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RE-EVALUATING THE POPULATION SIZE OF SOUTH AMERICAN FUR SEALS AND CONSERVATION IMPLICATIONS

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Abstract

1. South American fur seals (*Arctocephalus a. australis*) are widely distributed, yet surprisingly little is known about their ecology. In particular, population data are sparse and outdated for many breeding locations, including the Falkland Islands. Data deficiency impedes the development of coherent conservation and management strategies.
2. To address knowledge gaps, for the first time since 1965 an archipelago-wide census of South American fur seals breeding at the Falkland Islands was undertaken, which provided the first pup abundance estimate since 1926 - data that is critical for assessing population trends.
3. In total, 36,425 South American fur seal pups were counted at the Falkland Islands in 2018, a greater than four-fold increase since the last census, and far greater than the 7,990 pups counted in Uruguay, which was presumed to be the largest South American fur seal population in the world. Hence, based on pup abundance, the Falkland Islands is presently the largest population of South American fur seals, even when considering a correction factor of 3.9 that was applied to pup counts in Uruguay, which produced an estimated 31,160 pups.
4. The results redefine South American fur seal abundance, the contribution of breeding locations (Falkland Islands, Uruguay, Argentina, Chile) and the distribution of breeding colonies at the Falkland Islands, which has far reaching implications for conservation and management. In particular, the present study has effectively doubled the Atlantic population size of the species, which is now estimated to comprise about 75,500 pups, of which the Falkland Islands accounts for 48 % and Uruguay 41 %. Accordingly, changes in the number of South American fur seals breeding at the Falkland Islands will influence the global population trends and conservation status of the species. Monitoring South American fur seals breeding at the Falkland Islands is therefore crucial to understand the

impacts of anthropogenic pressures, such as fisheries, and to inform management and conservation policy. The results provide a baseline from which to measure changes in abundance.

Keywords: South American fur seals, population census, South Atlantic, UAV

Introduction

Quantifying trends in the abundance and geographic distribution of animal populations is a central tenet in ecology that underpins animal conservation and management (Caughley & Gunn, 1996). Within the marine realm, colonial breeding marine megafauna such as pinnipeds are ecological drivers that influence ecosystem structure and function, and are often considered sentinels of ecosystem status and change (Estes, Heithaus, McCauley, Rasher, & Worm, 2016). Pinnipeds are also relatively easy to monitor owing to their highly synchronous typically land-breeding life-history (Bartholomew, 1970). Hence, many pinniped species have the time-series data necessary to assess trends in population abundance, and to ascribe causes of population change (Baylis et al., 2015; Croxall, McCann, Prince, & Rothery, 1988; Lonergan, Duck, Thompson, Moss, & McConnell, 2011; McIntosh, Holmberg, & Dann, 2018; McMahon, Bester, Burton, Hindell, & Bradshaw, 2005; Robertson & Chilvers, 2011; Shaughnessy & Goldsworthy, 2015). Nevertheless, for some conspicuous and widely distributed pinniped species, such as South American fur seals *Arctocephalus australis* (SAFS), population size and trends are poorly understood (Crespo et al., 2015).

SAFS breed along the Atlantic and Pacific coasts of South America, from Uruguay to Peru, including the Falkland Islands, and have a total population (all age classes) of > 200,000 (Cárdenas-Alayza, Oliveira, & Crespo, 2016). SAFS that breed in Peru and northern Chile are currently recognized as a separate unnamed subspecies from those that breed in southern Chile and the South Atlantic (*A. a. australis*), although there is evidence to support the reclassification of these sub-species into separate species (Cárdenas-Alayza et al., 2016). Despite the extended breeding range of SAFS, much of their ecology is, by necessity, inferred from anecdotal information and population data are sparse and outdated for some breeding locations. In particular, there is a paucity of SAFS population data for the Falkland Islands, the

last census being four decades ago (Strange, 1992). SAFS at the Falkland Islands are of particular interest because the number of breeding colonies, reported to be between 9 and 11, exceeds that of other South Atlantic breeding locations, with the exception of southern Chile (Baylis, Arnould, & Staniland, 2014; Baylis, Tierney, Orben, Staniland, & Brickle, 2018; Crespo et al., 2015; Franco-Trecu et al., 2019; Strange, 1992). Although the number of breeding colonies does not necessarily equate to population size, it does indicate that the Falkland Islands could be an important SAFS breeding population. However, there are no recent data on SAFS pup abundance at the Falkland Islands because the most recent censuses estimate relative abundance, but do not distinguish between adults and pups - the latter being a reliable index of population size (Berkson & Demaster, 1985; Strange, 1992; Wickens & Shelton, 1992). Indeed, the last SAFS census at the Falkland Islands was a partial census in the 1980s, which estimated 18,000-20,000 SAFS of all-ages (Strange, 1992). Based on the available data, the Falkland Islands SAFS population is considered to be small relative to Uruguay, which is reported to be the largest SAFS population in the world, with an estimated pup abundance of 31,160 pups in 2013 (Crespo et al., 2015; Franco-Trecu et al., 2019; Vaz-Ferreira & Ponce De Leon, 1987). Limited data on SAFS population abundance and trends hinder the development of coherent SAFS conservation and management strategies.

Given the paucity of SAFS population data at the Falkland Islands the aims of the present study were to (i) undertake a population census to determine the current location and size of breeding colonies, (ii) compile archival records to reconstruct trends in pup abundance at the Falkland Islands, and (iii) re-evaluate the current population size of SAFS (*A. a. australis*), using pup abundance as an index of population size.

Materials and methods

2018 Census

Like other temperate fur seal species, SAFS give birth to a single offspring during the austral summer. Adult females alternate between foraging at sea and suckling their pups ashore during an approximately 11 month lactation period (Baylis, Tierney, Orben, et al., 2018; Vaz-Ferreira & Ponce De Leon, 1987). The 2018 census was timed to occur after peak pupping, which is late December (Pavés & Schlatter, 2008; Vaz-Ferreira & Ponce De Leon, 1987). SAFS pups are easy to distinguish from other age-classes based on their size and black natal hair (lanugo). In addition, young pups (< 1 month old) do not leave their natal colony (Wickens & Shelton, 1992). In comparison, the proportion of adult SAFS away at-sea on any given day is unknown and juvenile SAFS colony attendance varies seasonally (A.M.M. Baylis unpublished data). Hence, as previously stated, pups are a useful index of population size, although the relationship between the number of pups and total population size depends on population status and life-history parameters like survival rates and recruitment (Berkson & Demaster, 1985; Shaughnessy & Goldsworthy, 2015).

SAFS breeding colonies were photographed using an Unmanned Aerial Vehicle (UAV) (DJI Mavic pro, 1/2.3" CMOS sensor 12-megapixel camera, ISO 200, max aperture 2.27) at a flight height of 30 m. There was no detectible disturbance to SAFS. Between 100 and 550 photographs were taken at each breeding colony. From these, a single orthomosaic photograph was created for each breeding colony using Agisoft Metashape Pro (v1.5.0). Finally, a shapefile layer was created in QGIS (v3.4.2) to count pups, which enabled pup location to be georeferenced, and the number of pups to be cumulatively tallied for each colony orthomosaic (McIntosh et al., 2018). Original photographs were used to count or confirm pups when sections of orthomosaics were missing or blurred. However, in some instances, the original photographs were also blurred. In addition, photographs during the early morning and late afternoon were avoided,

when low light and shadows reduced image quality, the exception being North Fur Island. Pups that could not be positively identified were not counted. Shapefiles (which recorded the location of pups within each colony) were error-checked independently by two counters. At the Falkland Islands, SAFS and Southern sea lion (*Otaria flavescens*) breeding colonies are segregated at the three islands where they breed in sympatry (South Jason, North Fur and Elephant Jason Islands) (Baylis et al., 2015).

Given colony terrain was often complex and included boulders, crevices and ledges, not all pups were visible. Count errors for unobserved pups were derived using a simulation procedure that involved drawing a fractional error from a uniform distribution, assuming the uncertainty of the original count was between 5 and 10 %. A value (count) was then randomly drawn from a sampling distribution based on the error and the procedure repeated 10,000 times. The resulting 10,000 possible estimates of pups generated for each breeding colony were summed and the 2.5 and 97.5 percentiles calculated as the lower and upper band of the 95 % confidence interval (Baylis, Wolfaardt, Crofts, Pistorius, & Ratcliffe, 2013).

Compilation of archival and contemporary census data

To reconstruct the historical Falkland Islands population of SAFS, all available documents housed at the Jane Cameron National Archives (Falkland Islands) related to sealing and seals in the 1800s and 1900s were examined. To compile census data from other breeding locations (Uruguay, Argentina, Chile), empirical data from peer-reviewed publications, agency and technical reports, and symposia proceedings were used.

Results

SAFS were found at 15 locations around the Falkland Islands, ten of which were breeding colonies and 5 were haul-out sites, which are places where SAFS congregate but do not breed (Figure 1). Between the 3-12 January 2018 a total of 36,425 pups were counted at the 10 breeding colonies (Figure 1, Table 1). The three largest breeding colonies were in the northwest Falkland Islands (Jason West Cay, Jason East Cay and Seal Rocks), which together accounted for 80 % of the total number of SAFS pups at the Falkland Islands (Table 1). The Jason Islands group, which is comprised of the three largest breeding colonies, along with North Fur Island and Elephant Jason Island, accounted for 97 % of the total SAFS pups born at the Falkland Islands (Figure 1). A reliable pup count at Beaver Island, where SAFS breed in small numbers amongst boulders, was not possible due to irregular terrain. Therefore, Beaver Island pup abundance was estimated. In addition, the number of pups at North Fur Island were likely underestimated (pictures were taken during the early morning, which reduced image quality). Other sites with small numbers of pups included Bird Island, Volunteer Rocks and New Island (Figure 1, Table 1). Eddystone Rock was incorrectly identified as a SAFS breeding colony in a previous census (Strange, 1992). SAFS pups were not observed at Eddystone Rock in 2018, or in 2014 during a sea lion census (Baylis et al., 2015). Beauchene Island is presently a winter SAFS haul-out (Baylis, Tierney, Staniland, & Brickle, 2018). North Island is a haul-out site that was visited separately in December 2016, but not in 2018.

Archival records revealed that the earliest census of SAFS at the Falkland Islands was in January 1920, when Elephant Jason Island and Volunteer Rocks were the main SAFS breeding colonies, and 5,500 SAFS of all ages were estimated. SAFS pup abundance was not reported until 1923 (Table 2). Censuses throughout the 1920s indicated that the total Falkland Islands population was < 10,000 SAFS (all age-classes) (Table 1). From 1927 to 2018 only two archipelago-wide censuses were undertaken (1951 and 1965), along with a partial census in the 1980s (Table 2).

The 1951 census was associated with three reports – the publication by R. Laws (Laws 1953), the original government report by R. Laws and a report by the sealing officer (J. B. Browning) that accompanied R. Laws in 1951 (Table 2). Each report varied in the estimated number of SAFS at New Island, which ranged between 3,000 - 8,000 SAFS of all age-classes (Table 2). The 1965 census was an aerial census that was undertaken in conjunction with a sea lion census, although there is also mention of direct counts at some sites in 1966 (Strange, 1972, 1979). Few details are available for the 1980s census (Strange, 1992). Based on the 2018 census, the number of SAFS at the Falkland Islands has at least quadrupled since the 1980s, given 36,425 pups equates to 36,425 breeding females (therefore the population comprises 72,850 SAFS breeding females and pups alone). However, the 2018 census represents the minimum number of pups born. Assuming an error of between 5 - 10 %, for unobserved pups, the upper 95 % confidence interval was 40,542 pups.

The number of SAFS pups at the Falkland Islands was over 4.5 times greater than the 7,990 pups counted in Uruguay (3,267 at Cabo Polonio and 4,723 at Punta del Este) during an aerial census, which was comprised of photographs taken in 2011 and 2013 (Franco-Trecu et al., 2019). Applying a correction factor of 3.9, derived from partial ground counts at one of six colonies, yielded 31,160 pups in Uruguay (Franco-Trecu et al., 2019). Although recent census data are lacking for southern Chile, the largest breeding colony is thought to be Guafo Island with roughly 2,500 pups, and the total number of SAFS pups in southern Chile estimated to be at least 6,000 (Oliva et al., 2012; Seguel, Pavés, Paredes, & Schlatter, 2011; Venegas et al., 2002). In Argentina there are <2,000 SAFS pups, but recent census data are incomplete (Crespo et al., 2015). When considering the estimated 31,160 pups derived from the correction factor used for Uruguay, SAFS pup abundance is approximately 75,500 pups of which the Falkland Islands accounts for 48 %, Uruguay 41 %, southern Chile 8 %, and Argentina 3 %.

Discussion

The Falkland Islands are currently the largest population of SAFS in the world, with at least 36,425 pups born in 2018. Given the paucity of data from the Falkland Islands, Uruguay has long been considered to be the largest SAFS breeding population, estimated to account for 70 % of the total SAFS population (Franco-Trecu et al., 2019; Vaz-Ferreira & Ponce De Leon, 1987). The 2018 Falkland Islands census findings are extraordinary because they have revealed that the number of SAFS pups at Falkland Islands are over 4.5 times greater than the 7,990 SAFS pups counted in Uruguay using comparable aerial photography census methods. To account for unobserved pups, a correction factor of 3.9 was applied to Uruguay counts, the final estimate being 31,160 SAFS pups (Franco-Trecu et al., 2019). All census methods have inherent biases and assumptions and the present study is no exception. A correction factor was not applied to counts at the Falkland Islands because of the unacceptable disturbance ground counts would have created, and recent studies show that in some scenarios, ground counts can actually underestimate pup number when compared to counts from high quality UAV photographs (*e.g.,* McIntosh *et al.*, 2018). Nevertheless, it is acknowledged that colony terrain could have obscured pups resulting in an underestimate. Hence, 36,425 is the minimum number of SAFS pups born in 2018 at the Falkland Islands (assuming a 10 % error for unobserved pups would yield 40,542 SAFS pups). These findings have far-reaching implications for SAFS population ecology and management. Specifically, the present study has established that the Falkland Islands accounts for at least 48 % of *A. a. australis* pup abundance, and Uruguay accounts for approximately 41 %, rather than 80 %, which is based on data available prior to the present study. Accordingly, this study has almost doubled prior estimates of the total SAFS pup abundance, from 39,000 to 75,500 pups (36,425 Falkland Islands, 31,160 Uruguay, ~6,000 Chile, <2,000 Argentina). However, SAFS population censuses are often sporadic and the

methodology used to census breeding colonies are inconsistent over time (Crespo et al., 2015; Franco-Trecu et al., 2019). The total pup abundance estimate is based on outdated census data for southern Chile and Argentina, and these populations could be larger than reported here. Lastly, the present study redefines the contribution of SAFS breeding locations and the distribution of breeding colonies at the Falkland Islands. SAFS population dynamics were thought to be driven by population trends at Uruguay (Crespo et al., 2015; Franco-Trecu et al., 2019). Owing to the number of pups born at the Falkland Islands, changes in the trends and status of SAFS breeding at the Falkland Islands will disproportionately influence the global population status and trend of the species, while SAFS dispersal from the Falkland Islands (and Uruguay) could be important to the growth and continued recovery of other SAFS breeding populations.

Direct comparison of the two largest SAFS breeding populations, the Falkland Islands and Uruguay, is problematic because the majority of SAFS pups estimated for Uruguay were unobserved (Franco-Trecu et al., 2019). Specifically, 74 % or 23,170 of 31,160 pups, were derived from a correction factor that was based on ground counts at one of six colonies, and applied to all colony counts (Franco-Trecu et al., 2019). Correction factors are commonly applied to pinniped counts to correct for unobserved animals, and the pup abundance estimated by Franco-Trecu et al. (2019) is consistent with prior estimates (*e.g.,* Mearns *et al.*, 1999). Nevertheless, the estimated number of unobserved SAFS pups could be associated with a high degree of uncertainty if the density and detectability of pups were inconsistent within and between breeding colonies, which ranged from 20 to 4,544 pups in Uruguay (Franco-Trecu et al., 2019). Given the present study reports the minimum number of pups born in 2018, the contribution of the Falkland Islands to the total SAFS pup abundance is likely to be greater than 48 %.

Presumably the pre-sealing population size of SAFS was substantial at the Falkland Islands (A. Dickinson, 2007; Palmer, 2004). Although the history of commercial sealing at the Falkland Islands is fairly well documented, accounts of skins taken are sparse and sealing vessels returned from the South Atlantic with skins from more than one species of fur seal, which makes it difficult to reconstruct population abundance (Busch, 1985; A. Dickinson, 2007; A. B. Dickinson, 1994; Palmer, 2004). However, SAFS have not recolonized their former breeding range at the Falkland Islands, which is thought to have included Tea Island, Sea Dog Island and Beauchene Island, the latter presently a haul-out site (Barnard, 1829; Fanning, 1924). By the early 1900s the number of SAFS at the Falkland Islands is thought to have been severely depleted by unregulated sealing, which is supported by early census data. Specifically, the first Falkland Islands SAFS population census was in 1920 and estimated only 5,500 SAFS of all-ages (Table 2). This prompted the Falkland Islands Government to cease issuing sealing licences in 1921 to protect the remaining SAFS population, effectively ending commercial sealing for SAFS at the Falkland Islands (A. Dickinson, 2007; Palmer, 2004). The first estimate of SAFS pup abundance was not until 1923, when the SAFS population was confined to two relatively small breeding colonies, Elephant Jason Island and Volunteer Rocks. Bird Island re-established as a breeding colony by 1925, when four pups were reported (Table 2). While sporadic counts were undertaken between 1927 and 1931, the next archipelago-wide census wasn't until 1951 when an imprecise census (based on estimates rather than counts) reported about 14,000 SAFS (Laws, 1953). The presumption by Laws (1953) that Beauchene Island and North Island were important SAFS colonies in 1951 was proven to be incorrect by a subsequent census in 1965 (Strange, 1983). A survey in 1965 resulted in a total count of 14,000 SAFS (Strange 1972). A partial census in the 1980s estimated 18,000 – 20,000 SAFS of all ages, which indicated that SAFS at the Falkland Islands increased between the 1920s and 1980s (Strange, 1992). However,

the largest increase was between the 1980s and 2018. Although data on pup abundance in the 1980s is not available to calculate the rate of change, the number of SAFS pups in 2018 was almost twice the total number of SAFS (i.e., all age-classes) estimated in the 1980s, which implies a period of rapid SAFS recolonization at the Falkland Islands, particularly considering that in other fur seal species, ratios > 4:1 are used to estimate the total population size from pup number (Kirkwood et al., 2010; Wickens & Shelton, 1992). Rapid recolonization is consistent with the post-sealing population recovery of other fur seal species, such as Antarctic fur seals (*Arctocephalus gazella*) breeding at Bird Island, South Georgia, which increased 10 fold between the 1960s and 1980s (Boyd, 1993; Payne, 1977).

Although the 2018 census provides unequivocal evidence that the number of SAFS and the distribution of breeding colonies have increased at the Falkland Islands, the increase primarily reflects trends at the three largest SAFS breeding colonies (Jason West Cay, Jason East Cay and Seal Rocks). Jason West Cay and Jason Easy Cay were visited in February 1935 during a southern sea lion census, when 500 and 250 sea lion pups were estimated, respectively (no sea lions were observed in 2018)(Hamilton, 1939). In 1982, these islands were SAFS haul out sites only(Strange, 1996). This implies that SAFS breeding colonies at Jason West Cay and Jason East Cay were established after 1982. However, not all breeding colonies have necessarily increased in pup number. For example, 257 pups were reported at New Island in 1995, greater than the 138 pups counted in 2018 (Strange, 2007). The reason for the discrepancy in pup abundance is unclear. Similarly, Elephant Jason Island increased from 400 pups in 1923 to 3,000 in 1926, which is greater than the 2,325 pups that is reported in the 2018 census. The extraordinary increase in the number of pups between 1923 and 1926 is likely to be an artefact of imprecise counts, but might also reflect SAFS immigration from other breeding locations. Uncertainty in the accuracy of early censuses notwithstanding, SAFS breeding at the Falkland Islands have not

yet recovered from commercial sealing, at least with regard to their distribution. There are no inherent reasons why SAFS could not recolonize their former breeding range. Accordingly, while the current SAFS population trend at the Falkland Islands and stage of population recovery is unknown, with appropriate conservation and management SAFS breeding at the Falkland Islands could increase in distribution and number.

The conservation implications of the present study are clear. Crucially, given that the Falkland Islands will disproportionately influence the global population status of SAFS, international conservation policies should now recognize the importance of the Falkland Islands. In particular, data from the Falkland Islands is required for improved assessments of the conservation status, population trends and genetic population structure of the species. In addition, the continued monitoring of SAFS breeding at the Falkland Islands is essential to understand the impacts of anthropogenic pressures, such as commercial fisheries and climate change, and to inform management and policy that aims to mitigate anthropogenic impacts. Understandably, given the paucity of data from the Falkland Islands, it is the considerable research effort at other breeding locations, in particular Uruguay, which has underpinned conservation assessments including the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, where SAFS are listed as Least Concern (Cárdenas-Alayza et al., 2016; Crespo et al., 2015; Franco-Trecu et al., 2019). However, scant attention has been paid to data deficiencies. Given that the IUCN Red List of Threatened Species is often used for planning and policy decision making at a national level irrespective of its original intent, future SAFS assessments should ideally be data driven and data deficiencies acknowledged (Possingham et al., 2002). For example, fishery interactions are a dominant threat to pinnipeds worldwide (Kovacs et al., 2012). Profound changes in the abundance and composition of commercially targeted fin-fish stocks has occurred in recent decades in the

South Atlantic, along with an increase in seal-fishery interactions in recent years at the Falkland Islands (Baylis, Tierney, Staniland, et al., 2018; Laptikhovsky, Arkhipkin, & Brickle, 2013). The current SAFS IUCN Red List of Threatened Species assessment concludes that South Atlantic fisheries have a 'negligible effect' on SAFS based on expert opinion (Cárdenas-Alayza et al., 2016). However, data deficiency hinders our understanding of whether changes in fish abundance and composition has affected SAFS population recovery, and the degree to which fisheries and SAFS interact is poorly understood (Baylis, Tierney, Orben, et al., 2018; Baylis, Tierney, Staniland, et al., 2018). Hence, a quantitative assessment of seal-fishery interaction, on the Patagonian Shelf, which maybe trophic or operational, is necessary to understand fishery impacts, if any, and is one of several SAFS knowledge gaps that exist (Baylis et al., 2014; Baylis, Tierney, Staniland, et al., 2018). The 2018 census will serve as a baseline with which to measure population change and to assess SAFS vulnerability to anthropogenic pressures, such as fisheries.

Finally, the Jason Islands group, which accounts for 97 % of SAFS pup production at the Falkland Islands, is important breeding habitat for the species. The Jason Islands group are a priority area for Marine Spatial Planning initiatives at the Falkland Islands, principally because of globally significant breeding colonies of seabirds (Augé, 2016; Augé et al., 2018). Hence, SAFS population data will support any future ecosystem-based Marine Spatial Planning initiatives. Fortuitously, the majority of islands where SAFS breed at the Falkland Islands are designated National Nature Reserves under the *Conservation of Wildlife and Nature Ordinance 1999*, and SAFS are protected in the Falkland Islands under the *Marine Mammal Ordinance 1992* (Otley, Munro, Clausen, & Ingham, 2008). These laws afford enhanced protection within national legislation (Otley et al., 2008). Therefore, SAFS breeding colonies at the Falkland Islands have adequate protection. However, knowledge of movement ecology, particularly from the largest

breeding colonies at the Falkland Islands, is required to understand the at-sea spatial usage of the species and facilitate the development of coherent management and conservation initiatives.

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Author contributions

AMMB conceived the project. AA, JB, PB, AMMB secured resources. AMMB undertook the census and compiled archival material. AMMB and RAO counted photographs. AMMB wrote the manuscript with contributions from all authors.

Conflicts of interest

None

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Table 1: Results of a 2018 census of South American fur seals *Arctocephalus a. australis* breeding at the Falkland Islands. A total of 36,425 pups were counted. *Counts at Beaver Island were particularly challenging due to colony terrain, and the number of pups is an approximation. Values presented as ± 2 s.e., assuming the uncertainty in the original count was 5 - 10 %.

Breeding location	Pup number	% total
Jason Islands Group		
Jason West Cay	12,032 ± 457	33.0
Seal Rocks	9,076 ± 346	24.9
Jason East Cay	7,889 ± 297	21.7
South Jason Is.	2,473 ± 94	6.8
Elephant Jason Is.	2,325 ± 90	6.4
North Fur Is.	1,669 ± 64	4.6
Other		
Bird Is.	493 ± 19	1.4
Volunteer Rocks	230 ± 9	0.6
New Is.	138 ± 5	0.4
Beaver Is.*	100	0.3
Total	**36,425**	

Table 2: Details of South American fur seal *Arctocephalus a. australis* censuses at the Falkland Islands between 1920 and 1980. The census in the 1980s was a partial census. Individual colony counts are not available for censuses in 1965 and in the 1980s. All-age estimates reported in 1925 and 1926 were derived from multiplying the number of pups by 3.16.

Year	**1920**[1]		**1923**[1]		**1925**[1]		**1926**[1]		**1930**[1]	**1931**[1]	**1951**[1,2]		**1965**[3,4]	**1980s**[4]	**1995**[5]
Month	Jan		Jan		Jan		Jan		Jan	Jan	Feb		Jan - March	?	
	Pups	**All ages**	**Pups**	**All ages**	**Pups**	**All ages**	**Pups**	**All ages**	**Pups**	**Pups**	**Pups**	**All Ages**	**All ages**	**All ages**	
Elephant Jason		5,000	400	1,544	2,000		3,000			640		4,000			
Volunteer Rocks		500	50	193	250		47		560			2,000			
Bird Is.			0	500	4	1,000					38				
Beauchene Is.						12									
New Is.												3,000-8,000			257
North Fur Is.												0			
TOTAL	NA	5,500	450	2,237	2,254	8,134	3,047	9,628	560	640	38	9,000-14,000	14,000	18-20,000	

Sources: [1] Data compiled from reference folders NAT/SEA/3–NAT/SEA/5 at the Jane Cameron National Archives, Falkland Islands. [2]Laws (1953), [3]Strange (1983),[4]Strange (1992). [5]Strange (2007)

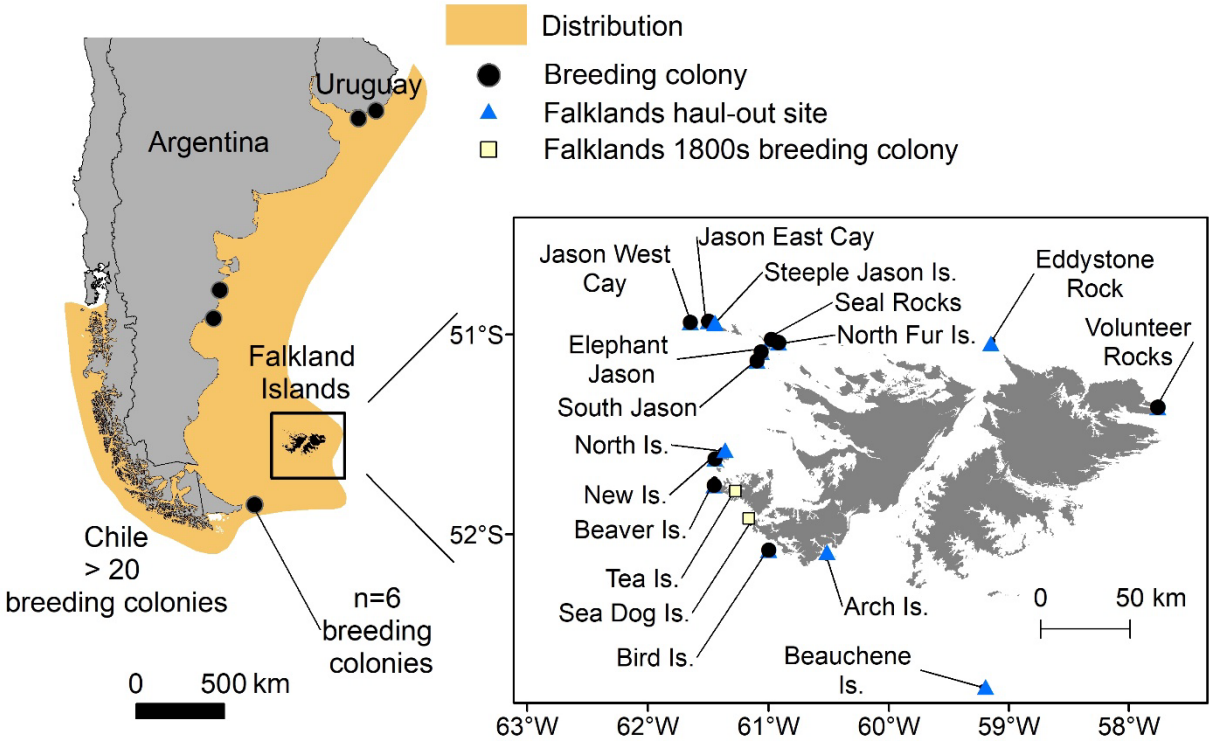
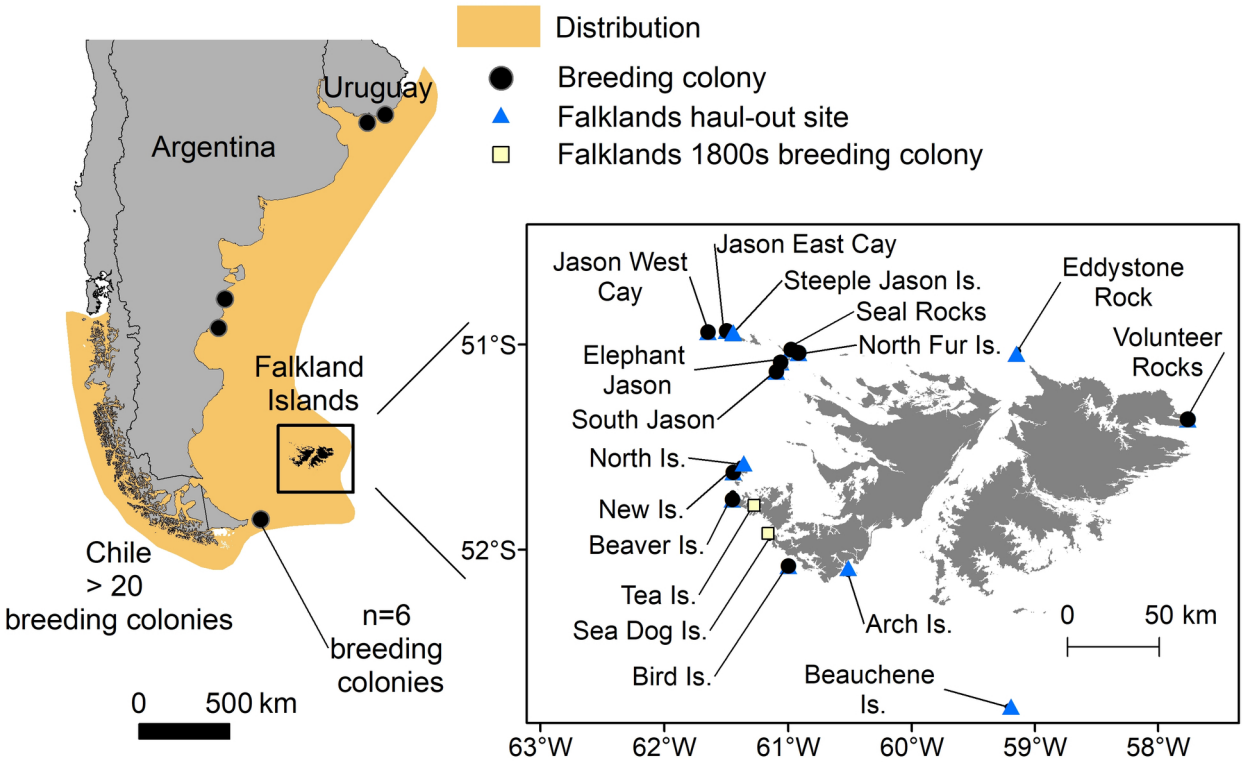


Figure 1: Distribution of South American fur seals *Arctocephalus a. australis* (orange shading) and the location of breeding colonies (black dots). Also presented are the locations of breeding colonies and haul-out sites (blue triangles) at the Falkland Islands, and unconfirmed breeding colony locations in the 1800s (yellow squares).



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