

AN UP-DATE ON THE IMPLEMENTATION OF THE REGIONAL TUNA TAGGING PROJECT IN THE INDIAN OCEAN

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Abstract

The Regional Tuna Tagging Project in the Indian Ocean started its tagging operation in May 2005 and will pursue them until September 2007. After 15 months, 72,176 tuna have been tagged and released in the South-West Indian Ocean (Seychelles, Mozambique Channel, Tanzania & Kenya) including 24,855 yellowfin (34%), 11,242 bigeye (16%) and 35,798 skipjack (50%). In these conditions, the minimal target of 80,000 tagged tunas assigned to the project will be exceeded. The species composition as well as the size ranges of the tagged tunas are fairly good and permit to expect some significant results in the improvement of the stock assessment of the three tuna species. A publicity and tag recovery scheme is in place and insures a steady and increasing return of the tagged tuna caught by the fisheries. Of about 2,600 recoveries already registered almost all are presently coming from the purse seine fishery. The majority of the recoveries concerns tuna with a time-at-liberty greater than one month and up to one year now. This demonstrates a good dispersion and mixing of the tagged tuna among the rest of the population: a basic necessity for tagging for stock assessment purpose. The overall recovery rate is now 4% but it will need later to be adjusted by the tag shedding and tag reporting rates. The assessment of these two rates is taking care via the double-tagging of 20% of the tagged fish and a tag seeding operation on board purse seiners. So far essentially the South-Western Indian Ocean has been well surveyed; in the future other regions of the Western Indian Ocean will be covered.

Résumé

Le Programme Régional de Marquage de Thons dans l'Océan Indien a démarré ses opérations de marquage en mai 2005 et va les poursuivre jusqu'en septembre 2007. Après 15 mois de marquage, 72.176 thons ont été marqués et relâchés dans le sud-ouest de l'Océan Indien (Seychelles, Canal du Mozambique, Tanzania et Kenya) dont 24.855 albacore (34%), 11.242 patudo (16%) et 35.798 listao. Dans ces conditions, l'objectif du programme de marquer un minimum de 80.000 thons va être dépassé. La composition spécifique et la gamme des tailles marquées sont particulièrement intéressantes et laissent espérer des résultats significatifs dans l'amélioration de l'évaluation des stocks des trois espèces de thon. Une campagne de publicité et d'aide au retour des marques est fonctionnelle et assure maintenant un retour régulier et croissant des thons marqués recapturés par les pêcheries. Des 2.600 retours de marque déjà enregistrés, la quasi-totalité provient de la flotte des senneurs. La majeure partie des retours présente des durées de liberté supérieures à 1 mois et allant jusqu'à un an pour l'instant. Cela démontre une bonne dispersion et un bon mélange des thons marqués parmi le reste de la population : une nécessité fondamentale des marquages ayant pour but l'évaluation des stocks. Le taux global de retour atteint maintenant 4% mais il devra être ensuite corrigé par les taux de perte de marques et de report. L'évaluation de ces deux taux est assuré au travers du double marquage d'environ 20% des thons marqués et par une opération de salage à bord des senneurs. Jusqu'à présent, essentiellement la zone sud-ouest de l'océan Indien a été prospectée ; à l'avenir les autres régions de l'océan occidental seront couvertes.

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This is a brief description of the present achievements of the Regional Tuna Tagging Project-Indian Ocean (RTTP-IO) up to July 22th 2006. These data need to be used with a lot of caution especially the recovery data as we have started tagging in May 2005 and at the end of 2005, only 21750 tuna have been released. Therefore, 70% of the tagged tunas have been released during the last 7 months. In these conditions, it will be very premature to draw any firm conclusions.

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. With a chartering period of 30 months, we still have 13 months of operations before the end of the tagging in September 2007.

The monthly tagging results are given in table 1. After a difficult start (from May to September 2005), a more or less expected result as the tagging started with the beginning of the SE monsoon, the situation has improved constantly (Figure 1).

Table 1: Monthly tagging by the RTTP-IO

Month	Yellowfin	Bigeye	Skipjack	Unknown	Total
May 2005	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
January 2006	2119	1	6740	0	8860
February	615	3	2386	0	3004
March	791	0	2298	0	3089
April	4973	2941	2513	79	10506
May	5637	2467	3750	65	11919
June	2838	2254	1198	26	6316
July*	2424	2203	2049	58	6734
Total	24855	11242	35798	281	72176

* Up to 22/07/2006

The minimal target of the project is 80,000 tagged tunas, this should be reached soon and we can even expect to tag more tunas before the completion of the tagging.

1.2. *The different tagging*

Most of tuna are tagged with one yellow dart tag; some receive two yellow tags in order to assess the tag shedding rate but white and orange dart tags are also used in smaller amounts.

Double-tagging

The RTTP double tagging target is 20%. So far 19.2% of all tagged tunas have been double tagged but the figure is variable according to species:

- 5,708 YFT or 23%
- 3,628 BET or 32.3%
- 4,485 SKJ or 12.5%.

The percentage of double-tagged fish according to species is in fact directly related to the facility to perform this technique: BET is very quiet therefore very easy to double-tagged while SKJ is the worst often being caught in a frenzy battling.

Chemical 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. The first 630 tunas (296 YFT & 334 BET) have been released in April and May 2006. We waited until we get a few recoveries of OTC tagged tunas to make sure the procedure, the product used and the volume injected were working fine. We recently had this confirmation. Therefore OTC tagging just resumes and the three species are tagged. The objective is to tagged a few thousands tunas with OTC.

Archival tagging

The TAGFAD project (DG-Fish funded project) has donated 130 archival tag to the RTTP. So far only 17 archival tags have been released off Mayotte and Tanzania (6 YFT and 11 BET). These tunas received also a orange dart tag. None has been recaptured yet.

1.3. The species composition

Yellowfin and bigeye are the primary species targeted by the project. However, in the ocean, skipjack is the most abundant species especially when using a surface fishing gear as the pole-and-line fishing technique. Consequently almost all similar large scale tuna tagging project end up with a large majority of skipjack in their catch even though the two other species were their primary objective. So far the RTTP is having a very good score with 50% of the tagged fish being Yellowfin and Bigeye (Figure 2). The RTTP of the Western Pacific Ocean (SPC 1989-1992) achieved 27% YFT (40,075) and 5.5% BET (8,074), the rest (67.1%) being SKJ. Already the RTTP has tagged more BET. This is particularly important as the main concern of the IOTC scientific committee is directed towards this species that is generally very difficult to tag in large numbers.

1.4. 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 for pole-and-line fishing especially for YFT (YFT bigger than 100 cm are difficult and dangerous to handle). The bulk of the YFT are between 50 and 69 cm but still 8% of smaller YFT and 13% of bigger YFT have been tagged including 2552 YFT between 80 and 110 cm. Three main modes are visible: 40, 58 and 90/92 cm.

BET offers three distinctive modes at 46, 61 and 82/84 cm. These three groups represent respectively 49, 43 and 8% of the bigeye tagged.

As it is generally the case for SKJ, there is no particular mode; the small fish (FL < 46 cm) are not well present (3%), this is most probably due to the fact that the two vessels have very rarely fished on FADs. The bulk of the tagged SKJ are between 46 and 60 cm (83%) while the larger SKJ (> 60 cm) account for 14%.

1.5. The area surveyed

The two vessels have surveyed the waters of Seychelles, Madagascar, Mayotte, Comoros, Tanzania, Oman and the international waters between these countries. The waters of Mozambique and Kenya have been moderately surveyed and only in the North for Mozambique and in the South for Kenya with very little success. In Seychelles, the survey concerns only the West of the EEZ and the South of Mahé Plateau. Baits from Madagascar have to be used to fish Seychelles waters and consequently favour this Western and Southern area of Seychelles waters.

In Oman, the waters from Salalah to the West (17°N – 54°E) to Fujairah to the North (25°N – 57°E) in the Persian Gulf have been surveyed but no yellowfin were caught. In fact the 2005/2006 yellowfin fishing season has been very bad and with a very late start in 2006.

Figure 4 shows the localisation of the tagged tunas and figure 5a & 5b gives the distribution of the tagging between the main areas surveyed respectively in 2005 and 2006.

From figure 5a it is clear that yellowfin and bigeye have been fished and tagged in large numbers only off Tanzania. Therefore at the beginning of April when the skipjack proportion within the tagged fish reached 73% it became obvious that more tagging off Tanzania could permit to tag more yellowfin and bigeye. The RTTP of the Western Pacific of the SPC faced the same situation and at the end they managed to tag 8000 bigeye by concentrating their effort in the Coral Sea as the only place where they can have access to bigeye sitting close to the surface. This year while fishing off Tanzania, the Aita Fraxku managed to associate to the vessel a mixed school of yellowfin, bigeye and skipjack. This is not surprising because the presence of bigeye near the surface and in mixed school with the two other species is a prerequisite to the school association fishing technique developed by pole-and-line vessels off Mauritania.

1.6. The associated school fishing technique

The development and the keeping of this school until today have changed a lot the achievements and the tagging perspectives of the RTTP-IO.

Until July 22nd, 32,174 tunas have been tagged in this school including 14,545 YFT (45.2%), 9,838 BET (30.6%) and 7,598 SKJ (23.6%).

Of course this technique generates a large number of returns. They are re-released because the RTTP vessels are not part of the normal fishing effort in the Indian Ocean and if kept on board they will not participate to the main objective of the project: tagging for stock assessment purpose. However all associated data are properly recorded: species, tag number(s), FL, tag(s) and fish state, as well as date and position. Some fish are recaptured several times and the record is 7 times for two yellowfin: for one during a 30 day period and the other during a 84 day period.

The returns are followed day-by-day in order to eventually adapt the tagging strategy in order to decrease the number of returns. The return rates by fortnight are given in figure 6 where all returns are considered even those related to multiple returns. The rates remained more or less the same during this 3 month period for BET and SKJ. For BET it is stabilized at around 6%, even decreasing a bit recently. For SKJ, it is stable at around 8%. For YFT it increased a lot during the first 3 fortnights and it is now stable since mid-June at 25%. It is obvious that this stability of the return rates is underlying a continuous turn-over of the tagged fish in the school. Tagged tunas are regularly leaving the school and newcomers are replacing them (the skippers have not noticed any particular variations in the size of the school). The higher return rate for YFT than for the two other species is to be compared to the tagging composition: more YFT are tagged than BET and SKJ. But the distribution of the returns in number of times the same fish are returned shows a similar trend between YFT and SKJ (Figure 7). While less BET undergone multiple recaptures - in fact no BET were recaptured more than 3 times - 0.2% of the returns for YFT and SKJ correspond to fish recaptured six times! The durations spent by some fish in the school are also different between species and of course higher is the proportion of long-time resident greater is the probability to register multiple recaptures. The figure 8a, b & c are confirming this point. The distributions of the time-at-liberty show a higher turnover for BET but not so different from YFT while no SKJ have been recaptured more than 48 days after tagging while it reaches 63 days for BET and 77 days for YFT. The general picture is:

- YFT is the most abundant species and the most tagged and they tend to remain within the school for a longer period. Consequently they have the highest return rate (25%), the highest number of multiple returns and the greater number of long-term recaptures.
- SKJ is the less abundant species in the school and the less tagged but they are more attracted to the vessel (or as they are more surface fish they are more vulnerable to the

poles) but they remain less time into the school. Consequently they have a reasonably low return rate (8%) but a quite high number of multiple returns but in a shorter time.

- BET is quite abundant in the school (but not as much as YFT) and remains quite some times but it is less attracted to the vessel or it is less vulnerable to the poles because it tends to stay deeper. Consequently he has a low return rate (6%), the lowest number of multiple returns even though some have long time-at-liberty.

This area of Tanzania could be compared to a hub with tunas coming in regularly before departing soon in other directions: a very convenient situation for our tagging purpose. Consequently, the associated school technique offers to the project the unique opportunity to tag a large numbers of YFT and BET of a wide size range and hopefully the high and constant fish turnover maintains the return rates at a stable level even if it differs between species. Not only most of the tagged fish are leaving the school but furthermore they are dispersed rapidly and quite far from the tagging area. This is confirmed by the returns reported by the purse seiners. Apart from the recaptures made directly by the two RTTP vessels, purse seiners are also catching tagged tunas from the associated school even though they are not fishing in the Tanzania area.

From the end of 2002 to the beginning of 2005, tuna catches, especially yellowfin, have been very high in Tanzania waters. But today, Tanzania is again the area what it used to be: a place with low abundance of tunas. Since the beginning of April 2005, our two vessels have seen very few purse seiners and when present, they never remain a long time because there are little tuna around. Their abundance is sufficient for the RTTP but too low for purse seiners preventing too many tagged tunas of being recaptured quickly. Up to now, 139 tagged tunas from the associated school have been reported by purse seiners (97 YFT (70%), 19 BET (14%) & 23 SKJ (16%)) and their distribution by date of return (the date the tag was returned to us) is given in figure 9.

We already have the position and the date of catch for 25 of them that were recorded on board the purse seiners. The lowest time-at-liberty is 16 days with a distance of 375 miles, the highest is 82 days and 920 miles and the closest recovery is 250 miles away. The direction of tuna movements is mainly East & North-East but one fish travelled South-East towards Comoros. The general picture is:

- Purse seiners are not fishing near the associated school;
- Most of the returns are registered more than a month after tagging (68% of the returns have a time-at-liberty of 45 days or greater).

The returns offer also the opportunity to follow the short term growth of the three species. Figures 10a, b & c are giving the short term growth of YFT, BET and SKJ respectively. These data confirm the general picture coming out from the overall returns:

- YFT and BET show a growth of about 3 cm/month;
- SKJ is hardly growing 1 cm per month.

2. TAG RECOVERY

2.1. The Tag Recovery Scheme

An elaborated system has been put into place in the region to ensure a smooth return of the recaptured tuna to the RTTP. This system is based on targeted publicity with the corresponding publicity materials (posters, banners, leaflets, radio & TV ads, lotteries, etc...) and by the setting of a network of National Focus Officers (NFO) and Recovery Officers (RFO) with the corresponding materials (posters, banners, training materials such as a small video film on what to do when a tuna with a tag is found, manuals, return forms, callipers, etc...).

This system is into place and yielding good returns in Seychelles, Mauritius, Madagascar, Comoros, Mayotte, Kenya and Oman. The system is getting developed in Thailand, Iran and

Yemen for the Indian Ocean region and in Spain, Portugal and Italy for Europe. Contacts have been taken for Turkey, Colombia, Malaysia and Indonesia. Of course we are also relying on the recovery scheme developed in the framework of the small-scale tagging operations of IOTC in Mayotte, Lakshadweep (India) and Maldives. We have also developed collaboration with the other Tuna Organizations dealing with tropical tunas such as CSIRO, SPC, IATTC and ICCAT.

2.2. The recoveries overall and by area of tagging

There are about 2600 returns in the database and now returns are coming every day and most purse seiners coming into Victoria have tags on board.

On 2613 recoveries (not including those coming from the RTTP vessels) 2603 are coming from the purse seine fleet or 99.6%. The remaining 0.4% is from troll line (4 from Comoros), pole-and-line (3 from Maldives), handline (2 from Kenya and Tanzania) and 1 from longline.

The tagged tunas are mainly found on the fishing vessels (mainly by the stevedores when they are unloading or trans-shipping the catch) and in the canneries (Figure 11). Most of the tagged tunas are found when unloading or transferring the catch (68%) then while sorting, ranking or at the butcher place (Figure 12).

The species composition of the recoveries is:

- 366 YFT or 14.0%
- 121 BET or 4.6%
- 2122 SKJ or 81.4%

The species composition at tagging is 34.4% YFT, 15.6% BET and 49.6% SKJ. But it is only recently (since mid-April) that a large part of the YFT and most of the BET have been released.

The distribution of the recoveries for each return month is given in figure 13a. Until January 2006 the number of returns per month was lower than 100. But at the end of January, 30,000 tuna have already been released. This lack of returns during the first 9 months of the project is directly related to the tagging strategy followed by the project: we avoid tagging within or even near the purse seine fleet. In order to fulfil the basis hypothesis of tagging for stock assessment – a necessary dispersion and mixing of the tagged fish within the rest of the population – we try to tag as much as possible away from the purse seine fleet. This strategy is not always easy to implement because tuna abundance is generally spread in a patchy way where tunas are concentrated in the richest waters in term of prey. For instance, our attempts to tag tuna in the Mozambique Channel after the PS fleet leaves the area (in June and July 2005) or before the PS fleet arrives (in February and March 2006) failed. In this area there very few tuna left outside of the main fishing season. On the contrary this strategy works for Tanzania because this area is mainly a transit place for tunas of this region.

Almost all tunas tagged before January were released far from the purse seine fleet consequently it takes them several months before they start to get caught by purse seiners. This picture is given for the three main tagging zones:

- Mozambique Channel (Madagascar, Mayotte, Comoros) in figure 13b;
- Seychelles and adjacent waters (West and South of Seychelles) in figure 13c;
- Tanzania and Kenya in figure 13d.

In the Mozambique Channel, tagging started at the end of the purse seine fishing season while some purse seiners were still present. This is the reason of the peak of YFT returns. In the following months, tagged tunas continued to be recovered but in small numbers and obviously far from the Mozambique Channel. They start to be recaptured in large numbers one year later most certainly when the purse seiners returned to this area. Obviously most of the fish we

tagged in the Mozambique Channel were not fished by the purse seiners until they return near or in the tagging area.

In the Seychelles waters, recoveries started only and slowly in December and January. But tagged tunas were released in large numbers in this area only from mid-December and until the beginning of February. Then more tags were released until the beginning of April but in smaller amounts. The peak of the recoveries is registered in March.

In the Tanzania there is steady increase of the recoveries starting from October 2005 with acceleration from March 2006 until June. From August to October 2005, 8,300 tagged tunas were released but they really started to show up in the purse seine catch only in March 2006 then in April and May. The large number of tuna tagged in the associated school does not show up in the purse seine catch before June 2006 (Figure 9).

2.3. The recoveries rates

The overall recovery rates are 1.5%, 1.2% and 6.3% respectively for YFT, BET and SKJ (Figure 14a). It should be kept in mind that these rates will have to be adjusted with the tag shedding and tag reporting rates. If tag shedding deducted from the double tagging data should be quite low the reporting rate from purse seiners is roughly 50%.

The recovery rates are quite variable according to the tagging area (Figure 14b, c & d). In the Mozambique Channel (Fig. 14b), the high recovery rate for YFT (11%) is mostly due to the large number of YFT recaptured by purse seiners a short time after tagging. The very high recovery rate of BET in Seychelles (Fig. 14c) is based only on 46 tagged BET of which 11 have been recaptured. Tuna tagged off Tanzania show the lowest recovery rates for all species (Fig. 14d). But it must be kept in mind that 80% of the tagged tunas in Tanzania were released during the last 3 months.

2.4. Time-at-liberty

Most recoveries from purse seiners are discovered by the stevedores during unloading and trans-shipment or by cannery workers. Only few are directly discovered at sea (167). Apart from those discovered at sea for the vast majority we have at the best the vessel name, the unloading or trans-sipping date and the well number. This information is later crossed with the logbook of the vessels in order to get one or several possible fishing dates and positions. This work has not been done yet. For the moment, the time-at-liberty presented here is calculated as the duration elapsed between the tagging date and the date the tag is known to us. As the purse seine trips last about 45-50 days, the time-at-liberty calculated this way are on average 25 days longer. Therefore, the following data and figures are very preliminary.

The overall time at liberty (all tagged fish whatever the area) is given in figure 15a and in figures 15b, 15c & 15d for Mozambique Channel, Seychelles and Tanzania respectively.

2.5. Length increments

The distributions of the lengths (FL) at tagging and at recapture are given whatever the area in the following figures:

- In figure 16a for yellowfin;
- In figure 16b for bigeye;
- In figure 16c for skipjack.

Some recent changes in the return strategy for tagged tuna spotted by the stevedores in Victoria harbour has greatly improved the quality of the data collected especially the lengths and weights. This is essential as the majority of the recoveries (68%) are discovered by these persons (ref. § 2.3 and figure 12).

3. CONCLUSIONS

The RTTP-IO tagging operations started in May 2005 and will continue until August 2007. The minimal target in term of number of fish to tag is 80,000. With 72,000 tagged tunas already released and still 13 months of tagging to go the number of tagged tuna will be above the target and in fact much better than we hope.

Bigeye and yellowfin are the two main targeted species of the project even though no breakdown of species is assigned in the description of the project. However, the proportion of bigeye and yellowfin already achieved is higher than expected and the overall number of tagged bigeye (more than 11,000) is already a great achievement. Nevertheless, other areas still need to be surveyed where more tuna will be released in order to better spread out the tagging effort in the Western Indian Ocean.

The tag recovery scheme, into place in the Western Indian Ocean, insures a steady and efficient flow of recoveries from Seychelles, Mauritius, Madagascar, Kenya and Comoros. The system is currently implemented in other countries and contacts have already been taken with all possible countries where Indian tropical tuna can end up.

Tag seeding operation, an on-going operation of the IOTC, will provide a good estimate of the tag reporting rate from purse seiners. Tag seeding will also be developed on reefers in order to obtain the reporting rate for tuna trans-shipped from Seychelles to other countries for processing.

Hopefully the RTTP-IO is on a good track that should offer the opportunity to reach the main objectives assigned to it by the scientific community.

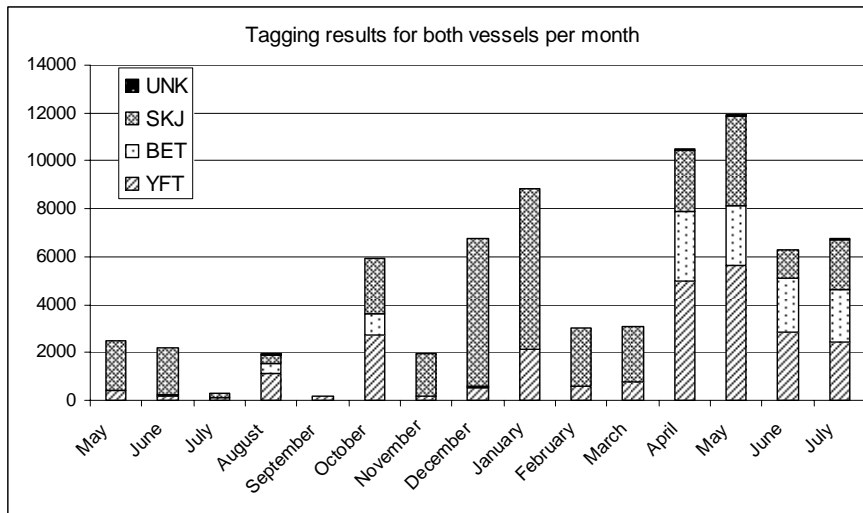


Figure 1: Monthly tag distribution (May 2005 – July 2006; for July up to 22nd)

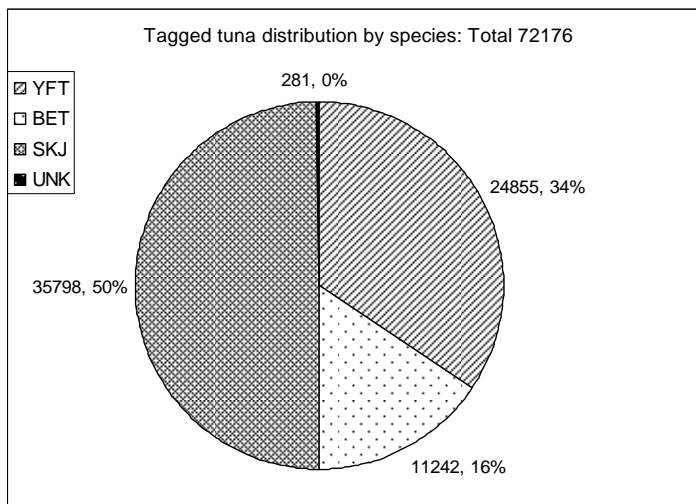


Figure 2: Species composition of the tagged tunas up to 20/07/2006

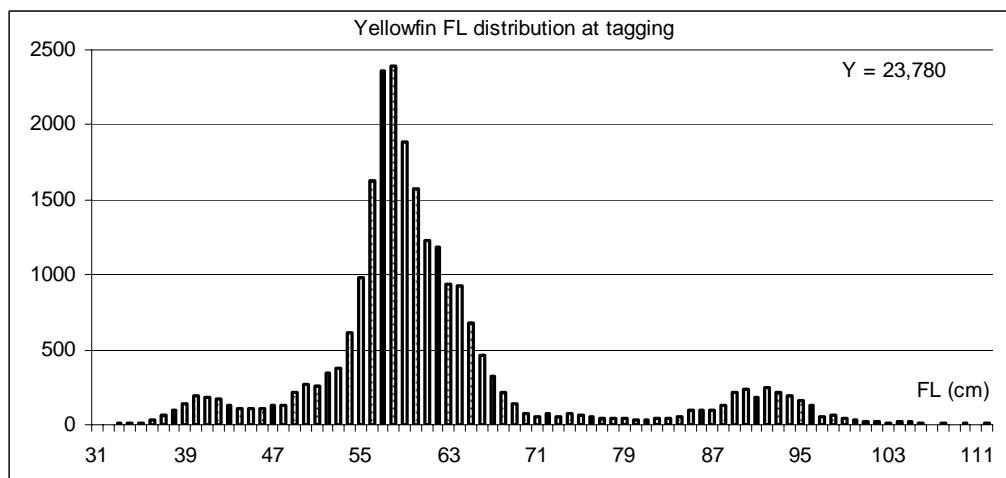


Figure 3a: Distribution of the lengths (FL in cm) of the tagged yellowfin

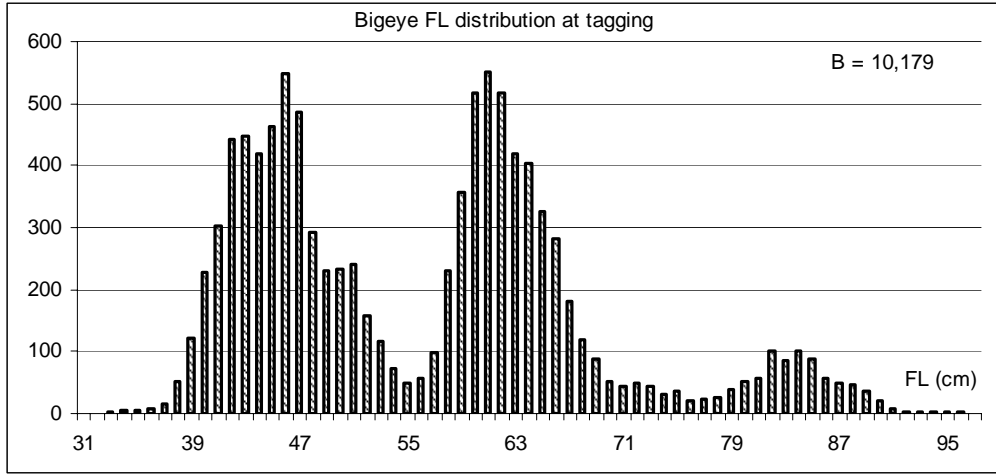


Figure 3b: Distribution of the lengths (FL in cm) of the tagged bigeye

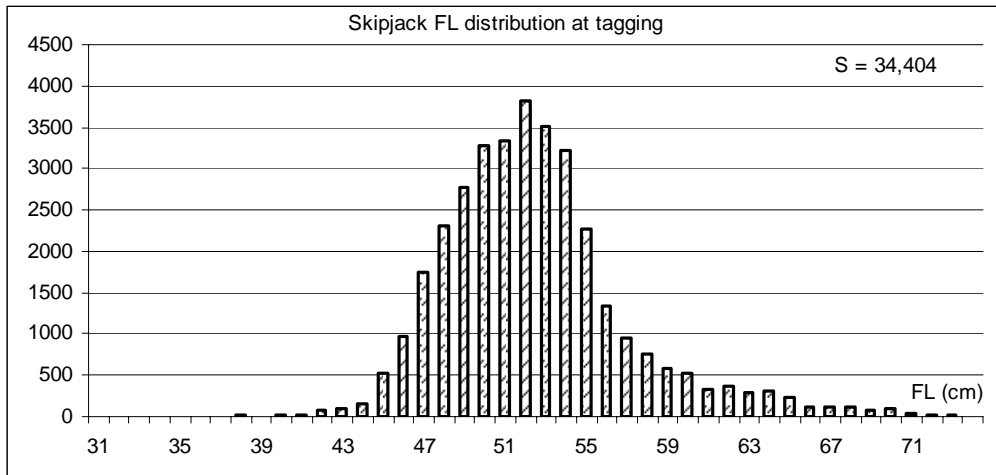


Figure 3c: Distribution of the lengths (FL in cm) of the tagged skipjack

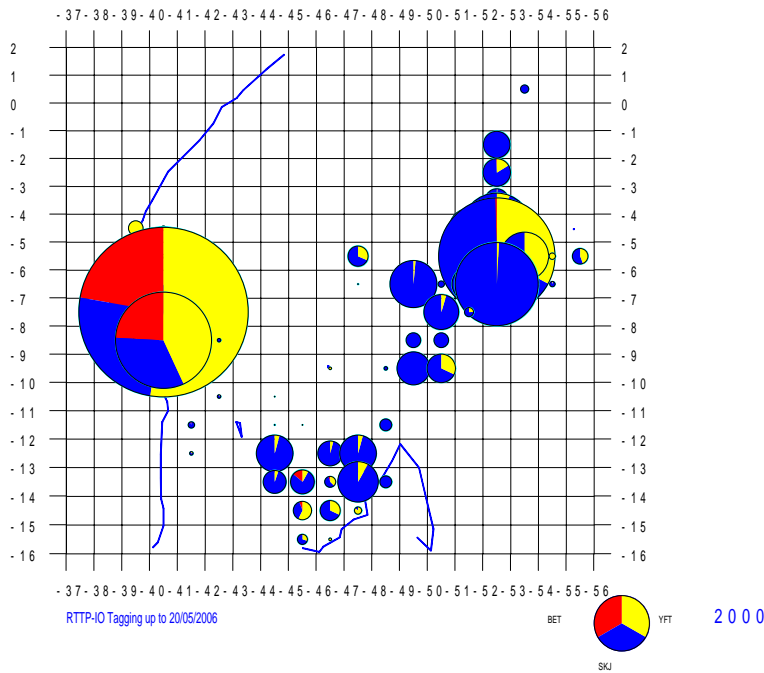


Figure 4: Localisation of the tagged fish up to 20/05/2006

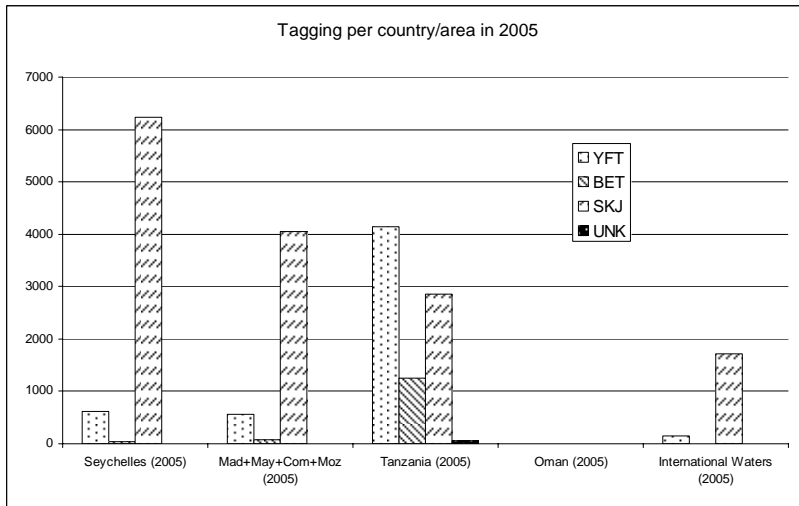


Figure 5a: Distribution of the tagged tuna per country/area in 2005

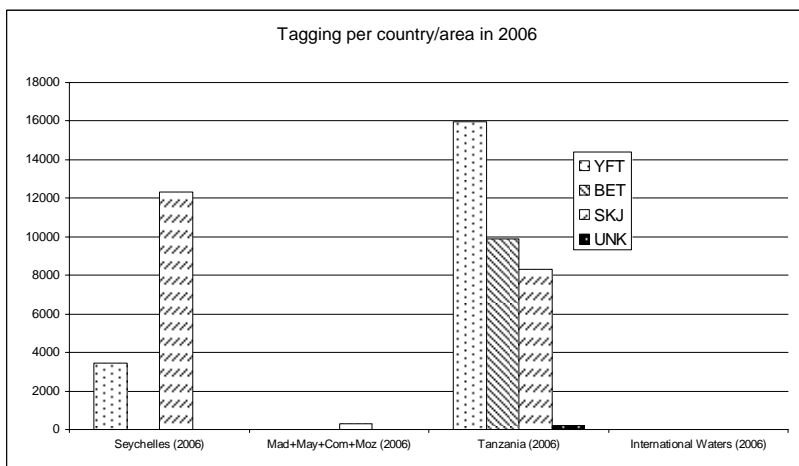


Figure 5b: Distribution of the tagged tuna per country/area in 2006

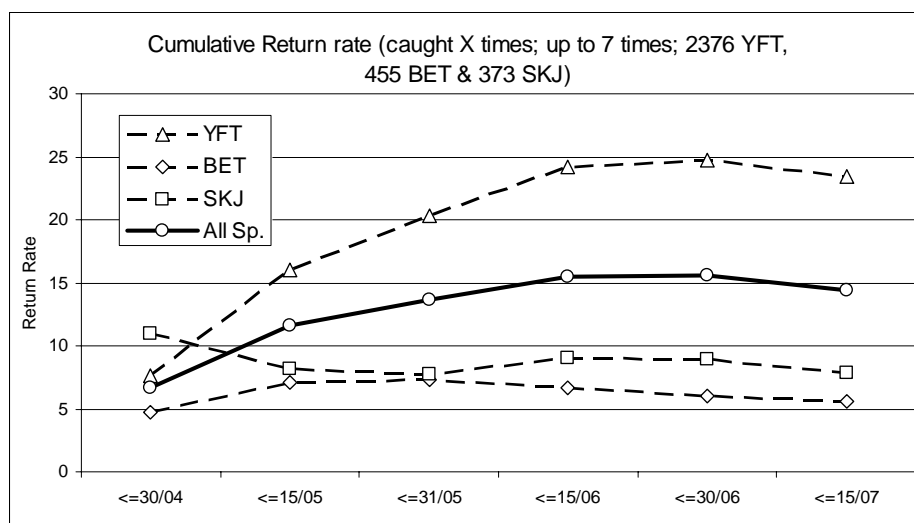


Figure 6: Cumulative return rate from the associated school from mid-April to mid-July 2006

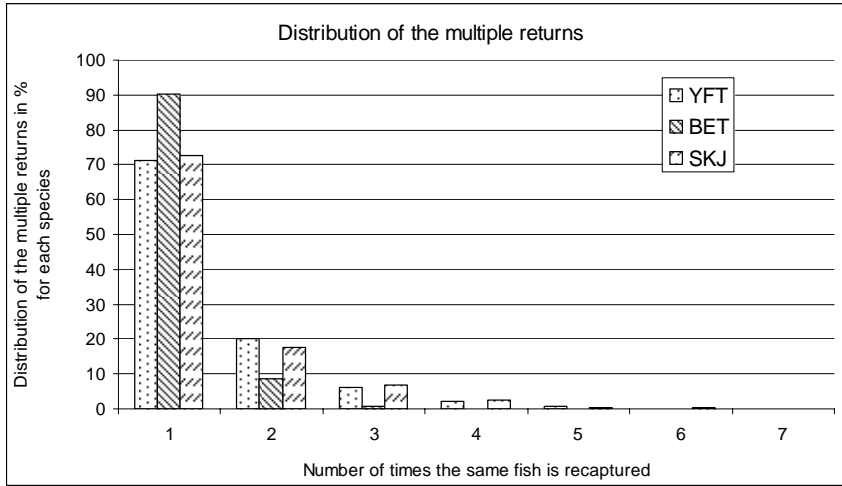


Figure 7: Number of multiple returns from the associated school from mid-April to mid-July 2006

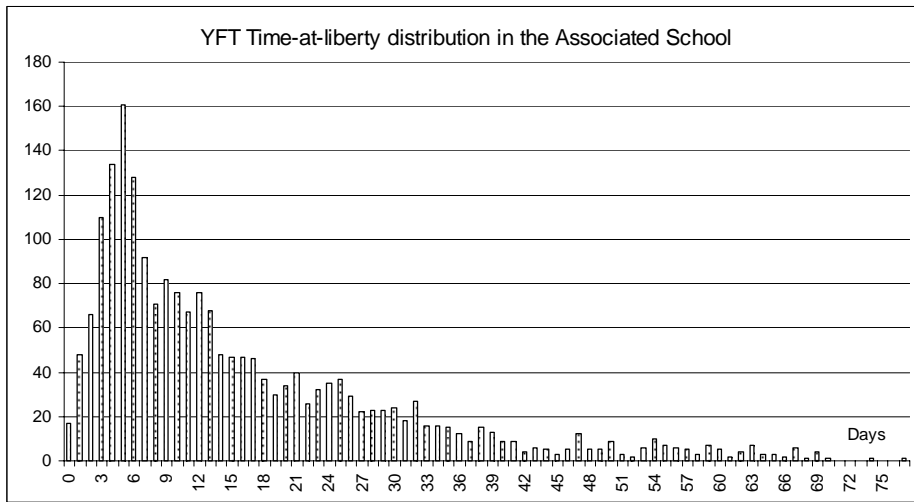


Figure 8a: Time-at-liberty for yellowfin in the associated school

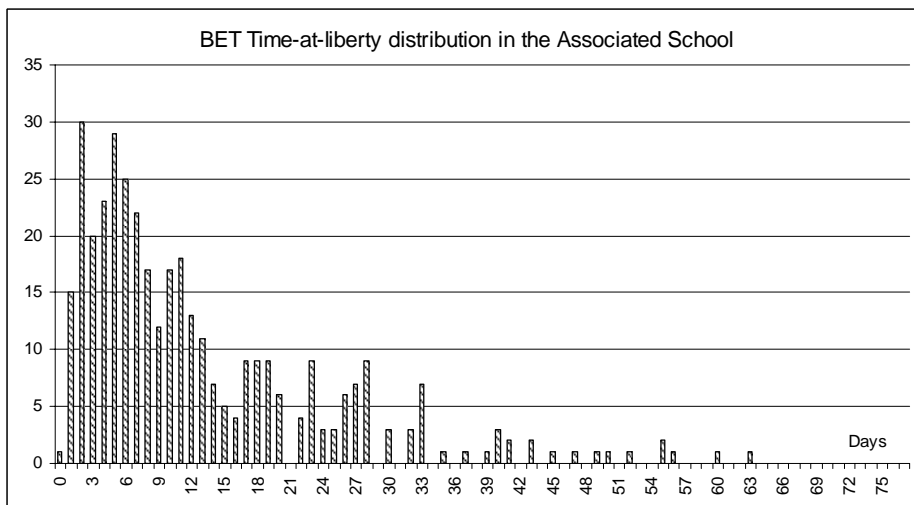


Figure 8b: Time-at-liberty for bigeye in the associated school

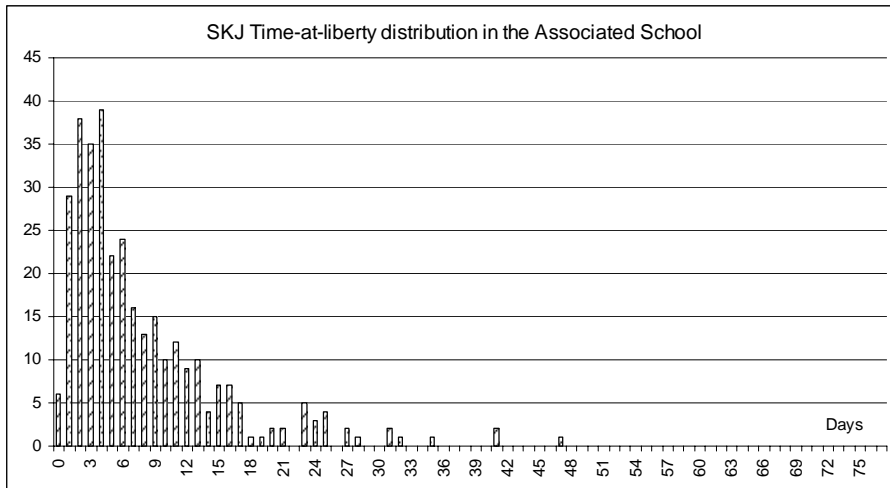


Figure 8c: Time-at-liberty for skipjack in the associated school

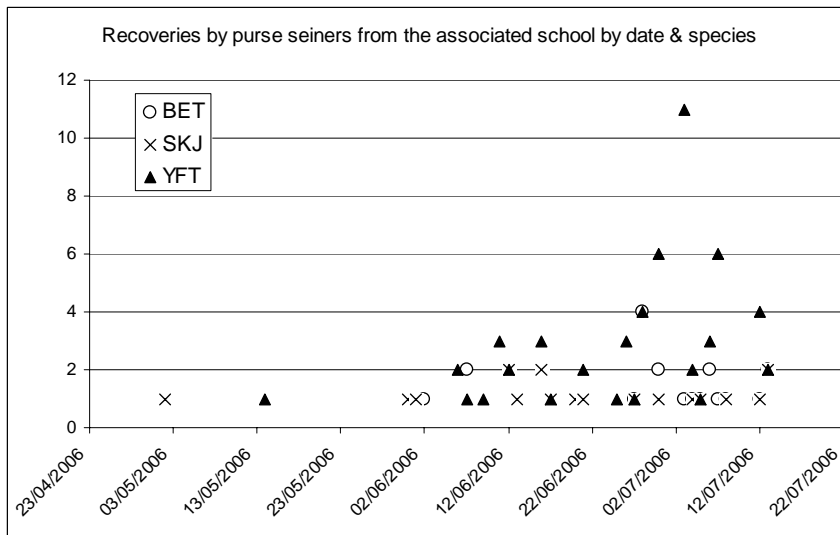


Figure 9: Tagged tuna from the associated school recaptured by purse seiners by date of return

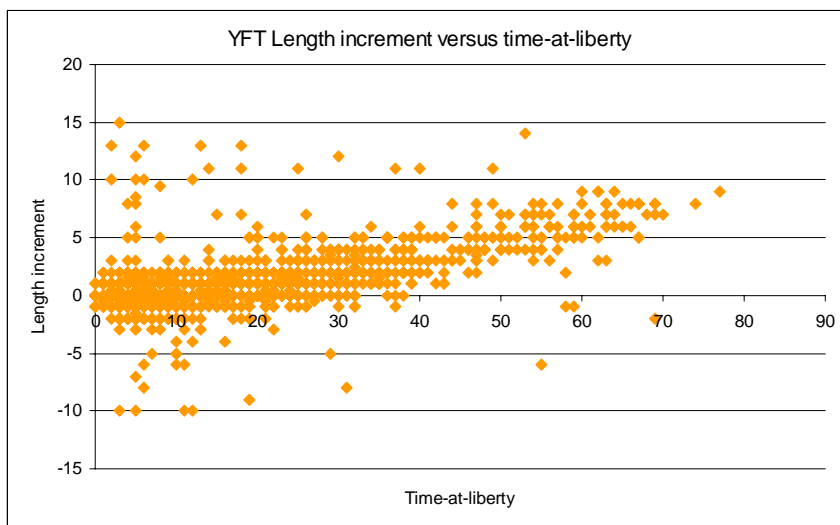


Figure 10a: Length increment versus the time-at-liberty for Yellowfin from the associated school

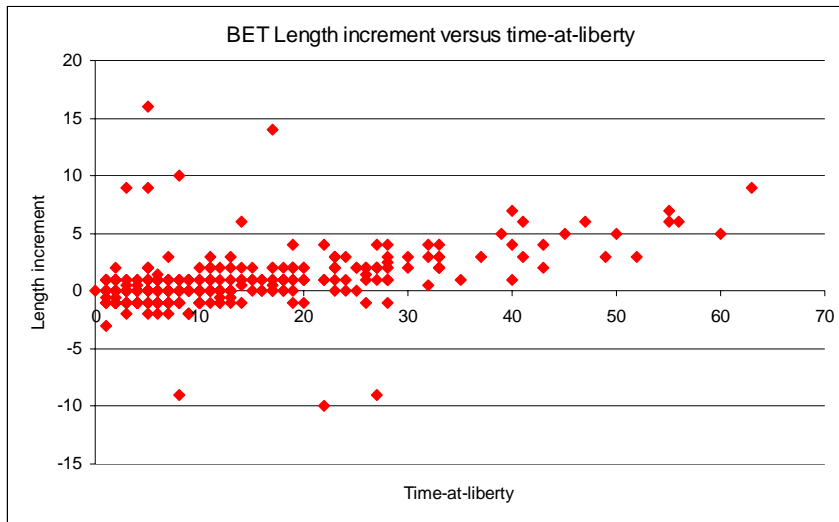


Figure 10b: Length increment versus the time-at-liberty for Bigeye from the associated school

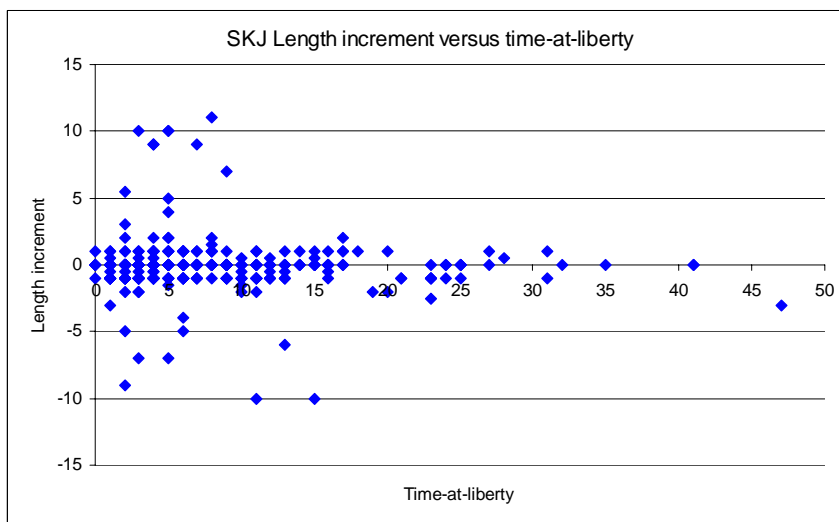


Figure 10c: Length increment versus the time-at-liberty for Skipjack from the associated school

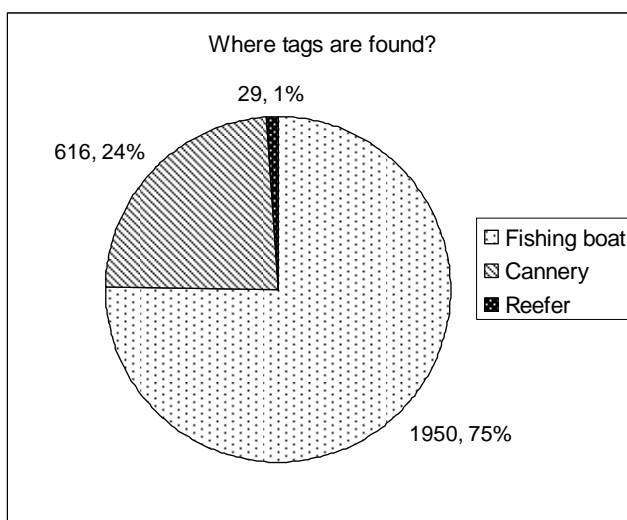


Figure 11: Localisation of the recovered tags

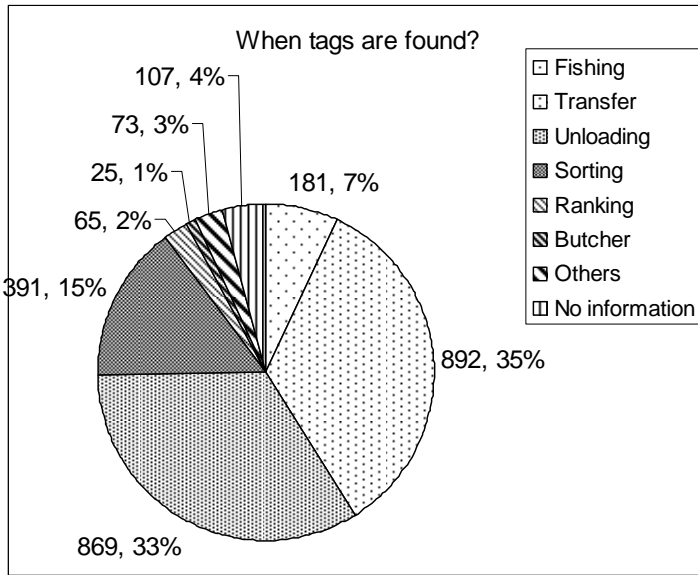


Figure 12: During which process the recovered tags are found

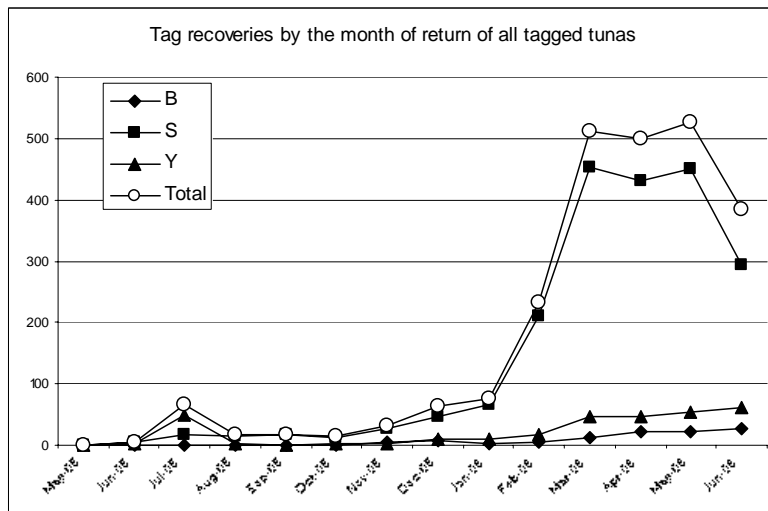


Figure 13a: Tag recoveries per species and per month of return for all tagged tuna

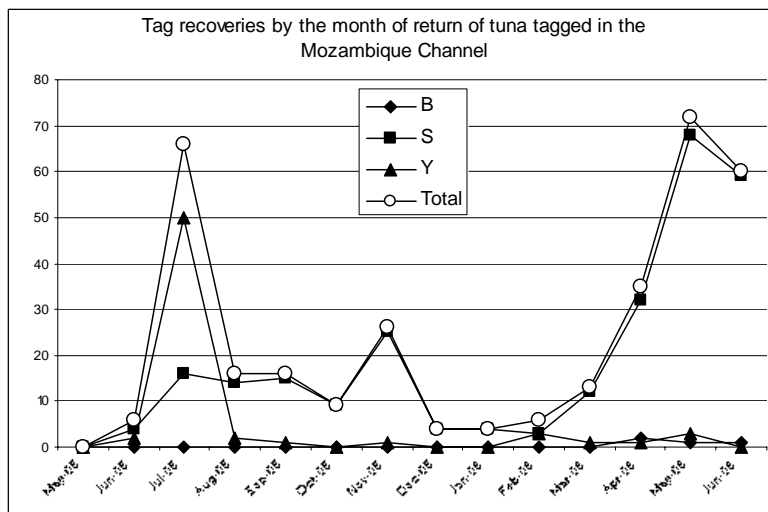


Figure 13b: Tag recoveries per species and per month of return for tuna tagged in the Mozambique Channel

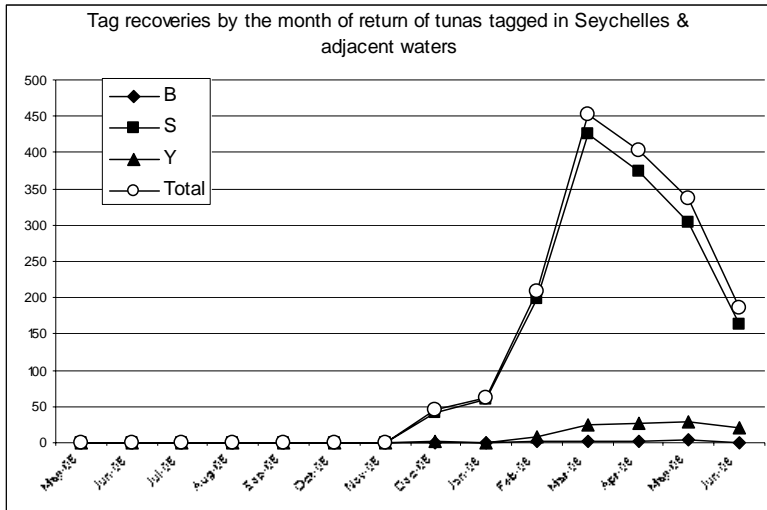


Figure 13c: Tag recoveries per species and per month of return for tuna tagged in Seychelles & adjacent waters

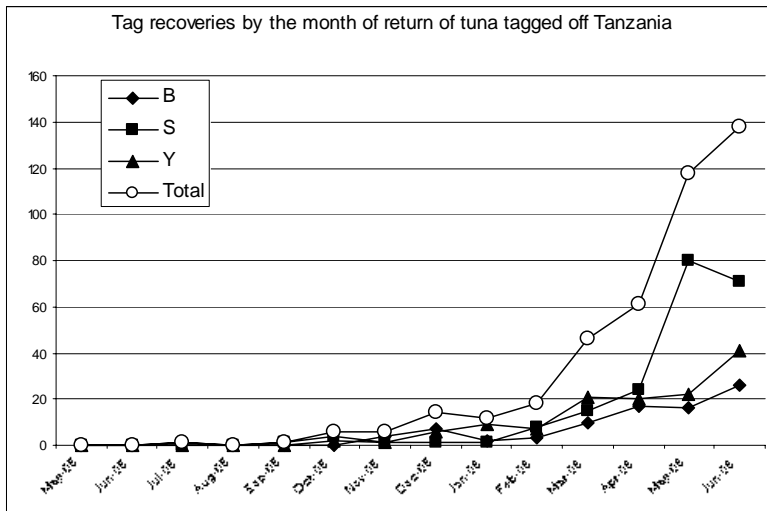


Figure 13d: Tag recoveries per species and per month of return for tuna tagged off Tanzania

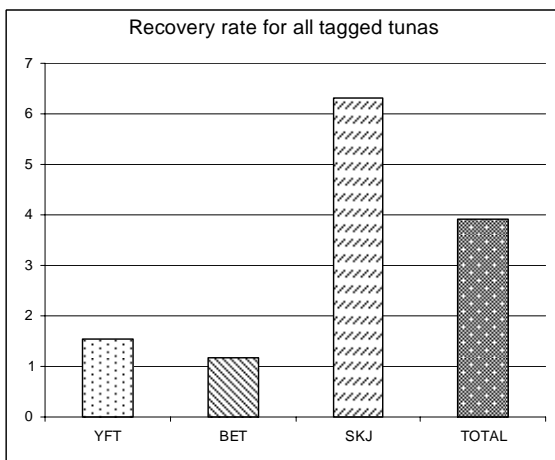


Figure 14a: Recovery rate for all tagged tuna

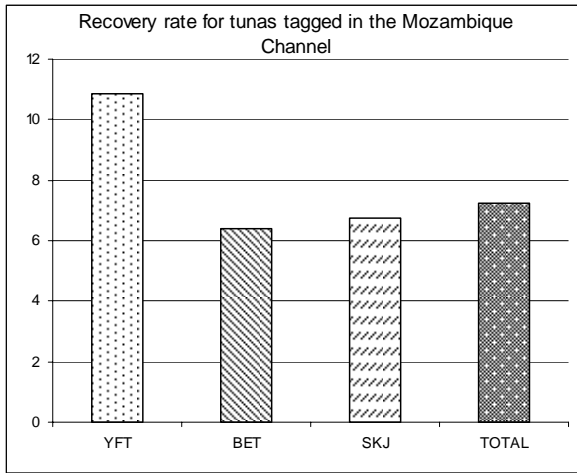


Figure 14b: Recovery rate for tuna tagged in the Mozambique Channel

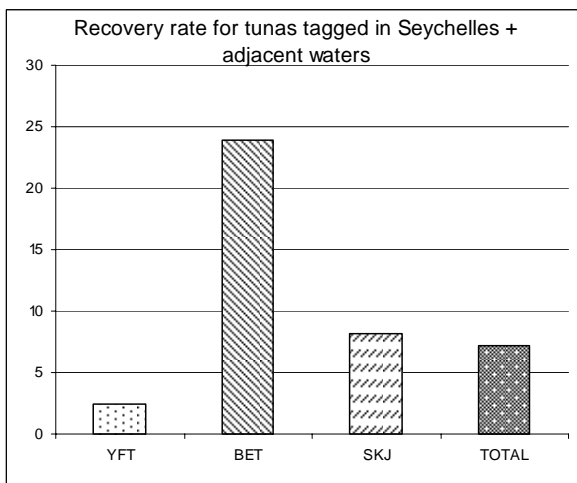


Figure 14c: Recovery rate for tuna tagged in Seychelles & adjacent waters

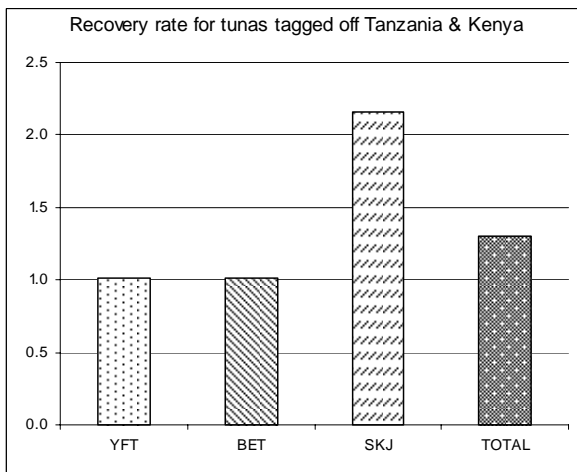


Figure 14d: Recovery rate for tuna tagged off Tanzania & Kenya

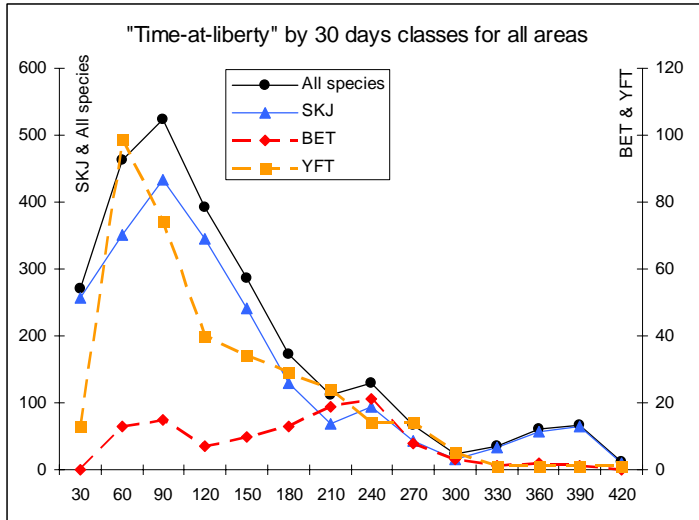


Figure 15a: Time-at-liberty distribution for all tagged tuna

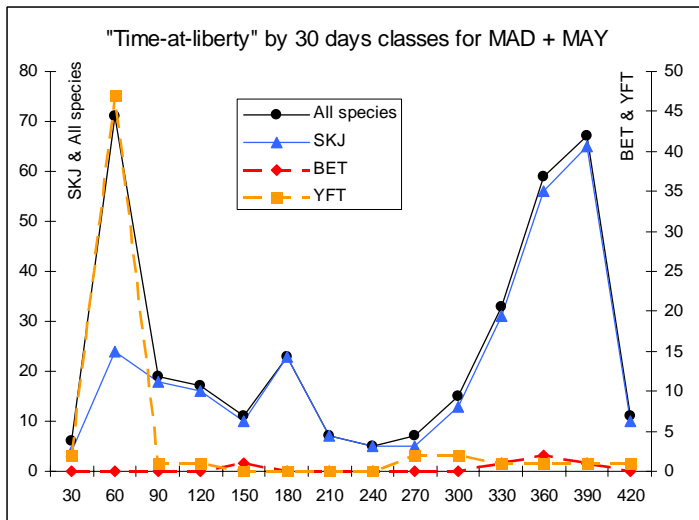


Figure 15b: Time-at-liberty distribution for tuna tagged in the Mozambique Channel

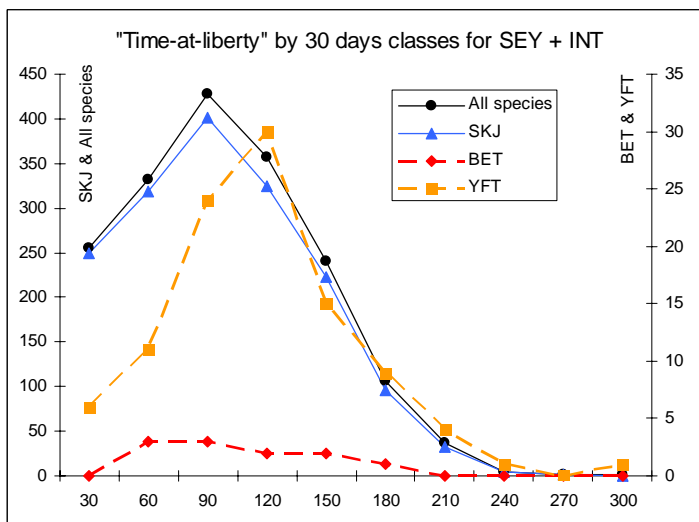


Figure 15c: Time-at-liberty distribution for tuna tagged in Seychelles & adjacent waters

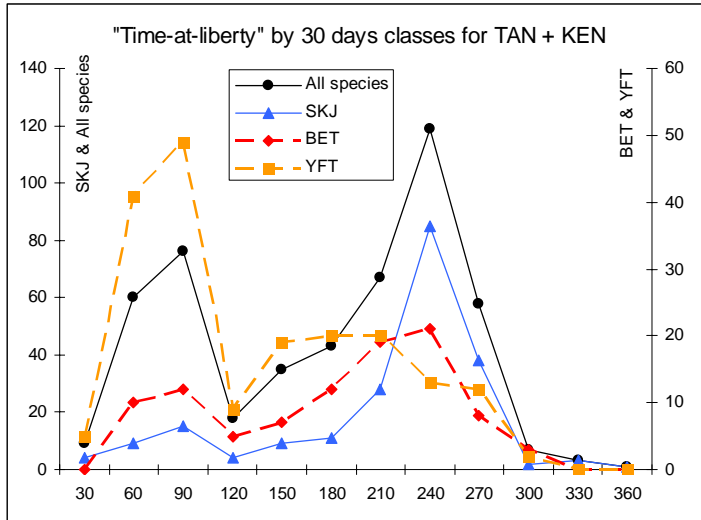


Figure 15d: Time-at-liberty distribution for tuna tagged off Tanzania & Kenya

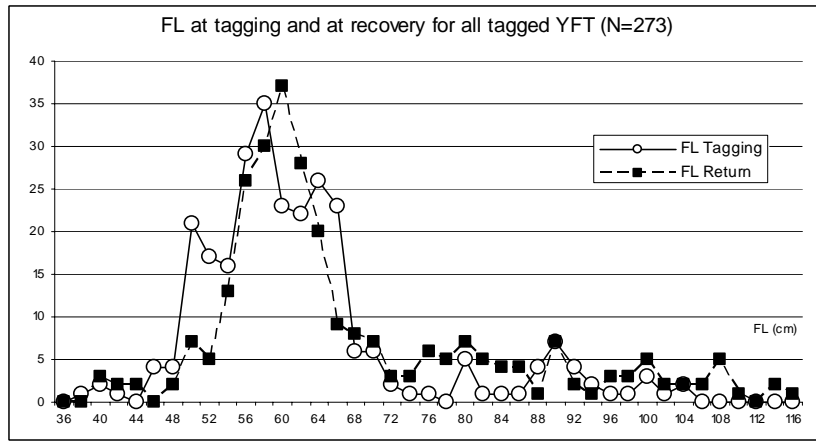


Figure 16a: FL at tagging and at recovery for all tagged Yellowfin

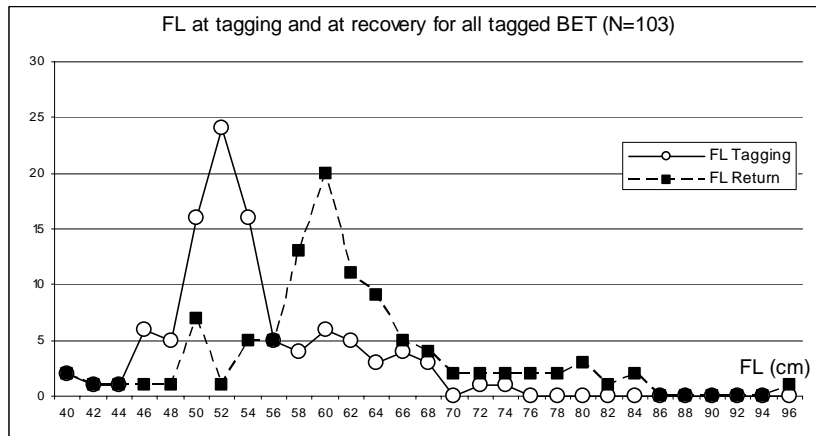


Figure 16b: FL at tagging and at recovery for all tagged Bigeye

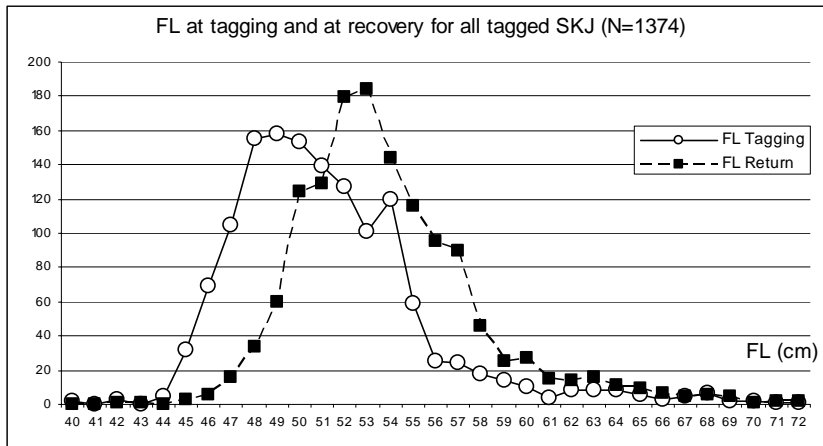


Figure 16c: FL at tagging and at recovery for all tagged Skipjack