A Hidden World of Color

By Hannah Beckett

The beautiful hues and plumes of birds have long drawn the attention and interest of mankind. But, do we really know the true spectrum of avian coloration and vision? The answer may lie in the unique biology of a bird's eye.

While all animals see a portion of the electromagnetic radiation emanating from the sun, which portion of the spectrum is perceived varies among species. Humans detect light with three different types of retinal cone photoreceptors for red, green, and blue light. This allows us to see light from wavelengths of roughly 400 nanometers (violet) to 700 nm (red), but not the longer (infrared) wavelengths or the shorter (ultraviolet) wavelengths. Our vision is thus "trichromatic."

In contrast, may birds have "tetrachromatic" vision. They have red, green, and blue cones similar to our own, but they also have a cone enabling them to detect wavelengths in the ultraviolet range (300–400 nm). With the exception of the nocturnal species, the eyes of avians are able to see ultraviolet "colors". Since birds rely on vision to choose mates, find food, and scan for predators, how might this knowledge of enriched UV vision affect what we already know about birds?

The past few decades have seen a flurry of studies testing the premise of how bird behavior may be shaped by the secret visual signals humans cannot see. Research involving European Starlings found the normal sexual monomorphism (males and females of a species look identical) appeared different when the color of UV reflectance was measured. The researchers found females used UV cues to choose males as mates, suggesting the difference is from sexual selection.

In the case of the common and well–studied Blue Tit bird, the male and female appear visually identical to the human eye. However, when viewed under UV light, males have UV-reflectant crown patches. These are used in the avian community to identify males from females. Studies found that females preferred bright-crowned males. This sexual dichromatism under UV light appears in about 70 percent of songbird species once thought to be sexually monochromatic. These studies fill in missing pieces of the puzzle of why certain species, whose males and females look the same, displayed such intense sexual selection and mate assessment.

Ultraviolet vision and reflectance play roles not only in interactions among birds, but also in interactions between birds and their environment. Ultraviolet patterning on flower petals may attract pollinating hummingbirds. Many fruits and seeds use UV reflectance to advertise themselves to seed-dispersing birds. The use of UV color range in insects may play a role in avian foraging as well. Some birds of prey have been shown to use the UV reflective urine of rodents to follow the inconspicuous trails of their prey through the tall grass.

Knowing what an animal really sees is a crucial step toward understanding its behavior. Many behavioral and ecological studies are now taking into account the differences between avian and human vision. Scientists using technology to view, describe, and experimentally alter avian plumage in the UV range have already reinterpreted signaling among birds in several systems. As technological equipment becomes more available and affordable, ornithologists may be able to better understand the world of avian ecology.

Photo: A macro shot of a red-and-green macaw's (*Ara chloropterus*) eye, Serra da Capivara National Park, Piauí state, Brazil.

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