Arizona State University

SolarSPELL

Shrimp

Habitat

Mantis shrimp live in burrows where they spend the majority of their time. The two different categories of mantis shrimp – spearing and smashing – favor different locations for burrowing. The spearing species build their habitat in soft sediments and the smashing species make burrows in hard substrata or coral cavities. These two habitats are crucial for their ecology since they use burrows as sites for retreat and as locations for consuming their prey. Burrows and coral cavities are also used as sites for mating and for keeping their eggs safe. Stomatopod body size undergoes periodic growth which necessitates finding a new cavity or burrow that will fit the animal's new diameter. Some spearing species can modify their pre-established habitat if the burrow is made of silt or mud, which can be expanded.

Eyes

Mantis shrimp can perceive wavelengths of light ranging from deep ultraviolet (UVB) to far-red (300 to 720 nm) and polarized light. In mantis shrimp in the superfamilies Gonodactyloidea, Lysiosquilloidea, and Hemisquilloidea, the midband is made up of six omatodial rows. Rows 1 to 4 process colours, while rows 5 and 6 detect circularly or linearly polarized light. Twelve types of photoreceptor cells are in rows 1 to 4, four of which detect ultraviolet light.

Rows 1 to 4 of the midband are specialised for colour vision, from deep ultraviolet to far red. Their UV vision can detect five different frequency bands in the deep ultraviolet. To do this, they use two photoreceptors in combination with four different colour filters. They are not currently believed to be sensitive to infrared light. The optical elements in these rows have eight different classes of visual pigments and the rhabdom (area of eye that absorbs light from a single direction) is divided into three different pigmented layers (tiers), each for different wavelengths. The three tiers in rows 2 and 3 are separated by colour filters (intrarhabdomal filters) that can be divided into four distinct classes, two classes in each row. It is organised like a sandwich - a tier, a colour filter of one class, a tier again, a colour filter of another class, and then a last tier. These colour filters allow the mantis shrimp to see with diverse colour vision. Without the filters, the pigments themselves range only a small segment of the visual spectrum, about 490 to 550 nm. Rows 5 and 6 are also segregated into different tiers, but have only one class of visual pigment, the ninth class, and are specialised for polarization vision. Depending upon the species, they can detect circularly polarized light, linearly polarised light, or both. A tenth class of visual pigment is found in the upper and lower hemispheres of the eye.

Some species have at least 16 photoreceptor types, which are divided into four classes (their spectral sensitivity is further tuned by colour filters in the retinas), 12 for colour analysis in the different wavelengths (including six which are sensitive to ultraviolet light) and four for analysing polarised light. By comparison, most humans have only four visual pigments, of which three are dedicated to see colour, and human lenses block ultraviolet light. The visual information leaving the retina seems to be processed into numerous parallel data streams leading into the brain, greatly reducing the analytical requirements at higher levels.

Six species of mantis shrimp have been reported to be able to detect circularly polarized light, which has not been documented in any other animal, and whether it is present across all species is unknown. Some of their biological quarter-waveplates perform more uniformly over the

visual spectrum than any current man-made polarising optics, and this could inspire new types of optical media that would outperform the current generation of Blu-ray Disc technology.

Behavior

Mantis shrimps are long-lived and exhibit complex behaviour, such as ritualised fighting. Some species use fluorescent patterns on their bodies for signalling with their own and maybe even other species, expanding their range of behavioural signals. They can learn and remember well, and are able to recognise individual neighbours with which they frequently interact. They can recognise them by visual signs and even by individual smell. Many have developed complex social behaviours to defend their space from rivals.

In a lifetime, they can have as many as 20 or 30 breeding episodes. Depending on the species, the eggs can be laid and kept in a burrow, or they can be carried around under the female's tail until they hatch. Also depending on the species, males and females may come together only to mate, or they may bond in monogamous, long-term relationships.

In the monogamous species, the mantis shrimps remain with the same partner up to 20 years. They share the same burrow and may be able to coordinate their activities. Both sexes often take care of the eggs (biparental care). In *Pullosquilla* and some species in *Nannosquilla*, the female lays two clutches of eggs - one that the male tends and one that the female tends. In other species, the female looks after the eggs while the male hunts for both of them. After the eggs hatch, the offspring may spend up to three months as plankton.

Although stomatopods typically display the standard types of movement seen in true shrimp and lobsters, one species, *Nannosquilla decemspinosa*, has been observed flipping itself into a crude wheel. The species lives in shallow, sandy areas. At low tides, *N. decemspinosa* is often stranded by its short rear legs, which are sufficient for movement when the body is supported by water, but not on dry land. The mantis shrimp then performs a forward flip in an attempt to roll towards the next tide pool. *N. decemspinosa* has been observed to roll repeatedly for 2 m (6.6 ft), but specimens typically travel less than 1 m (3.3 ft).

Attributions To:

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