SENSORY DRIVE AND SPECIATION

Do ecological constraints favour certain perceptual systems and, thus, generate species-specific modes of mate signalling; or, do these modes and traits vary arbitrarily? Boughman (2002) proposes that – while Fisher's runaway model accurately predicts the exaggeration of males signalling traits – a more holistic model based on the exact nature of the environment and the physiology of the organism, and its perceptual systems, better explains interspecific differences. Specifically, Boughman suggests clinal-like differences in habitat, or microhabitat, can promote sensory system differences, which then shape signalling modalities. This model – called the sensory drive hypothesis – does not necessarily contest Fisher's model, and may work in conjunction with it and other models to promote the variation of mating-specific traits.

The sensory drive hypothesis predicts that signalling systems will be shaped by three specific environment-organism interactions. Given the general nature of intersexual pressures, for our discussion the receiver of a signal will be taken as the female of the species, while the signaller as the male. Boughman briefly describes the three interactions and defines them as: [1] habitat transmission, [2] perceptual tuning, and [3] signal matching. Taken in turn, each of these properties shape the signalling system of the organism and interact to generate a specific signalling system. First, habitat transmission describes what signal best passes through the environment. Theoretically, the best 'call' would travel relatively intact through the environment; preservation – in light of the degradation caused by the abiotic properties of the habitat – is favoured. Secondly, perceptual tuning describes the exploitation of female adaptations specific to non-mate-finding tasks by males: such as finding food and/or detecting predators. For example, Smith *et al.* (2004) suggest that the female preference for red coloured jaws and throats in male three-spined sticklebacks (*Gasterosteus aculeatus*) evolved in response to foraging preferences; in essence, male sticklebacks exploit females' preferences for red colouring. Finally, the third tenant of Boughman model – signal matching – implies that males should produce calls that females can easily detected given the physiological nature of their sensory systems. Unsurprisingly, producing a call that is within the female's range of greatest sensitivity is beneficial both to the males (wasting 'unheard' calls) and to the females (reducing search costs for potential mates).

Under allopatry, then, is easy to see how these signalling constraints could changes in response to habitat and cause divergence. Boughman describes several examples of such changes in habitat producing divergent sensory adaptations – such as the colour sensitivity in fish. She observes that several inland varieties of snapper (*Lutjanidae* family) have spectral shifts towards green – enhancing their perception in the yellow-green waters of their habitat – while their reef dwelling cousins have spectral shifts towards blue, best for their less turbid waters. It then follows that if colouration were important for mate choice in this family, sexual selection would produce male colourings best for the snapper's environment and most easily matched to females' sensory ranges. Such a system could drive divergence of shore populations and reef populations in both female preference and male signalling modes.

Consequentially, Boughman suggests these changing systems could then promote speciation via assortative mating. She verbally describes a modal where, under allopatry, sensory drive produces enough changes in the two populations to prevent heterospecific mate recognition should sympatry reoccur. These changes could both strengthen other reproductive barriers and/or act as the primary barrier to heterospecific mating. In addition, she observes that species-specific microhabitat assortment during mating would also enforce species boundaries. This microhabitat assortment could be a by-product of sensory system changes, usually related to niche specific adaptations or constraints, or related to predatory pressures.

As always, Boughman recognizes that a host of apomorphic traits might work together to promote assortative mating and that specific studies are necessary to observe the causality of a speciation event presumed to be a product of sensory drive. Furthermore, she recognizes that "ecologically similar species are unlikely to coexist, even when some sexual isolation exists" (574). That is to say that under sympatry, if the changes are not large enough to prevent hybridization then stabilizing selection might push the species together again. Conversely, if the species are sexual isolated, but occupying the same niche, then one species may go extinct if they do not evolve towards different environments first. It seems that, while sensory drive is pivotal to certain speciation events, it often works in conjunction with other isolating mechanisms to produce species. Boughman's model helps refocus the researcher's eye on the ecological that produces and physiology of an organisms sensory system. Future studies can, therefore, be illuminated by this model and take into account the effect of the habitat on the signalling modality.

THIS TEXTS REFERS TO:

Boughman, JW (2002) "How sensory drive can promote speciation". *Trends in Ecology and Evolutionary Biology* 17:571-577.

Smith, C. *et al*. (2004) "A receiver bias in the origin of three-spined stickleback mate choice". *Proceedings of the Royal Society of London Series Biological Sciences* 271 (1542): 949-955