The nutritional ecology structuring bee-flower communities in the sierra and sagebrush and implications for conservation

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Topic: Pollinator considerations in natural areas management
Proposal Type: Individual Presentation

Abstract:
Understanding the nutritional drivers of bee-flower interactions is crucial to the conservation of native plants and pollinators. Pollen provides the primary source of protein and lipids necessary for bee development and reproduction. Yet, pollen nutrient composition differs widely among plant species, requiring diverse communities to provide a spectrum of nutrient rewards to support the bee community. Our previous research indicated that pollen protein:lipid ratios (P:L) shape bumble bee host-plant choice. Different bee species may have species-specific P:L nutritional needs driving their own foraging patterns. Therefore, pollen nutrition may shape bee-flower interactions and drive community stability. To understand how nutrition structures communities, we assessed pollen nutrient concentrations among co-flowering plant species in Sierra Nevada meadow and Great Basin sagebrush steppe habitats. We systematically sampled pollen-collecting bee species to create bee-flower visitation networks, and collected bees' pollen loads to analyze their nutritional foraging targets. We determined the relationship between plant species' pollen P:L and diversity of their bee visitors, and whether plants that shared bee visitors offered similar or dissimilar/complementary nutrition. Likewise, we asked if bees differ in P:L targets, and if species collecting similar pollen nutrients share host-plants. In the Sierra Nevada meadow (sagebrush steppe analysis in process), co-flowering plant species varied substantially in pollen nutrition, forming a wide spectrum of P:L values. Specialized plants, with the lowest diversity of visitors, offered the highest (and lowest) P:L values; and bee species diversity was highest on host-plants offering mid-range pollen P:L ratios. Correlating visitor and nutritional similarity, we found that plants with similar P:L ratios did not tend to share visitors, yet bees with similar nutritional targets overlapped in pollen host-plants. This offers new insight into how bees may achieve preferred nutrition by combining visits to plants offering complementary P:L ratios. For example, by collecting pollen from different host-plant species, related bee species within the genera Bombus and Calliopsis collect different pollen P:L ratios. This may indicate that bee species reduce competition by having different nutritional targets, collecting from different host-plant species at different frequencies, and emphasizing the need of diversity for sustainable populations. This study presents a novel approach to understanding fundamental nutritional factors that assemble bee-flower communities across varying environments. Our new framework can be used to identify key host-plants to enhance and complete deficient nutritional landscapes, providing quality forage for bee communities and facilitating their population stability.

Wild bee diversity increases following a bark beetle outbreak in a Douglas-fir forest

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Abstract:
Authors and affiliations: Gabriel G. Foote (1,6,7), Nathaniel E. Foote (2), Justin B. Runyon (3), Darrell W. Ross (1,4) , Christopher J. Fettig (5). 1 Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331, 2 Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523, 3 Rocky Mountain Research Station, USDA Forest Service, 1648 South 7th Street, Bozeman, MT 59717, 4 Present address: Department of Entomology, University of North Dakota, Fargo, ND 58108, 5 Pacific Southwest Research Station, USDA Forest Service, 1731 Research Park Drive, Davis, CA 95618, 6Present address: Department of Entomology and Nematology, University of California, Davis, Davis, CA 95616, and 7 Corresponding author, email: gfoote@ucdavis.edu. Abstract: Wild bees (Hymenoptera: Apiformes) provide essential pollination services to the majority of flowering plant species in forest ecosystems. However, knowledge is lacking regarding the effects of disturbances, such as insect outbreaks, on resident bee community assemblages. To assess the early responses of bees to bark beetle disturbance, the bee community of a Douglas-fir, Pseudotsuga menziesii (Mirb.), forest in western Idaho, USA was sampled during a Douglas-fir beetle, Dendroctonus pseudotsugae Hopkins (DFB), outbreak beginning in summer 2016. The area was re-sampled in summer 2018 following reductions in forest canopy cover resulting from mortality of dominant and co-dominant Douglas-fir. Overall, results from repeated measures ANOVA showed a significant increase in bee abundance, richness, and diversity (Shannon's H) in 2018 compared to 2016. Logistic regression analyses revealed percent tree mortality from DFB was positively correlated with increases in total bee abundance and species richness, where community response variables displayed a cubic trend with percent tree mortality. Percent reduction in canopy cover from 2016 to 2018 was also correlated with bee species richness and diversity. These findings suggest that wild bee communities may benefit from changes in forest structure following bark beetle outbreaks.

Nectar Resources in Oak Savanna Pollinator Habitats

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Abstract:
Nectar quality is an important resource to consider for restoring habitats for butterfly conservation. Literature shows that butterflies with diets rich in sugars or amino acids often have improved fecundity, longevity, and increased lifetime fitness, but most habitat assessments only consider host plants and flowering stem counts when evaluating habitats for pollinators. The Karner blue is a bivoltine butterfly listed as federally endangered since 1992 with varying reintroduction success. The aim of this study was to examine nectar quality characteristics of oak savanna forbs in Karner blue butterfly habitats and quantify the variation in nectar sugar resource availability during each flight period. Using existing data on flowering plant density, we measured floral availability, nectar volume, and sugar concentration to estimate nectar resources across 16 sites in Ohio and Michigan. We found that nectar resources per flower were influenced by relative humidity and species present. Nectar sugar availability on the landscape varied with site, season, and species present. Analyses revealed a difference in sugar available per quadrat between seasons among sites with a history of occupation and former release sites no longer occupied. These data on the species-specific characteristics and temporal variation in nectar resources will aid habitat restoration planning and benefit conservation efforts for nectar feeding pollinators of this critically imperiled habitat. Co-author: Ryan Walsh, The Toledo Zoo, Toledo, OH