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Effects of environmental, landscape, and disturbance gradients on native bee diversity, abundance and composition in the Canadian Prairies

21 September 2017, 10AM
BioSci CW410

Native bees provide pollination services to a range of crops, supporting food production and the global economy. They also support the fitness of native flowering plants and terrestrial plant diversity. These functions are delivered by a diverse community of bees with a broad spectrum of life history traits. Recent evidence indicates that many native bee species are in decline as a result of the cumulative effects of multiple human-induced stressors, such as habitat loss, pesticide exposure, disease, and climate change. These declines have raised interest in the status and trends of bee communities over time, and in tools that support management of bee communities and the services they deliver. Here, I use a two-year inventory of native bees from a large geographic area of the Canadian prairies to evaluate patterns in bee communities along ecological and disturbance gradients. First, I evaluate the effects of two land use types—canola fields and rangelands—on native bee abundance, richness, diversity, and composition, across three ecological regions. Secondly, I evaluate response of bee abundance, diversity, richness, evenness, and composition to the proportion of undisturbed grassland habitat and surrounding landscape heterogeneity at three spatial scales. Composition of bee communities was different between canola fields and rangelands, with several species of cavity-nesting bees strongly associated with rangelands. I found evidence for clear differences in bee abundance and composition across ecoregions, with more abundant and unique bee community assemblages in the southern Grassland ecoregion—a pattern that is likely driven by differences in climate. Both the proportion of undisturbed grassland habitat and the heterogeneity of the landscape surrounding a site had positive impacts on bee richness and community evenness. However, not all bees responded consistently to these variables. Bumble bees, which are often resource generalists, were more abundant in more heterogeneous landscapes, and less abundant in landscapes with higher amounts of grassland cover, while Megachilid bees, a group of typically cavity-nesting bees, showed the opposite response. These results present clear evidence of linkages between environmental, disturbance, and landscape gradients and bee communities. Of note is the tendency for different groups of bees to differ in their response patterns based on nesting strategy. This survey is one of the first to sample the complete bee community and its response to landscape disturbance across a broad spatial area of the prairies.