Bumble bee colony density and foraging distance in relation to agricultural landscape simplification

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1 Abstract

Agricultural landscapes represent a mosaic of disturbance regimes, where land use types vary in their ability to provision nesting and floral resources for pollinators and other insects. For highly-mobile organisms like bumble bees, resource distribution is believed to be a major driver of foraging distance, duration, and profitability. Land cover configuration and quality may influence both foraging behaviour and effective population size, with repercussions for wild plant/crop pollination and bumble bee conservation. Specifically, if landscape-scale simplification of agricultural environments (e.g., increased field sizes, reduced crop diversity, and removal of non-crop vegetation along field margins) drives increased foraging distance to meet colony nutritional demands, this could lead to reduced foraging profitability and lower colony- or population-level persistence. Alternatively, if structural connectivity is a key factor in facilitating bumble bee movement, landscape simplification could result in reduced foraging distance due to challenges navigating the matrix between suitable habitat patches. To test these hypotheses, we captured and microsatellite-genotyped bumble bee workers of two species (*Bombus mixtus* and *B. impatiens*) in six replicate landscapes across an agricultural region of southwestern British Columbia, Canada. We developed fine-scale landcover rasters to assess the configurational diversity and density of unmanaged or enhanced field margins within each landscape. Using these datasets we will fit spatially explicit genetic capture-recapture models to assess the effects of two landscape metrics (edge density and patch-type interspersion) on colony abundance and foraging distance of each species. By leveraging our two-year, multi-timepoint dataset, we will also assess allelic and colony lineage turnover both within and between years. Finally, we will make comparisons between a common but understudied native species (*B. mixtus*) and its invasive relative (*B. impatiens*) to determine whether differential responses to landscape characteristics may be

facilitating the rapid spread of *B. impatiens* outside its native range. Our work will provide insights for pollinator movement ecology in anthropogenically disturbed landscapes, while also deepening our understanding of how these systems may influence species invasions.