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BETWEENNESS-BASED ATTACKS ON NODES AND EDGES OF FOOD WEBS

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Abstract. Food webs provide a prototype for studying the effects of attacks on complex networks. Instead of the variation of the relative size and average path length of the largest cluster, the loss of species is used to describe the effects of attacks for food webs. Taking the global energy transportation character of food webs into consideration, the node and edge attacks based on betweenness are studied for 14 food webs. The robustness of food webs is defined as the fraction of species that had to be removed in order to result in a total loss of 50% of the species. The results reveal that the betweenness-based attack is more effective than the degree-based attack for most food webs. Moreover, considering the same removal rate of edges, the attacks on edges have better effects than on the nodes.

Keywords. complex network, food web, attack, betweenness, robustness

1 Introduction

Many empirical and theoretical works have led to great advances in our understanding of complex networks [1, 7], including topology, evolution and complex evolution in the networks. All these works are trying to discover the fundamental structure and mechanism of various complex networks. One important problem is the robustness of complex networks under attack, using variation of the relative size and average path length of the largest cluster to describe the effects of attacks. It is found that natural and social networks, ranging from protein-protein interactions [12] to the World Wide Web [3], exhibit a similar characteristic: error tolerance and attack fragility [2, 4-6, 10, 11, 13-15].

Besides the effects of attacks on the connectivity of networks, the attacks aimed at the functions or the processes taking place on the networks is also an interesting and important problem. In this kind of research, food webs provide a nice prototype. Food webs represent a very important 'gastronomic' aspect of relationships between species in ecosystems, and have recently come under scrutiny as complex networks. In such a web, nodes are species in an