Multi-year growth progression of a neoplastic lesion on a bull shark (*Carcharhinus leucas*)

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Abstract

Neoplastic lesions have been described in the literature from a variety of shark species, but the inability to observe morphological changes of a tumour through time remains a challenge. Here, we describe the growth of a proliferation through a 7–year period from a female bull shark (*Carcharhinus leucas*), characterise the proliferation, and speculate on its origin. Based on macroscopic observation from photographs and videos, the most likely morphological diagnosis is chronic, proliferative gingivitis and cellulitis with necrosis and deformation of lower jaw cartilage due to multiple events of fishing gear embedded in the mandibular angle.

Introduction

Chondrichthyans (sharks, batoids, and chimaeras) have been identified as having a remarkable ability to heal and regenerate from grave injuries such as gill destruction or body wall penetration [1] [2] [3]. In the early 1990s, this ability extended to claims that sharks do not, or rarely, get cancer [4] [5]. This misconception has repeatedly been shown to be inaccurate, with 44 cases of lesions being reported in the Registry of Tumors in Lower Animals in 21 species over 9 families and 6 of the 9 extant chondrichthyan orders. At least 15 of these cases were malignant and some individual sharks have been reported with more than one neoplasm [6].

Compared with bony fishes, there is scant literature describing diseases or lesions of chondrichthyans. However, the popularity of sharks as exhibit animals in aquariums with the consequent need for adequate care [7], increased awareness of conservation issues [8], and evidence that the epigonal cells of sharks can inhibit growth of mammalian tumour cell lines [9] have recently led to an increased interest in describing tumours from various shark species. However, the two main difficulties with diagnosing tumours are the logistical constraints of obtaining the necessary samples to diagnose the lesion (but see [10]) and the inability to observe morphological changes of a tumour through time.

Objective

Here, regular visits of a female bull shark (*Carcharhinus leucas*) across multiple years at a site where wildlife tourism occurs [11] provided the rare opportunity to describe the growth of a proliferation through a 7–year period. This individual was identified across the study period based on an injury of the right lower jaw and a growing lesion. Characterisation of the proliferation and speculation on its origin is provided based on macroscopic examination of high-resolution photographs and video footage.

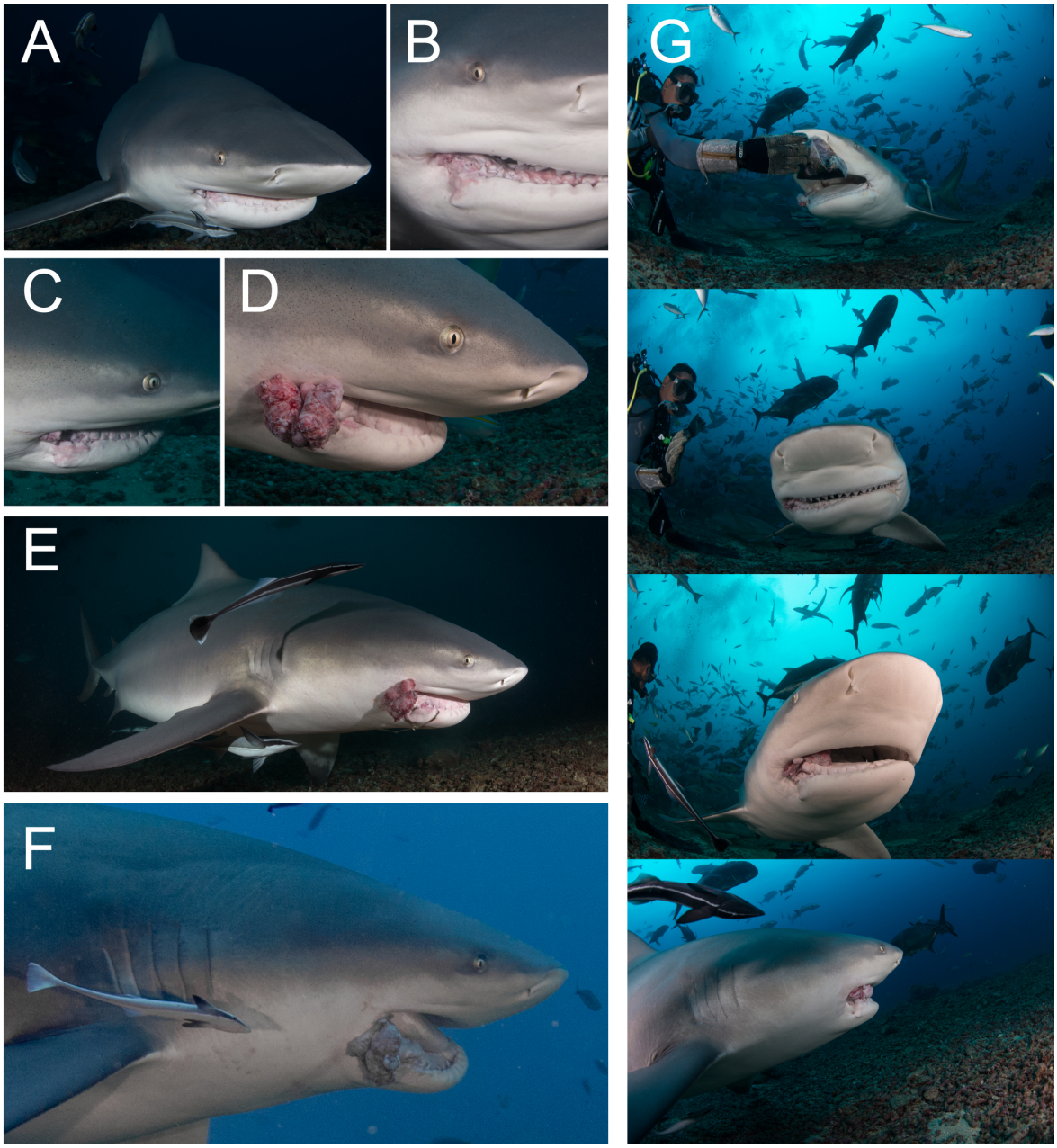

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Figure Legend

Figure 1. Growth progression of a proliferation through a 7-year period. **A,B** *Carcharhinus leucas* photographed on January 10, 2010, **C** June 7, 2011, **D** March 24, 2013, **E** April 26, 2014, **F** June 3, 2016. The healed injury (broken jaw) is visible in **A–F**. **G** Sequence showing the proliferation dangling inside the mouth when the shark takes a fish head from the feeder. Photographs taken on March 24, 2013.

Results & Discussion

Since January 2010, a female bull shark, identified based on a healed injury of its right lower jaw, has been regularly observed at the Shark Reef Marine Reserve. It was observed 67 times between January 1, 2010 and December 31, 2016, typically and most often in the first half of the calendar year (Table 1). Photographs that were taken in January 2010 (Figure 1A, B) and footage from April 2010 (Video 1) showed a small proliferation in the right corner of the shark's mouth. This region looks like an erosion with

a centrally located elongated dark fissure, compatible with a fishing hook or a lesion created by a detached hook. Only little growth, if any, was documented until May–June 2011 (Figure 1C). At the end of May 2011, a fishing lure can be seen attached to the right mandibular corner, with a discolored slightly sunken area of the gingival margin visible anteriorly to the lure (Video 2). The dark hook-compatible structure visible in April 2010 is visible and looks like a deep fissure central to an irregularly outlined wound in the corner of the mouth. By June 2011, the shark had lost the fishing lure and a mild light pink multi-lobulated tissue proliferation can be seen, forming a small, irregularly outlined mass where the fishing lure was attached. With the fishing lure gone, a downward deformation of the gingival area inferiorly to the lesion and lack of dentition in the affected region can be seen. Observations from March 2013 onwards reveal a large red-brown multi-lobulated mass, attached the gingival margin via a narrow, white stalk (Figure 1D–F, Video 3), similar in appearance to the proliferative lesion recently documented in a white shark *Carcharodon carcharias* [10] [12]. The stalk is long enough to allow the mass to move in and out from the oral cavity (Figure 1G). This female shark has been a regular feeder at the Shark Reef Marine Reserve. Direct observations show that the proliferation wobbles, and when the shark is taking a fish head from the feeder can dangle inside the mouth (Figure 1G). This likely leads to the shark chewing on the proliferation. Footage that was taken on January 5, 2017 shows the proliferation inside the mouth of the shark and seemingly being bitten (Video 4). This was, however, at a provisioning site and such biting on the proliferation might not occur or might occur less frequently during natural predation. The multi-lobulated surface is compatible with chronic proliferative processes including granulation tissue and fibrosis, but a neoplastic process cannot be excluded. The mandibular angle is deformed and ulcerated, the central fissure is still visible, and the skin adjacent to the lesion is irregularly pitted indicating of underlying remodeling processes within the jaw. By April 2014, the lesion is similar to March 2013, but a fishing hook can be seen embedded in the lower jaw anteriorly to the mass. In videos from January 2017, the pedunculated mass seems similar to 2014, but the lower jaw appears to have a more pronounced angular ventral deformity.

Origin of the proliferation

Based on macroscopic observation from photographs and videos, the most likely morphological diagnosis is chronic, proliferative gingivitis and cellulitis with necrosis and deformation of lower jaw cartilage due to multiple events of fishing gear embedded in the right mandibular angle. The persistent foreign objects (fishing hook or lure) resulted in a fibro-proliferative tissue response that created a pedunculated mass compatible with fibropapilloma. Histological evaluation of multiple biopsies or serial sectioning of the entire mass is required for a more precise diagnosis i.e. confirmation of a neoplastic transformation within the affected tissues. Based on observations of tissue responses in sharks with retained fishing gear [13] or chronic lesions due to attached gut parasites [14], we speculate that a neoplastic transformation of the affected tissues is likely. Although gingival neoplasms have been reported in sharks previously [15], this is the first documentation that links them causally to retained fishing gear and expands the types of lesions caused by such gear in sharks [16].

It will be interesting to observe the development of the proliferation in the coming years. In order to do this best, citizen scientist [20] diving in the Shark Reef Marine Reserve are invited to share their photographs and videos of the female shark with the authors.

Additional Information

Methods and Supplementary Material

Please see https://sciencematters.io/articles/201709000002.

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Ethics Statement

Not applicable.

Citations

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