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Investigating the role of farmland birds in complex ecological networks

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Birds provide important ecological functions such as seed dispersal, pollination, consumption of carrion, and predation on vertebrates and invertebrates. Many of these functions (such as insect pest control) can be considered as ecosystem services as they directly benefit mankind. Currently, a significant proportion of bird species worldwide are threatened with extinction. We are only just beginning to understand the ecological and societal consequences of bird declines in terms of ecosystem services. Indeed, some species are already functionally extinct and contribute negligibly to ecosystem processes.

According to the UK National Ecosystem Assessment, the economic benefits of nature are seen most clearly in food production, which depends on organisms such as soil microbes, earthworms and pollinating insects. Farmland birds (which have declined significantly in recent decades) also have an important functional role, although traditionally ecologists have regarded them mainly as bioindicators of environmental change. But despite knowing much about the autoecology of many bird species, we know little about the direct and indirect ways in which birds interact with species across trophic levels and within entire ecosystems. Ecological networks describe the interactions between species, the underlying structure of communities and the function and stability of ecosystems. Thus, they have considerable potential for quantifying the effects of human activities on a wide range of complex ecological interactions and ecosystem services.

In this paper, we discuss how recent advances in our understanding of qualitative and quantitative ecological networks can be applied to the study of ecosystem services provided by birds. We present data from an intensive 3-year study of species interactions on an organic farm in SW England – the Norwood Farm network. This comprised 1501 quantified unique interactions between a total of 560 taxa, including plants and 11 groups of animals: those feeding on plants (butterflies and other flower visitors, aphids, seed-feeding insects, and granivorous birds and mammals) and their dependants (primary and secondary aphid parasitoids, leaf miner parasitoids, parasitoids of seed-feeding insects and rodent ectoparasites). Here, we focus on the sub-components of the Norwood Farm network that involves feeding interactions between farmland birds and seeds and the ecosystem service of avian seed dispersal. We then consider bird interactions in the context of the overall network.

First, we show the importance of over 120 seed species as a source of food for over 50 species of birds within the network. However, the overwhelming majority of seed-feeding animals identified within the network were invertebrates (82%) relying predominantly on non-crop and weed species. Second, we present data on the structure of our quantitative bird–seed dispersal network and show that a diverse (and sometimes surprising) range of birds present on the farm disperse an equally diverse range of seed species. Finally, we consider the ‘robustness’ of the networks to species loss and show that the robustness of linked networks in an agroecosystem varies but does not co-vary. In other words, targeting one guild of animals for conservation or restoration purposes (such as insect pollinators) will not inevitably benefit others (such as birds).