Why is Colour Vision on Coral Reefs so Variable?

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Visual ecology links the physical constraints of the world to the physiology of visual systems. Freshwater fish living in a world often dominated by greenish to orange light (500-700nm), generally place rod and cone spectral sensitivities in this part of the spectrum in order to capture enough light. Ultraviolet (UV) sensitivities in species living close to the surface may also operate where there are UV wavelengths to see by. In the ocean, the spectral envelope of light is shifted to shorter wavelengths (350-500nm) and marine fish place sensitivities in this spectral zone. Again there are species with and without UV sensitivities and this and other fine tuning of spectral sensitivity may be correlated with depth and / or feeding habits such as planktivory. Ideas such as the sensitivity hypothesis and the twilight hypothesis (see John Lythgoe, Bill McFarland and co authors) effectively explain the spectral positioning, of rod (and maybe double cone) sensitivities. Single cone sensitivity placement, spacing and number are harder to explain. While single cone sensitivities also generally fit within the illuminant envelope, their variability between species suggests, either that unknown selection pressures are at work, or that, uncomfortably for a visual ecologist, 'neutral mutation' or relatively 'unconstrained' adaptation exists. Recent data from reef fish are examined here, including 3 closely related species of Apogonids (Cardinal fish) with similar lifestyle but variable single cones. What are we missing? Why such diversity in apparently similar light habitats? Are there sufficient behavioural differences to explain the observed diversity or is it related to the astonishing array of colours? What do models of colour vision performance predict? All these questions will be examined, chewed over and possibly swallowed.

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