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PTTP SUMMARY REPORT: REVIEW PHASE 1

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Executive Summary

The Pacific Tuna Tagging Programme is a WPCFC endorsed project being implemented by SPC. PTTP phase 1 was completed in April 2008 and involved 2 cruises focused upon the Papua New Guinea EEZ and 3 cruises focused upon the Solomon Islands EEZ. The pole and line FV Soltai 6 was chartered for the first 4 cruises and FV Soltai 105 for the last Solomon Island cruise to assess its suitability for the next PTTP phase.

Phase 1 of the PTTP has been demonstrably successful, with all of the operational objectives of the cruises achieved, with the exception of the conventional tag release numbers for bigeye. Efforts to increase the bigeye tag numbers were hampered by the apparently low abundance of the species of a size vulnerable to pole-and-line and FAD-associated night hand line fishing.

Archival and sonic tag release numbers were significantly increased during the second cruise in PNG by the incorporation of two purpose-built sonic/archival tagging cradles into the general tagging strategy. These cradles were positioned on the bow (between two conventional tagging cradles) and on the stern where the cradle was used as a combination conventional/sonic/archival tagging station. This allowed the selection of desirable species and size ranges of fish to be implanted with archival/sonic tags during normal pole-and-line operations. The small sized archival tags proved to be unreliable and their use suspended for Phase 2 until a new model is released by the manufacturers. NFA counterparts were successful trained in surgical procedures necessary for archival and sonic tagging provided the possibility of continuation of sonic tagging experiments beyond the PTTP in PNG.

The two week trial cruise of the Soltai 105 as a tagging platform for Phase 2 was successful and confirmed its suitability. This vessel has more extensive working space, greater vessel speed, better fuel consumption, increased bait carrying capacity, and greater operational flexibility. During Phase 2, it likely that 5 scientific personnel will be carried on most occasions, including an observer from the operational area/country. The number of vessel officers and crew is likely to be between 28 and 30, as opposed to 25 on the Soltai 6, with additional crew needed to support both the hauling of the larger net and the additional tagging cradle.

Tag recoveries from Phase 1 are currently above 10% with recoveries distributed according to tagging locations, fishing efforts and unloadings. Reported recoveries however are low in American Samoa and Thailand. The PTTP recovery officer has recently visited these locations to identify the reasons for the low recovery rates.

Achievements of Phase 1 include:

- Successful implementation of 5 cruises.
- A total of 61, 751 tuna were conventionally tagged in the 2 Papua New Guinea cruises and 41,162 tuna conventionally tagged in three Solomon Islands cruises.
- A total of 222 tuna tagged with sonic tags and the successful use of sonic receivers on FADs
- A total of 318 tuna tagged with archival tags to understand fine scale movement and FAD behaviours.

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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 non-members of the Western and Central Pacific Fisheries Commission. The goal of the Pacific Tuna Tagging Programme is to improve stock assessment and management of skipjack, yellowfin and bigeye tuna in the Pacific Ocean. The specific objectives of Phase 2 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 Commission 8th European Development Fund (through the PROCFish Project), European Commission 9th European Development Fund (through the SciFish Project) and the Global Environment Facility (through the Pacific Oceanic Fisheries Management Project).

This summary report presents the results of Phase 1 of the PTTP.

2 Introduction

Phase 1 has focused its efforts upon the territorial waters of Papua New Guinea (two three-month cruises) and the Solomon Islands (two one-month cruises and one two-week trial cruise). The pole and line FV Soltai 6, owned and operated by Soltai Fishing and Processing Ltd, a Solomon Islands-based company, was chartered for the first 4 cruises and FV Soltai 105 for the last Solomon Island cruise to assess its suitability for the next PTTP phase.

The operational objectives for Phase 1 were:

- To tag and release 30,000 tuna using conventional tuna tags, with an ideal species composition of skipjack 60%; yellowfin 30%, and bigeye 10%.
- To tag and release 300 plus tuna using electronic archival tags, with a priority on bigeye and yellowfin tuna;
- To undertake sonic tagging and deployment of FAD monitors
- To train scientific staff, including two full-time PNG biological technicians, on tagging and sampling methods, including archival/sonic tagging procedures and data management;
- To undertake biological sampling (length, sex, stomach contents and tissue samples) according to an experimental design in order to obtain information on the trophic status of tunas in different school associations.

3 General Methods

3.1 Conventional tagging methods and equipment

The project has adopted tagging methods and equipment that have been tried and tested in previous SPC projects, notably the Regional Tuna Tagging Project in the early 1990s. Conventional tagging is carried out primarily from three tagging stations – on the starboard port bow and on the port stern. Specially designed tagging cradles consisting of a vinyl fish support attached to a metal frame are used to restrain the fish during the tagging procedure.

Fish are captured using pole-and-line fishing, and tagged with a single conventional tuna tag near the posterior insertion of the second dorsal fin, securely anchoring the tag head in the pterygiophores. Tags are inserted using stainless steel applicators. The tags are 11 cm or 13 cm Hallprint™ dart tags. The 11 cm tags are generally applied to tuna <38 cm and the 13 cm tags to larger tuna. All tuna are measured prior to release using a scale drawn on the cradle. The tagging operation typically lasts less than 20 seconds from fish capture to release.

3.1.1 Electronic tagging methods and equipment

Two additional tagging cradles designed for archival/sonic tagging were installed (see Figure 1.) These cradles greatly increased the possibilities of deploying archival and sonic tags during standard pole-and-line fishing operations but also increased the numbers of conventional tag releases during fast biting schools.

3.1.1.1 Archival tagging

Fish were captured during pole and line operations during the day and at night by using hand lines or rod and reel techniques for archival tagging. Smaller bigeye and yellowfin (< 70 cm FL) were prioritized for tagging during pole and line fishing as fish condition was not compromised by the fishing technique. Larger sized fish (> 70 cm FL) were caught with rod

and reel or hand line during the night and lifted from the water using a purpose-built, dedicated sling, to minimise injury or stress.

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 60 cm and larger; and (2) the smaller LTD-2410 and LTD-1110 (Lotek Wireless, Newmarket, Canada) which were 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 LTD-2410 has limited memory capacity (128 Kb) and to extend the period of sequential records of all data, the tag was programmed to record every 5 minutes. The LTD-1110 model also has limited memory and only records depth and internal temperature. The sampling interval for this tag is pre-programmed by the manufacturer. The sampling interval also varies with the duration of tag deployment (7 and 3 minute intervals were observed).

Figure 1. Additional tagging cradle designed for archival and sonic tagging.

3.1.1.2 Sonic tagging

Underwater telemetry gear manufactured by VEMCO[5] was used. Coded V9 pinger tags and depth recording V9P tags were utilized due to their adequate power range balanced with a small size capable of being used on a wide size range of tuna. This aspect of gear selection allowed the sonic tagging of all three tuna species throughout the size range of fish encountered. The relatively small size of sonic tag also allowed double tagging of medium sized tuna with both a sonic and an archival tag which was undertaken to provide a useful

[5] http://www.vemco.com/

combination of fine and larger-scale movements. Sonic tagging was incorporated into the overall project goals through collaboration with the Pelagic Fisheries Research Program (University of Hawaii) that has funded similar studies on anchored FADs in Hawaiian waters[6].

3.1.1.3 Surgery procedures

Tuna selected for archival or sonic tagging were placed in a smooth vinyl tagging cradle or left in the vinyl landing sling if greater than 10 kg. The eyes were immediately covered with a wetted artificial chamois cloth, a sea water hose inserted in its mouth to irrigate the gills and the hook removed. If fish condition was judged suitable, an electronic tag(s) was surgically implanted. Implantation involved the insertion of the Betadine rinsed tag into the body cavity through a small incision (3cm) made with a knife-blade, which for yellowfin and bigeye tuna was closed using a dissolvable suture after insertion. Each fish was also marked with a conventional dart tag placed below the second dorsal fin. Orange colored dart tags were used to mark fish receiving an archival or archival plus sonic tag. Green colored tags were used for sonic tag releases. Fish were measured to the nearest cm (FL) before being released. The time of release with school and location data were recorded and stored on an Access database. The tagging operation lasted between 50 seconds and 2 minutes. Identical methods were used for the implantation of archival and sonic tags with one exception Skipjack receiving an internal sonic tag were closed using three stainless steel staples delivered by a 3M 35W surgical staple gun.

3.1.2 Recovery procedures

Considerable efforts have been made to publicize the project and establish tag recovery procedures in the main locations where recoveries are likely to occur, both within PNG and beyond. Tagging posters, providing information to finders on what information to collect, where to send the tags and information, and the rewards that will be paid, have been produced in 13 languages. Posters have been sent to industry and Government contacts throughout the Pacific and East Asian regions. Arrangements have been made 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.

The rewards being for the return of tags and recovery data are:

Conventional tags	USD10 or a project shirt or cap
Archival tags	USD 250
Sonic tags	USD 50

3.2 Biological sampling

Biological sampling has been conducted as a part of the tagging cruises to obtain information on the trophic status of tunas in different types of school association. A sampling design was developed and design stratification included species, school association type, area (Bismarck Sea, Morgado Square, and Solomon Sea) and time of day. The sampling strategy was to sample 15 individuals from 2 schools within each stratum. For each individual, we recorded species, length and sex, and collected stomach contents and a muscle tissue sample.

[6] Dagorn, L., Holland, K.N., and D.G. Itano. (2006) Behavior of yellowfin (*Thunnus albacares*) and bigeye (*T. obesus*) tuna in a network of fish aggregating devices (FADs). Mar. Biol. 227(511). 12 pp.

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.

4 Summary of Papua New Guinea results

The PNG tagging experiment comprised 2 cruises of 3 months, from the 12 Aug to the 12 Nov 2006 and from the 19 Feb to the 20 May 2007. Figure 2 provides details of the vessel track during these 2 cruises.

During PNG tagging, a total of 61,273 tuna were tagged with conventional yellow tags of two sizes, 283 with archival tags and 222 with acoustic tags. Archival and acoustic-tagged tunas were also conventionally tagged. Further details of these releases are given in the following sections.

As at 08 July 2008, 8,087 tag recoveries had been received from the PNG releases for an overall recovery rate of 13.1%

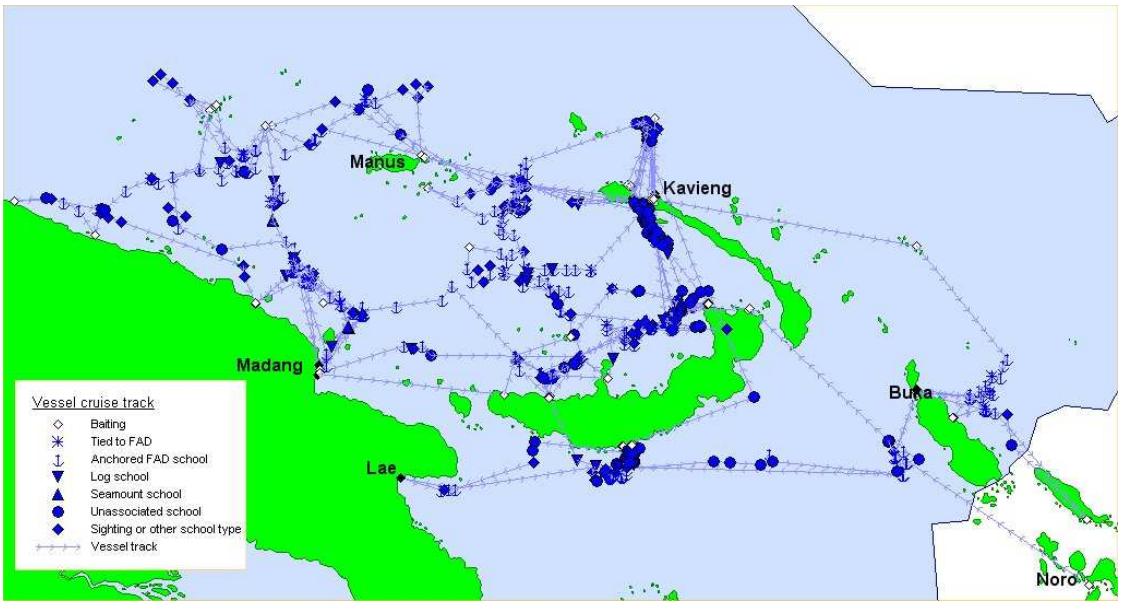

Figure 2. Cruise plot of Soltai 6 in the PNG EEZ.

4.1 Conventional tag releases during PNG tagging

4.1.1 Number of releases

During the PNG tagging, a total of 61,273 tuna were tagged with yellow conventional tags (skipjack 65.4%; yellowfin 33.4%; bigeye 1.1%). A further 478 fish received conventional tags as part of the electronic tagging activities. The number of conventional tag releases in PNG (and recaptures as at 08th July 2008) by species and school association is given in Table 1. The species composition of releases (65:34:1) was close to the skipjack: yellowfin target (60:30), although the overall proportion of bigeye tagged was much less than desired. It

proved difficult to catch and tag large numbers of bigeye in the Bismarck Sea by both pole-and-line and night line fishing (jigging) while tied up to anchored FADs, due to the general inefficiency of pole-and-line gear in capturing bigeye in equatorial waters and an apparent low local abundance.

Table 1. Conventional tag release numbers by species and school association, for PNG, as at 8/07/08.

School association	Releases			
	SKJ	YFT	BET	Total
Unassociated/free	7,805	2,571	23	10,399
Log	1,976	851	28	2,855
Anchored FAD	27,995	16,023	582	44,600
Drifting FAD	1,043	85	3	1,131
Marine mammal	259	169	1	429
Current line	261	13	0	274
Seamount	968	657	54	1679
Island or reef	102	282	0	384
TOTALS	**40,409**	**20,651**	**691**	**61,751**

4.1.2 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 3. The majority of tag releases were made on schools associated with anchored FADs (Table 1; Figure 2). A large and useful tag release cohort of skipjack and yellowfin was made from free schools found in the Solomon Sea, close to the south coast of New Britain. Free (or island associated) releases of yellowfin and skipjack were also made close to Tench Island, north of New Ireland and on anchored FADs west and east of Bougainville.

4.1.3 Size distribution of conventional tag releases

The size distributions of tag releases in PNG waters (red) by species and the corresponding size distributions for the locally-based purse seine fleet in PNG (blue) are shown in Figure 4. For skipjack, the size range tagged is similar to the size range of fish captured by purse seiners setting on anchored FADs in PNG. For yellowfin, the purse seine size distribution consists of multiple modes, with the tag releases corresponding in size to the smallest mode. The larger mode centered at around 100 cm in the purse seine distribution was not available to any substantial degree to the pole-and-line tagging vessel. For bigeye, the numbers tagged are concentrated into two modes within a wider overall range of sizes taken by the purse seine fleets. These differences in size distributions of tag releases and purse seine catch mean that size will need to be included in any models utilizing both the tagging and fishery data.

These size distributions include significant numbers of fish <40 cm fork length. These small fish are often not seen in landed purse seine catches in the broader western and central Pacific because they are avoided or discarded at sea. However, they are seen in the catches in PNG because the locally-based purse seine companies have a “retain all” policy centered on FAD associations.

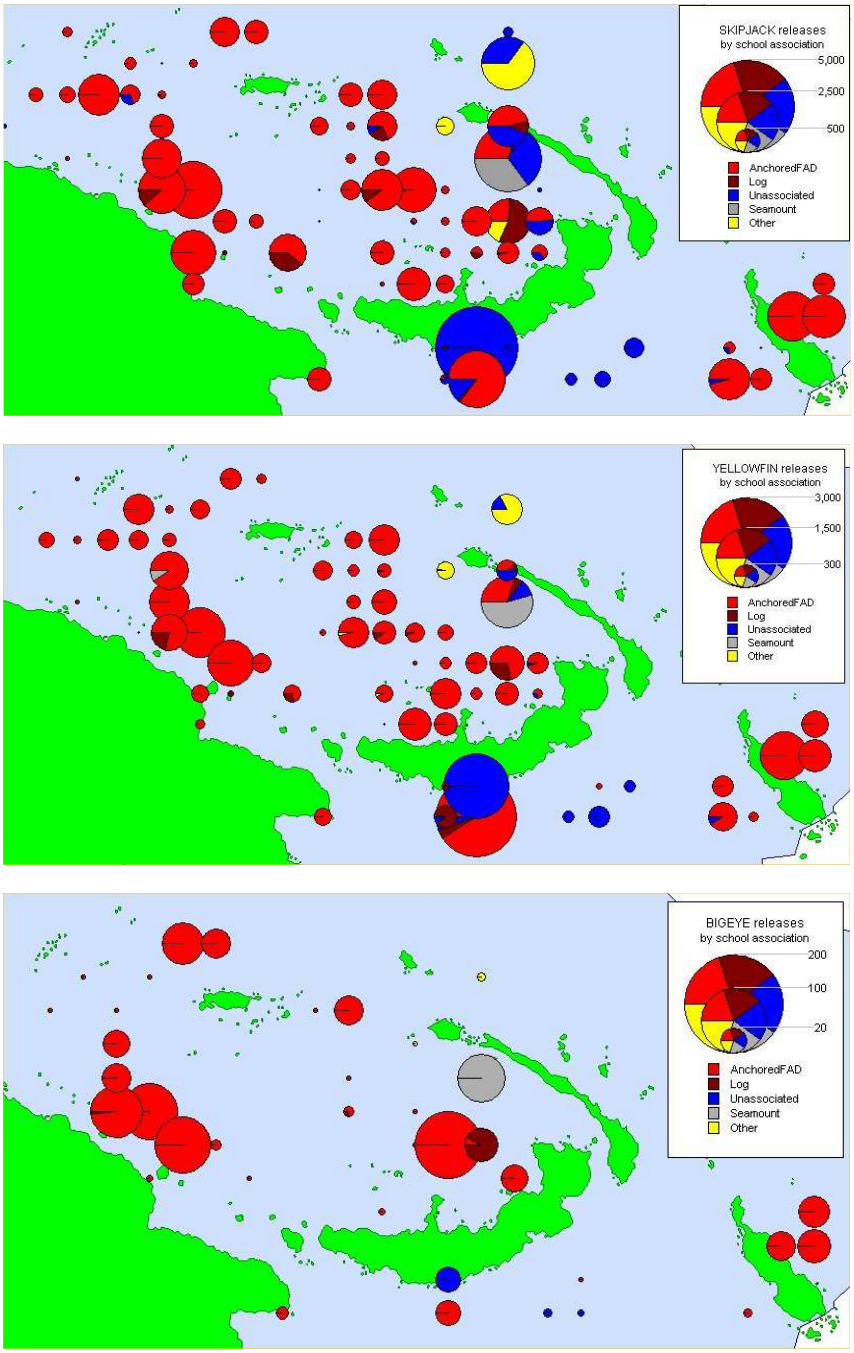

Figure 3. Spatial distribution of releases of skipjack (upper), yellowfin (middle) and bigeye (bottom) by school association.

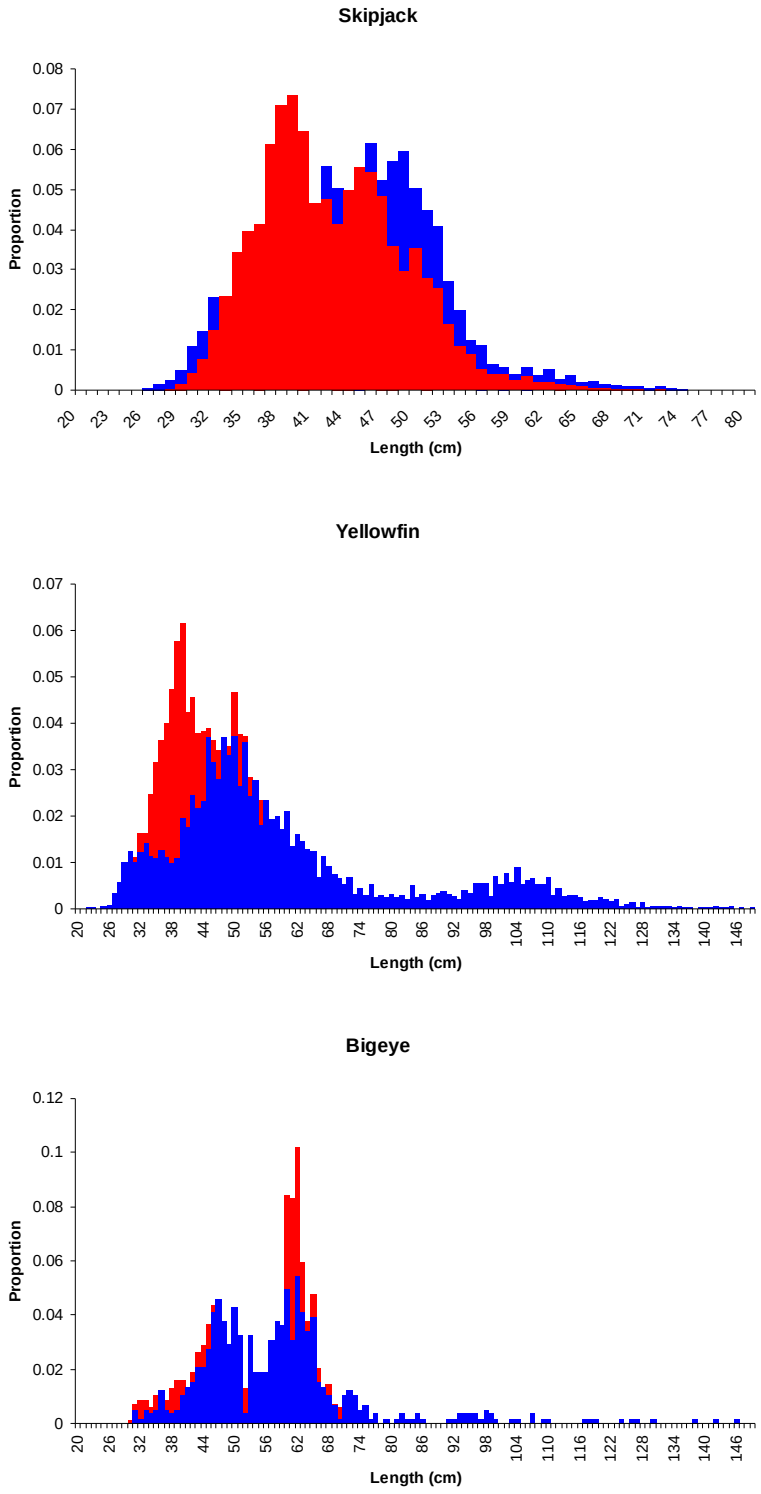

Figure 4. Size distributions of FAD-associated conventional tag releases (in red) compared to the size distribution of fish captured at the same time by purse-seiners operating in PNG (in blue), for each species.

4.1.4 Fish movements

Figure 5 shows the displacement of recaptured PNG tagged tunas by species.

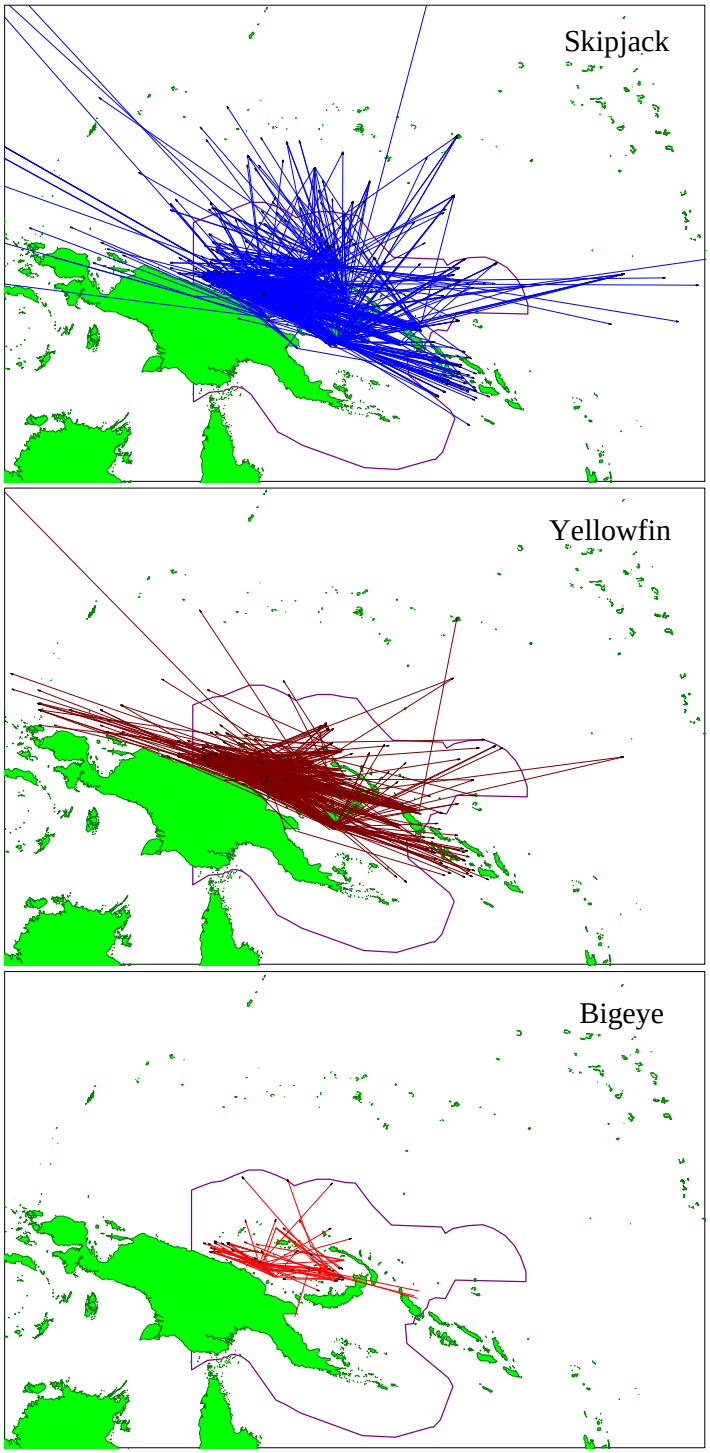

Figure 5. Displacements of PNG tagged fish (movements > 300 nm for skipjack and yellowfin, movements > 100 nm for bigeye).

4.2 Archival tagging

4.2.1 Archival tag releases

Two hundred and eighty-three tuna (233 yellowfin, 48 bigeye, 2 skipjack) were tagged with archival tags. Table 2 shows the total archival tag release number in PNG by gear type. The numbers of releases by species and school association are given below (Table 3). One pop-up satellite tag was also deployed on a large yellowfin caught on a troll line.

Table 2. Total archival tag release by fishing gear.

Fishing gears	Cruise 1	Cruise 2	Total
P&L	18 (25%)	171 (81%)	189 (67%)
Rod-handline	53 (74%)	29 (14%)	82 (29%)
Trolling	1	11(5%)	12 (4%)
Total	72	211	283

Table 3. Total archival tag release numbers by species and school association.

Species	Free school	Fad	Drifting Fad	Log	Whale Shark	Current line	Seamount	Total	%
BET	6	41	1					48	17
SKJ		2						2	0.7
YFT	59	156		8	2	2	6	233	82.3
Total	**65**	**199**	**1**	**8**	**2**	**2**	**6**	**283**	100
%	23.0	70.3	0.4	2.8	0.7	0.7	2.1	100	

4.2.2 Size distribution of archival tag releases

Archival tag releases were separated into two different size classes: The LTD-2310 (Lotek) and the Mk9 (WLC) are physically larger than the LTD-2410 and LTD-1110 (both Lotek). Initially, release sizes were set conservatively with the larger AT models used on tuna greater than 70 cm and the smaller ATs in fish greater than 50 cm. With increasing speed of archival tagging procedures and the observed positive fish condition, these size limits were reduced to 60 and 40 cm respectively. Figures 6 shows the size distribution of archival tagged fish by tag size for bigeye and yellowfin tuna.

4.3 Sonic tags and FAD monitors

4.3.1 Sonic tag releases and FAD monitor deployment

A total of 222 sonic tags were deployed in PNG (18 bigeye, 135 yellowfin and 69 skipjack tuna) as detailed in Table 4. Of these, 27 tuna (19 yellowfin and 8 bigeye) were implanted with some combination of archival and sonic tag. Skipjack were not double tagged with electronic tags due to the limited space available in their peritoneal cavity.

4.3.2 Size distribution of sonic tag releases.

The size distribution of sonic tag releases attempted to span a wide size range to gain information on the aggregative dynamics of “small” versus larger tuna by species. Figures 7 indicate the size distribution of skipjack, yellowfin and bigeye tuna released with sonic tags in PNG waters.

28 anchored FADs were equipped with a VR2 sonic receiver in 8 groups in the Bismarck Sea and 1 group in the Solomon Sea (Figure 8).

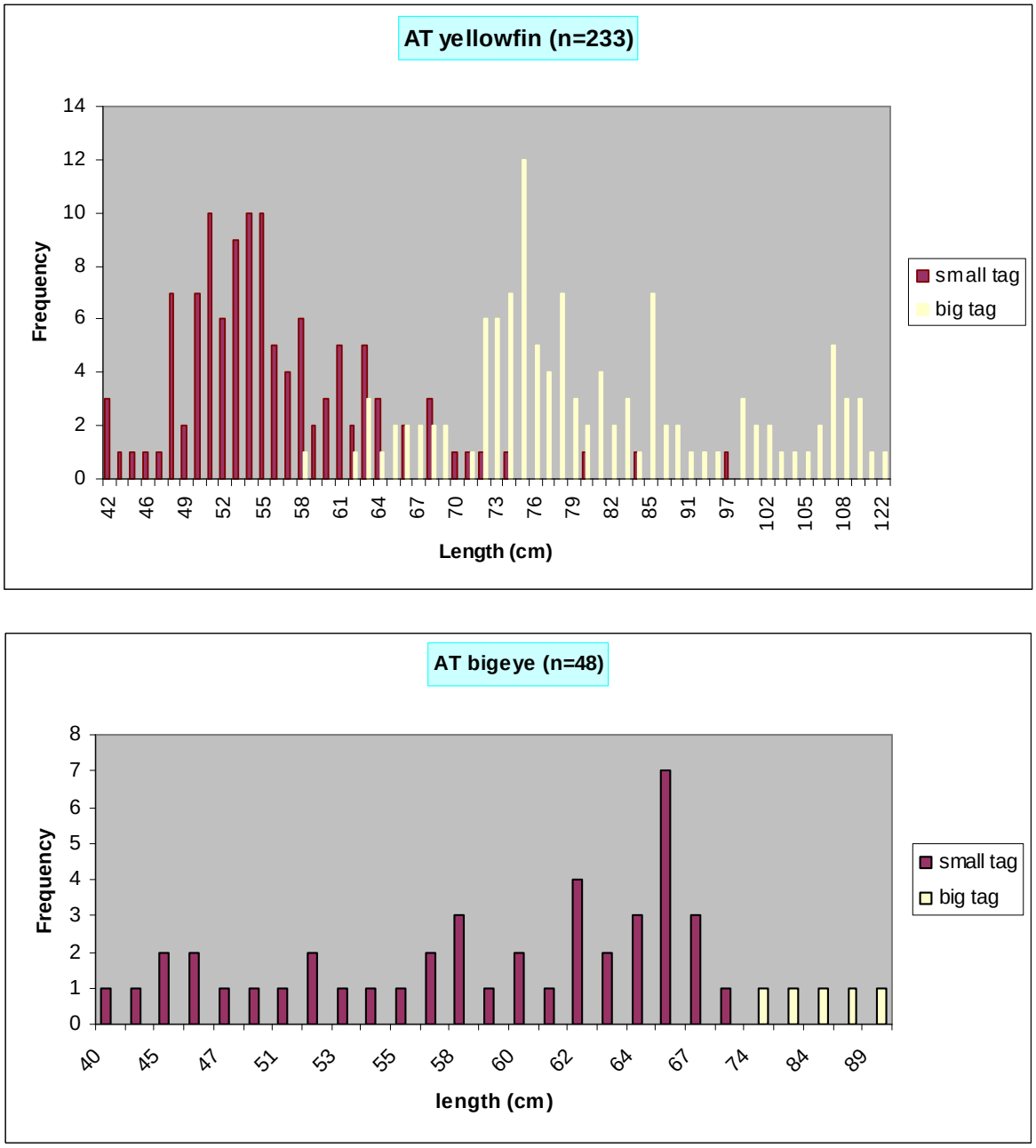

Figure 6. Size distribution, by tag type, of archival tagged yellowfin and bigeye.

Table 4. Summary of sonic tag releases for PNG.

Sonic tag type	Archival tag	BET	YFT	SKJ	Total
V9 coded	Sonic tag only	6	49	27	82
V9 coded	LTD 1110	5	8		13
V9 coded	LTD 2410	1			1
V9 coded	Mk9	1	5		6
	V9 coded subtotal	13	***62***	***27***	***102***
V9P depth	Sonic tag only	4	67	42	113
V9P depth	LTD 1110		1		1
V9P depth	LTD 2310	1	3		4
V9P depth	LTD 2410		1		1
V9P depth	Mk9		1		1
	V9P depth subtotal	***5***	***72***	***42***	***120***
	Sonic tag release total	**18**	**135**	**69**	**222**

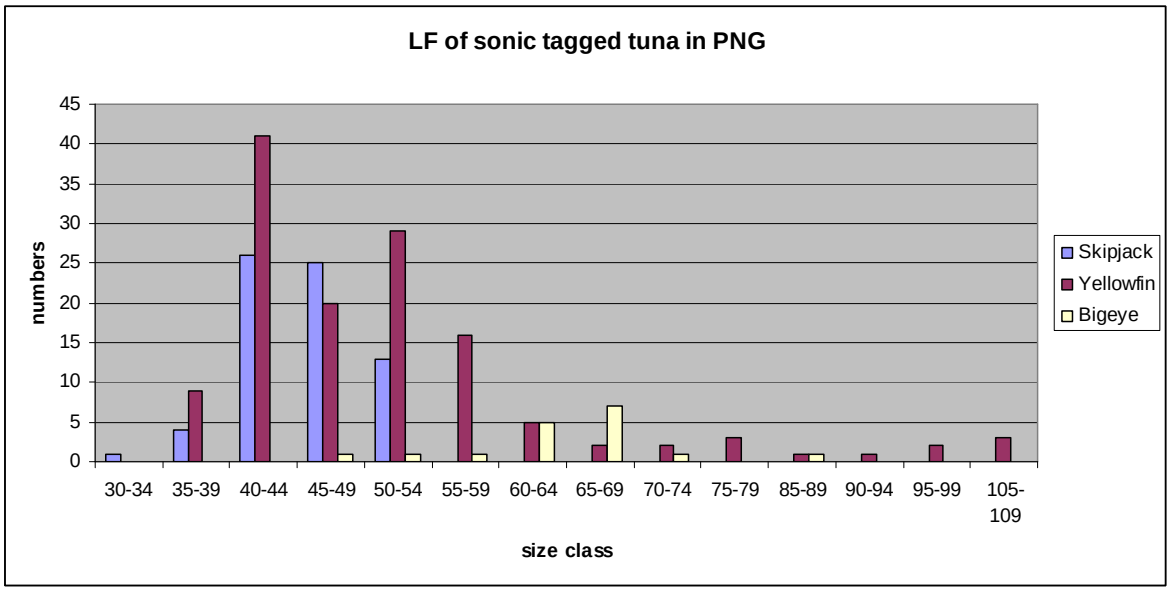

Figure 7. Length frequencies of sonic tag releases in PNG waters.

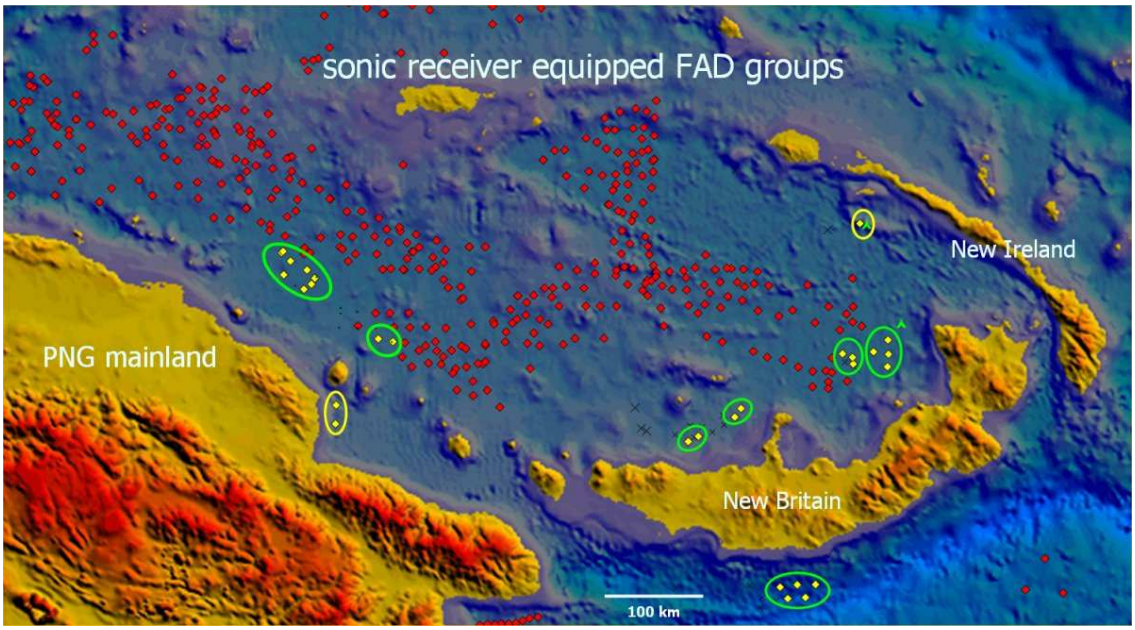

Figure 8. Areas of Fad monitor deployment.

4.3.3 Data acquisition and receiver status

Examination of retrieved data indicated high reporting rates of sonic tag releases. However, for the most part, all sonic tag releases appeared to maintain association with their FAD of release for short periods with most releases apparently departing *en masse* within a few days of release.

4.4 Biological sampling

The total number of samples collected during PNG tagging experiment was 2,275 as detailed in Table 5. To date, about one third of these stomachs have been analyzed at OFP biological laboratory.

Table 5. Number of biological samples taken in PNG.

PNG sampling	Free school	Drifting log	Anchored FAD	Whale	Seamount	Total
Skipjack	258	111	732	10	44	**1155**
Yellowfin	164	28	667	8	44	**911**
Bigeye	1		25		5	**31**
Rainbow runner	10	5	48		10	**73**
Kawakawa	22				10	**32**
Frigate tuna	15		43	2		**60**
Dolphin fish			8			**8**
Silky shark		2	2			**4**
Blue marlin	1					**1**
Total	**471**	**146**	**1525**	**20**	**113**	**2275**

A total of 544 fish were examined with the Fatmeter including 316 skipjack and 228 yellowfin. Fillets for calibration were collected from 74 skipjack and 20 yellowfin.

5 Summary of Solomon Islands results

The Solomon Islands tagging comprised 3 cruises, from the 26 October to the 26 November 2007, from the 20 February to the 20 March 2008 and from the 26 March to the 8 April 2008. Tagging method and equipment were the same as for the PNG. The tagging platform changed for the last cruise (26/03 to 08/04) with the new vessel Soltai 105 being chartered mainly to assess its suitability for the PTTP phase II which require a boat with an operational range longer than Soltai 6 s'. Figure 9 provides details of the vessel tracks during these tagging experiments.

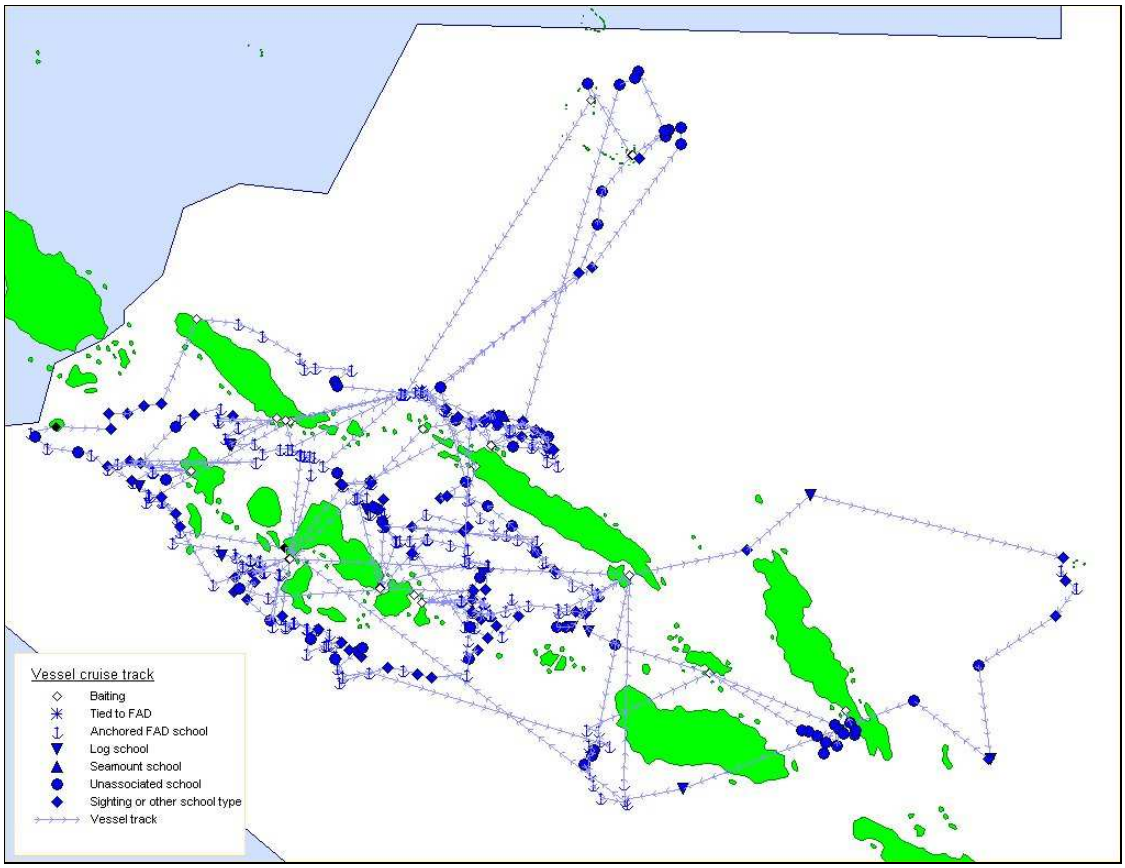

Figure 9. Cruise plot of the combined 3 tagging cruises in the Solomon Islands EEZ.

5.1 Conventional tag releases during Solomon Islands tagging

5.1.1 Number of releases

In Solomon waters, a total of 41,127 tuna were tagged with conventional yellow tags of two sizes (skipjack 55.1 %; yellowfin 43.6 %; bigeye 1.3 %, Table 6). The majority (81 %) of tag releases were made on schools associated with anchored Fads.

Table 6. All tag release/recapture numbers by species and school association, for Solomon Islands, as at 8/07/08.

School association	Releases			
	SKJ	YFT	BET	Total
Unassociated/free	2,957	463	124	3,544
Log	2,239	459	2	2,700
Anchored FAD	16,447	16,430	425	33,302
Drifting FAD	914	611	2	1527
Island or reef	89	0	0	89
TOTALS	**22646**	**17,963**	**553**	**41162**

5.1.2 Spatial distribution of releases by school association

Figure 10 shows the spatial distribution of skipjack, yellowfin and bigeye releases, by species and school association.

5.1.3 Size distribution of conventional tag releases

The size distributions of tag releases in the Solomon Islands by species are shown in Figure 11. No information on the size distribution of purse-seine captures in the Solomon Islands was available for comparison.

5.1.4 Fish movements

Figure 12 shows the displacement of recaptured Solomon Islands tagged tunas by species.

5.2 Archival tagging

5.2.1 Archival tag releases and size distribution

Thirty-five archival tags were deployed in the Solomon Islands cruises (27 yellowfin and 8 bigeye). No acoustic tags were deployed in Solomon EEZ. The size distribution of the archival tag fish was 59 to 90 cm for the yellowfin and 39 to 60 cm for the bigeye.

5.3 Biological sampling

Biological sampling continued in the Solomon Islands cruises. Total number of samples collected by school type is provided in Table 7. About 10% of the samples have been analyzed in the lab.

Table 7. Number of biological samples taken in Solomon Islands.

Solomon sampling	Free school	Drifting log	Anchored FAD	Total
Skipjack	33	59	61	153
Yellowfin	13	52	60	125
Bigeye	7		2	9
Total	**53**	**111**	**123**	**287**

A total of 406 fish were examined with the Fatmeter including 190 skipjack, 206 yellowfin and 10 bigeye.

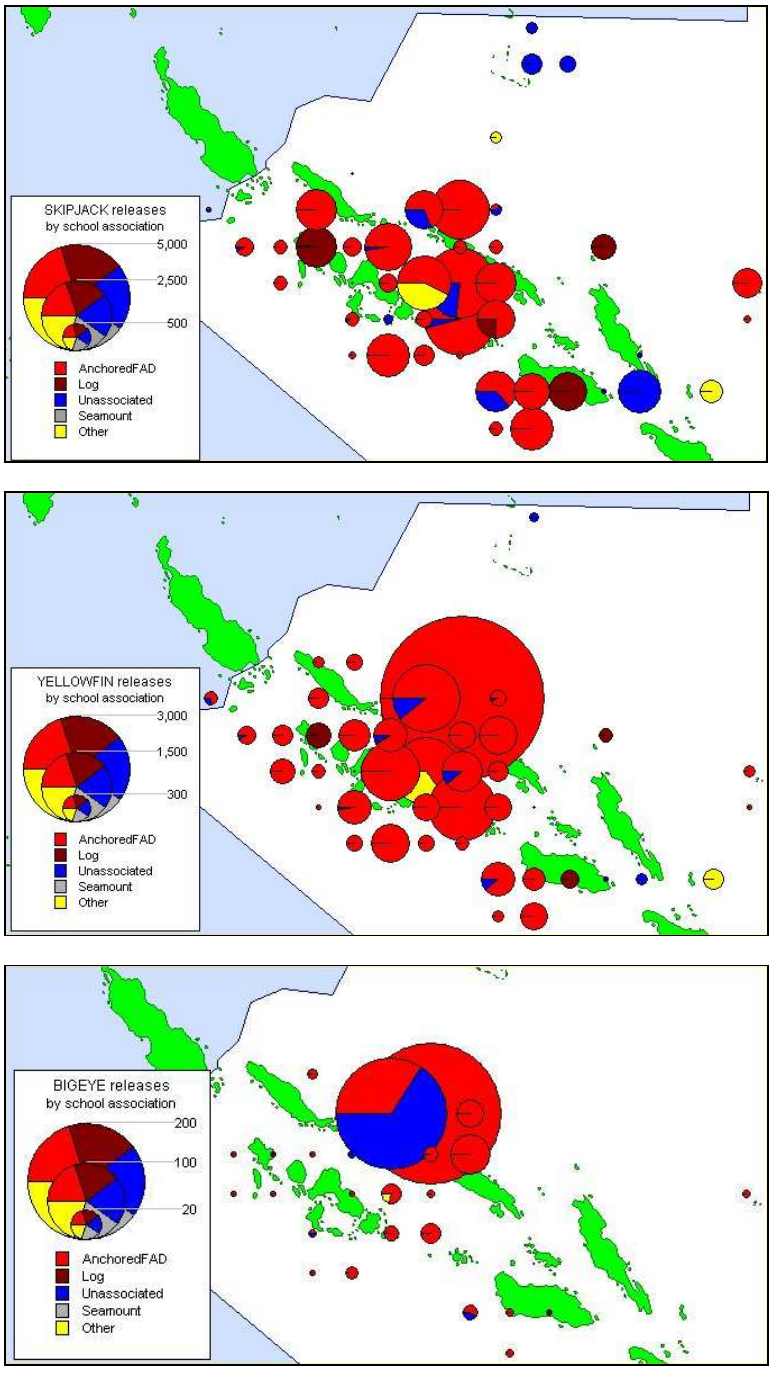

Figure 10. Spatial distribution of releases of skipjack (upper), yellowfin (middle) and bigeye (bottom) by school association.

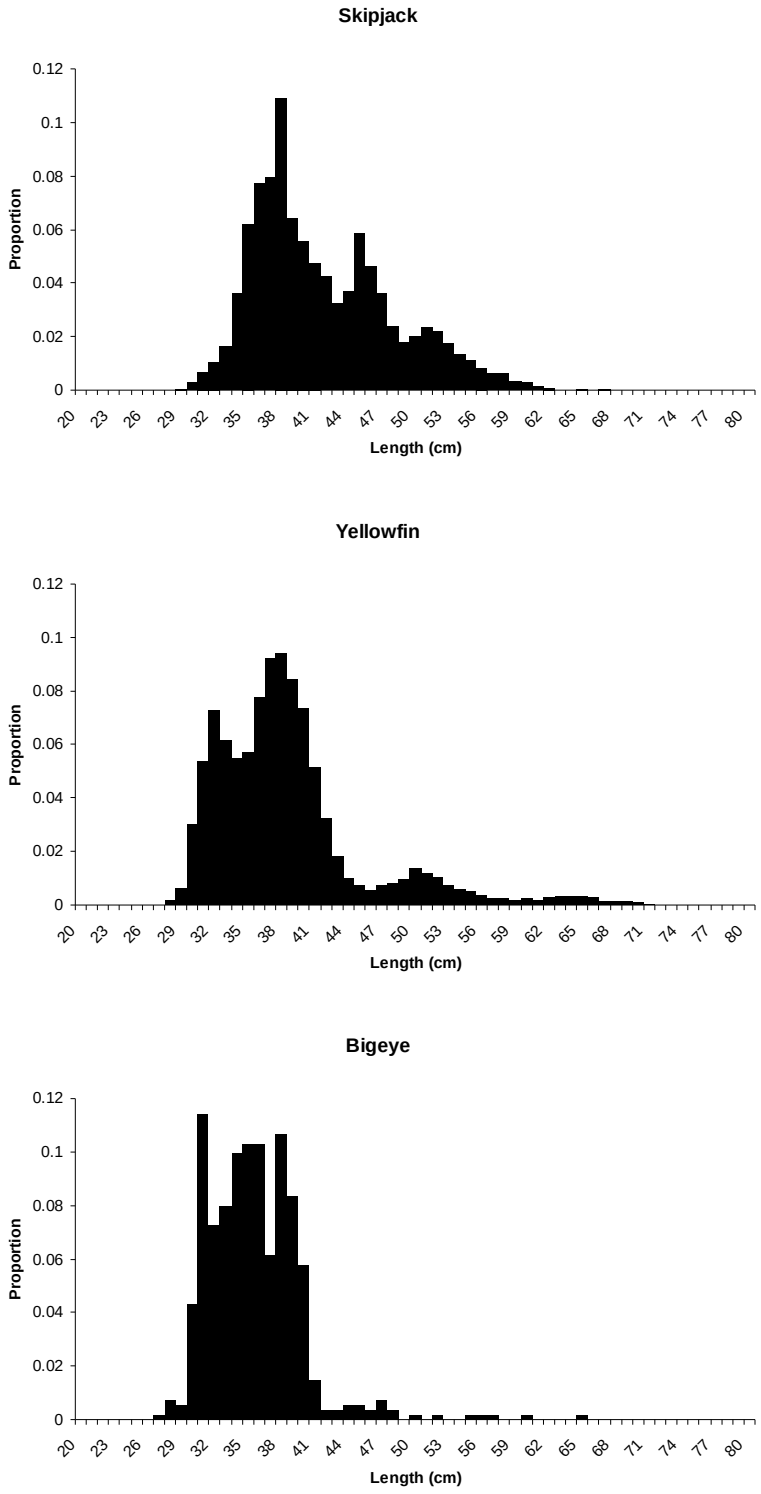

Figure 11. Size distributions of FAD-associated conventional tag releases in the Solomon Islands for each species.

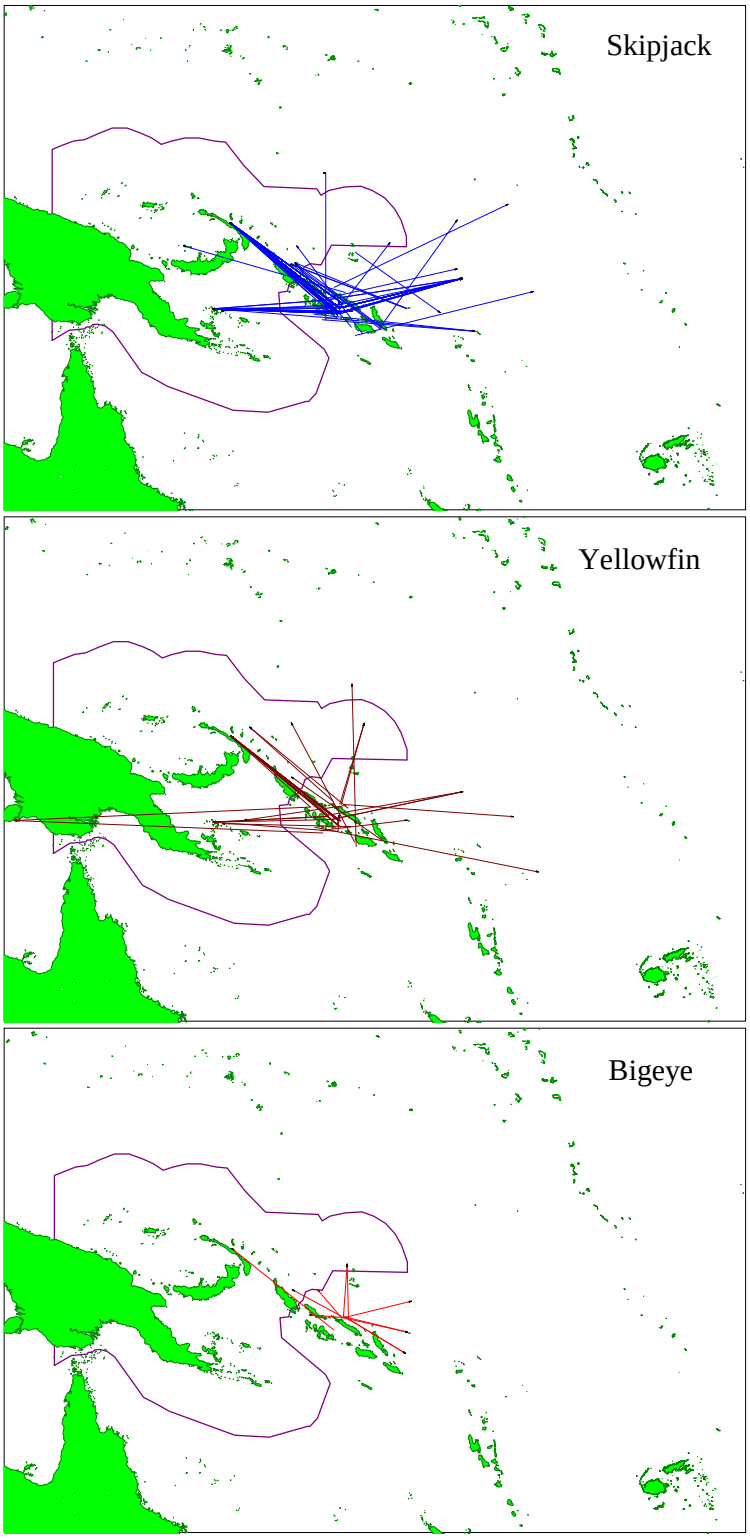

Figure 12. Displacements of Solomon Islands tagged fish (>300 nm for skipjack , >200 nm yellowfin, >100 nm for bigeye).

6 Tag recoveries

Tag recoveries for PNG and the Solomon Islands are just over 13 % and 9 % respectively (Table 8). Recoveries from fish originally tag in association with marine mammals (14.7 %) and anchored FADs (14.5 %) have been higher than average, whereas those originally associated seamounts (7.5 %), drifting FADs (7 %) and current lines (5.8 %) have been low in PNG (Table 9). The recapture of fish originally caught on other types of school associations has been close to the average. In the Solomon Islands recoveries from fish originally tagged on drifting FADs (16.5 %) has been higher than average whereas those that were originally tagged in free-schools (6.5 %) has been low (Table 9). Approximately 50 % of the recaptured fish were at liberty for less than 30 days (Figure 12). Distances moved between release and recapture were consistent the time at liberty statistics with most fish captured within 60 nm of there release location (Figure 13).

Table 8. Number and percentage of recaptures per tag type for PNG and Solomon Islands (as of 28/07/08).

PNG	**Recaptures**							
Tag type	Skipjack	%	Yellowfin	%	Bigeye	%	**Total**	%
Conventional tags	4780	11.8	3,041	15	215	34.4	8036	13.1
Archival tags	1	50	30	12.8	11	22.4	42	14.8
Sonic tags	3	4.3	9	7.8	3	6.1	15	6.7
Total	**4,784**	**11.8**	**3,080**	**14.9**	**229**	**33.1**	**8,093**	**13.1**
Solomon Islands								
Conventional tags	2,288	10.1	1493	8.3	32	5.8	**3,813**	**9.3**
Archival tags			2	1			**2**	**1**
Total	2,288	10.1	1495	8.3	32	5.8	**3815**	**9.3**

Table 9. Total number of tag release numbers by species and school association, for PNG and Solomon Islands (as of 28/07/08).

School association	**Releases**				**Recaptures**			
	SKJ	**YFT**	**BET**	**Total**	**SKJ**	**YFT**	**BET**	**Total**
PNG								
Unassociated/free	7,805	2,571	23	10,399	809 (10.4%)	187 (7.3%)	0	996 (9.6%)
Log	1,976	851	28	2,855	207 (10.5%)	66 (7.8%)	13 (46.4%)	286 (10%)
Anchored FAD	27,995	16,023	582	44,600	3,582 (12.8%)	2,711(16.9%)	196 (33.7%)	6,489 (14.5%)
Drifting FAD	1,043	85	3	1,131	72 (6.9%)	8 (9.4%)	0	80 (7.1%)
Marine mammal	259	169	1	429	42 (16.2%)	21 (12.4%)	0	63 (14.7%)
Current line	261	13	0	274	16 (6.1%)	0	0	16 (5.8%)
Seamount	968	657	54	1679	47 (4.9%)	59 (9.0%)	0	126 (7.5%)
Island or reef	102	282	0	384	9 (8.8%)	28 (9.9%)	0	37 (9.6%)
TOTALS	**40,409**	**20,651**	**691**	**61,751**	**4,784 (11.8%)**	**3,080 (14.9%)**	**229 (33.1%)**	**8,093(13.1%)**
SOLOMON ISLANDS								
Unassociated/free	2,957	463	124	3,544	187 (6.3%)	41 (8.9%)	3 (2.4%)	231 (6.5%)
Log	2,239	459	2	2,700	260 (11.6%)	46 (10.0%)	0	306 (11.3%)
Anchored FAD	16,447	16,430	425	33,302	1,712 (10.4%)	1,275(7.8%)	29 (6.8%)	3,016 (9.1%)
Drifting FAD	914	611	2	1527	120 (13.1%)	133 (21.8%)	0	253 (16.6%)
Island or reef	89	0	0	89	9 (10.1%)	0	0	9 (10.1%)
TOTALS	**22646**	**17,963**	**553**	**41162**	**2,288 (10.1%)**	**1,495 (8.3%)**	**32 (5.8%)**	**3,815 (9.3%)**

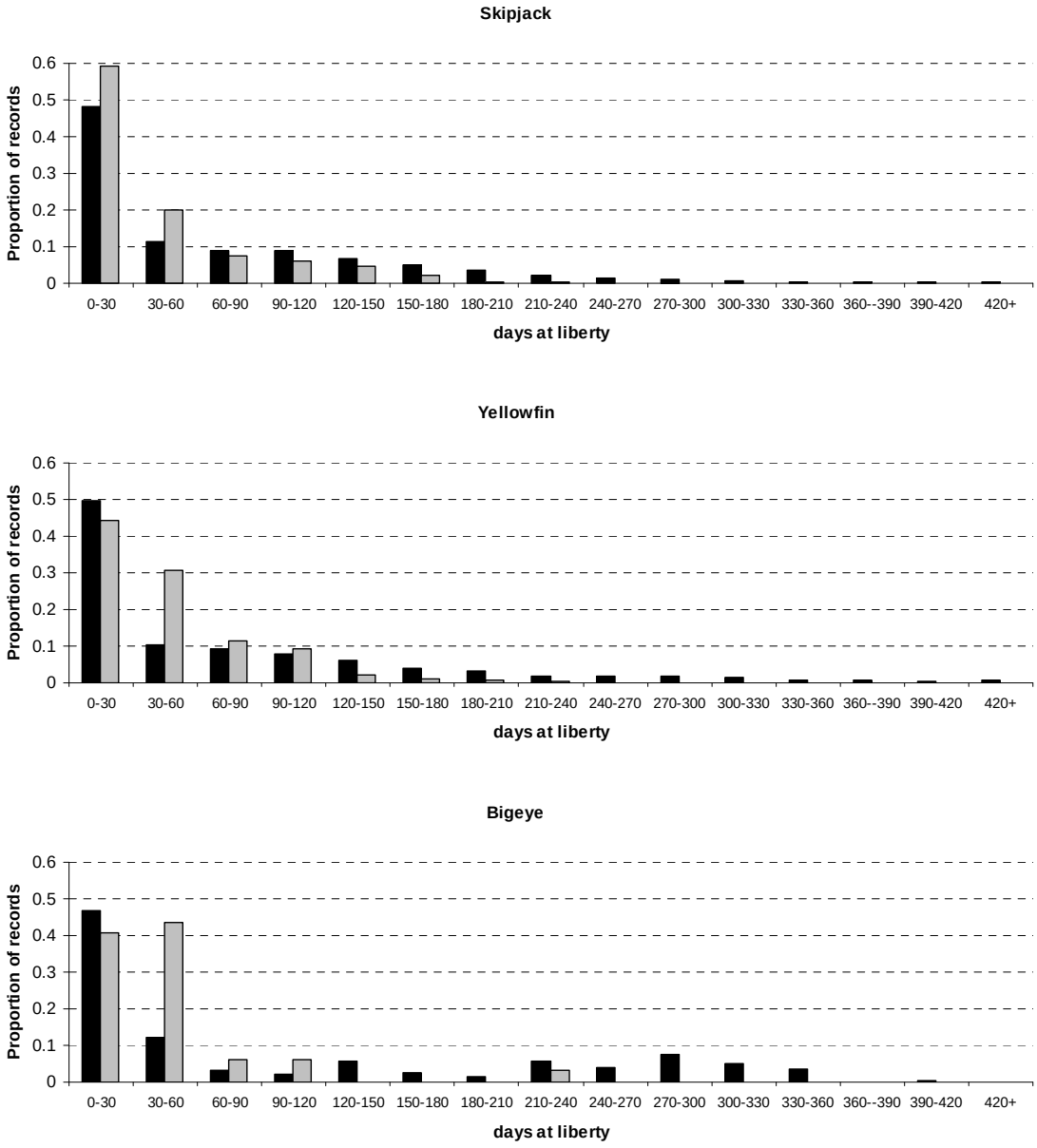

Figure 12. Proportion of time at liberty for conventionally tagged skipjack, yellowfin and bigeye (Black bars= PNG releases and grey bars = Solomon Islands releases).

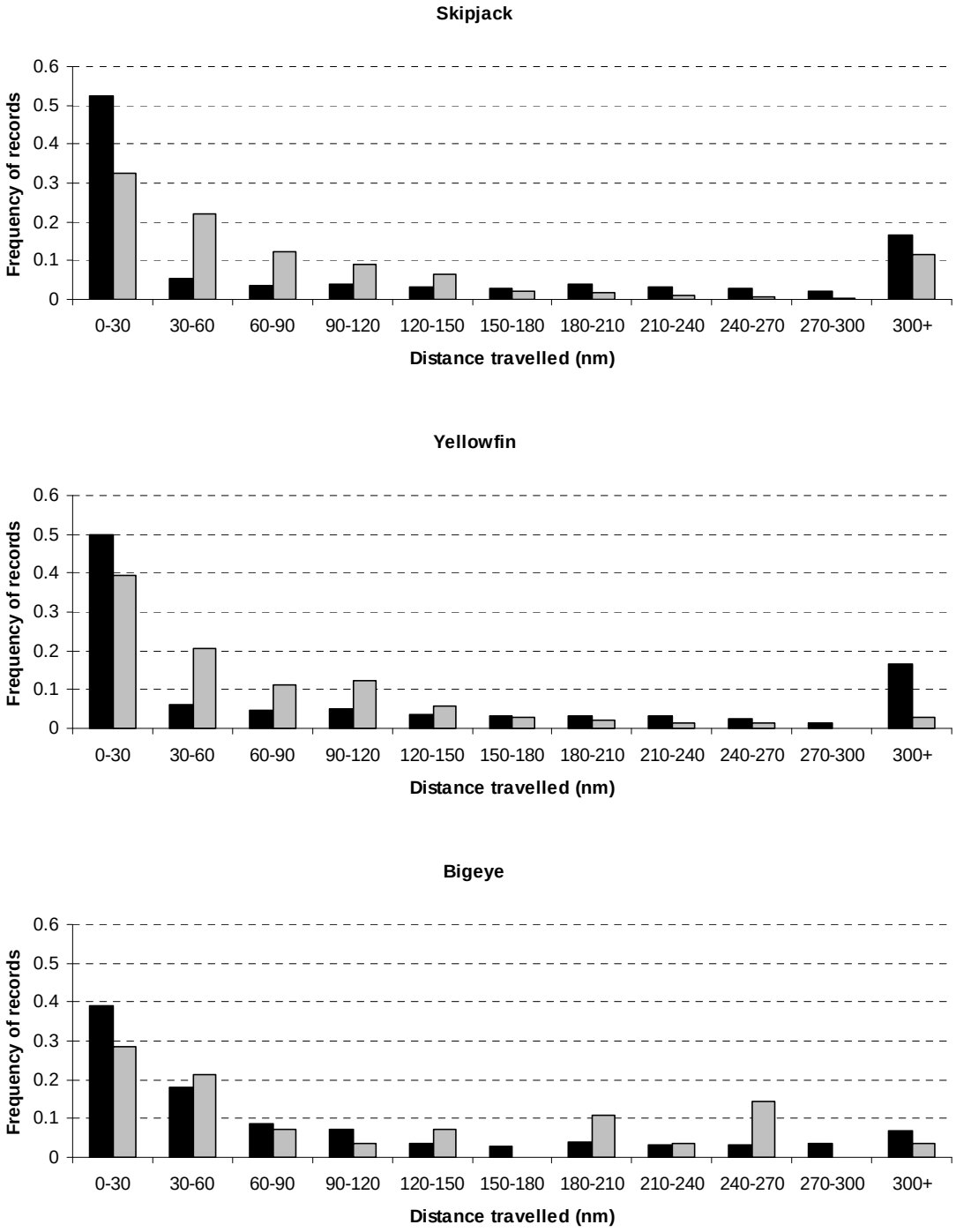

Figure 13 Frequency of distance between release and capture location for conventionally tagged skipjack, yellowfin and bigeye (Black bars= PNG releases and grey bars = Solomon Islands releases).

Tag recoveries appear consistent with release history, fishing effort and unloading history, except for American Samoa and Thailand where recoveries are lower than expected (Table 10 and 11). Visitation by the PTTP recovery officer has occurred recently to ascertain the reasons for this lower rate in these locations. Advertisement of the PTTP has also been increased in these locations.

Table 10. Total tag recoveries by tag source (as of 28/07/08). Note totals for conventional tags also include the fish that were archival and sonic tagged.

Tag source	Tag type	Number
IATTC	Archival tags	1
Philippines (direct)	Archival tags	2
Philippines (Frabelle)	Archival tags	1
PNG (Frabelle)	Archival tags	7
PNG (Frabelle)	Archival tags	1
PNG (NFA)	Archival tags	1
PNG (other)	Archival tags	1
PNG (RD)	Archival tags	22
Solomin Islands (MFMR)	Archival tags	1
Solomon Islands (NFD)	Archival tags	3
Thailand	Archival tags	4
American Samoa	Conventional tags	18
China	Conventional tags	1
FSM	Conventional tags	3
IATTC	Conventional tags	135
Indonesia	Conventional tags	77
IOTC	Conventional tags	5
Japan	Conventional tags	273
Korea	Conventional tags	154
Marshall Islands	Conventional tags	1
Other	Conventional tags	7
Philippines (direct)	Conventional tags	368
Philippines (Frabelle)	Conventional tags	162
PNG (Frabelle)	Conventional tags	645
PNG (NFA)	Conventional tags	91
PNG (other)	Conventional tags	33
PNG (RD)	Conventional tags	5022
PNG (SST)	Conventional tags	181
Solomon Islands (MFMR)	Conventional tags	108
Solomon Islands (Global Investment)	Conventional tags	946
Solomon Islands (NFD)	Conventional tags	2545
Solomon Islands (other)	Conventional tags	23
Solomon Islands (Soltai)	Conventional tags	194
Tagging vessel	Conventional tags	23
Thailand	Conventional tags	892
Philippines (direct)	Sonic tags	1
PNG (Frabelle)	Sonic tags	1
PNG (RD)	Sonic tags	12
Solomon Islands (NFD)	Sonic tags	1
Thailand	Sonic tags	1
Total		**11967**

Archival tags have been recovered at a similar rate to conventional tags (13.8% for PNG and Solomon Islands combined). Tag reliability has become an issue with the small sized Lotek tags have an approximate 50% error rate (Table 12). The deployment of small sized tags has been suspended until this reliability issue is resolved.

Table 11. Total tag recoveries by flag (as of 28/07/08). Note totals for conventional tags also include the fish that were archival and sonic tagged.

Flag	Tag type	Number
FM	Archival tags	1
KI	Archival tags	2
PG	Archival tags	30
PH	Archival tags	4
SB	Archival tags	4
Unknown	Archival tags	3
CN	Conventional tags	38
FJ	Conventional tags	1
FM	Conventional tags	11
ID	Conventional tags	85
JP	Conventional tags	293
KI	Conventional tags	13
KR	Conventional tags	340
MH	Conventional tags	8
NZ	Conventional tags	4
PA	Conventional tags	8
PG	Conventional tags	5589
PH	Conventional tags	976
SB	Conventional tags	2797
SY	Conventional tags	1
TW	Conventional tags	339
US	Conventional tags	26
VU	Conventional tags	920
Unknown	Conventional tags	458
PG	Sonic tags	12
PH	Sonic tags	2
SB	Sonic tags	1
TW	Sonic tags	1
Total		**11967**

Table 12. Archival tag recoveries and observed faults.

Tag Type	Total released	Total recovered	Tag Failures	% Failure
MK9 (Wildlife Computers)	103	7	1 (shed)	
2310 (Lotek)	49	6	1	17 %
2410 (Lotek)	117	26	14	54 %
1110 (Lotek)	49	5	3	60 %

7 Conclusion

Phase 1 of the PTTP has been demonstrably successful, with all of the operational objectives of the cruises achieved, with the exception of the conventional tag release numbers for bigeye. Efforts to increase the bigeye tag numbers were hampered by the apparently low abundance of the species of a size vulnerable to pole-and-line and FAD-associated night hand line fishing. The results however were nevertheless outstanding, with over 100,000 fish conventionally tagged which was well above the overall target.

Archival and sonic tag release numbers were significantly increased during the second cruise in PNG by the incorporation of two purpose-built sonic/archival tagging cradles into the general tagging strategy. These cradles were positioned on the bow (between two conventional tagging cradles) and on the stern where the cradle was used as a combination

conventional/sonic/archival tagging station. This allowed the selection of desirable species and size ranges of fish to be implanted with archival/sonic tags during normal pole-and-line operations.

The successful training of NFA counterparts in surgical procedures necessary for archival and sonic tagging provided the possibility of continuation of sonic tagging experiments beyond the PTTP in PNG. Materials necessary for archival and sonic tagging were left with NFA (surgical supplies, tagging mattress, conventional tags, recorders) including eight VR2 receivers. Initial plans were developed for NFA to conduct sonic tagging within a group of anchored FADs set in the Huon Gulf, near Lae, with NFA agreeing to fund the purchase of sonic tags and expenses related to personnel time and vessel use.

The small sized archival tags have proven to be unreliable and their use suspended. Their manufacturer is producing a new model of small tags and once sufficient trialling demonstrates there reliability, archival tagging of small fish should recommence in phase 2 of the PTTP.

The excellent results obtained were possible in no small part due to the trouble-free operation of the *Soltai 6*, which is a tribute to the professionalism of the Solomon Islands officers and crew, and the logistical support provided Soltai Fishing and Processing Ltd. The teamwork and dedication of the officers, crew and scientific staff were instrumental in the success of the cruise. We thank also the fishing industry and our tag collection contacts in the various locations for their cooperation and assistance in the return of tags.

Phase 1 included a two week trial cruise of the Soltai 105 as a tagging platform for Phase 2 to confirm its suitability. This vessel has more extensive working space, greater vessel speed, better fuel consumption, increased bait carrying capacity, and greater operational flexibility. The outcome of the cruise was positive and with minor modifications and correction of some existing defects, the vessel is essentially ready for service. Increased spatial coverage of Solomon Islands waters was achieved during this short cruise, as a result of the commitment to longer range operations. During Phase 2, it likely that 5 scientific personnel will be carried on most occasions, including an observer from the operational area/country. The number of vessel officers and crew is likely to be between 28 and 30, as opposed to 25 on the Soltai 6, with additional crew needed to support both the hauling of the larger net and the additional tagging cradle.

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Or visit the project website: http://www.spc.int/oceanfish/Html/TAG/index.htm


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