



STERNAL MORPHOMETRY OF COMMON MYNA (*Acridotheres tristis*), HIMALAYAN BULBUL (*Pyconotus leucogenys*) AND HOUSE SPARROW (*Passer domesticus*)

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ABSTRACT

The present study was conducted on Indian mynah, bulbul and sparrow with the aim to study their gross morphological features of sternum. Birds, three each of mynah, bulbul and sparrow, were collected dead and processed in air-tight jars, for 3 weeks. Morphometric measurements of sternum were carried out using standard methods. The study revealed that the anterior two-third of body in the sternum of mynah, unlike the posterior one-third, had a distinctly designed median groove. The sternal body in sparrow was divided into a concave anterior half and a flat posterior half. The lengths and width of sternum were highest in mynah. The length of sternum was nearly double the width in all three birds. The dorsal surface of sternum in bulbul, as compared to mynah and sparrow, was characteristically enriched by median pneumatic foramina. The rostrum was typically 'Y' shaped. The lateral border of sternum on either side displayed 5, 5 and 4 costal facets in mynah, bulbul and sparrow, respectively. The sternal keel was highly developed in all the 3 species of birds. The presence of highly developed keel is indication for strong flight capability of these birds. The study suggests that the presence of 'Y' shaped rostrum is a significant feature of passerine birds.

Key words: Passerine birds, sternum, morphometry

INTRODUCTION

Birds like mynah (*Acridotheres tristis*), bulbul (*Pyconotus leucogenys*) and sparrow (*Passer domesticus*) belong to Passeriformes, one of the densely populated Order of birds. The birds of this order, commonly known as perching or passerine birds, comprise of 5712 species with 45 families representing over half the avian diversity (Sibley and Monroe, 1990; Sibley and Ahlquist, 1990). The worldwide population of sparrows, especially in urban areas, has decreased significantly (Chamberlain *et al.*, 2007). The bones of birds, depending upon species, habitat and especially flight capabilities, differ significantly in their structural features (Duzler *et al.*, 2006). The skeletal system is a reliable measure of structural size as well as a predictor of average size with in populations (Freeman and Jackson, 1990) and is a better source of study than other systems (Laydyguin, 2000). Sternum is one of the highly developed bones in birds and is closely related to the flying ability of birds. It leads to the formation of an important bridge between sternum and shoulder girdle.

An appreciable variation has been reported in sternal and pneumatic foramen as well as in the shape of rostrum in various species of birds (John *et al.*, 2014a, 2015). The studies have revealed a

correlation between movement style and sternal measurements in avian species (Duzler *et al.*, 2006). The present study was, therefore, aimed to record the gross morphological features of sternum (skeletal component) and also compare the morphometric characteristics of sternum in these birds.

MATERIALS AND METHODS

In present study nine birds, three each of mynah, bulbul and sparrow, were collected dead in Kashmir during 2016-2017. Their carcasses were kept in air tight jars, for 3 weeks to allow maceration under anaerobic conditions. The loosened muscular tissues were separated and bones cleaned and dried under sunlight. Morphometric measurements of sternal crest and body of sternum with respect to length, width, height and curvature length of keel were performed using standard methods (Duzler *et al.*, 2006). The height of keel, taken as the sternal height, was recorded from centre of ventral lip to the tip of keel base. The width of sternum was recorded at three different places viz., at anterior end in between the bases of craniolateral processes, at middle in between the bases of caudolateral processes and at the posterior end as the length of caudal border. Curvature length of keel was recorded along its ventral border. The length of sternum was recorded along the median groove.

The data was analyzed using statistical methods as provided by Snecdor and Cochran (1994). In present study, the average values of different sternal morphometric parameters like length width and height were calculated. Further, the ratio of average values of these parameters were used to arrive at a simple morphometric comparison between the sternum of these three birds.

RESULTS AND DISCUSSION

The sternum, was a rectangular shaped bone with a highly concave dorsal surface in mynah followed by bulbul and sparrow. The concavity of dorsal surface in case of mynah was differentiable into two distinct regions, the prominent anterior two-third and a relatively less concave posterior one-third (Fig. 1). The latter was situated at a relatively higher level. The anterior two-third of body, in sternum of mynah, unlike the posterior one-third had a distinctly designed median groove (Fig. 1). The sternal body in case of sparrow was divided into a concave anterior half and a flat posterior half (Fig. 2). In comparison, the dorsal surface in sternum of bulbul was concave throughout (Fig. 3). The sternum in case of owl and crow was highly concave, whereas the posterior third of sternum was flat in case of

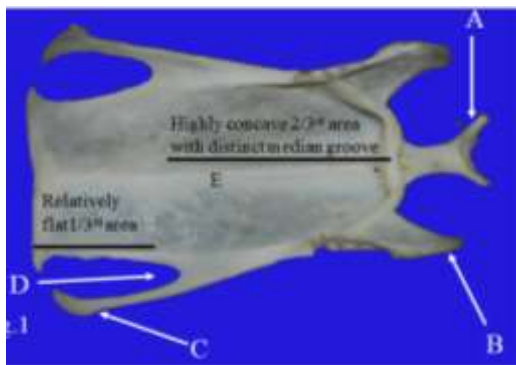


Fig. 1: Sternum of mynah showing A – ‘Y’ shaped rostrum, B – craniolateral process, C - caudolateral process, D - oval notch, and E - median groove

pigeon and red wattled lapwing (John *et al.*, 2014a, 2015). The median groove in both sparrow and bulbul sternum was uniform throughout (Fig. 2 & 3). The dorsal surface of sternum in bulbul, as compared to mynah and sparrow, was characteristically enriched by median pneumatic foramina (Fig. 3) as reported earlier in pigeon, crow, owl and green winged macawa (John *et al.*, 2014a; Sreerengini *et al.*, 2015).

In all the three species, the keel was a highly developed triangular structure with base directed cranially and the caudally directed apex (Fig. 4). The tip of base in mynah and sparrow carried well forward almost in level with the rostrum, whereas in bulbul it was just in front of cranial end of sternal body (Fig. 4). The height of keel, in all three types of birds,

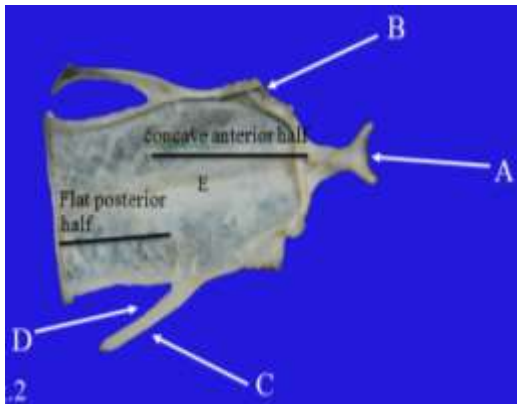


Fig. 2: Sternum of sparrow showing A – Y-shaped rostrum B - craniolateral process, C - caudolateral process, D - oval notch, and E - median groove

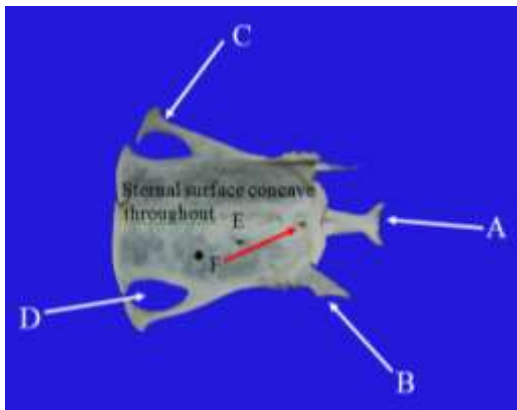


Fig. 3: Sternum of bulbul showing A – Y-shaped rostrum B - craniolateral process, C - caudolateral process, D - oval notch, E - median groove, and F - pneumatic foramen

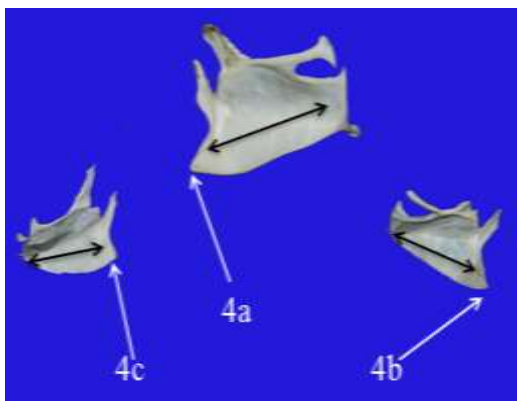


Fig. 4: Sternum of mynah (4a), sparrow 4b) and bulbul (4c) showing Keel (black arrow) and tip of the base (yellow arrow)

decreased from cranial to caudal end. The keel did not reach to the caudal border and finished just in front of it is in agreement with findings of John *et al.* (2014a) in crow. Jaychitra *et al.* (2015) have reported the absence of keel in emu.

The average length of sternum in mynah, bulbul and sparrow was 3.0, 1.7 and 1.8 cm, respectively, whereas the average width in the same order was 1.43, 0.97 and 0.93 cm. The mean height of the sternum was 1.1, 0.6 and 0.7 in mynah, bulbul and sparrow, respectively. The ratio between the width and height of sternum was 1.30, 1.61 and 1.32 in mynah, bulbul and sparrow, respectively. Thus, the width of sternum was well ahead of the height of keel in all the three species. Duzler *et al.* (2006) have mentioned the width and height of sternum in flying birds to be approximately equal. Similarly, the ratio between length and width of sternum was 2.10, 1.75 and 1.93 in mynah, bulbul and sparrow, respectively. The above observations indicated that the length of sternum was nearly double the width of sternum in all the bird species.

The craniolateral process was highly developed in mynah and least in sparrow (Fig. 1-3). The caudolateral processes did not reveal any appreciable difference. The caudo-lateral process is single in crow, owl and lapwing, whereas, in pigeon a pair of caudolateral processes originate on either side of the sternum (John *et al.*, 2014a, 2015). There was a greater variation with respect to the presence of lateral notch. The number of lateral notches, on either side of sternum, varied from two in pigeon, one in crow and lapwing to none in owl (John *et al.*, 2014a).

In all the three bird species, the rostrum was fused with the dorsal part of cranial end of keel and was typically 'Y' shaped (Fig. 1-3). The rostrum was placed roughly at an angle of 30° against the cranial end of body. John *et al.* (2015) have reported that the sternum of crow (passerine bird) was 'Y' shaped, whereas it was pointed in pigeon and highly reduced in owl. The presence of 'Y' shaped rostrum is, therefore, a peculiar feature of these birds. A noteworthy feature of the sternum in bulbul was the presence of pneumatic foramen at the base of rostrum. The lateral border of sternum on either side displayed 5, 5 and 4 costal facets in mynah, bulbul and sparrow, respectively; whereas, the number of costal facets on each lateral border is 6 in green winged macaw, red wattled lap wing and pigeon hawk (John *et al.*, 2014b, Sreerengini *et al.*, 2015; John *et al.*, 2015). The troughs, enclosed in between costal facets, were

devoid of pneumatic foramen in all the three species. Pneumatic foramina associated with these troughs have been reported in Spot Billed Pelican and pigeon hawk (Sathyamoorthy *et al.*, 2012; John *et al.*, 2014b). The dorsal lip of the transverse groove in all the three species was notched centrally. Similar reports have been recorded in the sternum of red wattled lapwing by (John *et al.*, 2015). However, the central notch was relatively faint in the sparrow. Ventral lip of transverse groove, in all three species, was fused with the rostrum.

Conclusion: From the present study, it may be concluded that a) keel is strongly developed in passerine birds; b) common passerines are featured with the presence of an oval notch enclosed by caudolateral processes, c) presence of 'Y' shaped rostrum is a typical feature of passerines; and d) the length of sternum is nearly double its width. The gross morphological features of sternum appear supportive for taxonomic studies. Also, the gross morphological study of avian sternum can act as a reliable tool for forensic study of birds.

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