Learning to Discern Color Aberration in Birds

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Melanin, the pigment that results in the black coloration of the flight feathers in this American White Pelican, also results in stronger feathers. Photo by Peter Burke.

THE PROFESSOR'S CORNER IS A NEW COLORADO BIRDS FEATURE THAT WILL EXPLORE A WIDE RANGE OF ORNITHOLOGICAL TOPICS FROM HISTORY AND CLASSIFICATION TO PHYSIOLOGY, REPRODUCTION, MIGRATION BEHAVIOR AND BEYOND. AS THE TITLE SUGGESTS, ARTICLES WILL BE AUTHORED BY ORNITHOLOGISTS, BIOLOGISTS AND OTHER ACADEMICS.

Did I just see an albino bird? Probably not. Whenever we see an all white or partially white bird, "albino" is often the first word that comes to mind. In fact, albinism is an extreme and somewhat rare condition caused by a genetic mutation that completely restricts melanin throughout a bird's body. Many birders have learned to substitute the word "leucistic" for "albino," which is certainly a step in the right direction, however, there are many conditions that can cause a bird to have patches of white, muted coloration or even appear uniformly white. This article will review how birds achieve their glorious and intricate coloration and explain many of the plumage abnormalities that result in the absence of color.

One reason we are so attracted to birds is an appreciation of their natural beauty from their rich, bright and often complex colors. Coloration in birds is highly species dependent. Sometimes it is for mate attraction, such as in the Yellow Warbler, where brighter males are more likely to attract female partners. Sometimes the coloration is important for same sex signaling, such as the wing bars on a male Red-winged Blackbird, where the brighter red signals dominance to other males as they vigorously defend their territories. Other times, coloration serves as camouflage to avoid detection by predators, such as the color patterns we see on Dusky Grouse or Wilson's Snipe.

PIGMENT COLORS

Color is a result of pigments in the feathers or the microscopic structural components of feathers, or oftentimes a combination of both. The three main types of pigments in birds are melanin, carotenoids and porphyrins. Melanin is found in all vertebrates and is the most common pigment in birds. In humans, melanin results in our skin and hair color. In birds, tiny melanin granules are deposited in feathers from the feather follicles, resulting in a range of colors from dark black to reddish-brown or even a pale yellow appearance. Have you ever wondered why so many mostly white birds, such as the American White Pelican, Ring-billed Gull and Swallow-tailed Kite, have black wing feathers? This is due to melanin. Melanin makes feathers stronger, which helps combat the wear and tear of flight, abrasion and weather-related damage.

Carotenoids are another common type of pigment in birds. If you're thinking that sounds like carrots, you aren't far off! Carrots are loaded with carotenoids, an important antioxidant and a pigment that shows up in feathers, skin and beaks. Birds obtain carotenoids from their diet, either eating plants or eating something that eats plants. Carotenoids are responsible for the bright yellow of American Goldfinches, the brilliant red of Scarlet Tanagers and the rich orange of Bullock's Orioles. They also turn a male Wood Duck's bill bright orange and a Snowy Egret's feet yellow. Carotenoid expression is enhanced by hormones such as testosterone, which is why many breeding birds have feathers that are even brighter during the breeding season. Carotenoids often interact with melanin resulting in colors such as the olive-green seen on the upper parts of Ruby-crowned Kinglets and the back of the Lesser Goldfinches.

Porphyrins, produced biochemically through the modification of amino acids, are a third type of pigment found in birds. In some species of birds, such as quetzals and parrots, porphyrins result in brilliant greens and reds when exposed to ultraviolet light. However, not all porphyrins result in bright or fluorescent colors. Several species of owls and

On first inspection, you might think this leucistic Eared Grebe is an albino due to its red eye. However, note the dark beak and leg in the photo, and of course, adult Eared Grebes have red eyes! Photo by Ron Wolf.

A combination of melanin pigment and the microstructural anatomy of the feathers of the Black-billed Magpie result in the iridescent blues and greens seen in direct sunlight. Photo by Peter Burke.

nightjars also have porphyrin pigments in their feathers. Because porphyrin pigments degrade when exposed to sunlight, researchers are able to determine molt status and age classification of individual birds by examining feathers under UV light in the field.

STRUCTURAL COLORS

But what about the brilliant flashes of iridescent fuchsia on a Calliope or Anna's Hummingbird gorget, or the stunning blue of an Indigo Bunting or Mountain Bluebird? Would you believe that these colors are not really in the feathers? One of my favorite party tricks is to show someone a blue feather under normal lighting conditions and then hold the feather with the light behind it. The backlit feather appears brown! Most of the iridescent coloration found in birds results from the microscopic structure of the feathers that reflects and/or refracts light. In other words, the microscopic anatomy of the feather splits or scatters light, which in turn produces the colors we see. The principle is the same with a prism that splits white light into a visible color spectrum we call a rainbow.

In some cases, birds achieve their coloration through a combination of pigments and the microstructural anatomy of the feathers. For example, the brilliant green we see on the back of Violet-green Swallows or the tail feathers of Black-billed Magpies requires melanin and carotenoids as well as a specific feather structure.

ABSENCE OF COLOR

With this basic understanding of the primary mechanisms for coloration in birds, let's explore plumage abnormalities that result in the absence of color. Perhaps you've seen a bird with white splotches on its wings or a few white tail feathers? I'll never forget the time in Summit County, Colorado that I saw a nearly all-white Steller's Jay. Naturally I did a double take thinking it might be an escaped cockatiel! And of course there is the famous white Red-tailed Hawk that so many Coloradans have reported seeing in the Denver Metro area. These are examples of leucism, probably the most common cause of aberrant avian plumages, but there are other causes such as albinism, progressive greying, even a condition known simply as "brown" that affect a bird's appearance.

Albinism, from the Latin word albus, for "white," is the result of a single gene mutation that is a recessive trait, meaning that both parents must carry the mutation for it to be passed on to the offspring. The parent bird is unaffected and looks perfectly normal,but there is a 25% chance that each offspring would inherit the

Leucistic Red-winged Blackbird. Note the red on the wing. Since leucism does not affect the carotenoid pigment, the red is still expressed. Photo by Dan Zmolek.

Leucistic American Robin. Note the abnormal white coloration on the head, a common expression of leucism in birds. Photo by Dave Leatherman.

recessive copy of the gene resulting in albinism. This mutation disrupts the production of melanin, which affects the feathers as well as tissues. An albino bird may retain some coloration due to carotenoids, but otherwise will have white feathers and pinkish flesh that is often visible on the legs, bill and orbital ring. The lack of melanin makes their eyes appear red, from visible blood vessels, but also causes poor depth perception and makes them very sensitive to light. In fact, impaired vision makes it unlikely that albino birds will survive to adulthood in the wild.

So, what about those birds that have strange white patches, or even just a few feathers that are white? These conditions are most commonly the result of leucism, which takes its name from the Greek word leukos, for "white." Leucism is also a genetic mutation that affects melanin, but unlike albinism, it may be caused by as many as 50 different genetic mutations according to some estimates. Leucistic birds can be quite varied in appearance ranging from all or mostly white to sometimes just a single feather that lacks melanin (see photo of Wilson's Warbler and the American Robin). Because leucism does not affect the pigment in the eyes and thus vision, these birds tend to survive and even reproduce. Interestingly, although leucism is inherited, the offspring often do not look like the parents. Because so many different genes can be involved, coloration can be very different, but often the expression is bilaterally symmetrical, and most commonly affects feathers on the wings, tail, head and belly.

Genetic mutations resulting in leucism are very common in individual birds rather than entire populations. However, one study by Edelaar (2011) and colleagues in Argentina reported a high degree of leucism in a coastal population of Southern Caracaras and suggested that this condition likely provides an evolutionary advantage in that particular habitat.

Generally speaking, leucism likely has neutral or even negative consequences for an individual bird because plumage coloration is often used by birds

Leucistic Wilson's Warbler. Bilateral display of the abnormal feathers on the wing and tail is one of the hallmarks of leucism in birds. Photo by Steve Brown.

for species identification and mate attraction. Also, a high degree of white feathers on a bird that is usually darker in appearance may make it more susceptible to predation.

Another condition that can cause some or even a lot of white feathering is called progressive greying.

The mechanisms for progressive greying are poorly understood but are thought to be inherited, and result in the loss of pigment cells with age. The process is probably not dissimilar to the way that human hair tends to gray with age. It can be challenging to distinguish progressive greying from leucism in wild birds without knowing the bird's history. One rule of thumb is that birds with more symmetrical white patches are often leucistic while more random, asymmetrical whiteness is more likely the result of progressive greying.

To make matters even more confusing, there are several conditions, including progressive greying, that can cause birds to fade in color. One condition, termed dilution, is due to a reduced quantity of melanin. Birds with dilution that have mostly black feathers may have a ghost-like appearance. Some birds may even appear white, yet on closer inspection have a grey hue to them. In addition to having less melanin in the feather follicles, dilution also causes feathers to fade more quickly. Another condition affecting melanin that can cause fading is simply called "brown." Without knowing details about a specific bird's history, it can be difficult or impossible to determine the cause of fading in the field.

Armed with all this knowledge about the different conditions that can cause birds to exhibit some or even a lot of white or faded feathers, I wish all of you good birding! I'll leave you with a final quiz, which is appropriate because it was this bird that inspired me to write this first installment of The Professor's Corner!

REFERENCES

Edelaar, P., J. Donázar, M. Soriano, M. Santillán, D. González-Zevallos, P. Borboroglu, N. Lisnizer, A. Gatto, M. L. Agüero, C. Passera, L. Ebert, M. Bertellotti, G. Blanco, M. Abril, G. Escudero, and F. Quintana. 2011. Apparent selective advantage of leucism in a coastal population of Southern Caracaras (Falconidae). Evolutionary Ecology Research 13:187-196.

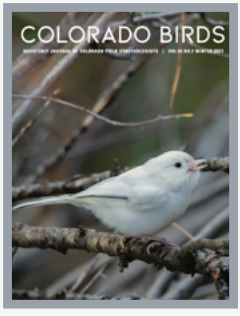
McGraw K. J., M. D. Beebee, G. E. Hill, and R. S. Parker. 2003. Lutein-based plumage coloration in songbirds is a consequence of selective pigment incorporation into feathers. Comp Biochem Physiol B Biochem Mol Biol. 2003 Aug;135(4):689-96. doi: 10.1016/s1096-4959(03)00164-7. PMID: 12892761.

van Grouw, H. 2006. Not every white bird is an albino; sense and nonsense about colour aberrations in birds. Dutch Birding 28:79-89.

van Grouw, H. 2013. What colour is that bird? The causes and recognition of common colour aberrations in birds. British Birds 106:17-29.

Weaver, R. J., E. S. A. Santos, A. M. Tucker, A. E. Wilson, and G. E. Hill. 2018. Carotenoid metabolism strengthens the link between feather coloration and individual quality. Nat Commun 9, 73. https://doi.org/10.1038/s41467-017-02649-z.

Weidensaul, C. S., B.A. Colvin, Brinker, F., and Huy, J.S. 2011. Use of ultraviolet light as an aid in age classification of owls. The Wilson Journal of Ornithology 123(2): 373.



QUIZ

WHAT CAUSED THE LOSS OF PIGMENT IN THIS MOUNTAIN CHICKADEE? (THE ANSWER WILL APPEAR IN THE FALL ISSUE OF COLORADO BIRDS!)