

## 2008 Spotlight on Undergraduate and Graduate Research Abstracts

### 1. BIOCONVERSION OF XYLOSE, YEAST EXTRACT AND CHEESE WHEY TO ETHANOL *Z. MOBILIS*

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Yeast extract is typically used as a nitrogen source for ethanol production from xylose by *Zymomonas mobilis*. Cheese whey, another nitrogen source, is a waste product of the cheese industry making it a more inexpensive and recycled option for ethanol production. The ability of *Z. mobilis* to produce ethanol from xylose in combination with these two different nitrogen sources was investigated. *Z. mobilis* was grown on different concentrations of yeast extract and cheese whey with a fixed concentration of xylose. Samples were taken from each treatment after 0, 24, 48 and 72 hours. The samples were measured for ethanol and xylose content using GC and HPLC respectively. All of the samples showed a decrease in xylose concentration and an increase in ethanol concentration over time. The yeast extract cultures produced more ethanol and utilized more xylose over time than the cheese whey cultures of the same concentrations. This study suggests that *Z. mobilis* is more efficient at producing ethanol from yeast extract than cheese whey as a nitrogen source.

### 2. DETERMINATION OF GENETIC FINGERPRINTS OF 16 VARIETIES OF SHRUB WILLOW (*SALIX* SPP.) THROUGH MICROSATELLITE ANALYSIS

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The cross hybridized and cloned willows were propagated for commercial use as a biomass source. It is difficult to distinguish them by their morphology. Therefore, the molecular level analysis was needed to identify them. Microsatellites are tandemly repeated sequences at non-coding regions and are highly variable, so that microsatellite analysis can be useful as genetic markers for variety identification. Genotypes were determined at eight microsatellite loci to analyze their fragment lengths at those loci. The DNA was extracted from sixteen willow varieties. Fluorescently labeled PCR product was purified to reduce the PCR reaction residues. Fragment analysis by Applied Biosystems Automated 3730xl DNA Analyzer resulted that some PCR products had relatively high peaks compare to other PCR products. Not all genotypes were worked, but the seven species' unique genotypes were identified according to the fragment analysis with eight loci.

### 3. A POST-AUDIT OF A NITROGEN MODEL FOR A SEVERELY POLLUTED URBAN LAKE

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A post-audit of a two-layer nitrogen (N) model for Onondaga Lake, Syracuse, New York was conducted. Calibration and verification of models is common, however, post-audits are typically not conducted. The N model was developed to simulate nitrogen cycling and predict total ammonia (T-NH<sub>3</sub>) and nitrogen oxides (NO<sub>x</sub>) for various loading reduction management alternatives. The N model had been previously calibrated and verified for the years of 1988-1989. The post-audit included extending the model testing for an additional 16 years, 1990-2007. Over this period loading to the lake dropped by approximately 40%. Model performance was evaluated graphically by examining time-series of observed versus predicted T-NH<sub>3</sub> and NO<sub>x</sub> and quantified by calculating the root mean square error for those differences. The post-audit showed T-NH<sub>3</sub> and NO<sub>x</sub> were both over predicted in the upper mixed layer throughout the study period. Three changes were made to the model to reflect changes in the in-lake processes. First, the period of anoxia, originally fixed, was made dynamic to reflect reduced period of anoxia. Second, the sediment release rate was changed to allow for a dynamic value, reflecting the decrease in sediment release observed over this extended period of time. Third, the original model allowed for only uptake of T-NH<sub>3</sub>. Based on recent observations the nitrogen uptake process in the model was revised to allow for uptake of N from both the T-NH<sub>3</sub> and the NO<sub>x</sub> pools, with T-NH<sub>3</sub> taken up preferentially. The revised model improved its performance significantly.

#### **4. INVERTEBRATE DIVERSITY IN MOSS ON DIFFERENT SUBSTRATES**

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We decided to investigate whether the invertebrate load of a certain type of moss differed depending on the substrate the moss was growing on. It was purely an investigative study and we had no preconceived hypotheses about which substrate type would yield the highest number or most diverse community of invertebrates. We selected moss found on four different substrates, stone (boulder), dead tree, live tree, and soil. Ten samples were collected from each substrate type. We measured the percent coverage and height of the moss, and preserved the invertebrates in ethanol. We counted number and type of invertebrates present. Our results demonstrated that the samples from the stone substrate were significantly different from the other three substrates. A Simpson's Diversity index revealed greater species diversity in moss on the boulder substrate with an index of 5.0479. The Shannon Weiner (H) result was 1.17 for stone compared to an average of 0.7 for the other three substrates. We think that the greater evenness of the boulder substrate can be attributed to niche partitioning among the invertebrate species found there

#### **5. ASTEROID DISTRIBUTION AND SPECIES ABUNDANCE OF HERON ISLAND AUSTRALIA**

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Heron Island is a small cay located in the southern Great Barrier Reef. The surrounding waters contain at least 5 different species of Asteroids. We conducted a census in order to determine the population distributions around the island. The number of species were distributed equally all around the island, however the populations were discovered to be statistically larger on the windward side of the island. In addition, the ambulacral groove length was statistically shorter on the windward side of the island in contrast to disk size, which was on average longer than on the leeward side. Our distribution data could be used in conjunction with further studies in order to create a sound conservation plan for the island.

## **6. SAVING YOUR ASH... FROM EMERALD ASH BORER, AN INVASIVE WOOD-BORING BEETLE**

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The objective of this senior capstone project was to develop an informative pamphlet and poster on a recently discovered invasive beetle. Emerald ash borer (EAB) (*Agrilus planipennis*) was discovered in Michigan in 2002 and has since been found in Indiana, Ohio, Illinois and Pennsylvania and Canada. Recently, EAB was discovered on the strip of land located between Niagra Falls, NY and Toronto, Ontario. Invasion of New York forests is considered imminent and unavoidable. Impacts of this aggressive wood-boring insect are that colonized ash trees (*Fraxinus* spp.) experience 100% mortality. Ash trees are important components of northeastern forests. Green ash trees have important ecological roles in riparian areas and are economically important as they are widely planted in urban areas. White ash is an important timber species as it used to make tool handles and baseball bats. Black ash trees are ecologically important in northern wetlands and also are culturally valuable as they are used by Northeastern indigenous people to make intricate baskets. Movement of EAB to new areas is often facilitated by transportation of firewood in which larvae are present. The best way to avoid EAB movement is through education, following local firewood ordinances and to purchase of local firewood. The target audience of this outreach is the general public, specifically both urban and rural users of firewood and wood products. The Forest Health division of the New York State Department of Environmental Conservation is a cooperating partner and project success will be pamphlet distribution and increased public awareness of EAB.

## **7. A COMPARISON OF THE DIASPORE RAIN COMPOSITION BETWEEN THE EDGE AND INTERIOR ENVIRONMENTS IN FABIUS SWAMP, ONONDAGA COUNTY, NY.**

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Human activity has resulted in extensive fragmentation of habitats, which is known to significantly affect biodiversity. Northern white-cedar swamp communities are rich in bryophytes and have been

significantly impacted by habitat fragmentation. While bryophytes (i.e. mosses and liverworts) are small in stature and often overlooked, they contribute significantly to biodiversity and may be indicators of ecosystem function. Bryophytes are particularly vulnerable to the negative effects of habitat fragmentation due to their limited dispersal ability. As part of a larger study on the effects of habitat fragmentation and the resultant increased proportion of edge environment, the composition of the bryophyte diaspore rain was examined. Bryophytes reproduce using a variety of diaspores including spores, gemmae, and gametophyte fragments, all of which can be present within the diaspore rain. During the 2007 growing season, diaspore traps with four substrate types were placed at three sites within Fabius Swamp, Onondaga County, NY. The traps were collected and placed in a greenhouse under conditions suitable for diaspore growth. The four substrates yielded different bryophyte compositions. The composition of the diaspore rain was compared between edge and interior environments, 10 m and 100 m from the edge, respectively. Several taxa found within the diaspore rain were absent from the existing communities. These observations can be explained, in part, by the life histories of the different species, but may be suggestive of limitations to current understanding of dispersal abilities in certain taxa. This work will help assess the vulnerability of bryophytes to impacts of fragmentation.

## **8. FATTY ACID COMPOSITION OF THEMARINE MACROALGAE DICTYOTA DICHOTOMA AS AN INDICATOR OF REEF HEALTH.**

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The health of coral reefs on the whole is decreasing in environments close to shore. Human development is speculated to be one of the main causes of this decline. The focus of this experiment is to assess the overall condition of coral reef ecosystems on and offshore in the Florida Keys. To do this and still preserve the delicate coral, the marine macroalgae, *Dictyota dichotoma*, on the coral were analyzed for their fatty acid compositions and concentrations. The isolated fatty acids were analyzed by gas chromatography. The results could be analyzed in two ways. The concentration of fatty acids in the samples is an indication of overall production in the plant, and therefore reflects on the overall health of *Dictyota* within the ecosystem. The composition of the fatty acids can also be looked at as an indicator of overall health of the other organisms that depend on the *Dictyota* to obtain essential fatty acids, that they themselves can not produce. The essential fatty acids that are produced by *Dictyota* are DHA (22:6w3) and EPA (20:5w3). *Dictyota* contains up to 8% by weight of EPA, and approximately 1% by weight of DHA. These fatty acid compositions are being compared to each other at eight different sites. One possible way to further investigate this analysis would be to explore the relationship between the plants and the coral directly. In other words, when the coral health is lacking, does the production in the *Dictyota* plants increase, decrease, or simply remain the same.

## 9. QUANTIFICATION OF DIMETHYLSULFOXIDE IN SEAWATER

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Dimethyl sulfoxide is a key intermediate in the marine sulfur cycle. However, very little is known regarding the factors that affect its concentration in the water column, and what is known is contradictory owing to analytical constraints. Therefore, three analytical methods used for the detection and quantification of DMSO in seawater were compared to evaluate differences. All three methods are based on the reduction of DMSO to dimethylsulfide (DMS), which is subsequently analyzed by gas chromatography. Each of the three methods uses a different reducing agent: titanium chloride ( $\text{TiCl}_3$ ), cobalt-doped sodium borohydride ( $\text{Co-NaBH}_4$ ) or DMSO reductase. All three methods agreed within experimental error for aqueous DMSO standards. However, analysis of several marine algal cultures including *Isochrysis galbana* and *Amphidinium caterae* showed differences. In all cultures, the three methods yielded the same dissolved DMSO ( $\text{DMSO}_d$ ) concentrations, irrespective of the algal growth stage. In contrast to  $\text{DMSO}_d$ ,  $\text{DMSO}_p$  was greatly overestimated by  $\text{Co-NaBH}_4$  reduction method compared to the  $\text{TiCl}_3$  or the enzyme reduction techniques, the latter two of which agreed quite well. The magnitude of the overestimation was different between cultures, suggesting a species-dependent interference. These findings will be discussed in the context of our current understanding of the marine DMSO cycle.

## 10. ASSESSING RECOVERY AND COMPOSITION OF A BENTHIC MACROINVERTEBRATE COMMUNITY FOLLOWING REMEDIATION IN ONONDAGA LAKE, NY

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Over 100 years of anthropogenic pollution in Onondaga Lake, NY, have led to sediments saturated with numerous toxic contaminants, limiting the benthic macroinvertebrate community able to live there. Our objective was to determine whether the current restoration plan, including the dredging and capping of contaminated sediments, is sufficient to restore a more diverse and less contaminant-influenced macroinvertebrate community. We used a field experiment to eliminate poor sediment quality as a factor in recovery and determine the naturally dispersing community pool of macroinvertebrates. Hard (unglazed tiles) and soft substrates (planting pots with sterilized Otisco Lake sediment), representing macroinvertebrate habitat, were deployed in the littoral zone of Onondaga Lake. We repeated the experiment in Otisco Lake, a similar unpolluted lake in the same watershed which serves as a reference for the regional community and rates of dispersal. Each month, substrates were collected and the number and taxon of colonists are currently being assessed. We will eventually compare the observed colonization by the macroinvertebrate community in Onondaga Lake to both the existing species composition in Onondaga Lake and the colonization measured in unpolluted Otisco Lake. Here, we use preliminary data, from August tiles, and compare composition, diversity and level of impairment within

and between each lake. We also report on the colonization of a new Trichopteran species in Onondaga Lake. The final results of this study will help determine whether supplementing Onondaga Lake with local species after sediment remediation will assist a full and speedy recovery, and has implications for the effects of remediation to higher trophic levels.

### **11. DOES MICROCLIMATE AFFECT THE PLACEMENT OF GOLDEN ORB-WEAVER SPIDER WEBS?**

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The golden silk orb-weaver spiders are a group that can be found throughout the world. These spiders rebuild their webs regularly at about the same location every time (Brunet, 1996). In an attempt to explore the placement of these webs we recorded a number of microclimatic factors in Jindalba forest at Daintree National Forest, Queensland, Australia. For each web found, we recorded a non-web sample 5 m away. The wind was predominantly from the north and northwest, while the percentage of spiders oriented in those directions was least. As web height increased, web size also increased. We did not find any significant difference in microclimate between sites with and without spiders, so we cannot conclude that spiders chose their web locations based on microclimate.

### **12. SURVEY OF FUNGI IN LAMINGTON NATIONAL PARK, AUSTRALIA**

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This study examined fungal communities in Lamington National Park in Queensland Australia. We calculated fungal community similarity indices and species richness across subtropical, temperate and disturbed environments. In total, we found 121 distinct species across all environments. We found 67 species in the subtropical environment, 35 in the temperate environment, and 26 in the disturbed environment. None of the indices of community similarity showed a high level of similarity between any two environments, suggesting that the macrofungi in Lamington National Park are both highly diverse and sensitive to microclimate and general environmental variation.

### **13. EVALUATION OF DIFFERENT APPROACHES TO ESTIMATING MERCHANTABLE BOLE VOLUME FOR DIFFERENT UTILIZATION STANDARDS IN *PINUS OCCIDENTALIS***

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To properly evaluate the effect of different forest management alternatives on long-term wood yields and to ensure that harvest levels are maintained at sustainable levels, it is necessary to develop appropriate

tools that will provide reliable estimates of current and future inventory levels. One such set of tools are accurate individual-tree, merchantable volume tables/equations that have the capacity to separate volume estimates for a diversity of wood products. This research evaluated different approaches for estimating merchantable bole volume that explicitly incorporates a product distribution component. Data from 191 trees of *Pinus occidentalis* sampled from three different “life zones” of La Sierra, Dominican Republic were used in the evaluation. Separate models for each zone were required. Wood product distribution was based on current local utilization standards. The evaluation included the development of taper equations which permit volume estimation to different merchantable upper diameter limits, and total bole volume equations with proportional product distribution adjustments. Evaluation was based on goodness-of-fit in total wood product volume prediction. Results showed that total bole volume prediction with a proportional product distribution adjustment factor provided better results compared to product volume estimates derived from taper equations. Significance of results with respect to efficient use of wood resources and maximizing wood product revenues are discussed.

#### **14. REHABILITATION OF EDWARD’S FALLS DAM ON LIMESTONE CREEK IN MANLIUS, NY**

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Edward’s Falls Dam has been identified as both a safety and ecological hazard by the New York State Department of Environmental Conservation (NYS DEC). At more than 100-years old, the dam structure—with little to no annual maintenance since its construction—is deteriorating and ultimately fails to meet current dam safety regulations. The Dam has been classified by the NYS DEC as Class B intermediate hazard dam; which implies that failure would result in ecological, property and road damage, as well as the disruption of important utilities. In addition to the structural issues with the dam, the spillway is currently inadequately designed to manage 150% of a 100-year flood as required by the NYS DEC, thus creating the potential for flooding during a major storm event. As part of FEG489: Engineering Planning and Design, our research has detailed design alternatives for dealing with the challenges associated with Edward’s Falls Dam. These alternatives include the complete removal of the dam, a partial reduction in the height of the Dam, or maintaining the current structure while redesigning the spillway. Each alternative has been ranked using decision criteria that address financial, structural and cultural considerations. Based on these decision criteria, our recommended design is to remove the current dam structure. Detailed specifications of the recommended design will be presented and a written and oral presentation of the design process will be provided to the client and community stakeholders.

#### **15. ATTEMPTS TO PREPARE CARBOXYMETHYL-CELLULOSE DIRECTLY FROM WOOD SUBSTRATES**

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Carboxymethyl-cellulose (CMC) is an important industrial polymer widely used as additives in food, drug, cosmetics, detergents and paper products. It is generally prepared from a pure cellulose substrate such as cotton cellulose or dissolving pulp. The latter cellulose pulp is obtained from wood by a series of pulping and bleaching operations to remove the lignin component. Ideally, it would be very beneficial if CMC could be prepared directly from a wood substrate. This concept is being examined in this study for both softwood and hardwood. The initial carboxymethylation (CM) of aspen wood meal sample was conducted with monochloroacetic acid and alkalis in an acetone-ethanol mixture (7:3) at 50°C for 4h. The product mixtures were separated into a water-soluble (37%) and a water-insoluble (63%) fraction. The lignin content for the soluble fraction was determined to be 9% and was higher (20%) for the insoluble fraction. It appears that the bulk of the polysaccharides present in the water-soluble fraction are associated with the hemicelluloses, and the polysaccharides remained in the insoluble fraction are most likely to be the cellulose component. In addition, the nature of the reaction media was shown to have a significant influence on the CM process in terms of the product yields and compositions. The present results indicate that a second CM treatment or separation of the water-insoluble fraction is necessary for the CMC preparation, and this study is continued further.

#### **16. SYNERGY BETWEEN THE NSF GK-12 PROGRAM AND THE ESF IN THE HIGH SCHOOL PROGRAM: ENRICHING K-12 EDUCATION AND CREATING COLLABORATIVE PARTNERSHIPS BETWEEN HIGH SCHOOLS AND HIGHER EDUCATION**

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The National Science Foundation (NSF) GK-12 program provides graduate students in science, technology, engineering, and math disciplines an opportunity to work in K-12 education. By interacting with teachers and students at high schools, graduate students improve communication and teaching skills, while enriching K-12 education and creating collaborative partnerships between high schools, science education, and higher education. Through a NSF GK-12 grant awarded to the SUNY ESF Outreach Office, nine graduate students (Fellows) are working collaboratively with the Syracuse City School District and other schools in New York State to infuse scientific research and inquiry-based learning into science education.

The Global Environment is a college level course offered to high schools through the ESF in the High School (ESFHS) program. This ESFHS program serves as the foundation for our NSF GK-12 project. Fellows are partnered with local high school teachers at nine home schools to infuse their knowledge, skills and expertise into the Global Environment course. In their home schools the Fellows bring research into the classroom, by using their graduate research as examples of the scientific method and by guiding

students in developing and completing independent research projects. These research projects are showcased at the end of the year at Environmental Summit, where student present their work. Additionally, Fellows take inquiry-based lessons on the road to the 25 participating schools. Ultimately, the ESFHS and the NSF GK-12 programs aim to produce scientifically literate, well-informed young adults who possess the skills required to meet society's immediate and future challenges.

### **17. INTERACTION OF A CULTURALLY SIGNIFICANT PLANT, *HIEROCHLOE ODORATA*, WITH ITS ENVIRONMENT AND ITS SUBSEQUENT SUCCESS**

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The effect of surrounding plant composition, soil pH, soil composition, moisture, and nutrient levels on plant survivorship and growth are critical to understanding the interaction of a species with its environment. This knowledge is especially crucial when applied to efforts that aim to restore and preserve *Hierochloe odorata* (sweetgrass). The survival and growth of sweetgrass transplants in five habitats, including man-made gap, fern glade, spruce-tamarack bog, beaver meadow, and woodland edge at Cranberry Lake Biological Station in Cranberry Lake, NY were examined. Data was compared to a pre-existing stand at LaFayette Field Station in Syracuse, NY as a control. The effect of clipping surrounding vegetation on sweetgrass survival and growth at transplant sites was also recorded. There was no significant difference in clipped and unclipped plots. The fern glade had the highest average survivorship, 55.0%, and the gap had the highest mean growth, 9.3 cm, for transplant sites. When transplant sites were compared to LaFayette, LaFayette was found to have the second lowest mean growth, 0.8 cm. Soil pH, nitrogen and organic matter composition were statistically different among sites; however, little evidence supports a connection between survivorship, growth and those factors. Disturbed and open sites, such as the gap, experienced greatest sweetgrass growth regardless of whether sweetgrass was transplanted or previously established.

### **18. THE USE OF COMPUTER MODELS IN COLLABORATIVE DECISION-MAKING IN THE GREAT LAKES: TWO CASE STUDIES**

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Two evolving dynamics are a feature of environmental decision making. First the movement to empower participants in developing and implementing solutions and second the use of models as tools to inform decisions within complex scenarios. The co-evolution of these dynamics aids stakeholders with different perspectives to understand the system in question. This study examined these movements focusing on the ways in which the decision to use computer models influenced the definition of the issue, the allocation of resources, the group structure and the decision process, by using semi-structured interviews in two case studies from the Great Lakes system: Salmon Stocking in Lake Ontario (1992 – 1997) and Lake Ontario-Saint Lawrence River Study (2000 – 2007). We found that the unilateral selection of a modeling

framework constrains the decision process. An agreed definition of the issue sets for a smoother process. In conclusion, the value of computer models is not only determined by output's certainty but also by the thoughtfulness and preparation of its development process.

## **19. EFFECTS OF PROCESS ORIENTED GUIDED INQUIRY LEARNING IN THE LARGE LECTURE HALL SETTING**

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Student learning styles are never consistent, so teachers must endeavor to find a way to appeal to all the learning styles of the students. Process Oriented Guided Inquiry Learning (POGIL) is a development to aid in this endeavor. POGIL gives the students the basis to solve a problem, but relies on the student to find the process to get to the answer. This helps the student better understand the material and the application of the material taught in class. We implemented the POGIL techniques of learning into one section of General Chemistry II for a specific topic, to compare the effects of POGIL on the students understanding of the material as compared to the traditional lecture style of learning. It is our hope that the POGIL technique improves upon the traditional lecture style of teaching that has been performed in the past. We will be evaluating its success based on the test grades of the specific topics covered by the POGIL technique in the specific sections of General Chemistry II.

## **20. EVALUATING SOLUTE FLUXES AND CONCENTRATIONS IN AN ADIRONDACK WATERSHED: A COMPARATIVE APPROACH FOR EXAMINING EFFECTS OF ATMOSPHERIC DEPOSITION**

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Two independent studies have evaluated the effects of atmospheric and specifically acidic deposition on surface waters of the Adirondack Mountains in New York State (USA). The Arbutus Lake Watershed was sampled weekly by the Biogeochemical Laboratory at the State University of New York, College of Environmental Science and Forestry (SUNY-ESF) and monthly by the Adirondack Long Term Monitoring (ALTM) program. Comparisons between weekly and monthly measurements found differences of <7% for most solute concentrations. Differences in annual discharge flux concentrations were also generally very small for both sampling protocols. Monthly solute fluxes calculated for ALTM and SUNY-ESF chemistry differed markedly for maxima/minima values. These results suggest that effects to surface waters from changes in atmospheric deposition can be quantified from monthly sampling, but that other factors like climate change that would be more closely linked with changes in discharge will require more frequent sampling protocols.

## **21. NEUROANATOMY OF THE PREFRONTAL CORTEX AND CEREBELLAR VERMIS IN CHILDREN WITH AUTISM: A VOLUMETRIC MRI STUDY**

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Autism is a genetic disorder that shows abnormalities in behavior, such as language impairments, social and emotional problems, and repetitive or restricted manners. Individuals with autism often demonstrate volumetric abnormalities in specific regions of the brain, such as the cerebellar vermis and prefrontal cortex. Volumetric data of the cerebellar vermis and the prefrontal cortex was obtained using Magnetic Resonance Imaging (MRI) brain scans that were collected from autistic twin children. Four subregions were studied, the anterior and posterior vermis, the dorsolateral prefrontal cortex (PFC) and the dorsomedial PFC. Anterior vermis, posterior vermis and dorsomedial vermis show no significant difference in the brain volumes when compared to co-twins and control subjects. The dorsolateral PFC showed a significantly larger volume when compared to co-twins and control subjects. Knowing the neuroanatomical changes in the human brain will be very beneficial in advancing our knowledge about autism.

## **22. IMMUNOPRECIPITATION FOR THE COMPARISON OF $\alpha$ -DYSTROGLYCAN IN WILD-TYPE MICE AND POMGnT1 KNOCKOUT MICE AND PROTEOGLYCAN SEPARATION**

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Congenital muscular dystrophies (CMD) with brain malformations, such as Walker–Warburg syndrome (WWS) muscle–eye–brain disease (MEB) and Fukuyama CMD (FCMD) and muscular dystrophy type 1D, are a group of genetic disorders characterized by muscular dystrophy, retinal atrophy, and type II lissencephaly at birth. Proteins encoded by these genes have glycosyltransferase domains that are believed to be involved in the synthesis of O-mannosyl glycans. Proteoglycans (PG) and dystroglycan (DG) are conjugated by these O-mannosyl glycans. Lack of O-mannosylation in proteoglycans in congenital muscular dystrophies play important roles in the pathomechanisms of the disease. This experiment will reveal the presence or absence of O-mannosyl glycans in the brains of mice by performing an immunoprecipitation using monoclonal antibodies against  $\beta$ -DG, which, in theory, would also precipitate  $\alpha$ -DG since the two proteins are in a complex together. We concluded that  $\alpha$ -DG can be precipitated by  $\beta$ -DG antibody with the immunoprecipitation performed in this experiment.

## **23. THE EFFECTS OF WHITE-TAILED DEER *ODOCOILEUS VIRGINIANUS* ON UNDERSTORY HERBACEOUS SPECIES OF THE NORTHERN HARDWOOD FOREST IN NEW YORK**

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White-tailed deer herbivory has long been suspected of limiting the abundance and distribution of native forest herb species in northern hardwood forests. However, few long-term data sets from controlled experiments are available with which to test this hypothesis. The objectives of this paper were to determine effects of deer herbivory on (1) the density, (2) the reproductive success, and (3) the relative size of native forest herbs in Adirondack northern hardwood forests. Forest herb populations were monitored at nine sites containing paired plots inside and outside of deer exclosures constructed 18 - 26 years prior to measurement. Red trillium was present in denser populations, covered a greater leaf area, and had a higher proportion of flowers within the exclosures. Rosy bells did not appear at all in any of the control plots, but was present in five of the nine exclosed plots. Painted trillium had a higher proportion of flowers within the exclosures. Cucumber root, Solomon's seal, and false Solomon's seal had no significant difference between the exclosures and the control plots. The effects of deer herbivory on the two trillium species and rosy bells indicate deer as a potential factor in limiting the persistence of these forest herbs in natural and managed ecosystems. My data suggest that, in areas where management for diversity of forest-dwelling organisms is a priority, deer populations need to be controlled to support greater growth and sexual reproductive success of these forest herb species.

#### **24. SYNTHESIS OF WATER QUALITY DATA COLLECTED THROUGH THE WESTCHESTER COUNTY CITIZENS' VOLUNTEER MONITORING NETWORK**

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The Westchester County Citizens' Volunteer Monitoring Program (WC-CVMP) was established in 2003 to generate a database of water quality data for streams and rivers in Westchester County and to make that data available to the public. WC-CVMP is funded by the NYS DEC and includes over 80 volunteers that have monitored more than 18 individual sites for up to four years. Volunteers go to sites once a week during the summer to measure water temperature and flow, turbidity, phosphorus, nitrate, dissolved oxygen, pH, alkalinity, salinity, and conductivity. The WC-CVMP database of water quality data was used to examine differences between sites of various land uses, including rural, suburban and urban. A subset of monitored sites was selected for analysis based on the quantity of available data for each site. Sites were included in this analysis if they had been sampled more than 20 times. For each water quality parameter at each site, the median, minimum, maximum, 25<sup>th</sup> quartile and 75<sup>th</sup> quartile of the observed concentrations were calculated. These statistics were used to create box plots for each parameter at each site. Box plots were used to qualitatively compare differences in water quality between sites with different types of land use. This analysis was repeated for solute loads (in contrast to solute concentrations), which are derived from stream discharge and concentration data. Our results show that volunteer monitoring data can be a valuable resource for cataloging differences in water quality between sites with contrasting land use.

## **25. HABITAT SELECTION OF COMMON TURTLES IN THE ADIRONDACK PARK, NY: WHAT IS THE ROLE OF BEAVER PONDS?**

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Habitat loss and fragmentation has become an increasingly important threat to turtle species in New York State and worldwide. Conservation practices involving turtles can benefit from expanding knowledge of the different habitats exploited by various turtle species. Frequently occurring wetlands in the Adirondack region of New York include ponds created by the impoundment of forest streams by beaver (*Castor canadensis*). The use of beaver- modified habitats by turtles is not well known. The contribution of the beaver in creating aquatic habitat with regard to common aquatic turtles was investigated on the Huntington Wildlife Forest in Newcomb, NY. A total of 10 wetlands were sampled over 8 weeks in July and August of 2007 using baited hoop nets for a combined 110 trap nights. In beaver ponds (n = 5), one female snapping turtle (*Chelydra serpentina*) and one female painted turtle (*Chrysemys picta*) were captured and in wetlands not created by beaver (n = 5) 14 female snapping turtles were captured. Significant differences in likelihood of capture were detected between sites, though no other parameters revealed differences. The overall low capture numbers experienced by this study leave questions regarding turtle community structure in beaver- modified wetlands of the Adirondack region. Further study may reveal significant relationships between beaver ponds and various turtle species.

## **26. STORMWATER BEST MANAGEMENT PRACTICES TO REDUCE COMBINED SEWER OVERFLOW INTO HARBOR BROOK, SYRACUSE, NY**

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The City of Syracuse combines sanitary sewer water and stormwater into one pipe system for transmission to the Syracuse METRO wastewater treatment plant. During large storm events the increase in stormwater runoff in the pipe system generates a flow greater than the pipe capacity. In this situation combined flow will discharge into local waterways before reaching the wastewater treatment plant. This untreated discharge enters local streams, including Harbor Brook and Onondaga Creek, and eventually ends up in Onondaga Lake. This study aims to reduce the stormwater entering these combine sewer overflow (CSO) systems by employing before pipe solutions for several CSO drainage areas in the Harbor Brook system. Many design alternatives have been investigated, and a combination of these alternatives will be recommended to reduce CSO events in Harbor Brook. The alternatives investigated include bioretention basins, cisterns, permeable pavement and swales. The relative advantages of the different alternatives were assessed using design criteria that consider minimizing cost, planning for a 1-year, 2-hour design storm, creating a self sustaining system, and providing a solution that satisfies public needs. The final design will also adhere to climatic and maintenance constraints.

## **27. CALCULATING THE ENERGY RETURN ON INVESTMENT FOR OIL AND GAS PRODUCTION WORLDWIDE**

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We supply what we believe is the first assessment of the energy return on investment (EROI) for the world's most important fuels, oil and gas. We made our calculations from time series of global production and estimates of energy inputs derived from monetary expenditures for all publicly traded oil and gas companies. Our best estimate is that EROI at the wellhead was approximately 25:1 in 1992, increased to 35:1 in 1999, and then decreased to about 19:1 in 2006. The uncertainty of these estimates is roughly 20%.

## **28. A PROXY INDICATOR OF CORAL REEF HEALTH USING FATTY ACID CONTENT OF MARCOALGAE**

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Coral reefs throughout the world are under threat by increasing coastal development and other human activities. To monitor the effect of human activities on the health of coral reefs requires long term monitoring and extensive data sets. We are developing a proxy indicator to look at reef health using the chemical composition of macroalgae that grow on many reefs. *Halimeda sp.* are macroalgae that are ubiquitous on Caribbean reefs, and *Halimeda* produces fatty acids that are essential to the fish and other organisms that depend on reefs for their survival. We collected *Halimeda opuntia*, *Halimeda goreau*, and *Halimeda tuna* from eight sites in the Florida Keys and analyzed their fatty acid content as an indicator of plant health, and also as a potential indicator of general health of the reef. We will correlate macroalgal plant health, measured as essential fatty acid content, with coral cover and nutrient status of reefs to determine whether macroalgae fatty acid content can be used as a proxy indicator of reef health. The dominant fatty acid in *Halimeda* is hexadecanoic acid (16:0), which makes up to 30% of the total lipid content. These macroalgae also contain substantial amounts of the essential fatty acids (also known as fish oil fatty acids), EPA (up to 5%) and DHA (up to 3%).

## **29. GREENHOUSE PROPAGATION OF TWO MOSSES, *CERATODON PURPUREUS* AND *POLYTRICHUM JUNIPERINUM***

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A preliminary step in evaluating the potential of moss as a restoration tool is to determine if mosses can be grown in sufficient quantities for field application. Currently there is little documentation on the successful propagation of mosses. Published research primarily involves the axenic culture of mosses

from spores for genetic and developmental research. The objective of this research was to determine propagation techniques necessary to grow *Ceratodon purpureus* and *Polytrichum juniperinum* in high enough density to transplant to the field. The influence of a nutrient application, asexual fragment size, fragment origin, and substrate type were investigated. Nutrient application did not influence the mean number of shoots. Fragment origin plays a significant role in the number of new *P. juniperinum* shoots produced; rhizoids showed greater growth than the shoots. In general, whole stems produced fewer new shoots than fragments that experienced some disturbance from cutting or chopping. Under humidity dome conditions mean number of *C. purpureus* shoots was higher on burlap over sand than on sand, while mean number of *P. juniperinum* shoots was higher on sand than on burlap over sand. Under a timer controlled misting system environment, mean cover of *C. purpureus* was greatest on top soil out of the nine substrates tested; there was no effect on the mean number of stems of *P. juniperinum* different between the six substrates tested. These results demonstrate that growth response to propagation techniques is species specific and further influenced by the growing environment.

### **30. FUTURE STATUS OF MOOSE (*ALCES ALCES*) IN THE ADIRONDACK PARK OF NEW YORK UNDER PREDICTED CLIMATE CHANGE SCENARIOS**

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Studies indicating significant declines in moose (*Alces alces*) populations have been conducted throughout their southern range, specifically in Isle Royale National Park in Michigan and Agassiz National Wildlife Refuge in Minnesota. Exact causes remain speculative, however warming temperatures have been blamed due to the susceptibility of moose to heat stress. When heat stressed, moose alter their behavior by reducing activity, panting, and finding coniferous cover, resulting in decreases in food intake, decreases in birth rates, and increases in their vulnerability to parasites and disease. I intend to evaluate the potential impacts of climate change on the distribution of moose in Northern New York by creating a thermal balance component to existing Habitat Suitability Index models. Using black globe thermometers (which incorporate wind velocity and radiative heat transfer along with dry bulb temperature), I will measure the standard operative temperature of various cover types associated with moose habitat. I will then create a thermal cover map reflecting the temperature indices to classify areas that are suitable relative to heat stress. I will create a model using stochastic dynamic programming to predict the behavior of a moose in response to any thermal regime; more specifically, it will determine where a moose *should* go under specific meteorological conditions to alleviate heat stress. With this information, I will produce an improved habitat suitability model that includes a thermal component in its characterization of optimal habitat for moose in North America.

### **31. GROWTH PROHIBITION BY GENETICIN AND PAROMOMYCIN WITH AMERICAN CHESTNUT SOMATIC EMBRYO**

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Antibiotics are often used for selection during plant transformations, but their effects on cell growth must first be assessed to determine the best antibiotic and optimal concentrations to be used. Concentrations that prohibit growth of American chestnut somatic embryos, cell lines Ellis 1 and 30015-2, were investigated using antibiotics Geneticin and Paromomycin. Embryos were applied to several concentrations of these antibiotics and monitored for several weeks until all the embryos in one plate were observed to be dead. The concentration was narrowed down to obtain a specific concentration that kills embryos completely or prohibited their growth. Ellis 1 embryos died entirely on Paromomycin concentrations between  $10\mu\text{g mL}^{-1}$  and  $20\mu\text{g mL}^{-1}$ , but the embryos did not die with Geneticin at the concentrations tested. Paromomycin prohibited the growth of 30015-2 embryos at a minimum concentration of  $300\mu\text{g mL}^{-1}$ , indicating this cell line was much more resistant to the antibiotic than Ellis 1. This research shows that there are significant differences in antibiotic resistance among chestnut cell lines and this should be taken in consideration when developing transformation protocols.

### **32. GENETIC ENGINEERING OF *ESCHERICHIA COLI* USING THE *FABH* GENE FOR THE PRODUCTION OF POLYHYDROXYALKANOATES (PHA)**

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Polyhydroxyalkanoates (PHAs) are biodegradable polymers that can have drastically different properties based upon their monomer composition. These monomers can be classified as either short-chain-length (SCL) or medium-chain-length (MCL). SCL PHAs are rigid and have thermoplastic properties consisting of monomers with 3-5 carbons, while MCL PHAs have more elastic properties and contain monomers with 6-14 carbons. *Escherichia coli*, which does not naturally produce PHA, can synthesize the polymers upon introduction of specific genes. One gene of particular interest is *fabH* since it is involved in producing PHA with both SCL and MCL monomers. Plasmids were constructed that contained *fabH* along with either *phaC1* or *phaC*. These plasmids were introduced into *E. coli*, making it possible to analyze the production of PHA by gas chromatography. It was hypothesized that the incorporation of *fabH* and *phaC1* would result in polymers with MCL monomers and that *fabH* and *phaC* would result in polymers with SCL monomers (poly-3-hydroxybutyrate (P[3HB])). PHA production results from these recombinant strains will be discussed.

### **33. THE EFFECT OF CELLULASE ENZYMES ON THE MORPHOLOGY AND CRYSTAL STRUCTURE OF CELLULOSE**

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One of the major components of the plant cell wall is the biopolymer cellulose, a homopolymer consisting of  $\beta(1-4)$  linked glucose monomers. Cellulose has come into focus in recent years because of its potential in the conversion of Lignocellulosic biomass into ethanol. During the process of ethanol production from cellulose, a cocktail of cellulase enzymes are used to degrade cellulose into glucose. One of the major goals of Lignocellulosic ethanol production is to reduce the recalcitrance of cellulose to conversion by cellulase enzymes. This project considers the digestion of pure cellulase enzymes on pure cellulose samples. Past and current research on this topic has considered the hydrolysis of cellulose I, and cellulose II, and cellulose III (polymorphs of cellulose I made by different pretreatment methods) by different types of cellulases. Past hydrolysis experiments have found that cellulose II was digested at a higher rate than that of native cellulose I. We are considering the factors that cause a higher digestion rate in cellulose II. They include crystallite size, the surface area, and initial percent crystallinity. Future research will consider the surface and chemical environment of cellulose II as is it degraded by pure cellulase enzymes, and the conversion mechanisms. We are also curious of the adsorption of cellulases to the surface of cellulose, and what impact that has on cellulose morphology.

#### **34. SPECIES DIVERSITY AND RELATIONSHIP BETWEEN ENVIRONMENTAL CHARACTERISTICS AND BIOASSAY RESULTS FOR TROPICAL DISEASES FROM CYANOBACTERIA COLLECTED IN PANAMA**

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Although cyanobacteria are often associated with negative effects in marine and estuary ecosystems, some cyanobacteria species can be beneficial to humans by providing chemical compounds capable of inhibiting the infection or preventing the spread of tropical diseases such as Chagas' disease, malaria, and leishmaniasis. Objectives for the present study were (1) to collect cyanobacteria from two locations and screen extracts for biological activity, (2) to measure ecological variables (pH, salinity, total dissolved solids (TDS), dissolved oxygen (DO), light intensity, temperature, and electrical conductivity) and to investigate their relationship with cyanobacteria diversity. We used ecologically guided marine collection techniques to collect various cyanobacteria specimens in two of Panamas National Marine Parks. Extractions were made from all of the eighteen cyanobacteria collections, and biological activities of extracts against the three tropical diseases were determined. Correlations were determined between the ecological variables and biological activity. pH explained 84% of variation in inhibition of leishmaniasis parasites ( $P = 0.0097$ ). pH values were also found to be significantly different between the six total collection sites. Preliminary results from this research indicate that environment characteristics may have considerable influence on the biological activity of cyanobacteria. These results should help future researchers understand cyanobacteria habitats and how these factors influence the chemical and biological processes of cyanobacteria.

### **35. ASSESSMENT OF WOOD-INHABITING FUNGI IN OLD-GROWTH AND MATURING FOREST IN THE ADIRONDACK PARK, NEW YORK**

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The objectives of this study were (1) to assess diversity of wood-inhabiting fungi in old-growth and maturing forest in the Adirondack Park, N.Y., (2) to determine similarity in species composition at both forests, and (3) to investigate relationships between wood-inhabiting fungal diversity and coarse woody debris properties including volume, decay stage, and degree of soil contact. Knowledge of fungal diversity is limited, and studies like this are important in providing base-line data to aid in future management objectives. In the study, I used a field survey approach to assess wood-inhabiting fungal diversity and coarse woody debris properties. I identified 98 species of wood-inhabiting fungi; 75 species in old-growth forest; 53 species in maturing forest. Thirty species were common to both forests. Fungal diversity in old-growth and maturing stands was 48% similar with Sorensen's Coefficient of community similarity. I estimated total diversity of wood-inhabiting fungi at 255 species with Chao 1 (95% CI = 169-445) and 214 species with Chao 2 (95% CI= 155-336). The multiple linear regression model explained 4.7% of the variation in fungal diversity, which was statistically significant ( $P < 0.001$ ). CWD volume was the only variable to be a significant predictor of fungal diversity ( $P < 0.001$ ). A continuing rise in the species accumulation curve, with no sign of an asymptote, suggests that these are more wood inhabiting fungi to be found in the Adirondack Park. Unexplained variation of fungal diversity could be due to variables not measured such as dispersal mechanisms of wood-inhabiting fungi.

### **36. AMERICAN ELM TRANSFORMATION AND IN VITRO SHOOT INITIATION**

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American elm (*Ulmus americana*) is a significant tree species that was decimated by Dutch elm disease in the mid 20<sup>th</sup> century. However, through the field of biotechnology, the American elm can be genetically modified towards disease resistance which would have a positive impact on the environment by allowing restoration of this important tree species. There is some concern that genetically modified trees may have detrimental effects on the environment due to genetic drift of inserted genes. Therefore, even though there has been no evidence to date of detrimental environmental effects, controlling flower production of the tree could halt this concern by the general public. A protocol describing the transformation and tissue culture techniques for use with American elm exists. This was used in the transformation of leaf pieces containing midveins, lamina and petioles through *Agrobacterium tumefaciens*. *Agrobacterium* strain EHA105 containing the constructs SLF and SAP1 that affect flower development in *Salix discolor* were used. Certain aspects of this protocol were tested for optimization resulting in two studies, dealing with the co-cultivation and sonication of the elm leaf pieces. In an attempt to increase the transformation rate,

co-cultivation trials of leaf pieces were held at 24 and 72 hours. Results showed that the 24-hour co-cultivation had better survival rates, although no leaf pieces were transformed. Sonication trials dealt with differing combinations of wounding and treatments of various leaf pieces to promote callus and shoot formation. Our results showed the lamina of the leaf as well as midvein portions can form shoots.

### **37. THEORETICAL STUDY OF THE DEGRADATION PATHWAY OF GAS PHASE NAPHTHALENE IN THE ATMOSPHERE FOLLOWING FORMATION OF HYDROXYL RADICAL ADDUCT**

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Naphthalene (NAP) is the most abundant polycyclic aromatic hydrocarbon (PAH) found in urban air. It is reactive in the atmosphere under ambient conditions; chiefly its reaction partner is the hydroxyl radical, OH·. Much work has been done experimentally to identify the products of naphthalene degradation in reaction chambers. Unfortunately, many of the reaction mechanisms that yield these products remain unidentified. The purpose of this study is to establish the fate of the radical products of reaction of naphthalene with hydroxyl radical using quantum chemical calculations. Computational studies were performed on the retention of aromaticity and on the reactions of the products of the naphthalene + OH· with O<sub>2</sub>. To identify mechanisms we looked at the analogous chemistry of hydroxylcyclohexadiene (the product of OH + benzene). Initial results show a substantial correlation between the enthalpy of formation of similar reactions between the two. This suggests that the presence of the second aromatic ring does not substantially change the chemistry of the first. This study also found that disturbing the aromaticity of the second ring caused a substantial rise in the energy of the products suggesting that these compounds are not favored.

### **38. EFFECTS OF LIMING OF FOREST SOILS ON SALAMANDER OCCURRENCE IN THE CENTRAL ADIRONDACK MOUNTAIN REGION**

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Salamanders are sensitive to low pH conditions, which reduce salamander density and distribution negatively. Thus, salamanders are important indicators of the soil conditions within a forest ecosystem. The Adirondack State Park is known to have relatively acidic soil due to atmospheric pollutants and other naturally occurring substances. The objective of this study was to determine if salamanders were sufficiently acid-stressed to respond to artificial buffering of acid soils with lime (CaCO<sub>3</sub>). In this study two sites were used at the Huntington Wildlife Forest in Newcomb, New York. A total of 72, 4m<sup>2</sup> sampling plots were used at two sites; at each site 36 sampling plots (fallen logs) were identified. Out of those 36, half of the plots were treated with 4lbs of lime in an aqueous solution and the other halves were the controls (tap water). Soil samples were collected from the plots to measure change in pH. Data combined from both sites reveal salamander occurrence to be equivalent on both treated and controlled

plots. Occurrence of salamanders at each site is equivalent on both treated and controlled plots. Occurrence of *P. cinereus* and *Notophthalmus v. viridescens* on both treated and controlled plots was equivalent. Juvenile salamanders favored controlled plots (41%) to treated plots (25%), where adults occurred on both treated and controlled plots equally. Based on this experiment the practice of liming can be used in areas where salamander populations are declining due to acidification of soils.

### **39. SYNTHESIS, CHARACTERIZATION AND FURTHER REACTIONS OF 1-(3-HYDROXYPROPYL)-DICARBORANE AND 1,2-BIS(2-HYDROXYETHYL)-DICARBORANE**

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Two hydroxyalkylcarborane derivatives were synthesized using ionic liquids. The carboranes were made from decaborane and silyl protected 4-pentyn-1-ol and 3-hexyn-1,6-diol, to afford the mono- and disubstituted products respectively. Deprotection was accomplished using iron (III) chloride in acetonitrile. The synthetic route outlined here is the first high yield route to a terminal and primary hydroxyalkylcarborane, which are used as starting materials for a variety of important materials with applications from materials to BNCT drugs. The synthetic strategies, drawback of Ionic Liquids, NMR and GC/MS characterization of the carboranes and the other products made from them as well as their potential applications will be discussed.

### **40. XYLEM VESSEL CHARACTERISTICS OF TRANSGENIC ULMUS AMERICANA EXPRESSING A SYNTHETIC ANTIMICROBIAL PEPTIDE**

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Natural resistance in *Ulmus americana* to *Ophiostoma novo-ulmi* depends on several factors. Research has shown a correlation between disease susceptibility and increasing xylem vessel size in several *Ulmus* species. It is believed that elms with smaller xylem vessels can quickly compartmentalize infected vascular tissue in order to minimize further spread of the disease. Our laboratory has produced transgenic American elms expressing a synthetic antimicrobial peptide, ESF39, in the vascular tissue. Preliminary research has shown that these trees exhibit reduced symptoms of *O. novo-ulmi* compared to wild type trees. Cross sections from three-year-old field grown transgenic (TG), wild type seedlings (WT), and wild type tissue culture (TC) grown elms were examined to assess whether or not reduced symptoms of the disease is the result of transgene expression or size differences in the water conducting elements. Trees from transgenic line FS5 displayed significantly larger xylem vessel diameter and area when compared to wild type and tissue culture grown seedling ( $p \leq 0.05$ ). Mean values of average xylem vessel diameters for TG, WT, and TC were  $60.552 \pm 0.975 \mu\text{m}$ ,  $50.3069 \pm 0.753 \mu\text{m}$ ,  $56.31 \pm 0.74 \mu\text{m}$  respectively (mean  $\pm$  SE). This data suggests that the reduced disease symptoms observed by our transgenic trees is more likely to be due to transgene expression than due to anatomical characteristics. It might also indicate that using

trees with smaller vessel diameters for starting material for the transformations might yield even higher levels of DED resistance.

#### **41. THE PATTERN OF DISSOLVED ORGANIC CARBON (DOC) IN INLET STREAM AND EXPORT OF ARBUTUS LAKE: ANALYSIS OF DOC PRECESSING USING A STABLE ISOTOPE**

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Dissolved organic carbon (DOC) in a lake can be divided by allochthonous and autochthonous sources. Autochthonous DOC is dominated by algal production, and in the growing season of algae the contribution of autochthony in DOC at the lake outlet can be predicted to be higher than that in the dormant season. We studied the DOC at inlet stream and export of Arbutus Lake during the growing (Jul. to Sep.) and dormant (except the growing) periods from 2004 to 2007. Stable carbon isotope ( $\delta^{13}\text{C}$ ) analysis of DOC was used to determine the carbon characteristics in 2007. Mean DOC concentration were  $537 \mu\text{mol/L}$  ( $\pm 211$  SD) at inlet stream during the growing period and this value was higher than during the dormant period (one-way ANOVA,  $p < 0.05$ ). These results suggest a net loss of DOC due to within lake processes. The patterns of DOC concentration in the study period in 2007 differed from the average for the period with higher concentrations at the inlet and outlet. These elevated concentrations were likely due to the low discharge conditions, especially during the growing season in 2007. There was no significant difference (one-way ANOVA,  $p > 0.05$ ) in the average  $\delta^{13}\text{C}$  values of  $-26.5 \text{‰}$  ( $\pm 0.7$  SD) between sampling periods and sites in 2007. These concentration and isotopic results suggest that for 2007 there were no marked changes in DOC due autochthonous processes.

#### **42. URBAN GREEN BUILDING REHABILITATION OF ILLICK HALL, SUNY ESF**

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Illick Hall, home to the Department of Environmental and Forest Biology at SUNY ESF, needs renovation due to its outdated structure, poor aesthetics and lack of efficiency. The main problems with the existing building include the presence of hazardous materials such as asbestos, waterproofing issues mainly on the upper floor, the condition of the rooftop greenhouses, poor insulation, poor artificial lighting scheme, unnecessary energy consumption, and poor natural lighting due to an insufficient amount of windows on the building. Through the use of Green Building Renovation techniques existing buildings can be redesigned to be more resource-efficient. This project will center on improving indoor environmental quality, which considers factors such as lighting, sound, temperature, vibration and indoor air quality. This project specifically focuses on evaluating alternatives for window and lighting improvements. The project aims to meet the needs and major concerns of our client, SUNY ESF Facilities

Program Coordinator, Brian Boothroyd, as well as the inhabitants of Illick Hall. The project design also seeks compliance with the SUNY goal of Leadership in Energy and Environmental Design (LEED) Silver© standard A recommended design was selected according to decision criteria such as compliance with industry codes and standards, cost efficiency, feasibility within constraints of existing structure, integration of artificial and natural light, lifetime and thermal efficiency. The recommended design proposes expanding window size to maximize available natural lighting, utilizing interior windows to allow natural light into the hallways, and implementing daylighting and occupancy motion sensors to increase overall energy efficiency.

#### **43. BACTERIAL COMMUNITIES ASSOCIATED WITH *RHIZOPOGON VINICOLOR* TUBERCULATE MYCORRHIZAE**

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Bacterial communities are ubiquitous members of the mycorrhizosphere and mediate mycorrhizal symbioses. This project analyzed the bacterial communities associated with a tuberculate ectomycorrhiza (ECM) from the basidiomycete *Rhizopogon vinicolor*. Bacteria present on the *R. vinicolor* ECM were identified by 16S rRNA gene amplification. Amplicons were sequenced and subsequently analyzed by BLAST. Only eubacterial sequences were amplified due to the specificity of the 1223r primer developed in our lab, which excluded mitochondrial and chloroplast rDNA amplification. In total, 32 eubacterial sequences were attained from the *R. vinicolor* ECM sample #18. Three dominant bacterial groups were recognized from alpha- and gamma-Proteobacteria, and Acidobacteria. 16S rDNA libraries obtained in a previous study from two other tuberculate ECM samples (*Rhizopogon vinicolor* #24 and *R. vesiculosus* #13) were compared to the current one using TreeClimber, which assesses differences in sequence composition between libraries. All pairwise comparisons were significant at the 0.05 level, except between libraries of *R. vinicolor*-18 (Rvi-18) and *R. vinicolor*-24 (Rvi-24) which had a p-value of 0.07. The lower significance value may indicate greater similarity between libraries from the same ECM fungi, *R. vinicolor*. However, more eubacterial 16S rDNA sequence libraries must be attained to confirm or deny structure consistencies of bacterial communities on *R. vinicolor* and *R. vesiculosus* tuberculate ectomycorrhizae.

#### **44. LONG-TERM IMPACTS OF FILTRATION, REFRIGERATION AND FREEZING OF ENVIRONMENTAL WATER SAMPLES PRIOR TO CHEMICAL ANALYSIS**

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In water quality research accurate characterization of water chemistry is imperative and samples often must be stored before analysis. Preservation techniques remove microbes that change concentrations or speciation of untreated samples. We are concerned with how sample treatment and storage prior to

analysis affects nitrate, chloride, and sulfate over time. We compared the impact of two treatments (filtered and unfiltered) and four storage techniques (sun, shade, refrigerator, and freezer) on analysis of water samples from Onondaga Creek. One water sample was analyzed by ion chromatography on collection day to determine the initial ion concentrations. Half the sampled water was then filtered through a 0.45 micrometer glass fiber filter, and portions of filtered and unfiltered water were stored using the four techniques. A sample of water from each treatment was analyzed every 24 hrs for four days and then once every week for the next four weeks. Sample treatment had the greatest impact on ion preservation, regardless of the storage method. Unfiltered samples yielded lower nitrate concentrations than filtered samples, and this difference increased over time. Nitrate concentrations in unfiltered samples stored in the sun decreased from 4.95 to 4.32 ppm over four weeks, while nitrate concentrations in filtered samples stored in the sun decreased less than 0.05 ppm. For nitrate, we found freezing also aids preservation. Sulfate and chloride are not considerably affected by storage and treatment. In conclusion, our results show samples analyzed for nitrate should be filtered prior to analysis if they will be stored for >72 hrs.

#### **45. PRESENT AND PROJECTED DISTRIBUTION AND GROWTH RESPONSE OF *CYRILLA RACEMIFLORA* TO ELEVATIONAL AND MOISTURE GRADIENTS IN THE LUQUILLO MOUNTAINS, PUERTO RICO**

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Within a montane setting, rapid changes in elevation create wide ranges of environmental conditions that affect the distribution and abundance of species. The Luquillo Mountains of Puerto Rico, where numerous environmental factors (e.g. precipitation, temperature) exhibit elevational gradients that influence directly the distribution of individual species, are an ideal environment to investigate gradient effects. The main objectives of this study were to determine the distribution and growth of *Cyrilla racemiflora*, the dominant species of the mid-elevational (600-900m) colorado forest, in response to environmental gradients. I also tested the hypothesis that growth rates along the elevational gradient approach a normal curve, or maximum power curve, reflecting energy costs and gains at different elevations. During the summer of 2007 I established 100 10 x 10m plots along an elevational gradient (450-950m) in the Luquillo Mountains to assess the distribution of *C. racemiflora* using direct gradient analysis. Presence or absence of *C. racemiflora* was recorded, as well as individual characteristics, such as diameter at breast height (DBH) and height. GPS coordinates were taken at each plot to create a spatial dataset. Long-term growth data on *C. racemiflora* was obtained from previous studies by the US Forest Service and was used to evaluate historical growth along an elevational gradient. I then combined these two geographic datasets to create maps of 1) gradient space 2) suitable habitat for *C. racemiflora* within the Luquillo forest and 3) growth. Simulation modeling will be used to project how the range of this species will be affected by projected future climate change.

#### **46. RESPONSE OF ECTOMYCORRHIZAL FUNGI ALONG A NATURAL NITROGEN GRADIENT IN THE WHITE MOUNTAINS, NH**

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Carbon and nitrogen fluxes in terrestrial ecosystems are influenced by mycorrhizal fungi, but ecosystem scientists have been slow to incorporate mycorrhizal fungi into conceptual and quantitative models of how ecosystems function. In this study, we assessed the ectomycorrhizal (EM) community along a natural nitrogen availability (NA) gradient in the White Mountains, NH, as part of a larger objective to quantify and model the importance of mycorrhizal fungi for ecosystem C-N cycling. We hypothesized that shifts in fungal taxa and fungal species richness along the natural NA gradient would reflect parallel changes in ecosystem and mycorrhizal C-N cycling. The belowground EM community was assessed on three sample dates at 24, 100 m<sup>2</sup> plots over five months (72 cores). Molecular techniques were used to identify fungi from field collected roots. The highest degree of similarity was between high and medium NA sites (Sørensen's Coefficient of community similarity (CCs) = 0.314), with lower similarity between medium and low NA sites (CCs = 0.189), and least similarity between high and low NA sites (CCs = 0.120). Ectomycorrhizal genera differed along the NA gradient but the sampling effort was insufficient to capture all fungal species present at each site, therefore species responses could not be quantified. The shift in EM genera along the NA gradient suggests these EM fungi may play variable roles in C-N dynamics. These and additional studies will be synthesized to support inclusion into an ecosystem model that simulates the C-N dynamics in northeastern Forests (PnET-CN).

#### **47. IDENTIFYING AND SEQUENCING GENES ENCODING PROLINE-RICH PROTEINS, FROM AMERICAN AND CHINESE CHESTNUT, DIFFERENTIALLY EXPRESSED IN CHESTNUT BLIGHT CANKERS**

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Several gene sequences were identified from a subtraction cDNA library that appear to be differently expressed at the canker margins of blight-resistant Chinese chestnut (*Castanea mollissima*) and blight-susceptible American chestnut (*Castanea dentate*) trees. This research focused on comparing the genomic sequences of one of these genes that is more highly expressed in the Chinese chestnut. From blast searches of GenBank, this gene most closely resembles sequences from proline-rich proteins. The goal of this project is to find polymorphic marker sequences that could be used to differentiate between the Chinese chestnut and American chestnut alleles. The results from this research will be used to help map the chestnut genome and determine if the gene is linked to blight-resistance loci.

#### **48. DOES BANDWIDTH SELECTION REALLY MATTER IN APPLICATION OF GEOGRAPHICALLY WEIGHTED REGRESSION**

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A forest plot with a clustered spatial pattern of tree locations was used to investigate the impacts of different kernel functions (fixed vs. adaptive) and different sizes of bandwidth on model fitting, model performance and spatial characteristics of the GWR coefficient estimates and model residuals. Our results indicated (1) the GWR models with smaller bandwidths fitted the data better, yielded smaller model residuals across tree sizes, significantly reduced spatial autocorrelation and heterogeneity for model residuals, and generated better spatial patterns for model residuals. However, smaller bandwidth sizes produced high levels of coefficient variability; (2) the GWR models based the fixed spatial kernel function produced smoother spatial distributions for the model coefficients than those based on the adaptive kernel function; and (3) the GWR cross-validation or AIC optimization process may not produce an “optimal” bandwidth for model fitting and performance. It was evident that selection of spatial kernel function and bandwidth has a strong impact on the descriptive and predictive power of the GWR models.

#### **49. THE REACTIVITY OF RESIDUAL LIGNIN IN KRAFT PULP UNDER ACIDIC CONDITION**

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After a typical kraft pulping, the pulp still contains 2-5% of residual lignin, which has to be removed by a multiple bleaching sequence as being practiced in the paper industry. Recent reports suggested that the bulk of residual lignin in softwood kraft pulps were existed in the form of lignin-carbohydrate complexes (LCC). Conceptually, these LCC would be hydrolyzable with acid, which however could induce lignin condensation reactions. The study was initiated to evaluate the extent that the residual kraft pulp lignin could be removed by controlled acidic treatments. In a typical condition (with 0.1 M HCl at 100°C for 1h) containing dioxane to minimize lignin condensation reactions, the kappa number reduction for an unbleached softwood kraft pulp was 65%, and higher (80%) for the O<sub>2</sub>-delignified sample. Similar acid treatments without the addition of dioxane slightly reduced the lignin removal. These findings support that LCC is a significant factor affecting the reactivity of the residual lignin. It should be noted that about 35% of the residual pulp lignin was resistant to acid hydrolysis, and this may be attributed to their lignin structures being more condensed. Also, a similar treatment of kraft pulp with nitric acid (0.1 M) resulted in lignin removal comparable to that of the HCl treatment. The extent that the acid-catalyzed delignification of kraft pulps may be enhanced by the presence of additives is being examined further.

#### **50. ENGINEERING A PHAZ KNOCKOUT STRAIN OF *PSEUDOMONAS PUTIDA* KT2440 FOR THE ENHANCED ACCUMULATION OF POLYHYDROXYALKANOATES**

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Glycerol, the backbone of triacylglycerides, is a primary waste product of biodiesel production from plant oils. While glycerol is an additive to many food products, waste glycerol from industrial biodiesel production cannot meet the standards for addition to food products without costly purification. For this reason, waste glycerol is being investigated as a carbon source for the production of polyhydroxyalkanoate polymers (PHAs), biodegradable, microbially-produced polyesters. Successful implementation of this strategy could reduce the costs of both products.

Our research group has successfully grown *Pseudomonas putida* KT2440 on a minimal salts media (MS) with biodiesel waste glycerol as the sole carbon source and shown the bacterium to accumulate up to 31% of cell dry weight as PHA after 72 h. The gene known as *phaZ* encodes for an intracellular PHA depolymerase. It is suspected that *phaZ* is constitutively expressed. Removal of this phenotype by the insertion of an antibiotic selective marker sequence (spectinomycin) in place of the *phaZ* sequence will allow the cells to retain any PHA accumulated and presumably increase the final PHA contents of the cells.

## **51. ILLICK HALL GREEN ROOF RENOVATIONS**

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Illick Hall has been home to the Department of Environmental and Forest Biology (EFB) since the building was dedicated in 1968. Illick Hall provides SUNY ESF with offices, classrooms, conference rooms, research labs, and greenhouses. The building is outdated and contradicts the increasing popularity and need for environmentally sustainable infrastructure. The roof requires immediate attention due to major water leaks and the resulting structural deterioration. The greenhouses located on the roof of Illick Hall are poorly insulated and have inefficient heating and cooling systems. In addition, the greenhouses do not provide adequate research and teaching space to EFB. This study focuses on greenhouse and roof redesign of Illick Hall. An alternative solution includes the redesign of the greenhouses and consolidation of the seven current greenhouses into two larger greenhouses. Alternative solutions were compared and contrasted by employing a variety of decision criteria. The proposed greenhouses will include more efficient climate control systems with better temperature management and insulated glass. Rainwater captured using a gutter system at the edge of each greenhouse roof will be utilized to supply the greenhouses with water for irrigation. A living roof of varying depths will be installed on the remaining exposed roof. Living roofs extend roof life and provide insulation to the building. The varying depths provide the school with the opportunity to research living roofs. The construction site, removed debris, and new materials will be managed following green building techniques outlined by the United States Green Building Council Standards.

## **52. DESIGNING SOLUTIONS TO REMEDIATE COMBINED SEWER OVERFLOWS ON HARBOR BROOK, SYRACUSE, NY**

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The City of Syracuse employs a wastewater management system that combines stormwater and sanitary wastewater into combined sewer conduits for treatment at the METRO water treatment facility. During heavy precipitation events, the flow of wastewater in these conduits exceeds treatment capacity of METRO, creating combined sewer overflows (CSOs) which send untreated sewage into nearby Onondaga Creek and Harbor Brook waterways. This discharge poses a significant threat to public health and aquatic life in these streams which discharge into Onondaga Lake. There are currently 18 active CSOs along Harbor Brook, two of which are the focus of this study. The selected CSOs are in residential sections of west Syracuse with drainage areas of 1.4 km<sup>2</sup> and 0.6 km<sup>2</sup>. Existing designs that address overflows from combined sewer systems typically focus on “end of pipe” solutions which provide treatment to overflow waters. While these systems address water that has already entered the CSO network, opportunities exist for innovative “in the watershed” solutions. These methods capture stormwater before it gets to the CSOs using detention, transpiration, or infiltration to reduce system load and prevent overflow events. Our investigation of alternative solutions to reduce the system load includes rain gardens, cisterns, stormwater ponds, and permeable pavement. Each alternative will be considered according to its effectiveness, invasiveness, and durability. Specifications for the designs will be based on a 1-year, 2-hour duration storm. The preferred design incorporates a combination of alternatives, developing a holistic solution to this complex environmental problem.

### **53. ANALYSIS OF *PINUS SYLVESTRIS* FOR EVIDENCE OF *SIREX NOCTILIO* OVIPOSITION AND LARVAL FEEDING SCARS**

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*Sirex noctilio* (Hymenoptera: Siricidae), an invasive wood-boring wasp, has the potential to become a serious forest pest of North American pine (*Pinus* spp.) since its introduction into New York forests. *Sirex noctilio* is native to Eurasia and Northern Africa and has caused widespread timber losses in stands planted with North American pine species in Australia and New Zealand. This insect has a fungal symbiont, *Amylostereum areolatum*, which causes chlorosis and mortality of infested trees. Objectives of this research were to determine if oviposition and infection with *A. areolatum*, and perhaps larval feeding scars, could be identified and attributed to *S. noctilio*. Infested Scots pine, *P. sylvestris*, bolts taken for rearing purposes were stripped of bark and examined for external oviposition scars and emergence holes after *S. noctilio* emergence. Dissection and subsequent observations of transverse cross sections cut from bolts at points of postulated oviposition indicated that oviposition sites could be identified. Sixty-three 10 cm thick cross sections were removed at one meter intervals along the boles of two felled Scots pines and one red pine, *P. resinosa*. All cross-sections were examined for scarring and discoloration potentially attributable to *Sirex* oviposition or larval feeding. There were no scars noted on red pine cross-sections, however, 16 cross-sections from the Scots pines had evidence of scarring and discoloration. These scars

will be further investigated and dated as part of a larger study to gather pre-introduction baseline data for native *Sirex* populations as contrasted to changes in occurrence of scarring after *S. noctilio* introduction.

#### **54. THE EFFECTS OF SOCIALIZATION ON THE FEEDING BEHAVIOR OF BIRDS AT O'REILLY'S RESORT IN LAMINGTON NATIONAL PARK, QUEENSLAND, AUSTRALIA**

**C. DeJesus<sup>1</sup>, M.L. Miller<sup>2</sup> and L. Rodriguez<sup>2</sup>.** <sup>1</sup>Division of Environmental Science and <sup>2</sup>Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Unintentionally by tending to one injured parrot, the O'Reilly family caused the socialization of Australian king parrots, crimson rosellas, Australian brush turkeys, and red-browed finches near the resort in Lamington National Park, Queensland Australia. Numerous birds flock to the feeding area on the resort daily in search of food from the resort staff and visitors. We investigated the extent to which the birds have become accustomed to feeding by humans. We accomplished this by counting the number of birds at certain times in the presence of people and in the presence or absence of food (in feeders that we constructed). Our results show that the presence of humans had a significant impact on the bird's feeding behaviors. The birds also displayed stimulus discrimination by mainly reacting to people with food than to those without.

#### **55. FORAGING PREFERENCE OF SUBTROPICAL RAINFOREST BIRDS IN LAMINGTON NATIONAL PARK, QUEENSLAND, AUSTRALIA, 2008**

**C. DeJesus<sup>1</sup>, M.L. Miller<sup>2</sup> and L. Rodriguez<sup>2</sup>.** <sup>1</sup>Division of Environmental Science and <sup>2</sup>Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The Australian king parrot and crimson rosella are social birds with their own species and with humans. The tradition of feeding birds at O'Reilly's Resort in Lamington National Park, located in Queensland Australia, has taught a few of the local birds that the presence of people means a presence of food. We questioned the extent to which the birds have learned to associate people with food or if they are simply opportunistic feeders and flock to where the food is ample. We accomplished this by counting the number of birds at certain times in the presence or absence of people and in the presence of free feed in feeders with different access levels that we provided. Our results showed that the birds preferred feeding bowls with larger feeding holes, however in the presence of people the birds feeding behavior changed significantly.

#### **56. ASSESSING AND COMPARING AQUATIC INSECT DIVERSITY IN NORTHERN QUEENSLAND, AUSTRALIA**

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Our research project was based on conducting a survey of aquatic insect diversity in fresh water aquatic sites of Northern Queensland, Australia. Our main objective was to assess and compare the diversity of our chosen aquatic sites. Results indicated that a higher overall aquatic insect diversity and species evenness exists in the riffles of Cooper Creek and two of its tributaries. Cooper Creek itself was the site with the highest aquatic insect diversity. We concluded that stochastic events such as floods influence the abundance and distribution of aquatic insect communities. A total of 7 aquatic insect orders, 19 families, and 124 specimens were collected.

#### **57. SEA CUCUMBER DISTRIBUTION ASSOCIATED WITH CURRENTS AND STRUCTURE ON THE REEF FLAT OF HERON ISLAND, NORTHEAST QUEENSLAND, AUSTRALIA, 2008.**

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Sea cucumbers are marine echinoderms in class Holothuroidea. The Great Barrier Reef in Queensland, Australia is home to a wide variety of these organisms. We were interested in how the sea cucumbers oriented themselves to structure based of their size and the direction of currents. We observed them on the reef flat of Heron Island, which is on the southern end of the Great Barrier Reef .We found that the sea cucumbers tended to most frequently occur near structure in the presence of a current, and away from structure in the absence of a current. Their location near structure, relative to current, tended to shelter them. We concluded that sea cucumbers use fixed structures on the reef flat as shelter from current. We attribute this behavior to be energy conserving.

#### **58. FACTORS INFLUENCING THE SIZE OF DARK HEARTWOOD IN SUGAR MAPLE**

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Dark heartwood in sugar maple is less valuable than the lighter colored sapwood. Factors leading to the prediction of this characteristic would be very helpful to foresters and timber managers. Shigo has written much on compartmentalization of plant injury, which is commonly thought to affect the darkwood size in sugar maple. Few studies have examined the relationship between dark heartwood size and site or individual tree factors. Four sites were considered in this analysis, with the possibility of additional sites being added as they become available. These areas include the Adirondacks, Catskills, Central NY, and Western NY. The results presented in this poster focus only on tree and site factors, and not stand history and/or logging injury.

#### **59. STRATEGIES UTILIZING FABD FOR POLYHYDROXYALKANOATE(PHA) MONOMER SUPPLY FROM UNRELATED CARBON SOURCES**

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Polyhydroxyalkanoates (PHAs) are microbially produced polyesters that have a wide variety of uses and are biodegradable. *Escherichia coli* are normally incapable of producing PHAs because they lack the enzymes to do so. The synthases required for PHA production have been isolated and inserted into *E. coli* in combination with FabD, leading to PHA production in this non-native organism. PHA synthase (PhaC1) from *Pseudomonas* sp. 61-3 has substrate specificity for medium-chain-length (MCL) monomers. FabD is a transacylase enzyme used naturally in fatty acid biosynthesis of *E. coli* that catalyzes the conversion of malonyl-CoA to malonyl-ACP. An increase in the presence of FabD with the PHA synthases permits the production of polyhydroxyalkanoates. Mutations in FabD may result in a reverse in acyl-transfer or a change in substrate specificity, leading to an increase of PHA production. These mutations will be made through error-prone PCR on the FabD insert, and then relegated into the original construct with PhaC1. An increase in production of biodegradable plastics may reduce or eliminate the need for synthetic polyesters that harm the environment.

#### **60. POLY-3-HYDROXYBUTYRATE PRODUCTION IN RECOMBINANT *ESCHERICHIA COLI* USING PLASMID PBBREDQKAB AND ACID WHEY**

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Acid whey is a waste product of the dairy industry, consisting of lactose proteins and salts with high biological oxygen demand, and high cost for disposal. Poly-3-hydroxybutyrate [P(3HB)] is a biodegradable plastic polymer of polyhydroxyalkanoate (PHA) produced by enzyme pathways within bacteria. PHAs are a sustainable alternative to petroleum derived plastics. Currently P(3HB) production is too expensive to have a practical industrial process. This study examined acid whey as a cheap alternative to produce P(3HB) in recombinant *Escherichia coli*. *E. coli* were transformed with the plasmid pBBREDQKAB giving it the genes needed to produce P(3HB). Two strains, JM109 and S17-1, had the plasmid inserted via electroporation and were grown up in mineral salt (MS) media to find PHA%. JM109 had low cell dry weights from an inability to produce its own thiamine, a necessary nutrient for growth. Yeast extract, which contains thiamine, was found to increase the cell dry weight of JM109 in MS media. The yields for P(3HB) were negligible for JM109, since this strain is unable to metabolize lactose. S17-1 showed improvements in yields; however the PHA% was still low.

#### **61. *SPARTINA PATENS* ABOVEGROUND BIOMASS PRODUCTION ON DIFFERENT AGED SETTLING BASINS AT SITES OF EXPOSED BYPRODUCTS FROM THE SOLVAY PROCESS**

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The Solvay settling basins, near Onondaga Lake, were constructed to hold the byproducts of the Solvay process for producing soda ash. The primary use of the settling basins ended in 1986 when the soda ash facility closed; however, Linden Chemical and Plastics used one small area from 1988-1990. The byproducts contain large quantities of calcium, chloride, and carbonate, creating some areas of high

salinity that inhibit the growth of plants. The majority of the settling basins have vegetative cover, but a few notable exceptions include several saline seep areas and two sites of exposed byproducts. These bare sites could support inland salt marshes, which would cover and stabilize the substrate and recreate a rare ecosystem once found around Onondaga Lake. In order to evaluate the sites of exposed byproducts for the potential to support an inland salt marsh, plugs of the salt marsh grass *Spartina patens* were planted in 1m<sup>2</sup> plots in the spring of 2007. Half of the plots were treated with 200 kg/ha N, P, and K. Above ground biomass was harvested from the plots in August 2007. The sites of exposed byproducts differ dramatically in age. The newer site was abandoned from use in 1990, while the older site was abandoned from use in the 1950s. Aboveground biomass production increased with fertilization at both sites, but the older site had higher biomass totals and greater variance in totals than the newer site. The evidence suggests that plant growth may be limited by different factors at the two sites.

## **62. EFFECTS OF ANTIMICROBIAL PEPTIDES ON BACTERIA**

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Antimicrobial peptides, found in all classes of life, have been demonstrated to act as antibiotics, killing both gram negative and gram positive bacteria. This antibiotic, or antimicrobial, activity poses a significant potential for these peptides to be used as therapeutic agents in the control of foodborne pathogens. Recently there have been several bacterial outbreaks due to the contamination of produce and animal food products. It has been proposed that these peptides may also be used in some type of wash to reduce infection after consumption of contaminated produce. Here we develop an antimicrobial assay using chlorine which can then be applied to the use of antimicrobial peptides such as ESF12-R and ESF15-R. The purpose of the assay is to determine the minimum concentration of antimicrobial peptide required to inhibit two different strains of bacteria, *Escherichia coli* and *Salmonella typhimurium*, both of which are gram negative bacteria. Chlorine was used to determine optimum parameters for each assay. Each bacterial strain was mixed into a serial dilution of chlorine solution to determine the minimum inhibition concentration. The same parameters could be used for the antimicrobial peptide ESF12-R. The minimum inhibition concentration as determined by the chlorine assay for *E. coli* between 6.25µg per 1000µL and for *S. typhimurium* the MIC was between 100µg per 1000µL and 12.5µg per 1000µL.

## **63. A TIME SERIES ANALYSIS OF GFP EXPRESSION IN *CASTANEA DENTATA* EMBRYO CLUMPS**

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The primary objective of this study was to record, by using a microscope mounted camera, when exactly the highest level of transient expression of Green Fluorescent Protein (GFP) occurred after *Agrobacterium tumefaciens* mediated transformation of somatic embryos of the American chestnut (*Castanea*

*dentata*). GFP has become well established as a marker of gene expression and protein targeting in intact cells and organisms. In this study a binary vector containing a constitutively expressed GFP gene was used to transform American chestnut somatic embryos. The embryos were photographed every day after inoculation in order to determine an expression curve. The expression of GFP followed a visual curve line with an incline, a peak in GFP expression, and then a decline back to the normal state of the embryo clump.

#### **64. MONITORING CYANOBACTERIA IN THE LOWER GREAT LAKES USING CONTINUOUS REAL-TIME FLUORESCENCE**

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Large cyanobacterial blooms reoccur in both Lakes Erie and Ontario. Regular monitoring of these potentially harmful blooms is important for implementing prompt water protection strategies. Such efforts necessitate a monitoring method that is reliable and easy to employ. A flow-through monitoring system composed of three commercial fluorometers (Turner Designs Algaewatch, Turner Designs Cyanowatch, and a Hydrolab) was installed on board the CCGS Limnos in the summer of 2007 to provide continuous real-time data on algal blooms throughout the two lakes. To standardize fluorescence measurements between cruises, fluorometers were calibrated pre-cruise using a standard Rhodamine WT solution. Calibration was monitored routinely en-route with the standard solution to ensure fluorescence data stability (i.e. check for instrument drift). The real-time fluorescence data were then compared to extracted chlorophyll and phycocyanin concentrations in order to map algal distribution. The effectiveness of fluorometer calibration and accuracy of resulting bloom mapping will be discussed.

#### **65. EFFECTIVENESS OF AGRICULTURAL BEST MANAGEMENT PRACTICES IN REDUCING NUTRIENTS AND SEDIMENT LOSSES TO SURFACE WATER**

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Six subwatersheds located in Skaneateles Lake Watershed (SLW), New York, were monitored to evaluate the effectiveness of agricultural best management practices (BMPs) on surface water quality impacts associated with agricultural activities. Nonpoint source (NPS) transport of nutrients, sediment, and pathogens is a major concern in this area. This study seeks to quantify the effects of BMPs implementation on water quality by assessing the subsequent concentration of sediment and nutrients. In its initial stages, we synthesize watershed and the associated water quality data to determine relationships between hydrologic, weather and water quality parameters that have significant influence on stream water characteristics. Each sub-watershed was instrumented with an ISCO automated sampler near the outlet for downstream sampling and at the transition between forested land and agricultural land use. This instrumentation allowed collection of flow triggered samples that represented storm events and low flow from May 2007 through November 2007. Snow melt samples were collected as manual grab samples

during March 2007 and April 2007 and sediment and nutrient concentrations were measured. Further, this study performs comprehensive modeling analyses, using the Annualized Agricultural Non-Point Source (AnnAGNPS) model to determine how impact of BMPs implementation on sediment and nutrient loadings from the various subwatersheds in the SLW.

#### **66. URBAN GREEN BUILDING DESIGN FOR ILLICK HALL, SUNY-ESF**

**C. Doty, M. Pullano, R. Read , K. Smith, K. Teitsma, C. Kroll and L. Quackenbush.** Department of Environmental Resources and Forest Engineering, State University of New York, College of Environmental Science and Forestry, Syracuse NY 13210

Illick Hall, on the northern side of the SUNY ESF campus, contains the Department of Environmental and Forest Biology facilities, including classrooms, offices, conference rooms, laboratories, a wildlife museum, and rooftop greenhouses. The building has had minimal renovation since it was dedicated in 1968. The goal of this project is to utilize green building techniques to renovate Illick Hall with attention to energy conservation and occupant environmental quality. There are several design constraints: the building cannot be razed, renovations must comply with governmental regulations, and there needs to be a relocation plan for building residents during renovation. Leadership in Energy and Environmental Design (LEED) concepts will be applied as applicable. LEED standards aim to reduce the environmental impact of construction and renovations, improve energy efficiency, reduce resource consumption and improve indoor environmental quality. The first goal of this project is to redesign the existing greenhouses to provide a more functional configuration, reducing energy costs, increasing greenhouse quality, and allowing for the quarantine of invasive species. The second goal is to explore the use of green roofing over unoccupied roof areas. The preferred design will be one large subdivided greenhouse with a smaller free standing greenhouse for quarantine, combined with the installation of a modular, extensive vegetative roof. This will provide sustainable roof cover, increase greenhouse functionality, and enable rainwater capture. This design will benefit ESF students and staff and serve as an example of responsible, sustainable building for the community.

#### **67. DETERMINING THE OPTIMAL CONCENTRATION OF PARAMOMYCIN NEEDED IN AMERICAN CHESTNUT TRANSFORMATIONS**

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American chestnuts were very important hardwood timber trees across the northeast until the early 1900's when an Asian bark fungus started killing them. In order to save the American chestnut, a transformation process was designed to produce trees that are resistant to the blight. It is important to have this transformation process done as efficiently as possible. One stage of the transformation process calls for paramomycin to be used to destroy untransformed tissue. To determine which concentration worked the best, different amounts of paramomycin were added to the selection plates containing the American

chestnut embryos of two clones. The concentration with the greatest transformation rate could then be used in the transformation protocol.

#### **68. THE INVASIVE ORCHID *EPIPACTIS HELLEBORINE* (L.) CRANTZ FORMS MYCORRHIZAE WITH TRUFFLES (*TUBER* SPP.) AND OTHER ASCOMYCETES IN NEW YORK STATE**

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*Epipactis helleborine* is a member of the Orchidaceae family that is native to Europe. The plant is viewed as an invasive species in North America and is now found in thirty U.S. states from Maine to California, as well as three Canadian provinces. *Epipactis helleborine* is a generalist in Europe, associating with Basidiomycetes and Ascomycetes. Limited data suggest the plant is associated with *Tuber* (Ascomycota – true truffles) in North America. Here we sampled the orchid from a wide variety of locations in New York state and identified its fungal associates using molecular methods. All samples of *E. helleborine* were colonized by members of Ascomycota with the majority being members of the genus *Tuber*. We were unable to identify the species of the *Tuber* in our study, largely because this fungus is undersampled in the northeast and as a consequence, there are few sequences deposited in Genbank for comparison. Surprisingly, *Tuber* spp. appear to be common in New York given the orchid is widespread and frequently encountered in the state. These results suggest mycorrhizal fungi play a role in the invasion biology of the orchid.

#### **69. PURIFICATION OF THE N-TERMINAL NUCLEOTIDE BINDING DOMAIN OF P-GLYCOPROTEIN (MDR3) FOR AID IN PHARMACEUTICAL AND CANCER RESEARCH**

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One of the major obstacles to successful treatment of cancer by chemotherapy is resistance of the cancer cells to cytotoxic drugs. Multidrug Resistance (MDR) protein, also known as P-glycoprotein (Pgp), is known to be one of the resistance causing factors. Pgp is a member of the ATP binding cassette (ABC) family of transport proteins. P-glycoprotein uses the energy from ATP hydrolysis to pump unwanted hydrophobic molecules, such as the drugs used in chemotherapy, across the plasma membrane to the exterior of the cell. Our understanding of the molecular mechanism of Pgp is limited mainly due to the lack of detailed structural information for the protein. In this project, we successfully purified the N-terminal nucleotide-binding domain (NBD-NT) of P-glycoprotein from amino acid residues 382 until 628 (these were used to conserve the natural folding of the protein). NBD-NT was cloned from full length Pgp cDNA and expressed as fusion with maltose binding protein in *E. coli*. The fusion was purified to

homogeneity by using an amylose resin. With this major step complete, we anticipate to obtain structural information using NMR spectroscopy or X-ray crystallography as well as biochemical characterization. This, in turn, will lead to a better understanding of the transporter's catalytic mechanism, knowledge that will be invaluable for the design of therapies in the fight against cancer.

## **70. EFFECTS OF NITRATE DEPOSITION ON GREEN FROG TADPOLES (*RANA CLAMITANS*) IN THE CENTRAL ADIRONDACK MOUNTAINS OF NEW YORK STATE**

**M.E. Santana.** State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

It has been well-documented that pollution affects aquatic organisms, including amphibians. Acid deposition found in the Northeastern US is in the form of sulfate, nitrate, nitrite, and ammonium, which usually decreases pH in water and soils. Several studies have been conducted on nitrate tolerances in amphibians revealing that high concentrations of nitrate increase mortality rates. Nitrates in concentrations as low as 35 $\mu\text{m}/\text{l}$  can have adverse effects on amphibians; specific areas in the Adirondack State Park have nitrate peaks as high as 71 $\mu\text{m}/\text{l}$ , following the spring thaw. It was hypothesized that with increased nitrate ( $\text{NO}_3$ ) there will be both an increase in mortality and a decrease in the overall mass gain for green frog tadpoles (*Rana clamitans*) over the course of three weeks. In order to test this hypothesis several aquaria were used, with three concentrations of sodium nitrate ( $\text{NaNO}_3$ ), 48 $\mu\text{m}/\text{l}$ , 60 $\mu\text{m}/\text{l}$ , and 71 $\mu\text{m}/\text{l}$ . Non-chlorinated tap water was used as a control, having a nominal nitrate level. The experiment was conducted twice due to time constraints, for a combined duration of six weeks. Tadpoles displayed increased vitality in low concentrations of nitrate and high mortality rates in high concentrations of nitrate, agreeing with previous study results.

## **71. INTERSTITIAL GAS ANALYSIS OF SILICON**

**M. Sathyamurthy and N. Lepage.** Evans Analytical Group, Syracuse, NY 13210

Silicon has been noted to have greatest impact on the modern world's lifestyle. Its effects resulted in silicon wafers used in electronic devices and in the development of integrated circuits. Chemical analysts have been using the Interstitial Gas Analysis to further study the properties of Silicon. This analysis used High temperature furnaces to rapidly heat a sample and thereby converting them to some common chemical species to volatile forms in order to separate and measure them. The analytical method was based on the complete and instantaneous oxidation of the solid sample by "combustion" in oxygen. The combustion of the sample released gases, which are then measured by four infrared detectors, after dust and moisture removal. N, O, C and H mass fractions in solid samples are evaluated using the principles of inert gas fusion or solid carrier gas heat extraction. This method detected the total concentration of each impurity regardless of its chemical and electronic state and provided an accurate determination of gas forming elements with a wide detection range from sub-ppm to wt%.

## **72. PERMANENTLY AQUATIC SALAMANDER DISPERSAL CAPABILITIES; IMPLICATIONS FOR WETLAND CONNECTIVITY**

**Christopher Schalk.** Division of Environmental Science, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Amphibians inhabiting isolated wetlands rely on terrestrial landscape connectivity between wetlands for long-term population persistence. Research focusing on the role of landscape connectivity for amphibians has been restricted to species with a terrestrial life-stage component. Although permanently aquatic salamanders are commonly encountered in isolated wetlands, their movement ecology has yet to be conclusively determined. For these salamander species, temporary waterways formed during heavy rains may provide transient dispersal opportunities between otherwise isolated wetland patches. I assessed the vagility of two obligate aquatic salamanders, greater siren (*Siren lacertina*) and two-toed amphiuma (*Amphiuma means*), by running them on a Living Stream track under three simulated environmental conditions: terrestrial dispersal (damp but no standing water), shallow standing water (one centimeter of water), and complete submergence (approximately five centimeters of water). Both species demonstrated a trend towards exhaustion in the 0cm and 1cm treatments, and failed to move more than 8m in either treatment. As expected, animals in the fully submerged treatment were the most vagile and showed little to no tendency to exhaust. Physical characteristics (body length, mass, and condition) did not affect dispersal ability. An aquatic corridor in which these salamanders are completely submerged is the likely method of movement. Therefore, maintaining the surrounding landscape to allow formation of temporary waterways is important for successful inter-wetland movement. Human activities that alter flooding events and watershed connectivity, such as flood control regimes and roads, may have important implications for wetland connectivity, and thus metapopulation viability of permanently aquatic salamanders.

## **73. SUNY-ESF FOREST SOILS LABORATORY:40 YEARS OF RESEARCH AND SERVICE SUPPORTING THE ESF COMMUNITY**

**C.D. Schirmer and R.D. Briggs.** Department of Forest and Natural Resources Management, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Studies in forest ecology and biogeochemistry frequently require chemical and physical analyses of soils, plant tissue and surface and ground waters. For 40 years the SUNY-ESF Forest Soils Analytical Laboratory has been providing these services. The Forest Soils Laboratory complex, located on the third floor of Illick Hall, includes several individual laboratories which house a variety of activities ranging from drying and sample processing to analysis on sensitive instruments. Over the past four decades the lab has evolved with acquisition of new instruments and continuing evaluation and improvement of analytical procedures while continuing to support classic methods necessary for long-term monitoring studies. Our laboratory provides unique opportunities for students, faculty and staff in teaching and research through hands-on experience that many labs do not offer. The facilities are utilized by nearly every department on campus as well as individuals from Syracuse University and collaborators such as

the US Geological Survey, US Forest Service and various tree nurseries. Continued support from the college administration has contributed to our long-term viability.

#### **74. THE TWO STEP; DETOXIFICATION PATHWAY OF MICROCYSTINS IN FISH**

**J.L. Smith<sup>1</sup>, K.L. Schulz<sup>1</sup>, and G.L. Boyer<sup>2</sup>.** <sup>1</sup>Department of Environmental and Forest Biology and <sup>2</sup>Department of Chemistry, State University of New York, College of Environmental Science and Forestry, Syracuse NY 13210

Microcystins (MCs) are a class of potent liver/hepatopancreatic toxins produced by numerous species of freshwater cyanobacteria. After ingestion by aquatic animals, MCs are enzymatically conjugated to a tripeptide, glutathione, via the sulfur of the cysteine residue. Conjugation transforms the toxin to a more polar adduct, facilitating its elimination through urine. Our research identified a potential second step in the detoxification pathway: the biotransformed MCs are oxidized at the sulfur conjugation site, making the toxin even more polar and susceptible to elimination. We confirmed the oxidation step in fish liver extract with liquid chromatography coupled with mass spectrometry.

#### **75. EFFECTS OF SALT CONCENTRATIONS ON THE GROWTH AND TOXIN PRODUCTION IN THE CYANOBACTERIUM *MICROCYSTIS AERUGINOSA***

**T.T. Smith and G.L. Boyer.** Department of Chemistry, State University of New York, Environmental Science and Forestry, Syracuse NY, 13210

*Microcystis aeruginosa* is a cyanobacterium that produces multiple variants of microcystins, a potent class of hepatotoxins. *M. aeruginosa* grows around the world and toxic blooms have killed terrestrial and aquatic animals. *Microcystis*, a freshwater species, also occurs in estuaries with similar negative effects. To examine the effect of salt on toxin production, two strains of *M. aeruginosa* were grown in triplicate in five concentrations of sodium chloride to investigate its effect on growth rate and production of microcystin. The growth rate was measured by in vivo fluorescence and microcystins was measured by the protein phosphatase inhibition assay. Microcystin variants were determined by HPLC. Results of the experiment will be discussed.

#### **76. OXIDATION OF DIMETHYLSULFONIOPROPIONATE PRODUCES DIMETHYL SULFOXIDE: IMPLICATIONS FOR STRESS IN MARINE ALGAE**

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Dimethyl sulfoxide is a ubiquitous reduced sulfur compound in the marine environment. It is thought to be produced primarily by the oxidation of dimethyl sulfide (DMS), a climatically active trace gas. DMS, in turn, is produced by the hydrolysis of dimethylsulfoniopropionate (DMSP), a major secondary metabolite in many marine algal species. We present evidence that in some species, direct oxidation of DMSP to DMSO by hydroxyl radical (OH) is the primary production route for DMSO. DMSP is shown to

react with OH with a rate constant of  $(1.8 \pm 0.8) \times 10^7 \text{ M}^{-1} \text{ s}^{-1}$ , and that the rate of DMSO production is sufficient to account for the observed production in algal cultures. Coupled to a reduction of DMSO to DMS in marine algae, this process is solely responsible for the observed DMS production in many species, specifically those lacking DMSP lyase, an enzyme that produces DMS from DMSP. Turnover of DMSO mediated by this process occurs on the order of hours (0.5-44 h). Evidence of increased DMSO production under stress, coupled with increased DMSO consumption, supports the idea of DMSP, DMS, and DMSO being part of an antioxidant system, with DMSO emerging as the central species.

## **77. DEVELOPING A SPATIOTEMPORAL MODEL OF DENGUE FEVER TRANSMISSION IN ECUADOR**

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Dengue fever (DF), a virus transmitted to humans by the *Aedes aegypti* mosquito, has been identified as one of the most significant emerging vector-borne diseases. The spread of dengue is poorly understood but has been attributed tentatively to unstructured urbanization, increased human migration, lack of effective mosquito control, and climate change. The objective of this research is to develop a fine-scale, spatiotemporal model of Ecuador that integrates socioeconomic (e.g., poverty) and biophysical (e.g., climate) variables to identify populations at risk of DF. In June, 2008, we will conduct a small-scale, pilot study of DF in two low-income communities in Guayaquil, Ecuador, a major coastal city with year-round DF transmission. Although most DF cases occur during the rainy season, we will test the hypothesis that DF is sustained during the dry season by water accumulation in man-made containers. We will conduct household surveys in both neighborhoods to determine (1) history of infection, (2) at risk behavior, (3) knowledge about DF transmission, (4) household characteristics that affect transmission, and (5) to quantify pupal mosquito populations per household. Local weekly meteorological and epidemiological data will be provided by the National Meteorological and Hydrological Institute and Ministry of Health, respectively, and will be analyzed with survey data using GIS. Ultimately, this critical research will aid in the development of a geographical model of disease transmission that will provide guidance for public health policy makers in developing countries to anticipate and mitigate future epidemics.

## **78. ETHANOL PRODUCTION BY YAMADAZYMA (PICHIA) STIPITIS TO OPTIMIZE PRODUCT YIELD FROM WOOD HYDROLYSATES**

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The societal shift toward biofuels, such as ethanol, requires production methods that reduce cost and environmental impact. This study attempts to optimize wood hydrolysate-to-ethanol yields by *Y. stipitis*

through the examination of different culture conditions. Aeration and nutritional requirements were tested using cultures containing D-xylose as the carbon source and hydrolysate concentrations were examined with acid-treated and non acid-treated wood hydrolysates. Cultures of *Y. stipitis* were sampled for sugar and ethanol concentrations by high-performance liquid chromatography (HPLC) and gas chromatography (GC), respectively. Results indicate that high aeration (150 rpm) and a minimum of 10 g/L yeast extract are required to rapidly produce high ethanol concentrations. Cheese whey was not an adequate substitute for yeast extract at the concentrations tested. Acid-treated wood hydrolysate greatly inhibited *Y. stipitis* growth and fermentation. In fact, 50% non acid-treated wood hydrolysate maximized ethanol yields achieving  $13.42 \pm 0.21$  g/L within 51.5 hours at a rate of 0.26 g/L·h. It was concluded that ethanol production by *Y. stipitis* on wood hydrolysate is a feasible alternative to ethanol production from corn. Further hydrolysate processing would be required to remove inhibitory compounds and generate higher hydrolysate (sugar) concentrations resulting in maximum ethanol yields.

#### **79. CAROTENOID PIGMENT SIGNATURES IN THE BLUE-GREEN ALGAE *MICROCYSTIS AERUGINOSA***

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Cyanobacteria (blue-green algae) occur around the world in salt and freshwater systems. In nutrient-rich environments, cyanobacterial blooms can cause taste and odor issues in drinking water supplies. Some cyanobacteria such as *Microcystis* also produce toxins that impact drinking and recreational waters. Pigment analysis has been used to distinguish cyanobacterial blooms from blooms of other algae. We are interested to see if pigment signatures can be used to distinguish blooms of *Microcystis* from blooms of other cyanobacteria. Cultures of four *Microcystis aeruginosa* strains (LE-3 and UTEX LB 2386, 2664, and 2665) were grown in artificial culture under identical nutrient and light conditions. Samples were collected after 14 days in culture and extracted in 90% acetone before pigment analysis by HPLC using a photodiode array detector. Strain LE-3 was also grown under varied light intensities to determine the effect on relative pigment composition. The major carotenoids in the *Microcystis* species were beta-beta carotene, echinone, myxoxanthan, zeaxanthin, and an unidentified pigment. Significant differences in composition were observed between strains. Changing light intensities had little effect on the pigment composition of LE-3. A comparison of carotenoid composition between *Microcystis* and other species of cyanobacteria will be the focus of future research.

#### **80. HIGH PERFORMANCE LIQUID CHROMATOGRAPHY ANALYSIS OF PARALYTIC SHELLFISH POISONS (PSP) FOUND IN CYANOBACTERIA LYNGBYA SAMPLES FOUND IN LAKE ERIE , NY**

**M. D. Sunkin and G. L. Boyer.** Department of Chemistry, State University of New York, College of Environmental Science and Forestry, Syracuse NY 13210

Paralytic Shellfish Poisons (PSP's) are powerful biological neurotoxins produced by different strains of cyanobacteria commonly found in red-tide. These toxins can be consumed by shellfish and are a major economic threat to the shellfish industry and public health. The FDA approved Mouse Bioassay is available for toxin detection, but are limited in detection limits. Discovery of new PSP toxins found in species *Lyngbia wollei* lead to further investigation of toxin samples. HPLC Fluorometric Oxidation methods are promising in toxin analysis because they can separate different analogs of PSP toxins and achieve better detection limits than the FDA approved Mouse Bioassay. Method Detection Limits for a Post Column Reaction HPLC System are compared to the Pre-Column Reaction HPLC System and Electrochemical Oxidation System. Lyngbya samples found in Lake Erie were characterized for STX, NeoSTX, GTX(1-4), and B-1 toxins.

### **81. REGENERATION OF THREE ADIRONDACK BRYOPHYTES AFTER SIMULATED HARVEST**

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Bryophytes are an important component of northern plant communities in both biomass and species diversity. With over 350 species in the Adirondacks, mosses vary in growth forms and habitat adaptations. Mosses can regenerate as gametophyte fragments, with many influences, particularly substrate type, which can determine their success. The goal of this study was to investigate the artificial regeneration of *Dicranum scoparium*, *Hypnum imponens*, and *Thuidium delicatulum* from fragments on two substrates, peat moss and sand. The species were harvested from three sites at the Cranberry Lake Biological Station, New York. The regeneration from fragments and the natural re-growth in the post harvest sites were monitored from July to September 2008. Rates of regeneration between the three species and their substrate were compared, as well as the natural re-growth in the post-harvest sites of each species. Significant results showed that regeneration of *T. delicatulum* was statistically higher on sand than peat ( $p$ -value= $<.0001$ ). The natural re-growth at the post-harvest sites was found not to be statistically different. The average recovery rate (months) for *D. scoparium* is 9.56, for *H. imponens* is 5.69, and *T. delicatulum* is 4.16. We can conclude that sand was overall the more successful substrate, especially for *T. delicatulum*. The results of regeneration from all three species may have been a result of having a fixed or unfixed growth rate. The results may help in practicing successful regeneration of fragments and sustainable harvesting of these three common mosses.

### **82. DETECTING THE DIFFERENCES OF GENE EXPRESSION FORM *PSEUDOMONAS PUTIDA* KT2440 GROWING IN DIFFERENT CARBON SOURCE USING QRT-PCR**

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*Pseudomonas putida* is a gram negative rod-shape saprophytic soil bacterium. This strain has a variety of potential uses in bioremediation and the biosynthesis of biodegradable plastics. *P. putida* is metabolically

versatile and is able to utilize a wide range of carbon sources. In this research, *P. putida* KT2440 was grown in mineral salts (MS) medium supplemented with either glucose or glycerol as a carbon source. Using quantitative real time PCR (QRT-PCR), the differences in expression levels of genes involved in glucose and glycerol metabolism were detected. The results showed that when glycerol was the sole carbon source, the expression levels of genes related to glycerol metabolism were significantly higher than glucose as the carbon source. This research is helpful to find out how the genes are regulated by different carbon sources, and this study shows that QRT-PCR is a sensitive and quantitative method to detect differences in gene expression levels of *P. putida* grown under different growth conditions.

### **83. REHABILITATION OF EDWARD'S FALLS DAM ON LIMESTONE CREEK, MANLIUS , NY**

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Due to continuing deterioration and the inability to meet current regulations, Edward's Falls Dam in Manlius NY, requires a plan for rehabilitation. As part of the Environmental Resources and Forest Engineering senior planning and design class, we explored options for dealing with the deterioration of the dam and recommend a rehabilitation design. Three alternatives have been researched and analyzed as part of this project. The three alternatives are complete removal of the dam, removal of the existing dam structure and build a new dam, or fix, update, and maintain the current dam. Proposed specifications and costs have been presented for each alternative, which were then analyzed and compared using a set of decision criteria that considered durability, cost, public risk, and ecological impact. Based on these criteria, the preferred design is to remove the dam completely. Construction for this design will include sediment dredging, water diversion, and structural removal. We will also include an analysis of streambank restoration after the dam is removed. The final recommendation will include a fiscal analysis, further specifications, and detailed drawings of the preferred design in a final report to community stakeholders.

### **84. HOST CELL REGULATORS p21<sup>Cip1</sup> AND p27<sup>Kip1</sup> ARE INDUCED BY VARICELLA-ZOSTER VIRUS AND p21 IS SELECTIVELY PACKAGED INTO VIRIONS**

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Varicella-zoster virus (VZV) is a human alpha herpes virus that causes chicken pox and shingles. In individuals with these diseases, VZV is tropic for T cells, neurons, and skin. We found that when VZV infects cultured human skin fibroblasts (HFFs), host cell proteins are modified to create a favorable environment for viral replication. In particular, cyclin-dependent kinases (CDKs) and DNA-damage response proteins are dysregulated. The host cell proteins p21 and p27 are members of the Cip/Kip family

that have integral roles in both DNA damage and cell cycle pathways. These proteins are scarce in confluent HFFs. Upon VZV infection, however, levels of p21 and p27 increase substantially. The purpose of this study was to observe the localization of p21 and p27, working under the hypothesis that their localization would inform possible roles in VZV replication. Both proteins were plentiful in the cytoplasm of VZV-infected cells and weakly detected in the surrounding uninfected HFFs using immunofluorescence confocal microscopy. This indicated that upregulation of these proteins was due to VZV infection and was not a stress response of the culture. Curiously, purified virions contained p21 but not p27, as determined by immunoblot. To further validate this finding, p21 and p27 were detected by immunogold electron microscopy, yielding similar results. Again, p21 was associated with viral envelopes and the cytoplasm of infected cells, while p27 was not associated with virions. Thus incorporation of host cell proteins into virions was selective.

## **85. EXPLORING COMMUNITY WELLBEING AND SUSTAINABILITY AT A LOCAL SCALE: FINDING THE GAPS BETWEEN LOCAL RESIDENTS, LOCAL OFFICIALS, AND EXPERTS**

**M.A. Young.** Department of Forest and Natural Resources Management, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

In the past decade, researchers have recognized the need for localized sustainability initiatives at the community level that include local people in the decision making process. Community Sustainability Indicators (CSIs) have been developed as tools that local groups can use to monitor economic, social and environmental progress for their communities. Basing indicator selection on locally important criteria is essential for successful community sustainability efforts. The purpose of this study was to identify the set of criteria used by local people of the Tug Hill region of New York State to assess how they think about the wellbeing of their community. I conducted in-depth interviews with forty-eight local residents and twenty-four elected officials and analyzed the data to determine the criteria local people used to assess their communities. I compared the results of the two groups to identify differences of criteria used for assessment. This helps in making recommendations regarding the role of local officials in the development of CSIs. Results from my study were also compared to lists presented by experts as good examples of community sustainability indicator sets. I found that residents, elected officials, and experts differ in the sets of criteria they use to monitor community wellbeing and sustainability. This finding led to a decision by The Tug Hill Commission to involve a representative sample of people of the region in the development of CSIs for long-term monitoring of the region rather than relying on local government officials alone to do so.

## **86. DOES BANDWIDTH SELECTION REALLY MATTER IN APPLICATION OF GEOGRAPHICALLY WEIGHTED REGRESSION**

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A forest plot with a clustered spatial pattern of tree locations was used to investigate the impacts of different kernel functions (fixed vs. adaptive) and different sizes of bandwidth on model fitting, model performance and spatial characteristics of the GWR coefficient estimates and model residuals. Our results indicated (1) the GWR models with smaller bandwidths fitted the data better, yielded smaller model residuals across tree sizes, significantly reduced spatial autocorrelation and heterogeneity for model residuals, and generated better spatial patterns for model residuals. However, smaller bandwidth sizes produced high levels of coefficient variability; (2) the GWR models based the fixed spatial kernel function produced smoother spatial distributions for the model coefficients than those based on the adaptive kernel function; and (3) the GWR cross-validation or AIC optimization process may not produce an “optimal” bandwidth for model fitting and performance. It was evident that selection of spatial kernel function and bandwidth has a strong impact on the descriptive and predictive power of the GWR models.

### **87. FERMENTATION FOR POLYHYDROXYALKANOATE (PHA) BY *BURKHOLDERIA CEPACIA* USING RENEWABLE GLYCEROL**

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Polyhydroxyalkanoates (PHAs) are accumulated as microbial intracellular carbon and energy reserves. PHAs are environmentally compatible and biodegradable plastics compared with the more familiar petrochemical products. *B.cepacia* was employed to use biodiesel-glycerol as the carbon source in a 100L fermentation. After the 141-hour fed-batch fermentation, dry biomass accumulated to 15g/L and the homopolymer polyhydroxybutyrate (PHB) was the only polymer produced under these conditions with a PHB yield of 27% of dry biomass. However, in 1L fermentations, dry biomass reached 33g/L and PHB yield was 34.2% of dry biomass. By optimizing the C:N ratio and other fermentation and nutritional conditions, it may be possible to obtain higher yields of dry biomass and PHB in large-scale fermentations.

### **88. THE BALLOON GRAPH AND YOUR FUTURE!**

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Sufficient surplus energy is necessary for the survival and growth of any organism or ecosystem, including both humans and human endeavors. Thus energetics, and specifically an analysis of both the quantity and the quality of existing and potential energy resources, is an essential consideration. Energy return on investment (EROI) is a particularly useful tool because it measures, and allows the comparison of, the energy returned to society relative to the energy needed to find and exploit that energy. Fossil fuels have had a relatively high EROI in the past. During the early decades of the last century the United States experienced a period of very high EROI of roughly 100:1 as we exploited large oil reservoirs. This very high EROI allowed intense economic growth and the development of a powerful and wealthy nation. Since then there has been a general pattern of decline in EROI for most or all major fuels. Unfortunately,

all alternatives to fossil fuels, with the possible exception of nuclear power, do not have the favorable characteristics of fossil fuels: high energy density, transportability, relatively low environmental impact, relatively high EROI and large availability. The EROI for e.g. oil has dropped from 100:1 in 1930 to 30:1 at our peak production in 1970 to roughly 15:1 today. Most liquid alternatives (i.e. corn-based ethanol, biodiesel from crops, fuels from cellulose) have very low or even negative EROIs, and are limited in quantity. Photovoltaics and wind turbines at this time have low EROIs but a large potential magnitude.

## **89. SUGAR MAPLE DECLINE FOLLOWING DEFOLIATION BY FOREST TENT CATERPILLAR (*MALACOSOMA DISSTRIA*: HÜBNER)**

**D.M. Wood<sup>1</sup>, R.D. Yanai<sup>1</sup> and D.C. Allen<sup>2</sup>.** <sup>1</sup>Department of Forest and Natural Resource Management and <sup>2</sup>Department of Environmental and Forest Biology, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Defoliation has been suggested as a significant stressor of forest stands that may incite decline disease of sugar maple (*Acer saccharum*: Marsh; Manion 1991; Houston 1992). The recent outbreak (2002-2007) of forest tent caterpillar (*Malacosoma disstria*: Hübner; FTC) in the northeastern U.S. offered the opportunity to test if defoliation exacerbated forest damage (dieback, mortality, and loss of vigor), and to determine the site variables that predisposed the stands to damage. We measured 51 North American Maple Project (NAMP) stands in New York and Vermont in Summer 2007. Mortality ( $p=0.04$ ) and poor vigor ( $p=0.01$ ) were significantly higher in stands defoliated by FTC, and dieback neared significance ( $p=0.07$ ). Growing-season soil moisture during the outbreak, indicated by Palmer's Z-index, and defoliation measured in 2006 were the most significant predictors of forest damage. Mean annual temperature during the outbreak and site microrelief were also important predictors. We present the results of our multiple regression equations for stand dieback, mortality, and vigor in tables that can be used by forest managers to evaluate the vulnerability of their sugar maple stands to decline following defoliation by FTC.

## **90. UNDERSTANDING INTERACTIONS BETWEEN THE RX COILED-COIL DOMAIN AND STTRANGAP2**

**T.T. Baldwin, G.J. Rairden, S. M. Collier, M. A. Sacco, T. Boettrich and P. Moffett.**

Plant NB-LRR proteins confer resistance to specific pathogens by recognizing pathogen-encoded avirulence proteins and inducing a type of cell death known as the hypersensitive response. Many NB-LRR proteins possess a coiled-coil (CC) domain at their N termini. The CC-NB-LRR protein Rx confers resistance to potato virus X (PVX). Previous studies have shown that the Ran GTPase-activating protein 2 (RanGAP2) binds to the Rx CC domain and is necessary for Rx-mediated responses. We studied the interaction between RanGAP2 and the CC domain of the Rx protein using pre-developed CC mutant constructs and co-expression *in planta* followed by *co-immunoprecipitation*. C-terminal and N-terminal deletion constructs were used to determine the minimum structure of the CC domain required to bind RanGAP2. Our results identified a minimal region of eighty amino acids within the CC domain that were necessary and sufficient for the Rx/RanGAP2 interaction. An intra-molecular interaction also takes place between the CC domain and the rest of the Rx protein. Internal substitution mutations showed that the

region of the CC domain that mediates the intra-molecular interaction is overlapping, but separate from the RanGAP2 interaction interface. Functional analysis suggests that both interactions are necessary to produce a hypersensitive response.

## **91. IT'S NOT EASY BEING GREEN: SUNY-ESF MAIN CAMPUS GREENHOUSE GAS EMISSIONS ASSESSMENT**

We assessed direct energy use and other energy consumptive activities at the SUNY-ESF main campus during the 2006-2007 academic year to estimate associated greenhouse gas (GHG) emissions, and to evaluate overall trends in those emissions compared to prior years. We obtained electric, natural gas, and steam data from the SUNY energy management and budget system. We obtained and estimated transportation energy use from Physical Plant records and survey data. We analyzed supplies and equipment purchases from purchasing and bookstore records, as well as food consumption data related to the ESF Gallery Snack bar. We assessed the waste contribution to GHG emissions by collecting information on disposal, compost and recycling on campus. We input all direct energy data into the Clean Air-Cool Planet Carbon Calculator to yield CO<sub>2</sub> equivalent emissions. GHG emissions embodied in food, supplies and equipment were estimated using [NAME of GHG CALCULATOR] and compared to results from the 2001 energy analysis. GHG emissions from direct energy use totaled \_\_\_ metric tons, a \_\_\_% increase from 2002. Estimated embodied GHG emissions totaled \_\_\_ metric tons, a \_\_\_% increase from 2002. Per-student GHG emissions decreased due to rising enrollment. We make some recommendations that may facilitate future GHG emissions assessments, and also raise on-campus GHG impact awareness. Our methods provide an basis for future GHG assessments at SUNY-ESF and for developing GHG assessments at other SUNY campuses.

## **92. ICE PHENOLOGY OF FIVE ADIRONDACK LAKES**

### **R.A. Bishop.**

Lake ice phenology parameters, the dates of ice-in and ice-out, offer a partial narration of autumn and spring environments. These dates can offer an estimate of local climate variability and a long-term look at the effects climate change may be having on the system. Lake ice phenology provided by the Adirondack Ecological Center was analyzed for Arbutus, Catlin, Deer, Rich and Wolf lakes. Recorded ice dates are from as early as 1873. The most complete range of data on all five lakes is from 1973 to 2007. Regressions were run to assess the relationship between lake size and elevation on ice-on and ice-off dates. Data analysis shows a later ice-on date, earlier ice-off date, and an overall decreased duration of ice cover over the time of record.

## **93. ECUADOR: APPLIED CONSERVATION IN A TROPICAL REGION**

**S.E. Sumoski, L. J. Bishop – Boros, D.C. Crimmins, J.D. Kotarski, A.L. Reinhardt and J.A. Walker.**

Home to a plethora of biodiversity, the tropics represent an ecological hotspot in dyer need of conservation efforts. Our experience in Ecuador focused on the application of conservation principles in

tropical regions, specifically pertaining to animal rehabilitation. Two areas of the country were explored: the urban capital region of Quito and the highlands of the Amazon Rainforest. Our two week experience was affiliated with the Society for Conservation Biology – Central New York, Sustainable Horizon, and El Arca animal reserve. The information gathered offers a window to SUNY-ESF and the surrounding communities; fostering a better cultural and ecological understanding of tropical regions. In addition to ecological knowledge our interest as scientists in conserving the biodiversity of the tropics was ignited.

#### **94. AN ANALYSIS OF ESF CAMPUS SUSTAINABILITY USING THE AASHE SUSTAINABILITY TRACKING, ASSESSMENT, AND RATING SYSTEM**

The Association for the Advancement of Sustainability in Higher Education (ASHEE) has developed a voluntary, self-reporting framework called the ASHEE Sustainable Tracking, Assessment and Rating System (STARS) for colleges and universities. Its purpose is to help institutions gauge their relative progress towards achieving sustainability, and compare results. The system is all-encompassing, and accounts for the social, economic, and environmental aspects of sustainability. The format consists of comprehensive checklists for three categories, namely education and research (ER), operations (OP), and administration and finance (AF). A point system within each category allows institutions to rate themselves on a sustainability curve. We intend to complete the AASHE assessment for SUNY ESF's main campus, suggest ways the college can improve its rating, and recommend changes to the ASHEE checklists. Our tasks include working in groups of two or three, each with a specific category for assessment, and gathering relevant data from the ESF community using e-mail, surveys, and semi-structured interviews.

#### **95. EFFECT OF KUPFFER CELL DEPLETION ON MMP-2 LEVELS IN MDR-KNOCKOUT MICE**

**R. Akhouri, Y. Popov, J. Zaks and D. Schuppan.** Beth Israel Deaconess Medical Center, GI Department.

The experiment performed on MDR-knockout mice aimed to determine the effects on fibrosis levels with the removal of Kupffer cells. Kupffer cells activate protein molecule cascades that enhance liver cell recovery from a fibrotic state. MDR-Knockout are mice that are normally prone to liver fibrosis. In the experiment 8 week old knockout mice were used. There were two male and female mice for each time point. The Kupffer cells were depleted and the mice sacrificed at 0, 24, 48 and 72 hour time points. Beta<sub>2</sub> microglobulin, was the protein used as the base set for comparison and standard quantification of all other labeled sequences. Procollagen is the protein that provides information as to whether fibrosis was occurring. The MMP (metalmatrix proteins) series identify potential factors that are specific responses to the increase in Procollagen and collagen levels. The MMP-2 levels are of main interest because they are believed to be the main precursor to Procollagen. It is believed that the Kupffer cells are regenerated after a 24-48 hour period. The observation of Procollagen and MMP levels rising then recovering would be understandable. There is a large standard deviation on some of the data samples, and the information

found can only be considered inconclusive and would require further testing to determine the effects of the removal of Kupffer cells. This experiment was designed with a small sample set to determine what times and dose level for Kupffer cell depletion would be most effective in studying the levels of MMP-2 and Procollagen.

## **Abstracts for FEG 340 Engineering Hydrology and Hydraulics Course**

### **96. PROPOSAL FOR BIORETENTION BASIN AT SYRACUSE UNIVERSITY HEALTH SERVICES COMPLEX, SYRACUSE NY 13210**

**K.D.Berler<sup>1</sup>, T.A. Endreny<sup>2</sup> and S. Hirabayashi<sup>2</sup>.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

During the wet months of the Syracuse water year, the METRO wastewater treatment facility can become overloaded from the discharge flow of combined sewer overflows (CSO) that empties into Onondaga Creek and ultimately Onondaga Lake. Proposals have surfaced among engineers for regional treatment facilities (RTF) to take on the discharge from the CSO's. There have also been other proposals for off-line or in-line storage of the CSO volume during the wet weather months, this would then later be sent to the METRO facility for proper treatment. Taking into consideration community concerns dealing with possible disruptions in the area of the RTF, a series of ecologically based alternatives to help in the reduction of stormwater runoff resulting also in a reduction of the CSO discharges. Some alternatives in consideration include the following: Large Footprint Detention Basins, Porous Pavements, Smaller Footprint Infiltration Basins or Trenches and Vegetable Bioretention Basins. For this particular basin the location primarily considered was the front section located in the front of the Syracuse University Health Services Complex. Finding an area of 1906 square meters for the watershed, it was determined that to handle five percent of the discharge a bioretention basin would have to approximately be 19.2 square meters. The basin's dimensions would consist of a width of 1.3 meters and a length of 15 meters. This would be rather simple to install within the lawn located in front of the buildings of the Health Center Complex.

### **97. BIORETENTION AREA FOR VACANT DELL ST. LOT, SYRACUSE, NY**

**R.A. Bishop and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal of this project is to develop an original alternative design to aid in the control of runoff due to increased levels of impervious surfaces of a defined urban watershed. The bio-retention facility must: must be a bioretention facility, fit into existing development, capture the stormwater volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8 cm depth, have the bioretention under-drain tied into the storm-sewer, pond water for the design event to 15-cm, infiltrate water every 6-hr period to reset

the ponding depth, and must have the vertical layers and assemblage of microbes and plants outlined by the EPA fact sheet. Some possible alternatives that would reach a majority of these goals are: decreasing paved surfaces, decreasing treatment areas (done by increasing drainages and sewer-systems), and adding surfaces with greater percolation rates. Hydrologic knowledge was used to determine precipitation, runoff, and infiltration rates of the delineated watershed. More advanced Water Resources Engineering tools were used to complete the design; among those were: NRCS curve number method, Green and Ampt infiltration, curb capture efficiency, and the Haestad Methods FlowMaster simulation. The designed swale has a top width of 100 cm, a depth of 15cm, and a length of 433.53cm. The side of the device slope at a 45 degree angle. Swale size was based on a delineated area of 2055 ft<sup>2</sup> and a peak runoff discharge depth of 2.5cm. The design works best with an 8 inch pipe diameter. Goals and constraints were met quite efficiently. The scale of this project was effective in displaying the effects of establishing bioretention facilities.

## **98. BIORETENTION BASIN INSTALLATION AS A MEANS FOR STORMWATER COLLECTION FOR CARRIER DOME PARKING LOT, SYRACUSE NEW YORK.**

**J. Borden, S. Hirabayashi and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The area of interest for the location of the bioretention basin is located at the bottom southwest corner of the parking lot immediately adjacent (east of) to Sadler Hall on the Syracuse University campus. The area is composed of 100% impervious surfaces. The goal of the design project is to focus on establishing a stormwater bioretention device, which is a low impact development best management practice to treat point and nonpoint source runoff. The device must ensure continued flood control and human safety, improve aquatic health, and address terrestrial hydrology. The constraints of the project are outlined as follows: The device must be a bioretention facility; fit into existing development, etc., capture the stormwater volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8 cm depth, have the bioretention under-drain tied into the stormsewer or groundwater system, pond water for the design event to 15-cm, infiltrate water every 6-hr period to reset the ponding depth, and have the vertical layers and assemblage of microbes and plants outlined by the EPA fact sheet. Analyzing alternative designs incorporates the evaluation of existing and potential stormwater collection techniques. Bioretention basins utilize soils and both woody and herbaceous plants to remove pollutants from storm water runoff. The existing runoff processes simply capture storm water runoff and channels it into the existing sewer system. Alternative designs to bioretention basins also look at varying dimensions of shapes of device and its components. The final design of the bioretention basin has the following dimensions and statistics; the area of the impervious surface is 100m<sup>2</sup>, the volume of precipitation is 1.7 m<sup>3</sup>/6 hours, the volume runoff is 1.205 m<sup>3</sup>/6 hours, the area of the trapezoidal bioretention basin itself is 10.432 m<sup>2</sup>, the infiltration capacity is 1.11 cm/hr, and the infiltration volume is .115 m<sup>3</sup>/hr. The design will satisfy all constraints, while greatly reducing the runoff entering the existing sewer system from storm water runoff. The sandy loam soil, sand bed, and gravel layers, help slow down the previously rapid flow of the stormwater. The vegetation and soil layers will help to reduce pollutants and dissipate excess water. The underdrain

system, with 6 inch diameter pipe, also contributes in dissipating the water accumulated as well as increases the quality of the ground water. Along with the hydrologic benefits and contributions of the bioretention system, the aesthetic value of the associated vegetation will be much appreciated.

### **99. BIORETENTION BASIN PROPOSAL FOR HENRY STREET PARKING LOT, SYRACUSE, NEW YORK: A LEARNING PROJECT**

**C.S Bullard Jr. and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The location of the bioretention basin is in the land covered with grass just North of East Raynor Ave. and is designed to accept runoff from the Southern two thirds of the Henry St. Parking lot in Syracuse, New York. The goal of undergoing such an endeavor is to help relieve stress currently in place on Onondaga Creek, control storm water runoff from the Henry Parking Lot, provide water quality protection for Onondaga Creek, and be aesthetically pleasing to local community. Design constraints include a single bioretention basin treating a small area, and maximum 15cm ponding depth for a 24hour 2 year reoccurrence interval storm depositing 6.8cm of rainfall. One design that satisfies the design constraints includes a rectangular bioretention basin that is 2.627m wide by 41.105m long by 2m deep containing Loamy Sand underneath which is a gravel bed containing a 6in perforated PVC pipe for drainage. Just leaving the parking lot in the status quo could also work, but this is not aiding Onondaga Creek or Onondaga Lake because little water is retained in these areas. Darcy equations and Manning's equations were modified and used for calculating the above numbers. Such equations as these were placed in MathCAD and Excel to calculate the above design characteristics. This design, at the very end of the 24 hr storm had a calculated ponding depth of 14.5in, just under the maximum allotted, and then continued draining after the storm was finished. This removes pollutants from storm water and alleviates stress on Onondaga Creek from the Henry Parking Lot that eventually drains into Onondaga Lake .This will help protect the water quality of Onondaga Creek and Onondaga Lake .

### **100. BIORETENTION BASIN DECREASING STORM SEWER DEPENDENCE**

**C.H. Christoff and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

This bioretention basin is located off of Nottingham Rd at the Drumlins Golf Course west parking lot. The design needed to follow specific constraints such as; being able to filter and process water before entering a storm sewer, capturing storm water volume generated by a 24 hr 2 year recurrence interval storm with a ponding depth of 6.8 cm, have an under-drain tied into the storm sewer, pond water up to 15 cm, infiltrate water at a rate of 6 hour periods to reset ponding depth and finally be comprised of vertical layers acceptable by the EPA fact sheet. Alternatives include; having a larger ponding depth, smaller or no under drain, looking at other retention devices such as wetlands or swales and possibly several retention basins to be able to filter all the water during a storm runoff. A ponding depth of 14.9 cm was found based with a 6 hour resetting rate. The watershed area was determined using Google earth and site

visits, calculated to be  $900\text{m}^2$  with a final bioretention area of  $65\text{m}^2$  which would be a 5m by 13m area. Initially determining a size for the bioretention basin it was approximated using 5-7% of the watershed area, after calculating for infiltration depth the bioretention area was increased. Several formulas were used in order to design a basin such as the Manning's Equation, Rational method and the NRCS curve method. The CN number used for the parking lot was 90 because of the lack of infiltration. The slope of the parking lot is about 0.05. This bioretention basin will help to decrease the amount of runoff sent untreated to the metro plant or directly into the Onondaga Creek watershed.

### **101. BIORETENTION BASIN FOR ERWIN METHODIST CHURCH TO ADDRESS POOLING ON WESTCOTT ST., SYRACUSE, NY**

**P.M. Crim and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

During large-scale precipitation events, urban drainage is very important for ensuring the safety of civilians as well as property. Improper or inadequate drainage in certain areas can sometimes lead to pooling in heavily traveled roadways, leading to unsafe situations that can lead to dangerous driving conditions. This bioretention basin design for the Erwin Methodist Church on the corner of Euclid and Westcott streets, Syracuse, NY is intended to eliminate this sort of dangerous in-road pooling while at the same time reduce runoff from the church's main parking lot. Instead of utilizing alternatives such as highly absorbent pavement and/or regrading the parking lot area, this design will introduce a small 4x4 meter square area full of native American plants to maximize evapotranspiration, reduce runoff, and help purify the remaining water that infiltrates through. It will also replace an existing driveway near a busy intersection and potentially improve driver safety. The design for this basin was aided by downloading a high-resolution aerial image of the New York State GIS website. The project was designed for a 24 hour, 2 year precipitation event dropping 6.8cm of precipitation. Watershed area was calculated and run off depth was obtained using the NRCS Curve Number Method. The amount of infiltration the basin needed to achieve for every 6 hour period during the storm was calculated as well as ponding, which could not exceed the berm height design constraint of 15cm. The underdrain sizing for the basin was determined by solving for channel depth and integrating with local slope, Manning's coefficient for the PVC pipe, and the run off discharge rate, while leaving some margin for safety. The final result is a bioretention basin that melds utility, engineering, ecology, and aesthetics into a single functioning entity.

### **102. PROPOSED BIORETENTION FACILITY DESIGN: STADIUM PL. SYRACUSE , NY**

**J. DeBarth and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The bioretention facility proposed is to be located between Stadium Pl and the west end of the Ray parking lot. The goal of this facility is to capture and filter combined sewer overflow (CSO) after peak precipitation events with the intention of increasing ground storage time and minimizing immediate runoff. The alternative design is to leave the current CSO system intact with the installation of curb and

gutter system to direct runoff into existing sewer systems. Using a bioretention system allows for ground storage time and improved quality; along with minimizing the downstream affects of a precipitation event. The bioretention facility design process incorporated uses the NRCS/Rational Method, Darcy, and Manning Equations as well as hydrologic and hydraulic engineering knowledge. The internet and computational software were required for data collection and calculations. The design incorporates the removal of a paved sidewalk area and the installation of a 280m<sup>2</sup> bioretention facility between the street and the parking lot. This will be an adequate size to manage the runoff from the 3750m<sup>2</sup> watershed; consisting mainly of moderately sloped asphalt. The facility will consist of a thin strip of vegetation 70m long by 4m wide and a depth of 4m. The area will have steeply sloped grass edges and a 15cm trapezoidal depression extending the length of the area. The depression or ponding area will be planted with woody herbaceous annuals that can withstand relatively high volumes of runoff and pollutant concentrations. The installation a sand bed layer to increase the hydraulic conductivity; organic and clay layers provides for the absorption of pollutants. A 6in (15cm) PVC under-drain extends the length of the basin and is designed to tie into the existing stormwater system at the point with the lowest elevation. The design meets the goals and restraints of the system; the required precipitation event is captured and effectively stored for enough time to reduce the immediate affect to the stormwater system.

### **103. STORMWATER RUNOFF ANALYSIS OF GALLUP ROAD SUBDIVISION BEFORE AND AFTER CONSTRUCTION AND RETENTION PRACTICE DESIGN**

**J. Domm and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Development of vacant land into residential subdivisions often results in changes that increase the amount of runoff being discharged from the site. The goal of this stormwater design project is to evaluate the changes and propose a practice to reduce post-construction runoff. Some design constraints include practice size, location, and maximum runoff. Potential design alternatives include the wet pond, the extended detention wetland, bioretention areas, and infiltration basins. The chosen design was a hybrid design consisting of a wet pond with infiltration areas surrounding it. In order to contain the runoff from the site, with a factor of safety of 2, the stormwater containment portion of the project needs to be 1.5 acres in area, with a maximum depth of 5 feet. The maximum discharge allowed is 28cfs, with an infiltration area of .75 acre. A factor of safety of 2 was used when calculating infiltration. This gives a discharge of 14cfs, and a time to drain stormwater from a full pond of 4.7 hours. This design is able to meet all goals and constraints for containing runoff from a 10 year storm.

### **104. BIORETENTION BASIN DESIGN FOR LAMBRETH LANE, SYRACUSE, NY**

**C.D. Doty and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The objective of this exercise is to design a bioretention basin for a particular community that will reduce stress on storm drains and sewer pipes and decrease the amount of waste that makes it into our streams.

This design includes a bioretention basin of 61.7 square meters (12.34 m long and 5 meters wide), that completely drains an area of 775.25 square meters. After the water infiltrates, it will drain into a 6 inch diameter underdrain that will be approximately 1.5 meters under the basin. The soil used in this design consists of approximately 60% sand, 20% clay, and 20% topsoil. This combination of soil types allows the water level to stay under 15 centimeters at all times during the rain event. This design fits easily into existing development, which is also a constraint of the project. One alternative to the design proposed is to vary the soil types used in the basin. This would allow for faster or slower infiltration, and different amounts of filtration of pollutants. Another alternative would be to change the shape or placement of the basin, since the basin could be put in many places, and still significantly reduce the stress on storm drains. A final alternative is to design based on different methods of calculating infiltration. There are several ways of calculating infiltration, such as the Green and Ampt method, the Holtan method, and the NRCS curve number method. This design is based on the Green Ampt method of calculating infiltration. This method works best for ponding depths of water, which exactly fits this case. The Holtan method is for flowing water, and the NRCS Curve Number method was found to not be robust enough for this application. Also, this placement allows for the most water to be filtered, and fits into the existing development best. This is an example of hydrologic knowledge needed to design this project, one must choose the right method for the project. The Green Ampt equations and the NRCS Curve Number equations were used in the calculations of this project. Also, the drainage area was found by pouring buckets of water on the area and delineating where the water went, which is an example of using site data. Overall, this design satisfies all constraints and also provides an environmentally friendly way to reduce stress on the stormwater drainage system in this area of Syracuse, NY.

#### **105. BIORETENTION FACILITY PROPOSAL FOR DRIVEWAY ON UNIVERSITY AVE. BETWEEN HARRISON AND MADISON ST, SYRACUSE, NY**

**M. Fenley, J.Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The Bioretention Facility is going to be placed at the end of a driveway on University Ave. between Madison and Harrison St. The purpose is to treat and transport polluted runoff so as to reduce CSOs into Onondaga Creek. The chosen design will fit within the development at 25m<sup>2</sup>; have a ponding depth of 14.965cm (Less than 15cm); captures the runoff of a 24 hour storm even which occurs every 2 years; has an under-drain with pipe diameter of 6-8in tied into the sewer system; runoff infiltrates to reset the ponding depth ever 6 hours; has the basic design outlined in the EPA Fact sheet concerning filtering layers. Alternative designs consist of using the already present grass as a buffer for the runoff to decrease velocity; the other can be using extra drains to increase gathering of runoff into the facility.

Hydrologic and hydraulic knowledge was used in calculating infiltration rate 8.729 cm/hr, and figuring out the runoff rate, it is important to know how to use the Curve Number Method. For the driveway the CN was 98, used to calculate the Storage (0.518cm) then to calculate the runoff rate which equaled 9.353x10<sup>6</sup> cm<sup>3</sup>/hr. The design outlined in the EPA Fact sheet is the basis for this design. A drainage system will be used to direct the runoff to the basin in order to maximize runoff filtration. Once it is in the

ponding area, it will infiltrate through the mulch layer to rid the water of any petroleum based pollutants, then a loam and sand layer to extract larger pollutants, and finally carried off through the under-draining system to the sewer and ultimately to Onondaga Creek. The design overcomes the constraint of ponding to 15cm when it has the area of 25 m<sup>2</sup>. This size fits within the development already present. Where the Storm Water Runoff Volume is 3.741m<sup>3</sup>, the Effective Rainfall over a 6 hour interval is 1.554cm, and the Area of the Bioretention facility is 25m<sup>2</sup>. Moreover, the bioretention basin will be able to capture the runoff effectively by way of diverting the runoff to it through construction. It will be able to reset the ponding depth every 6 hours granted the Infiltration rate/ Runoff rate is satisfied. The design meets the criteria outlined in the EPA Fact sheet in that it consists of the mentioned layers, in order to perform the specified functions. Finally the under-draining system will consist of 6-8in PVC piping leading towards the sewer system.

#### **106. BIORETENTION BASIN PROPOSAL FOR FORESTRY DRIVE W. SYRACUSE, NY: SERVICE DESIGN PROJECT**

**R. Ferris, J. Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Onondaga Creek is the main route for stormwater drainage for the southern half of the city of Syracuse. Storm drains are located throughout the city and are connected to the creek. Water quality of the creek has declined due to higher concentrations of pollutants and the increased water velocity. The goal of this design project is to create a bioretention basin which will help reduce pollutant concentration and the rate at which stormwater runoff enters the storm sewer system. The bioretention basin design had constraints on the design including fitting into existing development, be tied into storm drain, and ponding depth. Alternative designs including a small drainage pond or grass buffer zone in front of storm drain were considered. The watershed area of 158.70m<sup>2</sup> and NRCS curve number were used to calculate the runoff volume (9.864 m<sup>3</sup>). The hydraulic conductivity of the soil layers was used to calculate infiltration rates with the basin dimensions with the required ponding depth. The basin was designed according to EPA guidelines. It was found the bioretention design satisfies the given constraints having an area of 5.5m<sup>2</sup> and an infiltration rate of 0.438m<sup>3</sup>/hr.

#### **107. BIORETENTION PROPOSAL FOR WOMEN'S BUILDING SOUTH PARKING LOT, MT.OLYMPUS RD., SYRACUSE, NY**

**R. Furey, J. Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal of this project is to design a bioretention device to improve water drainage, water quality, and to decrease the volume of flow to Onondaga creek through the city storm sewer system. The device should also be aesthetically pleasing, and satisfy the EPA's requirements and design constraints. Design constraints include: The bioretention device must fit into the existing location, capture the storm water volume from a 24-hour, 2 yr recurrence interval storm of 6.8 cm depth, it must drain into the city storm

sewer system, it must not allow standing water for the event over 15 cm., it must infiltrate water every 6 hr period to rest the ponding depth, and it must meet the EPA's bioretention requirements. Alternatives include the shape of the bioretention basin can be altered. Currently, the device is large enough to hold all of the 24 hr stormwater runoff at a ponding depth of 14.5 cm, but the bioretention area can be decreased if infiltration is more accurately accounted for. Vegetation, soil types and infiltration materials can vary depending on the desired ponding depths and infiltration rates, soil textures, and depths. The vegetation must meet the EPA's general requirements, and help satisfy the project goals.

Hydrologic and hydraulic knowledge was used in the final design decision. For the design, specific site alterations need to be made in the beginning. The parking lot needs to be re-graded and paved with a consistent slope. The area of the parking lot/watershed is 1,394 m<sup>2</sup>. The effective precipitation for the 24 hr, 2 yr event is 6.8 cm. Runoff depth is calculated using the NRCS curve number method with pavement curve number being 98. The runoff depth was found to be 6.216 cm. Ponding depth must be lower than 15 cm, so the size of the bioretention area had to be adjusted. Maximum ponding depth for the event is 14.441 cm when the bioretention basin has a surface area of 150 m<sup>2</sup>. That is a 10m x 15m plot in this design. The infiltration rate was calculated to be 12.023 cm/hr using sand as the soil texture. After the stormwater runoff filters through the system, remaining runoff volume will be directed into a 6 inch perforated PVC pipe and fed into the Syracuse storm sewer system. The physical make up of the bioretention system will follow the EPA's standards. The area in the middle of the device will dip down to a level pooling surface at least 15 cm deep to hold ponding water during infiltration. The vegetation in this middle section will include native plants that are tolerant to local pollution and can sustain higher concentrations, especially salt.

### **108. BIORETENTION DESIGN FOR CHAVEZ TERRACE LOCATED AT INTERESESECTION OF S. STATE ST. AND E. ADAMS. ST. IN SYRACUSE, NEW YORK: COURSE DESIGN PROJECT**

**N.W. Kelly and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

In the City of Syracuse, NY we are seeing our sanitary sewers becoming overflowed with stormwater. As a result of this the CSO systems are potentially discharge some sewer water into the local water supplies and waterways, such as Onondaga Creek. A bioretention swale has been designed to eliminate some of this overflow in the creeks in the city. The project is located at the intersection of S. State Street and East Adams Street .The housing complex has the capacity of upwards of 200 to 300 people living at Chavez Terrace. The Area for design encloses roughly an area of 780 square meters and will have a ponding depth of 15 cm. Other designs like Detention basins, and Bioinfiltration swales, that capture stormwater and high percentages of pollutants could prove to be some great alternatives and may produce a lower cost in the long run. The ultimate goal of the design was to keep the stormwater out of the sanitary sewer systems to stop them from overflowing and disturbing the water supply of Onondaga Creek. The design would also prove to have some aesthetical quality to it making it a positive bonus for the residents that it affected.

### **109. DESIGN OF A POTABLE WATER DISTRIBUTION NETWORK FOR THE BARRIOS OF LOS VEGAS AND LOS ROSALES IN THE COMMUNITY OF BUENA VISTA, YORO, HONDURAS**

**S. Kelsen, Y. Cheng, S. Mills and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal for the water delivery design is to distribute potable water to two different communities in the village of Buena Vista, near Olanchito, Yoro Honduras . The system includes approximately 25 tap stands for each of the 25 different households using the U.S. Environmental Protection Agency's EPANET 2.0 software. According to Honduran Federal Government, each tap stand must deliver 25 gallons per person per day with all excess water supply stored in a tank. The two main design alternatives considered use two different programs, EPANET 2.0 and Microsoft Excel, to model and analyze the system. EPANET system parameters such as flow units, friction headloss formula, pipe diameter, viscosity, specific gravity and water quality values or formulas can be varied in order to examine the effects on the overall system. The Darcy-Weisbach equation with the Moody diagram are considered to be the most accurate model for estimating frictional head loss in steady pipe flow. Design constraints include source flow rate, pressure tolerance, tubing, tank and fitting costs, tapstand elevations, and tapstand distances relative to households. The system includes approximately 1000 meters of PVC piping, which is rated to withstand 150 psi, 25 tap stands to each of the two community's households, churches and schools. A base demand is assigned at each tap stand of 25 gallons per person per day, times 6 persons assumed for each household. Pipe diameter varies from 4" to 1" according to pressure stipulations. The tank volume for the three Barrios must be greater than 5967 gallons, which is 40% of the maximum daily consumption. Each 5,000 gallon tank costs roughly US \$5,000. Average daily consumption was calculated to be approximately 7 gallons per minute, which fulfills the constraint of 25 gallons/person/day. The system is gravity fed and requires no pump. System planning and analysis will continue between the design team members to produce the optimal system layout and overall system performance for Buena Vista as well as an assessment of ecological impact for the surrounding watershed area.

### **110. BIORETENTION BASIN FOR THE ED SMITH SCHOOL PARKING LOT**

**P. Kenline and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goals of this stormwater design is to produce alternative ecological solutions that can be integrated into the neighborhoods to reduce the amount of storm water runoff flowing directly into the sewer lines and improve water health. My proposed basin is at the Ed Smith Elementary School located at 1107 Lancaster Ave , Syracuse , NY 13210 . The design should be able to handle 6.8cm of water in a 24-hour storm with total infiltration every 6 hours to reset the ponding depth. The max depth of water in the retention facility should be less than 15cm for safety reasons. Also an under-drain tied into the storm

water sewer system must be provided with a layered build-up of microbes and plants above it. Alternatives to the design would include making the under-drain larger to remove more water from under the basin. Another different design would be to use mulch and gravel instead of grass on the floor of the basin to allow better infiltration.

For this design I used the NRCS curve method to calculate the runoff depth (6.215cm) of the rainfall from the selected parking lot area (720 square meters) into the basin. To determine the size of the basin I used the stormwater infiltration method and found the size (65 square meters) that would allow for a 6 hour reset with a depth under 15cm. The design for my basin will incorporate wildlife that will remove water and clean the remaining water without being affected by the pollutants that may accumulate. Trees that are native, tolerant to floods, and acidic soils will be selected along with bushes and other plants that add to the appearance of the basin. Grass will be planted to help remove more water and keep the soil in its place. My design will promote improvement of water quality and site aesthetics by using plants that capture pollutants and debris in the water before they travel through the sewer and make an even bigger mess in Onondaga Creek.

### **111. BIORETENTION BASIN FOR STADIUM PL. PARKING LOT, SYRACUSE, NY**

**P. Lyons, J. Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Naturally, precipitation infiltrates, is abstracted, evaporates, or runs off into surface water, but impervious surfaces like parking lots and buildings allow only runoff. Sudden and extreme volumes of runoff enter surface water with higher doses of pollution. The object of the design is to reduce the flow rate and pollution that stormwater has on combined sewers through low-impact treatment and rerouting. The specific method will be to optimize a bioretention device, to manage stormwater in an aesthetically pleasing and environmentally sound way. The device should be twice as long as it is wide, and follow the standards set by the Environmental Protection Agency (EPA) for stormwater bioretention devices. The device should not have a negative impact on the area where it is installed, nor should it be any type of safety hazard. The pooling depth is to be 15cm for a 24-hr duration 2-yr recurrence interval storm of 6.8cm depth, and it must infiltrate every 6 hours to reset the pooling depth.

Alternatives for the design are to leave the parking lot as it is, to install a bioretention basin in the northeast corner of the lower lot with no drain beneath it, or the same with a drain beneath it to the storm sewer. The first design option features 5.9m<sup>3</sup> of runoff, with a lag time of less than a minute. The second design option prevents that water from entering the storm drain, but may cause expensive and dangerous potholes. The third design option delays the water from entering the storm drain by at least 46 hours, providing a filtered and gradual flow. The analysis included measuring the watershed area, using the Curve Number method, the Darcy equation for infiltration, and the Manning equation for a pipe flowing full. The final design is a rectangular bioretention basin 1.9m by 3.8m, with a 6in diameter PVC under-drain, that follows the EPA guidelines. The design pools to 14.7cm during the 24-hour storm, which

neither exceeds the 15cm maximum depth nor wastes valuable parking space. The design has a low impact and is less disruptive than the larger pothole already in place.

### **112. BIORETENTION PROPOSAL FOR STANDART PARKING LOT SYRACUSE, NY**

**M. Malkoc and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal of the project is to restore the surface water channel that is linked to the restoration of terrestrial stormwater runoff process that is used to normalize the baseflow and reduces the excessive peak flow. The constraint is it must capture the stormwater volume generated by a 24hr duration 2yr recurrence interval storm of 6.8 cm depth and it must infiltrate water every 6 hr period to reset the ponding depth. The alternative designs that satisfy the goal and constraints are a pond, wetland, and a mini forest. The best alternative design option of a bioretention basin is a mini forest because it is appealing to the community and there is a far less chance of a flood to occur. Put different layers of sediments in the bioretention basin for example (grass, sand, mulch, planting soil, and plants). These layers will purify the polluted water before it enters the underground water system.

The utilized site had the water run in one direction and the ground was paved. The tools used to measure the area was google earth (Area of watershed =  $112.45 \text{ m}^2$ ). Once the area was given you could find out if the bioretention is going to be good for it (Bioretention area =  $5.623 \text{ m}^2$ ). The equations that were used in this design were curve number to find the Runoff depth (6.22cm), stormwater runoff volume ( $6.994 \text{ m}^3$ ), stormwater infiltration (11.682 cm), ponding depth (11.66 cm), and under drain sizing piping (6 inches). The basis of the design is the area needed to be calculated and 5% of that area the bioretention takes up. The design satisfies the goals and constraints because the bioretention basin can cover that area without overflowing. That means that there won't be pollution in that area. It satisfied all the requirements that was needed and the impact on the community will be minimal.

### **113. BIORETENTION PORJECT PLANS FOR THE 700 BLOCK OF EUCLID AVE, SYRACUSE, NY**

**S. Manley and A.T. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal of this project was to design a low-cost, environmentally based, stormwater management bioretention facility. Its installation would help to prevent flood situations which result in too much water reaching sanitary sewers causing polluted overflows to reach the Onondaga Creek. The bioretention facility would retain redirected stormwater and recharge the groundwater supply with purified water. Constraints include; must fit into an existing development within the Onondaga Creek watershed, capture stormwater volume generated by a 24-hr duration 2-yr storm of 6.8 cm, must have an under-drain tied into the stormsewer or underground system, must pond water for the design event to 15 cm, infiltrate water every 6-hr period to reset the ponding depth, have vertical layers and assemblage of microbes and plants outlined by the EPA. Working alternatives include a design that uses two large retention basins on

the street sides of the site or a design that uses multiple basins dispersed throughout the site. Understanding the flow of water, the NRCS Curve Number method, effective rainfall, ponding depth, and runoff volume the required bioretention area can be mathematically determined. Because the site has a CN value of 89 and ponding needs to be 15 cm, the site requires that 110 square meters be devoted to the bioretention facility. The alternative choice was based on what portions of the site needed to be allocated to the bioretention basin, as all other factors were kept consistent. The design meets the goal and constraints by diverting a portion of the flow, which would normally go directly to storm drains of the site, into the retention basins located between the sidewalk and curb of the corner property. Here the water ponds, is filtered, and recharges the groundwater supply with purified water. This takes stress away from the sewer system in the event of a rain storm and reduces the chances of contamination due to polluted overflow.

#### **114. BIORETENTION FOR EVERSON ART MUSEUM, SYRACUSE, NY**

**C. Martin, J. Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The stormwater goal for this project is to filter out pollutants in storm waters in the plaza at Everson and control runoff. Another goal is to reduce garbage in the water. To do this we must use a bioretention that can be incorporated into an existing facility. It needs to capture water in a 24-hr duration 2-yr recurrence interval storm of a depth of 6.8. It needs to pond water in a depth of 15 cm and the water must infiltrate every 6 hours and be reset. Vegetation and microbes must be present. After the water filters through the soil, it will then run into a storm drain via a pipe.

An alternative design would be a storm drain directly to a water treatment plant. Another alternative design would be to remove all the concrete and replace it with grass. The bioretention basin would be the best because it would naturally remove pollutants without the need for expensive water treatment and it would not involve tearing up all the concrete. In order to produce the area for the bioretention basin, one must first figure out the total area for the sub watershed. Then with that the runoff volume can be calculated to determine the dimensions of the bioretention basin. After the stormwater infiltration is calculated, the discharge into the pipes under the basin and their dimensions can also be calculated.

This design will remove the existing pool at the Everson Museum of Art and replace it with a new “pool” with vegetation. The current pool has an abundance of garbage in it. With the bioretention basin, it will be dry and easily cleaned up. It will expand the plaza so you can add more art work to it. Under it the bioretention, there is a 6 inch PVC pipe to drain the water to a storm drain. This design was found to be able to control and store runoff effectively.

#### **115. PROPOSED BIORETENTION BASIN FOR FINE PARKING LOT ON HENRY STREET, SYRACUSE, NY: SERVICE DESIGN PROJECT**

**S.R. Mastin and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The potential location of a bioretention device is a small blacktop-covered parking lot on Henry Street. The device is designed to slow the runoff's rate of entry into the storm drains of the Onondaga creek watershed and to protect from erosion and sedimentation. The design is established based on a storm of 2-year reoccurrence lasting 24-hour rainfall totaling 6.8 centimeters. The bioretention device must provide aesthetic qualities to the surrounds. The development of this bioretention device may further congest the minimal amount of parking available on North Campus. The bioretention can potentially be designed so that it is a series of basins working as a single device. The water filtered through the Loamy Sand must be removed from the site or the device will continuously lose efficiency. Furthermore, the bioretention basin can be designed in case of a greater capacity storm as the additional water will be removed from the site to prevent flooding. The study of water flow allows for the determination of the flow direction and capacity of Fine.

To determine the best design, the use of mathematic modeling and the weight of other factors were implemented. The development of land into parking lots however effects the water infiltration into the ground increasing runoff and sedimentary erosion. By the use of ARC-GIS the watershed area is determined to be approximately 6872 square meters. The area of the bioretention device is 195 square meters or 3.9% of the watershed area. Using Mathcad, it is possible to solve the NRCS curve number method, assuming that the soil is impervious. From here, a modified Darcy's equation can be utilized to solve for the infiltration of the surface. As the water collects at the bottom it must be removed. A PVC pipe that has an effective diameter of 8 inches and is calculated using the Manning equation is installed to accomplish the movement of the water. The incorporation of these criteria allows for the choice of design. The design allows for green space in a highly developed section of Syracuse. The bioretention device allows for the relief of the Onondaga Creek Watershed.

## **116. BIORETENTION BASIN DESIGN FOR LEVY MIDDLE SCHOOL ON FELLOWS AVE, SYRACUSE NY LOCATED IN THE ONONDAGA CREEK WATERSHED**

**K. Mattice and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The problem in the Onondaga creek urban watershed is overflow from storm events, water contamination and the depletion of groundwater due to the combined sewer outflow system used to transport storm water to the Metro and storm sewers that discharge directly into Onondaga Creek. The goal is to design a bioretention basin which is a best management practice design to remove pollutants from storm water that has run over impervious surfaces, store the storm water to avoid flooding in the sewer systems, and infiltrate the water back into the ground. The constraints of the design are as follows: 1. The design must be a bioretention facility that fits into existing urban development in Syracuse. 2. The basin must capture the storm water volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8 cm depth. 3. It must have the bioretention under-drain tied into the storm sewer or groundwater system 4. It must pond water for the design event to 15-cm 5. It must infiltrate water every 6-hr period to reset the ponding depth 6. It must have the vertical layers and assemblage of microbes and plants outlined by the EPA fact sheet.

This design is based on knowledge from the Engineering Hydrology course offered at SUNY ESF. Watershed delineation techniques were used to capture the full area which was measured to be 90 m<sup>2</sup>. The NRCS curve number method was used to calculate the runoff depth of the storm and the total volume of runoff was calculated to be 1.398 m<sup>3</sup>/6hr. The dimensions of the basin are based on a trapezoidal design and are 5.16 m by 1.8 m at the top and decrease with depth. The alternative square dimensions were dismissed to avoid the sidewall of the basin from caving in. The infiltration rate was calculated based on the Green and Ampt Infiltration Model. The assumption was made that the soil would reach total saturation and therefore the infiltration rate for sandy loam is 1.09 cm/hr. The piping diameter set on the sewer drain is 2m allowing for safety factors. The actual basin will have a 0.5 m sand layer below a 1.2 m sandy loam layer. The vegetation will consist of a yellow birch tree surrounded by witch hazel shrubbery. A mulch layer will surround the tree and shrubs to protect the root system. Any leftover space will be planted with grass acting as a buffer zone. This design satisfies the goals and constraints because it will decrease the amount of pollutants from storm runoff over impervious surfaces, fit into the urban development of Syracuse, NY and allows for a 24 hr storm event to be captured.

### **117. STORMWATER BIORETENTION BASIN PROPOSAL FOR BUCKINGHAM AVE., SYRACUSE, NY**

**D. Mayer, J. Crispell and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

In order to reduce stress on urban stormwater conduits/sewers and prevent CSO overflow, cities with aging water infrastructure must develop smarter methods of stormwater management. Like many old cities, Syracuse, NY was designed with a Combined Sewage Overflow (CSO) system (sanitary and stormwater in the same sewers). During heavy rainfall, the CSO flow often exceeds what the METRO wastewater treatment facility can process and is discharged directly into Onondaga Creek, severely raising levels of contamination such as fecal coli-form bacteria. The focus of many alternative stormwater catchment designs is to incorporate ecologically-based filtration, retention (or detention), and percolation components. This design project focuses on the triangular road median at the intersection of Buckingham Ave. and Kensington Rd. in the residential section of the University Hill neighborhood.

For this project, the design requirements specify a bioretention basin that must be able to capture the volume of water generated by a 2 year recurrence interval (RI) storm of 6.8 cm depth, must be able to pond water to a depth of 15 cm and completely infiltrate this depth of water once every 6 hours. In addition, it must be connected to the existing sewer or groundwater system. Alternative designs include an assembly of rock, gravel, mulch and shrub ("rain garden") with underlying PVC pipes to carry infiltrated water to the nearby storm sewer. This design can meet the requirements, however its aesthetics are less than ideal and it is relatively construction-intensive. Another alternative is a small grove of *Salix spp.* (willow) trees, which have excellent evapotranspiration properties and are aesthetically pleasing, however, they contribute to road litter and are short-lived. The selected design is a minimally invasive grading of the existing soil into a shallow bowl of depth 15 cm, length 9.8 m, and width 8m (for an area of 39 m<sup>2</sup>) planted with various flood tolerant grasses and sedges. This design is low cost, low

maintenance, satisfies the design requirements, and is aesthetically pleasing. From the NRCS Curve Number method, runoff volume for this urban sub-watershed is  $25.6 \text{ m}^3$ . From the Green-Ampt infiltration model, infiltration was estimated at  $0.178 \text{ cm/hr}$ .

## **118. PROPOSED STORM WATER MANAGEMENT SYSTEM BIORETENTION FACILITY HOWARD ST., SYRACUSE, NY: SERVICE LEARNING PROJECT**

**J. O'Farrell, S. Hirabayashi and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The City of Syracuse, NY, is located at the northern end of the Onondaga Creek watershed and has a system of stormsewers and combined storm and sanitary sewers designed to collect water from impervious urban areas and discharge to the METRO wastewater treatment facility before flowing into Onondaga Creek. During periods of heavy precipitation, combined sewer overflow (CSO) is discharged directly into Onondaga Creek causing unacceptable pollution levels. To alleviate the problems associated with CSO, many sites within the city should be fitted with LID's for stormwater control mechanisms. The subject of this project is a  $300\text{m}^2$  portion of a parking lot located on Howard St. , between Wayne St. and Green St . The overriding goal is to create a stormwater retention basin to normalize baseflow and reduce excessive peak flows, as well as filter pollutants from runoff. The design should provide an environmentally based, low-cost stormwater management device to combat the pollution of Onondaga Creek. The design must conform to EPA best management practice standards and be a low impact development. The project constraints include that the device must: be a bioretention facility and fit into existing development; capture stormwater generated by a 24 hour, 2 year recurrence interval storm event of 6.8cm depth; have an underdrain tying into existing stormwater management systems; pond water for the design event to a maximum of 15cm; infiltrate water every 6 hours to reset the ponding depth; and have the layers and assemblages outlined by the EPA.

Variations of bioretention designs were considered, including creating one or multiple devices for the entire lot. Estimates of runoff depth and volume, time of concentration, necessary volume flow and infiltration rates were obtained using the NRCS Curve Number method, mass flow equations, the Green and Ampt infiltration model and Manning roughness values. Due to the characteristics of the lot, it would be most effective to construct two devices for the lot. A bioretention cell placed near the center of the lot best meets the site goals because it will effectively control the runoff rate and volume and provide numerous water quality benefits. Orienting the device to fit into the area of two parking spaces will minimize parking losses and provide an aesthetic element to the site. The device should be 5% of the drainage area, able to capture continuously flowing runoff at a rate of  $215.819 \text{ cm}^3 \text{ s}^{-1}$  and pond  $2.25 \text{ m}^3$  of water to a maximum depth of 15 cm. The cell will have an area of  $15 \text{ m}^2$ , a total depth of 2 m with multiple strata and be planted with appropriate native plants. The overflow pipe in the center of the device should connect to a drainage pipe that leads excess water to the existing stormsewer system. Coarse grass should be planted around the device to even flow and collect large debris. The soil type should be loamy sand so that the infiltration rate will be  $1.218 \times 10^{-4} \text{ m}^3 \text{ s}^{-1}$  and the ponding depth will be reset every 6

hours. The PVC underdrain pipe should flow toward the existing stormsewer drain. A bioretention facility having these characteristics meets the project design criteria described above.

### **119. BIORETENTION SWALE FOR STORMWATER COLLECTION FOR MEACHEM SCHOOL ON SPAULDING AVENUE: SERVICE LEARNING PROJECT**

**E. Paduano and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

The goal of this project is to design a bioretention basin capable of reducing stormwater runoff into Onondaga Creek. The site is located at Spaulding Avenue in Syracuse, NY near the Syracuse City School District of Meachem on the school's athletic field. Design constraints for this project were that the basin had to fit into existing development, and capture the stormwater generated by a 24 hour duration 2 year recurrence interval storm of 6.8 centimeter rainfall depth. It must also be tied into the existing stormsewer system, infiltrate water every 6 hours, and have EPA outlined plants and microbes. The design is to create a basin from the runoff point on Spaulding Ave to the outlet point at Onondaga Creek. The 75.2 m long and 5.2 m wide basin is perpendicular to the creek and in line with the avenue and the sewer. This shape will have minimal disturbance to the school's existing athletic field. The slope is low, around five percent and the ground is semi-impervious. This allows for infiltration and evaporation before discharging into the creek. The basin has sand and low shrubs on the bottom to reduce velocity and promote infiltration. Trees and taller plants placed within the basin resemble a natural forest. Microorganisms living within help breakdown petroleum products and material within the runoff. An alternative design was to place the bioretention basin parallel to Onondaga Creek, but this may not have passed all constraints. With the slope and the location of the sewer, the perpendicular basin was the best design. Calculations included the NRCS curve number method and the Green and Ampt infiltration equation helped figure ponding depth and basin area. For this design, the Topozone website and Google maps were used to choose a location for the basin.

### **120. BIO -RETENTION FACILITY DESIGN FOR 131 COLLEGE PL., SYRACUSE, NY**

**M. Plummer and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Bio-Retention facilities are a best management practice used in treating storm water runoff. In this case a site located at 131 College Pl. Syracuse, NY was examined to be the recipient of a bio-retention facility. The goal here is to decrease the amount of pollution from runoff from entering Onondaga Creek and the water supply. The design constraints include that it must be a bio-retention facility that can fit into the existing development. It must capture the storm water volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8cm depth. It must have an under-drain tied into the storm sewer or ground water system. It must pond for the design event to 10-15cm. It must infiltrate water every 6-hr period to reset the ponding depth. It must have the vertical layers and assemblage of microbes and plants outlined by the EPA fact sheet. An alternative design would be to construct the bio-retention facility beneath a

permeable layer of pavement. This would allow for the high traffic in the area to remain, while still cleaning the storm water.

Using mapping software the area of the watershed was first calculated, this value is 1333 meters squared. A CN number of 80 was found using Table 8.3 in the text. This is based on the hydrologic soil group for this area in conjunction with land use description. Using the NRCS CN method a value for S in the equation  $S=(2,540/CN)-25.4$ , this number was found to be 6.39cm. Runoff volume was found next using  $V_r = ((6.8\text{cm}-.02S)^2)/(6.8+0.8S)$ , this number was found to be .732 cm. An area of 21m<sup>2</sup> for the bio-retention facility a ponding depth of 11.61cm was calculated. Also by using a layer of sand and a layer of silt loam an infiltration rate of 9.751 cm/hr was calculated using the green and Ampt infiltration model. The design will include a grass buffer strip which reduces incoming runoff velocity, which in this case will be low due to the small slope. There will also be a sand bed approximately 1.2 meters deep along with a layer 0.3 meters deep of a silt loam. The sand and silt loam will allow for the CEC of the soil to pick up unwanted compounds in the water. There will also be a variety of woody and herbaceous plants covering the area. After the water infiltrates it will leave the facility via a six inch perforated PVC pipe. The water will then enter back into the water system cleaner than it did before the bio-retention facility was constructed

## **121. BIORETENTION DESIGN FOR OAKLAND ST. IN SYRACUSE NEW YORK**

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In the Syracuse area there has been a constant need for storm water removal and flood control. The storm sewers in the city of Syracuse have been used to convey the water from impervious surfaces to Onondaga Creek. Because of this Onondaga creek has been bombarded with non-point, and point source pollution. One way to help reduce this problem is to design and implement a sustainable, environmentally based, low-cost, small-footprint, storm water management system. The chosen area for this design is in the Syracuse University area on Oakland St. This location contains side walks, driveways, lawns, and apartments. The watershed area at the given location is equal to 100 meters squared. The design constraints are that it must be a bioretention facility, it must have an under drain, it must be designed for a 24-hr duration 2-yr recurrence interval storm of 6.8 cm depth, it must have a ponding depth of 15cm, and it must follow the guide lines given in the EPA fact sheet. The constraints have been put in place to ensure that the design is appropriate for the micro-watershed. There are several alternative designs that can meet the constraints. The purpose of the alternative solutions is to make it possible for the best design to be chosen. One alternative is a bioretention facility. This design solution offers the best result for the given constraints and will be the chosen design. Other design options would be a detention basin and a storm drain. These alternatives can be used but the best solution is the bioretention facility. The design was chosen after considering how it would be affected by hydrologic and hydraulic data. There were several equations used to make this design. Equations that were used are effective precipitation, curve number, runoff volume, and infiltration as well as others. There was also site data that was used in the development of the solution. This data included slope, land cover type, and drainage area. The design of

the bioretention facility is determined by making several calculations. That can be utilized to determine the specifications for the bioretention facility. The specifications for the bioretention facility are that it has a length of 15 meters, a width of 2 m, a ponding depth of 15 cm, and an under drain of 6 inches diameter. The runoff volume and infiltration rates have to be calculated given the data for the storm event. These values are then used and applied within the constraints to find length and width of the bioretention facility. The chosen design meets the criteria in the given constraints. The bioretention facility was designed under the constraints to ensure it would work for the micro-watershed. It also solves the design goal by making a design that implements a sustainable, environmentally based, low-cost, small-footprint, storm water management system.

## **122. BIORETENTION SWALE DESIGN FOR STANDART ST., SYRACUSE, NY: SERVICE LEARNING PROJECT**

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The location being chosen for a bioretention facility is the Standart/E. Raynor Street block located in Syracuse, NY. College students in various apartments occupy this area. The goal of this facility is to capture stormwater volume generated by a 24-hr duration 2-year recurrence interval storm of 6.8-cm. It must also be tied into current stormsewer or groundwater system. The facility must be able to pond water to 15-cm, and be capable of infiltrating water every 6-hr period in order to reset the ponding depth. Finally, the bioretention facility must conform to the details outlined in the EPA fact sheet.

By utilizing the information found on the EPA fact sheet, the bioretention swale was designed according to set standards. Using images of the area, it was able to be analyzed and determine such figures as the Curve number and general size, including the watershed area. Various hydrologic methods were used in computing the data. Using the NRCS Curve Number Method, it was found that the swale would have to be able to handle a runoff volume of 681.69 cubic meters for a 24-hr 2-year recurrence interval storm of 6.8-cm, of which 5.44-cm was effective precipitation. By using the Green and Ampt model, the size of the swale was determined to have a base width of 2.2-m, a top width of 3.7-m, and a depth of 0.15-m. The design conforms to the various constraints, and achieves the set goal of the bioretention facility. While it conforms to all constraints, few minor issues are raised. One such issue would be to decide who is in charge of the maintenance of the swale, and how often it would be checked and ensured that it is working properly. Also, it may need occasional modifications, as it is only designed to withstand a 2-year occurrence storm as opposed to a more massive storm.

## **123. RIVERBANK STABILIZATION PROPOSAL FOR THE RIO CANGREJAL IN LA CEIBA , HONDURAS : SERVICE DESIGN PROJECT**

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The location was along the Rio Cangrejal, west of La Ceiba, Honduras. The goals include; **Primary** – stabilize riverbank, prevent erosion of the road by decreasing shear stress on the banks, create aesthetically pleasing design, and maintain channel capacity. **Secondary** – encourage vegetative growth, encourage further aquatic biodiversity, and design to handle bankfull flow. Constraints include; heavy construction equipment required on narrow roads, design based on the D84 particle size (54 mm), must use dense rock, funding a concern, economic constraints present from kayaking businesses, ecological constraints present, and normal flow and historical peak flow data sometimes inconsistent. Alternatives for this design are channel naturalization through the utilization of J-hooks and cross vanes, and riprap. Channel naturalization diverts the shear stress away from the banks, while riprap armors the banks against the hydrologic forces. The hydrologic and hydraulic knowledge used deals with shear stress (1.46 lb/sq. ft.) applied to the banks, the way water flows off the mountains, and other forces and volumes of flow within the channel. It was all combined to determine the best alternative, then generate a preliminary design capable of withstanding the forces applied.

Site data, tools and equations for the analysis and design considerations were utilized throughout. Partial gage height data of the river at Las Mangas was obtained from the USGS and excel was used to generate graphs of peak flow, with the highest flow being 6.47 meters over two years. River dimensions from the survey were entered into a “Reference Reach Survey 4-3” spreadsheet to calculate values. Discharge was determined to be 1993.1 cfs. Manning’s roughness coefficient was determined to be .031. The river dimensions, gage height and values from the Reference Reach spreadsheet were then entered into “ARS Bank and Bank-Toe Erosion Model,” providing an estimate of potential bank erosion. Further values were obtained using MathCAD. Synthesizing design components first included analyzing the area around the site. A survey and gage data of the Rio Cangrejal was required. It is then necessary to input this data into the aforementioned data sheets. These values and the shape of the river can be used to calculate the size of the material required. Placement and length of the vanes can then be calculated. The design satisfies each goal set forth, reducing shear stress on the banks and preventing erosion, encouraging vegetative growth, maintaining channel capacity, and is aesthetically pleasing. Cost can be cut by utilizing some material present along the river, and it is designed to handle bankfull flow. Constraints are satisfied because the construction equipment can be driven off the road at a parking area, and during low flow, machinery can be driven below the road along the river. The design will also create standing waves, improving kayaking along the treated region.

#### **124. BIO-RETENTION BASIN FOR 330 OSTROM AVENUE, SYRACUSE NY: DESIGN PROJECT**

**K. Smith and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Syracuse, NY is one of many cities that is in need of revamped storm sewers. Not only is there flooding in the Onondaga Creek watershed there is also an influx of polluted water. Bio-retention devices could be a potential solution to these problems. The design that I have created will aid in easing the load on storm sewers as well as filtering pollutants at 330 Ostrom Avenue in Syracuse, NY. The section of parking lot at

330 Ostrom Ave. is black top 1080 square feet. The goal is to design a bio-retention device that can be integrated into the already existing storm drain system, be able to handle a 24hr 2yr storm, and infiltrate every six hours. An alternative to this design would be to leave the already existing storm sewers as is. The NRCS Curve number method was used to determine the runoff depth of .204ft. Using the know area of the parking lot as well as the runoff depth of .204ft the necessary area of the bio-retention device could be determined. The design findings show that a 6ft wide by 12ft long bio-retention device could help to filter water from a 1080 square foot drainage area.

## **125. BIORETENTION BASIN PROJECT FOR ALLEN ROAD ELEMENTARY SCHOOL, 803 ALLEN ROAD NORTH SYRACUSE, NY 13212**

**C.J. Straight and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

This project is to design a Bioretention basin for the runoff from the permeable and impermeable area for the prescribed rain fall event of 6.8 cm for a 24hr 2yr event. The total area of the basin is 5% to 7% of the total runoff area. The Bioretention basin will be designed for a maximum of 15cm berm height, (6 in) ponding depth. It must infiltrate water every 6 hr period to reset the ponding depth. The goal of this project is to design a Bioretention basin big enough to hold and filter the runoff for a selected area and the stated rainfall event. In doing so, effectively removing contaminants from runoff deposited on impervious surfaces through biological means. The design must tie into existing sewer storm drains or groundwater systems through under-drains. The design should have the vertical layers and assemblage of microbes and plants outlined by the EPA fact sheet. Alternatives to this design could be installing grass swales. Swales would channel the runoff and slow the velocity of the flow while draining off and effectively filter the sediments and contaminants from the water. With the addition of strategically placed check-dams within the swale route to encourage ponding, the filtration benefits could be maximized. In the initial design of the property the installation of pervious pavement could be used to maximize pavement space while allowing for percolation or infiltration of storm waters. For this area a Bioretention basin would be most suitable due to the grade, layout, the age of the sewer system, in that a Bioretention basin will alleviate the taxing on the system in the case of such a storm event. More importantly the aesthetics of the neighborhood won't be compromised with open swale's or drainage ditches. To make sure the design is correct exact calculation of runoff depth, storm water runoff volume, and storm water infiltration for the given design parameters are needed first.

The designed runoff flow across the impervious pavement running into the Bioretention system designed for this site has many components. As the water runs to the collection basin it is channeled through multiple cuts or grates along the curb. This allows for distribution of the runoff into the system. The slope into the basin could be lined with riprap to slow the velocity of the water entering the system. The design will hold a max of 15cm ponding for the event and will incorporate at least one grated drain for overflow into the storm drain system. An under lying drain system to the storm drain is covered by at least 12" of sand and then a minimum of 4' of planting and filtering soils, which is finally covered by a mix of soil and mulch. The top layer is planted with grass and understory shrubs, plants and trees aesthetic to the

landscape. And drains are installed above the 15cm ponding depth to remove excess runoff exceeding the capacity of the design.

### **126. BIORETENTION DESIGN FOR RUNOFF REDUCTION AND BIOREMEDIATION AT LENNOX AND ROOSEVELT STREETS, SYRACUSE, NY**

**K. Teale and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

A bioretention device needs to be designed in order to reduce strain on the current municipal storm water system and improve water quality. The design must: capture storm water volume created by a 24-hr storm of 6.8-cm depth with a 2-yr recurrence interval, have an under-drain, pond water to a depth of 15-cm, fully infiltrate every six hours, and fit into the existing landscape. Design alternatives that were considered that meet the constraints are as follows: 1. A trapezoidal swale that would replace the sidewalk, with grass and trees lining the swale. 2. A rectangular swale to increase available area for trees. 3. A retention area under the sidewalk in order to keep the sidewalk intact. 4. A trapezoidal swale with an under-drain running water directly to groundwater, therefore bypassing the sewer system altogether.

With an understanding of water flow and the properties of certain hydrologic conditions of land cover, in addition to hydraulic equations, the chosen design was a trapezoidal swale with an under-drain tied directly to groundwater. Using Google Earth, a site map was made and the size of drainage area (300 m<sup>2</sup>) found, which, in addition to the infiltration rate, allowed for the runoff volume and dimensions of the swale to be calculated. The final design is intended to take the place of the sidewalk on Lennox Street, and is 14m in length with a bottom width of 1.025 m and a top width of 1.0602 m, a slope of 10°, and a depth of .1m. The under-drain will be 6 in. in diameter perforated PVC pipe, connecting the swale to groundwater. This design will not flood based on the given constraints, whilst cleaning the water and reducing storm water load on the municipal system, thus meeting the goal of the design.

### **127. BIORETENTION DESIGN FOR ALTERNATIVE STORMWATER COLLECTION ON SYRACUSE UNIVERSITY CAMPUS**

**K. Teitsma, S. Hirabayashi and T.A. Endreny.** FEG 340 Engineering Hydrology and Hydraulics Course, State University of New York, College of Environmental Science and Forestry, Syracuse, NY 13210

Catchment Area in interest is Syracuse University Campus, between Physics Building, Archbold, and Carnegie, a (13m x 13m) area with 100% impervious surface, populated by college students and staff members. Goal, to analyze alternative design options to help control stormwater runoff in urban areas and investigate methods that might ease the impact on the city's waste water facilities. Design constraints are must be a bioretention facility, fit into existing development, capture stormwater volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8cm depth, have the bioretention underdrain tied into the groundwater system, pond water for the design event to 15cm, infiltrate water every 6-hr period to

reset the ponding depth, and have the vertical layers and assemblage of microbes and plants outlined in the EPA fact sheet.

Bioretention devices reduce the impacts on lakes and streams of excessive runoff from roads, roofs and paved surfaces, enhancing natural landscape and biodiversity elements in urban environments. First option is a dry bioretention device, second is a wet bioretention device, and third is to leave the existing location as is. Other options include examination of bioretention devices like area shape, vegetation, soils, and drainage systems. The sandy loam soil, grass buffer, and sand beds slow down the runoff while filtering the stormwater, vegetation filters runoff from pollutants and dissipates water. The design proposed for a bioretention device to be implemented on Syracuse University, meets all required constraints. The volume runoff needed to be treated is  $2.333 \text{ m}^3/6\text{hr}$ . The ponding depth is 15cm, and is a trapezoidal depression, 6 m long with a top base of 3.192m and bottom base of 1.992 m. The infiltration of the sandy loam soil is 1.11 cm/hr. The discharge rate needed for the underdrain was calculated to be  $20 \text{ m}^3/\text{hr}$ . The underdrain utilizes two 6in. pipes 6m long to return treated water to the stormwater system and an overflow drain to dissipate any excess ponding water to the stormdrain system. Innovative Stormwater engineering is essential in the Onondaga Creek urban impervious drainage system, guaranteeing continued flood control and human safety, improvements in the aquatic health, and terrestrial hydrology. I believe this plan for a bioretention basin will greatly benefit Syracuse University's ascetics and the Staff and Students as well as the Onondaga Creek urban impervious drainage system

#### **128. BIORETENTION BASIN PROJECT FOR PARKING LOT AT 240 WEST SENECA STREET, MANLIUS, NY 13104**

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The project area, measuring  $2350 \text{ m}^2$ , is the South-West portion of the plaza parking lot at 240 West Seneca Street in Manlius, NY. The parking lot borders a well traveled road (US Rte 173) and a branch of Limestone Creek. Being adjacent to a popular fishing stream, there are concerns about stormwater runoff getting into this creek without some treatment. Currently all stormwater at this location enters the village sewer system in the middle of the lot. The goal of this project is to remove sediment, contaminants and increase the amount of time for infiltration of the stormwater into the water table. The bioretention basin, measuring  $105.741 \text{ m}^2$ , will be designed for a 6.8cm 24hr, 2 year rain fall event and the area of the device will be between five and seven percent of the total project area with a 15cm ponding depth which is designed to reset every 6 hours. Swales and large detention basins are alternatives to a bioretention basin. A bioretention basin offers microbes and other plant material a chance to utilize the sediments and contaminants. A bioretention also adds some aesthetic appeal to the location. The components for this bioretention basin are based on the EPA Fact Sheet design criteria with multiple soil layers with an under drain and topped with grass, shrubs and other vegetation.

### **129. IMPROVING ONONDAGA CREEK ONE BIORETENTION AT A TIME**

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The purpose of this project was to design a bioretention basin of a best management practice in the Onondaga Creek water shed. The location of this bioretention is in the lower parking lot of Burnet Park Golf Course in Syracuse NY on the grass next to the storm drain. The goal of a bioretention is to be a low impact development and a best management practice that will treat point and non-point runoff. This goal must be met under the constraints of that it must capture the storm water volume generated by a 24-hr duration 2-yr recurrence interval storm of 6.8cm depth, it must have the bioretention under-drain tied into the storm sewer or groundwater system; it must pond water for the design event to 15-cm; it must infiltrate water every 6-hr period to reset the ponding depth; and it must have the vertical layers and assemblage of microbes and plants. These goals and requirements can be met using a variety of methods. One of these methods would be to install a rain garden. This is a collection of wetland vegetation that are carefully placed and are used to absorb water and release it back into the atmosphere. Another alternative would be to put in a retention basin. This is a type of bioretention where it holds the water to form small ponds and infiltrates slowly into the ground. The opposite of the retention basin is the detention basin. This system usually only ponds water for a minimal amount of time before it is infiltrated.

When choosing from the different alternatives to meet the goal and constraints of the project you must first base the decision on hydrologic and hydraulic knowledge. This will tell you how much runoff will occur for a given storm event and the best solution to capturing and treating this water. Given the rainfall length of 6.8 cm for the 24 hour 2 year event the best method for the project would be a detention basin. To get the specifics of the design you must take into account many factors such as site data, tools and equations. This is necessary to determine the curve number, storage, storm water runoff, and then the size of the detention basin. With all of this information you can begin to put the specifics of your design together. This bioretention will be 25 square meters in a 5 x 5 layout. This will give it the necessary allowable ponding depth of 15cm. There will be 0.5 meters of loamy sand as the top layer with 1 meter of sand below that for the soil layer. This will allow for 53.1cm for a six hour interval of infiltration. Below these layers will be an 8 inch PVC pipe to tie the bioretention into the sewer drainage system. This design will satisfy the goal since it is a low impact development and a best management practice while being confined to all of the project constraints.

### **130. REDUCING RUNOFF POLLUTION AT FINEVIEW PLACE, SYRACUSE, NY**

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This bioretention device is designed to reduce the amount of pollution that enters into the Onondaga Creek watershed in Syracuse New York. This device is constrained to fit into existing conditions and capable of capturing storm water volume generated by a 24-hr duration 2-yr recurrence interval of 6.8 cm depth. The device must tie into the storm drain on Fineview Place. It must pond water up to 15 cm and

infiltrate water every 6-hr period to reset the ponding depth. The bioretention basin must have vertical layers and assemble microbes and plants outlined by the EPA. Satellite images were used to size the area (302 m<sup>2</sup>). The NRCS curve method calculated the runoff depth then multiplied by area to find runoff volume (21.37 m<sup>3</sup>). This information was then applied to the 6 hour interval for the 24 hour duration 2 year event. Infiltration and drainage (7.86 cm/hr or 47.16 cm/6hr) was calculated using principles of Darcy's law and Manning coefficient. An alternative design would be to install a rain guard into the storm drain. Installation of a rain guard would be cheaper to install and not change the layout of the lot. Disadvantages of rain guards include replacement every 11-12 months, 10-30lbs sediment capacity and used filter disposal.

The bioretention device was designed using hydrologic equations, tools, and site information. The device is capable of handling storm water volumes generated by 24hr duration 2 year recurrence interval storm of 6.8 cm depth. Runoff enters the device through a grass buffer strip. The grass and sand reduce the runoff velocity, filters particulates, provides aeration, and distributes the flow. The ponding area allows particles to settle and temporary storage, infiltration, and evaporation. Petroleum-based products are filtered by microorganisms in the organic layers. The planted growth cover provides erosion control and drying of underlying soils. The bioretention basin offers many benefits in reducing runoff, pollution, and sediment flow into storm drains. The design meets the required constraints and is easily maintained. Additional bioretention basin plans would also be helpful to further reduce runoff and pollution.