



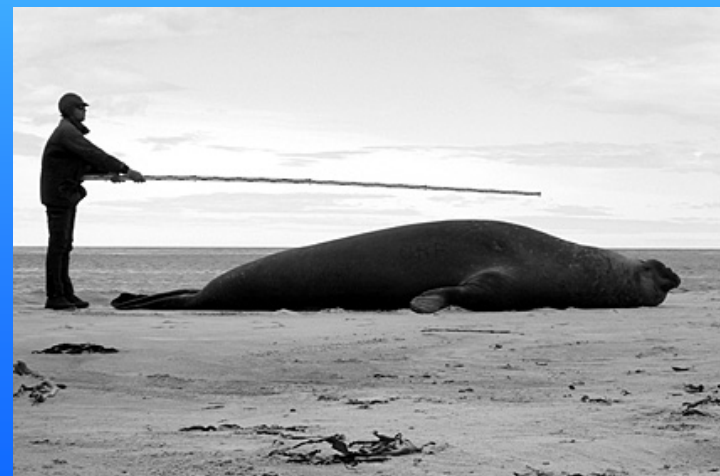
Male vocalizations in southern elephant seals

A long-term research project

**Simona Sanvito, ESRG, 1995-2005
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Field work

- Small and localized population
- Individual recognition of males
- Recording of vocalizations
- Measurement of structural phenotype
- Hormones
- Observation of agonistic behavior
- Estimation of breeding success (behavior and genetics)



Agonistic behavior

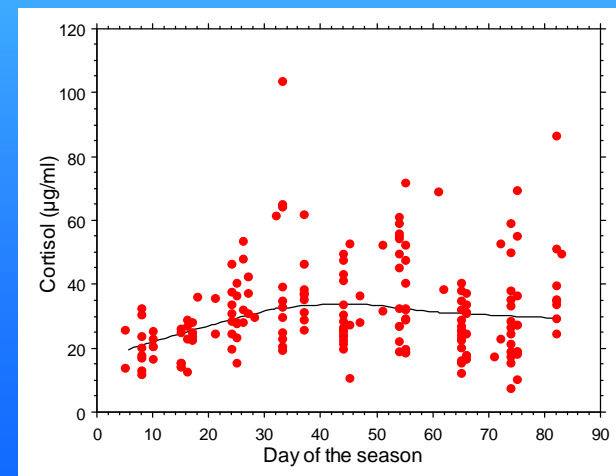
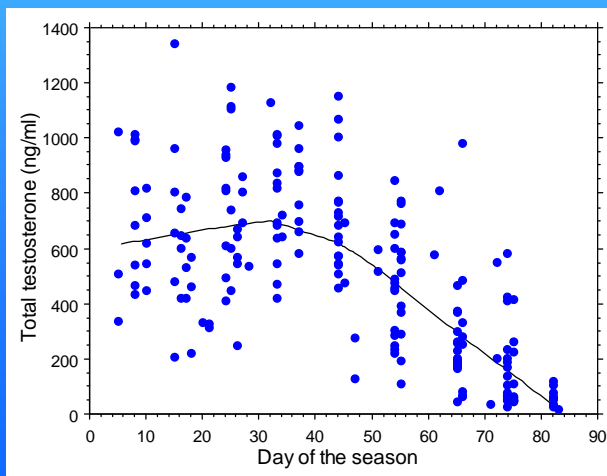


- Majority of contests settled without contact between the males
- Use of visual and/or vocal displays

- Fight involved in most harem takeovers
- Both endurance and fighting ability crucial for success

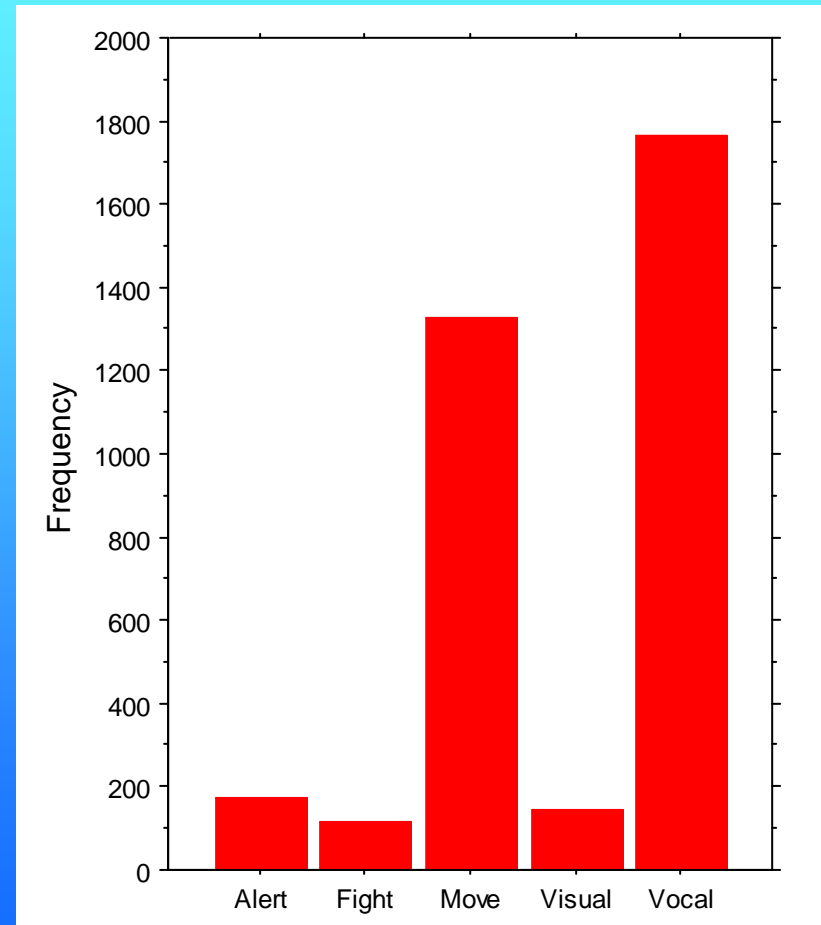


Hormone studies



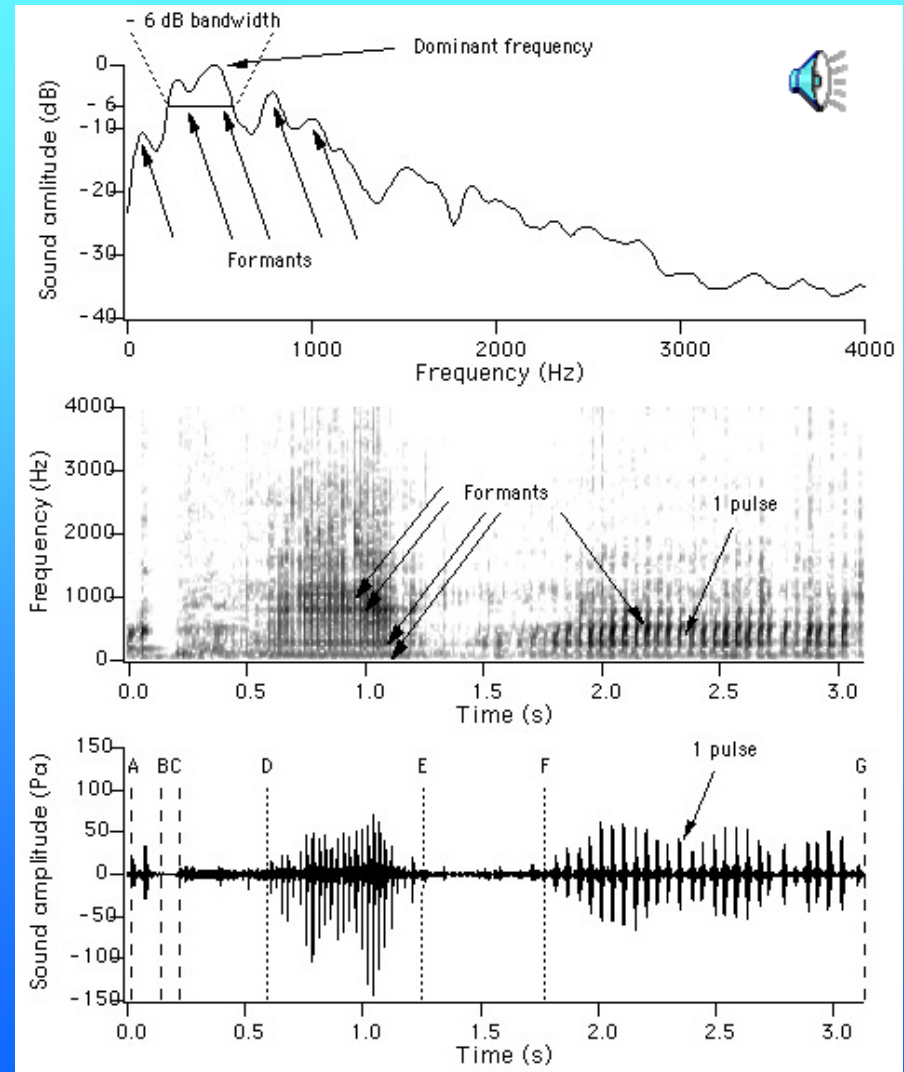
The role of vocalizations

- Voc's present in about 70% of interactions
- Voc settles about 50% of interactions
- Voc is reciprocated in 4.2% of cases
- Harem holders settle contest with peripherals using voc's in 56% of cases

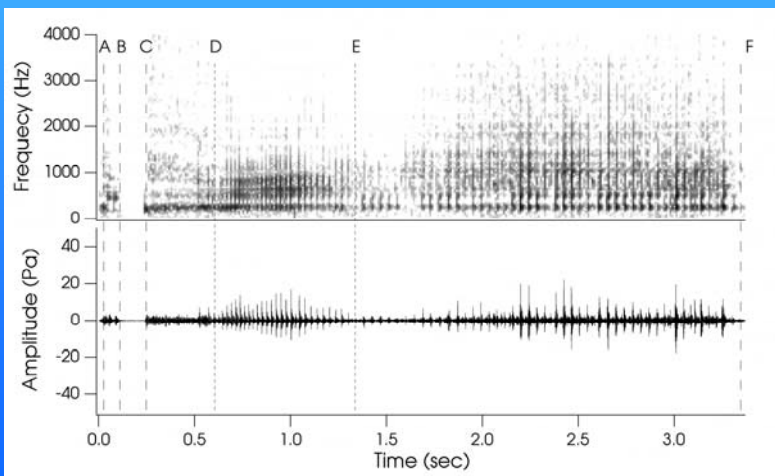
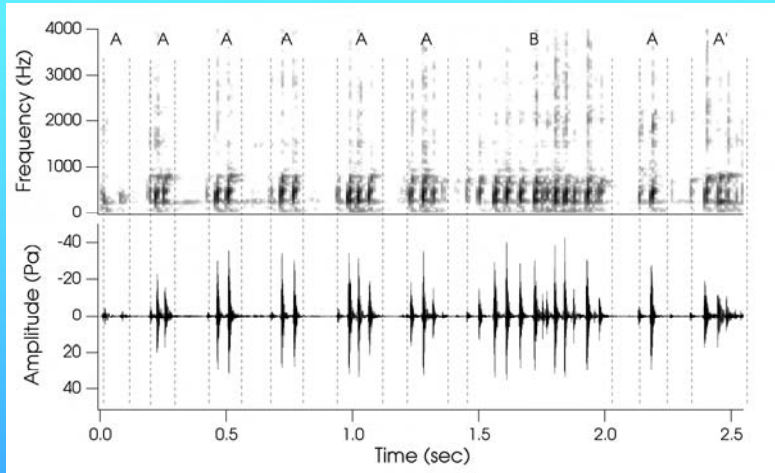


Acoustic of vocalizations

- Pulse trains
- Bouts of pulses repeated one or more time
- High sound level (up to 120 dB)
- Low frequency (dominant freq around 250 Hz)



Individual repeatability

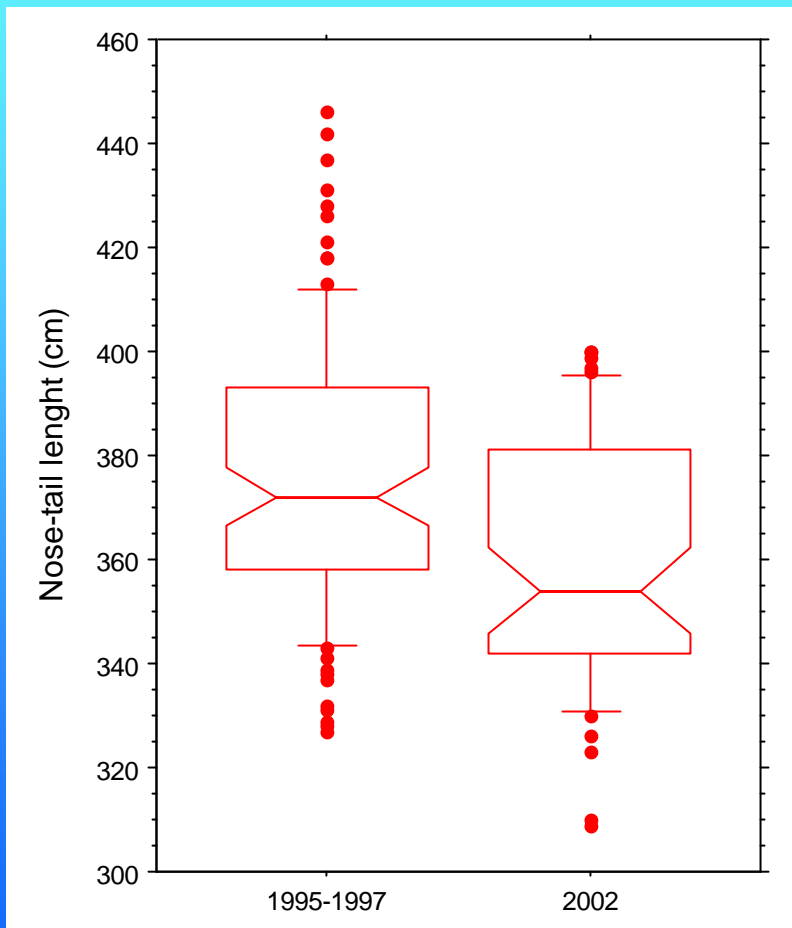


- Vocalizations are variable between individuals and stable within
- Repeatability is high (average 0.56) and statistically significant for most acoustic variables
- Fundamental frequency and first formant show very high repeatability

Body size, vocal tract and honest signals

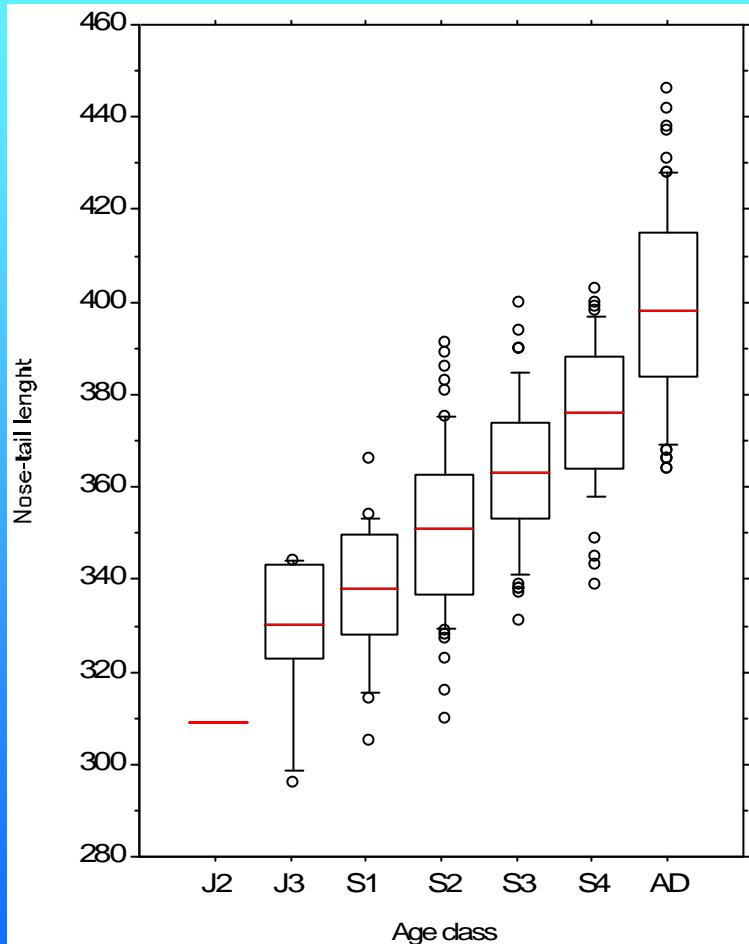
- Fundamental frequency is expected to be related to vocal folds structure, while formants are expected to be related to vocal tract structure
- Vocal tract size is related to body size in Mammals, but vocal folds size is not
- Formants can, therefore, be an honest signal of body size: they should be related to body size, while F0 should not

Body size and age distribution



- Mean nose-tail length of all males decreased 15 cm, max size 46 cm
- Mean holder length decreased 20 cm
- Mean difference between holders and non holders decreased from 41 to 34 cm
- Relative variability in size decreased for harem holders, but not for non holders

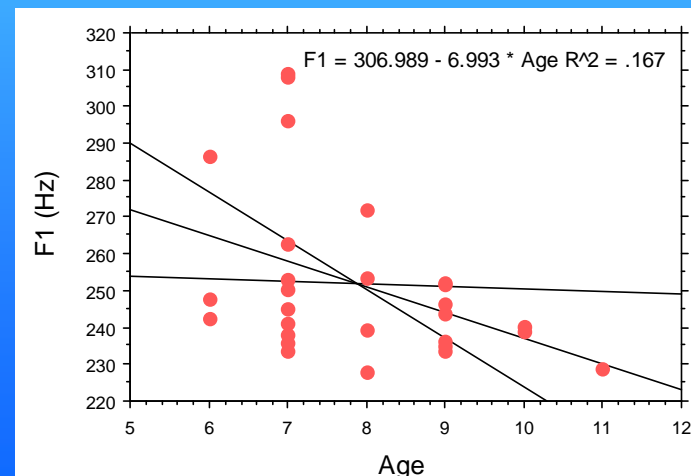
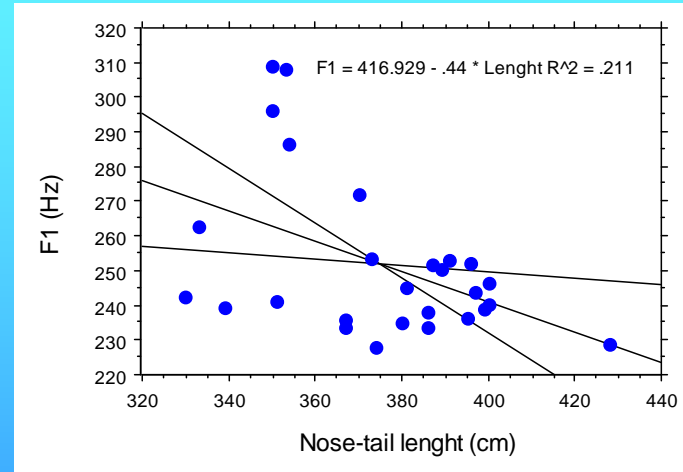
Body size and age



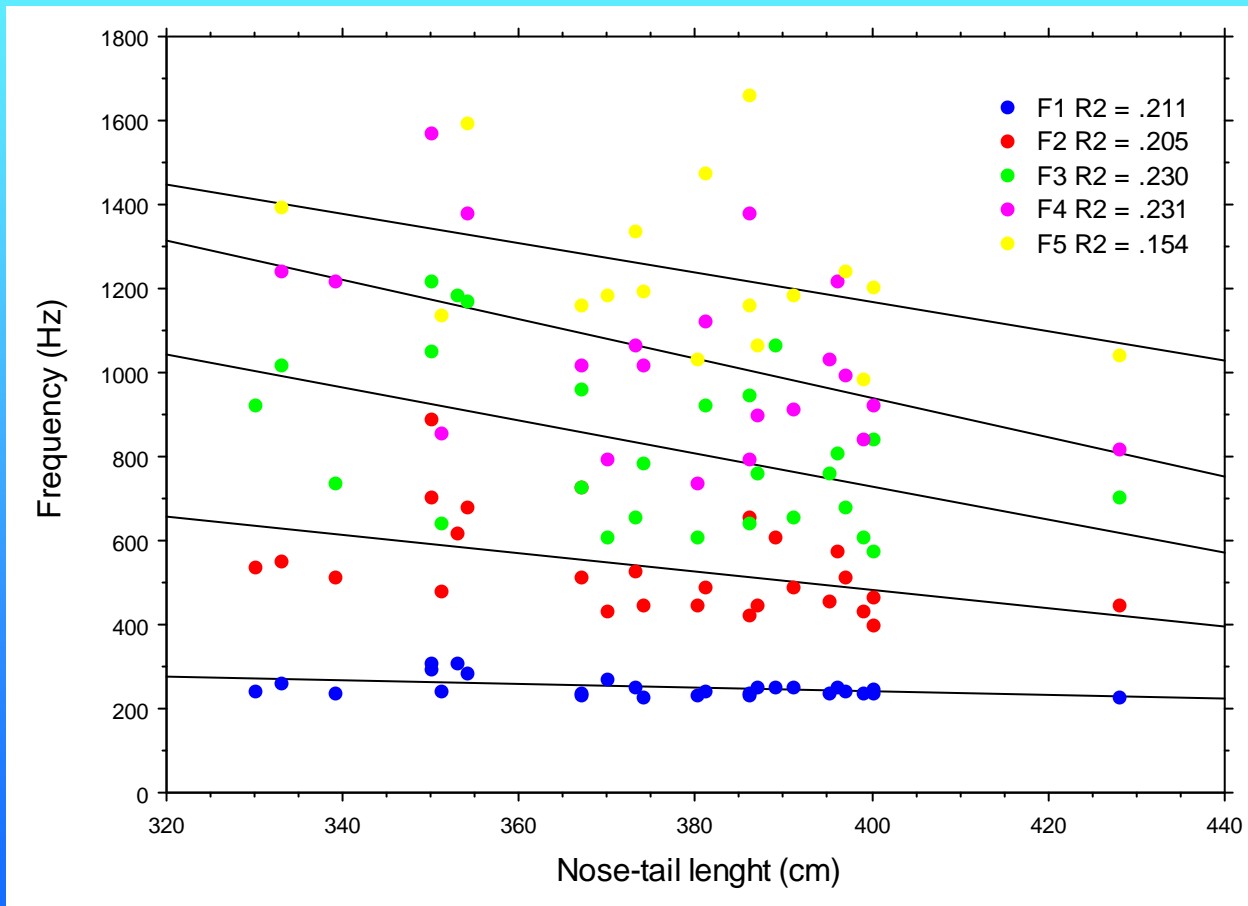
- Body size and age are correlated ($r = 0.795$)
- Differences in size between age classes are significant at 0.05 level
- Variability in body size within each class is large (SD = 15 to 21 cm)

F0 and first formant

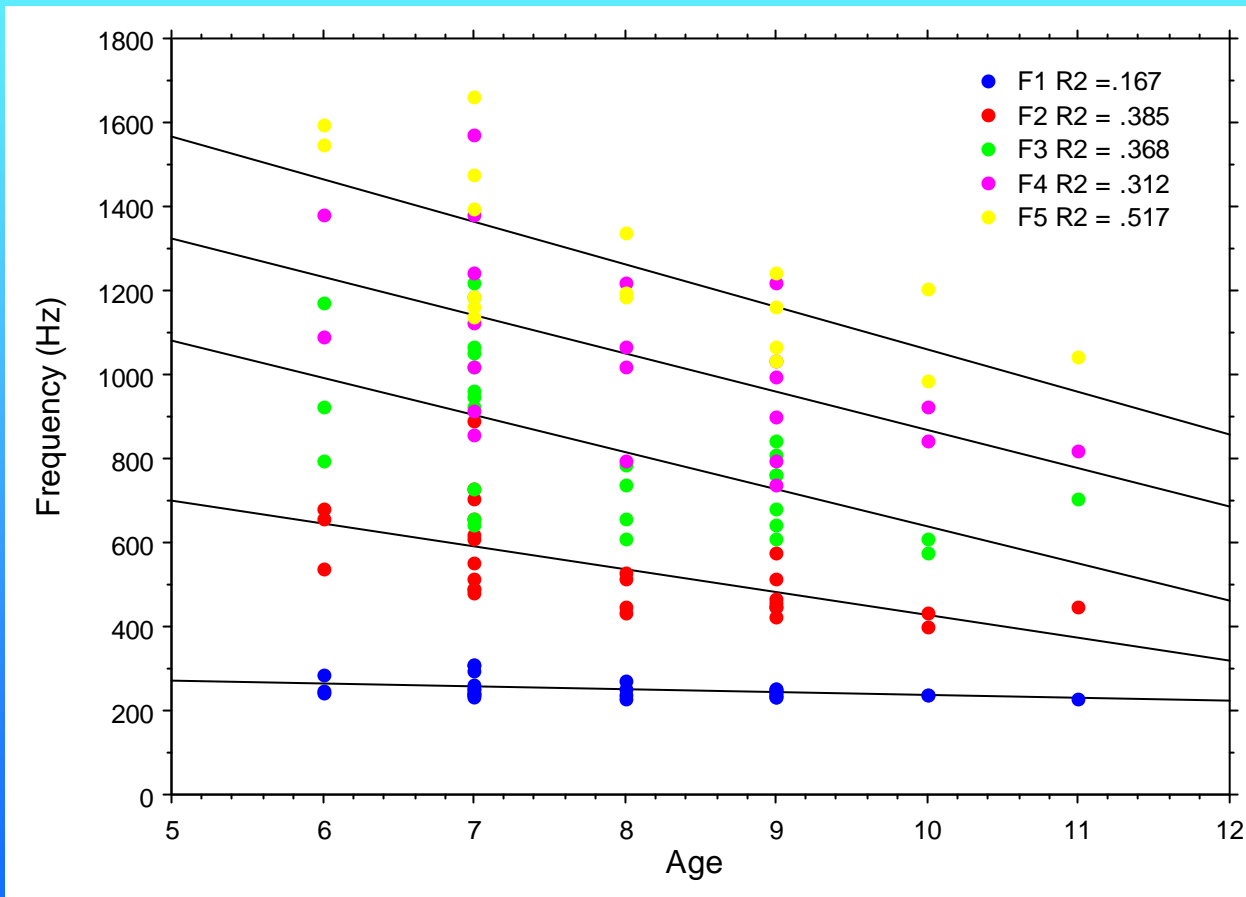
- F0 is not related to body size or age (R^2 about 0)
- F1 is significantly related to both body size and age, although variance explained is low in both cases



Higher formants and size



Higher formants and age

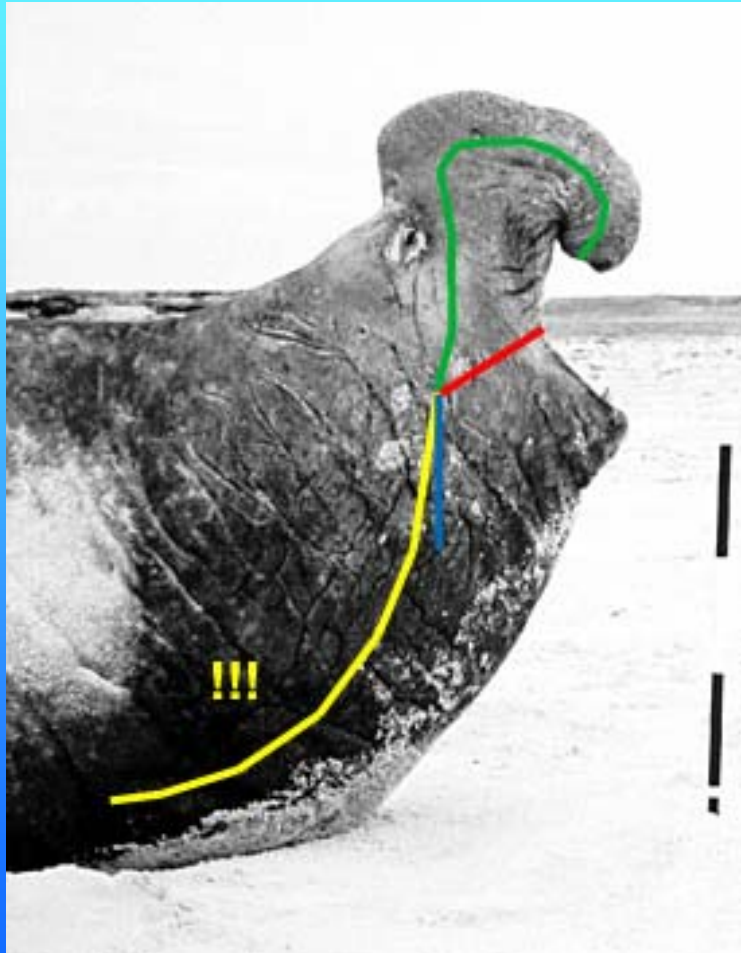


Partial regression results

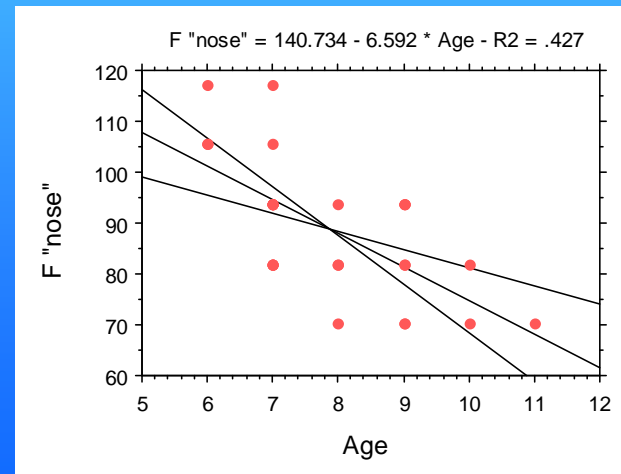
Length					
Formant	b	se(b)	b'	t	P
F1	-0.289	0.267	-0.302	-1.081	0.2903
F2	0.088	1.222	0.018	0.072	0.9435
F3	0.231	1.995	0.028	0.116	0.9087
F4	-1.060	2.800	-0.109	-0.379	0.7094
F5	2.984	2.652	0.336	1.125	0.2794

Age					
Formant	b	se(b)	b'	t	P
F1	-3.66	4.97	-0.206	-0.737	0.4680
F2	-55.05	22.72	-0.615	-2.423	0.0233
F3	-100.82	37.10	-0.663	-2.718	0.0120
F4	-86.82	50.13	-0.498	-1.732	0.1004
F5	-132.21	42.09	-0.938	-3.141	0.0072

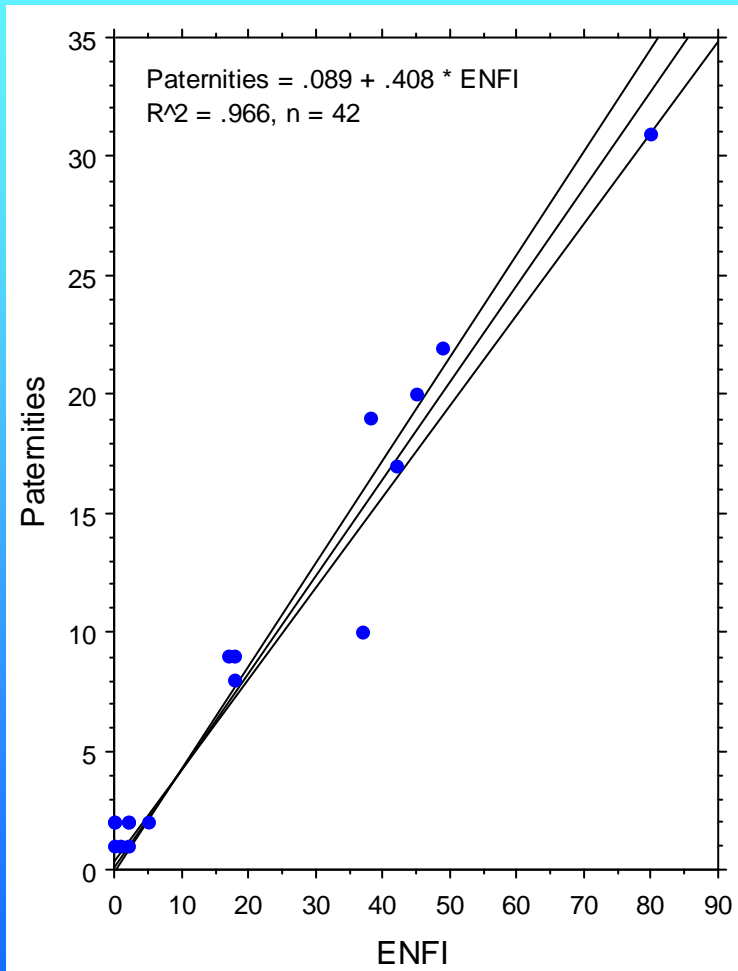
Having a BIG nose...



- $F_1 \sim 80 \text{ Hz} \Rightarrow$ vocal tract length $\sim 120 \text{ cm}$
- $F_1 \sim 250/300 \text{ Hz} \Rightarrow$ vocal tract length $\sim 55 \text{ cm}$
- Oral only tract length of 120 cm is not realistic !

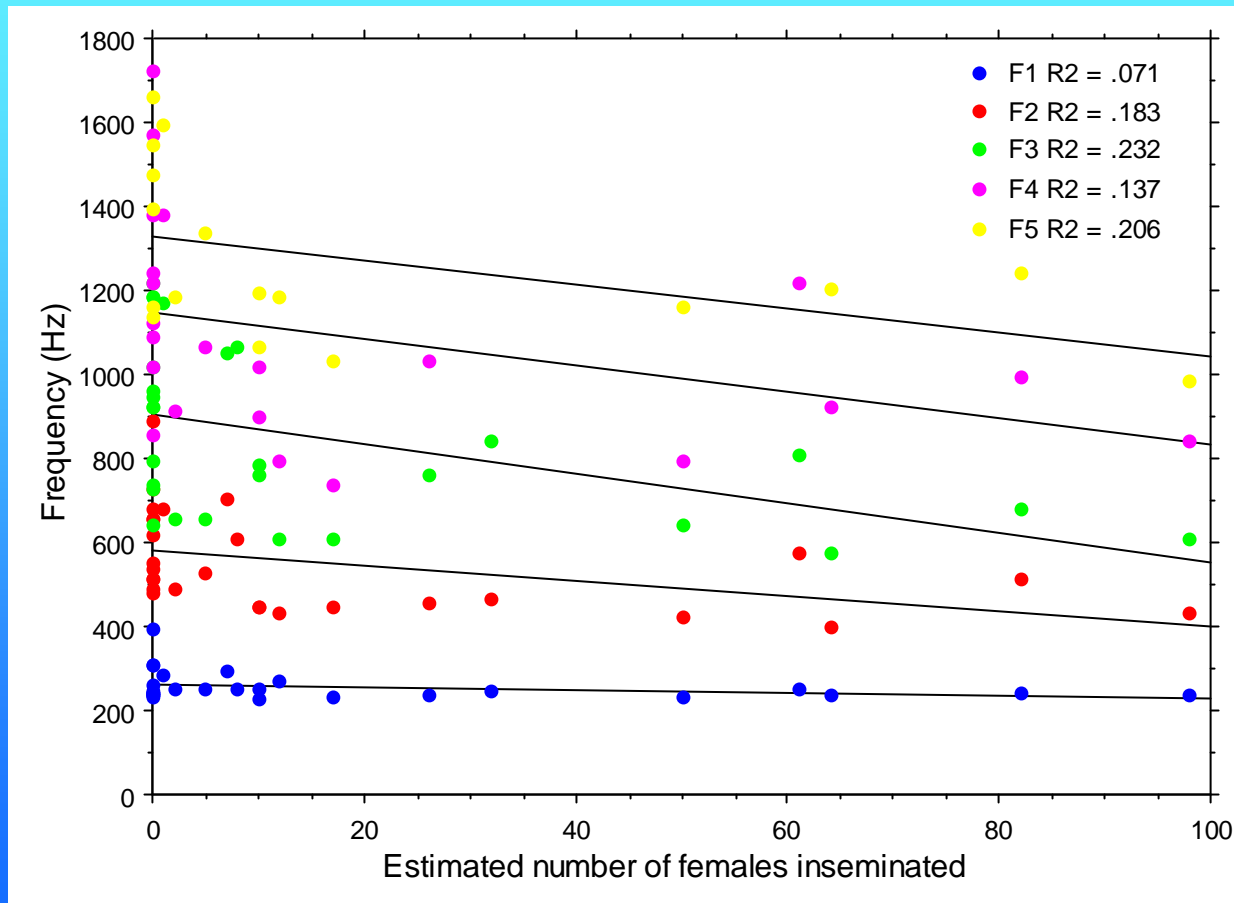


Breeding success



- Demographic and behavioral measures of breeding success show high concordance with genetic paternity
- Breeding skew is the highest recorded
- Harem holders monopolize both copulations and paternities

Vocalizations and breeding success



Future developments

- Body growth and acoustic ontogenesis
- Variation of body size distribution and the effectiveness of vocalizations
- Effects of hormone status changes along the breeding season
- Cultural transmission of vocalization styles
- Personality effects



That's all folks

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