BIPHONATION ENHANCES A POTENTIAL FOR INDIVIDUAL RECOGNITION IN THE DHOLE *Cuon alpinus*

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INTRODUCTION

Sharing extreme sociality with African hunting dogs, dholes posses by elaborate vocal repertoire, involving bifonic calls, representing combination of independent high and low frequency components, produced by simultaneous work of two vocal sources (Volodin et al., 2001). Among canids, the biphonic calls occur also in timber wolf and domestic dog, but are especially prominent just both in the dhole and the African hunting dog (Berry et al., 1996; Wilden et al., 1998; Frommolt, 1999). It's unclear to date, why these calls are especially well-expressed in vocal repertoires of these highly specialised collective hunters. We hypothesised that the biphonic calls may function in supporting of pack cohesion under poor visibility during pray chasing. Repeatedly produced, the biphonic calls may represent a close-distant mechanism for control of pack members' transitions, allowing constantly be "shoulder to shoulder" with partners (Volodina, Volodin, 2001). So far as collective hunting imply division of roles among pack members, precise individual vocal identification must be necessary. Here we test, if the combination of the high and low frequency components provide more reliable potential for individual identification in the dhole calls, than these components are taken separately.

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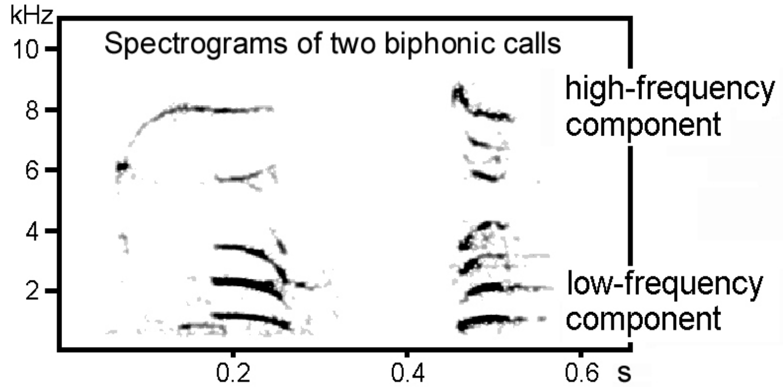
ANIMALS & METHODS

Calls were tape recorded from 6 sad dholes (aged from 7,5 to 9 month) from two litters (1 males + 2 females & 3 males), born in Moscow Zoo (Russia). We selected 30 biphonic calls per individual (180 in total) of high quality, being produced in the context of nonaggressive intra-pack communication.

The calls were digitised with 22 kHz sampling frequency and analysed using Avisoft-SASLab Pro software. Applying alternately high-pass and low-pass filter, we measured separately parameters correspondingly of the high- and low-frequency components for each of the calls (7 frequency and 4 temporal parameters for each component, totally 22 parameters for each call, see Figure and Table).

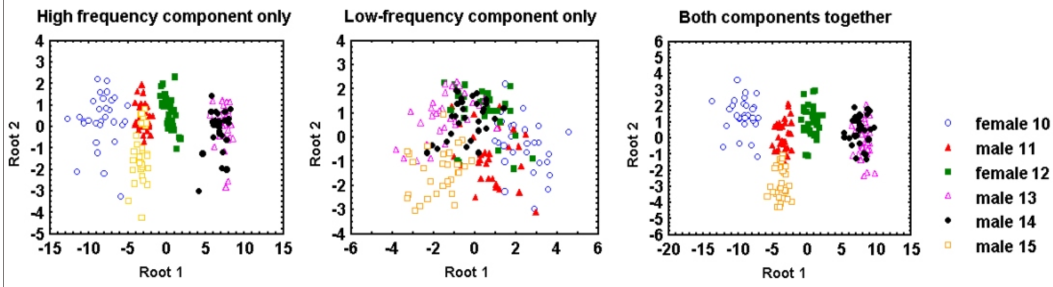


Call parameters	**High-freq. component**	**Low-freq. component**
Start frequency	F_BEG1	F_BEG2
End frequency	F_END1	F_END2
Maximum fundamental frequency	F_MAX1	F_MAX2
Minimum fundamental frequency	F_MIN1	F_MIN2
Frequency of maximum amplitude	F_DOM1	F_DOM2
Bandwidth of frequency of maximum amplitude	BANDW1	BANDW2
Number of frequency extrema	EXTREM1	EXTREM2
Duration from start to maximum frequency point of a component	DUR_INC1	DUR_INC2
Duration from maximum frequency point to end of a component	DUR_DEC1	DUR_DEC2
Ratio: duration of a component/ total call duration	K_DUR1	K_DUR2
Ratio: from start to maximum duration of a component /total duration of a component	KTMAX1	KTMAX2

To test how accurately call parameters could be used to identify callers, a discriminate function analysis was performed in STATISTICA package using those variables selected by the stepwise analysis. We made also cross-validation analysis (the classification of one half of the data set with a discriminate function derived from the other half). Call samples from each of the dholes were randomly split half-and-half, that provided training set (90 calls) and test set (90 calls).

RESULTS

Three discriminate function analysis were performed, basing on 1) 11 the high-frequency component parameters; 2) 11 the low-frequency component parameters; and 3) 22 parameters of both the components together (i.e., for the whole calls).



For the high-frequency component, 82,8% of correct assignment has already been reached by using only two frequency parameters, F_END1 and F_MAX1. Contribution of other parameters was negligible small.

For the low-frequency component the analysis showed 71,1% of correct call assignment to individual. All the 11 parameters have contributed to discrimination, with primarily participation of both frequency and temporal parameters, F_MAX2, K_DUR2, DUR_DEC2, BANDW2, F_BEG2.

For the whole calls (both the components together), 95,6% of correct assignment has been achieved. Eight parameters of the high component and eight parameters of the low component provided contribution into discrimination (especially F_END1, KTMAX2, F_MAX1, F_MAX2, DUR_DEC2).

Cross-validation showed 92,2% of correct assignment for training set of calls, 15X6=90, from 80 to 100% for particular individuals. Correct assignment for test set of calls did not differ for training percentage of assignment, also 92,2%, varying from 76,7 to 100% between individuals.

CONCLUSION

The data support the hypothesis that use of biphonic calls, representing a combination of the high-frequency and the low-frequency components, enhances potential for individual discrimination in the dhole. However, was taken singly, the high-frequency component had higher potential for individual discrimination, then the single low-frequency component. Probably, in noisy habitats just the high component is responsible for short-distant individual recognition in the dhole, because it is well distinguishable from background noise. Analysing our tape recordings, we regularly face the problem, that the low-frequency components of the dhole calls are superimposed by cars, human voices, other animal sounds etc., while the high-frequency components may be accurately distinguished from the spectra.

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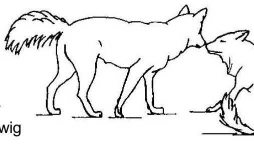

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