

Noninvasive approaches in zoo practice based on bioacoustics

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A new perspective based on the analysis of animal sounds has been developed by current zoo biology science. A noninvasive bioacoustic approach has produced some useful applications in zoo management practice: subspecies identification in adult gibbons (*Hylobatidae*) and in 1-day-age common pheasants *Phasianus colchicus*; sex identification in adult whooping cranes *Grus americana* and juvenile Galliformes, Anseriformes and Laridae; identification of female proceptivity in lion-tailed macaque *Macaca silenus* and beaver *Castor fiber birulai*; indication of pair compatibility in gelada *Theropithecus gelada*, white-handed gibbon *Hylobates lar*, four species of Anseriformes, ten species of Gruidae, and canary-winged parrakeet *Brotogeris versicolurus*; acoustic stimulation of egg-laying and reproductive behaviour of *Coturnix japonica*, *Tetrao urogallus* and *Lyrurus tetrrix*; acoustic stimulation of oestrus in red deer *Cervus elaphus* females; translation of comfort vocalizations in order to decrease aggression in juvenile Anseriformes and Galliformes in high density management conditions; and registration of onset of the reproductive season in snow leopard *Uncia uncia* and mink *Mustela vison*.

In Moscow Zoo keepers use patterns of vocal courtship of a cheetah *Acinonyx jubatus* male as an indicator both of female oestrus and of male quality. Some vocal indicators of social asymmetry (social role) were also found in the cheetah. During courtship, cheetah males produce pulsed and tonal sounds at a ratio of 3:1, whereas females produced a ratio of 1:3. However, when females raise their offsprings, they produce pulsed and tonal sounds at a ratio of 3:1, whereas their pups shout at a ratio of 1:3. In both contexts, a higher proportion of pulsed sounds was produced by stronger and presumably more confident animal. Future analysis of appearance of a certain vocal structure in different behavioural contexts has the potential to provide extensive information about correlations between emitted vocalizations and social subordination, emotions and welfare in various mammal species.