

FISHING ACTIVITY, SIZE DISTRIBUTION, TAG RELEASED AND RECAPTURE OF TUNA TAGGING IN EASTERN INDONESIAN WATERS

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ABSTRACT

Tagging of tropical tunas has a long history in Indonesian waters. Since 1987 tuna tagging has been conducted in Indonesian Waters. Tuna tagging in 2008 in eastern Indonesian waters was conducted in collaborative program with SPC to obtain new data about biological aspect and stock assessment of tuna. This tuna tagging was successfully conducted at 86 locations, with a total of 25,197 tuna tagged with conventional tags, at an average of around 900 fish per fishing day. The releases of conventional tags comprised of 19,576 skipjack (77.7%), 5,267 yellowfin (20.9%) and 354 bigeye (1.4%). From the length frequency composition, the skipjack size range was wide, between 29 – 83 cm, but mostly between 35 and 40 cm with 38.9 cm average. The yellowfin size range of 28 – 65 cm, with most fish between 37 and 41 cm of 40.1 cm average. The small numbers of bigeye tagged were mostly larger than 38 cm, ranging from 29 to 58 cm with 41.3 cm average. During the tagging cruise, bait fish to support the fishing activity was relatively easily found in and around the survey area, either with direct catching using bouke ami net or purchasing from the lift net fisherman. By the end of 2010, 4,594 tags was recovered representing a relatively high recovery rate of 18.2% overall.

KEYWORDS: Tuna, tagging, Eastern Indonesian Waters

INTRODUCTION

Information on fish migration is very important not only for the study of the biological behavior, but also for that of population dynamics. Fish may have several different patterns of migration derived by their biological habits. In order to evaluate information on migration, tagging experiment is one of the powerful method, especially in quantitative information has been obtained for several species. Many techniques of tagging have been developed so that suitable tag has been matched to fish behavior and fishing method (Ishii, 1979). Tag recapture studies are also used to estimate mortality rates as well as the number of fish in a certain area (biomass). These methods are extensively reviewed by Jones (1977) & Ricker (1975).

Tuna tagging in Indonesian waters especially in eastern Indonesian waters was already conducted since 1987 (Gafa *et al.*, 1987). The success of the tuna tagging programs was indicated, amongst other things, by the high number of fishes being tagged. During the 1990s, a collaborative tagging program also conducted using MV *Te Tautai* and it also recorded as one of more successful tagging programs. The area covered by MV *Te Tautai* operations included Irian Jaya, Moluccas Sea, and North Sulawesi (Itano & Opnai, 1991). Also a total of 1.180 fish had been tagged during 1990 tagging program in Bacan island, North Mollucas and Luwuk, central Celebes waters (Gafa & Susanto 1991).

This paper described technical and operational aspects of the fifth cruise of the Pacific Tuna Tagging Project (PTTP) Phase 2 2008 carried out in eastern Indonesian Waters as a collaborative project between SPC (Secretariat of the Pacific Community)/OFP (Oceanic Fisheries Programme) and the Republic of Indonesia Research Centre for Capture Fisheries (RCCF). Ministry of Marine Affairs and Fisheries of the Republic Indonesia.

The global objectives of the Pacific Tuna Tagging Project (PTTP) were comprised of 5 objectives; to obtain data that will contribute to and reduce uncertainty in WCPO tuna stock assessments, to obtain information on movement and mixing of tuna in the equatorial WCPO, to obtain information on species-specific vertical habitat utilization by tunas in the tropical WCPO, to examine the impacts of FADs on tuna vertical behavior, and to obtain information on local exploitation rates and productivity of tuna in various parts of the WCPO, including eastern Indonesia.

MATERIALS AND METHODS

Tuna tagging in eastern Indonesian Waters was conducted during the cruise of the Pacific Tuna Tagging Project (PTTP) Phase 2 involving a 33 day period in Indonesian waters, from September 27th 2008 to October 30th. A chartered pole and line vessel from

Solomon Islands (FV SOLTAL 105 with 199 GT size) was used during fishing and tagging operations.

The operation sequence during the tagging experiment involved baiting, fishing and tagging. Some genetic and biological sampling also conducted during the survey. *Baiting* for life bait was conducted using two ways, the first way was using a *bouke ami* net with underwater lights as attractor for the bait; baiting was conducted only when the weather and the location (depth, lack of current) was favourable. The second way to collect the bait was purchasing from local fishermen's lift net (*bagan*) catches.

The second activity of the tagging experiment was *fishing using pole and line*. Fishing activity started at daybreak (05.30 hrs) until late afternoon (18.00 hrs local time). Fishing was conducted around FADs, free schools associated with log or floating materials i.e. bamboo, and even schools associated with whale sharks. Fishes from pole-and-line fishing was caught gently by the catcher and put on the special tagging cradle for length measurement and tag application. Fish were checked for good condition and generally released within 15 seconds of hooking.

Two types of conventional dart tags were using during the tagging experiment - Z tags (11 cm streamer length) for small fish of 31 – 37 cm fork length, and P type tags (13cm streamer length) for bigger fish with more than 37 cm length. Figure 1 until Figure 3 show the tag types, illustration of tag placement under the second dorsal fin and example of the tags in live skipjack just prior to release (<http://www.spc.int/tagging/en/about-tagging>).

Certain information regarding the tagging program such as tagging number and address to claim the tags reward were printed in waterproof printing on the tags.



Figure 1. Conventional Plastic Tag

RESULTS AND DISCUSSION

FISHING ACTIVITIES

The track of the cruise, based on school and noon positions, is depicted in Figure 4 with 3,691 nm total distance covered by the cruise. A wide area of the Pacific portion of the Indonesian EEZ was covered, similar coverage compared to 1991 tagging cruise,

(Figures 4,5). Tagging in 2008 was conducted at a total of 86 locations. A large array of FADs near Gebe Island produced only modest catches, using good bait obtained in Aljui Bay, so the vessel redirected activity to the north of Waigeo Island, where more than 4,000 fish were tagged in three days before heading towards Halmahera. Good quality bait was obtained at Morotai Island, but relatively small catches were made off the west coast of Halmahera. The vessel then headed for Kepaluan Islands to the south west, large amount of catches were made on FADs located to be in the western Seram Sea (over 4,000 fish in 3 days), enabled by good bait obtained on the north coast of Taliabu island.

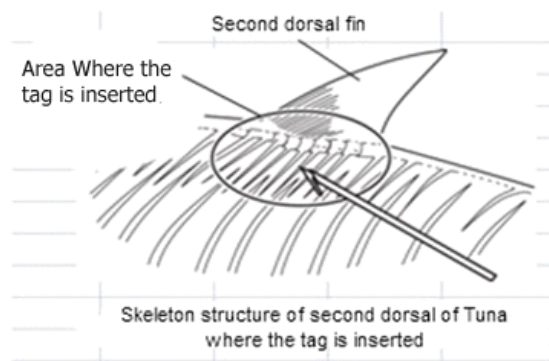


Figure 2. Illustration of tagging placement in a fish



Figure 3. Skipjack tuna tagged with a conventional plastic tag.

Good fishing was found in Banda Sea, to the south of Ambon where over 200 fish were tagged and bait purchases from lift net/*bagan* in Saparua Island enabled the vessel to fish eastwards across the Banda Sea towards Papua. Good number catches were made in FADs south of Fakfak, before heading to the north coast of Seram Island. *Bagan* bait was then used to fish north with success towards Gebe Island. The final five days of the cruise were spent in the Northern Papua

waters, before clearing out of Indonesia in Jayapura on October 30th. A short trip to the 00/138E TAO buoy was made before Jayapura but with limited success due to the associated school being fished by a local purse-seiner from Jakarta prior to the arrival of the tagging vessel.

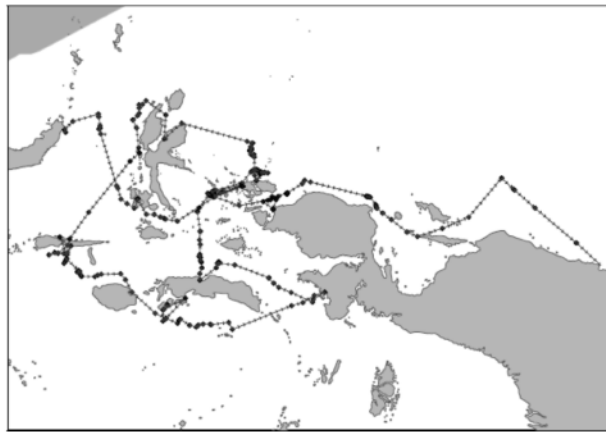


Figure 4. The track of 2008 tagging cruise



Figure 5. The track of 1991 tagging cruise (Itano Opnai, 1991)

TAG RELEASES

All of the 33 days of charter were spent Indonesian waters. Of these 33 days, 5.5 days we spent in port, and the remainder of the time was fishi time. The cruise time was relatively effective, considered only small portion of the time with lack of bait or bad weather, and only two days total were spent steaming either without or with limited bait.

Most of fishing days were productive, with just two zero catch days. Total of are eighteen days of the cruise with more than 500 fish were tagged and released.

In total, 25,197 tuna were tagged with conventional tags, at an average of around 900 fish per fishing day. No archival or sonic tags were released. The releases of conventional tags comprised 19,576 skipjack (77.7%), 5,267 yellowfin (20.9%) and 354 bigeye (1.4%) (Figure 6). The “yellowfin plus bigeye” proportion of the catch, at 22.3%, was lower than 1991 cruise, even though most fishing was on FAD-associated fish. Yellowfin comprised over 50% of the catch on just four fishing days, mostly in the area south of Kepulauan Islands. Bigeye were taken in small numbers throughout the cruise, but only more than 100 fish in a day on one occasion.

Over 80% of the 2008 releases were fished from anchored FADs which were not uniformly distributed throughout the Indonesian waters, but rather clumped in productive areas, invariably deeper than 1000 m and usually deeper than 2000 m. Only 7.8% of releases were from free schools, and 9% from logs or drifting FADs. Whilst the majority of releases were from associated schools, only 25.4 % of releases of conventional tags were the smaller 11cm Z tags (6,409), and 74.6% (18,788) the 13 cm P tags. The cruise releases are summarized by school in Appendix Table 1, while Figure 7 below shows the distribution of the releases in Indonesian waters by 0.5 degree square, by species.

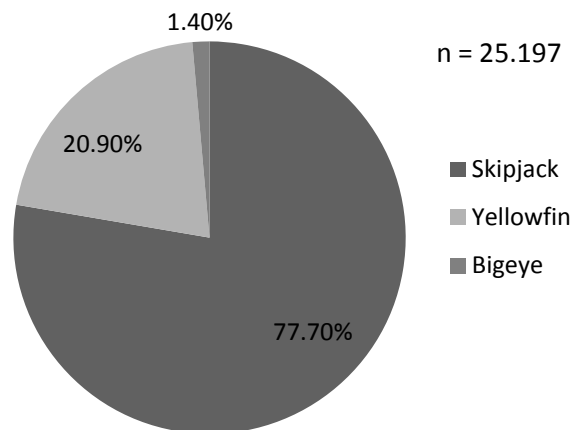


Figure 6. Tagged fish species composition

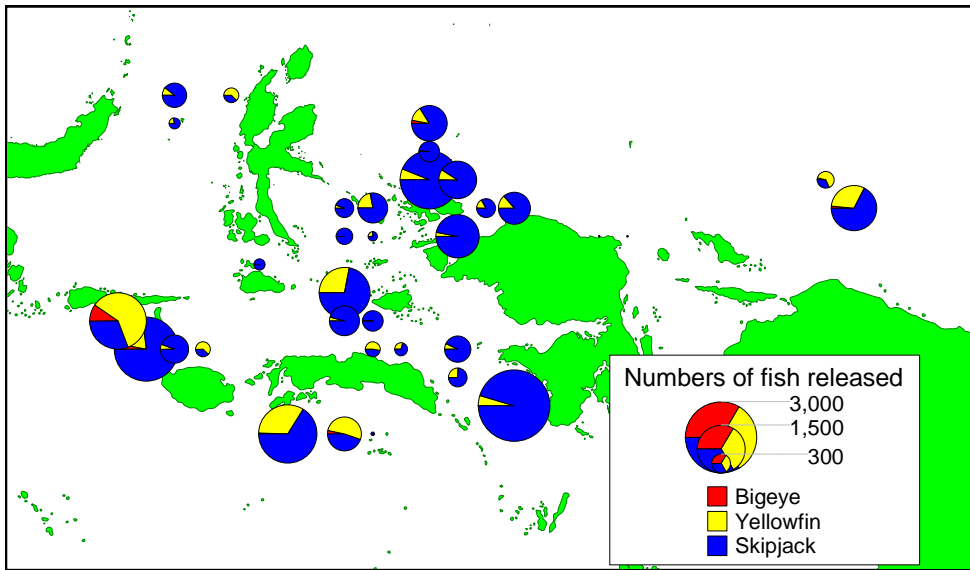


Figure 7. Distribution of releases in Pacific Indonesian waters of the Pacific by half degree square, by species, for PTTTP Phase 2 Cruise 5 (28/09 to 30/10/2008)

SIZE DISTRIBUTION OF TAGGED FISH

Figures 8, 9 and 10 show the size distribution of fish tagged during the cruise, while Table 1 shows the statistical summary of the length measurements. Skipjack size range was between 28 – 83 cm fork length, but from the length frequency graph, it can be seen that skipjack size was mostly between 35 and 40 cm (Figure 8).

Yellowfin size range was slightly smaller than skipjack, ranging from 28 cm to 65 cm length, but with most fish between 37 and 41 cm (Figure 9). The small numbers of bigeye tagged were mostly larger than 38 cm, with size range were between 29 to 58 cm length (Figure 10).

Comparison with previous data from 1991 tagging shows that average size of the fish tagged in 2008 tended to be higher for yellowfin and bigeye, while for skipjack the average size was slightly smaller. From the standard deviation for three fish groups it is likely that the SD for 2008 tagging is much lower than 1991 tagging - this show that the size variation during 2008 tagging was lower than in 1991. Since most of the fishing during the 2008 tagging was done on FAD,

with relatively homogenous size of the tagged fish that can be assumed as representative of size distribution fish associated with FAD.

Table 1. Summary of length frequency data collected from tuna tagged during the cruise

Species	Statistic	1991 tagging	2008 tagging
YELLOWFIN	Number of fish	2,641	5,267
	FL range (cm)	23 - 96	28 - 65
	Mean length (cm)	35.7	40.1
	Std deviation	8.2	3.9
SKIPJACK	Number of fish	4,784	19,558
	FL range (cm)	23 - 75	29 - 83
	Mean length (cm)	39.2	38.9
BIGEYE	Std deviation	8	3.8
	Number of fish	44	354
	FL range (cm)	24 - 56	29 - 58
	Mean length (cm)	35	41.3
	Std deviation	5.9	3.7

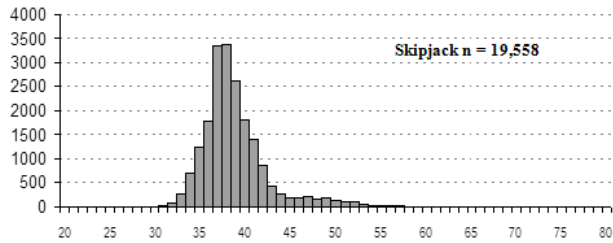


Figure 8. Size distribution of tagged skipjack

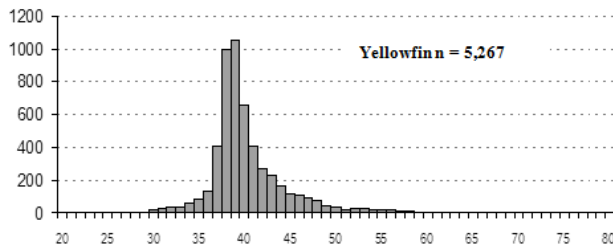


Figure 9. Size distribution of tagged yellowfin

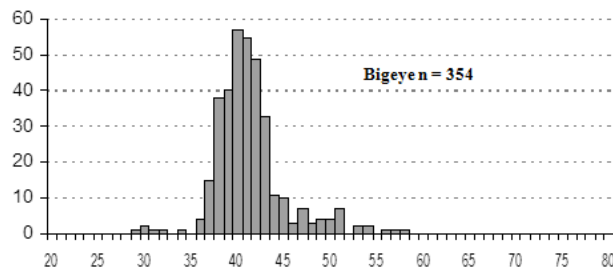


Figure 10. Size distribution of tagged bigeye

BAIT FISHING

The cruise was blessed with almost continuous good bait in plentiful supply, either from capture by the vessel itself using standard bouke ami gear or purchased from bagans, lift net vessels or platforms supplying bait to local pole-and-line vessels (*funai* and *huhate*). As noted, only two days during the cruise involved steaming with no bait, so bait was ultimately not a constraint.

Lights for bait fishing by the vessel were set on 15 nights in 12 locations. The average bait catch per night was 180 buckets, and was often supplemented with bait purchase from bagans. The tanks were filled on at least 10 occasions, enabling longer trips and translocations to new areas whilst fishing “en route”.

Catches were dominated by anchovies – *Encrasicolina punctifer* (ocean anchovy) was surprisingly common in the deeply shelving bays

where baiting often occurred, whereas two other common anchovy species (*E.devisi* and *E.heterolobus*) were taken in the more extensive shallow bays. Sprats (*Spratelloides* spp.) were not taken in large numbers at any location, a species of sardine new to the vessel – presumed to be *Sardinella longiceps*, with very adherent scales and good survival, proved to be a mainstay in many areas. Larger small pelagic predators were often taken in numbers at many sites and often needed to be scooped out with larger mesh nets before loading of suitable-sized bait could commence.

Obtaining bait from lift nets or bagans proved to be very successful and was carried out on 5 occasions. After negotiations regarding bait availability and price, the vessel could move alongside the keeper net and the bait transferred with the help of bagan fishers, with usually vessel crew scooping the progressively crowded bait into larger buckets for quicker transfer. On most occasions, these larger buckets contained 4-5 kgs of bait, or twice the usual bucket wet weight of bait used on the tagging vessel, but still less than the 6-7 kgs if the local vessels were loading. The price was generally Rp 25,000 per large bucket (~ USD 0.50 per kilo). Over 30% of the bait used in the trip was obtained from bagans and was usually of good quality if correctly and carefully loaded.

TAG RECOVERIES

Associated with the tagging cruise, wide publicity was undertaken, with posters publicizing the PTPP prepared in Bahasa Indonesia and widely distributed; TRO (tag recovery officers) were appointed in key ports and landings sites to publicize the project, collect tags with associated recapture information and pay the reward of Rp 100,000 (USD 10) for return of each tag. Although coverage may have been not complete throughout eastern Indonesia but the TRO was already well trained regarding the tags recoveries process.

PRELIMINARY RESULT OF RECAPTURES

Information from TRO (tag recoveries officer) in contributed countries and especially from Indonesia sites show that recovery number in late March 2011 was skipjack 3796 (19.4%), yellowfin 786 (14.9%), bigeye 70 (19.8%). The total recaptures was 4652 (18.4%) which was considered a moderately high return rate. Note that actual number of recaptures may be considerably higher, since there are known sources of non-reporting e.g. canneries and some landing points. Recovery rate by tag type compared to the

releases was not significantly different 18.0% (1158) for Z tags, 18.6% (3494) for P tags.

Recoveries percentage by size class shows slight variation but may not be significant. Recoveries for each size class was 18.7% for 30-34 cm size class (1,273 released); 17.3% for 35-39 cm size class (15,157); 20.3% for 40-44 cm size class (6,670); 21.4% for (1,414); 20.5% for 50-54 cm size class (547); and 14.6% for 55-59 cm size class (137). The highest recovery was found on 45-49 cm size class.

The movement of the tagged fish was described on Figures 11 to 13 this arrow plot of the movement was selected only for Indonesian area released tags recoveries derived from year 2011 SPC database. The movement pattern shows that most of the skipjack were recaptured again around the FADs where they are released, whilst yellowfin and big eye tuna have a longer and dispersed movement. The movement of the tagged fish could be grouped into two movements; outward movement and inward movement.

OUTWARDS MOVEMENT (emigration)

Recoveries from 2008 releases in Indonesia were made from a wide area of the western Pacific, with 439 (over 9%) of releases to date. Most of these were from contiguous areas/EEZs eg PNG (133 recoveries), Palau (133), Philippines (64), and international waters/high seas pocket (86), but also South China Sea (8), FSM (39), Malaysia (4), Nauru (1) and Vanuatu (1). Most of the international recoveries were skipjack (349), with 88 yellowfin and 8 bigeye.

INWARDS MOVEMENT (immigration)

Relatively fewer recoveries have been made in Indonesian waters from releases elsewhere in the WCPO by the project (approx. 225,000 releases, excluding the Indonesian releases), with only 317 to date eg PNG 131, Palau 135, FSM 28, and Solomons 16, with one each from Philippines and Kiribati. Although these recoveries still require verification, it can possibly be inferred that nett emigration occurs, but with significant immigration of yellowfin relative to skipjack.

Most recaptures were recaptured in Indonesian waters but some over a wide range of the western and central Pacific. Following verification of tag recapture data, collaborative analyses involving SPC and RCFMC scientists will be undertaken, are expected to provide much valuable information on migration, exploitation rate and population dynamics of Indonesian tunas.

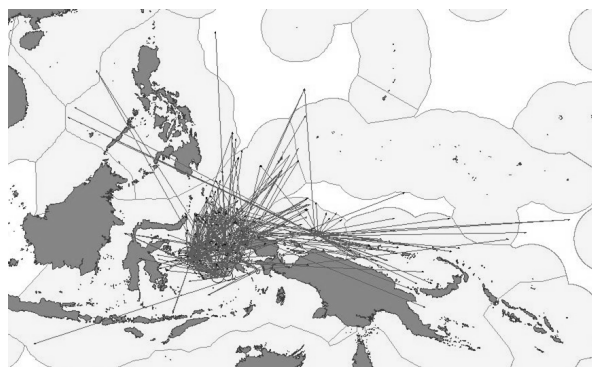


Figure 11. Movement pattern from yellowfin recoveries

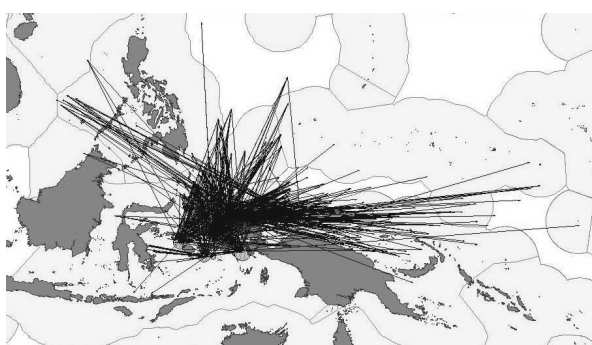


Figure 12. Movement pattern from skipjack recoveries

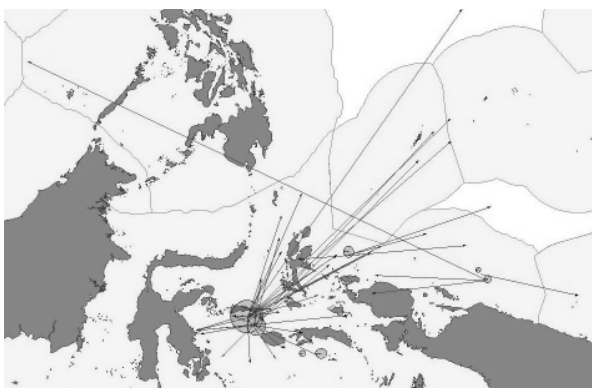


Figure 13. Movement pattern from bigeye recoveries

Tagging data from Indonesian waters will contribute during the analysis for regional Western and Central Pacific Ocean tuna assessment. The assessment will be comprised of movements, growth, mortality and longevity. The tagging data nevertheless provide important information for stock assessment. A subset of tuna tag returns provides useful information on growth rates. The most important contribution of the tagging data of tuna stock assessment is in the

estimation of natural mortality. Natural mortality is estimated internally by the stock assessment model. Tagging data also have the potential to provide substantial information on exploitation rates of the tuna fishery. (Hampton & Williams. 2005).

CONCLUSIONS

From the number of fish being released the 2008 tagging cruise can be concluded as a highly successful cruise and also good coverage cruise with a large number of fish tagged over a wide area of the Pacific, of the eastern Indonesian waters EEZ. Higher percentage of skipjack than other fish groups but still good proportion of yellowfin and bigeye. The average size of 2008 tuna tagging was mostly higher than previous tagging in 1991 except for skipjack, from the size variation aspect 2008 were lower than 1991 tagging. Availability of baitfish for tuna fishing was excellent all over the cruise area, which made wide coverage possible. Recoveries from 2008 tagging until March 2011 were considered as moderate.

ACKNOWLEDGEMENT

This cruise was part of Pacific Tuna Tagging Project (PTTP) Phase 2 2008 collaboration between SPC/OFP and is part of the overall Pacific Tuna Tagging Project. Thanks to the cooperation of many people, especially Dr. John Hampton as project leader, Dr Tony Lewis as cruise leader for most of the tagging cruise, and Dr. Victor Nikijuluw as Director of RCCF (now change to RCFMC) during the cooperation.

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Appendix 1. Tag releases (all tags) by school during the tagging cruise in eastern Indonesian waters

school no.	Date	Latitude	Longitude	type	Assoc.	Start	Stop	YFT	BET	SKJ	OTH	TOTAL
1	28-Sep-08	0154.088N	12611.444E	2	3	1040	1115	1	0	315	0	316
2	28-Sep-08	0133.501N	12614.321E	1	3	1356	1429	46	0	85	0	131
3	28-Sep-08	0129.337N	12614.645E	1	3	1509	1528	23	0	87	0	110
4	28-Sep-08	0128.873N	12613.541E	5	5	1600	1612	0	0	4	0	4
5	30-Sep-08	0101.682S	12734.858E	2	3	950	1020	0	0	15	0	15
6	30-Sep-08	0106.540S	12759.264E	2	1	1335	1405	0	0	103	0	103
7	2-Oct-08	0020.737S	12931.404E	2	3	450	535	9	0	162	0	171
8	2-Oct-08	0023.572S	12928.284E	2	3	606	655	16	0	268	0	284
9	2-Oct-08	0025.794S	12929.975E	2	3	719	728	0	0	1	0	1
10	2-Oct-08	0026.004S	12933.125E	1	3	805	823	34	0	35	0	69
11	2-Oct-08	0028.110S	12933.367E	3	3	835	900	88	0	73	0	161
12	2-Oct-08	0030.055S	12932.380E	4	3	930	952	21	0	24	0	45
13	3-Oct-08	0030.936S	12933.053E	1	3	545	615	0	0	1	0	1
14	3-Oct-08	0028.749S	12933.559E	3	3	630	705	1	0	103	0	104
15	3-Oct-08	0026.350S	12933.126E	5	3	725	743	7	0	16	0	23
16	3-Oct-08	0028.317S	12924.590E	5	3	910	930	0	0	2	0	2
17	4-Oct-08	0016.255N	13041.504E	1	3	630	710	3	0	178	0	181
18	4-Oct-08	0017.122N	13045.851E	2	3	740	817	0	0	386	0	386
19	4-Oct-08	0015.011N	13047.182E	1	3	835	919	13	0	329	0	342
20	4-Oct-08	0012.794N	13053.998E	1	3	1024	1036	7	0	6	0	13
21	4-Oct-08	0010.716N	13054.177E	1	3	1050	1058	4	0	1	0	5
22	4-Oct-08	0011.611N	13100.352E	2	3	1143	1225	19	0	381	0	400
23	5-Oct-08	0011.545N	13100.385E	2	3	656	755	60	0	490	0	550
24	5-Oct-08	0010.953N	13105.923E	3	3	835	900	8	1	32	0	41
25	5-Oct-08	0011.564N	13100.405E	3	3	1004	1014	3	0	10	0	13
26	5-Oct-08	0012.796N	13054.005E	1	3	1110	1122	10	0	14	0	24
27	5-Oct-08	0015.323N	13049.479E	3	3	1201	1306	92	0	940	0	1032
28	5-Oct-08	0015.126N	13047.270E	1	3	1320	1333	1	0	20	0	21
29	5-Oct-08	0017.158N	13045.842E	1	3	1348	1411	1	0	69	0	70
30	5-Oct-08	0016.353N	13041.311E	1	3	1446	1515	0	0	71	0	71
31	6-Oct-08	0053.718N	13038.093E	1	3	1300	1322	0	0	5	0	5
32	6-Oct-08	0056.925N	13036.427E	1	3	1348	1440	7	0	339	0	346
33	6-Oct-08	0103.008N	13038.466E	2	3	1532	1604	42	0	431	0	473
34	6-Oct-08	0103.438N	13039.972E	2	3	1616	1700	74	25	299	0	398
35	8-Oct-08	0155.334N	12722.285E	1	3	935	950	5	0	4	0	9
36	8-Oct-08	0144.044N	12711.553E	1	3	1145	1235	105	0	62	0	167

Appendix 1. continued

school no.	Date	Latitude	Longitude	type	Assoc.	Start	Stop	YFT	BET	SKJ	OTH	TOTAL
37	8-Oct-08	0129.505N	12717.979E	1	3	1423	1440	1	0	0	0	1
38	10-Oct-08	0212.262S	12516.678E	1	3	1519	1557	210	72	216	0	498
39	10-Oct-08	0219.222S	12516.606E	1	3	1644	1734	614	90	252	0	956
40	11-Oct-08	0210.556S	12511.213E	1	3	830	850	0	0	1	0	1
41	11-Oct-08	0210.118S	12501.267E	1	3	1450	1545	178	15	31	0	224
42	12-Oct-08	0212.784S	12516.746E	1	3	1050	1130	153	9	97	0	259
43	12-Oct-08	0241.113S	12536.015E	1	3	1529	1543	35	36	11	0	82
44	12-Oct-08	0242.729S	12536.488E	1	2	1548	1645	121	20	659	0	800
45	12-Oct-08	0244.588S	12537.932E	1	3	1720	1750	172	11	215	0	398
46	12-Oct-08	0241.347S	12538.455E	1	2	1813	1845	18	3	13	0	34
47	13-Oct-08	0250.811S	12542.049E	1	3	615	714	152	3	1004	0	1159
48	13-Oct-08	0248.527S	12610.664E	1	3	1043	1118	33	0	535	0	568
49	13-Oct-08	0246.013S	12650.038E	3	3	1555	1625	133	0	81	0	214
50	14-Oct-08	0409.131S	12803.525E	1	2	1502	1552	217	3	331	0	551
51	17-Oct-08	0412.955S	12829.020E	1	3	1525	1650	482	8	1056	0	1546
52	18-Oct-08	0419.684S	12901.790E	3	4	730	818	236	12	159	0	407
53	18-Oct-08	0414.326S	12913.841E	1	2	1020	1041	135	14	154	0	303
54	18-Oct-08	0415.570S	12927.555E	1	2	1212	1235	65	2	61	0	128
55	18-Oct-08	0411.311S	12958.074E	1	2	1600	1620	0	0	20	0	20
56	19-Oct-08	0336.642S	13207.088E	3	3	812	920	15	0	1023	0	1038
57	20-Oct-08	0335.874S	13223.966E	3	3	630	742	122	0	1820	0	1942
58	20-Oct-08	0302.592S	13116.298E	2	1	1554	1614	80	0	232	0	312
59	20-Oct-08	0253.125S	13107.856E	2	1	1738	1803	36	1	494	0	531
60	21-Oct-08	0230.570S	13008.548E	2	3	556	620	44	1	109	0	154
61	21-Oct-08	0227.462S	12938.718E	2	1	1003	1020	1	0	317	0	318
62	21-Oct-08	0227.305S	12938.747E	2	1	1025	1036	0	0	19	0	19
63	21-Oct-08	0227.905S	12940.789E	2	1	1130	1145	0	0	23	0	23
64	21-Oct-08	0235.531S	12936.495E	1	3	1247	1330	99	1	90	0	190
65	22-Oct-08	0222.828S	12908.760E	4	1	905	1008	23	0	393	0	416
66	22-Oct-08	0217.729S	12908.852E	4	1	1052	1056	1	0	38	0	39
67	22-Oct-08	0216.807S	12907.940E	3	1	1105	1125	5	0	214	0	219
68	22-Oct-08	0154.595S	12908.591E	1	3	1357	1425	127	0	315	0	442
69	22-Oct-08	0146.704S	12907.247E	1	3	1516	1547	225	0	291	0	516
70	22-Oct-08	0131.462S	12908.627E	1	3	1730	1801	102	0	569	0	671
71	23-Oct-08	0057.076S	12903.653E	1	3	555	607	0	0	46	0	46
72	23-Oct-08	0050.017S	12907.036E	1	3	700	712	0	0	190	0	190
73	23-Oct-08	0025.784S	12930.995E	1	3	1127	1140	0	0	6	0	6
74	23-Oct-08	0025.888S	12932.677E	1	3	1150	1156	0	0	29	0	29

Appendix 1. continued

school no.	Date	Latitude	Longitude	type	Assoc.	Start	Stop	YFT	BET	SKJ	OTH	TOTAL
75	23-Oct-08	0026.277S	12933.811E	1	3	1204	1216	0	0	67	0	67
76	23-Oct-08	0028.598S	12934.383E	1	3	1231	1236	0	0	3	0	3
77	23-Oct-08	0030.186S	12933.657E	1	3	1227	1259	0	0	43	0	43
78	24-Oct-08	0030.476S	13124.009E	3	3	920	1050	37	0	1171	0	1208
79	26-Oct-08	0025.057S	13138.192E	1	3	1035	1105	36	0	218	0	254
80	26-Oct-08	0026.176S	13139.945E	1	3	1127	1136	1	0	0	0	1
81	26-Oct-08	0024.236S	13140.439E	1	3	1149	1200	7	1	3	0	11
82	26-Oct-08	0002.082S	13210.114E	1	3	1607	1645	102	0	646	0	748
83	27-Oct-08	0031.520S	13359.062E	1	3	620	630	0	0	3	0	3
84	27-Oct-08	0031.777S	13403.990E	1	3	717	722	5	0	1	0	6
85	29-Oct-08	0001.985N	13752.840E	1	3	545	630	143	8	70	0	221
86	29-Oct-08	0017.300S	13813.040E	1	3	1038	1125	401	18	876	0	1295
TOTAL								5267	354	19576	0	25197