Ecologists get fish eye view of sexual signals

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Carotenoid pigments are the source of many of the animal kingdom's most vivid colours; flamingos' pink feathers come from eating carotenoid-containing shrimps and algae, and carotenoid colours can be seen among garden birds in blackbirds' orange beaks and blue tits' yellow breast feathers.

These pigments play a crucial role in sexual signals. According to the study's lead author Dr Tom Pike of the University of Exeter: "Females typically use carotenoid colours to assess the quality of a potential mate, with more colourful males generally being regarded as the most attractive."

This long-held assumption is, however, hard to study because we see colour very differently to fish and previous studies have not taken such differences into account, instead comparing only the colours perceived by humans.

"The major difference between stickleback vision and our own is that they can see ultraviolet light, which is invisible to humans. This may be important because carotenoids reflect ultraviolet light as well as the red, oranges and yellows that we can see," Dr Pike explains.

The model developed by Dr Pike and colleagues from the University of Glasgow and Nofima Marine in Norway mimics the stickleback's visual system, allowing the researchers to determine what 'colours' the fish see. "The model tells us how much of the light reflected from a carotenoid signal is actually detected by a female and how this information might be

processed by her brain, and so gives us exciting new insights into how females may use colour to choose the best mates," says Dr Pike.

Male sticklebacks can fine tune the colours they display to females by varying both the overall amount of carotenoids and the relative amount of the two constituent carotenoids, the red-coloured astaxanthin and the yellow tunaxanthin. The model reveals that sticklebacks' visual system and coloration are extremely well co-adapted, and that females are surprisingly good at assessing the quantity of carotenoids a male is able to put in his signal – which previous studies by the authors have shown is linked to his parenting ability.

The results will help ecologists get a better understanding of why carotenoid-based signals evolved in the first place, and provides insights into why males use the specific carotenoids they do. According to Dr Pike: "There are many carotenoids in the sticklebacks' diet, but males use only two of them for signalling; because the visual system evolved long before male coloration in this species, it suggests that males 'chose' to use those two carotenoids to make the most of what the female fish sees."

More information: Thomas W Pike et al (2010), 'How integument colour reflects its carotenoid content: a stickleback's perspective', doi:10.1111/j.1365-2435.2010.01781.x , is published in *Functional Ecology* on 3 November 2010.

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