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Modeling Riparian Zones Utilizing DEMs, Flood Height Data, Digital Soil Data and National Wetlands Inventory Via GIS, SINAN ABOOD[1], DR. ANN MACLEAN[2], MTU

Riparian zones are dynamic, transitional ecosystems between aquatic and terrestrial ecosystems with well defined vegetation and soil characteristics. Development of an all-encompassing definition for riparian ecotones, because of their high variability, is challenging. However, there are two primary factors that all riparian ecotones are dependent on: the watercourse and its associated floodplain. Previous approaches to riparian boundary delineation have utilized fixed width buffers, but this methodology has proven to be inadequate as it only takes the watercourse into consideration and ignores the critical surrounding geomorphology, associated vegetation and soil characteristics. This approach offers advantages over other previously used methods by utilizing a better sampling technique along the water course that can distinguish the 50-year flood edge associated with the floodplain and by utilizing the Digital Soil Data (DSD) and National Wetlands Inventory (NWI) databases to distinguish riparian soils and vegetation characteristics associated and adjacent with riparian zones of the same floodplain. The result of this study is a GIS based model in a form of an ArcGIS tool box attached to ESRI ArcMap software to delineate a variable-width riparian boundary.

Herbaceous Community Compositional Changes in a Northern Hardwood Forest. MARCELLA CAMPIONE, LINDA NAGEL, WILFRED PREVIANT. Michigan Technological University

In 1958, a demonstrational cutting trial, totaling 22.2 hectares, was established in a northern hardwood forest in Alberta, MI. The original goals of the study were to investigate stand productivity, financial rates of return, and tree quality improvement. Nine different treatments were established, including four diameter-limit (56 cm, 41 cm, 30 cm, and 13 cm), three single tree selection harvests with residual basal areas of 21 m2/ha, 16 m2/ha , and 11 m2/ha, a light improvement treatment, and an uncut reserve. The light improvement was not included in this analysis due to its high variability of past management. Within each treatment, a 0.4 hectare permanent plot was established and subdivided into 0.04 hectare square subplots. Harvests have been implemented every ten years with the most recent harvest occurring during the winter of 2008-2009. During the last harvest, the goals of the study were expanded to include overall diversity and composition of vegetation. Herbaceous and understory woody species were sampled pre- and post-harvest. Nonmetric multidimensional scaling (NMS) ordination was used to graphically determine if treatments were affecting herbaceous species composition. The NMS ordination showed a very distinct separation between the most intensive management treatment (13-cm diameter limit treatment) and the uncut reserve. The diameter limit treatments generally moved with greater directionality towards the 13-cm diameter limit treatment while the residual basal area treatments were generally more random and had less overall movement. Overall, herbaceous species percent cover generally decreased with increasing overstory basal area. However, weedy and early successional species composed a larger percentage in more open overstories. Fifty years of continuous treatment within this study site, have revealed that diameter limit harvests have a greater impact on the herbaceous community than single tree selection or no management.

Copolymerization of Peptidoglycan to Enhance Polyhydroxybutanoate Stability. NING CHEN[1], RATUL SAHA[2], SUSAN T. BAGLEY[1], & PATRICIA A. HEIDEN[1], [1]MTU, [2]NSF International

Polyalkanoates (PHAs) are aliphatic polyesters that are naturally produced by some bacteria, and have value as biodegradable polymers that might also be useful in applications that have traditionally employed petroleum-based polymers. However, bacterially-produced PHAs also have two drawbacks. One of these is that, while biodegradability is a useful trait, ideally the durability could be modulated so the PHAs might be employed in areas where longer lifetimes are appropriate. Secondly, the PHAs must be isolated from the other bacterial components, and this can be time and energy consuming. One of the cell residues that are separated from PHAs is peptidoglycan (PTG), a cell wall component that is durable and comprises ~ 50% of the dry cell mass of gram-negative bacteria. The purpose of this work was to copolymerize a PHA (polyhydroxybutanoate, PHB) with PTG residues to give a more durable polyesteramide copolymer (PHB-PTG). The PHB-PTG copolymers were confirmed by FTIR and showed significantly more thermally stability compared to pure PHB, but the extent of the increase depended on the PTG purity (125 ˚C with pure PTG and 35-50 ˚C with less pure PTG). The PHB-PTG copolymer also possessed a higher equilibrium moisture content than PHB alone.

Role of Auxin Polar Transport in Regulation of Tree's Growth and Development, YIRU CHEN[1]&VICTOR BUSOV[1], [1]Michigan Technological University

Development, growth and tissue differentiation in plants are highly dependent on polar auxin transport (PAT), which requires the proper asymmetric localization of auxin influx and efflux carriers. The PIN-FORMED (PIN) genes from Arabidopsis encode a group of auxin efflux carriers which are expressed in a tissue and developmentally specific manner and regulate a wide array of processes including lateral root formation, vascular differentiation, leaf phyllotaxis, gravitropic responses, flower development, and others. Role of PAT and specifically PINs in trees' growth and development is widely speculated but poorly understood. Here we show that manipulation of auxin efflux through transgenic modifications of a member of the PIN family in poplar results in altered auxin distribution indicated by DR5::GUS auxin response reporter. Also afew complex phenotypic changes were observed as evidence of an important role of the PtPIN9 in woody plant development.

Effects of Experimental Warming and Irrigation on Water-Use and Growth of Sugar Maple (*Acer saccharam*). ALEX R. COLLINS[1] & MOLLY A. CAVALERI[1], [1]MTU

Average global surface temperatures have increased by about 0.74°C over the past hundred years due to increased levels of CO_2, and temperatures are expected to increase an additional 1-3°C by 2100. Water supply will likely also be affected by climate change because the temperature of the atmosphere affects the amount and timing of precipitation around the globe. Annual mean temperature and precipitation is expected to increase in the northeast USA. The objective of this study is to investigate the effects of experimental warming and water addition on the physiological functioning of sugar maple (*Acer saccharum*) with respect to its water use and growth. The study will be conducted in the Ford Research Forest outside of L'Anse, Michigan. Water use, estimated via heat dissipation sap flow sensors, and growth measurements, estimated via dendrometer bands, will be recorded on 100 sugar maple trees in twelve 15 m x 15 m plots with three replicates each of four treatments: 1) warming (3-4 °C increase in ambient soil temperature), 2) water addition (20% increase to ambient precipitation), 3) a combination of warming and water addition, and 4) control. Direct ground and canopy meteorological measurements will also be recorded. Sap flow and growth in the warming treatment is expected to decrease because of reduced stomatal conductance. Stomatal conductance will decrease because of overheating of the canopy and decreased water availability caused by increased evaporation from the soil. Sap flow and growth in the water addition treatment is expected to increase because of increased stomatal conductance due to increased levels of soil available water. However, the addition of water will reduce the negative effects of the warming on sap flow and growth in the combination treatment, which will ultimately increase sap flow and growth.

Functional Analysis of Bidirectional Promoters in Rice. SURENDAR R DHADI, APARNA DESHPANDE and WUSIRIKA RAMAKRISHNA Department of Biological Sciences, Michigan Technological University, Houghton, Michigan 49931, USA

A bidirectional promoter regulates the expression of adjacent divergent genes organized in a head-to-head fashion. Study of bidirectional promoters will help in the identification of gene regulatory mechanisms used by these promoters. A subset of putative bidirectional promoters from rice were identified by computational analysis based on intergenic distances of <1 kb between adjacent genes with divergent arrangement. We have identified overrepresented cis-regulatory motifs in these promoters using Plant cis-acting Regulatory DNA Element (PLACE) database. Comparative analysis was used to identify cis-regulatory motifs conserved in three other grass genomes. To identify regions involved in bidirectional activity, rice promoters were analyzed using deletion constructs. Seven full length and deletions of their 5', 3' and central regions were cloned in a binary Gateway vector to drive the expression of enhanced green fluorescent protein (egfp) and red fluorescent protein (rfp) genes in forward and reverse orientations, respectively. Transient expression assays were carried out with 10-13 day old rice plants using Agrobacterium. Out of the seven promoters, four showed bidirectional activity. Site directed mutagenesis is being used to identify cis-regulatory motifs involved in the regulation of the bidirectional activity. These promoters can be used in coordinating expression of multiple genes in metabolic engineering and molecular farming to produce vaccines, pharmaceuticals and plastics.

Efficient One-Pot Synthesis and Loading of Self-Assembled Amphiphilic Chitosan Nanoparticles for Low-Leaching Wood Preservation. XIAOCHU DING[1], DANA L. RICHTER[2], LAURENT M. MATUANA[3] & PATRICIA A. HEIDEN[1]*,[1] MTU Department of Chemistry and [2]School of Forest Resources and Environmental Science, [3] Michigan State University

An environmentally benign methodology was adopted for wood preservation by controlled release of fungicide via nanotechnology. A simple, one-step and one-pot method was used to synthesize amphiphilic self-assembling chitosan-g-PMMA nanoparticles (~100 nm diameter by SEM, but ~150-200 nm in water by DLS), containing ~25-28 wt% (~82–93% capture efficiency) of the fungicide tebuconazole. The matrix composition was selected to be environmentally low impact, while the nanoparticle preparation conditions were designed to ensure the nanoparticles sufficiently small to be able to penetrate the pit-pairs of solid wood. These nanoparticles were delivered into southern pine sapwood blocks at target fungicide retentions of 0.2, 0.4 and 0.8 kg tebuconazole/m^3 wood. SEM analysis of a 19×19×455 mm nanoparticle-treated wooden stake confirmed penetration throughout the interior of the treated stake. Leaching studies confirmed that biocide introduced into sapwood via nanoparticle carriers leached only about 9% as much fungicide as solution-treated controls, while soil jar tests showed the nanoparticle-treated wood blocks effectively protected the wood from biological decay when tested against *G. trabeum*, a brown rot fungus.

Impact of Elevated Carbon Dioxide and Ozone on the Wood Anatomical Properties of Four Clones of Trembling Aspen. EMMANUEL EBANYENLE, ANDREW J. BURTON, ANDREW J. STORER, Michigan Technological University

Atmospheric CO2 and O3 concentrations have increased dramatically over the past century and are predicted to rise further. However, information on the effects of elevated CO2 and O3 on the wood anatomical properties of trees appears to be limited in spite of their significance as carbon sinks. This study is therefore evaluating the anatomical properties of the wood of four clones of Aspen (8L, 42E, 216 and 271) exposed to elevated CO2, O3 and CO2+O3 and control (ambient CO2, ambient O3) treatments for 12 growing seasons (1998-2009) at the Aspen FACE (Free-air CO2 and O3 enrichment) project site at Rhinelander, WI. Anatomical properties being studied include parenchyma, fiber and vessel characteristics. Analysis of vessel lumen diameter showed that each clone responded differently to elevated CO2 and O3. In clone 216, elevated CO2 and O3 did not have a significant effect on vessel lumen diameter but in clone 271, elevated CO2 and elevated O3 increased slightly and decreased significantly vessel lumen diameter respectively. Also in clone 42E, elevated CO2 increased vessel lumen diameter but elevated O3 had no effect on vessel lumen diameter. In 8L, elevated O3 increased vessel lumen diameter but CO2 had no significant effect on vessel lumen diameter. The results suggest that effects of either O3 or CO2 on vessel lumen diameter depend on clone type. Further anatomical characters are being studied to corroborate the current findings.

Biofilm Response to Nutrient Mitigation Using Salmon Carcass Analog in Central Idaho Streams. JONATHAN D. EBEL[1], AMY M. MARCARELLI[1], & ANDRE KOHLER[2] , [1]Michigan Technological University, [2]Shoshone-Bannock Tribes

In streams, epilithic biofilms influence nutrient transformation and retention, and are important food sources for stream invertebrates, yet biofilm production and community composition are often limited by nutrient availability. In the Pacific Northwest, salmon returns have declined 10 to 20-fold due to over-harvesting, habitat degradation and hydroelectric dams. As a result, the amount of nutrients delivered to streams via spawning salmon is currently 5-7% of historic levels and nutrient enrichment is an increasingly popular mitigation technique in the Pacific Northwest. We are conducting an experimental study of biofilm metabolism, nutrient limitation, biomass and community composition responses to salmon carcass analog (SCA; made from dried and pasteurized marine fishmeal) in six tributaries of the upper Salmon River, Idaho. Our experimental design includes upstream control and downstream treatment segments (3 km) in four streams, with two treatment levels: 30 g (low) and 150 g (high) analog / m^2, treated annually starting in August 2010. We also monitor two untreated control streams. We hypothesize that SCA additions will increase biofilm biomass, gross primary production (GPP) and ecosystem respiration (ER), and alleviate biofilm nutrient limitation (assessed using nutrient diffusing substrate bioassays). In 2010, biofilm ash-free dry mass (AFDM; includes both autotrophs and heterotrophs) on rocks increased 2-3 fold following treatment with high SCA, but responded variably to low SCA additions. Chlorophyll *a* (a measure of only autotrophs in biofilms) also increased in response to SCA additions, but not proportionally to changes in AFDM, suggesting that autotrophs and heterotrophs responded differently to SCA additions. In future years, we plan to quantify shifts in community structure between autotrophs and heterotrophs using fatty acid profiles, and to examine the relationship between microbial productivity and diversity at habitat and reach scales in our experimental streams.

On-Line Supercritical Fluid Extraction with Gas Chromatographic – Mass Spectrometric Analysis of Biogenic SOA, ROSA M. FLORES[1], JUDITH A. PERLINGER[1] and PAUL V. DOSKEY[1], [1]Michigan Technological University

Secondary organic aerosols (SOA) are formed by photooxidation of volatile organic compounds (VOCs) and nucleation and condensation of the oxygenated products. The Ozarks forest in the Midwestern United States is an important global source of biogenically-derived SOA. Estimated contributions of SOA to the measured organic carbon (OC) aerosol in the St. Louis area during July were about 60% with 70% originating from isoprene. Monoterpene- and monoaromatic-derived SOA contributed about 10-20% of the OC from July through October. The overall goal of the research is to evaluate SOA produced from a variety of biogenic and anthropogenic sources of precursors in the Midwestern United States. Functional groups of organic substances comprising SOA (i.e., hydroxyl, carbonyl, carboxylic acid, sulfate, and nitrate) complicate sample processing, analysis, and identification of the characteristic aerosol products of the precursor oxidation pathways. On-line sample processing methodologies that are exhaustive and suitable for thermally labile compounds and analytic techniques that provide more complete resolution of complex mixtures for sensitive detection of molecular species are required to quantify SOA. Common extraction techniques include solvent extraction, which requires large amounts of solvent and is labor intensive, and thermal desorption, which evolves organic substances from aerosol at temperatures not suitable for thermally labile compounds. A promising technique that does not involve sample processing with solvents or high temperatures is supercritical fluid extraction (SFE). In this work, SFE was coupled to a comprehensive two-dimensional gas chromatograph with time-of-flight mass spectrometric detection (GC×GC-TOFMS) and evaluated as an on-line sample processing and analytic technique. Carboxylic and hydroxyl compounds were derivatized during static extraction conditions and identified by GC×GC-TOFMS.

Quantification of a pH Gradient in an Insulating Dielectrophoresis Device. AYTUG GENCOGLU[1], FERNANDA CAMACHO ALANIS[2], VI THANH NGUYEN[2],ASUKA NAKANO[2], ALEXANDRA ROS[2], ADRIENNE MINERICK[1]; Michigan Technological University, [2]Arizona State University.

Insulator-based direct current (DC) dielectrophoretic (iDEP) microdevices have the potential to replace traditional alternating current (AC) dielectrophoretic devices for many cellular and biomolecular separation applications.Advantages of iDEP devices over traditional DEP devices include the possibility of single material fabrication, remote positioning of electrodes, and lesser fouling of the test region. One downside of iDEP devices is that they employ strong DC fields, which drive electrode reactions and ion transport mechanisms that then impact ion distributions in the nanoliters of fluid in the device. For example, ion distributions from H^+ and OH^- ions produced by water electrolysis reactions have been shown to result in a natural pH gradient in such devices. This work quantifies local pH at regular position and time intervals in the iDEP microdevices under conditions in which proteins can be focused. Using fluorescence microscopy with the pH sensitive dye FITC Isomer I, pH was observed to drop drastically in the microchannels within 1-4 minutes in a 3000 V/cm applied electric field, and drop less severely when a 100 V/cm electric field was applied. COMSOL simulations of ion transport in the iDEP device geometry showed qualitative agreement with experimental results. Our results indicate that significant pH changes may occur and thus influence the net charge of a protein or promote protein aggregation during iDEP experiments. The results also outline an operating window within which iDEP can be conducted without ion level disruptions.

The Effect of Food and Water Intake on Bioelectrical Impedance Analysis STEPHANIE HAMILTON and KAREN ROEMER, Michigan Technological University

As human biomechanical research develops, a greater focus will be placed on the problem of obesity and its effects on the body. Body Mass Index (BMI), the relationship between height and weight, has been used to divide subjects into body shape groups. However, BMI fails to factor in body composition. Body composition is a better determinate of obesity since obesity is the result of amassing body fat. Bioelectrical impedance analysis (BIA) measures body composition by using electrical current to measure resistance. BIA is simple to perform, portable and inexpensive compared with other current techniques, but certain factors affect the accuracy of the measurement. PURPOSE: The purpose of this study was to determine how food, water and exercise affect the accuracy of BIA. It is hypothesized that modifying the water intake and release through drinking, eating and exercise will compromise the accuracy significantly. METHODS: 19 subjects (age: 26.5 ± 6.5, 10 female, 9 male, BMI: 1.5kg/m^2 ± 3.4) participated in the study. Three 30 minute interventions were designed to violate each factor individually during daily measurements scheduled as follows: day 1, rest; day 2, 0.6L water intake; day 3, 2 granola bars of food intake; day 4, vigorous exercise. Baseline and post-intervention body composition were quantified using BIA and skinfold caliper method (SC). RESULTS: The water intervention resulted in an average increase of 0.77% body fat percentage (BFP) corresponding to a highly significant difference ($p<0.01$). The exercise intervention produced an average decrease of 0.77% BFP corresponding to a significant difference ($p<0.05$). Food intake provided no changes in BIA. SC was not affected by any intervention. CONCLUSION: Water intake and output in the body due drinking and sweating will significantly bias results from the scale. In conclusion, subjects should be instructed to refrain from excessive drinking or exercise prior BIA.

Sublethal Effects of Road Salt (NaCl) Exposure on the Survival and Growth of Larval Wood Frogs (*Lithobates* sylvatica). MEAGAN L. HARLESS[1], CASEY J HUCKINS[1], THOMAS G. PYPKER[1], and JACQUALINE B. GRANT[1,2], [1]Michigan Technological University, [2]Pennsylvania State University

Negative effects of runoff from managed roadways (e.g., northern roads treated with deicers) on surrounding aquatic habitats are known to exist although the nature of the effects on sensitive species using roadside water bodies are less well resolved. Amphibians are important indicator species of freshwater systems and are ideal ecotoxicological models to investigate the impacts of aquatic environment contamination. The goal of this study was to assess the sublethal effects of road salt (NaCl) pollution on recently hatched Wood Frog (*Lithobates sylvatica*) larvae. We conducted a chronic (> 90 day) toxicity test by collecting *L. sylvatica* larvae from Baraga County, MI and exposing them to a range of environmentally realistic concentrations of NaCl during larval development from hatching through metamorphosis. We quantified the effects of NaCl exposure by monitoring survival and developmental stage of larvae daily. At the end of 90 days, we measured snout-vent length (SVL) of remaining metamorphs and a proportion of the tadpoles with deformities in each treatment. Results suggest that the number of tadpoles completing metamorphosis decreased significantly in the high salt treatments. Metamorph size was significantly affected by NaCl concentration with the largest froglets metamorphosing in higher NaCl concentrations. Similarly, the proportion of metamorphs with deformities increased significantly as salt concentration increased with the largest proportion of deformities occurring in the treatment with the highest concentration. Duration and time to metamorphosis was not significantly affected by NaCl concentration. This suggests that exposure to high levels of NaCl pollution has negative impacts on survival, growth, and frequency of deformities in larval *L. sylvatica*. Future research on the long-term effects of NaCl and other deicers on this species, as well as other amphibians, is warranted.

Assessing Relationships Between LiDAR-Derived Vegetation Structure and Butterfly Density to Improve Butterfly Habitat Mapping. HESS, ANNA N[1], MICHAEL J. FALKOWSKI[1], CHRISTOPHER R. WEBSTER[1], & AMY POCEWICZ[2], [1]MTU, [2]The Nature Conservancy, Wyoming Chapter.

LiDAR remote sensing provides highly detailed, 3-dimensional information quantifying vegetation structure. This information may be useful for characterizing habitat quality at both local and landscape scales, and be valuable when comparing species presence and abundance to habitat characteristics. We evaluated the usefulness of LiDAR in a species-habitat context by pairing LiDAR data with field-based vegetation measurements. These data were then used to describe the density of four butterfly species along a grassland-forest interface in Northern Idaho, USA. Non-metric multidimensional scaling ordination was used to examine the relationship between butterfly species composition and environmental attributes derived from remote sensing and field measurements. Butterfly species displayed differential responses to environmental gradients, one group strongly associated with remotely sensed environmental attributes, and the other more strongly associated with attributes derived from field measurements. We conclude that LiDAR derived vegetation attributes may enhance modeling efforts aimed at identifying important habitat and could improve our understanding of species-habitat relationships across a range of spatial scales.

Plant- and Soil-Atmosphere Exchange of Volatile Amine Nitrogen as Precursors to Secondary Aerosols. MERAL L. JACKSON, PAUL V. DOSKEY & TOM G. PYPKER, Michigan Tech

Ammonia is the most abundant alkaline gas in the atmosphere and forms secondary aerosol by neutralizing sulfuric and nitric acids that are released by combustion of fossil fuels. Secondary aerosols produce haze, reduce visibility, negatively impact human and environmental health, and directly and indirectly affect climate. Ammonia is emitted from agroecosystems and from animal husbandry operations. However, volatile amines and amino acids, which are stronger bases than ammonia, are released by the same sources. Amines have been observed in nuclei mode aerosol, which is the precursor to secondary aerosol. Mixtures of amines and amino acids have been identified in aerosol, fog water, cloud water, the soluble fraction of precipitation, and in dew, but few measurements of volatile amine nitrogen (VAN) in air have been reported. To reduce uncertainties in forecasting production of secondary aerosols on the regional scale, emissions of VAN from plants and soil must be quantified. A modified Bowen ratio technique will be used to determine the exchange of VAN with a maize/soybean cropping system. The concentration of VAN at 2 levels above the surface will be measured by the scrubber coil technique with high pressure liquid chromatographic (HPLC) analysis of the derivatized VAN species. Preliminary evaluation of the VAN sampling technique will be conducted with a mist chamber. The sensitivity of the analytic technique is about 3 pptv, and thus, flux measurements over a period of about 30 min are achievable.

Sugar Maple Root Respiration Shows No Short-Term Acclimation to Soil Warming. MICKEY P. JARVI & ANDREW J. BURTON[1], [1]Michigan Technological University

Increasing temperatures in the face of climate change will present forested ecosystems with many challenges. Specifically, how these ecosystems will adjust and how quickly they can adjust to changing conditions is of great concern to land managers and ecosystem process modelers. Positive feedback loops can present themselves where exponential increases in plant respiration to temperature have an effect on the carbon balance of trees and the atmosphere. The objective of this study was to see if the fine roots (<1 mm) in northern hardwood forests could metabolically acclimate to increased soil temperatures. We experimentally warmed the soil of a sugar maple (*Acer saccharum* Marsh.) dominated northern hardwood forest to determine if acclimation is a short term (days to week) or long term (months to years) process. Three replications of four treatments: control, soil warming (+ 4 ^{o}C), water addition (ambient + 30%) and warming plus water addition were applied to 10 by 10 m experimental plots. Warming was initiated in later summer 2010. Root respiration was measured with an open-system infrared gas analyzer biweekly throughout the growing season at ambient soil temperature and a common reference temperature of 18 ^{o}C. Measurements from 2009 and 2010 indicate that the fine root respiration before the initiation of warming increased exponentially with temperature (Q_{10} = 2.7). Fine root respiratory capacity, as measured at a constant reference temperature of 18 ^{o}C, did not change in response to the warming plus water addition indicating that no short-term acclimation has occurred for this treatment. Respiratory capacity did decline on the warming-only plots, but it appears this is a response to drier soil conditions, rather than true acclimation. During the summer of 2011 continued measurements of the respiration will be conducted to assess the presence or absence of longer-term acclimation of root system respiration to experimental warming.

Viability and Vigor of *Phragmites australis* Rhizome Fragments. KEVYN JUNEAU[1] and CATHERINE TARASOFF[1],[1]Forest Resources and Environmental Science

Phragmites australis, common reed, is an invasive plant that reproduces poorly by seed but regenerates vigorously by rhizomes. Because *P. australis* propagates well through rhizome growth, invasion often occurs from transported rhizome tissue. We investigated the number of rhizome nodes and amount of biomass needed to produce a plant capable of photosynthesis. We also assessed the season in which *P. australis* shown the highest probability of growth. In the fall of 2009 and summer of 2010, rhizomes were collected along roadside ditches near Green Bay, Wisconsin. These fall and summer were chosen because the plants were either dormant or actively growing, respectively. Rhizomes were cut so each fragment had either1, 2, 3 or 4 nodes and lengths between 0.5 and 25 centimeters. The fragments were grown in a greenhouse for 60 days. Short rhizomes with one node had the fewest emergent stems and lowest survival, while long rhizomes with 4 nodes had the highest emergence and survival. Small fragments—as short as 4.0 cm and 3.03 g—were able to produce plants capable of photosynthesis. Rhizomes collected in the fall also had a higher frequency of growth and survival than those collected in the summer. There were no differences in stomatal conductance between treatments or any correlations with initial rhizome size. Large rhizomes produced taller plants with more biomass. This study shows that, under optimal greenhouse conditions, a rhizome fragment with a length ≥4 cm and at least one node is capable of producing a stem. By understanding the reproductive biology of *P. australis,* land managers can develop an integrated pest management program to control this weed and will have a greater awareness of the viability of rhizome fragments and their establishment risks.

Microtopography in Created Northern White Cedar (*Thuja occidentalis* L.) Wetlands, LAURA C. KANGAS[1], RODNEY A. CHIMNER[1], & MICHAEL PENNINGTON[2], [1]MTU, [2]Michigan Department of Transportation

Regeneration of northern white cedar (*Thuja occidentalis* L.) has been problematic for forest managers during the past several decades, with other species frequently replacing cedar after harvest. Northern white cedar is highly valuable both in forestry and for wildlife. Acreage of northern white cedar wetlands is also declining from development, with mitigation efforts failing to reproduce these ecosystems. The goal of this project was to determine the feasibility of creating a northern white cedar swamp as a mitigation option. As microtopography has been shown to be important for northern white cedar establishment and recruitment, a series of mounds, pools, and flats were created and planted with northern white cedar seedlings and wetland herbaceous seed during 2007 in two created forested wetlands in Northern Michigan. We further examined the influence of hydrology, microtopography, and deer browsing on cedar survivorship and height. Three years after establishment, microtopography had a strong effect on cedar survival, with hummocks positively affecting survivorship by creating drier microhabitats at wet sites. Tree height was less affected by microtopography. Protection from browsing increased survival and height, although results were only significant at one site. Incorporating microtopography into future restoration projects involving northern white cedar should be considered as a viable option where high or variable water tables are expected.

Insect and Disease Response to Prescribed Burning, Harvesting and Wildfire in Red Pine Forests, RITA M. KOCH[1], LINDA M. HAUGEN[2], LINDA M. NAGEL[1], MICHAEL E. OSTRY[2] AND ANDREW J. STORER[1], [1] Michigan Technological University [2] USDA Forest Service

The Muskrat Lakes and Sleeper Lake Fire sites represent a rare opportunity to investigate the impacts of both prescribed fire and wildfire on forest health in the fire-adapted species red pine, *Pinus resinosa*. At the Muskrat Lakes Fire/Fire Surrogate Site, treatments were applied that included mechanical harvesting only, prescribed fire only and a combination of prescribed fire and harvesting, as well as untreated control areas. Harvesting occurred in fall of 2005 and prescribed fire treatments in spring of 2006. Damage by red turpentine beetle (*Dendroctonus valens*) was evaluated in a network of plots within the treatment areas. Prior to treatment application signs of red turpentine beetle attack were rare. After treatments (2007-2008), the proportion of standing live trees attacked by red turpentine beetle was significantly higher in the burned treatment areas than the harvest only or control. The shoot blight pathogen *Sirococcus* spp. was monitored using microscope slide spore traps. In 2006, *Sirococcus* spore counts were significantly lower in burned treatment areas than harvest only and control areas and significantly lower in harvest areas than control. This shows a pattern of reduced fungal spore presence in stands that are actively managed. A similar plot network was applied to the Sleeper Lake Wildfire site, a lightning-ignited wildfire that burned 7,365 hectares (18,200 acres) in August of 2007. In the summers of 2008 and 2009, flight intercept traps measured insect response in burned and unburned red and jack pine (*Pinus banksiana*) stands. Sticky traps were used to assess landing behavior on individual scorched red pines. Increased pine engraver beetle, *Ips pini*, activity was also observed following the wildfire. This study will provide useful information to managers interested in using prescribed fire as a management tool in red pine.

Using Measurements of Human Values, Beliefs, and Attitudes as Predictors for Water-Impacting Behaviors in the Great Lakes Watershed. ANDREW T. KOZICH, Michigan Technological University

The Great Lakes watershed is perhaps the most water-rich region in the world, supporting countless species and providing billions of dollars to regional economies. Long-term sustainability of the ecosystem will require management strategies that consider the water-impacting behaviors of residents. However, surprisingly little is known about these behaviors or how they could be related to personal values, beliefs, and societal norms. For policies to be effective, it is critical to understand the public's perceptions of Great Lakes water resources and how their behaviors may impact them. My research addresses this knowledge gap by exploring potential value/belief/behavior relationships using a conceptual model modified from the Theory of Planned Behavior. I also examine how peoples' water-related values could vary by the type of water resource, their proximity to water, and their perceptions of water rights.

Soil Microbial Community Structural and Functional Responses to Short-term Warming in a Temperate Deciduous Forest. CARLEY J. KRATZ[1], ANDREW J. BURTON[1] & ERIK LILLESKOV[1,2], [1]MTU, [2]USDA Forest Service Northern Research Station

Temperatures are predicted to rise 5 °C over the next century due to increased levels of greenhouse gasses in the atmosphere. Globally soils contain about 80% of the carbon which resides in terrestrial ecosystems. Microorganisms act as a major driver of carbon cycling by metabolizing soil organic matter. The mechanisms underlying the storage of soil carbon and how these mechanisms might be altered at elevated temperatures are not well understood. In the short term, if microbial metabolism is limited by temperature then elevated soil temperatures may increase metabolic rates. However, in the long term, availability of labile carbon sources and other resources may become limiting to metabolism. When this occurs the rate of metabolism will decrease, causing an apparent acclimation to elevated temperature. Changes in function of the microbial community mediated by metabolism may co-occur with or be independent of changes in microbial community structure. This study documents the changes in the metabolic function and community structure of the soil microbial community after a short-term warming (+4 °C) and moisture manipulation (+30% ambient precipitation) experiment in a sugar maple dominated forest in Northern Michigan at the Ford Forestry Center. There were no significant differences in the relative abundance of microbial taxa, enzyme activity or biomass-specific microbial respiration between any of the treatments. These results suggest that the experimental manipulations did not cause the microbial community structure to change and that no short-term acclimation of microbial metabolism has taken place. According to typical enzyme kinetics the warmed plots would likely show higher metabolic rates if enzyme activity and microbial respiration were measured at field temperatures. This study was conducted after one month of soil warming and it is possible that more differences between treatments will emerge as experimental manipulation and investigation continues.

Acute Alcohol Ingestion Lengthens Sympathetic Burst Latency in Humans ROBERT A. LARSON, JOHN J. DUROCHER and JASON R. CARTER, MTU

Muscle sympathetic nerve activity (MSNA) is an important modulator of arterial blood pressure in humans. Bursts of MSNA are time-locked to the cardiac cycle with an average burst latency of 1300 ms, and a recent study reports that altered sympathetic burst latencies (SBL) may contribute to syncopal episodes. In the present study, we hypothesize that acute alcohol ingestion will increase SBL. Mean arterial pressure (MAP), heart rate (HR), respiration rate (RR), and MSNA were recorded in 24 subjects (age 24 ± 1 yrs). Subjects were randomly assigned to either the placebo (n=12) or alcohol (n=12) group. Alcohol ingestion significantly increased blood alcohol content (0.00 to 0.08 ± 0.01%; $P<0.001$). Both alcohol (1313 ± 16 to 1350 ± 17 ms; $P<0.001$) and placebo (1266 ± 22 to 1281 ± 19 ms; $P<0.01$) increased SBL, but these increases were significantly augmented in the alcohol group (time × group interaction, $P<0.02$). Alcohol increased resting HR (58 ± 1 to 64 ± 1 beats/min; $P<0.05$), MAP (92 ± 2 to 96 ± 1 mmHg; $P<0.05$), and MSNA (13 ± 2 to 19 ± 3 bursts/min; $P<0.05$), while placebo only increased resting MAP (90 ± 2 to 96 ± 1 mmHg; $P<0.05$). Alcohol and placebo did not alter RR. Changes in SBL were not correlated to changes in HR, MAP, or MSNA in either group. In conclusion, acute alcohol ingestion significantly increases SBL, a finding that could provide mechanistic insight into the increased risk of syncope associated with alcohol consumption.

Dielectrophoretic Spectrum of Human Erythrocytes: Experimental and Theoretical Observations.

KAELA M. LEONARD & ADRIENNE R. MINERICK. Michigan Technological University

Portable, fast medical diagnostic microdevices are a key growth industry that can quantify basic medical information from human blood samples to empower doctors in emergency situations or in international programs like Doctors without Borders. This research determines ABO-Rh blood type using an alternating current dielectrophoretic (DEP) microdevice to measure blood sample responses at varying AC frequencies. In a dielectrophoretic field, cells will either experience positive dielectrophoresis (pDEP) and move to areas of high field density or negative (nDEP) and move towards areas of low field density. ABO antigens are polysaccharide membrane surface chains with a base chain of galactose-N-acetyl-D-glucosamine-galactose-fucose that is the O antigen. A antigens have an N-acetyl-D-galactosamine attached to the second galactose and B antigens have another galactose. AB blood type occurs when the blood cell exhibits both A and B antigens. Rh antigens are a group transmembrane antigens that determine if blood type is positive or negative. To determine if the ABO-Rh antigens are responsible for the differing DEP forces observed, unaltered samples were compared to β(1-3) galactosidase digested blood samples which cleaves the ABO polysaccharides from the membrane surface. In all experiments, packed red blood cells were diluted in a 4% dextrose medium, loaded into a quad device with 100μm electrodes spaced 50μm apart and subjected to an applied voltage of 10 V_{pp}. High frame rate videos (30fps) were recorded and cell position tracked as a function of time. The crossover frequency at which cells switch from experiencing nDEP to pDEP (30MHz to 50MHz range) and then vice versa (greater than 70MHz), was found to be ABO antigen expression dependent in the 30 to 50 MHz range and Rhesus factor presence dependent in the >70 MHz range. Further, blood cell treatment with β(1-3) galactosidase alters the crossover frequencies compared to the unaltered counterpart.

Molecular Basis of Cambial Development in Poplar YANG LI[1], HAIRONG,WEI[1], MTU[1]

The vascular cambium is a meristematic cell population that supports secondary growth in plant stems. A substantial proportion of plant biomass originate from the activity of vascular cambium, however the molecular basis of radial plant growth is still largely unknown. Our work is to understand how the control of gene expression impacts plant growth and plant biomass. The project is to characterize the particular genes that play an important role in xylem expression in poplar. Previous analyses have indicated that Cytokinins are central regulators of cambial activity and Cyclase-associated proteins (CAPs) is involved in plant signalling pathways required for co-ordinated organ expansion. Our aim is to clone these genes and create Overexpression and RNAi transgenic plants by plant transformation and tissue culture techniques. The comparison of phenotype relationships and gene expression via Real-Time PCR between wild type and transgenic plant will address the mode of those gene function in the secondary meristem,vascular cambium. The preliminary results show that the CAP1 plants exhibit slightly curls on the stem decreased rate of root growth and reduced length, which may indicate that CAP1 gene correlate with the formation of actin cytoskeleton. Furthermore, after silencing the Cytokinin Oxidase gene, we observed faster growth and root hair changes. Further analysis including wood section and biomass measurements will be adopted.

Examining Genetic Variation and Local Adaptation in Hybridizing Sympatric Oak Species *Quercus rubra* L. and *Q. ellipsoidalis* E.J. Hill. JENNIFER F. LIND[1], OLIVER GAILING[1], [1]MTU

Climate change is predicted to bring many changes including a northward migration of temperate forest trees. In turn hybridization between related species is expected to increase as a result of new overlapping distribution ranges. Understanding the evolutionary consequences of hybridization will be essential in predicting how forest populations will respond to environmental changes. Interfertile oak species living in sympatry (i.e., showing overlapping distributions) maintain species identity and local adaptations despite high levels of gene flow. *Quercus rubra* L. and *Q. ellipsoidalis* E. J. Hill have a widely overlapping sympatric distribution but grow in different micro-environments. Previous analyses have indicated occasional hybridization. Our study aims to further characterize hybridization between *Q. rubra* and *Q. ellipsoidalis* and to better understand the role of hybridization in adaptive evolution. In particular, microsatellite markers that are derived from genic regions (EST-SSRs or Expressed Sequence Tag Simple Sequence Repeats) and markers derived from non-coding regions (SSRs or Simple Sequence Repeats) provide a way to examine genetic variation in forest tree populations. If species have different local adaptations we expect to see more interspecific differentiation at functional EST-SSR markers than at the selectively neutral SSR markers. In addition, a higher differentiation between populations that grow in contrasting environments relative to populations that grow in similar environments is expected (isolation by adaptation). Preliminary results indicate that there is greater genetic differentiation between adjacent populations growing in contrasting environments than between more distant populations growing in similar environments. Additional markers will be tested to obtain a clearer picture of the genetic variation patterns in these populations.

Spatial Patterning in White-tailed Deer Winter Habitat Use Affects Biogeochemical Hotspots, Eastern Hemlock Regeneration, and Understory Vegetation Dynamics. BRYAN D. MURRAY, MTU

Human activities affect ecosystem structure and function through complex, indirect pathways, which have consequences for biodiversity. The alteration of terrestrial food web composition and structure is a ubiquitous human impact which might have far-reaching and long-lasting impacts on ecosystems. In many parts of the world, humans have facilitated unprecedented increases in native and non-native ungulate populations, including white-tailed deer (*Odocoileus virginianus*) in North America. The primary objective of this proposal is to determine whether winter deer migrations to stands of eastern hemlock (*Tsuga canadensis*) indirectly affect plant communities and tree regeneration through the creation of soil biogeochemical hotspots from urinary and fecal inputs. To determine the impact of deer-facilitated biogeochemical hotspots, bioavailability of the soil minerals NH_4^+, NO_3^-, PO_4^{3-}, Ca^{2+}, K^+, and Mg^{2+} will be measured in 3 hemlock stands where deer are common and 3 stands which are enclosed within a deer exclosure. Ion exchange resin bags will be buried 5cm below the mineral soil surface to measure nutrient flux during spring. The resin bags will be placed in a spatially-structured sampling design so that semivariance analysis can be used model spatial variation in soil nutrients. Understory vegetation communities, tree regeneration, and deer fecal pellets will be sampled across the same study design at the time of resin bag removal to determine if deer-facilitated nutrient hotspots have an observable impact on plant communities. This study design will allow us to test the hypothesis that deer habitat use in hemlock stands increases nutrient availability in plants and drives spatial patterns in understory vegetation and tree regeneration dynamics. These variables are expected to differ between stands within deer exclosures and those which are commonly used by deer.

Local Mechanical Properties of Thin Poly(vinyl alcohol)-Cellulose Nanocrystal Barrier Membranes For Drug Delivery. ANAHITA PAKZAD[1], JOHN SIMONSEN[2], REZA S. YASSAR[1], [1] Michigan Technological University, [2] Oregon State University

Because of its capability to provide permeable and hydrophilic interfaces with body tissue, poly(vinyl alcohol) (PVOH) has been used as a drug delivery vehicle alone as well as in combination with other biomaterials. One of the determining factors affecting the application and compatibility of a material in human body is its mechanical properties, in bulk as well as on its surface. In spite of extensive studies on the preparation and characterization of different biomaterial systems, the correlation of their properties at nanoscale with those in bulk is a relatively unexplored area. In this study, nanomechanical characteristics of thin PVOH-poly(acrylic acid) (PAA)-cellulose nanocrystal (CNC) membranes were studied using nanoindentation module in an atomic force microscope (AFM) and the properties were compared with the macro scale properties obtained by tensile tests.

Here PAA was used as a cross-linking agent (since cross-linking of PVOH is closely linked with its mechanical properties and water content) and PVOH-PAA membranes were reinforced with CNCs, which are hydrophilic, biocompatible, and biodegradable and have a great potential to provide improved mechanical and barrier properties to hydrophobes in polymer matrices.

The results indicated that the incorporation of CNCs and PAA improved the elastic modulus of PVOH. The addition of 10 wt.% CNC and 10 wt.% of PAA or only 15% of CNC had the same effect on the overall modulus. It was found that the composites reinforced with cellulose nanocrystals had smaller indentation imprints and the pile-up effect increased with the increase of cellulose nanocrystal content. It was shown that indentation and tensile test results follow the same trend but in comparison to bulk properties, AFM experiments yielded in higher elastic moduli.

Northern Hardwood Forests of Michigan: Current Management and Potential Future Conditions NAN C. POND[1], ROBERT E. FROESE[1], LINDA M. NAGEL[1], [1]MTU

An assessment of harvesting practices in northern hardwood stands of Michigan was conducted in the summer of 2010. Ninety-six recently-harvested stands were measured. Stands owned by the State of Michigan, corporate landowners, and non-industrial private landowners were included in the sample. Harvesting practices and removal levels were compared to the Arbogast guidelines, a commonly-used northern hardwoods management guide. Quantitative and qualitative results show several different potential future conditions for Michigan's managed forests. A comparison of harvesting practices within and between each landowner type shows that there are some differences in management approaches being used.

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

Rapid blood typing is important because blood transfusions can become faster and save lives. Solution resistance can be measured within seconds in a capillary microdevice. ABO-Rh human blood cells have polysaccharides expressed on and in their membrane which code for the blood type. In these experiments, a micro-device was designed and fabricated to make a circuit with a 200 μm by 1 cm by 70 μm channel with a single measurement electrode (first generation device) and with multiple measurement electrodes (second generation device) filled with blood solution and buffer solutions. LabView, was used to monitor the voltage change with time for first pure buffer and then for 1:1000 dilution of red blood cells in buffer. These voltage traces provided information on buffer solution resistance to current and resistance across blood solutions of different ABO types. The average resistance of two isotonic solutions, 3% dextrose solution and 4% dextrose solution were found to be 0.165±0.00168V and 0.123±0.00704V, respectively. The blood types tested in the first generation device were AB+, O+, A-, O-, A+, and B-. The second generation devices consisted of a micro-device with micropatterned electrodes spaced 25 microns apart that reduced the volume of solution measured and noise across experiments. Our hypothesis is that red blood cell suspensions of different ABO blood types will yield differing solution resistances in a capillary microdevice. If this hypothesis is proven correct, it will demonstrate that ABO membrane antigens have a dominating effect on the cell's ability to conduct current in a solution. If this hypothesis is proven incorrect, this will be useful for generic preparation of all blood samples in medical microdevices. The results were studied carefully and found that the resistance across buffer solutions was very reproducible and that there was a drop in resistance once blood was introduced to the microdevices.

Sustainability of Residue Harvest: an inventory parameterized modeling based approach. TREVOR L.D. ROBERTS, Michigan Tech University

Forest residue products are those typically left after timber harvest and include tree tops, unmerchantable wood and downed dead wood. Removing residues from forests represents a substantial source of biomass feedstock for biofuel production. This scale of removal calls for research to understand the sustainability of residue removal from forests. The scope of the research objective is to address the efflux of carbon and nutrients released from forest residue products, which would otherwise be left on site, and to address recovery of forests' productivity from harvest operations when residue removal is increased. Recovery of soil productivity after harvesting is directly affected by forest management and there is a need to identify the level of organic matter that can be sustainably harvested. There is indication in the literature that carbon and nutrient pools and fluxes are extremely sensitive to site specificity and requires condition specific models to be built. Quantifying the pools and fluctuation of carbon and nutrients in operationally removed residues within the Northern Hardwood Forest Ecosystems is crucial to understanding the sustainability of residue harvesting in Michigan. Preliminary results will be presented from a Michigan based biomass inventory used to parameterize the modeling program CBM-CFS3 (Operational-Scale Carbon Budget Model of the Canadian Forest Sector).

Plant Species Composition in Northern Peatland Ecosystems may have Significant Effects on Carbon Cycling. KARL J. ROMANOWICZ[1], CARLEY J. KRATZ[1], EVAN S. KANE[1,2], RODNEY A. CHIMNER[1] & ERIK A. LILLESKOV[2], [1]Michigan Technological University, [2]USDA Forest Service – Northern Research Station

While previous research has shown strong climatic controls over biogeochemical cycling in northern peatlands, much less is known of how shifts in the abundance and productivity of plant functional groups due to climate change will in turn affect methane (CH_4) and carbon dioxide (CO_2) emissions. We hypothesized that dominant vegetation (sedges, Ericaceae) would significantly impact CH_4 flux as well as alter specific pathways of methanogenesis. Poor fen cores were harvested, housed in mesocosm chambers, and manipulated into a 2 x 2 factorial experiment (±sedge, ± Ericaceae) with peat mosses present in each treatment. Treatments were analyzed for plant community contributions to ecosystem C cycling; specifically gross primary production (GPP), net ecosystem production (NEP), and ecosystem respiration (R_e), as well as atmospheric CH_4 flux. In addition, acetate anion concentrations and the natural abundance of $^{13}CH_4$ were quantified to determine the effects of plant functional groups on the pathways of methanogenesis. The results of this study show two very different effects on methane flux and methanogenesis depending on which successional pathway these plant communities follow. As expected, sedge presence significantly increased CH_4 flux rates through passive diffusion bypassing oxidation in the rhizosphere. Isotopic analysis of $\delta^{13}C$ in CH_4 suggests sedges promote methanogenesis through acetate splitting. A novel result from this study is that treatments dominated by Ericaceae had a distinct tendency to lower CH_4 flux rates more so than treatments containing only mosses. This suggests that Ericaceae may have the potential to stimulate significant methane oxidation in the rhizosphere. Isotopic analysis of Ericaceae confirms increased oxidation and suggests a portion of methane produced through methanogenesis originates from CO_2 reduction. If peatlands transition to sedge dominated systems through climate change, atmospheric methane flux will continue to grow. However, if peatlands become dominated by Ericaceae then global methane flux rates may decline.

Cutting-Edge: TF-Cluster --- A Novel Computer Pipeline for Identifying Regulatory Genes Controlling a Trait via Gene Network Construction and Decomposition, FANG RUAN[1], JEFF NIE[2], RON STEWART[2], HANG ZHANG[1], JAMES THOMSON[1] & HAIRONG WEI[1], [1]MTU, [2]Morgridge Institute for Research

Identifying the key regulatory genes (formally called transcription factors, TFs) controlling a biological process is the first step toward a better understanding of underpinning regulatory mechanisms. However, due to the involvement of a large number of genes and complex interactions in gene regulatory networks (GRNs), identifying TFs involved in a biological process remains particularly difficult. We have developed a computational pipeline called TF-Cluster for identifying a set of TFs in two steps: (1) Construction of a new conceptual coexpression gene network that is represented by coexpression connectivity matrix (SCCM), in which each entry represents the number of shared coexpressed genes between two TFs. (2) Decomposition of the SCCM using a novel heuristic algorithm termed "Triple-Link", which searches the highest connectivity in the SCCM, and then uses two connected RG as a primer for growing a TF cluster with a number of linking criteria. We applied TF-Cluster to microarray data from human stem cells and Arabidopsis roots, and then demonstrated that many of the resulting TF clusters contain functionally coordinated TFs that, based on existing literature, accurately represent a biological process of interest. The high accuracy of TF-Cluster in recognizing true positive TFs involved in a biological process makes it extremely valuable in building core GRNs controlling a biological process. The pipeline implemented in Perl can be installed in various platforms.

Cellulose Synthesis in Trees, HALEY RUPP, CHANDRASHEKHAR P. JOSHI , Michigan Technological University

Genetic manipulation of cellulose biosynthesis in trees will provide important insights into the growth and development of trees. Recently cellulosic biofuels have become important as a part of global bioenergy agenda. Therefore, we are discovering novel ways of improving cellulosic biomass production for efficient biofuel production by understanding how trees synthesize cellulose. We are taking a multi-pronged approach. First, we have characterized expression of several cellulose synthesis related genes from poplar trees. Second, genetic manipulations of many of these genes in transgenic poplar trees have produced interesting phenotypes ranging from increase in the cellulose content and alterations of its properties to significant decrease in wood cellulose amounts. Finally, we have developed a virus induced gene silencing (VIGS) platform for rapid screening and identification of hitherto unknown genes involved in cell wall development with the hope to translate that knowledge to poplar trees. Our long-term goal is to unravel basic process of cellulose synthesis in trees in order to enable economically viable and ecologically sustainable utilization of bioenergy.

Influence of Omega-3 Fatty Acids on Neurovascular Responses to Mental Stress in Normotensive Humans. CHRISTOPHER E. SCHWARTZ[1], MICHAEL J. JOYNER[2], JOHN J. DUROCHER[1], and JASON R. CARTER[1], Michigan Technological University, [2]Mayo Clinic, Rochester, MN

Omega-3 fatty acid (n-3) supplementation has been reported to augment muscle sympathetic nerve activity (MSNA) responses to cold pressor and ischemic handgrip. In contrast, a recent study demonstrates that n-3 supplementation attenuates circulating catecholamine responses to mental stress (i.e. mental arithmetic). In the present study, we hypothesized that n-3 supplementation (i.e., fish oil) would attenuate MSNA responses to mental stress. Thirty six normotensive subjects (age 24 ± 2 yr; 16 male, 20 female) were randomly assigned (double-blinded) to an 8 wk supplementation of fish oil (n=19) or placebo (olive oil; n=17). Fish oil reduced resting systolic arterial pressure (SAP; 110 ± 1 to 107 ± 2 mmHg; interaction, $P<0.05$), but did not change diastolic (DAP) or mean (MAP) arterial pressures (3 day average). Fish oil did not alter resting MSNA or sympathetic baroreflex sensitivity (BRS) as determined by the spontaneous DAP-MSNA threshold analysis. MS significantly increased SAP, DAP, MAP, heart rate, and MSNA burst frequency in both groups during pre- and post-treatments, and these changes were not different between groups. In contrast, increases in total MSNA during mental stress were significantly attenuated by fish oil (Δ9265 ± 2986 to Δ4900 ± 1039 a.u.; interaction, $P<0.05$). In summary, n-3 supplementation decreased resting SAP and attenuated total MSNA responses to mental stress, but these favorable neural and cardiovascular adaptations appear to be uncoupled in normotensive humans.

Invasive Exotic Earthworm Populations within Great Lakes National Wildlife Refuges
LINDSEY M. SHARTELL[1], R. GREGORY CORACE III[2], ANDREW J. STORER[1]
[1]MTU, [2]Seney National Wildlife Refuge

Increasing attention is being directed to the invasion of forests in the Great Lakes region by exotic earthworms (Annelida, Oligochaeta). Though relatively understudied, earthworms are recognized to have significant impacts on forest ecosystem structure and function. They have recently been associated with a decline in native understory plant communities, which is expected to lead to ecosystem level changes. National Wildlife Refuges (NWRs) within the Great Lakes Biological Network (GLBN) have expressed concerns for the ecological integrity of Refuge forests; among these, invasion by exotic pests and pathogens, including earthworms. Few refuges are aware of the current distribution, community composition, and abundance of earthworms within their forests. An initial goal is to assess the current state of invasion by earthworms in GLBN Refuge forests. In 2010, earthworms were sampled in forests at Seney NWR (eastern U.P. of MI), Shiawassee NWR (southern L.P. of MI), and Ottawa NWR (northwestern OH) using the mustard extraction method. Differences in earthworm community composition were observed within and among these Refuges. Additional sampling will take place in 2011 at Rice Lake NWR (central MN), Tamarac NWR (northwestern MN), and Horicon NWR (S. WI). Our research will provide Refuges with a better understanding of earthworm populations, allowing for appropriate management efforts to lessen negative impacts in invaded sites and reduce further spread. In addition to this initial goal, patterns of invasion will be related to forest and landscape characteristics to better ascertain relationships among forest composition and structure, ecological condition, and dispersal pathways in the invasion of exotic earthworms.

Wetland Delineation in the Pilgrim River Watershed: Collaborative Efforts to Conserve a Vital Local Ecosystem. THE SOCIETY of WETLAND SCIENTISTS, MTU.

The Keweenaw Land Trust (KLT) is a local conservation organization assuming a leadership role in the permanent protection of a Pilgrim River riparian ecosystem near Houghton, Michigan. This conservation site currently exceeds 1300 acres and features numerous land-cover types and demands for multiple uses. The KLT must assess the range of conservation values within this parcel as part of their decision-making process for future site plans. The Michigan Tech chapter of the Society of Wetland Scientists is assisting with this process by providing an assessment of the wetland features at the site. We field-delineated wetland zones at the site to improve digital datasets that we found to be inaccurate. We also conducted assessments of soils and land cover. Our final report will provide valuable data to the KLT, and our combined efforts will ensure that this rich natural area is managed to protect the areas of highest ecosystem value while also providing the greatest public benefit.

Development of a Novel Vapor Deposited Silica Sol Particles for Use as a Bioactive Materials System. KATHERINE L. SNYDER[1], MICHAEL J. VANWAGNER[1], DONISHA DAS[1], NICHOLAS SCHAUB[1], NATALIE J. HARTMAN[1], & RUPAK M. RAJACHAR[1], [1]MTU

Nearly half of reported musculoskeletal injuries each year in the U.S. are to soft tissues (tendon-ligament). Although surgical repair and synthetic replacements offer substantial short-term success, these approaches pose long-term problems associated with failure at or adjacent to the site of repair. Consequently, tissue engineering looks to generate replacement tissues capable of restoring native structure and function. Mild processing conditions, the ability to serve as a delivery vehicle for inorganic and organic molecules, and substantial biocompatibility make silica sol-based materials popular for use in orthopedic tissue engineering. Furthermore, these materials possess an inherent active influence on cell behavior, modulated in part by surface chemistry and topography of the material. Using a novel nebulizer-based vaporization method, we aim to develop vapor deposited sol nano-particles with properties can be easily adjusted through manufacturing parameters and the incorporation of directive factors. We hypothesize that these particles can be used in conjunction with other biomaterials to create a bioactive material system that promotes appropriate cell behavior as a means for orthopedic tissue regeneration. The objective of this study was to establish dimensional analysis methods for synthesized particles and to evaluate the effects of key parameters (H_2O: tetramethyl orthosilicate (TMOS) molar ratio, pH, molecule incorporation) on particle chemical and physical properties. We are able to generate stable nebulizer based sol-particles whose size distribution-morphology and degradation can be modulated by changing the H_2O:TMOS molar ratio and/or the base sol pH. These particles can potentially be used to control the surface properties of substrates (i.e. hydrophobicity and mean surface roughness). Further, secondary molecules can successfully be incorporated into sol materials to generate particles of controlled hydrophilic character and size distribution. Calcium and phosphate ions can also be released from these particles and their release facilitates highly organized apatite-like mineral growth on 2D and 3D scaffolds.

Dielectrophoretic Response of Liposome-Core, Chitosan-Shell Nanoparticles CHUNGIA YANG[a], CHUN-JEN WU[b], AGNES OSTAFIN[b], ADRIENNE MINERICK[a],[a]Michigan Technological University, [b] University of Utah

Chitosan core-shell nanoparticles have beneficial properties for a variety of applications including encapsulated drug delivery, microreactors, and as structures to promote coherent light. Precise positioning of the nanoparticles in three dimensions is a challenge and necessary for many of these applications. Dielectrophoresis (DEP) is technique to manipulate, separate, and assemble polarizable synthetic particles or biological cells in solution using non-uniform AC electric fields within a microfluidic device. Chitosan is linear polysaccharide molecule with favorable biocompatibility, biodegradability, and low toxicity that is widely used in pharmaceutical and cosmetic applications. We report the frequency dependent responses of ~250nm chitosan core-shell nanoparticles to faciliate pearl-chain assembly of the nanoparticles in two dimensions. The experiments were conducted within a custom microdevice with 100um wide Au quadrupole electrode configuration within a 50nl chamber fed by 200um wide inlet and outlet channels. Frequencies from 100kHz to 80MHz at a fixed local field of $10V_{pp}$ were explored along with optimization of the nanoparticle concentration and medium conductivity and composition. Dielectrophoretic responses were classified as negative DEP where particles moved away from higher electric field, positive DEP where particle moved toward higher electric field, or zero DEP where particles cease to move also known as the crossover frequency (COF). The frequency-dependent motion was quantified via image intensity profiles in two perpendicular planes. These results represent a first step in ascertaining the electrokinetic properties of core-shell nanostructures; the work has implications in structural packing of similar polarizable particles for coherent light applications.

Sex-Related Differences in Firing Patterns of Integrated Muscle Sympathetic Nerve Activity in Humans. HUAN YANG[1], WILLIAM H. COOKE[2], KRISTEN S. REED[1] & JASON R. CARTER[1, 1]MTU, [2]UTSA

Recent studies demonstrate that the regulation of basal muscle sympathetic nerve activity (MSNA) is sex-dependent. The purpose of the present study was to determine if firing patterns of integrated MSNA differ in men and women. In *Study 1*, we hypothesized that men would demonstrate a higher percentage of consecutive bursts of integrated MSNA at rest compared with women. MSNA and diastolic arterial pressure (DAP) were recorded during a 5 min baseline in 31 men and 28 women (age 22 ± 1 yrs). Men demonstrated a higher percentage of consecutive bursts (49 ± 4 vs. 35 ± 3%; $P<0.05$) and DAP-MSNA coherence (0.49 ± 0.03 vs. 0.42 ± 0.02 au, $P<0.05$) compared to women. Moreover, DAP-MSNA coherence was significantly correlated to percentage of consecutive bursts in men ($r=0.54$, $P<0.01$), but not women. In *Study 2*, we hypothesized that percentage of consecutive bursts would increase more dramatically in men during lower body negative pressure (LBNP). 13 men and 13 women (age 24±1) were examined during progressive LBNP (-5, -10, -15, -20, -30, and -40mmHg). Men demonstrated a higher percentage of consecutive bursts during baseline and all stages of LBNP (group, $P<0.05$), but the percentage of consecutive bursts increased similarly during progressive LBNP between sexes (time × group, $P=0.51$). In conclusion, men and women demonstrate altered firing patterns of integrated MSNA that appear to be related to differences in DAP oscillatory patterns.

Variation in Carbon Stocks of Selected Tropical Trees Species from Ghana: DANIEL YEBOAH[1], ANDREW J. BURTON[1], ANDREW J. STORER[1] & EMMANUEL OPUNI-FRIMPONG [2]. [1] MTU, Houghton, Michigan, [2]Forestry Research Institute of Ghana

Research on carbon stocks of trees has focused on temperate species with little information on tropical tree species. This study investigates the carbon stock of selected tropical tree species and compares *Khaya spp* from two ecozones in Ghana. Two to three individuals of 18 tree species were randomly selected and harvested from 12-7-year old plantations. The diameter at breast height and total heights of the trees were determined. A 2 cm thick disc was cut at the base, middle and top positions of the main stem of each tree, and the respective diameters measured. Volume and weights were measured on wedge-shaped sections of wood from each disc to estimate wood density and carbon concentration using an elemental analyzer. Estimates of total tree carbon were computed using tree volume, density and carbon concentration. Our results indicate significant differences in carbon concentration, wood density and carbon stocks of 12-year old tree species. Average carbon concentration of the tree species ranged from 46.3- 48.9%. Volume for the 12 year old trees species varied widely, from 0.01 m^3 to 1.04 m^3. Wood density varied slightly among the three stem positions and was highly variable among species, ranging from 0.27 g cm^{-3} to 0.761 g cm^{-3}. The wide range and variability of tree species density suggest that it was the most crucial factor influencing carbon stocks of the trees species that is not considered when calculated volumes are converted to carbon stocks. Significant differences existed in density of *Khaya spp* from wet and moist ecozones. We have derived allometric equations for mixed-plantation stand for wet evergreen forest that verifies the expected strong relationship between tree volumes and dbh, volume and $dbh^2 \times$ height. This study has provided baseline species-level information which will be useful for carbon accounting and development of carbon sequestration strategies in Ghana.

One-pot Efficient Synthesis of Dimeric, Trimeric, and Tetrameric BODIPY Dyes for Panchromatic Absorption. JINGTUO ZHANG, SHILEI ZHU, GIRI K. VEGESNA, SARA A. GREEN, HAIYING LIU, RAVINDRA PANDEY , MTU

4, 4-Difluoro-4-bora-3a, 4a-diaza-s-indacene (BODIPY) dyes have received an upsurge of interest because they possess a variety of distinctive and desirable properties such as high absorption coefficients, narrow absorption and emission bands, good stability, excellent emission quantum yields, and have promising applications in supramolecular fluorescent gels, solar cells, sensing and imaging. A series of BODIPY-based oligomers, polymers and dendrimers have been reported. These oligomeric and polymeric BODIPY dyes display significant red shifts in absorption and emission, and possess broad absorption bands compared with their monomeric forms. Polymeric BODIPY dyes have been shown to have promising applications in solar cells. However, in most previous reports, multistep organic reactions were required, employing several protecting groups and reactive intermediates, in order to prepare oligomeric and polymeric BODIPY dyes. These tedious procedures limit practical use of these new BODIPY dyes. It is highly desirable to develop a facile, efficient and cost-effective method to prepare oligomeric BODIPY dyes for potential solar cell and other applications. In this poster, we report efficient synthesis of dimeric, trimeric and tetrameric BODIPY dyes with a formyl capping end group through a one-pot Knoevenagel self-condensation reaction of β-formyl BODIPY dye. The formyl capping end group of these new BODIPY dyes can be further functionalized with a variety of groups, e.g. a cyanoacrylic acid electron acceptor group, through the Knoevenagel reaction. These BODIPY dyes display panchromatic absorption from visible to partial near-infrared regions.

Nitrous Oxide Emissions from a Maize/Soybean Rotation. JIANQUI ZHENG & PAUL V. DOSKEY, MTU

Agricultural soils are the largest anthropogenic source of nitrous oxide (N_2O), which is one of the major greenhouse gases. Production of N_2O in soils is regulated by the activities of nitrifying and denitrifying microorganisms and agricultural activities, such as fertilization, tillage, and crop rotation. The estimated uncertainty of N_2O emissions from agricultural soils is about 70%-80%, which makes identifying and reducing these uncertainties the primary goal of N_2O studies. Novel process-scale models that link microbial population dynamics with soil nitrogen cycling are needed to reduce uncertainties and to improve predictions of N_2O emission rates.

The field investigation will be conducted in a corn/soybean rotation at the AmeriFlux site in Bondville, Illinois. Regular monitoring of soil physical and biochemical properties and N_2O exchange fluxes will be conducted. Emissions of N_2O will be measured at the plot and landscape scales by the static chamber and flux-gradient techniques, respectively. Soil moisture and temperature will be measured at several depths with wireless sensors. Soil samples will be collected for investigation of microbial communities. Soil microbial community composition will be characterized using phospholipid fatty acid (PLFA) analysis. Detailed study and quantification of nitrifying/denitrifying groups will be based on DNA sequencing and quantitative PCR data. Stable isotopic analysis of N_2O in soil gas and plot- and landscape-scale emissions will be used to partition the N_2O flux into nitrification and denitrification sources. A process-based nitrogen-cycling model will be developed based on the soil property data and the corresponding microbial community analysis. Data from measured fluxes and stable isotope analysis will be used to evaluate the model.