Pup vocalizations in southern elephant seals: communication in a noisy environment

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Introduction

Pup vocalizations are a core component of the mother-pup recognition system in many species, and they have a great functional value because they permit the establishment of the mother-pup bond that is essential for pup survival. Southern elephant seals (*Mirounga leonina*, SES) breed in dense aggregations called “harems” that may include up to hundreds of individuals and, therefore, present challenges for vocal recognition systems due to the abundant background “social” noise. Therefore we expect SES pups to have a rich communication system (Fig. 1), with large individual variation, that can permit an efficient recognition by the mothers, and the establishment of a stable bond during the suckling period.

Fig. 1 – Vocal duet of SES mother and pup just after parturition

Methods

Field work was carried out at Sea Lion Island, Falkland Islands, during Sept-Dec 2014. All females and pups were marked for easy recognition. Vocalizations were recorded opportunistically with digital recorders (Marantz PMD-660) and supercardiod microphones (Sennheiser MD-441) during times of low wind and background noise. We identified three levels in the structure of vocalizations: 1) call, i.e., a sound emission produced by a single air exhalation; 2) part, i.e., a call component separated from other components by silence; 3) subpart, i.e., a part component with a homogeneous acoustic structure. Based on recording quality, we selected 381 parts belonging to 40 pups. We measured time and frequency parameters using RAVEN (Cornell) and we classified parts by inspection of waveforms and spectrograms.

Results

- We observed three main part types, based on the predominant acoustic structure present in them (Fig. 2): tonal, i.e., having a harmonic structure; pulsating, i.e., made of pulse trains, which sometime produced “mini-harmonics”; harsh, i.e., having no clear periodic structure.
- Harsh parts were more frequent (65.1%; Fig. 3), followed by tonal parts (31.5%). Pulsating parts were very rare (3.41%).

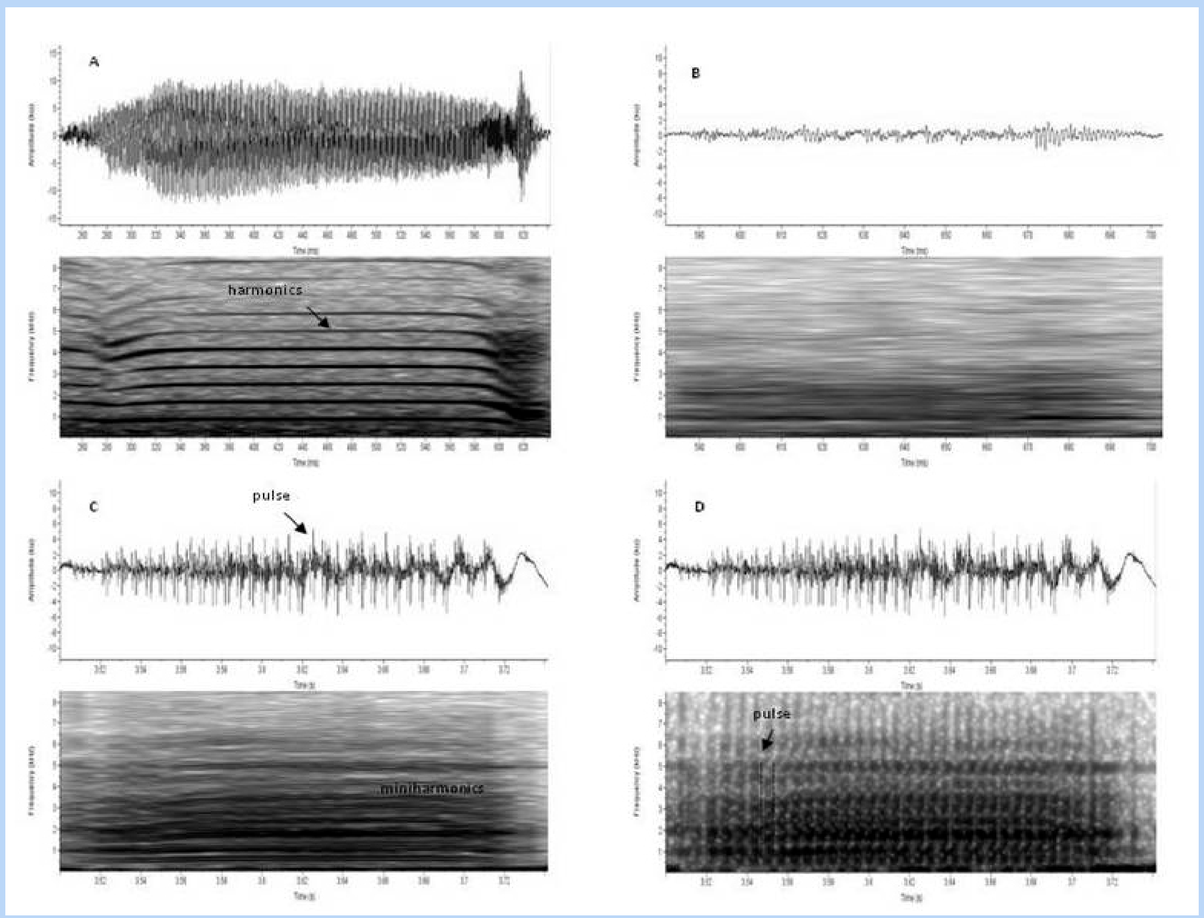

Fig. 2 Spectrograms and waveforms of each type of part: A) tonal; B) harsh; C) and D) pulsating (narrow-band, left, and wide-band, right).

- Pups often alternated between tonal and harsh components. Non-tonal parts (harsh + pulsating) often showed harmonics (13.41%) or inter-harmonics (59.39%), and tonal parts often had a harsh component (74.17%). A pulsating component was observed in most parts (69.29%).
- Formants (i.e., frequency bands of high amplitude likely produced by vocal tract resonances) were observed in most non-tonal parts (91.95%), and in many tonal parts (64.17%).
- Frequency modulation was observed in most tonal parts (76.03%), and in most cases the shape of the main spectrographic bands of tonal parts was non-linear.
- Parts were composed by 1-5 subparts, and we identified 39 different subpart sequences.
- Part types had different acoustic characteristics. Tonal parts were longer, had a lower frequency in both the first and third quartile, and showed a narrower frequency range.

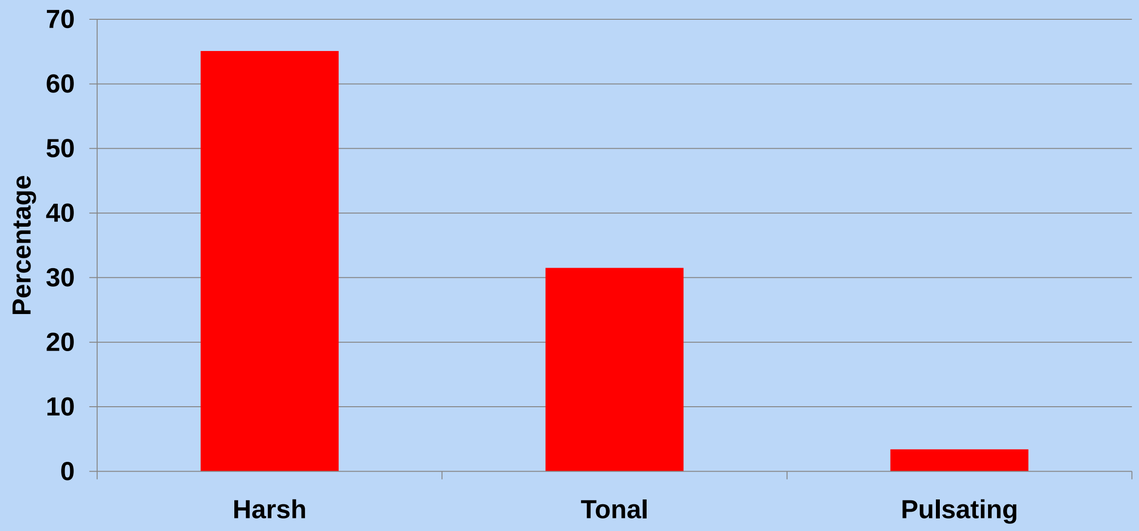

Fig. 3 – Percentages of the different part types.

Conclusions

- SES pup calls have a rich and variable acoustic structure, and often show a mixture of tonal, harsh and pulsating components.
- Within each part of the call there is usually a dominant component, that usually is tonal or harsh.
- Different types of parts have different acoustic characteristics in the time and frequency domain.
- The variability of part types, and the different acoustic features of the types, represent the raw material for the inter-variability of vocalizations that should be the basis of the SES vocal recognition system.