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The second progress report on the implementation of the IOTC bigeye thresher shark post-release mortality study project (IOTC BTH PRM Project)

IOTC BTH PRM Project Team*

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ABSTRACT

We present the progress report of the IOTC bigeye thresher shark post-release mortality study project (IOTC BTH PRM Project). The goal of the study is to evaluate the efficiency of the IOTC Conservation and Management Measure on non-retention of thresher sharks of the genus *Alopias* (Resolution 12/09). The summary of the collective efforts since the 13th and 14th IOTC WPEB are presented here, including development of formal documents, operating standard manuals, training, PSATs distribution, and field operations. Further steps for the project implementation are also described.

Introduction

Sharks are harvested either by direct targeting or as bycatch in the IOTC Area of Competence by a variety of fleets and gears, including industrial (purse seine and longline), semi-industrial (drifting gillnets, coastal longline and pole and line), artisanal (gillnets, hand lines) and recreational (sport fishing) (IOTC, 2014; IOTC-IOShYP01, 2014).

"Although diverse, the biological characteristics of these species share some general patterns that make them potentially more susceptible to overfishing than other species, namely because they generally have a low reproductive potential, are slow growing and mature late compared to other species" (IOTC-IOShYP01, 2014). Therefore, appropriate conservation measures are necessary to preserve shark populations in order to preserve biodiversity and ecosystem stability.

Sharks caught as unwanted bycatch for many fleets are discarded dead or released alive. Live release of sharks has been considered a robust measure of conservation for non-targeted species. IOTC Resolutions 12/09 and 13/06 prohibit the retention of any part of thresher and oceanic whitetip sharks, aiming at promoting the release of those species in order to support conservation efforts. However, the effectiveness of these retention ban policies has not been evaluated in the Indian Ocean and is probably overestimated due to the high level of haulback mortality (Coelho et al., 2011) and unknown levels of post-release survival of both species.

Tagging with Pop-up Satellite Archival Tags (PSATs) has proved to be an expensive but highly efficient tool to estimate post-release survival and mortality (both immediate and delayed) for many marine top predators (e.g. Moyes et al., 2006; Skomal, 2007; Musyl, 2015), and sharks in particular (Moyes et al., 2006; Campana et al., 2009; Musyl et al., 2011; Poisson et al., 2014). In addition to an efficient estimation of post-release survivorship, PSATs also provide important information on species ecology such as horizontal and vertical movements, habitat use and diel behaviour.

Post-release survival of sharks depends on numerous factors, including fishing gear, handling and release practices, shark condition or 'health' at the moment of capture/release, etc. In the Indian Ocean information on the post-release mortality of sharks is only available for a single species captured by a single gear, namely silky sharks caught under Fish Aggregating Devices (FADs) used in purse seine fisheries (Poisson et al., 2014). Based on this study, a 'Best practices' guide was developed for the release of sharks from purse seine fisheries (Poisson et al., 2012). Some preliminary informations from PSATs were also obtained for whale sharks released from purse seine nets (Escalle et al., 2014).

Survival rates of shark species caught and released from longline fishing gears are still unknown. This study is focused on the bigeye thresher shark (*Alopias superciliosus*, BTH), a species with a retention ban is in place (Resolution 12/09), which is the principal thresher shark species occurring as bycatch in the major fleets. The bigeye thresher shark is mostly impacted by LL gear as it has relatively minor interactions with other gears.

The primary objective of this study is to assess the post-release mortality of bigeye thresher sharks caught and released (in accordance with IOTC CMMs[1]) by the major commercial longline fleets fishing in the IOTC Area of Competence, using common handling practices.

[1] Indian Ocean Tuna Commission Conservation and Management Measure: Resolution 12/09 *On the conservation of thresher sharks (Family Alopiidae) caught in association with fisheries in the IOTC Area of*

Experimental design

Experimental design of the study was discussed during an *ad hoc* meeting of IOTC scientists organized within the framework of the 13th WPEB in San Sebastián, Spain, and further developed intersessionally before the 14th WPEB held in Cape Town.

Two types of tags are used in this study: (i) survivorship PATs (sPATs) that are designed to evaluate short-term post release mortality (up to 60 days) and (ii) miniPATs for evaluating potential delayed mortality beyond 60 days, and obtaining additional high-priority information for WPEB (IOTC-WPEB13, 2017, IOTC-IOShYP01 2014) such as data on horizontal movements and habitat use. The total sample size is 54 tags: 34 sPATs and 20 miniPATs, distributed across all fleets included in the project. Assuming an average non-reporting rate of 10%, it is expected that information will be obtained from at least 48 BTH tagged (minimum recommended sample size is 40 individuals) (Common Oceans, 2017). In order to obtain data that are representative of the actual level of post-release survival of bigeye thresher sharks in commercial fishing operations, tags are deployed from commercial longline vessels fishing following their usual shark handling practices. To ensure correct tagging procedure and data reporting only observer-covered vessels are considered. Tags are deployed by trained scientific observers or trained crew members who can allow sufficient time to tagging with minimal disruption to the standard release methods used by the crew.

Five major fleet were initially expected to take part in the project: Japan (tropical tuna fleet), Taiwan,China (tropical tuna fleet), EU: France, Portugal, and Spain. However, during the project development phase Spain withdrew itself from the project (communication with Instituto Español de Oceanografía (IEO) in January 2018) and South Africa agreed to join the team.

By late 2018, Japan expressed its will to decrease number of tags to be deployed (compare to initial experimental design, see IOTC-2018-WPEB14-27) in view of project timelines and logistic constraints. Therefore, during 2019, efforts were focused to invite another partner from the country that operates observer-covered longline fleet in the Indian Ocean. China was considered as a one of the major fleets in the region and China Shanghai Ocean University which manages an observer program was considered as a potential partner and joined the project.

The complete experimental design document was presented during the 14th WPEB and is available as appendix in working paper IOTC-2018-WPEB14-27.

Equipment acquisition

A tender for PSATs and tagging equipment acquisition was posted by IOTC in accordance with FAO rules, including a call for Expressions of Interest from suppliers to fully explore the market. Strict FAO requirements caused some delay in the purchase of equipment and this finally concluded in April 2018, i.e. five months after the intended purchase date of November 2017.

Pop-up Archival Satellite Tags (PSATs) were purchased from a single manufacturer, Wildlife Computers, to ensure comparability, reliability and performance. The supplier was selected based on known tag performance and reliability based on IOTC and international experts' opinion and available recommendations (Common Oceans, 2017).

Competence. http://www.iotc.org/cmm/resolution-1209-conservation-thresher-sharks-family-alopiidae-caught-association-fisheries-iotc

Complementary equipment including tagging poles, applicators and equipment for tag programming and manipulations (magnets, USB cables) were also purchased and polo shirts were designed as incentives for project participation and advertisement materials.

LoU

A Letter of Understanding was developed to formalize the engagement among project Partners by outlining the project objectives, methods and outputs as well as defining roles and responsibilities of each partner organization. The LoU was finalized by 21 June 2018 and was signed by all Partners by 15 August 2018.

China as a new Partner signed the LoU on 25 July 2019.

Tag preparation and distribution

The project coordinator, Dr. Romanov, undertook a mission to IOTC Headquarters in Seychelles between 29 April and 6 May 2018. The principal goal of this trip was the programming of tags and the preparation of tagging kits for each partner organisation. The mission was successfully completed: all 54 tags were programmed according to the tagging template agreed by the project team (see Experimental Design, IOTC-2018-WPEB14-27) and 54 tagging forms printed on waterproof paper with a unique tag ID number already printed on the form. The equipment was combined into five tagging kits; one for each partner. Each tagging kits included: tagging poles (1.8 m long), short tagging handles, tagging applicators, USB interface cable for satellite tags and magnets for tag activation and manipulation.

Tags were distributed between Partners during 2018-2019 (Table 1) behind planned schedule (2018). Tag distribution delay reflects delay in tag acquisition, shipping problems in view of tags cost, changes in the Project partnership and Partners tag deployment expectation.

Training material

In Febuary 2019 an updated version of the tagging manual (v2019.2) was developed: 'IOTC manual for tagging bigeye thresher shark (BTH) with pop-up satellite archival tags (PSAT) to evaluate post-release mortality (PRM)'. The manual is presented as an information document (IOTC-2019-WPEB15-INF07). Manual was translated into Chinese by Dr. Yi-Te Huang, Overseas Fisheries Development Council of Taiwan (IOTC-2019-WPEB15-INF08).

A tagging poster (Appendix I) was also developed in English and French for wide dissemination of the information about BTH PRM Project. The English english version of the poster was distributed among Partners for further dissemination in current form or translated into Partners' languages.

Training

Tagging training course was organized for Taiwan,China from 25 to 27 February 2019 in the National Kaohsiung University of Science and Technology (NKUST), Kaohsiung, Taiwan,China. At total of 43 participants (Appendix II) attended the training course, including 23 observers from Overseas Fisheries Development Council of the Republic of China, and 6 Master Students from NKUST who also will participate in the tagging activities. Training was given in English with translation into Chinese. All planned activities were achieved.

Training of French observers for Reunion Island-based longline fishing fleet is performed on a routine basis for all experienced observers.

Japan organized an observer training in NRIFSF in May 2019.

Several Partners requested video training material focused on successful BTH tagging operations, however, it is not available yet from IOTC BTH PRM Project. Following Partners' request the Program Coordinator have contacted several scientists involved in BTH tagging programs in other oceans. Three videos were kindly provided by Melanie Hutchinson and Mark Royer (http://sharktagger.org/) who performed a BTH PRM study on longline fleets in the Pacific Ocean. Video is available by request and will be presented during the 15th WPEB.

Tagging efforts to date

In 2018 tagging operations were performed by Portuguese observer onboard a Portugal-flagged longline vessel in the south-western Indian Ocean. Although IOTC tags were not yet available at the moment of vessel departure, thanks to co-operation with the similar PRM study (Project POREMO, IRD) for oceanic whitetip shark (*Carcharhinus longimanus*), the Portuguese Partner were supplied with four tags ahead of schedule: 2 mini-PATs and 2 sPATs.

A total of 3 BTH were tagged (2 with mini-PATs, and 1 with sPAT) (Table 1). Preliminary results were presented and discussed during the 14th WPEB meeting.

In 2019, tagging operations covered Portuguese, French, and Taiwanese fleets with a total nine bigeye thresher sharks tagged by 15 August 2019. Despite efforts developed by South Africa, no bigeye thresher shark has yet been tagged. Initial tagging strategy in South Africa was focused on local (South Africa-flagged) longline fishing fleet. Since March 2019 tagging attempts were extended to international longline fleet covered by South African observers.

Japan shipped 2 sPATs to their observer-covered vessels but fire accident on the designated vessel urged Japan to abandon all scientific operation onboard this vessel. Tagging operations onboard Japanese fleet are postponed until 2020.

Table 1. Summary of PSATs deployment by partner

Fleet	Partner	Number of tags distributed		Year of distribution	Shark tagged				
					2018		2019		Total
		sPAT	Mini-PAT		sPAT	mini-PAT	sPAT	mini-PAT	
Japan	NRIFSF	4	0	2019					
Taiwan,China	KNU	8	5	2019			3	3	6
EU,France	IRD	8	4	2018				1	1
EU,Portugal	IPMA	6	4	2018	1	2	4	3	10
South Africa	DAFF	4	2	2018					
Not yet distributed	ShOU	4	5	2019 (this meeting)					
Total		**34**	**20**		**1**	**2**	**7**	**7**	**17**

Preliminary results

Among the 3 BTH tagged in 2018 (PTTs: miniPATs 49082, 49084; sPAT 46289) all tag reported data. According to shark behaviour evaluated from depth profiles one bigeye thresher shark sank immediately (immediate mortality), another one shark experienced delayed mortality (2 days after tagging). One tag (sPAT) detached immediately after deployment and, thus, data was no useful (Fig. 1).

From the 14 BTH tagged since January 2019 (PTTs: miniPATs 56533, 56537, 56539, 56550, 56551, 56554; sPATs 46290, 56578, 56581, 56582, 56637, 56712, 56714, 56720) a total of 10 tags popped-up and reported data while 4 tags are still in water attached to sharks. Among the 10 tags that reported data, 8 operations resulted in immediate or delayed mortalities (Fig. 1). Two sPATs demonstrate sharks survival over 60 days (Fig. 1). Four not-yet-reported tags (assumed still to be attached to alive bigeye thresher sharks) are expected to pop-up in November-December 2019.

Geographic distribution of tag deployment is shown at the Figure 2.

As a preliminary estimation of post-release survival for bigeye thresher shark caught by pelagic longline fleet in the Indian Ocean is 37.5% (6 apparent survivals among 16 tags with non-failed attachment).

Perspectives

In view of the delay in the project implementation, it is expected that tagging operations will be extended through the entire year 2020. In this context it is highly desirable to extend project duration till December 2021 (i.e. one year extension behind schedule).

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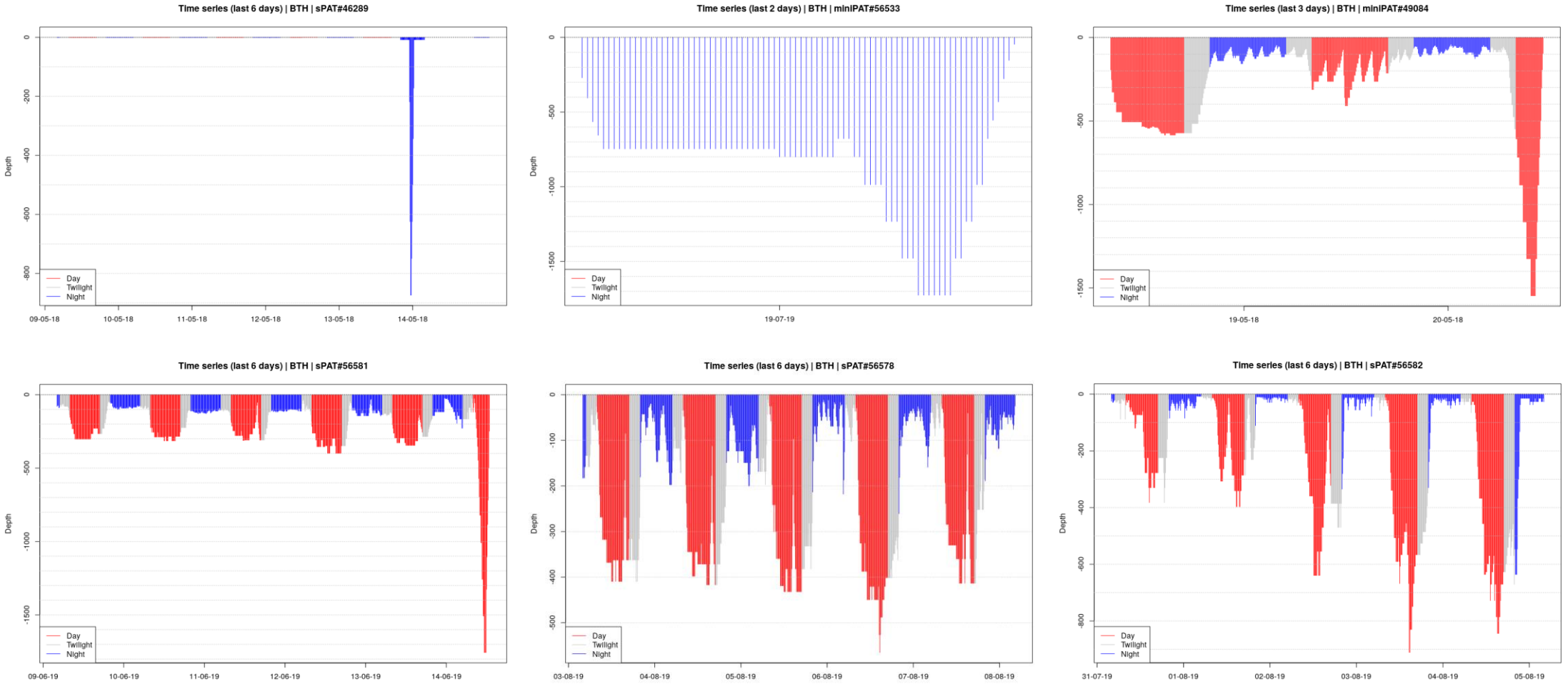


Figure 1. Preliminary results of sPATs and miniPATs deployments on bigeye thresher sharks in the Indian Ocean. Upper panel: left profile – tag detachment, middle panel – immediate mortality, and right profile – delayed mortality; Lower panel: left profile –delayed mortality, middle and right profiles – survival 60 days (profile corresponds to last 6 days before tag detachment).

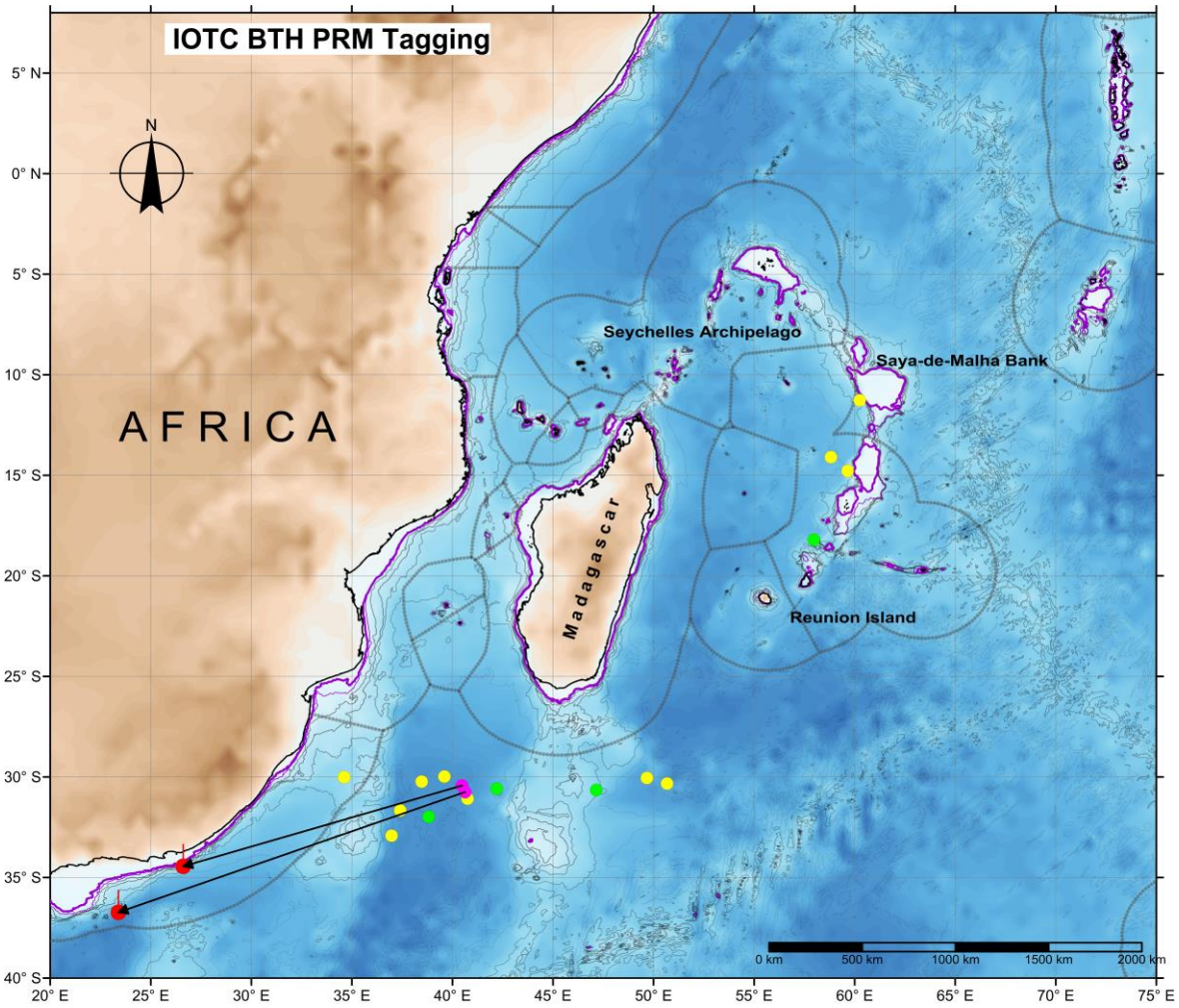


Figure 2. Tagging position for bigeye thresher sharks tagged during IOTC BTH PRM Project during 2018-2019. Yellow circles represents mortalities, green circles are tags that still in the water (apparent survivals), and circles in magenta are survivals over 60 days (full deployments). Red circles with antennas are pop-up locations.

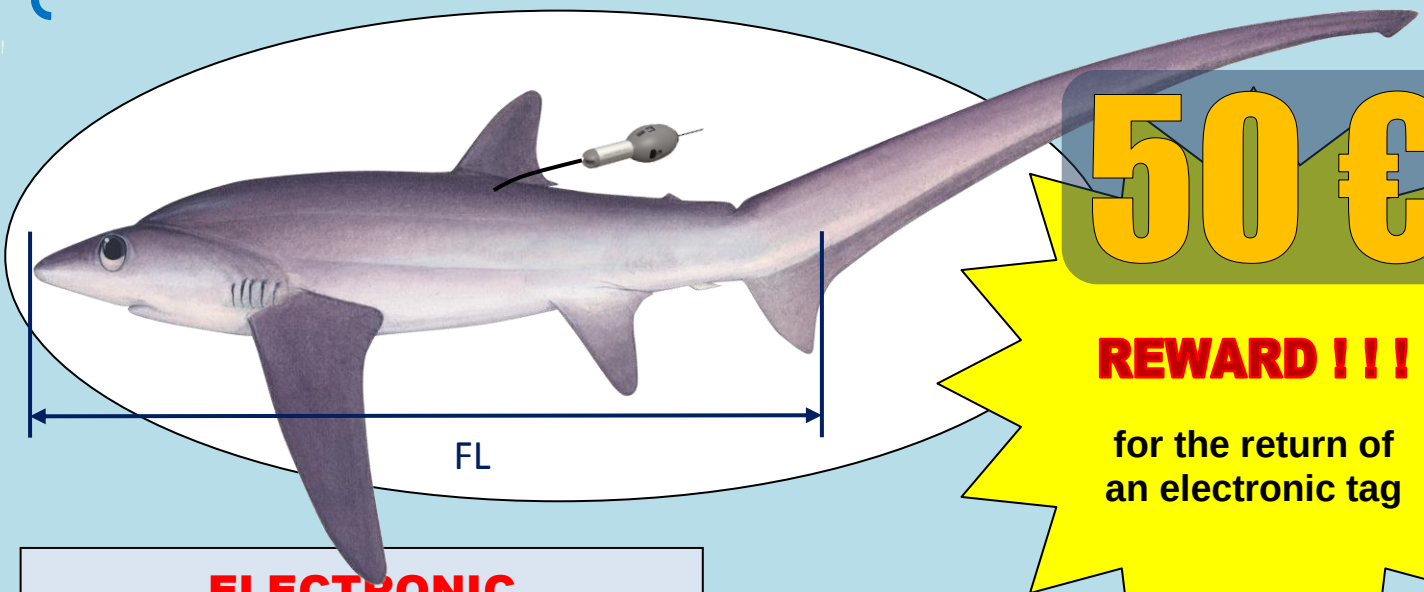
Appendix I

Food and Agriculture Organization of the United Nations

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

Electronic tagging of bigeye thresher shark in the Indian Ocean

IOTC and national institutions of Indian Ocean tuna fishing nations are placing electronic tags on bigeye thresher sharks in the Indian Ocean to evaluate shark survival in fishing gears



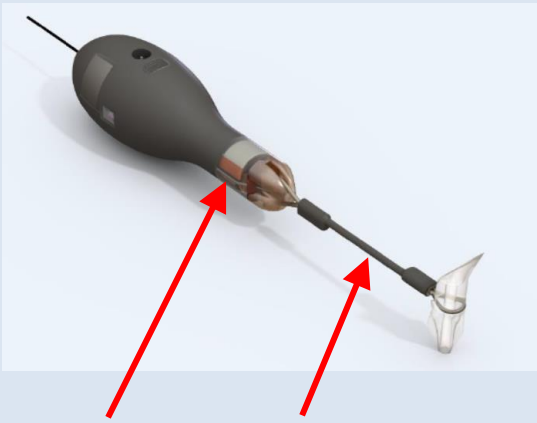
50 €

REWARD ! ! !

for the return of an electronic tag

ELECTRONIC TAGS

Archival satellite tags: mini-PATs are attached to the dorsal part of the shark.



Each tag and tether has unique identification number.

IF YOU FIND A TAG or TAGGED FISH

Record the following information:

- ✓ **Tag(s) identification number(s) and/or tether number**
- ✓ **Date and time of recapture/recovery**
- ✓ **Exact geographic position (latitude and longitude)**
- ✓ **Length of the shark (FL)**
- ✓ **Your name and name of the boat.**

Retrieve the tag and contact IOTC who will pay a reward of €50 on receiving the tag.

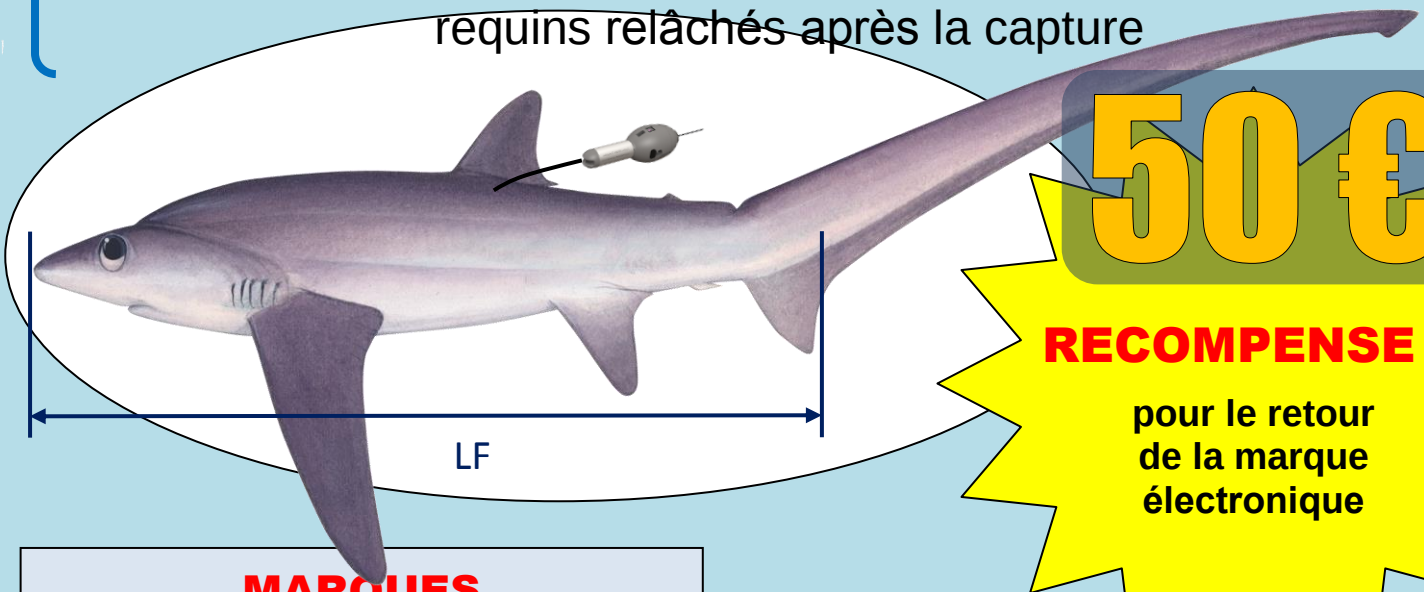
Contact as soon as possible:
IOTC +248-422-5494,
Paul.DeBruyn@fao.org, James.Geehan@fao.org and the Program co-ordinator island.www@gmail.com

Food and Agriculture Organization of the United Nations

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

Marquage electronique du requin renard à gros yeux dans l'océan Indien

L'**IOTC** et les institutions nationales des pays qui pêchent le thon dans l'océan Indien ont posé des marques électroniques sur les requins renard à gros yeux afin d'évaluer le taux de survie des requins relâchés après la capture



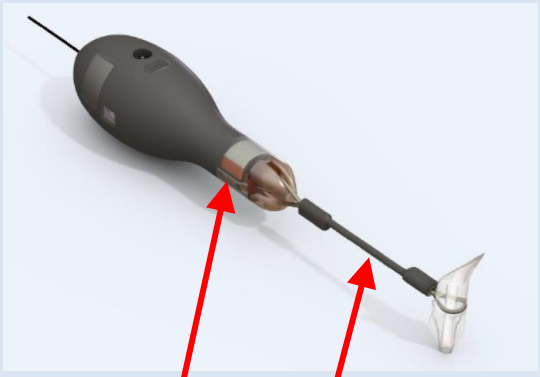
50 €

RECOMPENSE !!!

pour le retour de la marque électronique

MARQUES ELECTRONIQUES

Les marques archives satellitaires (mini-PATs) sont attachées sur le dos du requin



Chaque marque et ligne d'attachement porte un numéro d'identification unique

SI VOUS TROUVEZ LA MARQUE ou UN POISSON MARQUE

Notez informations suivantes :

- ✓ **Numéro de la marque et/ou numéro de la ligne d'attachement**
- ✓ **La date et l'heure de recapture/récupération**
- ✓ **La position géographique exacte (latitude et longitude)**
- ✓ **La taille du requin (longueur à la fourche, LF)**
- ✓ **Votre nom et/ou celui du bateau.**

Contactez-nous tout de suite par mail:
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