

## **The molecular genetics of color and polarization vision in stomatopod crustaceans**

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Stomatopod crustaceans have the most complex assemblage of visual receptor classes known; retinas of many species are thought to express up to 16 different visual pigments. We investigated subsets of expressed opsin genes in retinas of seven stomatopod species representing a broad taxonomic range (five families, three superfamilies) using degenerate primers targeting crustacean middle-wavelength-sensitive (MWS) opsins, and further examined three of these species with primers targeting putative ultraviolet-sensitive (UVS) opsins. Physiological studies suggest that stomatopods contain up to six photoreceptor classes with middle-wavelength sensitivity and six additional classes with ultraviolet sensitivity. Thus, we expected that the primers utilized would isolate up to six different opsin gene copies of each spectral class per species. In the MWS class, a total of 79 unique retinal opsin transcripts were isolated, representing six to fifteen different transcripts in each species. Minimally, this characterized sequence diversity requires four to ten opsin copies in the genome of each species. These MWS opsin transcripts form six distinct phylogenetic clades, grouping with other characterized crustacean opsins and sister to insect middle-wavelength types. Intra- and interspecific clusters of highly similar transcripts suggest that there has been rampant, recent opsin gene duplication in the stomatopods, together with ancient gene duplication events within the stem crustacean lineage. Using evolutionary trace analysis, 10 amino acid sites located in two distinct regions of MWS opsin polypeptides were identified as functionally divergent. These two clusters of sites indicate that stomatopod MWS opsins have diverged both with respect to spectral tuning and to signal transduction interactions. Interestingly, our preliminary results suggest that the UVS opsins are actually less diverse than expected, with as few as two distinct opsin transcripts expressed in a retina. Specialization for spectral diversity has apparently taken different evolutionary routes in the MWS and UVS opsin classes of these crustaceans.

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