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September 1999

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The Ultraviolet Birds of Nebraska*

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That the visual range of at least some birds extends into the ultraviolet region has been known since the early 1970s, when it was first discovered in hummingbirds and pigeons. The ultraviolet region is that energy consisting of light waves shorter than violet, and thus beyond human perception. Although UV perception has long been recognized to occur in many insects and other invertebrate groups, scientists had doubted that either birds or mammals have this ability. Instead, it was generally assumed that the vertebrate cornea provides a protective block to ultraviolet waves, perhaps because UV energy can do damage to the living cells of the retina. Similarly, melanin in the dead mammalian cells of the skin's surface layer provides such a block for preventing UV light from reaching living cells underneath.

However, recent studies (Bennett and Cuthill, 1994; Burkhardt, 1989; Burkhardt and Finger, 1991; Chen et al., 1984; Derim-Oglu & Maximov, 1994; Parrish et al., 1984) have shown that UV perception occurs in many birds, perhaps even most. It might prove useful to birds in several ways. One is that, although most vegetation does not reflect UV, some fruits

* Published in *The Nebraska Bird Review* 67:3 (Sep 1999), pp. 103-105. Used by permission of the Nebraska Ornithologusts' Union, http://rip.physics.unk.edu/NOU/ .

and seeds do, and thus they may be more obvious to fruit- and seed-eating birds when foraging. Additionally, some insects reflect UV as well, and this might also be significant in foraging by insectivores. Perhaps most importantly, UV perception may alter the way that birds see other birds of their own or other species. Thus, strong UV reflections might help make an individual more attractive to a potential mate, as has been shown in several recent studies (Bennett et al., 1996; Andersson & Amundsen, 1997). On the other hand, a plumage that does not reflect UV might allow a bird to blend into its background and thus make it less conspicuous to an enemy having similar UV visual sensitivity. Other suggested advantages of UV sensitivity in birds include its possible application in achieving celestial orientation when navigating over unfamiliar territory (Parrish et al., 1984), or for use by predators in following the spoor or scent marks of prey animals that leave UV "tracks" behind them (Koivula et al., 1997).

Intrigued by these thoughts, I recently obtained a research-quality source of UV light (much more effective than the "black light" bulbs that are readily, available commercially, although these might also serve for school science projects). I then examined some study specimens of Nebraska birds, using it as a sole source of illumination. Many of the birds, perhaps most, showed no apparent change in the colors we perceive under normal incandescent or so-called "white" light. However, some changes were quite remarkable. The bluish to black colors of the Corvidae were especially impressive. An American Crow literally shimmered in its violet iridescence, whereas a Gray Jay was transformed into a strange, rather unworldly greenish hue. Blue Jays and Steller's Jays were more intensively bluish and generally more brilliant. Their blue feather colors

are produced by a combination of typical light refracting metallic iridescent hues and the so-called "Tyndall effect." This latter results from a light-scattering of the shorter blue-to-violet light waves by extremely small melanin granules at or near the feather surface. The same visual effect is also responsible for the seemingly blue sky above us, and is caused by similar light-scattering by atmospheric dust particles. Scattering of even shorter light waves can produce ultraviolet reflectance.

Other visual effects that I noticed were equally remarkable. The reflectance levels of a male Common Grackle and of a male Brown-headed Cowbird were high, but those of a female Cowbird were nil, as one might expect from a bird that often remains hidden in vegetation while looking for nests to parasitize. The ruby gorget of a Ruby-throated Hummingbird became more intense and violet-tinted, and it is likely that many hummingbirds use the UV end of the spectrum for important gorget-related signaling (Goldsmith, 1980; Bleiweiss, 1995). The green head of a male Mallard seemed as it were lit up from within, and Mallards are also among those bird species now known to see into the ultraviolet. Even more remarkably, the large, seemingly black, spots on the scapulars and inner wing feathers of a Mourning Dove strongly reflected a beautiful purplish-violet cast, as did the small oval dark marks on its lower cheeks. Many other doves and pigeons have similar blackish head spots or neck markings that might be equally reflective of UV light, and perhaps these areas are of special behavioral importance to doves and pigeons generally. The bronzy iridescence on the necks of Mourning Doves and Rock Doves were also much more conspicuous under UV light, and these areas are very conspicuous during display calling.

All of these observations make me believe that our human eyesight does not allow us to perceive the world as most birds do, and that they at times might be responding to visual clues literally beyond our ken. For example, are the ultraviolet "teardrops" on the cheeks of a Mourning Dove an important visual "target" for close-up courtship, or are they perhaps important for stimulating preening by its mate? It would be interesting to modify or eliminate these small marks, and see what behavioral effects might result. Two individual male birds that, to human eyes, might appear identical, may be of quite differing attraction to females, depending upon their feathers' levels of UV reflectance. It has also been found that putting UV-reflectant leg bands on a bird can have social effects on other birds in ways we might not anticipate (Hunt et al., 1997; McGraw et al., 1999). The potential importance of recognizing the possible effects of avian UV light perception should not be underestimated by students of bird behavior hoping to understand and perhaps experimentally manipulate their research subjects.

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