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Impact of whale-watching on Southern Right Whale (*Eubalaena australis*) in Patagonia: Assessing the effects from its beginnings in the context of population growth

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1. Introduction

Whale-watching (WW) is a growing industry around the world (Cisneros-Montemayor, Sumaila, Kaschner, & Pauly, 2010; Hoyt, 2001). By 2006, Argentina had the largest number of whale watchers in Latin America (Hoyt & Iñíguez, 2008) and most of these came to Patagonia (Argentina). The majority of the WW activities are carried out on Southern Right Whale (SRW) *Eubalaena australis*, that every year migrates from their summer feeding grounds to the coasts of continents and islands, mainly to mate and calve (Best, 2000; Payne, Rowntree, Perkins, Cooke, & Lankester, 1990; Rowntree, Payne, & Schell, 2001; Whitehead, Payne, & Payne, 1986).

Commercial whaling during the 18th and 19th century caused a dramatic decrease in the number of SRW (IWC, 2001). However, during the last decades, most stocks from Argentina-Brazil, South Africa, Australia and New Zealand have shown signs of recovery (Bannister, 2001; Barendse & Best, 2014; Best, Brandão, & Butterworth, 2001; Carroll et al., 2014; Cooke, Rowntree, & Payne, 2001; Crespo et al., 2014; Groch, Palazzo Jr., Flores, Adler, & Fabian, 2005). In Argentina, the stock inhabiting northern Patagonian gulfs has shown a sustained growth since 1999 (Crespo et al., 2014). However, Crespo et al. (2017) reported a deceleration in the rate of population increase during the last years. They proposed that these changes could be related to a density-dependent process in which the preferred areas located surrounding Península Valdés (PV) seem to be close to the carrying capacity, "exporting" individuals to other areas. Recent studies using satellite transmitters implanted on SRW specimens in PV (Zerbini et al., 2016) have shown that this species makes trips of several hundred kilometers in a few weeks. Moreover, some specimens were observed to move between northern San Matías Gulf (SMG) and PV system (including San José and Nuevo gulfs) in the same season (Zerbini et al., 2016). These data provide new insights about connections between PV and SMG during the breeding season, supporting the hypothesis that the more frequent presence of SRW in the northern SMG could be related to the increase in the population and the associated density-dependent processes (Crespo et al., 2017). Therefore, the increasing number of whales, including solitary animals, mating groups and mother with calves observed during the last two decades in the northern SMG (Arias et al., 2016; Crespo & Dans, 2008; González, Curtolo, & Acosta, 1992; Svendsen, 2013) could be a consequence of this process.

The presence of whales in the northwest area of SMG within the San Antonio Bay Marine Protected Area (SABMPA) during winter and early spring has become frequent enough to set since 2012 an experimental program of WW tourism, designed and implemented according to the current legal framework and enforced by the Environment and Sustainable Development Secretary (SAyDS) of the Río Negro Province. An important point to consider when establishing a WW operation is that it should be done in a precautionary manner in order to avoid potential negative impacts on the whales and the environment, ensuring also the economic viability for the industry to be sustainable at a benefit-maximizing level (Cisneros-Montemayor et al., 2010). Also, an appropriate formal regulation could benefit the environment by keeping the ecosystem in good ecological condition with a positive effect on the delivery of ecosystem services, therefore, also benefiting the industry (Potts et al., 2014). Nevertheless, WW activity is not usually developed in a precautionary way and is linked to tourist demand (Chalcobsky, Crespo, & Coscarella, 2017). On the contrary, in SABMPA the WW activity has been regulated by a precautionary approach from its beginning. Studies aimed to gather information on population trend and ecological aspects of the species in the SMG began in 2006 (Crespo et al., 2011; Crespo & Dans, 2008; Svendsen, 2013; Vermeulen, Cammareri, & Holsbeek, 2012), therefore some pre-tourism

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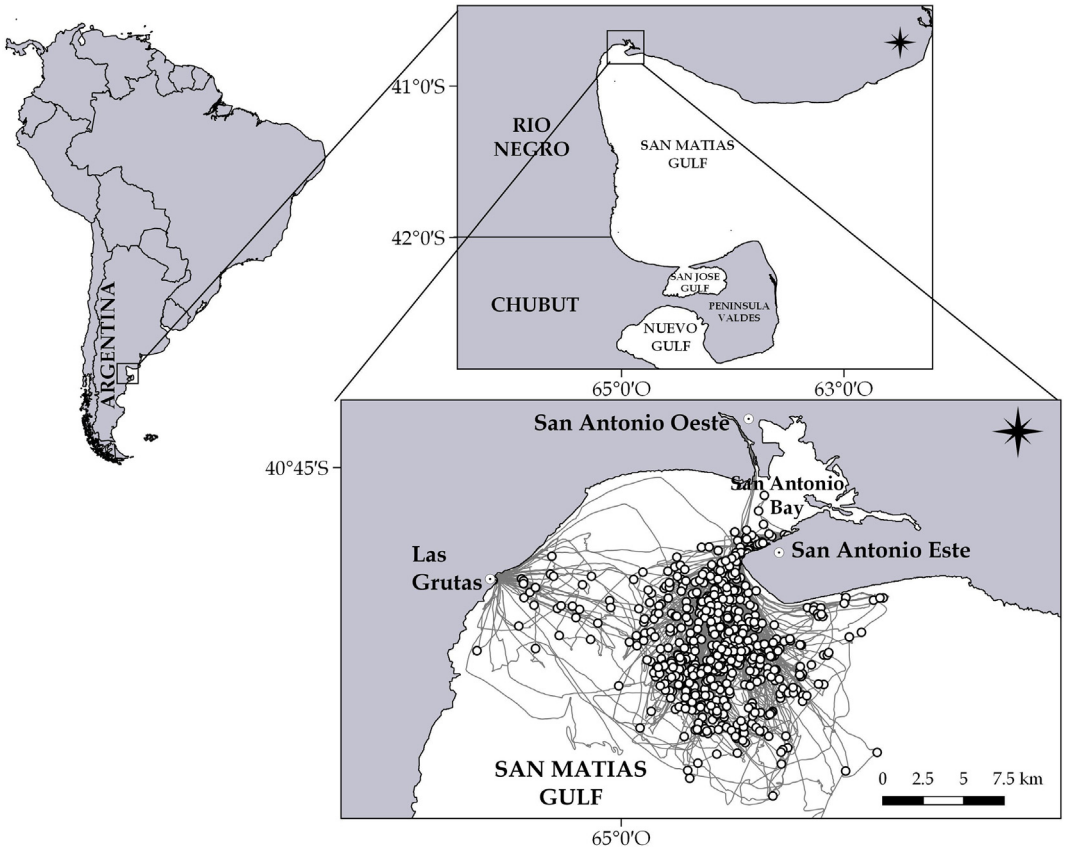

Fig. 1. Location and detail map of the study area in San Antonio Bay, Río Negro, Argentina. The white dots represent the locations of recorded SRW sightings between 2012 and 2016 and the grey lines represent vessels' tracks.

data are available. This is a rare and unusual situation that provides the opportunity of having a baseline prior to the development of the WW operations. In Argentina, the WW activity is mainly focused on PV and has been carried out over SRW for 40 years. However, the regulatory framework for the activity began to be developed approximately 10 years after it started (Chalcobsky et al., 2017). Additionally, there is a lack of studies about the impact of the commercial activity when started and therefore there is not an available baseline for PV. The fact that the WW regulation is established after the beginning of the activity can lead to a disorganized growth of the industry with negative impacts in the industry as well as in the target species (May-Collado et al., 2015). On the other hand, WW activity may not have a formal regulation (Garrod & Fennell, 2004; Parsons, 2012) and operators adopt voluntary codes of conduct that could have some inconsistencies in some of the key aspects and are also often inadequate (Cressey, 2014; Inman, Brooker, Dolman, McCann, & Wilson, 2016). In order to ensure that the WW industry grows within the limits of sustainable development, it is necessary to implement a management plan based on scientific studies intended to assess the impact of the activity. Besides the environmental and species traits, the management also should include socio-economic aspects and realistic operational rules, taking into account the participation of the involved stakeholders and the adequate funding and resources (Chalcobsky et al., 2017).

The recovering of SRW stock and the most frequent presence of specimens in areas that may have been ancient mating and calving grounds (i.e.: northern SMG), is allowing the development of WW activities. This type of activity could have negative impacts on the species. For example, many studies (Argüelles, Coscarella, Fazio, & Bertellotti, 2016; Christiansen, Lusseau, Stensland, & Berggren, 2010; Constantine, Brunton, & Dennis, 2004; Lundquist et al., 2012; Lusseau, 2003; Steckenreuter, Harcourt, & Möller, 2011; Stockin, Lusseau, Binedell, Wiseman, & Orams, 2008; Williams, Lusseau, & Hammond, 2006), showed that WW could change whale and dolphin behavior, including the displacement of the animals from their habitats (Allen & Read, 2000; Bejder et al., 2006; Lien, 2001; Lusseau, 2005; Morton & Symonds, 2002; Rako et al., 2013; Richardson, Finley, Miller, Davis, & Koski, 1995). Effects have been also observed in some biological and population parameters (Bejder et al., 2006; Fortuna, 2006; Lusseau, Slooten, & Currey, 2006). To our knowledge, there are not available studies that discuss the potential effect of these disturbs in the context of a population recovery considering also the expansion of its breeding ground range.

The relationship between short-term behavioral responses to the WW vessels and their long-term consequences is poorly understood (Bain, Williams, & Trites, 2014). However, some mechanisms as energy expenditure (Williams & Noren, 2009), separation of mothers from calves and disruption of mating (National Research Council, 2003) among others may contribute to population-level consequences. Energetic expenditure is likely to increase if the frequency of evasive behaviors in presence of WW vessels also increases (Christiansen & Lusseau, 2014). Therefore, in order to establish management measures that allow the sustainable development of the new WW activity in SABMPA, it is important to know over which group types the activity is carried out and how these groups react to the presence of the WW vessel in order to evaluate if there are more sensitive groups to the WW vessels (groups with more evasive reactions). This kind of information is important to understand the potential effect of the WW activity over the expansion process of SRW population.

The incipient development of WW in SABMPA and the scientific data collected from its beginning, provide a unique opportunity to answer questions that would contribute to the sustainability of the activity and help stakeholders to design a timely management framework.

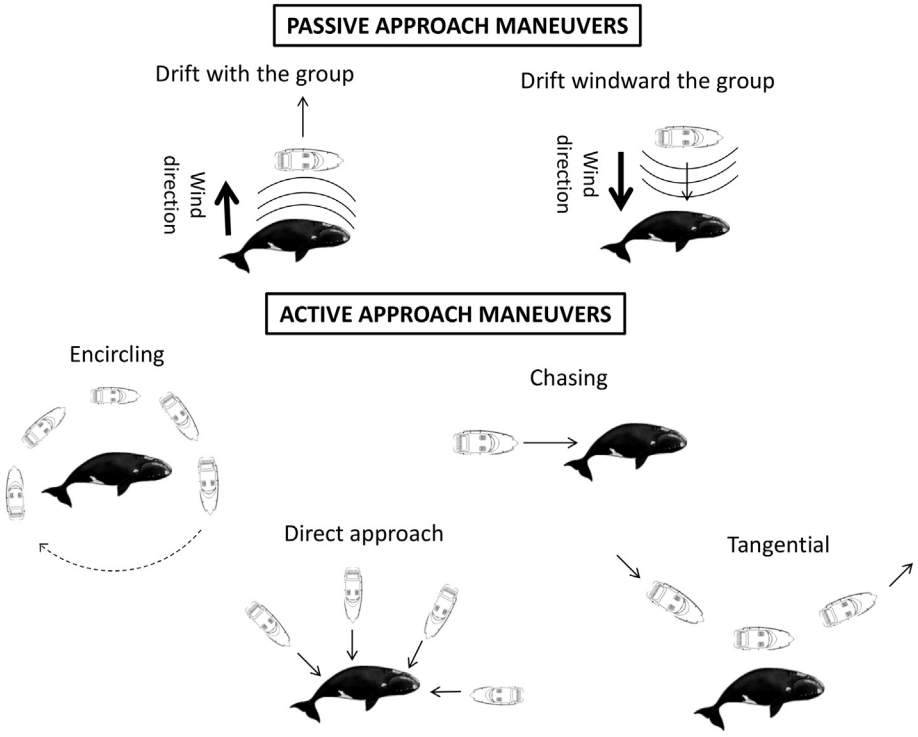

Fig. 2. Vessel maneuvers to approach the whales during a sighting. Passive maneuvers above and actives maneuvers below.

In this context, the aims of this study were to conduct a comprehensive assessment of WW activity from its inception phase in a new area of distribution of SRW, evaluating the potential effects of the activity on the colonizing groups. We provide an overview of the development and characteristics of the tourism activity from the beginning and its changes over the time, describing WW operations in SABMPA and the short-term reaction of SRW to WW vessels.

2. Methods

2.1. Study area

The study was conducted in SABMPA and its neighboring area, which is located in the northwest of SMG (40°46′S, 65°02′W) (Fig. 1). SABMPA presents a semidiurnal tidal regime with an amplitude between 6 and 9 m, that causes the approach of whales to the coasts during the high tide and move away during the low tide. The outer zone of the bay, where the WW is mainly carried out, is characterized by large sandy banks that form a large tidal delta (Alliota, Schnack, Isla, & Lizasoain, 2000; Schnack, Aliotta, Isla, & Lizasoain, 1996). The whole study area is included in the SABMPA.

2.2. Whale-watching industry in SABMPA and on-board surveys

Data were collected systematically from the beginning of the activity during five WW seasons (2012–2016) between August and October each year. Logbooks from the companies and Prefectura Naval Argentina (Argentinian National Coast Guard, in Spanish) provided information on the number of tourist. Onboard data were recorded by a trained observer on board of some of the four vessels (8–10 m length) authorized to operate. Each day between 1 and 6 commercial trips were monitored depending on the number of tourists and weather conditions. Several sightings were performed during the same trip. A "sighting" was considered when the vessel approached a group of SRW and remained at least for 1 min at a distance of at least 100 m from the focal whale. The distance was estimated "by eye" using vessel length to calibrate distance (Dawson, Wade, Slooten, & Barlow, 2008) and they were categorized into "close" (distances less than or equal to 50 m) or "distant" (distances between 50 m and 100 m).

2.3. Whale sightings data details

Date, hour, trip duration, track recorded by a handheld GPS and weather conditions for each trip were recorded. Data collected in each sighting included: position (lat, long), sighting duration, group size and group type.

Four categories of SRW groups were identified: a) mothers with calves, one adult female with a calf; b) solitary individuals, adult or sub-adult males or females; c) breeding groups, usually comprising one adult female and n − 1 males (Crespo et al., 2011); and d) non-social active groups, composed by adults or sub-adults whales not showing courtship behavior (Best, Schaeff, Reeb, & Palsbøll, 2003) and within a distance of two body lengths from one another.

2.4. Effects of different maneuver types on SRW reaction

A subsample of 363 sightings (selected from a total of 725 sightings) taken by 4 experienced observers between 2014 and 2016 was analyzed. This selection was made because it was considered that during the first two seasons of sampling the observers were learning and training.

During each sighting, an observer collected data on SRW groups using 3-min point sampling on a focal animal (Mann, 1999), recoding the group type, the maneuver type, the distance between vessel and whale and the reaction of the whale. In the case of mother calf pairs, the focal animal was the mother assuming that the mother's behavior is representative of the group behavior. For non-social active groups, the focal animal was the most easily identifiable individual (based on callosities, pigmentation or external marks); for breeding groups, behavioral data were collected on the individual assumed to be the female. The identification is possible since during the courtship behavior the males chase the female (Best et al., 2003; Kraus & Hatch, 2001). It is important to note that in the case of breeding groups, the number of males can change throughout the sighting.

Seven maneuvers were recorded (Fig. 2): (1) “Direct approach”: the vessel moves directly towards to a group of whales, (2) “Tangential”: the vessel approaches parallel and slightly behind the animal, then positioning the vessel to one side, out of the passageway; (3) “Encircling”: the vessel moves around the group, describing a semi-circle or whole circle; (4) “Chasing”, the vessel moves parallel to the group of whales, or behind it, chasing while decreasing the distance between them; (5) ‘Drift windward the group’: the vessel is positioned in a way that the wind moves it towards to a group of whales; (6 and 7) ‘Drift with the group’: the vessel is positioned in a way that drifts with the group of whales with the engines off (6) or neutral (7) without decreasing the distance between the vessel and the whales. The maneuvers 1 to 4 were classified within active approach maneuvers because they occur with the engines on. The maneuvers 5 to 7 were classified as passive approach maneuvers because they occur with the engines neutral or off (Fig. 2).

The whale reaction was categorized as: (1) “Neutral”, no visual cue of response to the approach of the vessel, whales do not change their behavior; (2) “Avoidance”, moving away from the vessel by increasing the speed or diving and disappearing; (3) “Approach”, approaching the vessel and staying motionless next to the vessel, or displaying surface activity next to it.

During each sighting data recording began once the focal individual was identified at a distance of ≤100 m to the vessel. When more than one group was present in the neighbourhood of the vessel, the closest group was chosen and a whale of this group was used as the focal animal. If a group split or joined up with another group during the sighting, the record stopped. Immediately a new sighting record was started on the closest (and recently formed) group (Magalhães et al., 2002; Stamation, Croft, Shaughnessy, Waples, & Briggs, 2010). Observations were stopped when: (1) whales showed an evasive behavior, (2) the skipper of the vessel decided to move to another group, or (3) it was time to return to the port. In order to minimize pseudo-replication, we excluded from the analysis the groups containing individuals which were suspected to have been seen on another trip of the same day.

2.5. Data analysis

To evaluate the relationship between the group type, the maneuvers and the distance between the vessel and the whale on the frequencies of the different whale reactions we used generalized linear model (GLM) with the Poisson error structure and a log-link function for categorical data (Crawley, 2013). To ensure the independence of the data, and reduce the potential effect produced by the time since the sighting began, only the first record of each sighting was used for this analysis. Statistical analysis was carried out using the software R (R Core Team, 2008). The model was constructed with four categorical explanatory variables: group type (GRP), maneuver (MNB), distance (DST) and reaction (RCT). Because the number of sightings was not enough to fit a full factorial model (GRP*MNB*DST*RCT), we start with a maximal model that has the main effects that we are interested in evaluating with the first-order interaction between the group type and the SRW reaction and second-order interaction between the maneuver, the distance and the SRW reaction (GRP*RCT + MNB*DST*RCT). This resulted in 52 candidate models, with 50 models corresponding to all possible combinations of the variables, one fully specified general model with all variables and all possible interaction between these variables (global model) and a base model without predictors (null model). The null model was useful for assessing the relative explanatory power of models containing predictors of interest. We estimated the overdispersion factor ($\hat{c}$) (Crawley, 2013) and because $\hat{c} > 1$ the standard errors were adjusted. Thus, we ranked all models according to the Akaike Information Criterion adjusted for small samples and for overdispersion (QAICc, Burnham & Anderson, 2002). Model comparisons were made with ΔQAICc that indicate the magnitude of the difference in QAICc values between each model and the best fitting model. Models with ΔQAICc ≤2 have substantial support from the data (Burnham & Anderson, 2002). Also, we estimated the QAICc weight value (w_i) that signifies the probability that model i is the best model, given the models considered.

3. Results

3.1. Whale-watching in SABMPA

SRW has been protected in Río Negro province since 2006 by provincial law No. 4066. Besides the protection of the species in the Río Negro marine jurisdiction (SMG and neighboring areas), this law also includes a regulatory framework to perform tourism related activities. Among other things, the regulation sets the beginning of the WW season in SABMPA each year in August and closes it at the end of October. In 2012 only two companies were authorized to operate departing from two different ports (San Antonio Este and Las Grutas) (Fig. 1). In 2013 other two companies were authorized to operate and a new port of departure was added (San Antonio Oeste). All companies were authorized to operate only with one vessel. Since 2014, the four companies have been departing from the same port (San Antonio Este). During the study period (2012–2016) there was an increase in the number whale-watchers (Linear regression, $r^2 = 0.73$; $p = 0.159$). A total of 603 trips and 5715 whale-watchers were reported (Table 1) with an average of 120.6 (n = 5, SD = 25.42) WW trips and 1143 (n = 5, SD = 335.26) whale-watchers pear year.

3.2. Commercial activity - encounter characteristics

Between 2012 and 2016 a total of 94 days of observation on-board were gathered. Information of 255 WW trips was collected and 725 sightings were monitored (Fig. 1, Table 1). In all in trips SRW were observed, with on average 3.09 sightings per trip (n = 725, SD = 1.73).

Out of the 363 analyzed sightings, 37.74% (n = 137) were performed on solitary animals, 36.36% (n = 132) on non-social active groups, 19.01% (n = 69) on breeding groups and 6.88% (n = 25) on mother calf pairs. The group type upon which the sighting was performed was significantly associated with the month (n = 363; X^2 test = 54.43, gl = 6, $p < 0.0001$) (Fig. 3). In August the sightings were performed on decreasing importance on solitary animals, non-social active groups, breeding groups and only occasionally on mother calf pairs. During September the pattern of sightings was similar to August but with an increase in the number of sightings on mother calf pairs. Finally, in October, the sightings were done mainly on mother calf pairs and solitary animals.

Table 1
Information about trips, passengers and sampling effort per year.

Year	2012	2013	2014	2015	2016	Total
# Trips	115	95	129	104	160	603
# Passengers	1041	797	1143	1036	1698	5715
# Trips with a research on board (% coverage)	51 (44.34%)	14 (14.74%)	98 (75.96%)	48 (30%)	44 (27.5%)	255 (42.28%)
# Days sampled	15	9	23	23	24	94
# Sightings sampled	85	37	319	149	135	725

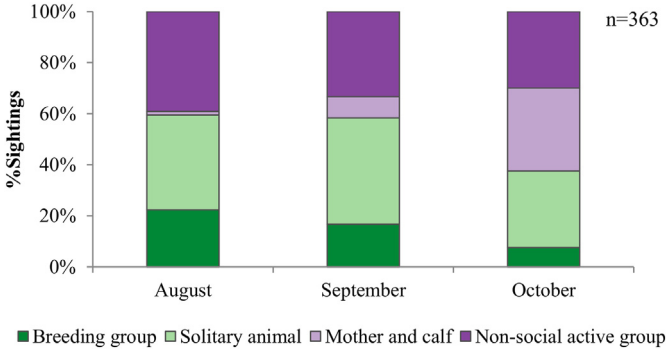

Fig. 3. Percentage of sightings, between 2014 and 2016, on different group types throughout the whale-watching season.

3.3. SRW reaction to the whale watching vessels

During a sighting more than one maneuver type can be performed, therefore the rate of occurrence of each maneuver for each distance was estimated. Six out of the seven maneuver types described herein were used (Fig. 4).

For the analysis of the whale reaction to the maneuvers, only those used at a rate > 0.03/min were included, leaving a total of 360 sightings to be analyzed (Fig. 4). Therefore, the maneuvers chasing and encircling were not included in the analysis.

The global model describing the frequencies of the different SRW reactions depended upon the group type, the maneuver and the distance was well fitted to our data. The model that best described the variation in the frequency of the different SRW reactions was the model 1 (Table 2) which explained the 82.41% of the variation. All the variables studied were important and there was significant first order interaction between them (Table 2). The best model indicates that the reaction was conditioned by the group type, the maneuver and the distance to the vessel. This model also included the relationship between the distance and the maneuver type denoting a greater use of active approach maneuvers at distant distances (Fig. 5). The presence of the interaction between the distance and the reaction in the best model pointed out that there were more neutral reactions at distant distances, both with passive and active approach maneuvers and for all group types, apart from mother calf pairs which had a similar proportion of neutral and evasive reactions (Fig. 5). At close distances, the reaction depended on the maneuver type and the group type. At this distance, there was a decrease of the neutral reaction and an increase of the approach reaction associated with passive approach maneuvers and particularly in solitary individuals and non-social active groups (Fig. 5). In the case of the breeding groups, the pattern of reactions was very different to the other groups, showing a dominance of neutral reaction for all maneuver types and at both distances.

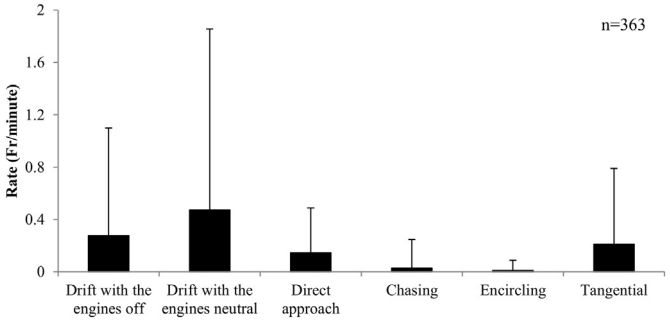

Fig. 4. Rate of types of vessel maneuvers to approach to the groups of whales, during each sighting. Each bar has its respective standard deviation.

Table 2
Summary of the model-selection results used to evaluate the effect of selected variables in the SRW reaction. The null model, the global model, and models with strong support are provided. Models are listed in decreasing order of importance.

Model	Variables	ΔQAICc	QAICc weight
1	DST GRP MNB RCC DST:MNB DST:RCC GRP:RCC MNB:RCC	–	0.737
2	DST GRP MNB RCC DST:MNB GRP:RCC MNB:RCC	2.13	0.255
Global	All variables all interactions	19.42	0.000
Null	–	235.64	0.000

DST = distance between the vessel and the whale (distant or close), GRP = group type (solitary animal, mother calf pair, breeding group, non-social active group), MNB = maneuver (direct, tangential, drift with the engine neutral, drift with the engines off), RCC = whale reaction (neutral, approach, evasive).

4. Discussion

This is the first study that evaluated the effects of tourist activities at the beginning of WW over a new area, following the development of the activity through time and space, while the main species is in the process of population recovery and expansion to other areas. The SABMPA is not yet an important WW tourist destination for SRW WW in Argentina. The number of whale watchers visiting the SABMPA each season represents < 1% of the total number of tourist that annually visit the area in summer looking for sun and beach (Secretaría de Turismo de San Antonio Oeste, unpublished results), and roughly represents 1% of the total number of whale watchers that annually visit PV during the last few years (Chalcobsky et al., 2017). However, considering the annual increase rate of this growing industry around the world (Cisneros-Montemayor et al., 2010; Hoyt, 2001; O'Connor, Campbell, Cortez, & Knowles, 2009), the potential of the area to receive tourists given the accommodation infrastructure and the proximity to PV, a growth of WW activity is expected in SABMPA for the next years.

The results of this study indicate that in SABMPA, WW on SRW mainly targets solitary animals and non-social active groups, in contrast to PV where tourism activity is mainly performed on mothers with calves (Argüelles et al., 2016). Although the proportion of sightings on mothers with calves was low, in October most of the sightings were on this group type, because at that time of the season the number of SRW in the area decreases and most of the groups that can be found in the area are mothers with calves and solitary animals (Arias et al., 2016). In the case of breeding groups, most of the sightings occur in the early and middle season. Considering that WW in SABMPA focus over the least vulnerable groups the potential impact of tourism over SRW seems low at the moment.

In this study, whale reaction to WW vessels depended on the distance to the vessel, maneuver and group type. At longer distances, most of the whale reactions were neutral regardless of the maneuvers and the group type. However, when the vessel was at closer (ie: 50 m) distance the reaction depended of the maneuver type, with more evasive reactions for active maneuvers (engines on) and more approach reactions for passive maneuvers (engines off or neutral). Therefore, the state of the engine could disturb SRW and change their reaction. Similar results for SRW were obtained by Vermeulen et al. (2012) who found that SRW only approached the vessel when it was still with the engines off at distances < 100 m, and by Argüelles et al. (2016) who found SRW approached the vessel when the engines were off and moved away from the vessel and avoided contact when the engines were on. This type of evasive reaction to WW vessels with the engine on was also observed in other species of whales as blue whales (Gendron & Busquets-Vass, 2016) and humpback whales (Stamation et al., 2010). Research on several species of cetacean, like killer whales (Erbe, 2002; Foote,

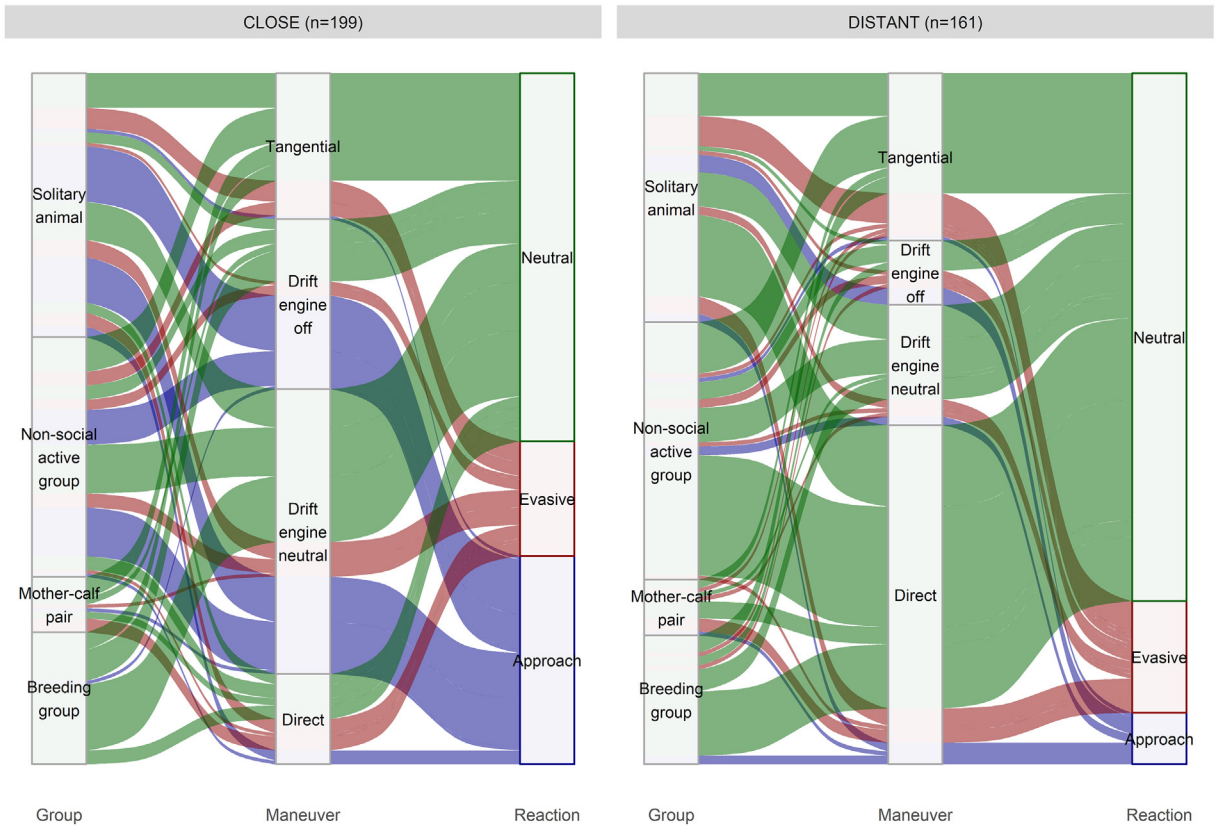

Fig. 5. Alluvial diagram (Brunson, 2017; Wickham, 2009) showing the relationships among the whale reaction of different SRW groups in relation with the maneuver of the vessel and the distance from them. The blocks represent the proportion of categories for each variable, and stream fields between the blocks represent the proportion of sightings corresponding to each category through all variables. The stream fields are color-coded according to the reaction type of the whale (green = neutral, red = evasive, blue = approach). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Osborne, & Hoelzel, 2004), belugas (Lesage, Barrette, Kingsley, & Sjare, 1999), bottlenose dolphin (Scarpaci, Bigger, Corkeron, & Nugegoda, 2000), pilot whale (Jensen et al., 2009) and humpback dolphins (Van Parijs & Corkeron, 2001) showed that engine noise could disturb acoustic behavior and obstructed effective communications among individuals.

Our study suggests that at distances of > 50 m, both passive and active approach maneuvers can be used, but at closer distances passive maneuver are appropriate to approach the whales. In SABMPA, for safety reasons, regulation prohibit to keep the engines off, but considering our results may be helpful to recommend changes on regulation, allowing to captain to decide, based on keeping the safety of passengers as a priority, to turn off the engine and use passive maneuvers.

The mother-calf pair was the group type with most evasive reaction. Similar responses were found for SRW in PV (Argüelles et al., 2016), and for other migrate whales as humpback whales, being the pods with calves more sensitive to the vessel presence than non-calf pods (Stamation et al., 2010). Particularly, in the case of the SRW, is important to consider that the lactation does not occur at a constant rate through the development of the calf during the nursing season (Thomas & Taber, 1984), therefore losing lactation opportunities because of the displacement induced by WW vessels could produce an energy investment that will not be easy to compensate at a later date (Lusseau, 2014). Therefore, considering the reactions by the mother-calf pairs and taking into account that during the time in their breeding grounds, both the mother and the calve have a great energy demand because the calves are growing and learning (Sironi, 2004) and mothers are gestating or lactating (Constantine, 2014), makes them the less appropriate group type to perform the sighting. In the case of breeding groups, they were focused on reproductive activities and usually showed a neutral reaction. This was also the most common reaction of breeding groups to the WW vessels in PV, irrespectively of the maneuver performed (Argüelles et al., 2016).

Even though the aim of this study was not to evaluate the dynamics of breeding groups in the presence of the vessel, in 53% (n = 34) of the sightings on this type of groups, whales were observed splitting or joining with another group during the sighting. However, we cannot assess whether this was due to the presence of the vessel or simply to the natural dynamic of breeding groups. Therefore, although the WW activity was not primarily performed on breeding groups and in most of the sightings the reaction of this type of group was neutral, the WW activity must be done carefully on these groups and their reaction to the presence of the tourism vessels should be further studied. Finally, solitary animals and non-social active groups were the least affected by the presence of the vessels, being the groups with more approach reaction, facilitating the sighting process over them. Therefore, the results of this study support the current regulation which dictates that the sightings should be done preferably on solitary animals, non-social active groups and to a lesser extent on breeding groups and mother calf pairs.

The results of this study allowed us to identify some differences between SABMPA and PV, in which the WW is mainly carried out on SRW in Argentina. These differences were observed in the type of groups and moment of the year of the SRW that are subject to WW. Our results have not only contributed to increase knowledge about the conservation status and ecology of the SRW in northern Patagonia in a context of population expansion and reoccupation of ancient areas and habitats, but also can be useful for the improvement of the management measures and regulations of the activity. It should be noted that the

initial regulations were made by copying regulations from other places (mainly PV). WW regulations should always be species and place specific, and it is not advisable to replicate them without considering the local reality (Coscarella, Dans, Crespo, & Pedraza, 2003). So, the aim of these studies is to make them more realistic and appropriate to local conditions.

For example, the regulations enforced during the former years (2012 to 2014) prohibited to boat skippers to perform the sightings on mother-calf pairs and breeding groups. This rule was one of the most conflictive and difficult to meet by boat operators because since earlier October to the end of the season the total number of whales in the area decreases and most of the groups that can be found are mothers with calves (Arias et al., 2016). Therefore, if operations are to continue during October the activity must be carried out on these groups. A similar situation occurs in middle August, when there is a high relative abundance of breeding groups in the area (Arias et al., 2015).

Although we consider that these groups would be the most vulnerable to the activity, our results indicate that most of the interactions occurred with solitary animals and non-social active groups. When interactions have to be performed on mother-calf pairs and breeding groups, the evasive reactions can be significantly reduced if appropriate maneuvers are performed and the sighting abandoned if evasive reactions is observed. Since recently (2015) the WW regulation was modified to allow the sighting on these types of groups under the condition of using appropriate maneuvers. Therefore, the results of this study have direct implications on the regulation of activity allowing the modification of certain rules in the regulation based on scientific studies. These studies need to be continued in the way of a monitoring program directed to detect changes in population and ecological conditions of SRW as well as in reactive behavior to vessels.

5. Conclusion

This work shows the importance of regulations being specific to each location and based on scientific studies that accompany the development of the activity from the beginning. It is necessary to consider that, in Argentina WW takes place in a dynamic system where biological changes occur rendering certain rules to be impracticable (Chalcobsky et al., 2017), especially in a population growth situation, therefore implement an adaptive management is absolutely necessary. This is the case of SABMPA, where an experimental approach and an adaptive management scheme was adopted in order to minimize the potential negative impacts of WW activities, that not only would have a detrimental impact on SRW populations but they also could threaten the sustainability of the new tourism activity itself. Continue these studies to collect a long-term data series will allow supporting decision-making related to the development of tourism and conservation of this species in a context of a population growth and reoccupation of ancient grounds.

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