

Undergraduate Student Forum 2011 Participants

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The Effects of Canopy Height on Leaf Mass per Area in *Eucalyptus Spp.* ALISHA M. AUTIO & MOLLY A. CAVALERI, Michigan Technological University

Historical plant physiology studies showed that leaves grown in high light conditions in greenhouses and growth chambers tended to have higher leaf mass per area (LMA) values than those grown in low light. As a result of these early experiments, scientists developed a sun/shade theory suggesting that vertical gradients of LMA, leaf respiration, nitrogen concentration, and photosynthetic processes are affected primarily by the light gradient within forest canopies. However, recent studies suggest that hydraulic constraints may have a stronger influence on leaf morphology than light does. The purpose of this study was to investigate relationships between canopy height and LMA in *Eucalyptus* spp. Within cohort ages of 1.5, 3, 5, and 6 years old, LMA was measured at three canopy positions (low, middle, and upper canopy) from five sites in Brazil and one site in Hawaii. Leaf sample height at each canopy position was estimated using total tree height and height to base of crown data. We found an overall linear relationship between LMA and leaf height, and a weak relationship between LMA averages and canopy position. The canopy development that comes with tree age may have an effect on how large the canopy height gradient is which will affect LMA values. In understanding LMA and height relationships, scientists know now that the leaf exposure to light may have less influence than height variations do in the prediction of LMA values. These trends may have implications for improvement upon forest modeling and LiDAR applications to forest ecology.

Investigation of an Ornithine α -Ketoglutarate Diet to Improve the Murine Succinic Semialdehyde Deficient Phenotype. EMILY M. GEIGER¹, PAIGE H. BEILFUSS¹, SHERRI L. WISEMAN¹, APARNA D. DESPHANDE¹, & K. MICHAEL GIBSON¹, ¹Michigan Technological University

Succinic Semialdehyde Dehydrogenase (SSADH) is responsible for the catalytic breakdown of GABA (γ -aminobutyric acid), a major inhibitory neurotransmitter. A mutated aldehyde dehydrogenase gene on chromosome 6 (ALDH5A1) causes SSADH deficiency. Normal GABA metabolism is blocked, resulting in a supraphysiological accumulation of GABA and GHB (γ -hydroxybutyric acid). Patients with SSADH deficiency are bioenergetically starved and suffer ataxia, hypotonia, psychomotor retardation, developmental delay, and seizures. An engineered ALDH5A1 knockout murine model shares phenotypic characteristics with human SSADH patients, but suffers from a more severe and lethal form of the metabolic disorder. A potential diet-specific treatment was examined in an effort to rescue the phenotype of ALDH5A1^{-/-} mice. SSADH knockout and wild-type mice were subjected to one of three diets at 5% by weight—ornithine α -ketoglutarate (OAK), casein control, or a regular chow diet. The efficacy of dietary OAK intervention on improving the quality of life of ALDH5A1^{-/-} mice was measured by monitoring the body weight and lifespan of the subjects. No significant improvements were observed in SSADH knockout mice fed the OAK diet. There were no differences in body weight or lifespan observed correlating to the diets. Brain tissue is being harvested to examine brain biochemistry in wild-type and SSADH mutant animals to determine if there are any biochemical differences on the OAK diet. An alternative approach will examine the effects of administering OAK in the animals' water to determine if the food preparation method may have altered the OAK prior to delivery.

Genetic Comparison between North American and European Populations of *Lumbricus terrestris* to Determine the Origin of Local Populations. ERIN HICKEY, ERIK LILLESKOV, OLIVER GAILING, MTU

The earthworm, *Lumbricus terrestris*, is currently considered an invasive species in North America with European origins which has been introduced through man-made vectors such as logging roads and release of unused fishing bait (Hendrix and Bohlen, 2002). Earthworms were once absent from northern forests of this region most likely due to their slow northward migration after the last glacial period. Subsequently, European settlement allowed for the invasions of these organisms over a wide geographic area (Alban and Berry, 1994; Scheu and Parkinson, 1994; Bohlen et al. 2004). *L. terrestris* can transform soil conditions by burrowing and consuming leaf litter, which ultimately leads to redistribution of organic matter and minerals throughout the soil horizon, causing considerable changes in the composition and distribution of soil biota and ecosystem processes (Frelich et al., 2006). In the present study we analyzed genetic variation patterns using three highly variable nuclear microsatellite markers in five North American and in five European populations covering a wide geographic distribution. The aim of the study is to better understand the geographic origin of local North American earthworm populations.

Magnetoelastic Materials as a Means to Control and Monitor Cellular Adhesion. HAL HOLMES¹, ELI VLAISAVLJEVICH¹, KEAT GEE ONG¹, & RUPAK RAJACHAR¹, ¹MICHIGAN TECHNOLOGICAL UNIVERSITY

The service life of percutaneous implants, such as bone anchored prosthetics and catheters, is substantially reduced by the onset of interfacial fibrosis. Currently, means to achieve a stable implant-tissue interface include anti-fibrotic drugs and bioactive coatings, however these methods are transient and ultimately failure at the implant site will occur. This work looks to supplement the transient nature of current bioactive coatings using magnetoelastic (ME) materials that can be remotely activated via a magnetic field to produce localized sub-micron vibrations. Initial work suggests ME vibrations can be used to control cell adhesion and further as a means to monitor and treat subsequent changes at the implant surface in real-time. In this work we demonstrate the ability to control fibroblastic cell attachment and the monitoring capacity via secondary magnetic field assessment. Direct adhesion experiments performed on fibroblasts and marrow-derived macrophages seeded on poly-L-lactic acid (PLLA) coated ME materials showed that frequency and amplitude controlled ME vibrations applied for 1 hour allowed for the control of surface cell adhesion. Further, vibration response monitoring (secondary field measures) was able to track cell adhesion in real-time. The findings that ME materials can control as well as monitor cellular attachment via sub-micron vibrations, suggests a possible novel approach to address interfacial fibrosis and ultimately the long-term service life of percutaneous devices. Ongoing work addresses the effect of ME vibrations on the adhesion behavior of clinically relevant bacteria and other cells involved in the host response to implantable biomaterials; as well as a detailed analysis of cell morphometry and gene expression in response to sub-micron vibrations. Funding: DoD-CDMRP Grant-OR090762.

Influence of Root Biomass and Specific Respiration Rates on Variation in Ecosystem Level Fine Root Respiration among Forest Types. GERALD P. JONDREAU¹, MICKEY P. JARVI¹, ANDREW J. BURTON¹, ¹Michigan Technological University

Fine root respiration utilizes a significant proportion of belowground C allocation and thus also contributes greatly to ecosystem soil CO₂ efflux. We sought to better understand the factors controlling variability across ecosystems in this important C flux by examining the influence on ecosystem fine root respiration, specific root respiration rates, fine root N and fine root biomass. Specific root respiration rates were measured periodically during the growing season of 2010 on excised roots samples from seven common Lake States forest ecosystems (sugar maple, red pine, red oak (moraine and outwash soils), trembling aspen, eastern hemlock and jack pine. These rates were then extrapolated to an ecosystem respiration level ($\mu\text{mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) based on estimates of fine root biomass from the samples. Root N was measured for all samples using an elemental analyzer. Sugar maple (*Acer saccharum*) on a productive moraine demonstrated the highest ecosystem fine root respiratory flux, while jack pine (*Pinus banksiana*) on a glacial outwash plain had the lowest ecosystem fine root respiration. Patterns among ecosystems in root respiratory CO₂ efflux were dependent on both specific respiration rates and root biomass. For example, sugar maple had highest root biomass, which contributed its having the highest ecosystem fine root respiratory flux. Trembling aspen had the overall highest specific root respiration rates, but its ecosystem root respiration was lower than that for sugar maple due to a lower root biomass. Across ecosystems, specific root respiration rates were significantly correlated with fine root N concentration ($P = 0.002$). The most productive ecosystems (sugar maple, aspen and eastern hemlock) tended to have higher ecosystem fine root respiration while less productive ecosystems had lower ecosystem fine root respiration. Further measurements in 2011 will allow for a cross site comparison of ecosystem fine root respiration to nutrients required for annual foliage production.

Wolf-hunting dog conflict in the Upper Great Lakes Region. CHELSEA M. MURAWSKI¹, JOSEPH K. BUMP¹, & DEAN E. BEYER², ¹MTU, ²Michigan Dept. of Natural Resources & Environment

In the Great Lakes region many people voice concerns over increasing wolf (*Canus lupus*) populations and fear growing populations will have undesirable effects on many recreational activities, including the success and quality of black bear (*Ursus americanus*) hunting with the use of hounds (*Canus lupus familiaris*). In an effort to understand and mitigate these concerns, we examined the relationship between wolf population size and the number of hounds attacked using data from Michigan and Wisconsin (Minnesota does not permit bear hunting with hounds). Regression analysis shows a positive correlation between wolf population size and the number of dog attacks in Wisconsin, however this trend is not present in Michigan even though wolf and bear habitat are similar. To explain this difference, we used parametric tests and regression models to compare state bear hunting regulations, license numbers, hunter effort & success, compensation policies, and locations of the attacks. Bear regulation in baiting differed significantly between the states with Wisconsin baiting three months earlier than Michigan. It is believed that the earlier baiting in Wisconsin allows wolves to identify bait sites and defend them against other species, including hunting dogs. Delaying the timing and reducing the duration of baiting may help reduce wolf depredations on hunting dogs.

What can their eyes tell us? - Assessing mechanisms for variation in the extent of white under the eye of Golden-winged Warblers. AURIEL VAN DER LAAR¹ & AMBER ROTH¹, ¹Michigan Technological University

Golden-winged Warblers are a species of concern throughout the United States and are being considered for listing as a threatened or endangered species because of their sharp population decline. This decline is not well understood but may be driven by habitat loss as abandoned fields succeed out of their acceptable range and also hybridization with Blue-winged Warblers. The objective of this study is to understand if there is a mechanistic pattern to variation in the extent of white under the eye of Golden-Winged Warblers which is related either to the individual's age or their breeding location. If we were able to find a correlation it would help us to understand their migration, since birds captured in their wintering range in Central America could be assessed for breeding location. To assess this, we developed an index for the amount of white under the eye. We caught 140 individuals on territories in Wisconsin and Minnesota, scored the white under the eye using our index, ascertained their age, and collected the geographic coordinates of the capture location. There was no significant relationship between age and eye stripe index; this may be because we can only differentiate birds into three age categories: 1, 2 and 3+ year old birds. Birds three years old or older cannot be differentiated. The small geographic range that our samples were taken from did not show a strong relationship but more work is needed across a wider section of the birds range to fully test the method.

American Larch and Black Spruce Adventitious Root Patterns are Similar in Their Ability to Estimate Organic Layer Depths in Lowland Lake States Forests. TIMOTHY J. VEVERICA¹ & EVAN S. KANE², ¹Michigan Technological University ²Michigan Technological University

The Adventitious Root Method has been gaining traction as a common tool in estimating the depth of organic layer burned following wildfires in coniferous ecosystems. The existing biometric is limited by two parameters: it is intended for use in soils with less than 40 cm of organic layer depth and it is designed for use with a single tree species, *Picea mariana*. In this study, we explored the possibility that *Larix laricina* displays similar adventitious root growth patterns as *P. mariana*. We collected adventitious root depths from both species (n=423 trees) in four peatland complexes in Michigan's Upper Peninsula, and evaluated their utility in estimating total organic layer depths, for organic layer reconstruction following a wildfire. Our results indicate a correlation between the depths from the soil surface to the first adventitious root found for the two species ($R^2=0.56$, $P=0.02$), as well as a correlation between the depths from the first adventitious root to mineral soil for the two species at the plot level ($R^2=0.97$, $P<0.001$). From this information, we surmised that one would be able to utilize the Adventitious Root Method to reconstruct pre-fire soil conditions at a post-burn site with either species.

Solution Resistance of Human Blood Types in Microchannels with Erythrocyte Concentration Variation. KELLY-ANNE ZAYAN, CARLOS PRADO, KAELA LEONARD, ADRIENNE R. MINERICK, Michigan Technological University

Blood types are distinguished by polysaccharide presence in (Rh factor) and on (ABO) erythrocyte membranes. As a fluid, blood has different dependencies (pH, concentration, buffer conductivity) which can be measured by the voltage drop and calculated resistance change across a channel in a microdevice. In these experiments, a microdevice designed and fabricated with a $200\mu\text{m} \times 1\text{cm} \times 70\mu\text{m}$ channel was filled with buffer solutions containing varying erythrocyte concentrations for each blood type. This device tracks the voltage drop across three measurement electrodes spaced $25\mu\text{m}$ apart. Each measurement electrode is $50\mu\text{m}$ in width and comprised of titanium followed by gold sputtered material. The concentrations are by volume: 1-1000, 1-2000, and 1-4000 microliters of red blood cells to milliliters of 4% dextrose solution. The dextrose solution concentration did not vary throughout these experiments. LabView was used to measure and record the change in voltage and resistance as the solution was introduced to the microchannel. Different blood types react differently to each dependency and can be categorized based on trends in the data. Our hypothesis is that the erythrocyte concentration will vary the voltage and resistance change based on blood type. If this hypothesis is proven correct, we can determine blood type based on resistance change, further allowing us to determine hematocrit level with the blood type information.