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Structure and function of female and pup contact calls in Southern elephant seal (*Mirounga leonina*)



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Introduction

Vocal communication is widespread in pinnipeds species that breed in dense colonies because it helps to establish social relationships, and permits the maintenance of the mother-pup bond, and the successful suckling of the pup. Southern elephant seals (*Mirounga leonina*, SES) breed in harems with tens or hundreds of females, and extensively use vocal signalling (Fig.1). We studied SES to describe the acoustic structure of mother and pup calls, measure call individuality, and determine which acoustic features are good candidates for mother-pup recognition.



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

Methods

Field work was carried out at Sea Lion Island (Falkland Islands) in 2014. Females and pups were artificially marked. Vocalizations were recorded using digital recorders and super-cardioid microphones. We obtained 252 calls of 40 pups and 104 calls of 29 females. We visualized spectrograms and measured time, frequency and intensity features of calls with Raven Pro. We extracted structural features of calls by visual inspection of spectrograms. We measured variability of acoustic features using the within- (CV_i) and between-individual (CV_b) coefficient of variation. We measured individuality with the potential for individual coding (PIC; $CV_b/\text{mean}CV_i$). PIC values > 1 indicate that the acoustic feature can encode individual identity.

Results

- Females produced mostly high-pitched calls (80%, harsh: 11%, pulsating: 9%), frequency modulated and rich in harmonic structure, while pups produced mostly harsh calls (69%, tonal: 29%, pulsating: 2%), with a less clear harmonic structure.
- Pup calls had a complex and variable structure, and showed non-linear phenomena (sub- and mini-harmonics; Fig. 2).

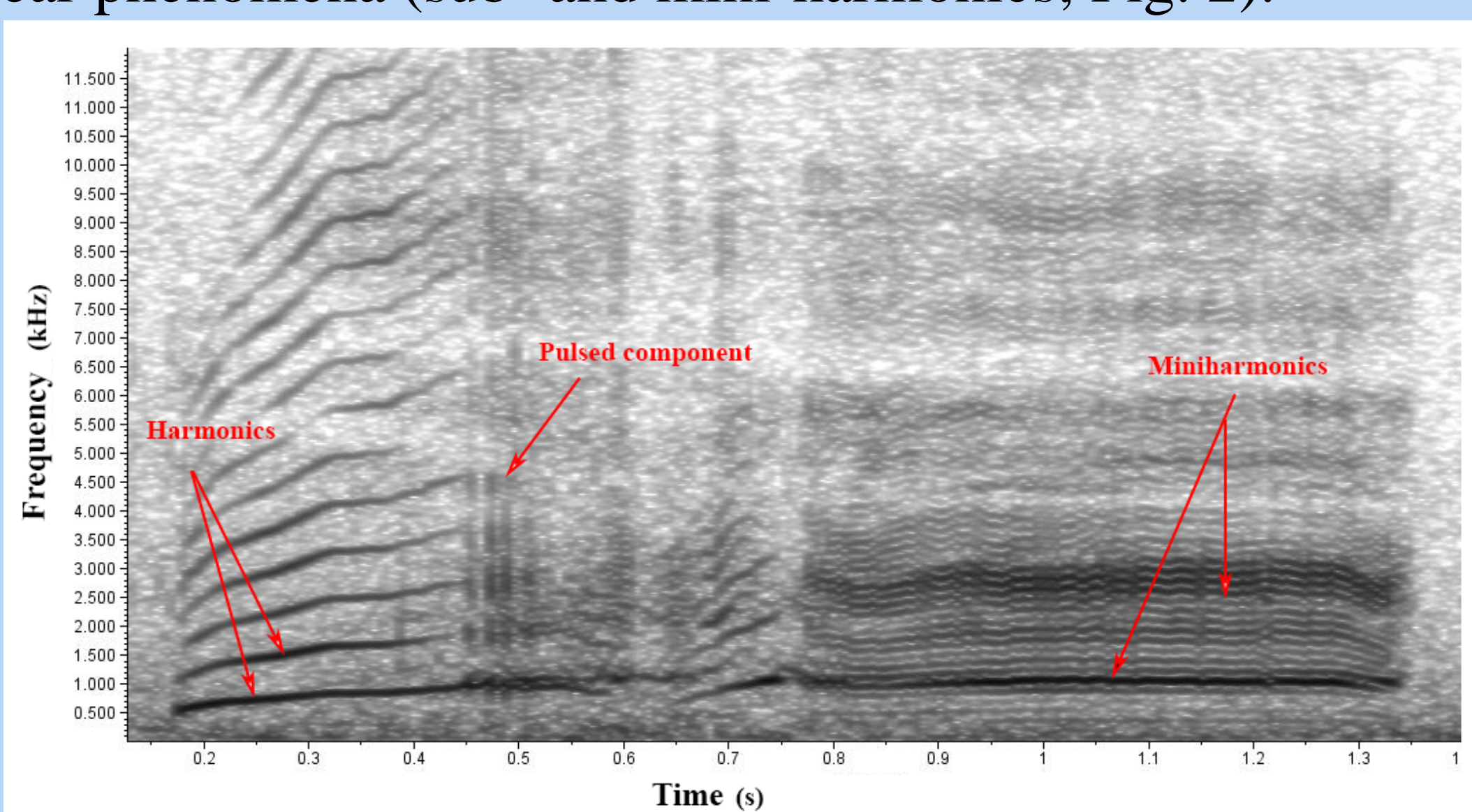


Fig. 2 – A pup call with a combination of pulsating and tonal parts.

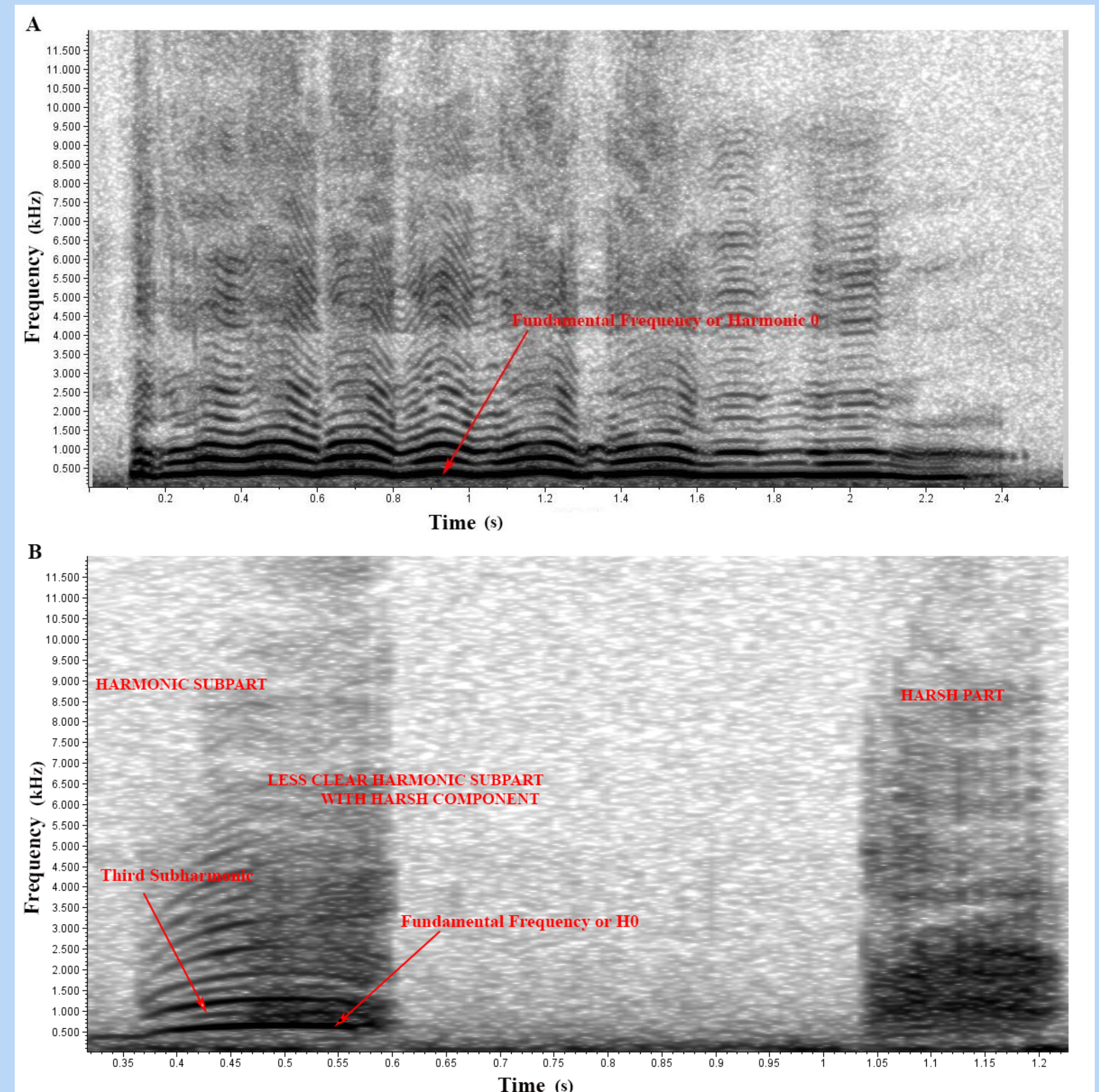


Fig. 3 – Spectrograms of a tonal female call (A) and a harsh pup call (B).

- Female calls were long (mean = 1.20 sec), and had a mean dominant frequency of 521 Hz, while pup calls were shorter (0.34 sec) and had a higher mean dominant frequency (888 Hz; Fig. 3).
- Individuality of acoustic features was not homogeneous between females and pups, e.g., PIC of duration features was higher in females (Fig.4).
- Frequency features measured on the call harmonic part showed the highest individuality both in females and pups (Fig. 4).

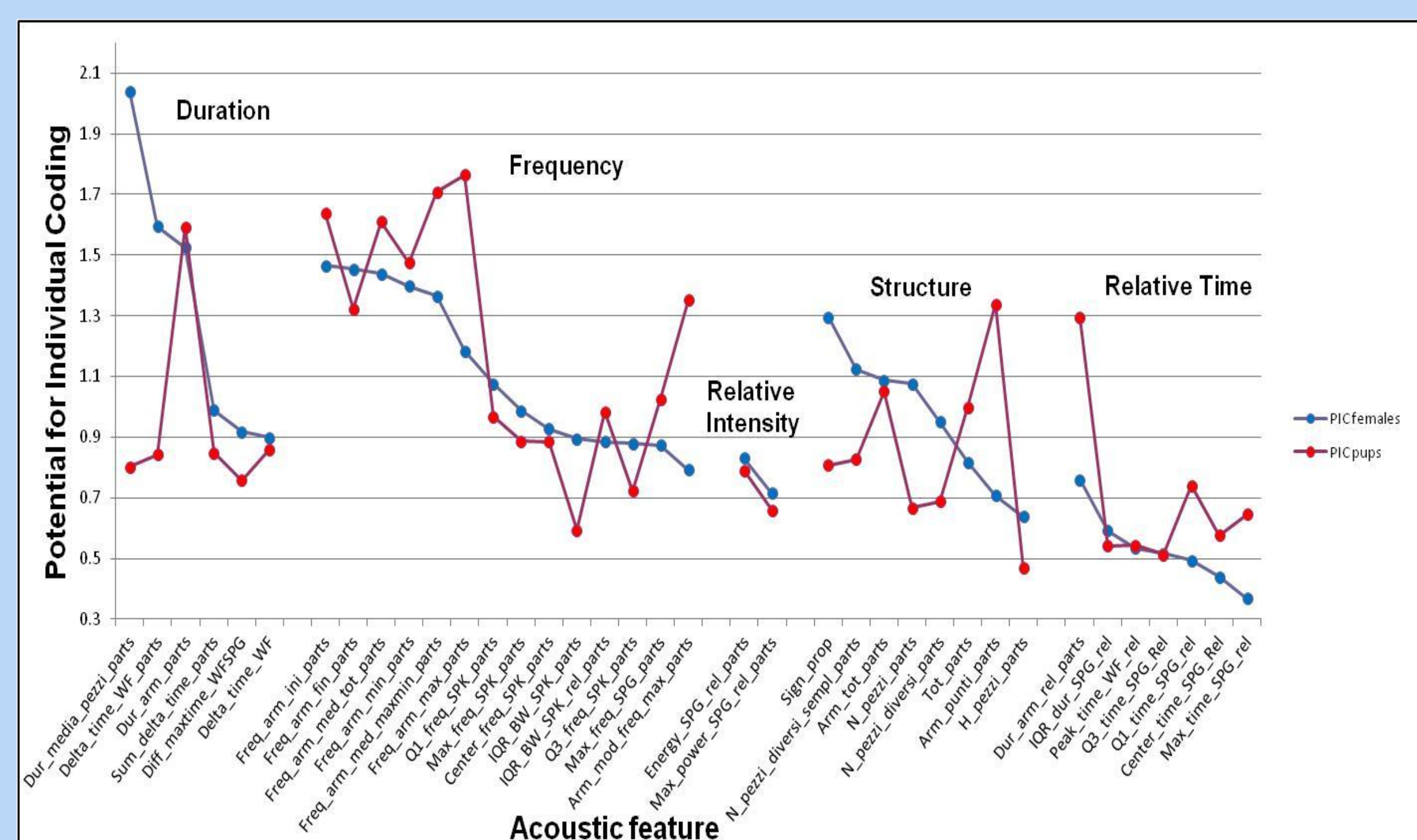


Fig. 4 – PIC values of acoustic features of female and pup calls.

Conclusions

- Mothers emitted mostly tonal calls with a rich and clear harmonic structure, while pups emitted mostly harsh calls with a complex structure, and clear harmonics just in a part of the call.
- Pup calls showed non-linear phenomena that can be used by the mother as a cue to pup status and well-being.
- Calls showed individuality both in mothers and pups, and, therefore, can be used for individual recognition.
- The acoustic features that showed greater individuality were the frequency features measured on the harmonic structure.