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A comparative social network analysis of wasp colonies and classrooms: Linking network structure to functioning

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ARTICLE INFO

Article history:
Received 13 December 2007
Received in revised form
3 October 2008
Accepted 6 October 2008
Published on line 26 November 2008

Keywords:
Social insect
Ropalidia
Centrality
Small world

ABSTRACT

A major question in current network science is how to understand the relationship between structure and functioning of real networks. Here we present a comparative network analysis of 48 wasp and 36 human social networks. We have compared the centralisation and small world character of these interaction networks and have studied how these properties change over time. We compared the interaction networks of (1) two congeneric wasp species (*Ropalidia marginata* and *Ropalidia cyathiformis*), (2) the queen-right (with the queen) and queen-less (without the queen) networks of wasps, (3) the four network types obtained by combining (1) and (2) above, and (4) wasp networks with the social networks of children in 36 classrooms. We have found perfect (100%) centralisation in a queen-less wasp colony and nearly perfect centralisation in several other queen-less wasp colonies. Note that the perfectly centralised interaction network is quite unique in the literature of real-world networks. Differences between the interaction networks of the two wasp species are smaller than differences between the networks describing their different colony conditions. Also, the differences between different colony conditions are larger than the differences between wasp and children networks. For example, the structure of queen-right *R. marginata* colonies is more similar to children social networks than to that of their queen-less colonies. We conclude that network architecture depends more on the functioning of the particular community than on taxonomic differences (either between two wasp species or between wasps and humans).

1. Introduction

In recent years, network science has become an important tool for studying complex systems. Both the global topology of whole systems and the local patterns of interactions within them can be characterised by suitable network indices (Estrada, 2007; Scotti et al., 2007). In fact, holistic approaches are now more exact than ever before: we are able to quantify *to what extent* everything is connected to everything else, we have techniques for the identification of critically important nodes in networks and we can quantify and compare the topology (“shape”) of different networks. Network properties help us to

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1476-945X/$ – see front matter
doi:10.1016/j.ecocom.2008.10.004