Animal vision and colour change for camouflage

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Project description:

Understanding why individuals of the same species differ among and within populations, including those found in different environments, and the mechanisms that lead to such variation is a fundamental problem in biology. A major cause of individual variation is colour change. This ability is widespread in nature, from insects and crustaceans, through to reptiles, fish, and amphibians. It occurs on a wide range of timescales (seconds, hours, days, weeks, and months), and usually involves changes in special pigment-containing cells in the body. Colour change is vital in guiding the camouflage of many species, and has received much attention in unusually rapid changing species such as cephalopods and chameleons. However, a major gap in our knowledge exists – although colour change is widely assumed to be based on animals visually inspecting the background, this has rarely been directly investigated. In fact, we know very little about how the visual systems of colour changing animals enable them to match their visual environment.

This project will study two common UK species that are highly diverse in appearance and known to be able to change colour for camouflage: shore crabs (*Carcinus maenas*) and chameleon prawns (*Hippolyte varians*). It will involve conducting experiments in marine tanks with crabs and prawns and putting them on different backgrounds to assess their ability to change colour. Using special image analysis techniques and models of predator vision, the effectiveness of colour change on each background in providing camouflage will be assessed. Concurrently, advanced techniques to determine what photoreceptors are present in each species vision, and the wavelengths of light they can detect, will be used to characterise the visual ability of each species. Using this information, models of prawn and crab vision can be constructed and used to determine how their visual ability guides and constrains colour change. Finally, experiments will be conducted using coloured light filters and LED lights to change the light conditions and patterns in experiments to tease apart the role of light intensity, direction, and composition in guiding colour change, versus other factors, such as diet.

This project will be the first to combine advanced understanding of the visual abilities and perception of animals and how this allows and constrains them to change colour for concealment in a wide range of visual environments.