International Journal of Livestock Research, Vol. 10 (10) Oct' 2020
http://www.ijlr.org
eISSN: 2277-1964
NAAS Rating 2020 – 5.36

Original Research

Comparative Gross Morphological Studies on the Lower Jaw (Mandible) of Cattle Egret (*Bubulcus ibis*), Jungle Babbler (*Turdoides striata*), Yellow-footed Green Pigeon (*Treron phoenicoptera*), Barn Owl (*Tyto alba*) and Shikra (*Accipiter badius*)

Jigyasa Rana[1]*, Shailesh Kumar Patel[2], S.B. Banubakode[3] and Rupali Charjan[3]

[1]Department of Veterinary Anatomy, FVAS, RGSC, BHU, Barkachha, Uttar Pradesh, INDIA
[2]Department of Veterinary Pathology, College of Veterinary Science & A.H., Anjora, CGKV, Durg, Chhattisgarh INDIA
[3]Department of Veterinary Anatomy and Histology, Nagpur Veterinary College, Seminary Hills, Nagpur, Maharashtra, INDIA

*Corresponding Author: rana.jigyasa@gmail.com

How to cite this paper: Rana, J., Patel, S., Banubakode, S., & Charjan, R. (2020). Comparative Gross Morphological Studies on the Lower Jaw (Mandible) of Cattle Egret (*Bubulcus ibis*), Jungle Babbler (*Turdoides striata*), Yellow-footed Green Pigeon (*Treron phoenicoptera*), Barn Owl (*Tyto alba*) and Shikra (*Accipiter badius*). *International Journal of Livestock Research*, 10(10), 105-110. doi: http://dx.doi.org/10.5455/ijlr.20200731080952

Received : Jul 31, 2020
Accepted : Aug 24, 2020
Published : Oct 31, 2020

Abstract

The present study was conducted on lower jaw (mandible) of five avian species 14 having different feeding habit (Cattle Egret, Yellow-footed Green Pigeon, Jungle Babbler, 15 and Raptor birds like Barn Owl and Shikra) with an aim to compare gross morphological 16 features of the mandible. Two specimens of each species were collected from the naturally 17 died birds, in Nagpur region and processed by simple maceration technique. The present 18 study revealed that the mandible of above avian species was formed by the fusion of seven 19 bones i.e. Os mentomandibulare, Os dentale, Os spleniale, Os supra-angulare, Os angular, Os 20 articulare and Os prearticulare. Dentary symphysis sulcus or Os mentomandibulare was 21 dorso-medially wider in Raptor birds than the Cattle Egret, Yellow-footed Green Pigeon and 22 Jungle Babbler. The prominent mylohyoid line was found on its medial aspect and a small 23 rostral mandibular fenestra was on the lateral aspect of the Os spleniale in Cattle Egret. Two 24 large caudal mandibular foramina were found on the lateral aspect of rami of the mandible in 25 Barn owl and Jungle Babbler. In Yellow-footed Green Pigeon, Raptor birds and Jungle 26 Babbler, medial mandibular process was well defined and prominent while this process was 27 inconspicuous in Cattle Egret and Yellow-footed Green Pigeon. Yellow-footed Green Pigeon 28 and Jungle Blabbler had maximum ventrally curved angulus mandibulae in comparison with 29 other birds under the study. Mandibular rami were found to bow outwards in order to enlarge 30 gap between them, and mostly seen in the Raptors. The modification of lower jaw of Raptors 31 may be ascribed to their feeding habits. Mandible of the Cattle Egret and Jungle Babbler had 2 32 narrow and V-shaped dentary symphysis sulcus, it may be because of their eating and 33 probing habit of insects, pests etc.

Keywords: Cattle Egret, Jungle Babbler, Mandible, Morphology, Raptor Birds, Yellow-footed Green Pigeon

Introduction

The Cattle Egret (*Bubuleus ibis*) belongs to Pelecaniformes order and is found in the tropics, subtropics and warm temperate zones of Africa, Europe and Asia. They forage in fields and ground with grazing animals. They feeds on a wide range of prey, particularly insects (Seedikkoy *et al.*, 2007), moths, spiders, frogs, earthworms and fishes (Siegfried, 1971 and Fogarty and Hetrick, 1973). The Yellow-footed Green Pigeon belongs to the order Columbiformes, is an herbivorous bird and common species of green pigeon in the Indian subcontinent. Moreover, the Yellow-footed Green Pigeon is the state bird of Maharashtra (Rebello, 2011) and mainly feeds on fruits, fig trees and grains. The Jungle Babbler is an insectivorous bird (Bhavna and Geeta, 2010) and is endemic in India (Bharucha and Padate, 2010). It is a passerine species and found in a wide range of habitats i.e. from dry deciduous woodlands to moist semi-evergreen forests (Gaston, 1978). They have habit of foraging in small groups and consume insects (grasshoppers, ants, bees, beetles, wasps, cockroaches, termites, moths, crickets, caterpillars, flies, spiders and grains (rice, bajra, wheat and maize (Anthal and Sahi, 2013). The Barn owl and Shikra are grouped under Raptor birds (birds of prey). The Barn owl belongs to Strigiformes order and is a medium-sized nocturnal bird found all over the world except Antarctica. Barn Owl occupies a wide range of habitats and altitudes, including grasslands, deserts, forests, urban areas and agricultural fields. They hunt on insects, birds, reptiles, amphibians and small mammals for their food. Among small mammals, Barn Owl mainly feeds on shrews and rats (Santhanakrishnan *et al.*, 2010). The Shikra is a small raptor bird of Accipitriformes order, and widely distributed in Africa and Asia (India, Bangladesh, Myanmar, Pakistan and Sri Lanka. They feed on insects, rodents, squirrels, small reptiles and small birds (Salim and Ripley, 1978).

The importance of birds has been increased as food producers, biological research models and pets. Hence the interest in avian structures and their functions is also increased (McLelland, 1990). The skeleton of birds is strong, compact, light in weight which represents an adaptation for flight (Egwu *et al*., 2012). Many of the bones contain air filled cavities which are connected to the respiratory system. Bird jaws are powerful organ used for feeding especially in the Raptor birds (John *et al*., 2016). Mandible is an excellent example of adaptation for feeding in all species. However large quantum of literature is available on beak type, feeding habit and food source in birds but only few reports are available on the anatomical features of skull of Cattle Egret and Raptor birds. Moreover, the reports on morphology of birds mandible are meager. Therefore, the study was carried out to obtain some information about the gross anatomical features of the mandible in mentioned avian species. The current investigation may be helpful in understanding the different mechanisms of feeding habits in birds and in determining the future area of research for veterinary anatomists.

Material and Methods

The current study was carried out on ten heads of freshly died adult birds of five species (Cattle Egret, Yellow-footed Green Pigeon, Jungle Babbler, Barn Owl and Shikra) which were collected from the Nagpur region. The specimens were processed by simple maceration technique. For these carcasses were kept for maceration for a period of about 3-4 weeks, then air dried at room temperature for at least one week. The macerated bones were kept in 3% hydrogen peroxide for one day to make the bones whitish and coated with thin layer of touch wood. The mandible was separated and its different segments were studied for the description of gross morphology.

Results and Discussion

The mandible is the largest facial bone of birds. It was found that each half of the mandible of all avian species consisted of fusion of seven separate bones i.e. Os mentomandibulare, Os dentale, Os spleniale, Os supra-angulare, Os angular, Os articulare or mandibular condyle with medial curved process and Os prearticulare. Our findings were in agreement with the findings of Baumel *et al.* (1993) and Tahon *et al.* (2013) in chicken that the mandible is formed of seven bones fused with each other's. However, Hogg (1983) described only six elements of mandible in domestic fowl i.e. os dentale, os supra-angulare, os angulare, os spleniale, os pre-articulare and os articulare. The present findings were differ with the reports given by Moselhy *et al*. (2018) in Ostrich and Kumar and Singh (2014) in Emu, who reported only four segments in each half of the mandible. However, Feduccia (1975) in fowl and Proctor and Lynch (1993) in the Rock Pigeon reported five parts of the mandible.

Os mentomandibulare

This element forms rostrum of mandible connected to the dentary bone. Mandible of each bird was nearly V-shaped with two curved rami, which connected rostrally forming mandibular symphysis. Similar finding was reported by Proctor and Lynch (1993) in the Rock Pigeon, Rezk (2015) in Cattle Egret (*Bubulcus ibis*), Moselhy *et al*. (2018) in Ostrich and Choudhary *et al*. (2020) in Crested Serpent Eagle (*Spilornis cheela*) and Brown Wood Owl (*Strix leptogrammica)*. The cranial border of the rostrum mandibulae was thick, broad and slightly U-shaped in Raptor birds; while it was pointed, V-shaped in Cattle Egret and Jungle Babbler (Fig.1A & 2A). Dentary symphysis sulcus or Os mentomandibulare was dorso-medially wider in Raptor birds (Fig. 3A & 4) than the Cattle Egret, Yellow-footed Green Pigeon and Jungle Babbler.

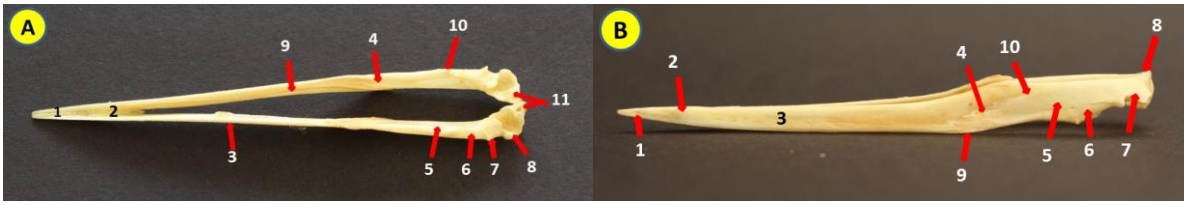

Figure 1: A. Dorsal view of Mandible of Cattle Egret showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Os supra-angulare (5), Os prearticulare (6), Os articulare (7), Os angulare (8), Mylohyoid line (9), Coronoid Process (10), Medial Mandibular Process(11); **B.** Lateral view of Mandible of Cattle Egret showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Os supra-angulare (5), Os prearticulare (6), Os articulare (7), Os angulare (8), Angulus mandibulae (9),Caudal mandibular fenestra (10).

Os dentale

This segment is the principal element of each ramus mandibulae. It articulates with the supraangular and splenial elements by squamous sutures. Dentary segment of either side were connected rostrally to adapt the shape of the upper jaw and form the mandibular symphysis, distally in all species. It was in line with the findings of Getty *et al*. (1930), Nickel *et al*. (1986), Proctor and Lynch (1993) and Dyce *et al*. (2002) in birds, Moselhy *et al*. (2018) in Ostrich and Choudhary *et al*. (2020) in Crested Serpent Eagle (*Spilornis cheela*) and Brown Wood Owl (*Strix leptogrammica*).

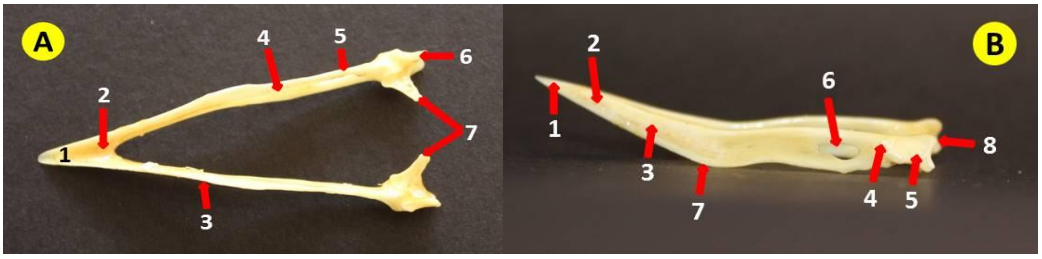

Figure 2: A. Dorsal view of Mandible of Jungle Babbler showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Mandibular foramen (5), Articular Process (6), Medial Mandibular Process (7); **B.** Lateral view of Mandible of Jungle Blabbler showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3),Os supra-angulare (4), Os articulare (5), Caudal mandibular foramina (6), Angulus mandibulae (7), Os angulare (8).

Os spleniale

It is a small thin plate placed on the medial aspect of the ramus mandibulae. The prominent mylohyoid line was found on its medial aspect (Fig.1A) and a small caudal mandibular fenestra was on the lateral aspect of the Os spleniale in Cattle Egret (Fig. 1B) similar to report of Rezk (2015). Two caudal mandibular foramina were found on the lateral aspect of rami of the mandible in Barn owl (Fig. 3B) and Jungle Babbler. These findings were in accordance with Baumel *et al.* (1993) who reported that Columba species possess only one of the fenestrae and two fenestrae occur in certain birds of strigiforms order.

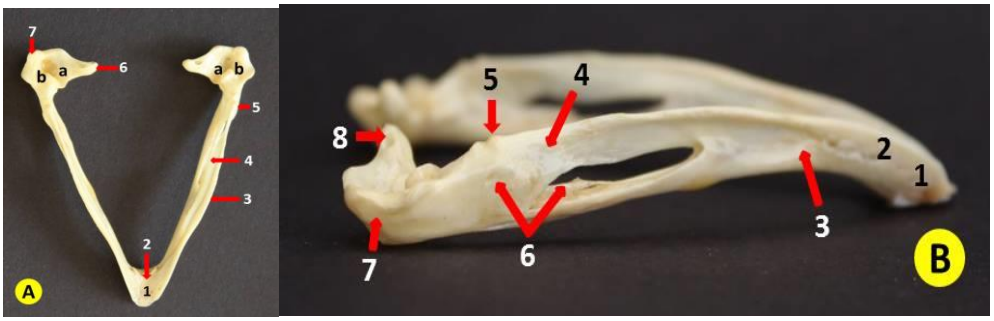

Figure 3: A. Dorsal view of Mandible of Barn Owl showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Coronoid Process (5), Medial Mandibular Process (6), Articular Process (7), Medial facet (a), Lateral facet (b); **B.** Lateral view of Mandible of Barn Owl showing Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os supra-angulare (4), Coronoid Process (5), Caudal mandibular foramina (6), Angular Process (7), Medial Mandibular Process (8).

Os supra-angulare

It is the largest bone of the caudal half of the lower jaw (pars caudalis). Pars supraangularis was fused caudally with pars articularis and had a coronoid process in all avian species. The present findings were in agreement with the reports given by Nickel *et al*. (1986) in birds and Previatto and Posso (2015) in *Cyclarhis gujanensis.*

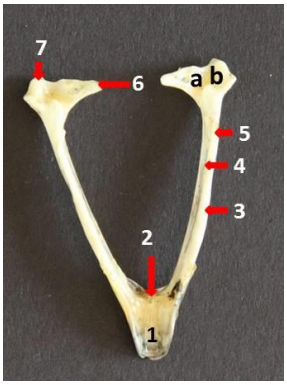

Figure 4: Dorsal view of Mandible of Shikra showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Coronoid Process (5), Medial Mandibular Process (6), Articular Process (7), Medial facet (a), Lateral facet (b).

Os angulare

Pars angularis is a slender strip of bone lying along the ventral border of the jaw. This finding was in agreement with the reports given by Nickel *et al*. (1986) and Dyce *et al*. (2002) in birds. Yellow-footed Green Pigeon and Jungle Blabbler had maximum ventrally curved angulus mandibulae (Fig. 2B & 5B) in comparison with other birds under study. Similarly, Baumel *et al.* (1993) reported angulated or ventrally curved rami in columbiform and passerine birds.

Os pre-articulare

Pre-articular part was the curved rostral prolongation that laterally articulated with the supra-angular bone and ventrolaterally with the angular bone. It was in line with the findings of Hogg (1983) in domestic fowl.

Os articulare

The articular part of mandible along with the curved processes appeared prismatic in outline in all species, which was in agreement to the findings of Choudhary *et al*. (2020) in Crested Serpent Eagle (*Spilornis cheela*) and Brown Wood Owl (*Strix leptogrammica*). Articular part was present posteriorly and meant for articulation with the quadrate bone of skull to form movable quadratomandibular joint. It was in agreement with the reports given by Hassan (2012) in Hooded Crow and Moselhy *et al*. (2018) in Ostrich. Articular surface of articular bone of mandible

consisted of two cotylae or facets i.e. medial and lateral in all Raptor birds (Fig. 3A & 4). The medial and lateral articular facets were also reported by Hassan (2012) in Hooded Crow and Choudhary *et al*. (2020) in Crested Serpent Eagle (*Spilornis cheela*) and brown wood owl (*Strix leptogrammica*). In cattle egret three facets i.e. medial, lateral and caudal facets were present in the articular part of mandible which was similar to the findings of Hassan (2012) in Cattle Egret (*Bubulcus ibis*). In Raptor birds, and Jungle Babbler, medial mandible process was well defined, strong and prominent than the process of Cattle Egret and Yellow-footed Green Pigeon (Fig. 1A & 5A).

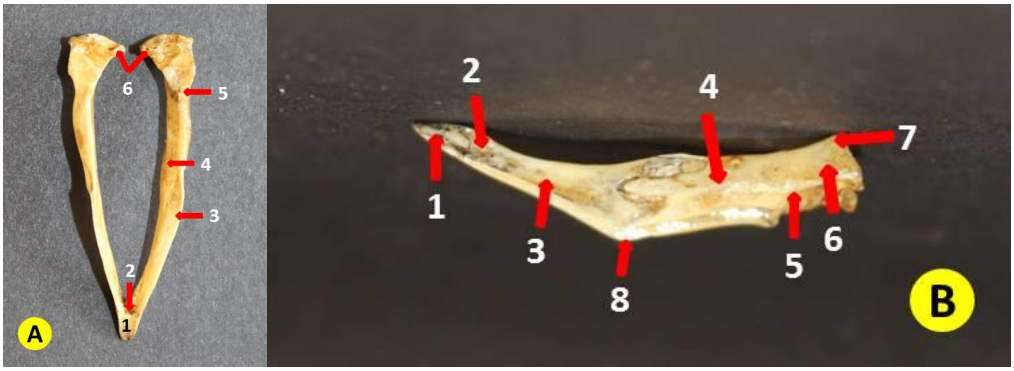

Figure 5: A. Dorsal view of Mandible of Yellow-footed Green Pigeon showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os spleniale (4), Coronoid Process (5), Medial Mandibular Process (6); **B.** Lateral view of Mandible of Yellow-footed Green Pigeon showing: Rostrum mandibulae (1), Os mentomandibulare (2), Os dentale (3), Os supra-angulare (4), Os prearticulare (5), Os articulare (6), Os angulare (7), Angulus mandibulae (8).

Mandibular rami of most of the Raptor birds were found to bow outwards in order to enlarge gap between them. This modification of lower jaw of Raptors may be ascribed to their feeding habits. Mandible of the Cattle Egret and Jungle Babbler had narrow and V-shaped dentary symphysis sulcus, it may be because of their eating and probing habit of insects, pests, moths etc.

Conclusion

Mandible is the most important organ for feeding and various adaptations are recorded in different species owing to their feeding habits. In this context, variations in the morphological features of lower jaw of Raptors might be attributed to their feeding habits as they mainly depend on various prey or their diet. It may help in gripping and tearing of prey. Moreover, the mandible of Yellow-footed Green Pigeon is more suited for herbivorous diet whereas the mandible of Cattle Egret and Jungle Blabbler are adopted for carnivorous diet. The present study developed a baseline data on the morphological study of mandible in avian species that could be used for planning future research in this field.

Conflict of Interests

There is no conflict of interest.

Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

References

1. Anthal, A. and Sahi, D.N. (2013). Food and Feeding Ecology of Jungle Babbler, *Turdoides striatus sindianus* (Ticehurst) in District Jammu (J&K), India. *International Research Journal of Environment Science*, 2(7), 54-57.
2. Baumel, J.J., King, A.S., Breazile, J.E., Evans, H.E. and Vanden Berge, J.C. (1993). *Handbook of avian anatomy:* Nomina Anatomica Avium. 2nd Edition, Chapter: 4, pp. 45-132.
3. Bharucha, B. and Padate, G.S. (2010). Assessment of beneficial role of an insectivorous bird, jungle babbler (*Turdoides striatus*) predation, on Helicoverpa armigera infesting pigeon pea (*Cajanus cajan*) crop. *Acta Agronomica,* 59, 228–235.
4. Bhavna, B. and Geeta, P. (2010). Histological and histomorphometric study of gametogenesis in breeders and

helpers of sub-tropical, co-operative breeder jungle babbler, *Turdoides striatus*. *Journal of Cell and Animal Biology*, 4, 81–90.
5. Choudhary, O.P., Priyanka, Kalita, P.C., Arya, R.S., Rajkhowa, T.K., Kalita, A., Doley, P.J. and Keneisenuo (2020). Morphometric and Radiographic Characteristics of the Skull in Crested Serpent Eagle (*Spilornis cheela*) and Brown Wood Owl (*Strix leptogrammica*). *Indian Journal of Animal Res*earch, 54(5), 1-7.
6. Dyce, K.M., Sack, W.O. and Wensing, C.J.G. (2002). *Textbook of Veterinary Anatomy*. 3rd Edition, Saunders, Philadelphia, London, New York, St. Louis, Sydney, Toronto.
7. Egwu, O.A., Ukoha, U.U., Okafor, J.I. and Chukwudebelu, T.G. (2012). The skeleton of domestic fowl (*Gallus domesticus*): a comparative morphologic study. *World Journal of Life Sciences and Medical Res*earch, 2, 39.
8. Feduccia, A. (1975). Aves Osteology. In Sisson and Grossman's. *The Anatomy of the Domestic Animals*, 5th Edition, R., Vol. 2, W.B. Saunders Company, Philadelphia, London and Toronto, 1790-1794.
9. Fogarty, Michael J., Hetrick, Willa Mae (1973). Summer Foods of Cattle Egrets in North Central Florida. *The Auk*, 90(2), 268–280.
10. Gaston, A.J. (1978). Demography of the Jungle Babbler, *Turdoides striatus. Journal of Animal Ecology*, 47, 845–870.
11. Getty, R., Sisson, S. and Grossman, J.D. (1930). *The Anatomy of the Domestic Animals*, 2nd Edition, Vol. 1, W.B. Saunders Co. Publ., Philadelphia, USA.
12. Hassan, S.A. (2012). Comparative morphological studies on the quadratomandibular articulation in hooded crow (*Corvus cornix*) and cattle egret (*Bubulcus ibis*). *Journal of Veterinary Anatomy*, 5(1), 43-46.
13. Hogg, D.A. (1983). Fusions within the mandible of the domestic fowl (*Gallus gallus domesticus*). *Journal of Anatomy*, 136, 3, pp. 535-541.
14. John, M.A., Baba, M.A., Khan, M. and Sasan, J.S. (2016). Anatomical Studies on the Skull of Crow (*Corvus splendens*). *International Journal of Science and Research*, 5(2), 189-193.
15. Knutsen, Espen M. (2007). Beak morphology in extant birds with implications on beak morphology in ornithomimids. M. Sci. Thesis, University of Oslo.
16. Kumar, P. and Singh, G. (2014). Gross anatomy of axial skeleton in emu (*Dromaius novaehollandiae*). *Indian Journal of Veterinary Anatomy*, 26(2), 87-91.
17. McLelland, J. (1990). *A colored atlas of avian anatomy*, Wolfe publishing Ltd, London, England.
18. Moselhy, A.A.A., Mohamed, S.K.A. and El-Ghazali, H.M. (2018). Anatomical features of bones and bony cavities of the ostrich skull (*Struthio camelus*). *International Journal of Anatomy and Research*, 6(2.3), 5390-5398.
19. Nickel, R., Schummer, A. and Seiferle, E. (1986). *Anatomy of the Domestic Birds*. Verlag Paul Parey, Berlin, Hamburg, pp. 202.
20. Previatto, D.M. and Posso, S.R. (2015). Cranial osteology of *Cyclarhis gujanensis* (Aves: Vireonidae). *Papeis Avulsos de Zoologia*, 55(18), 255-260.
21. Proctor, N. and Lynch, P. (1993). Manual of Ornithology: *Avian Structure and Function*. New Haven: Yale University Press, London, UK.
22. Rebello, S. (2011). Yellow-footed green pigeon retains the state bird tag. *Hindustan Times* June 29.
23. Rezk, H.M. (2015). Anatomical investigation on the axial skeleton of the Cattle egret (*Bubulcus ibis*). *Assiut Veterinary Medical Journal*, 61,145.
24. Salim, Ali and Ripley, S. Dillon (1978). *Handbook of the Birds of India and Pakistan*. 2nd Edition, Vol. 1, New Delhi: Oxford University Press, pp. 234–239.
25. Santhanakrishnan R., Mohamed A. H., Ali S. and Anbarasan U. (2010). Diet Variations of the Barn Owl *Tyto alba* (Scopoli, 1769) in Madurai District, Tamil Nadu, Southern India, Podoces, 5(2), 95–103.
26. Seedikkoya, K., Azeez, P.A. and Abdul Shukkur, E.A. (2007). Cattle egret as a biocontrol agent. *Zoos' Print Journal*, 22(10), 2864–2866.
27. Siegfried, W.R. (1971). The Food of the Cattle Egret. *Journal of Applied Ecol*ogy, 8(2), 447–468.
28. Tahon, R.R., Ragab, S.A., Abdel Hamid, M.A. and Rezk, H.M. (2013). Some anatomical studies on the skeleton of chickens. Ph.D. Thesis. Anatomy and Embryology, Faculty of Veterinary Medicine, Cairo University.

****