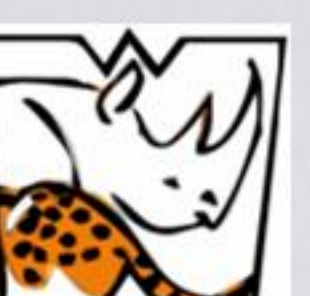


# Anatomical and vocal divergence between sexes in a ungulate species with prominent and descended larynx in males: parallels with "Adams apple" of humans

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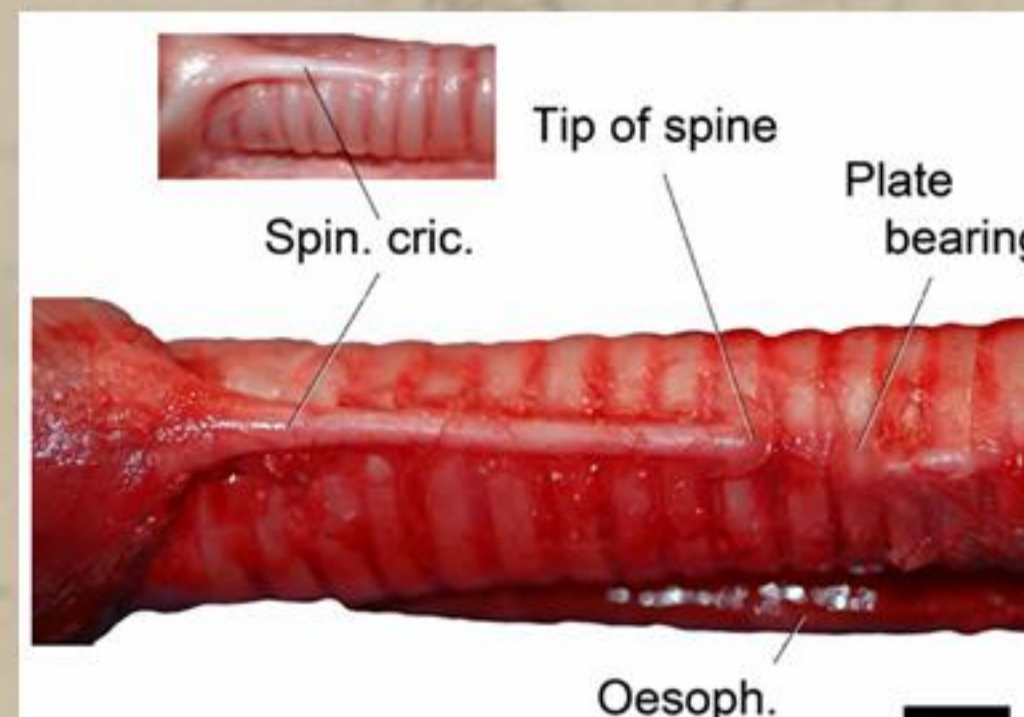


**IDEA:** Sexual dimorphism of descended larynx is not unique human, however gender-specific ontogeny of male and female descended larynx is only investigated in humans. As in humans, sexual dimorphism of the enlarged and descended larynx and vocalizations is prominent in adult goitred gazelles (*Gazella subgutturosa*), whereas in neonates does not differ between sexes.

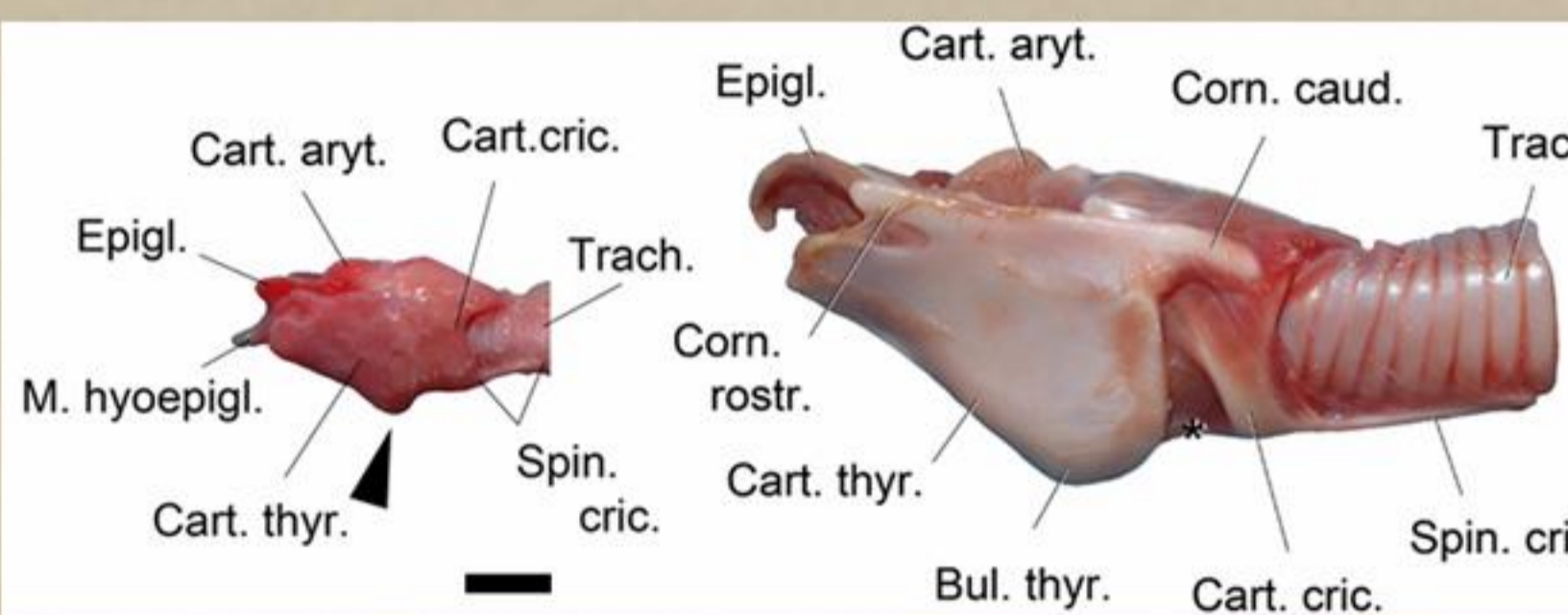
**METHODS:** Vocal ontogeny of male and female goitred gazelles across five age classes from neonates to adults. Acoustic variables of nasal contact calls were measured in 53 (24 male, 29 female) individuals, body mass and neck dimensions in 63 (31 male, 32 female) live individuals and nasal vocal tract and vocal fold lengths in 26 (16 male, 10 female) specimens.



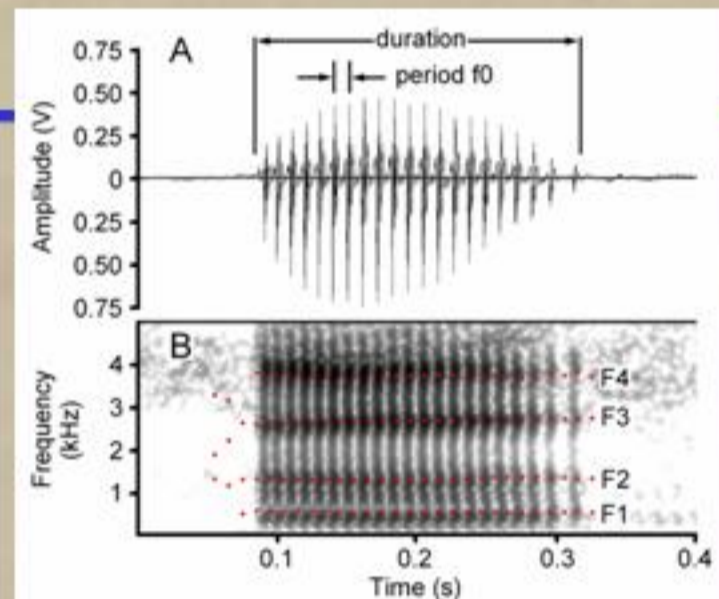
## Larynx



Unique cricoid spina

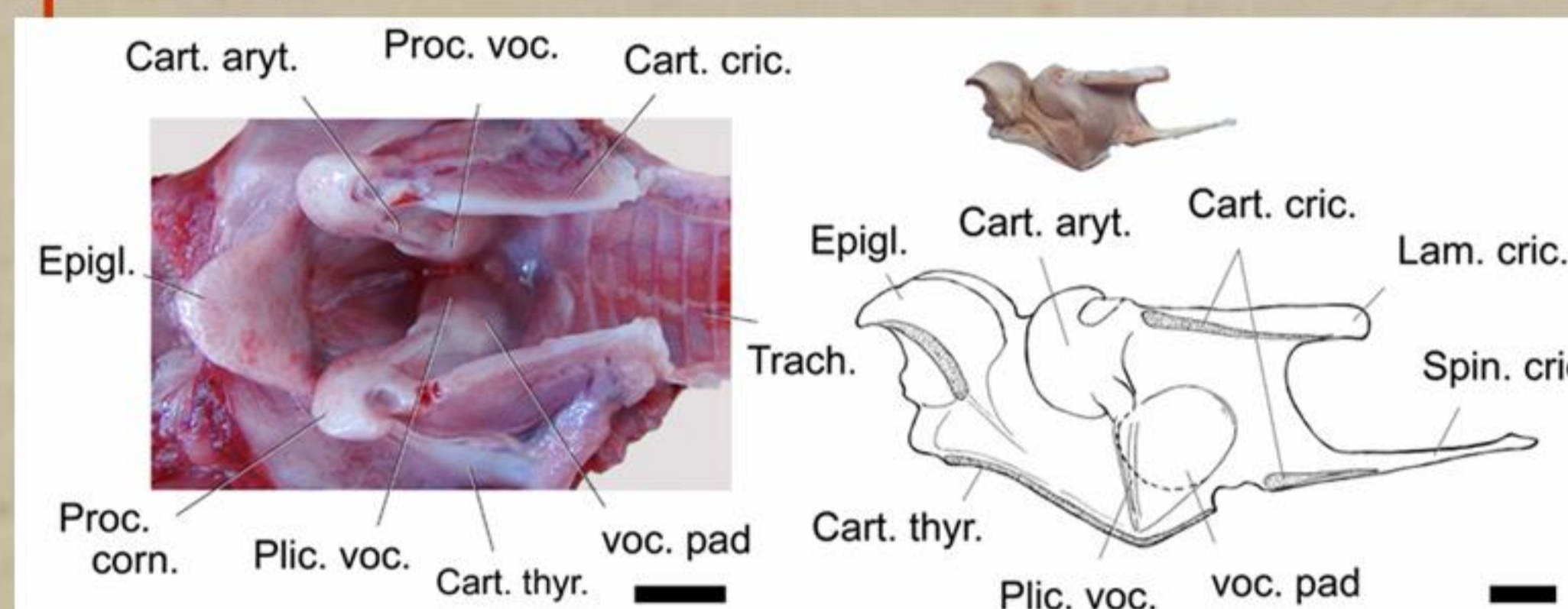
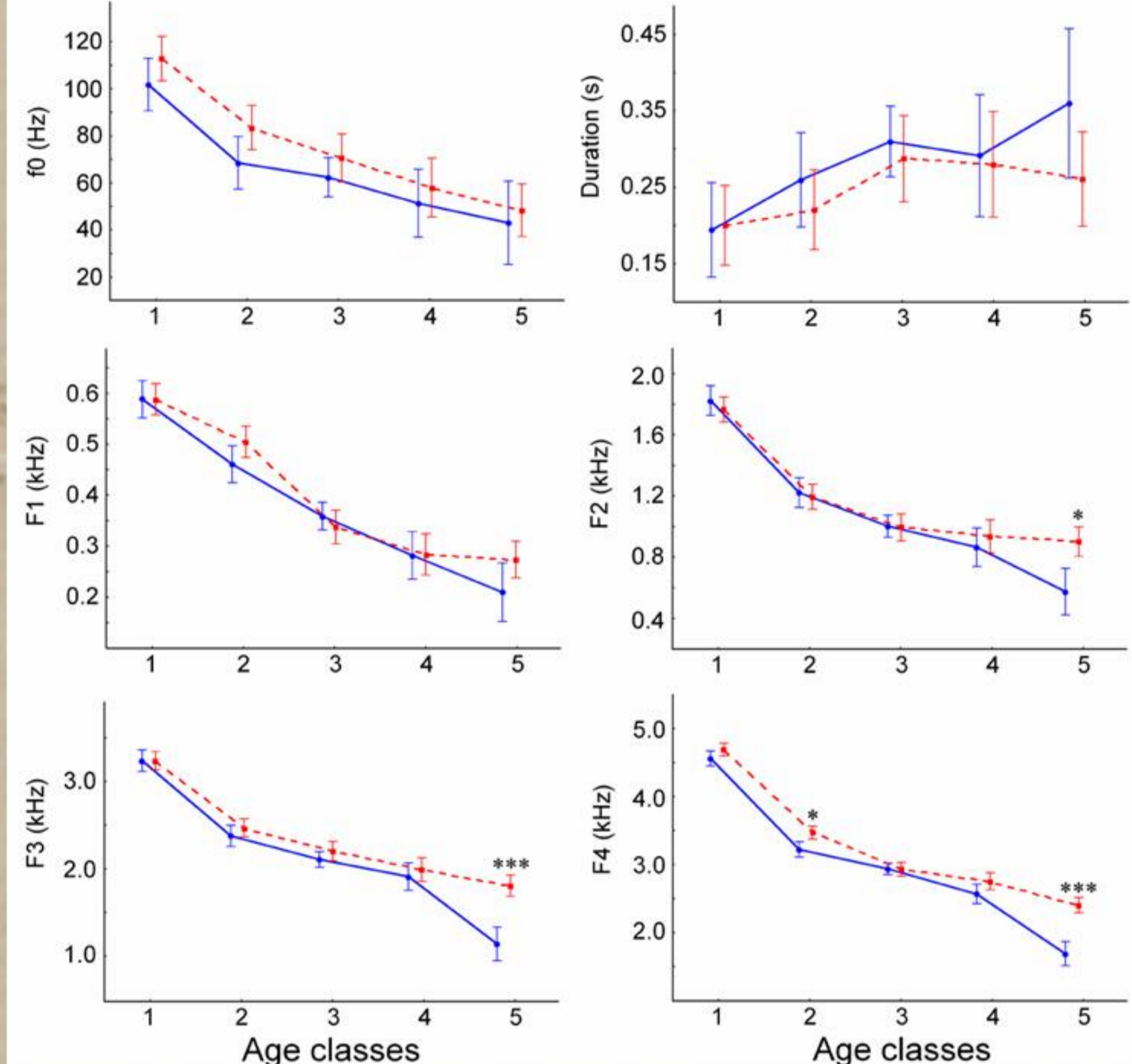


Enlargement of the thyroid cartilage



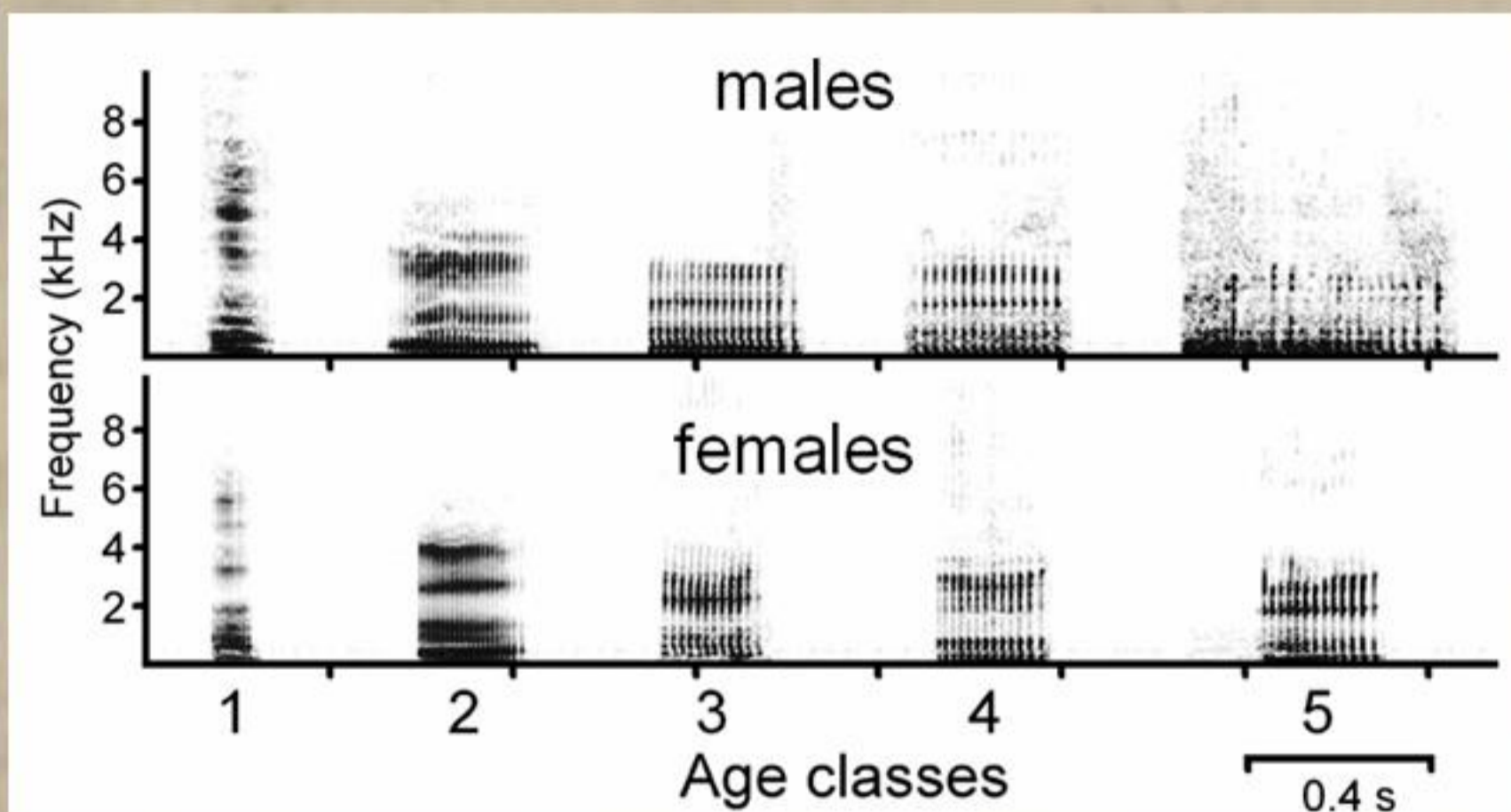
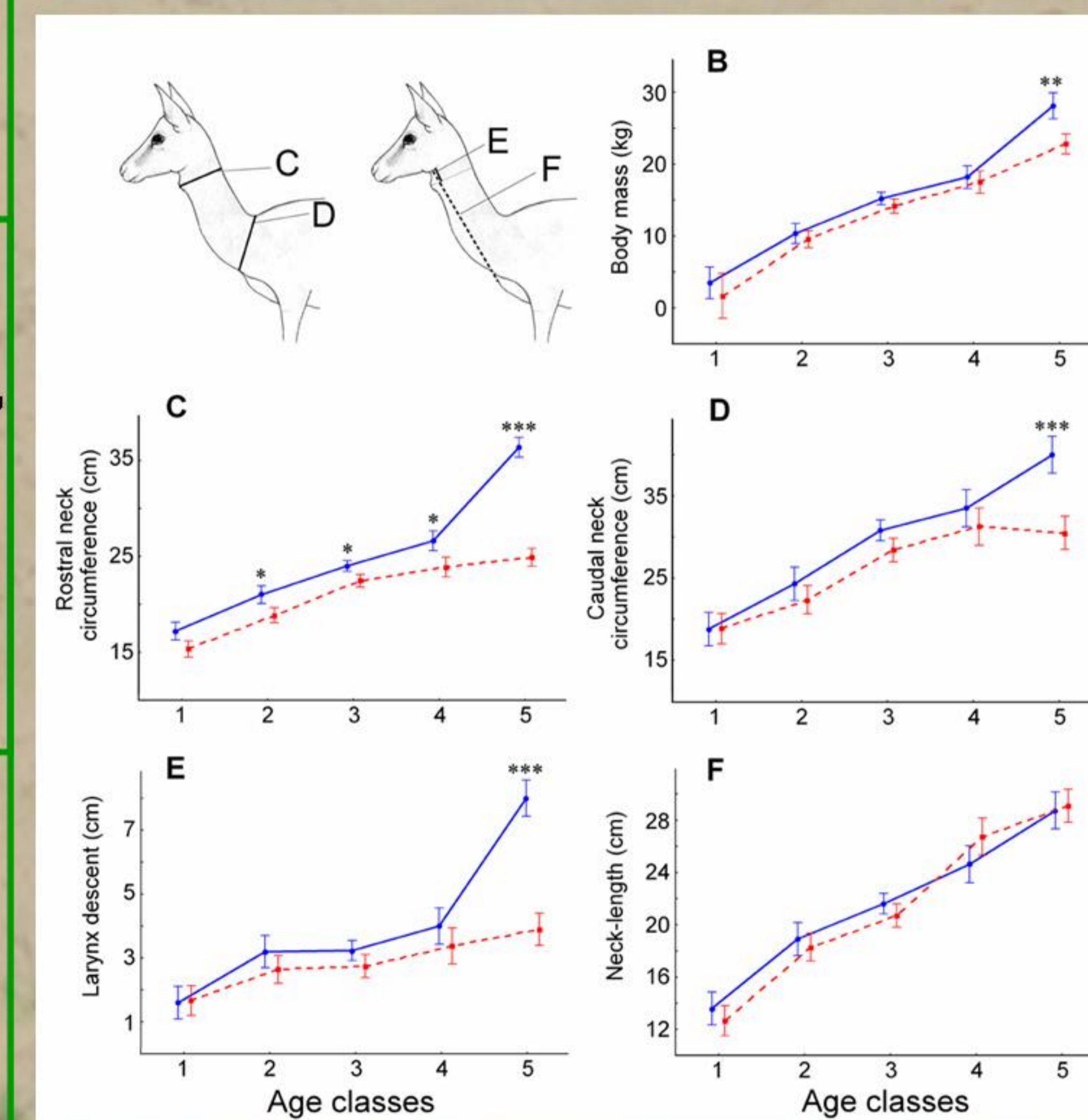
## Call acoustics

Call fundamental frequency ( $f_0$ ), the acoustic correlate of ontogenetically enlarging larynx, and call formants (second, third and fourth), the acoustic correlates of the elongating vocal tract, differed significantly only in adults.



Long and thick vocal folds with large vocal pads allow call fundamental frequency as low as in elephant rumbles.

## Body mass and neck dimensions



Sex differences in neck circumference over the larynx emerged at 2-3 months of age, whereas body mass, neck circumference at neck-body transition and the degree of larynx descent differed significantly only in adults.



adults (5 age class)

## Publications:



Vocal changes accompanying the descent of the larynx during ontogeny from neonates to adults in male and female goitred gazelles *Gazella subgutturosa*

Ilya A. Volodin<sup>a,\*,</sup>, Kseniya O. Efremova<sup>b</sup>, Roland Frey<sup>c</sup>, Natalia V. Soldatova<sup>d</sup>, Elena V. Volodina<sup>e</sup>

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The Postnatal Ontogeny of the Sexually Dimorphic Vocal Apparatus in Goitred Gazelles (*Gazella subgutturosa*)

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**CONCLUSION:** In contrast to humans, the male-specific enlargement of the larynx starts early in ontogeny. The larynx descends moderately in both sexes before early adulthood, whereas the additional prominent descent in males is shifted to late ontogeny, to avoid disadvantages of the descended larynx on males during their growth. Vocal changes are gradual in females, but undergo drastic changes in premature males. The male-specific descent of the larynx goes along with the increasing male chances of siring offspring.