CCAMLR

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Commission pour la conservation de la faune et la flore marines de l'Antarctique
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CCAMLR Ecosystem Monitoring Program on Ardley Island

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Ardley Island, in the Fildes Region, southwest of King George Island, South Shetland Islands (Fig. 1), is an Antarctic Specially Protected Area (ASPA N° 150) and is one of the few areas in Antarctica where the three Pygoscelis penguin species (Adélie, Chinstrap and Gentoo) breed sympatrically. In particular, this is an important area for the Gentoo penguin because a large number breed there, and in consequence, it is classified as 'Important Bird Area (IBA) N°48 (BirdLife International 2015).

In particular, Fildes Peninsula, separated from Ardley Island by an isthmus of approximately 400 m, is one of the largest ice-free areas in Antarctica (Lee *et al.* 2017). Because of this, and in addition to its proximity to South America and the construction of the Chilean airfield in the 1980s, it represents an important logistical hub for the South Shetland Islands and the Antarctic Peninsula. Consequently, this area has the highest density of scientific stations and shelters in Antarctica, and a high level of shipping activity, both tourist and logistical (Braun *et al*. 2014; Brooks *et al*. 2019).

Therefore, due to its geographical position in the rapidly changing western Antarctic Peninsula, in an area that is exposed to strong anthropogenic impact (Gao *et al*. 2021) and within the proposed MPA in the Domain 1 (Hogg *et al*. 2020), the establishment of continuous monitoring of penguin colonies in Ardley Island is relevant to understand the effects of long-term climate change and other sources of anthropogenic pressure such as tourism or fishing.

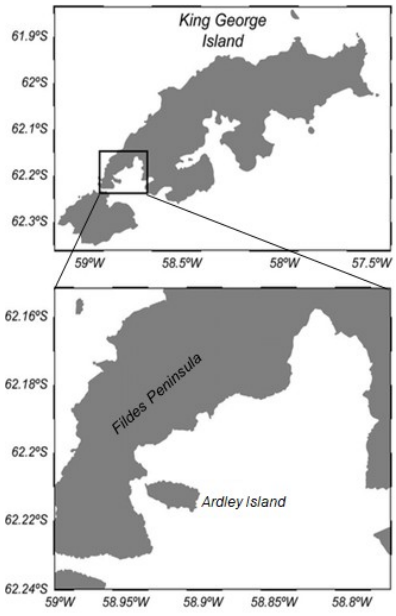

Figure 1. Location of Ardley Island in Fildes Peninsula, King George Island.

Since the 1980s, a research group from the University of Jena, Germany, has been monitoring the breeding pairs and breeding success of three penguin species. According to Braun *et al*. (2017), the numbers of breeding pairs of Chinstrap penguins have decreased by more than 90% since counts began in the 80s, and more than 30% for Adelie penguins. In contrast, Gentoo penguins increased over the same period by more than 80% (Fig. 2). However, this data, collected by this German research team has not yet been reported to CCAMLR.

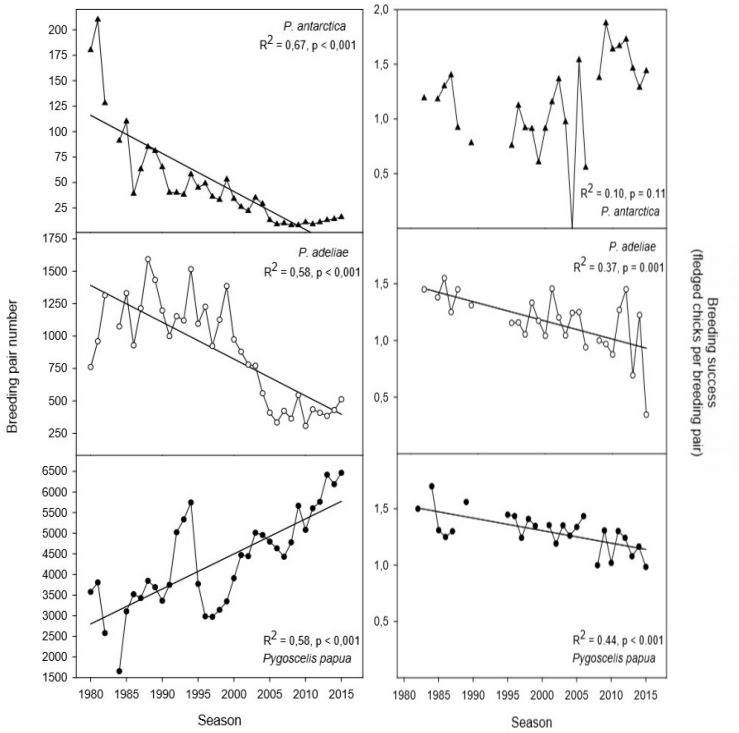

Figure 2. Breeding pair numbers (left) and breeding success (right) of Chinstrap (*P. antarctica*), Adelie (*P. adeliae*) and Gentoo penguins (*P. Gentoo*) on Ardley Island between the 1979/80 and 2017/18. Modified from Braun *et al*. (2017).

During the 2019-2020 summer campaign, as part of a CCAMLR Scientific Scholarship Scheme project, a collaboration with the University of Jena was established, to monitor some population parameters of the penguin colonies, following the standard methods of the CCAMLR Ecosystem Monitoring Program.

Three parameters were measured in the 2019-2020 and 2020-2021 seasons: breeding population size, breeding success and chick weight at fledging. For these parameters only Adelie and Gentoo penguins were considered due to the low number of Chinstrap pairs on the island.

The breeding population size was measured applying the A3A method, which consisted in one week after the peak of egg laying, counting the number of nests occupied in each of the colonies, as well as the number of nests in which the eggs are incubated, making three separate counts in the same day. Unfortunately, this parameter could only be measured in the first season, because in the 2020-2021 season logistical difficulties prevented arrival on time to record the beginning of laying.

The breeding success was measured in Gentoo and Adelie penguins, using the A6C method. For this, three counts were made during the season: (a) on the day that 95% of the nests had eggs, we counted the number of nests with eggs; (b) when hatching was over, we counted the number of nests with chicks; and (c) when all the chicks had entered the crèche, we counted the number of chicks in the crèche.

Finally, the weight of the chicks at fledging was measured applying method A7A. This method consisted of weighing 50 to 100 chicks for 3 periods of 5 days (up to a total of not less than 250 chicks). The chicks were caught on the beach while waiting for the departure to the sea, using a manual net. In the 2019-2020 season this parameter was only measured in Gentoo while in 2020-2021 it was possible to measure it also for Adelie.

The measured parameters and results are presented below (Table 1, 2 and 3):

Table 1. Breeding population size parameter measured with the standard method A3A, for Adelie and Gentoo penguins during the 2019-2020 season.

CCAMLR Standard Method	Species	Nest
A3A Breeding population size	Gentoo	6695
	Adelie	303

Table 2. Breeding success parameter measured with the standard method A6C, for Adelie and Gentoo penguins during the 2019-2020 and 2020-2021 seasons.

CCAMLR Standard Method		Species	Nest with eggs	Nest with chicks	Chicks in crèche
A6C Breeding success	2019-2020	Gentoo	6695	5768	8903
		Adelie	303	262	350
	2020-2021	Gentoo	-	6107	7720
		Adelie	-	353	408

Table 3. Chick weight at fledging measured with the standard method A7A for Adelie and Gentoo penguins during the 2019-2020 and 2020-2021 seasons.

CCAMLR Standard Method		Species	Period	Mean weight (g)	Standard deviation	Sample size (n)
A7A Chick weight at fledging	2019-2020	Gentoo	1	5400	647,17	100
			2	5100	682,65	100
			3	5050	615,48	60
	2020-2021	Gentoo	1	4320	495,50	100
			2	4220	616,00	100
			3	3915	640,40	100
		Adelie	1	3190	459,40	50
			2	2621	409,16	29

Overall, this pilot study settled the basis for a long-term monitoring of ecosystem changes using standard CCAMLR methods, in an area that has become a hub for touristic and logistic

activities in the South Shetland Islands, and where research stations from several countries accumulate. Using penguins as sentinels of Antarctic ecosystems (Le Bohec *et al.* 2013; Ropert-Coudert *et al.* 2019), the information generated by a long-term monitoring scheme will be key for the design, monitoring and assessments of the effectiveness of conservation measures as the proposed MPA. Remarkably, this pilot project allowed recording breeding parameters during the unusual conditions resulting from the logistic restrictions imposed by the COVID-19 pandemic. Thus, providing valuable data on colonies performance when human activities in the area are limited to a minimum. Finally, it highlights the value and relevance of cooperation between nations in Antarctica, as this initiative is aimed at complementing and contributing to the continuity of a monitoring scheme initiated by German scientists more than 30 years ago.

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