SUMMARY OF THE DATA ALREADY COLLECTED BY THE REGIONAL TUNA TAGGING PROJECT IN THE INDIAN OCEAN

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General context

This document summarizes the different data (tagging and recoveries) already collected by the RTTP-IO. This is the usual paper that I produce to keep you informed on the progress of the RTTP-IO. This paper gives a better idea of the quality and the nature of the recovery data as more than 13,500 recoveries are already registered into our database. I am fully conscious of the fact that presenting these information and not being in a position to make them available for analysis is like presenting a nice juicy cake to a kid without letting him to have a bit of it. But we are still in the tagging phase of the project, recoveries are plentiful and recovery data still need a lot of work before you can use them. The lack of staff and the necessity to check very carefully all recoveries is responsible of this situation. Presently our main priority is to make sure the recovery data are collected in the best possible way and are as clean as possible into the database. This takes up a large part of my time and the full time of the Publicity and Tag Recovery Officer's time. Later we will have to cross the well numbers of our recoveries with the logbooks of the purse seiners: a necessary but very time-consuming work that should start in September 2007 and will keep us busy for many months. Therefore you will have to be patient but with the prospect of getting at your disposal these recoveries for your next year meeting….and they are really appetizing!

I have limited the text to the minimum as everyone will be more interested in the tables and figures.

1. TAGGING

1.1. The number of fish tagged and released

The tagging operations by the two chartered pole-and-line vessels Aita Fraxku and Kermantxo started at the beginning of May 2005 in Seychelles and they were due to terminate at the beginning of August 2007. But for reasons detailed below we are in the process of extending the contract for one month (a 31 month contract instead of the initial 30 months) with an end of the tagging operations around September 8th and of the contract on October 22nd 2007 (giving to the vessels the necessary transit time back to the Atlantic Ocean).

On July 7th the number of fish tagged reached 135,108 (Table 1 & Figure 1) and we can expect to tag at least 15,000 more fish before the completion of the operation bringing the overall number of fish tagged around 150,000 or almost double the initial target of 80,000. We all know too well that greater the number of tagged fish released better the expected information extracted from the recoveries will be. Therefore in term of number of fish tagged, the RTTP-IO is a complete success. This success is even more pronounced when one looks at the species composition of the tagged fish (Table 1 & Figure 2). More than 50% of the tagged tuna are yellowfin and bigeye (35% yellowfin and 18% bigeye). The pole-and-line fishing technique, the gear used by the RTTP-IO, and which is the only possible fishing technique in our context has among its different drawbacks the particularity to be a surface gear. Only tuna coming at the very surface of the sea can be vulnerable to this gear. And skipjack is the most surface tropical tuna species and bigeye the least, yellowfin being between. Consequently all large scale pole-and-line tagging projects end up with a majority of skipjack. This is not the case of the RTTP-IO. This astonishing result was made possible via the dedication and vast experience of our fishermen and via the use of the associated school fishing technique together with the concept of the "tuna hub". We will explain later this context.

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The monthly tagging results are given in table 1 and illustrated in figure 3.

1.2. The different types of tag used by the RTTP-IO

Most tuna are tagged with one yellow dart tag; some receive two yellow tags in order to address the tag shedding rate issue but white and red dart tags are also used in smaller amounts some of them in conjunction with the implantation of archival tags or sonic tags. The distribution of the numbers of tag by types is given in table 2 and figure 4 illustrates the species composition for all those different types. Species composition for single dart tags is somewhat different of the species composition for double-tagged and OTC types of tag. This is due to the fact that double tagging does not start before January 2006 and OTC before June 2006. Archival tags because of their size and the fact they have to be inserted into the abdominal cavity of the tuna is restricted to yellowfin and bigeye generally greater than 60 cm. For the implantation of sonic tags together with OTC injection and a white tag was more or evenly distributed between the three species: yellowfin, bigeye and skipjack.

Single tagging

This is the general tagging mode of the RTTP-IO with 101,243 fish tagged or 78%.

Double-tagging

The RTTP double tagging target is 20% and the level of double tagged tuna by 24/06/2007 reached 24,434 or 18.8% very close to the target.

OTC tagging

- For growth and age study, some tunas receive an injection of Oxy-TetraCycline (OTC) an antibiotic commonly used for this type of study. To differentiate them from the normal tagged tunas that bear one or two yellow dart tags, a white tag is used on these fish. At the time of the analysis, 3,858 tuna have received a white tag or 3 % of the total

Archival tagging

The TAGFAD project (DG-Fish funded project) has donated 130 archival tags to the RTTP. Almost all of them have been released (128 or 0.1%). To differentiate these tuna as they receive a much higher reward they receive a red tag. They are also injected with OTC therefore if recovered otoliths are extracted.

Sonic tagging

A very limited survey took place in October-November 2006 with the financial and technical help of FADIO and IOTC with funds provided by Japan. The objective of this survey was to assess the time of residency of tuna in the associated school (cf. 2006 Scientific Committee). 40 tunas received a sonic tag, an injection of OTC and a white tag. As it is not essential to recover the sonic tags these fish deserve a normal OTC reward. Regional Recovery Officers are informed of the white tag numbers in question in order eventually to recover some of these sonic tags.

1.3. The size composition

The distributions of the sizes of the tagged tunas are given in figure 3a for YFT, 3b for BET and 3c for SKJ. The sizes for the three species are covering a wide range and I would say almost the maximum range that can be expected from pole-and-line fishing especially for YFT (YFT bigger than 100 cm are difficult and dangerous to handle).

In Oman the size distribution of the yellowfin tagged from mid-February to the beginning of April 2007 is given in Figure 6. There are clearly two modes: one at 75-80 cm spreading from 61 to 93 cm and a second mode at 108-112 spreading from 94 to 120 cm. There are also some bigger yellowfin up to 145 cm.

1.4. The area surveyed

The geographical distribution of the tagged tuna is quite awkward (Figures 7 & 8 and Table 3) with some fish tagged off the Amirantes of Seychelles, others in the Mozambique Channel, some off Oman coast (all yellowfin) and some on the way to Maldives from Oman (mainly skipjack). But the big bulk of the releases took place off the Tanzanian coast. This last group accounted for 75% of the tagged tuna released by the RTTP-IO. The reasons and the implication of this distribution are discussed in the § on the associated school fishing technique. After 8 months of tagging off Tanzania, it was decided to send the vessels in the Northern part of the Western Indian Ocean from January until the SE monsoon forces the vessels to shelter again off Tanzania (this happens at the end of May 2007).

From February to mid-April the vessels surveyed Oman waters. This was a very difficult survey in term of fishing, tagging and administrative issues. No pole-and-line vessel has ever tagged in Oman waters. A short survey off the waters of Yemen and North Somalia (Gulf of Aden) at the end of the sixties by a Basque pole-and-line vessel concluded on the impossibility to fish tuna with pole-and-line gear in this region. During 2005 survey by the RTTP-IO the bait were plenty and were not an issue but no tuna were present. The 2007 survey took place at a different season at a time when local fishermen were reporting yellowfin catches but bait was not always easy to catch and their survival rate was much lower than in 2005. Administrative framework for a survey of Oman waters by the RTTP vessels did not fit at all with the constraints of the RTTP vessels generating a lot of difficulties resulting in unnecessary delays and a lot of frustration from the skippers, cvrew and RTTP staff. Despite these many difficulties, the two vessels managed to release 3,041 yellowfin between 60 and 145 cm: considering the local constraints this is a good achievement. Now we have to wait to see when and where these yellowfin will be recovered.

At the end of April and the first half of May the vessels made an attempt to tag and release tuna offshore of Maldives. But the vessels have to purchase their bait from the local fishermen. After three days of trials for loading our vessels with local bait it became obvious that we were not getting anywhere: the bait survival rate was far too low and the rate of loading far to slow. Considering these conditions together with the high associated cost the survey was shortened. Furthermore the SE monsoon was starting to blow making the place too difficult to work and even dangerous. At the end no tuna were released by the RTTP-IO off Maldives waters.

1.5. The associated school fishing technique and the tuna hub

A first tagging survey off Tanzania took place mainly in October 2005. At the beginning of March 2006 after almost a full year of tagging surveys in the South-West Indian and a failed attempt in the Arabian Sea it was obvious that: (1) Tanzania was the only place where yellowfin and bigeye can be tagged in large numbers together with skipjack; (2) during the monsoon season (May to September) waters off Tanzania are a little bit more protected than all the other places making it one of the rare places if not the only place where our tagging vessels can work during these months; (3) Tanzania is generally quite poor in tuna schools making the area very lightly exploited by purse seiners. However tuna are present in sufficient numbers for tuna tagging. These three advantages are quite unique for tuna tagging especially when you target yellowfin and bigeye. But in April 2006 when the vessels steamed again in the waters of Tanzania we discovered that the region offer much more: (1) the possibility to implement the associated school fishing technique (ASFT); (2) the possibility to fish in sufficient number without any live bait just with lures and (3) a high turn-over rate of the tuna in the associated school (the concept of the “Tuna hub”).

Form mid-April to December 1st 2006 the two vessels worked only with the associated school: passing the school between vessels or splitting it when they work together at sea. Starting from mid-July we discovered by chance that we can tag in sufficient number just by using lures. This lifted one of the major constraints of pole-and-line fishing: the provision of live bait. Comparison of the achievements of this peculiar fishing technique is given in table 4.

At the start of the 2007 SE monsoon the vessels went again off Tanzania and were able to re-build an associated school. They will normally work with this school until the end of the tagging scheduled around September 8th 2007.

Tagging during several months with the associated school is only possible if you have a sufficient turnover of fish into the school otherwise you end up fishing mostly tagged tuna. This is precisely what the associated school off Tanzania is. The school is not big confirming the scarcity of tuna in this region but tuna are always passing through there making a continuous flow of new tuna into the school. Among the 79,255 tuna tagged in the associated school, 3830 fish (4.8%) were recaptured between 1 and 7 times accounting for 6051 times a fish already tagged was fished again or 7.6%. yellowfin have a higher recapture rate (8.5%) while it is only 3.3% for bigeye and 1.8% for skipjack. This underlines the higher turnover for skipjack, then bigeye and yellowfin.
The rate of recaptures per tagging day is given in figure 9. This rate changes over the time being high until mid-June, then average until mid-August and after that remaining very low until mid-November when it starts to increase again.
When recaptured if the fish was in good shape it was released this explains why some fish were recaptures several times. Only 215 recaptured fish tagged in the associated school ended up on deck of the Kermantxo or the Aita Fraxku (0.3%).

Only a high tuna turnover in the school can explain this low recapture rate. To describe this peculiar situation we generate the concept of the "Tuna hub" in similarity with the airline hub: tuna coming from different areas are passing through the associated school before leaving in different directions. Some fish stay into the school for a few days, weeks or months and consequently can be recaptured several times but most of them leave quickly and were not recaptured in the associated school. This situation can also be compared to a obliged busy area in one of the migratory route of tuna like birds when migrating over the Mediterranean Sea who either choose to fly through the Gibraltar strait or via Sicily, Malta and Tunisia as a way to avoid having to fly too large distances over the sea.

Sonic tagging
The sonic tagging experiment results were presented during the SC of IOTC in November 2006. 20 sonic tags are still on board and will be released soon.

2. TAG RECOVERY

2.1. The recoveries overall, by species and by place of discovery
There were 13,576 recoveries from the RTTP-IO into the database on 01/07/2007. The species composition is given in figure 10. Compared to tagging we have almost the same percentage of yellowfin but a greater percentage of skipjack and a lower percentage of bigeye. This gives us an overall recovery rate of 10.5%: 9.7% for yellowfin, 9% for bigeye and 11.7% for skipjack (Figure 11). These data are just an indication as we are still tagging fish and recoveries will still be registered in large numbers until mid-2008.

Figures 12, 13 and 14 give some indications on how the recoveries are distributed by place fo finding (where?), during which type of process (when?) and by which gear. 87% of the recoveries are found on the fishing vessel (either at sea or during unloading); 69% are found by stevedores (during transhipment or unloading), 21% are found directly at sea by the fishermen and 10% are found in the canneries. 98% of the recoveries are coming from the purse seiners.
In table 6, recoveries are given by country of origin. Of course Seychelles, as the main tuna fishing port for the purse seiner registered the bulk of the recoveries (69%). Furthermore almost all at-sea "country" are registered in Seychelles when the PS call in this port. This is why we have had to reinforce strongly the Tag Recovery Team in Seychlles (6 person now).

2.2. The quality of the data

Figures 15, 16, 17, 18 and 19 are giving some information on the quality of the recovery data:

- With good lengths (86% of all recoveries)
- With good weights (59% of all recoveries)
- With both good length and weight (57% of all recoveries)
- With a known date of finding: for purse seiners this date together with the well number will permit later to associate to the tag a date(s) and position(s) of recovery (96% of all recoveries);
- With known date of catch: they correspond to recoveries made at sea by the fishermen (20% of all recoveries).

In regard with the quality of the recovery data it should be noted that the proportion of recoveries found at sea by the fishermen has increased a lot (Figure 20) as it reaches 42% of all recoveries made in May and June 2007. At the beginning the awareness of the fishermen was very low and the one of the stevedores not so acute therefore they let pass on average 20% of the recoveries which were later discovered in the canneries. This situation prevailed until May 2006. After that the share of the canneries goes down to 5% on average. From the beginning the share of the stevedores varied with an average around 60% until June 2006. After that their share increased to around 75% until February 2007. But then their share decreased while the share of the fishermen increased. Now, there is a fierce competition between the fishermen on board purse seiners and the stevedores in port for finding the tagged tuna. This situation is for the benefit of the RTTP. It is recalled that recoveries made at sea are very often associated to better data (a known date and position at recovery) while recoveries made by the stevedores are at the best associated to a well number that will give us a date(s) and position(s) of recovery.

2.3. Recoveries per month

The distribution of the recoveries per month is given in figure 21. Until January 2006 the number of recoveries per month was lower than 100. Then from February to December 2006, it varies between 248 and 867 with an increasing trend. From January to May 2007, this number varies from 1493 (the maximum) in January to 990 in May 2007 with a decreasing trend.
It should be noted that starting from December 1st 2006 until June 2007 almost no tuna was tagged and released in the purse seine tagging area: the vessels were in drydock in December and then they surveyed the Arabian Sea and the Maldives area. Therefore the decline of the number of recoveries from January to May 2007 could be attributed to the general decline of the recoveries with time. However this trend must be weighted with the PS catch: this is illustrated in figure 22. This rate of recovery increased from almost 0 to about 40 recoveries/1000 mt of tuna fished by the PS in April 2006. Then from April to December 2006 it remained more or less around this level of 40. There was a dramatic increase in January 2007 to a maximum of 168 followed by a decrease in February to 86 but it reached again high values in March (145) and in April. Recoveries from March/April can only correspond to fish tagged at least in November 2006 or earlier as no tagging was down after December 1st. This underlines the large time-at-liberty of these recoveries (see next §).

2.4. Time-at-liberty

For the moment only a fraction of our recoveries (2018 over 13575 recoveries or 15%) have a known date of catch which authorizes to calculate the time-at-liberty (TL). The corresponding TL for the three species are given on figures 23a, b & c. In these figures we have also omitted the recoveries registered by the RTTP vessels when fishing on the associated school. The general shape of the three graphs show very well recoveries were done mostly for tuna being at sea for 3 to 7 months for yellowfin, 5 to 10 months for bigeye and 4 to 9 months for skipjack. Tagging uses for stock assessment purpose must respect a strong hypothesis: the well mixing of the fish before they get caught. With most fish being recaptured after several months at sea, the mixing necessity is very well enforced by this sub-sample.
The same task has been carried out for recoveries whose date of catch is not yet know. The date of return has been used instead = the date the recoveries become known to us. As purse seine

trip have at the most a 45 day duration trip, the date of return is about on average 30 days (one month) late on the date of catch. Therefore the graphs presented on figures 24a, b & c have to be shifted by one class (30 days) to the left. The general shapes are similar to those of figures 23.
These results are quite unusual for large scale tuna tagging and are giving more strength to the data and the future results from their use.

This large time-at-liberty for most recoveries is also illustrated in figures 25a, b, c & d. Recoveries have been separated according to different area/periods of tagging: Mozambique Channel-may-July 2005 (Fig. 25a); Tanzania-August-October 2005 (Fig. 25b); Seychelles-November 2005-March 2006 (Fig. 25c) and Tanzania-April-November 2006 (Fig. 25d). It is clearly evident that most recoveries are registered many months after the tagging took place. This explains why the recovery rate for each group of fish tagged each month is quite stable and is already around 10% for the groups of tuna tagged during the first months of the project (Figure 26). Tag seeding results well demonstrates that the awareness of the stevedores was at beginning of the project quite low and gradually increased. This lower awareness should have resulted in lower recovery rates for fish tagged at the beginning of the project. However this lower awareness hardly affected the recoveries as most of the recoveries were registered several after tagging when the awareness was much higher.

It must be noted that the recovery rate increased a lot for fish tagged in December 2006 and January2007. At that time the purse seine fleet was mostly fishing between Seychelles and Tanzania sometimes not too far from where we give up our associated school on December 1st 2006.

But as already said all these data are preliminary: tagging is still on and only one year after tagging we could have a better general view of the situation.

2.5. Recoveries per length at tagging

Figures 27a, b & c give the recovery rate for each FL class at tagging.
For yellowfin (fig. 27a), the recovery rates are in the order of 10% even for small fish. The rate drops suddenly at 74 cm and picks up again for yellowfin between 89 and 96 cm. Almost no recoveries are registered for yellowfin larger than 104 cm which is expected as almost all these fish have been recently tagged in Oman.

For bigeye (fig. 27b) we notice also the good recovery rates for the small fish, the increasing trend between 38 and 54 cm and a sudden drop of the rate between 54 cm (15.9%) and 55 cm (6.4%). After that drop the rates follow a decreasing trend up to 85 cm: none of the bigeye larger than 85 cm has been registered so far.

For skipjack (fig. 27c) there is an increasing trend from 38 to 49 cm and a decreasing trend after until 72 cm; no skipjack larger than 72 cm has been registered so far.

2.6. Geographical distribution of the recoveries

The geographical distribution of the recoveries is given in figure 28. Naturally this distribution is very similar to the distribution of the purse seine catch as 98% of our recoveries have been made with this gear.
In figures 29a, b & c a straight line has been drawn between the tagging and the recovery positions. Of course the data represented in these figures are only those recovered at sea for which we have already a position at recovery (about 2100 recoveries out of the 13,500 in the database).

The “Tuna hub” is well illustrated with recoveries from fish tagged off Tanzania in every possible direction. Skipjack tagged off Amirantes, Seychelles also show a spreading of the fish in all directions.

We can mention some outstanding recoveries:

- A yellowfin tagged in Tanzania in October 2005 and recaptured in September 2006 on the North coast of Oman;
- Another yellowfin tagged off Tanzania in November 2006 and recaptured off the costs of Iran in April 2007;
- Three skipjack recaptured in Maldives were tagged in Madagascar (2) and West of Seychelles.
- A bigeye recaptured by a Korean LL at 39°S-42°E but data are doubtful.
- The recapture in Sri Lanka have the position of the landing port.
- A bigeye tagged off Tanzania in October 2006 has been recaptured by a French purse seiner in the Eastern Indian Ocean (91°E).
- There are also a few fish tagged by the Japanese R.V. Nippon Maru in purse seine sets in the Eastern Indian Ocean recovered in the Western Indian Ocean by European purse seiners.

2.7. Recoveries by type of tag

In table 7 the number of recoveries and the recovery rates are given for each type of tagging:

- ST = Single yellow dart tag
- DT = Double yellow dart tag
- OT = Single white dart tag for fish with OTC injection
- OTS = Single white dart tag for fish with OT injection and a sonic tag implanted in its belly
- ET = Single red dart tag for fish with OTC injection and an archival tag implanted in its belly.

As double tagging and OTC tagging started respectively only in January and in June 2006, for a fairer comparison it is better to compare the recovery rate between those tags for the same periods of time (Table 8).

For the comparison ST/DT the result remains the same recovery rates are similar between the two types of tags. The setting of two tags does not seem to have a negative effect (higher mortality) on the fish survival.

For OTC/ST, the difference between the two recovery rates remains even if it is a bit less than in Table 7. Further studies are necessary to find out if the size of the sample can explain this difference. There are two other factors that can be involved: a higher mortality for OTC tagged tuna and a lower reporting rate for the OTC tagged fish. For the latter, it must be noted that the white tag has a smaller diameter than the yellow one, this aspect together with the white colour might makes these fish less visible by the stevedores. This is supported by the fact that only 73.8% of the white tags are spotted on the fishing vessels by the stevedores against 93.2% for the yellow tags and 23.6% are found on reefers or at the cannery while only 6.5% of the yellow tags are spotted in the two locations. If the lower reporting rate of white tags is the dominant factor trials should be made to find out which is prevalent the colour or the smaller diameter of the tag?

For OTS and ET tags the small size of the sample can explain this low recovery rate. For ET, it must be noted that 65 (or 51%) of the ET tagged fish have just been released recently in Oman.

The 2 ET yellowfin recovered have lost their archival tag most probably because the only stitch set get loose. Now all archival tags are better secure with two stitches.

2.8. Shedding of the tags

For the assessment of this important source of bias in the actual number of recoveries (the shedding of the tag), double tagging is implanted on 20% of the released tuna. This is done regardless of the species but by all taggers. This experiment was started on January 16th 2006. The number of double tags released as well as the recoveries including the recoveries with only one tag are given in table 9. Overall 7% of the double-tagged tuna recovered had lost one tag and 61% of the lost tags were the first set tag while 39% were the second tag and this aspect

was the same for all the three species. The percentage of one-tag lost is different with species: 9.2% for yellowfin, 4.1% for bigeye and 6.1% for skipjack.
The rates registered so far are similar to those of other double tagging experiment but somewhat lower which is most certainly to put to the credit of the taggers.
The actual shedding rates for the different species will be assessed later when most recoveries will have been registered.

2.9. Growth studies

Based on the recoveries made at sea with a known date of recovery and good length at tagging and recovery a file has been prepared for the use of the interested scientists of the WPTT. This file is made of 797 yellowfin, 358 bigeye and 863 skipjack; this represent already a fair amount of data only the size ranges will benefit from recoveries of tuna of large sizes. These data are already generating quite a lot of controversy for yellowfin and bigeye as the growth it shows is not in accordance with the growth equations actually use by the IOTC.

OTC Readings

So far, 175 pairs of otoliths have been collected for 217 OTC recoveries or 81% including 77 YFT, 38 BET and 59 SKJ. 42 otoliths have already been prepared and counted (35 YFT, 4 SKJ & 3 BET) and 28 others are in preparation by the IRD/IFREMER LASAA laboratory in France. For the yellowfin with known date of catch there are daily rings. For bigeye, we cannot say anything yet as only one with known date of catch but only 8 days at liberty. For skipjack no daily ring which was expected. Reading with electronic microscope will be conducted before the end of this year.

3. CONCLUSIONS

At the end of the RTTP-IO tagging operations in September, at least 150,000 tuna will have been released or nearly double the minimal target assigned to the project (80,000). But on a scientific point of view greater the number of fish tagged and the corresponding recoveries better the assessment of the stocks will be.

Mid-April 2006, the implementation of the associated school fishing technique has played an essential role in the out coming of the project:

(1) A steady and large number of fish tagged each day;
(2) The tagging of a majority of yellowfin and bigeye;
(3) A wide size range of fish tagged.

We have been able to use with great benefit to our tagging objectives this type of fishing only because:

(1) There is a high turnover of the three species of tuna into the school
(2) This school was located in an overall poor tuna abundance area not attractive to the purse seine fleet;
(3) The rapid dispersion of the fish away from the school and
(4) The important mixing of the tagged tuna among the rest of the population visible through the long time-at-liberty of most recoveries.

The first presentation of some of the characteristics of the 13,500 recoveries already registered shows:

(1) An overall recovery rate of 10.5% (9.7% for YFT, 9% for BET and 11.7% for SKJ);
(2) The utmost importance of the purse seine fleet in recovering the tagged tuna;
(3) Most recoveries are collected with a lot of appropriate data;
(4) The large majority of the recoveries have time-at-liberty between 3 and 9 months which is atypical for large-scale tagging operations as most of the recoveries occur in the three

first months after tagging; this situation underlies the very good mixing of the tagged tuna among the rest of the populations;

(5) The geographical distribution of the recoveries is giving the usual picture with a large majority of average distances between tagging and recovery (several hundreds miles up to 1,900 miles) and a few long range recoveries (10 between 2,000 and 3,000 miles and 8 between 3,000 and 4,000 miles) by the three species.

(6) OTC and ET tagged fish display a lower recovery rate than single tagged tuna; maybe a mortality effect or a small sample size effects.

(7) The percentage of tag that shed among the double tagged fish is on average 7%

The amount as well as the quality of these different data are very promising and most of them will be made available to the IOTC WPTT next year meeting for the benefit of the scientific community of the IOTC.

For the time being, the RTTP-IO will finish its tagging operations at the beginning of September and will continue to collect the many recoveries yet to come.

Table 1: Number of tagged tuna released by the RTTP-IO per species, per month and per year

Year	Month	YFT	BET	SKJ	UNK	TOTAL
2005	May	419	13	2033	0	2465
	June	155	64	1985	4	2208
	July	126	0	143	0	269
	August	1130	387	364	48	1929
	September	158	10	27	0	195
	October	2738	854	2364	1	5957
	November	202	0	1768	0	1970
	December	530	45	6180	0	6755
2005	**Total (Number)**	**5458**	**1373**	**14864**	**53**	**21748**
	Total (%)	***25.1***	***6.3***	***68.3***	***0.2***	
2006	January	2119	1	6740	0	8860
	February	615	3	2386	0	3004
	March	791	0	2298	0	3089
	April	4973	2941	2513	79	10506
	May	5636	2470	3750	65	11921
	June	2838	2254	1198	26	6316
	July	3033	3317	3939	67	10356
	August	3043	3160	5751	45	11999
	September	6073	2179	3198	11	11461
	October	3997	1219	5052	30	10298
	November	3288	1354	4742	103	9487
	December	81	144	27	5	257
2006	**Total (Number)**	**36487**	**19042**	**41594**	**431**	**97554**
	Total (%)	***37.4***	***19.5***	***42.6***	***0.4***	
2007	January	92	0	208	0	300
	February	653	0	0	0	653
	March	1403	0	0	0	1403
	April	1113	0	1706	0	2819
	May	268	2	83	10	363
	June	1409	2867	3236	59	7571
	July (up to 07/07)	246	1434	1015	2	2697
2007	**Total (Number)**	**5184**	**4303**	**6248**	**71**	**15806**
	Total (%)	***32.8***	***27.2***	***39.5***	***0.4***	
2005/07	**Overall total (Number)**	**47129**	**24718**	**62706**	**555**	**135108**
	Overall total (%)	***34.9***	***18.3***	***46.4***	***0.4***	

Table 2: Number of tag for all different types of tag used by the RTTP (up to June 24th 2007)

Type of tag	**YFT**	**BET**	**SKJ**	**UNK**	**Total**
Single yellow dart tag	34949	15124	50809	361	101243
Double yellow dart tag	9786	5863	8754	31	24434
OTC white dart tag	1546	972	1327	13	3858
OTC + Archival red dart tag	106	22	0	0	128
OTC white dart tag + Sonic tag	12	14	0	14	40
Unknown type of tag	0	0	0	91	0
Total	46399	21995	60890	510	129703

Table 3: Number of tuna tagged by area and by species (up to 07/07/2007)

Area	YFT	BET	SKJ	UNK	TOTAL	*%*
Tanzania/Kenya	37199	20291	31846	480	100419	***74.3***
Seychelles	4136	46	18713	0	22895	***16.9***
Mozambique Channel	560	78	4345	4	4987	***3.7***
International Waters	270	0	3496	0	3766	***2.8***
Oman	3041	0	0	0	3041	***2.3***
Total	**45206**	**20415**	**58400**	**484**	**135108**	

Table 4: Comparison in number of fish tagged, species composition and rate of tag per fishing day between fishiing (1) without or with an associated school; (2) with an associated school but with or without bait.

TYPE OF FISHING TECHNIQUE		YTF	BET	SKJ	TOTAL	N° of tag per fishing day
Fishing without an associated school (may 2005 to March 2006)	Number	15577	6715	34855	57147	**219**
	%	***27.3***	***11.8***	***61.0***		
Fishing with an associated school (April to November 2006)	Number	31633	19011	28213	78857	**345**
	%	***40.1***	***24.1***	***35.8***		
Fishing with an associated school and with bait (April to July 2006)	Number	15561	9121	8115	32797	**337**
	%	***47.4***	***27.8***	***24.7***		
Fishing with an associated school but with no bait (August to November 2006)	Number	16072	9890	20098	46060	**352**
	%	***34.9***	***21.5***	***43.6***		

Table 5: Statistics on the data related to the recoveries

Recovery Data quality	**YFT**	**BET**	**SKJ**	**No data**	**TOTAL**
FL Good	3952	1782	5897	1945	11631
Wt Good	2568	1256	4263	5489	8087
FL & Wt good	2443	1217	4049	5867	7709
With date found	4259	1907	6846	564	13012
With date of return	4279	1923	6883	491	13085
With date of catch	1072	494	1110	10900	2676
With position	1003	462	1016	11095	2481
Where Found					
Fishing boat	4067	1823	5901	1	11792
Cannery	331	129	1021		1481
Reefer	66	28	137		231
Cold store	9	4	27		40
Fish market		10		1	11
other	2		1	1	4
Unknown	5	1	11		17
					13576
Process when found					
Transfer	1849	670	2479		4998
Unloading	1173	663	2423		4259
Fishing	1132	527	1128	1	2788
Sorting	213	89	698		1000
Ranking	26	10	90		126
Butcher	43	10	45		98
Other	36	11	112		159
Unknown	18	5	124	1	148
					13576
Fishing Gear					
Purse seine	4222	1923	6986	1	13132
Pole-and-line	144	45	46		235
Gilnet	57	1	9		67
Handline	27	14	19		60
Troll line	15		27		42
Longline	8	2	3		13
other			1		1
Unknown	14		8	4	26
					13576

Table 6: Recoveries by country of origin

Country	Number	%
Seychelles	9354	69.13
At sea	2569	18.98
Mauritius	636	4.70
Madagascar	520	3.84
Kenya	208	1.54
Comoros	72	0.53
Tanzania	67	0.50
Thailand	65	0.48
Others (11 different countries)	41	0.30
	13532	

Table 7: Number of recoveries and recovery rates per type of tag

	Number of Tag released					Number of recoveries				*Recovery rate*			
	YFT	BET	SKJ	UNK	Total	YFT	BET	SKJ	Total	*YFT*	*BET*	*SKJ*	*All sp.*
ST	34949	15124	50809	381	101263	3343	1436	6143	10922	*9.6*	*9.5*	*12.1*	*10.8*
DT	9786	5863	8754	31	24434	1048	507	881	2436	*10.7*	*8.6*	*10.1*	*10.0*
OT	1560	984	1341	13	3898	98	40	76	214	*6.3*	*4.1*	*5.7*	*5.5*
OTS	14	12	14		40	0	0	0	0	*0.0*	*0.0*	*0.0*	*0.0*
ET	106	22			128	2	1		3	*1.9*	*4.5*		*2.3*
Total	**46415**	**22005**	**60918**	**425**	**129763**	**4491**	**1984**	**7100**	**13575**	*9.7*	*9.0*		*10.5*

Table 8: Number of recoveries and recovery rates for OT and ST tags and for ST and DT tags for similar periods of time.

	Tagging					Recoveries (up to 30/06/07)					**Recovery rates**			
	YFT	BET	SKJ	UNK	TOT	YFT	BET	SKJ	UNK	TOT	**YFT**	**BET**	**SKJ**	**TOT**
Non-OTC tags from 24/04/06 to 01/12/06	28535	16336	26719	351	71941	3202	1606	3078	1	7887	**11.2**	**9.8**	**11.5**	**11.0**
OTC tags from 24/04/06 to 01/12/06	1174	948	1200	12	3334	98	40	76		214	**8.3**	**4.2**	**6.3**	**6.4**
ST tags from 16/01/06 to 01/12/06	26331	12645	28835	382	68193	2920	1301	3587		7808	**11.1**	**10.3**	**12.4**	**11.4**
DT tags from 16/01/06 to 01/12/06	8803	5427	7787		22017	1042	508	882		2432	**11.8**	**9.4**	**11.3**	**11.0**

Table 9: Number of DT tags, recoveries with two tags and with only one tag and the potencial shedding rates by species

TAGGING					Recoveries with two tags				Recoveries with only one tag				% recoveries with only one tag			
YFT	BET	SKJ	UNK	TOTAL	YFT	BET	SKJ	TOTAL	YFT	BET	SKJ	TOTAL	YFT	BET	SKJ	TOTAL
9786	5863	8754	31	24434	946	488	831	2265	96	21	54	171	***9.2***	***4.1***	***6.1***	***7.0***

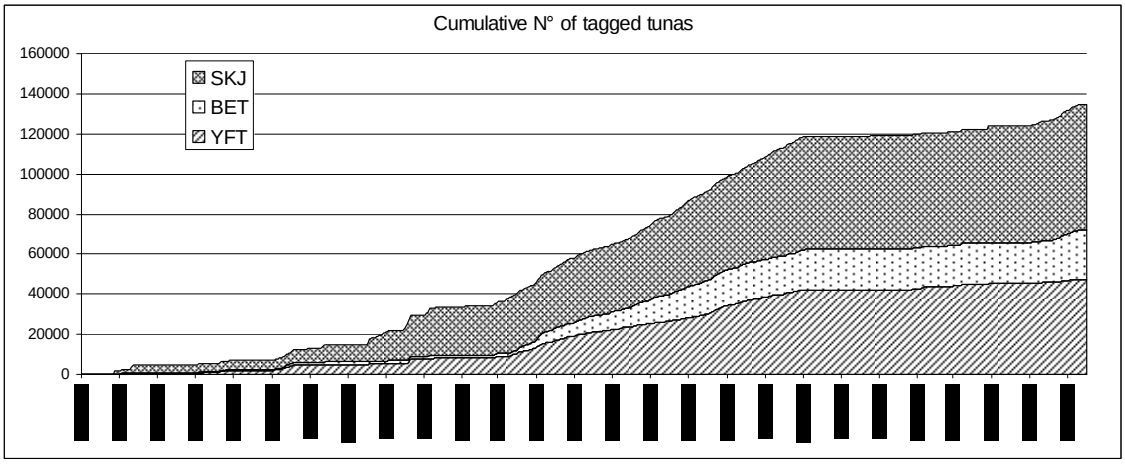

Figure 1: Cumulative number of tagged tuna released from May 2005 to July 2007

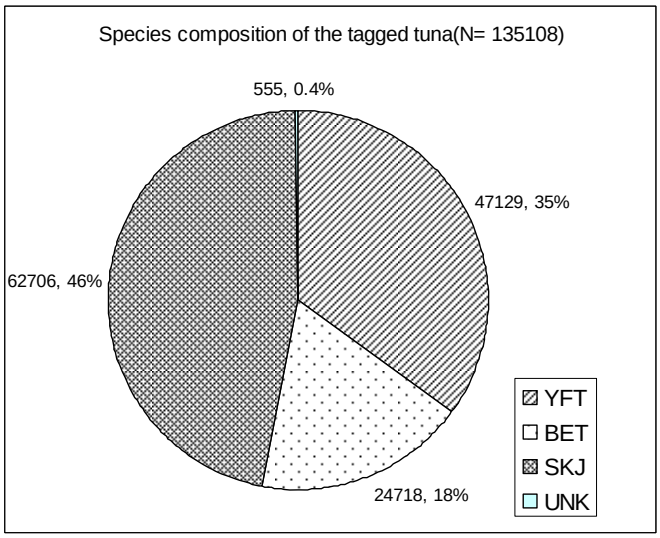

Figure 2: Species composition of the tagged tuna released by the RTTP-IO up to 07/07/2007

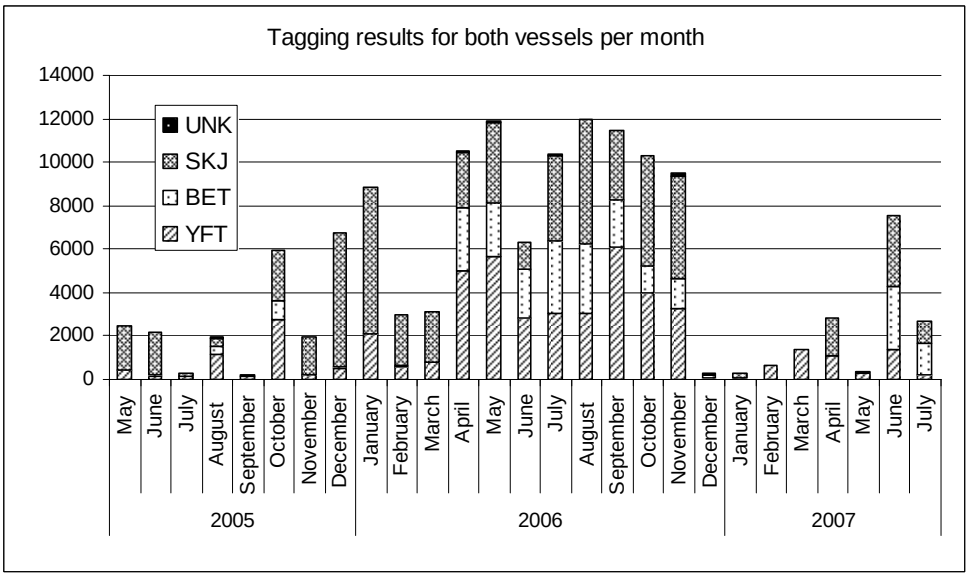

Figure 3: Monthly tag release per species (May 2005 – July 2007; for July 2007 up to 7th)

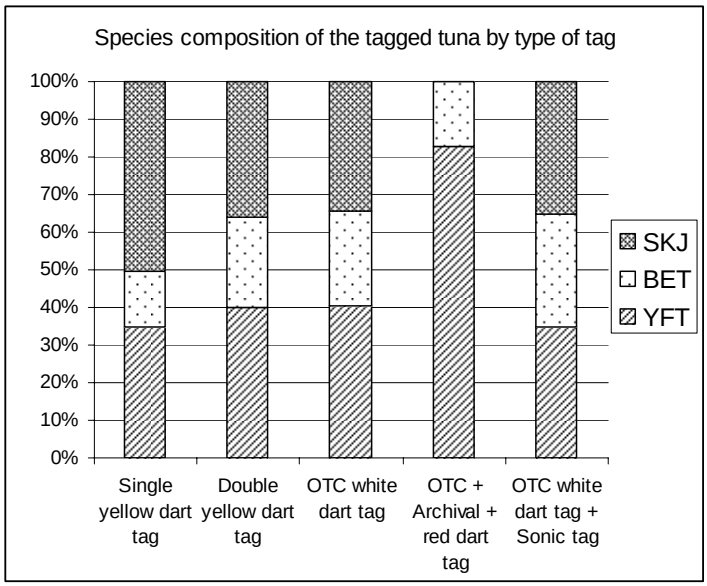

Figure 4: Species composition of the tagged tunas per type of tag (up to 24/06/2006)

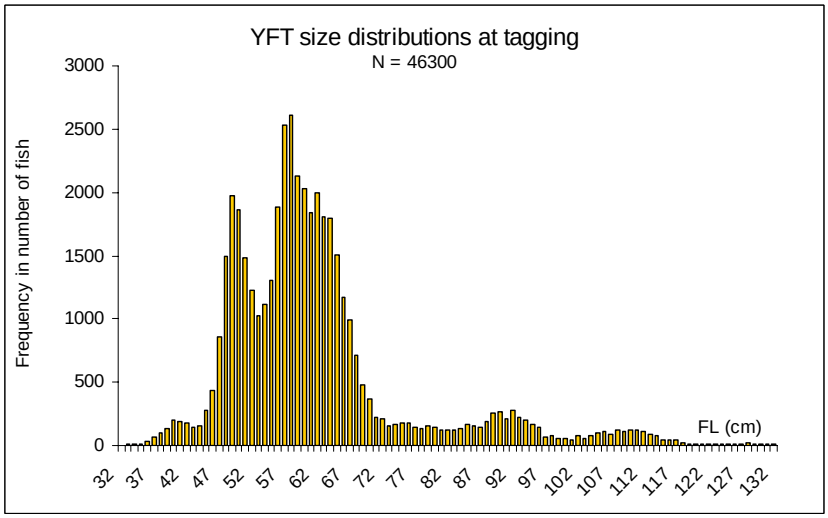

Figure 5a: Distribution of the lengths (FL in cm) of the tagged yellowfin

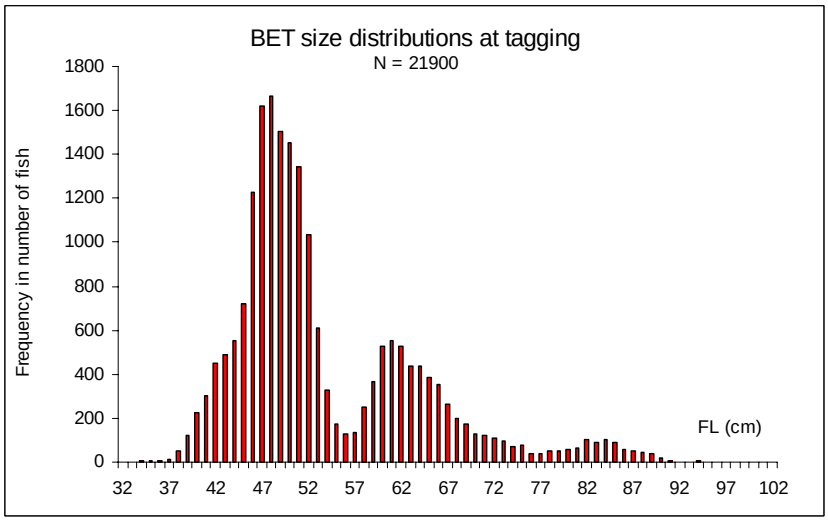

Figure 5b: Distribution of the lengths (FL in cm) of the tagged bigeye

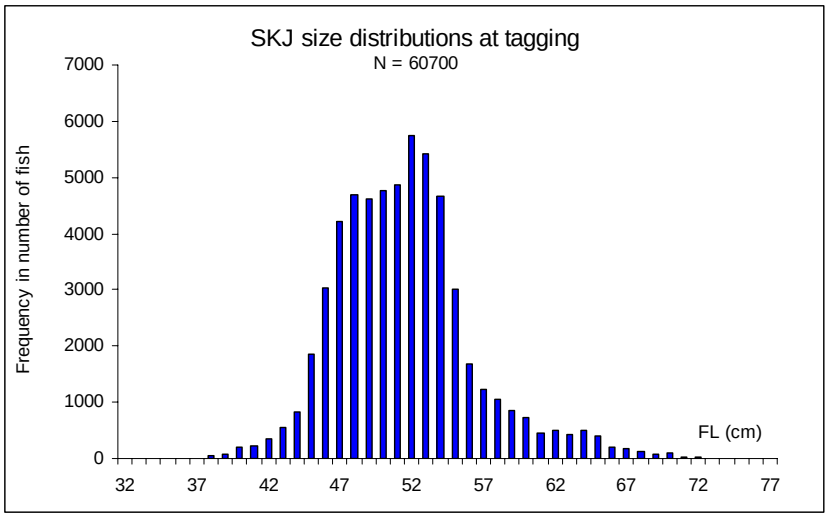

Figure 5c: Distribution of the lengths (FL in cm) of the tagged skipjack

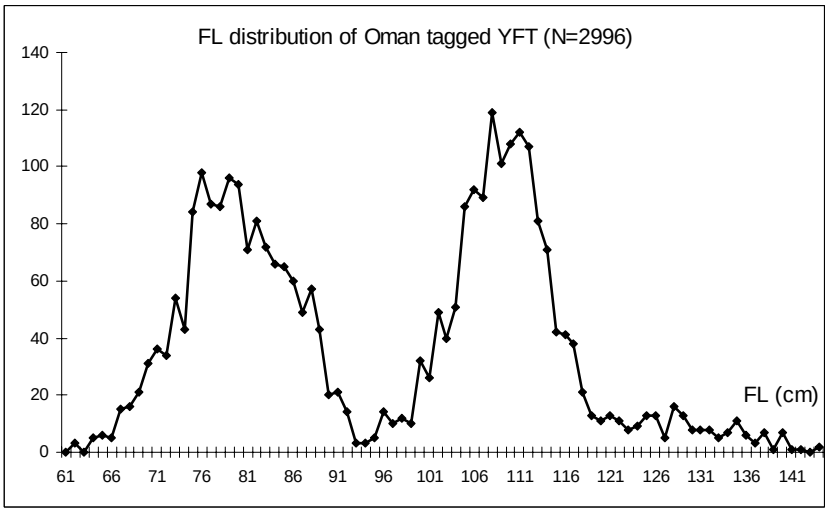

Figure 6: Size distribution of the YFT tagged in Oman (12/02 to 05/04/2007)

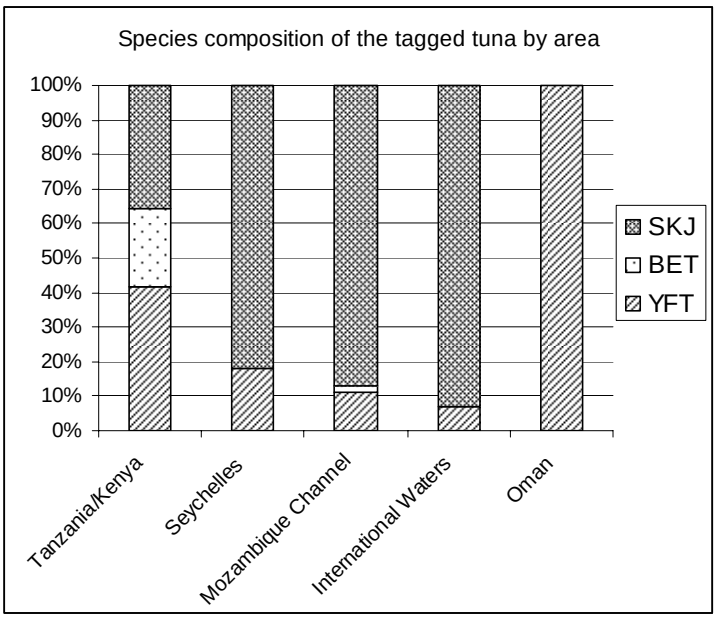

Figure 7: Species composition of the tagged tuna in each of the main areas.

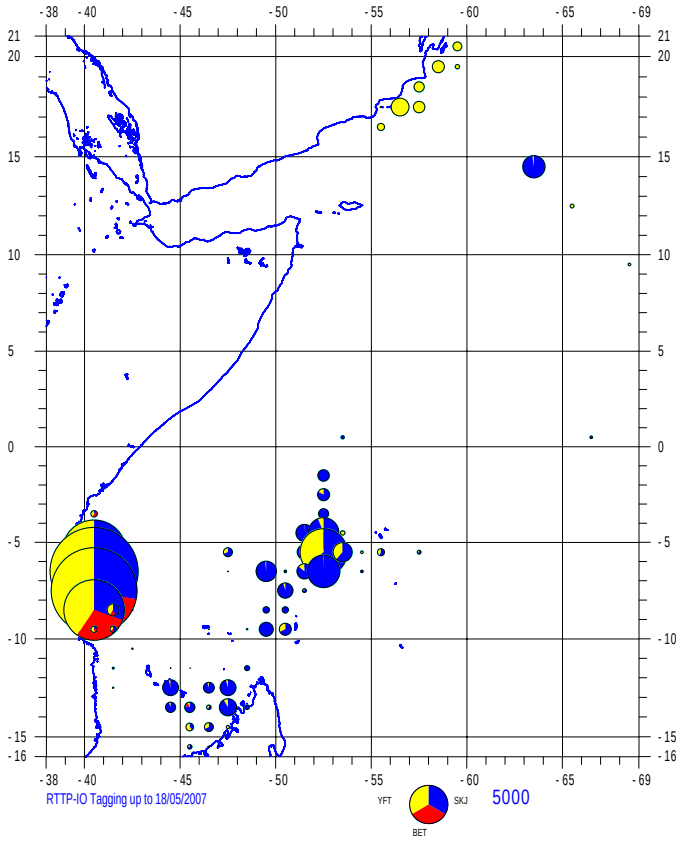

Figure 7: Localisation of the tagged fish up to 18/05/2007

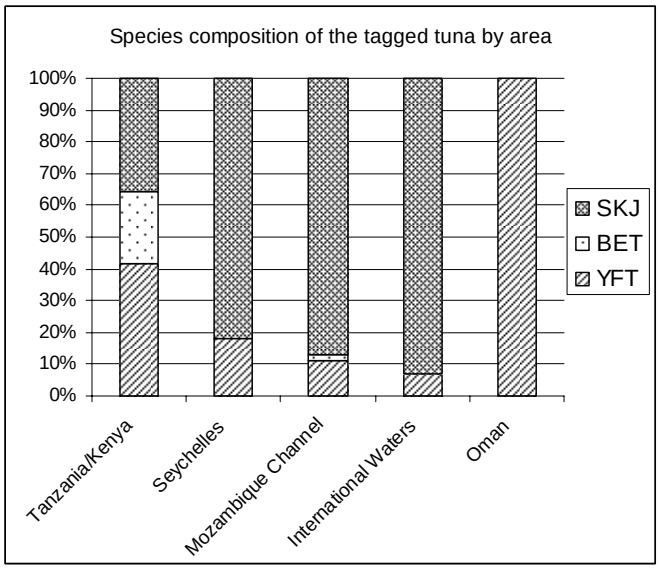

Figure 8: Species composition of the tagged tuna by area of release (up to 07/07/2007)

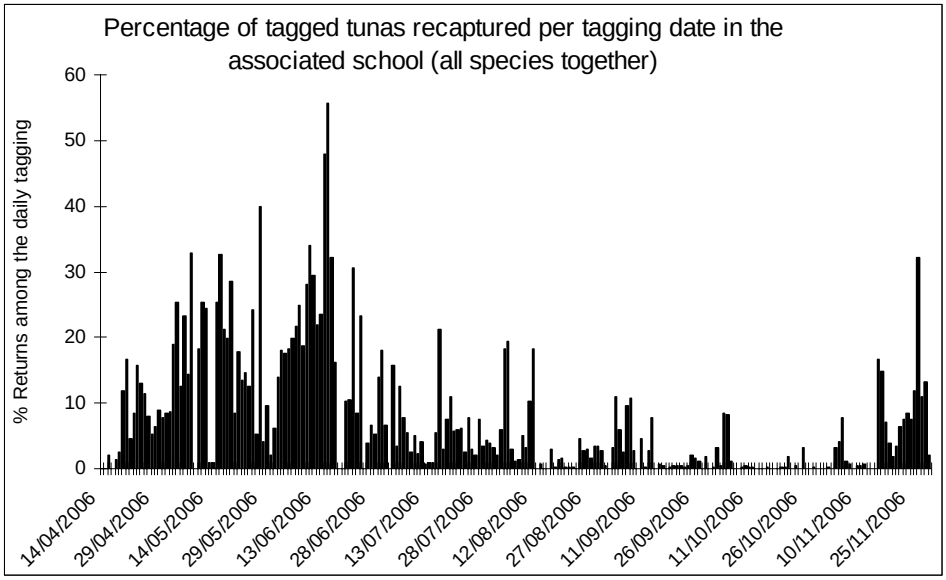

Figure 9: Percentage of tagged fish recaptured by tagging day on the associated school

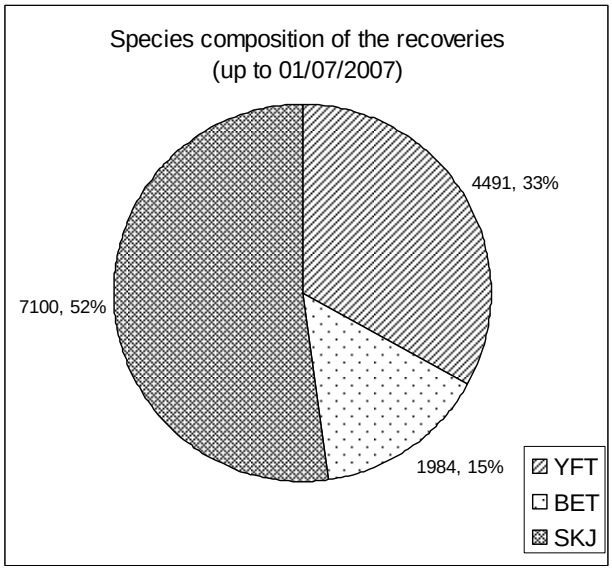

Figure 10: Species composition of the recoveries (up to 24/06/2007)

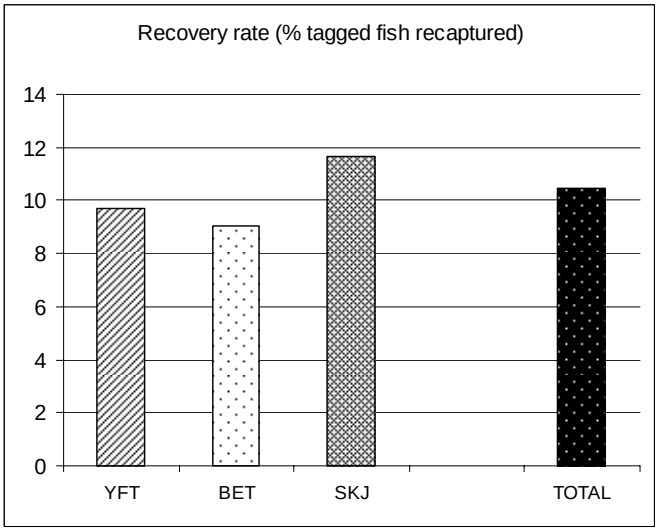

Figure 11: recovery rates per species and overall (up to 01/07/2007)

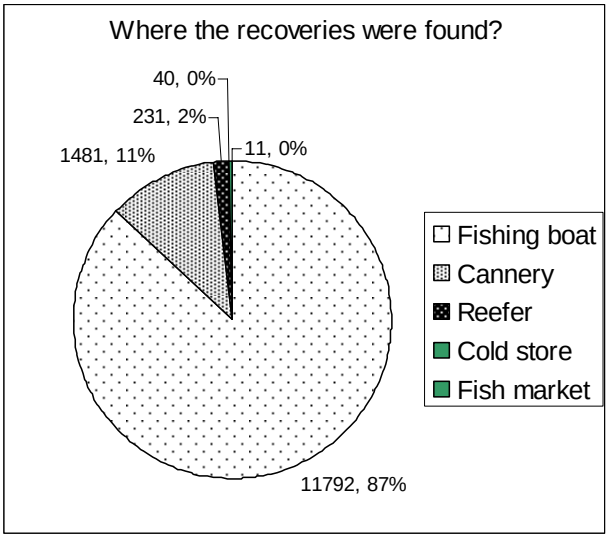

Figure 12: Where recoveries are found?

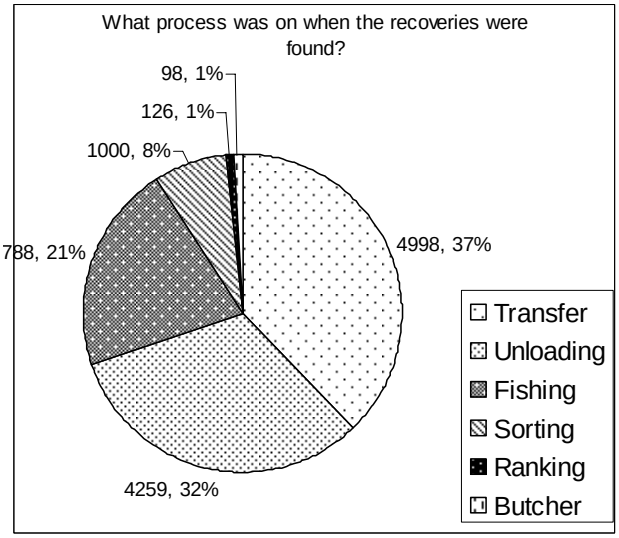

Figure 13: When recoveries are found?

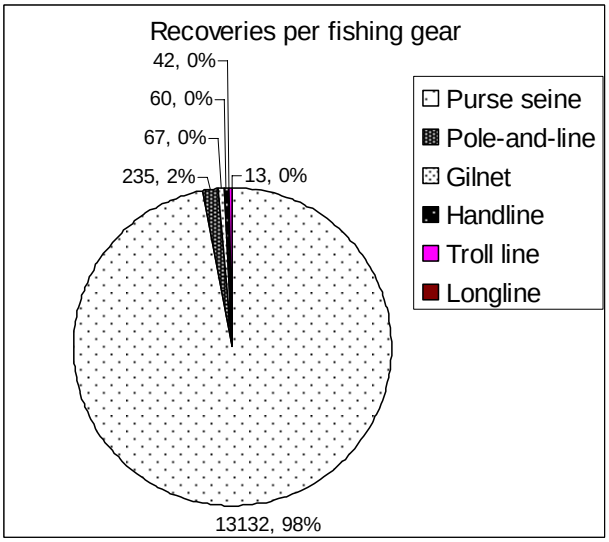

Figure 14: Which gear are catching recoveries?

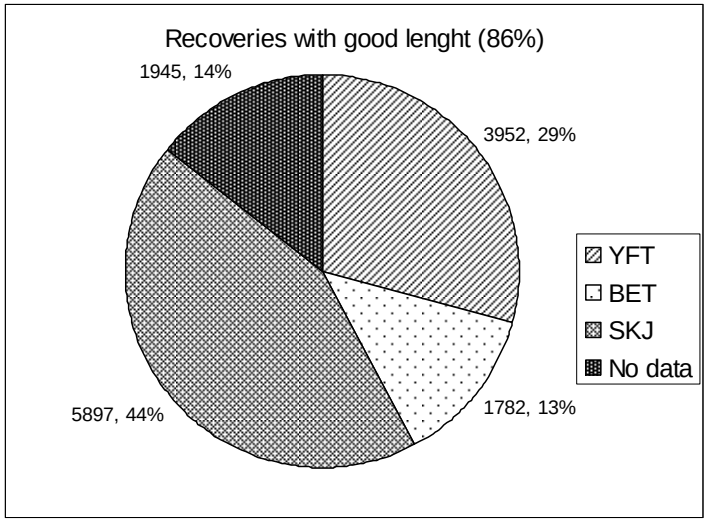

Figure 15: Species composition of the recoveries with “good length”

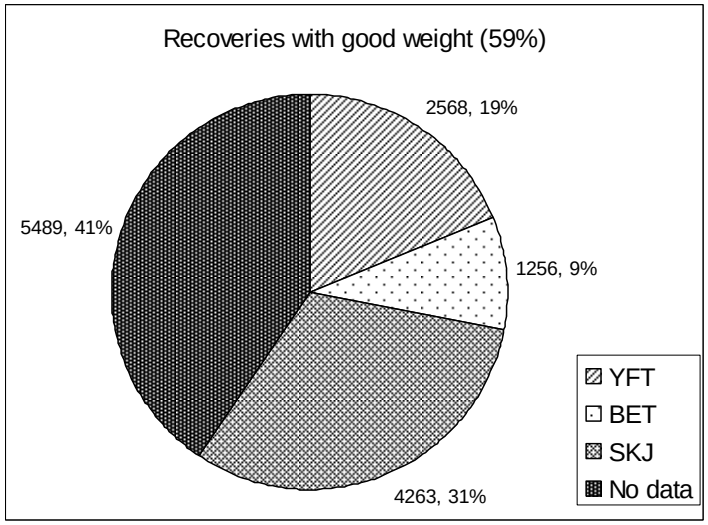

Figure 16: Species composition of the recoveries with “good weight”

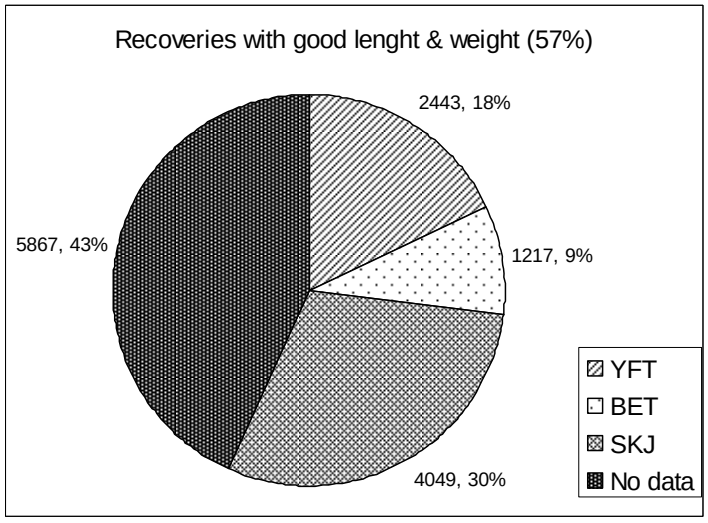

Figure 17: Species composition of the recoveries with “good length & weight”

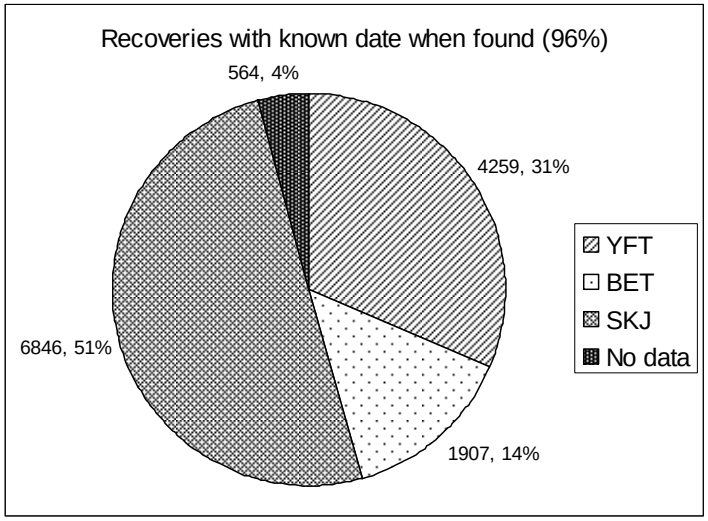

Figure 18: Species composition of the recoveries with a known date of finding

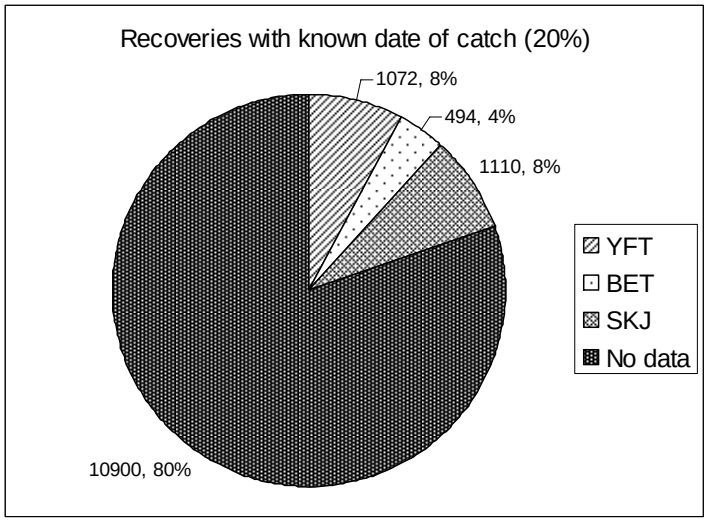

Figure 19: Species composition of the recoveries with a known date of catch

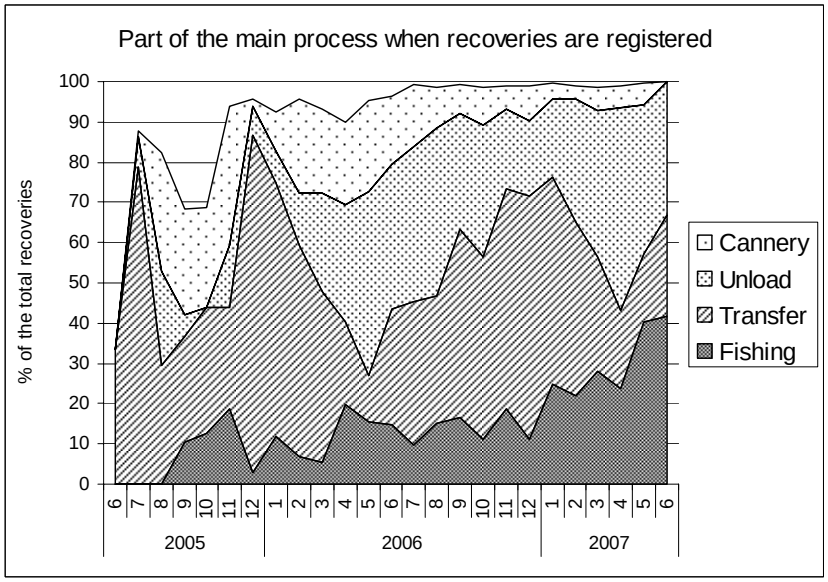

Figure 20: Monthly distribution (in % of all recoveries) of the main process involved when the recovery was found.

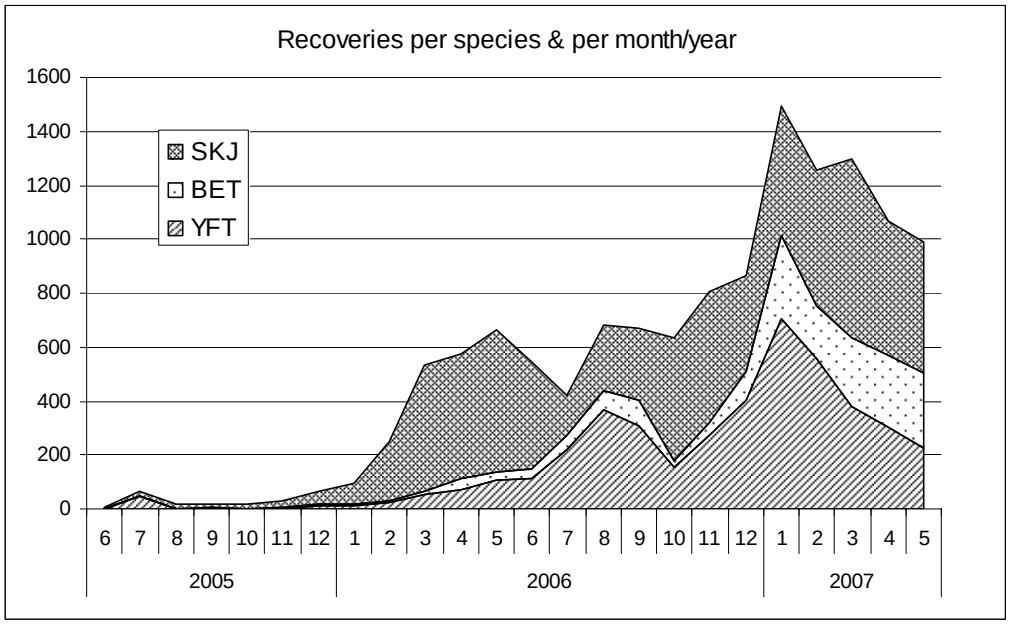

Figure 21: Number of recoveries registered by month (June 2006 – Mai 2007)

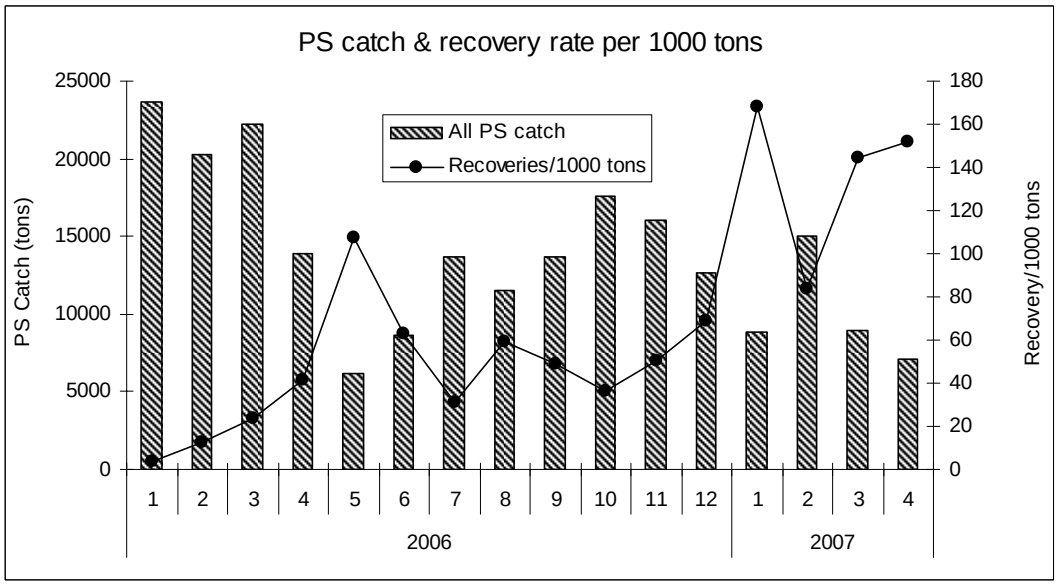

Figure 22: Monthly Purse seine catch (provided by SFA) and rate of recoveries per month per 1000 mt of tuna (January 2006 to April 2007)

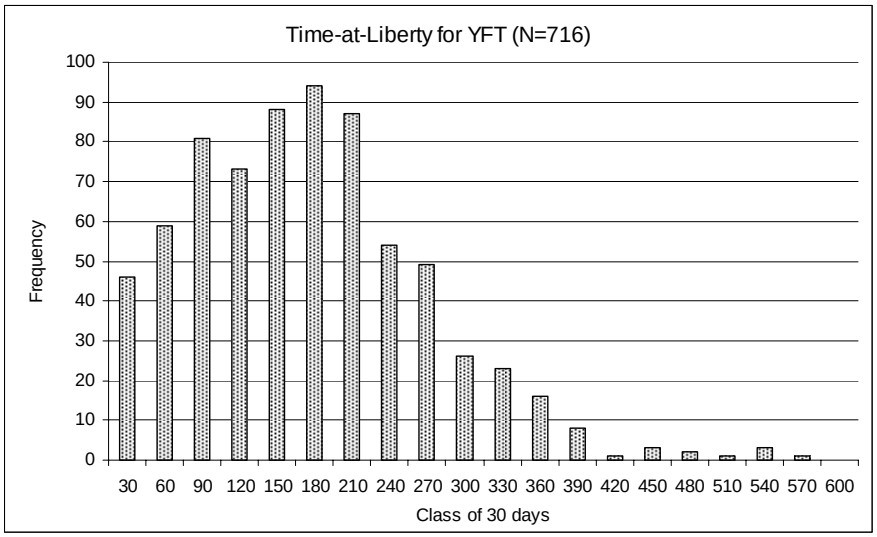

Figure 23a: Time-at-liberty for yellowfin with known date of catch

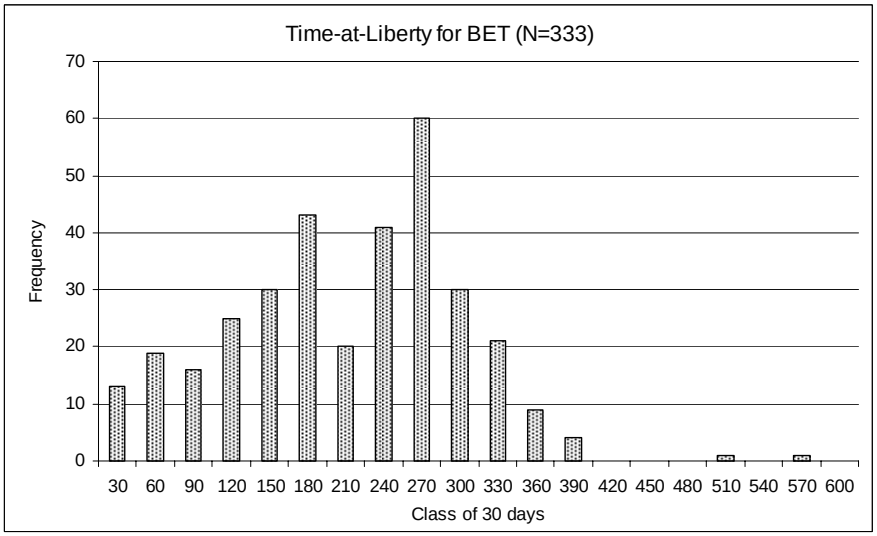

Figure 23b: Time-at-liberty for bigeye with known date of catch

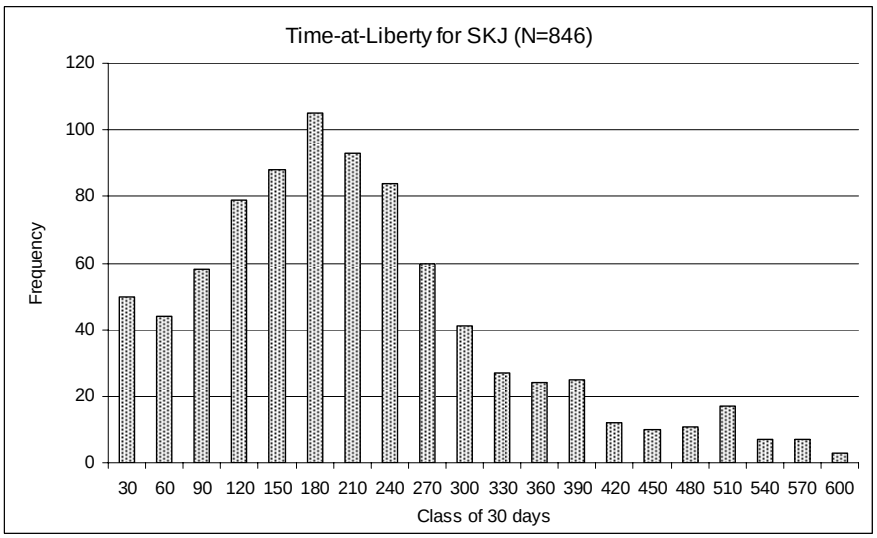

Figure 23c: Time-at-liberty for skipjack with known date of catch

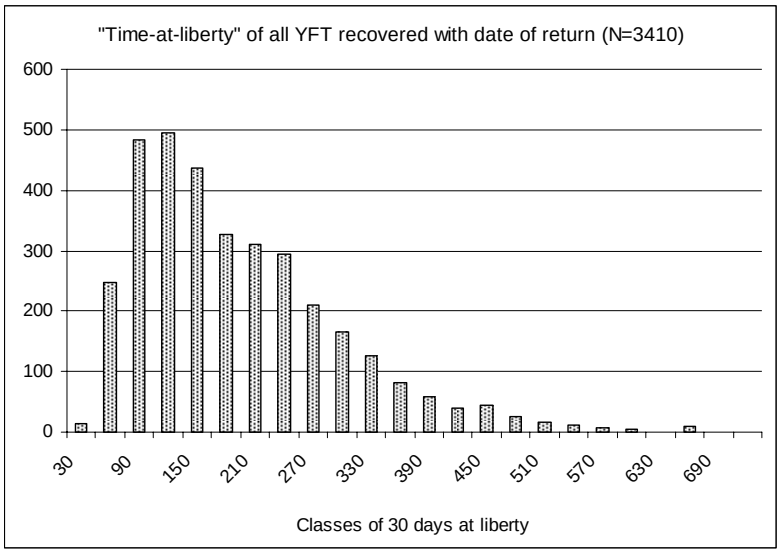

Figure 24a: Time-at-liberty for yellowfin with known date of return

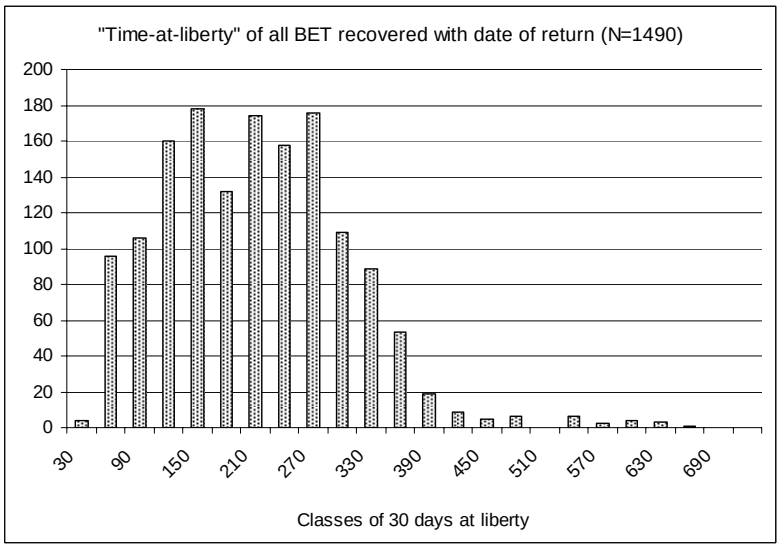

Figure 24b: Time-at-liberty for bigeye with known date of return

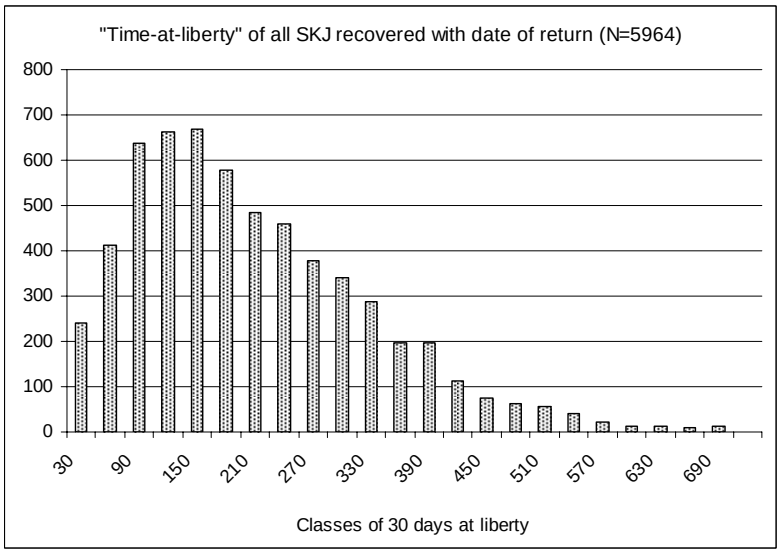

Figure 24c: Time-at-liberty for skipjack with known date of return

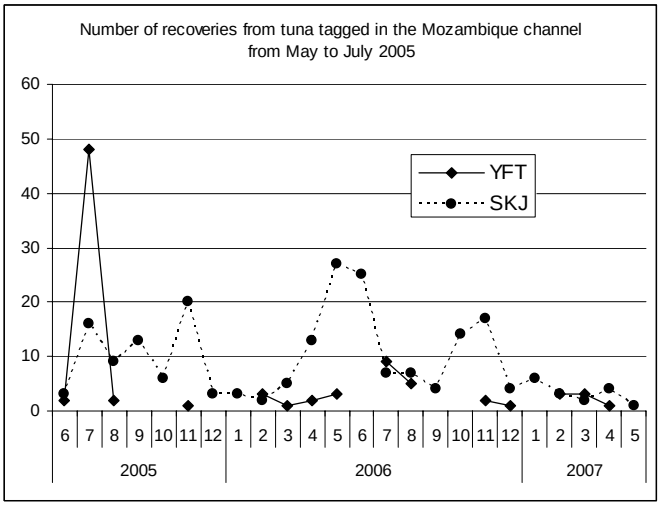

Figure 25a: Number of recoveries per month of return of tuna tagged in the Mozambique Channel from May to July 2005

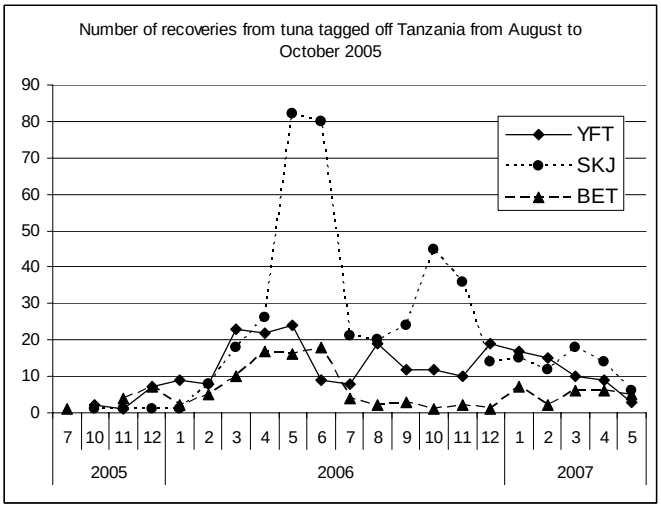

Figure 25b: Number of recoveries per month of return of tuna tagged off Tanzania from August to October 2005

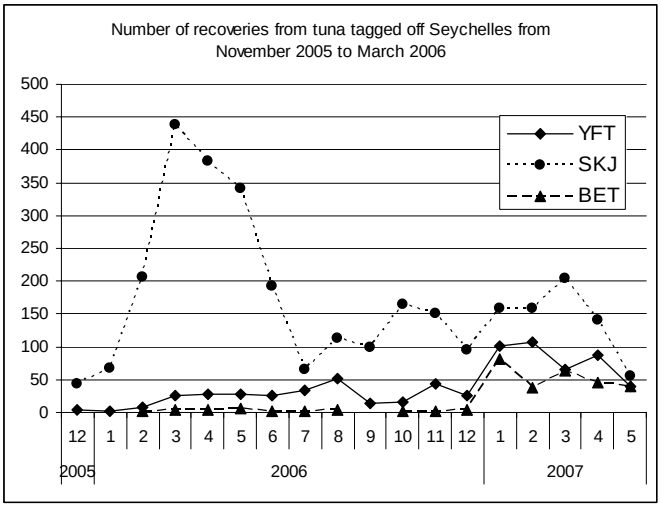

Figure 25c: Number of recoveries per month of return of tuna tagged off Seychelles from November 2006 to March 2006

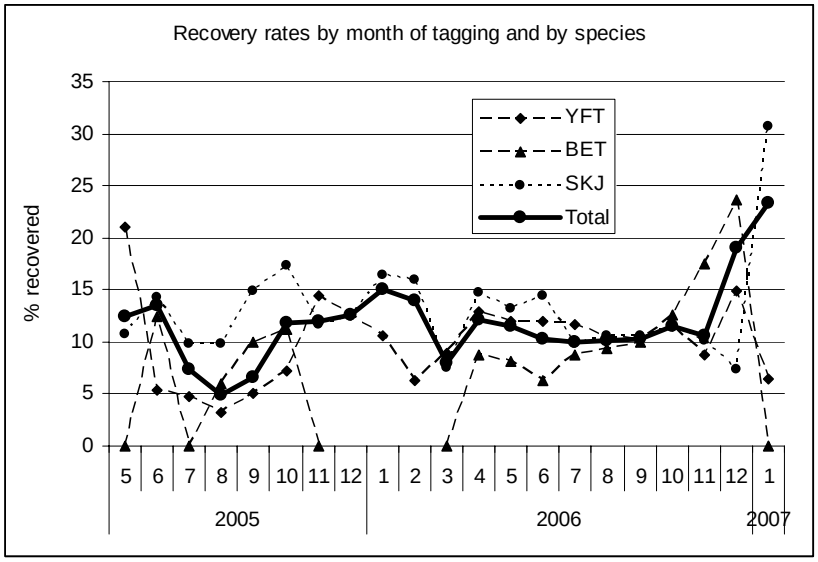

Figure 26: Recovery rate of tuna tagged per month and per species.

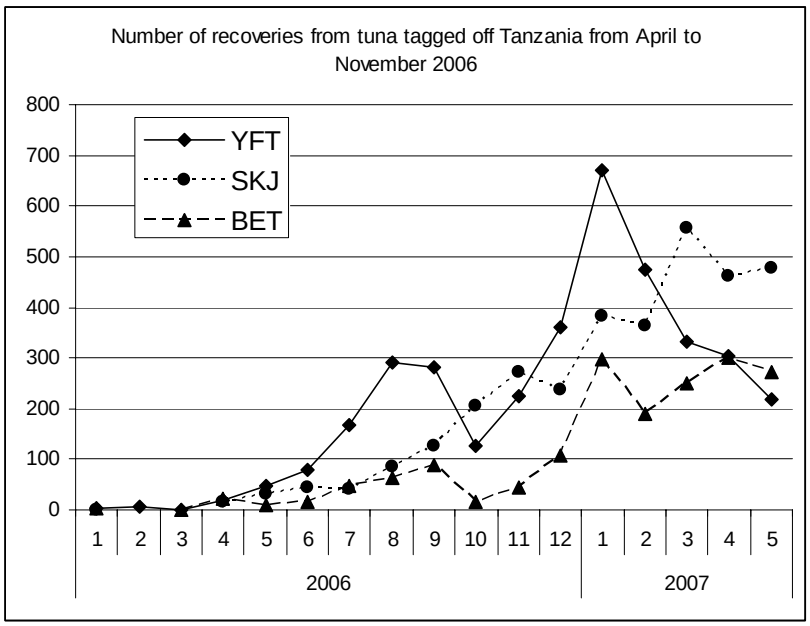

Figure 25d: Number of recoveries per month of return of tuna tagged off Tanzania from April to November 2006

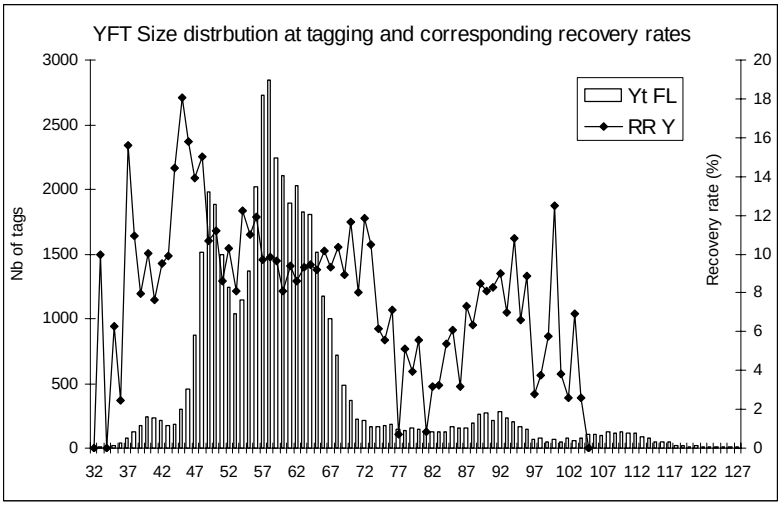

Figure 27a: Yellowfin size distribution at tagging and corresponding recovery rate for each FL class

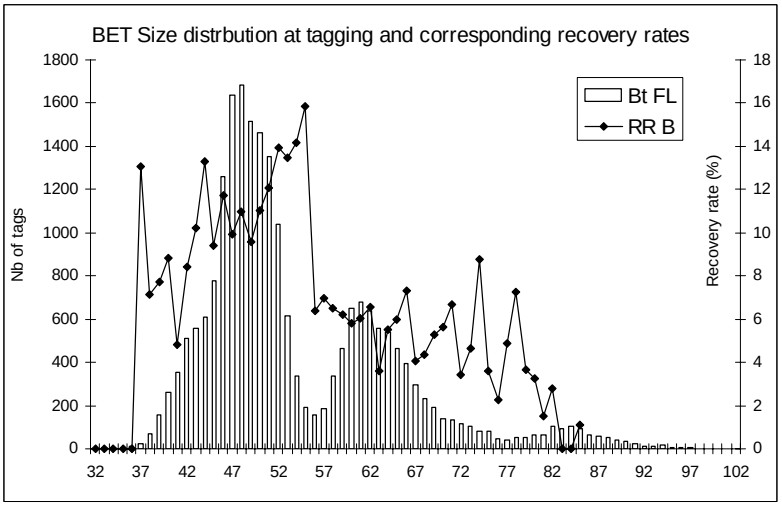

Figure 27b: Bigeye size distribution at tagging and corresponding recovery rate for each FL class

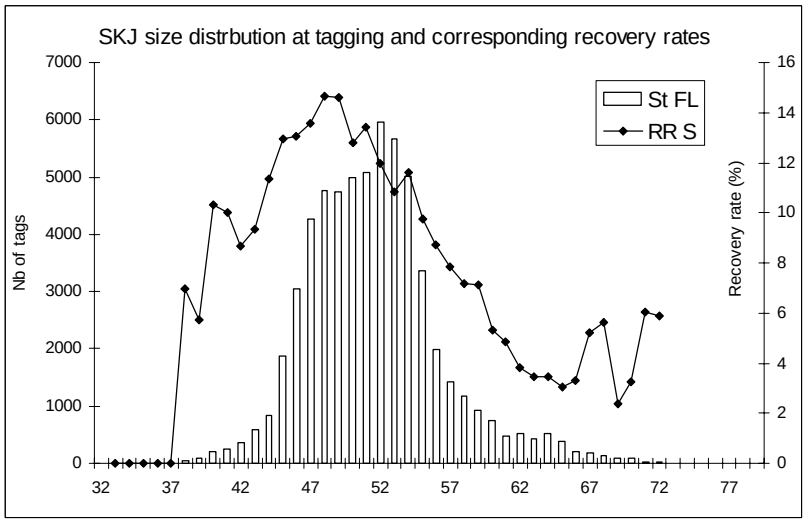

Figure 27c: Skipjack size distribution at tagging and corresponding recovery rate for each FL class

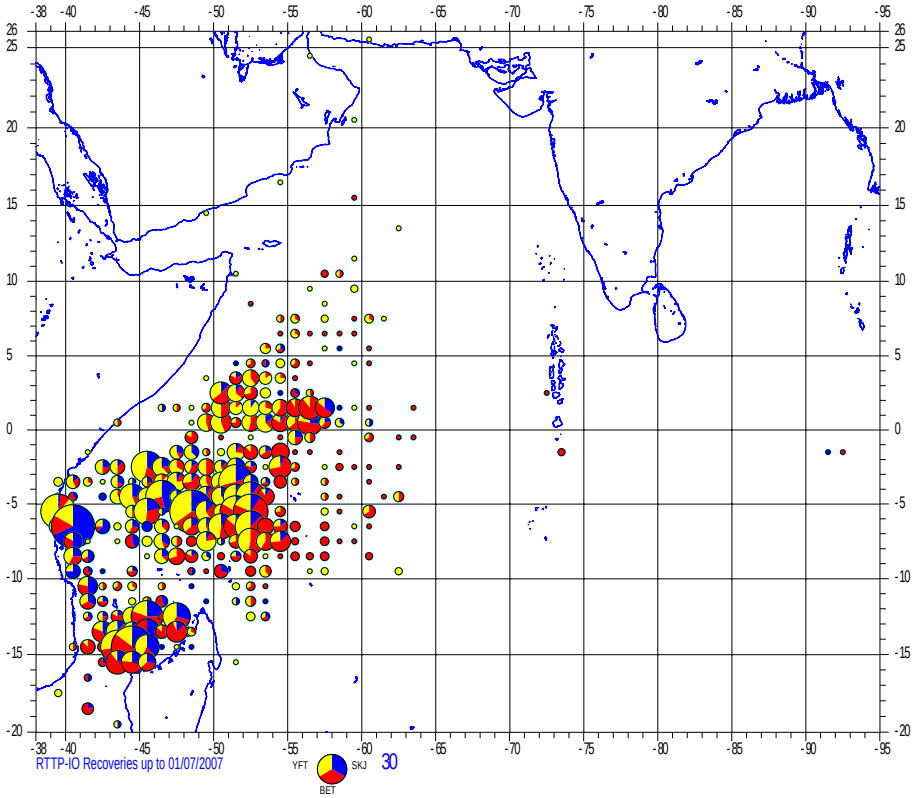

Figure 28: Geographical distribution of the RTTP-IO recoveries (up to 01/07/2007)

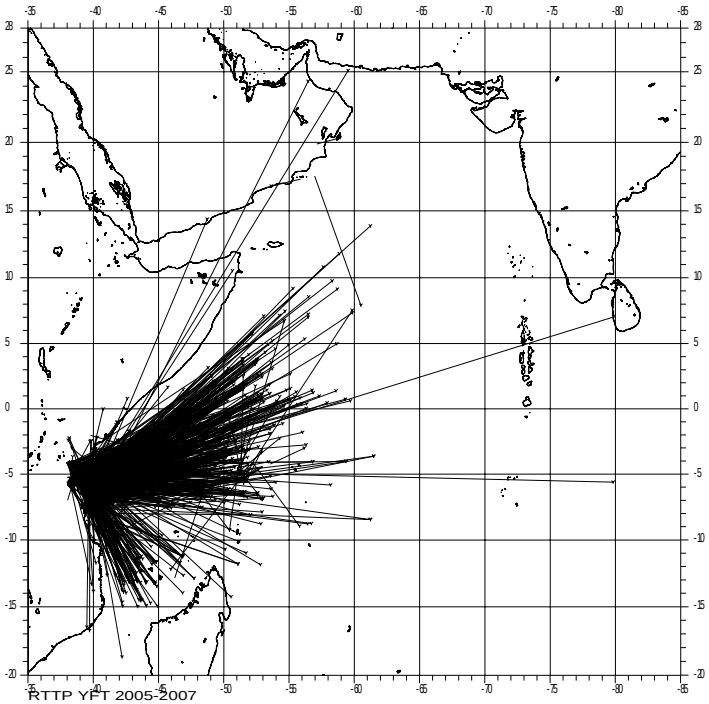

Figure 29a: Theoretical line between tagging and recovery positions for Yellowfin (up to 01/01/2007)

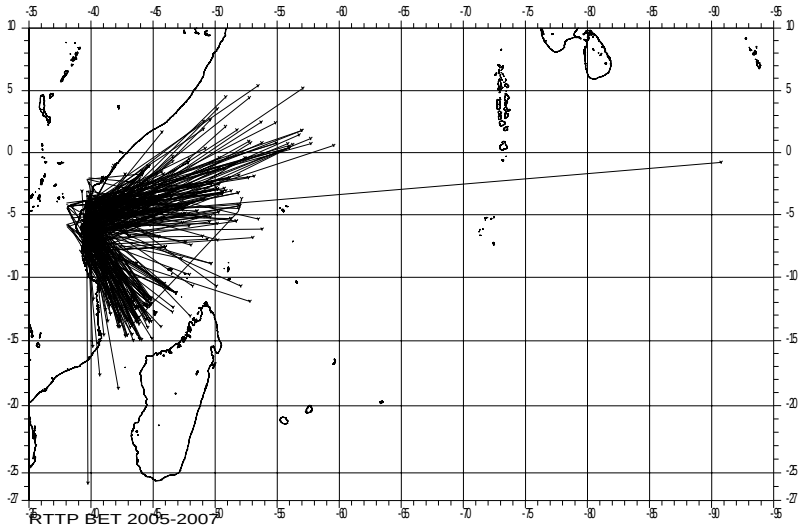

Figure 29b: Theoretical line between tagging and recovery positions for Bigeye (up to 01/01/2007)

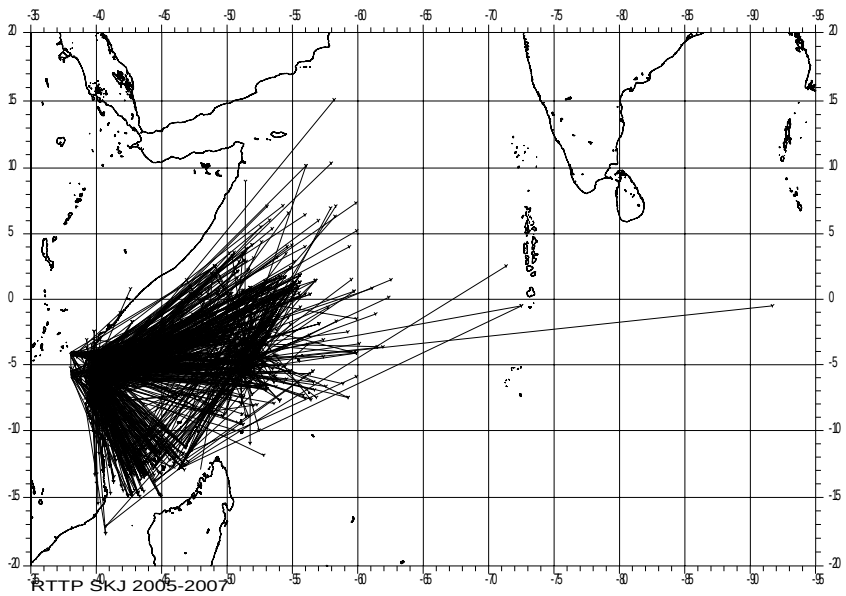

Figure 29c: Theoretical line between tagging and recovery positions for Skipjack (up to 01/01/2007)