



Reinforcing the regional management of tropical tunas through an integrated research programme.

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. 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:

1.- 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

2.- SMALL-SCALE LOCALISED TAGGING OPERATIONS

These tagging operations will be conducted at a local scale, starting in 2004 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 (Laccadives, Maldives, Indonesia, Australia). This tagging will rarely allow tagging 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).

3.- 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 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 Programme Management Unit.

PROPOSED PROJECT FOR EUROPEAN COMMUNITY FUNDING FOR 2004

The European Community DG-FISH is requested to consider providing funding to cover part of the small-scale tagging programmes described above as well as various global costs linked with the tagging operations planned by the IOTC. The specific activities and costs will involve:

- **Small-scale tagging in Maldives**
Tagging of 3,500 fish from pole-and-line vessels in the Maldives.
This a continuation of a programme initiated the previous year.....€45 221
 - **Small-scale tagging in Lakshadweep Islands, India**
Tagging of 4,000 fish, mainly from pole-and-line vessels, involves training of local scientists€47 834
 - **Assessment of live-bait resources**
Assessment of various techniques to secure a continuous supply
of bait for the main phase of the RTTP€81 000
 - **Extended simulation studies**
Development of computer simulation studies to assist in the planning
of the main phase of the IOTTP€10 000
 - **Equipment and communications**
Cost of communications and equipment in support of the tagging activities€15 000
- Total funding requested.....€199 055**

These proposed activities follow the general strategy of implementation of the RTTP, described in section IV above. The small-scale tagging in Maldives does not require pilot feasibility studies, as the tagging techniques have been developed and tested in the two very successful experiments conducted in the area in the early 1990's. The small-scale tagging in Lakshadweep Islands, also using a pole-and-line tagging platform will benefit from that previous experience, and will integrate a component for training of local tagging technicians.

An essential element for the success of the RTTP-IO, the main phase of the IOTTP involving two pole-and-line vessels operating for two and a half years in the western Indian Ocean, is to ensure a continuing supply of live-bait. To date, the availability of such resources in the area of Seychelles is poorly known. The proposal calls for a number of surveys to be carried out to assess the existence of such resources in the Seychelles area, and to develop efficient fishing techniques for capturing live bait.

The timing and location of the release of tagged fish during the RTTP-IO will be dictated primarily by logistic and operational constraints (availability of live-bait, prevailing weather conditions, etc.). However, within those constraints there will be various choices for the areas of operation at any given time. Computer simulation studies allow exploring the likely benefits, in terms of the advancement in the knowledge of the status of the resource, of various release strategies. The proposed studies build upon existing simulation models that incorporate movement hypotheses based on environmental conditions, therefore providing a better assessment of potential situation during the tagging period.

The following sections provide a more detailed description of each of these activities.

V. SMALL-SCALE TAGGING IN MALDIVES

A project calling for the tagging of 3,500 tunas has been scheduled to be conducted during the 2004-2005 season. For the benefits of such project to be fully realized, such an experiment should be conducted over a number of years and, in particular, while tagged fish are being released in the core area of operation of the industrial fisheries.

The Indian Ocean Regional Tuna Tagging programme (RTTP) offers a unique opportunity to conduct such simultaneous experiments that should shed more light on the relation between the resources in Maldives and the rest of the Indian Ocean. The current document proposes to complement the activities of the RTTP with a component of tagging in Maldives at a fraction of the cost of the main phase of the programme.

OBJECTIVES

Tagging from Maldives will contribute to several of the objectives of the RTTP, such as an improved estimation of growth rates for tunas, local exploitation rates, and, obviously, an improved knowledge about the exchange rates between the different areas of the Indian Ocean. While the RTTP will concentrate mainly on bigeye and yellowfin tuna, the small-scale tagging exercise in Maldives will also tag skipjack, which is the main resource targeted by the pole-and-line fisheries of these islands, in order to assess possible interactions between the purse seine fisheries and the local catches.

PLANNED ACTIVITIES

The proposed project is based on the experiences from previous two experiments. The tagging platform remains the traditional dhoni vessels. This fleet has undergone a remarkable transformation towards larger, more efficient vessels, virtually all of them now in the 75-90 ft size range. They are all fitted with GPS, many of them with echosounding equipment and some with bird radars. Releases and the eventual recoveries can be better located thanks to the positioning equipment. More deck space provides for safer operations. All these developments mean that the vessels will provide an even more efficient platform than in previous experiments. Fishing techniques have changed to some extent as the boats now catch bait in the early morning hours with the help of lights, allowing them to be back to the base port before noontime.

As it was done before, rather than chartering the vessel, the tagging team will be on board during a regular fishing trip and fishermen will be paid a price per tagged fish that exceeds the regular market price to provide a financial incentive. A price differential will be paid for yellowfin tuna as to provide an additional incentive and to reflect different market prices for that species.

The tagging rate is expected to be about 100 fish tagged per day, which a conservative estimate, considering past experience. In this calculation, the number of days including the days used for travel to and from the tagging sites.

The proposal anticipates that two tagging teams of three taggers each will be deployed in the field. This, together with the anticipated tagging rate of 100 fish/day, results in the total estimate of 210 man/days field work, equivalent to a total of 35 days of field work to complete the release experiment.

The tagging period anticipated covers the main fishing seasons, especially during the northeast monsoon between November 2004 and April 2005. This could be complemented by some tagging during the southwest monsoon between June-August 2005, if the targets have not been met in the northeast monsoon season. The intended area of tagging is the area west of the northern atolls. The choice of the season and areas is consistent with the main objective being the estimation of exchange rates with the western Indian Ocean.

Special emphasis was placed on provide attractive rewards for tags returned. In particular, the proposal contemplates the release of a number of double-tagged fish to complete to estimate tag-shedding rates. This of particular importance as most of the personnel in the tagging teams will have little or no previous experience in tagging. A premium reward is to be paid when the whole fish is returned. This is to minimize to the extent possible length-at-recovery measurement errors, which complicate the estimation of growth rates from tagging data.

The Marine Research Center, under the Ministry of Fisheries, Agriculture and Marine Resources, will be the institution responsible for the execution of the project. A small component for training of new personnel has been added to the budget. Training requested covers not only field techniques but also facilities to produce fast reports to the fishermen returning tags on the history of the tag returned.

On the publicity campaign side, the MRC will be in charge of translating, printing and distributing the posters offering rewards for returned fish. The MRC produces a popular programme for TV Maldives, which would be an excellent vehicle to communicate the objectives as well as the progress of the programme, therefore ensuring a high return rate from a motivated community. It would provide an opportunity for emphasizing the importance of returning tags with full information including an accurate measurement of the fish.

This project would complement the information obtained from the tagging proposed from the Lakshadweep Islands and could also be supplemented by a pilot proposal to conduct tagging of large yellowfin tuna from the handline fishery near Male.

BUDGET FOR TAGGING ACTIVITIES IN THE MALDIVES

	Cost in euro
Payment for tagged fish	18 275
Rewards for recovered tagged fish	11 747
Equipment	3 013
Publicity campaign	2 295
Field expense	7 990
Contingency	1 901
Total	45 221

VI. SMALL-SCALE TAGGING IN LAKSHADWEEP ISLANDS, INDIA

India has proposed a programme with combined pilot and small scale tagging. This tagging will be conducted mainly in the Lakshadweep Islands, India, located at 12°N-72°E where an active pole and line fishery has been fishing for centuries. This fishery is catching 5 000 to 10 000t yearly of skipjack and yellowfin using mainly pole and line vessels, but also various other fishing gears. Some opportunistic tagging by a research longliner is also planned off the Indian coasts of the Arabian sea.

These tagging exercises will help establish transfer rates between Lakshadweep Islands and Maldives and possibly emigration rates to the purse seine fishery. By publicising tagging, they will also make tag reporting more likely if and when offshore tagging of skipjack is effected to measure interactions between the purse seine fishery and the small-scale fisheries in Lakshadweep and Maldives.

OBJECTIVE

This pilot project will be run for a 21 month period starting at the end of 2004 (only funding for expenditure expected in 2004 is requested). The major objectives are:

- In a first phase during the first 3 months (late 2004 early 2005), to test the tagging procedure and efficiency of the local traditional pole and line vessels. This gear being very similar to the Maldivian vessels which has been successfully used to tag tuna during the early nineties, the expectation of success are very good, and the plan is to tag 4 000 tunas. Yellowfin and skipjack are the species targeted by this tagging. The procedure used in Lakshadweep Islands to catch and to keep live bait in this fishery will also be fully studied, as these traditional techniques may be developed later in other areas.
- In the same phase and simultaneously, to compare the tagging efficiency and costs of tagging from the other fishing vessels used in Lakshadweep which are using a combination of troll and hand lines.
- To train local scientists and technicians in tagging techniques.
- In a second phase (2005), a combination of the most efficient tagging gear, probably dominated by pole and line, will be used to tag tunas of various sizes and species (targeting mainly yellowfin and secondarily skipjack) during a period of 12 months.
- Simultaneously and independently, tagging of medium and large sizes tagged yellowfin taken by a scientific Indian longliner in the Arabian Sea. In the future, and as a function of its tagging performances, this vessel could also tag large yellowfin in the Arabian Sea.

ACTIVITIES

Three types of vessels will be tested: pole and line, troll and handline vessels and a scientific longliner belonging to the Fishery Survey of India.

It appears in this fishery that the most appropriate and convenient way to work would be pay to the fishermen an agreed high price for all released fishes (without charter of the tagging vessels). This formula has been used very successfully during the Maldivian tagging operation in the early nineties.

The initial tagging will require the assistance of a tagging expert provided during one month by the project (at the beginning of the initial phase) to train the Indian counterparts.

Publicity will be essential for the success of this programme to ensure recovery of tags. As fishermen and tuna traders who are active in the Indian Ocean are not aware of tagging programmes, an active publicity campaign at national level is

essential. This publicity in India will also help to ensure that tags from other programmes recovered in India are reported to IOTC. This national publicity covering all Indian fisheries and tuna landing places will be managed by the Fishery Survey of India through print as well as audio-visual media.

OUTPUTS

The main outputs will be as follow:

- Technicians in India trained in tagging techniques and capable of tagging in an autonomous manner;
- Feasibility, numbers and cost of tagging from livebait, handline and longline in India established;
- Up to 1 000 yellowfin and 4 000 skipjack 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 TAGGING ACTIVITIES IN THE LAKSHADWEEP ISLANDS FOR 2004-2005

	Cost in euro
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Operational Cost	
Equipment to be locally purchased(tag holders, tagging cradles, gloves, helmets, etc)	1 649
Cost of tagged tuna	7 892
Publicity (locally procured)	2 550
Tag recovery expenses	638
Travel (domestic)	1 700
Field allowance for local staff	5 100
Miscellaneous	1 700
Sub-Total Operational Costs	21 229
Tagging equipment	3 230
Consultancy (tagging expert)	17 425
Travel (international)	3 400
Publicity (procured by the IOTC Secretariat)	2 550
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Total	47 834

VII. ASSESSMENT OF LIVE-BAIT RESOURCES

BACKGROUND

Access to a continuous supply of live-bait has been identified as one of the major uncertainties in the execution of the RTTP-IO in the feasibility study commissioned by the DG-DEV. The two pole-and-line vessels scheduled to operate for two and a half years will require sufficient live-bait at a reasonable distance from the intended areas of operation. Failure to secure such a supply will reduce drastically the time available for tagging operations or the potential areas for tagging.

Live-bait resources are still poorly known in the western Indian Ocean, and the IOTC has been conducting studies to rectify this situation. One of such studies proposed is the assessment of the availability of live-bait resources in the vicinity of the Seychelles Islands. If live-bait fish can be captured and maintained live at holding facilities in Mahé Island (the intended base port for the RTTP-IO pole-and-line vessels), a large logistic constraint will be removed.

OBJECTIVE

To assess the seasonal abundance of live-bait resources in the areas surrounding the inner islands of Seychelles

To evaluate techniques for capturing bait fish and catch rates

To train local fishermen in these techniques

ACTIVITIES

The core activity is a series of transect surveys in the waters surrounding Mahé to detect any potential source of bait fish. These surveys will be conducted by a fishing vessel, chartered locally and equipped with the fishing and detection gears suitable for locating and catching live-bait fish. The plan calls for the surveys to be carried out at regular intervals in the waters around Seychelles to assess seasonal changes in abundance. A master fisherman with relevant experience in the catch of small-pelagic species will be hired as a consultant to develop the appropriate gear configuration and fishing techniques.

BUDGET FOR THE ASSESSMENT OF LIVEBAIT RESOURCES	Cost in euro
Sonar	15 000
Sonar installation	4 000
Bait fishing experiment equipment	15 000
Boat charter for test	31 000
Consultancy	14 000
Contingencies	2 000
Total	81 000

VIII. EXTENDED SIMULATION STUDIES

The timing and location of the release of tagged fish during the RTTP-IO will be dictated primarily by logistic and operational constraints (availability of live-bait, prevailing weather conditions, etc.). However, within those constraints there will be various choices for the area of operation at any given time. Computer simulation studies allow exploring the likely benefits, in terms of the advancement in the knowledge of the status of the resource, of various release strategies.

The proposed studies build upon existing simulation models that incorporate movement hypotheses based on environmental conditions, therefore providing a better assessment of potential situation during the tagging period. However, due to the structure and requirements of the model, these simulations require a careful tuning of the parameters. Scientists from the Institut pour la Recherche et Développement (IRD), France, have developed such general model for the

Indian Ocean with an initial tuning of its parameters to simulate the characteristics of the skipjack tuna. The funds requested will cover the expenses of hiring a junior scientist for a period of six months to complete this study, under supervision by IRD scientists, adapting the existing model for the cases of the yellowfin and bigeye tunas.

BUDGET FOR THE EXTENDED SIMULATION STUDIES	Cost in euro
Hiring of a junior scientist	10 000
Total	10 000

IX. EQUIPMENT AND COMMUNICATION

This component accounts for general expenses related to the implementation of the projects listed in previous sections. These expenses include travel for coordination and support by IOTC staff members, costs of communications, and purchase of materials needed for raising awareness of the goals and characteristics of the tagging activities.

BUDGET FOR EQUIPMENT AND COMMUNICATION	Cost in euro
Communications	3 000
Travel	10 000
Computer equipment	2 000
Total	15 000

X. FUNDING REQUESTED FROM THE EUROPEAN COMMUNITY

The funding requested from the European Community is presented in tabular form below, together with a partial estimate of counterpart costs for various national agencies involved. It should be noted that the administrative and monitoring costs of the IOTC Secretariat are not included here.

TOTAL COST OF 2004 TAGGING AND PROPOSED BREAKDOWN BY DONOR SOURCE IN EURO

Total costs	2004 EC cost	2004 counterpart costs
Small-scale tagging in Maldives	45 221	13 000
Small-scale tagging in India	47 834	30 000
Assessment of live-bait resources	81 000	25 000
Extended simulation studies	10 000	20 000
Equipment and communications	15 000	
Total	199 055	120 000
	Grand total	319 055

XI. FUNDING REQUESTED FROM OTHER DONORS

TOTAL COST OF 2004 TAGGING AND PROPOSED BREAKDOWN BY DONOR SOURCE IN EURO.

Total costs	2004 Japan cost	2002 China cost	National/IOTC counterpart cost
Tagging in the eastern Indian Ocean	71 400		80 000
Equipment cost and uncommitted funds		21 250	
IOTC staff and administrative support			40 000
Total	71 400	21 250	120 000
		Grand total	212 650

XII. TOTAL FUNDING REQUESTED FOR SMALL-SCALE PROJECTS IN 2004 (IN EURO)

Total costs	2004 Donor cost
European Community funding	199 055
Japan Funding	71 400
China funding	21 250
National counterpart cost	200 000
IOTC staff and administrative support	40 000
Total 2004 funding	491 705