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Short Note

A Suspected Scavenging Event by Red Foxes (*Vulpes vulpes*) on a Live, Stranded Harbour Porpoise (*Phocoena phocoena*)

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At about 0900 h on 15 February 2014, a live harbour porpoise (*Phocoena phocoena*) was found on the beach of Koksijde, Belgium. The stranding occurred on a sandy beach, with no mussel or oyster banks, wooden structures, or rocks in the vicinity. It was unknown at what time the animal stranded, but it was likely between 0120 h (high tide) and well before 0900 h given its position on the beach relative to the high water mark. The male porpoise was 1.08 m long (from rostrum to tail fluke), indicating it was a juvenile, likely 6 to 8 mo old adjudged by the well-documented breeding period (June-August) of harbour porpoise in this region (Lockyer, 1995; Lockyer & Kinze, 2003). The animal seemed to be in average to good nutritional condition: there was no depression behind the head as seen in emaciated porpoises, and the dorsal muscle area had a convex shape. The most prominent pathological features of the animal were a number of acute, irregular, and multifocal injuries (Figure 1). The distal third part of the left pectoral fin was missing; the injury presented frayed (jagged) edges. The distal part (3 cm) of the left side of the fluke presented a similar injury as the left pectoral fin, but only a small part was missing. On the left flank, part of the blubber and skin was missing in an injury that penetrated into the thoracic muscle layer; this injury was triangular, with edges of 8 cm, and was surrounded by puncture wounds and by numerous dorsoventral, irregular scratches of which some crossed each other. Posterior to this injury, similar superficial scratches, penetrating only the epidermis or the epidermis and the blubber layer, extended from the dorsal to the ventral side, as such, covering almost half of the left flank of the harbour porpoise. There was also a superficial, 2-cm-long, sharp-edged cut on the melon, penetrating only the epidermis. No injury was observed on the right side of the animal.

There were no signs of penetrating wounds extending into the thorax or abdominal cavity and, therefore, it was assumed that no vital organs were damaged. No blood spilled from the animal nor was bleeding observed when the local stranding coordinator first saw the animal; therefore, it was assumed that blood loss had been minimal. The animal was admitted for care at the SOS Dolfijn rehabilitation centre at Harderwijk, The Netherlands, where, in May 2014, part of the left pectoral fin was amputated (a small part of the left side of the fluke had been removed earlier). The harbour porpoise is still alive as of 1 November 2015, with its lesions fully healed (Figure 2).

There are a number of animals known to interact aggressively with harbour porpoises or to scavenge on carcasses, all leaving specific traces (Table 1). In the southern North Sea, aggression towards harbour porpoises by white beaked dolphins (*Lagenorhynchus albirostris*; Haelters & Everaarts, 2011) and bottlenose dolphins (*Tursiops truncatus*; Ross & Wilson, 1996; Patterson et al., 1998; Jepson, 2005; Barnett et al., 2009) is known; and at least the latter of these two delphinids can cause severe injury and even death. In the North Sea and other areas, grey seals (*Halichoerus grypus*) are known to predate on harbour porpoises (Haelters et al., 2012; Bouveroux et al., 2014; Jauniaux et al., 2014; Leopold et al., 2015a, 2015b; Stringell et al., 2015). The characteristics of the lesions left by delphinids and by grey seals have been described and illustrated in detail. The injuries on the harbour

Figure 1. The harbour porpoise (*Phocoena phocoena*) just admitted to the rehabilitation centre, showing severe injuries on its left flank and pectoral fin (top), pectoral fin (bottom left), and fluke (bottom right); pictures taken on day of stranding after arrival at SOS Dolfijn.

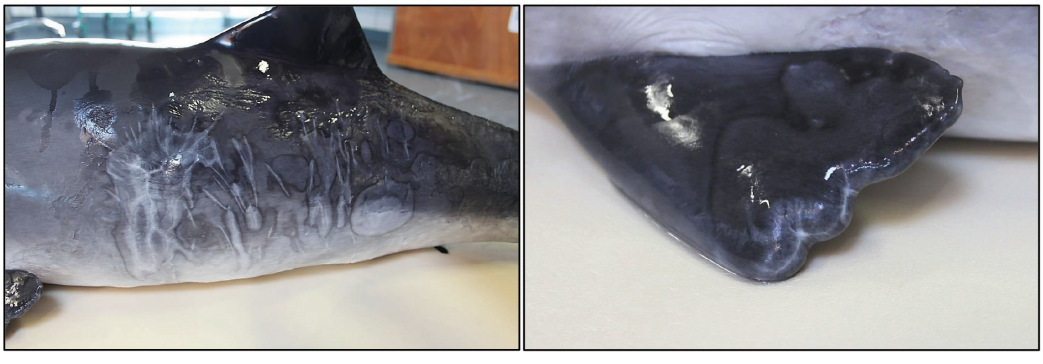
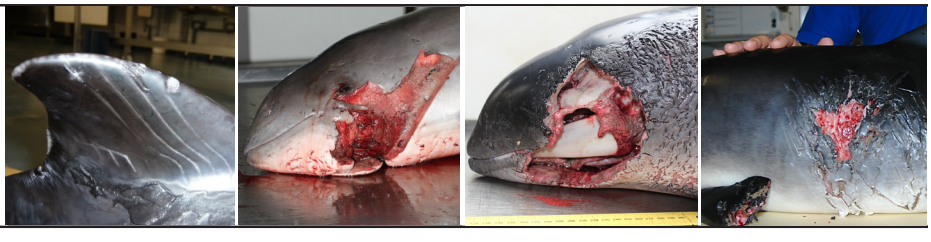


Figure 2. Healed lesions on the left flank (left) and healed left pectoral fin after surgery (right); both pictures taken approximately 6 mo after arrival at SOS Dolfijn.

porpoise in this study did not match with any of these described injuries.

The acute nature of the injuries and the fact that they were only present unilaterally make aggression or a predation attempt at sea highly unlikely. In contrast, it is plausible that the harbour porpoise was scavenged while it was lying on the beach on its right side. However, there were no witnesses to the stranding, and neither the individuals who found the porpoise nor the firemen who removed the animal from the beach reported traces or evidence of a scavenger (although their focus was on the animal itself, not on the search for such evidence).

Table 1. Well-documented injuries on harbour porpoises (*Phocoena phocoena*) left by other species occurring in the southern North Sea and along its coastline in comparison with the current case (suspected red fox)

	Interacting species			
	Delphinidae	Grey seal	Bird	Suspected red fox
Description	Rake marks: parallel scratches; distance between scratches consistent with inter-teeth distance of the aggressor; bruising	Puncture injuries left by teeth and claws; strips of blubber removed or hanging loose; sometimes muscle partly removed	Multifocal, relatively small, superficial injuries penetrating through the skin into blubber layer, triangular in shape (beak); sometimes deeper penetration injuries with irregular edges	Multifocal injuries; extremities partly removed with frayed edges (chewing?); irregular and relatively superficial scratches (claws?); deeper, focal injury where blubber is penetrated
Position on the body	Anywhere on the body	On all sides of the body; punctures specifically on melon and tailstock	Often unilateral as a result of a floating or stranded carcass; centred at softer tissue (around the eyes or genital split)	Unilateral on exposed side; lesions on extremities starting at the distal part
Pathology	Possibly internal bruising, damaged organs, and broken bones; trauma inflicted by dolphin attack identified as cause of death in the majority of cases	Mostly healthy animals; recent feeding; haemorrhages in underlying tissue of puncture wounds (*antemortem* occurrence); trauma inflicted by grey seal attack identified as cause of death in the majority of cases	No haemorrhages in underlying tissue (*postmortem* occurrence); lesions not identified as cause of death	Haemorrhages of underlying tissue (with no haemorrhages expected in cases of *postmortem* occurrence)
References	Ross & Wilson, 1996; Barnett et al., 2009	Haelters et al., 2012; Bouveroux et al., 2014; Jauniaux et al., 2014; Leopold et al., 2015a, 2015b	Personal observations by J. Haelters and L. IJsseldijk	
Sample images				

On the beach, possible scavengers are red foxes (*Vulpes vulpes*), dogs, and birds. The red fox has returned to Belgium and The Netherlands during the past three to four decades and has extended its range to coastal dune areas (Mulder, 1985; Bouwmeester et al., 1989; Van den Berghe, 1995; Keijl & Arts, 1998; Vervaeke et al., 2005), with the first report of fox presence in coastal dunes in Belgium dating from 1991 (Van Gompel, 1992). It now commonly occurs in the area where the harbour porpoise described in this study was found: tens of red fox road-kill carcasses are collected each year in the coastal community of Koksijde, and inhabitants often report instances of red foxes killing poultry (Milieudienst Koksijde, pers. comm., 31 August 2015). Occasionally, dead red foxes are found on the beach of Koksijde (Rosseel, 2014), and the presence of red foxes on the beach along the Belgian coastline was considered a main factor contributing to the decrease of intact carcasses of washed-ashore seabirds (Stienen et al., 2014). Foxes are opportunistic feeders (Dell'Arte et al., 2007; Macdonald & Reynolds, 2008) and, as such, they have been

reported feeding on stranded animals (dead and alive) (Schlacher et al., 2013, 2015; Stienen et al., 2015; A. van Neer, pers. comm., 25 March 2015) as well as scavenging on seal placentae and dead or moribund seal pups at mainland seal breeding colonies (Culloch et al., 2012).

In contrast to red foxes, free-ranging dogs are rarely observed; and if they are reported, they are caught as soon as possible and taken to an animal shelter (Milieudienst Koksijde, pers. comm., 31 August 2015). We cannot exclude that a person taking a dog for a walk on the beach let it cause extensive injury to a live stranded cetacean, although this seems very unlikely. The injuries described in the case presented herein were also different from the marks commonly left by birds (e.g., gull species) on stranded harbour porpoises (personal observations by J. Haelters and L. IJsseldijk on tens of harbour porpoises between 2010 and 2015; Table 1).

To confirm that red foxes had scavenged on the harbour porpoise in this study, we investigated if red fox mitochondrial DNA was present in its injuries. Van Bleijswijk et al. (2014) showed that DNA of a predator in its prey is likely better preserved in relatively small and deep wounds or in punctures that are closed quickly after the bite by overlying epidermis. To increase the chance of finding the perpetrator's DNA, wounds fitting this description were sampled. We took 11 dry-cotton swabs of several wounds immediately after the arrival of the harbour porpoise at the rehabilitation centre: one swab of a puncture wound on the left pectoral fin; one swab of a puncture wound on the left side of the tail fluke; five swabs of deeper scratches on the flank which still had overlying epidermis; two swabs of a puncture lesion on the left flank which still had overlying epidermis; one swab of the cut on the melon; and one additional swab of undamaged skin to function as a negative control sample. A positive control was obtained from a saliva swab of a freshly dead red fox. We investigated the occurrence of red fox mitochondrial DNA in DNA extractions of the swab samples using Easymag DNA isolation (BioMerieux, Marcy-l'Etoile, France) according to the manufacturer's instructions. A Quantitative Polymerase Chain Reaction (QPCR) was performed with a set of primers targeting the mitochondrion genome of *Vulpes vulpes* (NCBI Reference Sequence: NC_008434.1) according to Berry et al. (2007). In short, DNA was amplified using forward primer (5'attcatcgaccttcccgcaccatcaaatat-3') and reverse primer (5'actatacatctgacacagctactgctttct-3'). The thermal profile of the QPCR, carried out in a Lightcycler 480 II (Roche Diagnostics, Risch-Rotkreuz, Switzerland), consisted of a denaturation step of 94° C for 2 min, 30 cycles of 94° C for 30 s, 58° C for 20 s, 72° C for 15 s, and a final extension step at 72° C for 2 min. Amplification data were analysed using the Lightcycler 480 software *SW 1.5.1* (Roche Diagnostics); however, the QPCR revealed no evidence of the presence of red fox DNA in the swabs taken from the harbour porpoise's wounds.

We assume that the red fox is the prime suspect causing the injuries seen in the stranded harbour porpoise described herein, although we acknowledge that we do not present evidence. We argue that the dorsoventral scratches could have been made by fox claws, while the larger injury on the flank, extending into the muscle, and the injuries on the pectoral fin and the fluke were probably scavenging lesions caused by red foxes biting the porpoise. Although the QPCR analysis found no evidence of the presence of red fox DNA, this does not exempt the red fox as the perpetrator. DNA could have been absent or lost from the injuries—for example, due to bleeding, their open nature, DNA degradation as a result of the timespan between the scavenging and the time the swabs were taken, and/or washing out of DNA during initial care and transport of the animal during which time it was always kept wet. This highlights the importance of taking such samples *in situ* as quickly as possible.

Harbour porpoises from the North Sea are protected by the ASCOBANS (*Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas*) Agreement. Parties to this Agreement endeavour to establish an efficient system to carry out necropsies to reveal, among other issues, possible causes of death (ASCOBANS, 2003; Camphuysen & Siemensma, 2011). For researchers attempting to identify the cause of *ante-* or *postmortem* defects on a carcass, characteristic marks as seen on this animal help relate the damage back to a possible cause and estimate the relevance of the defects to the ultimate cause of death. As far as we are aware, a description of the marks left by scavenging red foxes does not exist in the literature. To prove that red foxes are scavenging on harbour porpoises (and potentially other marine mammals) that have stranded, a number of other methods could be used, including the use of camera traps or infrared (IR) video on the beach next to stranded carcasses (Culloch et al., 2012). Traces of fox paws or fox excrement could be searched for in the sand around the carcass (Stienen et al., 2014), although such trace evidence might disappear with incoming tides, wind, or the collection or displacement of the animal by members of the public or trained professionals. Furthermore, the frequency of fox scavenging could be revealed by investigating available photo databases of stranded marine

mammals and autopsy reports, which may also provide insight into the potential historical, temporal, and spatial extent of this phenomenon. If certain characteristics of wounds could definitely be attributed to the red fox, it would assist future *postmortem* examiners of marine mammals to distinguish scavenging injuries that occurred on the beach from scavenging or predation injuries that were inflicted at sea. Finally, if feral animals are scavenging upon stranded animals, then rehabilitation centres should consider the potential for cross-species zoonoses, including rabies (although currently eradicated from foxes in Belgium) (Odegaard & Krogsrud, 1981; Brochier et al., 1994; Van Gucht & Le Roux, 2008), brucellosis (Nielsen & Duncan, 1990), and tuberculosis (Gavier-Widén et al., 2012).

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