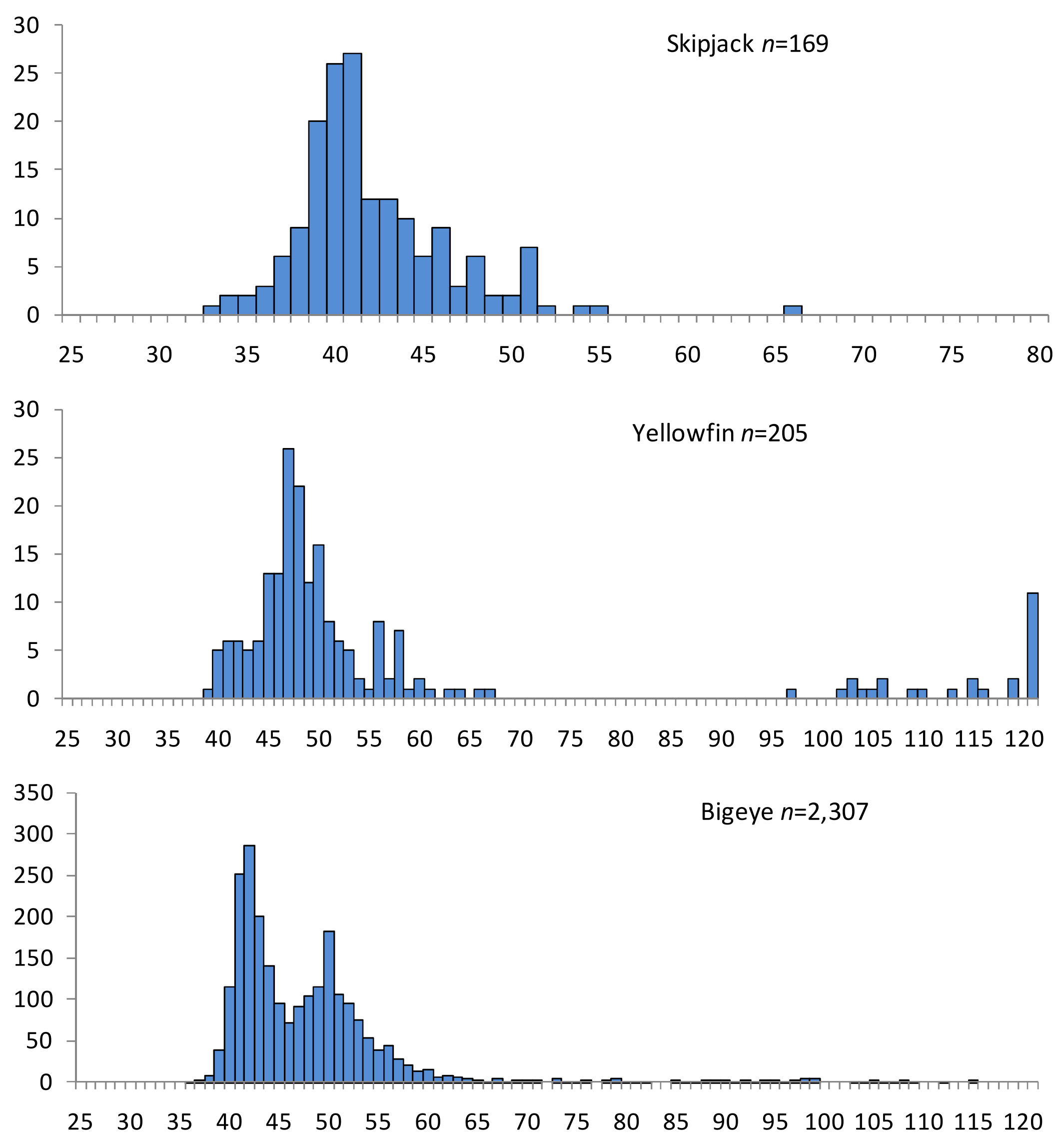


Figure 5. Size frequency of CP2 tag releases.

2.2.4 Archival tag releases

The deployments of the archival tags by fishing location and species are given in Table 5. A total of 19 BET and 10 YFT captured at the 0°N and 155°W TAO mooring, 21 BET captured at the NOAA weather buoy no. 51028, and 40 BET captured at the 0°N and 140°W TAO mooring were released with ATs. This deployment of ATs in BET concurrently at the 155°W and 140°W should provide some very interesting and useful information pertaining to movements and habitat utilization of BET in the equatorial central Pacific.

The length distributions of the BET and YFT tagged with ATs during this cruise are shown in Figure 6. The 80 BET ranged from 55 to 115 cm, and the 10 YFT ranged from 58 to 136 cm, with just one YFT less than 100 cm.

Table 5. Archival tag release details for CP2.

Buoy		YFT	BET		
Latitude	Longitude	MK9	MK9	LTD2310	Total
0.00 N	154.97 W	10	18		28
0.10 N	154.73 W		1		1
0.00 N	153.88 W		21		21
0.03 N	140.03 W			40	40
Total		10	40	40	90

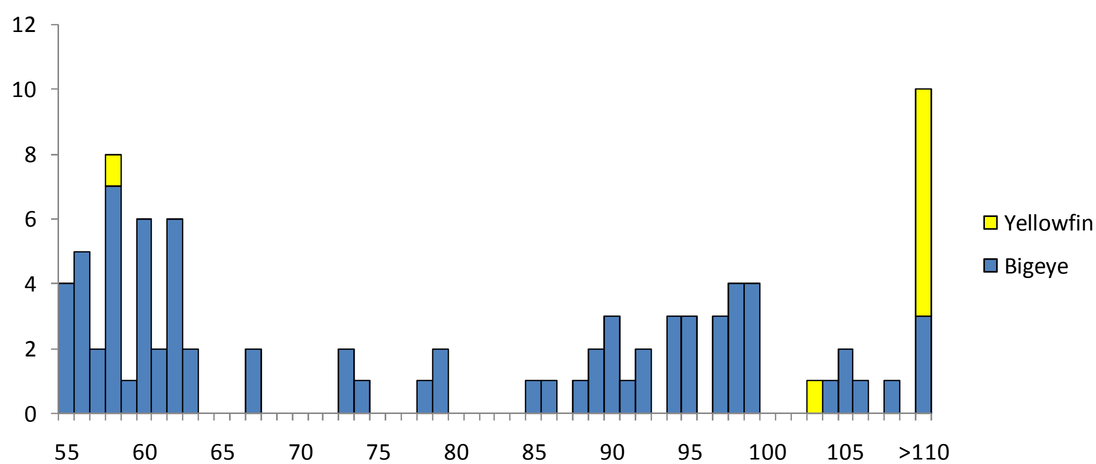


Figure 6. Size frequency of bigeye and yellowfin tuna archival tag releases during CP2.

2.2.5 Biological sampling

Bigeye and yellowfin tunas which were determined to be unsuitable for tagging, because of injuries or excessive bleeding, were retained for collections of various biological tissues. Saggital otoliths were extracted, cleaned, and stored in support of the Pelagic Fisheries Research Program investigation #651106 which entails examining otolith microchemistry for stock structure evaluations. In addition, otoliths, gonads, stomachs, and other tissues were collected in support of life history studies being undertaken on these species by scientists at the SPC.

2.2.6 Summary and recommendations

The tagging cruise was successful as the primary objective to deploy significant numbers of PDTs and ATs in BET in the equatorial CPO was accomplished. The numbers of PDT releases were within the range which we had hoped to deploy during the cruise, based on the outcome and expectations from CP1. Although most of the BET PDT releases were near the equator between 154°W and 155°W, with few along the 140°W meridian, the deployments of forty ATs in BET at the TAO moorings at the 0° 155°W and 140°W was more important. Successfully transferring the association of tuna aggregations from the moorings to the vessel, so as to be able to drift them significant distances away and then disperse them is essential, and was another important accomplishment during this cruise.

The cruise was fairly well documented with digital still images as well as digital video aboard the vessel and underwater. Video was captured of the unique BET dangler fishing technique and conventional tagging activities aboard the vessel. The underwater video was taken with a Splashcam Marine Video system manufactured by Ocean Systems Inc. Digital still images of the Furuno echo sounder display set at 50 kHz were also taken at selected concurrent times during the underwater recordings in order to document the acoustic signatures of the tunas when passing under the vessel.

For the next equatorial central Pacific tagging charter (CP3), of a proposed 6 week duration, within the period of October to December 2009, we will not utilize the same vessel or Captain but solicit bids from several other suitable vessels. The charter will most likely originate and terminate in either Hawaii or Samoa, dependent on the vessel selected. The crew should consist of two experienced fisherman in addition to a competent Captain, and there should be two scientists aboard to conduct tagging activities. The vessel should have the fuel capacity to be able to operate between the 140°W and 155°W and 5°N and 5°S, throughout the charter period. For safety concerns, the vessel will need to have the computer equipment and software aboard to receive daily weather updates and potential advisories from NOAA, since this proposed time and area can be subject to tropical storms and hurricanes.

Efforts will be made to further improve the fishing, tagging, and release techniques, based on observations and experience gained during CP2, to improve the potential survivorship of the fish released with PDTs and ATs and make those operations more efficient.

3 Tag recoveries

In this section we provide some information regarding the tag recoveries to date, from both Phase 1 and Phase 2 of the programme.

3.1 Tag recovery procedures

Recovery procedures have been established in major tuna landing ports throughout the region and elsewhere utilising, for the most part, established catch monitoring programmes. Recovery Officers have been appointed in key locations, including PNG ports, other Pacific Island landing sites, Philippines, Thailand, Japan and Korea, for tags to be collected, rewards to be paid, and the tags and recovery data sent to SPC. Arrangements have been put in place to obtain accurate length measurements of recaptured tuna through the provision of callipers, measuring decks and tag recovery forms.

3.1.1 Tagging project publicity

A publicity campaign has been carried out throughout the WCPO region to publicise the tagging project since the commencement of fieldwork in Phase 1. Publicity has occurred through tagging posters in various languages that have been distributed to landing ports and processing facilities, announcements in local newspapers and local radio as well as the personal contact of project staff with the fishing industry and local communities. Information sheets have also been distributed (eg. see http://www.spc.int/tagging). A website has also been established for the purpose of disseminating publicity and information about the project, and also as a means of collecting tag-recovery data (e.g., see http://www.spc.int/tagging). To maximise tag returns, publicity is targeted at canneries and unloading/transhipment points rather than at fishermen. Cannery workers are most likely to recover tags while handling fish or be in contact with personnel from fishing vessels who have recovered tags. This targeted publicity approach is likely to be more effective than a national publicity campaign aimed at the general public, whom have less of a chance of recovering tagged tunas. However, it is still important to make as many people as possible aware of the PTTP so as to be able to recover as many tags as possible with the proper associated information. The popular media has been used to publicise the PTTP to this later audience.

3.1.2 Articles for print media

The Information Section of the SPC Marine Resources Division produces a newsletter every four months that covers the work carried out by the various sections in the Marine Resources Division. The Fisheries Newsletter is widely distributed around the region to SPC member countries and contacts in the fisheries sector. The latest issue of Fisheries Newsletter ran an article on the PTTP set to achieve 200,000 tag releases. Copies of this article were sent to newspapers and magazines across the region for use as a public interest story.

The Business Mirror, a leading Philippine business newspaper, ran an article in March of 2009 following the work of the tagging vessel in the waters of the Philippines and reports of recaptures from local fishermen. This generated quite a good amount of feedback and several emails from fisheries contacts.

Since the initial publicity campaign articles have been written for the local newspapers of PNG and the Solomon Islands (SI) prior to the commencement of the second leg fieldwork in PNG and again at the end of the first leg of fieldwork in SI. An article written by David Itano also featured in the April 2007 issue of Niugini Blue, a magazine for recreational sports fishermen in PNG. An article was written for the Pacific Islands Business magazine emphasising the scientific value of the tagging programme, its usefulness in fisheries stock assessment and fisheries management, the types of tags used in the project, the rewards offered for tag returns, the information requested from tag finders and the tag recovery procedure.

3.1.3 Tagging Video

The Regional Media Unit (RMU) of SPC is based in Suva, Fiji. The RMU has produced a video on the work carried out during Phase 1 of the PTTP in Papua New Guinea. The video is titled ‘Taking stock of our tuna’. The documentary style video captures the day to day operations onboard the tagging vessel. The video highlights the regional concern over the status of juvenile bigeye and yellowfin stocks, the concern over the use of FADs in modern tuna fisheries and the importance of the work carried out by the PTTP to address these issues.

The video describes the pole-and-line fishing method and why it is the optimum fishing method used to tag-and-release large numbers of tunas. The video details the different types of tags used, the methods used for conventional and electronic tagging as well as the tag return procedure for tag recoveries.

The video has been televised extensively around the region courtesy of the RMU produced television series The Pacific Way and has proven to be a useful tool in raising initial publicity and the profile of the work carried out by the PTTP, particularly in areas where the tagging vessel has visited and conducted tuna tagging.

3.1.4 Direct email and faxes to fishing vessels

A new direction that has been taken this year was to send an email informing purse seine vessels of the work carried out by the PTTP and to ask the crew to keep a vigil for tags amongst their catch. This has resulted in over 200 tag returns reported directly from purse seine vessels. The direct email contact also allows for the coordination of tag recovery and tag reward payments with RO’s. This arrangement has been particularly effective in the Marshall Islands. A similar approach was taken with regard to Japanese longline vessels, whereby a message was sent to the fishing vessels to be on the lookout for tagged tunas.

3.1.5 Posters

As part of the initial publicity campaign, tag reward posters were printed in 13 languages and distributed to various ports in the region as well as key tag recovery points in Thailand, Japan, Korea and the Philippines. The tag reward posters clearly state the tag types used, the species targeted, the tag recovery procedure, the rewards offered for tag returns, the tag return information requested and the contact details for tag returns. Posters have also been developed that summarise the tagging operations and the importance of tag recoveries. The posters also provide a mechanism to reinforce the tag recovery procedure and emphasise the need for quality data measurement and collection. The posters developed can be easily adapted for use in subsequent reinforcement of the need for accurate data collection.

3.1.6 Radio Media

Prior to the tagging vessel entering the Marshall Islands an interview was conducted with the local radio station explaining the work of the PTTP and reinforcing tag recovery procedures set up with the Marshall Islands Marine Resources Authority.

Utilising the greater ‘reach’ of radio to publicise the PTTP, the interviews followed the general format of the initial publicity campaign, emphasising the scientific value of the tagging project, its usefulness in fisheries stock assessment and fisheries management, the tag types used, the species targeted, the tag recovery procedure, the rewards offered for tag returns, the tag return information requested, the contact details for tag returns and emphasised the need for industry cooperation as well as individual cooperation in the collection of good quality data.

3.1.7 PTTP Website

A website was developed as part of the tag recovery programme for the purpose of disseminating publicity and information about the project, and also as a means of collecting tag-recovery data.

The PTTP website features a table of tag releases and recoveries, which is updated monthly. Trip reports of the various legs of fieldwork (cruise reports) in PNG, SI, the central Pacific and the current fieldwork targeting the greater western Pacific region are posted on the website. At the end of each month a summary on the progress of the PTTP is posted on the website. This monthly summary is currently being developed into a form of e-newsletter to be distributed to in-country tag recovery officers, cannery staff and other interested parties. The website interface is also being assessed for means to make it more accessible and 'user friendly'.

3.1.8 Incentive to declare tags

Tagging data is the only viable method for collecting independent tuna fishery data and is therefore extremely valuable. The following incentives are provided to encourage the return of tags:

- USD 10.00 for conventional tags;
- USD 50 for sonic tags;
- USD 250 for archival tags; or
- A shirt or cap if the tag finder does not want cash rewards.

3.1.9 Longline publicity

Given that the first tag releases during Phase 1 of the PTTP occurred in late 2006, some of the tunas tagged during this time would be soon entering into the longline fishery if not already. Tag recovery publicity has now commenced for the longline fishery in the WCPO.

Targeted trips to conduct publicity and raise awareness of the PTTP and reinforce tag recovery procedures were conducted since the beginning of the year. Trips have been made to Palau, FSM, Marshall Islands, Korea, Taiwan and Japan to meet with industry representatives and establish RO's.

3.1.10 Meetings with cannery staff & industry

In addition to the above, PTTP officers have also actively met with cannery staff and industry. This has included public presentations for fishermen and fishing organisations, processors, local representative groups, scientists and all users of the fishery. PTTP officers have visited Thailand, Philippines, Solomon Islands, Papua New Guinea, Indonesia, Marshall Islands, Palau, Federated States of Micronesia, Guam, Korea, Samoa and USA to discuss the project.

3.1.11 Tag recovery envelopes

A novel approach being looked at is the use of tag recovery envelopes. Tag recovery envelopes will be used as a tool to assist fishermen keep the tag recovery information as well as the tag recovery information together while at sea, rather than scribbling the information on pieces of paper that they tend to lose after a while. The envelopes will be have a modified tag recovery form printed on the front to collect all the pertinent information and will have the return address also printed so tag finders can send directly back to SPC as an option.

3.2 Conventional and archival tag recoveries

The number of conventional tag recoveries (31 July 2009) by species is given in Table 6. The recovery rates are highly variable by location due to a number of factors, including tag reporting performance and the level of fishing activity in the vicinity of the tag releases which results in large variation in the numbers of tag recoveries soon after release. Nevertheless, some points are worthy of comment:

- The relatively high recovery rates of bigeye tuna in several locations and overall;

- The high recovery rates of bigeye and yellowfin tuna from the CP1 releases, in an area of low purse seine effort (indicating higher catchability in the central Pacific).

Note that tag recoveries are still being received in considerable numbers from WP2 releases and in lesser numbers from the earlier cruises. The recovery rates of yellowfin and bigeye tagged with archival tags (Table 7) are very similar to the conventional recovery rates. Significant numbers of skipjack have only recently been tagged with archival tags.

Table 6. Total conventional tag recapture numbers by species and school association, for the PTTP, as at 31 July 2009.

Phase 1	SKJ	%	YFT	%	BET	%	Total	%
PNG 2006 (Soltai 6)	2,620	18.8	1,779	22.8	226	40.2	4,625	20.7
PNG 2007 (Soltai 6)	2,437	9.2	1,618	12.6	6	4.7	4,061	10.3
SI 2007 (Soltai 6)	1,952	26.1	767	21.5	18	12.9	2,737	24.5
SI 2008 (Soltai 6)	765	12.3	1,447	13.8	46	11.9	2,258	13.2
SI 2008 (Soltai 105)	904	9.9	721	18.2	8	30.8	1,633	12.5
Phase 2								
CP1 (Double D)	4	7	22	19	409	23.6	435	22.8
WP1 (Soltai 105)	5,621	14.9	1,570	8.9	282	19.2	7,473	13.2
WP2 (Soltai 105)	577	1.7	216	1.6	138	4.4	239	1.8
Total	**14,880**	**11.0**	**8,140**	**11.6**	**1,143**	**15.1**	**24,163**	**11.3**

Table 7. All archival tag recaptures numbers by species and school association as at 31 July 2009.

Phase 1	Skipjack	%	Yellowfin	%	Bigeye	%	Total	%
PNG 2006 (Soltai 6)	1	100	17	37	11	44	29	40.3
PNG 2007 (Soltai 6)	0	0	15	8	0	0	15	7.1
SI 2007 (Soltai 6)	-	-	0	0	0	0	0	0
SI 2008 (Soltai 6)	-	-	1	9.1	0	0	1	8.3
SI 2008 (Soltai 105)	-	-	3	27.3	-	-	3	27.3
Phase 2								
CP1 (Double D)	-	-	2	40	10	22.2	12	24.0
WP1 (Soltai 105)	-	-	0	0	11	30.6	11	22.4
WP2 (Soltai 105)	0	0	1	1.8	1	1.2	2	1.1
Total	**1**	**2.4**	**39**	**11.7**	**33**	**15.1**	**73**	**12.3**

3.2.1 Recoveries by vessel nationality

During the PTTP to date, recoveries have been received from all vessel nationalities involved in the purse seine fishery. In Figure 7, we present the number of tags returned and reported as recaptured by different purse seine vessel nationalities, in relation to the catch of those vessels during the period of the PTTP (August 2006 – present). The index of catch is scaled such that, for Japan (which is thought to have a high tag reporting performance) the bar is of equal height to the number of tags returned. For the other nationalities, where the tag bar is higher than the catch bar, a larger number of tags/catch has been reported compared to Japan; where the tag bar is lower than the catch bar, tags/catch has been less than Japan. Inspection of Figure 7 reveals that:

- The numbers of tags reported by Indonesia, Philippines, PNG and Solomon Islands vessels has been very high in relation to their catches.
- In the case of Indonesia, this is thought to be a combination of a large number of tag releases in Indonesian waters, the proximity of intensive fishing effort to the tag releases and good tag recovery procedures in Bitung, Sorong, Kendari, Ambon and Ternate.
- In the case of Philippines, this has been due to the proximity of tag releases in PNG to Philippines purse seiners fishing in PNG, considerable fishing effort by Philippines vessels adjacent to the large number of tag releases in Indonesia, and good tag recovery procedures in the main Philippines tuna unloading port of General Santos City.
- For PNG, large numbers of tags were recovered by the domestic purse seine fleet fishing in the Bismarck Sea, particularly in 2006 and 2007, and also by PNG seiners fishing more widely in the region but unloading their catch in Wewak – see PNG panel in Figure 8.
- Likewise in Solomon Islands, the large number of returns from Solomon Islands vessels reflects the large number of releases in Solomon Islands archipelagic waters and highly concentrated fishing effort in that area by Solomon Islands purse seiners – see Solomon Islands panel in Figure 8.
- Japanese seiners fished relatively close to the main centers of tag release, which, in combination with good tag recovery procedures in the main unloading port of Yaizu and excellent assistance by the Japan National Research Institute of Far Seas Fisheries, results in a moderately high number of tags/catch.
- In the case of Vanuatu, a large number of tags have been recovered by several vessels fishing in Solomon Islands archipelagic waters, which largely accounts for their very high tags/catch.
- Chinese Taipei seiners had moderate tags/catch fishing in an area similar to the Japanese fleet. The lower tags/catch of this fleet compared to the Japanese probably reflects the lower tag detection/reporting rates in transshipment operations compared to direct unloading at home port.
- United States seiners had moderate tags/catch. despite the fact that its main area of activity was somewhat displaced to the east of the main tag release centers in PNG and Solomon islands. Most US recoveries came from fish that had been transshipped to Thailand, probably recaptured by vessels fishing closer to the main tag release sites. Very few tags have been recovered from vessels unloading in American Samoa (see following section), possibly because these vessels tend to fish further to the east.
- Korean vessels had a relatively low number of tags recovered, despite their fleet recording the highest overall catch since the start of the tagging programme. While the fishing activity of this fleet is largely to the east of the main tag release areas, it is similar to the areas fished by the United States and Vanuatu fleets. Possibly, the propensity of Korean purse seiners to target larger yellowfin tuna in free schools and a relatively low reliance on FAD sets resulted in fewer numbers of tags being recaptured per unit catch.
- Some of the smaller fleets, such as Marshall islands and New Zealand, had very low numbers of tags/catch, possibly due to their more easterly distribution of fishing effort.

Overall, most of the variability in numbers of tags returned in relation to the catch of the various fleets are potentially explainable due to the operational characteristics of these fleets. However, further analysis on a vessel-by-vessel basis is required to identify potential reporting problems if they exist. Also, it will be instructive to monitor tag recovery by some of the fleets that tend to fish more to the east, following the large numbers of tags released in the Kiribati EEZ in March-April of 2009.

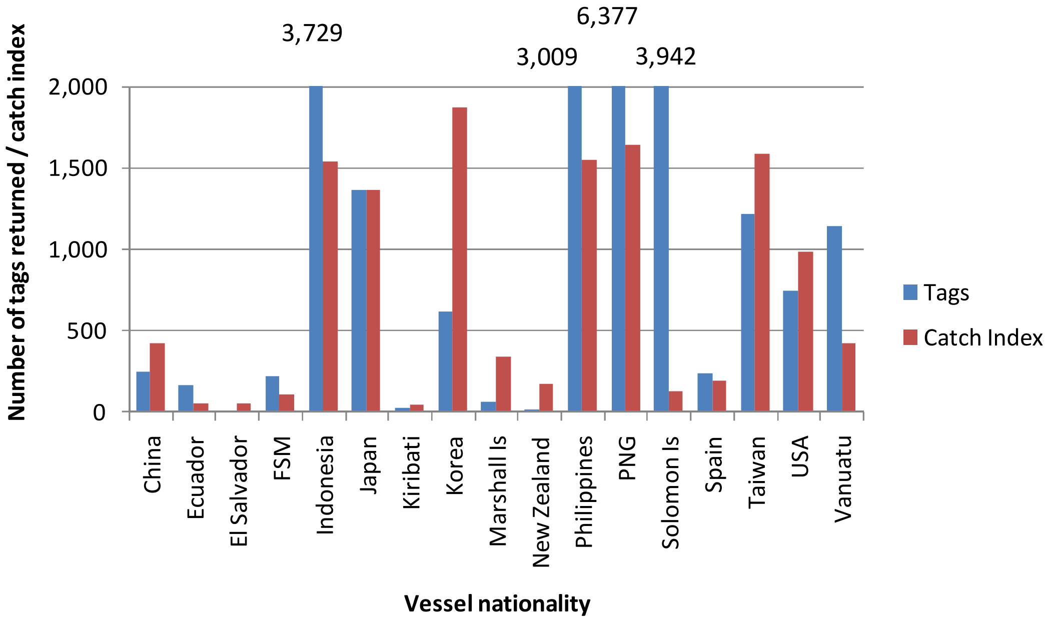


Figure 7. Tag returns by vessel nationality compared to an index of total tuna catch during the period 1 August 2006 to 31 December 2008. The index is scaled such that for Japan (thought to be highly cooperative in the return of tags) it is equal to the number of tags returned.

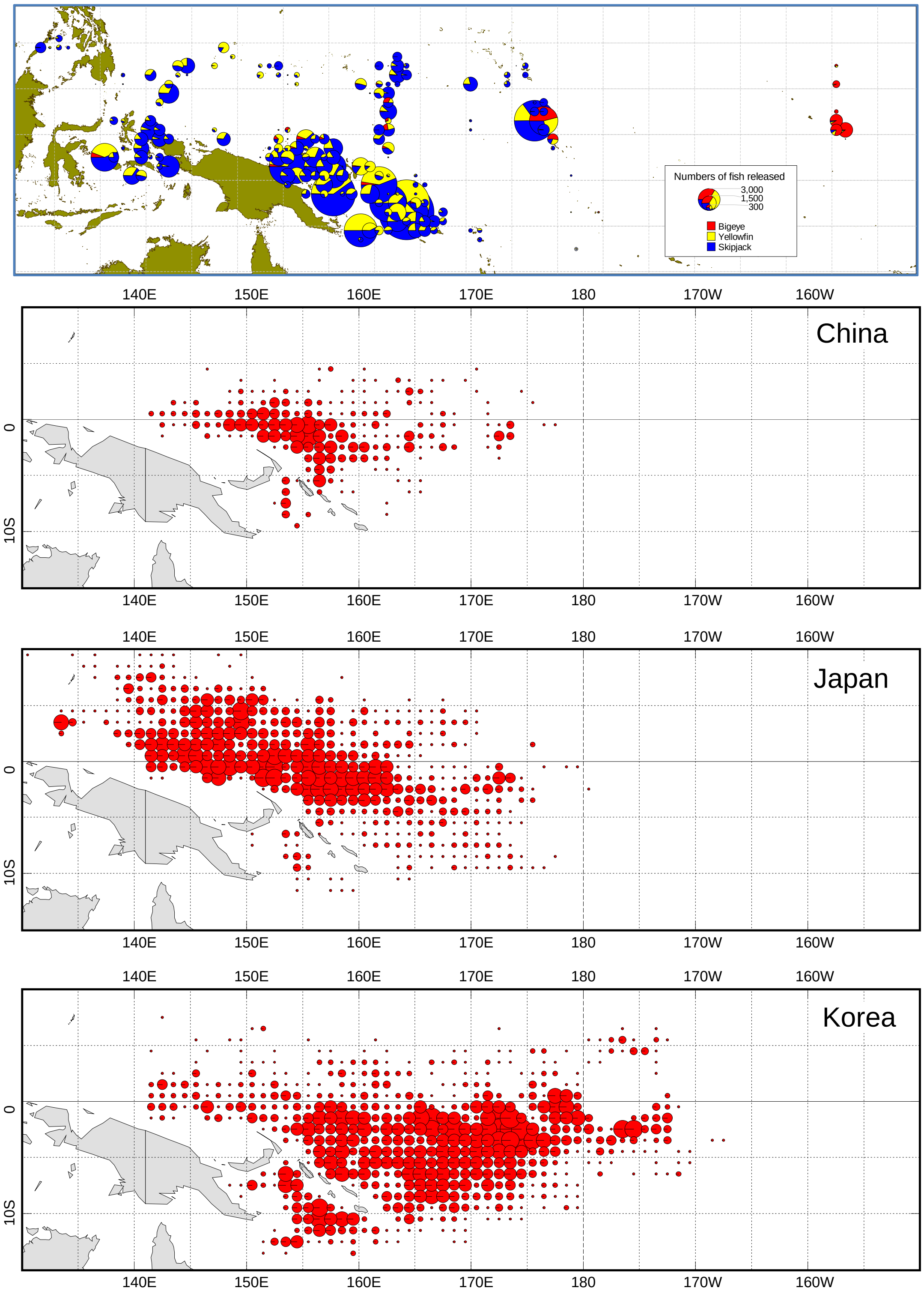
3.2.2 Recoveries by source

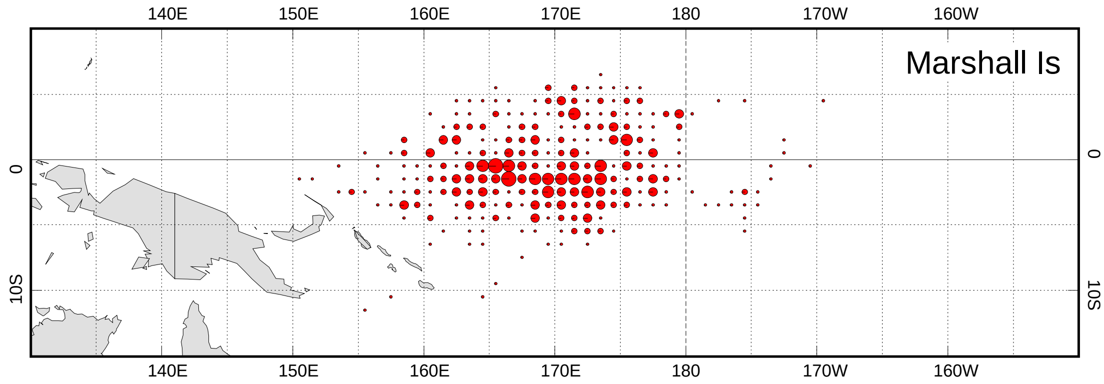
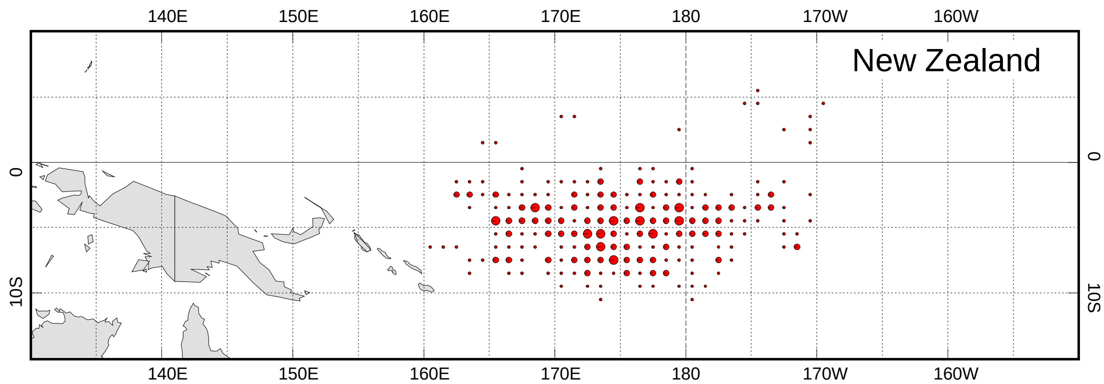
It is also instructive to examine the number of tag recoveries by source location to gain possible insights into reporting performance and problems (Table 8). The following observations are made:

- Very low numbers of tag recoveries have been reported from the canneries in American Samoa, despite the large volume of catch processed by these canneries. This may be partially because vessels unloading in American Samoa generally fish further east, away from the main tag release locations. An increase in recoveries has occurred very recently, from the WP2 releases in Marshall Islands and Kiribati, which provides some support for this hypothesis. However, a significant amount of fish is delivered to American Samoa by reefer vessels. This fish is likely to have been captured more broadly throughout the western and central Pacific and it is surprising that so few recoveries have been reported from these landings. Considerable efforts to raise awareness amongst cannery staff and stevedores have been made and it is hoped that the situation will improve.
- No recoveries have been reported from the several canneries in China processing Chinese-caught tuna from the WCPO. An SPC-OFP staff member will conduct a visit to these canneries in September,
- The number of recoveries from the Korean canneries has been thought to be below expectation. However, tuna processed by these canneries comes primarily from Korean-flagged purse seiners, which as noted earlier, may have lower tag recapture rates because of their operational characteristics. Also, around half of the Korean

catch is processed in Korea and the rest mainly in Thailand. A similar number of Korean-caught tags have been recovered in Thailand, indicating that there may in fact be no particular problems with tag reporting from the Korean canneries.

- Tag detection and reporting at various transshipment locations in the region (Pohnpei, Majuro, Tarawa, Honiara) have generally been low. This may be due to the speed of the transshipment operation not being particularly conducive to tag detection. However, special efforts have been made to alert crews to the possibility of tags being present in catches, and significant improvements in tag reporting from some locations have recently occurred. We are grateful for the assistance of the national fisheries offices in these locations in this regard.
- In early 2009, SPC-OFP sent an email message regarding tag recovery to all purse seine vessels for which we had direct email addresses. This approach has been successful in a number of cases (and there have been two notable standouts) resulting in significant numbers of tags now being detected during brailing. Tag detection at this stage of the handling process is highly desirable as it results in perfect data on date, location and type of set. In the recent Indian Ocean tagging programme, approximately one-third of all recoveries in the last year or so of the programme were obtained in this way (J-P. Hallier, pers. comm.), demonstrating that it is possible to obtain a substantial number of recoveries in this way. We would be grateful for all purse seine and longline vessel operators assisting us in tag recovery.


Numbers of fish released
3,000
1,500
300
Bigeye
Yellowfin
Skipjack
140E
150E
160E
170E
180
170W
160W
China
Japan
Korea
0
10S


Marshall Is
140E
150E
160E
170E
180
170W
160W
0
10S

New Zealand
140E
150E
160E
170E
180
170W
160W
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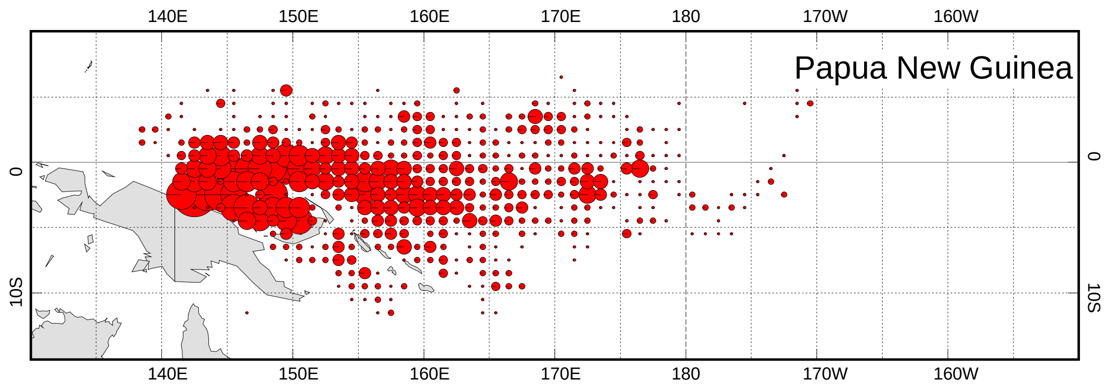
Papua New Guinea
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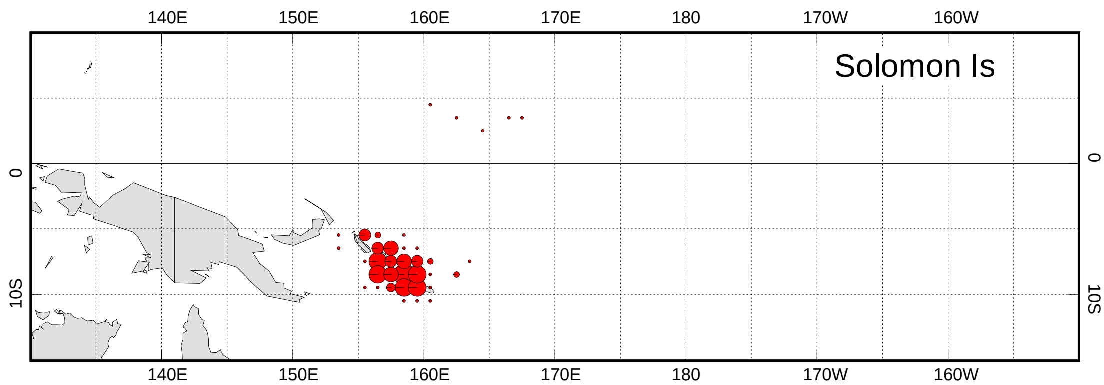
Solomon Is
140E
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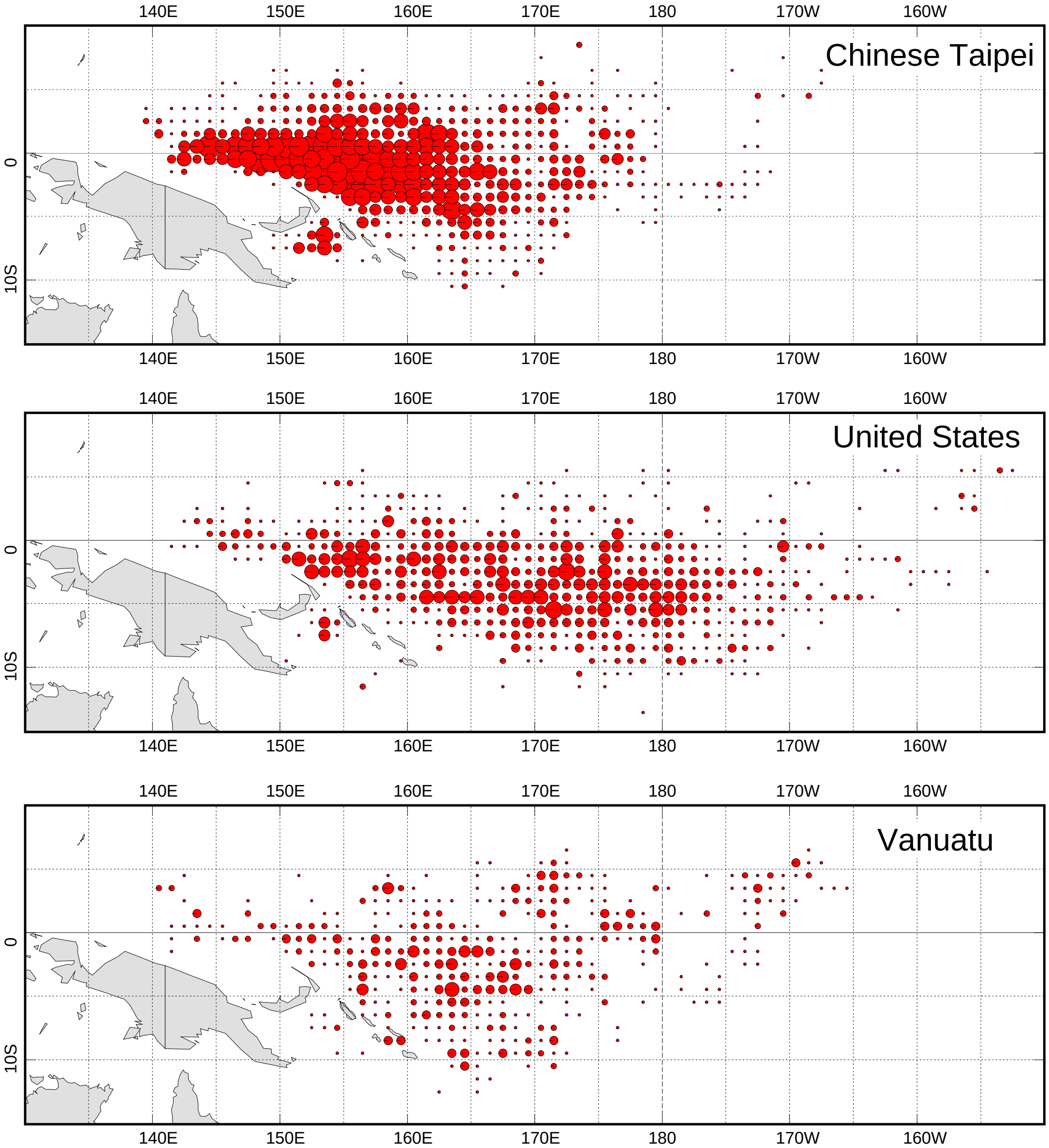

Figure 8. Distribution of tag releases (top panel) and distributions of catch by selected national fleets, August 2006 - December 2008.

Table 8. Numbers of tags recovered from different source locations, with some comments regarding data quality and suspected levels of reporting.

<table>
<tr><th>Cannery location</th><th>Tags returned (to 10 April 2009)</th><th>Suspected level of tag reporting or detection</th><th>Recapture data quality</th><th>Approximate WCPO product processed in 2007 (t)</th></tr>
<tr><td>American Samoa</td><td>38</td><td>Low</td><td>Poor</td><td>212,500</td></tr>
<tr><td>China</td><td>1</td><td>Low</td><td>NA</td><td>50,000</td></tr>
<tr><td>Latin America</td><td>950</td><td>High</td><td>Moderate</td><td>104,000</td></tr>
<tr><td>Indonesia</td><td>3,588</td><td>High</td><td>Moderate</td><td>20,000</td></tr>
<tr><td>Japan</td><td>1,299</td><td>High</td><td>Good</td><td>77,500</td></tr>
<tr><td>Korea</td><td>317</td><td>Low (?)</td><td>Poor</td><td>110,000</td></tr>
<tr><td>Philippines (GenSan)</td><td>2,536</td><td>High</td><td>Good</td><td>225,000</td></tr>
<tr><td>PNG (Lae)</td><td>935</td><td>High</td><td>Good</td><td rowspan="3">60,000</td></tr>
<tr><td>PNG (Madang)</td><td>5,097</td><td>High</td><td>Good</td></tr>
<tr><td>PNG (Wewak)</td><td>794</td><td>High</td><td>Poor</td></tr>
<tr><td>Solomons (Noro)</td><td>4,810</td><td>High</td><td>Good</td><td>5,000</td></tr>
<tr><td>Thailand</td><td>2,964</td><td>Moderate</td><td>Good</td><td>600,000</td></tr>
<tr><th colspan="5">Transshipment/other location</th></tr>
<tr><td>Pohnpei (FSM)</td><td>8</td><td>Low</td><td>Moderate</td><td></td></tr>
<tr><td>Indian Ocean</td><td>8</td><td>High</td><td>Moderate</td><td></td></tr>
<tr><td>Tarawa (Kiribati)</td><td>49</td><td>Low</td><td>Good</td><td></td></tr>
<tr><td>Majuro (Marshall Is)</td><td>46</td><td>Low</td><td>Good</td><td></td></tr>
<tr><td>Honiara (Solomon Is)</td><td>149</td><td>Low</td><td>Good</td><td></td></tr>
<tr><td>Kaoshiung (Ch. Tai.)</td><td>1</td><td>?</td><td></td><td></td></tr>
<tr><td>Fishing vessels</td><td>309</td><td>Low</td><td>Perfect</td><td></td></tr>
</table>

3.2.3 Characteristics of the tag recapture data

Some characteristics of the tag return data are shown in Figure 9 (spatial distribution), Figure 10 (time at liberty), Figure 11 (overall displacements), Figure 12 and Figure 13 (individual longer-distance displacements). Growth data will also be available; however the necessary screening of data for reliable growth measurements has not yet been undertaken. These figures are provided here for information and discussion and to give some general impressions of the nature of the data being collected.

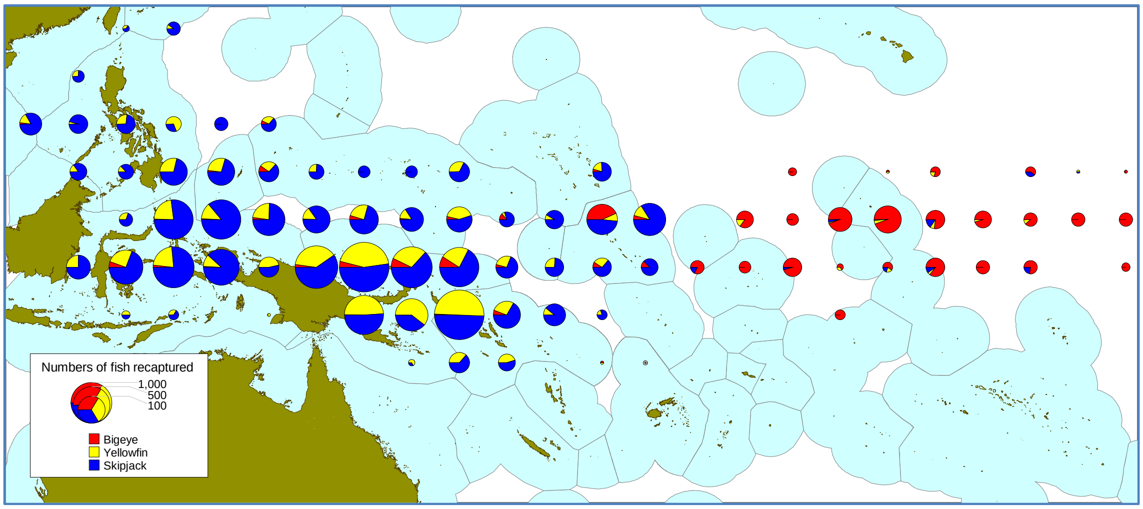

Figure 9. Spatial distribution of all PTTP recaptures reported to date.

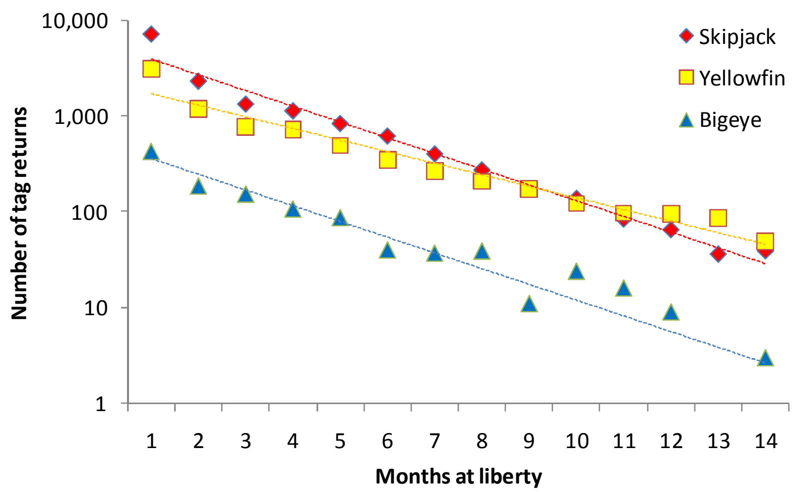

Figure 10. Tag returns by time at liberty from PTTP recaptures reported to date.

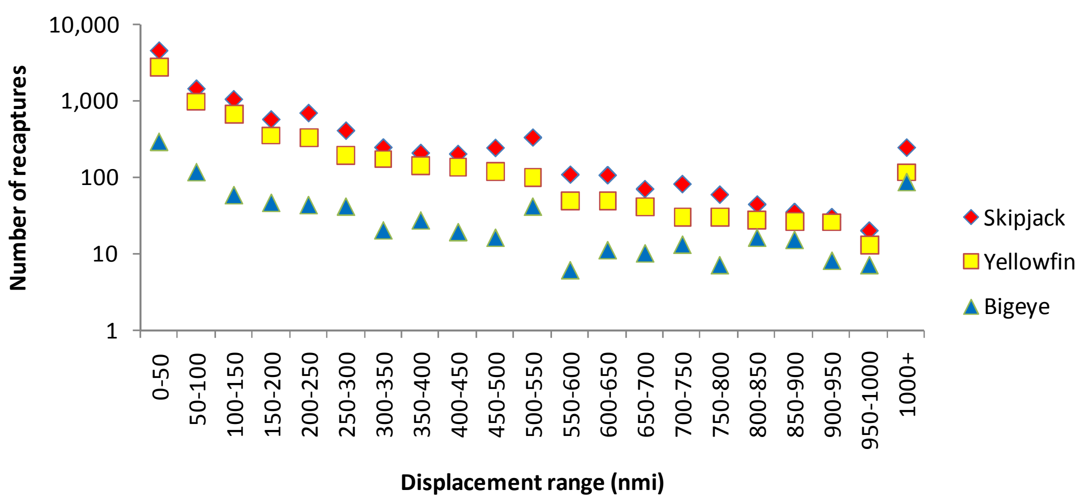

Figure 11. Tag return numbers by displacement range from PTTP recaptures reported to date.

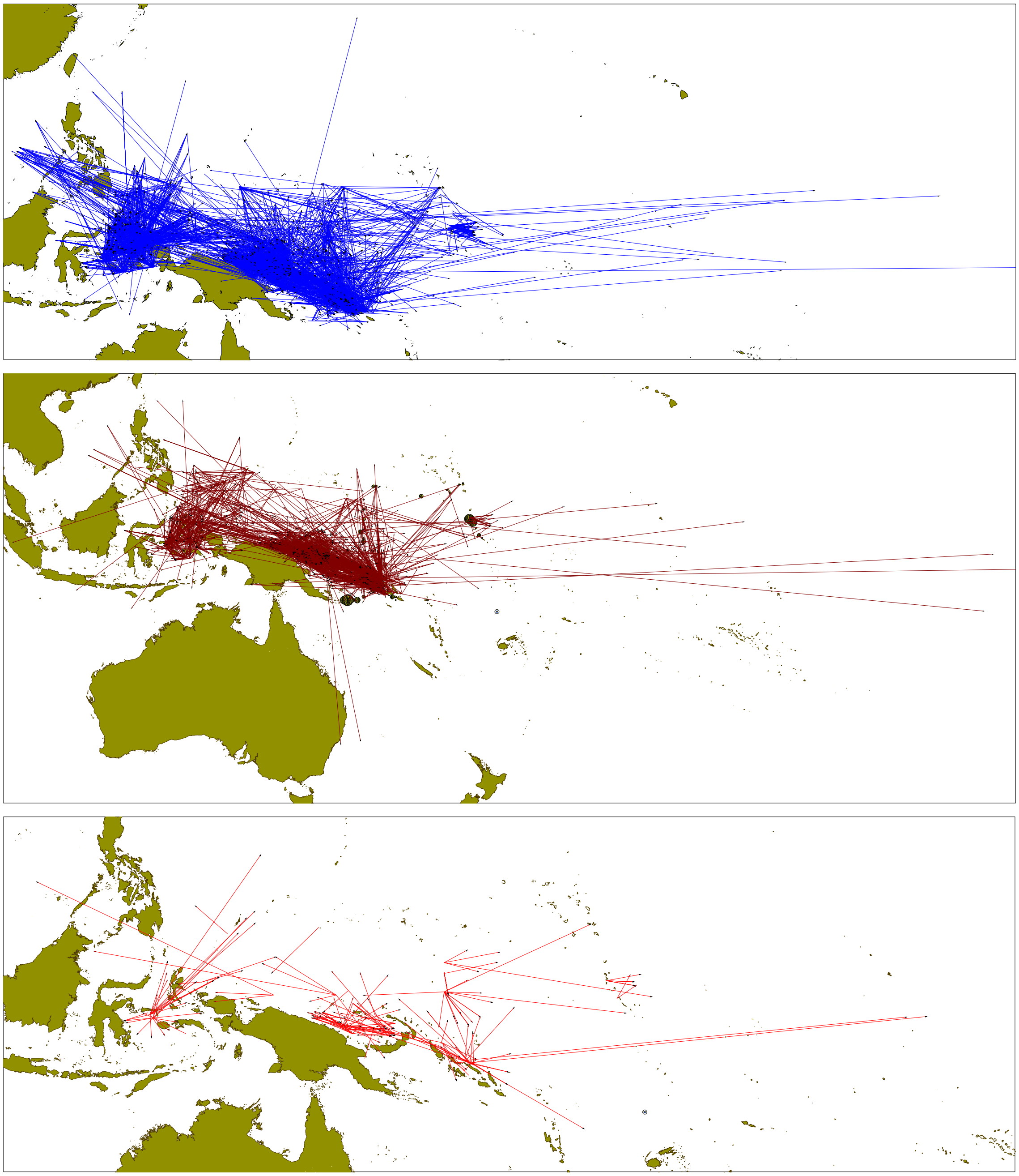

Figure 12. Displacements of skipjack (top), yellowfin (middle) and bigeye tuna (bottom) >100 nmi from Phase 1, WP1 and WP2 releases.

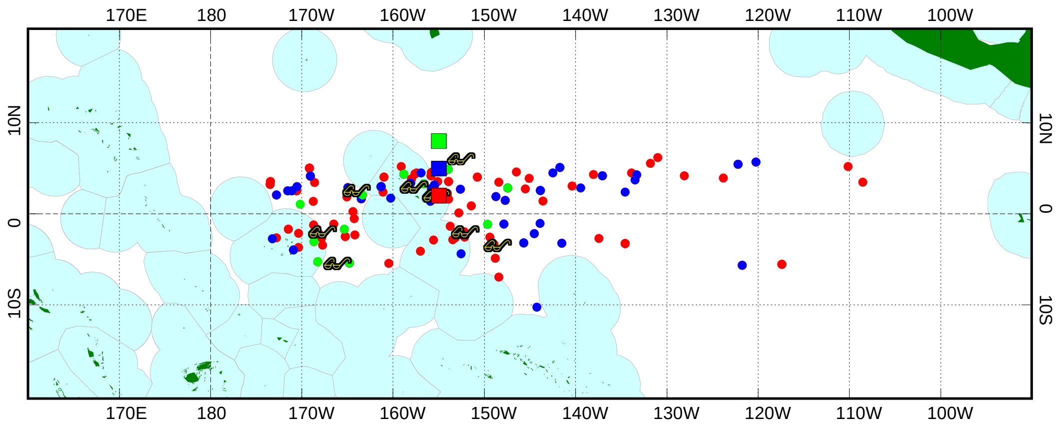

Figure 13. Bigeye tuna tag-recapture locations from CP1 releases (n = 280). Release (squares) and recapture (dots) locations are colour-coded according to release location – 8N (green), 5N (blue) and 2N (red). Recaptures were filtered to exclude those with questionable recapture position data. Archival tag recapture locations are shown by the yellow diamonds.

3.3 Data Quality issues

Common problems associated with the tag recovery data include misidentification of species, poor length measurements and no position of recapture (Table 9). Overall 11,655 records had at least 1 missing value.

Position data

6,262 tag recoveries did not have any position-of-tag-recapture data associated with the tag recovery data. In many cases, it will be possible to derive an approximate position based on logsheet and/or VMS records of vessel location. Work on this task has commenced and software has been developed to interrogate VMS and logsheet data for the purpose of estimating tag recapture positions and their spatial resolution.

Length at recapture

4,337 recoveries had no length measurements associated with tag recapture and there are a large number of recoveries for which the length measurements provided are of dubious quality (4,073). A priority task is to identify recapture records in the database where we are certain that the fish has been correctly measured. It will also be necessary to record the state in which the fish was measured, as frozen fish for example may be subject to length shrinkage.

Species Identification

1, 072 recoveries had species identification associated with tag recapture being different from species identification at tag release. Mis-identification records were as follows:

Skipjack at release, bigeye at recapture	71
Skipjack at release, yellowfin at recapture	1,028
Yellowfin at release, bigeye at recapture	173
Yellowfin at release, skipjack at recapture	1,315
Bigeye at release, skipjack at recapture	105
Bigeye at release, yellowfin at recapture	251

Identification issues commonly occur between small bigeye and yellowfin, however the miss-match between skipjack and bigeye and yellowfin and skipjack suggest that the data was more than likely fabricated, which is common when the tag and the fish become separated before details are recorded. Many tag finders continue to do this in spite of the fact that rewards are paid for tags regardless of the provision of associated (specifically so as not to provide an incentive to fabricate data).

Table 9. Number of tag return records by source with % missing information by category.

	Returns			% Data Missing in Categories					
Source	No.	% Complete	% Missing	Length	Wrong length	Position	Flag	Vessel	Sp ID
Fishing vessel	309	93.5	6.5	15.0	85.0	0.0	0.0	0.0	0.0
Solomon Is (NFD)	3436	85	15.1	16.2	64.4	23.6	2.5	1.5	0.0
Solomon Is (Soltai)	418	82.3	17.7	12.2	71.6	24.3	1.4	13.5	0.0
Marshall Is	82	80.5	19.5	31.3	50.0	18.8	0.0	0.0	0.0
Tagging vessel	150	74.7	25.3	2.6	39.5	60.5	0.0	0.0	0.0
PNG (RD)	5116	73.6	26.4	5.3	90.6	2.7	4.0	0.1	0.1
Philippines (Frabelle)	164	72.6	27.4	22.2	77.8	0.0	11.1	0.0	0.0
Japan	1299	68.4	31.6	8.8	62.8	31.4	0.0	2.9	0.2
PNG (Frabelle)	959	63.9	36.1	41.9	55.2	4.0	1.7	0.6	0.0
PNG (other)	58	63.8	36.2	19.0	47.6	52.4	28.6	42.9	0.0
Indonesia	3588	63.7	36.3	12.1	73.5	22.0	0.1	2.8	0.2
Taiwan	14	57.1	42.9	0.0	100.0	0.0	0.0	0.0	0.0
Other	30	56.7	43.3	46.2	38.5	46.2	7.7	15.4	0.0
Solomon Is (MFMR)	162	55.6	44.4	27.8	31.9	55.6	8.3	0.0	0.0
Kiribati	49	36.7	63.3	3.2	87.1	22.6	0.0	0.0	0.0
Solomon Is (GI)	1043	35.8	64.2	87.8	12.2	14.9	0.0	13.6	0.0
FSM	8	25	75	66.7	16.7	83.3	0.0	50.0	0.0
PNG (NFA)	116	24.1	75.9	86.4	8.0	69.3	62.5	63.6	1.1
PNG (SST)	817	21.5	78.5	46.8	32.4	89.9	0.9	0.6	0.0
Solomon Is (other)	30	20	80	20.8	45.8	62.5	0.0	29.2	0.0
Philippines (direct)	2385	18.3	81.7	91.7	5.3	64.1	0.4	2.8	0.0
Korea	317	13.9	86.1	20.1	27.8	89.4	3.7	18.7	0.0
American Samoa	56	5.4	94.6	71.7	3.8	86.8	9.4	18.9	0.0
IATTC	977	2.3	97.8	94.6	2.1	60.2	4.0	6.4	0.0
Thailand	3038	10.3	89.7	1.1	14.6	98.6	0.5	0.1	0.0
China	1	0	100	0.0	0.0	0.0	100.0	100.0	0.0
IOTC	8	0	100	0.0	25.0	100.0	0.0	12.5	0.0
Nauru	1	0	100	0.0	100.0	100.0	0.0	0.0	0.0

3.3.1 Data by gear

Most recoveries to date have been made by purse seine vessels. Few recoveries have been made by longline vessels (<1%; Table). Longline fleets are the only fleets that can potentially provide information on older age classes of bigeye tuna over the entire WCPO. Because of the careful individual handling received by longline-caught fish, it is unlikely that any tags would escape detection by longline crews. The fish released in 2006 and 2007 are now likely to be at a size caught by longline. If the recovery rate remains low it is likely that some longline fleets either have had a deliberate policy of non-reporting of tag recaptures, or that for some reason longline crews have been unaware of the tagging programmes and did not know what to do with recaptured tags. Publicity has commenced within the major longline fisheries to make fishermen and companies aware of the procedures for returning tags. Biological studies may shed some light on this issue by indicating other differences between surface and subsurface caught tuna. For comparison Table 10 shows the tag recoveries by vessel flag and gear type for the RTTP. Systematic visits by project staff or local fisheries officers to vessels while in port is also planned to assist in raising awareness of the project and improving the tag-reporting rate.

Table 10. Tag recoveries by gear type for the PTTP and the Regional Tuna Tagging Project (RTTP), conducted by SPC in 1989-1993 (note: only includes recoveries where gear type has been confirmed).

Gear Type	Number of tag recaptures	
	PTTP	RTTP
Purse Seine	20,224	13,841
Pole and Line	1,135	3,032
Longline	61	316
Other	671	1,174

3.4 Tag Seeding

From February 2007 to February 2009, 51 conventional tag seeding kits (consisting of 25 tags, applicators and data forms) had been distributed to observer coordinators in PNG, Solomon Islands, FSM, Marshall Islands, and American Samoa for deployment aboard purse seine vessels by senior observers. In 2009, to avoid rapid shedding, tags with metal attachments were distributed, in order to better secure anchorage within the flesh of the fish. From February 2009, 70 additional tag seeding kits (steel tag attachments) have been distributed but to date no tag seeding logs for this tag type have been received therefore only the tag seeding data for the conventional tags used for tag seeding is represented here.

In-country observer coordinators are being used as focal points for the distribution of tag seeding kits to trained observers. Trained observers on purse seine vessels were asked to deploy up to 25 tags in the catch during a trip. Optimally, observers were asked to tag 15 tunas with a single tag and to double tag 5 fish; making up the 25 tags released during the trip.

Fish are tagged discretely, usually on the wet deck, just below the work deck where the catch is landed before entering the well via a chute or in the well as part of an observer's routine sampling regime onboard. In order not to alter the detection of the tags, the streamer of the tag is strictly the same. Seeded tags are implanted on dead fish; as a result the anchorage of the tag within the pterigyophores is not secured by the healing of the flesh of the fish. However, the steel attachment tags now being used should guarantee firm attachment of the tags. Tag numbers, dates, species, fork lengths and well numbers are recorded on a specific tag seeding log form and the information sent to SPC at the completion of a voyage. Upon recovery, seeded tags are processed in the same fashion as genuine tag recoveries. Tag finders are paid the standard reward for tag recoveries and are not informed that the tags are part of a tag seeding experiment.

3.4.1 Tag seeding releases and recoveries

27 tag seeding logs have been received for observer trips between February 2007 and March 2009. During these cruises 610 tags were deployed and placed in fish wells of which 316 SKJ (51.8%), 201 YFT (33.0%) and 93 BET (15.2%). Of these 610 tags, 213 have been recovered during unloading or processing of catches in canneries of which 111 SKJ (35.1), 69 YFT (34.3%) and 33 BET (35.5). These data are currently being reviewed to indicate why the reporting rates are so low. A significant number of the observer trips were on vessels that subsequently unloaded in American Samoa, is at least superficially consistent with the low number of regular tags recovered from this location. More thorough analysis of the tag seeding data will be carried out over the next year.

3.4.2 Trained observers

The availability of trained senior observers, at a port at any single time, is the major constraint to tag seeding being carried out across all the ports. Initially, 10 PNG senior observers and 2 FSM senior observers were trained to do tag seeding, during in-country visits by Siosifa Fukofuka and Peter Williams. Tag seeding was also demonstrated to observer trainees at the last sub-regional observer training course in Vanuatu. The use of steel head tags and the method of conventional tagging were recently demonstrated by a project staff member to observer coordinators and the observers that were available at the time in FSM, Marshall Islands, PNG and Solomon Islands. Demonstrating the tag seeding method to observer coordinators hopefully will allow the tag seeding coordinators to brief senior observers that are available but have not yet been briefed on how to conduct tag seeding. This will then allow for the expansion of the pool of senior observers available to conduct tag seeding.

4 Conclusion

Phase 2 of the PTTP has been demonstrably successful, with all of the operational objectives of the cruises achieved. The numbers of conventional releases were well above the targets which we had hoped to deploy during the cruises, based on the outcome and expectations from Phase 1. The total number of tags deployed in the PTTP now exceeds 215,000. Bigeye releases remain low, however the total number conventionally tagged is now approximately 10,000. The central Pacific cruises appear to be a very viable method for tagging bigeye. In the western Pacific, it is hoped that additional numbers of bigeye can be tagged in schools associated with TAO buoys and other floating objects, or in association with seamounts, as occurred in Kiribati during WP2.

Tag recovery is progressing with generally good co-operation from industry, WCPFC members and participating non-members. Tag seeding remains problematic primarily due to the low number of senior observers available to deploy tags. Tag recovery efforts will need to be expanded over the next 12 months to include the longline fisheries as our expectations are that tagged fish should be at size classes expected to be caught by longline gear.

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