A Conscious Decision: Including Octopus in Welfare Laws on the basis of their self-awareness

Discusses the needs that octopus show for an improved standard of care in captivity, especially for a more stimulating and enriched environment.

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Introduction

Octopus are intelligent, curious predators with a remarkable ability for problem-solving (Dolev *et al*., 2011: Mather, 2008). But with animals so unlike humans, it is harder for us to place a similar value on them. In the USA, octopus are legally “invertebrates” and as such, are not protected under normal Animal Ethics and Welfare laws (Harvey-Clark, 2011; Moltschaniwskyj *et al*., 2007). One consequence of this is that octopus are often seen as “acceptable” replacements for mammals in experiments, and do not require review from ethics committees. This is all done under the assumption that all invertebrates are “lower-order” life-forms with little or no self-awareness (Mather, 2011). In the past decade, behavioural experiments have brought forth the idea of cephalopods having a form of primary consciousness similar to that of higher-order vertebrates (Mather, 2008). These developments in the understanding of octopus should be considered before reforming current welfare laws.

Discussion

Defining consciousness has been a controversial topic, but it has been narrowed down to a basic self-awareness and an ability to adapt to unique situations (Edelman & Seth, 2009). Self-awareness of individuals is regarded as a key feature of high-order phyla, characterised by the ability to recognise others, and the starting point of self-awareness. Tricarico *et al*. (2011), explored the ability of octopus to display individual recognition. Octopodes (n=24) were caught off the coast of Naples and taken to a laboratory. They were paired and placed together in tanks, each pair separated either by a transparent or opaque barrier. The octopodes remained in these tanks and were given three days to acclimate to each other. Each pair was then transferred to a shared tank where they were allowed to interact with each other for 15 minutes, once a day for three days. Finally, each pair was either switched or kept with its original partner, and allowed to interact with the new octopus for 15 minutes. Unfamiliar pairs tended to react physically towards one another more quickly, ending more often in aggression and ink-jetting. Those that were in familiar pairs avoided each other and established dominance sooner than octopus paired with an unfamiliar partner. The quickest assessments of dominance were performed by octopus pairs that were in visual contact for all seven days. Tricarico *et al*. (2011) hypothesised that the visual assessments made by octopus beforehand reduced the need for tactile reinforcement. This avoidance behaviour persisted through the entire experiment, leading the researchers to conclude that octopus do remember individuals for at least one day.

Along with individual recognition, self-monitoring is also a precursor to self-awareness, to a point where the animal bases its actions on the evaluation of sensory input (Edelman & Seth, 2009; Mather, 2008). Do octopus actively evaluate their environment before acting? Until 2011, researchers were unclear if there was a connection between the peripheral nervous input and the central neural control. To establish whether octopus have this link, Gutnick *et al*. (2011) constructed a three-choice maze that forced each trial animal to locate food in a particular compartment with the use of just one of its limbs. Although it took at least 20 trials to learn, successful limb movements changed from straight, pushing movements, to careful probing actions. The octopus also positioned themselves to be in visual contact with the extended limb. Gutnick *et al*. (2011) concluded that the octopus were making a connection between the visual input and the voluntary motor control. The change in arm movements demonstrates that the octopus were actively changing their behaviour to suit the task. This change was based on the visual input they were receiving, an indication of their ability to self-monitor.

In addition to providing evidence for higher-range cognition, seeing how an animal responds to varying standards of captivity assesses its need to be stimulated. Yasumuro and Ikeda (2011) investigated the effects of enriching the environment on octopus behaviour. Five adults were hand- and net-collected from Okinawa Island and reared in each of three experimental environments. The Poor environment had only a PVC pipe; the Standard had a black cover cloth with sand and coral grit; and the Enriched was a standard tank with coral skeleton and plastic kelp. Each octopus spent seven days in each tank, during which their exploratory and other behaviours were recorded, along with their reactions to stimuli (a pipette with a rubber cap) and their colour changes.

While no differences were observed between the Standard and Enriched environments, behaviour was markedly different for octopodes in Poor tanks. In the Poor environment, octopodes were less exploratory and tended to ignore the stimulus, whereas in the other two environments octopodes showed a preference for attacking the stimulus. While in the Poor environment, octopodes were acutely mottled and exhibited ink-jetting, both of which are signs of stress in cephalopods (Moltschaniwskyj *et al*., 2007). It was concluded that the best way to enrich the surrounding environment was through addition of a substrate. Much the same way rats are required to have environmental stimulation, octopus seem to benefit in a similar manner (Ras *et al*., 2002; Yasumuro & Ikeda, 2011). The octopus' need for environmental stimulation points towards the possession of a cognitive capacity at least equal to that of vertebrates. What is more important to note though, is their adverse reaction to minimal conditions. The reduction of natural exploratory behaviour and the increase in stress-signalling behaviours in the Poor environment highlight the need for stimulation in captivity. This is often not considered when containing octopus in commercial and research situations (Uriarte *et al*., 2011; Moltschaniwskyj *et al*., 2007).

Conclusions

Octopus engage in complex social interactions, learn rapidly and display a high level of exploratory behaviours (Uriarte *et al*., 2011; Tricarico *et al*., 2011; Dolev *et al*., 2011). Their self-monitoring, ability to recognise individuals and, more importantly, their adverse response to degraded conditions, all point towards a sense of consciousness (Borrelli & Fiorito, 2008; Mather, 2008; Mather, 2011). In many respects, octopus are mentally comparable to many higher-order vertebrates, so, in captivity, they must be treated with the same standard of care.

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