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RTD07 Progress in avian vision

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1 Issues

Vision is the key sense that guides many important aspects of bird behavior. Recent progress ranges from understanding the retinal mechanisms of color vision, including the tetra-chromatic visual system and wide distribution of UV sensitivity into UV (ultraviolet) light, to details of eye structure, visual fields and their relation to foraging. This RTD sought to summarize important recent findings and to identify, for interdisciplinary and collaborative investigation, areas of research that link eye, vision, and behavior. Two main areas were discussed: (1) vision and plumage coloration and their interactive roles in conspecific signalling, and (2) how knowledge of visual fields and color vision might be applied to reduce the hazard of bird collisions, especially with power wires.

Two speakers presented brief papers to stimulate discussion. First, Geoffrey E. Hill, Dept. Biological Sciences, Auburn University, USA, spoke on the effects of carotenoid acquisition and utilization on expression of colorful plumage in the house finch, *Carpodacus mexicanus*. Carotenoid pigments produce most of the red, orange, and yellow colors of feathers. Because birds cannot synthesize their own carotenoids, they must ingest such pigments to color their plumage. Given such diet-dependence, it is not surprising that access to carotenoid pigments during moult in house finches affects carotenoid-based plumage coloration, as demonstrated in both field observations and laboratory experiments.

Secondly, the senior convener addressed the question: what can vision research tell us about how to reduce bird-collisions with power wires? A review of eye structure and visual field capacity across 23 species of birds differing in ecology, phylogeny, size and flight capability suggested across-the-board convergence in three main topographies of visual field. Common to the majority of species is extensive visual coverage about the head, complemented by a narrow binocular field in front, of 20°–30° maximum width in the approximate horizontal plane. Some species even achieve complete visual coverage of the celestial hemisphere. In flight, objects ahead of such birds constitute a small fraction of the total space to which they might be attending at any one time (*cf.* human experience of visual space which stems from frontally-placed eyes). Moreover, many birds have foveae that project laterally rather than frontally, suggesting that attention may often be directed sideways and downward. Species that commonly experience aerial collisions (e.g. wildfowl, bustards, cranes, raptors) usually fly about in open space devoid of obstruction. It allows them to search around and down for conspecifics or suitable foraging sites, yet can distract them from “attending” to what is ahead.

2 Outcomes

1. Dr. Hill concluded that variation in the expression of carotenoid-based ornamental coloration is not explained entirely by differential access to carotenoid pigments. Male house finches must also utilize efficiently those pigments that they acquire in their diet. Even with abundant access to carotenoid pigments, parasitic infection and nutritional stress during moult can significantly reduce expression of plumage coloration. His data indicated that carotenoid access, parasite load, and nutritional condition combine to determine the brightness of plumage in male House Finches. What remains to be resolved in any wild population of birds is the relative importance of these factors.

2. Dr. Martin concluded that the avoidance of obstacles by birds flying under the conditions he described could be a perceptual rather than visual problem. To enable it, devices were needed to attract attention from below, to encourage the birds to fly lower or higher, or even land, rather than those which simply raised the visibility of hazardous objects in the flight path ahead. The aerial maneuverability of many of the species most at risk, moreover, was low, due to high wing loading and flight speed. Thus hazards needed to be signalled at considerable distances in advance. It was argued that color marking, including use of UV reflectivity, are not likely to increase significantly the detectability of hazards.