



## **Phenotypic Characteristics and Predicted Function of Several Type Feathers of Indian Peafowl in Sheikh Rashel Aviary and Eco -park, Chattogram**

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### **Abstract**

The study was carried out from January 2016 to February 2016 on Indian Peafowl under captive rearing condition at Shiekh Rashel Aviary and Eco-park, Rangunia, Chittagong. The objectives of current study were to describe the complete documentation of feathers present in different body parts of Indian peafowl (*Pavo cristatus*) including their phenotypic characters as well as predicted function. The data was collected from 3 male mature Peacocks and 2 mature Peahens. The range of crown feather was found 6-8 cm for male peafowl and 4-6 cm for female peafowl. Without this the length of flight feathers and tail feathers for male and female peafowl were found 30-40 cm and 25-35 cm as well as 39-45 cm and 35-43 cm respectably. Peacock exhibits greater diversity in the morphology of their feather pattern. The diversity of feather changes with age and affect the appearance of peacock significantly. Peacock was more attractive for their bright blue neck and his train. Peahen has no train and dull in looking due to white belly and most of body feathers are brown color. The male peafowl has short and curly blue feathers with long bare shafts on its head where as female peafowl has brownish feathers. Each feather has specific function like crest feathers used as signaling, neck feathers for mate choice, contour feathers for moving and stabilizing, tail fathers for fan formation and flight feathers for sustained flight. The causes of variations are not known and open a wide field for scientific research under developmental biology, ecology, ethology and behavioral studies.

**Keywords:** Indian Peafowl, Feathers, Phenotypic Characteristics, Predicted function, Sheikh Rashel Avairy and Eco-park.

### **Introduction**

Feathers are epidermal growths that form the distinctive outer covering or plumage. Feathers of birds are extraordinarily diverse and complex in nature (Lucas and Stettenheim, 1972). The diversification of feathers arises to agglomerate numerous physiological and functional requirements of the birds. Flight,

swimming, thermoregulation, physical protection, visual and tactile communication, sound production and water repellency functions are included (Stettenheim, 1976). Feather structure undergoes certain changes in size, shape, color and texture to conduct a specific function. Various layers of feathers are found in different parts of the body in an individual bird and it forms a complete plumage

pattern. Birds develop the most colorful plumage patterns. Identifying plumage patterns are different in each species. In many species intra-species variation of plumage pattern is observed and such variation is associated with age and sex (Bjorklund, 1991). Sexual dimorphism is a notable phenomena among birds which play a foremost role in avian communication such as mate selection. In females, sexual dimorphism arises due to camouflage and instead male developed ornamental feathers. Plumage coloration in birds can broadly be classified into two types: (1) pigmentary colour (2) structural color. The first one is the result of chemical properties of pigments and their concentration in feathers, whereas the second one is due to the presence of nanostructures present in it (Fox, 1976). The most common materials in these nanostructures are keratin, melanin and air. The result of such structural coloration is usually colors like blue, green, violet and ultraviolet. Different types of feather texture indicates that the body plumage has undergone several changes over a period of time independently, making the plumage pattern different and distinct and which may help for further study and analysis in this field. The Indian Peafowl (*Pavo cristatus*) is one of the iridescently colored bird belonging to the family of Pheasant. Members of this family possess sexual dimorphism in their plumage pattern. Besides sexual dimorphism strikingly diverse plumage patterns are observed over different parts of the peacock body. Males have an iridescent blue head, neck and breast, patches of bare white skin on the face and a thin crest topped with dark blue or black tufts. The wings are coppery or barred buff and black, and the tail is brown but seldom seen except outside the breeding season. Iridescent green scale-like feathers are bright on the upper back. The upper tail coverts-100-150 feathers in all grow to immense proportions to create the distinct train with large, blue-green "eyes" at the end of each feather. Females have overall brown plumage that shows dark barring on the wings. The under parts are pale but may show mottling. The neck has some blue-green iridescence, and the face has more white than on male birds. Juveniles resemble females but males may show copper or chestnut in the wings. Species is monotypic, though some distinct color variations such as an all white leucistic plumage are carefully bred for ornamental birds, but these are not considered subspecies. So far most of the studies focus only on the eye spot of the tail feather or its structural colorations and its role in mate selection process (Dakin and Montgomerie, 2013). The study describing the structure and color variation of various feathers present in different body parts is lacking from the literature. Feather coloration is a complex

phenomena and how various plumage coloration develop just from a single melanocyte is receiving attention in these days. The aim of current study is an attempt to analyze the phenotypic variations of plumage pattern and prediction function of several types of feathers in Indian Peafowl as no such studies were conducted earlier. This study will help in further research in various ways.

## Materials and Methods

The study was conducted between January, 2016 and February, 2016 in to the Sheikh Rashel Aviary and Eco-park, Rangunia. The experiment was carried out to determine the phenotypic characteristics of several type feathers of Indian Peafowl as well as their predicted function. The Indian peafowl were reared in captive condition in Sheikh Rashel Aviary and Eco-park, Rangunia, Chattogram.

Sheikh Rashel Aviary and Eco-Park, Rangunia is situated at Nischintapur Mouza of Kodala beat of Rangunia Range at Rangunia Up-Zilla in Chattogram district under the control of Chattogram South Forest Division near to the hill tracts' border within an area of 210.0 ha. It is 35.0 Km away from and easternly to Chattogram city and nearer to the Chattogram -Kaptai highway. It is already established an attractive eco-Park within this forest area by established a required infrastructures and modern tourism facilities (Ropeway-cable car, Artificial lake, Bird aviary, Deer park, Children park etc) for the nature loving tourist from home & abroad. A good numbers of birds are also found there, which include doves, pigeons, magpie robin, red jungle fowl, Indian peafowl, wood peckers, owls, eagles, vulture etc. Efforts are undertaken to protect and conserve the existing, rare and endangered birds and to welcome the seasonal alien birds by establishing an aviary park as a shelter and nursing place for those birds, the ever charming part of the nature's beauty. Birds enclosures and other aviary facilities are already established while a sound habitat will exist for birds.

At first I was selected 3 male and 2 female mature Indian peafowl in Sheikh Rashel Aviary and Eco-park, Rangunia. Then I observe the several body feathers of the Indian peafowl for color and prediction functions. The close keen observation was done for five days in a week for two months. Without this a well formed questionnaire with objectives wise questions and others related parameters were used for data collection. Then the birds are restrained physically and

I was taken data with my research interest. The length of different feathers was measured by using measuring tape and their different color patterns were observed visually. At least 5 feathers were used for the measurement and *Butler et al.* were followed for measuring various parameters.

## Results

Table 1 shows that range of crown feather were found 6-8 cm for male peafowl and 4-6 cm for female peafowl. Without this the length of flight feathers were found 3-40 cm and 25-35 cm for male and female peafowl.

**Table 1. The ranges of length of different feathers of Indian Peafowl**

| Indian Peafowl              | Feathers categories |              |                     |                 |                |              |                |
|-----------------------------|---------------------|--------------|---------------------|-----------------|----------------|--------------|----------------|
|                             | Crown feather       | Neck feather | Dorsal/Back feather | Contour feather | Flight feather | Tail feather | Breast feather |
| Ranges, Indian Peacock (cm) | 6-8 cm              | 2-6 cm       | 4-7 cm              | 3-12 cm         | 30-40 cm       | 39-45 cm     | 5-8 cm         |
| Ranges, Indian Peahen (cm)  | 4-6 cm              | 2-4 cm       | 3-5 cm              | 2-10 cm         | 25-35 cm       | 35-43 cm     | 4-6 cm         |

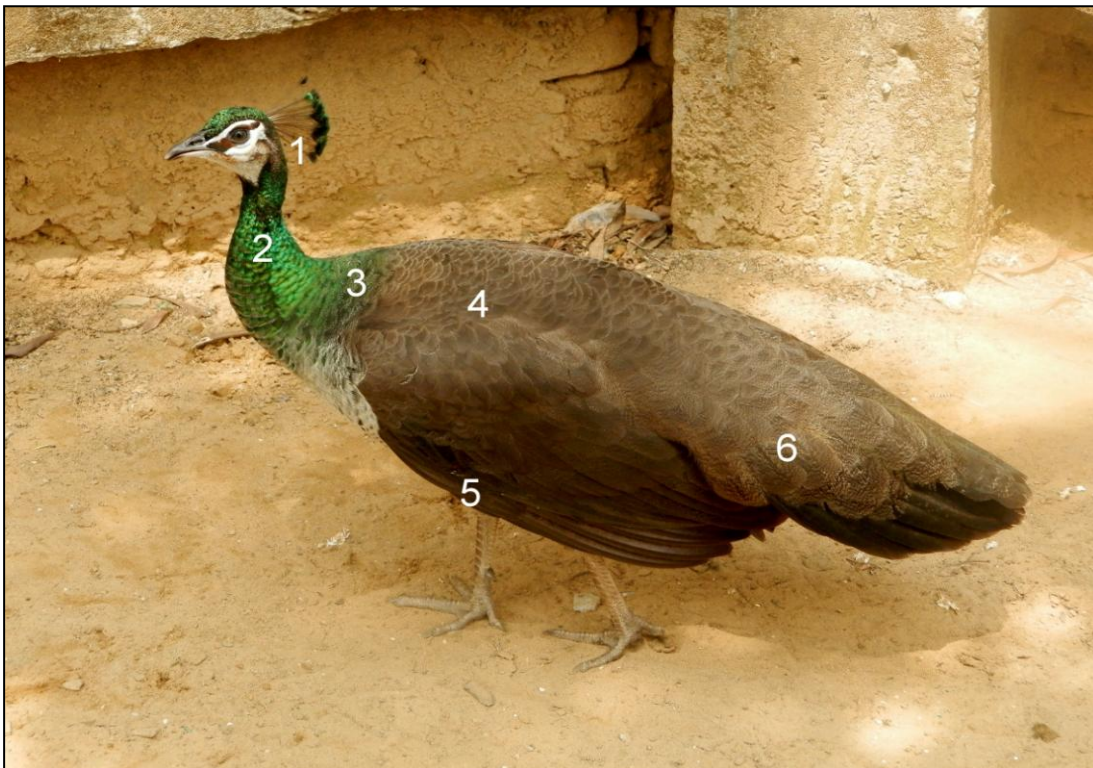
The tail feather and breast feather of male and female Indian peafowl was found 39-45 cm and 35-43 cm as well as 5-8 cm and 4-6 cm respectably (Table 1).

Peacock plumage can be classified into the following categories (Fig.1 and 2) such as (1) Crown feather (2) Neck feather (3) Dorsal/Back feather (4) Contour feather (5) Flight feather (6) Tail feather (7) Breast feather.





**Figure 1:** Plumage pattern of male peacock (A) Various feathers are numbered sequentially in different figures. Figures highlighted in this figure are 1) Crown feather 2) Neck feather 3) Back feather 4) Contour feather 5) Flight feather 6) Different tail feathers (B) 5) Flight feather 7) Breast feather

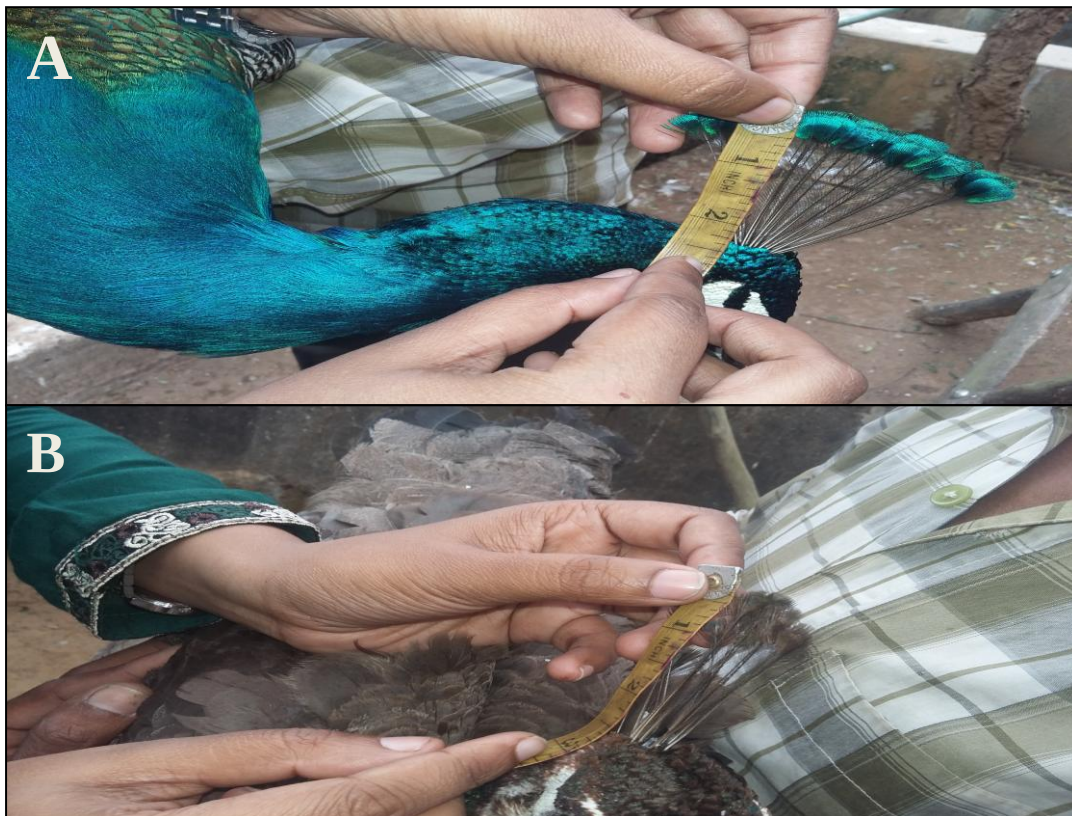


**Figure 2:** Plumage pattern of female peacock (A) Various feathers are numbered sequentially in different figures. Figures highlighted in this figure are 1) Crown feather 2) Neck feather 3) Back feather 4) Contour feather 5) Flight feather 6) Tail feather

### Crown Feather

Crown feathers are group of feather present at the top of the head. They are often called as crest feather. The crest is formed by 12-15 spatula tipped feather present in a fan shaped manner along the central axis at the top of the head. The length of the feather varies from 6-8 cm in case of male. The male peacock has short and

curly feathers on its head, and its fan-like crest consists of small blue feathers with long bare shafts (Fig. 3A). In female it varies from 4-6 cm. In a peahen, the crest has brownish feathers (Fig. 3B). The rachis terminates in a flat fan shaped triangular structure with a blackish dome at the centre which is surrounded by royal blue color. The fan is 0.3-0.5 cm in length with a width of 0.3cm.



**Figure 3 :** Crown feather in male and female peacock (A) Royal blue color feather in male (B) Brown color feather in female

### Neck Feather

The Indian male peafowl has an elegant long, slender neck with royal blue color (Fig. 4A). The blue color comes from the neck feathers which are overlaid over one another. The length of the feathers present in the neck varies from 2-6 cm in male and 2-4 in female. The basal part of the feather is plumaceous in nature and the rachis is covered with fluffy brownish barbs. The apical region terminates in vibrant blue barbs

which are widely spaced (Fig. 4B). The end of rachis is marked by a semi circular green band of barbules which progressively become more widely spaced and blue in color at its end. As the neck region terminates into breast, the diameter of green tinge increases which give rise to blackish green barbules which are comparatively closely spaced than the apical ones. The nape culminating onto the dorsal side has feathers that progressively form the back feathers.



**Figure 4:** Neck feather in male and female peacock (A) Royal blue color feather in male (B) Vibrant blue color barbs in female

### Dorsal/Back Feather

The dorsal or the back feathers are commonly known as saddle feathers (Fig. 5). The length varies from 4-7cm length in male and 3-5 cm in female. The basal part of one feather is overlaid over the apical part of the other. In a dorsal feather the rachis is covered with

brownish white barb during development which progressively form a brownish dome shaped structure at its end (Fig. 5A). The apical part of the rachis is green. The barbs are arranged in dome shaped structure with gap among each other. At the tip the barb has a rusty brown colored structure which surrounds the vibrant green barbules.



**Figure 5:** Back or Saddle feather in male and female peacock (A) Brownish white barbs which progressively dome shape in male (B) Grayish color in female

### Contour Feather

These feathers are localized above the wings. It is penneaceous in nature. The length of the feather varies from 3-12 cm in male and 2-10 in female peacock. (Fig.6). It consists of a feather shaft and an evenly

shaped flat vane extending from it 1, 5. Counter feather has a nice pattern in it which includes an alternative arrangement of creamy orangish brown and black latitudinal stripes. The width of the stripe is more in smaller feather. In long feather the numbers of stripes are more but the band width is small.



**Figure 6:** Measuring the length of contour feather of peacock, Presence of black latitudinal stripes

### Flight Feather

Collectively flight feathers are known as remiges. They can be classified as primary and secondary on the basis of body weight shared by the feather during the flight. The primaries are black in color (Fig. 7) and are 9-10 in number. The length of these feathers is 30-

40 cm in male and 25-35 in female. Barbs are arranged evenly on either of the rachis and hooked with each other. The calamus is flat, thick and hard in both primary and secondary flight feather. The secondaries are orange brown in color and 6 in number (Fig. 7A). The length of the feather varies from 30-45 cm.





**Figure 7:** Measuring the length of flight feather of male and female peacock (A) Male (B) Female

### **Tail Feather**

These are grayish brown in color and are overlaid by the decorative extended upper covert feathers and T-feathers. The length of these feathers varies from 39-45 cm in male and 35-43 cm in female (Fig. 8).

### **Breast Feather**

They are over layered over down feathers. They are semiplumes and both pennaceous and plumaceous in nature. The length of the feather varies from 5-8 cm (Fig. 1). They are white, fluffy and very light in weight. A white rachis is present at the centre which is surrounded by barbs of equal length. The rachis is thin and flexible in nature.





**Figure 8:** Measuring tail feather of Indian peafowl

## Discussion

Feather structure change with its length and to maintain the mechanical properties structural and mechanical component changes. Peacock develops a complex plumage pattern among birds. Complex plumage patterns are considered as a honest social signal and structural variations described in diverse parts of the body is a functional adaptation made by the animal (Bortolotti *et al.*, 2006). All the structural variations are discussed with the light of known function for feathers in various birds.

Crest feather of peacock share similar structural features with other bird species. Crest plumage is often used for signaling and display purpose. In *Callipepla californica* female selects the male on the basis of crest length (Calkins and Burley, 2003). In species like crested auklets *Aethia cristatella* (Jones and Hunter, 1999) and European shags *Phalacrocorax aristotelis* (Daunt *et al.*, 2003) crest ornaments are used for mutual mate choice. Besides crest length, the crest coloration is also involved in mate selection in *Cyanistes caeruleus* (Andersson *et al.*, 1998).

Neck contains the densest area of feather than any other parts of the body. Neck feather possess highest visual saliency in an open habitat bird (Moore *et al.*, 2012). In peacocks the neck is blue in color. Blue-ultraviolet plumage ornamentation is an honest advertisement of quality that can be assessed by conspecifics during mate choice or during male-male competition. Expression of blue plumage is an indicator of physical condition of a male during the

fall when new feathers molted in many birds (Keyser and Hill, 1999). According to sexual selection theory male with highly ornamented feather have greater reproductive success (Kodric-Brown and Brown, 1984). In peacock blue neck color changes to green as it move towards the nape.

Contour feathers are accessory structures and require a skeleton-muscular apparatus for moving and stabilizing them (Homberger and de Silva, 2000). These feathers stach on one another and protect the animal from rain and keep the body insulated. Besides, the integrity and smoothness, it helps to maintain the streamline condition of the body (Homberger and de Silva, 2000). The contour feathers during its movement create the stimuli that are received and transmitted by the various receptors and filiform feathers, and collected and processed in the spinal cord and cerebellum (Gewecke and Woike, 1978). In peacock contour feathers are localized above the wing and have a distinct pattern in it. Such kind of pattern falls under the sub category of "barred patten" as described by (Prum and Williamson, 2002). The function of this pattern is to camouflage and thus difficult to chase the animal's movement in barred environment (Stevens *et al.*, 2008). Birds such as cuckoo used this pattern as an indicator of cryptic behavior (Kruger *et al.*, 2007). In birds like *Taeniopygia gutatta* (Swaddle and Cuthill, 1994) used this for display purpose.

Tail is often associated with flight performance. Most birds develop two types of tail feather: (1) Main tail feather (2) Tail covert feather (Burgess, 2001).

The main tail feather is associated with flight where as the second one helps to protect the tail region. In most birds the covert feather is few cm where as in peacock these are elongated structures. These are often referred as ornamental /decorative feathers and are the primary source of mate selection (Dakin and Montgomerie, 2011; Burgess, 2001; Petrie *et al.*, 1991). The structure of the tail feather changes along with feather length and it requires extra energy. The tail feathers are very flexible in nature and this probably help the peacock while dancing. In peacocks the actual weight of tail feathers are borne by the main tail feather and hence it develop thick and flexibile calamus. Tail feathers are involved in fan formation and the fan size increases with the age of the animal. The coloration of the eyespot feathers are key determinant than variation in the number and size of eyespots in mate attraction during courtship period (Dakin and Montgomerie, 2011). T feather present in the margin further give a nice ogee pattern to the fan (Burgess, 2001).

Flight feathers are lightly textured and associated with sustained flight. The feathers develop thicker calamus and thus enabling the bird to support the body weight during short flight. All these structural adaptation help the bird for flight (Butler *et al.*, 2008). A similar kind of adaptation is also reported from other species as well (Hamilton and Gilbert, 1969). Flight feathers are associated with the flight efficiency and in maintaining thermoregulation of the body (Jenni and Winkler, 1994).

## Conclusion

Various feathers present in different parts of the body make Indian peafowl an ideal ornamental model to study plumage pattern. Feathers present in external parts of the body have a nice striking pattern in it. However, the feather which is involved in flight does not contain any specific pattern. Most of the feathers present in different parts of the body are blue and green in color for male and green and brown color for female. Ornamental feathers are metabolically costly organ.

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## References

1. Andersson, S., .Ornborg, J. and Andersson, M., Ultraviolet sexual dimorphism and assortative mating in blue tits. *Proc. R. Soc. Lond B*, 1998, 265, 445-450.
2. Bjorklund, M., Coming of age in fringillid birds - heterochrony in the ontogeny of secondary sexual characters. *J. Evol. Biol*, 1991, 4, 83 92.
3. Bortolotti, G. E., Blas, J., Negro, J. J. and Tella, L., A complex plumage pattern as an honest social signal. *Anim. Behav.*, 2006, 72, 423-430.
4. Burgess, S. The beauty of the peacock tail and the problems with the theory of sexual selection. *J. Creat.*, 2001. 15, 96.
5. Butler, L. K., Rohwer, S., Speidel, M. G., Quantifying structural variation in contour feathers to address functional variation and life history trade-offs. *J. Avian Biol.*, 2008, 39, 629-639.
6. Calkins, J. D. and Burley, N. T., Mate choice for multiple ornaments in the California quail, *Callipepla californica*. *Ani. Behav.*, 2003, 65, 69-81.
7. Dakin, R. and Montgomerie, R., Peahens prefer peacocks displaying more eyespots, but rarely. *Ani. Behav.*, 2011, 282, 21-28.
8. Dakin, R. and Montgomerie, R., Eye for an eyespot: how iridescent ocelli influence peacock mating success. *Behav. Ecol.* 2013, 24, 1048-1057.
9. Daunt, F., Monaghan, P., Wanless, S. and Harris, M. P., Sexual ornament size and breeding performance in female and male European Shags *Phalacrocorax aristotelis*. *Ibis*, 2003, 145, 54-60.
10. Fox, D. L., Animal Biochromes and Structural Colours. 1976. Berkeley: University of California Press.
11. Gewecke, M. and Woike, M., Breast feathers as an air current sense organ for the control of flight behavior in a songbird (*Carduelis spinus*). *Z Tierpsychol* 1978, 47, 293-298.

12. Hamilton, W. J. and Gilbert, W. M. Starling dispersal from a winter roost. *Ecology* 1969, 50, 886-898.
13. Homberger, D.G. and de Silva, K. N., Functional microanatomy of the feather-bearing avian integument: Implications for the evolution of birds and avian flight. 2000, *American Zoologist* 40 (4), 553-574.
14. Jenni, L. and Winkler, R. Molt and ageing of European passerines. 1994, London; Academic Press: 224 pp
15. Jones, I. L. and Hunter, F. M., Experimental evidence for mutual inter-and intrasexual selection favoring a crested auklet ornament. *Ani. Behav.*, 1999, 57, 521-528.
16. Keyser, A. J. and Hill, G. E., Condition-dependent variation in the blue ultraviolet coloration of a structurally based plumage ornament. *Proc. R. Soc. Lond. B.*, 1999, 266, 771-777
17. Kodric-Brown, A. and Brown, J. H., Truth in advertising: the kind of traits favored by sexual selection. *Am. Natl.*, 1984. 124, 309-323.
18. Kruger, O., Davies, N. B. and Sorenson, M. D. The evolution of sexual dimorphism in parasitic cuckoos: sexual selection or coevolution? *Proc. R. Soc. Lond. B.*, 2007, 274, 1553-1560
19. Lucas, A.M. and Stettenheim, P. R., 1972, Avian Anatomy- Integument. U.S. Dept. Agricult. Handbook: Washington, DC.
20. Moore, B. A., Baumhardt, P., Doppler, M., Randolet, J., Blackwell, B. F., DeVault, T. L., Loew, E. R. and Fernández-Juricic, E., Oblique color vision in an open-habitat bird: spectral sensitivity, photoreceptor distribution and behavioral implications. *J. Expt. Biol.*, 2012, 215, 3442-3452.
21. Petrie, M., Halliday, T. and Sanders, C. Peahens prefer peacocks with more elaborate trains. *An. Behav.*, 1991, 41, 323-331.
22. Prum, R. O. and Williamson, S., A theory of the growth and evolution of feather shape. *J. Exp. Zool.*, 2001, 291, 30-57.
23. Stettenheim, P., Structural adaptation in feathers. 1976, Proceedings of the 16th International Ornithological Congress. Vol. 16. p 385 401.
24. Stevens, M., Yule, D. H. and Ruxton, G. D., Dazzle coloration and prey movement. *Proc. R. Soc. Lond. B.*, 2008, 275, 2639-2643.
25. Swaddle, J. P. and Cuthill, I. C. Female zebra finches prefer males with symmetric chest plumage. *Proc. R. Soc. Lond. B.*, 1994, 258, 267-271.

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