FINDING KRILL: FORAGING EFFORT OF *Pygoscelis antarcticus* ON ELEPHANT ISLAND

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Abstract: Penguins were tagged with geolocators to determine individual variations in the foraging habitat of the Chinstrap Penguin (*Pygoscelis antarcticus*) from a breeding group on Elephant Island. The Kernel Density showed two large foraging areas, with the highest centre of density at the north of the Island. There is a difference in habitat between individuals, two individuals remained closer to the island, while two went farther, to the west and to the south. Chinstrap penguins are abundant seabirds that range widely across circumpolar regions. Understanding the foraging ecology of this specie is important for monitoring and ecosystem conservation and management.

Keywords: Foraging Behavior, Geolocation, Chinstrap Penguin, Elephant Island

Introduction

The foraging ecology of seabird species is an essential component for monitoring the ecosystem in Southern Ocean (CCAMLR, 2004), especially to trace a tendency in habitat use by species (Miller *et al.*, 2010; Wilson, 2010). The factors influencing the breeding seabirds foraging behavior include the physical limitations (like the ice barriers at sea), the proximity of the prey concentration to nesting sites, the inter-specific competition, the physiological capacities of each individual, the obligation to return to their colony to feed their chicks, and finally the necessity of a favorable body condition (Clarke *et al.*, 2006). However, individual variations of foraging areas should exist as consequence of the factors that act on a population. Therefore, the goal of this work is to evaluate foraging habitat used by individuals of *Pygoscelis antarcticus* tagged with geolocators and comparing the individual variations.

Materials and Methods

The study was conducted in the region of Stinker Point, Elephant Island (61°13'20.5"S 55°21'35"W) (Figure 1). Penguins were monitored by using Geolocators in the austral summer, December 2011 to March 2012. Lotek

Lat 2900 geolocators were used on penguins in the reproductive period. The devices were fixed in the feathers of the bottom dorsal part of the animals back with Tesa tape. The registered geographical points were filtered using the Standard Distance of ArcGis tool, through which was calculated a threshold distance of two standard deviations from the mean position of the cloud of points. All points outside the threshold distance were excluded from the analysis.

The extracted variables were: geographic positioning, distance from breeding group, depth from the used area and Kernel Density. ArcGis was used to extract the variables. Individual variation was assessed using Discriminant Analysis and ANOVA Multifactorial through SPSS 18.

Results

Four (4) individuals of Chinstrap Penguin (*Pygoscelis antarcticus*) were monitored. The foraging effort of individuals within the Polar Front zone was not homogeneous (Figure 2), but associated with productivity of oceanic areas (Nicol, 2006). The association between the foraging habitats of Chinstrap Penguin with these

Figure 1. Study area: A. Antarctic Peninsula, South Shetland Islands and South America; B. Elephant Island; C. Stinker Point region and a breeding group of *Pygoscelis antarcticus*.

productive oceanic areas reflects the availability of prey. Kernel Density showed two major foraging areas distributed latitudinally towards Elephant Island, with the center of higher density northeast of the island (Figure 2).

The Discriminant Analysis resulted in 2 Functions. Function 1 explained 95.1% of variation of data (Canonical Correlation = 0.97) and the Function 2 explained 4.9% of the variation of data (Canonical Correlation = 0.65) (Figure 2). The Function 1 is represented by the variables Longitude (0.83) and distance from the breeding colony (0.84), while the Function 2 is expressed by the depth (0.89), Latitude (-0.58) and Kernel (0.34) (Figure 3). There is a difference of foraging habitat between individuals (Function 1: $F_{3,39}=188,6; p < 0,001$; Function 2: $F_{3,39}=9,7; p < 0,001$) except between individuals A and B (Figure 4). The individual C travels more longitudes and therefore reaches distances far from the breeding colony, while other individuals remain at

latitudes closer to the colony. However, individual D used less profound, southernmost of foraging areas.

Discussion

The maximum distance that the individual D foraged from the breeding colony was 2.455 km, while the other individuals foraged in central areas, located north and closer to the breeding colony, corroborating with the records obtained from Chinstrap Penguins that breed on King George Island (Trivelpiece *et al.*, 2007). The penguins in Trivelpiece *et al.* (2007) traveled greater distances, as far as 1.500 km, but only roaming a 20 km distance from the breeding colony area. The highest population density zone of Antarctic krill (*Euphausia superba*) is in the South Atlantic around islands and along the continental shelf (Nicol, 2006). Therefore, it is expected that these habitats are targeted by seabirds, particularly the Chinstrap Penguin that relies almost exclusively of Antarctic Krill.

Figure 2. Spatial distribution of the foraging area by the individuals of *Pygoscelis antarcticus* on Elephant Island. Kernel Density obtained by the geographic points of the penguins tags.

Figure 3. Biplot of the discriminant analysis. Penguins A (purple circle), B (yellow circle), C (green square) and D (red triangle). C and D used different habitats than B and A. The Function 1 is represented by the variables Longitude (0.83) and distance from the breeding colony (0.84), while the Function 2 is expressed by the depth (0.89), latitude (-0.58) and Kernel (0.34).

Figure 4. Discriminant Scores average values (centroids) (F1 and F2) for each penguin. A, B, C and D are the tagged penguins. Error bars are standard error.

Conclusion

Telemetry is an excellent tool to evaluate the foraging habitat of breeding birds thus allowing essential knowledge for project applicability of management and conservation of these areas. It can be concluded that the Chinstrap Penguins have different individual foraging strategies; however more studies are needed on the foraging habit of this species, such

as increase the sampling numbers, use of satellite imagery resources and application of satellite tags to improve the evaluation of foraging routes.

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