

Impact of Vessel-based Tourism on the Welfare of Free-ranging Bottlenose Dolphins (*Tursiops* spp.)

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Introduction

Bottlenose dolphins (*Tursiops* spp.) are among the most commonly encountered cetaceans in the wild, and are frequently seen to approach and interact with marine vessels. This, coupled with explosive growth in the whale- and dolphin-watching industry within the past 20 years, has resulted in academic interest on the impact of these activities on dolphin welfare (Hawkins & Gartside, 2009; Higham *et al.*, 2009). Taxonomic ambiguity has clouded a clear classification of the bottlenose dolphin, with some debate over the number of species and subspecies within the genus. The two most commonly encountered varieties, the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) and the common bottlenose dolphin (*Tursiops truncatus*) are now considered separate species. However, in-shore and off-shore groups within these species exist, and thorough, practical taxonomic clarity is still lacking (Corkeron & Martin, 2004). This paper is an integrative assessment of the current literature investigating the effect of vessel-based tourism on the welfare of bottlenose dolphins, which are considered from a genus level (*Tursiops* spp.) by much of the available research.

Discussion

Frequent or persistent activation of the stress response, involving a complex of physiological adaptations to environmental changes or “stressors”, has been implicated as a cause of “chronic stress” conditions in humans, and these are linked to major health concerns. It is believed that chronic stress in dolphins may lead to a decline in populations due to conditions indirectly caused by, but not attributed to, human impact (Hawkins & Gartside, 2009; Wright *et al.*, 2009).

While stress is notoriously difficult to measure in bottlenose dolphins (Esch *et al.*, 2009), behavioural changes may occur as part of a stress response. Hawkins & Gartside (2009) assessed modifications in bottlenose dolphin behaviour during encounters with marine vessels in order to gauge any impact of vessel-based tourism. The study involved observations of Indo-Pacific bottlenose dolphins in the Byron Bay region between 2003 and 2006. In total, 2485 dolphins were observed in 201 groups, with observations being made from both a motor vessel and a sailing yacht. Interestingly, of these groups, only 22% showed any interactive behaviours, most of which were brief (<2min). While interactions with the motor vessel were more frequent, they were usually shorter than those with the yacht (Hawkins & Gartside, 2009), possibly because motor noise interfered with dolphin communication (Esch *et al.*, 2009; Hawkins & Gartside, 2009). Group behaviours, including milling, travelling, socialising and feeding, were assessed, and the onset of interaction was found to significantly increase milling activity, and decrease travelling, which disputes earlier theories of interaction as a form of energy conservation (Hawkins & Gartside, 2009). Importantly, the study shows a significant change in dolphin behaviour, suggesting that some level of impact does occur, an inference supported by an earlier report by Mattson *et al.* (2005) in which common bottlenose dolphin groups interacting with vessels also showed behaviour changes, and even changes in direction.

Changes in acoustic communication was a secondary factor assessed by Hawkins & Gartside (2009), revealing a sizeable increase (12x) in the rate of whistle repetition in dolphins interacting with vessels when compared with normally socialising animals. This result was supported in a study by Esch *et al.* (2009) in which the whistles of common wild bottlenose dolphins were measured before, during and after a capture-release situation (Esch *et al.*, 2009). Whistle rate increased during capture, and decreased throughout the capture-release process, as did the frequency with which whistle patterns were repeated, or “whistle loop” numbers. While the results of the study by Esch *et al.* (2009) are promising in leading toward

whistle assessment as an indicator of stress, further study is required in order to refine the results. Unfortunately, this study and those previously mentioned are limited by the ambiguity of measurements, and the possibility of biased responses resulting from the impact of research vessels on measurements of behaviour during “undisturbed” situations (Esch *et al.*, 2009; Hawkins & Gartside, 2009; Mattson *et al.*, 2005).

Vessel noise is thought to have a critical impact on dolphin species due to its interference with communication (Wright *et al.*, 2009), a theory investigated by Jensen *et al.* (2009) in a study of vessel-noise impact on populations of bottlenose dolphins in Western Australia and the Canary Islands. Sound frequencies and bandwidths were recorded from two small vessels designed to mimic commercial dolphin-watching boats, and compared against a baseline. Results showed vessels moving slowly (<2.5 knots) did not interfere with dolphin communication frequencies, but that vehicles moving faster, within 50 metres of dolphins, or those performing gearshifts, were likely to cause interference. Additionally, interference was more severe in shallow water areas, an important welfare issue for in-shore bottlenose dolphins.

The results of these studies, and others like them, are crucial in the sustainable management of vessel-based dolphin-watching tourism. Higham *et al.* (2009) propose a model for integrated and adaptive management of the industry with long-term solutions for local, national and international contexts. The model aims to ensure sustainability by addressing animal welfare issues associated with the industry, and introducing control measures accordingly. Ongoing research is critical in monitoring the impacts, providing information that can then be analysed and integrated into international and national guidelines and local regulations and permits. This would require quantifiable measures for monitoring welfare, such as those demonstrated by Jensen *et al.* (2009) in the study on the impact of vessel noise, which also provides immediate guidelines (speed, direction and gear changes of vessels) for tour operators. While behavioural and acoustic studies are promising, further research is needed to provide quantifiable “limits of acceptable change” (Hawkins & Gartside, 2009; Higham *et al.*, 2009).

Conclusion

Recent literature has made important progress in the field of marine mammal welfare, and particularly that of the bottlenose dolphin, leading to quantifiable impacts of vessel-based tourism for use in a sustainable management system, and new methods for measuring stress. With appropriate legislation and enforcement, the proposed regulation will dramatically improve the welfare of bottlenose dolphins worldwide, and allow for continued monitoring and appropriate protection (Higham *et al.*, 2009).

References

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