Signal, noise and information in the photoreceptors of a nocturnal bee

Eric Warrant[1] and Rikard Frederiksen[1,2]

[1]Department of Biology, University of Lund, Sweden, [2]Department of Physiology and Biophysics, Boston University, USA

Nocturnal animals relying on vision typically have eyes that are optically and morphologically adapted for increased sensitivity, and greater information capacity, in dim light. Here we describe how adaptations for increased sensitivity are also found in their photoreceptors, using closely related and fast-flying nocturnal and diurnal bees as model animals. The nocturnal bee *Megalopta genalis* is capable of foraging and homing using visually discriminated landmarks at starlight intensities. *Megalopta*'s near relative, *Lasioglossum leucozonium*, performs these tasks only in bright sunshine. By recording intracellular responses to Gaussian white-noise stimuli, we have shown that photoreceptors in *Megalopta* actually code less information at most light levels than those in *Lasioglossum*. However, as in several other nocturnal arthropods, *Megalopta*'s photoreceptors possess a much greater gain of transduction, indicating that nocturnal photoreceptors trade information capacity for sensitivity. By sacrificing photoreceptor signal-to-noise ratio and information capacity in dim light for an increased gain, and thus an increased sensitivity, this strategy can benefit nocturnal insects that use neural summation to improve visual reliability at night.