Welfare of whales by-caught in fishing gear or struck by vessels

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Introduction
The goals of this paper are to: define terms relevant to industrially induced, but unintentional, trauma to whales; place the issue in a context of the prevalence of such mortalities in North American east coast waters; examine pertinent case studies; summarise the resultant pathobiology; and from this infer likely welfare concerns.

Cetacean by-catch has been defined as mortality or serious injury of animals that are ‘captured’ but discarded (Alverson et al. 1994). By-catch can include drowning, or chronic injury from fishing gear entanglement. Serious injury is defined by the US Marine Mammal Protection Act (1972) as any injury that will likely result in mortality. A wound is any injury to living tissue, while a scar is a healed wound.

Vessels damage whales in two manners: incisions (sharp cuts) from rotating propellers, and blunt impacts from vessel bows, struts, skegs and rudders. Trauma can involve blubber, muscle, bone, viscera and neural tissues, with haemorrhage, oedema and haematomas.

In the period from 1970 through to 2009, a total of 323 whales were diagnosed as dead (222) or seriously injured (101) from fishing gear entanglement on the eastern seaboard of North America between Texas, USA and New Brunswick, Canada: species included minke (Balaenoptera acutorostrata), humpback (Megaptera novaeangliae), North Atlantic right (Eubalaena glacialis), fin (Balaenoptera physalus), sei (Balaenoptera borealis), Bryde (Balaenoptera brydeii), sperm (Physeter macrocephalus) and unknown species. A total of 171 of these same species, and a blue whale (Balaenoptera musculus), were diagnosed as dead (163) or seriously injured (11) from vessel strike through the same time-period. See van der Hoop et al. (2012) for these data.

Dead whales can be discovered in a variety of scenarios. By-caught whales can be found anchored in gear, drowned or alive, swimming entangled in gear or dead floating at sea or on the shore. Whales cut by propellers are found alive or dead at sea or beached dead. Whales with lethal blunt vessel trauma are dead on a ship’s bulbous bow at sea, floating or beached. Blunt trauma is usually cryptic from an external viewpoint. Some whales are negatively buoyant on death, and sink. They refloat later if water depth and temperature enable sufficient decomposition gas to refloat them with the passage of time (Allison et al. 1991). Much of the pertinent pathology observed in these scenarios has been described previously (Moore et al. 2004; Campbell-Malone et al. 2008; Cassoff et al. 2011) but will be summarised here.

By-catch
Whale by-catch mainly involves gillnets, mobile trawls and fixed pot and trap fisheries (Johnson et al. 2005). It can involve rope, net and other gear, such as surface float systems. Where a whale has insufficient power to break out of a system, it will either remain alive, if it can surface to breathe or it will drown. Where the whale has sufficient power to break out, as often seen with North Atlantic right whales and at times with humpback whales, the animal may carry the gear for months over thousands of miles. If there are two anchoring points on the animal with sufficient movement that the draw length of the gear exceeds the compliance of the epidermis and underlying tissues, the gear can saw into the blubber as recently modelled by Winn et al. (2008).

Gillnets
Evidence of gillnet entanglement is often quite cryptic with subtle linear abrasions not penetrating the epidermis. At times, gear is found, but often the animal has been removed from the gear post mortem. A classic example of gradual gillnet invasion is North Atlantic right whale No 2030 (Moore et al. 2004), where gillnet net stretched between both axillae slowly dissected off the intervening dorsal blubber sheet while the animal remained alive for six months (Figure 1).
Figure 5

Propeller incisions (with shark scavenging) along the head and chest of right whale GA 2006025 (Florida, USA 2006). Chest incisions penetrated the pleural cavity. Image by Katie Jackson, Florida Fish and Wildlife Conservation Commission, NOAA Fisheries Permit #932-1905-00/MA-009526.

Figure 6

Fractured transverse processes off twelve vertebrae from right whale mjm09406 (Nova Scotia, Canada 2006). Image by A Bogomolni, WHOI.
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