Honest signalling in male and female southern elephant seals

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Introduction

In animal communication, a signal is honest if it transmit reliable information about the phenotype of the emitter. Signalling during agonistic contests is particularly important, because it permits to settle social conflicts without fights. In mammals, acoustic signals can be honest because frequency formants depend on vocal tract length, which is constrained by body size and, therefore, age. We studied vocalizations of southern elephant seals (*Mirounga leonina*), that have a complex social and mating system, in which both males and females use vocalizations to establish dominance. We expected formants to be related to size and age in both sexes, but we also expected stronger relationships in males, due to the importance of vocalizations for male breeding success.

Fig. 1 – Reciprocal vocalization of two breeding males.

Methods

We carried out field work at Sea Lion Island (Falkland Islands) during the 2016 elephant seal breeding season. We recorded vocalization of individually marked, know age, elephant seals with digital recorders (uncompressed 48KHz WAV) and supercardiod microphones. We obtained recordings of 32 males and 88 females. Body length was estimated by photogrammetry. We extracted the first five formants (F1-F5) using PRAAT software, and we calculated the formant dispersion (= average spacing between consecutive formants; F disp). Individuality of formants was measured by the potential for individual coding (PIC). Strength of formant-phenotype relationships was measured by the proportion of variance explained by linear regression models (= coefficient of determination of the regression).

Results

- Formants showed high individuality (PIC > 1 in all cases), higher in males (Table 1).

Formant	Males	Females
F1	3.40	1.81
F2	6.02	2.90
F3	6.18	2.11
F4	6.96	2.26
F5	10.45	3.36
F disp	9.89	2.57

Table 1 – Potential for individual coding of formants.

- Formants showed negative relationships with body length and age in both males (e.g., F4, Fig. 2) and females, but strength of relationships was always greater for males than for females (Table 2).

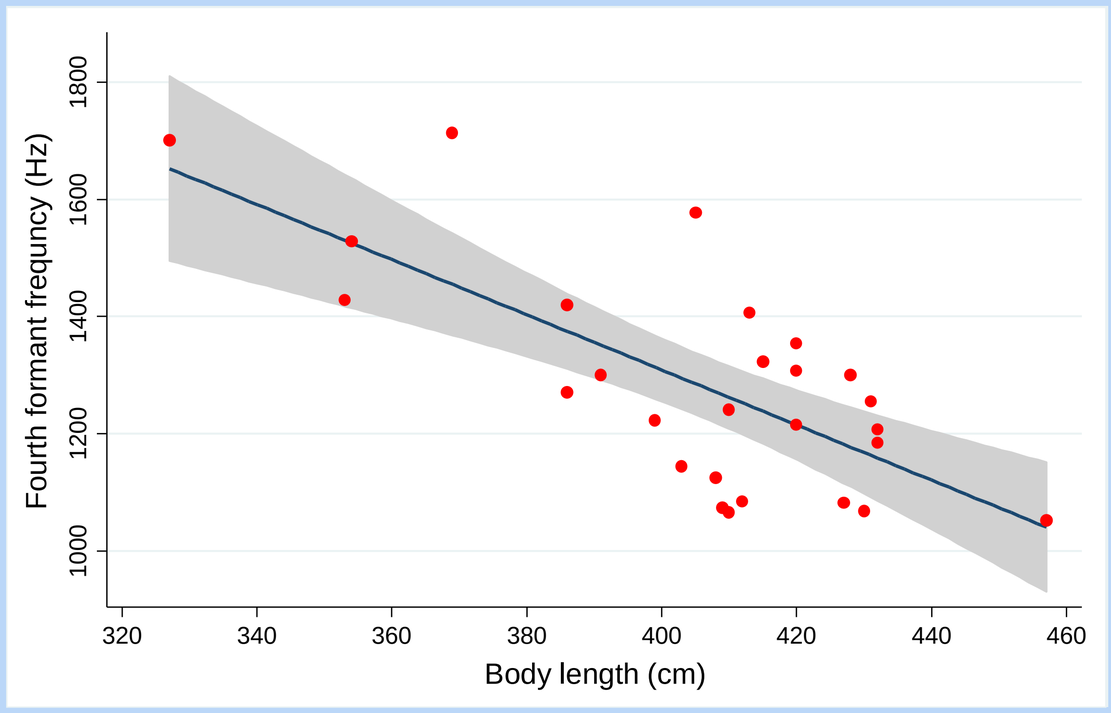

Fig. 2 – Linear model of the fourth formant vs. male body length. Blue line: regression line; grey area: 95% confidence band.

- Relationships between formants and both body size and age were stronger for higher formants in both sexes, with a maximum for F4 and body length in both sexes (Table 2).
- Relationships with body size were stronger than relationships with age in both sexes, and relationship with age was very week in females (Table 2).

Length		
Formant	**Males**	**Females**
F1	0.06	0.05
F2	0.26	0.03
F3	0.30	0.23
F4	0.51	0.35
F5	0.40	0.32
F disp	0.39	0.26
Age		
Formant	**Males**	**Females**
F1	0.00	0.07
F2	0.18	0.00
F3	0.12	0.06
F4	0.11	0.04
F5	0.15	0.06
F disp	0.16	0.03

Table 2 – Proportion of variance explained by the linear models of formant F1 to F5 and formant dispersion vs. body length and age.

Conclusions

- Formants were related to body size and age in both sexes, but, as expected, the relationships were stronger for males.
- In both sexes, formants were more related with body size than with age, in accordance with the great variation of size observed within elephant seal age classes.
- All together, formants, and in particular the higher ones, are honest signals of phenotype in both sexes of southern elephant seals, although the variance in phenotype associated to formants was rather low for females.

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