The intensity threshold of colour vision in two species of parrot

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Birds have advanced colour vision that has inspired to a great amount of research. Still however, only little is known about avian colour vision in dim light. We have used behavioural tests to determine the intensity threshold of colour vision in Bourke's parrot (*Neopsephotus bourkii*) and the budgerigar (*Melopsittacus undulatus*). These are Australian parrots with similar lifestyles and body sizes except for the eyes that are larger in Bourke's parrots. Furthermore, while the budgerigars are diurnal Bourke's parrots are active also before sunrise and after sunset. This suggests that its eyes are large to increase sensitivity. Since the intensity threshold of colour vision is dependent upon the sensitivity of the eyes, our hypothesis was that the Bourke's parrots have colour vision in dimmer light than budgerigars. To test this hypothesis we also performed morphological investigations and calculated the optical sensitivities of the single cones for white light. Surprisingly, Bourke's parrots loose colour vision at higher light intensities (-0.398 log cd/m^2) than budgerigars (-0.925 log cd/m^2). These results cannot be explained by the eyes' optical sensitivities that are almost identical (budgerigar = 0.27 μm^2 sr^{-1}, Bourke's parrot = 0.25 μm^2 sr^{-1}). However, the retina of Bourke's parrot has more (cone to rod ratio =1.2:1) and longer rods (18.5 μm) than the budgerigars (2.1:1, 13.3 μm). These adaptations together with the large eyes might provide the Bourke's parrots with good spatial vision in bright light and, due to pooling of rod signals, a high sensitivity that allows them to be active in dimmer light. As a consequence, the retina of Bourke's parrot contains fewer cones, which implies that budgerigars can pool more cones within each retinal receptive field and thereby acquire stronger colour signals. If so, it might explain the difference in the behavioural results between the parrots.