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## Effects of social density during the rut and arousal at mother-offspring separation on male and female vocalisation traits in Siberian wapiti

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Vocalisations of mammals represent potential indicators of animal welfare. Although the Siberian wapiti *Cervus elaphus sibiricus* is the most important cervid species among farmed animals of Russia, China and Kazakhstan, welfare standards are not yet established for this mammal. Local density of animals during the rut may affect vocal activity and the acoustics of rutting vocalizations in males. At the same time, separation of offspring from their mothers may affect the acoustic characteristics of females. We compared the acoustics of male rutting calls for two farmed populations that differed in density (0.08 deer/ha vs. 2.0 deer/ha), 103 and 123 calls per population. Individuals could not be identified, because calls were collected using automated recording systems (SongMeter SM2+) in September-October of 2013 and 2015, respectively for the low and high density population. To avoid the influence of pattern of fundamental frequency modulation on the acoustics, we took for acoustic analyses only calls with a “trapeze” pattern of modulation. In the high density population, calls were shorter (2.94 s vs. 3.15 s,  $p < 0.01$ ), higher in the mean fundamental frequency (1.20 kHz vs. 1.12 kHz,  $p < 0.001$ ) and higher in the maximum fundamental frequency (1.46 kHz vs. 1.34 kHz,  $p < 0.001$ ) than in the low density population. The peak frequency (1.45 kHz vs. 1.49 kHz) did not differ. We also compared mean individual values of acoustic variables for female calls emitted towards milk-dependent offspring (< 1 month) and milk-independent offspring (5-6 months) during mother-offspring separations, recorded respectively in June and in December 2015 in the high density population. In females with milk-dependent offspring (21 mothers, 1-15 calls per mother, 133 calls in total) calls were shorter (0.40 s vs. 0.56 s,  $p < 0.01$ ), lower in the peak frequency (1.78 kHz vs. 2.20 kHz,  $p < 0.05$ ), higher in the mean fundamental frequency (1.25 kHz vs. 0.99 kHz,  $p < 0.05$ ) and marginally higher in the maximum fundamental frequency (1.63 kHz vs. 1.44 kHz,  $p = 0.06$ ) than in females with milk-independent offspring (9 mothers, 14-15 calls per mother, 134 calls in total). We suggest that in Siberian wapiti, elevated emotional arousal (in males from low to high social density during the rut and in females from milk-independent to milk-dependent offspring) results in call shortening and elevation of fundamental frequencies. This will be useful to estimate discomfort and improve animal welfare on deer farms.

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