GROSS MORPHOLOGICAL AND MORPHOMETRICAL STUDIES ON THE FOURTH, FIFTH, SIXTH AND SEVENTH PAIRS OF RIBS OF BLUE BULL (*BOSELAPHUS TRAGOCAMELUS*)

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SUMMARY

The present study was carried out on fourth, fifth, sixth and seventh pairs of ribs of six specimens of adult blue bull (*Boselaphus tragocamelus*) of either sex. These ribs consisted of a head, neck and a tubercle at the proximal end, shaft and a costal cartilage at the distal end. The ribs of both the sides had similar structures and sex wise gross variations were not found. Most of the biometrical measurements on different parameters of fourth to seventh pairs of ribs of blue bull were having significantly more values (P<0.05) in males than females. The present gross and biometrical studies would be useful to the wild life professionals for determination of sex of this animal and solving vetero-legal cases related with this species.

Keywords: Blue bull, Morphology, Morphometry, Ribs

The blue bull (*Boselaphus tragocamelus*) is known to be one of the biggest antelopes in Asia and is widely found in both the forests and adjoining villages with enough green grass (Sathapathy *et al.*, 2017, Sathapathy *et al.*, 2018a,b,c,d). The blue bull belongs to the family Bovidae and comes under the genus Boselaphus (Sathapathy *et al.*, 2018e,f,g,h). It is quite prevalent in northern and central parts of India especially in the foothills of Himalayas, eastern part of Pakistan and southern part of Nepal, but has vanished from Bangladesh (Sathapathy *et al.*, 2018i). The blue bulls are safeguarded beneath the IUCN since 2003 and also under safeguard of 'Schedule III' of the Indian Wildlife Protection Act, 1972 (Bagchi *et al.*, 2004).

The massive body of the blue bull can be attributed to the large skeleton of the antelope. Further, the skeleton comprises of large and massive bones of axial and appendicular skeleton that not only protects the viscera, but also provides shape and support to the heavy musculature of the blue bull (Sathapathy *et al.*, 2018j). The present study developed a baseline data on the gross and biometrical sexual differentiation of fourth, fifth, sixth and seventh pairs of ribs of adult blue bull that would immensely help the wild life anatomists and Veterinarians in species identification and solving forensic and veterolegal cases as no previous work has been done in this field on the Blue bull.

The present study was carried out on the fourth to seventh pairs of ribs of six specimens of adult blue bulls of either sex. The skeletons were taken out from the burial ground that was located in the premises of the office of the Deputy Conservator of Forest Wildlife (WL), Jodhpur. The collected bones were boiled in aluminium container for about one hour and subsequently sun dried for 3-4 days. The gross study was conducted under the supervision of the Zoo Authority, Jodhpur, India. The different parameters of fourth, fifth, sixth and seventh pairs of ribs of blue bull of either sex were measured and subjected to routine statistical analysis as per standard technique given by Snedecor and Cochran (1994) and independent samples t-Test with Systat Software Inc, USA and SPSS 16.0 version software.

The fourth to seventh pairs of ribs of blue bull ribs consisted of a head, neck and a tubercle at the proximal end, shaft or body and a costal cartilage at the distal end (Fig. 1). Similar findings were also reported by Getty et al. (1930) in ox, Dyce et al. (2006) in ruminants and Frandson and Spurgeon (1992) in cattle. The shaft or body was curved and presented two surfaces and two borders. The curvature at the upper part was more and the distal part was inclined inward. The lateral surface was found to be convex and had a wide groove at its upper part. The medial surface was smooth and concave. The anterior border was thick and concave, whereas the posterior border was convex that lodged the costal groove for the intercostals vessels. This groove was prominent at the upper part. Further, the head presented two articular facets that were separated by a groove. These facets articulated with the facets of the body of the corresponding vertebrae to form the costo-central articulation. The tubercle was situated behind the head and the two structures were found to be separated by a constricted portion known as neck. The length of the neck was found to be variable. The neck presented a groove all along its length. The neck was long and formed a smaller angle with the shaft or body except in

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Fig. 1. Lateral view of ribs (13 numbers) of left side of adult female Bule bull (*Boselaphus tragocamelus*)

the caudal part of the series. An accessory tubercle was located below the main tubercle of the fourth, fifth and seventh pairs of ribs at the caudal border of the shaft (Fig. 2), which was in agreement to the observations of Sebastiani and Fishbeck (2005) in cat, where they found a small, pointed angular process termed as accessory tubercle was present on the angle of the rib. The distance between the two tubercles also varied in the ribs. The main tubercle of the rib presented articular facet that was usually concave in shape. However, variations were recorded with respect to the shape and size of the facets of the tubercle. This facet articulated with the corresponding facet present on the transverse process of thoracic vertebra to form the costo-transverse articulation.

The distal end of the ribs was little expanded that articulated with the costal cartilages. The cartilages were found to be cylindrical and little compressed from side to side. Similar findings were also reported by Getty et al. (1930) in ox, Dyce et al. (2006) in ruminants and Frandson and Spurgeon (1992) in cattle. Grossman (1960) reported that the costal cartilages were hyaline in nature that underwent extensive ossification in the adult camel. The ribs of both the sides had similar structures and sex wise gross variations were not found. The accessory tubercle was not found in the 4th rib, but it has a distinct costal groove. The curviness of the shaft decreased from 4th to 7th pairs of ribs in both the sexes of blue bull. Further, the accessory tubercle was located 3.1 ± 0.12 cm and 3.3 ± 0.08 cm below the proximal tubercle at the caudal border of 5th rib with a well developed costal groove in females and males respectively. The facet on the tubercle of 6th rib was more or less flattened and the accessory tubercle was absent with a well developed costal groove. The facet on the tubercle of the 7th rib was leaf like. The neck had a groove that was 0.2 ± 0.003 cm and 0.18 ± 0.001 cm in females and males respectively deep. The caudal articular



Fig. 2: Lateral view of right eighth rib of adult female Blue bull (Boselaphus tragocamelus) showing a) Tubercle, b) Accessory tubercle, c) Posterior border of shaft, d) Sternal extremity, e) Anterior border of shaft and f) Head

facets were bigger in size than the cranial ones. The accessory tubercle was located 4.7 ± 0.32 cm and 4.9 ± 0.21 cm below the proximal tubercle at the caudal border in females and males respectively. The costal groove ended at the middle of the shaft of the rib.

CONCLUSION

The various parameters of ribs showed characteristic sexual variations and the measurements were significantly more (P<0.05) in male animals than in females. There is no previous information on these parameters in the fourth, fifth, sixth and seventh pairs of ribs of blue bull, nor in any other domestic animals with which comparisons could be made. We therefore believe that the data presented above would form a baseline for further work.

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