iotc ctoi Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien

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

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 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.

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.

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 or 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.

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 call for by tuna experts in the Indian Ocean. As it has been shown in other regions, such a programme would be the most cost-effective way to produce a quantum improvement 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 understand the productivity of the 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 allow scientists to better assess the status of the resource and aspects of the biology and behaviour of the fish. Other types of electronic tags also provide 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 interaction;
- 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, using a variety of tagging platforms.

The proposed stages of a large-scale tagging programme

The current plan calls for a programme divided into two main phases:

a) An initial pilot phase.

This phase 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.

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.

b) A full-scale tagging programme.

This phase spans over five years and it is based on the operation of two pole-and-line vessels over two years, in addition to tagging operations from smaller vessels. It is planned to is 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 special tagging activities (e.g. longline/handline releases, Maldives in-country tagging);
- Application of conventional, archival and satellite tag technology;
- Commitment to standardized methodology to produce high number of tag releases;
- A thorough publicity and liaison effort to maximize 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. The Unit would comprise the following staff:

- Programme leader - Co-ordinate the programme, senior staff supervision, data analyses, reporting.
- Field Co-ordinator, - Responsible for field logistics, tagging protocols, supervision of tagging staff, publicity and tag recuperation.
- 4 Senior Tagging technicians – train national tagging teams, conduct tagging and record tagging data on oceanic pole-and-line vessels.

Funding of the programme

The pilot phase will be initiated from funds available to the IOTC Secretariat, with funding support from Contracting Parties anticipated in 2002. Only operating costs are budgeted in the coastal country activities as it is anticipated that vessels and staff time will be provided by the countries concerned.

For the main programme phase, it is anticipated that many elements, in particular those involving scientific analysis, vessel time for coastal activities, in-country publicity and tag recuperation, will be provided as in-kind contributions. The direct funding will be sought on a cost-sharing basis. Some of the main participants of the fishery, such as the European Union, has indicated its willingness to co-fund the main programme.

Conclusion

The Indian Ocean Tuna Tagging Programme (IOTTP) has been designed to provide data that is urgently required for the development of a sound management plan of the large pelagic ecosystem in the Indian Ocean. Such a strategic plan needs to be implemented as soon as possible to reduce risks of overexploitation and to allow for development when possible.

The IOTTP is based on the approach taken by very successful tagging programmes in other regions of the world. Most of the IOTTP objectives, logistic challenges and technological requirements are similar to those programmes and

the programme will benefit from the experience accumulated in those precedents. Thus, it is reasonable to assume that the IOTTP, to be run by the IOTC Secretariat and member countries, will be successful in meeting its broad objectives.

The cost of the six-year IOTTP, and associated pilot studies, is estimated at US$16.5 million. Given the immense social and economic value of the fishery throughout the Indian Ocean, we believe this level of investment is well justified. To delay this essential programme, and wait until stocks are clearly in decline before acting, would be contrary to the philosophy and treaties underpinning responsible fisheries management in the 21st century.

***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)	Very difficult to answer because: • Critically inadequate understanding of key biological parameters (age specific M& F, growth etc) lead to: • Inadequate stock assessment for any of the species	• 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.	• 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.	• 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.	• 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, movements patterns and rates of fish 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 Also the vertical movement of yellowfin and bigeye in the Indian Ocean poorly understood.	• 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)		

Table 2: *Chronological diagram of the planned IOTTP activities.*

	Pilot Study	IOTTP					
	Year 0	***Year 1***	***Year 2***	***Year 3***	***Year 4***	***Year 5***	***Year 6+***
Funding agreement by donors	**yes**	***yes***					
Tagging WG	1 WG early in year 0	1 WG early in year 1	1 WG	1 WG	1 WG	final symposium	
Tagging equipment	initiate: early year 0	full scale	maintenance	maintenance	maintenance		
Bait supply	Bait studies	organize access to bait	yes	yes			
Main tagging by P&L vessel			yes	yes			
Small scale tagging	Small scale Tagging		yes	yes	yes		
Tagging by sport fishers	initiate	full scale	full scale	full scale	full scale	full scale	
Training of technicians	initiate	full					
Publicity & Communication	initiate	full publicity	full publicity	lower publicity	lower publicity		
Rewards and lotteries	initiate	yes	yes	yes	yes	yes	
IOTC Scientific staff	1 study coordinator	Programme leader	Programme leader	Programme leader	Programme leader	Programme leader	
IOTC Scientific staff		Field coordinator	Field coordinator	Field coordinator	Field coordinator		
IOTC Scientific staff			4 tagging technicians	4 tagging technicians			
National tagging coordinators	yes	yes	yes	yes	yes	yes	

Table 3*: Proposed budget for the preliminary phase in 2001-2002 (in thousands of US dollars)*

Cost element	**Cost**
Seychelles LL tagging	30
India LL tagging	45
Oman tagging	20
Tags, tagging equipment and accessories	15
Small scale publicity	10
Tagging expert	120
Total budget	**240**

***Table 4**: Budget summary for the tagging programme (IOTTP) (in US dollars thousands)*

	Year					
Type of cost	**1**	**2**	**3**	**4**	**5+**	**Total**
Small vessels: Longline, artisanal & scientific		*150*	*150*	*150*		*450*
Sport fishery tagging: coordination & support	*40*	*10*	*10*	*10*		*70*
Tags, tagging equipment and accessories	*170*	*45*	*45*			*260*
Rewards and lottery for recoveries		*100*	*100*	*50*	*30*	*280*
IOTC technical and scientific staff	*220*	*690*	*690*	*290*	*150*	*2,040*
Publicity and communication	*80*	*10*	*10*	*10*	*10*	*120*
Training of tagging technicians	*10*	*10*	*10*			*30*
Support salaries of tagging staff		*100*	*100*	*100*		*300*
Travels costs	*50*	*100*	*100*	*50*	*30*	*330*
Meetings		*20*	*20*	*20*	*20*	*80*
Large P&L East rental & running cost		*1,500*	*1,500*			*3,000*
Large P&L West rental & running cost		*4,000*	*4,000*			*8,000*
Archival tags		*250*	*250*	*250*		*750*
Bait supply		*20*	*20*	*10*		*50*
Contingency	*29*	*350*	*350*	*47*	*12*	*788*
Total	***599***	***7,355***	***7,355***	***987***	***252***	***16,548***

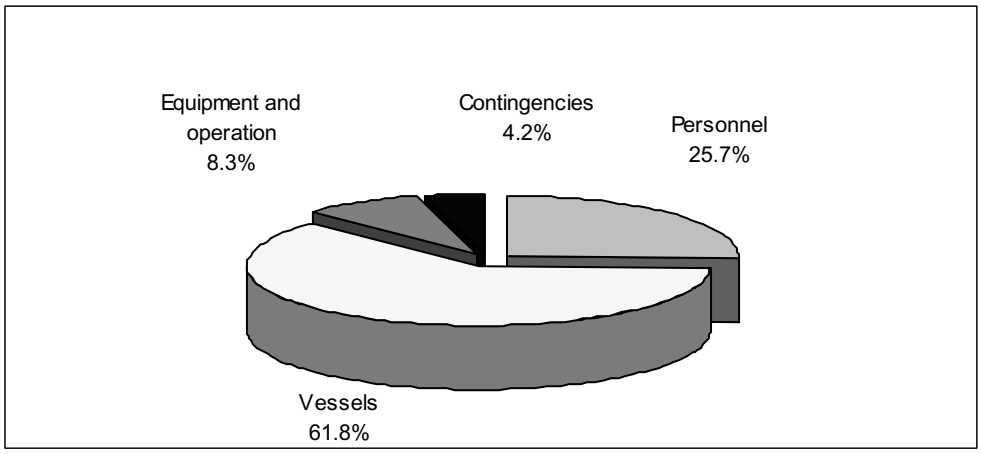

***Figure 2:** Synthetic diagram showing the main chapters of the IOTTP planned budget (total budget of US$16.6 million)*