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# A Bayesian hierarchical model to estimate natural enemies' movements between hedgerow and apple orchard based on immunological marking.

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## Abstract

Hedgerows are agro-ecological infrastructures assumed to favor natural enemies, but movement of arthropods from hedgerows to crops remains poorly understood. Such movements were analyzed in spring in 11 commercial apple orchards whose hedgerows were sprayed with egg white to mark arthropods. Canopy and ground arthropods were captured by beating and pitfall traps within the orchards and the hedgerows three times within the 13 days following the spraying. Arthropods' marking was assessed with ELISA: 18% of the 1272 captured arthropods were marked by the egg protein. Abundant predators captured included canopy spiders, lacewigs and earwigs; ground spiders and carabid beetles. The location (hedgerow or orchard) and the date of capture of marked and unmarked arthropods were analyzed using a Bayesian hierarchical model in order to estimate habitat preference and frequency of movements between the two habitats. The model included covariates describing orchard management and hedgerow composition and structure. Frequent bi-directional spillover between the hedgerow and the orchard were found for some canopy arthropods (among which spiders and lacewings) while other canopy arthropods (one spider and earwigs) preferred the hedgerow to the orchard and showed little spillover from the hedgerow to the orchard. Further, for these latter taxa, the amount of spillover depended on hedgerow and orchard characteristics. The most abundant ground spider and carabid beetle preferred the orchard

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habitat. These results indicate that hedgerows should be preserved along orchards since they act as a complementary habitat for many canopy arthropods that are predators of orchard pests.

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