

Scar-based inference into entanglement and serious injury

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Entanglement in fishing gear is a documented source of injury and mortality to humpback whales and other cetaceans. Although any body part can be involved, at least 53% of humpback whale entanglements involve the flukes and caudal peduncle (Johnson *et al.*, 2005). Even short-term, mitigated events produce scars at this location that persist from one year to the next (Robbins and Mattila, 2001). These injuries generally take the form of wrapping linear scars and abrasions, notches and other penetrating injuries, and occasionally substantial deformation. Since 1997, systematic photographic sampling and scar analysis have been used to study entanglement scarring on free-ranging Gulf of Maine humpback whales (Robbins and Mattila, 2001, 2004). More recently, the same techniques have been applied to humpback whales in other U.S. areas, including Hawaii (Robbins and Mattila, 2004; Robbins *et al.*, 2007), Southeast Alaska (Neilson, 2006; Robbins *et al.*, 2007), and areas of the U.S. West Coast (Robbins *et al.*, 2007).

Entanglement-related scarring has been detected in all of the areas in which research has been conducted to date. For example, more than half of the Gulf of Maine population has experienced at least one entanglement and annual acquisition rates range from 8% to 25%. Yet, even where public awareness is high and a formal reporting network exists, fewer than 10% of new entanglement injuries correspond to successfully reported and adequately documented events. Serious injury determinations presently depend on evidence that an event has occurred and that it is likely to lead to death. Scar analysis indicates that the vast majority of entanglement events are not witnessed.

Nearly all of the types of physical injuries observed in documented entanglements have also been observed among free-ranging (surviving) humpback whales. However, animals that die from entanglement do not necessarily have injuries as severe as those observed on free-ranging animals. Thus, external injuries alone may not be predictive of whether or not an entanglement will result in a serious injury. The mouth is involved in at least 43% of humpback whale entanglements, including cases known to have led to death (Johnson *et al.*, 2005). However, significant injuries at the head, such as those observed among North Atlantic right whales, are not common among free-ranging Gulf of Maine humpback whales.

Scar research has also provided insight into the fate of injuries over time. It is not uncommon for entanglement injuries to persist in an “raw” state from one year to the next, depending on the size of the original injury. In more rare cases, entanglement injuries appear not to ever heal. However, humpback whales also appear to tolerate persistent raw wounds from other sources, such as jaw scuffing acquired during bottom feeding. Therefore, it is unclear what the impact these persistent wounds might have on the health of the animal.

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