

Third progress report on tag deployments to investigate the post-release mortality of oceanic white sharks discarded by EU purse seine and pelagic longline fisheries in the South West Indian Ocean (POREMO project)

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Abstract

In this third progress report, we again briefly present the context of the POREMO project funded by EU France (FEAMP Measure 77, Data Collection Framework) for the development of appropriate IOTC conservation measures for both targeted and non-targeted large pelagic resources exploited by open ocean fisheries. The POREMO project specifically aims at quantifying the post release mortality of the oceanic whitetip shark *Carcharhinus longimanus* (OCS) caught as bycatch in the EU tuna purse seine and pelagic longline fisheries to assess the effectiveness of the OCS retention ban measure adopted in the IOTC Resolution 13/06. In this working paper we present activities done since the 14th WPEB (2018) regarding, in particular, the deployment of satellite tags (both miniPATs and sPATs) on OCS. Based on the tags reported data so far, the post release survival of the OCS is 100% for the pelagic longline, and 93% for the purse seine EU fisheries.

Keywords

Post release mortality | Oceanic whitetip shark | Tuna purse seine fishery | Pelagic longline fishery | Pop-up archival tag | Survival pop-up archival tag | Indian Ocean | Conservation measures

1. Context

Appropriate mitigation measures in fisheries must be set up to preserve protected, endangered, threatened and protected (ETP) species to maintain both biodiversity and ecosystem sustainability. Many of ETP species are susceptible to overfishing because their life history traits are mostly characterized by low reproductive potential with few offsprings and late maturity, low population growth rate, a slow growing and a high longevity. These traits characterize almost all shark species (Cortès, 2000). In the IOTC area of competence many pelagic shark species are either targeted or caught as bycatch by several gears (purse seine, pelagic longline, drifting gillnet, handline and pole and line) (IOTC-IOSHY01, 2014). Sharks caught as unwanted bycatch for many industrial fleets are discarded dead or alive. With the implementation of a regional observer program (IOTC Resolution 11/04 on a Regional Observer Scheme) more data are available to assess the status of shark. The release of alive sharks has been considered as a relevant conservation measure for threatened and endangered shark species. Such considerations led to the adoption of four IOTC resolutions to prohibit the retention of shark species, one that applies to thresher sharks (IOTC Resolution 12/09 *“on the conservation of thresher sharks (Family Alopiidae) caught in association with fisheries in the IOTC area of competence”*), another for whale sharks in IOTC resolution 13/05 *“on the conservation of whale sharks”*, one that applies to oceanic whitetip shark (OCS) (IOTC Resolution 13/06 *“on a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries”*) and one more general encouraging the release of live sharks in fisheries in which sharks are unwanted species (IOTC resolution 17/05 *“on the conservation of shark species caught in association”*).

Specifically for OCS in fisheries managed by IOTC, IOTC Resolution 13/06 specifies that *“CPCs shall prohibit, as an interim pilot measure, all fishing vessels flying their flag and on the IOTC Record of Authorized Vessels, or authorized to fish for tuna or tuna-like species managed by the IOTC on the high seas to retain onboard, trans-ship, land or store any part or whole carcass of oceanic whitetip sharks with the exception of paragraph 7 (dedicated for scientific purposes). The provisions of this measure do not apply to artisanal fisheries operating exclusively in their respective Exclusive Economic Zone (EEZ) for the purpose of local consumption”*. While this retention ban alone may be insufficient to halt the decrease of the oceanic whitetip shark population (Tolotti et al., 2015), its effectiveness has not been assessed in the Indian Ocean. Thus, we need to further explore the survivorship rate of released oceanic whitetip OCS.

In the frame of the EU Data Collection Multi-Annual Program (EU DCMAP) project, the French government has allocated IRD a budget of 100K€ in 2017 dedicated to a pilot study focused on post release mortality (PRM) of sharks bycaught by EU fleets operating in the Atlantic and Indian oceans. The Observatory for exploited tropical pelagic ecosystems (Ob7) of IRD, which manages the DCMAP for tropical fisheries for France, decided to focus this pilot study in the

Indian Ocean. As recent information on PRM have been obtained for whale shark (Escalle et al., 2014) and silky shark (Poisson et al., 2014; Onandia et al., 2021), this research was focused on the oceanic whitetip shark (OCS, *Carcharhinus longimanus*), a species commonly occurring as bycatch in EU purse seine (PS) and pelagic longline (LL) fisheries. The study covers purse seine fleets of Spain and France and pelagic longline fleets for Portugal and France and is coordinated by IRD (Bach et al., 2018). During an ad hoc discussion held at the 13th WPEB in San Sebastian, Spain, it was agreed that this IRD-coordinated study would be an excellent contribution to the IOTC Post Release Mortality (PRM) work plan, although it was recognized that some industrial PS and LL fleets would not be covered by this PRM study. Following the working documents presented at WPEB14 in 2018 and WPEB15 in 2019 (Bach et al., 2018; 2019), this paper is the third progress report aiming at providing an update on OCS tag deployments for the EU purse seine and pelagic longline fisheries and the latest survival rate of OCS for each fishery.

2. Material and methods

For this project, it was decided to combine two types of tags: survivorship PAT (sPAT) designed by Wildlife Computers to assess short term post release mortality (PRM) and programmed to pop-up at a maximum of 60 days after their deployment, and the miniPAT also from Wildlife Computers that is normally used for individual tracking purposes, the latter programmed to pop-up 180 days after deployment.

A total of 35 electronic tags (20 sPATs and 15 miniPATs) were purchased. Those tags were shared between several EU fleet/countries for deployment in both purse seine and pelagic longline fisheries in their respective fishing grounds (Table 1).

3. Results

To date, 24 electronic tags (16 sPATs and 8 miniPATs) have been deployed, representing a deployment rate of 68% (Table 2). This value is higher for sPATs than for miniPATs because sPATs were mainly deployed on PS on which the number of observers embarked were much higher than on LL. With regards to the gear type, the deployment rate reaches 71% for PS and 64% for LL.

For the purse seine, the first and last taggings were achieved in August 2018 and June 2021 (Table 3). It can be noted that the number of deployments decreased dramatically in 2020 and 2021 due to COVID-19. The impact of the COVID-19 pandemic on observer programs were noticeable worldwide. For example, in the Pacific, the Western Central Pacific Fishery Commission required a suspension until December 15, 2021 of the mandatory 100% coverage of the purse seine fishery observer program as well as at-sea transshipment for purse seine

vessels and at-sea transshipment for observers (<https://www.wcpfc.int/covid19>).

The tagging operations ranged between latitudes -24.6 °S and 6.7 °S with an average of -5.7 °S and between longitudes 40.2 ° E and 62.2 °E with an average of 51.1 °E. The fork length of individuals (measured and estimated on board, calculated with the relationship $FL = -1.875 + 0.817 TL$ from Joung et al., 2016) ranged between a minimum of 87 cm and a maximum of 180 cm with an average of 138 cm. Considering a fork length of 157 cm as the size of 50% of maturity, individuals tagged were mainly juveniles, 13 individuals out of 15. Although the sex was unknown for 4 individuals, the tagged individuals were mainly females (8 female individuals and 3 males). Tagged fish were in general “alive” and “alive good” before they were released at sea (Table 4). Five of them (33%) were released injured. The days at liberty for tagged individuals ranged from 3 to 62 days. For sPATs with a time specified to popup at 60 days, most of the tag deployed popped up at the time specified (i.e., full or close to full deployment). Mortality was observed for only one of the 15 tagged individuals, the individual whose tag popped up after three days of deployment (Table 4). For the other 14 individuals, tags popped up after an average of 50 days. One sPAT deployed in September 2018 did not transmit any message. Therefore, for the 14 individuals released from purse seiners (and for which data were transmitted) the survival rate reached 93 %.

For the longline, the first and last tagging were achieved in May 2018 and May 2021, respectively (Table 5). As observed for the purse seine fishery, it can be noted that the number of deployments decreased in 2020 and 2021 due to COVID-19. The tagging operations ranged between latitudes -32.75 °S and -20.5 °S with an average of -21.8 °S and between longitudes 34.9 ° E and 54 °E with an average of 52.2 °E. The fork length of individuals (measured on board or estimated on board) ranged between a minimum of 100 cm and a maximum of 200 cm with an average of 153 cm. Considering a fork length of 157 cm as the size of 50% of maturity, the individuals tagged were mostly juveniles, 5 individuals out of 9. Although the sex was unknown for 3 individuals, all tagged individuals were females (6 individuals) and no males were tagged. This result is similar to the sex ratio of tagged individuals in the purse seine fishery.

The tagged fish were generally “alive” and “alive good” before they were released at sea, (Table 6) with no individuals injured. Days at liberty of tagged individuals ranged from 9 to 185 days with an average of 58 days. For sPATs with a specified time to popup at 60 days, one tag popped up after 30 days and the second one after 60 days with a full deployment. For miniPATs, only one reached a full deployment of 3 months (180 days). Among the 9 individuals no post release mortality was observed. Therefore, for the 9 individuals released from longliners (and for which data were transmitted) the survival rate reached 100 %.

4. Conclusions

Although all eTAGs have not been deployed for the EU purse seine and longline fisheries, the current results presented in this third update of the POREMO project are encouraging and might be considered as incentives for fishermen to apply best practices when they release alive sensitive species like sharks, rays and/or sea turtles. Our results show that the post release mortality of the oceanic whitetip shark would be very low for both fisheries, 7% for the purse seine and 0% for the longline. Therefore, an effort must be made to significantly reduce at-vessel mortality, which varies from 15% to 58.9% depending on the fishery, in order to maximize the effectiveness of the retention ban.

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6. References

- Bach P., Sabarros P. S., Coelho R., Murua H., Krug I., Romanov E., 2018. Progress report of the post release mortality of the oceanic whitetip shark (POREMO project) discarded by EU purse seine and pelagic longline fisheries. IOTC-2018-WPEB14-38.
- Bach, P., Sabarros, P.S., Coelho, R., Murua, H., Krug, I., Romanov, E.V., 2019. Second progress report on the post release mortality of the oceanic whitetip shark (POREMO project) discarded by EU purse seine and pelagic longline fisheries, in: IOTC–2019–WPEB15–19. Presented at the 15th Session of the IOTC Working Party on Ecosystems and Bycatch, La Réunion, France, p. 13.
- Cortés, E., 2000. Life History Patterns and Correlations in Sharks. *Rev. Fish. Sci.* 8, 299–344.
- Escalle L., Chavance P., Amandé J.M., Filmalter J.D., Forget F., Gaertner D., Dagorn L., Mérigot B., 2014. Post-capture survival of whale sharks released from purse seine nets: preliminary results from tagging experiment. SCRS/2014/135. IOTC-2014-WPEB10-INF14.
- Joung S.-J., Chen N.-F., Hsu H.-H., Liu K.-M., 2016. Estimates of life history parameters of the oceanic whitetip shark, *Carcharhinus longimanus*, in the Western North Pacific Ocean. *Marine Biology Research*, 12, 7, 758-768. <http://dx.doi.org/10.1080/1745100>.

[2016.1203947](#)

Onandia I, Grande M, Galaz JM, Uranga J, Lezama-Ochoa N, Murua J, Ruiz J, Arregui I, Murua H, Santiago J. 2021. New assessment on accidentally captured silky shark post-release survival in the Indian Ocean tuna purse seine fishery. IOTC-2021-WPEB17(DP)-13.

Poisson, F., Filmalter, J. D., Vernet, A.-L., and Dagorn, L. 2014. Mortality rate of silky sharks (*Carcharhinus falciformis*) caught in the tropical tuna purse seine fishery in the Indian Ocean. *Canadian Journal of Fisheries and Aquatic Sciences*, 71: 795-798.

Tolotti, M.T., Filmalter, J.D., Bach, P., Travassos, P., Seret, B., Dagorn, L., 2015. Banning is not enough: The complexities of oceanic shark management by tuna regional fisheries management organizations. *Glob. Ecol. Conserv.* 4, 1–7.

Table 1. Number of available electronic tags (sPATs and mliniPATs) shared between EU fleets in the frame of the POREMO project

Country	Gear	sPAT	miniPAT	Total
Spain	Purse seine	9	1	10
France	Purse seine	9	2	11
	Total Purse seine	18	3	21
Portugal	Longline	0	1	1
France - Réunion	Longline	2	11	13
	Total Longline	2	12	14
	Total all fisheries	20	17	35

Table 2. Summary of the number of electronic tags (sPATs and miniPATs) deployed for each purse seine (PS) and pelagic longline (LL) fisheries by the end of July 2021

Gear	sPATs	MiniPATs	Total Deployed	Transmission failure	To be deployed
PS	14 (78%)	1 (33%)	15 (71%)	1	4
LL	2 (100%)	7 (58%)	9 (64%)	0	5
Total	16 (80%)	8 (47 %)	24 (68%)	1	9

Table 3. Information regarding the eTags deployments on oceanic whitetip sharks discarded by the purse seine fishery. (*) U = Unknown

Tag Type	Deployment date	Lat (°)	Long (°E)	Fork length (cm)	Sex (*)
sPAT	08/08/2018	-5.186	62.178	145	F
sPAT	09/08/2018	-5.303	61.054	130	F
sPAT	27/08/2018	-3.415	53.053	109	U
sPAT	03/09/2018	0.008	51.609	162	F
sPAT	03/09/2018	0.008	51.609	162	F
sPAT	04/09/2018	0.172	51.220	129	F
sPAT	12/10/2018	-3.862	50.605	132	M
sPAT	18/11/2018	-3.441	47.722	145	U
sPAT	18/11/2018	-3.441	47.722	180	U
MiniPAT	19/02/2019	6.683	55.583	133	F
sPAT	14/04/2019	-24.614	42.824	132	U
sPAT	08/05/2019	-14.917	44.092	145	M
sPAT	20/05/2019	-19.990	40.211	121	F
sPAT	09/01/2020	-8.067	48.867	87	M
sPAT	18/06/2021	-0.768	58.532	153	F

Table 4. Information regarding the fish condition at the eTag deployment and diagnostics of the popup of the tag and on the post release mortality of oceanic whitetip sharks discarded by the purse seine fishery

Tag Type	Deployment date	Fish condition	Popup date	Days at liberty	Diagnostic	Mortality
sPAT	08/08/2018	Alive	06/10/2018	59	Premature	No
sPAT	09/08/2018	Alive	17/09/2018	39	Premature	No
sPAT	27/08/2018	Alive good	26/10/2018	60	Full deployment	No
sPAT	03/09/2018	Alive good	02/11/2018	60	Full deployment	No
sPAT	03/09/2018	Alive good	-	-	Did not pop	-
sPAT	04/09/2018	Alive good	05/10/2018	31	Premature	No
sPAT	12/10/2018	Alive injured	10/11/2018	29	Premature	No
sPAT	18/11/2018	Alive injured	21/11/2018	3	Too deep	Yes
sPAT	18/11/2018	Alive injured	18/01/2019	61	Full deployment	No
MiniPAT	19/02/2019	Alive good	10/04/2019	50	Premature	No
sPAT	14/04/2019	Alive injured	15/06/2019	62	Full deployment	No
sPAT	08/05/2019	Alive good	24/06/2019	47	Premature	No
sPAT	20/05/2019	Alive good	19/07/2019	60	Full deployment	No
sPAT	09/01/2020	Alive good	09/02/2020	31	Premature	No
sPAT	18/06/2021	Alive injured	17/08/2021	60	Full deployment	No

Table 5. Information regarding the eTags deployments on oceanic white sharks discarded by the pelagic longline fishery

Tag Type	Deployment date	Lat (°)	Long (°E)	Fork length (cm)	Sex (*)
MiniPAT	12/05/2018	-32.750	34.866	195	F
MiniPAT	30/09/2019	-20.992	53.727	171	F
MiniPAT	20/12/2018	-21.033	54.750	135	F
MiniPAT	14/01/2019	-20.673	52.745	120	U
MiniPAT	18/09/2019	-19.127	56.203	134	F
MiniPAT	25/05/2021	-20.675	54.096	120	U
MiniPAT	28/11/2020	-20.351	54.132	200	F
sPAT	30/05/2021	-20.190	54.811	100	F
sPAT	25/05/2021	-20.517	54.030	200	U

Table 6. Information regarding the fish condition at the eTag deployment and diagnostics of the popup of the tag and on the post release mortality of oceanic whitetip sharks discarded by the purse seine fishery

Tag Type	Deployment date	Fish condition	Popup date	Days at liberty	Diagnostic	Mortality
MiniPAT	12/05/2018	Alive good	26/05/2018	14	Premature	No
MiniPAT	30/09/2019	Alive	29/11/2019	60	Full deployment	No
MiniPAT	20/12/2018	Alive good	24/01/2019	35	Premature	No
MiniPAT	14/01/2019	Alive good	23/01/2019	9	Premature	No
MiniPAT	18/09/2019	Alive good	15/11/2019	58	Too deep	No
MiniPAT	25/05/2021	Alive	02/08/2021	69	Premature	No
MiniPAT	28/11/2020	Alive good	01/06/2021	185	Full deployment	No
sPAT	30/05/2021	Alive	29/06/2021	30	Premature	No
sPAT	25/05/2021	Alive good	24/07/2021	60	Full deployment	No