

POPULATION BIOLOGY / ECOLOGY

Poster abstracts

RECORD 90 DAY SURVIVAL WITHOUT FOOD AND WATER BY ADULTS OF THE AMERICAN SPIDER BEETLE, *MEZIUM AFFINE*

Ark, J.T.¹, Benoit, J.B.¹, Rellinger, E.J.¹, Yoder, J.A.¹ and Keeney, G.D.²

¹ Department of Biology, Wittenberg University, Springfield, OH 45501

² Department of Entomology, The Ohio State University, Columbus, OH 43210

Colonies of spider beetles, *Mezium affine* and *Gibbium aequinoctiale*, have persisted in the laboratory without being provided water for nearly 7 years. These beetles are named for their spider-like appearance due to a lack of wings and fusion of the elytra, and are a common stored product pest of grain and oats. For *M. affine*, extreme desiccation resistance was provided by a thick cuticle, as indicated by a low permeability constant ($P_c = 43\text{kJ/mol}$), extremely low water loss rates averaging 0.3%/day, group effects reducing water loss, a low water content and impressive survival for 90 days with no food and water in arid air. When exposed to this long-term fasting and water shortage, the beetles entered quiescence, extended periods of physical inactivity as though dead. Replenishing lost water stores, albeit minimal, was restricted to drinking free water and confirmed by the observation of liquid uptake from Evans blue-stained water droplets and a critical equilibrium activity (CEA) of $1.00a_v$ ($a_v = \%RH/100$), indicating the spider beetle cannot balance water loss with gains from atmospheric air below saturation. Adaptation for maximum water retention, rather than water gain, was also featured by *G. aequinoctiale*. Water balance profile of the beetles was compared to a closely-related beetle, *Prostephanus truncatus*, having similar mass and surface area, but differing by the presence of wings rather than fused elytra. In contrast to spider beetles, the winged *P. truncatus* had a 4-fold reduction in survival time and 5-8x accelerated water loss rates in comparison to spider beetles. This difference, presumably, is attributed to the fused elytra design feature that acts to keep water from leaving the beetle externally. Capacity for quiescence in the spider beetles also contributes to enhance water conservation, and is reminiscent of the diapause syndrome. As such, it seems reasonable to suggest that spider beetles are uniquely adapted for coping with temperature extremes in addition to being particularly desiccation-hardy, which has promoted their ubiquitous distribution.

Keywords: *spider beetles, water balance*

LACK OF FUNGAL VECTOR CAPACITY BY TICKS HARBORING AN IMPERFECT FUNGUS, *SCOPULARIOPSIS BREVICAILIS*

Benoit, J.B.¹, Yoder, J.A.¹, Rellinger, E.J.¹, Gribbins, K.M.¹, and Telford III, S.R.²

¹Department of Biology, Wittenberg University, Springfield, OH 45501

²Department of Immunology and Infectious Diseases,
Harvard School of Public Health, Boston, MA 02115

A deuteromycete, *Scopulariopsis brevicaulis*, has been recovered internally from two tick species in our area, the American dog tick *Dermacentor variabilis* and lone star tick *Amblyomma americanum*. This fungus is present in all life stages with initial infection occurring maternally as a contaminant of eggs. The fungus benefits from this association by obtaining nutrients and water from the tick, in turn being born with this fungus sets up a pioneering effect conveying a protective advantage against secondary fungus attack that benefits the tick. Whether ticks can transmit this fungus is the subject of this study by analyzing tick saliva and feeding sites and blood from a host. Saliva was collected from larvae, nymphs and adults into glass capillary tubes inserted over the mouthparts and stimulated by pilocarpine. Fungal culturing on potato dextrose agar and methylene blue staining by light microscopy was used to analyze samples. Identification was based on microscopic and macroscopic colony characteristics of excised subcultures. Tissue biopsies were also examined for evidence of conidia from ears of an immunologically naïve New Zealand white rabbit, *Oryctolagus cuniculus*, of sites where *S. brevicaulis*-positive ticks had attached. Less than 4% of tick saliva (N=300 samples each from larvae, nymphs and adults) tested positive for *S. brevicaulis* with slide preparations viewed by light microscopy and from subcultures. Of 90 adult feeding sites from the rabbit, only 3 tested positive for *S. brevicaulis*, and no fungi (0/400 samples) was detected, microscopic observation and fungal culturing, in rabbit blood. Histochemical analysis of tick feeding sites showed no conidia or hyphae in the peristomal space surrounding the tick's mouthparts while imbedded in host skin. Results compared favorably to tissue biopsies where no ticks had fed. We recovered 100% of *S. brevicaulis* from tissue (N=40) that had received intradermal injection of fungal inoculum (200µl samples- 1.0×10^7 conidia/ml), which served as confirmation of our technique. With little fungi recovered from tick saliva, blood and tissue biopsies from where ticks had fed, our conclusion is that these ticks are not competent for transmission of *S. brevicaulis* by the blood feeding route.

Keywords: *Fungi, tick, transmission, Scopulariopsis*

EFFECTS OF CURRENT VELOCITY AND PARTICLE SIZE ON CRAYFISH (*ORCONECTES PROPINQUUS*) ACTIVITY

Clark, J.M. and Kershner, M.W.

Department of Biological Sciences, Kent State University, Kent, OH 44242

In streams, flooding can play a dominant role in the spatial distribution and relative abundance of species. Flood events vary in duration, frequency, and intensity with diverse effects on lotic communities. The use of refugia (e.g., substrate) by invertebrates may be important for increasing the likelihood of survival during high flow. Movement to potential refugia becomes risky as velocities increase and the range of velocities that benthic invertebrates can withstand is variable. In this study, activity time and slip velocities of small [carapace length (CL)=10-20 mm] and large (CL=20-30 mm) *Orconectes propinquus* were measured in an artificial flume on monolayers of small pebbles (16-32 mm), large pebbles (32-64 mm), and small cobble (64-128 mm) across a range of current velocities. Water velocity was increased by 0.1 m/s increments from 0.1-1.5 m/s at 5-minute intervals or until the crayfish slipped off of the substrate. In general, as current velocity increased, the probability of slipping increased for all crayfish. Regardless of particle size, small crayfish held their position at higher velocities (up to 1.5 m/s) than large crayfish (up to 0.9 m/s) and were also less active. Particle size effects only occurred with small crayfish, which had higher slip velocities on small cobble than other substrate treatments. Essentially, interstitial spaces in small cobble were large enough to allow small crayfish to seek refuge and avoid being swept into the drift.

Keywords: *Orconectes propinquus, crayfish, flooding, substrate*

TRANSMISSION OF FUNGAL ENDOPHYTES IN SEEDS OF *FESTUCA OBTUSA*

Cummings, J.A and A.S. Methven

Department of Biological Sciences, Eastern Illinois University, Charleston, IL 61920

Many plants have mutualistic associations with fungal endophytes. Studies of these relationships have shown that these associations provide a selective advantage for plants which can be passed on to future generations. *Festuca obtusa* is a cool season grass that is commonly infected by fungal endophytes that correspond to asexual forms belonging to the genus *Neotyphodium* (Fungi Imperfecti). This project was designed to ascertain: 1) the percentage of transmission of endophytes from infected tillers to seeds; 2) whether differing periods of cold stratification improve seed germination; and, 3) the percentage of infection in seedlings. Seeds of *F. obtusa* collected in summer 2003 were subsequently divided into four lots: 1) one lot was used as a control for detection of fungal endophytes in seeds; 2) one lot was germinated and grown without cold stratification; 3) one lot was germinated and grown after six weeks of cold stratification; and 4) one lot was germinated and grown after twelve weeks of cold stratification. Seedlings were subsequently grown for six to eight weeks, harvested, and inspected for infection. Fungal endophytes were found in 100% of the seeds collected from infected tillers, the percentage of seed germination increased with longer periods of cold stratification, and 100% of the seedlings were infected with the fungal endophyte.

Keywords: *Festuca*, *endophytes*, *mutualistic associations*

DETERMINING THE ECOLOGICAL REQUIREMENTS OF FRESHWATER TURTLES

Harms, H.M., and Root, K.V.

Department of Biological Sciences, Bowling Green State University,
Bowling Green, OH 43403

Freshwater turtle populations have been experiencing significant declines in population size and distribution over the past several decades. They are susceptible to fragmentation because of their long life span, which allows poor recruitment to go unnoticed, delayed age to sexual maturity, variable and often poor reproductive success. Freshwater turtles are an important part of the ecosystem, as they act as scavengers, provide a dispersal mechanism for plants, contribute to environmental diversity, and have the potential to contribute significant biomass. The study, conducted in the summer of 2003, investigated the habitat requirements of freshwater turtles, using painted turtles, *Chrysemys picta*, as a model organism. I (1) used a GIS program, ArcView, to locate local ponds surrounding Bowling Green, Ohio where pond and marsh turtles may be found in a fragmented setting; (2) performed a survey of painted turtles; and (3) measured a suite of environmental variables particular to that area (e.g., area, pH, amount of shade, etc.). This study demonstrated that the amount of shade and vegetation around a pond, the amount of debris in the water and the amount of other wildlife in the area are important factors for painted turtle habitat. The results also suggested that painted turtles prefer areas that are larger, appear to be more heterogeneous and have less motor vehicle traffic. Current research is underway to complement this study by investigating the ecological requirements of a rare freshwater turtle, the spotted turtle, *Clemmys guttata*. This mark-recapture study will collect individual specific data. A blood sample will also be collected to determine effective dispersal. Several individuals will be equipped with a radio transmitting device. Finally, Geographical Information Systems and a spatially-explicit population model will be utilized to evaluate this data on a landscape scale and to determine which variables are most critical to freshwater turtle

population viability. A predictive model will be developed to evaluate population viability through time and to evaluate different management plans and their potential outcomes. These studies will provide critically needed baseline data that will improve our understanding of the threats facing freshwater turtles and suggest management recommendations for their conservation.

Keywords: *Turtle, Ecology, Conservation, Model*

EXAMINING THE POTENTIAL FOR LOCAL ADAPTATION OF *APOCYNUM CANNABINUM*
(HEMP DOGBANE) POPULATIONS AT AN ABANDONED LIMESTONE QUARRY

Helm, B.R. and Dudle, D.A.

DePauw University, 500 Anderson Street, Greencastle, Indiana 46235

Abandoned limestone quarries offer valuable opportunities to study primary succession. Species that establish first in a quarry are of particular interest because they may show morphological and/or physiological adaptations to extreme environmental conditions at a small geographic scale. In order to identify local adaptations allowing a species to endure primary successional conditions, variation within the species must be documented. We compared two populations of *Apocynum cannabinum*, one in an early successional area in the quarry basin and one in a later successional area in a nearby wet meadow. Population density, proportion of flowering individuals, number of umbels, and number of fruits were sampled. We also quantified on the microsite conditions of the plants, and determined water content of the soil. Microsite type and water content varied significantly between the sites, indicating that abiotic environments may impose divergent selective pressures on the two populations. The patchy distribution of the *A. cannabinum* population at the quarry bottom indicates that microsite or soil conditions suitable for germination and/or vegetative spread of this species may be rare in the quarry bottom relative to the wet meadow. We also found that the population of *A. cannabinum* in the wet meadow was more robust overall, with a larger population density, more flowering individuals, more umbels per area, and more fruits per area. Plants in the quarry roadside were more likely to flower than in the quarry bottom; however, we found that the number of umbels and number of fruits per flowering individual did not differ between the two sites. These data show that some individuals are able to reproduce successfully in the harsh quarry basin. The barrier for the reproduction in the quarry bottom seems to be in their ability to flower, which may be related to drought tolerance. Perhaps intense competition at the wet meadow prevents higher levels of flower and fruit production in that population, despite less stressful abiotic conditions.

Keywords: *Primary succession, Apocynum cannabinum, local adaptation*

AGE SPECIFIC SURVIVORSHIP OF *DROSOPHILA MOJAVENSIS*
REARED ON DIFFERENT HOST CACTI

Jaureguy, L. and Etges, W.J.

Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701

Multiple mechanisms have been implicated in causing senescence in different species making a general understanding of the evolution of aging patterns unclear. Ecological determinants of aging are probably best studied, especially age specific mortality, but these types of studies have been rare in *Drosophila* given the poor understanding of the ecology of most species in this genus. *Drosophila mojavensis* uses two principal host cacti, agria cactus, *Stenocereus gummosus*, in Baja California and organ pipe cactus, *S. thurberi*, in Sonora and Sinaloa, Mexico

and southern Arizona. Populations of *D. mojavensis* have undergone evolutionary changes in a suite of fitness components including adult longevity under stress conditions due to the host shift from agria cactus in Baja California to organ pipe cactus in mainland Mexico. Thus, differences in longevity, and possibly rates of senescence, are directly related to host cactus use. Therefore, the ecology and evolutionary history of *D. mojavensis* makes this species a very useful model for the study of senescence because the flies can be reared on their natural substrates in the laboratory. In this study we analyzed survivorship and rates of mortality in flies from a mainland population grown on two host cacti and laboratory food during their life cycle. Three-day adult cohorts were sorted by sex and housed in cages in groups of 400 individuals. They were fed with the same food they were exposed to as larvae plus 4% atmospheric ethanol. Dead flies were counted daily. PROC LIFETEST in SAS was used to estimate both mortality rates and mean longevity. There was a significance difference among groups using both Log-Rank and Wilcoxon tests. Lab food females exhibited the highest longevity, whereas agria females the lowest. Mortality rates of organ pipe females were lower than all the other treatments. Fermenting agria and organ pipe tissues compared with lab food differ in their chemical composition, and therefore influence different levels of larval and adult nutrition. To the extent that these substrates influence age specific survivorship in adults is not well understood. Future studies are planned with additional populations and characterization of gene expression profiles with age using DNA microarrays.

Keywords: *Drosophila*, *aging*, *cactus*

POPULATION ECOLOGY OF THE JEFFERSON SALAMANDER, *AMBYSTOMA JEFFERSONIANUM*, IN ILLINOIS

Klueh, S.

Department of Biological Sciences, Eastern Illinois University, Charleston, IL 61920

Amphibian populations utilizing small isolated wetlands are often small in size, have little to no contact with other populations, and are susceptible to stochastic extinction processes. The persistence of such populations can only be ascertained by obtaining data that allow the prediction of the population's growth, trajectory, and capacity to achieve a sustainable size. The Jefferson salamander, *Ambystoma jeffersonianum*, is a state-threatened species, occurring at fewer than 15 ponds within Illinois. Individuals at a pond in the east-central part of the state are captured using a drift fence-pitfall trap array, then sexed, measured for SVL, and marked using a unique combination of toe clips. Also obtained are the number of egg masses, average percentage of successfully hatched eggs, and number of juveniles leaving the pond. All data is then entered into a life history table and used to develop a population model. Information obtained from the model will be used to determine which life history stage is critical to the survival of the population, and it will allow management efforts to focus on mechanisms that are most likely to cause declines.

Keywords: *isolated wetlands*, *life history stage*, *life history table*, *population model*,

GEOGRAPHIC VARIATION IN COURTSHIP SONGS AMONG MAINLAND AND BAJA CALIFORNIA POPULATIONS OF *Drosophila mojavensis*

Over, K., de Oliveira, C.C., and Etges, W.J

EFFECTS OF HABITAT FRAGMENTATION ON *ECHINACEA ANGUSTIFOLIA* POLLINATOR VISITATION AND SEED SET

Pimm, S.A.L. and Wagenius, S.

Institute for Plant Conservation, Chicago Botanic Garden, Glencoe, IL 60022

To examine the effects of habitat fragmentation on the abundance and diversity of pollinators visiting a common prairie purple coneflower (*Echinacea angustifolia*), we observed and collected insect visitors on 254 flowering *Echinacea* plants in 20 prairie remnants in western Minnesota. We visited each site 3-4 times during the flowering season, and observed 5 randomly selected plants during each visit. We characterized the spatial pattern of flowering conspecifics at both the population level (i.e. population size) and the individual level (i.e. distance to the n th nearest neighbor for $n=1$ through 31). Population size ranged from 3 to 4500, and distance to the first nearest neighbor ranged from 0.1 m to 127 m. We estimated seed set by weighing a subset of seeds from each observed plant. *Echinacea* appears to be pollinated primarily by variety of native bees, with 8 genera of bees from 4 different families (Halictidae, Anthophoridae, Andrenidae, Megachilidae) represented in our collections. Overall bee visitation was low, with 203 visits observed during 139 hours and 40 minutes of observation. After accounting for temporal variation in visitation rates, we were unable to detect any clear relationship between the frequency of bee visitation and *Echinacea* population size, or between the frequency of bee visitation and the isolation of individual *Echinacea* plants. Likewise, we found no significant relationship between estimated seed set and population size. However, there appears to be a significant negative relationship between seed set and the isolation of individuals, at least at some spatial scales. Observed rates of pollinator visitation and estimates of seed set were not significantly correlated. We discuss the role of pollinator scarcity and other factors in limiting reproductive success in fragmented landscapes.

Key words: *Echinacea angustifolia*, *pollination*, *habitat fragmentation*, *bees*

PHENOTYPIC PLASTICITY IN *MIMULUS RINGENS*: A STUDY OF DROUGHT TOLERANCE AND INDUCED HERBIVORE RESISTANCE

Rohde, A.R.¹ and Carr, D.E.²

¹ Department of Biology, University of Evansville, Evansville, IN 47714

² Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22904

Phenotypic plasticity allows an organism of a given genotype to alter its phenotype dependent upon the environment, within genetic constraints. Plasticity is believed to have a genetic basis, and so could be acted upon by selection. Inbreeding can cause inbreeding depression, when deleterious alleles become fixed in a line of organisms. Because plasticity is a way of fine tuning an organism's phenotype to better suit its environment, mutations affecting plasticity genes would be likely to reduce fitness in some environments, though not in all, and would not necessarily cause the death of the organism. In a study at the Blandy Experimental Farm (VA), I examined two aspects of phenotypic plasticity in *Mimulus ringens* – drought tolerance and induced herbivore resistance –and how they are affected by inbreeding. I found no significant effect of inbreeding on drought tolerance, though there was a marginally significant effect of water treatment on date of first flower. Induced resistance was found to cause a reallocation cost in plants induced at a small size, with induced plants growing less than controls. A marginal effect of breeding*induction was found, with self plants showing the greatest growth lag. However, selfed plants still outperformed outbred plants, growing as much as outbred when induced, and growing more when uninduced. No reallocation costs were found for flower number or date of first flower. Induced resistance was not found to slow herbivore (cotton aphids) population

growth. However, induced resistance may increase fitness in cases of herbivory by other herbivores. Further studies are needed.

Keywords: *Mimulus ringens*, *plasticity*, *inbreeding*, *herbivory*

ASSESSMENT OF THE CUTICULAR HYDROCARBONS INVOLVED IN MATE-CHOICE
WITHIN AND BETWEEN TWO POPULATIONS OF *Drosophila mojavensis*

Tripodi, A.D. and Etges, W.J.

Department of Biological Sciences, University of Arkansas, Fayetteville, AR 72701

Understanding the physiological mechanisms involved in mate-choice behaviors in closely related, yet isolated populations can lead to a greater understanding of the processes that drive speciation. It remains unclear whether the mechanisms that cause premating reproductive isolation between populations or species are an extension of mate-choice systems governing individual mating decisions within populations. Two allopatric populations of *Drosophila mojavensis* from Baja California, Mexico and mainland Arizona exhibit a degree of premating reproductive isolation and are considered possible nascent species. Male cuticular hydrocarbons have been shown to be one of the major factors determining success of courtship attempts in many *Drosophila* species including *D. mojavensis*. Baja California and mainland populations exhibit characteristic differences in hydrocarbon composition, and are thus particularly useful models in which to explore the relationships between mate-recognition cues, sexual selection and reproductive isolation. Mating trials within and between the populations were conducted and the cuticular hydrocarbons of each male individual were characterized and quantified. Hydrocarbon profiles were examined to determine the contribution of each component to mating success within each population. The results were then compared to determine if the hydrocarbons that determine mating success within a population are the same as those that determine success between populations.

Keywords: *Drosophila mojavensis*, *hydrocarbons*, *mate-choice*, *reproductive isolation*

NEST PARAMETERS OF ALLIGATOR SNAPPING TURTLES (*MACROCHELYS TEMMINCKII*)
AT BLACK BAYOU LAKE NATIONAL WILDLIFE REFUGE IN NORTHEAST LOUISIANA

Woosley, L.B. and Carr, J.L.

Department of Biology, University of Louisiana, Monroe, LA 71209.

The Alligator Snapping Turtle (*Macrochelys temminckii*) is a predominantly aquatic turtle, with females exiting the water only to lay eggs. Oviposition takes place over approximately two weeks between the months of April and June. Nest surveys of a population of *M. temminckii* have been conducted intermittently since 1997. In 2004, monitoring became more regular and intensive. In this preliminary study, a total of 22 intact or partially intact nests were found between 1997 and 2004 (9 intact, 13 partially intact). Clutch size averaged 33.4 eggs (N = 9, range 28-44). Mean egg weight for 21 clutches was 31.26 g, with mean egg length and width of 38.4 and 36.8 mm, respectively (N = 20). In 2004, 12 nests were found along a railroad embankment abutting the lake and two along a wooded, old-field margin. The fourteen ovipositional sites were an average of 8.28 m from the water's edge, a slope of 12.9° above the horizon, and with 43 percent canopy cover.

Keywords: *Macrochelys temminckii*, Nest ecology, Reproduction

