The effects of boat-based tourism on the behavioural budget of bottlenose dolphins and biological significance of these for welfare

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Introduction

Bottlenose dolphins are frequently exposed to boat-based dolphin watching due to their preference for costal areas (Constantine et al., 2004). The following three studies contribute to growing evidence that such interactions have a detrimental effect on the behaviour and, consequently, the energy demands and social cohesion of dolphins (Constantine et al., 2004).

Discussion

In the first study, Constantine et al. (2004) observed an isolated population of approximately 450 bottlenose dolphins in the Bay of Islands, New Zealand, to determine whether their transition between behavioural states altered in response to boat interactions. A small aluminium boat was used to observe the behaviour of the dolphins over 27 months, as well as the number and type of boats that came within 300m of a pod. The predominant behaviour of the dolphins within a group was determined using a focal scan and allocated one of eight behavioural states, including resting, milling, socialising and travelling. Using the CADMOD statistical model to analyse the data, it was found that, as the number of boats grew, milling behaviour increased (from 28% to 46%) and resting behaviour decreased (from 68% to 0.5%). These effects were amplified in small pod sizes and when coupled with irregular tour-boat departure times. These results support several previous studies that have shown that resting (and to a lesser degree, socialising) dolphins are most sensitive to disturbance from boat interactions, for example, Lusseau (2003) and Würsig (1996). It is this finding that the following research relied on.

To establish whether restricting boat access to 'critical habitats' (areas predominantly used for resting/socialising) would be an effective means of mitigating anthropogenic impacts on dolphins, Lusseau and Higham (2004) studied the relationship between behavioural state and location. A remote population of dolphins in Doubtful Sound, New Zealand, had their location and behavioural status (using similar categories as the first study) recorded at 30-minute intervals from a 4.8m boat. The proportion of time the dolphins spent socialising and/or resting in all regions was then calculated to reveal where they were most likely to participate in either activity. The study found that 53.1% of resting and 48.6% of socialising occurred in only 15% of the entire fjord. As a result, it was concluded that sanctioning off these areas would help minimise effects without overly restricting boat traffic (including dolphin tours), and would also be easier to enforce than other methods. As this study was performed over a relatively short period (27 months), further studies must be conducted to verify that these preferred sites do not change over time.

In a third study, Lusseau (2004) aimed to determine the longer-term effects of exposure to boats. Markov chains were used to analyse behavioural data comparing two geographically similar, yet isolated, communities of dolphins exposed to different levels of boat traffic (Milford Sound versus Doubtful Sound, New Zealand). Scan sampling of behavioural transitions displayed by individuals within a pod were recorded from a 4.8m boat. It was found that resting behaviour was significantly reduced in both fjords owing to boat interactions, while socialising dolphins were more sensitive in Doubtful Sound (concurrent with the findings in study two) than in Milford fjord. Interestingly, despite boat traffic being five times greater in Milford Sound than in Doubtful Sound, the proportion of time dolphins spent interacting with boats was found to be very similar (12.8% and 10.8% respectively). Additionally, the average interval between boat interactions did not vary with seasons in Milford Sound, highly suggestive that the dolphins exercise area avoidance (a long-term effect). A threshold must exist after which it is too costly, in terms of energy expenditure, to remain in an area.

The main limitations associated with all three studies are, first, human error in allocating a discrete behavioural state (Lusseau, 2004). Second, despite using low horse-power motors and being manoeuvred to cause minimum disturbance, the boat as a research platform may have exercised an impact on the behaviour of the dolphins (Lusseau and Highan, 2004). Third, the behavioural budget of undisturbed dolphin populations is largely unknown, so it is difficult to ascertain true increases in the level of behavioural divergence displayed by dolphins exposed to boat traffic. Despite these limitations, relative changes still indicate significant disruption.

Expression of certain behaviours at particular times is essential for survival of a population for a multitude of reasons. A reduction in resting was documented in study two and three; a finding as significant as inadequate rest is associated with physiological stress (Constantine et al. 2003 and Fowler, 1999), and has been directly linked with lower reproduction rates in birds (Culik et al., 1990). Socialisation also has a significant impact on reproductive output and offspring survival, which relate directly to the long-term viability of a population (Constantine et al., 2004). Furthermore, synchronisation of behaviour itself is important for group cohesion and maximal utilisation of resources through bonding and cooperation (Emlen, 1999). In short, although these modifications of expression allow short-term adaptation to their environment, they may come at a substantial price to the individual and the population.

When threshold is reached and behavioural displacement becomes too energetically costly to maintain, other avoidance strategies are employed (Lusseau, 2003), as was seen in study three. Lusseau (2004) suggests that these long-term avoidance strategies could lead to increased risk of predation. This was echoed in Constantine et al. (2004), who commented that alterations in ideal habitat occupancy due to human disruption could put young at an increased risk (Stevens and Boness, 2003). These long-term effects pose a significant threat to the survival and well-being of dolphins and act as evidence that these forced behavioural modifications can have a cumulative effect over time.

Conclusion

In summary, this research has increased our knowledge of the various coping mechanisms that bottlenose dolphins employ in response to growing dolphin-based tourism and how these adaptations may affect their welfare. While study three alludes to the reality of long-term effects, further studies should be conducted to explore what these truly entail.

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