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TESTING THE SAFETY AND EFFICACY OF SHARK BYCATCH RELEASE DEVICES: VELCROS AND HARNESSES

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SUMMARY

Large sharks captured as bycatch in tuna purse seine fisheries present significant handling challenges. often remaining on deck longer than necessary due to crew safety concerns, leading to elevated mortality rates. Two novel bycatch release devices (BRDs) — a "shark Velcro" and a "shark harness" — with padded straps have been developed to lift large sharks by the caudal peduncle using a vessel crane or a winch (on smaller vessels), reducing time out of water and improving crew safety. The IATTC Commission has formally authorized a controlled pilot study under Resolution C-25-08, permitting tail-lifting exclusively within this research context. A rigorous protocol has been developed for large silky sharks exceeding 150 cm Total Length, incorporating satellite tagging to assess post-release survival and swimming performance. The IATTC scientific staff recommend the Commission allocate funding to advance this study.

BACKGROUND

When large sharks (>150 cm Total Length) are captured in tuna purse seine fisheries, they can be very active on deck and dangerous to handle. The best practices adopted in Resolution C-25-08 for reducing mortality to shark bycatch in this fishing gear require that sharks are released back to the sea as soon as possible, with minimal harm, taking due consideration for the safety of any person on board. However, in practice, due to the hazard of handling large active sharks on deck for the crew, most are left on deck until they are calmer and safer to maneuver manually. Unfortunately, this equates to increased time out of water and higher mortality rates.

Recently, a new method of releasing large sharks using a novel shark bycatch release device (BRD) (i.e., ‘shark Velcro’ and a ‘shark harness’) were tested on a purse seine vessel in the Indian and Atlantic Ocean for its safety and practicality in moving large sharks out of brails and back to the sea. These devices (see Fig.1) have a wide padded strap that wraps around the caudal peduncle of large sharks and can be

clipped to a winch to hoist the animals out of the brail, off the deck or out of a hopper and moved overboard for faster release. Use of these devices has the potential to reduce the time out of water for large sharks captured in tuna purse seine fisheries and potentially improve survival rates if there are no deleterious impacts from lifting the animals by the tail on the integrity of the soft connective and hardened vertebral tissues of the animals that would compromise their survivorship.

This study is specifically motivated by concerns regarding the potential effects of tail-based lifting practices on both survival and locomotor performance. There are longstanding concerns about the physiological and physical impacts of lifting large sharks by the caudal peduncle, including possible damage to soft connective tissues, unsupported viscera and the cartilaginous components of the vertebral column (Poisson et al. 2014; Eddy et al. 2016). Historically, this practice was widely discouraged or prohibited due to reports of audible "popping" sounds during lifting, which were interpreted as indicative of serious spinal injury and potential mortality.

The padded straps of the harness and the Velcro BRDs are built to increase the surface area over which the lifting forces are applied for greater support of the body weight (than using a small line or rope) to reduce the risk of injury both at the caudal peduncle and to the entire cartilaginous vertebral column. Preliminary results of the study in the Indian Ocean showing 100% survivorship of N=4 sharks tagged and released using the Velcro and harness devices were presented to the 4th Ecosystem and Bycatch Working Group (EBWG-4) and the 16th meeting of the Scientific Advisory Committee (SAC-16) in 2025. Because the device may also improve the safety of the crew involved in the handling of the large sharks, the SAC-16 recommended:

"a) With the aim of strengthening efficient and safe mechanisms for the handling and release of sharks, it is recommended that the scientific staff, in collaboration with researchers associated with CPCs, continue to evaluate through a controlled pilot study the use of specific tools such as Velcro and harnesses and associated protocols for lifting large sharks from the caudal peduncle (except for whale sharks); (b) It is suggested that this pilot study be designed with a rigorous experimental approach, in line with the objective of determining the effectiveness and safety of these tools, the survival of individuals, and the safety of the crew and it is considered essential to include the fishing industry and specialists with experience in the handling and tagging of large sharks; (c) It is recommended that the scientific staff submit the results of the pilot study to the EBWG and the SAC for consideration as a possible good practice for the management and release of incidentally caught sharks, in order to contribute to their survival; (d) Given that the conduct of this study could be subject to restrictions arising from existing measures, the SAC requests the Commission to clarify whether this pilot study could be carried out and under what circumstances, and consequently consider, if necessary, an update of Resolution C-24-05 on sharks to that effect."

The IATTC shark conservation and management measure, Resolution C-25-08 (and all previous versions of the Resolution) contains a provision which disallows the lifting of sharks by the tail in Paragraph 11.d. which states,

"prohibit the lifting of sharks by the head, tail, gill slits, or spiracles, or by using bind wire against or inserted through the body. Prohibit the punching of holes through the bodies of sharks (e.g., to pass a cable through for lifting the shark)."

To accommodate the advice from SAC-16, especially point (d) above, and to allow for further testing of the shark harness and shark Velcro devices in the IATTC convention area the 103rd Meeting of the Commission updated the shark conservation Resolution (C-25-08) by adding the following paragraph (14):

"The scientific staff, in collaboration with researchers associated with CPCs, EBWG and SAC, shall continue evaluating – through a specific pilot study – the use of specific tools, such as Velcro straps and harnesses to lift sharks by their caudal peduncle and present the results to the EBWG and SAC for consideration as a potential best practice for safe handling and release methods for sharks. Exceptionally, for this controlled pilot experience managed by the staff, the lifting of sharks by the tail will be permitted. Whale sharks shall be excluded from the pilot study."

To this end the IATTC scientific staff have worked with CPC scientists at AZTI (Spain) to develop the following protocols (Appendix 1) for testing the safety and efficacy of the shark Velcro and shark harness on purse seine vessels under the IATTC purview. Any research endeavor that seeks to contribute to the state of the science for this method in the IATTC convention area must meet the following conditions: i) collaborate with IATTC Scientific Staff responsible for leading the research across the EPO; ii) strictly follow the methods provided herein; and iii) obtain a letter of collaboration from the IATTC Director to conduct the work during a given experimental trip.

PROJECT PROGRESS

To date the pilot study (Project M.1.f) budget (see Appendix 3) and objectives were presented to the 103rd Commission meeting in 2025. Funding was not allocated for this study but progress towards the projects goals has been made by the IATTC scientific staff, in collaboration with partners like AZTI. At present, the pilot study methods (protocols) and a budget have been developed (Appended to this document). The methods are currently being tested at sea during a scientific research cruise aboard the *F/V Rosita C* which departed Manta in late March 2026 with an AZTI scientist and an IATTC observer onboard to test the protocols. The protocols will be refined as needed with the feedback from this first experimental cruise. The scientific staff are continuing to seek funding to support this study (unfunded project M.1.f; Appendix 3) and will find ways to continue momentum on it at different intensity levels, subject to resource availability.

STAFF RECOMMENDATIONS

To address the requests of the SAC-16 that a study, into the safety and efficacy of releasing large sharks using lifting devices in tuna purse seine fisheries, be conducted the scientific staff recommends:

The Commission allocate funding to support unfunded project M.1.f on the use of the shark Velcro and shark harness lifting devices.

APPENDIX

A.1. Testing the Safety and Efficacy of Bycatch Release Devices for Sharks: Research Protocols

OBJECTIVE

To conduct a pilot study to test the safety and efficacy of shark bycatch release devices, the 'shark Velcro' and the 'shark harness' which may reduce time out of water and thus survivorship for large sharks captured in purse seine fisheries.

MATERIALS AND METHODS

Materials

Bycatch Release Devices (BRDs)

In this study we will be testing the function and safety of three devices; a ***small Velcro*** for sharks 150-180 cm Total Length (TL), a ***large Velcro*** for sharks of any size > 150 cm TL and a ***shark harness*** for sharks of any size (Figures 1. a-c below). The strap on the small Velcro device has a width of 6 cm, being more suitable for sharks under 180 cm TL. The strap on the large Velcro is wider (12 cm) and thus suitable for all sharks that are too large to be handled manually and/or using a stretcher.

Velcro or 'hook and loop' products are known to deteriorate over time – thus in this pilot study it is very important that the integrity of each device after use is noted. A failure of the device could have devastating consequences for a crew member if the Velcro were to open with a shark overhead. Therefore the protocols for the study contain safety actions for the crew to ensure they are never directly under a shark during the operation. Furthermore, the cycle lifespan of these products still needs to be determined where 'cycle life' for Velcro defines how many disengagements can be completed until the closure loses 50% of its initial performance value. Every time hook and loop tape (or Velcro) is opened, the hooks pull on the loops, contributing to a level of deterioration. Increased closure strength (desirable for these products) reduces the cycle lifespan and vice versa. Furthermore, practical performance of these will also be affected by contaminants, debris and fouling (e.g. scales or mucous), UV exposure, moisture and washing. So, care of the devices and ensuring they are completely clear of debris prior to use are imperative. As well as careful assessment of the performance – once the closure strength begins to show signs of weakening, the device will need to be replaced.

It is also important to note that the Velcro straps for sharks currently in use are prototypes. Therefore, they are still in the development phase and there is room for improvement in terms of design, materials, and method of use. Taking photos and videos to demonstrate how the Velcro straps work or why they fail is very useful in informing improvements to design and instruction. Any suggestions for improving the current BRDs are welcome!

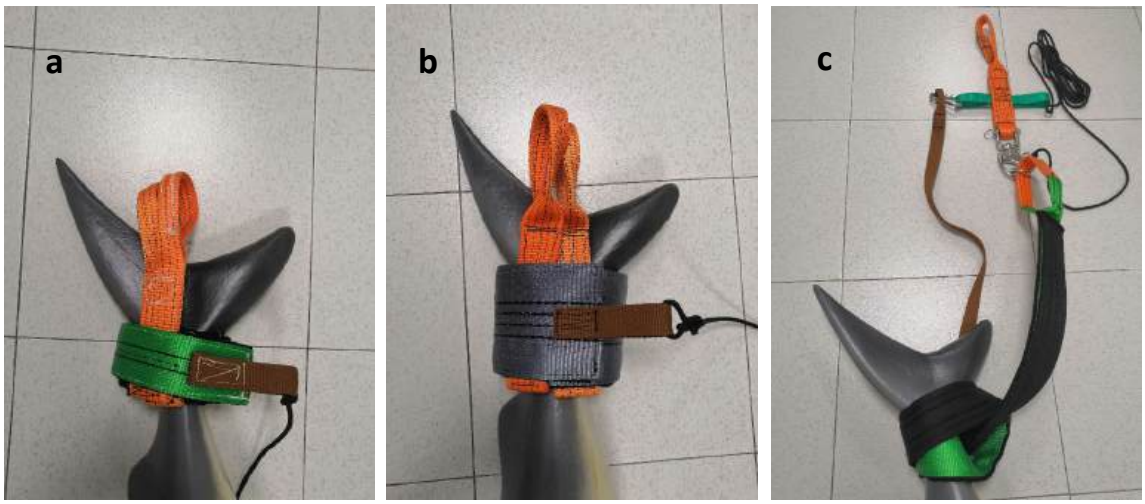

FIGURE 1. Three shark bycatch release devices for testing in this study. Small Velcro (a), large Velcro (b), shark harness (c).
FIGURA 2. Tres dispositivos de liberación de capturas incidentales de tiburones para probar en este estudio. Velcro pequeño (a), velcro grande (b), arnés para tiburones (c).

Satellite linked archival tags

The present study aims to quantify not only survival outcomes but also potential sublethal effects of lifting sharks by the tail, using the bycatch release devices (BRDs) described above, on swimming efficiency and longer-term viability.

To assess the short and long-term impacts of the BRDs on post-release survival (PRS) and swimming efficiency of sharks captured in **good condition** (see Table 1 for condition definitions) we will use two different types of satellite linked archival tags. Animals selected for this study will be tagged with either a survival Pop-off Archival Tag (sPAT) or a MiniPAT (Wildlife Computers, Inc. Redmond, WA. USA). The tagging plan will be decided prior to departure on each trip.

MiniPAT tags will be programmed under two deployment strategies. For the assessment of longer-term survival and longevity, tags will be deployed for up to 360 days. To evaluate swimming efficiency, a subset of tags will be programmed for shorter deployments (<96 days) with high-resolution orientation time-series data enabled. Resulting datasets from pilot study animals will be compared with existing silky shark accelerometer datasets maintained by the IATTC to assess deviations from expected movement patterns. Standardized programming parameters will be provided by the IATTC staff to ensure comparability across datasets.

SPAT tags will be used to validate post-release fate and to assess whether tagged individuals exhibit normal diel vertical movement behavior. Given the uncertainty surrounding the potential delayed effects of spinal injury, these tags will be programmed to their maximum deployment duration of 60 days.

Methods

Study design

To constrain the number of variables that might influence the results of this pilot study we will; i) test the bycatch release devices (BRDs) on **one species, silky sharks** (*Carcharhinus falciformis*); ii) restrict the BRD tests to **animals that are in good condition** when brought onboard (see Table 1 for condition criteria);

and iii) only test the BRDs on **animals that are larger than 150 cm Total Length (TL)** as depicted in Figure 2.

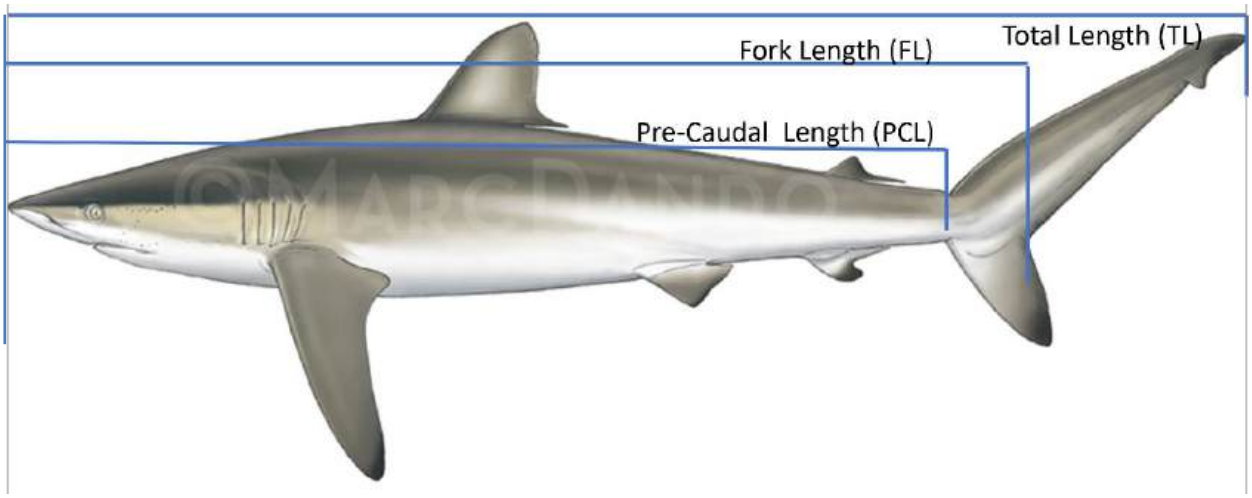

FIGURE 3. Length measurements. Only use the BRDs on silky sharks that are > 150 cm LT.
FIGURA 4. Medidas de longitud. Solo se utilizarán los DLCI en tiburones sedosos que midan >150 cm LT.

To ensure that all the data required for accurate assessment of the efficacy and safety of the device is recorded **no more than three animals per set** may be tested during this pilot.

Additionally, any subsequent tests of the Velcro and harness devices may only be initiated and conducted after the previous test is complete (i.e. the previous shark has been fully released and their swimming performance upon release has been observed completely and recorded).

TABLE 1. Capture Condition
TABLA 1. Condición de captura

Condition	**Criteria**
Dead	No movement or signs of life
Injured and or moribund	Animal is lethargic but exhibits signs of life. May have clear signs of injury, blood in the eyes, or bleeding from the gills or vent.
Good	Active and moving, no signs of injury or lethargy. Only tag animals that are in good condition when brought on board.

Testing shark BRDs

Shark Velcros

Before using the Velcro straps, check that the Velcro is free of scales, blood, or any other debris that may clog the hooks of the Velcro and to ensure that the adhesive surfaces can stick firmly (Figure 3). It is recommended to have several Velcro straps on board in case any worn or dirty ones need to be replaced.

When a shark comes on board establish an approximate length prior to selecting which device is the most appropriate. The Velcro strap should be tightly wrapped around the shark's caudal peduncle, just in front of the caudal fin and securely attached. The fabric panel should be adjusted to the size of the tail base

using the Velcro (Figure 3c). It is important to try to adhere as much of the inner and outer surface of the two Velcro patches as possible (Figure 3b) and press them with your hand for a good hold (Figure 3c), as poor application (Figure 3d) can result in the shark accidentally coming loose. The latest Velcro models being tested come in two sizes, the small Velcro has a 6 cm wide strap and the Large Velcro is 12 cm wide. Please record which Velcro size was used for each shark in the space provided on your data sheet.

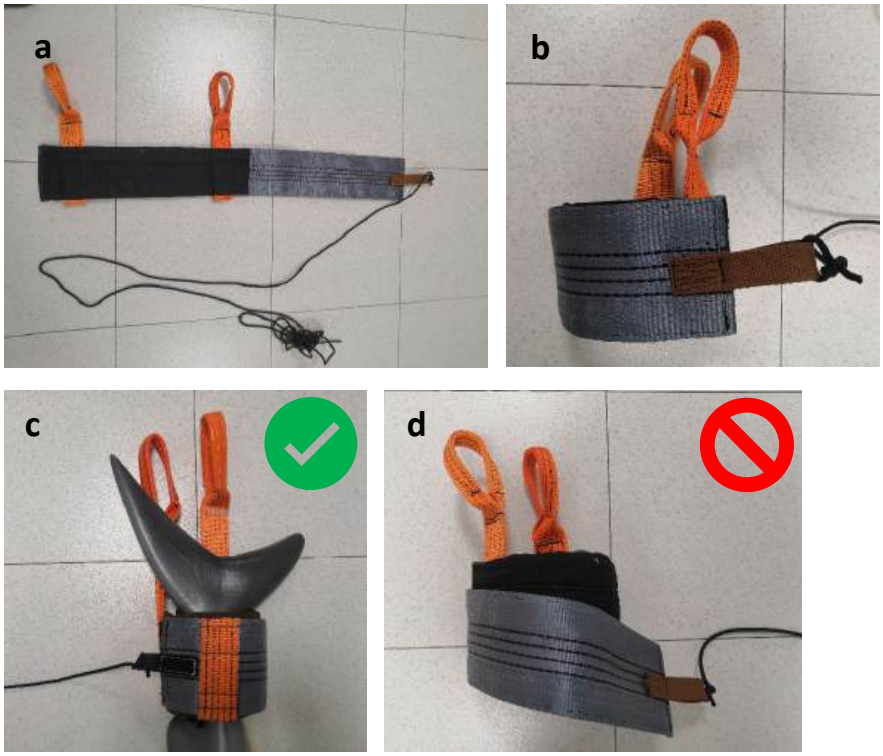

FIGURE 5. Large velcro shark BRD. In image (a) the device is open and shows the long line that must be attached to the small tab on the Velcro portion of the device to disengage the Velcro and release the shark. The length of the line must be > than 5 meters long to ensure the crew has enough line to open the device from the deck when the shark is near the water surface. A closed Velcro is shown in (b). Image (c) shows the BRD around the caudal peduncle of a shark and adjusted appropriately to the shark's size. In (d) the large Velcro is closed incorrectly, affecting the strength of the closure. If the device is improperly closed it could slip open and release the animal while it is overhead-if the animal lands on or near a crew member the injuries could be of grave consequence. So please ensure the devices are properly closed and that all crew are clear of the path of the shark from the lifting point towards the rail.

FIGURA 3. DLCI de velcro grande para tiburones. En la imagen (a) el dispositivo está abierto y muestra la línea larga que debe atarse a la lengüeta pequeña en la parte del velcro del dispositivo para desenganchar el velcro y liberar al tiburón. La longitud de la línea debe ser >5 metros para asegurar que la tripulación tenga suficiente línea para abrir el dispositivo desde la cubierta cuando el tiburón esté cerca de la superficie del agua. En la imagen (b) se muestra un velcro cerrado. La imagen (c) muestra el DLCI alrededor del pedúnculo caudal de un tiburón y ajustado adecuadamente al tamaño del tiburón. En la imagen (d), el velcro grande está mal colocado, lo que afecta la resistencia del cierre. Si el dispositivo no está bien sujeto, podría abrirse y liberar al animal mientras está por encima de la cabeza; si el animal cae sobre un miembro de la tripulación o cerca de él, las lesiones podrían ser graves. Por lo tanto, es necesario

asegurarse de que los dispositivos estén bien cerrados y de que toda la tripulación esté alejada de la trayectoria del tiburón desde el punto de elevación hacia la barandilla.

The strap has a tab or "eye" to which a safety line is tied so that the Velcro can be opened with a pull from a distance (Figure 3). Be sure the line is attached and prepared **in advance** and tied securely to the "eye" of the belt. It is recommended that the line is at least 5 meters long so that there is a sufficient distance between the shark and the fisher.

The Velcro has two large, reinforced handles at the top through which the crane or winch hook can be placed to hoist the shark up and out of the brail or off the deck. **Ensure the Velcro is oriented correctly on the shark with the loops pointing towards the tip of the caudal fin (Figure 3c).** Once the Velcro is securely fastened and the crane hook is placed through the loops or handles, the animal will be hoisted to the side of the vessel and lowered over the rail for release. At present – the opening mechanisms are more effective when the line connecting to them are pulled almost horizontally. So lowering the animal just over the rail and until the tail is near horizontal to the crew member holding the release line – and then the release mechanism can be pulled releasing the animal to the sea.

Velcro straps (and harness straps) are designed for use with large sharks (e.g., > 1.5 cm TL) that are difficult or dangerous to remove by hand. A critical point to remember is that, unlike rope, where the crane can be used to lift the shark in one sudden, forceful movement, Velcro is not as resistant to sudden strong forces, so the lifting maneuver must be performed more carefully and gradually. When lifting the shark with the crane, this must be done with a slow but consistent lifting force to prevent additional injury to the vertebra of the animal and to reduce the jerking forces on the Velcro. You must also ensure that no persons are below the lifting trajectory of the shark during this maneuver in case the Velcro comes loose accidentally. Once the shark is over the water, the sailor holding the safety line should pull hard and swing his arm sideways (from left to right) to open the Velcro and release the shark into the water (Figure 4). **Please walk through the procedure with the captain/deck boss/crew members prior to fishing to ensure everyone has the same understanding of the process.**

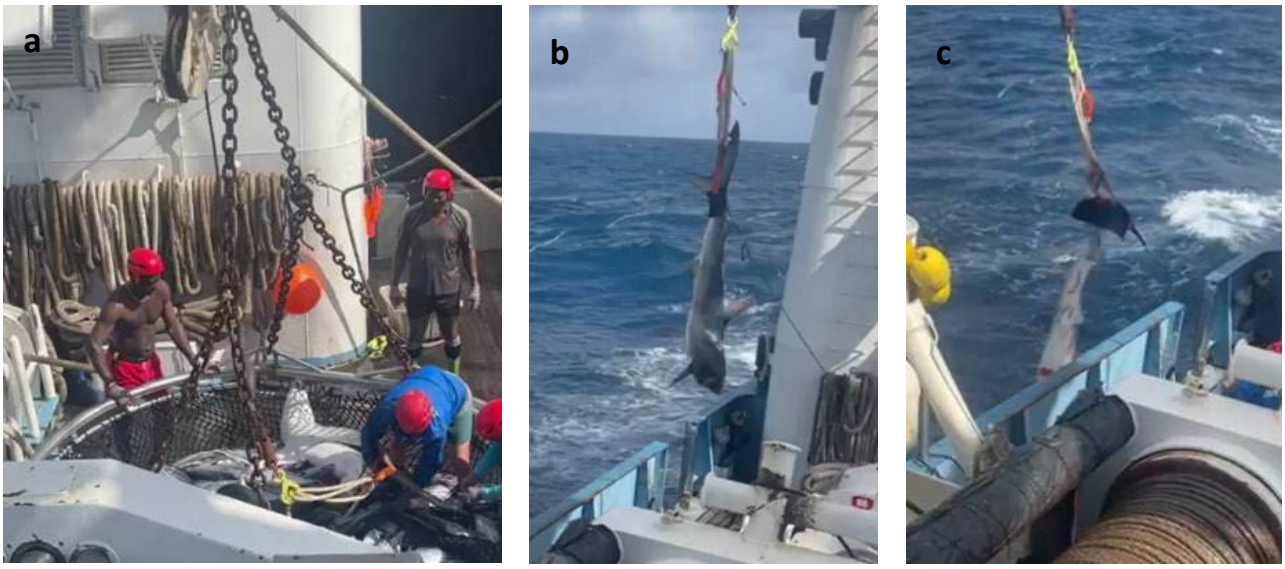

FIGURE 6. Process for attaching the shark BRDs to large sharks in the brail (a), hoisting them slowly using the crane over the side of the vessel (b) and then opening the Velcro to release the sharks (c).
FIGURA 7. Proceso para colocar los DLCI a los tiburones grandes en el salabardo (a), levantarlos lentamente con la grúa al costado del buque (b) y luego abrir el velcro para liberar a los tiburones (c).

Although the length of the instructions may make it seem like a complicated process, it is actually very simple and quick. The most important things to remember are to secure the Velcro flaps properly, have a safety line prepared for releasing the shark, do not pull up abruptly with the crane when hoisting and ensure crew are not below the animal when lifted. Please record the time the Velcro was on the shark and the release time. Please also listen for any “popping” sounds during the lifting/hoisting of the shark that might point to an injury to the spine for each animal and record whether or not there were audible dislocations that may have occurred.

Shark harness

We also want to test the utility, efficacy and safety of an alternative shark BRD called the shark harness (Figure 5). The harness is a padded strap composed with two loops for hoisting sharks with the help of the deck crane. To use it, place the padded area around the shark's caudal peduncle and pass the smaller loop (with the metal ring) through the larger loop connected to the winch hook loop and safety line (Figure 5a, c, d). It is important to ensure the padded strap is tightly fastened around the tail. If the loop is loose, manually pull the strap until it tightens around the caudal peduncle.

Once the harness is in place, the metal ring on the small loop is inserted into the metal carabiner by pulling the trigger connected to the line (Figure 5b,e). The harness has a handle or loop for the crane hook to hoist the animal. Again, care should be taken to control speed during the hoisting of the shark so as not to pull abruptly on the animal. Please listen for any audible popping sounds during the lifting process.

As with the Velcro devices, the harness must have a long safety line (> 5m) that must be connected to the metal ring to open the trigger to release the harness and shark (Figure 5e). Once the shark has been hoisted out of the brail and to the side of the vessel, the safety line is pulled to open the trigger. This releases the harness due to the weight of the animal and the shark falls into the water (Figure 6). Please note that recent experiments have indicated that the release is more efficient if the tail and the release trigger are perpendicular to the height of the deck. When the angle of the trigger line is perpendicular to the crew member-it can be pulled/jerked towards the vessel to open the harness.

During the tests, please also note any difficulties encountered in securing and lifting the sharks and releasing them with the Velcros or the Harness. This would greatly help us to understand the different issues that arise. It is also important to record the entire event with video and especially the shark’s swimming behavior upon release so that scientists can review the release operation and the condition of the shark upon release.

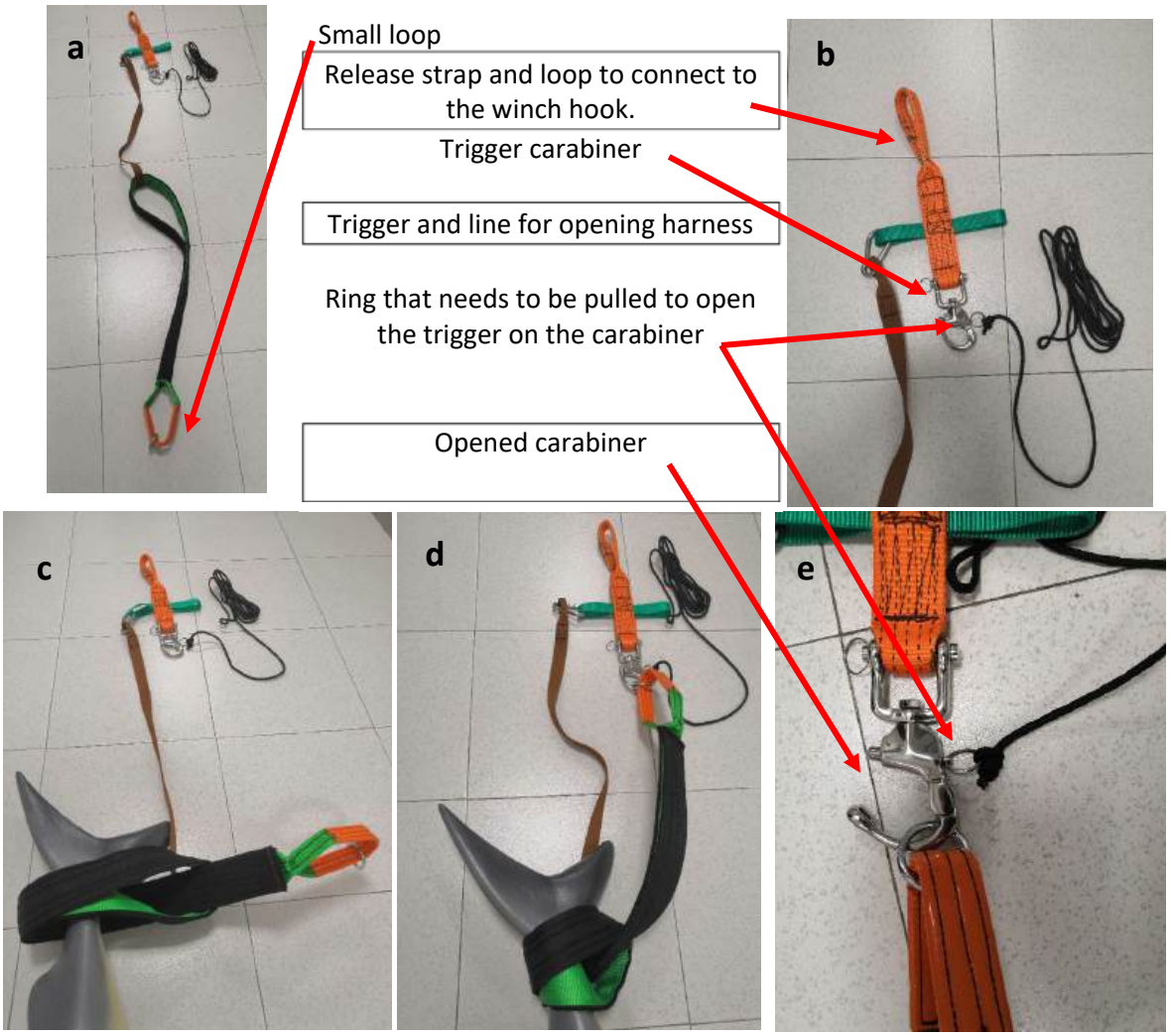

Figure 8. Shark harness (a) and configuration. In image (b) the loop that goes on the winch is shown zoomed in (orange strap) with the release trigger carabiner and the line attached to the release trigger for releasing the harness and the shark. In image (c) the small loop is passed through the large loop around the caudal peduncle of a shark. Image (d) shows the final set up with the ring on the small loop attached to the carabiner. Image (e) shows the strap with carabiner to attach the harness belt and rope tied to the trigger release ring which opens after pulling the rope sideways.

FIGURA 9. Arnés para tiburones (a) y configuración. En la imagen (b) se muestra con zoom el lazo que va en el cabrestante (correa naranja) con el gatillo de liberación del mosquetón y la línea conectada al gatillo de liberación para soltar el arnés y el tiburón. En la imagen (c) el lazo pequeño se pasa a través del lazo grande alrededor del pedúnculo caudal de un tiburón. La imagen (d) muestra la configuración final con el anillo en el lazo pequeño sujeto al mosquetón. La imagen (e) muestra la correa con el mosquetón para sujetar el cinturón del arnés y la cuerda atada al anillo de liberación del gatillo que se abre tras tirar de la cuerda lateralmente.

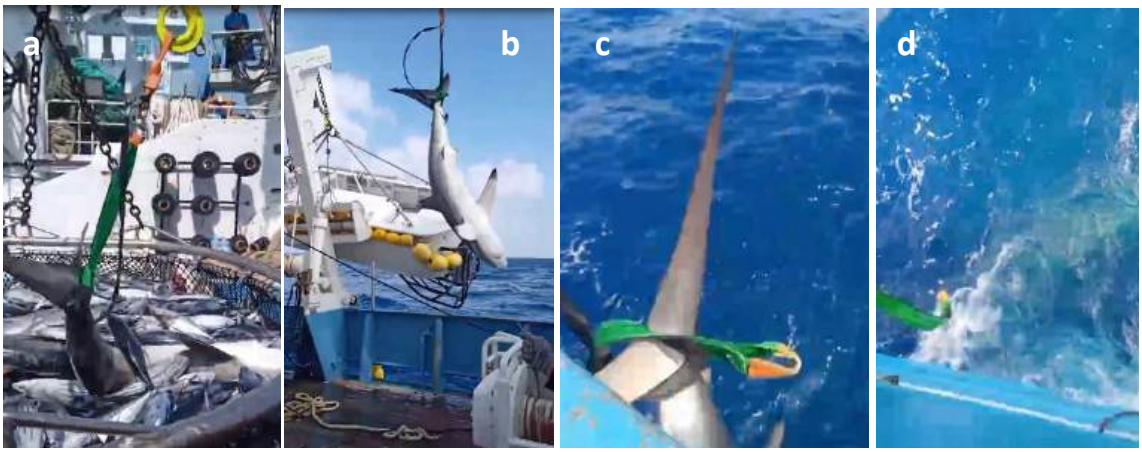

FIGURE 10. Process of releasing a shark with a harness. Harness is applied to a large shark in the brail and the winch hook is attached (a). The shark is lifted very slowly with the crane and transfers the shark to the starboard side so it is over water with the tail close to deck level (b). The shark is released when the harness belt opens after pulling the trigger cord (c). Shark can be seen swimming underwater (d).
FIGURA 6. Proceso de liberación de un tiburón con arnés. Se coloca el arnés a un tiburón grande en el salabardo y se fija el gancho del cabrestante (a). El tiburón se levanta muy lentamente con la grúa y se transfiere el tiburón al lado de estribor de modo que quede sobre el agua con la cola cerca del nivel de la cubierta (b). Se libera al tiburón cuando el cinturón del arnés se abre tras tirar de la cuerda del gatillo (c). Se puede ver al tiburón nadando bajo el agua (d).

Tagging methods

In this pilot study all sharks released with Velcro or harnesses will be tagged with a satellite tag. It may be difficult to tag the animals in the brail or on the hopper so it is advisable to have a stretcher or tagging platform location that the shark can be moved to for tagging after being fitted with the BRD (Figure 7). Once the Velcro or the harness has been attached and the shark has been hoisted out of the brail/hopper, quickly place it on the stretcher/platform to attach the tag (without releasing the harness or Velcro). While the shark is on the stretcher, a ventilator or seawater hose (at ambient sea surface temperature), flowing at 1,000-2,000 gallons per hour can be inserted into its mouth to flush seawater over the gills. After attaching the tag (following the methods below), the shark will be lifted back into the water with the crane and released by pulling the safety line connected to the device to open it (Figure 8).

FIGURE 7. Shark being tagged after the Velcro has been attached. Remember to remove the tag label prior to releasing the shark.
FIGURA 7. Tiburón siendo marcado después de colocarle el velcro. Antes de liberar al tiburón, se debe retirar la etiqueta de la marca.

Storing your tags

FIGURE 8. Tagged shark release using large Velcro.
FIGURA 8. Tiburón marcado liberado con velcro grande.

Satellite tags should be stored in a refrigerator when not on deck for potential deployment. They must also be kept dry and in a waterproof container with dessicant packs to control atmospheric humidity. Your tags should be programmed with the assistance of IATTC project scientists to ensure comparablility across tag datasets and a proper deployment.

Setting up your tags

In addition to two different tag types, there are also two different anchors that will be used in this study, the small titanium anchor (metal dart) and the black plastic Domeier umbrella anchor shown in Figure 9. **Please make sure that you have the appropriate applicators for your tag anchors prior to departure on your trip.** The Domeier anchor applicator comes to a point like a needle to fit into the center of the umbrella (as shown in Figure 9) and the small Titanium anchor applicator has a split at the end for the anchor to slide into. Proper alignment of the tag on the applicator is imperative to get a good anchoring of the tag into the dorsal musculature of the shark. This is especially important for tags configured with the small Titanium anchors. For the anchor to be able to 'toggle' into place under the ceratotrichia (depicted in Figures 10 & 11), the hardened structures under the dorsal fin, the tag applicator must be fitted onto the 'top' of the tag anchor as shown below in Figure 9c.

Tag placement

Make a preliminary incision with a sterilized scalpel for the tag anchors to pierce the skin by making two small cuts in the shape of a cross (+) at the base of the dorsal fin directly under the apex of the fin. Place some iodine gel on the hole and on the tip of the anchor. Using the tagging handle, insert the tag anchor at a shallow angle towards the head and across the body to about half-way up the leader. Remove the

handle and the label with the tag's serial number, give the tag a quick light tug to anchor the tag in place and instruct the fishers to slowly and carefully lift the animal for release. The entire procedure should take less than 3 minutes (placing the BRD, tagging the animal and release).

Video recording

Please make sure to record the entire procedure using your GoPro or a phone (ask for help if using a phone). Most importantly, please observe the shark's swimming behavior upon release and describe the condition of the animal and swimming efficiency using the criteria in Table 2. **It is very important that the swimming performance of the shark upon release is observed and documented.** In addition, the IATTC scientific staff are requesting video of the entire event from capture in the brail to release and post-release swimming observation. Videos should be named with the tag serial number, set number and brail number separated by an underscore (e.g. 24P2036_05_11).

TABLE 2. Release condition and swimming efficiency.
TABLA 2. Condición de liberación y eficacia natatoria.

Condition	**Criteria**
Not observed	Either because the animal was not seen after release, or the observer was not able to get to the rail to watch the release
Moribund	Animal is seen making attempts to swim but it appears labored and or the animal is seen sinking upside down
Lethargic	Animal is making attempts to swim but they may appear laborious, twitchy and confused or odd, but it swims away on its own.
Good	Swimming appears normal.
Excellent	Swimming performance is strong and animal swims away strongly and rapidly.

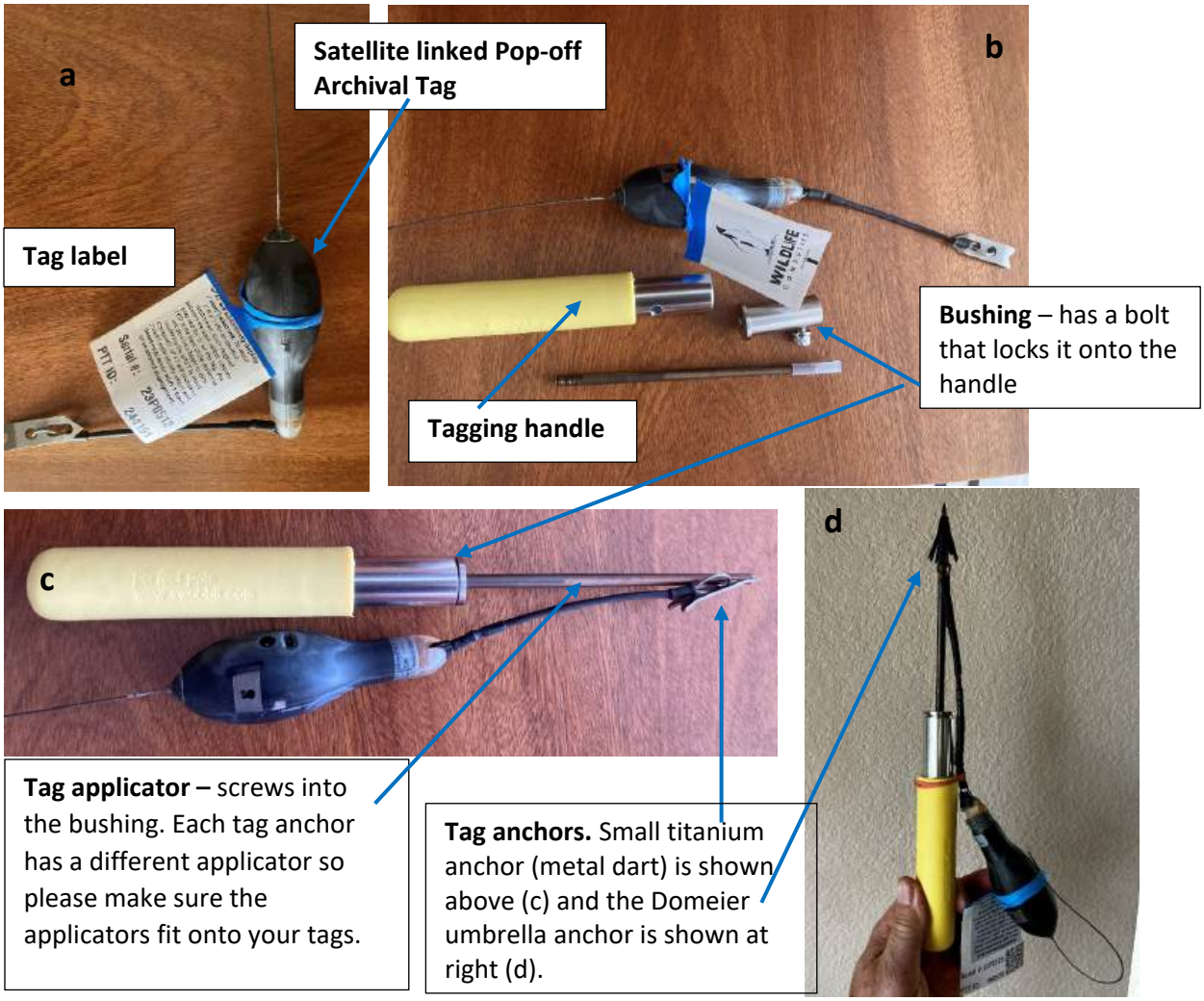

FIGURE 9. Tagging applicator and tag set up on the handles.
FIGURA 9. Aplicador de marcas y marcas colocadas en los mangos.

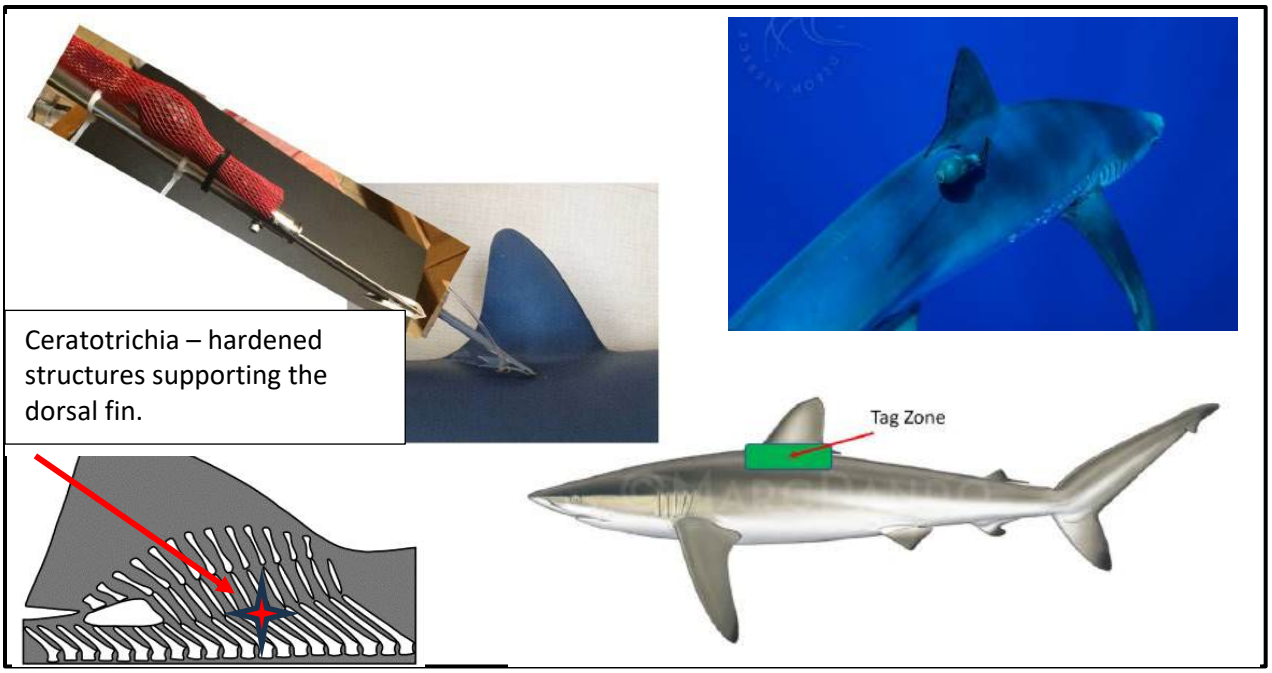

FIGURE 11. Tag orientation. The point of the tag's anchor must point down and towards the head. The tag must be applied at a 45-degree angle to the animal´s head and pass beneath the dorsal fin and through the dorsal musculature to lock into the *ceratotrichia*, as indicated by the red arrow in the bottom left.
FIGURA 10. Orientación de la marca. La punta del ancla de la marca debe apuntar hacia abajo y hacia la cabeza. La marca debe aplicarse en un ángulo de 45 grados con respecto a la cabeza del animal y pasar por debajo de la aleta dorsal y a través de la musculatura dorsal para fijarse en la ceratotrichia, como indica la flecha roja de la parte inferior izquierda.

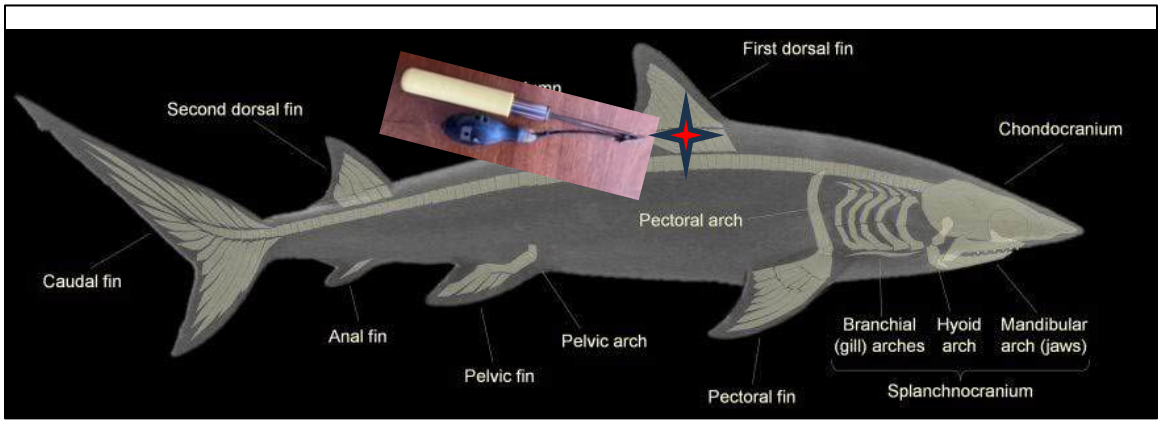

FIGURE 12. Tag placement. Make two very small cuts in the skin in the shape of a cross (+) under the apex of the dorsal fin, to allow the tag anchor to pierce the tissue.
FIGURA 11. Colocación de la marca. Hacer dos cortes muy pequeños en la piel en forma de cruz (+) bajo el ápice de la aleta dorsal para permitir que el ancla de la marca perfore el tejido.

Tagging steps:

a. Record the serial number of the tag and PTT on the RMMT and/or data sheet before placing it on the applicator. The serial and PTT numbers are also located on the label attached to each tag (don't forget to remove the label before tagging the shark).

b. Clean the applicator pin, anchor and tag tether with iodine or alcohol wipes.

c. Have a tag setup on its applicator and ready to go prior to the onset of brailing.

d. Please only tag sharks that are in **Good** condition when brought on board (refer to Table 1 for condition definitions).

e. Record the entire procedure from placement of BRD to tagging and release using your GoPro or other camera, in video mode.

f. When a large (> 150 cm TL) silky shark in good condition is brought onboard and the crew is amenable to testing the shark BRDs, ask for help placing the BRD on the shark. Have it carefully hoisted or manually moved to the tagging location and place the tag on the animal.

g. Using a scalpel or blade to make two small cuts in the shape of a cross (+) at the base of the dorsal fin, directly below the apex of the fin (Figures 10 & 11). This is the insertion point for the tag anchor.

h. Be careful not to place the tag near the head or gills.

i. Place the tag at a shallow 45-degree angle to the sagittal plane of the body (a line between the head and tail), with the tip of the anchor inserted toward the head and across the body, under the dorsal fin to get the anchor embedded in the ceratotrichia (Figure 10). The goal is for the anchor to cross the body under the dorsal fin so that the tag is anchored in the cartilage under the dorsal fin and does not pierce the body cavity or hit the vertebrae and spinal cord running through the center of the body.

j. Use the incision indicated above as a guide for the anchor tip to break the skin. Push the anchor quickly and forcefully into the dorsal muscle and bury it until half of the leader has penetrated. The tip of the anchor should point downward and toward the head. See Figures 10 and 11 to identify the manner of insertion and the angle of the mark on the body.

k. Record the time of release.

l. Using the descriptions in Table 2, determine the condition and swimming behavior of the shark at the time of release.

m. Record all data on the RMMT form and the attached data sheet according to the instructions.

Data required

This study will be conducted in parallel with trained IATTC observers. The observers will be using the normal shark catch record (RDT) and the experimental shark tagging and handling data (RMMT) forms as well as collaborating with the scientists contracted to conduct the experiment, when present. When a contracted scientists is not onboard, alternatives would need to be considered, such as, for example, having a second tag trained observer onboard. Where contracted scientists conduct the tagging, they must also record all the additional data listed in Table 3 below (until the RMMT forms are updated to incorporate the additional data required for this study). An example data sheet with all the required data fields has been developed and provided in the Annex. **It is very important that the swimming performance of the shark upon release is observed and documented.** In addition, the IATTC scientific

staff are requesting video of the entire event from capture in the brail to release and post-release observation. Videos should be named with the tag serial number, set number and brail number separated by an underscore (e.g. 24P2036_05_11).

Please submit the videos along with photos of each of the data sheets for each trial, immediately upon return to port, to: Dr. Melanie Hutchinson, mhutchinson@iattc.org

TABLE 3. Data fields that need to be documented during the experiment.
TABLA 3. Campos de datos que deben documentarse durante el experimento.

Data Required	Description
Vessel Name	
Departure Date	
Departure Port	
Trip No	IATTC Trip Number – this gets assigned by IATTC
Set No	Set Number
Latitude	Decimal minutes
Longitude	Decimal minutes
Time sack up (HH:MM)	Time crew initiates sacking up procedure
Brail No	The brail number the animal is brought on board in
Time Brail on deck (HH:MM)	Time the brail is loaded onboard
No. Sharks in Brail	Number of sharks in the brail
At Vessel Condition	Condition of the animal when brought onboard using condition codes and definitions in the RMMT form – only tag animals and conduct the shark BRD trials on sharks that meet the criteria for Good condition in Table 1 of this protocol.
Species	3 Alpha code - see table – only FAL will be tagged in this study
Sex	Male or Female
Pre-caudal Length (cm)	
Total Length (cm)	
Device Type	Use names (from instructions) of device type selected for this individual (ie. small Velcro, large Velcro, harness)
Time Device on (HH:MM)	Time Velcro/harness is placed on animal
Tag Type	MiniPAT or SPAT
Tag Serial	Serial number from tag
Time Tag on	Time (local) tag is placed on animal
Time Release (HH:MM)	Time on the clock when the animal is released
Time hanging (minutes)	Number of minutes between when the hoisting/pulling of the animal begins to when the shark is released from the harness
Swimming Performance & Release Condition	Please describe swimming performance/behavior on release using the following categories and any additional information deemed important: **1. Not observed** - either because the animal was not seen after release or the observer was not able to get to the rail to watch the release. **2. Moribund** - Animal is seen making attempts to swim but it appears labored and or the animal is seen sinking upside down. **3 Lethargic** - Animal is making attempts to swim but they may appear laborious, twitchy and confused or odd, but it

	swims away on its own. **4 Good** - swimming appears normal. **5 Excellent** - swimming performance is strong and animal swims away strongly and rapidly.
Audible effects of lifting on spinal column	Could you hear the spine popping when the lifting started or during the hanging of the shark prior to release?
Video Name	Please provide the full length video recorded during the whole event (from when the shark is brought onboard and the decision is made for this shark to be a test animal - to its release. Be sure to record the swimming after release. Please add the name of the video here. Ideal video naming convention is the tag serial number_set number_brail number (e.g. 24P2036_05_11)
Notes	Please describe any additional nuances that should be noted, including the performance of the device

Appendix 2. Example data sheet

Date:	Latitude:	Longitude:	Set No:	Time sack up (HH:MM):
		Shark 1	Shark 2	Shark 3
RDT Page Number				
Brail No				
Time Brail on deck (HH:MM)				
No. Sharks in Brail				
At Vessel Condition				
Species				
Sex				
Pre-caudal Length (cm)				
Total Length (cm)				
Device Type				
Time Device on (HH:MM)				
Location of shark when hoisted				
Tag Type				
Tag Serial				
Time Tag on				
Time Release (HH:MM)				
Time hanging (minutes)				
Release Condition				
Audible effects of lifting on spinal column				
Video Name				

Notes			

APPENDIX 3. Unfunded Project M.1.f

Project M.1.f: Testing Shark Bycatch Release Devices: 'Velcros and Harnesses'	
THEME: Ecological impacts of fisheries: assessment and mitigation **GOAL:** M. Mitigate the ecological impacts of tuna fisheries **TARGET:** M.1. In collaboration with the industry, conduct scientific experiments to identify gear technology that will reduce bycatches and mortality of prioritized species **EXECUTION**: Ecosystems and Bycatch Program in collaboration with CPC scientists and industry personnel	
Objectives	To test the safety and efficacy of shark bycatch release devices (e.g., shark Velcro, shark harness) to lift sharks from the tail
Background	• When large sharks are captured in purse seine fisheries they are often very active on deck and dangerous to handle. Best practices for reducing mortality to shark bycatch in this fishing gear requires that sharks are released back to the sea as soon as possible, with minimal harm. Due to the hazard of handling large active sharks on deck, most are left on deck until they become calmer and more subdued. Unfortunately, this equates to suffocation and higher mortality rates. • Recently, new shark bycatch release devices ('shark Velcro', and a 'shark harness') were preliminarily tested in the Indian Ocean for their safety and practicality in moving large sharks out of brails and back to the sea. The Velcro fits around the caudal peduncle of large sharks and can be clipped to a winch or crane to hoistthe shark up and out of the catch overboard and can be complemented with a harness for additional support. Use of the device has the potential to reduce the time out of water and potentially improve survival rates pending the evaluation of the physiological impacts that the method may have on the unsupported viscera, soft connective and hardened vertebral tissues of the animals, and ultimately, post release mortality. • The device is also considered to improve the safety of the crew involved in the handling of the large sharks. • Considering the above, the 16th meeting of the Scientific Advisory Committee recommended: *"a) With the aim of strengthening efficient and safe mechanisms for the handling and release of sharks, it is recommended that the scientific staff, in collaboration with researchers associated with CPCs, continue to evaluate through a controlled pilot study the use of specific tools such as Velcro and harnesses and associated protocols for lifting large sharks from the caudal peduncle (except for whale sharks). (b) It is suggested that this pilot study be designed with a rigorous experimental approach, in line with the objective of determining the effectiveness and safety of these tools, the survival of individuals, and the safety of the crew and it is considered essential to include the fishing industry and specialists with experience in the handling and tagging of large sharks (c) It is recommended that the scientific staff submit the results of the pilot study to the Working Group on Ecosystem and Bycatch (WGECB) and the SAC for consideration as a*

<table>
<tr><td></td><td colspan="2">possible good practice for the management and release of incidentally caught sharks, in order to contribute to their survival."</td></tr>
<tr><td>Relevance for management</td><td colspan="2">• Improving the safety of the crew when releasing large sharks from purse seine vessels.
• Reducing mortality to incidental large sharks in purse seine fisheries</td></tr>
<tr><td>Duration</td><td colspan="2">24 months (2026-2027)</td></tr>
<tr><td>Work-plan and status</td><td colspan="2">• Establish an expert group (including veterinarians, IATTC scientists, CPC scientists, vessel operators, observer program personnel) to finalize study design.
• Purchase telemetry devices and other relevant equipment.
• Train observers in tagging techniques, data requirements, necropsy and sampling/imaging techniques.
• Conduct pilot study:
– Test the short term and long-term physiological impacts of lifting Silky sharks from the caudal peduncle on two size classes of silky sharks (150-180 cm FL and > 180 cm FL) using necropsy, X-ray and CT scanning in partnership with wildlife veterinarians.
– Assess post release survivorship using both survival pop-off archival tags (SPAT) and miniPATs.
–</td></tr>
<tr><td>External collaborators</td><td colspan="2">CPC scientists, experienced fishers, wildlife veterinarians</td></tr>
<tr><td>Deliverables</td><td colspan="2">• Annual updates to the EBWG, the SAC, and the Commission, as needed, including documents and presentations.
• A data-based assessment of the short-term and long-term impacts of the devices on shark physiology and survival</td></tr>
<tr><td rowspan="4">Budget</td><td>Item</td><td>Cost (US$)</td></tr>
<tr><td>Telemetry (tags, satellite transmission fees, supplies)</td><td>150,686</td></tr>
<tr><td>Physiological investigations</td><td>20,000</td></tr>
<tr><td>Workshop and training (IATTC scientists and wildlife veterinarians)</td><td>14,000</td></tr>
<tr><td></td><td>Total Project Costs</td><td>$184,686</td></tr>
</table>