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Short Communication

First observations of dusky sharks (*Carcharhinus obscurus*) attacking a humpback whale (*Megaptera novaeangliae*) calf

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Abstract. Direct observations of sharks attacking mysticetes are rare. The present study provides the first direct observation of dusky sharks (*Carcharhinus obscurus*) attacking a humpback whale (*Megaptera novaeangliae*) calf. The event was witnessed on 16 July 2014 within the Pondoland Marine Protected Area, South Africa, during the annual sardine run. The event involved a group of ~10 to 20 dusky sharks ranging in length between 2 and 3 m. The sharks followed in a loose group behind the whale and attacked it while it was on the surface as well as when diving. Shark bites were concentrated on the left-hand side of the whale's body primarily between the pectoral fin and tail fluke, with almost no bites on the right-hand side. Most of the bites were superficial and resulted in tooth impressions and scrapes with little tissue removed. The condition of the calf deteriorated over the study period and it was presumed to have drowned from exhaustion when it stopped surfacing. These observations provide a new insight into the potential threat that dusky sharks may pose to whale calves.

Additional keywords: predator–prey, sardine run, South Africa.

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Introduction

There is a paucity of literature describing observations of shark attacks on mysticetes, which is limited to a second-hand account of two tiger sharks feeding on a humpback whale (*Megaptera novaeangliae*) calf (Mazzuca *et al.* 1998). Owing to the unpredictability of shark–cetacean interactions in both time and space, evidence of predatory attacks has largely been inferred from stomach content studies (Cockcroft *et al.* 1989; Long and Jones 1996; Dudley *et al.* 2005) and from scarring patterns on animals (Long 1991; Cockcroft 1991; Heithaus 2001*a*; Naessig and Lanyon 2004; Taylor *et al.* 2013). These studies have identified five species of sharks to be relatively frequent predators on small odontocetes: white (*Carcharodon carcharias*), tiger (*Galeocerdo cuvier*), bull (*Carcharhinus leucas*), sixgill (*Hexanchus griseus*) and sevengill (*Notorynchus cepedianus*) sharks (Heithaus 2001*a*).

The dusky shark (*Carcharhinus obscurus*) is considered an occasional predator of small odontocetes (Heithaus 2001*a*) on the basis of cetacean remains recorded from an analysis of stomach contents (Bass *et al.* 1973; Cockcroft *et al.* 1989; Dudley *et al.* 2005). It is a large species of shark reaching ~380 cm, (Dudley *et al.* 2005). In the western Indian Ocean it occurs from the Red Sea to the southern tip of South Africa, as well as off Madagascar (Bass *et al.* 1973). In South Africa, its principal range is along the KwaZulu-Natal coast, where it is the most commonly caught species in the bather protection nets of the KwaZulu-Natal Sharks Board (Dudley and Simpfendorfer 2006).

Catches of adult (>285 cm) and subadult (>192 cm) dusky sharks (Dudley *et al.* 2005) are influenced by the seasonal influx of sardines (*Sardinops sagax*) – a phenomenon known locally as the 'sardine run' (Armstrong *et al.* 1991). The sardine run is an annual event involving the northward movement of sardines from the Agulhas Bank up the east coast, during austral winter (van der Lingen *et al.* 2010). One of the most commonly observed mysticete species at this time of year is the humpback whale (*Megaptera novaeangliae*) (O'Donoghue *et al.* 2010), as it makes its northward reproductive migration from the Antarctic to winter breeding grounds in Mozambique (Findlay 1994; Best *et al.* 1998; Clapham and Baker 2002). During this migration, calves are born, at a length of ~3.9 to 4.5 m (Clapham *et al.* 1999), mainly between July and October with a peak in August (Matthews 1938).

This paper presents a new first-hand observation of dusky sharks attacking a humpback whale calf and demonstrates that

interactions between these species are not limited to scavenging events.

Materials and methods

An attack involving several (10–20) dusky sharks on a humpback whale calf was witnessed by one of the authors (Morne Hardenberg) ~3 km offshore from Port Johns (31°37′875″S, 29°36′065″E) at ~0930 hours on 16 July 2014 (Fig. 1). The event was also witnessed by other (up to 10) sardine run charter boat operators while viewing sardine activity in the area. Port St Johns is located within the Pondoland Marine Protected Area and is considered one of the best stretches of coastline to view the sardine run, as the narrow continental shelf concentrates the sardine and their associated predators close inshore (Aitken 2004; O'Donoghue *et al.* 2010). The attack was observed for 4 h and 30 min from both above and below the water by Hardenberg before he had to leave the area at 1400 hours. At the time he left the whale was still alive, but was reported to have finally died sometime between 1430 and 1500 hours by personnel on one of the other charter boats.

The species, size, sex and behaviour of any sharks in the vicinity of the whale calf were recorded, together with the location of any bite marks on the calf. Sizes were estimated visually by Hardenberg using the known length of his boat and his own body length while snorkelling. All measurements in this paper, including those cited from the literature, are total lengths. High-resolution photographs were taken with a Cannon 7D camera with a Tokina 10–17-mm lens and video footage with a Red Epic camera fitted with a Cannon 10–22-mm lens (Cape Town, South Africa). Both cameras were enclosed in a Nauticam housing. The sharks and the whale calf were identified to species from high-definition video footage (captured at 120 frames per second), and independently verified by Dr Matt Dicken and Dr Alison Kock (two of the authors) as well as Geremy Cliff (Head of Research, KZNSB).

Results

On 16 July 2014, an ~4 m-long humpback whale calf was observed (with no mother or escort whale in attendance) with multiple fresh shark bites (Fig. 2*a*). Although fetal folds were not observed, its small size and unfurled dorsal fin indicated that it was a neonate less than 2 weeks old (McBride and Kritzler 1951; Etnier *et al.* 2008; Cartwright and Sullivan 2009).

In close proximity and following the whale calf were 10–20 dusky sharks. No other shark species was sighted over the observation period. The attack was first reported at 0800 hours by another sardine run charter boat in the area and subsequently up to 10 other boats observed the event over the course of the day. Hardenberg arrived at ~0930 hours. The day was sunny and calm (Beaufort Scale 2), with a light north-easterly wind (<10 km h^{-1}) and southerly current. The water depth was ~60 m (recorded with a Garmin echoMAP 50s, Cape Town, South Africa) and the water temperature was 20°C (recorded with a Suunto D6i dive computer, Cape Town, South Africa) with good visibility estimated to be 8–12 m underwater.

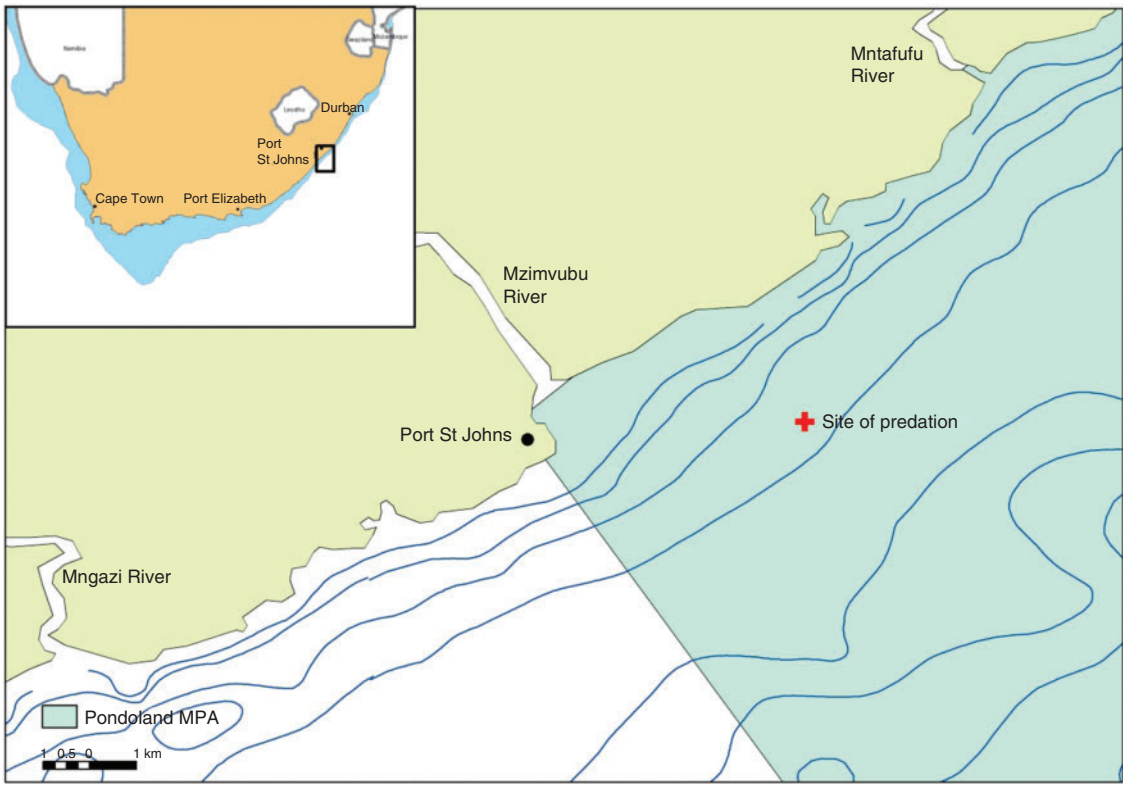

Fig. 1. Map showing the exact location where dusky sharks (*Carcharhinus obscurus*) were observed attacking a humpback whale (*Megaptera novaeangliae*) calf.

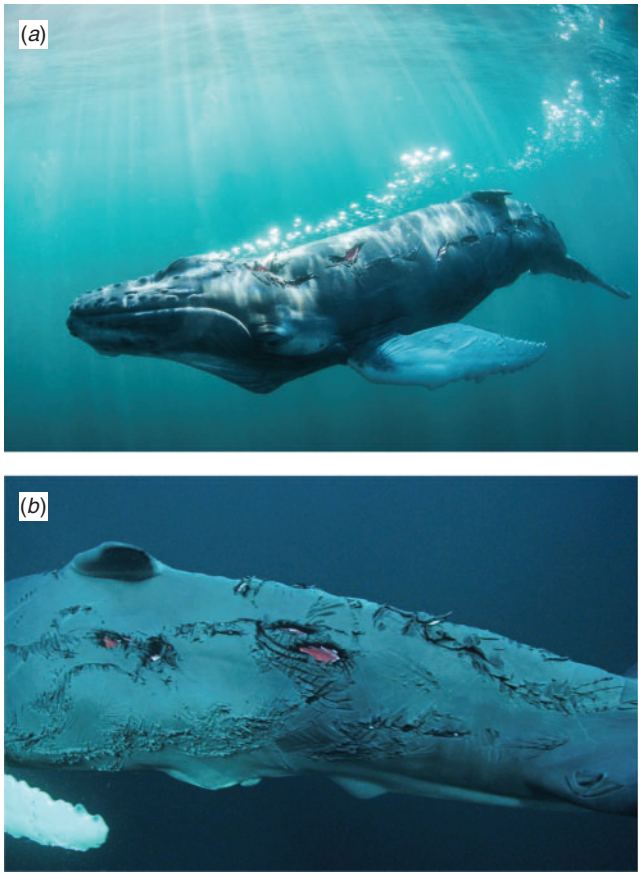

Fig. 2. Location of bites on the left hand side (*a*) and close up of bites (*b*) on the humpback whale (*Megaptera novaeangliae*) calf.

The calf appeared to be in distress and was swimming relatively quickly at ~6–7 km h^{-1} (estimated from following boat speed). The calf's pattern of movement was directionless and at times it moved in large irregular circles, and appeared to be struggling to breath. It spent most of its time swimming within 5 m of the surface and frequently surfaced to take a breath (approximately every minute), but for short (<10 s) periods. Occasionally, it dived to deeper depths of >20 m. Although numerous humpback whales swam past during the observation period, none showed any obvious signs of interacting with the calf and none approached it. At the time of Hardenberg's arrival, the calf already had fresh bleeding shark bites (Fig. 2*b*).

The dusky sharks were all large individuals ranging in size from 2 to 3 m and followed in a loose group below and behind the whale wherever it swam. The sharks swam at relatively slow speeds, and were deliberate in their movements, keeping close to the whale during the entire observation period with no signs of intraspecific aggression. Although the presence of claspers was not noted on any of the sharks observed, the sex of the sharks could not be confirmed. While the calf was at the surface, the sharks displayed cautious behaviour in the presence of the observers and kept their distance from the whale calf, usually >8 m. On several occasions, when the calf swam away from the observers (>20 m), large (~3 m) dusky sharks were seen to charge along the surface of the water (from behind the whale) and bite the calf along the rear of its left flank. In response the whale started to vigorously thrash about before diving to >20 m for up to 3–4 min (longer than previous observations). The whale calf did not appear to protect itself by acting aggressively in any other way.

The number of bites visible on the calf increased over the observation period. Since only a few bites were actually observed at the surface, it is believed that the sharks were inflicting most of the bites when the whale dived and was at depths of >20 m and out of sight. The bites were concentrated on the left-hand side of the whale's body, between the pectoral fin and tail fluke, with almost no bites on the right flank. Most of the bites were superficial and did not penetrate through the thick skin of the whale and resulted in tooth impressions and scrapes with little tissue removed. The largest and deepest of the bites were located near the head of the whale. These bites managed to penetrate through the skin and blubber layer to expose the muscle layer, but once again little tissue was removed

The whale's condition deteriorated throughout the day and by 1400 hours it was spending little time at the surface and when it dived there was a continuous stream of bubbles from its blow hole. Eventually the calf was observed surfacing only intermittently and then eventually at ~1430 hours it stopped surfacing and wasn't seen again. Given the excellent sea conditions and good visibility it was assumed that after 1 h of not surfacing the calf had drowned due to exhaustion and stress. No further reports of the whale calf were received.

Discussion

This paper represents the first direct observations of dusky sharks attacking any cetacean species. Other cetacean and shark species, which could potentially attack a humpback whale calf in the region, include the killer whale (*Orcinus orca*), the false killer whale (*Pseudorca crassidens*), the white shark, the tiger shark, the shortfin mako shark (*Isurus oxyrhincus*) and possibly the bull shark (Long 1991; Mazzuca *et al.* 1998; Heithaus 2001*a*; Taylor *et al.* 2013). The size, shape and condition of bites observed on the calf, however, were not characteristic of any of these species (Long and Jones 1996; Bornatowski *et al.* 2012). Dusky sharks have smaller bite widths (usually less than 30 cm) than these other potential shark predators as well as smaller, more numerous overlapping teeth with finer serrations (Long and Jones 1996). As a result, the bites observed were small and clean cut with almost no tissue removal and consisted predominantly of rakes and scrapes, which are typical of carcharhinid sharks (Long and Jones 1996). This is not surprising since mammalian remains are rarely found in this species, which feeds primarily on bony fish and other elasmobranchs (Compagno 1984; Smale 1991; Dudley *et al.* 2005).

The bites and rakes observed on the whale calf were concentrated on its dorsal and lateral surfaces, particularly in the region between the dorsal fin and fluke. This observed pattern of bites is probably due to a combination of factors. First, the whale calf is likely to turn its back to the pursuing sharks in an attempt to reduce the probability of exposing its more vulnerable ventrum. It is a tactic that has been postulated for dolphins when evading a shark attack (Heithaus 2001*b*). Second, previous studies have observed that predatory attacks on cetaceans occur more frequently from the rear (Cockcroft

1991; Long and Jones 1996; Maldini 2003; Turnbull and Dion 2012). Attacks directed to the tail region support the hypothesis that attacking sharks or killer whales attempt to slow and immobilise the victim, preventing escape (Cockcroft 1991; Long and Jones 1996; Heithaus 2001*a*; Naessig and Lanyon 2004).

Gray whale (*Eschrichtius robustus*) calves have been observed to act submissively when attacked by killer whales (Barrett-Lennard *et al.* 2011) and to even exhibit capture myopathy (Reeves *et al.* 2006). Although the humpback whale calf observed in this study thrashed vigorously on the surface of the water when bitten by sharks it displayed no other aggressive behaviour to protect itself, such as rolling (Ford and Reeves 2008) or tail slaps (Cartwright and Sullivan 2009). Its primary defence strategy appeared to consist of swimming relatively quickly away from the pursuing sharks. It is likely that the energetic costs of continued swimming, a limited breath-hold capacity coupled with an almost continual stream of air escaping from the blowhole resulted in the calf eventually drowning.

The East African humpback whale population is increasing at a rate of 9–11.5% along the east coast of South Africa (Findlay *et al.* 1994). Increasing calving rates may lead to more frequent observations of shark attacks on whales. Although signs of predatory attacks on humpback whales are extremely rare (Naessig and Lanyon 2004; Bornatowski *et al.* 2012) these events may occur more frequently than the existing literature suggests (Long and Jones 1996; Mazzuca *et al.* 1998; Heithaus 2001*a*). Very little is known about the frequency of shark attacks on humpback whales, or on mysticetes in general (Heithaus 2001*a*; Naessig and Lanyon 2004; Bornatowski *et al.* 2012). Further work is required to better understand the threat that dusky, and indeed other, shark species may pose to whale calves.

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