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Network approach to understanding the organization of and the consequence of targeted leader removal on an end-oriented task

Sumana Annagiri[a,*], Swetashree Kolay[a], Bishwarup Paul[a], and Chandan Sona[b]

[a]Behaviour & Ecology Lab, Department of Biological Sciences, Indian Institute of Science Education and Research, Kolkata, Mohanpur, West Bengal, 741246, India and [b]Department of Pharmacology, CSIR-CDRI, Jankipurm Vistar, Lucknow, Uttar Pradesh, 226021, India

*Address correspondence to Sumana Annagiri. E-mail: sumana@iiserkol.ac.in.

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Abstract

Relocation is an important event in the lives of several social insects whereby all colony members have to be transferred to a new nest when conditions in the old nest become unfavorable. In the current study, network tools were used to examine the organization of this goal-oriented task in the Indian queenless ant *Diacamma indicum* which relocate their colonies by means of tandem running. Individual ants were used as nodes and tandem runs as directed edges to construct unweighted networks. Network parameters were characterized in control relocations (CRs) and in relocations where the node with the highest outdegree, that is, the Maximum tandem leader (Max TL) was experimentally removed. These were then compared to 1) randomized networks, 2) simulated networks in which Max TL was removed, and 3) simulated networks with removal of a random leader. Not only was there complete recovery of the task, but the manner in which it was organized when Max TL was removed was comparable to CRs. The results obtained from our empirical study were significantly different from the results predicted by simulations of leader removal. At an individual level, the Max TL had a significantly higher outdegree than expected by chance alone and in her absence the substitute Max TL did comparable work. In addition, the position of the Max TL in the pathway of information flow was conserved in control and experimentally manipulated conditions. Understanding the organization of this critical event as more than the sum of individual interactions using network parameters allows us to appreciate the dynamic response of groups to perturbations.

Key words: *Diacamma indicum*, division of labor, networks, relocation, tandem running.

Division of labor is a central theme in the organization of social insect colonies and is thought to be one of the major reasons for their ecological success (Wilson 1985; Robinson 1992). Multiple tasks are performed simultaneously by different groups of individuals within the colony leading to increased efficiency and higher productivity. However, the contributions of individuals involved in the particular task is unequal as few individuals perform most of the task while others contribute very little (Robinson 1992; Gordon 1996; Beshers and Fewell 2001). Hence, it is common to see certain individuals perform a particular task more frequently than others (Robinson and Page 1989). There may be certain members of the colony who influence efficient execution of specific tasks in a variety of ways. These key individuals either perform majority of the work required or impact the functioning of nestmates involved in a task