Functional richness and ecosystem services: bird predation on arthropods in tropical agroecosystems

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In agroecosystems, biodiversity correlates with ecosystem function, yet mechanisms driving these relationships are often unknown. Examining traits and functional classifications of organisms providing ecosystem functions may provide insight into the mechanisms. Birds are important predators of insects, including pests. However, biological simplification of agroforests may decrease provisioning of this pest removal service by reducing bird taxonomic and functional diversity. A recent meta-analysis of bird exclosure studies from a range of agroecosystems in Central America concluded that higher bird richness is associated with significantly greater arthropod pest removal service by reducing bird taxonomic and functional diversity. However, no functional classification predicted arthropod removal better than simple species richness; thus other factors may be important. Our analysis indicates that the sampling effect may also play a role, as other metrics of functional diversity (FD and Rao’s Q) were better predictors of arthropod reduction than this ecosystem function. The predictive ability of functional classifications increased with the number of traits included in the classification. For the two best classifications examined, functional group richness was a better predictor of arthropod reduction than functional group complementarity in tropical agroforests. We classified birds according to relevant traits (body mass, foraging strategy, foraging strata, and diet) and then examined how design of functional classification, including trait selection, classification methods, and the functional diversity metric used affect the suitability of different classifications as predictors of ecosystem services. We determined that vegetation characteristics are not likely drivers of arthropod removal by birds. For some functional classifications, functional richness positively correlated with arthropod removal, indicating that species complementarity may be an important mechanism behind this ecosystem function. The predictive ability of functional classifications increased with the number of traits included in the classification. For the two best classifications examined, functional group richness was a better predictor of arthropod removal than other metrics of functional diversity (FD and Rao’s Q). However, no functional classification predicted arthropod removal better than simple species richness; thus other factors may be important. Our analysis indicates that the sampling effect may also play a role, as one species and two functional groups were responsible for disproportionate effects of arthropod removal.

Keywords: agroforest, biodiversity, birds, Central America, ecosystem function, exclosure experiment, functional richness, insects, meta-analysis, predation, species complementarity, species trait

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