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LETTER

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DO RAPTORS REACT TO ULTRAVIOLET LIGHT?

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Birds are renowned for their excellent vision, including the sensitivity of many species to ultraviolet light (UV; Birkhead 2012). Bird color vision is mediated by four single-cone types, one of which houses SWS1 pigments that determine whether a species is sensitive to UV (<400 nm in wavelength) or only to longer wavelengths (reviewed by Hart 2001). Field observations led to the proposition that certain raptors might use the UV reflectance of vole urine to aid in hunting (Viitala et al. 1995, Koivula and Viitala 1999), although others have maintained that differences between UV reflectance of vole urine and underlying substrates were likely indistinguishable (Lind et al. 2013). Genetic studies by Odeen and Hastad (2003) suggested that raptors generally lacked UV-sensitivity, and most recently, sequencing of a Golden Eagle (*Aquila chrysaetos*) genome by Doyle et al. (2014) revealed genes indicating sensitivity to the violet spectrum and not to the near-ultraviolet part of the spectrum. In field tests of the efficacy of UV reflectance in reducing the incidence of raptor collisions with wind turbine blades, Young et al. (2003) found no effect of blades painted with UV reflective paint on mortality rates. A remaining question regarding the potential of UV light to deter raptors from entering hazardous areas was their possible sensitivity to projected, rather than reflected, UV light. Here we recount observations made during exploratory field tests of the potential of projected UV light to elicit an avoidance response in a small sample of Golden Eagles and other raptors.

We tested two light-emitting devices. One was a portable 25-watt LED unit emitting 385 nm +/−10 nm that strobed at two pulses per second and projected as a beam in a +/−30° cone angle. The second was more a powerful bulb system, yielding a constant ~250-watt beam between 330–390 nm and projected as a beam in a +/−30° cone angle. Light from the 250-watt device decreased from a calculated intensity of 0.3 mW/cm^2 at a distance of 10 m to 0.013 mW/cm^2 at 50 m. Both devices required 120V AC power provided by a quiet 5-kW portable generator removed ca. 30 m by an extension cord.

Test subjects included three adult Golden Eagles, one Harris's Hawk (*Parabuteo unicinctus*), one Aplomado Falcon (*Falco femoralis*), one hybrid Peregrine Falcon/Gyrfalcon (*F. peregrinus x rusticolus*), one Prairie Falcon (*F. mexicanus*), and one Gyrfalcon (*F. rusticolus*), all trained in falconry and well-behaved. We tested the hypothesis that projected UV light can elicit a physical response from raptors to a degree that could be used to induce area avoidance. The hypothesis would be rejected if birds initially exposed to the stimulus failed to turn away, whereas the hypothesis would be strengthened in proportion to the degree of response. Repeated trials would examine the process of habituation, if any.

We tested the response of the three eagles to the 25-watt device on the first day, the rationale being that reaction to it might reveal greater sensitivity than would the initial use of the 250-watt device. A falconer called each of the three Golden Eagles upwind across an open field ca. 450 m in length. Parallel to the intended flight path and ca. 40 m distant were four white pickup trucks spaced at 80-m intervals; we did this on the (correct) assurance that the trained eagles would ignore stationary vehicles. This configuration minimized the possibility of the eagles reacting to the visual image of the device rather than the beam. The device was placed on the ground behind (and next to) the second or third truck, out of sight of the eagle at the point of takeoff. The beam was directed tangentially to the intended flight path; our rationale was that the tested eagle would not perceive the beam from the starting point, but would unexpectedly encounter it along the flight path. Video cameras recorded the eagle's movements during each trial. We conducted 12 trials, alternating in each successive trial between the three eagles. The light was inactivated during the first trial for each eagle, and activated in all but one of the remaining trials (sky variable thin overcast, −3°C, winds ca. 8 km/hr).

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In trials on the second day, again with the three eagles, a falconer stood ca. 50 m away from the front of the 250-watt device with a hooded eagle on his glove, facing the device. A second person stood with the falconer to help assess the eagle's reaction from the time of hood removal until the nature of the reaction was clearly evident, typically in <1 min. The falconer then replaced the hood, moved 10 m closer to the device, and again removed the hood (walk-up procedure). The sequence was repeated at 10-m increments, with the eagle's behavior at each station recorded by video. The light was inactivated during the first trial for each eagle and activated thereafter. In four subsequent trials, eagles were induced to fly 50 m toward the device to a falconer standing near it (sky overcast, winds <16 km/hr, and −3°C).

On the third day, we used the walk-up procedure to test each of the other raptors, this time with both devices activated, side-by-side. The falconer approached, as before, in 10-m increments beginning at 50 m, without hooding and rehooding. In the last trial, the falconer called the Gyrfalcon to a lure dropped ca. 2 m in front of the devices (sky overcast, −6 C°, winds ≥25 km/hr, and intermittent light snow).

No clear evidence emerged that the eagles responded to the 25-watt UV light device during the flight trials on the first day, despite three vague, possibly circumstantial events: (1) the eagle in Trial 4 deviated from the area where the beam first encountered the flight path before continuing its flight; (2) in Trial 7, the eagle appeared unwilling to fly until the light was turned off, and was thought to be watching the truck that hid the light prior to takeoff, and (3) the eagle in Trial 10 landed when the light was activated. On the other hand, in three trials, eagles encountering the beam showed no response; these included Trials 5 and 9 during which the eagles appeared to pass (≤30 m) through the central portion of the beam with no observed reaction. Results of Trial 8 were more ambiguous in that the eagle was ca. 80 m from the light source at the closest point.

On the second day, neither the walk-up tests nor the flight tests produced any noticeable response by the eagles to the light, even at distances of 10 m and less. Similar trials on the third day with the five other raptors also showed no indication of response.

Although results within our small sample of test subjects cannot exclude the possibility of reaction to higher UV doses or different modes of projection, the weight of evidence from the trials suggests no tendency toward avoidance, even at very close distances. Where circumstances suggested that possibility, observed behavior was mild and not in agreement with the notion of avoidance. It remains to be tested whether (1) bird species known to be UV-sensitive can be deterred from hazards by the application of projected UV light, and (2) a light source well-matched to the spectral sensitivity of the species of concern might prove useful for the purposes of conservation management (Blackwell 2002).

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