MORPHOMETRY OF SPECIMENS OF CAPE PETREL (*Daption capense*) (LINNAEUS, 1758) ON ELEFANT ISLAND, ANTARCTICA

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Abstract: Birds with monomorphic plumage, such as *Daption capense*, could indicate a lack of research due to the difficulty in identifying males and females, especially if the difference in body size between the sexes is small. With this study we (i) verify the existence of a correlation between morphometric measures and (ii) identify which measures present a greater variation between individuals of a species. The study occurred in Sinker Point, where 10 morphometric values were measured in 45 adult individuals. The four axes of the Principal Components Analysis explained 64.3% of the variation, with axis 1 explaining 23.1%, axis 2 15.4%, axis 3 13.2% and axis 4 12.4%. The variables right wing and left wing were most highly correlated ($r = 0.648$), followed by the weight and beak height ($r = 0.426$), right wing and beak height ($r = 0.352$) and length and weight ($r = 0.330$). Distinguishing the sex of individual specimens is an essential component in animal studies. It is necessary to confirm these results through deoxyribonucleic acid analyses since factors such as geographic variation may influence the size of species.

Keywords: Biometry, Cape Petrel, Principal Component Analysis, Antarctica

Introduction

The bright colors present in many animal species may be related to evolution (Andersson, 1994). Various variables have been suggested to explain colors in birds, including protection against ultraviolet (UV) radiation, thermoregulation, camouflage and predator distraction (Bortolotti, 2006). Birds with monomorphic plumage, especially if the difference in body size between the sexes is small, could indicate a lack of research due to the difficulty in identifying males and females.

Morphometric measures are considered to be important tools in the determination of a specific sex. However, true identification requires other factors such as observing behaviors of copulation and courtship during the reproductive season cloacal exam (Boersma & Davies, 1987; Catry *et al.*, 1999; Gray & Hamer, 2001), or more recently, the use of techniques based on deoxyribonucleic acid (DNA) (Ellegren & Sheldon, 1997; Jodice *et al.*, 2000), which will truly provide adequate information. Sex determination becomes a valuable tool in behavioral and population

studies in species without apparent sexual dimorphism (Winkler & Leisler, 1985), and considerably increases the correct interpretation of ecological data (Fletcher & Hamer, 2011). According to Kilhan (1970), males and females can exploit different ecological niches. Winkler & Leisler (1985) believed that the competition between partners could be reduced through different forms of habitat exploration between the sexes.

Daption capense, popularly known as the Cape Petrel (Sick, 1997), is a small Procellariiform and presents the least amount of sexual dimorphism among this order (Sagar, 1986). Weidinger & Van Franeker (1998) state that *D. capense* presents small morphometric differences between males and females. Sexual dimorphism is evident in most petrels, in which males tend to be larger than females, with the exception of Storm Petrels (*Oceanites oceanicus*), where they may be smaller (Bourne, 1985). Considering the importance of morphometric variables in the comprehension of ecological and biological aspects, and particularly in sex

determination, which has been cited in the literature, this study aims to (i) verify whether or not there is a correlation in the morphometric data and (ii) identify which measures vary the most between individuals measured.

Materials and Methods

Study area

The study was conducted on Stinker Point, Elephant Island, Antarctica (61°07'31"S, 55°19'26"W). Stinker Point is one of the diverse regions found on Elephant Island that is not covered by ice during the summer, and along with the rock escarpments it serves as a nesting and reproductive area for various marine bird species, including *D. capense*.

Methodology

During the austral summer of the southern hemisphere and in locations that would supposedly support nesting, adult individuals of *D. capense* were captured with bare hands. The captured individuals were placed in cloth bags and were measured. The following 10 morphometric data were collected: weight (in grams) with a dynamometer (1000g); total body length and length of both wings and tail (500 mm ruler); and tarsus, middle toe length, height, width and total bill length with a caliper. Measurements were usually taken by two different researchers. All of the measurements, except weight, which was recorded in grams, were recorded in millimeters in a field data sheet.

Data analysis

In order to determine which morphometric measures presented the greatest variation between individuals and the consequent ability to infer sexual determination for *D. capense*, we applied a Principal Components Analysis

(PCA). A correlation analysis was also used as a measure of similarity and the data were normalized by the principal variable method. The analyses were performed on the software Statistical Package for the Social Sciences (SPSS) 18.

Results

Forty-five individuals were captured and measured (Table 1).

The four principle axes of the PCA explained 64.3% of the variation: axis 1 explained 23.1%, axis 2 explained 15.4%, axis 3 explained 13.2% and axis 4 explained 12.4%. The variable middle toe length contributed the most to the variation of axis 1, followed by the variable total length (Table 2). The variables right and left wing contributed the most to the variation of axis 2, followed by the variable tarsus (Figure 1).

The variables right wing and left wing were most highly correlated ($r = 0.648$), followed by the weight and beak height ($r = 0.426$), right wing and beak height ($r = 0.352$) and length and weight ($r = 0.330$). The average weight of the 45 individuals (442.8 ± 87.7) found in our study was less than that found in other studies in Antarctica for known individuals such as *D. capense* males (Marchant & Higgins, 1990; Weidinger & Van Franeker, 1998).

Discussion

Sagar (1986) also found lower values for males of *D. capense australe*. Pinder (1966) found the same weight as that which was measured at Signy Island and greater than the weight measured by Weidinger & Van Franeker (1998) on King George Island. The weight of the females of our study was greater than that of the females of these other islands.

Table 1. Average and standard error of the measurements of 45 individuals of *Daption capense*.

	Beak				Wing		Tail length	Length	Mf	Tarsus
	Weight	Height	Width	Length	Right	Left				
Mean	442.8	13.8	15.3	30.6	277.0	276.4	97.3	358.8	46.8	41.1
SD	± 87.7	± 1.7	± 1.4	± 2.7	± 9.1	± 8.9	± 6.4	± 25.2	± 3.6	± 3.4

Key: Mf: middle finger, SD: standard deviation

Figure 1. Results of the PCA (Principal Component Analysis) demonstrating the group formed and the biometric variables that best explain each axis.

Table 2. Scores of the biometric variables that participated in the formation of the Principal Component Analysis (PCA) axes.

Variable	Dimension	
	1	2
Weight	-0,101	0,109
Peak height	0,169	-0,151
Peak width	0,56	-0,483
Length of nozzle	0,496	-0,404
Right wing	0,604	0,725
Left wing	0,566	0,669
Length of the tail	-0,078	-0,217
Length	0,713	-0,147
Middle finger	0,776	-0,047
Tarsus	-0,321	0,576

Andersson (1994) states that in groups of birds, mammals and reptiles, the male individuals are generally larger than the females. The larger body size in males can be attributed to the act of sexual selection, or, evolutionally speaking, the larger the male's body size the greater is his access to females (Andersson, 1994). Body mass in birds can vary according to the season, sex, population and hour of the day, since weight will usually be higher at the end of the day and lower after a night of fasting (Clark, 1979). However, due to caring efforts before and after incubation, it is possible that females increase their accumulated energy reserves and therefore become heavier (Clark, 1979). The state of the life cycle and the activity of molting, especially in migratory birds, influence their weight since the energy spent during reproduction, reproductive resting and

molting feathers is different and have different physiological requirements (Gill, 1995). Additionally, studies show that small variations in weight and other measurements occur in different geographical distributions (Weidinger & Van Franeker, 1998).

Conclusion

Determining the sex of individuals is essential in most studies of animal species. Through comparisons of some of the morphometric measurements taken in this study with those found in the literature, it is not possible to identify whether the individuals measured in this study are males or females. It is still necessary to confirm these results with DNA analysis, which will be conducted next, as there could be other factors that influence the size of this species, such as geographic variation. However, we were able to determine that some morphometric measurements are more important

in their contribution of more information in explaining the axes.

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