The dynamical and spectral characteristics of pupillary response in the owl-fly *Ascalaphus macaronius*

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The owl-fly *Libelloides* (*Ascalaphus*) *macaronius* (Insecta: Neuroptera) has bipartite eyes composed of dorso-frontal (DF) part and ventro-lateral (VL) part. These are typical superposition eyes with an extensive clear zone and the screening pigments located in the primary and secondary pigment cells. These cells mediate a light adaptation mechanism which is not be well suited for rapid fluctuations in environmental light intensities.
We investigated the dynamics of the pupillary action with reflectance measurements, electroretinography and microscopy. In the reflectance measurements, the amount of violet (405 nm), green (525 nm) and red (625 nm) measuring lights reflected from the tracheal tapetum in the proximal part of the eye was measured. The pupil response was elicited with 3 to 50 s flashes of intense UV and blue light (BG28). In the DF part, the decrease of the eye glow never exceeded more than 90 % in the violet band and was typically 60 % in the green band, and 20 % in the red band. With sufficiently strong adapting stimuli, the attenuation level reached saturation in the violet band and sometimes also in the green band but never in red. Not surprisingly, the amplitude of the ERG response followed the attenuation level of the eye glow in the violet band. The saturation effect and simultaneous ERG recordings suggest that a light filtering mechanism is present in this particular eye design, possibly in addition to the cone mechanism of diafragm aperture regulation. The amplitudes of the changes in the eye glow correspond to the extinction characteristics of screening pigment in the primary pigment cells (Schneider et al 1978). On the basis of absorption characteristic of screening pigments and the decrease of eye glow we ascertained that the pupillary action in the DF part of the eye is due only to the primary pigment cells and that in contrast to previous reports (Stušek and Hamdorf 1999), the apparent double dynamic of the pupil response can be ascribed to the saturation effect of the extinction characteristics of primary pigment granules.
The effect of successive adapting stimuli is roughly inversely proportional to the amplitude of the eye glow. Therefore, we suggest that the location of the pupil trigger is proximal with respect to the primary pigment cells. In the VL part, the eye glow changes had similar time course, except that they could be elicited only with ten fold longer stimuli and their amplitude reached typically only 20 % attenuation in the violet band, 15% in the green band and 10% in the red band. The morphological data indicate a profound light dependent reshaping of the primary pigment cells in both DF and VL parts of the eye. However, the corresponding light dependent changes of the eye glow can be well discriminated only in the DF part of the eye.
By such light filtering mechanism, this type of the eye can not adjust the acceptance angle very sharply. This may not present a problem for an animal that catches prey against a considerably uniform UV background of the sky.

References:

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