Blue Sharks Identification Guide

Atlantic Ocean - Azores

2024

IICM Okeanos –
University of the Azores, Portugal

First edition

Cover by Margaux Le Brun

About the author:

A graduate in oceanography/marine biology, professional diver and underwater cameraman, Margaux Le Brun has built up her experience of diving with sharks all over the world!

She is a naturalist guide, a shark seminar leader specializing in human-shark interactions, and accompanies groups of divers on shark encounters in a dozen different destinations as part of the Shark Education organization. With Shark Education, she fights to promote quality shark ecotourism by involving local communities.

Acknowledgements :

This blue shark photo-identification catalog was made possible thanks to the support of Steven Surina, founder of Shark Education, Jorge Fontes / Okeanos, who provided us with the laser photogrammetry tool used to measure the animals, and also to the entire CW Azores team with whom we organize all our citizen science workshops. Thanks to all of you.

Photo credits:

M. Le Brun, S. Avril, A. Verde, P. Marshall

This catalog was developed as part of the citizen science workshops organized by Shark Education from July to September, following 18 dives, aimed at studying the population of blue sharks (*Prionace glauca*) frequenting the waters of the Azores using photo-identification.

Its main objective is to enable the individual identification of sharks observed during dives, thanks to the analysis of their distinctive morphological characteristics and behaviors. These data are used to study the fidelity of individuals to dive sites on different time scales: daily, weekly, monthly and yearly.

In particular, this work seeks to determine whether the blue sharks observed are merely passing through the region, or whether they exhibit recurrent migratory behaviors, such as regularly returning to the same sites at similar times each year. The information gathered will contribute to a better understanding of the ecology and dynamics of this species in the North-East Atlantic, as well as to appropriate conservation initiatives.

Introduction

Blue sharks (*Prionace glauca*) are emblematic predators of temperate and tropical oceans. With their slender silhouettes, deep blue pigmentation and exceptional migratory behavior, they embody the beauty and complexity of marine ecosystems. These pelagic sharks play a crucial role in balancing food chains by regulating fish and cephalopod populations, thus contributing to the health of the oceans.

The blue shark is a cosmopolitan species found in almost all the world's seas, with the exception of polar waters. A long-distance migrant, it can travel thousands of kilometers during the year to feed, reproduce or follow favorable currents and temperatures. Females, capable of producing litters of up to 135 pups, often use specific areas as nurseries, a behavior essential to the species' survival.

Mainly observed in the open sea, the blue shark is characterized by its relative sociability and sometimes curious behavior towards divers. However, despite its wide distribution, it remains a species vulnerable to a number of threats.

According to the International Union for Conservation of Nature (IUCN), the blue shark is classified as Near Threatened (NT), although significant regional declines have been reported. Overfishing is the main threat to this species, as it is one of the most heavily caught sharks in the world, often accidentally by industrial fisheries targeting tuna or swordfish. Blue shark fins are also highly prized for the fin soup market, contributing to excessive pressure on their populations.

Despite its ecological importance and widespread presence, the blue shark remains relatively unstudied compared to other species such as the white shark or whale shark. Current research focuses mainly on :

- Transoceanic migrations: Understanding migration routes is essential for establishing effective marine protected areas.

- Interactions with fisheries: Identifying the areas where bycatch is most frequent can help reduce its impact.
- Biology and genetics: Exploring the genetic diversity of populations to better understand their resilience to anthropogenic pressures.

In addition, awareness-raising efforts and participatory science programs, such as those we run, play a key role in improving knowledge of this species and mobilizing the public to protect it.

This catalog aims to :

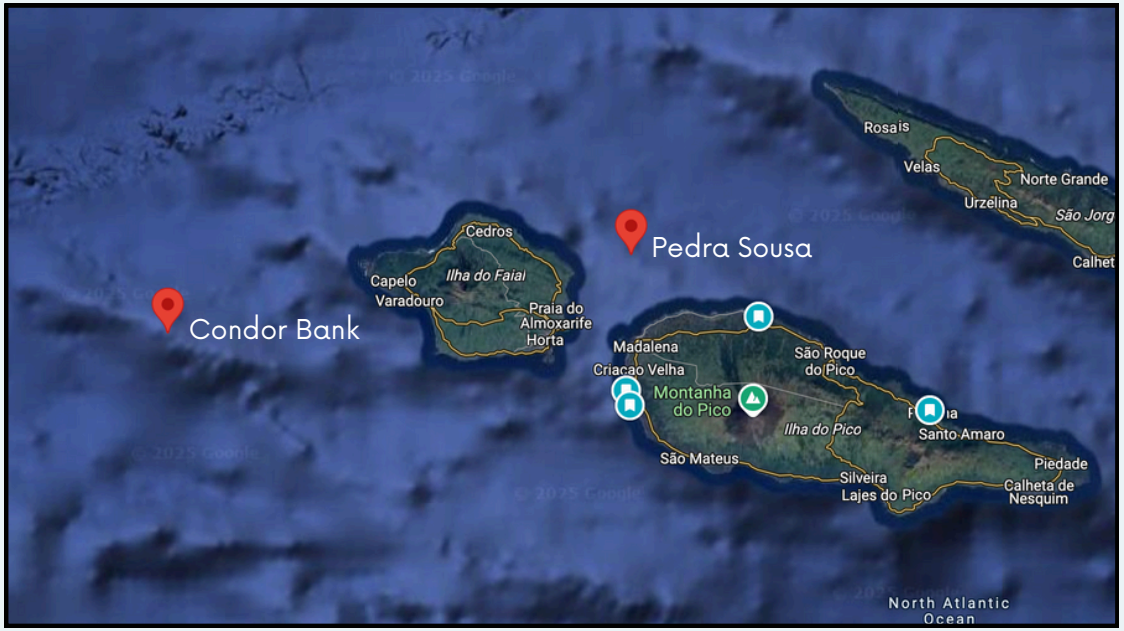
- Build up a visual database to track individuals encountered during dives around Pico and Faial.
- Encourage divers and enthusiasts to actively participate in the data collection effort.
- Provide an educational tool to raise awareness of the importance of conserving this fascinating species.

Together, we hope to better understand blue sharks and contribute to their protection for future generations.

A catalog based on observations in the Azores

This catalog has been designed to document and identify blue sharks encountered during dives at two main sites off the Azores: **Pedra de Sousa** and **Condor Bank**. These sites, located in pelagic areas rich in biodiversity, offer unique opportunities to interact with this species in its natural habitat.

Introduction



Satellite map of the islands of Pico and Faial, in the Azores archipelago.
In red, the dive sites of Condor Bank and Pedra Sousa.

Our observations are focused on these two strategic areas for several reasons:

- Accessibility and regularity of encounters: These sites are known for the presence of blue sharks, enabling frequent and recurrent observation.
- Ecological importance: These areas are essential habitats for blue sharks, attracted by the concentration of prey and favorable currents.
- Proximity to research initiatives: By collaborating with local program, these observations contribute to global scientific knowledge.

By collecting visual and behavioral data on these sharks, we hope not only to identify individuals, but also to better understand their ecology, movements and site fidelity.

Materials and methods

Photo-identification

Photo-identification is a method widely used in marine fauna studies to recognize individuals within a population. It is based on the analysis of each animal's unique physical characteristics, which act as a “visual fingerprint”. This technique plays a key role in tracking individuals over the long term, enabling us to better understand their movements, site fidelity, population composition and abundance, residence and migration patterns, social behavior and role within the local population, biology and ecology.

Its interests are manifold:

- non-intrusive
- easy to install
- can complement the use of tags
- less expensive
- helps educate diving communities

The technique consists of photographing or filming an animal in whole or in part, to highlight the characteristics that differentiate it from its congeners. To guarantee usable data, photographs need to be taken under optimum conditions, with an angle perpendicular to the shark's body to capture clear profiles. Image quality is essential, as it enables accurate comparison between successive encounters. By minimizing the impact on the animals and respecting their space, this method is ethical and non-intrusive, perfectly suited to studies on sensitive marine species.

The animal can then be named, registered, added to a database or compared within the same database.

Materials and methods

Laser photogrammetry

Laser photogrammetry is a non-invasive method used to measure the dimensions of an animal in its natural environment without the need to capture it. The system is based on the use of two green or red laser beams, mounted fixed and parallel on an underwater camera. The lasers are spaced a precise distance apart - in our workshops, 25 cm - and projected onto the shark's body as it swims.

The principle is simple: when the camera captures an image or video showing both the laser beams and the shark, it is possible to calculate the size of the animal using the fixed spacing of the lasers as a scale reference. For example, if the laser points of light appear on the shark's body, the distance measured on the image between these points can be related to the known spacing of the lasers to accurately estimate the actual size of different parts of the shark (total length, dorsal fin height, etc.).

This method is particularly well-suited to blue sharks, as it enables reliable measurements to be obtained without having to handle or stress the animals. However, the shots must be taken with care: the camera should be positioned at an ideal distance of 2 to 4 meters so that the laser beams are clearly visible and aligned parallel to the shark's body. Light conditions and underwater visibility also play an important role in the quality of the data obtained.

Laser photogrammetry is therefore an invaluable tool for studying growth, morphology and variations between individuals, while respecting their well-being and natural behavior. By combining this technique with photo-identification, researchers can associate precise measurements with specific individuals, enhancing knowledge of blue shark biology and ecology.

Materials and methods

Development of an experimental method for individual identification of blue sharks *(Prionace glauca):*

Unlike species such as the great white shark (*Carcharodon carcharias*) or the whale shark (*Rhincodon typus*) for which standardized methods of individual identification are well established, no concrete technique has yet been validated for blue sharks (*Prionace glauca*). The reasons for this gap include the absence of distinct, enduring body patterns, as well as a biology and behavior that make individual recognition difficult.

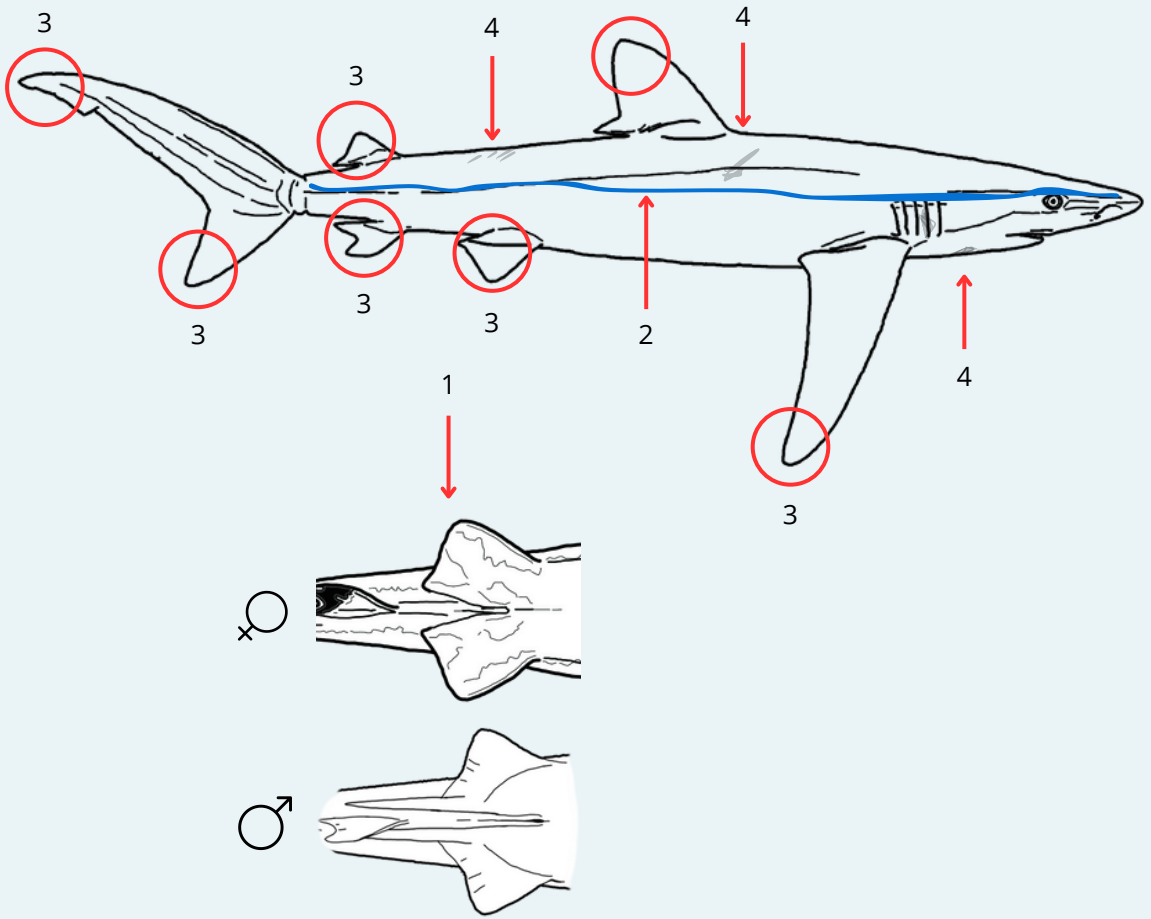
In our work, we are developing an experimental approach based on the analysis of several morphological and particular characteristics specific to each individual. The following criteria are used as potential markers:

- **Dorsal pigmentation pattern**: We exploit the marked transition from blue on the back to ventral white, similar to the approach used for the great white shark. This line, although subtle, can present distinct variations in shape, intensity or interruption.
- **Trauma and physical anomalies**: Cuts, scars, partial removals or malformations of fins or body are meticulously documented. These marks, often the result of predation, human interaction or pathology, are potentially unique and long-lasting.
- **Presence of hooks or other foreign objects**: The detection of hooks still attached or wounds associated with fishing gear provides a differentiating, albeit temporary, criterion.
- **Specific individual characteristics**: Abnormalities such as cataracts affecting one eye or unusual pigmentation patterns (spots, localized depigmentation) are also included in our analysis.

Materials and methods

For each observation, we make a photographic and videographic record, capturing views of the right and left flanks, as well as details of each fins. These data are then analyzed and archived in a visual database. The aim is to identify characteristics that are sufficiently constant over time to enable longitudinal tracking of individuals.

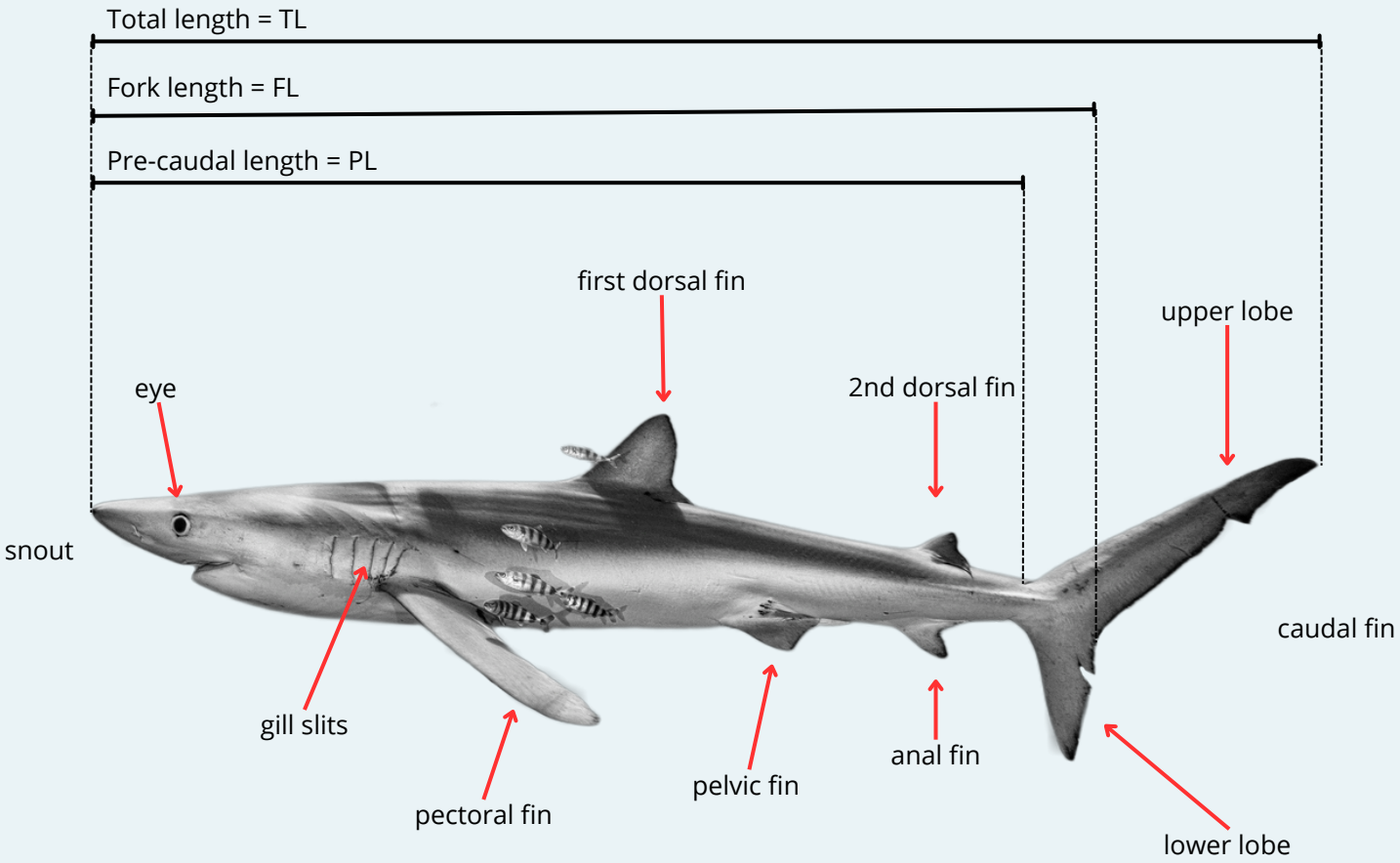
This method, although preliminary, is intended to establish a basis for standardized protocols in the future. If it proves reliable, it could provide a valuable tool for population studies, behavioral analyses and the conservation of this emblematic but vulnerable species.



To identify a blue shark, we have defined the following observation points, present on one or both sides of the animal:

1. Sex
2. Pigmentation pattern
3. Cuts, lacerations, gashes, ablations
4. Scars, distinctive marks, hooks

Materials and methods



If you would like to support the study through participatory science, please send your images to the following address: margaux@sharkeducation.com

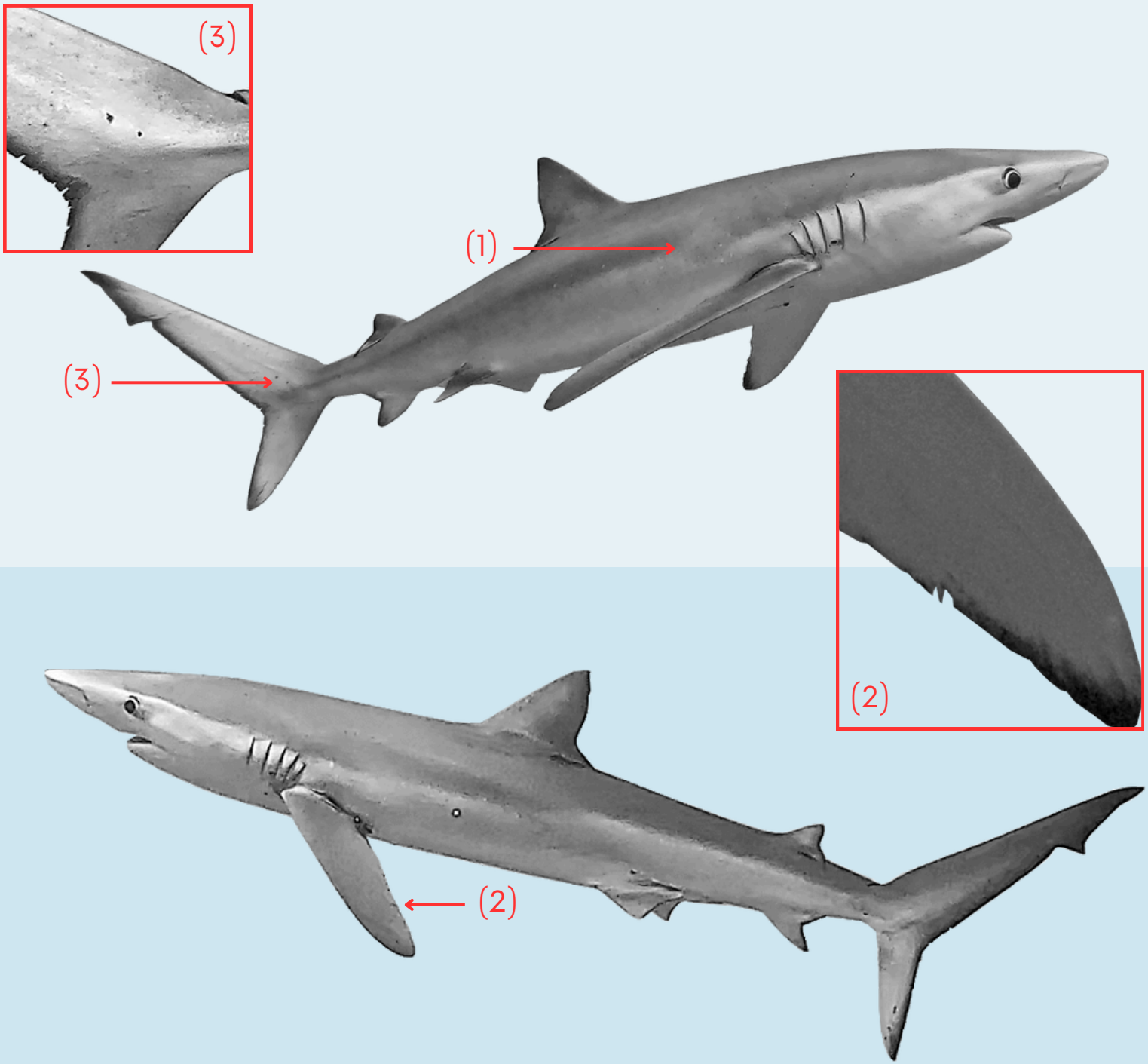
Blue Shark #1

TL: 273,6 cm
FL: 229,1 cm
PL: 208,6 cm

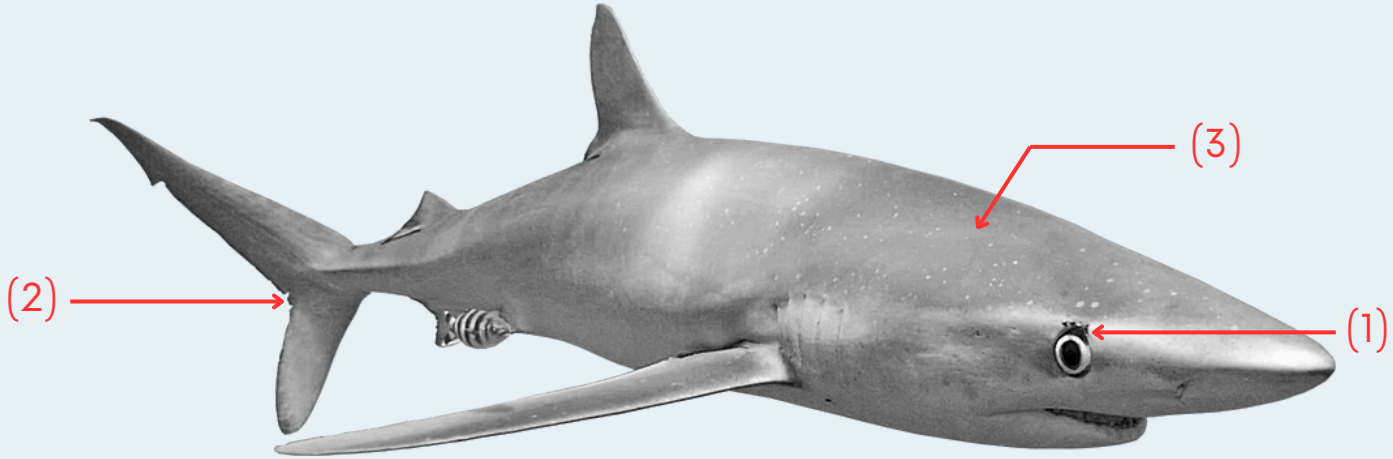
Sex: ♂

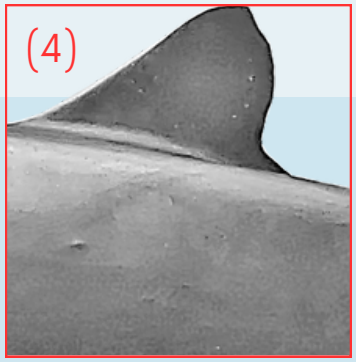
ID: A lighter circle is present on the pigmentation pattern (1), an M-shaped cut on the left pectoral fin (2), 2 black dots on the right side of the caudal fin (3).

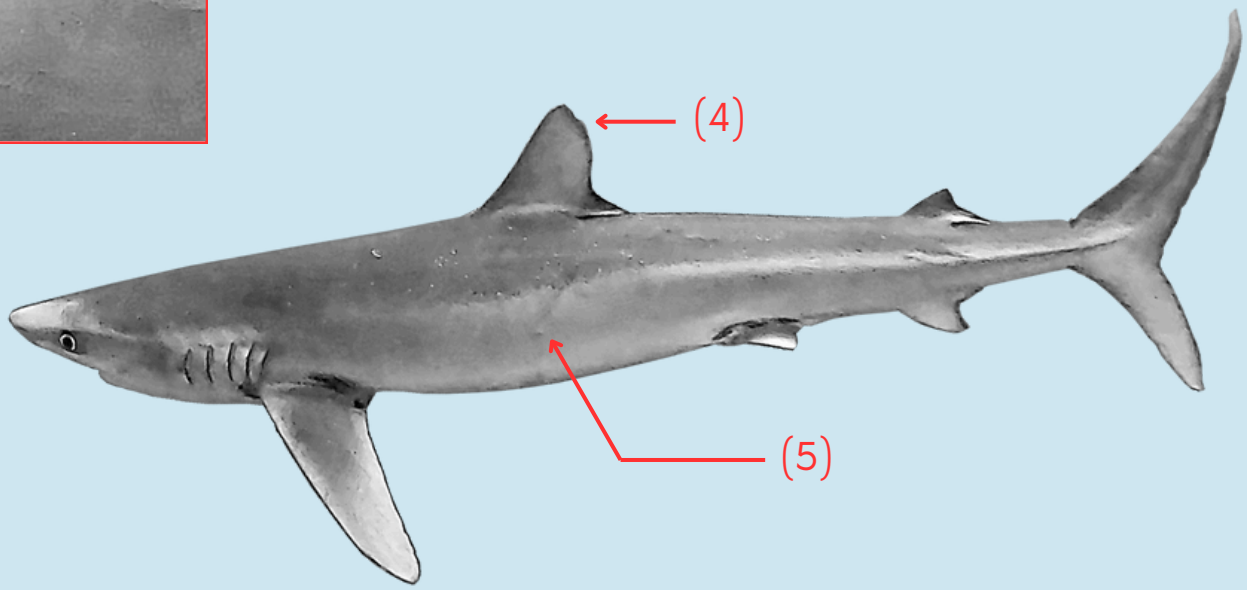
Sightings: Pedra Sousa 2024



Blue Shark #2







TL: 281,6 cm
FL: 230,7 cm
PL: 213 cm

Sex: ♂

ID: Black mark above the right eye (1), 2 cuts on the caudal fin between the two lobes (2), body dotted with white spots (two distinct ones above the right eye) (3), notch at the tip of the dorsal fin (4), a raised spot followed by a linear surface mark (5).

Sightings: Pedra Sousa 2024

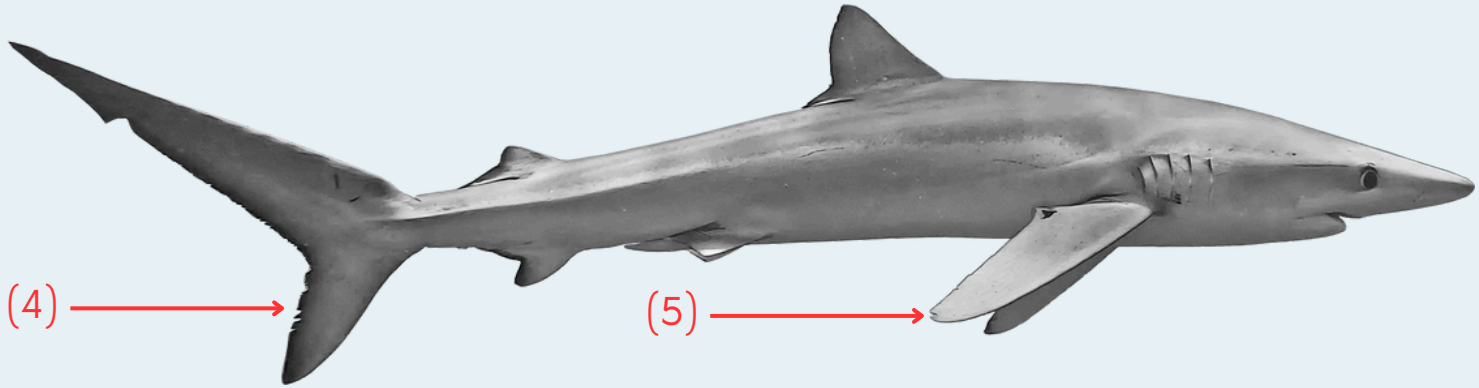
Blue Shark #3

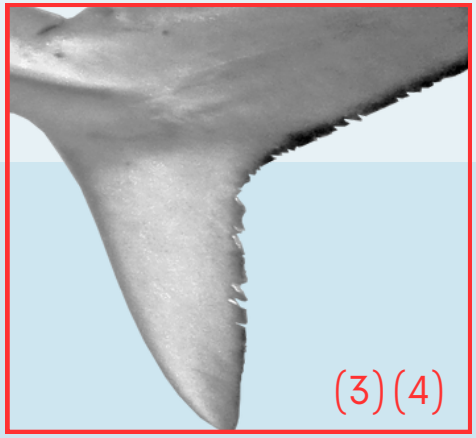
TL: null
FL: null
PL: null

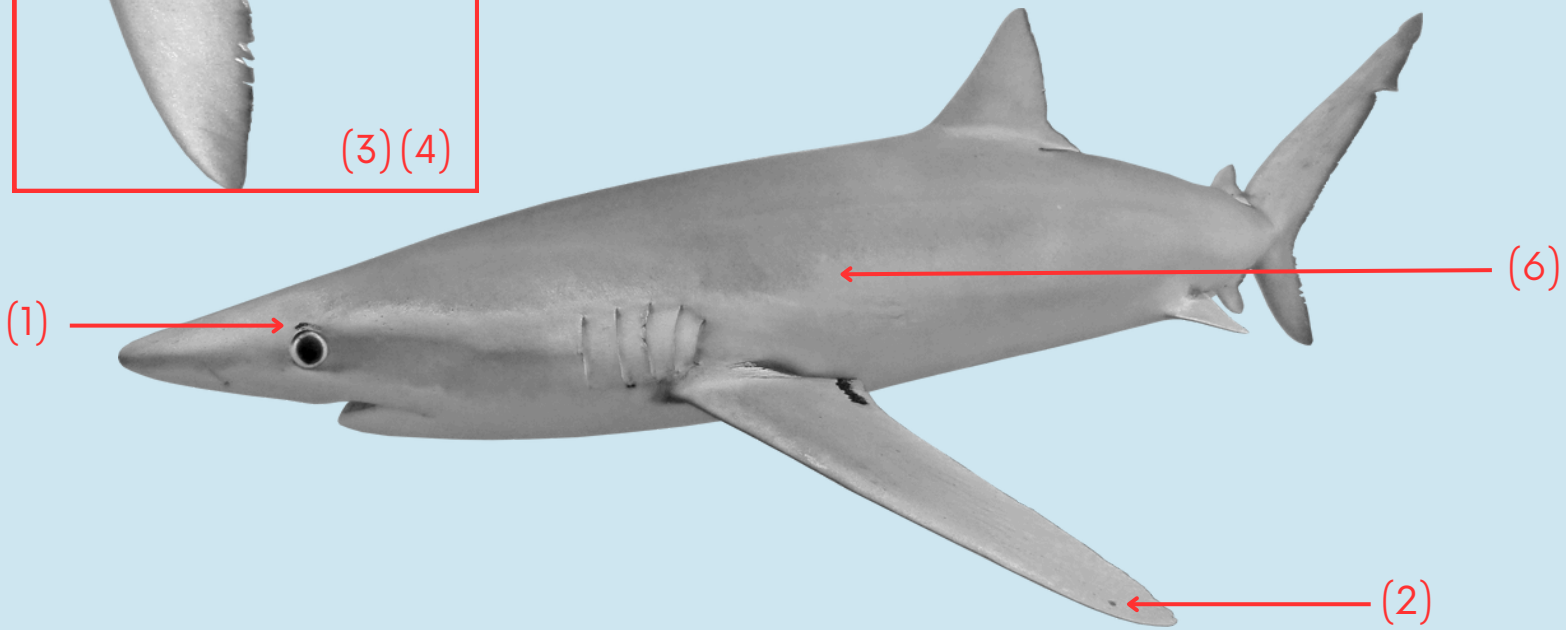
Sex: ♂

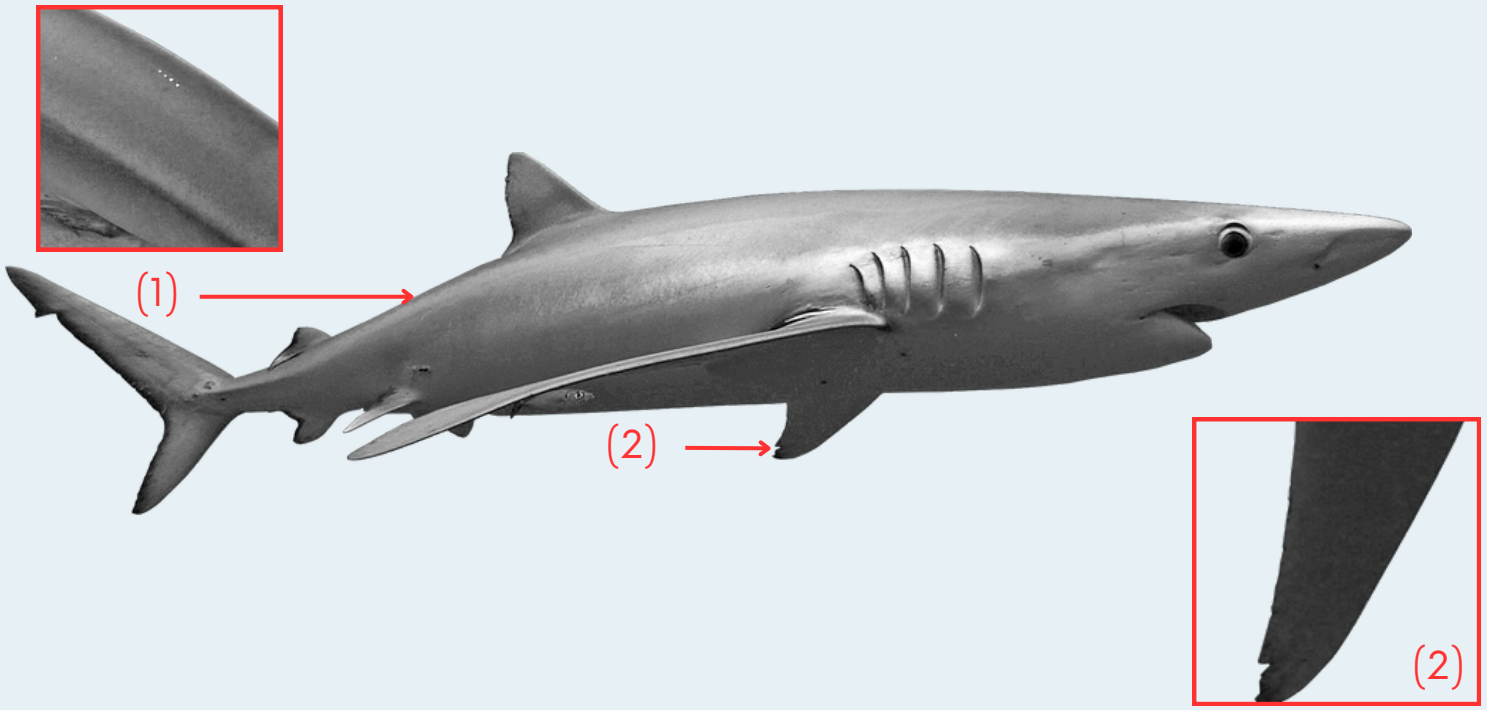
ID: Black spot above left eye (1), round black spot at tip of left pectoral fin (2), 2 black spots on left caudal fin (3), 5 notches on the lower lobe of the caudal fin (4), cut at tip of right pectoral fin (5), the discontinuous, staircase-like pigmentation pattern (6).

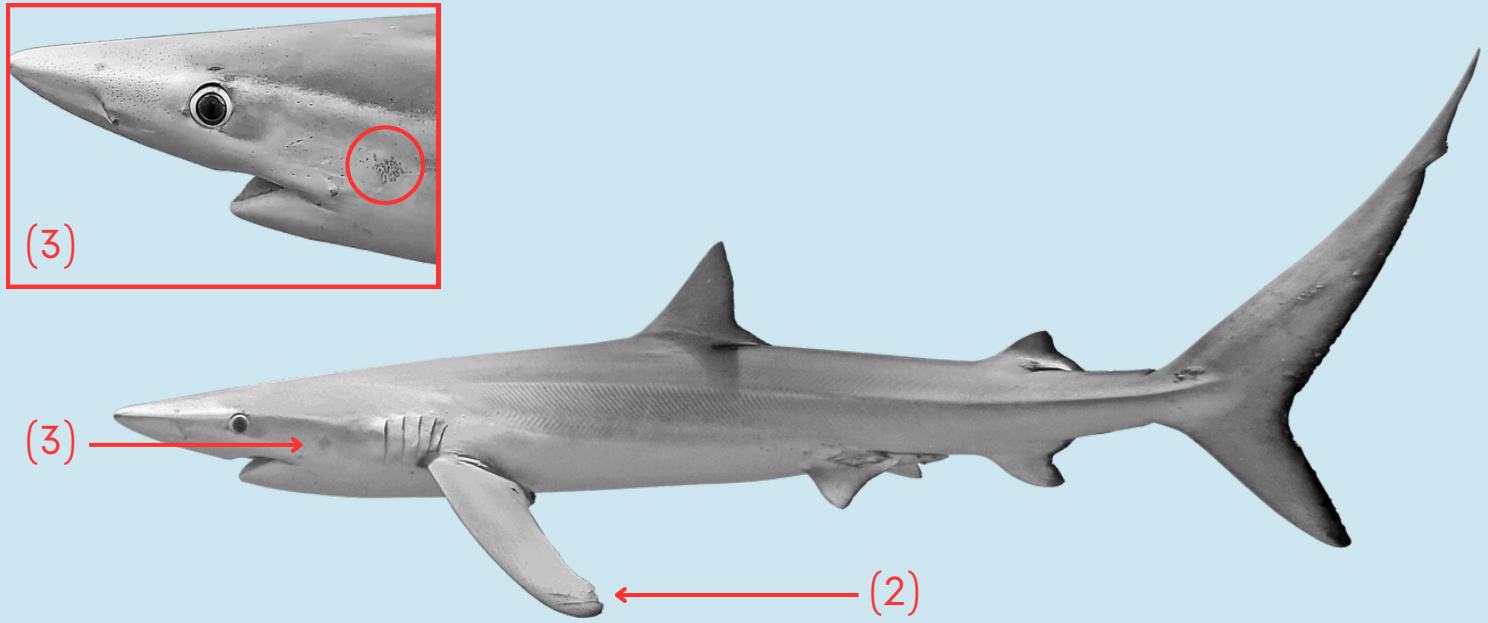
Sightings: Pedra Sousa 2024











Blue Shark #4

TL: 181,7 cm
FL: 147,5 cm
PL: 137,6 cm

Sex: ♂

ID: 4 white dots are present on the back between the first and second dorsal fins (1), a notch is visible on the tip of the left pectoral fin (2), a mark made up of several black dots between the mouth and the gills on the silver part on the left side (3).

Sightings: Pedra Sousa 2024

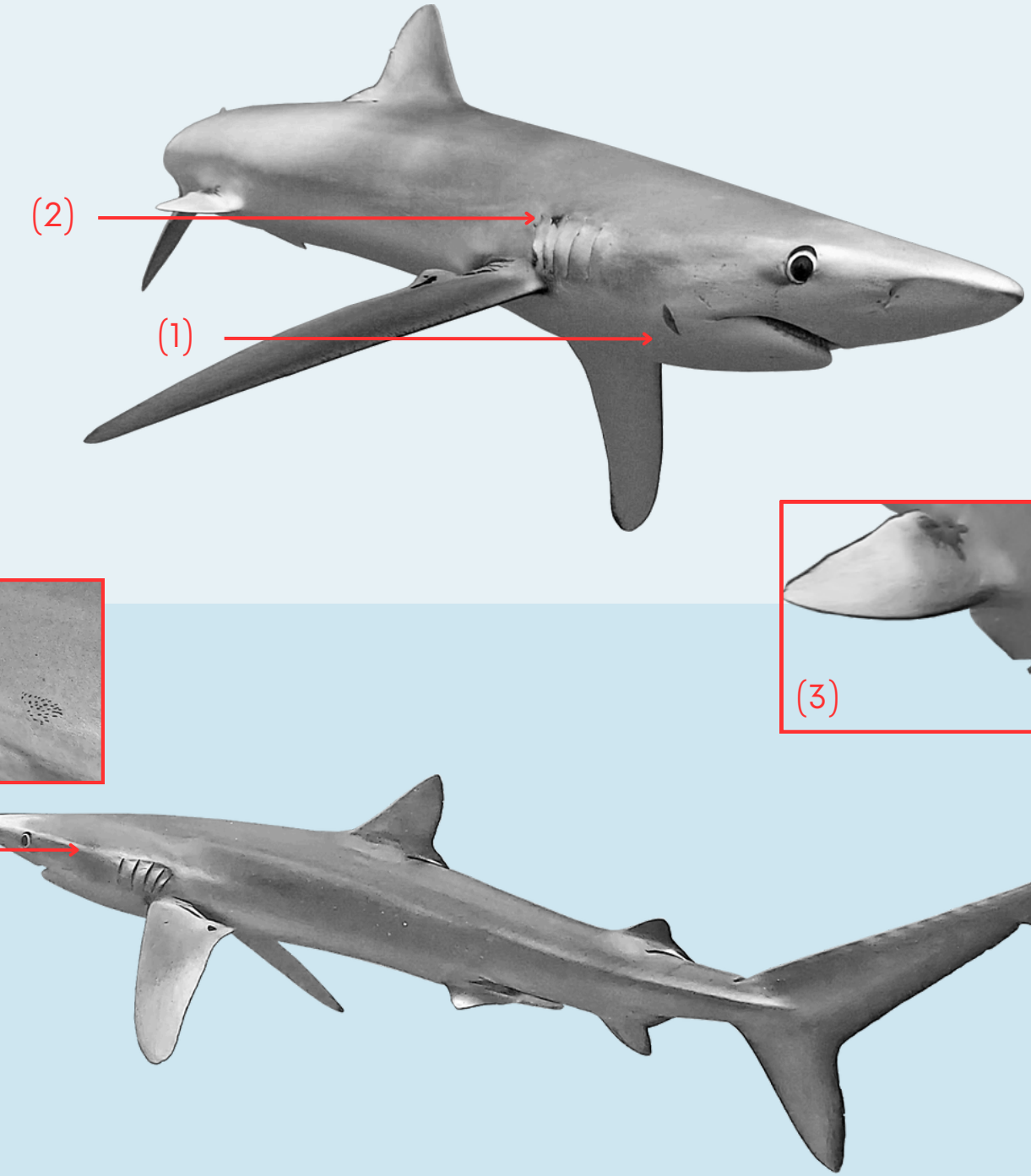
Blue Shark #5

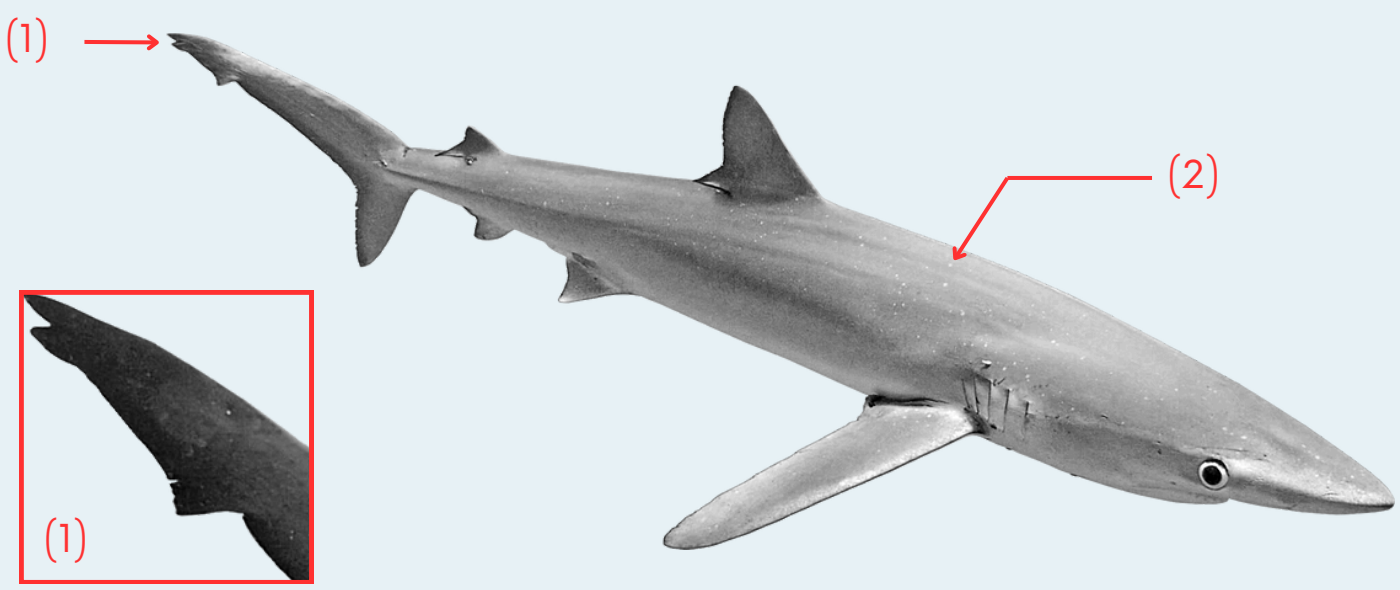
TL: null
FL: null
PL: null

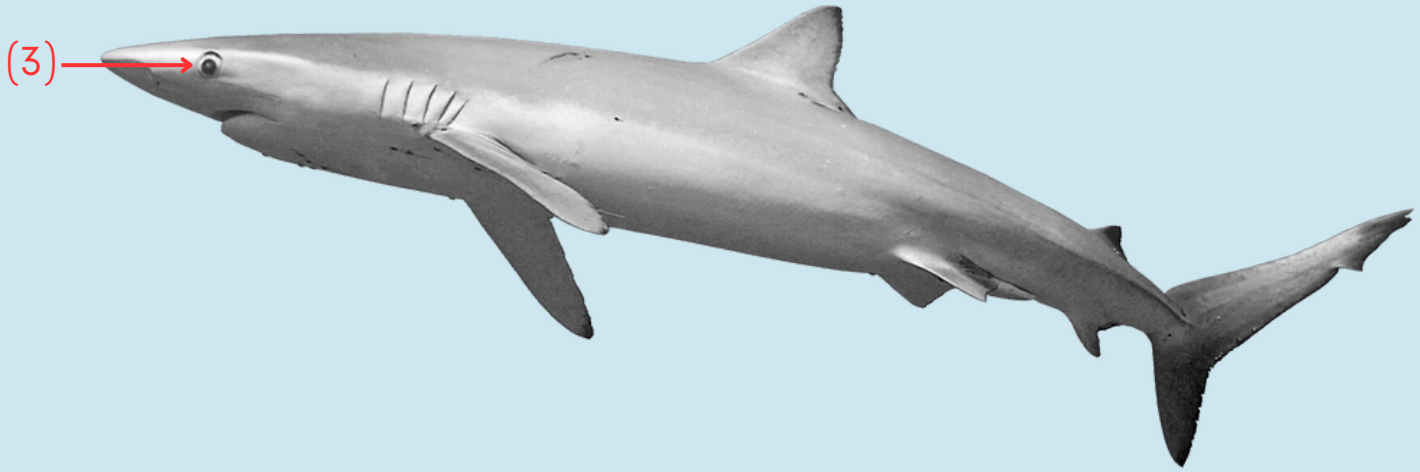
Sex: ♂

ID: Dark cut between mouth and gills on the white part of the skin on the right side (1), dark spot on the 4th gill slit (2), notch on the left pelvic fin (3), a mark made up of several black dots between the mouth and the gills on the blue part on the left side (4).

Sightings: Pedra Sousa 2024







Blue Shark #6

TL: 225 cm
FL: 191,1 cm
PL: 173,1 cm

Sex: ♂

ID: Caudal fin tip cut in two (1), body dotted with white spots (2), left eye slightly opaque (blind, punctured, parasite or cataract?) (3).

Sightings: Pedra Sousa 2024

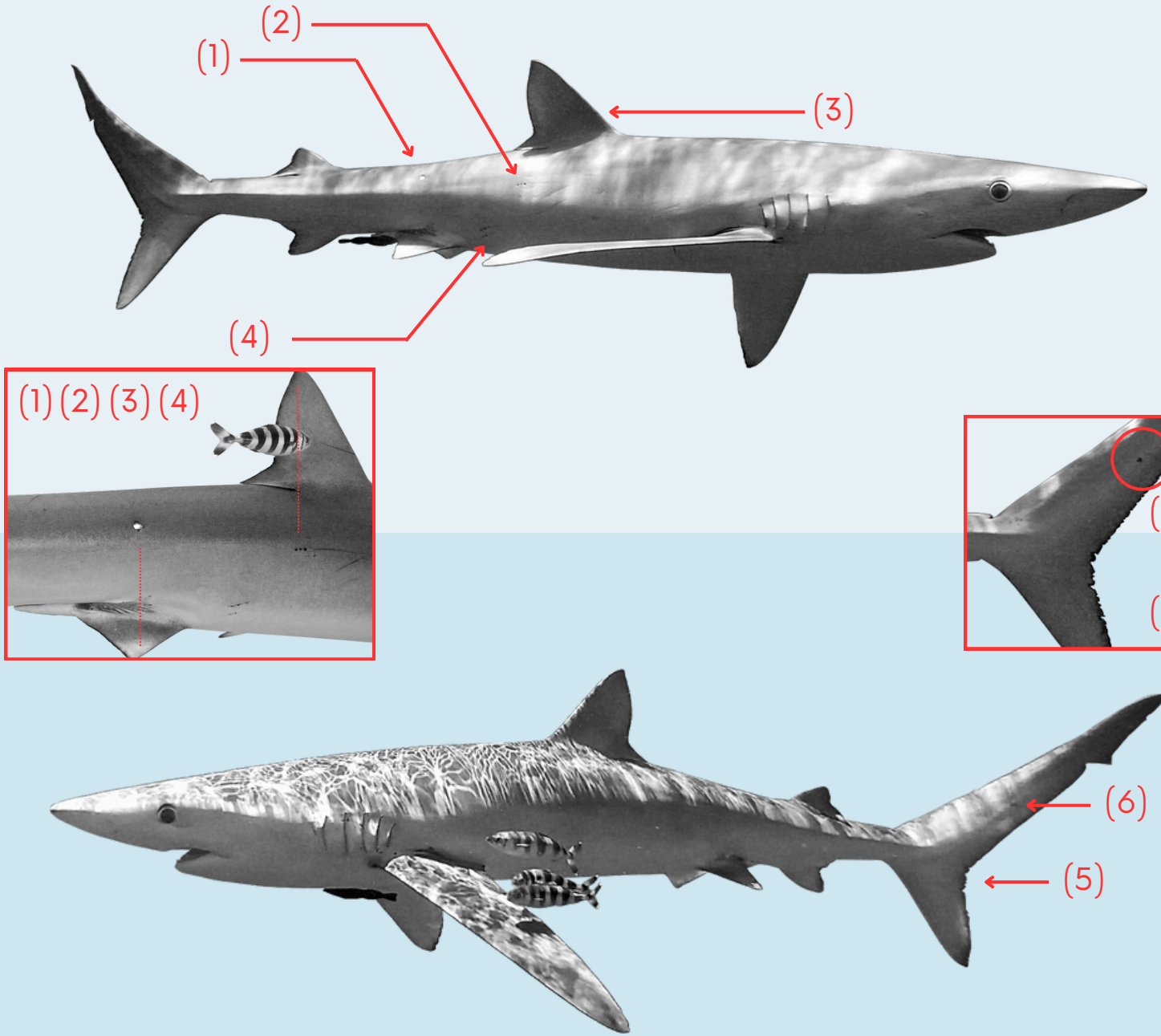
Blue Shark #7

TL: 256,8 cm
FL: 207,8 cm
PL: 195,3 cm

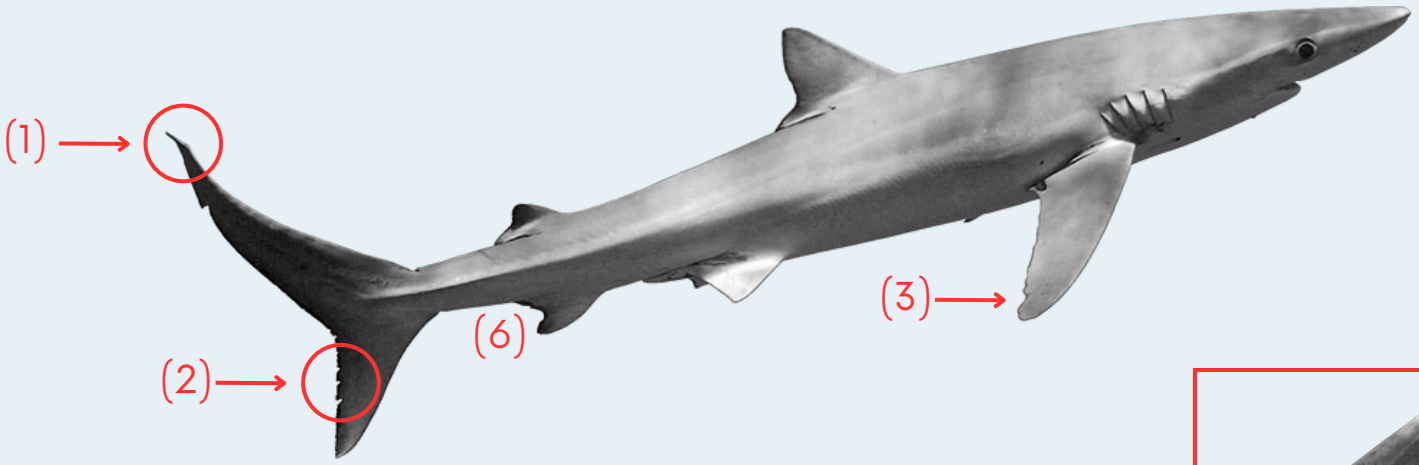
Sex: ♂

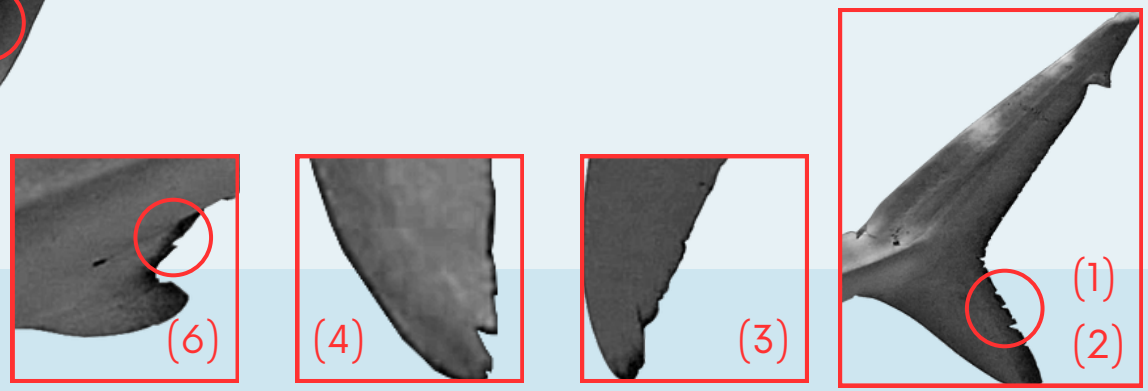
ID: Round, white scar between the first and second dorsal fins perfectly aligned with the right pelvic fin (1), 3 black dots aligned on the right flank with a deep appearance in line with the dorsal fin (2), black stripe on the right dorsal fin (3), 2 parallel scratches (one large and one small) on the clear part of the right flank a little before the pelvic fin (4), 4 major cuts on the caudal fin (2 on the lower lobe and 2 between the two lobes) (5), round black spot on the left upper lobe (6).

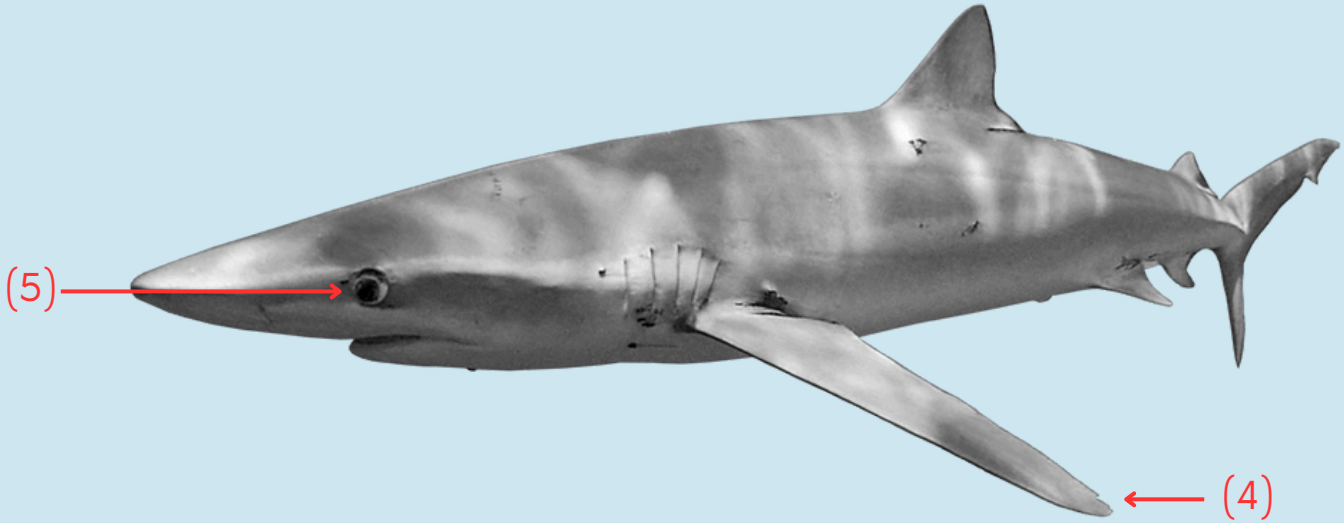
Sightings: Pedra Sousa 2024



Blue Shark #8







TL: null
FL: null
PL: null

Sex: ♂

ID: The tip of the caudal fin is twisted to the right (1), 3 main cuts on the lower lobe of the caudal fin (2), notches present on the tips of both pectoral fins (3)(4), damaged left eye (blind, cataract, parasite, punctured?)(5), tiny cut and "rounded" anal fin (6).

Sightings: Pedra Sousa 2024

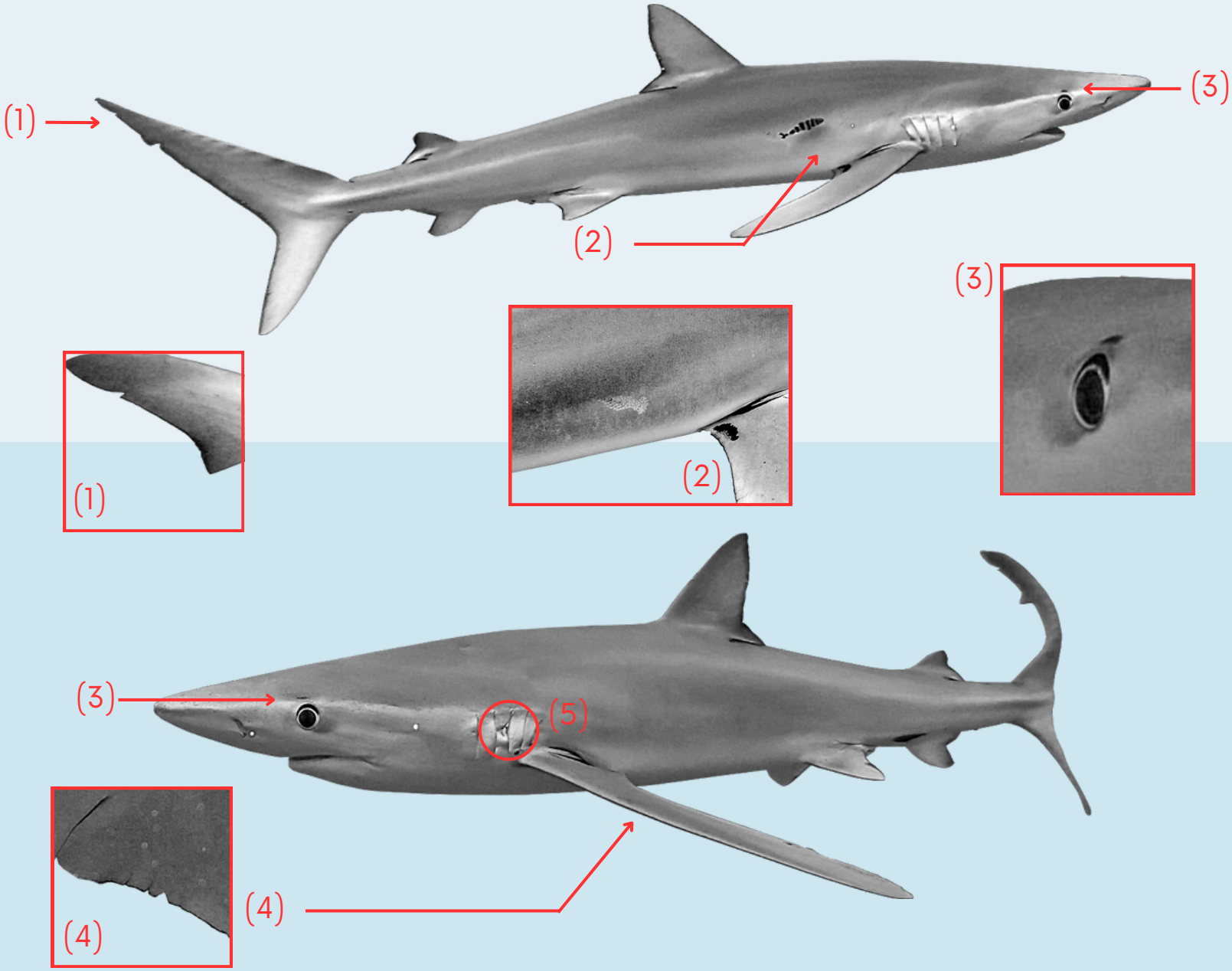
Blue Shark #9

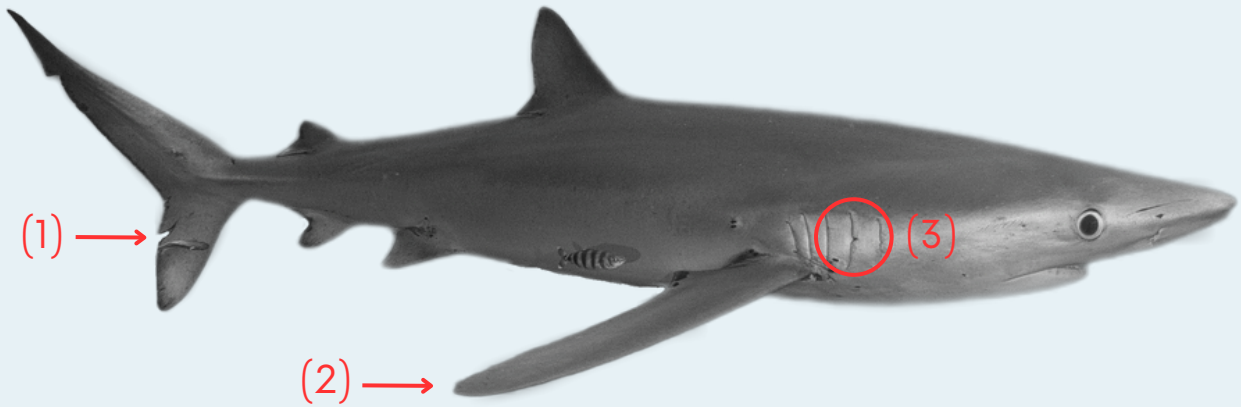
TL: 262,2 cm
FL: 217,4 cm
PL: 198,5 cm

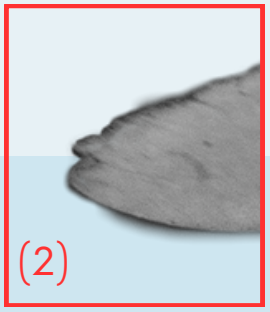
Sex: ♂

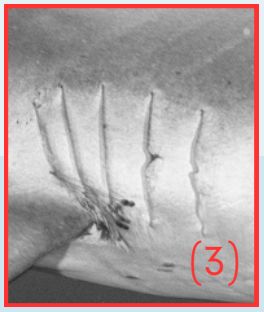
ID: Notch on the spur of the upper lobe of the caudal fin (1), mark on the right flank (2), black mark above the two eyes (3), notch on the left pectoral fin (4), deformation on the third gill slit on the left side (5).

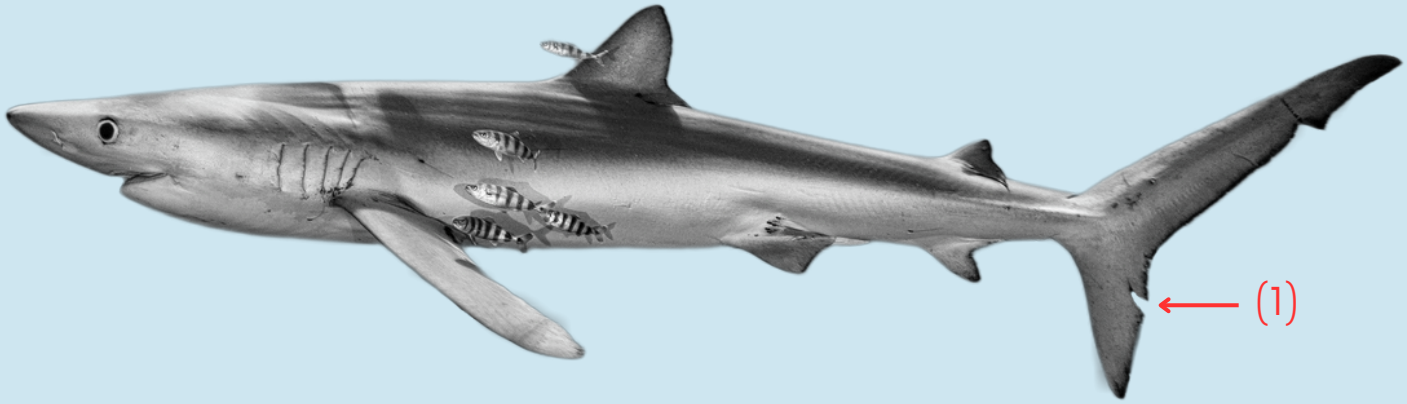
Sightings: Condor Bank 2024











Blue Shark #10

TL: 220,2 cm
FL: 191,5 cm
PL: 173,5 cm

Sex: ♂

ID: Clear cut on the lower lobe of the caudal fin (1), small 90° notch on the tip of the right pectoral fin (2), slight snag on the second gill slit on the right side (3).

Sightings: Condor Bank 2024

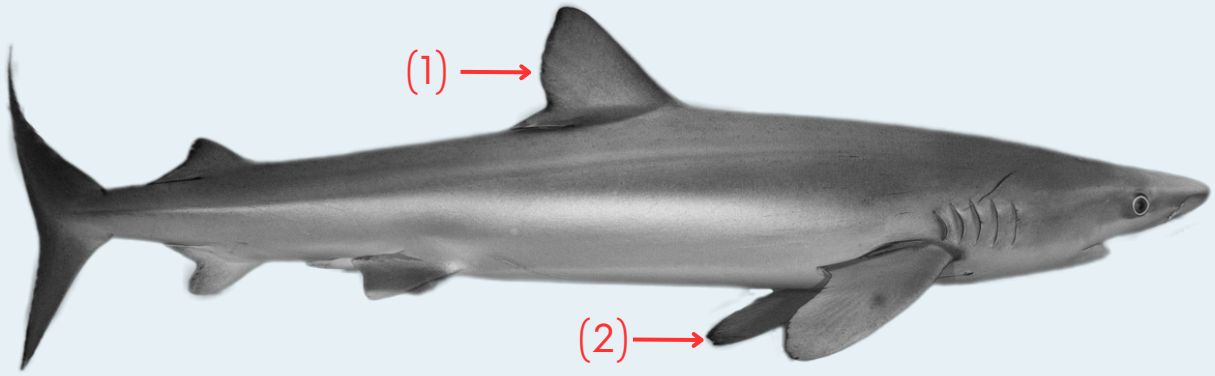
Blue Shark #11

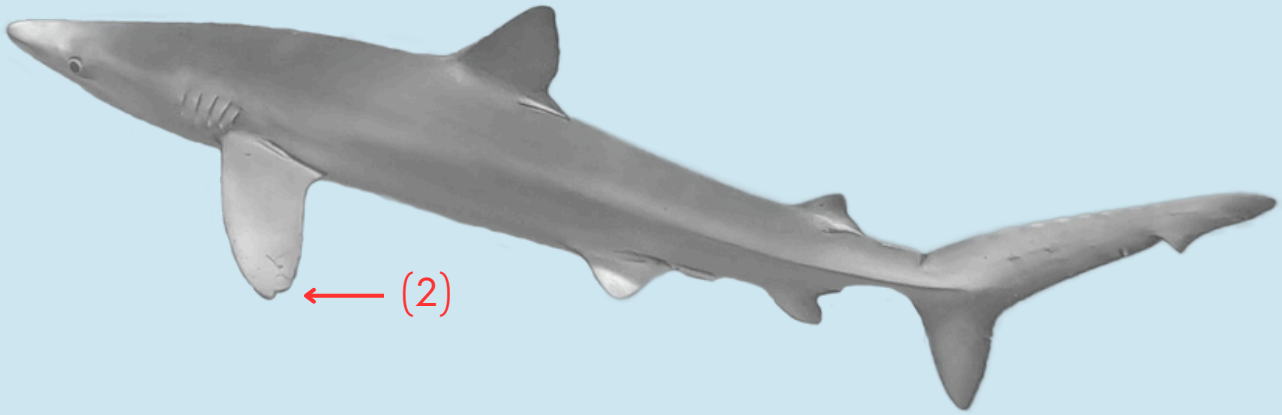
TL: 178,6 cm
FL: 160,6 cm
PL: 143,4 cm

Sex: ♂

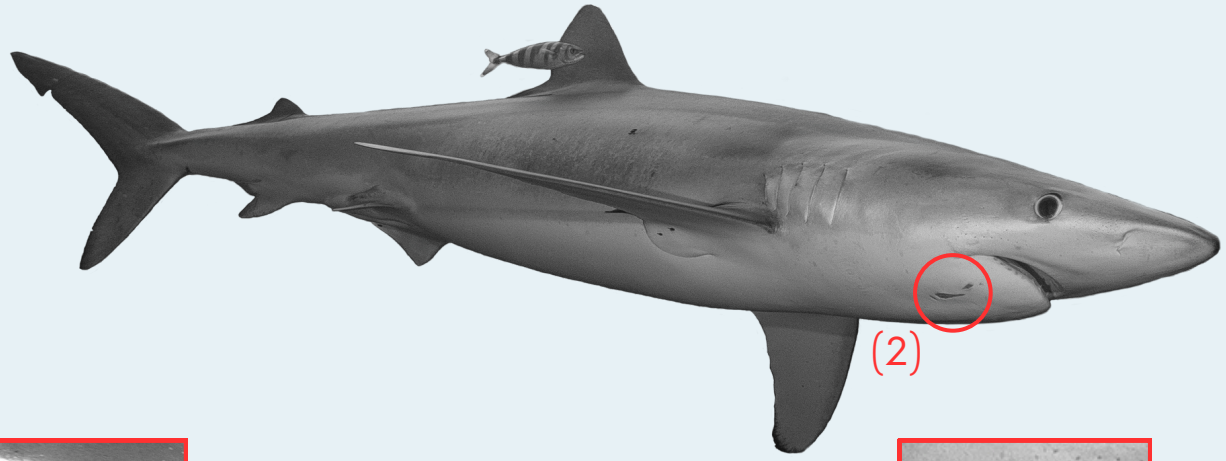
ID: Distinctive dorsal fin shape (1), cut/serrated tip of left pectoral fin (2).

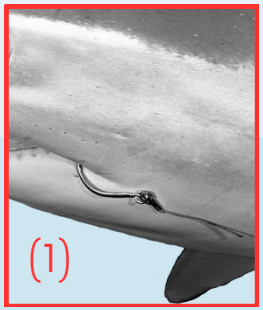
Sightings: Condor Bank 2024

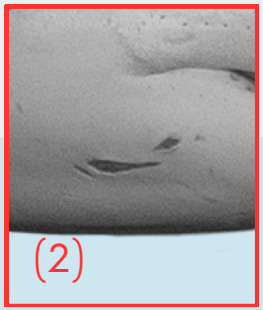


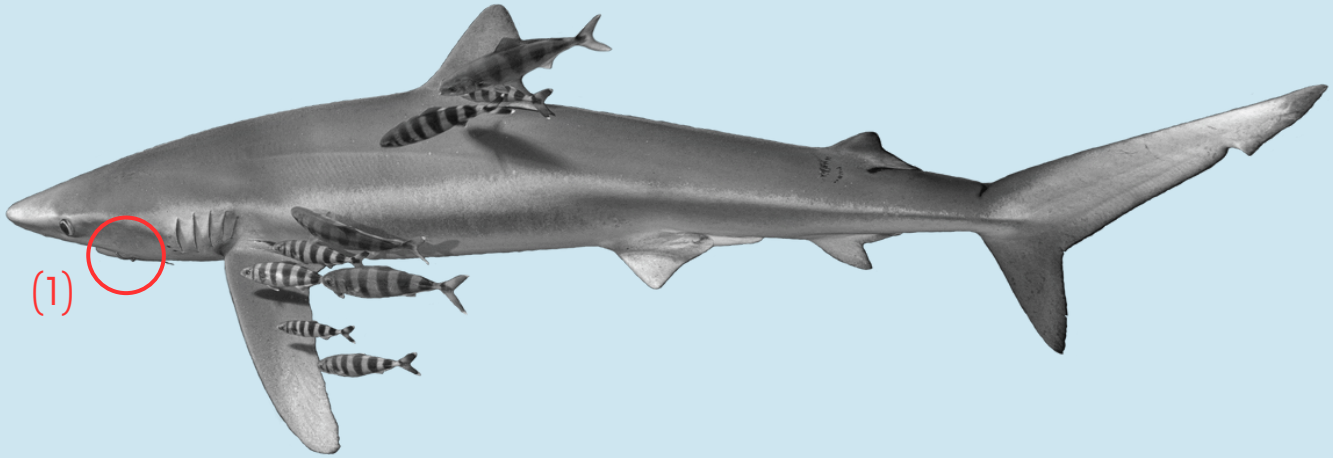


Blue Shark #12









TL: 225 cm
FL: 188,9 cm
PL: 176 cm

Sex: ♂

ID: Hook at the right corner of the mouth (1), 3 cuts under the mouth on the right (one large and two smaller ones framing it) (2).

Sightings: Condor Bank 2024

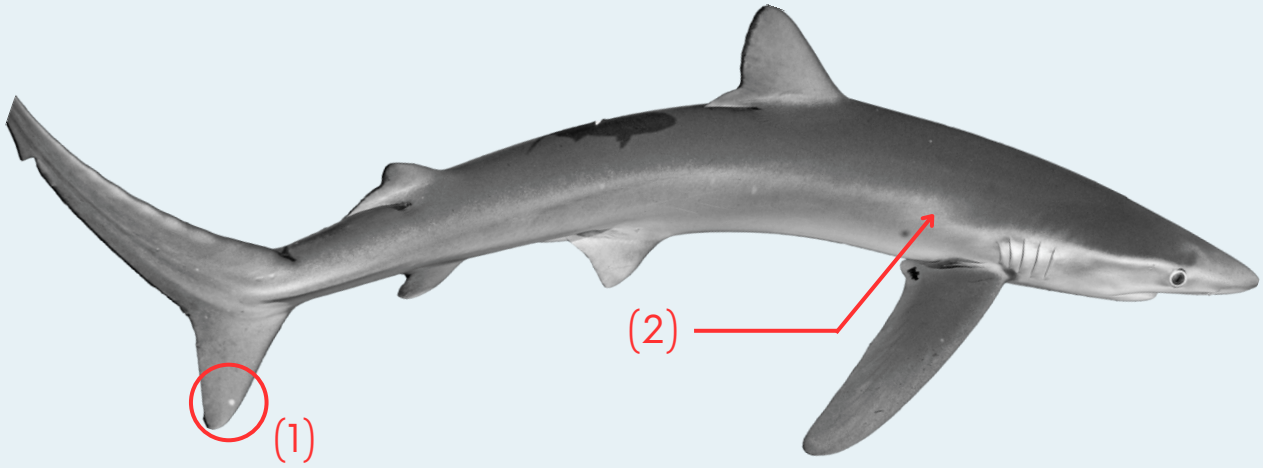
Blue Shark #13

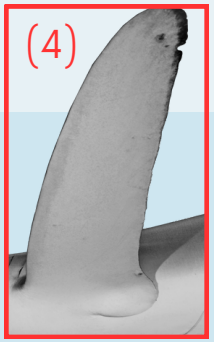
TL: 169,5 cm
FL: 143,3 cm
PL: 134,2 cm

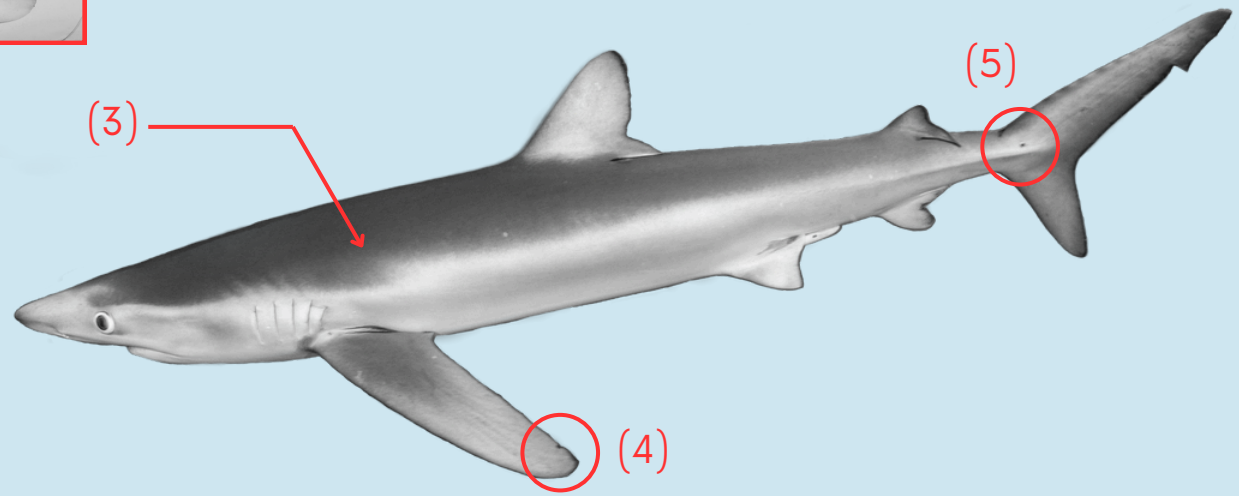
Sex: ♂

ID: White spot on the lower right caudal lobe (1), Z-shaped pigmentation pattern aligned with the pectoral fins on both sides (2) (3), small cut on the left pectoral fin (4), black spot between the pre-caudal pit and the upper lobe of the left caudal fin (5).

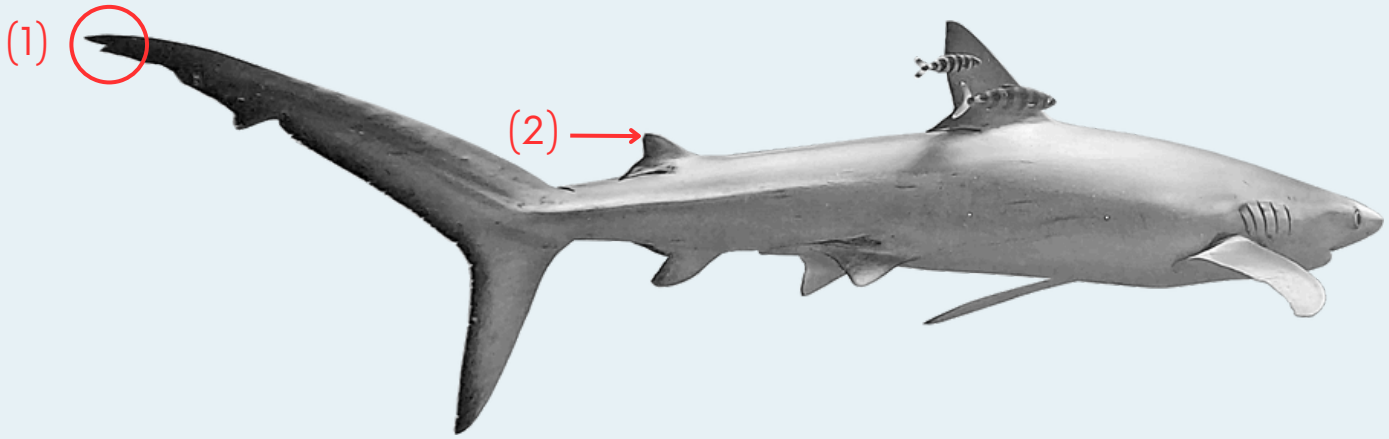
Sightings: Condor Bank 2024

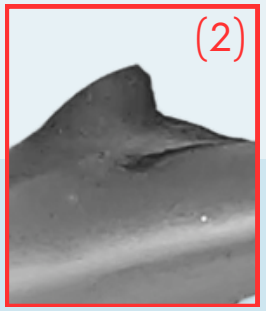


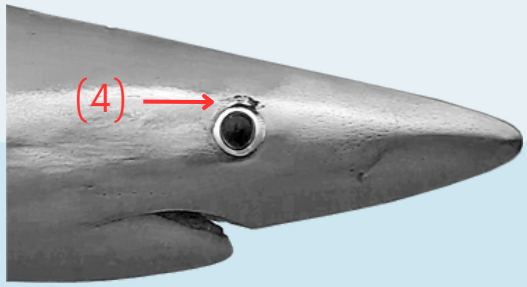


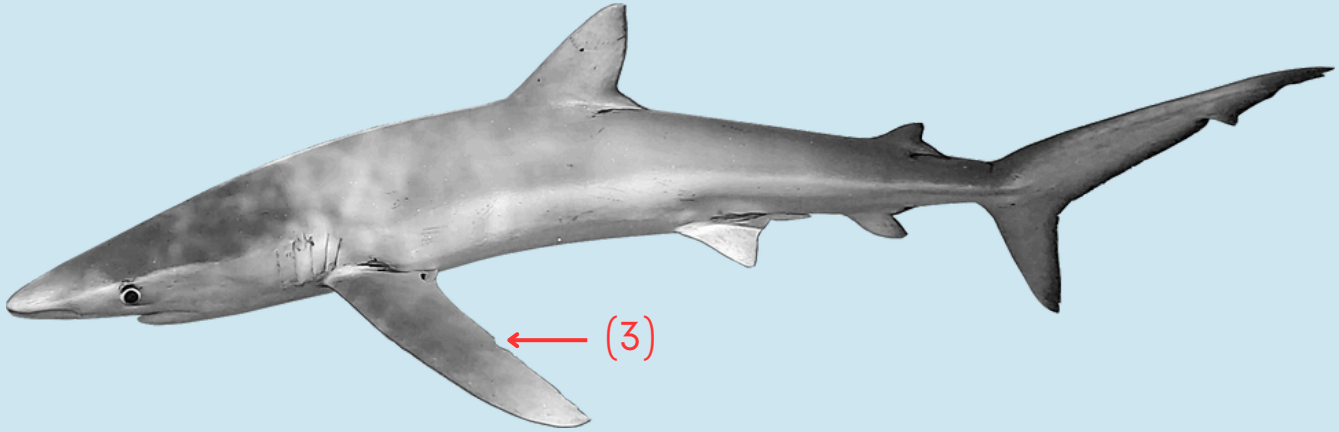


Blue Shark #14









TL: 206,6 cm
FL: 168,1 cm
PL: 154,8 cm

Sex: ♂

ID: Tip of caudal fin (posterior tip) cut in two (1), tip of second dorsal fin cut off (2), left pectoral fin deformed/creased (3), and black marks above right eye (4).

Sightings: Condor Bank 2024

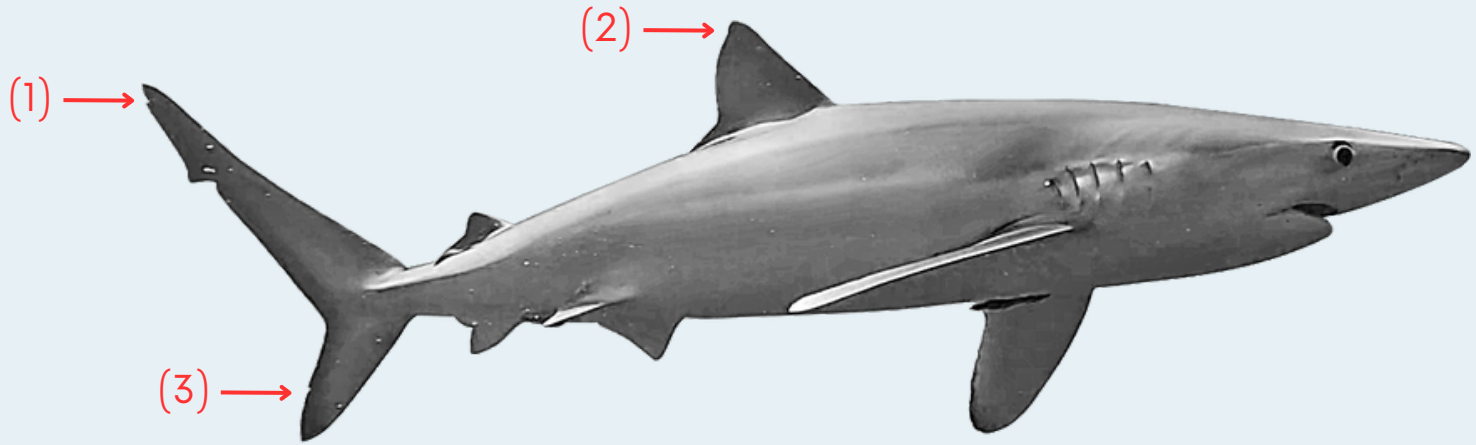
Blue Shark #15

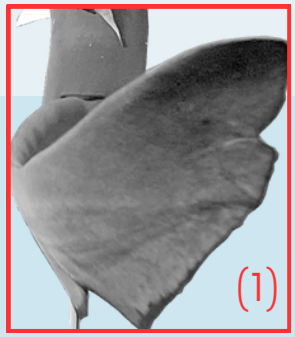
TL: 206,2 cm
FL: 169,3 cm
PL: 154,6 cm

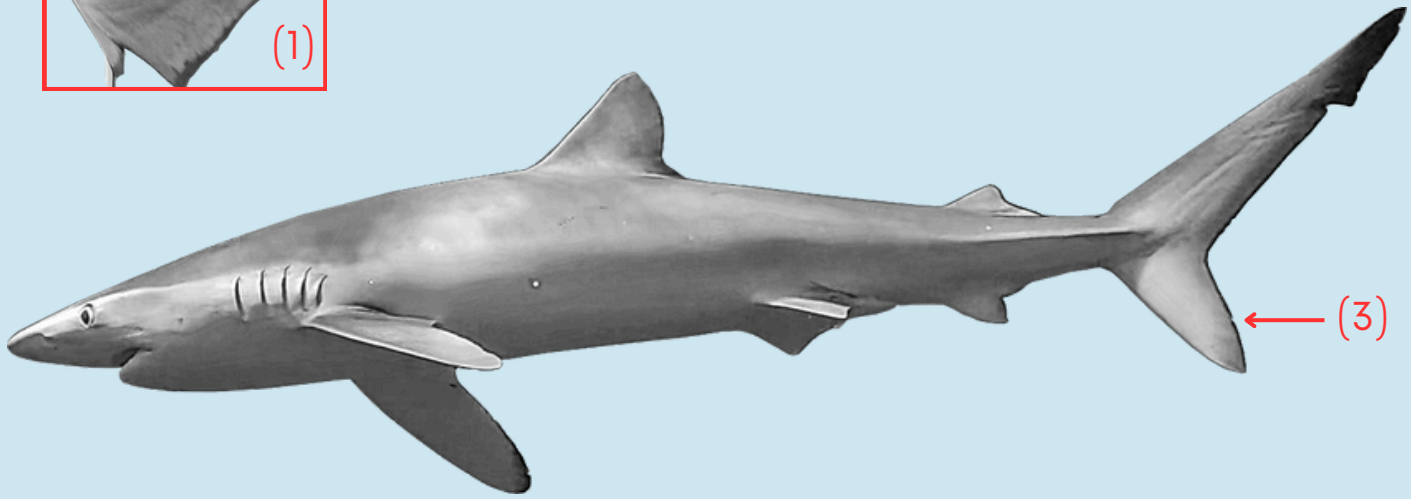
Sex: ♂

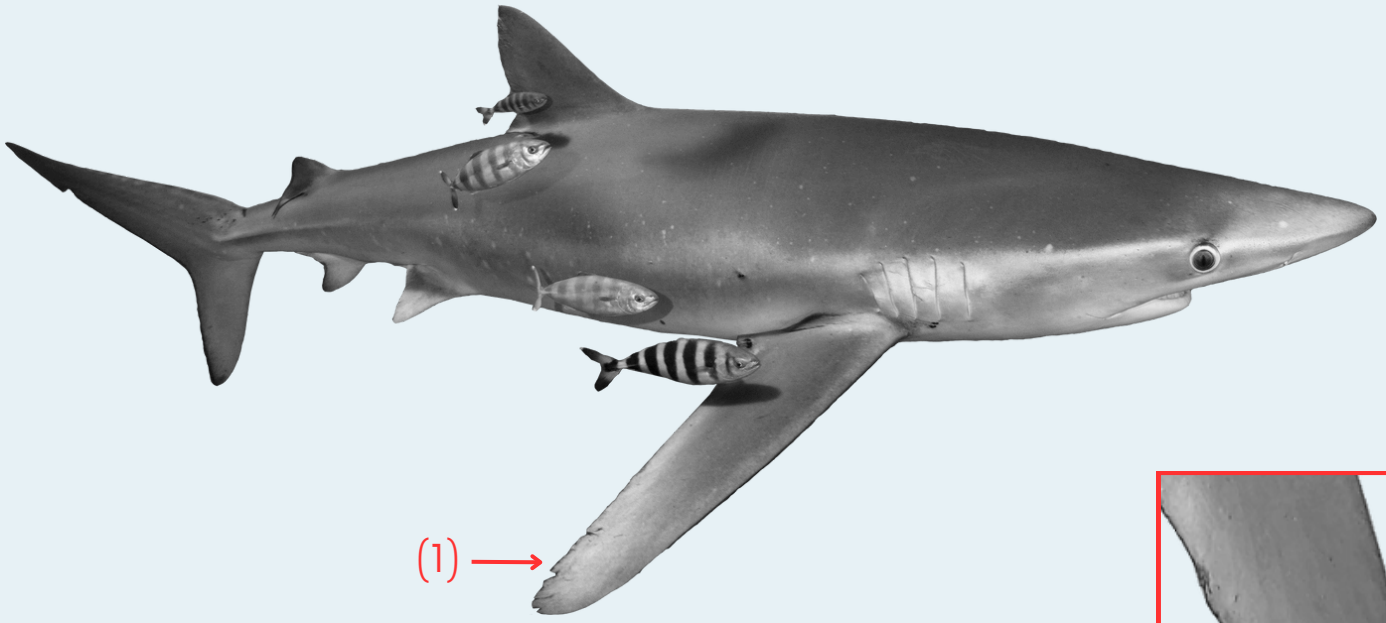
ID: Notch on upper lobe of caudal fin (1), deformation of dorsal fin (2), and cut on the lower lobe of the caudal fin (3).

Sightings: Condor Bank 2024









Blue Shark #16

TL: null
FL: null
PL: null

Sex: ♂

ID: Right pectoral fin damaged, with multiple cuts (1).

Sightings: Condor Bank 2024

Observations: Impossible to photograph the left side, the shark remaining at a distance and circling the divers (on the outside, never passing between them) on one side only.

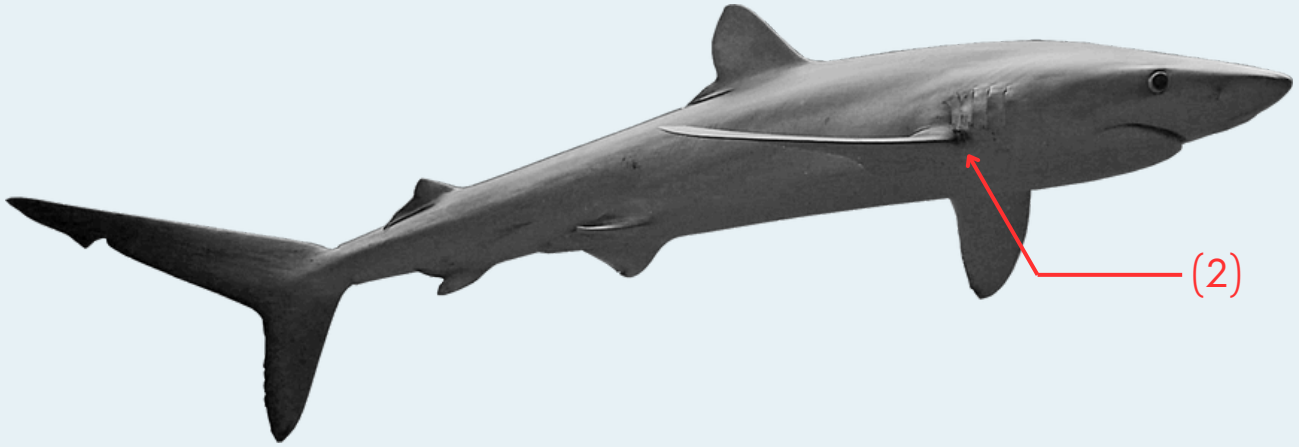
Blue Shark #17

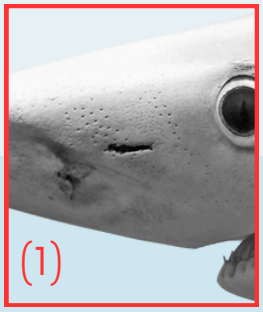
TL: 234,1 cm
FL: 202,4 cm
PL: 188 cm

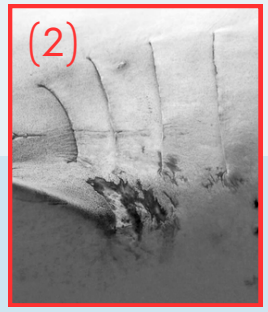
Sex: ♂

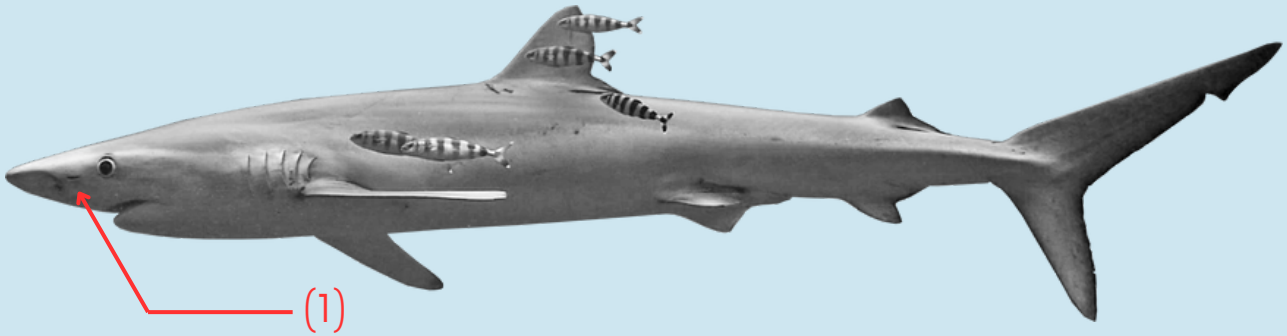
ID: Deep horizontal scar on snout between nostril and eye on left side (1), left pectoral fin origin damaged (2).

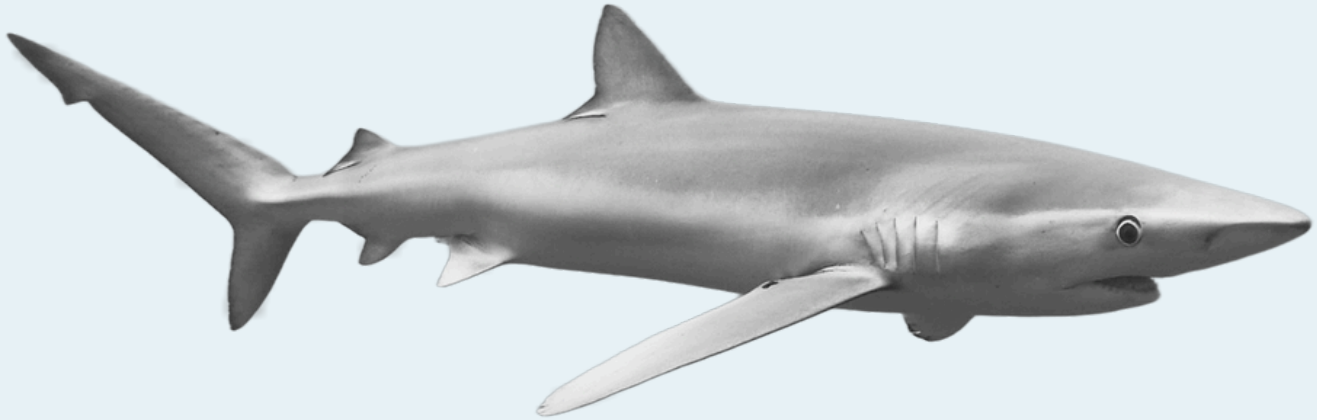
Sightings: Condor Bank 2024

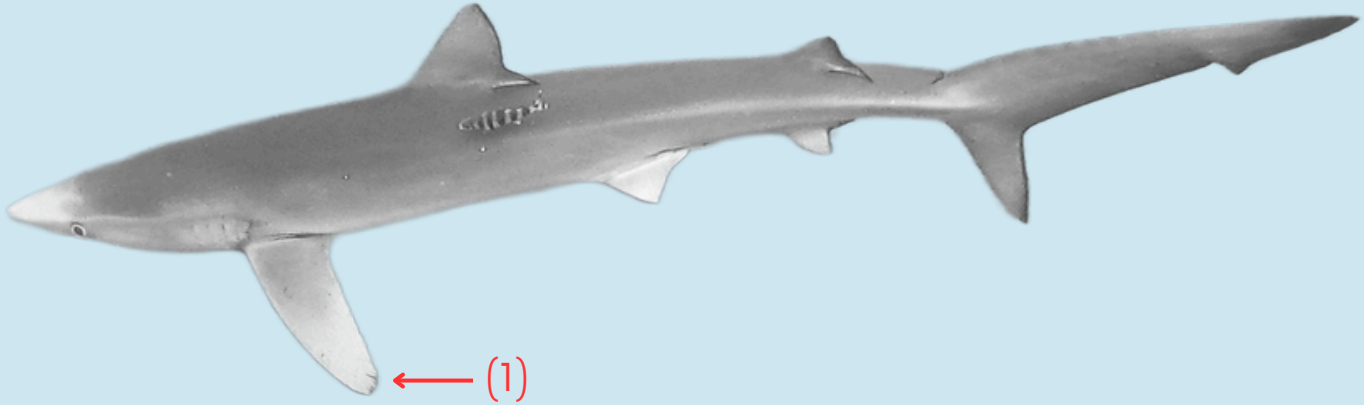












Blue Shark #18

TL: 214,9 cm
FL: 176,4 cm
PL: 163,4 cm

Sex: ♂

ID: Notch at tip of left pectoral fin

Sightings: Condor Bank 2024

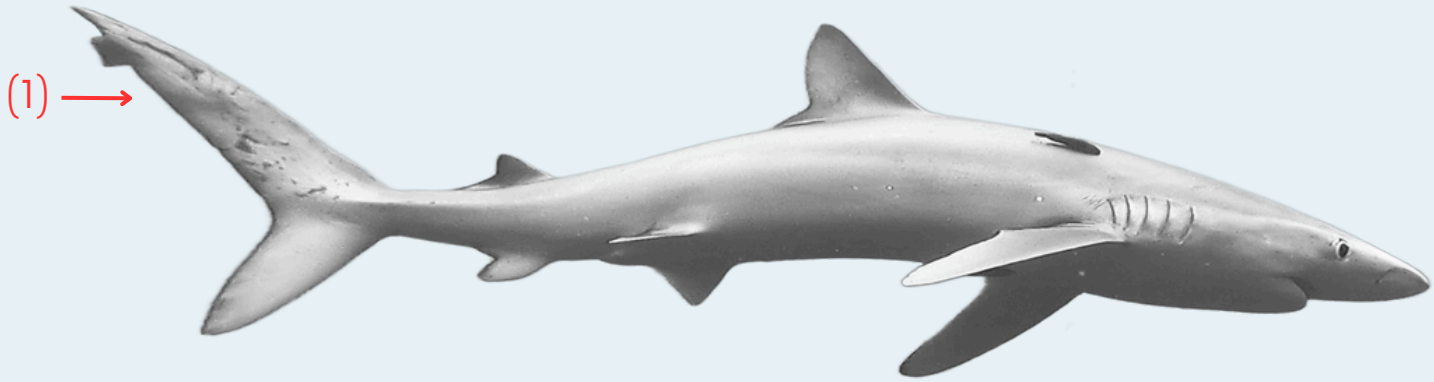
Blue Shark #19

TL: 216,7 cm
FL: 203,7 cm
PL: 183,7 cm

Sex: ♂

ID: Upper lobe of caudal fin very damaged with scars and removal of part of the tip (1).

Sightings: Condor Bank 2024



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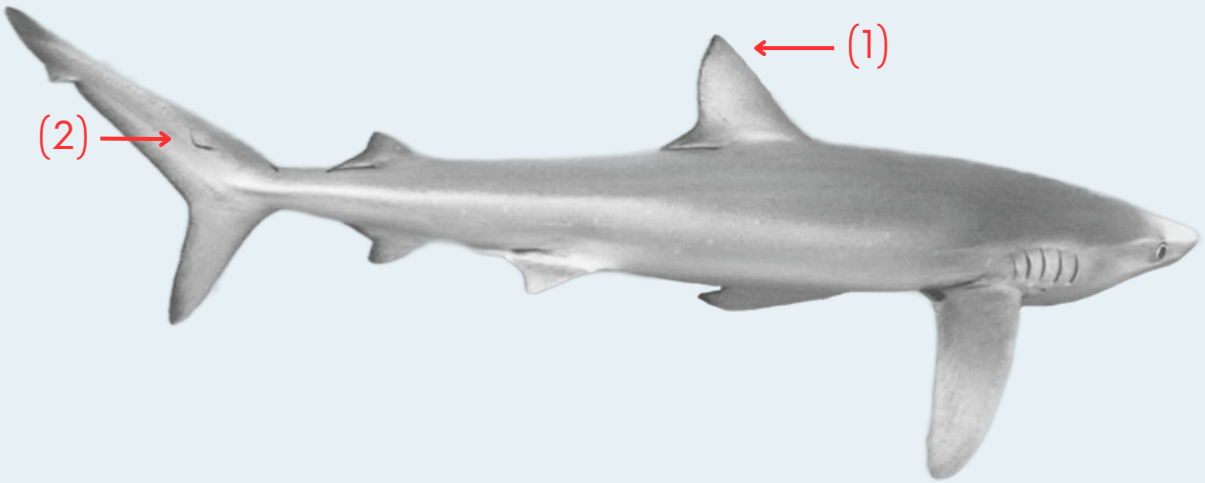


Blue Shark #20

TL: null
FL: null
PL: null

Sex: ♂

ID: "Pointed" dorsal fin (1), black trace on upper lobe of caudal fin (2).

Sightings: Condor Bank
2024

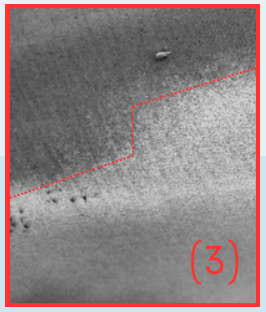
Blue Shark #21

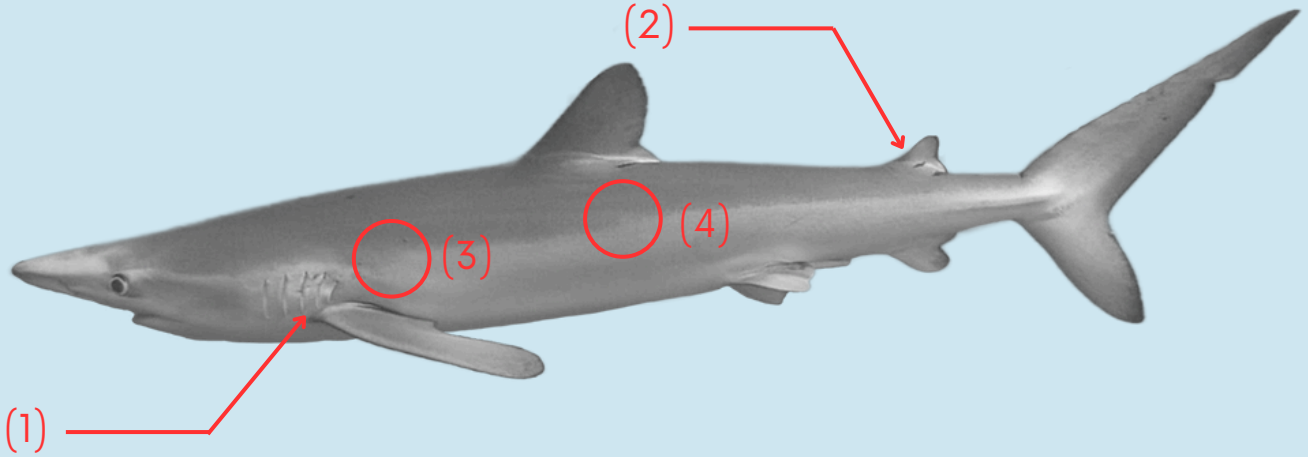
TL: null
FL: null
PL: null

Sex: ♂

ID: Branchial slits 3 and 4 damaged (1), black mark or scar on second dorsal fin (2), pigment pattern (3) (4).

Sightings: Condor Bank 2024





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