Kelp gulls (*Larus dominicanus*) feeding on southern right whales (*Eubalaena australis*) at Península Valdés, Argentina: updated estimates and conservation implications

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ABSTRACT

Kelp gulls (*Larus dominicanus*) feed on the skin and blubber of southern right whales (*Eubalaena australis*) at Península Valdés, Argentina, notably affecting the whales' behavior. We have monitored the frequency of gull attacks from 1995 to 2008, and studied behavioral aspects of these interactions during the 1999 - 2001 right whale calving seasons. Gulls did not direct their attacks evenly among all whale age classes. Mother-calf pairs received 81% of the attacks and were attacked five times more often than juvenile whales. Juveniles spent over half of their time alone, and they received most of the gull attacks while they were solitary. However, the attack rate per hour was highest (5.2) when juveniles interacted with mother-calf pairs and lowest (0.7) when they were with adults. The attack frequency has continued to escalate since it was originally studied in 1984 (Thomas 1988) and 1995 (Rowntree *et al*. 1998). In 1995, 12% of 5-min intervals collected during focal follows of mother-calf pairs contained attacks at two study sites, compared to 26% in Golfo San José and 25% in Golfo Nuevo in 2008. The proportion of whales with gull marks between 1974 and 2008 increased steadily from 1% of whales in 1974 to 37.8% in 1990, 67.6% in 2000, and 76.8% in 2008. Adult whales have learned to reduce the likelihood of being attacked by gulls by changing their resting posture at the surface, arching their backs to keep them underwater. The local gull population has grown since the 1970's possibly as a consequence of the refuse available from fishing boats operating at sea and at fishery and urban landfills. In 2005, 2007 and 2008 unusually high right whale calf mortalities were recorded at Península Valdés. It has been suggested that gull inflicted wounds could reduce calf survivorship. We provide recommendations for the management of the gull population to reduce the negative effects of gull harrassment on right whale behavior and to reduce the potential impact of gull attacks on calf health. We present a brief account of the three workshops held to analyze this conservation and management problem in Argentina.

KEY WORDS: BEHAVIOR SHORT-TERM CHANGE; CONSERVATION; ENERGETICS; KELP GULL; SOUTH AMERICA; SOUTHERN RIGHT WHALE; SURVIVORSHIP; PARASITES

INTRODUCTION

Kelp gulls (*Larus dominicanus*) at Península Valdés, Chubut Province, Argentina eat the living skin and blubber of southern right whales (*Eubalaena australis*) (Thomas 1988). The attacks of gulls affect the behavior of whales, whose response is to immediately arch their backs and then submerge or swim away rapidly underwater (Rowntree *et al*. 1998). This flight behavior may increase the whales' energy expenditure, during a critical period when cows are fasting, calves are growing and could potentially raise calf mortality (Rowntree *et al*. 1998). The parasitic behavior of kelp gulls on whales has not been observed in any other location, with the exception of two isolated instances recorded off the coast of Brazil (Groch 2001).

In the early 1970s, Cummings *et al*. (1972) reported that kelp gulls and brown-hooded gulls (*L. maculipennis*) landed on the backs of right whales at Península Valdés and pecked at their backs, possibly to feed on parasites. At that time, brown-hooded gulls took strips of peeling skin from the whales, but apparently the gulls did not feed on the whales' flesh (Rowntree *et al*. 1998). In 1984, Thomas (1988) saw kelp gulls actively eating peeling skin and the dermal and subdermal layers of mother right whales mostly in one bay at Península Valdés. In 1995, Rowntree *et al*. (1998) recorded gull attacks on whales of all age classes in at least three aggregation areas at the Península. Compared to undisturbed whales, mothers with calves under gull-induced disturbance spent about one-quarter of their day fleeing from gull attacks, and thus significantly increased the time they spent traveling at medium to fast speeds (Rowntree *et al*., 1998). At present, the parasitic behavior of gulls has become widespread on the Valdés nursery ground.

Gull attacks also affect the behavior of juvenile whales. Juveniles at Valdés spend one-fifth of their daylight hours resting at the surface and almost one-half of their time interacting with other whales (Sironi 2004). Resting behavior and social interactions are interrupted by the attacks, potentially affecting the social development of juvenile right whales.

In many regions gulls are considered a "problem species" due to the negative impact they have on other bird and mammal species (Yorio *et al*. 1998), water resources for human consumption (Dept. Environmental Protection 1998a), buildings and vehicles (Dwyer *et al*. 1996), and aircraft safety (Dolbeer *et al*. 1993). Gulls have varied and flexible foraging strategies (Pierotti and Annett 1990, Yorio *et al*. 1998, Bertellotti and Yorio 2000). Gull population expansion has been linked to the use of artificial food sources at waste disposal sites in France (Pons 1992) and in South Africa (Steele and Hockey 1990). Kelp gulls are the most abundant bird species feeding at urban and fishery waste landfills in northern Patagonia (Yorio and Giaccardi 2002). Most kelp gull colonies in Patagonia have increased in size between the late 1970's and mid-1990's (Bertellotti *et al*. 1995, 2001, Yorio *et al*. 1998). Of the estimated 83,000 pairs that breed in 115 colonies along the Argentine coast, 69,000 breed on the coast of Chubut Province (García Borboroglu, in III Workshop on Right Whale – Kelp Gull Interactions 2008). It is possible that the availability of abundant fishery refuse has enhanced the survival, breeding success and population growth of kelp gulls in the area (Bertellotti *et al*. 2001, Giaccardi and Yorio 2004).

In this paper we present frequencies of kelp gull attacks on southern right whales at Península Valdés for the period 1995-2008. We compare these frequencies among whale age classes and provide information on the temporal distributions of whales, gulls and gull-whale interactions throughout the right whale calving season for the 1999-2001 period. We discuss the interrelationship between whales, gulls, fishery and urban waste and landfills. We summarize the outcomes of three local workshops held to discuss this management and conservation problem, suggest possible management measures to reduce the frequency of the interactions and analyze the socio-economic implications of this conservation problem that is affecting Argentina's coastal wildlife.

MATERIALS AND METHODS

The interactions between kelp gulls and right whales reported here were studied during the months of right whale peak abundance at Península Valdés (Aug to Nov) between 1999 and 2001. When Rowntree *et al*. (1998) studied the interactions in 1995, they concentrated their observation effort (79%) on mother-calf pairs. Because the present study was part of a larger research project on the behavior of juvenile right whales our observations were focused on juveniles, but data on abundance of all whale age classes at the study site were also gathered. These data were collected from an Observation Hut located on a cliff top overlooking the ocean at 45m above sea level in Golfo San José (42°25'S, 64°9'W).

The methodology described by Rowntree *et al*. (1998) was used to estimate the frequency of gull attacks on juvenile whales. We used a 20X wide-angle spotting scope to visually follow individual whales and observe whether they were attacked by gulls. We defined a "gull attack" as any event during which the bill of a kelp gull contacted the body of right whales, most notably the portion of their back that is exposed to the air when the whales are at the surface. An "attack episode" was a sequence of attacks (or one isolated attack) that occurred within 5 min of the first attack (Thomas 1988, Rowntree *et al*. 1998).

Continuous focal animal follows (Altmann 1974) of juvenile whales were divided into 5-min intervals (Rowntree *et al*. 1998). The occurrence of gull attacks was recorded using one-zero sampling (Altmann 1974, Martin and Bateson 1993). When an attack occurred, the corresponding 5-min interval during the follow was scored as 1; intervals that had no attacks were scored as 0. The percentage of intervals scored as 1 over the total number of intervals provided an estimation of the frequency of gull attacks (Rowntree *et al*. 1998) on right whales during follows. Using this methodology, we have monitored gull attack frequency at the Observation Hut in Golfo San José every year between 1995 (Rowntree *et al*. 1998) and 2008 and at La Adela-Punta Pirámide in Golfo Nuevo in 1995 and 2005-2008.

Right whales at Península Valdés have lesions on their backs that are likely caused and enlarged by repeated attacks of kelp gulls (Thomas 1988, Rowntree *et al*. 1998). The lesions are visible on photographs because they are mostly white (from the exposed blubber) and surrounded by black skin. We analyzed photographs of right whales taken during aerial identification surveys (Whale Conservation Institute / Instituto de Conservación de Ballenas data) in 1974, 1990, 2000 and 2008 to calculate the percentage of whales with lesions for those years. We determined whether the backs of individually photoidentified whales could be seen well enough to tell whether they had lesions, and of those whales we calculated the percentage of whales with lesions. During follows, we recorded whether attacks were aimed at the lesions or at smooth skin. The age class of the attacking gulls was determined by plumage and the percentage of adult *vs*. juvenile gulls was calculated.

Focal right whale juveniles were considered to be "social" when there were one or more "secondary" whales within a five whale-length (WL) radius from the focal subjects; otherwise, they were considered to be "solitary" (Sironi 2004). Secondary whales were classified into four age classes: mother-calf pairs, adults, juveniles and whales of indeterminate age. The proportion of time juveniles were solitary or socializing with each age class was calculated from

focal follows. We counted the number of times juveniles were attacked under the different social contexts and calculated the rate of attack per hour spent alone or socializing with each class during the follows that contained attacks.

The 3.8 km-long and 2 km-wide strip of coast of the observation area was scanned every hour to count the number of whales and gulls present using instantaneous scan sampling (Altmann 1974). During the scan the whales' age class, behavior, sociability, and whether or not they were attacked by gulls were recorded. Behavior was divided into four categories: surface active (behavior patterns causing white water, such as rolling, flipper and tail slapping, breaching), travel (locomotion that resulted in a change of location), rest (motionless at the surface), and underwater (when whales were submerged and their behavior could not be recorded) (Sironi 2004).

Attacks on cows and calves during scans were recorded as occurring "on the pair" and not on the individual member of the pair. As a consequence, mother-calf pairs were counted as one "whale unit" (and not as two individual whales) for the purposes of calculating the percentage of attacks that were aimed at all whale age classes. We counted kelp gulls at roosting sites on the beach and on mussel beds during the low tide to estimate the number of gulls that could potentially attack the whales. Because we did not count the gulls flying or floating on the water during scans, our counts underestimated the true number of gulls present at the study site. To analyze the seasonal trends of the gull-whale interactions, we divided the study period into 12 ten-day intervals and calculated the mean number of whales, gulls and attacks per scan for each 10-day interval.

RESULTS

Focal follows of juveniles and scans were collected during nine months in three field seasons (1999-2001), and gull attack frequencies on mother-calf pairs were obtained for the period 1995-2008 (except 2001). Between 1999 and 2001 we observed 154 juvenile right whales during 238 h of focal follows totalling 2,855 5-min intervals. During these follows, we observed 187 gull attacks in 126 episodes. During 1,077 hourly scans we counted 69,713 gulls (x = 64.7 gulls per scan, SD = 53.1, range = 0 – 340) and observed 652 gull attacks on 10,331 whales (including resightings) of all age classes (x = 9.3 whales per scan, SD = 3.8, range = 0 - 37).

Mother-calf pairs (considered as a unit) represented 41.2 % (3,013 pairs or 6,026 whales) of all whales counted in the scans, followed by adults (24.7 % or 1,807 whales), juveniles (22.6 % or 1,651 whales) and whales whose age could not be determined (11.6% or 847 whales). Gulls did not aim their attacks evenly among all whale age classes (Fig. 1). If we assumed that gulls attack whales of all age classes evenly, then we would expect to observe 41.2 % of attacks on mother-calf pairs, 24.7 % on adults and 22.6 % on juveniles. However, mother-calf pairs were attacked twice more frequently than expected. The majority of attacks (80.8 %) were aimed at mother-calf pairs, followed by 8.9 % of attacks aimed at juveniles, 8.4 % at adults, and 1.8 % at whales of indeterminate age (juveniles or adults). The observed distribution of gull attacks per whale age class was significantly different from the expected based on the age class distribution of whales ($\chi^2 = 426.2$, df = 3, $P < 0.001$) (Fig. 1).

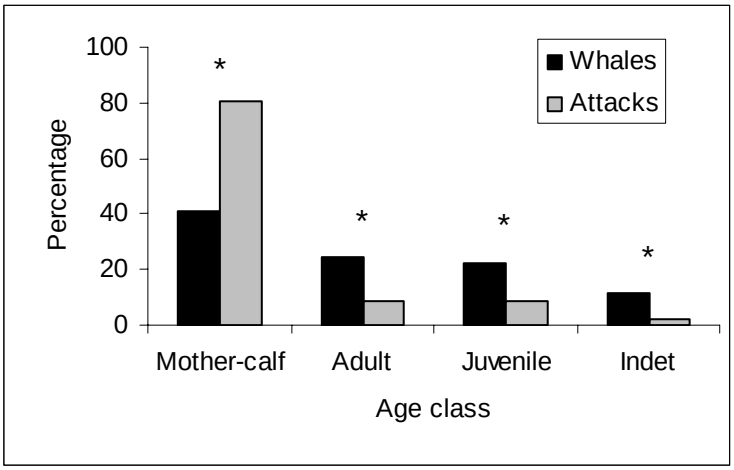


Figure 1. Age class distribution of right whales at the study site and percentage of gull attacks aimed at each age class. The two distributions are significantly different ($\chi^2 = 426.2$, df = 3, $P < 0.001$).

Gull attack frequencies at Península Valdés have been estimated primarily on right whale mother-calf pairs since the study of Rowntree *et al*. (1998) in 1995. Because the majority of our continuous follows focused on juveniles, we could not compare gull attack frequencies on juveniles directly to those obtained for mothers and calves. However, we used the gull attack frequency obtained during follows of juveniles to estimate the frequency on mother-calf pairs based on the distribution of attacks among all age classes obtained during scans from 1999 to 2001.

During scans, we observed 0.035 attack per juvenile whale (or 58 attacks on 1,651 juveniles) and 0.175 attack per MC pair (or 527 attacks on 3,013 pairs). This indicates that individual mother-calf pairs experienced gull attacks five times more frequently than individual juveniles. During focal follows, gull attacks on juveniles occurred in 5.2% (148) of all 5-min intervals over the three year period (2.5% of intervals in 1999, 7.4% in 2000 and 6.3% in 2001). Based on the 5-fold difference in the number of attacks observed on individual mother-calf pairs and juveniles during scans, we estimated that mother-calf pairs would have been attacked on 26% of 5-min intervals during follows in the same period (12.3% in 1999, 37.1% in 2000 and 31.6% in 2001). For comparison, gull attacks occurred in 42 % of 81 intervals in 2000, in 33 % of 224 intervals in 2002 and in 26 % of 763 intervals in 2008 when we monitored the attack frequency on mother-calf pairs in Golfo San José (Fig. 2). In Golfo Nuevo, attack frequency was 12 % in 1995 and increased to an average of 26 % for the period 2005-2008 (Fig. 2).

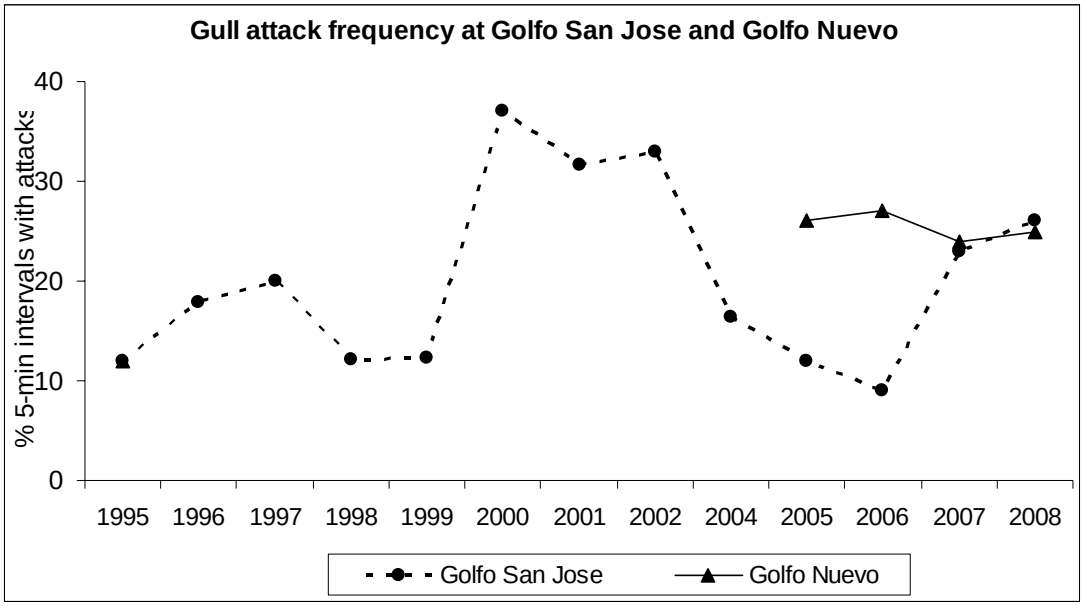
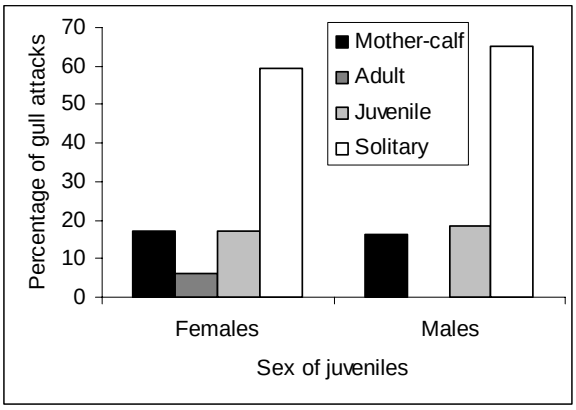


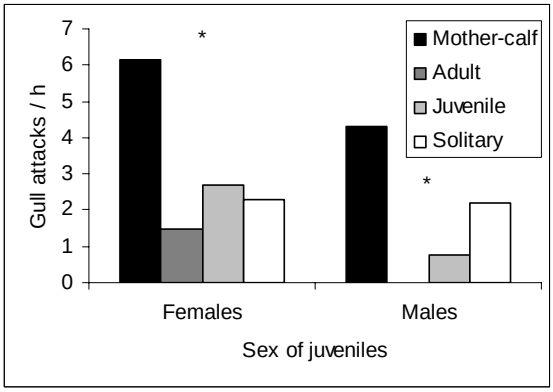
Figure 2. Annual percentage of 5-min intervals with gull attacks during focal follows of right whales in Golfo San José and Golfo Nuevo. 1995: from Rowntree *et al.* (1998). 1996-1998 and 2002-2008: several observers. 1999-2001: based on extrapolations from this paper (see text for explanation).

Similarly, we used the number of attack episodes per hour of observation of juveniles to estimate the number of attack episodes per hour for mother-calf pairs. The attack episode rate per hour for juveniles was 0.53 for the three-year period (126 episodes in 238 h). We estimated mother-calf pairs experienced 2.65 attack episodes per hour during the same three-year period.

A total of 142 attacks were observed during 42.7 h and 21.7 h of focal follows of juvenile females and males, respectively. During these follows, females and males spent most of their time alone (56% and 61%, respectively), and during the remaining time they socialized with whales of all age classes. Female juveniles spent most of their socializing time with mother-calf pairs (57.2%) followed by juveniles (25.7%) and adults (17.1%). Juvenile males spent most of their socializing time with other juveniles (63.6%) followed by mother-calf pairs (31.3%) and adults (5.1%). Because juveniles spent most of the time alone, most attacks occurred while they were solitary (Fig. 3a). However, during these follows the attack rate *per hour* was highest (5.2 attacks/h) when juveniles interacted with mother-calf pairs and lowest (0.7 attacks/h) when juveniles were in groups containing adults (Fig. 3b). The attack rate during the four social conditions (*i.e.*, solitary or social with mother-calf pairs, adults or juveniles) was significantly different for females (χ^2 = 8.28, df = 3, P = 0.041) and for males (χ^2 = 12.4, df = 3, P = 0.006).



(a)



(b)

Figure 3. Percentage of gull attacks (a) and gull attack rate per hour (b) on juvenile females and males during their social interactions and solitary time. The attack rate per hour was significantly different from an even distribution for females ($\chi^2 = 8.28$, df = 3, P = 0.041) and for males ($\chi^2 = 12.4$, df = 3, P = 0.006).

We could determine where the gulls' bill contacted the body of right whales in 115 attacks. Gulls aimed 90.4% of the attacks at the existing lesions on the whales' backs and the remaining 9.6% at apparently smooth skin. The percentage of whales with lesions increased from 1% in 1974 (Rowntree *et al*. 1998) to 37.8% in 1990 to 67.6% in 2000 to 76.8% in 2008 (Whale Conservation Institute / Instituto de Conservación de Ballenas data) (Fig. 4). Most gulls (80.2%) that fed on the whales were adults and the remaining (19.8%) were juveniles.

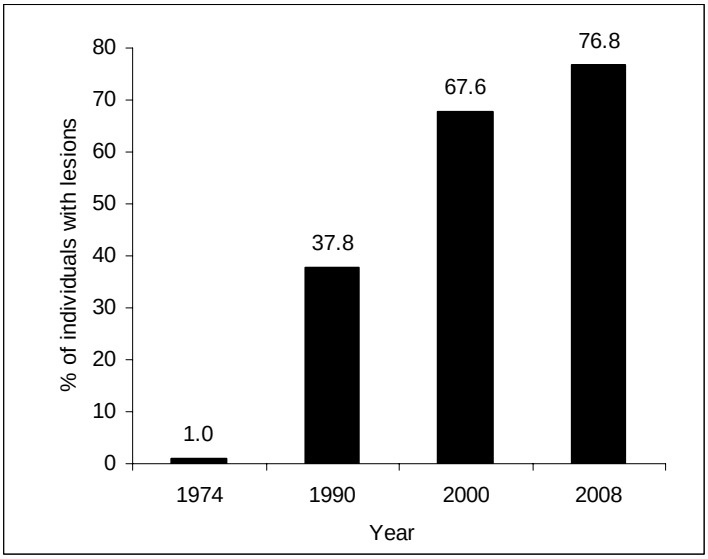


Figure 4. Prevalence of gull lesions on right whales at Península Valdés for the period 1974-2008

The number of whales, gulls and their interactions varied throughout the season (Fig. 5). The average number of right whales and gulls per scan was highest (12.8 and 114.8, respectively) between Sep 25 and Oct 4 in the three years of the study. However, there was no significant correlation between the number of whales and gulls at the study site throughout the 12 ten-day intervals of the season (Pearson correlation = 0.35, N = 12, P > 0.05) (Fig. 5a). The correlation was also non-significant when only mother-calf pairs were considered (Pearson correlation, r = -0.17, N = 12, P > 0.05). A small proportion of the gulls that were visible at any one time were involved in the attacks (Fig. 5b). However, the abundance of gulls was positively correlated with the number of attacks observed during scans (Pearson correlation, r = 0.77, N = 12, P = 0.003) (Fig. 5b) and negatively correlated with the percentage of gulls attacking whales over the total gulls counted (Pearson correlation, r = -0.74, N = 12, P = 0.006) (Fig. 5c). After Oct 4, the number of whales decreased gradually while the number of gulls plummeted and the percentage of gulls involved in the attacks increased (Fig. 5a,c).

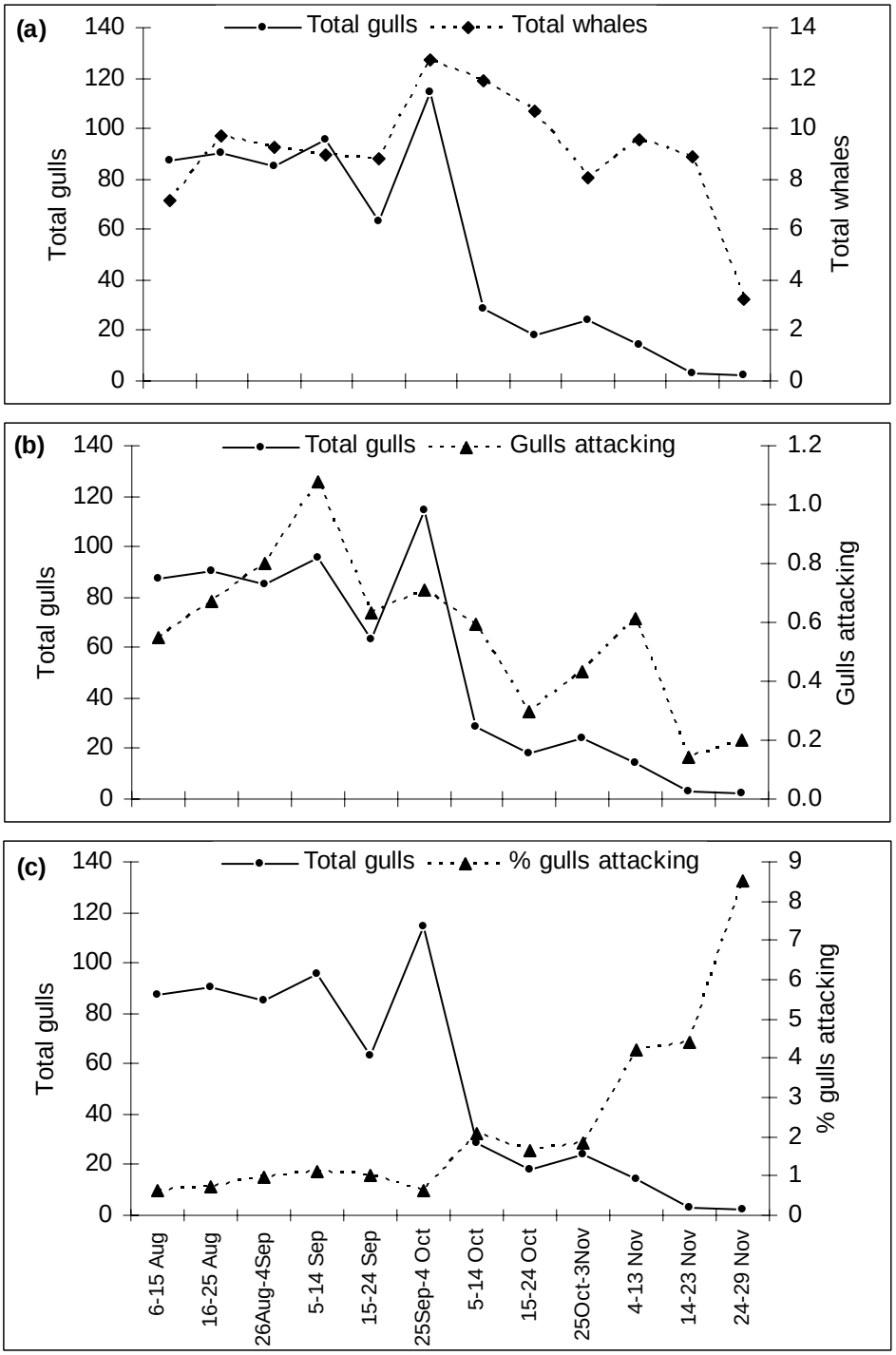


Figure 5. Correlation between the mean number of gulls and (a) whales (r = -0.17, N = 12, P > 0.05), (b) gulls attacking (r = 0.77, N = 12, P = 0.003), and (c) percentage of gulls attacking whales (r = -0.74, N = 12, P = 0.006) per scan per 10-day interval.

DISCUSSION

Because the attacks occur at a time when right whale mothers are fasting and calves are growing, Rowntree *et al.* (1998) suggested that intense gull harassment could compromise calf survivorship in the Península Valdés population. Our observations confimed that the majority of gull attacks were aimed at mothers with calves. This preference for mother-calf pairs could result from: calves swimming slowly and surfacing more often to breathe and thus, spending more time at the surface where they are more exposed to the attacks; calves may have softer skin than adults; mothers and calves

tend to swim closer to shore than other age classes (Payne 1986) and so they are the first whales that gulls encounter when they fly from shore to feed on the whales; and finally the larger "patch size" represented by the two whales in mother-calf pairs may be more attractive for the gulls than solitary whales. A combination of these factors may explain the higher frequency of attacks on mother-calf pairs than on other whale age classes.

Also, adult whales have developed postures to keep their backs underwater when they are at the surface: they rest with their head and tail above the surface and their back arched underwater (the "Galleon" position) to keep it away from the attacks of gulls (Rowntree *et al.* 1998), a behavior that is not observed among newborn calves. This arched resting posture was observed in 1995 for the first time and is now widespread in the population. However, as reported in this paper, the percentage of whales with gull marks has continued to increase since the 1990's.

Mother-calf pairs return to pre-attack behavior after 30 to 60 min following an attack, spending 24% of their daylight hours under states of gull-induced disturbance (Rowntree *et al*. 1998). Assuming that juvenile whales experience a similar recovery time, then we speculate that juvenile right whales spend 4.8% of their daylight hours under gull disturbance. This suggests that the impact of gull attacks may be less severe on juvenile whales than on mothers and their calves.

However, gull attacks may affect social interactions that are important for the normal development of juvenile whales. For instance, on one occasion a juvenile female approached and interacted with five different mother-calf pairs over the course of 70 min. Three of the five interactions stopped after kelp gulls attacked the groups and the juvenile female subsequently left the cows and calves. The rate of harassment on juvenile females was almost three times higher when they interacted with mother-calf pairs than when they were alone. If juvenile females spend less time with mother-calf pairs and more time alone to seek relief from gull harassment, then the time juvenile females have available at Valdés for potentially learning important behavior such as maternal care (Sironi 2004) will be reduced. This may affect their future maternal skills.

The intensity and high frequency of kelp gull attacks on southern right whales are unique to Península Valdés (Rowntree *et al*. 1998, Groch 2001). The updated estimates presented in this study indicate that the attack frequency continues to escalate with time. Based on our estimation of attack episodes per hour on mother-calf pairs, the incidence of attacks for the period 1999-2001 was 11 times higher than in 1984 (Thomas 1988) and 2.3 times higher than in 1995 (Rowntree *et al*. 1998). In 1995, 12% of 5-min intervals obtained on mother-calf pairs in Golfo San José contained attacks, compared to an estimated 26% for 1999-2001 and 26% in 2008. A similar trend is observed in Golfo Nuevo. The increase in gull attack frequency may be a consequence of the growth of local kelp gull colonies during the same period, and also of the ability of gulls to imitate and quickly learn new behaviors.

Gull attack data were collected from mid-September through late November in 1999 and from early August through late October in 2000. As shown in Fig. 5, the number of gulls present at the study site during most of the sampling period in 1999 is notably lower than in 2000. This may explain the difference in gull attack frequency between the two years.

During an examination of 9 right whale carcasses on the shores of Península Valdés in 2007, McLellan *et al*. (2007) observed that all the animals with visible backs showed gull peck craters. It is likely that those lying on their backs also had these lesions. Scars from gull attacks are commonly found on the backs of dead whales at Península Valdés. Necropsies and histopathology from calves sampled in 2007 showed that bleeding and inflammation under gull-peck lesions extended through the blubber layer and possibly could have led to systemic infections in some cases, as was suspected in a few cases from previous years (McLellan *et al*. 2007) (Uhart *et al*. 2008).

Of the estimated 83,000 pairs that breed in 115 colonies along the Argentine coast, 69,000 breed on the coast of Chubut Province (García Borboroglu, in III Workshop on Right Whale – Kelp Gull Interactions 2008). Most of the colonies whose sizes has been monitored expanded during the 1980's and 1990's at rates of 6.4 to 58% annually, including the colonies at Península Valdés (Bertellotti 1998, Yorio *et al*. 1998). The population growth of the largest breeding colony at Valdés (Isla de los Pájaros) has been attributed to the kelp gulls regularly foraging on fish and urban waste at nearby local landfills, which probably enhances gull survival during the winter and increases life-span and breeding performance (Annett and Pierotti 1999, Bertellotti *et al*. 2001).

A combination of factors may explain the increase in gull attack frequency. There are enough alternative food sources for the gulls in northern Patagonia other than whale skin and blubber. The gull colony at Isla de los Pájaros is surrounded by relatively rich intertidal areas with abundant invertebrates that are part of the natural diet of kelp gulls at other locations (Bertellotti *et al*. 2001). The fish refuse discarded at sea by fisheries in Golfo San Matías (adjacent to Península Valdés) could potentially support over 30,000 gulls; however, less than 8,500 kelp gull pairs breed there (Bertellotti and Yorio 2000). Therefore, there must be nutritive benefits for the gulls that prefer whale skin and blubber over other foods. Over 90% of the attacks observed were aimed at the open wounds on the whales' backs, suggesting that the gulls may prefer the blubber over the skin. The fact that juvenile gulls also feed on the whales indicates that they are able to learn this behavior at an early age. Imitation and learning contribute to spread the attack behavior in the gull population.

Conservation implications

Right whales are the main tourist attraction in Península Valdés. The number of whale watching tourists increased 548% from 17,446 in 1991 to 113,148 in 2007 (Sironi *et al*. 2009). In 2006, whalewatching in Puerto Pirámides generated total revenues of over U$D 42.6 million (Hoyt and Iñíguez 2008). The disturbing sight of right whales arching violently and swimming away after kelp gulls have pecked on their backs to feed has become very common at Valdés. There is substantial popular support for the whales in Argentina and as a consequence, the pressure from the general public and whale-watch tour operators to reduce the levels of gull harassment on the whales is high.

Three workshops were held in Puerto Madryn, Chubut Province in 2002, 2004 and 2008 to analyze this conservation and management problem. Participants included whale and gull researchers, whalewatch company owners, guides, NGOs, government officials, managers and other interested parties. In the first meeting, whale and gull researchers described the state of knowledge of the interactions between the two species, their effects on right whales, and explored potential solutions to reduce the frequency of the interactions (I Workshop on Right Whale – Kelp Gull Interactions 2002). A major concern was the fact that it was not known if all the gulls feed on the whales infrequently or if there are specialists that feed on them frequently.

Our results appear to support the specialist hypothesis. The reduction in the number of gulls at the study site after October 4 is likely the result of nest attendance at the gulls' breeding colonies (Giaccardi and Yorio 2004). The dramatic increase in the percentage of gulls involved in the attacks following the decrease in gull numbers after October 4 suggests that potential specialists remain in the area longer and continue to feed on the whales before they leave for their nesting colonies to breed. Some gulls that feed on the whales may also leave the area in early October following the movement of most individuals. This would explain the decrease in the absolute number of gulls involved in the attacks after October 4.

The specialist hypothesis is also supported by the fact that very few of the gulls that are in one area attack the whales at any one time (Thomas 1988, Rowntree *et al*. 1998, Bertellotti in III Workshop on Right Whale – Kelp Gull Interactions 2008; this paper). We counted nine whales and 65 gulls on average in each scan. However, we rarely observed two or more whales under attack simultaneously, suggesting that the relative abundance of whales is not a limiting factor for the attack behavior of gulls to occur. In contrast, virtually all gulls present were seen feeding at the intertidal areas during low tide. Rowntree *et al*. (1998) found that gull attacks were relatively less frequent at low and rising tides. Nearly 20 % of the attacking gulls were juveniles, indicating that the gulls have the ability to learn this behavior early in their lives and relatively rapidly. If the parasitic behavior began in the 1970's, then it could be argued that enough time has passed for most or all gulls in the population to have learned the behavior. Yet, few gulls display it at any one time. The percentage of adult *vs*. juvenile gulls that show the attack behavior reflects the age structure of the overall gull population (Bertellotti and Yorio 2000). Obtaining conclusive data to support or reject the specialist hypothesis was identified by the workshop as very relevant to determining an effective management strategy to reduce gull attack frequency.

In the second workshop, a plan to minimize the interactions and a schedule with short-, mid- and long-term actions was created (II Workshop on Right Whale – Kelp Gull Interactions 2004). The Secretary of the *Administración del Área Natural Protegida Península Valdés* was appointed to monitor the plan.

The following actions were proposed:

- To optimize fish and urban waste management practices to reduce the food available to the gulls. This included a review of waste management regulations, the reduction in the time the waste is exposed and available to the gulls (e.g. by covering them) and the reduction of the area covered by landfills.
- To report the conclusions of this meeting to the National Fishery Council, stressing the importance of reducing fish waste produced by fish by-catch at sea.
- Continue on-going and the development of new research projects that could help to minimize the interactions between gulls and whales. The projects should (a) continue to monitor the gull and whale populations, (b) determine if there are specialist gulls that feed on whales and (c) if so, evaluate the possibility of managing these individuals to minimize the interaction.
- To create a working group to design a communication strategy based on scientific data to inform the community.

The aim of the third workshop was to report the progress of the studies proposed in the 2nd workshop, and suggest new actions to reduce the frequency of gull attacks (III Workshop on Right Whale – Kelp Gull Interactions 2008). Between the second and third workshops progress was made in relation to sanitation and garbage landfill management within the Península Valdés Protected Area. The open-air landfill in Puerto Pirámides was closed and a system of waste collection and removal from the area was begun (Arranz, in III Workshop on Right Whale – Kelp Gull Interactions 2008). A larger project to close all open-air landfills in the cities around Península Valdés (Puerto Madryn, Rawson, Trelew, 28 de Julio and Gaiman) was announced and it is in its initial phase at present (Maruchak, III Workshop on Right Whale – Kelp Gull Interactions 2008). The main conclusion from the study to test the specialist hypothesis that involved artificially marking gulls was that only a small fraction of the gull population displays the

attack behavior, and when individual gulls attack, they do so only sporadically (Bertellotti, in III Workshop on Right Whale – Kelp Gull Interactions 2008). These observations reinforce the results presented in this paper.

The following conclusions were presented:

- Although it is not known to what extent gull attacks can impact the conservation of whales, they affect the welfare and health of the animals with a potential sanitary impact (transmission of pathogens to other species including humans). Also, there is a visual impact for the visitors that affects the quality of the whalewatching experience at Península Valdés.
- Human intervention is necessary to reduce the frequency of attacks. This intervention has begun by closing landfills to reduce the food available to gulls. More lobbying at the National Fishery Council and fishery companies is necessary to improve fish waste management practices.
- Provincial authorities would be willing to promote management experiments maximizing precautions to ensure the viability of the project. Experiments should include the culling of gulls that feed on the whales with the main objective of reducing the frequency of attacks. A working group should prepare a research proposal for a project to be conducted during the 2009 right whale nursery season.

Management recommendations

Managing the problem of right whale – kelp gull interactions at Península Valdés is challenging for several reasons. Both species are native to Patagonia, most interactions occur within a protected natural area where right whales are the main tourist attraction, there is a strong public pressure to solve the problem, and there is an important economic component associated with whalewatching, the local fishery industry and the management of urban and fishery landfills by the government.

In 1998 the International Whaling Commission held a Workshop in South Africa to assess the worldwide status of right whales (IWC 2001). Among the factors potentially affecting the recovery of right whales, the workshop recognized that "kelp gull harassment of right whales off Península Valdés, Argentina (Rowntree *et al*. 1998) has grown substantially worse in parallel with increasing areas of open waste disposal sites and a concomitant growth in gull populations. Avoidance reactions of the whales significantly impact their behavior and perhaps their distribution. The workshop recommends that these disposal sites be aggressively regulated" (IWC 2001).

The main recommendations from the three Workshops held in Puerto Madryn include:

- Reducing the food available to gulls by improving waste management practices at landfills (covering the fish refuse, recycling, incineration) and reducing fishery discard offshore (Yorio *et al*. 1998, Giaccardi and Yorio 2004). Participants recognized that a reduction in the available food from fisheries could induce more gulls to feed on whales at least temporarily.
- Gull culling. The removal of specialist gulls could reduce the frequency of the interactions. This should be accompanied by a research project that monitors the effect of gull culling on the attack frequency.
- Gull dispersion methods at landfills (habitat alteration, propane cannons, gull distress calls, trained dogs, pyrothecnics) (Dept. Environmental Protection 1998b) should be explored. Kelp gulls at the urban landfill in Puerto Madryn appear to be dispersed by human and dog presence and by frequent fires set to burn waste (Giaccardi and Yorio 2004).
- Research to monitor the frequency of whale – gull interactions and the population dynamics of both species should be supported and continued. Monitoring the interactions should be done around the same dates each year (preferably during the peak concentration of right whales in September) to avoid biases due to seasonal variations.

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LITERATURE CITED

I Workshop on Right Whale – Kelp Gull Interactions at Península Valdés. 2002. Puerto Madryn, Argentina. EcoCentro / Fundación Patagonia Natural / Instituto de Conservación de Ballenas. 16 pp. Available from: icb@icb.org.ar

II Workshop on Right Whale – Kelp Gull Interactions at Península Valdés. 2004. Puerto Madryn, Argentina. EcoCentro / Fundación Patagonia Natural / Instituto de Conservación de Ballenas. 19 pp. Available from: icb@icb.org.ar

III Workshop on Right Whale – Kelp Gull Interactions at Península Valdés. 2008. Puerto Madryn, Argentina. 10 pp.

Altmann, J. 1974. Observational study of behaviour: sampling methods. Behaviour, 49, 337-367.

Annett, C. and R. Pierotti. 1999. Long-term reproductive output in western gulls: consequences of alternate tactics in diet choice. Ecology 80:288-297.

Bertellotti, M. 1998. Dieta y estrategias de alimentación de poblaciones en expansión de la gaviota cocinera (*Larus dominicanus*). Ph.D. Thesis. Universidad Nacional de la Patagonia, Puerto Madryn, Argentina.

Bertellotti, M., Carribero, A. and P. Yorio. 1995. Aves marinas y costeras coloniales de la Península Valdés: revisión histórica y estado actual de sus poblaciones. Boletín Técnico No. 1. Plan de Manejo Integrado de la Zona Costera Patagónica. Fundación Patagonia Natural. Puerto Madryn, Argentina. 21pp.

Bertellotti, M. and P. Yorio. 2000. Utilisation of fishery waste by Kelp Gulls attending coastal trawl and longline vessels in northern Patagonia, Argentina. Ornis Fernica 77:105-115.

Bertellotti, M., Yorio, P., Blanco, G. and M. Giaccardi. 2001. Use of tips by nesting kelp gulls at a growing colony in Patagonia. Journal of Field Ornithology 72:338-348.

Cummings, W.C., J.F. Fish, and P.O. Thompson. 1972. Sound production and other behavior of southern right whales, *Eubalaena australis*. Transactions of the San Diego Society of Natural History 17:1-14.

Department of Environmental Protection. 1998a. Gull control at landfills and other solid waste management facilities. Commonwealth of Massachussetts, Policy #BWP-98-003. 12pp.

Department of Environmental Protection. 1998b. Manual for gull control at Massachusetts landfills. Commonwealth of Massachussetts. 14pp.

Dolbeer, R.A., Belant, J.L. and J.L. Sillings. 1993. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport. Wildlife Society Bulletin 21:442-450.

Dwyer, C.P., Belant, J.L. and R.A. Dolbeer. 1996. Distribution and abundance of roof-nesting gulls in the Great Lakes of the United States. Ohio Journal of Science 96:9-12

Giaccardi, M. and Yorio, P. 2004. Temporal patterns of abundance and waste use by Kelp Gulls at a urban and fishery waste tip in northern coastal Patagonia, Argentina. Ornitología Neotropical 15: 93-102.

Groch, K.R. 2001. Cases of harassment by kelp gulls (*Larus dominicanus*) on right whales (*Eubalaena australis*) of Southern Brazil. Biotemas 14: 147-156.

Hoyt, E. and Iñíguez, M. 2008. Estado del avistamiento de cetáceos en América Latina. WDCS, Chippenham, UK; IFAW, East Falmouth, USA, and Global Ocean, London. 60pp.

International Whaling Commission (IWC). 2001. Report of the Workshop on the Comprehensive Assessment of Right Whales: A Worldwide Comparison. Journal of Cetacean Research and Management (Special Issue)1:1-60.

Martin, P. & P. Bateson. 1993. Measuring behaviour. 2nd edn. Cambridge. 222 pp.

McLellan, W. A., Moore, M. J. and Touhey, K. M. 2007. Patagonian Southern Right Whale Mortality Investigation. Report on the Collaborative Investigation of Southern Right Whale (*Eubalaena australis*) Mortalities, Peninsula Valdés, Chubut, Argentina 31 October – 9 November 2007. 86 pp.

Payne, R., O. Brazier, E.M. Dorsey, J.S. Perkins, V.J. Rowntree and A. Titus. 1983. External features in southern right whales, *Eubalaena australis*, and their use in identifying individuals. pp 371-445 *In* R. Payne, ed. Communication and behavior of whales. AAAS Selected Symposium 76. Westview Press, Inc., Boulder, CO.

Payne, R. and V.J. Rowntree. 1984. Southern right whales: a photographic catalog of individual whales seen in the waters surrounding Península Valdés, Argentina. Fundación A. Fortabat, Buenos Aires, and Whale Conservation Institute, Lincoln, MA. 19pp + 55 plates.

Pierotti, R. and C.A. Annett. 1990. Diet and reproductive output in seabirds. Bioscience 40:568-574.

Pons, J.M. 1992. Effects of changes in the availability of human refuse on breeding parameters in Herring Gull *Larus argentatus* population in Brittany, France. Ardea 80:143-150.

Rivarola, M., Campagna, C. and A. Tagliorette. 2001. Demand-driven commercial whalewatching in Península Valdés (Patagonia): conservation implications for right whales. Journal Cetacean Research and Management (Special Issue)2:145-151.

Rowntree, V.J., P. McGuiness, K. Marshall, R. Payne, M. Sironi and J. Seger. 1998. Harassment of right whales, *Eubalaena australis*, by kelp gulls, *Larus dominicanus*, at Península Valdés, Argentina. Marine Mammal Science 14:99-115.

Sironi, M. 2004. Behavior and social development of juvenile southern right whales (Eubalaena australis) and interspecific interactions at Península Valdés, Argentina. Ph.D. Dissertation. University of Wisconsin, Madison. 6 chapters, 198pp.

Sironi, M., Leske, N., Rivera, S., Taboada, D. and R. Schteinbarg. 2009. **New regulations for sustainable whalewatching at Peninsula Valdes, Argentina.** SC/61/WW10. presented to the International Whaling Commission Scientific Committee, June 2009 (unpublished). [Available from the IWC Office].

Steele, W.K. and P.A.R. Hockey. 1990. Population size, distribution and dispersal of Kelp Gulls in the southwestern Cape, South Africa. Ostrich 61:97-106.

Thomas, P.O. 1988. Kelp gulls, *Larus dominicanus*, are parasites on flesh of the southern right whale, *Eubalaena australis*. Ethology 79:89-103.

Uhart, M., Rowntree, V.J., Mohamed, N., Pozzi, L., La Sala, L., Andrejuk, J., Musmeci, L., Franco, M., Sironi, M., Sala, J. E., McAloose, D., Moore, M., Tohuey, K., McLellan, W.A., Rowles, T. 2008. Strandings of southern right whales (*Eubalaena australis)* at Península Valdés, Argentina from 2003-2007. Paper presented to the International Whaling Commission Scientific Committee, June 2008 (unpublished). [Available from the IWC Office].

Yorio, P., Bertellotti, M., Gandini, P. and E. Frere. 1998. Kelp gulls *Larus dominicanus* breeding on the Argentine coast: population status and relationship with coastal management and conservation. Marine Ornithology 26:11-18.

Yorio, P and M Giaccardi. 2002. Urban and fishery waste tips as food sources for birds in Northern Coastal Patagonia, Argentina. Ornitología Neotropical 13:283-292.