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To reunite or not: A study of artificially fragmented *Diacamma indicum* ant colonies

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ABSTRACT

Social insects live together in groups and maintain cohesion to enhance their chances of survival and productivity. Colony cohesion is severely challenged during relocation. We examined the dynamics of colony reunification and the factors affecting nest choice of artificially fragmented colonies of the queenless ant *Diacamma indicum*. None of the twelve undisturbed colonies fragmented or relocated when a good nest was available in their neighbourhood. When colonies were artificially fragmented, they mostly (25/30) reunified into a single nest unlike in randomized time-ordered network models, indicating that reunification is not the result of random recruitment acts. When the reproductive individual was present in a good nest, the colonies reunified at this address. However, when she was present in a suboptimal nest, colonies relocated her to a better quality nest and reunified there, illustrating that quality of the new nest is more important. The work distribution and relocation dynamics of reunification were comparable to intact colonies relocating to a single new nest. This is made possible by enhanced exchange of information among tandem leaders in the form of increased number of tandem runs among them. We conclude that colony cohesion is very important and is maintained after incorporating the risks of relocation and preference for nest quality during decision making.

1. Introduction

Cohesion between individuals of a species to form social groups has been noted in the animal kingdom across a wide range of organisms belonging to different taxa and across a wide range of group sizes (Parrish, 1999; Puckett et al., 2014). Various advantages of maintaining cohesive groups like enhanced protection from predation, increased survival of juveniles, efficient foraging have been found in flocks of birds, shoals of fishes, and swarms of insects (Peeters and Ito, 2001; Wilson, 1990). Further, animals living together in large groups may show new behaviours or functions such as mobbing of predators in some bird flocks (Parrish, 1999) that are not seen when they lead solitary lives. Cohesion operates at a different level in social insect colonies which can range in size from a few individuals to millions of individuals living together as one unit. All members of the colony coordinate their activities and share the work required for survival and raising the next generations (Hölldobler and Wilson, 1990; Wilson, 1990).

While there are many challenges to maintaining colony cohesion among these social insects, it becomes particularly severe when these colonies have to relocate from one nest to another. When colonies of wasps, bees, and ants relocate, they are likely to face the risk of colony fission, leading to decrease in survival among the fragmented subunits and suboptimal fitness for both the reproductives and the workers (Visscher, 2007). Lack of information or coordination in the process of relocation, simultaneous build-up of quorum thresholds at more than one nest option, increased stress levels at the old nest are some of the factors that can cause colonies to fragment. Colony fission has been observed in *Aphaenogaster senilis, Aphaenogaster araneoides and Pogonomyrmex badius* in the context of relocation (Galarza et al., 2012; McGlynn et al., 2004; Tschinkel, 2014). Another context in which colony fragmentation occurs is colony reproduction, particularly in those species that reproduce by means of dependent colony founding (DCF), which involves the division of established colonies into smaller autonomous colonies. This occurs in several species of ants, bees, and wasps. The cases in which a group of nestmates accidentally gets separated from the parent colony but has a reproductive individual within it or is capable of requeening forms a new colony in a phenomenon termed as opportunistic dependent colony founding (Cronin et al., 2013). A few studies have considered the outcomes of orphaned workers in the cases where the fragments lack a reproductive individual. In the African army ant *Dorylus molestus*, when the queen is removed from the colony, the orphaned workers fuse with other queen right colonies (Kronauer et al., 2010). In *Aphaenogaster senilis,* it was

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