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A Study of Morphological Modifications in Birds

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Abstract - Birds are ideal models for studying speciation because of their wide range of traits and accompanying spatial patterns. For centuries, morphological procedures were the preferred method for determining the degree of relatedness between species and intraspecific variation, until molecular genetic investigations gravely questioned traditional morphology-based results. However, with the advancement of multivariate statistics and the ease with which morphological, phylogenetic, and ecological information can be combined, morphology is being reconsidered as a valuable tool for ornithological research. This chapter examines the most essential features of morphological variation in birds, including how to assess its plasticity and how phenotypic variation can be included into a larger evolutionary framework that explains avian body alterations in light of speciation events.

Keywords - Avian morphology, Phenotypic plasticity, Trait evolution, Geographic variation, Eco-morphology

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ASPECTS OF PHENOTYPIC VARIATION IN BIRDS IN GENERAL

Studying speciation entails examining character variation, whether at the molecular or organismic level. Because phenotypic features account for so much variety in birds, morphological assessments are an important method for gathering data for both identification and classification. Birds' identification is naturally linked to their exterior appearance. Birds, unlike many other animal groups, are thought to be more or less easily recognised based on their size, shape, colour, singing, and other behaviours. Birds have been themes of both popular enjoyment and scientific employment for millennia due to their abundance and popularity ***(Birkhead et al. 2014)***.The study of bird population differentiation using comparative methodologies is at the heart of this. Although different conceptual ideas may result in different species distinctions, phenotypic features remain important criterion for bird species delimitation.

One of the key reasons is that no other vertebrate group has as rich a heritage of historic graphic records as birds do—the large quantity of contemporary identification guides, whether printed or digital, speaks for itself. It's a fascinating concept that such guides effectively blend pictures and descriptions in a time-honored manner that can be traced back to the narrative reports of the first popular natural history books. Despite the fact that contemporary analytical approaches, led by molecular genetics, have shattered our understanding of avian species boundaries, we still rely heavily on phenotypic assessment for species delimitation and categorization. So, why are exterior traits of birds still so important that they serve as a marker of species identity?

First and foremost, despite their relatively identical body plans, birds have a wide range of morphological variance. Even at the lower taxonomic level, where structural and coloration patterns generally resemble those of closely related taxa, the diversity of structural and coloration patterns is striking. Because many of these phenotypic differentiations can be interpreted as functional adaptations to a particular lifestyle and/or environmental conditions, they provide valuable information regarding the ecological origins of phenotypic divergence. As a result, we have a better knowledge of the evolutionary restrictions that may lead to speciation. Given the current state of multidisciplinary methods to evolutionary research, it's worth taking a closer look at the various facets of morphological variation relating to the challenge of bird speciation.

PHENOTYPIC MODIFICATION AND PLASTICITY OF CHARACTER

Birds have become great models for studies in speciation due to the remarkable diversity of their morphologies and corresponding spatial patterns. However, much as with other animal groupings, there isn't always a direct link between exterior appearance and species identity. It is unavoidable to examine the level of intraspecific variation in order to appropriately distinguish between interspecific differences and intraspecific variation.Within and across possible species, there is geographic and individual variety (Mayr 1969). Character plasticity must be considered as well, because the limits of such variation may move temporarily as a result of adaptive processes (e.g., Grant and Grant 2014). Of course, this isn't limited to morphological characteristics. A slew of molecular investigations have demonstrated that genetic character variation (i.e., DNA sequence polymorphisms) is a strong tool for defining groupings of organisms on a fine scale.

Individual Variation By definition, individual variation comprises all phenotypic manifestations at the same locality (Mayr 1969). Such local variation, however, does not necessarily need to be less pronounced than geographic variation. There are different forms of individual variation and all of these forms may be represented by Inter individually variable characters again.Furthermore, the distinct types of individual variation are not mutually exclusive, as they might occur in the same person at different ages or seasons. Sexual, age-dependent, and seasonal variation are the most common types of individual variation in birds, with local eco-morphological differentiation within populations rounding out the picture.

Variation in Sexuality All features of phenotypic diversity between the sexes are included in sexual variation. Of course, this is most visible in birds with considerable sexual dimorphism, whether in size, colour (patterns), or both. Because more noticeable breeding plumages differ more significantly between the sexes than non-breeding plumages, sexual dimorphism does not have to remain constant throughout the year, illustrating the overlap with seasonal variation.

There is a significant size variation between the sexes in several raptors (Falconidae, Accipiter), with the larger females evidently exploiting a different food spectrum than the smaller males. Again, there is variance in the respective characters that defines the level of sex-specific traits within females and males. Other unusual situations include birds in which one sex's outward appearance is highly linked to specific parts of the mate selection process, and intense sexual selection results in extreme phenotypic variation within one sex.

The Ruff Philomachus pugnax is a classic example, with males that have unique plumage patterns and colour. But, in addition to the males' considerable plumage variety (which can be classified into primary character groups), there are female-mimicking males who constitute a size group in wing length between "proper"males and females.(Jukema and Piersma 2006).

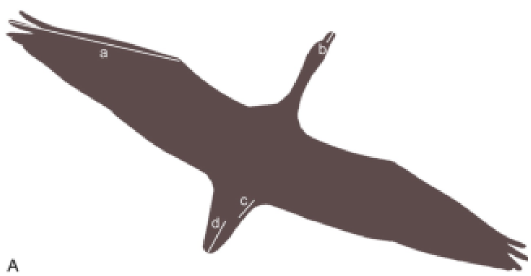
Seasonal Changes Seasonal variation is another common type of variation: Throughout the year, many birds develop two different plumages, one of which is usually more noticeable. Because the needs of mate choosing and breeding account for the majority of conspicuousness, breeding plumage tends to be more apparent in at least one sex (cf. sexual variation). Seasonal fluctuation in external characteristics is an adaptive technique for a number of birds, notably nonmigratory temperate species, to cope with drastically shifting climatic conditions. One of the most notable examples is the change in summer and winter plumage of various ptarmigan Lagopus species, which allows for year-round seasonally efficient camouflage.

Plasticity of Phenotype The preceding paragraphs demonstrate that morphological variety refers to many manifestations of outward differentiation on an individual, population, or global scale, and that multiple types of variation can sometimes overlap. They illustrate the phenomenon of phenotypic plasticity as a whole. Keeping in mind that selection acts on the phenotype, it's important to remember that character variation isn't a result of evolutionary adaptation in the first place, but rather a way to flexibly improve a population's evolutionary success by stochastically offering variants of morphological traits for selective processes. The phenotype that results through natural selection of beneficial features may thus represent a subset of past generations' character variance, with its own range of variation.

ASSESSING MORPHOLOGICAL VARIATION

They enable detailed descriptions of the avian body and its alterations when combined with advanced statistical studies. Advanced spectrum analyses are used in a similar endeavour to objectivize colour assessments of plumage and bare parts, and the description of colour patterns is currently being modernised by the use of pattern recognition software ***(Bostwick et al. 2017; Burns et al. 2017).***

Measurements that are linear Linear measures are used in practically every scientific ornithological investigation as a standard means of measuring morphological variation. The literature is replete with explanations and recommendations for approaches (e.g., Baldwin et al. 1931; Svensson 1992; Eck et al. 2011). However, because most biometric approaches rely on a set of more or less well-defined measurements, students of morphological variation should be aware that these standard measurements may only capture some morphological characteristics of the avian body.



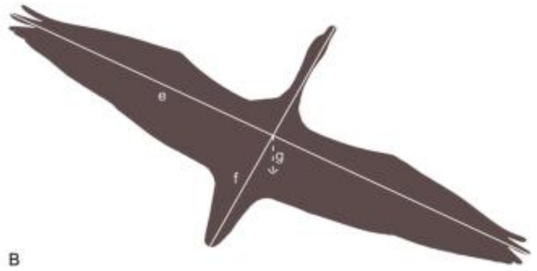


Figure 1 Morphometric assessment of avian body size. (A) Classical partial measurements, usuallytaken from study skins; (B) biologically relevant total measurements, meaningful for flight performanceanalyses. While measurements under (A) can be re-collected from specimens virtually at anytime, those under (B) are irretrievable from study skins and must be taken from the fresh dead or livebird. a, wing length; b, bill length; c, tarsus length; d, tail length; e, wing span; f, total body length;g, body mass.

Measurements in 3D Three-dimensional scanning techniques, which supplement traditional linear measurements, are desired not only for the reproducibility and precision of digital data, but also for the ability to reconstruct more complex morphological shapes and proportions that are difficult to access using linear measurements. Although much work is still done by hand, such as placing digital markers for final computations, it is expected that these operations will become increasingly automated, speeding up the analysis process.Because three-dimensional visualisations enable for less intrusive investigations of the inside body (e.g., via CT scanning), a number of novel discoveries will shed light on the relationship between phenotypic and interior characteristics in birds (James 2017).

Color Assessment

Only by comparing charts from the same issue (and by storing the charts in identical conditions) can fine-scaled comparability of results be guaranteed. Meanwhile, descriptive approaches have been supplemented by spectrophotometric analyses (Burns et al. 2017). The existence of pigments and light-reflecting feather microstructures can be determined from the reflectance spectra of colour patches based on wavelength-specific reflection patterns that also allow quantification of involved pigments.

Pattern analysis

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BODY CONTOUR MORPHOLOGICAL ADAPTATIONS

The birds' bodies are fashioned like a spindle to reduce air resistance during flight.This allows the birds to conserve energy and improve their flying efficiency.

The Body Is Small

To maintain equilibrium in the air, a bird's body is compact, dorsally robust, andventrally heavy. Their wings are attached to the thorax, their light organs, like as the lungs and sacs, are positioned high, and their heavy muscles are positioned centrally, all of which aid in flying.

Body covered with Feathers

The feathers are smooth, angled backwards, and tightly fitted, resulting in a streamlined body that reduces friction during flight. It reduces body weight and protects it from the effects of temperature changes in the surroundings. They also have a large surface area that can be used to strike the air.

Feathers offer buoyancy to the body. It protects the body by insulating it and preventing heat loss. This allows the birds to survive at higher altitudes in colder temperatures.

Wings made from forelimbs

The forelimbs are transformed into wings, which are the only organs that allow you to fly. Bones, muscles, nerves, feathers, and blood arteries make up the framework.

The wings are big and have a lot of surface area. They also assist the flying bird. A thick, strong leading edge with a concave lower surface and convex higher surface is seen on the wings. This aids in the reduction of air pressure above and the increase of air pressure below. During flight, the bird can thus fly upward and forward.

Neck and Head Mobility

The birds have a long and flexible neck that aids in the movement of the head, which is necessary for a variety of purposes. They have a horny beak that aids in the selection of grains and insects when feeding.

Bipedal Movement

The front section of a bird's body aids in taking off during flight. The anterior section of the body also aids in the landing of birds. On land, the hindlimbs assist with locomotion. They can support a bird's entire body weight.

Perching

A bird's toes wrap around the twig when it sits on a tree branch. Perching is the term for this. A bird can sleep in that position without falling because its muscles are so highly developed.

Tails that are short

Long feathers on the tail spread out like a fan and act as a rudder during flying. While flying and perching, they also aid in balancing, lifting, and steering.

PHYLOGENETIC AND ADAPTIVE CONSTRAINTS SEPARATED

Detecting whether phenotypic variation represents phylogenetic or adaptive restrictions is probably the most difficult challenge in the study of phenotypic variation. In terms of evolution, morphologicalNatural selection has resulted in flexibility within and between bird speciesmight induce convergent phenotypes for functional traits under identical extrinsic stressesreasons. As a result, externally resembling bird taxa are not required to benear relatives (and vice versa), because morphological consistency may conceal cryptic information.As a result, superficially similar bird taxa do not always have to be closely related (and vice versa), and morphological homogeneity may mask cryptic variation at the species level. Both polymorphism and cryptic diversity can block our ability to distinguish between species. While molecular genetic counterchecking has made the former occurrence considerably easier to identify in terms of species assessment, the latter is still difficult to detect and is typically only detected after other methods have offered more evidence. When analysing morphological variation, the challenge of disentangling phylogenetic and adaptive constraints is made more difficult by the fact that phylogeny and adaptation are rarely independent of one another.As a result, it's acceptable to conclude that current morphological variety is the product of a causally mixed outcome of feature evolution within an avian lineage. Within avian lineages, it appears that character flexibility is limited. A certain amount of alteration can be seen once a set of characters is obtained within a lineage, but revolutionary reconstructions are unusual.

A CONTEMPORARY PERSPECTIVE ON MORPHOLOGICAL MODIFICATIONS

We have seen that studies of morphological variation are important elements ofmultidisciplinary studies by combining classic and modern approaches. Havingbecome modernized themselves by sophisticated statistical analytic tools, they donot only complement other cutting-edge methodologies but add considerable newinput to our contemporary understanding of bird evolution and adaptation.

Reconstructions of trait differentiation are not confined to the study of a few avian lineages, but can be extended to eco-morphological investigations within and between communities at any geographic scale ("integrated eco-morphology," Leisler and Schulze-Hagen 2011). Such analyses are likely to become viable much further back in time if enough comparison data (from historical specimens or fossils) is available. The rapidly developing area of (population) genomics will undoubtedly play a role in this.

REFERENCES

1. Alström P, Rasmussen PC, Zhao C, Xu J, Dalvi S, Cai T, Guan Y, Zhang R, Kalyakin MV, Lei F,
2. Olsson U (2016) Integrative taxonomy of the Plain-backed Thrush (Zoothera mollissima)complex (Aves, Turdidae) reveals cryptic species, including a new species. Avian Res 7:1
3. Baldwin SP, Oberholser HC, Worley LG (1931) Measurements of birds. Sci Publ Cleveland MusNat Hist 2:1–165
4. Baptista LF, Kroodsma DE (2001) Avian bioacoustics. In: del Hoyo J, Elliott A, Sargatal J (eds)Handbook of the birds of the world, vol 6. Lynx Edicions, Barcelona, pp 11–52
5. Birkhead TR, Wimpenny J, Montgomerie B (2014) Ten thousand birds. Ornithology since Darwin.Princeton University Press, Princeton
6. Bostwick KS, Harvey TA, Scholes E III (2017) Leveraging diverse specimen types to integratebehavior and morphology. In: Webster MS (ed) The extended specimen. Emerging frontiers incollection-based research. CRC Press, Boca Raton, pp 75–88
7. Botero-Castro F, Figuet E, Tilak MK, Nabholz B, Galtier N (2017) Avian genomes revisited:hidden genes uncovered and the rates versus traits paradox in birds. Mol Biol Evol 34:3123–3131
8. Eck S, van den Elzen R, Fiebig J, Fiedler W, Heynen I, Nicolai B, Töpfer T, Winkler R, Woog F(2011) Measuring birds. Vögel vermessen. Wilhelmshaven, Deutsche Ornithologen-Gesellschaft.
9. Grant PR, Grant BR (2014) 40 years of evolution. Darwin's finches on Daphne Major Island.Princeton University Press, Princeton and Oxford.
10. James HF (2017) Getting under the skin. A call for specimen-based research on the internalanatomy of birds. In: Webster MS (ed) The extended specimen. Emerging frontiers

incollection-based research. CRC Press, Boca Raton, pp 11–22.

11. Yousefi M, Kaboli M, Eagderi S, Mohammadi A, Rezai A, Nourani E (2017) Micro-spatialseparation and associated morphological adaptations in the original case of avian characterdisplacement. Ibis 159:883–891.

12. van Grouw H (2013) What colour is that bird? Br Birds 106:17–29.

13. Webster MS (2017) The extended specimen. Emerging frontiers in collection-based research. CRCPress, Boca Raton.

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