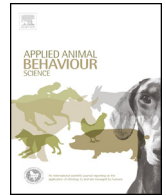




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Wildlife tourism: Underwater behavioral responses of South American sea lions to swimmers

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ABSTRACT

The aim of the present study was to describe the type of interaction between swimmers and sea lions, during tourist trips, at a small colony in Northern Patagonia, Argentina. Particularly we explored if sea lions would show agonistic behaviors towards people, or behaviors that potentially poses a danger, and to detect which interaction may produce such behavior. Underwater sea lions behavior was recorded by videotapes, and significant behavioral sequences were determined by two-event sequences analysis. During the resting period, sea lions swim around and look at the swimmer most of the time, and vice versa. During the pupping period, sea lions breathe more frequently during these behavioral sequences. During both seasons, the sequences including *bites* as the target behavior were significant (Adjusted residuals z-scores larger than 1.96 at the $p < 0.05$ level). These sequences consisted mainly in a sea lion allowing a swimmer to touch it and then biting him/her and a sea lion allowing a swimmer to touch it and then going away. Although these bites did not finished in cutting wounds, they represent potential risk of injuries. These results support the recommendation of no allowance of physical contact, or at least no looking for physical contact actively.

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1. Introduction

Wildlife watching is one of the fastest growing sectors of tourism worldwide. It covers a spectrum of opportunities for tourists to interact with non-domesticated animals in their natural environment. This type of tourism generates economic and social benefits, by means of direct and indirect incomes but also stimulating local development (Tapper, 2006). In this context, marine mammals and the marine environment have driven a significant part of this growth, representing a large industry nowadays. In particular, whale watching generated U.S.\$2.1 billion in total expenditures in 2008, growing at a rate of 3.7% per annum between 1998 and 2008 (O'Connor et al., 2009). Whales, dolphins and porpoises are the main target for this industry, however pinniped-focused tourism (seals and sea lions) has also expanded due to several behavioral traits these animals present: species are generally colonial, providing a viewing spectacle, their annual attendance patterns at sites are predictable, and they exhibit interactive and 'playful' behaviors which appeal to the public (Kirkwood et al., 2003). Viewing expe-

riences with pinnipeds range through guided tours on-shore, boat cruises, and swimming and scuba diving interactions.

Pinniped-focused tourism is largely unregulated, in comparison with whale-watching. However, guidelines are necessary for conservation goals, to ensure the impact of tourist presence is minimal and does not affect population sustainability. Possibly generated by a large history of exploitation and populations depletion, most concerns about pinniped-based tourism, focused on the negative impacts of tourism on individuals' fitness and population sustainability. Among them, it can be mentioned changes in behavior, site abandonment, stampeding, disturbance to suckling bouts and reduced reproductive rates (Cowling et al., 2014). However, tourists interacting with wild marine mammals very close, like swimming and diving with, may be exposed to unpredictable reactions and potential injury. This area of research has received less attention, and it is also needed to generate guidelines and minimize risks.

In Patagonia, Argentina, the World Heritage Protected Area Península Valdés (PV), represents an important target for national and international tourism year-round. The presence of elephant seals *Mirounga leonina* and sea lions *Otaria flavescens*, promoted the creation of wildlife reserves in the 60's which attracted the first visitors to the area. Later, Southern Right Whales *Eubalaena australis* and Maguellan penguins *Spheniscus magellanicus*, promoted the rapid development of the tourism industry. At present more

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than 250,000 tourist come every year to watch whales, and a similar figure visit the penguins. Pinnipeds are a secondary attraction, however the rapid growth of the industry promoted the diversification of activities, looking for novel and alternative attractions like diving and swimming with marine mammals.

At present, a small colony of sea lions located very close to one of the main urban centers, Puerto Madryn, is being visited by tourists year-round. The colony is visited mainly for viewing sea lions from a small cliff (20 mts approx.). However, an experimental boat-based swimming and diving program started in 2005. The whole tour consists in carrying tourists to the proximity of the colony, sailing in a small boat, stop sailing at a distance of 70 mts from the shore where sea lions are located, and allowing tourists entering the water and snorkeling. Tourists may swim a short distance to approach sea lions but most of times sea lions are attracted to tourists by curiosity.

The aim of the present study was to describe the type of interaction between swimmers and sea lions, in particular if sea lions would show agonistic behaviors towards people, or behaviors that potentially poses a danger, and to detect which interaction may produce such behavior. It is expected that results of this study may serve for avoiding undesired behaviors and considered at the moment guidelines and regulations were to be established.

2. Materials and methods

2.1. Study area

The study was carried out at Punta Loma, 12 km from Puerto Madryn (Fig. 1). In this site, South American sea lions are present during the whole year. The site is under protection and managed as a Natural Protected Area administered by the Department of Conservation and Protected Areas of the Chubut Province. This protection level implies that a limited number of activities can be done, like visiting and watching sea lions by land, the existence of an exclusion zone for boats traffic, and the presence of rangers controlling that people walk by habilitated paths.

The colony is mainly a haul-out site but a small breeding area is formed during the austral summer. The number of pups born at this colony increased at an annual rate of 15% between 1970 and 2002 (Dans et al., 2004). Even that, the nonbreeding fraction still represents more than 80% of the total number (Grandi et al., 2008). During the pupping period, the total number of sea lions is close to 500 and this figure may be doubled during the winter (unpublished data).

Commercial swim-with sea lions trips were monitored by researchers from June 2011 to March 2012. During this period 8 companies operated, although they were not active at the same time, depending on the number of tourists visiting the zone. The maximum number of boats in the surroundings of the colony was three, and the maximum number of tourists engaged in a swim-with sea lion was 20 per boat, with a maximum of six tourists per boat plus the scuba divers guides.

2.2. Sampling methodology

During tours, underwater sea lions behavior was recorded by videotapes, taken by scuba-diving personnel of the company engaged in the tour. Tourists only did snorkeling. Observations were made on these underwater videotapes. Personnel engaged in recording videos were previously instructed by researchers. The recording protocol consisted of picking up a sea lion at random and following it as long as possible. During the follow, the sea lion could approached a tourist or vice versa. If the sea lion went away, another

Table 1
 Events defined for behavioral sequences analysis during the interactions between sea lions and swimmers.

Code	Description (the action refers to what a sea lion does)
S	swims around or very close to a swimmer
CS	leaves a swimmer and get close to another
LS	looks at a swimmer without any movement
TN	touches a swimmer with the nose
TF	touches a swimmer with the flip
LT	keeps quiet when a swimmer touches it
A	goes away when a swimmer touches it
PB	plays with bubbles
Bi	bites
Br	goes to the surface, breathes and dives again
KS	goes to the surface, breathes and keeps at the surface
SEX	mimics copulatory behavior with a swimmer

sea lion was chosen and followed. Videotapes from different tours and days were stored and then facilitated to researchers.

The study focused on which behavioral events occur, how often they occur and in what order they occur, during the interaction. Then, data consist of a continuous record of successive events. Events were defined as short lasting behaviors (Altmann, 1974; Lehner, 1998). Based on preliminary observations on underwater sea lions behavior, 12 events, mutually exclusive and exhaustive, were defined (Table 1). Videotapes were reproduced in a computer. Each individual follow was observed continuously, recording each time a behavioral event occurred. The occurrence of events was recorded by using the program Etholog®.

2.3. Data analysis

Sequences were extracted as double-entry tables by using the same program, extracting one table for each individual follow. As 12 events were defined, each table consisted of 12 files and 12 columns. These tables conformed transitional frequency matrices, where each cell contained the number of times a given behavior G was followed by a target behavior T , files representing given behaviors and columns target behaviors (Bakeman and Gotman 1997; Nowacek, 2002; Slooten, 1994). It must be denoted that in some instances, a behavior may be followed by the same behavior, and these occurrences are represented on the diagonal of the matrix.

	T_1	T_2	T_3	T_{12}
G_1	$x_{G_1T_1}$	$x_{G_1T_2}$	$x_{G_1T_3}$				
G_2	$x_{G_2T_1}$	$x_{G_2T_2}$	$x_{G_2T_3}$				
G_3	$x_{G_3T_1}$	$x_{G_3T_2}$	$x_{G_3T_3}$				
⋮							
⋮							
⋮							
G_{12}							

These matrices were exported to excel files for further analysis. Matrices corresponding to sequences sampled from June to December were combined and assigned to the “resting period”, while those sampled from January to March, were combined and assigned to the reproduction or “pupping period”. The proportion of time each event occurred was obtained following Dans et al. (2012) and Grinstead and Snell (1997).

In order to detect if first-order sequences (given event G , target event T occurs immediately after) really exist, we tested if observed transitional probabilities deviate significantly from their expected values. We used a z score to compare observed versus

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