

Comparative Characteristics of Shoulder Blade (*Scapula*) of Kashmir Stag (*Cervuscanadensishangul*), Common Leopard (*Panther pardus*), Himalayan Goral (*Nemorhaedus goral*), Spotted Deer (*Axis axis*) and Himalayan Bear (*Ursusthibetanus*).

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ABSTRACT

A comparative study was conducted on the scapula of the Kashmir Stag (*Cervuscanadensishangul*), Common Leopard (*Panther pardus*), Himalayan Goral (*Nemorhaedus goral*), Spotted Deer (*Axis axis*), and Himalayan Bear (*Ursusthibetanus*). The study included morphological and certain morphometrical parameters of the scapula bones of these animals. In Kashmir Stag, Himalayan Goral, and Spotted Deer the bone was triangular with a spine that divides the lateral surface into two unequal halves. In Himalayan Bear, the scapula was rectangular in outline, extremely wide, and very well-presented supraspinatus and infraspinatus fossae. In Common Leopard, the scapula was a quadrilateral flat bone, the spine was inclined to the infraspinous fossa, and it was not tuberosus in the middle. A well-developed suprahamate process was present before the acromion process over the infraspinous fossa in the scapulae of the Common Leopard and in Himalayan Bear. The features can be used to identify the animal species and serve as a forensic tool.

Key words: Scapula, Kashmir Stag, Morphology, Himalayan Goral

INTRODUCTION

The body of the primates has been adapted to different forms of locomotion, from bipedal species to quadrupedal species as in the majority of primates. The latter form of locomotion requires the support of both pelvic and pectoral bones for terrestrial and arboreal displacement (Ankel-Simons, 2007). The primate shoulder plays an important role in quadrupedal movement between trees or swimming in water or predation in forest. These primates have muscles that provide adequate strength to move the levers formed by bones and joints, as well as restricting movement to avoid falling when the animal is supported by their limbs (Velez-Garcia *et al.*, 2018). Among the fore limb bones, the scapula plays a fundamental role, as it articulates synovially with the humerus and the clavicle in primates, which gives greater mobility to this articulation when compared with mammals without a clavicle (Preuschoft *et al.*, 2010). The flat bone, scapula being a morphologically complex segment of the forelimb, transmits locomotor loads to the thorax, stabilises the shoulder, and allows forelimb mobility, e.g., for climbing and prey

apprehension (Fischer and Blickhan, 2006). The scapula also serves as the origin and insertion of muscles that generate movements of this bone, as well as the shoulder and complementarily, the elbow (Dyce *et al.*, 2010). However, there is a scarcity of information on the comparative Characteristics of Shoulder Blade (*Scapula*) of the Kashmir Stag (*Cervuscanadensishangul*), Common Leopard (*Panther pardus*), Himalayan Goral (*Nemorhaedus goral*), Spotted Deer (*Axis axis*) and Himalayan Bear (*Ursusthibetanus*). So, the present study was designed to record and document morphological and certain morphometric parameters of the scapula of these animals for identifying the animal species.

MATERIAL AND METHODS

Present work was carried out on Scapula of Kashmir Stag (*Cervuscanadensishangul*), Common Leopard (*Panther pardus*), Himalayan Goral (*Nemorhaedus goral*), Spotted Deer (*Axis axis*) and Himalayan Bear (*Ursusthibetanus*) collected from Department of Wild life Protection Kashmir, India after post-mortem of the said animals. A proper permission was taken from the warden of the Department of Wildlife Protection Kashmir for carrying out the present study. The bones were processed by sarco digestion, cleaned, and observations were made. The study included morphological and certain morphometric

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parameters of the scapula bones of these animals without any apparent skeletal disorders, using scale, thread, and Vernier callipers. The morphometric parameters were as:

1. Scapular length: Maximum scapular length (from the cranial angle to the coracoid process).
2. Scapular width: Maximum scapular width (from the caudal angle to the mid-point of the anterior border)
3. Scapular index: $\text{Scapular width} \times 100 / \text{scapular length}$
4. Length of Supraspinous fossa: Maximum length of supraspinous fossa
5. Width of Supraspinous fossa: Maximum width of supraspinous fossa
6. Index of Supraspinous fossa: $\text{Supraspinous width} \times 100 / \text{supraspinous length}$
7. Length of Infraspinous fossa: Maximum length of infraspinous fossa
8. Width of Infraspinous fossa: Maximum width of infraspinous fossa
9. Infraspinous index: $\text{Infraspinous width} \times 100 / \text{infraspinous length}$
10. Ratio of Supra Spinous and Infraspinous fossa

RESULTS AND DISCUSSIONS

In Kashmir Stag, Himalayan Goral and Spotted Deer, the bone was triangular in shape with a spine that divides the lateral surface into two unequal halves (Fig. 1). It was wider at the dorsal end and narrower at the ventral end which was similar to the findings of Choudhary *et al.* (2013) in chital, Choudhary (2015) in Indian blackbuck and Rohlanet *et al.* (2017) in Blue bull. The scapula presented two surfaces, three angles, and three borders. The medial surface presented a shallow subscapular fossa for the subscapularis muscle. The subscapular fossa was much deeper in Kashmir stag, followed by Himalayan Goral, and then Spotted Deer. The free edge of the spine, being subcutaneous, was somewhat rough and tuberosity in the middle to form the tuberosity of the spine for the trapezius muscle. The spine was prolonged downwards to form the acromion process for the deltoideus muscle.

In Himalayan Bear, the scapula was rectangular in outline (Fig 2), extremely wide, and presented supraspinous and infraspinous fossae in accordance to Galateanu *et al.*, (2013). The scapular

neck was very wide that exceeded the cranio-caudal diameter of the glenoid cavity by about one-third. A well-developed scapular spine that ends with a large, plate-like acromion process projected ventrally towards the glenoid cavity. The scapular spine doesn't divide the lateral surface completely, but towards the caudal border, it was incomplete. The medial surface of the scapula was again divided into two shallow fossae by a blunt ridge for the accommodation of the subscapularis muscle (Fig. 3). The cranial border was concavo-convex and ends towards the glenoid cavity with a shallow notch. The dorsal border was more rounded, and the caudal border was convexo-concave and ended over the coracoid process in the form of a deep notch. The coracoid process was very well developed, was farther from glenoid cavity, and projected beyond it. Anterior angle was practically absent. The acromion process was laterally flattened to form a hamate process. The caudal scapular border curves medially and caudally to delineate an additional fossa, the postscapular fossa (Fossa postscapularis). In the Common Leopard, the scapula was a quadrilateral flat bone (Fig. 4) as similar shape reported by Archana *et al.* (2015) in the domestic European breed of the tiger. The spine was inclined to the infraspinatus fossa and it was not tuberosity in the middle. The caudal border was rounded, and a well-developed hamate process was present before the acromion process over the infraspinatus fossa in corroboration to the finding of Dyce *et al.* (2010) in the cat. The morphometric parameters of the shoulder blade in different species were given in Table. 1

CONCLUSION

An appreciable differences in the scapula were found, in the five species studied in the present paper. In Kashmir Stag, Himalayan Goral, and Spotted Deer the bone was triangular, while in Himalayan Bear, the scapula was rectangular in outline. In Common Leopard, the scapula was a quadrilateral flat bone, and the spine was inclined towards the infraspinous fossa. A well-developed suprahamate process was present before the acromion process over the infraspinatus fossa in the scapulae of the Common Leopard and in the Himalayan Bear. The features found in the scapulae of the five studied species can be used for the identification the animal species and also serve as a forensic tool for solving any vetrolegal case.

Table 1: The morphometric parameters of the shoulder blade in different species

Species	Scapular length(inch)	Scapular width(inch)	Scapular index	Length of Supraspinous Fossa (inch)	Width of Supraspinous Fossa (inch)	Length of Infraspinatus Fossa (inch)	Width of Infraspinatus Fossa (inch)	Ratio of supra and infraspinatus fossa (taken from mid pint of spine to respective borders))
Kashmir Stag	9.20	4.90	53.26	7.50	0.92	7.40	3.96	1:3
Common Leopard	8.50	4.50	52.94	7.10	1.10	6.89	3.38	1:1.4
Himalayan Goral	9.50	4.80	50.52	8.40	1.20	8.20	3.59	1:2
Spotted Deer	9.80	4.50	45.91	8.70	0.96	8.11	3.51	1:3
Himalayan Bear	8.00	6.50	81.25	6.00	3.20	6.00	3.30	1:1.5



Fig. 1: Scapulae with unequally divided lateral surface. **Fig. 2:** Lateral surface of the scapula of bear. 1. Hamate process, 2. Lateral spine, 3. Coracoid process and Fossa postscapularis (curved line). **Fig. 3:** Medial surface of the scapula of bear. 1. Blunt ridge, 2. Sub scapula fossae, 3. Coracoid process and Fossa postscapularis (curved line). **Fig. 4:** Lateral surface of the scapula of leopard. 1. Lateral spine, 2 Acromion process, 3. Hamate process

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