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POST-CAPTURE SURVIVAL OF WHALE SHARKS RELEASED FROM PURSE SEINE NETS: PRELIMINARY RESULTS FROM TAGGING EXPERIMENT

Escalle[1,2] L., Chavance[1] P., Amandé[3] J.M., Filmalter[1,4] J.D., Forget[1,4] F., Gaertner[1] D., Dagorn[1] L., Mérigot[2] B.

Abstract

In the tropical Atlantic Ocean, whale sharks are at times encircled in tuna purse seine nets. While the apparent survival rates after encirclement have been assessed through scientific observer programs, the post-released survival has not yet been investigated. This study describes pop-up satellite tagging and release methods and provides preliminary results on the assessment of survival of whale sharks after release from purse seine nets. Five whale sharks were tagged in July 2014. Three tags popped-up on the programmed date (30 days) and thus these sharks are considered to have survived. One tag surfaced prematurely (after 21 days), complicating the interpretation of the fate of this animal, and one tag failed to report altogether. Obtaining accurate estimations of the post-release survival of whale shark encircled by purse seine nets will require the deployment of further tags on incidentally captured individuals.

Keywords

Whale sharks, Post-release survival, Satellite tracking, Tropical tuna purse seine, Megafauna

[1] Institut de Recherche pour le Développement (IRD), UMR 212 Ecosystèmes Marins Exploités, Sète, France (lauriane.escalle@ird.fr, pierre.chavance@ird.fr, john-david.filmalter@ird.fr, fabien.forget@ird.fr, daniel.gaertner@ird.fr, laurent.dagorn@ird.fr)
[2] Université de Montpellier 2, UMR 212 Ecosystèmes Marins Exploités, Sète, France (bastien.merigot@univ-montp2.fr)
[3] Centre de Recherches Océanologiques (CRO), Département Ressources Aquatiques Vivantes, Abidjan, Côte d'Ivoire (monin.amande@cro-ci.org)
[4] South African Institute for Aquatic Biodiversity (SAIAB), Grahamstown, South Africa

1 Introduction

Tropical tuna purse seine vessels actively search for signs that indicate the presence of tuna schools at the surface of the sea (Ariz et al., 1999). As tuna are known to aggregate around natural or artificial floating objects, including various megafauna species (*e.g.* whale shark (*Rhincodon typus*, Smith 1828); marine mammals) (Hall 1998, Ariz et al., 1999, Romanov, 2002, Matsunaga et al., 2003, Hoffmayer et al., 2005), they may be used to detect tuna schools. Thus in the Atlantic Ocean, whale sharks sometimes become encircled by purse seine nets, even if skippers were often unaware of their presence, and thus did not voluntarily set on them. The whale shark is listed as Vulnerable by the International Union for Conservation of Nature, in Appendix II of the Convention of Migratory Species of Wild Animals (IUCN; www.redlist.org), and is included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; www.cites.org). It is thus important to assess the potential impact of the tuna purse seine fishery on the species.

While a previous study based on the French and Spanish scientific observer programs has shown very limited apparent whale shark mortality directly after being released from the net (apparent mortality rate of 0.93% in the Eastern Atlantic Ocean), the need to estimate the post-release mortality rates to accurately assess the impact of this fishery on these large animals has been highlighted (Capietto et al., 2014). The aim of this study is to describe the tagging and release methods and to provide preliminary results to assess the survival of whale sharks released from tuna purse seine nets.

2 Method

We developed a tagging procedure that could be conducted by scientific observers onboard fishing vessels. The experiment was conducted in the Eastern Atlantic Ocean between June and September 2014, a period identified as having high numbers of whale sharks sightings and encirclements events (Capietto et al., 2014).

Tagging was performed at the end of the fishing set, prior to the whale shark being released. Tagging was only possible when the whale shark was parallel to the vessel, with the dorsal fin visible at the surface. Tagging was conducted from the deck of the purse seine vessel using a 4-meter tagging pole fitted with a tag applicator pin (Wildlife Computers, USA). Pop-up archival tags (miniPATs, Wildlife Computers, USA) were externally attached to whale sharks using a titanium anchor implanted into the muscle below the dorsal fin. Sizes of the whale sharks (total length) were estimated using reference points on the deck and thereafter measured (accurate to ± 0.5 m). The sex of the individuals was visually determined by the presence or absence of claspers, when possible.

To assess the short-term post-release survival of whale sharks after the capture and release operation, the pop-up tags were programmed to detach 30 days after the deployment. The miniPATS are equipped with guillotine which causes the tags to mechanically detach itself at depths of approximately 1800 meters, to prevent barometric damage to the tag. Furthermore, the tags would automatically detach if the depth of the animal did not change by more than 5 m during a 48 hour period (*e.g.* if it died and sank to the bottom in waters shallower than 1800 m).

Within the framework of a maximizing the survival of non-target species, best handling practices have been developed for the crew of purse seine vessels when releasing whale sharks from the net (Poisson et al., 2014). During the cruises in this study, these practices were generally followed. Whale sharks were released from the sack after most of the tuna had been brailed onboard, in order to prevent major losses should the net have broken during the release procedure. If the position of the whale shark was perceived to be good (at the surface, parallel to the vessel and not in a vertical orientation in the sack) the crew would release it by rolling it over the floats, head first (**Figure 1**). This was achieved by using a rope placed either under the whale shark or under the entire sack (which seemed less harmful for the animal). The crew then alternated between pulling and slacking this rope, and dropping the float line, such that it would sink under the pressure of the whale shark. A speed boat was then used to help lower the floats and to move the part of the net between the power block and the sack, such that

the sharks head was free to move over the slack float line. This method was used irrespective of the orientation of the shark in the sack in the horizontal plane (head towards the bow or the stern), however, the maneuver was faster when the head of the animal pointed towards the bow of the vessel (a few minutes long as opposed to 20–30 minutes). When the shark was very large (*e.g.* 12 meters for shark n°2, see **Table 1**), the crew had problems sacking up the catch, thus the shark was first released before any tuna were brailed, by cutting a few meters of nets in front of the sharks head, allowing it to swim out.


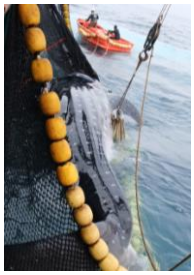

Figure 1. Best handling practice to release whale sharks from encircling purse seine nets (Poisson et al., 2014), observed in the Atlantic Ocean.

3 Preliminary results

Five whale sharks were tagged in July 2014, of which four were females (the sex of the last one could not be determined), with sizes ranging from 8.5 to 12 meters (**Table 1**).

Table 1. Summary information of the five whale sharks tagged in the Atlantic Ocean.

Shark n°	Tag n°	Tagging date	TL[5] (m)	Sex[6]	Latitude[7]	Longitude[7]	Pop-up date	Tacking duration[8]
1	11P0095	03/07/14	11	F	-2.49	8.07	02/08/14	30
2	11P0122	05/07/14	12	-	-2.41	8.29	04/08/14	30
3	11P0285	24/07/14	8.5	F	1.42	3.17	23/08/14	30
4	11P0283	24/07/14	10	F	1.50	3.36	14/08/14	21
5	10P0458	24/07/14	8.5	F	1.45	3.23		

While we received data from 4 tags, the tag from the last shark did not report. There are various explanations for this non reporting, i) a failure of the pop-up tag guillotine, preventing the tag from detaching when the shark descended beyond pressure resistance of the tag, and ii) the tag or antenna could have also been damaged by another organism which could prevent tag data transmission.

Figure 2 shows the tagging and pop-up (first Argos data transmitted) locations. While the pop-up location of the first shark is very close to the tagging location (**Figure 2**), the other three sharks showed large movements during the 3-4 week tagging deployment period (nearly 1500 km in 21 days for shark n° 4).

All sharks undertook dives deeper than 800 meters. Furthermore, all but one shark dove close to the tags' maximum limit of 1800 meters, which confirmed the whale shark capacity to perform deep dives (Rowat and Brooks, 2012) and seemed to indicate a normal behavior. **Figure 2** presents an example of a depth profile of one shark during the week following tagging. We also noticed that all sharks dove immediately after tagging and release (up to 360 m), before returning to the surface waters (after approximately 1h40 ± 30 minutes).

[5] Total length
[6] "F" = Female, "-" = Sex unknown
[7] Tagging location
[8] The pop-up tags were programmed to detach 30 days after tagging, if the shark dives deeper than 1800 meters or if the depth of the animal did not change by more than 5 m during a 48 hour period.

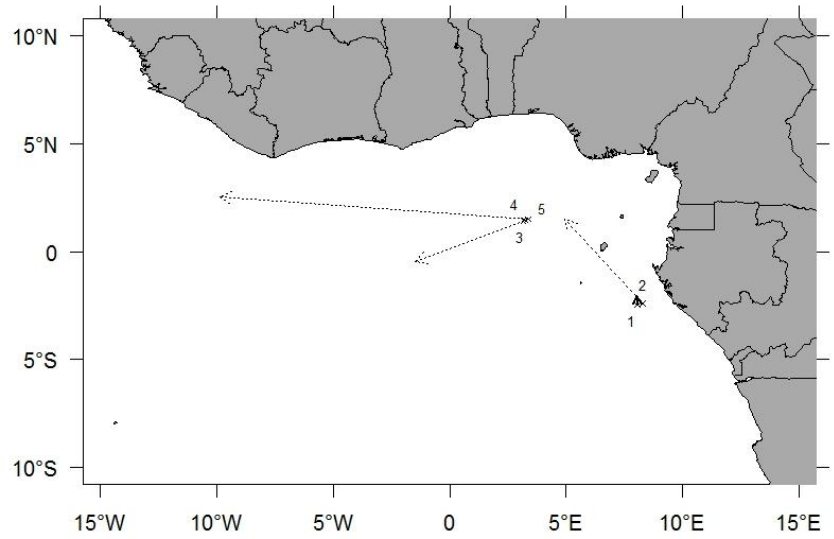

Figure 2. Map of whale sharks tagging and pop-up locations in the Atlantic Ocean. Numbers represent the tagging location of each shark, and arrows represent the straight line distance between tagging and pop-up locations.

Three tags popped-up on the programmed date and thus the sharks are considered to have survived 30 days after being released. One tag detached earlier, 21 days after tagging, after a deep dive (last recorded depth above 1800 meters). However, the three other sharks also displayed similar deep dives. Even if the fate of this shark cannot be determined with certainty, the similarity of its last deep dive with other deep dives tends to indicate that it was a dive and not the shark sinking after dying. Indeed the descent speed of this last dive was of 55.6 meters/minutes (m/min) compared to 49.3 ± 6.9 m/min for the mean deep dive (> 800 meters) speed of the other sharks. In the 21 days preceding this final recorded decent, the shark showed no signs of unusual behavior when compared with the results from other individuals. In addition we noticed that while the deep dives descent and ascent speed were similar, the ascent speed was slightly slower (average of 42.5 ±8.0 m/min)

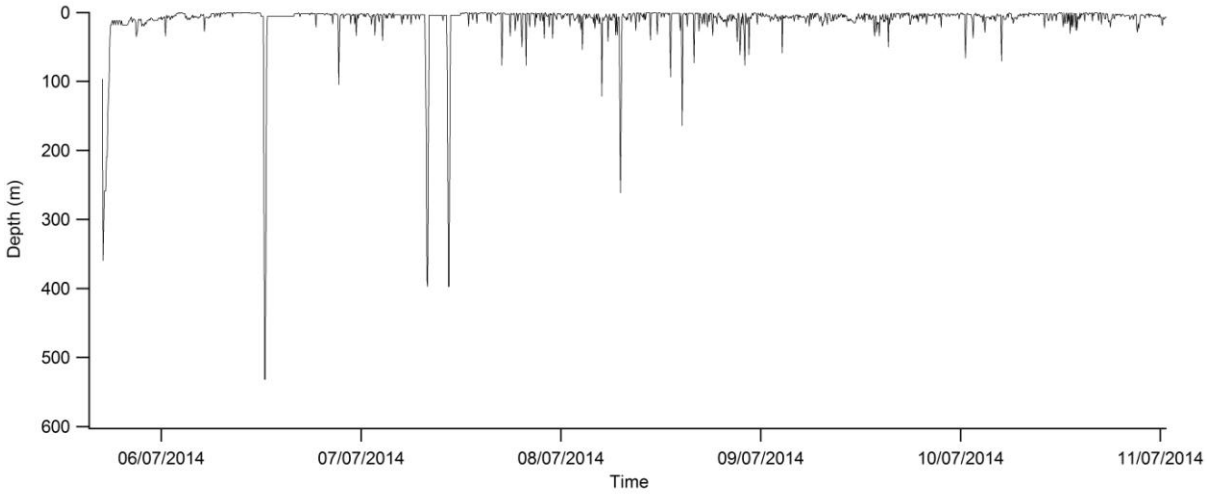

Figure 2. Depth profile during the first week following tagging for the whale shark 2 tagged the 05/07/14.

4 Conclusion

Through this tagging experiment, we have shown that one whale shark survived at least 21 days, and three individuals survived at least 30 days, after being encircled by a purse seine net, and released. All whale sharks undertook deep dives (more than 800 meters), with a few close to the depth limit of the tag (1800 m). The tagged individuals presented different horizontal movement patterns, with 3 sharks undertaking large movements and one presenting a pop-up location very close to it original point of capture.

This study represents a first step in the investigation of whale shark post release survival from tuna purse seine nets. It is necessary to tag more individuals, *i.e.* to increase the sample size, in order to provide a representative estimation of post-release survival.

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