Report of the Fifth Session of the IOTC Working Party on Tagging

Victoria, Seychelles, June 10th-13th, 2003

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1. OPENING OF THE MEETING

The meeting was convened at 9:30 am on Tuesday 10th of June 2003 in Victoria, Seychelles. After participants had introduced themselves to the assembly, the agenda was adopted with the addition of several points under Items 8 and 10 (Appendix I). J-P. Hallier was nominated rapporteur with the help of C. Anderson et D. Itano.

2. CURRENT STATUS OF FUNDING AVAILABLE FOR THE IOTTP

The Executive Secretary of IOTC made a presentation of the current status of the IOTTP funding. There are separate funding components for the main phase of IOTTP and for the pilot and small-scale tagging operations.

For the IOTTP itself, the budget of € 13.9 Million has been approved by the member countries of the COI and has been submitted for funding by the European Community. The funds are not likely to be available before mid 2004.

Funding has been received for the pilot tagging operations and some have already been spent in 2002 and 2003 (US$ 64 800). The details of the expenditures were made available (**WPT-03-inf5**).

The funds from EC (€ 200 000) are for the fiscal year, any funds not spent are lost. As these funds from the 2002 budget were made available to IOTC only in March this year, only 20% have been spent so far. Some restrictions on their use have to be taken into account. The EC is prepared to give € 200 000 annually over the next five years on well defined projects to be presented by IOTC Secretariat and discussed within the Working Party on tagging.

It should be noted that the funding already secured is close to the US$ 20 millions of the project estimated total costs even though their availability through many different sources does not facilitate their management.

T. Nishida informed the working party that the annual US$84 000 contribution received by IOTC in 2002 and 2003 will be increased in subsequent years, but it will be reserved primarily for tagging operations in the Eastern Indian Ocean to be conducted by a Japanese vessel (**WPT-03-12**).

3. THE EC WESTERN INDIAN OCEAN TAGGING PROJECT (BASED ON MRAG REPORT, WPT-03-11TER)

Following a request from the Governments of Seychelles and Mauritius, a study entitled "Feasibility study for a proposed Indian Ocean Tuna Tagging Program" was conducted by MRAG from October 2002 to January 2003. The Working Party recognized the quality of the report and a brief summary of the main points and recommendations of this report was presented and discussed.

The discussion focused on:

- The calendar for the availability of the funds;
- The charter of the vessel;
- The Program Management Unit (PMU); and

- The studies that need to be completed before the start of the project.

Objectives

The objectives assigned to the project were those defined by the Working Party on Tagging, with a tag release target of 80 000 tunas and the estimation of parameters necessary for the assessment of the stocks of bigeye, yellowfin and skipjack in the Indian Ocean, of interactions between fisheries and the influence of FADs.

Scheduled activities

The tagging operations are planned for 2.5 to 3 years depending on the choice of the vessel charter (cf. item 3 e). The tag recovery and data analysis will last 2 more years, which gives an expected end in 2009, although it is anticipated that tag recoveries will be taken in charge by IOTC after the end of the IOTTP.

Institutional arrangements relationship between PMU, the IOTC Secretariat, COI and WPT

Funds will be handled by the Commission de l'océan Indien (COI) in Mauritius (the Contracting Authority). IOTC will act as the Executing Agency, acting through the Project Management Unit (PMU). The EC Delegation in Mauritius will be the financial donor and endorser of payment requests made by the COI. The PMU will be established by contracting a Chief Coordinator, a Publicity Officer, a Financial Administrative Officer and a Secretary. The IOTC Secretariat and the PMU will be advised on technical issues by the WPT.

Possible vessel arrangements

The importance of the vessel choice for the success of the programme was emphasized in discussions. These focused on the need for consultants to draft the charter agreement, the fact that vessels have to be from EC or ACP countries, the availability of such vessels, the options of two vessels for 30 months or only one vessel for a longer period. The Working Party on Tagging indicated a wide consensus for the one-vessel option as the longer period of operation carried less risks. Furthermore, this option was likely to be less costly because as transfer costs between the vessel's base and the Indian Ocean would be halved.

Considering the complexity of drafting a boat charter agreement and its implications, the WPT feels it is necessary to contract a consultant to conduct this task before the start of the IOTTP.

Tender procedures of EC would normally require a wide distribution but this procedure is very long and will delay the start of the tagging activities. Therefore, for our particular situation, it might be advisable to have a restricted tender as very few boats will meet the requirements drafted in the MRAG report. There was a general consensus on this subject and it will be the task of the Scientific Committee to eventually propose a recommendation along this line.

A quick review was made of the EC and ACP countries with suitable pole-and-line vessel (Cape Verde, Solomon Islands, Fiji, Kiribati, Senegal, Ghana, Portugal, Spain and France), but it seems that only few countries can provide vessels meeting the requirements. Vessels from most countries are either too small or too old.

The group agrees that members of the WPT especially from Spain and France should search for suitable IOTTP pole-and-line boats according to the specifications and the charter rate established by MRAG report on the basis of 2½ or 3 year contract. Boat owners should be

approached to know their potential interest and results reported to IOTC before December 2003.

Guidelines for planning of releases (Simulation studies)

The WPT stressed the necessity to develop, prior to the start of the project, simulation studies for planning tag releases. The objectives are to design the time-area strata and number of tags that have to be released in order to obtain the parameters needed with a certain degree of precision. In order to identify the best approach for this type of work, a sub-working group has been designated with T. Polacheck (Australia) at his head, other members being O. Maury (France), S. Adam (Maldives) and A. Anganuzzi (IOTC Secretariat). The conclusions of this sub-working group are endorsed by the WPT and are annexed to this report. The development of a simulation model will be realized through joint collaboration between S. Adam (Maldives) and T. Polacheck in Hobart (Australia) and should be funded in the context of the pilot studies.

Progress on this tagging simulation model will be reported during the December Scientific Committee meeting.

4. THE PROBLEM OF LIVE- BAIT IN THE EASTERN AND WESTERN INDIAN OCEAN

The WPT noted that live-bait pole and line fishing is the preferred means of catching surface tunas for tagging. Indeed, it is the only method that can produce releases of high-quality tagged tunas in the numbers (many thousands) that are needed to ensure the success of the IOTTP. For this reason, a major part of the budget for the IOTTP is devoted to chartering an ocean-going pole and line vessel. This vessel will need access to reliable sources of live-bait in order to operate successfully. However, live-bait resources are scarce in much of the Indian Ocean, and the availability of live-bait remains a cause of concern for the IOTTP.

During the 1960s and early 1970s Japanese pole and line vessels operated successfully in the Indian Ocean. They are known to have obtained adequate live-bait supplies from Nosy-Bé in Madagascar. Spanish boats based on Seychelles in 1981-82 also found adequate bait for 9 months of the year. Since then, commercial pole and line ventures in the western Indian Ocean (French-Seychelles in the early 1980s; Spanish in 2001) appear to have had difficulties in obtaining sufficient live-bait. In the eastern Indian Ocean the situation appears less difficult, as adequate live-bait supplies can be found in Indonesia. In the central Indian Ocean, Maldives and Lakshadweep have large pole-and-line fisheries.

The one or two pole and line vessel(s) chartered under the IOTTP will need to tag tunas in the same areas and seasons as the main purse seine fishery. It will therefore need access to live-bait supplies in those areas and times as listed underneath :

Area	Season	Live-bait availability
Seychelles area	November to March	Limited
Mozambique Channel	March to May	Adequate, e.g. in NW Madagascar
Tanzania-Kenya	June to September	Uncertain (possibly Mayotte or Zanzibar Channel)
Somalia	August to December	Unavailable (nearest areas Seychelles and Oman)

It was noted that any pole and line vessel(s) chartered under the IOTTP would need to have a range of bait catching gear available (and crew experienced in their use). In particular, the vessel should carry both bouki-ami and small purse seine nets. It might also be necessary in some instances to buy live-bait from local fishermen or commercial ventures. On this subject it was noted that milkfish (*Chanos chanos*) should be available commercially in Indonesia, and is a hardy bait, but is not the best live-bait for chumming. It was noted that a Taiwanese company was considering starting milkfish culture in Seychelles, for use as longline bait. In addition it might be possible to raise milkfish at Mayotte, but the IOTTP was not in a position to support a live-bait culture project. The main varieties of bait likely to be available in the Indian Ocean, and their key characteristics are summarized below:

Species	Family	Chumming	Hardiness
Milkfish (*Chanos chanos*)	Channidae	Medium	Good
Sprats	Clupeidae	Good	Poor
Herrings & Sardines	Clupeidae	Medium-good	Medium
Pilchards	Clupeidae	Good	Good
Anchovies	Engraulidae	Good	Poor (good if conditioned)
Cardinalfishes	Apogonidae	Good	Good
Fusiliers	Caesionidae	Good	Good
Scads (*Decapterus*)	Carangidae	Medium-good	Good

Likely sources of live-bait in the Indian Ocean

The WPT briefly reviewed likely sources of live-bait in the Indian Ocean:

Western Australia

In south Western Australia, substantial supplies of pilchards (*Sardinops sagax*) are available (**WPT-03-Inf2**). Obtaining supplies of live pilchards may be expensive and the area of abundance is a long way from likely pole-and-line grounds for tropical tunas.

Indonesia

Live-bait resources are dominated by anchovies (of which there are many species locally, but only 3 are used for live-bait). These are predominantly available on the Indian Ocean side of the Greater Sunda Islands (**WPT-03-Inf2**). Anchovies are generally considered to have poor hardiness, but can survive well in bait tanks with good circulation if pre-conditioned. Cultured

milkfish is available in Bali and in Java, and it is planned to use this source of live-bait for the planned Japanese pole and line tagging operation in the eastern Indian Ocean.

Maldives

Maldives has a large traditional pole and line tuna fishery, and substantial live-bait resources (**WPTT-03-23**, **WPT-03-Inf2**). Livebait are caught by simple lift-net (bouki-ami type), either during the day, or at night using lights. The main varieties caught are:

English name	Species	Daytime catches (species comp.)	Night-time catches
Silver sprat	*Spratelloides gracilis*	38 ± 10 %	50-90 %
Fusiliers	Caesionids	37 ± 9 %	0
Cardinalfishes	Apogonids	10 ± 3 %	0
Anchovy	*Encrasicholina heteroloba*	7 ± 2 %	4-12 %
Blue sprat	*Spratelloides delicatulus*	5 ± 1 %	3-38 %
Others	Various species	2 ± 2 %	0-3 %

Local live-bait resources are quite sufficient for local tagging by local pole and line fishing vessels. Relative quantities of the different varieties vary according to the monsoon season. It was reported that it would be most unlikely that foreign vessels would be given permission to fish for live-bait in the Maldives. It might be possible for a foreign vessel to purchase livebait from local fishermen, as part of a collaborative research activity. If an IOTTP vessel did require access to Maldivian live-bait, this would need to be proposed and negotiated in good time.

India (Lakshadweep)

Lakshadweep has a small traditional pole and line fishery, with adequate supplies of live-bait for tagging from local fishing vessels (**WPT-03-2**). The main varieties caught include:

Fusiliers 40%

Cardinalfishes 18%

Spratelloides 17%

Damselfishes 16%

Oil sardines (*Sardinella longiceps*) are known to exist off the west coast of mainland India from September to April-March. Their availability will be studied by India.

Chagos Archipelago

The WPT noted that Chagos should have live-bait resources similar to those of Maldives and Lakshadweep. Access to Chagos is not straightforward but the question of access to Chagos for baiting should be investigated.

Seychelles

Because of its central location in the western Indian Ocean, and within the context of the IOTTP, the question of live-bait supply in the Seychelles is of particular importance. In general, live-bait resources in the Seychelles appear limited. The Seychelles Fishing Authority (SFA) plans to initiate a pilot study of live-bait aggregation, which will deploy 3-4 FADs (of simple bamboo type) around Mahé. SFA has an interest in this development because it hopes to improve livebait availability for local fishermen, but there are clear implications and advantages for the IOTTP. Live-bait will be captured in the vicinity of these FADs using bouki-ami, then transferred to a floating cage. This cage will be towed to holding pens anchored in sheltered locations around Mahé. The distance between the FADs and the holding pens should be less than 10 miles. A bathymetric survey has been made and there is a need to conduct current monitoring to locate the best locations for deploying FADS and holding pens. A modular and robust design of holding pen has been proposed (**WPT-03-07**). The cost of deploying such pens, including anchoring, is estimated to be of the order of US$100,000 (this cost has been included in the IOTTP budget). This project should be of great interest to the IOTTP pole-and-line boat for the supply of its live-bait.

Oman

It was reported that Oman appears to have substantial quantities of small fish that could be used as live-bait. The main species available is the oil sardine, *Sardinella longiceps*, which are used as live-bait in artisanal fisheries, but other varieties including anchovies are also available. It was noted that these might be used to support pole and line tagging in Oman itself, but in addition this country is within range of the Somali purse seine area.

East Africa

Tanzania and Kenya are believed to offer some possibilities for supply of live-bait, but the details (e.g. species, seasonality, sizes) need to be documented as soon as possible. It is known that live-bait is taken by a light fishery in the Zanzibar Channel, and some might be purchased, dependent on negotiations.

Conclusions

Even though some difficulties are expected for the supply of bait, this is available in various places of the western Indian Ocean sometimes in large quantities (Madagascar, Zanzibar, Oman) or in sufficient amount for a tagging pole-and-line boat (Mayotte, Seychelles, Chagos). According to species and areas, different fishing gears will be necessary to catch these baits in good condition in order to keep them for long durations (up to several weeks) in bait tanks on board the boat. The hardiness of the bait will determine the range of the pole-and-line boat. The skill of the crew in different bait fishing technique and the specifications of the bait holding system on the boat will be essential for the success of this operation.

It was emphasised that securing adequate bait fish supplies that would allow tagging in all major areas where fisheries occur in the western Indian Ocean was critical for the success of the tagging program and for it to meet its main objectives. Thus, it was recommended that work to ensure that baitfish can be obtained for tagging operations be pursued as a matter of high priority.

The WPT noted that the right to fish live-bait within the national waters of coastal countries would require prior permission from the governments concerned. The Commission was thus requested to recommend the cooperation of the concerned countries.

5. PROSPECTS FOR LARGE-SCALE TAGGING IN THE EASTERN INDIAN OCEAN

The WPT noted that, while there are plans for large-scale tagging in the western Indian Ocean, the prospects for tagging on a similar scale in the eastern Indian Ocean were much less well-developed. The WPT noted that simultaneous tagging on a similar scale on the two sides of the ocean was highly desirable. Unequal levels of tagging in the two areas could reduce information obtained on certain parameters, including spatial variability in growth rates, migration, and stock structure.

Japan

It was reported that Japan plans to conduct a pilot tagging activity in the eastern Indian Ocean in February-March 2004 (**WPT-03-12**). Two trips of two weeks each will be carried out, using Benoa in Bali (Indonesia) as a base. This location was chosen because of the availability of live-bait (cultured milkfish). It is planned to use a commercial Japanese fishing vessel. This is not a pole and line vessel, but experienced pole and line crew will be hired for the project. Fishing will be mostly carried out on drifting FADs previously seeded at sea. SEAFDEC offered to give to the Japanese vessel access to its FADs. It is planned to tag 2 000 fish in total, of which it is anticipated that 60-70% will be skipjack, 30-40% yellowfin and less than 10% bigeye. If this pilot activity proves successful it is anticipated that the project will be continued for a further 3 years.

SEAFDEC

The Southeast Asia Fisheries Development Centre has a purse seine training vessel. This has operated in the eastern Indian Ocean every year since 1994, during the period October to March/April, and mostly on FADs. SEAFDEC will carry out tuna tagging in support of the IOTTP. During 2002 a pilot (training/feasibility) activity was carried out and 50 small yellowfin (maximum 65cm) were tagged and released. During the coming season (October 2003 to January 2004) it is planned to tag and release 1 000-1 500 tunas. It is hoped to tag about 100 tuna per set (using one man to scoop fish from the net enclosure and two to tag). It was reported that efforts were made to ensure that only active fish were selected for tagging. Nevertheless, the WPT expressed some concern about the possibility of tunas becoming crowded and damaged in the net. The WPT commended SEAFDEC on its efforts, and requested SEAFDEC to film several operations so that capturing and tagging procedures could be more widely reviewed. It was noted that it should be possible to distinguish yellowfin and bigeye in the net (for example, yellowfin tend to have brown backs, while bigeye tend to be violet dorsally). It was reported that the 2002 tagging had been carried out with a limited supply of tags obtained locally. IOTC undertook to supply tags for future operations.

Indonesia

Indonesia has a large tuna fishery. At present there are no plans for tagging within Indonesia itself (although as noted above there are plans for some Japanese tagging using a vessel based in Indonesia). It was noted there might be some possibility for collaboration between Indonesian and Australian scientists to carry out tagging from an Indonesian vessel in Indonesian waters. This possibility should be investigated by CSIRO and Indonesian scientists. The IOTC Secretariat noted that it would be receptive to a funding proposal for tagging in Indonesia.

Australia

The tuna fishery of Western Australia is relatively small, and funding for large-scale tagging program are unlikely to attract priority research within Australia. The possibility of collaborating with Indonesia on a tagging activity should be investigated, as noted above.

India (Andaman Islands)

The WPT was informed that there are plans to introduce pole and line fishing to the Andamans by 2005. At present, however, there has been no livebait survey. It is therefore most unlikely that tagging from a pole and line vessel will be possible in the Andamans during the IOTTP. The possibility of limited tagging (of large yellowfin) from longline vessels will be investigated.

Conclusions

The WPT recognized with satisfaction the different plans for large-scale tagging in the eastern Indian Ocean but also the fact that, so far, these plans are not in any way comparable to the IOTTP tagging effort that will start in 2004 in the western Indian Ocean.

6. REVIEW OF PILOT STUDIES CONDUCTED SINCE JUNE 2002

A presentation was made of the four pilot studies conducted so far by IOTC (Mayotte in May 2002, Seychelles in October 2002 and in February 2003 and Oman in January 2003). The corresponding reports are in papers **WPT-03-05, 08, 09 and 06**. In general, tuna abundance was low during all these studies, possibly in relation with the El-Niño year 2002-2003. Therefore, very few fish were tagged (30 all together with none taged in Oman).

It is obvious that small-scale tagging is often sensitive to inter annual variability of tuna abundance as well as all fisheries but also to the spatial heterogeneity of the resources. It is also quite difficult to monitor many different small-scale tagging due to the specificity of each different operation while it requires a good standardization of the tagging procedure and a strong commitment of the countries involved. However, handline tagging gives access to large-size yellowfin and bigeye that would remain largely inaccessible to the IOTTP pole-and-line vessel. The lack of these large size tunas is a potentially weak point of large-scale tagging programmes. These small-scale tagging operations can be achieved at a reasonable cost and they are a complementary and necessary component to the IOTTP.

FAD-fishing around Seychelles (Itano report; IRD/SFA follow-up)

In Seychelles, during the pilot study in October 2002 (**WPT-03-08**), only two of the four FAD anchored before the study were found. But the study was inconclusive because of the lack of tunas. Therefore, a second trip on these two FAD was performed in February 2003 (**WPT-03-09**), but the FADs were missing. It is presumed they were either cut away by local fishermen or fished by a purse seine boat.

Oman

Small-scale tagging is possible (**WPT-03-06**), although the number of fish that can be tagged might not justify the effort. However, the prospects of large-scale tagging by the IOTTP pole-and-line boat are good (presence of suitable baits and tunas). Therefore, it seems reasonable to first try such a campaign and, according to species and sizes of tuna tagged, to decide whether small-scale tagging is necessary.

7. PILOT PROJECTS AND SMALL-SCALE TAGGING, 2003-04

Complementary to the large-scale IOTTP program, some small-scale operations will be developed to tag large-size tunas not easily available to the IOTTP pole-and-line vessel or to tag in areas or off-season not reachable by the boat. Several small-scale tagging studies are planned:

Maldives

Maldives has already conducted two successful tuna tagging projects, in 1990 and 1993-95. The local pole and line fishery provides a cost-effective means of tagging and releasing large numbers of high-quality tunas. It is planned to start new tagging activities in late 2003 (**WPT-03-10**). Options for tagging include skipjack, small yellowfin and large yellowfin. The funding currently available for tagging in the Maldives is limited, because the main EC funding for the IOTTP is restricted to ACP countries (i.e. not Maldives).

Quantifying the scale of interaction between the important Maldivian skipjack fishery and the western Indian Ocean purse seine fishery is a major goal of the IOTTP. To address this issue, the WPT stressed the importance of simultaneous releases of large numbers of tagged skipjack in both fishery areas. The WPT noted that some means should be found to provide adequate funding for tagging in the Maldives, not only because it was highly cost-effective but also because the issue of interaction was largely between an EC fleet and a traditional artisanal fishery of a coastal country.

India (Lakshadweep)

India plans to start tuna tagging in the Lakshadweep in late 2003 (**WPT-03-2**). It is planned to start the programme with a short training exercise. Tagging will be carried out from three types of fishing platform: local pole and line vessels (skipjack and small yellowfin); local handline vessels (medium-large yellowfin); and longline research vessel (medium-large yellowfin and bigeye). It is initially planned to tag 5 000 tunas, during the two main fishing seasons, November-December and March-May. If this first programme is successful it is planned to apply to the Government of India for further financial support. The possibility of expanding tagging activities to the Andamans will also be investigated. The WPT noted that tagging in Lakshadweep should be highly cost-effective, and therefore encouraged India to continue tagging activities beyond this initial project.

Chagos Archipelago

It was reported that it would be technically feasible for Maldivian pole and line vessels to sail from Maldives to Chagos, and carry out tagging there. This would require prior permission but might offer a cost-effective means of tagging in this area. Nevertheless, costs would not be insignificant and could not be met out of the EC IOTTP funding.

Iran

Iran has previously indicated its willingness to carry out tagging and IOTC is ready to study a proposal for a small-scale tagging in Iran waters. The presence of medium-sized yellowfin in its fisheries make this a particularly attractive proposition, because this size of yellowfin is not found in most other fisheries. However, it was noted that the main gears used are driftnet and purse seine, neither of which is ideal for tuna tagging. Local scientists are advised to draft a proposal for small-scale tagging in their waters to be submitted to IOTC.

Seychelles

Seychelles does not appear to be an ideal location for small-scale tagging because, unlike other places in the region, large concentration of tuna are seldom found within 80 nm offshore (large Seychelles plateau with shallow waters), hence such a programme will involve substantial costs. Nevertheless, there are some opportunities for important contributions to the IOTTP. These include: deployment of relatively small numbers of electronic or archival tags (e.g. in yellowfin from caught by handlines), tagging on drifting and anchored FADs, tagging of longline-caught tunas (to investigate interactions between the longline and surface fisheries). Accordingly a small-scale tagging proposal should be prepared for submission to IOTC.

Coco-de-Mer Seamount

The Coco-de-Mer Seamount lies north of Seychelles, just outside the Seychelles EEZ. It is an important catch location for purse seiners, which take about 10-15 000 t of tuna from this one spot each year. Two Spanish supply vessels (owned by separate companies) are moored permanently on the seamount. They act as FADs themselves and also release drifting FADs. This location offers a natural laboratory for tuna tagging. The cooperation of at least one supply vessel has been offered to the IOTTP. This should allow, for example, year-round releasing of tagged fish and/or deployment of acoustic tags which could provide much information on tuna residency around seamounts. In addition, it is anticipated that the IOTTP bait boat will carry out tagging in this area.

Mayotte

Yellowfin are taken by artisanal fishermen using handlines and longlines in Mayotte. It is planned to tag medium-large sized yellowfin from the handline fishery in March-May 2004. This project should receive full support from IOTC if Mayotte shows its willingness to go ahead.

La Réunion

A French national pilot tagging project will start in La Réunion in 2004. It is planned to tag a few hundred medium-large yellowfin, which will be caught by handline and longline. IOTC will supply tags and assist with publicity, but no funding.

Sports Fisheries

The possibilities of using sports fishers to tag and release tunas for the IOTTP were reviewed (**WPT-03-Inf1**). It was recognized that there were a number of potential problems with this approach, including quality of tunas released, quality of tagging and quality of data collected. It was noted that sports fishers usually use light line and lures, either of which can result in fish being exhausted or damaged by the time they are tagged. Perhaps as a result, recovery rates from other sports fishery tagging programmes are generally low (0.3-2.0%). Nevertheless, there was the potential to have some tunas tagged and released at little cost, in areas that might otherwise not be covered by the main tagging programme. And tag recoveries form sport fishery tagging programmes have provided useful information, e.g. on long distance migrations. The WPT agreed that tagging should not be encouraged by all sports fishers. Rather, efforts should be concentrated on encouraging high-quality tagging in a few selected localities. These might be localities where tagging of tuna and billfish has already been conducted for some time (e.g. South Africa, Australia, Seychelles and Mauritius), or areas with possibilities for tagging fish that cannot be tagged in any other way (e.g. medium-sized yellowfin off Tanzania or Oman). It was noted that some sports fishers

sell their catch, which can be an important part of total income. However, it was emphasized that compensation should not be paid for fish tagged and released since this might encourage claims for compensation without tagging. One approach that has proved successful in the Pacific was to make use of sports fishing operations with dedicated visits by a programme tagging team led by a fisheries scientist. This could allow relatively large numbers of fish to be tagged under specific protocols.

Observer Schemes

It was noted that there are at present no major observer schemes in operation in the Indian Ocean. There is very limited observer presence on Chinese longliners; some observer presence on Indonesian longliners; and some observer presence in the limited Chagos longline fishery. Nevertheless, the potential importance of observers for both releasing and recovering tags was noted. The need for tagging training of observers was also stressed.

Training and Tagging manual

The WPT emphasized the importance of training, especially at the start of all tagging activities. IOTC is producing a tuna tagging manual which will be available to all interested parties before the start of the IOTTP (see below). Maldives has produced a manual detailing methods used in its two previous tagging programmes. The WTP also noted that the CCSBT had produced a tagging manual.

Tagging is easy but to be efficient it needs to be performed with the greatest caution. It is not easy to estimate tag shedding rate and even more mortality rate due to tagging. Therefore every precautions should be taken to minimize these rates of uncertainty. Furthermore it is necessary to obtain the most homogeneous and optimal set of tagged tuna. Therefore, tagging procedures need to be well standardized within taggers and operations. To achieve these goals, it is necessary to have a tagging manual that will describe precisely the rules and ways to obtain the best tagging quality and to standardize the tagging procedures. A very preliminary tagging manual was prepared by J-P. Hallier as field manual for pilot tagging (**WPT-03-06bis**). Recognizing the importance of this topic, the WPT recommend the completion of this tagging manual which should cover all types of tagging platforms. This will be prepared by tagging experts from France, Hawaii, Maldives, Australia, SPC, etc…

Summary of planned tuna tagging activities (large and small-scale operations except the IOTTP)

Activity	**Dates**	**Method**	**Target Sp**	*Target No*	*Budget*
Japan-EIO	Feb-Mar 2003	P&L – Troll line	SKJ & YFT	2 000	
SEAFDEC-EIO	Start 2002	Purse seine	YFT & BET	1 000+ / yr	
Maldives	Late 2003	P&L, HL	SKJ & YFT	1 000s	US$ 52 500
Lakshadweep	Late 2003	P&L, HL, LL	SKJ & YFT	5 000	US$ 70 500
Mayotte	2004	HL	YFT		US$ 20-30 000
La Réunion	2004	HL, LL	YFT		

Conclusion

Small-scale tagging can be conducted in the western Indian Ocean and will generate valuable information on tuna growth, movements and behaviour as well as interactions (especially in the case of the Maldivian programme). The WPT recognized the importance of these operations and recommend IOTC to bring them its full support.

8. RELATED PROJECTS

TAGFAD

This is a € 380 000 project planed by France and Spain and funded by EC that has just been approved. The objective is to study the behaviour of tunas associated to drifting FAD (vertical and horizontal movements, time of residence. For this purpose, 200 archival internal tags will be set on medium to large size yellowfin and bigeye in the Somalia area in September-November 2003 (partly in conjunction with a FADIO campaign). The late approval of this project might prevent the entire realisation of the tagging this year. However tags will be bought and if they cannot be used this year, they will be available in 2004.

FADIO

Fish Aggregating Device as Instrumented Observatories of pelagic ecosystem. This project is funded by EC and involves cooperation project between several EC countries. The work is also complementary to the 'Smart FAD' project of PFRP in Hawaii, to TAGFAD and IOTTP. The objectives are first to develop new instruments to observe associated pelagic fish and then to follow the associated school biomass. Instruments used are acoustic tags with listening stations, sounders and sonar. A partially joint campaign is planned with TAGFAD and it is envisaged to tag some fish simultaneously with acoustic tags from FADIO and archival tags from TAGFAD. FADIO intends to compare behaviour of tunas tagged around drifting FADs with those tagged around anchored FADs. In that respect, if FAD are set around Seychelles in the IOTC tagging program, FADIO would like to tag tunas around those FAD with acoustic tags.

The IOTC Secretariat recognizes that the objectives of TAGFAD and FADIO are entirely convergent with those of IOTTP. In that respect, IOTC is ready to lend equipment which is not needed at the same time by IOTC operations. TAGFAD and FADIO will use the IOTC spaghetti tags and IOTC will pay the rewards for tag recovery. Sonic tagged fish will also receive an ordinary yellow spaghetti tag, but TAGFAD will require spaghetti tags of a different colour in order to identify the electronic tags which will bring very valuable data. It is recommended to IOTC to urgently order such tags for the first tagging cruise planned next September. The question of the intellectual properties generate by these two projects conducted in association with IOTC was raised by the Secretariat and is discussed in item 10.

Archival tags within IOTTP

Classic stock assessment approaches suffer severe parameterization problems. New process and habitat base models stress those problems but their parameterization requires data on tuna vertical behaviour, environment preference and movements of tunas between tagging and recapture that can be obtained from archival or pop-up tag data. That very valuable information brought by archival tags complements but does not replace spaghetti tags is recognized by the scientific community as a major input for a better and more comprehensive understanding and modelling of tuna stock exploitation. The archival tag technology is developing rapidly, and archival tags might soon be small enough to be used on skipjack tuna. In Hawaii, yellowfin and bigeye as small as 5 kg (FL 60cm) have been tagged successfully

with archival tags. Furthermore, if location by satellite of pop-up tags become more efficient, especially in the Indian ocean, the use of this type of tag can be considered as it gives data totally independent of the fisheries. In that respect, the 200 archival tags planned in the MRAG report on IOTTP will be insufficient as only few recapture can be expected from the release of that limited number.

Nevertheless, scientific questions that cannot be answered by conventional tagging and will require archival tagging should be well identified, with a release planning that will give the number of tags required. Then, the way to finance these extra tags will have to be addressed.

9. TAG RECOVERY

Guidelines on rewards for tagged fishes:

Fixed vs per-country rewards

The WPT discussed options for the value and type of rewards for tag recoveries and agreed that the IOTTP should remain flexible as to the amount and type of reward offered in different countries and to different fisheries. For example, European purse seine or Japanese longline fishermen would require a substantially higher value or different type of reward than one that may be suitable for artisanal fishermen of some coastal states. However, all agreed that the reward would need to be carefully chosen and adjusted so that each tag would have a very high likelihood of being reported.

Recommended reward value and type

The WPT was reminded that the MRAG study had provisionally set an average value of each tag reward at €5 per conventional tag and €500 per archival tag. It was felt that the conventional tag reward of $5 mean value may be conservative and should be carefully evaluated. Conversely, a reward of €200 might be sufficient for archival tags. This activity should be flagged as a priority item considering that medium scale tagging efforts may begin in 2003 in the Maldives and India.

A short discussion followed as to the need for cash rewards for sonic tags if they are used by projects related to the main tagging effort (see FADIO). Some felt that no reward should be offered for sonic tags since they do not archive data. However, experience in other regions has noted that fishermen make little differentiation between sonic or archival tags, and expect some level of reward for sonic tags. The return of sonic tags can be beneficial to the program as they can be re-deployed if they have adequate battery reserves. Discussion of exact amounts of cash rewards were deferred to a later date.

While a dollar value per tag needs to be estimated for budgetary purposes, the general type of reward also needs to be decided, and was the subject of lengthy discussion. The meeting agreed that it would be ideal to offer a choice of cash or merchandise rewards, i.e. items of clothing such as T-shirts or caps. It was noted that the articles of clothing serve two purposes: to provide attractive gifts for those returning tags and to advertise the IOTTP and promote awareness of the program to the general public. In this regard, caps, shirts or other tag rewards should be eye-catching, attractive and offered in a wide range of colours and sizes.

In order to advertise the IOTTP and emphasize the related nature of pilot tagging projects, it was felt that a single program logo should be included on all tag rewards and posters. Other aspects of poster and reward design may be customized to reflect localized concerns, such as printing in different languages. In other tagging programs, items such as insulated drink holders, coffee mugs, cups, calendars, etc. have been used to effectively advertise tagging efforts and foster tag returns with printed instructions. An interesting suggestion was to

modify the design of reward shirts periodically throughout the tag recuperation period to enhance their desirability. The main point was that tag rewards should be sufficiently desirable to promote the return of tags and associated recapture information. It was noted that incentives other than money create stock management difficulties (keeping stocks of different items and their distribution in many locations concerned by the IOTTP and small-scale tagging).

Due to the crowded agenda and time constraints, discussion on the details of specific tag rewards and the design of an IOTTP logo were deferred to a later date. It was felt that program personnel or special sub-groups of WPT members with experience in large-scale tagging programs could be trusted to address these points when necessary.

The Maldives project proposes to offer higher rewards for tags returned with full recapture data vs those returned without information. The Maldives has conducted highly successful tagging projects in the past, and their plans are likely to be very effective, given the small scale and community based nature of their fishery. However, it was agreed that the main IOTTP should not offer differential rewards based on levels of recapture data due to the risk of fishermen falsifying information to obtain the higher monetary rewards.

A WPT member with long experience with tagging programs suggested an interesting way to tailor the value of tag return rewards on a species and country specific basis. His experience noted that tag rewards could be set at the average value of the fish at local market price, or alternately set at approximately 3% of the local monthly minimum wage.

The WPT endorsed the importance of double tagging and agreed that each tag of a double-tagged fish should receive the same level of reward. .

Additional incentives to promote tag returns

It was pointed out that fishermen who recover a tagged fish also want to know when and where it was released. The meeting agreed that tag rewards and associated release information needs to flow back to those returning tags as quickly as possible in order to promote subsequent tag returns with more complete recapture data. It was noted that tagging programs normally issue a letter to every person returning tags, noting the date and location of release, distance between release and recapture, days at liberty and growth over that period, if accurate recapture length data is provided. It was noted that the IOTTP plans to do the same, although the mechanics of how this will be coordinated throughout the region have yet to be determined.

Lotteries and other incentives

Substantial cash lotteries are often offered by tagging programs to promote tag returns and publicize the tagging and tag return efforts. The WPT agreed that cash lotteries would be a regular part of the tag return and publicity work of the IOTTP, ideally tailored to target specific segments of the fishing industry. For example, lotteries are often held at tuna canneries, large landing ports or within a specific fishery, with the results widely publicized by local newspapers, radio and television.

It was suggested that specially coloured tags be seeded out at regular intervals during the tag release phase that would be worth high cash rewards. The use of high value tags would promote tag return awareness and also serve as a way to estimate reporting rates. To some degree, archival tags with high cash rewards would serve the same purpose.

Another innovative tag return mechanism suggested was to provide national lottery tickets for each tag returned, thus giving the fisherman a chance to win large cash prizes that would be taken care of by an outside, independent source.

Guidelines for the publicity campaign:

Where ?

The Secretariat supplied the WPT with tables indicating that more than 75% of the combined yellowfin and bigeye catch of the Indian Ocean is taken by 12 countries (or fleets). The highest proportion of the catch is taken by EC purse seiners and Taiwan-Chinese, Indonesian and Japanese longline-based fisheries. However, more than 30% of this catch is taken by countries engaged primarily in artisanal fisheries. The major unloading ports of Iran, Oman, Pakistan and Sri Lanka were listed in the table, which will be difficult to cover, requiring the cooperation of national fishery agencies and staff. The tagging program goals will benefit from national port sampling programs in countries like Sri Lanka, but tag recuperation efforts will be very difficult in most artisanal fishing areas. Countries like Oman with significant tuna exports, national fishery agencies might be able to approach export firms for cooperation.

It was noted that publicity for the major industrial purse seine fleets will be relatively easy by concentrating on the five major landing ports of Victoria, Diego Suarez, Port Louis, Mombassa and Phuket, as well as the major tuna canneries of the region. Likewise, IOTC port sampling programs for ice-carrying longline vessels will greatly assist tagging program publicity and tag return mechanisms.

However, tag program publicity and reporting from DWFN deep-freezer longline vessels of Taiwan and Japan will be much more difficult due to their long duration voyages and use of unloading ports outside the region or transhipment at sea. The assistance of national tuna research bodies and national tuna fishing federations will necessary and should be promoted by the IOTC and WPT members. A separate page on the IOTC website is recommended.

When ?

Considering that medium-scale pilot tagging projects may begin later this year in the Maldives and India, work towards a limited publicity campaign will need to begin in the near future. Tag recovery publicity will need to concentrate on these countries as well as on Sri Lanka and possibly the Laccadives where the bulk of recaptures may occur. However, the high seas purse seine fleet will also need to be informed.

The timing and scale of publicity was discussed, as the initiation a large-scale publicity program too soon could be counter-productive. However, there was a strong suggestion that a work plan and timetable be established, based on the beginning of the main tag release phase of the IOTTP. Start of the publicity campaign, finalization and printing of posters may be designed to begin 2 months prior to the beginning of tagging operations.

How ?

WPT members experienced with large-scale tagging programs stressed that every effort should be made to foster tag returns, particularly for longline fleets. Experience has established that it is not sufficient to rely on national fishery programs, volunteer efforts, posters or tag return envelopes. The importance of paid, dedicated tag liaison officers in major ports and working with significant fleets was stressed, particularly if they could speak the native language of the targeted fishery. Personal contact with the industry was also noted as essential to promoting tag recoveries.

It was pointed out that a full-time tag publicity and tag recovery post is budgeted within the IOTTP and will coordinate tag recovery efforts with IOTC port samplers and national tagging correspondents.

The IOTC has a basic tag return poster design that could be distributed to national tagging correspondents for translation into their native language. However, it will initially be necessary to determine which languages should be translated and which agency and contact address will be printed on the posters. The full commitment of the cooperating agency to handle tags, rewards and data will have to be secured, preferably in writing.

T. Nishida volunteered to assist with tag publicity efforts with the Japanese distant water longline fleet. The Secretariat indicated they would supply him with a tagging poster to translate and format in A4 size to be faxed to Japanese longline vessels for posting in vessel wheelhouses.

In addition, it was suggested that tag return envelopes with printed space to note capture date and details be made in a standard format that can be distributed to fishing vessels, landing ports and processing centres throughout the region. A further suggestion was made to print tag return information on vessel logbooks.

IOTTP logo and tuna tagging poster

The meeting suggested that a small working group coordinated by the IOTC Secretariat and WPT members be formed to design a suitable IOTTP logo and tag return poster(s).

Conclusion

The WPT emphasised the necessity for a well planned and designed publicity campaign that should use all means in order to insure and improve the tag return. This campaign should be initiated by IOTC Secretariat, at least on a limited basis, as soon as the small-scale tagging operations will start. This publicity campaign should be extended and increased when the IOTTP commences.

10. ESTIMATION OF REPORTING RATES:

It was stressed that estimates of reporting rates with reasonable precision from all major sector of the fishery were critical (especially for the estimation of fishing mortality rates and interactions). In this regard, it was noted that estimation of reporting rates for the longline and artisanal sectors has proved problematical in other large scale tagging programs and the importance of attempting to develop effective approaches for obtaining estimates from these sectors was stressed.

Tag seeding

Tag seeding experiments to estimate tag reporting rates are planned to take place within the IOTTP and were discussed by the WPT. A suggestion was made to double tag fish for seeding experiments to also allow some estimates of tag shedding rates in holds. However, the higher visibility of double tagged fish and possible higher shedding rates when tagging dead fish should be considered.

The meeting agreed that it would be important to conduct regular and numerous tag seeding experiments throughout the tag release and recovery phase on as many different fleets, fisheries and landing sites as possible, rather than concentrating on a few large experiments.

The suggestion to use some high value tags of a unique colour (i.e. gold?) to estimate reporting rates was also discussed. There is a body of literature on the use of high value tags that should be examined to assess the suitability of this tool for the IOTTP.

PIT tags as an alternative tagging tool

It was noted that PIT tags provide one approach that could potentially provide estimates of reporting rates for the longline and artisanal fisheries – two sectors identified above where this has been difficult in other large scale tagging programs. The potential use of PIT tag technology by the IOTTP was discussed. These tiny electronic tags are commonly used in salmon research and management and have been tested on cage-cultured southern bluefin tuna. Their ability to identify specific tuna may be another means to estimate reporting levels and shedding rates if fish are double tagged with conventional and PIT tags. Several technical questions arose that highlighted the lack of familiarity the WP had with PIT tag technology. It was suggested that the technical specifications and potential utility of PIT tags be investigated and reported to future WPT meetings.

It was emphasized that the major issue with the use of PIT tags for estimating reporting rates were not technical but in determining whether it was feasible for a substantial fraction of the catch to be scanned for the presences of these tags at the time of landing or in subsequent markets. This matter should be investigated further, particularly with respect to the practicality of being able to scan a substantial fraction of the longline and/or artisanal catches.

Observer data to investigate reporting rates in longline fisheries

It was noted that the only existing method for estimating reporting rates from longline vessels required observers on these vessels, while return rates from large, deep freezing longliners have been low in most tagging projects. Thus, unless observer programs are established for these longline fleets or other methods developed (e.g. PIT tags), the IOTP is unlikely to be successful in estimating reporting rates and thus fishing mortality rates and interactions for these major components of the yellowfin and bigeye fisheries.

The possibility of funding observers to enhance tag reporting by longline fleets was briefly discussed. Unfortunately, the Secretariat stated that the funding and running of a longline observer program specifically to assist the tagging program would not be an option due to funding and manpower constraints. The IOTTP may add further justification to the case for observer programs in the Indian Ocean, but can not be responsible to fund such a program. This was seen by some WPT members as a major drawback in the ability of the IOTTP to address interaction issues, unless some other means can be found to estimate non-reporting by longline vessels. It is the responsibility of the Commission to address a strong recommendation to member countries to study the implementation of observer programme in conjunction with the IOTTP.

Role of IOTC and the national correspondents

The IOTC has endorsed volunteer national correspondents to assist the IOTTP in each IOTC member country as well as some coastal states of the Indian Ocean. It is expected that these national correspondents will assist the tagging program with in-country publicity, tag returns, data handling and issuance of rewards.

Some WPT members felt that IOTTP needs will not be met by the volunteer efforts of persons already occupied with their own professional duties, and suggested the funding of dedicated tag recuperation agents at major landing ports and processing sites. At the least, it was suggested that the national correspondents be contacted by the IOTC to see if they were still willing and in a position to assist the program and what level of assistance can be expected.

11. OTHER MATTERS

Ancillary data collection

A dedicated tagging vessel supporting the IOTTP will have a complement of scientists, technicians and crew capable of conducting data collection and sampling in conjunction with tagging operations. These data concern both the tagging operations (state of the tagging fish and of the tag placement, etc.) and the collection of biological samples and data from fish rejected for tagging. For instance, WPT members suggested tagging cruises would offer valuable opportunities for marking of hard parts with OTC or other chemicals for age validation and growth studies and to collect samples to support a variety of studies that included:

a. standard biological data (length, sex, maturity, gut contents, etc.);
b. hard parts for age studies, i.e. otoliths, vertebrae; and
c. tissue samples for genetic databases;

In that respect, chemicals to tag tuna hard parts for growth and age studies are a subject of debate among scientists. Therefore, the group recommend that the best chemicals for injection should be studied to find out which one should be used.

In addition, it was suggested that data on vessel activity, condition factors of tag releases, tag placement, and baitfish should be collected. The abundance, species, size and capture details of all bait hauls should be recorded to assist the planning of tagging cruises, given the seasonality of Indian Ocean baitfish resources..

The large-scale tagging programs of the South Pacific Commission routinely collected a large amount of biological and environmental data, which is well documented in the technical literature. It was suggested that these programs be examined to assist in planning data collection and design of forms and databases. To some degree, this is already being undertaken by the Secretariat.

Data handling and analyses

It was agreed that the IOTC would serve as the central repository for the master conventional and archival tagging release, recapture and sampling database with subsets of the data made available to bona fide researchers or institutions. Subsets of the basic tag release data could also be made available to national correspondents to assist timely issuance of tag recovery letters to those returning tags and receiving rewards. Those requesting data for analytical purposes would make formal requests to the Secretariat and be held subject to standard rules covering confidentiality, distribution, crediting and publication. The FADIO coordinator reminded the WPT that special rules regarding the intellectual properties of data and analysis applied to this programme, notably as concern equipment, and that these data might not be provided for the tagging database.

A discussion followed concerning the importance and means to obtain the highest quality of tag release and recapture data, particularly in regard to accurate recording of release and recapture fork lengths. Publicity, training, the provision of measuring boards or callipers, the recording/calibration of measuring instruments and keeping a record of the persons making the measurements were noted as important to obtain high quality data. The use of a string to indicate fork length was noted as a simple, reliable means of obtaining accurate recapture lengths from artisanal fishermen.

Funds for the analyses of data generated by the IOTTP were not included in the EC funded projects, with the understanding that IOTC member countries would provide the necessary

manpower and funds. It was suggested that the Secretariat should at this time remind the member countries to reiterate their commitment to see this project through and assist with the analyses of IOTTP data.

A useful step towards the analyses of the tagging data is provided for in the project proposal in the form of IOTC coordinated workshops with member country participation. It is anticipated that the WPT will also play an important role in the coordination and implementation of these workshops and data analyses efforts.

Rate of double tagging?

The WPT discussed the rate of double tagging to be conducted by the IOTTP. It was suggested that it may be ideal to double tag every release which would allow the best possible estimates of tagger-specific shedding rates and safeguard to some degree the loss of release/recapture data if only one tag is shed. However, it was noted by experienced tuna taggers that the overall quantity of tag releases would be compromised if every fish were to be double-tagged due to the high catch rates possible on pole-and-line vessels associated to sporadic nature of the biting response.

It was suggested that some compromise in double tagging rates be reached that would not restrict overall release numbers while providing a statistically defensible quantity of double tags to allow robust estimates of taggers, species and size specific shedding rates.

It was suggested that fewer double tags might be needed for the full-time program staff on the pole-and-line vessels due to their supposed high expertise level and the possibility that double tagging might reduce the number of releases at times of very high catch rates. Other tag release platforms that produce fewer fish at slower rates, such as longline or handline vessels during small-scale operations could be required to double tag all releases. However, the impact of a high proportion of double tag releases on the rewards budget and possible differential return rates should be examined.

12. ELECTION OF CHAIRPERSON

Alain Fonteneau was nominated and elected unanimously to continue as WPT Chairperson for the next biennium.

13. ADOPTION OF THE REPORT

The report was adopted by the WPT on Friday the 13th of June 2003.

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APPENDIX II – AGENDA

1- *Opening of the meeting*
2- *Current status of funding available for the IOTTP*
3- *The EU DG-DEV Western Indian Ocean tagging project (based on the MRAG report)*
    a. *Objectives*
    b. *Proposed budget*
    c. *Schedule of activities*
    d. *Institutional arrangements: relationship between PMU, IOTC Secretariat, COI and WPT*
    e. *Possible vessel arrangements*
    f. *Guidelines for planning of releases (Simulation studies)*
4- *The problem of live-bait in the eastern and western Indian Ocean*
    a. *Study on availability of live bait*
    b. *ARDA feasibility study*
    c. *Proposed bait survey around Seychelles*
    d. *Situation in the eastern Indian Ocean*
5- *Prospect for large-scale tagging in the Eastern Indian Ocean*
    a. *Feasibility study for tagging from baitboat*
    b. *Other initiatives*
6- *Review of pilot studies conducted since June 2002*
    a. *FAD-fishing around Seychelles*
    b. *Tagging from handline fisheries in Oman*
7- *Small-scale and pilot projects for the period June 2003-2004*
    a. *Maldives*
        i. *interaction study*
        ii. *Handline*
    b. *Lakshadweep, India*
    c. *Mayotte*
    d. *Tagging by sport fishermen*
8- *Related projects*
    a. *TAGFAD*
    b. *FADIO*
9- *Tag recovery*

APPENDIX III – PLANNING FOR THE IOTTP RELATED ACTIVITIES

DATE OF COMPLETION	MAIN SUBJECT	RECOMMENDATION OR TASK	PERSON OR GROUP
Before Sept. 2003	Related projects; TAGFAD / FADIO	Order of yellow and red dart tags	IOTC Secretariat
For the next SC	Tag recovery efforts	Draft suggestions for the value and type of tag rewards for key areas, fleets and fisheries of the Indian Ocean region for review by WPT and national correspondents	IOTC Secretariat in collaboration with tag correspondents
For the next SC	Tag recovery efforts	Design generic IOTTP logo & poster	IOTC Secretariat with collaboration of national scientists
Before the end of 2003	Tag recovery efforts	Prepare a special tagging website on IOTC website	IOTC Secretariat
End of 2003	Tag recovery efforts	Investigate options for printing posters, shirts, hats, etc.	IOTC Secretariat
To report to next SC	Tag recovery efforts	Examine literature on use of high value tags for estimation of tag reporting, and utility to IOTTP	IOTC Secretariat
Before end of 2003	Tag recovery efforts	Study the feasibility of using passively detected tags (e.g. PIT tags) to estimate reporting rates	IOTC Secretariat/ Consultancy
End of 2003	Tag recovery efforts	Establish national collection point for tag returns, address, phone, fax, email etc that will go on native language poster	IOTC Secretariat
End of 2003	Vessel arrangements for main phase	Consulting for drafting the charter agreement.	Consultancy
End of 2003	Vessel arrangements for main phase	Research for suitable vessel(s)	All national scientists

DATE OF COMPLETION	MAIN SUBJECT	RECOMMENDATION OR TASK	PERSON OR GROUP
End of 2003	Pilot projects and small-scale tagging	Draft a proposal for a small-scale tagging program in Iran waters	Scientists from Iran
End of 2003	Pilot projects and small-scale tagging	Request official confirmation of Mayotte's commitment to small-scale tagging program	Administration from MayotteScientists
Progress Report at the next SC	Planning of releases	Simulation modelling to assist with the design of a robust tagging program in terms of release activities	National Scientists/IOTC Secretariat
Before the start of the IOTTP	Bait resources	Permission to countries concerned (Tanzania, Kenya, Madagascar, Mayotte, Comoros, Oman, Chagos)	IOTC Secretariat
Before the start of the IOTTP	Bait supply	Conduct a bait survey in the Seychelles Plateau	IOTC Secretariat/SFA
	Bait supply		
Before the start of the IOTTP	Pilot projects and small-scale tagging	Explore to possibility of access to Chagos area with authorities in charge	National scientists
Before the start of the IOTTP cruises	Pilot projects and small-scale tagging	Encourage high-quality tagging in a few selected localities.	Countries concerned (South Africa, Australia, Seychelles, Mauritius, Tanzania, Oman
Before the start of the IOTTP	Pilot projects and small-scale tagging	Tagging Manual, Draft protocols for conventional, archival and PIT tagging to be followed by IOTTP. Circulate for comment, revision and finalization	J-P. Hallier in collaboration with tagging experts
Before the start of the BB cruises	Tag recovery efforts	Extend list of national correspondents to assist IOTTP for DWFN fishery agencies, DWFN fleets and non-IOTC member countries	IOTC Secretariat

DATE OF COMPLETION	MAIN SUBJECT	RECOMMENDATION OR TASK	PERSON OR GROUP
Before September 2003	Tag recovery efforts	Contact national tag correspondents and determine level of assistance they will be capable of offering. Determine their ability to handle cash rewards, store shirts and hats, issue tag recovery letters and rewards. Obtain commitments to do so.	IOTC Secretariat/ National Correspondents
Before September 2003	Tag recovery efforts	Evaluate budgeted value of tag rewards and level of cash rewards for archival and sonic tags	National Correspondents
	Tag recovery efforts	Design tag recovery programs for key tag recuperation ports, areas and fleets. Establish flow chart of tags, data, letters and rewards.	IOTC Secretariat
	Tag recovery efforts	Draft a work plan and timetable of tag program publicity and reward mechanisms based on theoretical start date of Maldives/Lakshadweep Pilot Project and main large-scale tagging by IOTTP	IOTC Secretariat
Before the start of tagging operations	Tag recovery efforts	Determine languages and countries to translate poster. Send out for translation. Print copies as needed.(send poster to Tom Nishida for Japanese translation)	IOTC Secretariat with collaboration of national correspondents
For next SC meeting	Ancillary data collection	Study the best chemicals for injection to find out which one has to be used for age study	IOTC Secretariat
During IOTTP cruises	Ancillary data collection	To collect data on vessel activity, condition factors of tag releases, tag placement, and baitfish as well as abundance, species, size and capture details of all bait hauls.	IOTTP staff on board pole-and-line vessel
Before IOTTP cruises	Rate of double tagging	Examine and propose level of double tagging to be carried out by IOTTP to estimate tagger, species and size specific tag shedding rates	IOTC Secretariat

APPENDIX IV - REPORT OF THE SUBGROUP ON SIMULATION MODELLING APPROACHES

A subgroup met to discuss simulation modelling approaches to assist with the design of a robust tagging program in terms of release activities. The primary question that needs to be addressed is: the spatial/temporal distribution of tagging effort (i.e. where, when and how many tags should be released). It was recognized that the simulation needed to provide a design that would ensure there was a reasonable chance of getting sufficient returns to allow for reliable estimates of parameters of interest (particularly fishing, natural mortality and movement rates). It was recognised that, at this stage, the emphasis should be on a robust design that would provide a general plan for the number, location and timing of tag releases. It was also recognised that there are practical and logistical constraints in the implementation that will limit the tagging design. To the extent possible these need to be included directly into a simulation study. However, some issues cannot explicitly be incorporated into the modelling exercise and these will need to be considered when evaluating results from a simulation study.

Two simulation modelling approaches were considered, namely a simple compartmental spatial model and a more complex advection-diffusion model driven by environmental/habitat data. An initial model using the second approach had been developed for skipjack (REF). The group agreed that the two approaches are complementary. In the light of the type of questions needing to be addressed, the need to ensure robustness and the time constraint for getting answers (some initial results by December 2003), the group considered that in the short term a simpler model would be preferable, but that in the longer term, and as tags return data start to be collected, a more detailed and complex approach incorporating environmental factors would be valuable. It was recognized that such a model fitted to the tagging and other related data is potentially one of the important outputs from the tagging program when it is completed.

The small group recommended that a relatively simple simulation model be developed that could mimic a range of alternative hypothesis for the broad scale movement and the fishery among relatively large areas (e.g. Somalia, E and W Seychelles, Maldives) in the Indian Ocean and which could generate simulated tag return data for different release strategies. The group agreed that the model should at least contain the following features:

- spatial structure, in the form of sub-areas, for fish and fishery dynamics
- age/size structure for fish dynamics
- appropriate time scale (e.g. monthly or quarterly)
- different species with particular emphasis on yellowfin and bigeye

The model would need to be explored over a range of values with regard to key inputs, such as natural and fishing mortality, growth rates, movement rates, fishery selectivities, etc. to determine its sensitivity. The choice of time and spatial scale in the model would dictate the finest scale of detail at which answers could be given regarding where and when tags should be released.

The primary goal of constructing the simulation model is to provide a tool to help design a tagging program that is likely to deliver data (i.e. sufficient number of tag returns by areas and time period) which would allow one to distinguish between major differences in fishing mortality rates and movement hypotheses and thus to help ensure that the design was robust to uncertainties about movements, levels of fishing mortalities, etc. (One member of the group believed that a greater focus should be given to optimising the design in terms of statistical precision and accuracy.) Given this focus on robustness, the simulation model will need to be evaluated for a range of hypotheses, informed by the fishery data and any other knowledge. In order to ensure that the design is robust, it is important that not only the 'best' estimate of likely movement hypotheses is used, but also alternatives that are compatible with the spatial-seasonal distribution of fish as evident from the fishery.

It was considered that it would be sufficient in the development of the simulation model to retain the spatial structure only for juvenile fish and the purse seine fishery. In order to consider likely interactions between the

purse seine and longline fisheries, it was considered that the longline fisheries should be included, but the fish dynamics could be modelled in a simpler way (e.g. a single compartment).

Two key components were identified that need to be considered in generating simulated return data: (a) fishing mortality rates and (b) reporting rates for the purse seine and the longline fisheries.

It was noted that the design should be linked to the way in which data are likely to be analysed. For example, if it is likely that cohorts could be 'tracked' and tagged in subsequent years, then the focus of the simulation output should be the change in rate of returns from the same cohort over time. On the other hand, if this is unlikely, then the focus output would be pooled over release years. The group agreed that at this stage, and given current knowledge about growth and age structures, the latter approach (pooled return rates) would be sufficient.

The group noted that it is possible to evaluate a potential design by (a) considering numbers of returns in space and time (since the estimates of variance of most quantities to be estimated from tag are usually dominated by the actual number of returns and this is what will be most influenced by different release strategies), or (b) by developing estimators which would generate an estimates for the parameters of interests and their associated variances from the simulated data. The group agreed that option (b) was a complex exercise and may not provide realistic results since the estimator used is unlikely to reflect the actual analysis that would be used with the real data from the tagging program. Therefore, option (a) was considered sufficient for the task at hand, particularly given time and resource constraints.

It was noted that if the primary output from the simulation model were the spatial/temporal distribution of tags, criteria would be required to evaluate the relative merits of different designs. It was suggested that this might be done by attempting to ensure a minimum number of tag returns relative to the exploitation rate within a time/area strata. Developing appropriate performance/evaluation criteria will be an important part of the overall simulation project.

The group also agreed that the simulation model should be used to evaluate the effects of different assumptions about reporting rates including difference between fleets (particularly the longline fleet) on the performance of different potential tagging design.

The need for considering practicalities was emphasized and the effects of possible difficulties that might be faced by a tagging program should be tested. For example, the effects of a hypothetical scenario involving inability to tag in specific areas (due to a lack of suitable bait) should be investigated.

The small group considered that it was essential for there to be collaboration and feedback between whoever does the actual model development the Tagging Working Group. To facilitate this, it was recommended that a Steering Committee comprised of the members of the subgroup be set up that would work primarily through e-mail.