



Impact of whale-watching on the short-term behavior of Southern right whales (*Eubalaena australis*) in Patagonia, Argentina[☆]



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ABSTRACT

In the last 30 years, whale watching tours in Patagonia, which are primarily based on viewing pods of Southern right whale, have become increasingly popular. The aim of this study was to evaluate the impact of whale watching boat trips on the behavior of whales. Data were analyzed by means of a Generalized Linear Model using a log-link function for categorical data. The model that best fitted the data had four selected first-order interactions among factors. Whales showed short-term reactions to boats, changing their behavior in response to the approaching boats. If the boat approached appropriately (i.e. with the engines off), whales reacted positively by approaching the boat and seeking contact, whereas if the boat approached inappropriately (i.e. with the engines on), whales reacted negatively by moving away from the boat and avoiding contact. The results of this study may have significant implications for whale watching regulations and their enforcement.

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1. Introduction

Whale watching is one of the most rapidly growing and economically attractive tourist activities worldwide (Cisneros-Montemayor, Sumaila, Kaschner, & Pauly, 2010; Hoyt, 2001; Hoyt & Hvenegaard, 2002; Orams, 2002), valued at over US\$ 2 billion a year (Bailey, 2012; Chen, 2011; O'Connor, Campbell, Cortez, & Knowles, 2009). The global industry of whale watching attracts over 13 million people annually in over 119 countries and whale watching operations around the world now include 3330 operators and employ an estimated 13,200 people (O'Connor et al., 2009). This activity not only provides employment and economic benefits for many local communities around the world, but also is an incentive for the conservation of whales as it is a non-lethal activity that provides important information of cetaceans and their environment (IFAW, 1995) and encourages people to appreciate and protect whales (Wearing, Cunningham, Schweinsberg, & Jobberns, 2014). Over the last 20 years, there has been an awakening interest and a general fascination in observing marine wildlife in their natural environment (Bertellotti, D' Amico, & Cejuela, 2013; Corkeron, 2004; Curtin, 2003; Muloín, 1998; Neil & Breeze, 1998; Orams, 2000; Schofield, Scott, Katselidis, Mazaris, & Hays, 2015; Seminiuk, Bourgeon, Smith, & Rothley, 2009; Topelko & Dearden, 2005; Villanueva, Walker, & Bertellotti, 2014), which may benefit conservation through changing attitudes towards wild animals and natural habitats

(Duffus & Deaden, 1993) and creating a need within people to help protect them (Lien, 2001). In this sense, whale watching can act as a platform from which commercial tour operators can educate tourists about long-term sustainable benefits of whale watching (Wearing et al., 2014). Species that live in coastal environments are the most used as a tourist attraction because of their easy access (Christiansen & Lusseau, 2014; Coscarella, Dans, Crespo, & Pedraza, 2003; Lusseau, 2004; Schofield et al., 2015). Great whale species approach coastal waters during part of their life cycle activities (i.e. reproduction, nursing, feeding), making them more susceptible to human disturbance (Orams, 1997). If conducted properly, whale watching is relatively benign (Blewitt, 2008; Jensen et al., 2009; Lusseau, Bain, Williams, & Smith, 2009; Noren, Johnson, Rehder, & Larson, 2009). However, uncontrolled whale watching may disturb whales, causing changes in their natural behavior, which could in turn modify their distribution, reproduction and survival (Berrow & Holmes, 1999; Constantine & Baker, 1997; Heckel, Reilly, & Sumich, 2001; IFAW, 1995; Lusseau, Lusseau, Bejder, & Williams, 2006; Williams, Bain, Ford, & Trites, 2002). Governments and NGOs have attempted to reduce the impact of this activity worldwide by developing Guidelines and Codes of Conduct that aim both to reduce the negative effects of this activity and to give an educational opportunity to visitors (Cole, 2007; Garrod & Fennell, 2004; Orams, 1997). When educational objectives are met, contrary to what can be expected, close-range observation of whales does not influence the satisfaction level of tourists (Orams, 2000).

In Argentina, whale watching has developed on the observation of Southern right whales (*Eubalaena australis*) around Península Valdés, Chubut Province, and this has promoted a growing ecotourism industry for more than 30 years (Coscarella et al., 2003; Rivarola, Campagna, &

[☆] In memory of Mariano Van Gelderen: "The king of the whales".

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Tagliorette, 2001). This activity, which generated total revenues of over US\$ 42.6 million in 2006 (US\$ 2.1 million in direct expenditure and US\$ 40.5 million in indirect expenditure) (Hoyt & Iñiguez, 2008), is currently one of the fastest growing sources of income and employment for the province after oil exploitation and fisheries (Argüelles & Bertellotti, 2008).

Southern right whales come to Península Valdés coast in mid-May to mate and give birth to their calves, remaining in the area until mid-December. Península Valdés is internationally known as one of the most important breeding areas for this species in the southwestern Atlantic Ocean (Bastida, Rodríguez, Secchi, & Da Silva, 2007). In addition, it is considered one of the best places in the world to watch Southern right whales, due to the large number of animals as well as to their predictability and proximity to the coast (Fazio et al., 2015, in press). The annual population growth rate is around 4–6% (Crespo et al., 2014) and the breeding population of Península Valdés is estimated in around 4000 whales (Cooke, 2012). The number of whales peaks in September, with up to 1000 individuals (Crespo et al., 2015).

The whale watching season in Península Valdés extends from June to December and, like other wildlife tourism destinations, this touristic place has also experienced a rapid growth (Secretaría de Turismo y Áreas Protegidas, 2015). The number of tourists that visit Península Valdés to see whales at close range from boats has increased from 70,462 in 2002 to more than 120,000 in 2015 (Ruiz Diaz & Ganduglia, 2013; Secretaría de Turismo y Áreas Protegidas, 2015). During each season, the number of tourists peaks in October (Ruiz Diaz & Ganduglia, 2013), coinciding with the peak of whale abundance (Crespo et al., 2014). Whale watching in Península Valdés started in the 1970's but it was not until 1983 that it was commercially established (Rivarola et al., 2001). The activity began in Puerto Pirámides with only two small companies working with three boats. Since the early 1990's, six companies operate one boat at a time, but under exceptional circumstances up to 12 boats can be simultaneously operated (Tagliorette et al., 2008). Whale watching was first regulated in 1984 by Provincial

Law N° 2381, which was made taking into account the laws of other countries. In 2008, the Government Tourism Office of Chubut Province implemented a new whale-watching Law N° 5714, and Decree 167, including the “Patagonian whale-watching technique”, which is a set of rules, codes of conduct and maneuvers developed throughout the years to interact correctly with Southern right whales. Although this technique was developed mainly by experienced whale-watchers, a few studies have also referred to the boat's approach (Argüelles, 2008; Carribero, Berrier, & Lindner, 2006; Fazio, Marino, & Bertellotti, 2006; Rivarola et al., 2001) and to the short-term effects of this approach on the behavior of whales (Alvarez Colombo, Arias, & Garciarena, 1990; Argüelles, 2008; Arias, Alvarez Colombo, & Garciarena, 1992; Garciarena, 1988; Rivarola et al., 2001). Although these studies have provided recommendations to improve whale-watching management, it is unknown how the sound of the engines and maneuvers made by the vessel operators at Península Valdés affect whale behavior. The question on the convenience of keeping engines turned on or off during the sighting has been a controversial theme within the community of whale watchers and the government for at least two decades.

The main objective of this study was to evaluate the impact of whale watching through observable reactions of Southern right whales to this activity in Península Valdés, and thus obtain new impact indicators that may be relevant for the design of future research protocols and management.

2. Methods

2.1. Study area, survey procedure and data collection

This study was carried out during the breeding season of Southern right whales, between August and December 2006. The area surveyed corresponded to the surroundings of Puerto Pirámides (42°56 S, 64°28 W), between Punta Piaggio (42°32 S, 64°28 W) and Punta Alt (42°41 S, 64°16 W) (Fig. 1). This area is the only licensed by the government for whale watching operations.

A total of 611 whale watching commercial trips were undertaken to observe whales, obtaining 186 h of direct observation. Between one and four trips were made each day depending on the weather conditions. Patagonia is a windy region and therefore navigation during days with strong wind is restricted. With south winds of more than $35 \text{ km} \cdot \text{h}^{-1}$ intensity, coast guard authorities close the port and prohibit all navigation (Fazio et al., 2015, in press). All observations were carried out with Beaufort sea level below four (Beaufort scale is an empirical measure that relates wind speed to observed conditions at sea and ranges from 0 to 12, increasing in a non-linear manner). Trips were made with three of the six whale watching companies currently operating in Puerto Pirámides, on different types of boats, including one catamaran, four rigid-hull boats and one zodiac. All boats sailed from Puerto Pirámides and the number of passengers ranged from 19 to 70, depending on the size of the boat. Large boats usually have more than one out-board engine, while small boats have only one, and these engines had between 150 and 300 hp each. For every trip, the date, trip duration and weather conditions were recorded. During each trip, a “sighting” was considered when the boat stopped and stayed for at least 1 min observing one or more whales. Several sightings could be performed during the same trip. On each sighting, the following variables were recorded: the onset and finishing time, the weather condition, the number of whales observed, the group type and the behavior.

Whale groups were classified according to their composition as: mother with calf (a mother and a calf born in the current season – MC), solitary individual (a young or lonely adult – SI) and mating groups (one female and up to six males – MG). In a given sighting, more than one group could be seen. However, if a MC was seen interacting with a SI, the group was classified as MC. For analysis purposes, group types were grouped as MC/J (mother and calves plus juveniles or solitary individuals) as opposed to MG. The behavior of



Fig. 1. Geographical location of the whale-watching area in Península Valdés, Chubut, Argentina.

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