

PILOT AND SMALL-SCALE TAGGING OF TROPICAL TUNAS IN THE INDIAN OCEAN
PROJECT PROPOSAL FOR JAPAN
IOTC SECRETARIAT

I. The role of tuna fisheries in the Indian Ocean

A traditional fishery has existed for the three species of tropical oceanic tunas (skipjack, yellowfin and bigeye) in Maldives for a millennium. In 1952, the first industrialised longline fisheries entered the Indian Ocean and these were followed in the mid-80s by purse seiners. Catches have expanded tenfold over the last 25 years and now attain over 700,000 tonnes annually with an estimated value of over US\$2 billion (value at landing), to make this one of the largest and probably one of the most valuable tuna fisheries in the world.

To date, the main harvesting nations remain distant-water fishing nations. However, the benefits that are retained by the coastal nations, in particular the small island developing nations, are crucial to the welfare of their populations. The food security of many small coastal communities depends directly on these resources. Furthermore, the economies of coastal nations and, small island nations in particular depend on the benefits accrued not only as direct benefits from harvesting but also as indirect benefits in the form of licenses, servicing to the industrial fleets and fees paid for the use of port facilities.

II. Current management framework

The Indian Ocean Tuna Commission (IOTC), established in 1996 as an organization under Article XIV of the FAO Constitution, provides an appropriate institutional framework for the joint management of these resources. IOTC Members include most of the major participants in the fisheries, including both distant water fishing nations and coastal nations. As is the case with similar regional fishery bodies, IOTC makes management decisions on the basis of the advice provided by scientists from all Member nations with the purpose to ensure a sustainable use of these resources.

III. Uncertainties in the basis for management

In recent years, there have been reasons for concern about the status of the resources. Total fishing effort has been increasing rapidly. In addition, a large fishery has developed on purse seine fishing with Fish Aggregating Devices (FADs). These are drifting man-made objects, usually tracked by satellite or radio that aggregate small fish and greatly increase the ability of large purse-seine vessels to capture fish. Concerns have been voiced about the negative effects that excessive fishing on FADs might have on the productivity of important tropical tuna resources such as bigeye and yellowfin tunas because of the catches of juveniles. There have also been suggestions that this mode of fishing might be altering the ecosystem by modifying the behaviour of the tunas, their prey and predators aggregated to FADs.

Indian Ocean coastal states are also now strongly committed to increasing their direct stake in fishing for these species. This will therefore create a situation where accurate quantification of resources becomes crucial to permit equitable allocation and avoid harmful interactions between fisheries. The conservation of tropical tuna species, a key component of the large pelagic ecosystem in the Indian Ocean, depends directly on sound management decisions.

However, management requires scientific advice based on reliable data to fully realize the benefits from the resource. If significant uncertainties regarding the status of the resources remain, the tenets of the precautionary approach dictate that development should be limited by caution in order to avoid irreversible damage to the resource.

The statistical database available for the Indian Ocean, established under an FAO/UNDP programme, cover the full period of expansion of the fishery. Countries from the region are committing significant resources to maintain and improve their national monitoring systems and are contributing to the funding of IOTC.

However, while fishery data are and will remain crucial for monitoring the fishery, they cannot provide biological information related to stock structure, migrations, reproduction, growth and mortality of the fish that are essential for management of the fisheries. In addition, the analysis of traditional fishery statistics, although essential to correctly evaluate the status of the resources, is insufficient to resolve basic uncertainties. Even in a best-case scenario, the information from many years of monitoring and research are necessary to evaluate the potential productivity of shared resources. It is also now recognised that trophic relationships and environmental variability can have quantum effects on recruitment and spatial distribution of resources and these are as yet not fully understood.

Due to the highly migratory nature of tuna and tuna-like species, national research programmes can only provide partial answers to the existing uncertainties in assessments. Fundamental questions such as nature and extent of the migrations

of tuna stocks across the Indian Ocean cannot be adequately answered through national programmes but they will require an integrated effort to provide a global answer.

IV. A strategic programme to produce answers for management

The Scientific Committee of IOTC has recognized these problems and its inability to provide the much needed answers with the data currently available. Accordingly, it has proposed a strategic approach to reinforce the support needed by the decision making process of the Commission and to improve the management of the large pelagic ecosystem in the Indian Ocean.

The approach chosen is through the execution of a large-scale tagging programme coordinated at a regional level that has been repeatedly called for by tuna experts in the Indian Ocean. As it has been demonstrated in other regions, such a programme would be the most cost-effective way to produce a quantum improvement in the efficient modelling of stock status and in the quality of the information available for management decisions.

Precedents for tagging programme

The Indian Ocean is not a unique case in this respect. In the western Pacific Ocean a similar challenge was posed in the 1980s when scientists realized that the lack of knowledge about the characteristics of the resource significantly increased the risks of falling into an unsustainable situation. The solution was to engage into a large-scale tagging programme executed by the Secretariat of the Pacific Community and largely financed by EU funds that, in the course of a few years, provided the elements necessary to better model and manage tuna resources.

During the course of a tagging programme, large numbers of fish are captured and released alive after a small plastic tag has been attached. The fisheries will eventually recapture some of these fish and the information on these recovered fish allows scientists to better assess the status of the resource and aspects of the biology and behaviour of the fish. Other types of electronic tags, internal or pop up, also provide valuable behavioural information.

Benefits from a tagging programme

Table 1 provides an overview of strategic management issues that would be addressed by the proposed tagging programme. Although the list is by no means exhaustive, it is clear that the results of the tagging programme will have far-reaching implications for how well the Scientific Committee will be able to respond to key questions from the IOTC.

It is anticipated that, for the main Indian Ocean tuna stocks, this comprehensive programme conducted over the entire Indian Ocean basin will provide data to address the following issues:

- Structure of stocks and movement of tropical tunas;
- Exploitation rates by area and fishing gear;
- Biological characteristics of the resources, such as growth rates and validated age estimates;
- Data useful for estimating rates of fishery interactions;
- Influence of FADs, seamounts and areas of elevated vulnerability on the movement and exploitation of tunas, particularly for juvenile yellowfin and bigeye tunas associated to drifting FADs;
- Better understanding of the role of the oceanographic conditions on movement and exploitation of Indian Ocean tunas.

Tagging over a three-year period is required to:

- Tag individual cohorts over sequential years, an important element in estimating age-specific population characteristics; and
- Ensure that, regardless of major climatic events such as El Niño/La Niña, tags are released throughout the geographic range of the fisheries and across the size range of each species.

Tuna tagging programs throughout the world have traditionally tagged fish less than three years old, principally because these fish of these ages occur in large schools near the surface, where they are available to pole-and-line fishing boats. When only young fish are tagged, tag losses due to mortality and tag shedding result in very few fish being recaptured after more than 2-3 years at liberty. The short period at liberty of most recaptured fish makes the estimation of age-specific population parameters more difficult. As one of the main objectives of the proposed programme is to obtain estimates of these parameters over a broad range of sizes/ages, the programme will release tags into a wide a range of sizes/ages in each species, including medium and large tunas, using a wide variety of tagging platforms.

Table 1: Overview of important management issues addressed by the IOTTP.

Management Issues	Current scientific responses to management issues	The role of a tagging programme in improving scientific responses to management issues
1. What is the likelihood that the recent rapid increases in catches of small yellowfin and bigeye on FADs are having significant negative impacts on the Indian Ocean populations of these species? (B, Y)	<p>Very difficult to answer because:</p> <ul style="list-style-type: none"> Critically inadequate understanding of key biological parameters (age specific M& F, growth etc) lead to: Inadequate stock assessment for any of the species 	<ul style="list-style-type: none"> Tagging data will provide estimates of growth, age specific fishing and natural mortality for input into stock assessment models. Tagging data can also be used to estimate exploitation rates for each species, and as such provide allow the Scientific Committee to determine whether current levels of fishing are likely to lead to significant population decline.
2. Are there too many boats fishing in the Indian Ocean? (B, Y, S)		
3. Is the Indian Ocean basin the appropriate management unit for each of the key species?	As the stock structure of all key species remains uncertain, it is not possible to determine this with any confidence.	<ul style="list-style-type: none"> Data on movement patterns provided by a well designed, ocean basin-wide tagging programme would provide a basis for determining the stock structure of all species tagged.
4. What is the influence of FADs on the distribution and efficiency of the Indian Ocean purse seines fishery?	Unknown, because the influence of FADs on the movement and exploitation of tropical tunas in the Indian Ocean is unknown.	<ul style="list-style-type: none"> Within a tagging programme a core objective would be to determine the movement patterns and residency of fish at FADs and to examine the interactions between FADs,
5. What is the efficiency of time-area closures as a management tool for tropical tunas in the Indian Ocean?	Without information on residency, movement patterns and mixing rates it is not possible to evaluate this.	<ul style="list-style-type: none"> As above, data from a tagging programme would allow scientists to advise managers on the likely impact of time-area closures, taking into account the residence times, fish movement patterns and rates within different portions of the Indian Ocean.
6. What is the level of interaction between skipjack fisheries in the central and western Indian Ocean?	Largely unknown because little to nothing is known about residency, movement patterns and mixing rates of any species in the Indian Ocean	<ul style="list-style-type: none"> A critical output of a basin-scale tagging programme would be to provide data with which to examine the nature and extent of interactions between the many different sectors of the Indian Ocean tropical tuna fishery. Archival and pop-up satellite tags will provide the necessary information on habitat preferences of yellowfin and bigeye, and how these may change with age.
7. What are the nature and level of interactions between purse seine and longline fisheries? (B, Y)	Also the vertical movement of yellowfin and bigeye in the Indian Ocean poorly understood.	

V. The proposed stages of a large-scale tagging programme

The current plan calls for a programme divided into three main components and phases which are developed and coordinated under the IOTC framework:

An initial pilot phase

This phase of pilot tagging will take place during the first year of the project and its objectives are to:

- Assess the feasibility of tagging from non-conventional platforms such as longline, handline and troll fisheries in coastal countries and refine tagging techniques as necessary;
- Train personnel from coastal countries in tagging techniques from non-conventional platforms;
- Adjust estimates of total tags required to achieve the objectives of the main programme;
- Publicise the tagging programme and organize tag recoveries and reporting.

This phase is intended to adapt and improve existing techniques for tagging fish from vessels and gears not usually used for this purpose. This component is necessary as these platforms allow tagging fish of the required size range. When this pilot tagging has been proven to be successful, the IOTC and the concerned scientist will immediately plan a subsequent small scale tagging program and its budget (see V-b thereafter).

Small-scale localised tagging operations

These tagging operations will be conducted at a local scale, starting in 2002 and during the entire duration of the programme. They will be conducted in close co-operation between the IOTC and the various countries interested to run these small scale tagging in their fishing zones. These tagging operations will be limited to areas where tuna fisheries are already active. This tagging will be conducted using most often non conventional tagging gear, such as hand line, troll or longline. Small pole and line vessels will also be widely used to do this small scale tagging, but only when they are already available (Lakshadweep, Maldives, Indonesia, Australia). This tagging will rarely allow to tag large numbers of tunas because of its small scale. However, large tunas which are seldom tagged by the pole and line vessels used in most large scale tagging programme will be tagged in significant numbers. This small scale tagging will tag significant numbers of medium and large tunas with archival tags in various selected geographical spots.

The major difficulty faced by this widespread national tagging will be to ensure a consistent quality of tagging; this problem will be solved by a good selection and training of tagging technicians as well as by various real time monitoring of tagging operations by external tagging experts. The additional cost of this training and control will be included in each small scale tagging programme. This technology will provide highly valuable information on tuna behaviour and movements. This small scale tagging will also initiate active local publicity by IOTC to ensure reporting and recovery of tagged tunas.

The scientific goals of such small scale tagging will be limited primarily to measure tuna growth and to know better tuna movements in selected areas (and also their behaviour when archival tags are used).

A full-scale tagging programme

This phase of full large scale tagging has been proposed in 2000 by the Scientific Committee. It would span over five years and it is based on the operation of two pole-and-line vessels over two years, in addition to the various localised tagging operations from smaller vessels (cf. paragraph 5-b) and from various sport fisheries. It is planned to release about 80,000 tagged fish of the three target species. The main features of this phase include:

- Use of two major pole-and-line tagging platforms, based in the east and west of the Indian Ocean and supported by smaller vessels to be used in small scale tagging activities (e.g. longline/handline releases, Maldives in-country tagging);
- Simultaneous application of conventional, archival and satellite tag technology;
- Commitment to standardized methodology to produce high number of tag releases;
- A thorough publicity managed by IOTC and liaison effort with all landing places to maximise reporting of tag recaptures with high quality data on size and location at recapture;
- Comprehensive data analyses incorporating the integration of results across the time and spatial scales for which data will be collected.

Given the ocean-basin scale of the fieldwork, the tagging programme will need to be a multi-national effort. All IOTC members and co-operating non-contracting parties would be approached to assist with the programme. However, IOTC would take the lead role of programme co-ordination through formation of a special Tagging Programme Unit.

VI. Programme organization

The cost of the six-year IOTTP, and associated pilot studies, was estimated in 2000 at about US\$16.5 million. This sum is unlikely to be obtained from a single source, but several programmes are either already operational or are being planned. These include:

- A programme for the improvement of tuna statistics in Indian Ocean coastal developing countries. This programme, funded by the Overseas Fishery Cooperation Foundation (Japan), while not addressing tagging directly, does cover an essential complement to any tagging programme, which can only be effective if reliable statistics are available. The programme will also assist in tag recovery. The funding level is at about \$500 000 annually, and the programme is expected to run for five years.
- Funds recovered from the Indo-Pacific Tuna Programme. The funds amount to \$184 000 and are being used for consultancies and pilot programmes, one of which has recently been successfully concluded in Mayotte.

- A sum of €14 million has been requested and from the European Community DG-DEV Lomé VIII funds by Seychelles and Mauritius to initiate tagging in the western Indian Ocean. The beginning of this programme is planned for November 2004. There are also indications that further funds may be earmarked in the next funding cycle.
- The European Community has pledged annual funding at a level of about €200 000. A request has been submitted with specific proposals covering pilot or small-scale tagging operations in Mayotte, Seychelles and La Réunion, as well as a livebait project, a study on sports fishery tagging, publicity, rewards for tag recoveries, coordination and communications costs.
- The People's Republic of China has provided \$25 000 to support tagging activities.
- Indirectly, a large amount of funding in kind has also been provided or pledged by the various countries planning to initiate pilot and small scale tagging within the IOTC tagging programme.

VII. Proposed project for Japanese funding for 2003

Japan is requested to consider providing funding to cover part of the pilot programmes described at V(a) above which have been discussed and approved by the Working Party on Tagging. The specific activities and costs will involve:

- Small-scale tagging in Mayotte
- Small-scale in Eastern Indian Ocean, Indonesia
- Coastal FADs in Seychelles and live bait surveys

VIII. Description of pilot and small scale tagging activities

8-1- Small-scale tagging in Mayotte

Mayotte, French territory in the Indian Ocean, is situated at the entrance of the Mozambique Channel, which is an important fishing zone for purse-seiners and long-liners between March and June. Moreover, a traditional tuna fishery is active outside the lagoon of the island. Fishermen catch medium and big yellowfin with handline on free school or associated with anchored FADs. Some opportunistic tagging in collaboration with the artisanal fisherman is planned between March and June in Mayotte.

These tagging exercises give opportunities to tagged medium and big yellowfin which are not very catchable by pole and line. This could permit to have precision on biological parameters and on movement of these fish and will be a completion of the main phase.

Objective

This small-scale project will be run for a 3 month period in 2004. The major objectives are:

- To tag 400 medium and big yellowfins in the entrance of the Mozambique Channel
- In the same phase and simultaneously, to compare the tagging efficiency and costs of tagging in collaboration with the traditional handline fishery of Mayotte.
- To train local scientists and technicians in tagging techniques.

Activities

The catamaran of the fishery department (Service des Pêches et de l'Environnement Marin) of Mayotte will be the tagging platform for this project, but it will work in collaboration with the fisherman of the island. This device was tested during a pilot project in 2002 (Hallier *et al.*, 2002) and it was very effective. The fishermen are anchored near to a FAD and when they catch a fish they call the catamaran. The fish are bought from the fishermen at a higher price than the market price to motivate them to take part in the operation.

Publicity will be essential for the success of this programme to ensure a full recoveries of tags. As fishermen and tuna traders who are active in the Indian Ocean are not aware of tagging programmes, an active publicity campaign in the island to motivate the fishermen to work with the SPEM and to motivate them to report any recovery.

Outputs

The main outputs will be as follow:

- Technicians in Mayotte trained in tagging techniques and capable of tagging in an autonomous manner;
- Feasibility, numbers and cost of tagging from handline and Mayotte;

- Up to 400 yellowfin tagged with conventional tags;
- Data collected needed to estimate residence time and transfer rates for the main species tagged;
- Data collected needed to estimate growth.

Budget of the small-scale tagging 2003 in US\$

Cost of tuna	16 864
Fuel	7042
Salary (technician)	2 003
Rewards	661
Equipment/maintenance	630
Training by a tagging expert	3000
TOTAL	30 200

8-2- Pilot tagging in Eastern Indian Ocean (Indonesia)

A major gap in the IOTTP is the lack of tagging in the eastern Indian ocean. In order to obtain a comprehensive understanding of stock structure, movements dynamics and fisheries interactions, it is essential in a tagging experiment to release tags in all areas within a region in which a species occurs and where large fisheries exist. A first small-scale project will be conducting in the beginning of 2004 by the National Research Institute of Far Seas Fisheries (NRIFSF) in Indonesian water and this program will be complete another pilot project in Indonesia.

Objective

This project will be conducted by CSIRO in collaboration with Indonesia's research Institute of Marine Fisheries (RIMF) in the Indonesian waters off western Sumatra. The main objective of this Pilot project is to test methods and prepare a small-scale project targeting to tag more than 5000 tropical tunas with a bait boat. Furthermore, this program will permit to develop arrangements for voluntary tagging of yellowfin and bigeye tuna by recreational fishers in Western Australia.

This project is a first step to prepare more important fishing activities in the same area.

Activities

- Assess the daily catch rates at various sizes of the tropical tunas;
- Assess the operational conditions and costs for tagging larger numbers of tropical tunas;
- Assess the availability of bait
- Identify and train local tagging teams

Outputs

As the objective is to assess the number of fish that can be tagged in this area, it would be pointless to define the outputs in terms of the number of fish tagged. The outputs would then include:

- Fishermen and taggers from the area trained in tagging methods; and
- Catch/tagging rates assessed, needed to plan and budget for a full scale tagging programme estimated for each species.

Budget of the pilot tagging 2003 in US\$

Charter of tagging vessels for test	10000
Tagging/fishing equipment	7620
Operational cost	3000
Scientist consultant/travel	10000
Logistics	3000
Contingencies	1800
Total	35420

8-3- Coastal FADs in Seychelles and live bait surveys

The year around availability of high quality live bait to support the large pole and line vessels in the eastern and western Indian Ocean will be critical to the success of the program. Live bait has been seldom used by pole and line vessels in the Indian Ocean. It is of prime importance to study and to solve as soon as possible, before the beginning of the main phase of IOTTP, the problem of live bait availability in the Indian Ocean. One of the possibilities to supply the pole and line vessels with live bait, would be to catch them and store them in Seychelles where the boats will be based. It is planned to settle some coastal FADs (Indonesian model) to aggregate these bait and to make some fishing test with the Seychelles Fishing Authority R/V L'Amitié.

Activities

- Settle coastal FADs near the island of Mahé on the Mahé plateau;
- Follow and study the aggregation of potential live baits by observations *in situ*;
- Make some fishing tests with R/V L'Amitié around the FADs;

Outputs

Such a project will give assessment of the possibilities of catching live baits around Seychelles islands using coastal FADs.

- Assessment of the aggregation of potential live bait around coastal FADs in Seychelles;
- Catch rate assessed with different fishing methods and one different species;
- Possibilities of developing live bait storage facilities in Seychelles to supply the tagging vessels.

Budget of the coastal FADs project in 2003 in US\$

Coastal FADs material	2000
Charter of R/V L'Amitié (settlement of FADs, aggregation studies...)	2000
Fishing material and fishing tests with R/V L'Amitié	1000
Total	5000

IX. Funding requested from Japan

The funding requested from Japan is presented in tabular form below. It should be noted that national counterpart costs and the administrative and monitoring costs of the IOTC Secretariat are not included here.

Total cost of 2003 tagging and proposed breakdown by donor source in USD.

	Total costs	2003 Japan cost
Mayotte Small-scale		30 200
Pilot tagging in Eastern IO		35 420
Coastal FADs in Seychelles		5 000
Coordination costs (travel and communication...)		11 000
	Total	81 620