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Short Note

Seeking dimorphism in monomorphic species: the lure of the gannet's mask

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Introduction

In fieldwork studies it is often important to be able to sex individuals reliably and rapidly. In many birds, secondary sexual ornaments or plumage variations distinguish males from females, but most seabirds are monomorphic, requiring other sexing techniques. Egg laying is the most reliable way to distinguish breeding females, but this implies sustained periods of observation. Other behavioural differences related to sex (e.g. reproductive displays, copulation, songs) may be used but they are not absolute indices. Other techniques involve cloacal examination (e.g. Samour *et al*. 1983) or blood/feather sampling for molecular analysis (Griffiths *et al*. 1996). The latter is increasingly used because of its reliability and relative ease of sampling, but it is an expensive technique that requires specific skills and equipment.

Gannets and boobies (Sulidae) exhibit limited plumage dimorphism and limited size dimorphism (Nelson 1978, Redman *et al*. 2002), although Red-footed Boobies *Sula sula* have reverse size dimorphism (Weimerskirch *et al*. submitted) and Northern Gannets *Morus bassanus* exhibit different foraging patterns at sea between sexes (Lewis *et al*. 2002). The mask that surrounds the bill and eyes and extends in a gular stripe in gannets is a unique feature of these birds. While interspecific differences exist in the extent of the gular stripe between Australasian Gannets *M. serrator* and Cape Gannets *M. capensis* (Nelson 1978), sexual dimorphism in the patterns of the mask have not been noted.

During fieldwork to study Cape Gannet foraging ecology in South Africa, we observed substantial inter-individual variability in the length of the exposed black skin extending behind the gape (Figure 1), hereafter termed as 'psilodermal stripe' (from Greek *psilos* = bare, and *derma* = skin). Because the sexes of all birds equipped with loggers were determined using molecular analysis, we collected a series of morphometrics, including the length of the psilodermal stripe, to test if individual differences in the length of this feature could be related to sexual differences.

Methods

The study took place at Cape Gannet breeding colonies on Malgas Island (33°3'S, 17°55'E) and Bird Island, Lambert's Bay (32°5'S, 18°18'E), South Africa, during November–December 2003. The following morphometrics were measured on 30 birds at Malgas Island and 51 birds at Bird Island: total head length (to nearest 0.1mm), wing (1mm) and psilodermal stripe from the rictus of the mouth to the visible end of the strip (length L in Figure 1; to the nearest 0.1mm using calipers). Measurements were performed by the same person throughout. A few feathers were taken for sexing (see Griffiths *et al*. 1996 for further details). Morphometrics were compared between males and females with Mann-Whitney test using Statview (Version 4.57, Abacus Concepts Inc. 1996). Values are presented as means ± SD (Table 1).

Results

For each sex, there was no difference in the lengths of the psilodermal stripe and heads of birds between each colony (Table 1). Similarly, the wing length of females did not differ between Malgas and Lambert's Bay, but the wings of males from Lambert's Bay were significantly longer than those of males in Malgas (Table 1). The length of the psilodermal stripes of males (27.61 ± 5.28mm, $n = 37$) was not significantly different ($Z = -1.02$, $P = 0.30$) from that of females (26.48 ± 4.27mm, $n = 44$) when data were pooled by colonies, as well as when compared within colonies (Malgas: $Z = -1.95$, $P = 0.05$; Lambert's Bay: $Z = -0.25$, $P = 0.81$). Similarly, the lengths of the head (190.3 ± 35.3mm) and wings (475 ± 10mm) of males ($n = 32$) were not significantly different (head length: $Z = -1.06$, $P = 0.29$; wing: $Z = -0.4$, $P = 0.66$) from that of females (head length: 194.0 ± 8.8mm; wing: 473 ± 11mm, $n = 41$). The distribution of the psilodermal stripe lengths appeared bimodal when data from males and females were pooled together, as well as when considered separately, with a first peak at 25mm and a second peak at 31mm. However, the distributions of males and females overlapped largely (Figure 2).

Discussion

Our results show that the length of the psilodermal stripe does not seem to be related to sexual dimorphism. Although the Mann-Whitney tests indicated that there is no statistically significant difference between the sexes at both the Malgas colony and the Lambert's Bay colony, there was a greater degree of dimorphism at Malgas Island (12.3% difference between males and females) compared to that at Lambert's Bay (0.7% difference). It is interesting to note that the population at Malgas Island is much bigger (70 000 breeding pairs) than the colony at Lambert's Bay (17 000 breeding pairs; Grémillet *et al*. 2004). Colony size is known to affect the degree of dimorphism of a species. For instance, Tomkins and Brown (2004) documented a transition from completely monomorphic to dimorphic populations on two colonies of European Earwig *Forficula auricularia* separated by only 40km. They showed that population density drove the local evolution of the male dimorphism in these populations. In our data, the sample size at Malagas was unfortunately smaller than that at Lambert's Bay, so that we cannot fully ascertain that the near-difference in psilodermal stripe length may represent a form of sexual ornamentation in this bigger colony.

Nonetheless, the distribution of the length of the stripe showed substantial inter-individual variability, with a tendency to bimodality. Since all birds sampled were tending small chicks, this bimodality is unlikely to be related to differences in the breeding stage. Further studies should test the biological significance, if any, of this morphometrical difference, especially in relation to other factors than sex, such as age, fitness or environmental variables.

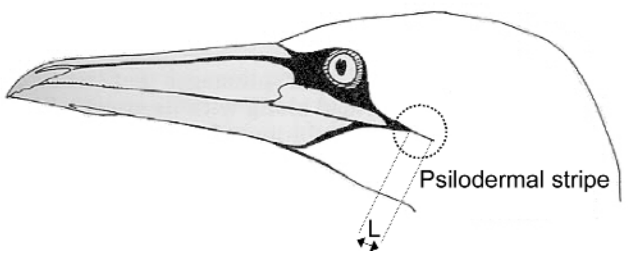

Figure 1: Head of a male Cape gannet, showing the psilodermal stripe. Modified from Nelson (1978)

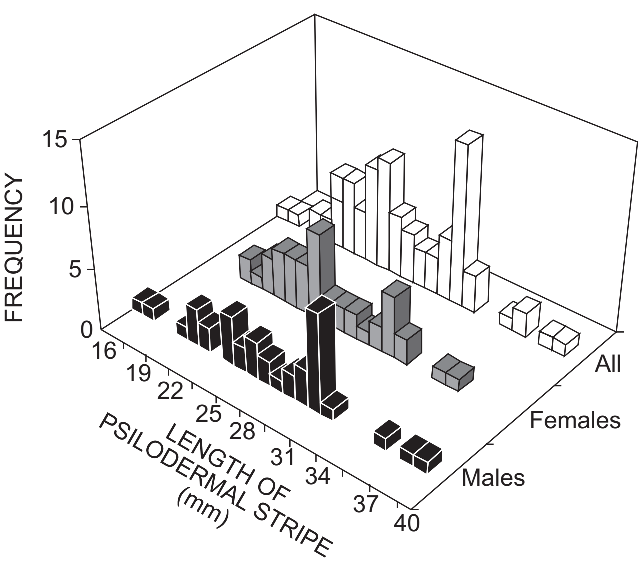

Figure 2: Frequency distribution of the length of the psilodermal stripe of males (black bars), females (grey bars) and all birds pooled together (clear bars)

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Table 1. Morphometrics of male and female Cape Gannets from the colonies of Malgas Island and Lambert's Bay, South Africa. Values are presented as means ± SD

		Malgas Island (n)	Lambert's Bay (n)	Mann-Whitney tests
Males	Wing length (mm)	193.0 ± 8.0 (13)	199.0 ± 7.2 (19)	Z = –2.19, P = 0.03
	Head length (mm)	476.0 ± 127.2 (13)	474.4 ± 91.4 (19)	Z = –0.50, P = 0.62
	Psilodermal stripe (mm)	29.3 ± 5.8 (13)	26.7 ± 4.8 (24)	Z = –1.77, P = 0.08
Females	Wing length (mm)	193.9 ± 11.2 (17)	194.1 ± 6.8 (24)	Z = –0.73, P = 0.47
	Head length (mm)	475.1 ± 9.2 (17)	471.5 ± 12.7 (24)	Z = –0.89, P = 0.38
	Psilodermal stripe (mm)	25.7 ± 3.9 (17)	26.9 ± 4.5 (27)	Z = –0.90, P = 0.38

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