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ABSTRACT VOLUME



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Cattle bulls can produce low-frequency roaring and high-frequency bugling with an unspecialized larynx

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Usually, domestic cattle bulls produce low-frequency bellows with fundamental frequencies below 300 Hz. However, high-frequency calls of up to 600 Hz were reported for free-ranging male Chillingham cattle *Bostaurus* in England. In this study, high-frequency bugles and low-frequency bellows of three mature free ranging crossbred Brahman x European cattle bulls from Okambara ranch in Namibia were analyzed. The maximum fundamental frequency of the bellows (n=29) was 113.6 ± 18.8 Hz, whereas the maximum fundamental frequency of the 22 bugles (n=22) was 958.4 ± 180.8 Hz, ranging from 801 to 1125 Hz in different males. These amazingly high fundamental frequencies of bull bugles are comparable with those reported for Siberian wapiti *Cervus elaphus sibiricus*, but lower than those of North American wapiti *Cervus canadensis*. Similarity of bovid bugles and cervid bugles was further enhanced by the occurrence of biphonic bull bugles with two fundamental frequencies: a low and a high one. We suggest the bugles of domestic cattle bulls as an excellent model for comparatively investigating vocal production mechanisms and the associated anatomical and behavioural transformations. Domestic bulls have a typical ruminant larynx, not pronouncedly different from the larynx of European red deer and Siberian and North American wapiti, but their hyoid apparatus does not include an extensible thyrohyoid ligament similar to that involved in larynx retraction in the cervid species. Pronounced larynx retraction occurs simultaneous with low frequency roaring in European red deer, whereas only a restricted retraction of the larynx accompanies bugle production in wapiti and the structure of the bovid hyoid apparatus does not allow larynx retraction during bugling at all. Apparently, a long extensible thyrohyoid ligament and larynx retraction are important for low frequency roaring, as in European red deer, but are not critically necessary for producing bugles.