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Gross morphological studies on the sternum of common hawk cukoo (*Hierococcyx varius*) and yellow billed babbler (*Argya affinis*)

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Abstract
The current study aimed at recording the morphological features of sternum in common hawk cukoo and yellow billed babbler. The sternum of both bird vary considerably. The mesosternum of common hawk cukoo was wide, quadrelateral with no extension of posterolateral processes and moderately developed anterolateral processes. The width of the sternum at cranial and caudal end was 1.68 and 2.57 centimetres respectively. The sternum of yellow billed babbler was like that of domestic fowl. The mesosternum was quadrilateral and metasternum was very long. The sternum of yellow billed babbler showed one pair of moderately developed anterolateral processes and one pair of well developed postero-lateral processes. The later was further divided into medial and lateral divisions. The sternal crest was moderately developed in both the birds under study. The W/H ratio of sternum in common hawk cukoo and yellow billed babbler was 1.09 and 0.76 respectively.

Keywords: Sternum, common hawk cukoo, yellow billed babbler, morphology, keel

1. Introduction
The common hawk cukoo and yellow billed babblers were the most common birds of southern part of India. The common hawk cukoo was arboreal and rarely descend to the ground. The yellow billed babblers were with short rounded wings with a weak flight. The major division of the birds as carinates and ratites was on the basis of keel of sternum as it gives attachment for the pectoral and supracoracoid muscles which were the flight muscles [1]. Owing to the attachment of muscles of flight to the sternum, this morphological variation might be related with the flying abilities of different birds and their habitat. Therefore, the current study was aimed at recording of different anatomical features of sternum in common hawk cukoo and yellow billed babbler and also to compare them with those of other flight birds.

2. Materials and Methods
The carcass of common hawk cukoo and yellow billed babbler were collected and the bones were procured by natural maceration by anaerobic microorganisms. Then sternum bones were kept in water added with 10 % washing soda (Na_2Co_3) [2]. The bones were washed in tap water and dried under room temperature. The distance between the craniolateral processes was taken as width (W) at anterior end. The width of posterior end was measured between the lateral tips of caudal border. Height of sterna crest (H) was taken at the level of its base of body. The keel curvature was measured at the free border of sterna crest.

3. Results and Discussion
3.1. Common hawk cukoo: The sternum was a flat bone. The dorsal aspect of the sternum was very much concaved, the ventral side being correspondingly convex (Fig.1). The sternum was attached to coracoids, clavicles and sternal component of the sternal ribs. The sternum of common hawk cukoo consisted of three parts body or mesosternum, rostrum and keel. The body of sternum was roughly quadrilateral. The width of the sternum at cranial and caudal end was 1.68 and 2.57 centimetres respectively. The sternal body length was 3.08 centimetres. The body presented an anterior border, two lateral borders and one posterior border. The cranial border was convex and strongly built (Fig.2, 3). It presented a dorsal and a ventral lip, both of which enclosed a groove for the distal extremity of coracoid bones. At the junction of anterior and lateral border on either side, a short, triangular moderately developed craniolateral process with trough on its dorsal aspect was noticed (Fig.2).

The lateral border of cranio lateral presess unveiled four costal facets (FIG.2, 3). John et al.[3] documented the presence of a pair of cranio-lateral process in the sternum of owl, pigeon and crow. These processes were highly developed in owl, moderately developed in crow and highly reduced in pigeon. In fowl the process is very large and in duck and goose small [4]. The Lateral border was thick anteriorly and thins posteriorly. According to Dyce et al., [5] the caudal end of the sternum was cartilaginous in young birds and hence, its flexibility was an indicator of age. The posterior border was convex and posterior part of the sternum was not completely ossified as the bird was young (Fig 2, 3). The caudolateral processes and lateral notches were absent. The rostrum was very small and projected from the middle of the ventral lip (Fig. 1). Tomar et al. [6] reported the absence of rostrum in the sternum of pariah kite. The sternal crest was triangular in outline. Its cranial border was Cocavo-Covex from above downwards. The dorsal border of the keel fused with body. The ventral border was convex and completely extends till the posterior border (FIG.1). The sterna crest was absent in some flightless birds like emu and ostrich [7]. The present study unveiled several pneumatic pores on the visceral surface of sternum like that of bald ibis [8] . Whereas Nickel et al. [4] observed the presence of a single large pneumatic foramen behind the cranial border of sternum in domestic fowl.

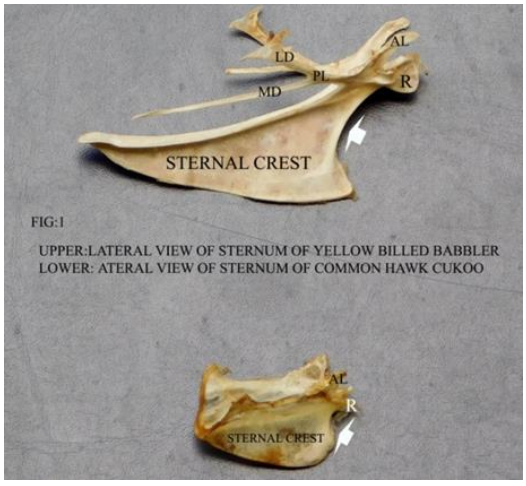

Fig 1: Shows anterior border of keel

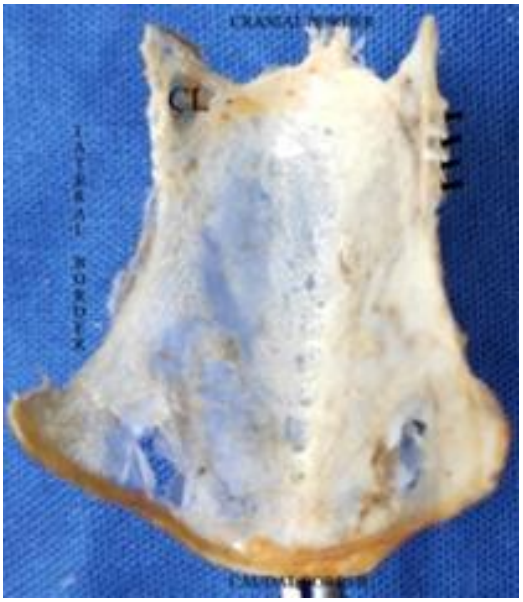

Fig 2: Dorsal view of sternum of common hawk Cukoo.

Fig 3: Ventral view of common hawk cukoo. CL: craniolateral process, arrows indicate costal facets, AL: anterolateral process, PL: Posterolateral processes, LD: lateral division, MD: medial division, R: rostrum, white arrow head in

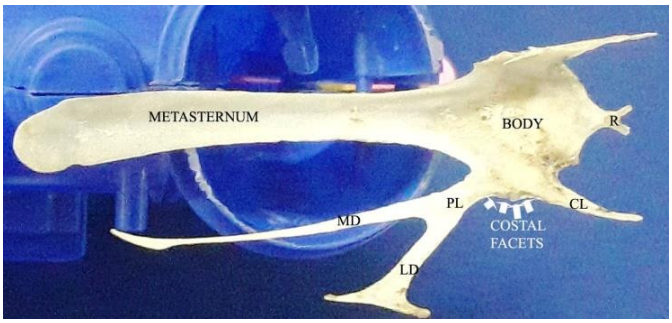

Fig 4: Dorsal aspect of sternum of yellow billed babbler

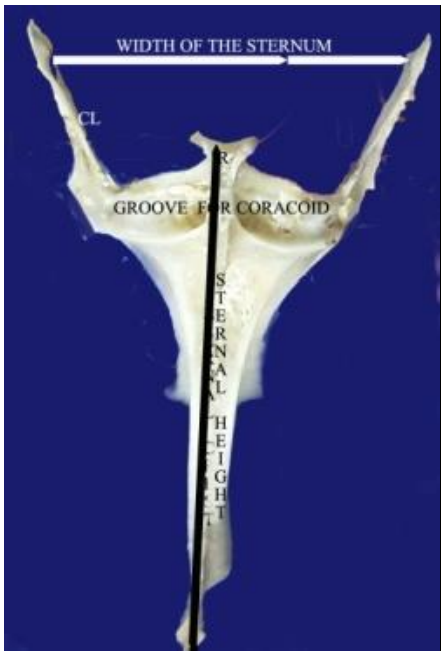

Fig 5: Anterior view of sternum of yellow billed babbler shows the coracoid grooves, measurement of a sternal height and width.

3.2. Yellow billed babbler

The sternum of yellow billed babbler showed rostrum, body and metasternum when viewed from dorsal aspect. The body or mesosternum of the bone was quadrilateral and showed one foramina on its dorsal surface. The anterior border was highly convex .The rostrum was modified into a well-developed 'Y' shaped structure in the present study (FIG.4) like that of sternum of crow [3] On either side of plate like rostrum elongated convex grooves were present for the distal end of the coracoids. The medial aspect of the coracoid grooves showed pneumatic foramen which pierced the rostral plate (Fig.5). The metasternum was very long and had a prominent keel attached to its ventral aspect (Fig.1, 4). One pair of moderately developed anterolateral processes and one pair of well developed posterolateral processes were observed. In between the posterolateral process and anterolateral processes four oval facets were present for the distal ends of third, fourth, fifth and sixth ribs (FIG.4). The number of costal facets were four, five, six in the sternum of sparrow, myna [9] and pigeon hawk [3] respectively. The posterolateral process was again divided into medial and lateral divisions. The lateral division directed laterad and caudad and the medial slender process projected caudally parallel to metasternum (FIG. 4). Anterior border of the keel was concave and grooved (FIG1, 5). The literature showed a positive correlation between height of keel and flight capability [10]. In contrary duzler et al.[2] stated that those birds with a higher sterna crest fly, while those possessing a lower sternal crest walk would not be correct. He further stated that swimming birds had W/H ranged between 1.56 and 1.95 mm, walking birds it was between 0.50 and 0.68 mm and In the flying birds the width and height of the sternum were approximately equal and W/H ranged between 0.96 and 1.35 mm. The W/H ratio of sternum in common hawk cukoo and yellow billed babbler was 1.09 and 0.76 respectively.

Table 1: Table showing various parameters of sternum in common hawk cukoo and yellow billed babbler.

Measurements of sternum	Common hawk cukoo	Yellow billed babbler
Height in centimetres	1.51	2.64
Width in centimetres	1.64	2.00
W/H ratio	1.09	0.76
Keel curvature	2.7	5.8

4. Conclusion

It can be concluded that in overall appearance, the sternum of common hawk cukoo showed the similar features like that of pigeon hawk but with convex posterior border. However, the common hawk Cukoo showed the morphological features of flying group of birds. The sternum of yellow billed babbler was more like that of domestic fowl with W/H ratio of 0.76 which strengthened the sedentary nature and less flying nature of that bird.

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