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Regular Article

# APPLYING COMMUNITY STRUCTURE ANALYSIS TO ECOSYSTEM FUNCTION: EXAMPLES FROM POLLINATION AND CARBON STORAGE

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Human enterprise is increasingly affecting biodiversity beyond outright species losses, causing changes in ecosystem functions and the services they deliver to human beings. However, few tools are available to analyze how community attributes other than simple species richness affect ecosystem functioning, or how relative contribution to the function is distributed among the species within a community. Here, we adapted methods for describing the evenness in relative abundance among species (i.e., community structure) to the description of the evenness in species' relative contribution to ecosystem function (i.e., functional structure). We developed graphical approaches to: (1) describe the functional structure, (2) show the relationship between community and functional structures, (3) examine the influence of species identity on ecosystem function, and the relationship between species' relative functional contribution and relative abundance, and (4) determine the effects of management on the total magnitude of ecosystem function, on community and functional structures, and on individual species' contribution to the function.

We applied these methods to two contrasting ecosystem function cases: watermelon pollination by native bees in California and carbon storage in trees of a tropical humid forest in Chiapas, Mexico. Functional structure for pollination under organic management within a conserved forest matrix showed that the first two species contributed 80% of the function. Increasingly intensive management (e.g., conventional agriculture) caused the loss of 60% of the species, reductions in abundance of functionally important species, loss of 60–80% of the pollination function, and decreased evenness in functional structure. Functional structure for carbon storage of a conserved forest showed that 13% of species contributed 90% of the function. Forest under a hypothetical scenario of selective timber extraction showed a loss of 60% of carbon storage, no species loss, and an increase in evenness of the species' contribution to the function. Compared to conserved forest, secondary forests shared only 17% of species, 80% less carbon storage, but similar evenness of species' contribution to this function.

Overall, the tools developed here, and their applications, show that impacts of management regimes on functional structure vary with the analyzed function and ecosystem, differentially affecting species richness, species composition, dominance of the first-ranked species, evenness in species' functionality, and potentially the stability of the function itself.

Keywords: biodiversity conservation, community structure, carbon storage, crop pollination, diversity–function, dominance–diversity curves, ecosystem function, ecosystem service, indicator species, management, species richness

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