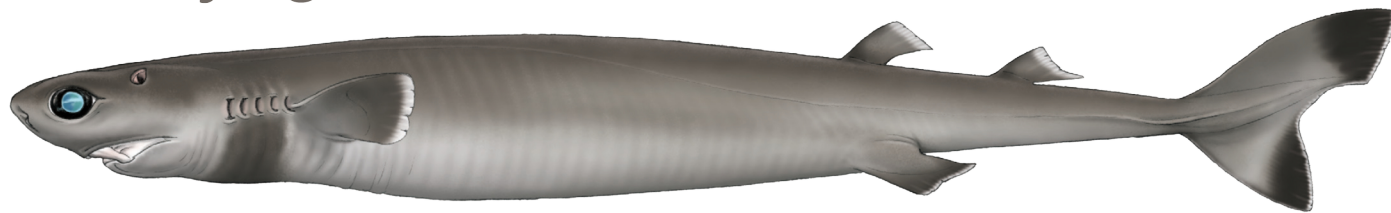


THE REAL JAWS

Identifying the “demon whale-biter”



Theoni Photopoulou

Centre for Statistics in Ecology, Environment and Conservation,
Department of Statistical Sciences, University of Cape Town.



Crater-like wounds can be seen on many large marine organisms – including whales, fish, and seals – that inhabit or visit tropical oceans. The identity of the ‘biting agent’ was once shrouded in mystery and became the topic of quite some debate and speculation within the scientific community.

However, analysis of a unique historical dataset names the culprit as belonging to the genus *Isistius*, a group of small oceanic sharks known as cookiecutter sharks, and documents trends in the occurrence of bitemarks on four whale species (the Sei Whale *Balaenoptera borealis*, Fin Whale *B. physalus*, Bryde’s Whale *B. brydeii* sp. and Sperm Whale *Physeter macrocephalus*) harvested on the west coast of South Africa. This dataset was collected personally by the late Professor Peter B. Best who was a research officer with the Fisheries Development Corporation of South Africa at that time. He was granted permission to examine carcasses while they were on the platform, prior to flensing, by the Saldanha Whaling Co. Ltd.

Between 2nd March and 31st October 1963 Peter personally examined a total of 1,737 whales at the Donkergat Whaling Station in Saldanha Bay, 110km north of Cape Town, South Africa. He recorded detailed measurements of body length and reproductive status for each whale and scored the presence of bite-marks and scars which make up the present dataset. His dedication to the scientific questions puzzling him did not stop there. He also made extensive notes and measurements on the shape, depth and position of the bites themselves, making it possible to match them to the dentition of cookiecutter sharks.

Other biting organisms thought to perhaps cause the crater-wounds and white scars on whales include lampreys and sleeper sharks, but neither fit the description of wounds seen on whales at Donkergat. Wounds inflicted by sleeper sharks were more circular and shallower, whereas those attributed to lampreys were round, about 50mm in diameter, with visible marks left by the teeth on the sucking disc. In addition, the resultant scars were not permanent, disappearing within a year, contrary to the evidence documented here for cookiecutter bite-marks.

The culprit

The species now held responsible, the Cookiecutter Shark *Isistius brasiliensis*, occurs in water depths of 200-3700m, but is caught at shallower depths, particularly in night time surface trawls. This suggests that it performs diel vertical migrations (moving up into surface waters at night, then returning to deeper water during the day), during which it presumably makes attacks on whales and other targets. Without direct observations it is not possible to identify the attacker with certainty, but the recent capture of a specimen, together with the fish it was biting, is the most compelling evidence we have for a cookiecutter shark being the “demon whale-biter”.

Another rare find was that of a ‘reverse scoop’, the complement of a crater-wound, in a Sperm Whale’s stomach. Detailed measurement of this scoop give us clues to more than just the biter’s identity, it also tells us about the biomechanics of the biting action. From above, the scoop is elliptical and smoothly convex in profile with its deepest point slightly closer to one end than the other. This, together with the



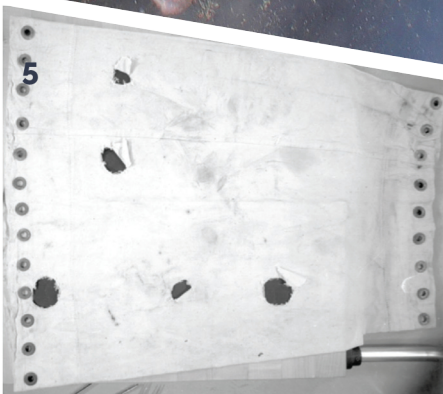
Images (this page)

Main image: Cookiecutter Shark *Isistius brasiliensis*
© Marc Dando www.wildlifeillustrator.com.

Inset: Peter Best, Donkergat, 1963 © Peter Best.

Image 1: Cookiecutter Shark caught off Hawaii
© NOAA.

Image 2: Cookiecutter Shark jaws
© JSU Biology (CC BY 2.0).



anatomy of cookiecutter jaws, led Peter to conclude that the jaw actually flexes on impact to enlarge the biting area and results in an elliptical rather than a round plug being removed.

The total count of unhealed bite-marks gave us information about the intensity of predation on different whale species and age classes therein. Peter also counted the number of recent bite-marks and calculated them as a proportion of total bite-marks. Total bites and recent bites were higher in deeper waters, with the incidence of recent bites reaching 83% for all whales caught in water deeper than 3000m. There was a complete lack of any bites on whales taken in water less than 200m deep.

Interaction with Sperm Whales

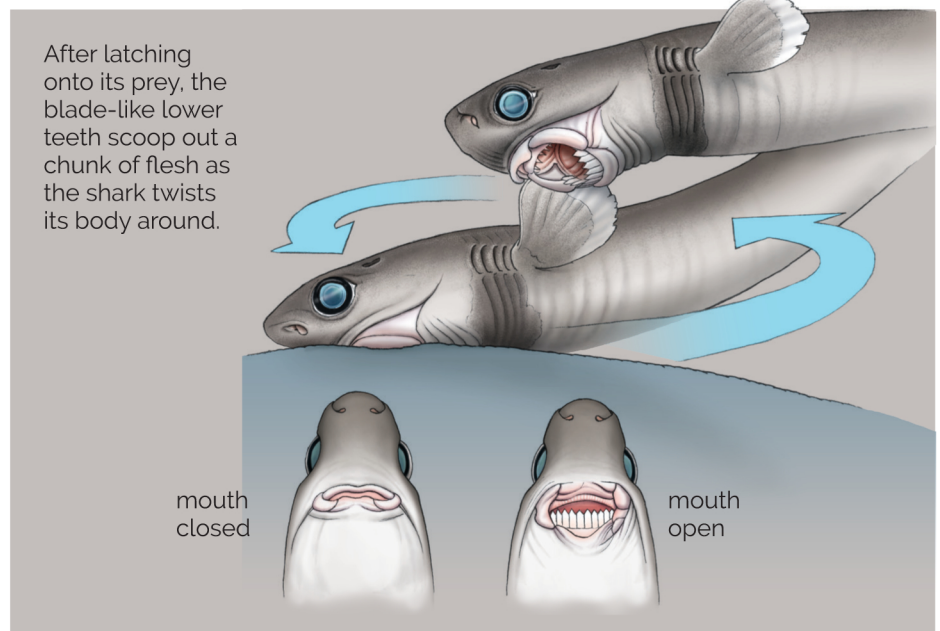
Cookiecutters seem to interact differently with Sperm and baleen* whales. Firstly, the average number of recent bites on Sperm Whales is about an order of magnitude less than for any of the baleen whale species. Target areas also differ, with bites being concentrated on the rear half of the body in baleen whales but spread more widely over the body in Sperm Whales – with unsuccessful attacks (resulting in an incomplete bite) occurring more often on Sperm Whales. The reasons for these differences are unknown.

As well as shining a light on the predatory behaviour of poorly understood cookiecutter sharks, the conclusion of this 60 year old puzzle also offers new insights into one of the least known areas of Sperm Whale behaviour. We have a good understanding of the seasonal movements of adult Sperm Whales: adult females congregate in the tropics each year to give birth and mate, while adult males also spend considerable amounts of time at high latitudes. However we do not know where medium-sized males – those not yet fully mature – spend their time. The fact that this age group had fewer bite-marks from cookiecutter sharks suggests they spend less time than mature males at lower latitudes and within the range of *Isistius* – the “demon whale-biter”

Read the full paper:

Best & Photopoulou. 2016. Identifying the “demon whale-biter”: Patterns of scarring on large whales attributed to a cookiecutter shark *Isistius* sp. *PLoS ONE* 11(4): e0152643

* Those species of whale which use bristles to filter prey from seawater (as opposed to ‘toothed whales’ i.e. Sperm Whales).



Images (this page)

Image 3: Cookiecutter bite on tuna, Hawaii © Jennifer (CC BY-NC 2.0).

Image 4: Scars from Cookiecutter Shark bites on Gray's Beaked Whale © Avenue (CC BY-SA 3.0), via Wikimedia Commons.

Image 5: 'Cod end' of a scientific midwater trawl bitten by a Cookiecutter Shark.

Image 6: Plug of fish tissue found in the stomach of a Cookiecutter Shark caught in a scientific mid-water trawl. Images courtesy of *PLoS ONE* | Theoni Photopoulou.

Graphic: Cookiecutter Shark feeding action from *Sharks of the World- a fully illustrated guide*, www.wildnaturepress.com.