RESPONSES OF AN ANTARCTIC KELP GULL *Larus dominicanus* REPRODUCTIVE POPULATION TO CLIMATE

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Abstract: The influences of El-Niño over seabird populations have been demonstrated for a great number of species, including Antarctic species. We evaluated the effects of Southern Oscillation Index (an atmospheric component of El-Niño) over a breeding population of Kelp Gulls in Admiralty Bay, King George Island. We counted breeding pairs in all ice-free areas in the 2009/10 and 2010/11 summers, and used past values of the same areas from literature. We found the lower numbers of kelp gull pairs occur at the extreme values of Southern Oscillation Index, the lower and the higher. This is strong evidence of the El-Niño influences on population processes within Admiralty Bay kelp gulls, probably by affecting the decision on breeding or skipping breeding in a given year. Such a situation can affect the population in the long term by reducing their instantaneous breeding success.

Keywords: climatic changes, El-Niño Southern Oscillation, King George Island

Introduction

Climate is the main force driving high-latitude bird populations (Mallory *et al.*, 2009; Croxall *et al.*, 2002). Climate variations can eventually induce breeding adults to abandon their nests or chicks (comprising the main cause of decrease in reproductive success) (Mallory *et al.*, 2009), and affect populations in the long term by reducing adult survival (Rolland *et al.*, 2010) and recruitment rates (Ainley *et al.*, 2005). Egg laying, and size of breeding population can also shift year by year as a response to climate constraints (Croxall *et al.*, 2002; Barbraud & Weimerskirch, 2006). The Variations of the El-Niño Southern Oscillations are influential over the Antarctic Climatic Oscillations and temperature (Changzheng & Feng, 2010). Studies demonstrated that the temperatures are not the only important predictor of seabird responses to climate, but also climatic indexes (Rolland *et al.*, 2010). Thus, our objective is to evaluate whether a breeding population of Kelp Gull respond to El-Niño Southern Oscillation Index (SOI).

Materials and Methods

All the ice-free areas of Admiralty Bay, King George Island (Antarctica) were sampled, excluding the areas near the American Station Copacabana, but including the southern areas of SSSI8 (Figure 1). Censuses were conducted during the 2009/2010 austral summer between November 2009 and March 2010. All breeding pairs were counted, taking in account the active nests, or those that had eggs laid in them. The nests were also mapped with GPS receptors. The ice-free areas were classified in accordance with Sander *et al.* (2006). The abundance of breeding pairs in past years was used (Jablonski, 1986; Sander *et al.*, 2006) to detect time variation as a response to weather. We get the Southern Oscillation Index (SOI – the atmospheric component of El-Niño) data bank from NOAA (www.noaa.gov). To analyze the response of Kelp Gull pairs to SOI we applied an Analysis of Covariance using a negative binomial distribution model as the number of pairs has a similar distribution using the SPSS 18.0 ($\alpha = 95\%$).

Figure 1. Sampled areas in Admiralty Bay, each letter corresponds to a usually ice-free area during the spring and summer. Image adapted from Sander *et al.* (2006). A SSSI 8; B Point Thomas; C Breccia Crag; D Cytadela; E Belweder; F Point Hill; G Dufayel Island; H Cardoso Cove; I Emerald Point; J Lis Point; K Urabnek Crag; L Denais Stack; M Klekowski Crag; N Cre ´pin Point; O Keller Peninsula; P Stenhouse Bluff; Q Cordillera Ullman; R Promotorio Negro Notable; S Ternyck Needle; T Szafer Ridge; U Waikocz; V Hennequin Point; W Rembiszewski Nunataks; X Vaureal Peak; Y Chabrier Rock; Z Harnasia hill.

Results

The number of breeding pairs in all Admiralty Bay was 20 and 24 in 2009/10 and 2010/11 summers, respectively. Five areas presented Kelp Gull reproduction in 2009/10 (A,B,G,O and V) and nine areas in 2010/11, from which five were the same from the last summer plus H,Q and R (Figure 1). By a simple visual comparison with past data (Jablonski, 1986; Sander *et al.*, 2006) we clearly see an abrupt reduction of number of pairs of Kelp Gulls in Admiralty bay between 2004/05 and 2009/2010, which is followed by an increase in the subsequent year, the referred reduction seems to be related to the variation of SOI (Figure 2).

In fact, the number of pairs can be explained by the variation of SOI (Wald- $\chi^2 = 3.7$; $B = -0.31$; $P = 0.05$). The

lower average number of pairs occurred at the extreme values of SOI (Figure 2) in the extreme negative and in the extreme positive, in both years we sampled (2009/10 and 2010/11) (Figure 3). The Higher SOI the warmer the temperature (Figure 4), so, extremes of SOI tends to cause reduction in the reproductive population of Kelp Gulls.

Discussion

One of the consequences of global climate changes is the increase in frequency of cold or warm anomalies. The fauna, particularly the top predators, is simultaneously affected in its breeding and survival by the increased sea ice-cap (Croxall *et al.*, 2002) and variations on the availability and accessibility of food during the breeding period and winter

Figure 2. Average number of Kelp Gull pairs (bars) and average Southern Oscillation Index (line) at each summer in Admiralty Bay. Error bars are standard errors.

Figure 3. Variation of average number of Kelp Gull pairs in response to the average Southern Oscillation Index. Trend line is a quadratic function represented by the equation $Y = 1.6 \cdot X - 1.75 \cdot X^2 + 6.34$; $R^2 = 0.62$.

(Lescroël *et al.*, 2009; Beaulieu *et al.*, 2010). One explanation for such changes is the increasing influence of ENSO in Antarctica (Croxall *et al.*, 2002). The 2009/10 summer was the coldest in the last decades (INPE, 2010). We verified in surveys that there were few ice-free areas, reducing the availability or suitability of breeding habitat, but the subsequent summer (2010/11) was warmer providing a

Figure 4. Variation of Temperature as a response to Southern Oscillation Index (SOI).

greater number of ice-free areas, but there were few breeders as a function of high SOI.

The variations of El-Niño have an influence on Antarctic waters and can affect the animal population and ecological processes within populations. In the short term such effect reduces the numbers of breeding pairs and as a consequence the breeding success of the population. In the long term, recruitment rates can be affected, and it may imply in lower growth rates.

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