

The compound eyes of mantis shrimps (Crustacea, Hoplocarida, Stomatopoda). I. Compound eye structure: the detection of polarized light

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SUMMARY

Stomatopod crustaceans possess compound eyes divided into three distinct regions: two peripheral retinae – the dorsal and ventral hemispheres – and the mid-band. Throughout the eye, in particular in the mid-band, there are many structural adaptations that potentially enable different portions of the eye to perform different visual tasks. A high degree of optical overlap between these eye regions allows the parallel sampling of various parameters of light from one direction in space. In consecutive papers, we present structural evidence that stomatopods have the receptors necessary for colour and polarization vision.

The first paper describes the retinal structures that suggest the existence of polarization sensitivity in stomatopods. mid-band rows five and six, together with the hemispheres, are probably involved in this visual process. By using two strategies, rhabdomal modification and varying the orientation of similar ommatidial units in the three eye regions, stomatopods have the capacity to analyse polarized light in a very detailed manner. All the species included in this study live in shallow, tropical waters where polarized light signals are abundant. It therefore seems likely that their eyes have evolved to take advantage of such environmental cues.

Structural evidence also suggests that all retinular cells in rows one to four of the mid-band, and the distal most retinular cells (R8) over most of the retina, are not sensitive to polarized light. These mid-band rows are instead adapted for colour detection. This function of the stomatopod retina and structural features concerned with colour sensitivity are described in paper II (*Phil. Trans. R. Soc. Lond. B* **334**, 57–84 (1991)).

1. INTRODUCTION

Stomatopods, or mantis shrimps, are highly aggressive, predatory marine crustaceans. They live in cavities or burrows, which they may excavate themselves, and from which they stalk and kill other crustaceans,

annelids, molluscs and fish (Caldwell & Dingle 1976). They possess two large raptorial limbs which, with a rapid strike, can smash or spear prey. Mantis shrimps are commonly classified by using this functional distinction as ‘smashers or spearers’. Four modern superfamilies of stomatopod exist; the Bathysquilloidea,