3D PRINTING OF PELAGIC SHARK FINS FOR USE AS A TRAINING AND COMPLIANCE TOOL

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SUMMARY

Identical 3D replica fins of CITES Appendix II-listed sharks, and one non-CITES listed species, covering a total of 10 species and two families[1] have been developed through a collaboration between TRAFFIC and the South African Department of Forestry, Fisheries and the Environment. The entire process from scanning, printing and painting has been documented and is available online at https://www.traffic.org/3d-replica-shark-fins/. The scan files and images providing painting guidance are all open access documents, available at no cost. The development of the 3D printed fins accompanied by QR codes, which link to dedicated webpages providing additional guidance on identification, will facilitate the identification of dried shark fins in trade and allow for rapid and confident decision-making by relevant law enforcement officials. It also has the potential for improving the collection of trade and catch data which in a CITES context should assist in strengthening the scientific basis for the development of Non-Detriment Findings by CITES Scientific Authorities.

KEY WORDS

Fin identification, 3D printing, compliance tool, training

AFFILIATIONS

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[1] Bigeye Thresher *Alopias superciliosus*
Blue Shark *Prionace glauca*
Bowmouth Guitarfish *Rhina ancylostoma*
Common Thresher *Alopias vulpinus*
Giant Guitarfish Family: *Glaucostegidae*
Great Hammerhead *Sphyrna mokarran*
Oceanic Whitetip *Carcharhinus longimanus*
Porbeagle *Lamna nasus*
Scalloped Hammerhead *Sphyrna lewini*
Silky Shark *Carcharhinus falciformis*
Shortfin Mako *Isurus oxyrinchus*
Wedgefish Family: *Rhinidae*

INTRODUCTION

Globally, overfishing of pelagic sharks has led to a 71% decline in relative fishing pressure since the 1970s, with three quarters of species threatened with extinction (Pacoureau *et al*. 2021). The intensive fishing has not been matched with the implementation of appropriate fisheries management at national and international levels. In addition, implementation of trade regulations has come far too late for many of these species (Pacoureau et al. 2020). These declines have been linked to the fin trade which has been well documented (Vannucini 1999; Dulvy et al. 2014). Recently, the use of genetics has provided a glimpse into the species composition within the retail markets of Hong Kong SAR and Guangzhou (Fields et al. 2018; Cardeñosa et al. 2020). These studies have highlighted a need for greater transparency in the global shark fin trade and the need to improve compliance and enforcement abilities through resources, knowledge and training that would support conservation (Cardeñosa et al. 2020).

Over 40 shark and ray species have been listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In order to export CITES-listed shark species, a permit must be issued by the exporting country's CITES Management Authority confirming that the shipment was obtained legally and that the catch and trade are not detrimental to the survival of the species (sustainable). The illegal trade in CITES-listed species is of extra concern given the conservation reasons related to those species being added in the CITES Appendices.

As is the case globally, effective enforcement of CITES listings of sharks requires that customs, compliance and other law enforcement officials are able to identify fins suspected of being from CITES-listed species. These officials face many challenges in detecting illegally traded sharks due to high volumes passing through land, air and seaports. These same law enforcement officials are searching for products from other CITES-listed plants and animals as well as illegal contraband such as drugs and weapons.

A number of guides, posters, and other tools have been developed to assist in the identification of shark fins, and there have been many training sessions in countries across the world. Some of this training has included the use of real dried shark fins that enforcement agencies have collected over the years from seizures. However, the vast majority of enforcement agencies have not been trained using real shark fins and do not have access to real fins, limiting their ability to identify the fins of CITES-listed sharks.

METHODS AND RESULTS

A collaborative initiative between TRAFFIC and the South African Department of Forestry, Fisheries and the Environment (DFFE), funded through the TRAFFIC ReTTA project by Arcadia – a charitable fund of Lisbet Rausing and Peter Baldwin, set out to investigate the use of 3D scanning and printing technology to develop replica shark fins, that could support the identification of shark fins in trade. The subsequent development of the 3D replica fins was a collaborative process involving many international stakeholders. Dried fins from CITES-listed sharks were sourced from Debra Abercrombie - a US based expert in shark fin identification - and DFFE.

All shark fins were 3D laser scanned to provide a digital representation of each fin (Figure 1).

Figure 1. Blue Shark fin (pectoral) are 3D laser scanned using 3D image software. Photo: Markus Bürgener

Once a digital representation of each fin was created, the 3D scanned images underwent a process known as retopology whereby the 3D scanned image was modified to produce an optimally printed product. The retopologized shark files were then 3D printed using a selective laser sintering process with nylon as the main material. Sintered nylon provides a slightly rough sandpaper-like texture similar to real dried shark fins which also allows for better adhesion of paint (Fig. 2).

Figure 2. The replica shark fins after 3D printing using sintered nylon as the main material for printing (Bowmouth Guitarfish (*Rhina ancylostoma*) caudal fin, Oceanic Whitetip (*Carcharhinus longimanus*) dorsal fin, and Great Hammerhead (*Sphyrna mokarran*) pectoral fin)

The most challenging step in the process was the painting process as it was essential that the 3D printed replicas have the identical colours and markings of the scanned fins so that important identifying features are not missed. The painting of the replica fins was completed by skilled artists from Cosmesis Advanced Prosthetics, a company based in Cape Town, South Africa, using photos of the real fins with grey and colour reference cards. The final painted fins involved multiple layers of airbrushing to create the exact colour of each fin, with specific paint marking added, depending on the fin and key identifying features of various species (Fig 3).

Figure 3. Replica shark fins after painting (Bowmouth Guitarfish (*Rhina ancylostoma*) caudal fin, Oceanic Whitetip (*Carcharhinus longimanus*) dorsal fin, and Great Hammerhead (*Sphyrna mokarran*) pectoral fin)

With the assistance of Cosmesis Advanced Prosthetics, TRAFFIC also developed the concept of being able to provide a QR code-based link from each printed fin to dedicated web pages providing information on the key identifying features for each species. Accordingly, a second set of fin scans has been developed (through retopology) which provides printed fins that contain the name of each shark along the leading edge of the fin and a raised square section on which QR codes can be attached. With the use of these fins, law enforcement officials can scan the QR codes on smartphones and obtain detailed guidance on key identification features of that specific fin.

DISCUSSION

The development of the 3D printed fins accompanied by the QR codes will facilitate training of customs, compliance and other law enforcement officials in shark fin identification – especially for fins from sharks listed in the CITES Appendices. The combination of replica fins with QR codes will allow for rapid and confident decision-making by officials. TRAFFIC will continue to build the collection of replica fin scans for CITES, and non-CITES, listed shark species in trade, and expand the how-to-guide and fin identification web-pages into other languages,

dependent on need and funding availability. For further information, please contact: Markus Burgener markus.burgener@traffic.org or Simone Louw simone.louw@traffic.org

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