

# Lethal Great White Shark (*Carcharodon carcharias*) Attack on a Bottlenose Dolphin (*Tursiops truncatus*) off the coast of North Carolina

Cunningham, C.H.<sup>1</sup>, Campbell, G.P.<sup>2</sup>, McAlarney, R.J.<sup>1</sup>, McLellan, W.A.<sup>1</sup>, Rotstein, D.<sup>3</sup>, Bialek, J.W.<sup>1</sup>, Conrad, C.<sup>1</sup>, Rittmaster, K.<sup>4</sup>, Thayer, V.G.<sup>5</sup> and D.A. Pabst<sup>1</sup>  
<sup>1</sup>University of North Carolina, Wilmington, <sup>2</sup>Davidson College, <sup>3</sup>Marine Mammal Pathology Services, <sup>4</sup>NC Maritime Museum, <sup>5</sup>NC Division of Marine Fisheries

## Abstract

Shark attacks on delphinids occur globally, but have been notably rare within North Carolina. On 13 December 2016, a freshly dead adult (2.52m), female bottlenose dolphin (RJM 021), stranded on Topsail Island, North Carolina. Both gross and histopathological exams identified the cause of mortality as exsanguination (and ensuing hypovolemic shock) due to shark attack. A large, gaping wound was located on the animal's ventral surface, with several other bite marks on the left lateral flank. Forensic analysis (based upon Lowry *et al.*, 2009) was applied to determine both the size and species of shark, by examining the wound, teeth bite marks and interdental distances (IDD). Information from the literature on shark behaviour and distribution were used to support the forensic findings. Two digital photographs, taken before necropsy, were used to measure IDD: one with the carcass hanging vertically by its flukes and the other with the carcass positioned prone (to estimate maximum and minimum distances, resulting from varying blubber tension with each position). Three independent judges decided on which lacerations to use as part of the bite arc, and only when in unanimous agreement were the bite marks used. Resulting IDDs yielded an estimated shark length between 6.65-7.15m, identifying the species as a white shark (*Carcharodon carcharias*). Publicly available shark tracking data (OCEARCH.org) demonstrated that there were multiple white sharks off the North Carolina coast in December 2016. Intriguingly, the attacking shark did not consume RJM 021, potentially implying a more complex interaction than just predation.

## Goal

To identify length, and if possible, species of shark responsible for attacking RJM 021, using the IDD forensic analysis tool outlined by Lowry *et al.* (2009).

## Methods

An adult female bottlenose dolphin (*Tursiops truncatus*), RJM 021 underwent gross exam, and histological sampling at UNCW. Left ribs and both flippers were collected whole, radiographed and dissected to examine for fractures. Digital photographs, taken during the necropsy, were used to measure interdental distances (IDDs) (Lowry *et al.*, 2009) (see Figure 1). Images were taken with the carcass hanging vertically, and in ventral recumbancy. Each IDD was measured three times and mean value was reported. Measurements in vertical position likely overestimate IDDs due to added tension expanding the wound, while those in prone position likely underestimate IDDs as blubber was compressed. Measurements were taken as the distance between the center of each tooth laceration. The resulting IDDs were input into the log-log equation formulated by Lowry *et al.* (2009):  $y = 1.005x - 2.111$

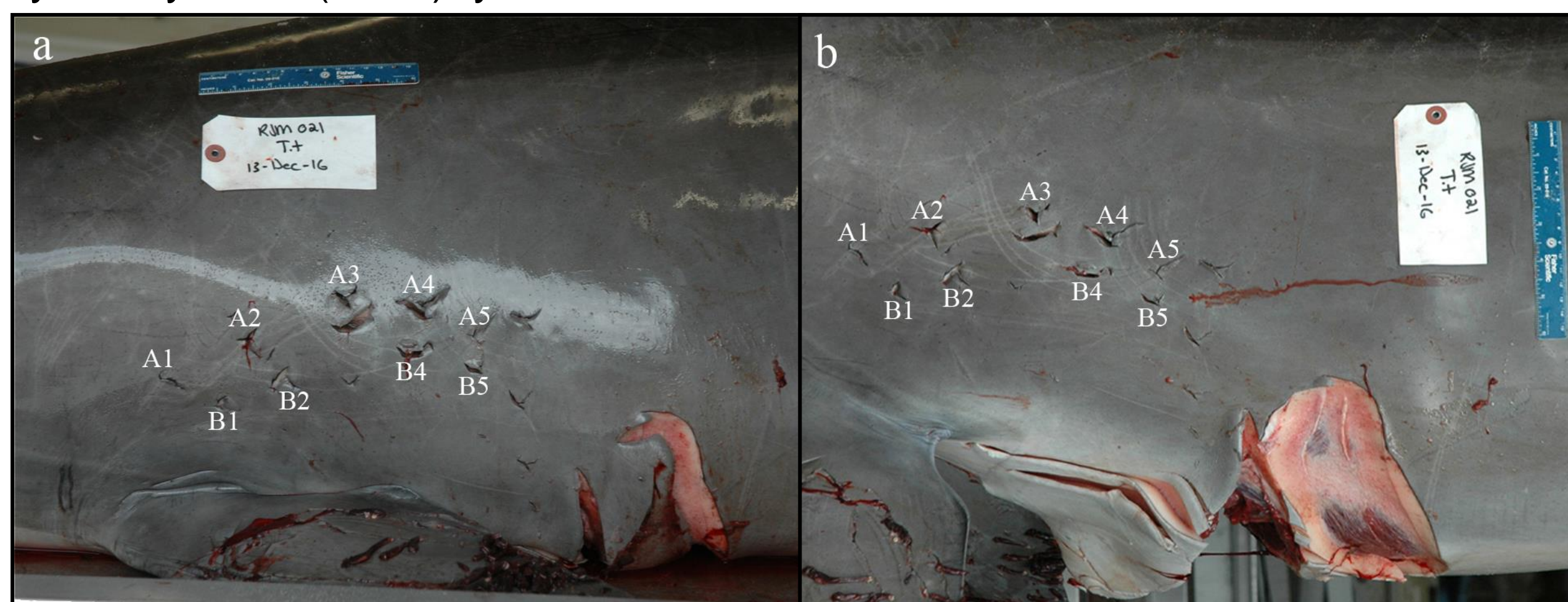


Figure 1. Labelled images (showing the bite arc) of shark bite wounds on left thorax, used to measure IDDs on RJM 021, *Tursiops truncatus*, with carcass (a) positioned prone on the dissection table, and (b) hanging vertically (image rotated here) from an overhead hoist. Bite wounds labelled as reported in Table 1 in Results.



Figure 2. RJM 021 stranded on Topsail Island, showing large, gaping shark bite wound on the left lateral flank and ventrum.



Figure 3. Cross-section through blubber of RJM 021 showing clean, deep puncture wounds, displaying dark, focal red staining, consistent with perimortem trauma.



Figure 4. Right flipper of RJM 021, showing puncture wounds and lacerations from shark bite.

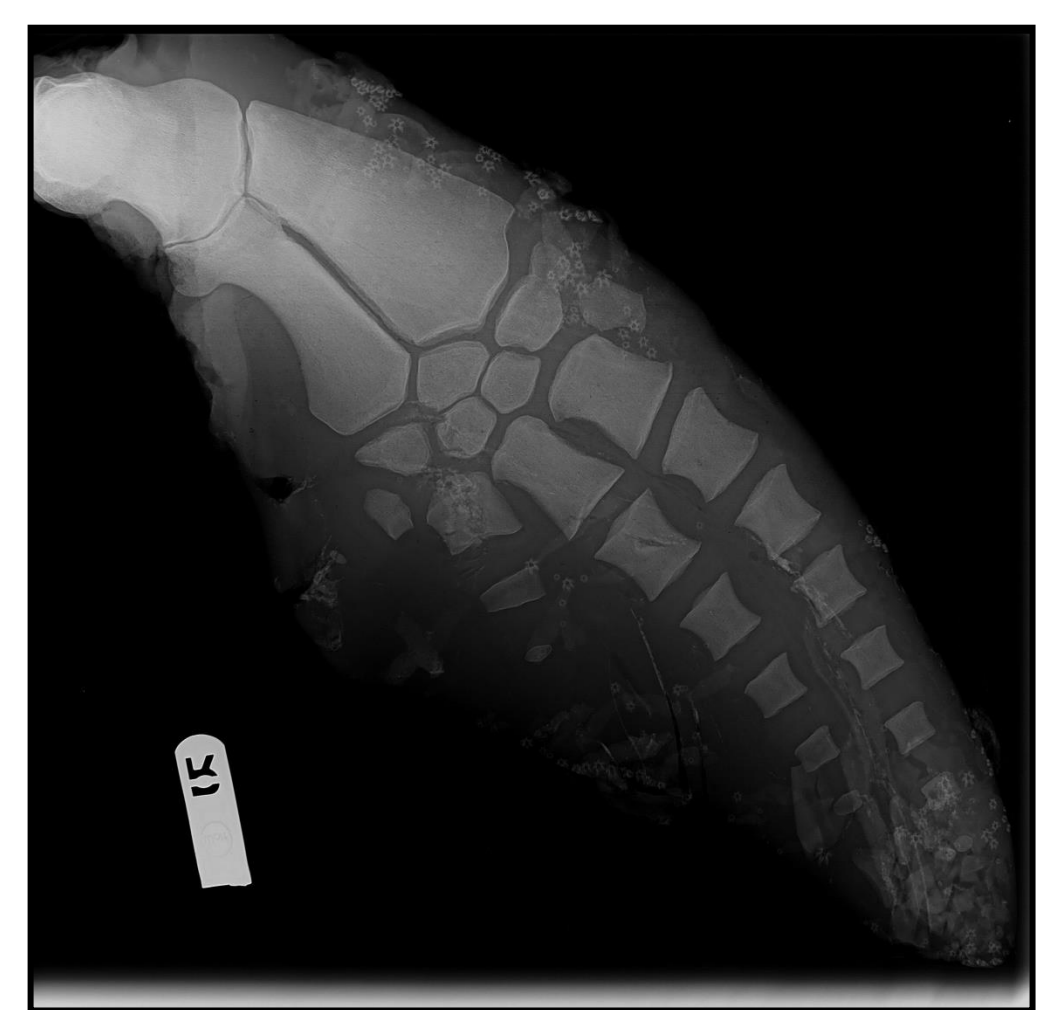


Figure 5. Radiograph of right flipper of RJM 021, showing fractures.

## History of Event

- Fresh-dead (SI Code 2), adult, female bottlenose dolphin found on North Topsail Beach on 13 December 2016
- Large, fresh laceration across ventrum (52.7cm length)
- Multiple parallel lacerations and puncture wounds across head, thorax, and flippers
- Both flippers, and left sternal ribs 5-6 fractured
- Overall pallor of multiple organs, evidence of blood loss
- Areas of compressed tissue with petechial hemorrhage on left lung at site of injury
- Well-healed shark bite wound on dorsal caudal keel
- Other findings: presence of *Campyla* sp. flukes in liver and pancreas; region of dark reddening of the distal colon; small white cyst on thyroid gland; multiple *corporea albicantia* on left ovary; and small amount of exudate from left mammary gland
- Histological findings: blubber at shark bite site displayed hemorrhage; myofiber changes observed at shark bite sites considered antemortem; also observed verminous pneumonia and hepatitis; likely background endoparasitism; myocardial fibrosis and chronic epicarditis

**Cause of death diagnosed from gross and histological examinations – exsanguination, and ensuing hypovolemic shock, resulting from injuries sustained from a shark attack.**



Figure 6. Carcass of RJM 021 hanging vertically from overhead hoist, showing multiple lacerations across ventrum.

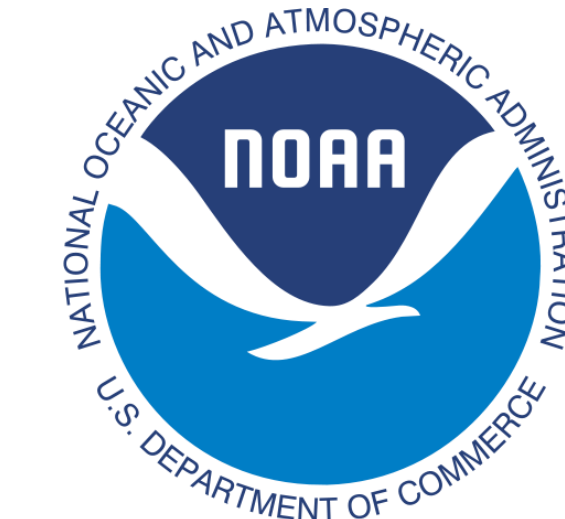
## Results

Table 1: Mean measured Interdental Distances (IDDs), and resulting estimated total body length of attacking shark (using median IDD value), when carcass positioned prone (horizontal), and hanging (vertical). Total body length range was calculated using the smallest and largest IDDs measured. Percentage difference between mean IDDs measured, and median length estimated from horizontal and vertical positions are reported.

Puncture Position	Average Measured IDD (cm)		Percentage Difference
	Horizontal	Vertical	
A1-A2	5.7	5.73	0.6
A2-A3	7.07	7.57	6.6
A3-A4	5.17	5.94	12.9
A4-A5	3.97	4.17	4.8
B1-B2	5.15	5.1	0.9
B4-B5	4.1	5.03	18.5
Median IDD	5.16	5.4	4.4
Total Body Length (m) using median IDD and (range)	6.6 (5.1-9.0)	6.9 (5.3-9.7)	4.3

## Acknowledgements

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## Discussion

- Bull, tiger, and great white sharks known to frequent North Carolina waters (Schwartz, 2003) and regularly feed on delphinids (Heithaus *et al.*, 2001).
- In North Carolina, bull shark abundance highest between May-September (Schwartz, 2012); individuals recorded to reach 2.4m (Schwartz, 2003).
- In North Carolina, tiger sharks present from May-November; maximum size 3.8m (Schwartz, 2003); tiger shark population has experienced up to a 97% decline since 1972 (Myers *et al.*, 2007).
- Great white sharks were present in North Carolina waters in December 2016 (OCEARCH.org) – two satellite tagged individuals located off Bald Head Island, south of the stranding location.
- Maximum size of great white shark reliably recorded was 6.4m (Schwartz, 2003), slightly below the median length estimated from IDDs in this study.
- There is evidence of a previous interaction between a bottlenose dolphin and white shark in North Carolina on 2 June 2014. A 204cm female (KAR 039, SI Code 3) stranded at Calico Creek displaying multiple shark bites (NC Division of Marine Fisheries). A white shark tooth was extracted from the fractured jaw of this individual carcass. Condition precluded definitive identification of mortality cause, but shark attack was considered likely.
- Forensic IDD analysis, coupled with known seasonal distributions of multiple shark species in North Carolina waters, strongly support that RJM 021 was attacked and killed by a large great white shark, though no tissue was removed.

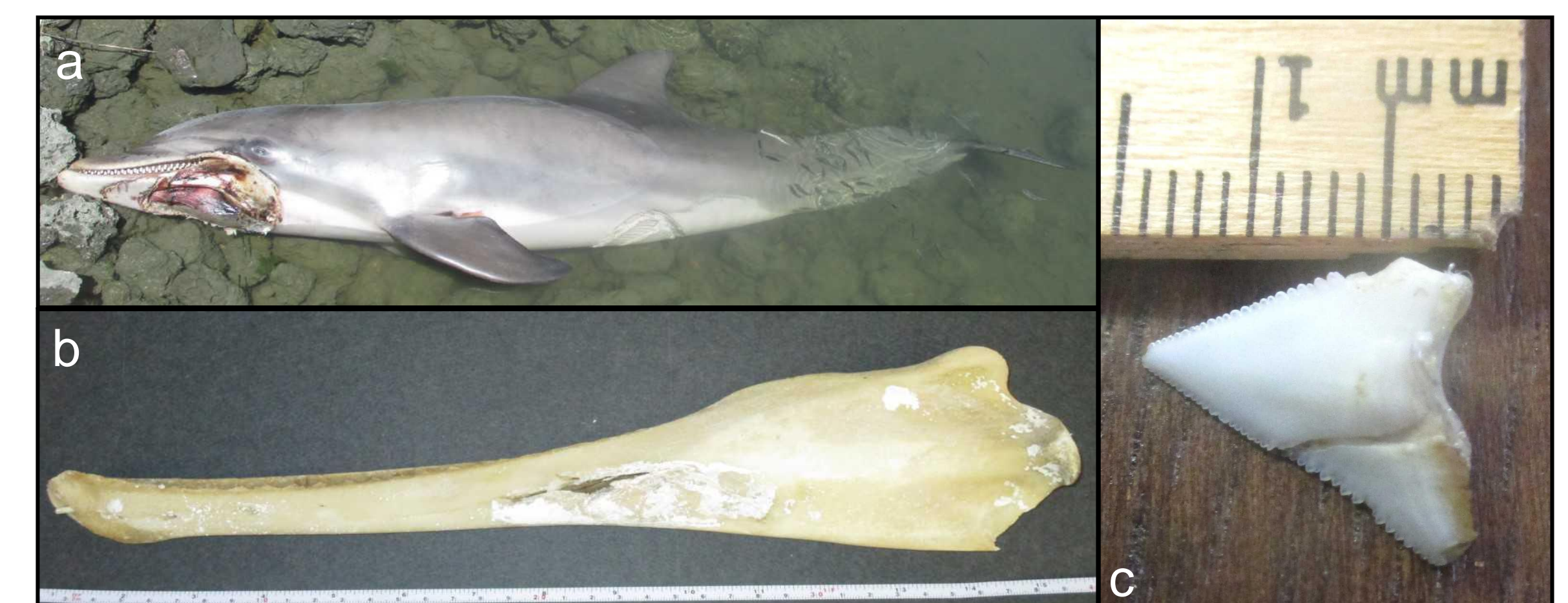


Figure 7. Female bottlenose dolphin, KAR 039, (a) shown stranded, (b) prepared fractured left mandible, and (c) great white tooth found embedded in fracture.