

## COMMUNITY ECOLOGY

*Poster abstracts*

### THE EFFECTS OF SOURCE POPULATION SIZE ON THE PERFORMANCE OF PRAIRIE PLANTS

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Midwest tallgrass prairies have suffered extensive habitat loss and as a result remain isolated and highly fragmented. In these small, isolated populations, genetic drift and inbreeding depression can lead to a loss of heterozygosity over time. Reduced genetic variation is often associated with reduced levels of growth, survival, and reproduction as well as increased susceptibility to stress. This study examined fitness traits including seed weight and total reproductive output, of six common species in central Illinois prairie fragments one to five acres in size, to determine whether plants in small fragmented populations had reduced fitness compared to those in larger populations. Analysis of variance showed that there was significant reduction in seed size, total reproductive biomass, or number of flowering stems between plants in small and large populations in five of the species analyzed. A second goal of the study will be to determine within a prairie restoration setting whether plant performance is affected by the size of the source population. When locally adapted genotypes are used, seed sources for prairie plants are often restricted to small, isolated populations. If seed collections from small remnants lead to unsustainable or weak populations, restoration methodologies should be altered to address this.

*Key words: isolated population, fragmented, prairie, plant.*

### ALTERATION OF FINE PARTICULATE ORGANIC MATTER AVAILABILITY AND QUALITY BY CRAYFISH

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As omnivores, crayfish play diverse roles in stream ecosystems. For example, crayfish predation and herbivory can directly and indirectly affect invertebrate and fish populations. Crayfish can also be detritivorous, shredding and consuming particulate organic matter, potentially influencing fine particulate organic matter (FPOM) availability. FPOM is consumed by a wide variety of organisms (e.g., collector-gatherers) and crayfish may indirectly affect these organisms by altering FPOM bioavailability through organic matter fragmentation and fecal discharge associated with foraging. To assess how coarse particulate organic matter (CPOM) processing by crayfish affects FPOM availability and quality, we allowed crayfish to feed on either one or three stream-conditioned maple leaves in hanging 1-mm mesh-bottom baskets in aquaria. After 12 h, crayfish and remaining CPOM were removed from each basket. FPOM fragments that had fallen through the mesh were vacuum filtered and analyzed for ash free dry weight (AFDW) and C:N ratio. Crayfish feces were collected separately using a finger cot that encased crayfish abdomens during the experiment. Average percent ash of fragmented FPOM was 60% lower

than for unprocessed CPOM. C:N ratios in the three-leaf treatment differed significantly among FPOM types and CPOM ( $P = 0.0004$ ; CPOM > Feces > FPOM fragments). In contrast, C:N ratios in the one-leaf treatment did not differ between FPOM fragments and CPOM, but were lower for crayfish feces ( $P = 0.0012$ ). These results indicate that crayfish may be foraging on higher quality CPOM sources when there is high CPOM availability.

Keywords: *Shredders, crayfish, FPOM, CPOM.*

## EFFECTS OF DETRITAL SUBSIDY ON DIVERSITY OF GROUND-DWELLING SPIDERS AND INSECTS

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Productivity is a factor that has been shown to have a strong effect on species diversity in some systems. Terrestrial arthropods have been underrepresented in productivity-diversity studies. In terms of competition theory, productivity can be defined as the flow of energy into resources for which competition is occurring. Spiders are generalist arthropod predators that are limited by prey availability. Previous studies have established that a bottom-up linkage exists between detrital food webs and spider assemblages. We conducted our study in a no-till soy agroecosystem where we manipulated densities of spider prey through detrital additions. This is a cyclical ephemeral ecosystem in which an interaction between the annual recolonization by spiderlings and competition for prey may drive spider diversity. The purpose of our study was to investigate the species diversity and community composition of ground-dwelling spiders in response to an experimentally imposed range of prey densities. We added detritus at four levels (control, low, medium, high) at early and mid-season. We sampled insects and spiders at early, mid-, and late season. Insects were collected on sticky traps, and spiders were collected by destructive sampling of litter and soil. We will present results on densities of key orders of insects as well as effects on spider diversity.

Keywords: Biodiversity, productivity, spiders, insects

## RE-EXAMINATION OF CRITICAL TRANSITION TEMPERATURE AND ACTIVATION ENERGY CORRELATING WATER LOSS IN INSECTS WITH HABITAT PREFERENCE

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Water-proofing cuticular lipids in insects undergo a phase change at a certain temperature, called critical transition temperature (CTT), accompanied by an abrupt, lethal acceleration of water loss. As such, CTT is an effective indicator of habitat preference for a species with regard to temperature tolerance best suited for survival. Identifying CTT has been problematic, leading to misinterpretations about its use, because of improper data analysis and inconsistencies in specimen pretreatment and measuring water loss rates. It was the purpose of this study to evaluate the significance of CTT and standardize how it is determined. The specific amount of energy required for a molecule of water to pass through the lipid boundary between the insect and its surroundings is designated as the activation energy,  $E_a$ . Historically,  $E_a$  has been calculated from the slope ( $-E_a/R_{gas}$ ) over a range of temperatures where  $\ln$  water loss rate is proportional to reciprocal absolute temperature  $1/T$  (Arrhenius plot) in typical Boltzmann fashion.

Where lipids 'melt' at the CTT is reflected by a change in the amount of energy, presumably less, that is needed to cross the boundary as indicated by a steeper slope due to water loss increase. The regression more adequately describes a permeability constant  $P_c$  rather than an  $E_a$  because low water loss rate indicative of an impermeable barrier does not yield a high  $E_a$ .  $P_c$  is found using same methods to derive  $E_a$ ;  $P_c$  more appropriately illustrates that water loss increases with temperature. Proper determination of CTT involves using an untransformed plot (rate vs. temperature) with logarithmic values, causing CTT in many previous studies to disappear. Although CTT is absent,  $P_c$  permits correlation between insects with a low  $P_c$  and presence of a water impermeable barrier, suggesting xeric-adaptation. In conclusion, the regression has been improperly designated as  $E_a$  but useful for analysis of water loss, prompting redesignation as  $P_c$ . Additionally, CTT, in many previous studies, arises from improper graphical analysis.

Keywords: *Insect, activation energy*

## EFFECTS OF PREDATORS AND HABITAT COMPLEXITY ON FORAGING EFFICIENCY IN A SPECIES OF WOLF SPIDER (*PARDOSA MILVINA*)

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Structurally complex habitats are important for both species abundance and diversity. Here was a laboratory assessment designed to study the effects of habitat complexity on spider foraging efficiency. The primary study species was *Pardosa milvina*. We manipulated foraging conditions by adding habitat complexity and predators. Two habitat treatments were used: simple (peat moss) and complex (peat and straw). Three predator treatments were used: *Pardosa* alone, *Pardosa* and *Hogna* together, and *Pardosa* foraging with other *Pardosa*. Logistic regression analysis was used to compare the effects of various treatments on prey capture. Both complex habitat and predator additions had negative effects on foraging efficiency. High levels of complexity reduced prey capture by *Pardosa*. However, when spiders were at high densities, complexity reduced intraguild predation and interference among coexisting spiders. These results suggest that there are costs and benefits to habitat complexity.

Key words: *habitat complexity, intraguild, predation, foraging*

## EDGE-MEDIATED SUCCESSION AND DROUGHT RESPONSE IN A PLANT COMMUNITY

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Edges are important in determining community structure, but the impacts on community dynamics are unclear. We examined patterns of vegetation succession along an edge gradient between 1996 and 2001 at the Hutcheson Memorial Forest, New Jersey, a time period that also included a severe drought (1999). Measures of community and population attributes were obtained in order to determine possible edge-mediated successional and drought response patterns. Percent cover of all understory plant species was estimated for 1996 and 2001 in a grid stretching across a forest-field edge. Cover, diversity, and evenness were lowest in the forest, higher at edge, and higher still in field. Rather than show the expected successional pattern of increasing colonization of late-successional species over time, grasses as a group showed a significant increase in cover. This successional reversal was likely due to the effects of the 1999 drought, which would have killed off many established species, allowing the openings to be quickly filled

by grasses and other early successional species. Species turnover increased significantly with distance from the edge indicating the increasing replacement by grass species in the field following the drought. Increasing cover of exotic species, also mostly in the field, suggests the area is returning to earlier stages of old field succession following the disturbance. The observed trends suggest community dynamics across an edge system were more related to the drought than to the process of succession. In this case, the edges serve primarily as buffers from drought stress. Areas farther from the edge experienced greater drought-related community change.

Keywords: *edge, succession, drought response, understory vegetation*

## EFFECTS OF DEER HERBIVORY ON FLORISTIC HETEROGENEITY AND PLANT INVASIONS IN ILLINOIS

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Nine deer exclosures and paired control plots were sampled at locations throughout the state of Illinois. A paired-sampled T-test found tree cover significantly lower in control than exclosure plots. Mean cover of herbs and grasses were higher in control plots, while liana, shrub, and total cover were higher in exclosures, though these differences were not significant. Cover of invasive exotic herbs, shrubs, and lianas were compared at sites where they occurred. Mean cover of exotic invasive herbs was higher in control plots than exclosures, but the difference was not significant. Mean cover of the invasive exotic liana *Lonicera japonica* was significantly higher within exclosures than in control plots. Coefficients of species accumulation were also higher in exclosures at (several) sites. These results suggest (1) deer herbivory may be reducing tree regeneration and floristic heterogeneity throughout Illinois, and (2) deer herbivory inhibits invasion by preferred woody browse species such as *Lonicera japonica*, and could facilitate invasions by herbaceous species.

Keywords:

## AMPHIBIAN COMMUNITY DYNAMICS AT TWO SCALES OF ANTHROPOGENIC PERTURBATIONS

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Pond-breeding amphibians are important components to wetland ecosystem energy dynamics by consuming primary and secondary production and providing relatively large amounts of biomass to higher trophic levels. Although numerous factors are linked to recent declining amphibian populations, anthropogenic perturbations such as habitat modification and introduced species have had the greatest impacts. I conducted a field experiment at two different scales to examine the effects of these factors on a pond-breeding amphibian community in east-central Illinois. On a temporal scale, I investigated the effects of introduced fish on a native amphibian community and the resilience of the amphibian community after mitigation, via the experimental application of Rotenone. On a spatial scale, I also assessed the influence of the landscape composition surrounding wetlands on amphibian distribution. Landscape composition is critical for amphibians to complete many life-history functions. Therefore, I associated the distribution of amphibians along a terrestrial habitat gradient surrounding breeding ponds, and I examined the additional effects of landscape composition of the terrestrial habitat on the migration orientation of adult and

juvenile amphibians. Mitigation of introduced fish did not improve the reproductive success of all amphibian species; only smallmouth salamander recruitment increased following fish removal. However, I observed an increase in species richness and diversity within the community following mitigation, indicating the resilience of pond-breeding amphibian community following restoration. The abundance of amphibians increased with increasing width of the forested terrestrial buffer habitat. Similarly, juvenile dispersal patterns significantly deviated from random expectations in favor larger buffer habitats. My results indicate that management objectives promoting larger buffer habitats around breeding ponds and removal of predator populations are important strategies for maintaining populations of pond-breeding amphibians.

Keywords: *Amphibians, Perturbation, Mitigation*

## ROUND GOBY (NEOGOBIUS MELANOSTOMUS) AND DREISSENID EFFECTS ON YOUNG-OF-THE-YEAR SMALLMOUTH BASS (*Micropterus dolomieu*)

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The Lake Erie community has fluctuated considerably over the past century. Anthropogenic perturbations to the system, including the introduction of invasive species, have played a major role in shifting abundances and species compositions. The introduction of dreissenids (quagga and zebra mussels), round goby (RG), *Bythotrephes*, *Echinogammarus*, and white perch have impacted fish communities through food-web shifts and alterations of the physical environment. The importance of these interactions has led fisheries management to shift from an individual species perspective to the level of the entire fish community. Mesocosms were used to quantify how two particular invasives, dreissenids and RG, indirectly and directly affect the growth and vulnerability of young-of-the-year smallmouth bass (YOYSMB). The impact of these invasives on smallmouth bass is of special concern due to their importance as a game fish in Lake Erie. Dreissenids potentially indirectly aid YOYSMB by providing structural complexity which increases invertebrate prey resources. RG, because of their aggressive behavior, probably directly influence YOYSMB by interfering with habitat use (potentially decreasing foraging efficiency and increasing predation risk). Additionally, young RG may indirectly affect the abundance of invertebrates among dreissenids because of diet overlap between the two species. Therefore, it becomes important to evaluate how dreissenids mediate YOYSMB growth through their influence on food density and to evaluate how RG directly and indirectly affect YOYSMB growth. Treatments within mesocosms (N=54, 0.3-m<sup>2</sup>) included varying densities of YOYSMB, dreissenids (presence/absence - how mussels mediate competition), and RG (presence/absence), and in these growth, diet, and survivorship of YOYSMB were quantified. In the presence of conspecifics or RG, YOYSMB growth was 66 and 65% lower, respectively, than YOYSMB alone (ANOVA, P=0.013, and Tukey's LSD, P<0.05). This suggests that intraspecific and interspecific competition are equivalent. Because RG are found at high densities (up to 15·m<sup>-2</sup> - unpublished data, C. Knight), the competitive effects of RG on YOYSMB appear to be substantial. Overall, our proposed experiment contributes information on growth of SMB exposed to invasive species and their potential increase in vulnerability to predators, two major factors that contribute to their recruitment into the fishery.

Keywords: *invasive species, smallmouth bass, competition, fisheries*

## COMMUNITY RESPONSE TO RAINFALL DEVIATION IN A SUCCESSIONAL SYSTEM

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Perturbations such as drought, herbivory and fire often influence community structure through shifts in resource availability. Although changing resource levels can affect community structure, the mechanisms by which communities respond to fluctuating resource levels are not well understood. We examined species turnover dynamics to determine the mechanisms behind successional community responses to yearly changes in rainfall. Using long-term data from the Buell-Small Succession Study, we compared species richness and turnover rates to rainfall deviation. Species richness declined in wet and dry years and remained low following wet years. Declines in diversity resulted from decreased community colonization and increased extinction rates during wet and dry years. Species most strongly affected during wet and dry years were rare and infrequent in the community. High turnover of the rare species may be driven by increased competition during extreme events, limitations on establishment sites due to high cover during wet years, and physiological mortality during drought years. These findings are further supported at the population level as ruderal species (annuals, biennials and perennials) were most strongly affected during wet and dry years. Our results suggest that successional systems can have predictable responses to changes in resource availability.

Keywords: *Species turnover, drought, resource availability, succession*