SPATIAL FAMILIARITY IN THE BLIND CAVE CRAYFISH,
\textit{ORCONECTES AUSTRALIS PACKARDI}

BY

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ABSTRACT

This study examined behaviour of cave-adapted blind crayfish to novel territories of various sizes. Cave crayfish, \textit{Orconectes australis packardi}, were kept within a dark room in individual aquaria for 7 days. They were then placed into a small tank (33 $\times$ 28 $\times$ 23 cm, 10-15 cm water depth), and a large tank (54 $\times$ 37 $\times$ 30 cm, 10-15 cm water depth). Time, distance of movements, and length of pauses were recorded. Upon initial placement in a new setting, crayfish will walk around the perimeter where their antenna can contact the side of the tank. The animals will subsequently move around the tank away from the perimeter, or they will begin to dig a burrow. Familiarity within the environment for an individual crayfish was defined as when the animal initiates digging or remains in one place for over 5 minutes. The study demonstrates that time required to become familiar to a new setting depends on the size of the setting. The authors suggest that a balance between sensory input and inner processing, termed “familiarity”, can be reached.

RÉSUMÉ

Cette étude examine le comportement de l’écrevisse cavernicole aveugle lorsqu’elle est placée dans des territoires nouveaux de tailles variées. Des écrevisses cavernicoles \textit{Orconectes australis packardi}, ont été maintenues dans une pièce sombre dans des aquaria individuels pendant 7 jours. Les écrevisses ont été ensuite placées dans un petit bac (33 $\times$ 28 $\times$ 23 cm, 10-15 cm d’eau), et dans un grand bac (54 $\times$ 37 $\times$ 30 cm, 10-15 cm d’eau). Le moment, la distance de mouvements, et la longueur des pauses ont été notés. Dès son arrivée dans un nouveau cadre, les écrevisses marchent tout autour du récipient, leur antenne étant en contact avec la paroi du bac. Les animaux vont ensuite se déplacer autour du bac, à distance de la paroi, ou bien ils vont commencer à creuser un terrier. La familiarisation avec le nouvel environnement pour une écrevisse a été définie quand l’animal commence à creuser ou reste à un endroit pendant plus de 5 minutes. L’étude démontre que le temps requis pour être familiarisée avec un nouveau lieu dépend de la taille du lieu. Les auteurs suggèrent qu’un équilibre entre la réception sensorielle et le processus interne, nommé “familiarisation”, peut être atteint.

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Crustaceana 74 (5): 417-433
INTRODUCTION

Spatial learning is a process that animals use to gain familiarity with the surrounding sensory cues. This phenomenon has been well-demonstrated by Tinbergen’s (1932) studies with digger wasps. When a wasp leaves its burrow it hovers over the surrounding area to become familiar with spatial cues (e.g., rocks, pine cones, and shrubs). This provides orientation and learning of spatial cues so that upon returning to the vicinity the wasp can find its burrow. This type of familiarization with the local environment is important not only for insects, but also for reptiles, birds, and mammals, in order to be able to retreat for protection in the threat of predation. Even cave organisms do have predators and patterns of behaviors which are adaptive to survival (Uiblein et al., 1992).

In invertebrate species, regions of the nervous system that are responsible for spatial learning are not as well-known. But it is known that in crayfish and lobsters tactile, chemosensory, and visual information all project to the central brain. To reduce the complexity of investigating spatial learning in crustaceans, we chose a crustacean that lacks visual sensory structures and, therefore, develops spatial familiarity using its olfactory and tactile senses. The animal we used in our studies was the blind cave crayfish, Orconectes australis packardi Rhoades, 1944. We assumed that blind crayfish learn their environment by both tactile and chemosensory cues. Crayfish primarily move their first pair of antennae (i.e., the antenna) to sample the chemical environment around them, although there are also other chemosensory hairs elsewhere on the body. In stagnant pools within a cave, crayfish can initiate water movement by producing gill currents or by moving through the water in order to better perceive chemosensory cues. In a small pool, the chemical cues may be uniform unless there is a point source of a signal, so chemical signals might not be so informative for the animal to locate its position within the environment. The tactile knowledge of the overall terrain may well provide a blind cave crayfish with information of location, sufficient to allow the animal to be familiar with the local territory. In a novel setting the blind cave crayfish could use a multitude of sensory modalities to gain familiarity. In many animals there is a complexity to learning spatial orientation, which arises by assessing the relative contributions of the different senses (Whishaw, 1998). In order to spatially orientate to the environment, by tactile sense, the animal would need to move over the terrain in which it is to become familiar. This type of sampling is referred to as path integration.

The cave crayfish used in this study inhabit a completely dark cave environment containing streams or pools of water. The cave crayfish, O. a. packardi, has elongated lateral antenna as compared to epigean crayfish. It is likely that this morphological characteristic, which enhances the tactile sense, is a cave-adaptive