



Shark fins and other body parts in trade can be identified to the species level

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## Genetic Identification of Shark Body Parts in Trade: Rapid, Reliable, Inexpensive

### A Summary of a New Scientific Analysis

Demian D. Chapman, Ph.D., and Debra L. Abercrombie, M.S., School of Marine and Atmospheric Sciences, Institute for Ocean Conservation Science, Stony Brook University, Stony Brook, N.Y.

Four proposals to restrict the trade of shark products will be under consideration by the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) at their meeting in March in Doha, Qatar. If these proposals are successful, a number of shark species would be listed in CITES Appendix II, a

designation that would require export permits or certificates before international trade would be allowed. To assist Parties in their decision-making, this document explains how shark fins and other body parts in trade can be identified to the species level, aiding in enforceability.

Identification of seafood products by DNA barcoding is increasingly common

TABLE 1: VERIFIED CHINESE MARKET CATEGORIES, literature source for species-diagnostic PCR and reference DNA barcodes\* for seven shark species proposed for CITES listing.

Species	Chinese Trade Name	Species-Diagnostic PCR	Reference DNA Barcode
Great hammerhead ( <i>Sphyrna mokarran</i> )	Gu Pian <sup>2</sup>	Abercrombie et al., 2005	Accession # FJ519473, 1 of 40
Smooth hammerhead ( <i>S. zygaena</i> )	Gui Chun <sup>2</sup>	Abercrombie et al., 2005	Accession # FJ519539, 1 of 28
Scalloped hammerhead ( <i>S. lewini</i> )	Bai Chun <sup>2</sup>	Abercrombie et al., 2005	Accession # FJ519453, 1 of 114
<i>S. lewini/S. zygaena</i>	Chun Chi <sup>2</sup>	Abercrombie et al., 2005	(See Scalloped hammerhead above)
Dusky shark ( <i>Carcharhinus obscurus</i> )	Hai Hu <sup>1</sup>	Shivji et al., 2002**	Accession # FJ519136, 1 of 28
Sandbar shark ( <i>C. plumbeus</i> )	Bai Qing <sup>1</sup>	Pank et al., 2001**	Accession # FJ519623, 1 of 14
Oceanic whitetip shark ( <i>C. longimanus</i> )	Liu Qiu <sup>1</sup>	Shivji et al., 2002**	Accession # FJ519620, 1 of 20
Porbeagle shark ( <i>Lamna nasus</i> )	Hei Sha <sup>1</sup>	Shivji et al., 2002	Accession # FJ519727, 1 of 81

\* Available at GenBank: [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov).

\*\* Test developed but validated only in a specific region (additional development is necessary).

## Detached shark fins can be identified to species or group

Chinese fin traders sort shark fins under specific trade names based on how the fin looks.<sup>1</sup> The reason is that each type has a specific economic value.<sup>1</sup> For shark species with valuable fins, including most of those proposed for listing at the CITES Conference of the Parties, there is strong association with specific trade names<sup>1</sup> (see Table 1). Thus, potential monitoring approaches for the shark fin trade could include:

- Mandatory labeling of fins by their Chinese trade names early in the supply chain.
- Training and/or equipping inspectors to visually identify the fins of listed species. As discussed below, genetic techniques could then be used to verify or refute the visual identification of fins suspected to originate from listed species that lack the appropriate CITES permit.

## Genetics can be used to reliably identify shark body parts

These parts (fins and meat, for example) have been identified using many genetic techniques,<sup>2-6</sup> most commonly through DNA barcoding and species-diagnostic PCR (polymerase chain reaction).

- **DNA barcoding** involves comparing part of the DNA from an organism of unknown origin (e.g., using a sample from a shark fin or filet) to DNA from a known population or species using a reference library of genetic sequences,<sup>4,5</sup> which are available on the Internet (see Table 1).
- **Species-diagnostic PCR** is a standard procedure used to “amplify”—make many copies of—a targeted part of the genome using synthetic bits of DNA, known as primers. Species-diagnostic PCR uses custom-designed primers that match only the species of interest and therefore amplify that species alone, generating a species-specific-size

DNA fragment. Species identification is then possible using the simple and well-established technique of gel electrophoresis, which separates these DNA fragments. Many primers can be combined in one PCR, permitting simultaneous testing for more than one species.<sup>2,3</sup>

### Genetic techniques are available for all proposed species

DNA-barcodes for all proposed species are available in searchable internet databases (e.g., GenBank: [www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)), allowing identification of these species using DNA-barcoding methods (Table 1). Species-diagnostic PCR assays have been published in the primary scientific literature for all three hammerhead shark species—scalloped hammerhead<sup>2</sup> (*Sphyrna lewini*), smooth hammerhead<sup>2</sup> (*S. zygaena*), great hammerhead<sup>2</sup> (*S. mokarran*)—and porbeagle sharks (*Lamna nasus*).<sup>3</sup> These assays have been shown to work for populations of these species around the globe. Tests for the remaining proposed species are in the late stages of development.<sup>3,6</sup> In addition, the geographic origin of some proposed species can be assessed using publicly available DNA sequences.<sup>7</sup>

### Methods require only a basic laboratory set-up and are relatively inexpensive (materials cost US\$5 to \$10 per sample)

The identification of seafood products by DNA barcoding is increasingly common. DNA sequencing facilities are found in many laboratories around the world and sequencing costs are declining.<sup>4</sup> Many countries now have such facilities at academic and research institutions. Species-diagnostic PCR is even easier and more cost-effective than DNA barcoding because virtually all molecular laboratories in the world are equipped for this relatively simple technique.<sup>2-3,6</sup> In most of these labs, identification of about 50 shark samples can be completed in a single work-day by one technician using species-diagnostic PCR. Additional investment in equipment and automation can further speed analyses.

### Genetic testing of shark body parts is being conducted around the world

Molecular approaches for identifying shark species have been developed or applied in East Asia,<sup>1</sup> North America,<sup>2,6</sup> South America<sup>5</sup> and Oceania,<sup>4</sup> in many cases providing useful information on the fin trade and law enforcement.



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901 E Street NW, 10th Floor, Washington, DC 20004 ■ Phone: 202.552.2000  
Email: oceanscience@pewtrusts.org ■ www.pewenvironment.org

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