Bottlenose dolphins (*Tursiops truncatus*) increase whistling in the presence of 'swim-with-dolphin' tour operations

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ABSTRACT

The impact of cetacean eco-tourism on subject animals is not clearly understood. Studies that monitor this impact have traditionally concentrated on observable surface behaviour despite the fact that sound is the primary communication channel for cetaceans. This study monitored whistle production in free ranging bottlenose dolphins (*Tursiops truncatus*) to evaluate if dolphins vocalise at different rates in response to commercial dolphin-swim boats. Thirty-two hours of sound were recorded in the austral spring and summer of 1995/96. Results indicate that whistle production is significantly greater in the presence of commercial dolphin swim boats, regardless of dolphins' behavioural state prior to the arrival of the vessels. The increase in whistle production suggests that group cohesion may be affected during approaches made by commercial dolphin swim tour-operators or may serve some other social function. Monitoring vocal behaviour offers another insight into short-term human impacts on cetaceans.

KEYWORDS: BOTTLENOSE DOLPHIN; ACOUSTICS; VOCALISATION; BEHAVIOUR; WHALEWATCHING

INTRODUCTION

Bottlenose dolphins (*Tursiops truncatus*) have a long history of interaction with humans (e.g. Lockyer, 1990). Commercial 'swim-with-dolphin' and 'dolphin-watching' tour operators are now adding to the number of boats encountered by dolphins. Resident populations of dolphins are more susceptible to developing chronic effects from commercial cetacean watching operations than, for example non-resident migratory baleen whales, primarily because the same resident individuals may be targeted each day (Corkeron, 1996). Dolphin watching operations have been shown to alter dolphins' behaviour, apparently due to the operators' tendency to follow and stay with dolphins (Acevedo, 1991; Janik and Thompson, 1996). The effect of this form of tourism industry on resident dolphin populations is still not clearly understood. Port Phillip Bay, Victoria has a resident population of inshore bottlenose dolphins that are exposed to recreational users, five commercial 'dolphin-swim' tour operators and three 'dolphin-watching' boats (Scarpaci *et al.*, 2000). The length of the trips ranges from 3.5-4.5 hours with each boat departing 2-3 times a day. Although sound is the primary dolphin communication channel (Caldwell *et al.*, 1990; Smolker *et al.*, 1993), and is also used for echolocation (Janik *et al.*, 1994), studies on the anthropogenic impacts on dolphins have tended to concentrate on observable surface behaviour. This study assesses how dolphins' sound production changed depending on the presence or absence of dolphin-swim tour operators.

MATERIAL AND METHODS

The study was conducted at Port Phillip Bay (38°05'S, 144°50'E), on the southeastern coast of Victoria, Australia (Fig. 1). The study site was on the southernmost end of the bay and covered an area of 26.25km^2. This area was selected because it is the most intensively used by the commercial dolphin-swim charters. All commercial dolphin-swim boats depart from Sorrento Pier with the exception of one boat, which departs from Queenscliff. Dolphin watching boats depart from both Sorrento and Queenscliff primarily because these boats may also operate as ferries between these locations.

Dolphins were observed in the Bay from September 1995 to February 1996. Recordings and observations were conducted from a 4.7m aluminium dinghy equipped with an 8hp outboard motor. A group of dolphins was defined as an aggregation of individuals swimming in a coordinated manner within 100m of each other while displaying the same type of behaviour (Shane, 1990). Data were collected from focal groups rather than from focal individuals because it was not possible to identify individual dolphins or determine which individual dolphin was vocalising. Sound recordings were conducted simultaneously with behavioural observations. The dolphins were observed using: (1) continuous sampling for whistle production; and (2) five minute scan samples of their behavioural state and group size as described by Altmann (1974). This information was immediately transcribed onto prepared data sheets. The recordings were later analysed by ear and compared against data sheets to ensure accuracy; any that did not tally were rejected.

To minimise the effect of the presence of our research boat, the following precautions were taken: (i) no data were collected for the first 10 minutes after encountering a group of dolphins; and (ii) dolphins were approached according to the 1990 Wildlife Whale Watching Regulations[1]. A total of 32 hours of sound recordings was made from September to February 1995. 'Absence' refers to no boats in the area with the exception of the research boat (with its engine off) and 'presence' refers to the presence of at least one dolphin-swim tour operator. Observations began in the early morning before the commercial dolphin-swim operators left the dock. This allowed the researcher to monitor sound production

[1] Wildlife Whale Watching Regulations 1990. SR 102. VGPO, Melbourne, Australia.

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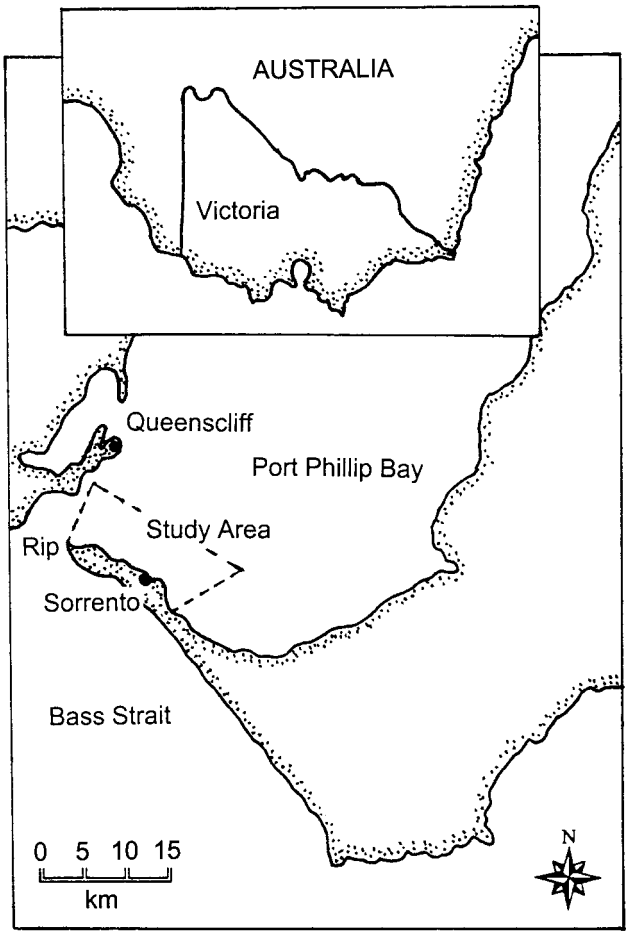

Fig. 1. Map of Port Phillip Bay, Victoria, Australia. Box caption indicates the southern end of Port Phillip Bay and the study area.

prior to dolphins being exposed to commercial dolphin-swim boats on the day of observations. Observations were made for 30-120min before any commercial dolphin-swim operators approached, followed by additional 30-135min of observation in the presence of dolphin-swim operators. Vocalisations were recorded underwater using a custom built mono-hydrophone and pre-amplifier. A standard audio tape recorder (*National* RX-C37) was used. The frequency response of the equipment was 20Hz to 16kHz, limited by the tape recorder. Most sounds produced by the dolphins were categorised by ear as: whistles; echolocation; or 'burst pulsed sounds' as defined by Caldwell *et al.* (1990) and Buck and Tyack (1993). Whistles were defined as continuous narrow band sound emission delineated by breaks (Schultz and Corkeron, 1994) and are the only vocalisation type analysed in this paper.

At distances exceeding 200m, the hydrophone was unable to record whistles by a vocalising group clearly. Once the research vessel moved within 200m of the dolphins, whistles could be heard clearly. All sound recordings occurred within 200m of the most distant animal in the group which ensured that the proportion of whistles detected remained the same in all situations (presence and absence of commercial dolphin-swim operators). If the dolphins moved outside the 200m range, the hydrophone was collected from the water and the boat re-approached within 200m of the focal group. During this time, no data on whistle production could be recorded. If more than one group of dolphins was observed within 200m of the boat, data were disregarded. This ensured that the whistles heard were from the focal group. On the arrival of a commercial dolphin-swim boat, sound production was recorded in the presence of dolphin-swim boats. In most instances swimmers were placed into the water after the operator approached the dolphins. If recreational boats (non-commercial marine vessels including jet skis) were observed during sampling, these data were disregarded from the sample. The results of this study do not include sound production after the departure of an operator because in many cases, once a group of dolphins was sighted the operators would work cooperatively with one following the other until dusk or the presence of operators would attract recreational boats to the area.

Behaviour

Behavioural states were defined as travel, feeding or social, following Shane (1990). Units of behaviour associated with each state were derived from Corkeron (1995).

Travel behaviour was defined as steady movement of a group of dolphins in one direction. During *feeding behaviour* dolphins engaged in either long dives (preceded by fluke up or fluke down dives, or peduncle arches) or erratic swimming, and were often seen chasing fish at the surface of the water. Feeding dolphins' dives were temporally, but not necessarily spatially, coordinated.

During *social behaviour*, animals were involved in active surface behaviour that included interactions with other group members. Units of behaviour observed during socialising included aerial leaps, rubbing, biting and splashing.

Rate of whistle production

The rate of whistle production by bottlenose dolphins was standardised by observation time and group size. For this, the total number of whistles produced during an observed behavioural activity was divided by the time spent observing that group of bottlenose dolphins in that behavioural state for each sighting, divided by the number of dolphins present. This result (whistle/min/dolphin) was calculated for each behaviour in every experiment for each period in the presence of 'dolphin-swim' tour operators and in the absence of 'dolphin-swim' tour operators. The individual data points were used in statistical analysis to calculate the median.

Bottlenose dolphins were the only cetacean species present during all recordings. The number of whistles in each time period was scored. Qualitative features of whistles, such as frequency and contour, were not measured. Data were analysed using SPSS (8.0) and MiniTab (11.2) on a PC.

Statistical analysis

As data were not normally distributed, non-parametric tests (Zar, 1984) were used. The Kruskall-Wallis test (Zar, 1984) was used to determine the effect of whistle rate in the presence and absence of dolphin-swim operators. The Mann-Whitney U test (Zar, 1984) determined if whistle rate differed in the presence and absence of commercial dolphin swim-boats for each category of behaviour.

RESULTS

The rate at which dolphins whistled (whistles/min) differed depending on the presence of commercial swim-with-dolphin operators ($\chi^2 = 47.64$, df = 5, $p = 0.001$, $n = 98$); see Fig. 2. Data were further analysed according to behavioural state and vessel presence. During travel ($p = 0.001$), feeding ($p = 0.001$) and socialising ($p = 0.001$), dolphins produced more whistles when dolphin-swim tour operators were present than when they were not.

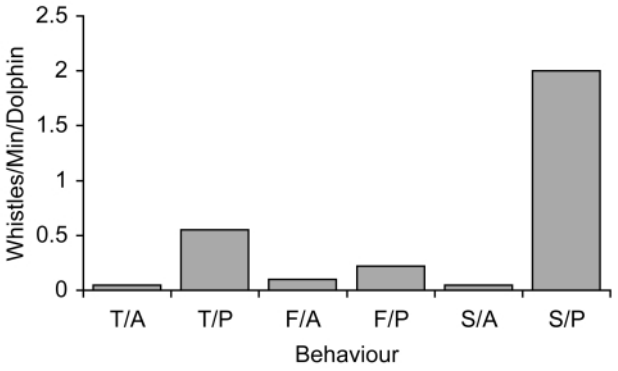

Fig. 2. The median number of whistles produced per minute per dolphin in the presence (P) and absence (A) of commercial dolphin-swim tour operators during travel (T), feeding (F) and social (S) behaviour.

DISCUSSION

Bottlenose dolphins living in inshore coastal waters are frequently in contact with humans (e.g. Acevedo, 1991). The cetacean viewing industry has introduced a new source of possible impact on resident populations of inshore dolphins, however the extent to which this affects dolphin behaviour remains uninvestigated in most cases. This paper shows an increase in whistle production during travel, feeding and social behaviour in the presence of dolphin-swim operators for bottlenose dolphins in Port Phillip Bay, Victoria. It is believed that the function of the whistles is to allow individual recognition of members in a social group (Caldwell and Caldwell, 1965; Caldwell *et al.*, 1990) and as a contact call to maintain physical and vocal contact (Smolker *et al.*, 1993; Janik and Slater, 1998; Smolker and Pepper, 1999). The observed increase in whistle production suggests that group cohesion is somehow affected during approaches made by commercial dolphin swim tour operators. Either the approaches made by tour operators result in the physical separation of individuals in the group, or the increase in ambient noise created by a vessel's presence leaves dolphins needing to ascertain the whereabouts of other group members. Alternatively, an increase in whistling could also mean dolphins are more excited around commercial dolphin-swim boats. An increase in whistling rates has been documented during excitement and stress in Hawaiian spinner dolphins, *Stenella longirostris* (Norris *et al.*, 1994) and during bow riding in bottlenose dolphins (Wells *et al.*, 1980). This study uses a novel technique to monitor the impacts of cetacean eco-tourism. The results suggest an immediate acoustic response by wild dolphins as a result of the presence of dolphin-swim tour boats. The authors suggest that monitoring acoustic responses is fundamental to our understanding of the impacts of eco-tourism on cetacean populations.

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