Comunicaciones especiales: mascotas urbanas y aves

URBAN DOG ATTACKS ON MAGELLANIC PENGUINS IN A PROTECTED AREA

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Resumen.- ATAQUES DE PERROS URBANOS A PINGÜINOS DE MAGALLANES EN UN ÁREA PROTEGIDA. La presencia de perros no supervisados en áreas urbanas próximas a sitios de alto valor natural puede tener efecto negativo sobre la fauna silvestre. En la costa patagónica, donde las ciudades suelen estar rodeadas de ambientes naturales, esta problemática puede afectar a colonias de aves marinas. Dos islas con colonias de Pingüinos de Magallanes (*Spheniscus magellanicus*) pertenecientes a un área protegida vecina a Puerto Deseado, Santa Cruz, sufrieron ataques de perros no supervisados. En 2016 y 2022, varios perros cruzaron a estas islas durante bajamares y atacaron pingüinos. En la isla Quiroga murieron 421 pingüinos en 2016, causando una disminución del 21.4% de su población. En la isla Quinta murieron 30 individuos en 2016 y 32 en 2022, correspondiendo en ambos casos a casi el 100% de la colonia. Estos son los primeros registros de ataques desde que monitoreamos estas colonias (> 30 años). El crecimiento de las ciudades costeras es constante y estos eventos podrían volverse más frecuentes y afectar a más especies de aves marinas. El control de los perros no supervisados en áreas naturales cercanas a urbanizaciones costeras es un desafío que los entes gubernamentales deberían asumir en el corto plazo.

Palabras claves: *aves marinas,* Canis lupus familiaris, *colonias reproductivas, depredación, depredador exótico, impacto.*

Abstract .- The presence of unsupervised dogs in urban areas close to sites of high natural value can have negative effects on wildlife. On the Patagonian coast, where cities are often surrounded by natural environments, this problem may affect seabird colonies. Two islands with Magellanic Penguin (*Spheniscus magellanicus*) colonies belonging to a protected area neighboring Puerto Deseado, Santa Cruz, suffered attacks by unsupervised dogs. In 2016 and 2022, several dogs reached these islands during low tides and attacked penguins. At Isla Quiroga, 421 penguins died in 2016, causing a decrease of 21.4% in its population. At Isla Quinta, 30 individuals died in 2016 and 32 in 2022, representing in both cases almost 100% of the colony. These are the first records of attacks since we are monitoring these colonies (>30 years). The growth of coastal cities is constant and these events could become more frequent and affect more species of seabirds. The control of unsupervised dogs in natural areas near coastal developments is a challenge that government entities should respond to in the short term.

Keywords: *breeding colonies,* Canis lupus familiaris, *exotic predator, impact, predation, seabirds*

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In urban areas, unsupervised domestic dogs (*Canis lupus familiaris*) (uncontrolled free roaming dogs, with or without owners) reach extremely high population densities because they are directly or indirectly subsidized by human activity (shelter, food, garbage dumps, etc.) (Gompper 2014). Despite receiving food, the unsupervised dog retains the instinct to chase and attack, making it an exotic predator of wild animals (Silva-Rodriguez and Sieving 2011). The proximity of high nature value sites to urban areas can increase the risk of negative interactions of unsupervised dogs with native fauna. The dog, regardless of its degree of dependence on humans, may affect the native fauna on multiple levels. Impact can occur through direct predation (Ritchie et al. 2014, Wierzbowska et al. 2016), behavioral changes (Banks and Bryant 2007, Silva-Rodríguez and Sieving 2011, Zapata-Ríos and Branch 2016), competition (Vanak et al. 2014), disease transmission (Acosta-Jamett et al. 2011, Knobel et al. 2014), and hybridization (Leonard et al. 2014).

In Argentina, the persecution of wild animals by dogs has been witnessed in all ecoregions (Zamora-Nasca et al. 2021). In this country, at least 80 animal species, of which 48% are birds, have been persecuted or predated by dogs; these events very often occur within protected areas (Zamora-Nasca et al. 2021).

Seabirds have life histories that make them vulnerable to introduced predators, such as late sexual maturity, low reproductive rates and long chick-rearing periods; they are also usually colonial and philopatric (Towns et al. 2011, Dias et al. 2019). The presence of dogs may impact seabird colonies in different ways, from energetic expenditure due to disturbance, interruption or abandonment of the clutch, predation on eggs, chicks and adults, to the complete destruction of the colony (Towns et al. 2011). Penguins are particularly vulnerable due to their inability to escape flying. Mortal attacks by dogs have been recorded in at least seven of 18 penguin species of the world (Barnett 1986, Hocken 2000, Anderson et al. 2006, Holderness-Roddam and McQuillan 2014, Suazo et al. 2014, Barrera 2018 , Morgenthaler et al. 2018, Vanstreels et al. 2019), including the threatened Yellow-eyed Penguin, *Megadyptes antipodes* (Hocken 2005). However, the extent of the impact of dogs on penguin populations in general is unknown (Dann 1991). Few studies describe repeated attacks on breeding colonies (Barnett 1986, Van Dooren 2011). In Argentina, only isolated events of dog attacks on Magellanic, *Spheniscus magellanicus*, and Rockhopper Penguins, *Eudyptes chrysocome*, are known (Morgenthaler et al. 2018, Zamora-Nasca et al. 2021).

In this work, we report repeated dog attacks on Magellanic Penguins at two breeding colonies located in a protected area adjacent to a city on the Patagonian coast, and we assess the impact of these attacks on the population size of these colonies. Finally, we evaluate the incidence of the presence of unsupervised dogs in the surroundings of the islands.

METHODS

Study area

Puerto Deseado is a city of approximately 20,000 inhabitants, located in the province of Santa Cruz, Argentina. The growth of the city through the annexation of new neighborhoods and the expansion of the "chacras" zone (zone destined to the production of farm animals and orchards) has progressively brought the urban areas closer to the limits of the Ría Deseado Provincial Reserve (47.75°S, 65.94°W). This reserve has nine colonies of Magellanic Penguins, all located on islands, totaling approximately 49,000 breeding adults (Millones et al. 2022). Two of them, Isla Quiroga and Isla Quinta, are found less than two kilometers from the city and the farming area (chacras) (Fig.1). Before the first dog attacks, Isla Quiroga hosted 3,144 reproductive adults (2015) and Isla Quinta hosted 18 reproductive adults (2013; Millones et al. 2022).

These two islands are separated from the coast by narrow channels with strong tidal currents (maximum amplitude: 5.2 m; Isla et al. 2004). During low tide, Isla Quinta joins the coast by an intertidal zone with mud and rocks, while Isla Quiroga is separated from the coast by an approximately 50 m wide channel (Fig.1).

Dog attack records

Records of the presence of dogs at the colonies, of dogs attacking penguins and/or of dead penguins attacked by dogs, were based on our own sightings and on reports from different government and non-government entities (Consejo Agrario Provincial, Fundación Conociendo Nuestra Casa, Club Náutico Capitán Oneto) and on the sightings of specific individuals. After each record, we visited the colonies to confirm the attacks of dog on penguins, and if applying, we counted the dead penguins. On four oc-

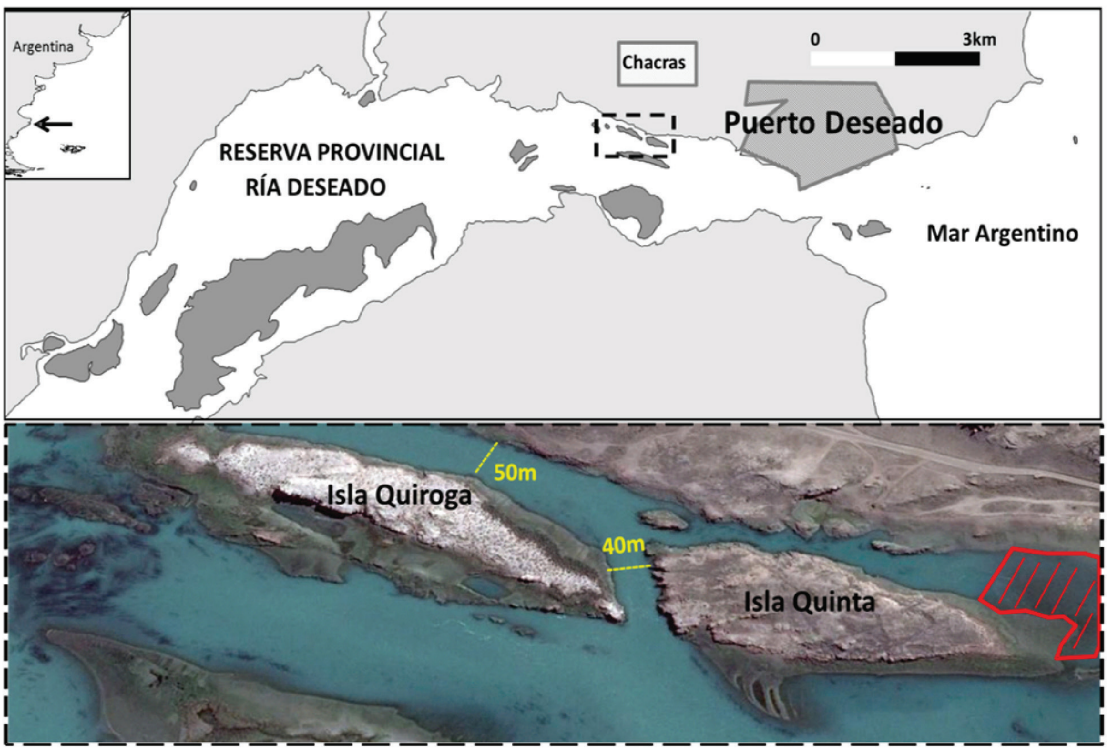

Figure 1. Location of Isla Quiroga and Isla Quinta at the Ría Deseado Provincial Reserve. Yellow lines indicate reference distances during mid-low tides. The red lines indicate the intertidal zone that connects Isla Quinta to the mainland coast at low tide. **Figura 1.** Ubicación de las islas Quiroga y Quinta en la Reserva Provincial Ría Deseado. Las líneas amarillas indican distancias de referencia durante mareas medias-bajas. Las líneas rojas indican la zona intermareal que conecta la isla Quinta a la costa del continente durante la marea baja.

casions the attacks were observed directly. In those cases when the attacks were not directly observed, the cause of death of the penguins was attributed to attacks by dogs due to a combination of the following conditions: a) they presented external wounds consistent with bites, b) the evidence found in necropsies carried out on several individuals presented: unequal internal tears of the muscles, several broken bones and distances between fangs greater than 3 cm; consistent with wounds by dogs according to Nallar et al. (2008) and Gonzales (2019), c) a large and conspicuous number of dead penguins in a short period of time, and d) the observation of repeated presence of packs of dogs in the area associated with mortality events. For each date at which dogs were witnessed on any of the islands, the height of the low tide (m), obtained from the website of the Naval Hydrography Service (2022) was reported.

Impact on colonies

To assess the impact of dog attacks on penguin colonies, we compared the number of breeding pairs from the years before and after the attacks. We used 2012 to 2017 data published by Millones et al. (2022) and we carried out counts using the same method as these authors (direct counts) between 2018 and 2021 (excluding 2020 due to access limitations). Since interannual population fluctuations involving different causes are known (Millones et al. 2022), the average (± standard deviation) of the four reproductive seasons prior to the 2016 attacks (2012-2015) and the average (± standard deviation) of four out of the five subsequent seasons (2017-19 and 2021) were used at Isla Quiroga. For this colony, the percentage of the dead penguins against the total population of Ría Deseado estuary, estimated at 49,000 reproductive adults, was calculated (Millones et al. 2022). For Isla Quinta, given its small number of breeding pairs, the observed decline does not contribute significantly to the total population of the estuary. Besides, it was not possible to calculate the percentage of decline precisely since the number of reproductive adults at this island fluctuates greatly between years (Millones et al. 2022 and unpublished data) and, due to the date of these attacks, the penguins found dead were not all reproductive adults, but they also included immature individuals which came to the island to molt.

Since 2010, numerous pairs of adult penguins were ringed (with small numbered caravans that are fixed on the web of the feet) on Isla Quiroga, as part

of a reproductive biology study (Barrionuevo et al. 2018). The sex of the adults was determined at the time of banding considering the width of the beak (Gandini et al. 1992). The sex ratio of ringed penguins found dead in 2016 (N=30) was estimated.

Incidence of the dogs on the islands

Dogs in small urban areas have more opportunities to interact with wildlife, or with other rural dogs that interact with wildlife, than in large urban areas. In these setting, the home range of unsupervised dogs can vary widely (Vanak and Gompper 2010). For example, Meek (1999) found that half of a group of dogs monitored in an Australian village had a range of <3 ha, while the other half had a range of >900 ha, with dogs ranging from 8 to 30 km to hunt kangaroos.

We assessed the incidence of the presence of dogs in the surroundings of Isla Quinta and Isla Quiroga based on estimates of unsupervised dog densities at the town. These estimates were obtained from a census carried out in April 2022 within the framework of the annual monitoring of the population of unsupervised dogs in Puerto Deseado by the SIGECCO research group (Ecology and Conservation Geographic Information System - UNPA - UACO; SIGECCO 2022). For 10 consecutive days, all the streets of the city were traveled by vehicle at 5 km/h for a single time, stopping to record (geotagging and photograph) each unsupervised dog that was observed. To assess the incidence of unsupervised dogs on the islands, taking into account the great variability of the dogs' ranges, we used four different search range scenarios around the islands, from the most conservative (1 km) to the most comprehensive (4 km). These four search radii were projected from the centroid of the islands on the map of unsupervised dog densities using a geographic information system QGIS (QGIS Development Team, 2022).

RESULTS

Isla Quiroga

Between October and November 2016, packs of between three and four dogs were observed on Isla Quiroga on three occasions, coinciding with periods of extraordinary low tides (lows of less than 0.6m, Table 1). For those months, which include egg incubation and hatching period, we recorded a total of 421 killed adult penguins (Table 1). Only on one of the dates (11/17), in addition to observing the pack, we were also able to witness the attacks. Most of the dead individuals, attributed to the attacks by dogs, did not appear to have been consumed. Some had bite marks and tears (Fig. 2), while others had no external injuries. On several occasions, it was possible to observe dog excrement in the vicinity of the carcasses. Of the 30 ringed adults, 15 were females, 14 males and one

Figure 2. Some of the 371 adult Magellanic Penguins killed by dogs in October 2016 at Isla Quiroga Island, Ría Deseado Provincial Reserve (above). Detail of an individual with marks from recent attacks (below). Photographs taken on November 1st 2016. **Figura 2.** Algunos de los 371 adultos de Pingüinos de Magallanes muertos atacados por perros en octubre de 2016 en la isla Quiroga, Reserva Provincial Ría Deseado (arriba). Detalle de un individuo con marcas de ataques recientes (abajo). Fotografías tomadas el primero de noviembre de 2016.

of indeterminate sex, indicating equity in the sex ratio of mortality caused by dogs.

The average number of breeding individuals was reduced by 21.4%, comparing the four seasons previous to the attacks with the four seasons subsequent to the attacks (3092±191 vs 2429±195 respectively; Fig. 3). As for the total penguin population of the Ria Deseado estuary, the penguins dead at Isla Quiroga in 2016 were equivalent to 0.9% of the estimated population of 49,000 reproductive adults for the entire area.

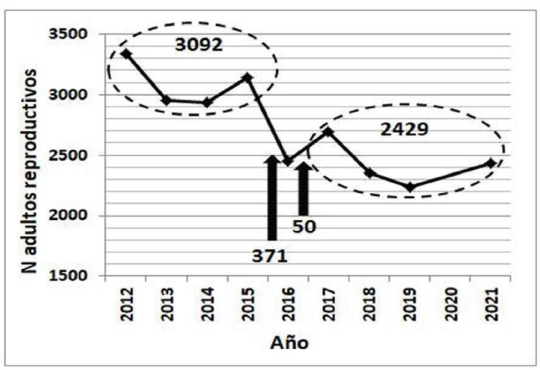

Figure 3. Evolution of the number of breeding adults of Magellanic Penguins at Isla Quiroga. The arrows indicate the dog attacks along with the number of adult penguins killed. The number inside each circle indicates the average number of reproductive adults for the four seasons, before and after the attacks. **Figura 3.** Evolución del número de adultos reproductivos de Pingüinos de Magallanes en la isla Quiroga. Las flechas indican los ataques por perros junto con el número de pingüinos adultos muertos. El número dentro de cada círculo indica el promedio de adultos reproductivos para las cuatro temporadas, previas y posteriores a los ataques.

Isla Quinta

On several occasions between 2016 and 2022, dogs were witnessed on Isla Quinta; they accessed the island walking through the intertidal area during low tide (Table 1). Three of these accesses culminated in attacks on penguins, while one did not (Table 1).

In March 2016, during the penguin moulting period, 30 dead individuals attacked by dogs (including adults and immatures; Table 1) were recorded. Again, between February and April 2022 (fledglings, immatures and adults moulting), we observed dogs attacking at two different times and counted a total of 32 recently killed penguins (Table 1).

The 30 dead individuals from 2016 and the 32 dead individuals from 2022 (among adults, immatures and chicks) consisted of almost 100% of this small colony in both events (Fig. 4). In October 2013, the colony hosted 18 reproductive adults. After the March 2016 attacks, no pair was found breeding during the following season (October 2016). Over the next several years, the colony began to recover, reaching 16 breeding adults in 2020. However, the latest attacks in 2022 appear to have decimated this small breeding colony again (Fig. 4).

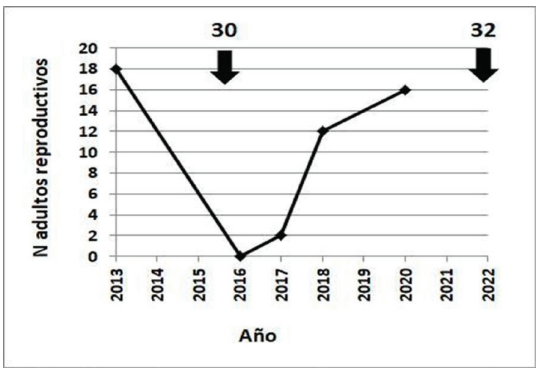

Figure 4. Evolution of the number of breeding adults of Magellanic Penguins at Isla Quinta. The arrows indicate the dog attacks along with the number of dead penguins, which includes adults, immatures and chicks. **Figura 4.** Evolución del número de adultos reproductivos de Pingüinos de Magallanes en la isla Quinta. Las flechas indican los ataques por perros con el número de pingüinos muertos, los cuales incluyen adultos, inmaduros y pichones

Incidence of dogs on the islands

Considering the most conservative search range, located 1 km from the islands, the density was null (absence of unsupervised dogs in this area). With a range of 2 km, the densities varied between 0.01 and 6.25 dogs/ha. For the most extensive search ranges, whose distances were 3 and 4 km, the values of unsupervised dog densities varied between 0.01 to 13.35 dogs/ha and 0.01 to 13.59 dogs/ha, respectively (Fig. 5).

DISCUSSION

The events from Isla Quinta and Isla Quiroga are the first record of repeated attacks by unsupervised dogs on seabird colonies along the Argentine coast. Until 2016, for over 30 years of penguin colony monitoring at the Ría Deseado estuary, no attacks had ever been recorded on the islands. These new and unfortunate occurrences might be explained by the sum of several factors. During the last seven years, parallel to the expansion of the city and the farming area (chacras), an increase in the population of unsupervised dogs and the increasingly frequent presence of packs in the adjoining protected area have been observed (SIGECCO 2022). Extraordinary low tides facilitate accessibility to the small colony of Isla Quinta and shorten the distance from the coast to Isla Quiroga in case a dog wants to swim across. When Isla Quinta connects

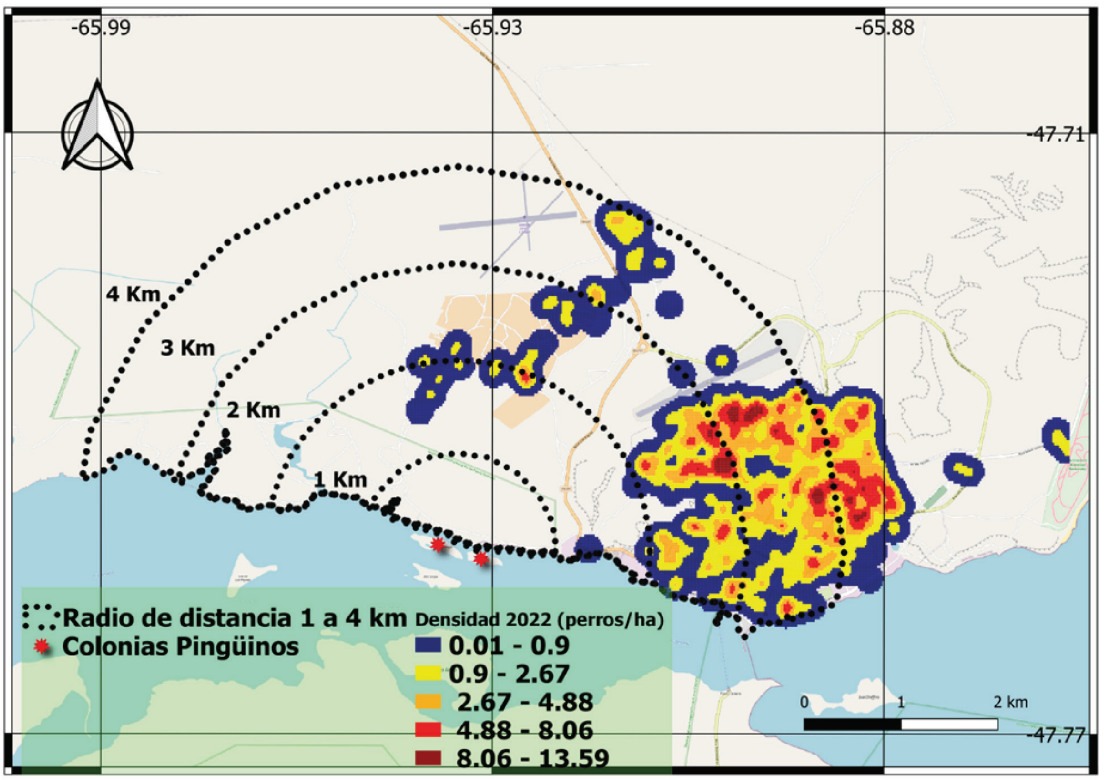

Figure 5. Unsupervised dog densities whose search ranges are 1, 2, 3 and 4 km from the centroid of Isla Quiroga and Isla Quinta (red stars).
Figura 5. Densidades de perros no supervisados cuyos rangos de búsqueda se encuentran a 1, 2, 3 y 4 km del centroide de las islas Quiroga y Quinta (estrellas rojas).

to the mainland, it is the most easily accessible colony, allowing the dogs, which are becoming more frequent in the area, to find new and easy prey to attack due to the low ability of penguins to escape on land (they are flightless, clumsy and trusting). Finally, we hypothesize that the dogs' visual, auditory, and/or olfactory detection of penguins from Isla Quiroga was likely what prompted them to subsequently swim across and continue with the attacks. The predation instinct stimulated by their very acute senses allows dogs to detect their prey at a distance with great skill (Taborsky 1988, Cablk et al. 2008) and sometimes to kill many more prey than they can possibly feed on; behavior that is enhanced when dogs are in packs (Ritchie et al. 2014).

The total number of penguins killed by dogs in 2016 is only a small percentage of the total population of the Deseado estuary. However, the reduction at the colony level on Isla Quiroga was significant, since, even five years after the attacks, its population has not managed to recover and reach the numbers of breeding individuals recorded in previous years. On the other hand, attacks by dogs are an additional threat to those already existing, among which are the interaction with the fishery, oil pollution and climate change (Boersma 2008, Crawford et al. 2017, Rebstock and Boersma 2018). The Magellanic Penguin is a long-lived species, with late sexual maturation (> 5 years) and slow reproduction that normally suffers low mortality during the adult stage (Pozzi et al. 2015). Any threat that impacts the survival of breeding adults in a colony, such as attacks by dogs, directly affects its population size, and its recovery may take years, since the species presents, in addition to delayed sexual maturation, low annual recruitment of breeders (Pozzi et al. 2015).

It is interesting to highlight the absence of predatory events between 2017 and 2021, the years following the first mortality event. We assume that this may be due to two reasons. One is that during 2016, four dogs were captured on Isla Quiroga and removed from the streets, and the second is that during those years (2017-2021) a research project was carried out at Isla Quiroga, and during most of the days of the breeding season, there were researchers in the colony (Marchisio et al 2021).

The recent attacks that occurred in 2022 on Isla Quinta, along with the high incidence of dogs in the surroundings of the islands (taking into account the

Table 1. Records of the number of dogs and height (m) of the low tide on the dates the dogs were observed and number of dead Magellanic Penguins at Isla Quinta and Isla Quiroga. In parentheses, the age of the dead penguins is reported. Ad: adults, inm; immature and pich: chicks. NA: not determined. **Tabla 1.** Registros de cantidad de perros y altura (m) de la marea baja en las fechas en las que se los observaron y/o cantidad de Pingüinos de Magallanes muertos en las islas Quinta y Quiroga. Entre paréntesis se reporta la edad de los pingüinos muertos. Ad: adultos, inm: inmaduros y pich: pichones. ND: no determinado.

	Isla Quiroga			Isla Quinta		
Fecha	# Perros	Marea baja (m)	# Pingüinos muertos	# Perros	Marea baja (m)	# Pingüinos muertos
Marzo 2016				ND		30 (ad e inm)
18/10/2016	4	0.6				
1/11/2016			371 (ad)			
16/11/2016	4	0.3				
17/11/2016	3	0.3	50 (ad)			
26/11/2019				1	0.6	0
6/2/2022				3	0.9	26 (ad, inm y pich)
3/4/2022				3	0.9	6 (ad e inm)
TOTAL MUERTOS			**421 (ad)**			**62 (ad, inm y pich)**

different search ranges that we analyzed), hint at the possibility of new attacks at Isla Quiroga in the near future. The 2022 attacks reinforce the need to take action to mitigate the problem of unsupervised dogs in this protected area through coordinated multidisciplinary policies and actions. We believe that these should include surveillance actions in the reserve supervised by the enforcement entity, which could be accompanied by citizens through an alert system on the presence of unsupervised dogs (Van Dooren 2011). However, these measures are more of a palliative nature, so it is also necessary to have effective measures that act on the source of the problem, which is the great abundance of unsupervised dogs in Puerto Deseado. Currently, the vast majority of existing measures are directed primarily towards dogs with responsible owners (owners who respect public health and safety regulations). Measures should be increased to control harmful species, which should also include the management of unsupervised dogs (either those with irresponsible owners or without owners). It is important to design management plans that take into account the sources of the increase in individuals (abandonments and births) and free-roaming dogs regardless of their supervision status (Smith et al. 2019, 2022). Finally, citizen education and awareness, both on responsible ownership and on the negative impact that dogs can have on wildlife -whether due to disease transmission, persecution or predation- are key aspects that should accompany the measures previously mentioned (Zamora-Nasca and Lambertucci 2022).

In conclusion, we highlight the importance of recording dog predation events and the impact on seabird colonies. The population growth and development of the Patagonian coast is constant and sustained, so we believe that, as in the Ría Deseado Nature Reserve, these events will become more frequent and will affect more species of seabirds. The control of unsupervised dogs in natural areas near coastal developments is a challenge that government entities must take on in the short term.

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