Structure analysis of niche-overlap graphs

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The joint analysis of the structure and dynamics of complex networks has been recently a common interest for many researchers. In this study, we focus on the structure of ecological networks, specifically on niche-overlap graphs. In these networks, two species are connected if they share at least one prey, and thus represent competition graphs. The aim of this work is to reveal if these graphs show small-world/scale free properties. To answer this question, we select a set of 14 niche-overlap graphs from highly resolved food-webs, and study in the first part their clustering coefficient and diameter.

Interestingly, we observe that all the niche-overlap graphs display a higher clustering than that in random networks (Figure 1). This suggests that species tend to compete entire sets of species that are already themselves competing with each other. However, we find that real niche-overlap graphs display a higher diameter than random webs. The latter result is intriguing, and may arise because there are well-defined competing groups formed according to their specific resources (herbivores and carnivores do not compete), and a lack of omnivores, which would compete with both carnivores and herbivores and hence reduce the network diameter.

In the second part of this study, we investigate the degree distribution. We find that the 14 niche-overlap graphs take the form of single-scale networks characterized by a connectivity distribution with a fast decaying tail. This highlights the absence of hubs (highly connected vertices) in these networks, and shows that species within a community tend to have a similar number of competitors. The study of the characteristics of niche-overlap graphs may therefore reveal general patterns in the evolution of competition and niche overlap.

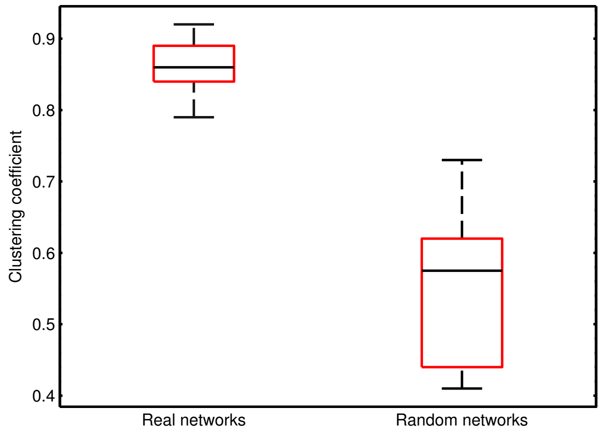

Fig. 1. The two box plots (minimum, quartiles and maximum) illustrate the distribution of the clustering coefficient of real and random networks, respectively. The clustering coefficient is significantly lower in random networks. One hundred random graphs were generated for each observation.