Anatomical correlates of honest communication in Southern Elephant seals

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Introduction

Honest signalling is the transmission of reliable information about the phenotype of the individual emitting the signal. As per the source filter theory, frequency formants of vocalizations should be an honest signal of phenotype because they depend on vocal tract size (VT, hereafter), that is constrained by body size. Southern elephant seal (*Mirounga leonina*) males use vocalizations to settle agonistic interactions and establish dominance. A high dominance rank is a crucial factor to get a high reproductive success in the extremely polygynous mating system of elephant seals. Here, test the key assumption of the theory of honest vocal signalling, i.e., that VT of male elephant seals is related to their structural phenotype (body length, skull length, age).

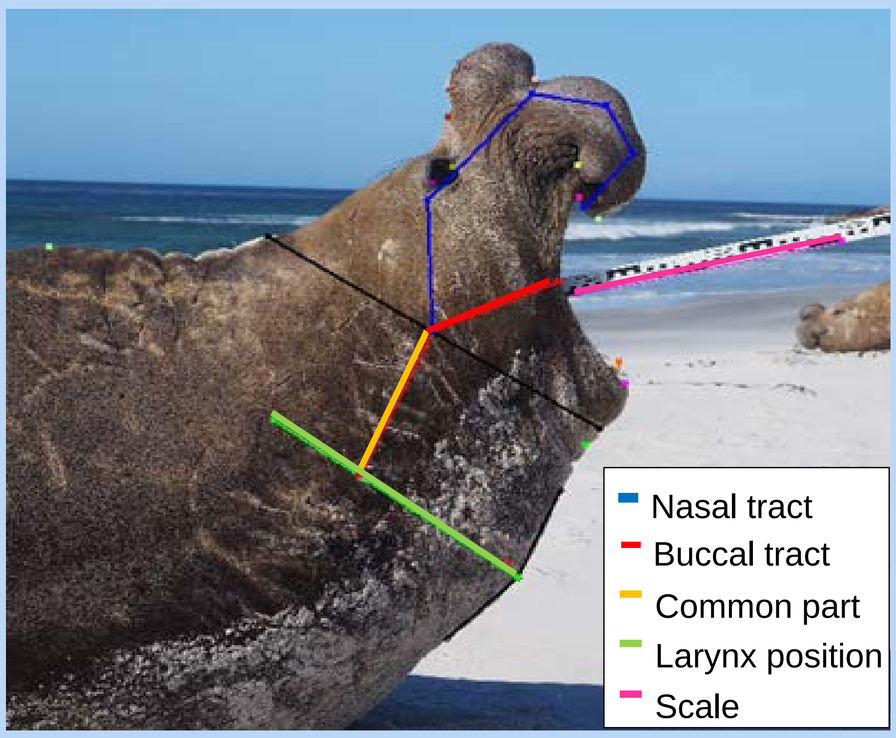

Fig. 1 – Diagram of the VT measurement method.

Methods

We studied southern elephant seals at Sea Lion Island, the main colony of the species in the Falkland Islands, in 2016. We estimated body length, skull size, and vocal tract length of 34 breeding males. We estimated body length by photogrammetry, and vocal tract length by videogrammetry. Each male was marked at birth, so his age was known. We placed a scale in front of the vocalizing male, aligned to the middle plane of his body, and we took a digital video from the side of the subject. The larynx was clearly visible in videos of all males. From videos we extracted high resolution frames (using Adobe Premiere CS6). We imported the frames in ImageJ, and we measured various features of VT using the ObjectImage plugin. We obtained measurements of all the parts of VT (common, buccal, nasal).

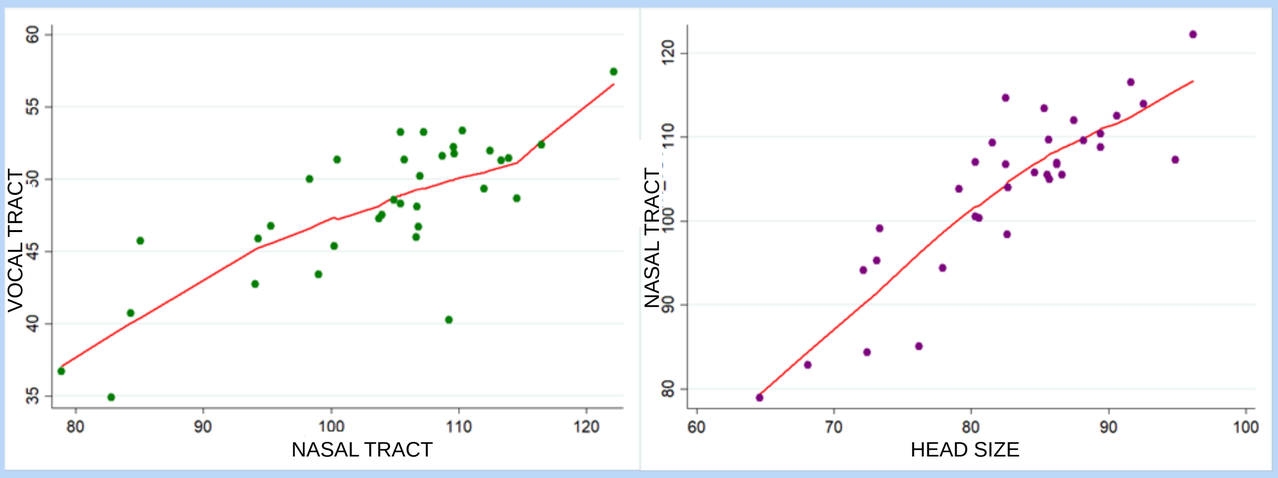

Fig. 2 – Relationships between different parts of the vocal tract.

Results

We obtained a high repeatability for all measurements (R>0.80), so our method was reliable.

We confirmed the expected positive relationships between VT, body length, skull size, and age, but with some differences respect to other studies:

- the relationships were less strong than the ones obtained in studies of captive subjects of other species (VT obtained by radiography of sedated subjects)
- the relationships were stronger for the nasal part (R^2 = 0.61) than for the buccal or common part of the tract (R^2 = 0.19 and 0.08 respectively)
- although vocal tract size was related to age (R^2 = 0.14), the relationship was less strong than the one with size (R^2 = 0.32).

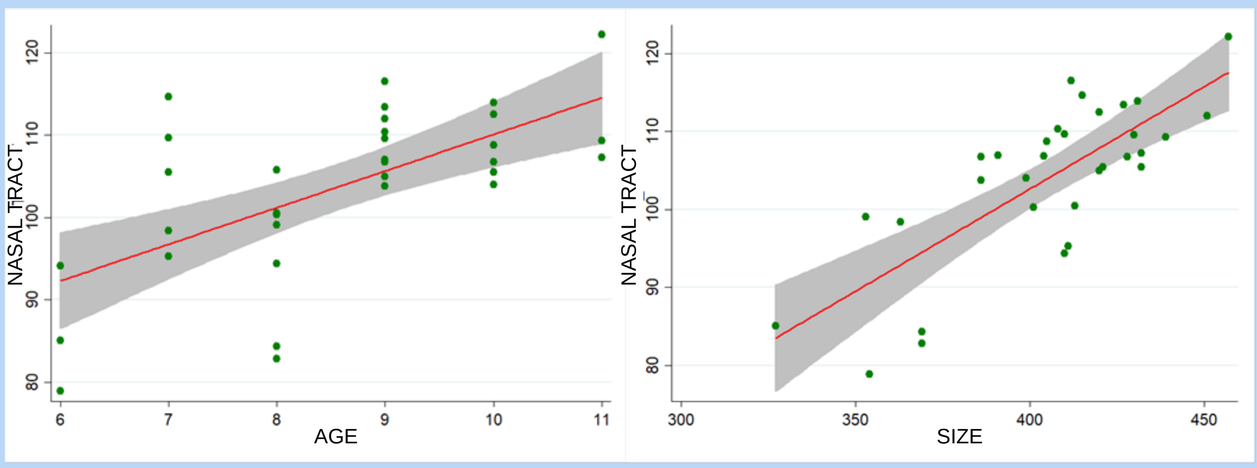

Fig. 3 – Relationships between vocal tract and age and vocal tract and length.

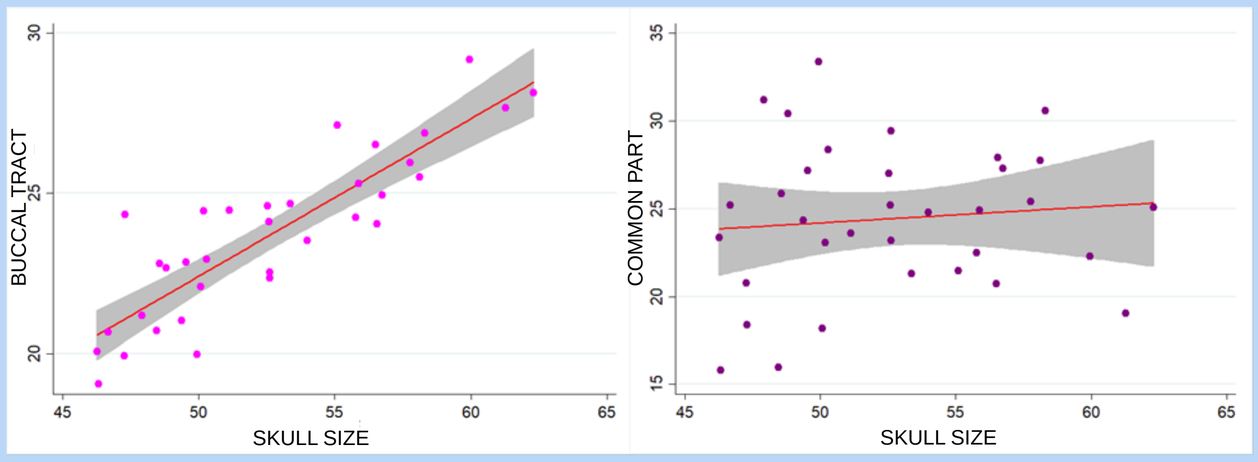

Fig. 4 – Relationships between vocal tract parts and skull size.

Conclusions

- It is possible to obtain reliable estimates of VT in a large mammal, studied in a wild population, and in the course of its natural behavior.
- VT of southern elephant seals has a positive relationship with body length, skull size and age.
- The structural bond between size and vocal tract provides the anatomical basis for the honesty of the vocal signals used by elephant seals during competition for access to females.

Research project website: www.eleseal.org