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PENGUIN COLONIES AND WEATHER IN ADMIRALTY BAY IN A COLDER YEAR

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Abstract: *Climate change will affect many species in the next decades. Antarctic seabirds are of special concern given their dependence on the balance of sea ice-caps. The objective of this paper is to present information about weather and penguin colonies in the last extreme cold summer of 2009/2010. We verified the average temperature in November (beginning of seabird breeding) which was lower than for most years since 1987 with a slight tendency to decline, and thus the number of snow days was also high in relation to the period average, with a tendency to increase in time. The Adelie Penguin has the biggest colony area followed by Chinstrap Penguin, while Gentoo Penguin has the smallest area. As seabirds breed on ice-free areas, the joint effect of lower temperatures and enhanced precipitation in Spring can affect habitat availability for nesting, potentially disrupting reproduction timing and the future breeding population and success.*

Keywords: air temperature, climate change, ice-fre areas, *Pygoscelids genus*

Introduction

Climate change may affect a great number of species in the next decades (Walther *et al.*, 2002; Thomas *et al.*, 2004). Antarctic seabirds may be particularly sensitive to climate change since they rely on sea ice cap dynamics, which is the factor behind the Antarctic food web balance (Smetacek *et al.*, 1990). The penguins remain on the edge of sea ice caps during the winter months, depending on the Antarctic resources even then, thus they are still more affected by severe weather variations (Ballerini *et al.*, 2009; Dugger *et al.*, 2010) more than flying Antarctic Seabirds (Santora *et al.*, 2009). In the last 2009/2010 summer, the temperature conditions and ice-free areas were limiting factors for most penguin colonies in Admiralty Bay. The enhanced snow accumulation, as a consequence of a rigorous winter registered by the Instituto Nacional de Pesquisas Espaciais (INPE, 2010), lasted until mid-February, when most areas were expected to be ice-free. This weather phenomenon was characterized by the lowest temperatures in the last 40 years (INPE, 2010).The aim of this study is to describe this phenomenon and evaluate its potential effect on the area of penguin colonies at Admiralty Bay.

Materials and Methods

The study was conducted in all the ice-free areas of Admiralty Bay, King George Island, South Shetlands in the 2009/2010 summer. The summer was characterized by lower temperatures than the average for previous years. The average summer temperature in Admiralty bay between 1987 and 2009 was 1.7 °C, while the average in 2009/2010 was 0.6 °C (INPE, 2010). The average temperature at the beginning of seabird breeding (November) was even lower than in most years (Figure 1a), and also snow days were relatively high (Figure 1b). The effect of higher precipitation with lower temperatures was the reason for late snow accumulation. The areas were visited by boat or on foot, and all the periphery of penguin colonies were mapped through GPS receivers.

Figure 1 shows that there has been a slight declining trend in average temperature since the 80's, and a slight trend of enhancement in the number of days with snow precipitation, despite the greater annual variation below the average.

Results

We found a total of 10 colonies of the three *Pygoscelis* species: Gentoo (*P. papua*, Figure 2a), Adelie (*P. adelie*, Figure 2b) and Chinstrap (*P. antarctica*, Figure 2c) (Table 1). Adelie Penguins showed the greatest amount of occupied area in Admiralty Bay, while Gentoo Penguins occupied the smallest amount of area. We found colonies of Gentoo and Adelie only at Point Thomas, while Gentoo occurred in two points, Chabrier Rock and Demay Point (Figure 3).

Discussion

Our results aim only to describe the colonies during the especially cold weather event without assuming any trend, but the distribution of colonies and their analyzed dimensions in the last summer have provided strong indications of how penguins will answer to predicted weather in Admiralty Bay. The ice-free lands are the most

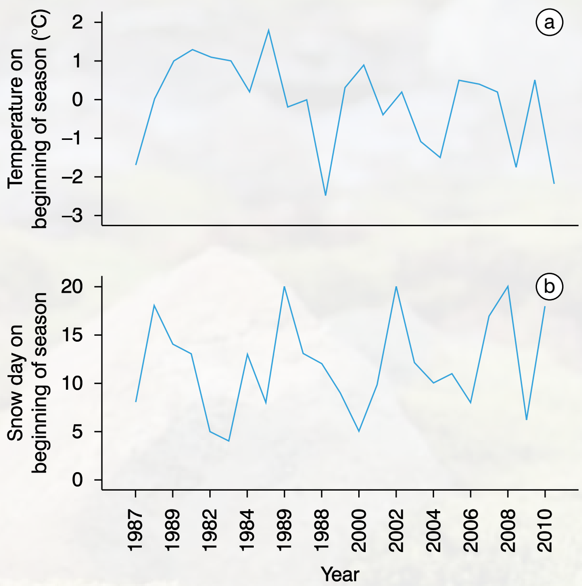

Figure 1. Weather at the beginning of the seabird breeding season (November) in Admiralty Bay: monthly average temperature (a) and cumulative number of days with snow precipitation. The average temperature in these years is –0.1 °C ± 1.2, and the average snow days are 11.9 ± 5. Thus, 2009/2010 summer was a relatively cold season (–2.2 °C) with snow days above average (17).

Figure 2. *Pygoscelids species* that breed at Admiralty Bay: (a) Gentoo *P. papua*, (b) Adelie *P. adeliae*, and (c) Chinstrap *P. antarctica*.

used locations by these species, and the joint effect of greater precipitation and lower temperatures has an immediate disrupting effect on the future reproduction of these species of penguin. We can not justify the effects of temperature on population trends, but the effect of weather is indicative, verified by climate research (Doran *et al.*, 2002; Turner *et al.*, 2005), related to penguins. The several research studies indicate a cooling in Antarctica in different seasons, and although the peninsula tends to warming, South Shetlands average temperature, in particular, is showing a slight decline in Spring. This season is fundamental for breeding seabirds as it is the moment they start reproduction, choosing nesting places and re-establishing their colonies. Seabirds rely on the ice-free areas available at this time and lack of availability can delay the start of reproduction lowering the average success of a colony (Barbraud &Weimerskirch, 2006). Also, late snow-storms and cold fronts can cause greater egg loss and nest abandonment by adults (Mallory *et al.*, 2009), as observed in our field samples at Admiralty Bay and in Elephant Island as well. Other studies provide evidence of the negative effect of enhanced cold for penguins, affecting success, adult survival and size of the breeding population

Table 1. Number of Breeding Groups and total colony areas of each *Pygoscelis* species at Admiralty Bay in the 2009/2010 breeding season.

Penguin species	Number of breeding groups	Total area (m^2)
Chinstrap	7	2469
Adelie	1	7704
Gentoo	2	47

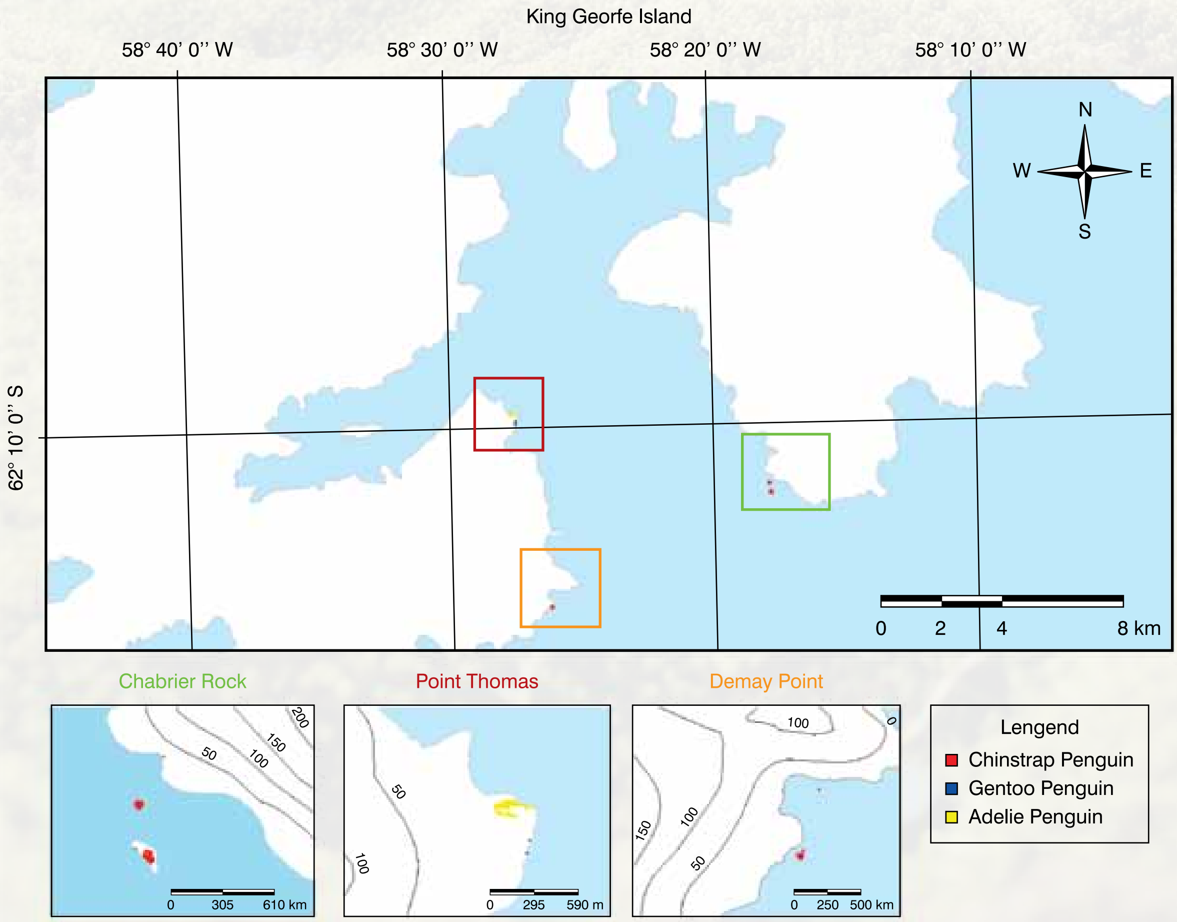

Figure 3. Penguin Colonies at Admiralty Bay in the 2009/2010 breeding season.

(Croxall *et al.,* 2002; Ballerini *et al.,* 2009; Lescröel *et al.,* 2009; Dugger *et al.,* 2010).

Conclusion

Extreme weather events can potentially affect seabird population parameters and colony dynamics. As is expected by weather in Admiralty Bay, the possible scenarios are not favourable in an *a priori* assumption. Our analysis must in the future include the timing between ice-free areas and penguin breeding, plus the variation of colony areas and breeding populations to ice and temperature variation as well; in this way enabling that our expectations can be tested.

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