Pollinator considerations in natural areas management

Nectar Resources in Oak Savanna Pollinator Habitats

Topic: Pollinator considerations in natural areas management

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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

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

Topic: Pollinator considerations in natural areas management

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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

Topic: Pollinator considerations in natural areas management

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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.

Invasive species management - new and effective approaches

A Comprehensive Method for Detecting and Controlling Angiopteris evecta in Inaccessible Terrain on O'ahu, Hawaii.

Topic: Invasive species management - new and effective approaches

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Angiopteris?evecta?is an invasive tropical fern that has negatively impacted O'ahu's??ecosystems by displacing and outcompeting native species. ?Many of O'ahu's intact wet forests are located in remote areas with steep terrain that is often inaccessible to humans. They are diversity rich and being overrun by A. evecta. The State of Hawaii Division of Forestry and Wildlife Native Ecosystem Protection and Management Section (DOFAW-NEPM) is tasked with protecting many of the ecological resources in these areas. In collaboration with public and private partnerships new approaches including aerial imagery, precision helicopter herbicide application, and GIS mapping are being used to combat this highly invasive species. These new approaches have increased safety for ground crews and the efficiency of surveying large inaccessible tracts of land. Precision helicopter spraying has enabled us to control remote and dense patches that act as a reservoir for newly emerging plants. With the continued collaborative effort of our partners, DOFAW-NEPM hopes to bring populations of A. evecta to a manageable threshold and ultimately remove it from areas with high conservation potential. ?

Can mastication and prescribed burning be applied to simultaneously reduce fuels and control invasive plants?

Topic: Invasive species management - new and effective approaches

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Over the past 20 years, managers of public lands in the western United States have witnessed an explosive spread of the highly invasive annual grass medusahead (Elymus caput-medusae). Traditional control methods (e.g. manual removal, herbicide application, prescribed burning) developed for rangeland applications may differ when applied to dry mixed conifer forests where land managers must balance fuel reduction goals with invasive plant control objectives. We implemented a small-scale, replicated field trial to investigate the effect of high intensity prescribed fire and treatment timing on medusahead abundance. We then applied these findings to a larger spatial scale, by designing an experimental fuel reduction treatment that had the dual purpose of lowering fuel loads and reducing medusahead abundance. The specific purpose was to investigate how some of the methods commonly used in landscape-scale fuel management, specifically mastication and prescribed fire, influence the frequency and cover of medusahead over both short (1-year) and long (10-year) time periods. The application of high intensity fire, regardless of timing, reduced the percent cover of medusahead at small scales. At larger scales, mastication and prescribed fire treatments significantly reduced the frequency of medusahead in the first year following treatment. However, in the absence of follow-up treatments medusahead increased over time, and ultimately had higher abundance than prior to treatment. These findings suggest that while some treatments may be effective at small spatial scales and over short timeframes, the variable effects often seen in prescribed fire treatments applied at larger scales can facilitate dispersal of medusahead into newly treated areas over the long term.
(Authors include: Ryan Tompkins, UC Cooperative Extension;
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Jim Belsher-Howe, USDA Forest Service, Plumas National Forest)

Nevada Department of Wildlife's Approach to Prevention and Containment of Dreissenid Mussels

Topic: Invasive species management - new and effective approaches

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Nevada Department of Wildlife

Nevada has been affected by a number of significant invasive species in recent decades, but none more devastating than the quagga mussel (Dreissena rostriformis bugensis). The 2007 discovery of quagga mussels in Lake Mead catapulted the west and Nevada into action. Watercraft inspection programs have been the primary focus in containing regional mussel populations on the lower Colorado River system and preventing their expansion throughout the State of Nevada. With no viable eradication measures available, containment and prevention are our only options. A brief overview of the watercraft inspection program will show case NDOW's efforts to combat this prolific invader.

Restoration of Invasive Annual Grass Degraded Landscapes: Overview of the Indaziflam Field Trial Program

Topic: Invasive species management - new and effective approaches

Harry Quicke
Bayer

Western natural areas and rangeland are undergoing catastrophic degradation through invasion of annual grasses such as downy brome (Bromus tectorum), ventenata (Ventenata dubia), medusahead (Taeniatherum caput-medusae) and red brome (Bromus rubens). These grasses compete directly with desirable vegetation for water, nutrients and sunlight. They complete their life cycles from late spring into summer, turning brown and adding fine fuels at the exact time that wildfire risk increases. The result is increased fire frequency and size with impacts that can include societal disruption, health effects from smoke, destruction of infrastructure and degraded habitat for wildlife and livestock. Additionally, the increased fire frequency can prevent desirable perennial grass, forb and shrub species from recolonizing, resulting in invasive grass dominated landscapes. There is an urgent need to slow the spread of invasive annual grasses and to restore degraded areas. Starting in 2015, multiple university researchers installed trials to investigate the use of indaziflam to restore landscapes through control of annual grasses. Trials included the major invasive grass species and covered multiple levels of annual grass infestation. Results showed that a single application of indaziflam herbicide resulted in multiple years of annual grass control, often with rapid biomass increases of desirable perennial species. This provides a new opportunity to start depleting annual invasive grass seedbanks and restore and protect intact desirable habitats. Additionally, indaziflam is a new site of action for annual grass control (Group 29 Cellulose biosynthesis inhibitor) that can mitigate herbicide resistance pressure resulting from current over reliance on Group 2 Acetolactate synthesis inhibitors.

Successes and Failures, Ten Years of Managing the First Predator Fence in Hawaii

Topic: Invasive species management - new and effective approaches

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Kaena Point, located on the westernmost tip of Oahu, is one of the last intact sand dune ecosystems in the main Hawaiian Islands. It is currently managed by the State of Hawaii's Division of Forestry and Wildlife as a part of the Natural Area Reserve System. In 2010, a predator-proof fence was constructed to establish Kaena NAR as the first predator-free reserve in Hawaii. Eliminating predators from the 20-hectare reserve, while challenging, has allowed Laysan albatross and Wedgetail shearwater populations to flourish, as well as a host of native plant species. The reserve is also being used as an introduction site for black-footed albatross, to mitigate effects of sea level rise due to climate change, as well as a recovery site for Hawaiian yellow-faced bees, an endangered species endemic to Hawaii. However, constructing a metal fence with exact specifications in a coastal area with high winds, salt air and high waves has proven difficult and costly to maintain. Additionally, complications with rodenticide labelling and permitting has led to gaps in rodent control efforts. Management strategies had to be developed to mitigate these issues, including improved fence hardware, diversifying trap and bait types, bait deployment, and rodent tracking tools. This presentation will discuss the successes and difficulties met over the last ten years of management at Kaena Point since the construction of the predator-proof fence.

Rare species management

Coastal Swamp-Cedar Regeneration 14-Years Post-Hurricane Katrina

Topic: Rare species management

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Coauthors: Dr. Joshua J. Granger, Dr. Sandra B. Correa, Dr. Courtney M. Siegert, Dr. Janice L. DuBien

The number and severity of hurricanes in the Gulf Coast are increasing, resulting in intensified disturbance to coastal forest communities. Coastal swamp-cedar (Chamaecyparis thyoides (L.) B.S.P.) grows no further than one hundred miles from the coast, making the species and associated plant communities particularly vulnerable to large-scale disturbances such as hurricanes. Occurring primarily along the Atlantic Coast from Maine to Florida, this species does form isolated communities along the Gulf Coast regions of Florida, Alabama, and Mississippi. Coastal swamp-cedar is imperiled and at risk of extirpation by extreme weather events, altered disturbance regimes, changes in hydrology, and management. The primary objective of this study was to evaluate the recovery of coastal swamp-cedar 14-years post-Hurricane Katrina. Pre and post- Hurricane Katrina data were compared with recent data to determine how Southern Mississippi's coastal swamp-cedar has recovered post-Hurricane Katrina. All coastal swamp-cedar ? 2.5 cm at breast height (1.37 m) were inventoried within a ~4.85 ha study area located within Grand Bay National Wildlife Refuge, Jackson County, Mississippi. This inventory was compared with data obtained after Hurricane Katrina in 2005 to evaluate the long-term impacts of hurricanes on the stand density for this species. Following the 2005 hurricane, coastal swamp-cedar has increased in density across the study site. This increase was spatially correlated with wind damaged and toppled trees previously recorded within this population just after the hurricane. The structural changes caused by the hurricane disturbance supported the regeneration of this imperiled species. Understanding the long-term recovery of coastal swamp-cedar allows land managers and conservationists to more effectively manage for the species on the landscape.

Demographic evaluation of the federally endangered Florida goldenaster (Chrysopsis floridana) in Florida scrub

Topic: Rare species management

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The composite genus Chrysopsis includes 14 Florida taxa; one species, Florida goldenaster (Chrysopsis floridana), is federally endangered and endemic to west-central Florida. C. floridana is a perennial herb occurring in xeric upland Florida scrub habitat; it was federally listed in 1986. Subsequent discoveries and translocations increased the number of known populations to 40, with numerous introduced populations now occurring on conservation lands. In the fall of 2017-2019, we followed populations of 18 wild and introduced populations of C. floridana across five counties, using both stage-class and level-3 demographic monitoring. Annual survival rates were higher in introduced compared to wild populations, with approximately 11% and 12% higher survival through 2018 and 2019, respectively. Recruitment and fecundity rates were also higher, with introduced populations producing approximately 18-19% more seedlings annually than wild populations and significantly more flowering heads per reproductive plant. Overall, populations were stable at introduction sites, but decreasing at wild populations, perhaps owing to management or site differences. While occasional burning may have helped to maintain beneficial open conditions for some populations, aggressive mechanical treatments caused others to decline within the short duration of this study. However, it is still unclear how management impacts C. floridana populations over longer durations.

Environmental conditions and disturbance drive whitebark pine community characteristics in the intermountain west, USA

Topic: Rare species management

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Upper-elevation whitebark pine (Pinus albicaulis) forests are experiencing widespread decline and mortality across their extensive range in western North America. Causes are complex and driven by sometimes interacting factors including infection from non-native white pine blister rust (Cronartium ribicola), outbreaks from native bark beetles, and seral competitive exclusion by other native tree species. To investigate the forest health condition of whitebark pine stands in the northern intermountain region of the western US, we collected forest composition, health, and structural data across 63 plots in 2017. With these data we identified forest structural community types using a hierarchical cluster analysis and investigated patterns in forest community structure using ordination and environmental gradient analysis. Overall, whitebark pine continues to be present in the understory and overstory of forest stands across our regional network of plots. Forest community types and species size class abundances significantly aligned with topographic and climatic variables. Climax whitebark pine stands occurred on higher elevation sites with longer growing seasons while seral whitebark pine stands occurred on more northerly sites with subalpine fir (Abies lasiocarpa) competing well on sites with greater water availability and lodgepole pine (Pinus contorta) competing well at lower elevations. Surprisingly, stands experiencing loss of overstory trees and low seedling recruitment were not predicted well by topographic and climatic gradients, but instead were driven by fire, mountain pine beetle, and white pine blister rust disturbance. White pine blister rust and mountain pine beetle occurred most frequently in stands with the greatest whitebark pine abundances; however, proportional severity was greatest in stands with lower whitebark pine abundances. Stands with the greatest abundance of lodgepole pine in the understory coincided with heightened occurrence of fire and bark beetles. Understanding the patterns and drivers of forest composition and tree mortality rates is critical for the management of forest ecosystems and the conservation of species and ecological communities.

Oligarchy and Rareness in Large-scale Forest Inventories; Identifying and Managing for Vulnerable Species

Topic: Rare species management

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Oligarchy is a common trait of forest stands in the eastern USA. It is evident in forest inventory stand tables of large-scale forest inventories, areas the size of individual states or larger. The degree of forest stand oligarchy is variable and is the result of a complex set of factors arising from competition, disturbance, and species characteristics. In contrast to oligarchy, these types of large-scale forest inventories are also useful in identifying rare tree species. Rare may be defined either spatially or in regard to a proportion of the total population of tree species. A general premise of rareness is that these particular species populations are vulnerable to environmental and/or anthropogenic fluctuations because of their small numbers, thus lessening the probability of survival and prompting the need for possible protective measures. I used data from the USDA Forest Service, Forest Inventory and Analysis (FIA) program to study oligarchy and rareness patterns of tree species in Arkansas. In the 2015 forest inventory 114,872 trees were tallied on 5600 plots representing 109 species. One species, Pinus taeda L., (an oligarch) accounted for 25 percent of all trees tallied. In contrast, 22 species (rare) only occurred 5 times or less in the tally. Because of the low frequency of rare species in a probabilistic sample, statistical parameters are weaker. However, baseline information can be established allowing for stronger follow-up stratified sampling. Establishing and defining specific levels of rareness may be difficult but conservationists might find large-scale forest inventories useful in monitoring changes in rareness. Changes in degrees of rareness in repeated samples over time could be used as alerts in modifying forest management practices in respective states to protect vulnerable tree species.

Quantifying the relationship between soil seed bank and plant community assemblage in Ivesiawebberi A. Gray populations

Topic: Rare species management

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The soil seed bank is an important ecosystem component that can be pivotal for long-term persistence of many plant species. However, many Great Basin Desert perennials invest in clonal regeneration at the expense of seed production, which could limit the importance of their soil seed banks for species persistence. Furthermore, large areas of the Great Basin are currently invaded by alien weeds. Therefore, this study evaluates the relationship between the aboveground flora and the soil seed bank in 10 sites containing populations of the federally-threatened perennial forb Ivesia webberi. We used redundancy analysis, multiple regression on distance matrices, and variation partitioning to quantify the relationship between the aboveground flora and the soil seed bank, accounting for the effects of spatial processes and environmental variables describing the climatic and site conditions in the 10 studied sites. Findings reveal high dissimilarity in species assemblage and abundance between the aboveground plant communities and the soil seed bank. This is largely driven by the abundance of invasive alien weeds that are prevalent in the seed bank. The majority of the dominating native plants sampled in the standing vegetation were absent in the soil seed bank, suggesting high seedling mortality, possibly exacerbated by the competitive effects of invasive weeds. Overall, the plant community structure in the sampled sites is influenced by climatic factors, while floristic dissimilarity between the standing vegetation and the soil seed bank may be due to the abundance of invasive weeds. This indicates low resilience and high risk of native species loss following perturbation. Post-disturbance succession in these plant communities will be largely dominated by invasive annual species, and therefore native plant seeding may be necessary to sustain the ecological legacies of the desert ecosystem.

Reintroduction of American Burying Beetle (Nicrophorus americanus) in Missouri

Topic: Rare species management

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The American Burying Beetle (Coleoptera: Silphidae) was federally-listed in 1989 and was historically known from a wide range of habitat across Missouri. Extensive surveys failed to find any extant populations, and captive rearing was begun by the St Louis Zoo in 2004. Mated pairs have been released with food source on Wah-Kon-T'ah Prairie in St Clair County since 2012. 3 years of mark-recapture study were undertaken to assess reintroduction success. Populations while reintroduction occurred peaked at 144+/- 11 individuals. After moving reintroduction sites, the population in the core area dropped to 45 +/- 7 individuals, though it is unclear the driving factor of this decline. Occupancy of the landscape was concentrated on high ridges throughout the prairie in low years, although the population occupied a much larger portion of the landscape in good year. Dispersal was documented to nearby protected sites over the course of the project, with the farthest site being 7 miles form the reintroduction site. Management for the species may require sustained reintroductions in Missouri, and carrion resources on the landscape may be an impeding factor to long-term establishment.