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## **Nasal roaring and flehmen in rutting male saiga**

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The involvement of the unique saiga nose in vocal production has been neglected so far. Rutting male saigas produce loud nasal roars both towards rival males and towards females. During this vocal display the males take up a calling posture in which head and neck are raised and kept almost horizontally. Prior to nasal roaring, rutting males inflate their noses in an overall stereotypic manner. However, inter-individual differences of nose shaping entail acoustically distinguishable rutting calls. Nose shaping includes dorsal folding and convex curving of the nasal vestibulum and is maintained until the roar ends. In addition, nose shaping includes a rostral elongation of the nasal vestibulum, mainly achieved by contraction of the superior incisive muscle pulling the vestibular floor rostrally.

The larynx of the saiga has a conspicuous thyroid bulla housing the vocal folds. Each vocal fold is supported by a large ellipsoid fat pad. The thyroid bulla and these fat pads might increase the amplitude of nasal roaring which is the loudest vocal output of saiga. The vocal folds are set at an acute angle relative to the long axis of the trachea. This might improve control over the vocal folds and the glottic cleft. The flexibility of the thyrohyoid and the resilience of the thyrohyoid connection may allow for a rostral tilting of the larynx. This might facilitate an efficient connection between nasopharynx and laryngeal aditus during vocal exhalations via the nasal vocal tract.

Orally roaring red and fallow deer males achieve a temporary increase of vocal tract length (vtl) by larynx retraction. Saiga males attain a similar effect by pulling their flexible nasal vestibulum rostrally, allowing for a temporary elongation of the nasal vocal tract by about 20 %. Decrease of formant frequencies and formant dispersion, as acoustic effects of an increase of vtl, are assumed to convey important information on the quality of a dominant male to conspecifics, e.g. on body size and fighting ability. Nasal roaring in saiga may equally serve to deter rival males and to attract females. Anatomical constraints might have set a limit to the rostral pulling of the nasal vestibulum. Probably, the sexual dimorphism of the saiga nose was induced by sexual selection.

Flehmen in saiga is accompanied by reverse, pronouncedly concave nose shaping. The saiga's incisive duct, into which the vomeronasal organ opens, connects the oral to the nasal cavity and then gradually turns into the saiga's ventral nasal recess.

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