Signals in light of visual perception: a study of opsin evolution in New World warblers

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Animal signals are thought to evolve in response to environmental pressures (e.g. predation) and selection for intraspecific communication. However, the sensory system and its role in signal evolution has been much more difficult to study. In the case of visual communication, the sensory system has been largely studied without considering signals or the ecological setting. Consequently, we do not understand the evolutionary relationships between these components. Here, we propose to assess how opsins, and thus color vision, vary in relation to color visual signals, using the New World warblers as a model system. These species vary greatly in their colors and their ecology has been well studied, making them an ideal system to study the role visual perception plays in signal evolution. We will evaluate differences in color vision among species from opsin sequences and from relative opsin abundances.

We have amplified complete coding sequences for all five opsin genes in more than 15 New World warblers, and found substantial non-synonymous variation in all cone opsins, but none in the rhodopsin. Interestingly, close to 80% of the observed substitutions are in, or adjacent to the binding pocket, and therefore, have the potential to alter the opsins' spectral sensitivity. However, we are still unable to verify that the observed variation indeed translates into differences in the opsins' spectral sensitivity. We will obtain this information by expressing the different opsins *in vitro*. Additionally, we found considerable variation in relative opsin abundances among New World warbler species. Contrary to our expectations from cone photoreceptor abundance, we found the SWS1 (UVS) opsin to be the most abundant in all studied species.

Understanding the observed variation in the opsins of New World warblers will shed some light into avian color vision and its role in the evolution of plumage coloration.