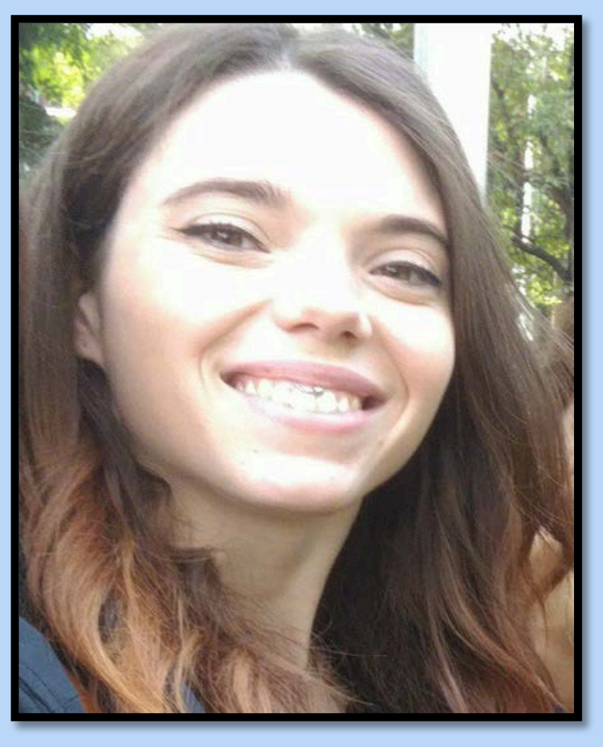

Southern elephant seals 'nose-metrics'using image analysis in wild animals

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Introduction

Geometric morphometrics is usually applied to hard tissues, such as bones, and rarely to soft tissues of live animals. The proboscis of male Southern elephant seals (*Mirounga leonina*) is one of the most impressive secondary sexual traits, plays a role in the emission of vocalizations, is related to breeding status, and can be a target of female mating choice.

Fig. 1 – Landmark/semilandmark configuration on the outline of the proboscis.

Methods

We carried out the field work at Sea Lion Island (Falkland Islands) in 2016, on individually recognized, know age, males. We took digital photos in side view of 43 vocalizing males, with fully inflated proboscis, with a scale bar aligned to the body mid plane (Fig. 1). We took three independent series of photos of each male, and from each series we chose the photo with maximum proboscis inflation. Each male was classified as mature (>= 9 years) or immature (age range: 6-8 years).

A configuration of 4 landmarks and 19 semilandmarks was digitized twice on the outline of the proboscis to estimate the proportion of variation explained by: 1) the age class; 2) the male identity; 3) the photographic error; 4) the landmarks digitalization error.

Size		Shape	
Age class	30.4%	Age class	7.6%
Individual	53.2%	Individual	80.3%
Photo	8.8%	Photo	10.0%
Digitalization	7.6%	Digitalization	2.0%

Table 1 – Percentages of variation in proboscis size and shape accounted for by different factors.

Results

- Mature and immature males differed significantly in both size and shape (respectively, P=0.0001 and P=0.0080; Fig. 2, 3) However, size accounted for much more variation than shape (ca. 4 times more - Tab. 1).
- Individual variation was significant and ca. 3 (size) to 7 (shape) times larger than total measurement error (Tab. 1).

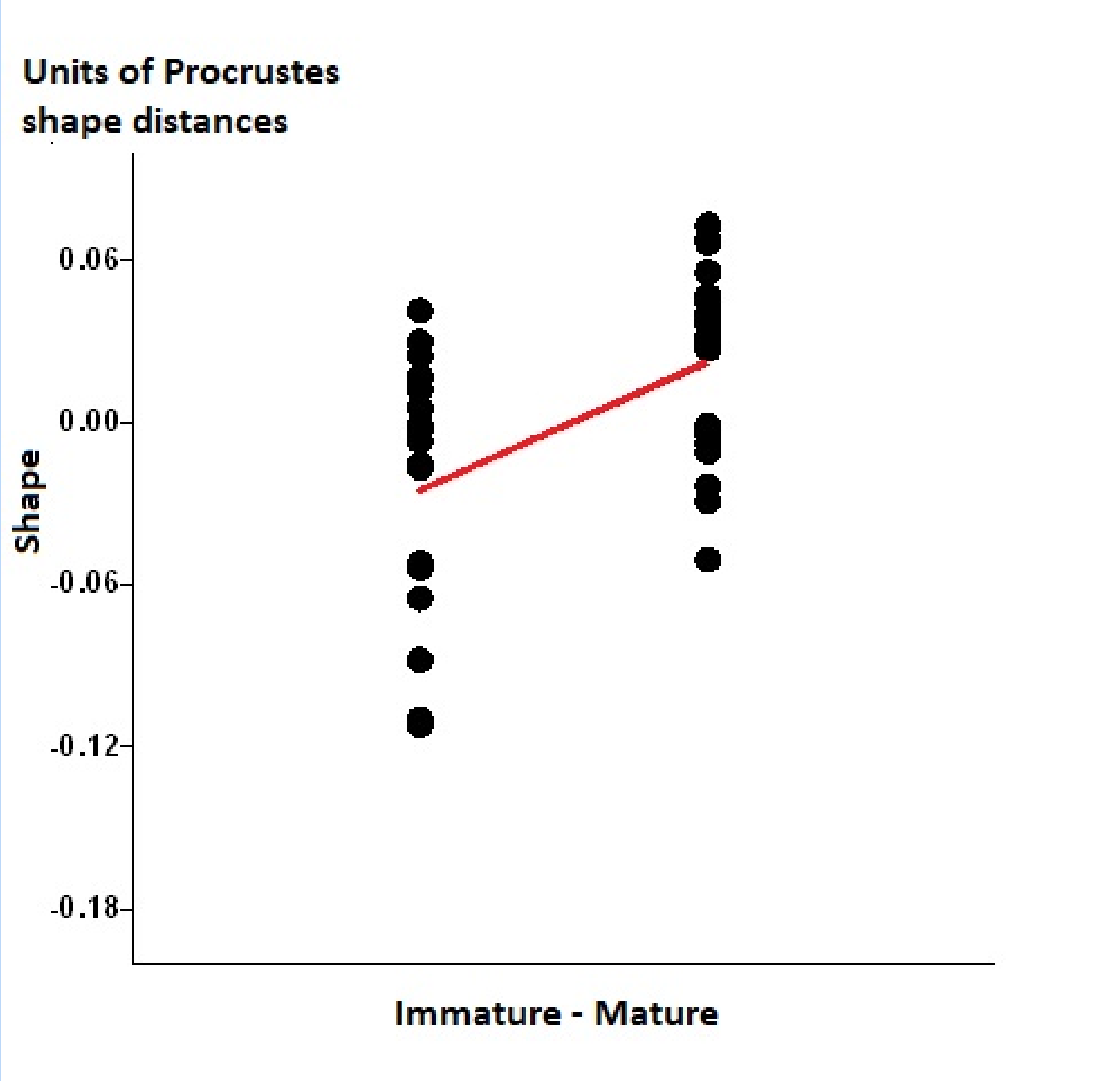

Fig. 2 – Summary 'jitter plot' of between age shape differences; the regression line connects the average shapes.

- Digitizing error was smaller than photographic error where as total error was greater for size than shape (16.4% vs. 12.1%).

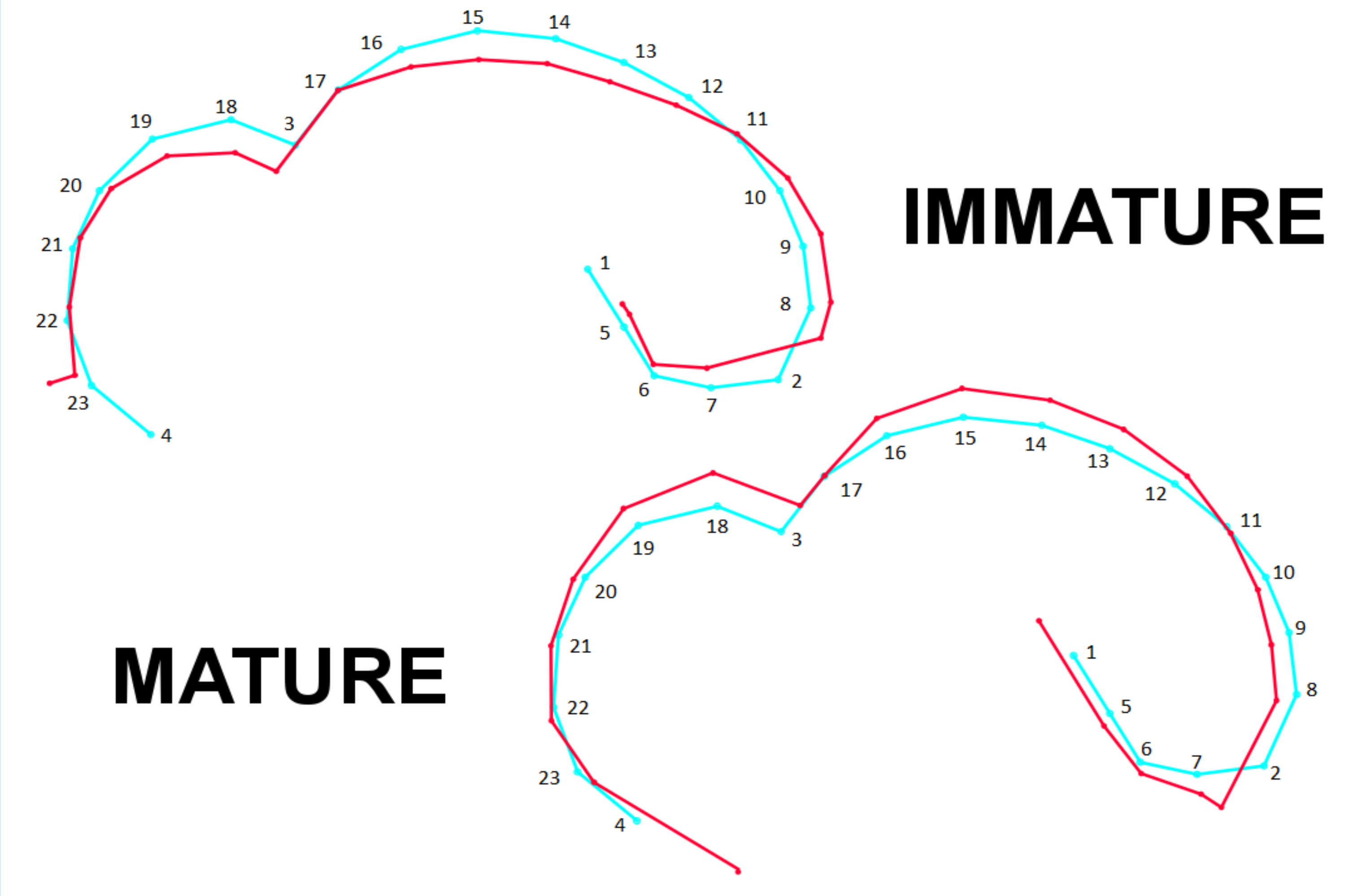

Fig. 3 Average shapes of the two age classes (red wireframes) compared to the total sample grand average (light blue). Differences are magnified 5 times.

Conclusions

Fully adult males not only have longer proboscis but also show remarkably different shapes. On a larger sample, it will be interesting to assess whether shape differences are largely correlated to size (i.e., they are allometric).

Although measurement error is large, despite the difficulties of standardizing pictures of live animals, it is several times smaller than inter-individual differences. Also, a larger error in size than shape is unusual but might be explained by the different swelling of the proboscis in relation to the animal motivational state and thus partly reflect a 'biological effect'.

The good repeatibility suggests that this type of analyses can be fruitfully used to quantify the proboscis size and shape and investigate whether they covary with individual fitness or other life history traits.

Research project website: www.eleseal.org