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## Similarly low-frequency stag rutting calls and hind contact calls develop from the high-frequency newborns calls in Pannonian red deer

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Studying the vocal ontogenetic pathways across subspecies and populations of red *Cervus* elaphus highlights evolution of vocal communication. Formerly, similarity of high-frequency stag and hind calls and their development from similarly high-frequency newborn calls was revealed in American C.e. canadensis and Siberian wapiti C.e. sibiricus. At the same time, similarity of low-frequency stag and hind calls and their development from high-frequency calf calls was revealed in Iberian red deer C.e. hispanicus. This study investigated stag, hind and newborn calls in the Central European Pannonian red deer C.e. hippelaphus of Southern Hungary. Audio recordings were collected by using automated recorders in the rutting seasons of 2015 and calving season of 2016. Keeping females with calves apart from males on the farm and distinctive acoustics of calves allowed us to identify and analyze their calls blindly from the automated recordings. Analysis of 71 stag rutting roars (the longest roars within bouts), 159 oral contact calls of hinds and 148 oral contact calls of calves revealed very close values of the maximum fundamental frequency between hinds and stags (160±28 Hz and  $163\pm65$  Hz respectively, p=0.79), whereas peak frequency differed between sexes (610±596 Hz in stags and 1034±877 Hz in hinds, p<0.001). At the same time, both maximum fundamental frequency and peak frequency of calves contact calls was high (785±82 Hz and 1641±1008 Hz). Stag calls (1.62±0.53 s) were longer than either hind of calf calls (1.22±0.67 s and 0.29±0.12 s respectively). We discuss that the descending ontogeny of fundamental frequency observed in Pannonian red deer, is typical for other studied European subspecies of Iberian and Corsican *C.e. corsicanus* red deer in opposite to the non-descending ontogeny of fundamental frequency in Siberian and American wapiti. Supported by RFBR grant 19-04-00133.