The Negative Effects of Anthropogenic Activities on the Welfare and Behaviour of Bottlenose Dolphins (*Tursiops truncatus)*

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Introduction

The common bottlenose dolphin, *Tursiops truncatus*, is found in tropical and temperate oceans worldwide (Jefferson *et al*., 2008). Inshore bottlenose dolphins live along coastal areas subject to intensive human use so interaction between the two species is inevitable. As a consequence, bottlenose dolphins are susceptible to numerous threats such as hunting and habitat modification due to pollution (Currey *et al*., 2009). This paper discusses three studies highlighting the effect of some of these anthropogenic activities on the behaviour and welfare of bottlenose dolphins.

Discussion

An aim of the study conducted by Bechdel *et al.* (2009) was to determine behavioural changes in bottlenose dolphins in the presence of boats. Behavioural data collected during photo identification surveys conducted between September 1996 and October 2006 in the Indian River Lagoon, Florida, on 3224 dolphins (including repeated encounters), showed that in the presence of 5 or more boats within 100m of the group, bottlenose dolphins were observed to be spending more time travelling and less time feeding. In addition, resting behaviour was the least common activity. These behavioural changes are similar to findings by Miller *et al.* (2008) at Mississippi Sound. A consequence of the combination of these behavioural changes is chronic interference with normal physiological equilibrium, stress. Over time this stress becomes distress, compromising the immune system, making the bottlenose dolphins more prone to diseases such as lobomycosis (Reif *et al*., 2009*)*. In addition, expenditure of limited energy in vessel avoidance depletes energy usually expended in expressing normal behaviour, such as mating, as well as maternal care and ultimately species survival.

Another observation by Bechdel *et al.* (2009) was that 6% of 714 bottlenose dolphins with distinctly marked dorsal fins in the photo identification data had vessel-impact-related injuries. However, the intensity of this damage might not be fully realised in this study due to limitations from under-representation of secondary deaths such as those of dependent calves and internal injuries such as haemorrhages and pneumothorax, unnoticeable through photo identification. A study conducted by McFee and Lipscomb (2009) showed that 15.5% of the mortality in bottlenose dolphins stranded in South Carolina between 1993 and 2006 was due to human interaction in the form of collisions with boats or entanglement in fishing gear.

Increased exploitation by fisheries has reduced the amount of prey available for natural fish predators such as bottlenose dolphins, resulting in modified feeding behaviour and increased interactions with humans (Rocklin *et al*., 2009). In order to increase rate of feeding while decreasing energy expenditure associated with foraging, bottlenose dolphins seem to view fishing operations as a new food resource, feeding on fish caught in nets (Gomerčić *et al.*, 2009; Rocklin *et al*., 2009). This behaviour is thought to have been learned from conspecifics as deaths resulting from this activity were mostly observed in dolphins older than 7 years (Gomerčić *et al.*, 2009; Levy *et al*., 2009). Dolphins younger than 7 years are primarily dependent on their mothers for sustenance, still acquiring the necessary skills to survive (Gibson & Mann, 2008).

Apart from this change in behaviour, bottlenose dolphins are also in mortal danger from incidental capture. In the study by Gomerčić *et al*. (2009), post-mortem examinations on 120 bottlenose dolphin carcasses on the Croatian coast of the Adriatic Sea revealed 10% of deaths due to laryngeal strangulation by gill-net parts made mainly of cotton and of mesh size 20-40mm, a common type of net used by small-scale commercial and private fisheries in the

area. The structure of the larynx makes the bottlenose dolphin susceptible to this form of injury. Death is either almost immediate upon strangulation or prolonged with oedema and hypergranulation of the laryngeal mucosa leading to aggravated respiration and inability to feed. Strong infestation by *Anisakis simplex* was also found in bottlenose dolphins with heavy forestomach ulceration due to gill-net part ingestion (Gomerčić *et al.*, 2009; Levy *et al*., 2009). Preventative measures to reduce dolphin interactions include reduced fishing seasons, establishing protected marine areas and gear modification, such as the use of pingers (acoustic deterrent devices) (Gomerčić *et al.*, 2009; Buscaino *et al*., 2009).

Bottlenose dolphins use acoustics for a variety of behavioural functions such as mediating social structure, predator avoidance and mate choice. Naval sonar, oil exploration and whale-watching cruises are examples of anthropogenic sources of noise contributions to the ocean that could potentially interfere with this communication (Nachtigall *et al*., 2009*)*. Jensen *et al.* (2009) investigated the noise generated by two types of small vessels, representative of those commonly used, in shallow (Koombana Bay) and deep (Canary Islands) locations. Using sophisticated audio equipment, background noise at mid-water was measured in the absence of boats and cetaceans, vessel noise was recorded at two locations, the front and side of the vessel, and lastly loss of acoustics transmission between dolphins was measured when the vessels were either approaching or circling at 10 knots. Impact on the bottlenose dolphins was then assessed, factoring in these components. The study found that small vessels with outboard engines travelling at speeds greater than 5 knots and approaching bottlenose dolphins at closer than 50m significantly reduced dolphins' acoustic communication range. In addition, other studies have shown that when duration of exposure to noise was decreased, greater sound energy was required to induce temporary hearing loss in dolphins (Mooney *et al.*; Nachtigall *et al.*, 2009). Vessel-quietening techniques, such as inboard engines and larger distances between vessel and bottlenose dolphins, are just two ways to reduce these negative effects.

Conclusion

Studies conducted on captured animals generally do not provide a true correlation to their counterparts in the wild, and inherent difficulties exist in demonstrating a link between human-mediated threats, behavioural changes and welfare issues in wild bottlenose dolphins. This uncertainty is often used as justification for management inaction (Currey *et al.*, 2009). The studies outlined above are positive steps in finding a means to improve welfare in bottlenose dolphins affected by anthropogenic threats. As they have been conducted over relatively long periods and factored possible complications into the analyses, uncertainty is reduced to a minimum.

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