

Species co-occurrence networks Can they reveal trophic and non-trophic interactions in ecological communities

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Abstract

Co-occurrence methods are increasingly utilized in ecology to infer networks of species interactions where detailed knowledge based on empirical studies is difficult to obtain. Their use is particularly common, but not restricted to, microbial networks constructed from metagenomic analyses. In this study, we test the efficacy of this procedure by comparing an inferred network constructed using spatially intensive co-occurrence data from the rocky intertidal zone in central Chile to a well-resolved, empirically based, species interaction network from the same region. We evaluated the overlap in the information provided by each network and the extent to which there is a bias for co-occurrence data to better detect known trophic or non-trophic, positive or negative interactions. We found a poor correspondence between the co-occurrence network and the known species interactions with overall sensitivity (probability of true link detection) equal to 0.469, and specificity (true non-interaction) equal to 0.527. The ability to detect interactions varied with interaction type. Positive non-trophic interactions such as commensalism and facilitation were detected at the highest rates. These results demonstrate that co-occurrence networks do not represent classical ecological networks in which interactions are defined by direct observations or experimental manipulations. Co-occurrence networks provide information about the joint spatial effects of environmental conditions, recruitment, and, to some extent, biotic interactions, and among the latter, they tend to better detect niche-expanding positive non-trophic interactions. Detection of links (sensitivity or specificity) was not higher for well-known intertidal keystone species than for the rest of consumers in the community. Thus, as observed in previous empirical and theoretical studies, patterns of interactions in co-occurrence networks must be interpreted with caution, especially when extending interaction-based ecological theory to interpret network variability and stability. Co-occurrence networks may be particularly valuable for analysis of community dynamics that blends interactions and environment, rather than pairwise interactions alone..

Keywords

Anthropogenic impacts, Co-occurrence, Ecological networks, Food webs, Intertidal, Keystone species, Non-trophic interactions, Species interactions.