Program of Research Experiences for Undergraduates (REU) and Graduates at Alabama A&M University and Nanjing Forestry University

Proceedings of the Student Research

&

Trip Reports

August 2012

Center for Forest Ecosystem Assessment
Department of Biological and Environmental Sciences
College of Agricultural, Life, and Natural Sciences

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Research Experiences for Undergraduates in China

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Alabama A&M University and Nanjing Forestry University

2012

Table of Contents

Preface

Alabama A&M University (AAMU) was awarded a three-year grant by the USDA-National Institute of Food and Agriculture (NIFA) International Science and Education Program (ISE) in 2009 to develop an international exchange program with China. The program is designed to strengthen AAMU's ability to develop globally competent students and faculty through collaborative partnerships with higher education institutions and research organizations in China. The program focuses on the fields of agricultural and environmental sciences. The exchange program also aims to enhance courses with international contexts to prepare and mentor students for international opportunities in agricultural and environmental sciences, as well as to add new dimensions to scientific research and teaching capabilities of AAMU faculty via exposure to international resources and technologies. Our primary Chinese partner for this program is Nanjing Forestry University (NFU), a comprehensive university with a tradition of forestry programs. In the summer of 2010 and 2011, a total of 25 students and faculty participated in this program and travelled to China. The development and the opportunities created by this program led to a new three-year program: Research Experiences for Undergraduates (REU) in China, funded by the National Science Foundation (NSF) in 2011. The goal of the REU program is to expose undergraduate students with an interest in pursuing a graduate research degree in science to hands-on research experience.

In the summer of 2012, eight undergraduate students from six different institutions across the U.S. (including AAMU), four AAMU graduate students (funded by the NIFA-ISE grant), and five faculty and staff participated the REU program. The program started with a three day orientation to prepare for international travel. Once they arrived at China, students and faculty took language, cultural, and history classes at NFU. Each student was then paired with mentors—including graduate students and faculty from both universities—with similar research interests to conduct a research project. The research projects included a diversity of subjects such as "Urbanization Effect on Birds," "Effects of Forest Thinning on Soil Microbial Diversity," "Spatial Dynamics of Air Quality in the Jiangsu Province of China," and "Anthocyanin Pathway Gene Expression of Peach Flowers." Students learned to design research, collect data, operate research equipment, analyze data, and communicate their research results with peers—some even with their newly learned Chinese language skills!

The team had a three-day field tour to northern Jiangsu Province, including the poplar tree plantation and industry base at Sheyang County. In the early 1980s, faculty from NFU helped to introduce a hybrid poplar (genus *Populus*, hybridized in part from eastern cottonwood originating in Mississippi), to Shiyang. Once one of the poorest counties in China because of its high human population density, shortage of natural resources, and frequent flooding, Sheyang's economy has been transformed, and the poplar has played a major role in its economic growth. A visit to Dafeng National Milu Reserve demonstrated the initiative and interest of Chinese to

recover and protect endangered species by setting aside lands necessary for the survival of a species of deer that is extinct in the wild, the Père David's deer (*Elaphurus davidianus*), known simply as the *milu* in China. The Chinese are working diligently to increase the population of their small herd, to eventually release it back into the wild.

While at Nanjing, AAMU team experienced the culture, people, and a whole host of foods that they never in their lives dreamed they would eat! They explored the city by foot, bus, taxi, and subway and became intimately familiar with the city in a way that tourists almost never experience when visiting a foreign land. Students climbed Purple Mountain; visited Dr. Sun Yat Sen's Mausoleum; observed as weavers created hand-made silk tapestries in the Jacquard Museum; paid tribute to the fallen victims of the massacre by the Japanese during World War II, as commemorated in the Nanjing Massacre Memorial Hall; posed with enormous hand-carved mythical figures at the Xiaoling Mausoleum of the Ming Dynasty; celebrated the Chinese traditional Dragon Boat Festival with a big crowd of locals and foreign visitors; and visited a wide variety of stunningly beautiful gardens.

The team had the opportunity to visit other major cities such as Shanghai, Beijing, and Yangzhou and witnessed the effects of dramatic economic development during last 30 years. From Nanjing, they travelled to Beijing on a high-speed train at over 300 miles per hour. There, they climbed the Great Wall, walked through the halls of the (once) Forbidden City and the Summer Palace, maneuvered through a crowded Tiananmen Square, and observed the mile-long line of people waiting to see Chairman Mao's body.

Upon return to AAMU after six week abroad, each student completed two reports, research and trip/cultural, and created an individual website. The students had the opportunity to talk about their research and China experiences at two symposiums, once to an NFU auditorium packed with NFU students and faculty and another to the AAMU community including some students' parents and friends.

In short, faculty and students in the program are still reeling from the exchange trip to China that has significantly broadened their research, educational, cultural and language experiences. They are grateful to AAMU faculty and staff for their hard work to develop and coordinate this program and to NFU for hosting us, and for their gracious hospitality.

The documents in this proceeding consist of the students' cultural reports and their scientific research papers. Students and mentors worked together to complete these documents. Each student also created a website with additional information, which can be accessed at: http://myspace.aamu.edu/users/sha.li/reu/reu2012/

Acknowledgements

On behalf of all of the Research Experiences for Undergraduates (REU) program coordinators at Alabama A&M University (AAMU), we would like to thank the Alabama A&M University administration, the Nanjing Forestry University (NFU) administration, and most importantly, the National Science Foundation for their support in the implementation of this program. This program was a great success, and it absolutely would not have transpired without the support and understanding of the aforementioned. Thank you to NFU for allowing the REU program participants into your labs, your office spaces, and being so forgiving of our social faux pas. The students and faculty had a wonderful, once-in-a-lifetime educational and cultural experience in China, and you all contributed significantly to this occurring.

The AAMU professors, Drs. Yong Wang, Xiongwen Chen, Khairy Soliman, and Elica Moss, chose these eight undergraduate students from a highly competitive group of individuals from many universities across the nation. These students were chosen because of their academic strengths, their interest in the areas to be researched, and their compatibility with the project. In addition, we selected four AAMU grad students to assist with research projects and conduct their own research. We are proud of each of these students and all that they accomplished at Nanjing Forestry University and Alabama A&M University during this time.

Thank you!

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Department of Biology and Environmental Sciences
College of Agricultural, Life, and Natural Sciences
Department of Biological and Environmental Sciences

August 20, 2012

Participating Students

REU Undergraduate Students

Erin Brechbiel: Ms. Brechbiel is currently a senior majoing in Biology at Arizona State University in Tempe, Arizona. She was mentored by Dr. Xiongwen Chen and Emily Summers from AAMU, as well as Drs. Yulong Ding, Honghua Ruan, and Lin Cao from Nanjing Forestry University. Ms. Brechbiel examined soil compaction around different sites in Jiangsu Province and compared compaction between more and less urban areas. Her scientific research paper, which was presented to both the NFU and AAMU communities, was titled "An Analysis of Soil Compactness at Six Sites in Jiangsu Province, China."

Joanna Kukla: Ms. Kukla is currently a junior majoring in Physiology at Michigan State University in Lansing, Michigan. She was ,mentored by Dr. Khairy Soliman and Rashidah Farid from AAMU, as well as Dr. Lian Xu from Nanjing Forestry University. Her research focused on the cloning of genes. Her scientific research paper, His scientific research paper, which was presented to both the NFU and AAMU
community, was titled "Gene Cloning and Identification of the Fatty Acid Biosynthetic Pathway in *Camellia chekiangoleosa*."

David Farris: Mr. Farris is currently a senior majoring in Ecology at the University of Connecticut in Hartford, Connecticut. He was mentored by Drs. Yong Wang and Jianqiang Li from AAMU, as well as Dr. Changhu Lu from Nanjing Forestry University. Mr. Farris worked closely with Dr. Li on surveying for birds within a variety of habitat types in Nanjing. His scientific research paper, which was presented to both NFU and AAMU faculty, staff, and students, was titled "The Effects of Different Land Use Practices on the Avian Population in Nanjing, China."

Calvin Means: Mr. Means is currently a senior majoring in Biology a AAMU. He was mentored by Dr. Khairy Soliman and Rashidah Farid from AAMU, as well as Dr. Tongming Yin from Nanjing Forestry University. His scientific research paper, which was presented to both the NFU and AAMU community, was titled "Genetic Map Construction of the *Salix integra*."

Rakeyta Scales: Ms. Scales is currently a senior majoring in Environmental Science at AAMU. She was mentored by Dr. Elica Moss and Jonjala Jackson from AAMU,
as well as Drs. Yei Tian and Shengzhou Fang from Nanjing Forestry University. She studied the availability of nitrogen in thinned poplar plantations. Her scientific research paper, which was presented to both the NFU and AAMU communities, was titled "Soil Nutrient Availability at the Chenwei Forest Research Station in Jiangsu Province, China."

Nara McCray: Ms. McCray is currently a senior imajoring in Environmenta Science at AAMU. She was mentored by Dr. Elica Moss and Jonjala Jackson from AAMU, as well as Dr. Ben Fan from Nanjing Forestry University. She worked closely with Dr. Fan and helped conduct research to determine if several unknown rhizobacterial strains were plant growth promoting

rhizobacteria. Her scientific research paper, which was presented to both the NFU and the AAMU community, was titled “Determining Plant Growth Promoting Effect of Potential PGPR (Plant Growth Promoting Rhizobacteria) Strains.”

Iwo Gross: Mr. Gross is currently a senior in Biotechnology at Eastern Illinois University in Charleston, Illinois. He was mentored by Drs. Yong Wang and PhD candidate Kevin Messenger. They conducted herpetofaunal surveys in southern China, primarily Hainan Island. from AAMU, as well as Dr. Liang Wei from Hainan Normal University. Mr. Gross worked closely with Mr. Messenger, who was an NSF EAPSI recipient this year. His scientific research His scientific research paper, which was presented to both the NFU and AAMU community, was titled “Trouble in Paradise: Examining the Impacts of Human Activity and Elevational Gradients on the Herpetofauna of Hainan Island.”

Dustin Mielke: Mr. Mielke is currently a senior in Biotechnology at St. Cloud State University in St. Cloud, Minnesota. He was mentored by Dr. Xiongwen Chen and Emily Summers from AAMU, as well as Drs. Yulong Ding, Honghua Ruan, and Lin Cao from Nanjing Forestry University. Mr. Mielke explored the concept of power laws in nature and their possible relation to several species of economically important trees as well as bamboo. His scientific research paper, which was presented to both the NFU and AAMU communities, was titled 'Distribution Patterns of Plant Branches in Dongtai, Jiangsu Province, China.'

AAMU Graduate Students

Rashidah Farid: Ms. Farid is a Master of Science candidate under the guidance of Dr. Khairy Soliman, at AAMU. Her master's research is examining the potential for genetic bottlenecks in amphibian populations related to silvicultural practices such as burning and thinning, and a combination of the two. Ms. Farid assisted Drs. Soliman, Lian, and Xu in mentoring Calvin Means and Joanna Kukla. Additionally, she conducted her own research experiment at NFU in Dr. Lian's laboratory, with the assistance of his students.

Emily Summers: Ms. Summers is a Master of Science candidate under the guidance of Dr. Xiongwen Chen, at AAMU. Her master's research is examining the ecological significance and role that forests play in the ecological service of satisfactory air quality. Ms. Summers assisted Dr. Chen in mentoring Erin Brechbiel and Dustin Mielke. Additionally, she conducted her own research experiment at NFU, analyzing one aspect of the air quality data they collected around the City of Nanjing and surrounding areas.

Kevin Messenger: Mr. Messenger is a PhD candidate under the guidance of Dr. Yong Wang, at AAMU. His PhD research has not yet been refined, but he is interested in behavioral ecology of herpetofauna in China and is in the process of determining which species is most appropriate for his focus. In particular, he is interested in the natural history of the genus *Rhabdophis* (keelback snakes), some of which are both venomous and poisonous. Mr. Messenger assisted Drs. Wang and Liang in mentoring Iwo Gross.

Jonjala Jackson: Ms. Jackson is a Master of Science candidate under the guidance of Dr. Elica Moss. Her master's research is examining the biochemical nutrient cycling of soils in a forest ecosystem. Ms. Jackson assisted Drs. Moss and Tian in mentoring Rakeyta Scales.

Participating REU Mentors

Alabama A&M University Mentors

Dr. Yong Wang: Dr. Wang is professor of biometry, statistics, and wildlife ecology at AAMU. His research interests are behavioral ecology of avian migration; wildlife and habitat relationships and conservation; and natural resource modeling with statistics, Geographic Information System (GIS), and remotely acquired data. His recent research efforts include (1) stopover ecology of migratory birds at the southern Cumberland Plateau of northern Alabama; (2) wildlife (amphibians, reptiles and birds) response to anthropogenic habitat and landscape alternations such as forest management practices and urbanization; (3) breeding distribution and biology of Cerulean Warblers; (4) classification of land types for forest management based on GIS, remotely sensed data and statistical models; and (5) avian biology and conservation in China. Dr. Wang's research has been supported by organizations or agencies such as NSF, USDA, Forest Service, EPA, State of Alabama, TNC, and private landowners. Dr. Wang mentored David Farris and Iwo Gross, with the assistance of his PhD student Kevin Messenger and Postdoc Dr. Jianqiang Li.

Dr. Elica Moss: Dr. Moss is an assistant professor of environmental microbiology. Her research interests are in identifying microbes that contribute to the environment and subsequently effect human health. Her recent research efforts include: Arsenite oxidizing/resistance genes in soils; presence and abundance of pathogenic fecal bacteria in water systems; and biogeochemical nutrient cycling in a disturbed forest ecosystem. She was instrumental in the accreditation of the Environmental Health Science program at Alabama A&M University after only one year in existence; rendering it the only accredited Environmental Health Science Program in the state of Alabama. She is heavily involved in undergraduate research, which is evident in her involvement in the REU and URM programs. Additionally she oversees a program that takes undergraduates to scientific meetings to present their research. Dr. Moss's research has been supported by organizations or agencies such as NSF, USDA, and the State of Alabama. Dr. Moss mentored Rakeyta Scales and Nara McCray, with the assistance of masters student Jonjala Jackson.

Dr. Xiongwen Chen: Dr. Chen is professor of landscape ecology, ecological processes, forest fire ecology and management, and aerial photogrammetry. He is interested in using field information (including field experiment and survey), ecological analysis and modeling, remote sensing and GIS for basic ecological and forestry research, especially for ecological systems (e.g., forest landscapes and ecosystems) dynamics, biodiversity conservation and integrated environmental management for sustainable development under complicated settings (e.g., global climatic change and human activities). Dr. Chen mentored Erin Brechbiel and Dustin Mielke, with the assistance of Master of Science candidate Emily Summers.

Dr. Khairy Soliman: Dr. Soliman is professor of plant molecular biology. His research interests are in the genetic variations of oak species on the Cumberland Plateau, and genetic variations of amphibians in relation to different silvicultural management practices. Dr. Soliman mentored Joanna Kukla and Calvin Means, with the assistance of masters student Rashidah Farid.

Dr. Jianqiang Li: Dr. Li is a post-doctoral fellow at AAMU. He recently graduated from Beijing Normal University with a PhD in Ornithology. Dr. Li's research interests rest primarily with the behavioral ecology of birds. Dr. Li assisted Drs. Wang and Lu in mentoring David Farris, and was key to correctly identifying all of the birds encountered during field work.

Nanjing Forestry University Mentors

Dr. Yulong Ding: Dr. Ding is Dean of the College of International Education and professor of forestry ecology of Nanjing Forestry University. As the Dean, he is directly involved in the daily operation and management of the AAMU and NFU collaboration. He supervised one REU student, collaborated with faculty on research projects, and lead field trips.

Dr. Honghua Ruan: Dr. Ruan is the deputy dean of the College of Forest Resources and Environment in charge of the international collaborations. He is also a professor of soil ecology. He coordinated collaboration between AAMU REU faculty and students and the NFU faculty and students. He also mentored on AAMU REU student, who worked on a soil project.

Dr. Lin Cao: Mr.Cao is a faculty of GIS of Nanjing Forestry University. He helped to mentor one REU student and lead field trips.

Dr. Changhu Lu: Dr. Lu is a professor of wildlife ecology. He worked with Dr. Wang and his graduate student to mentor one REU student who worked a project that investigated the effect of urbanization effect on avian community.

Dr. Tongming Yin: Dr. Yin is a professor of forest genetics and biotechnology of Nanjing Forestry University. He and his research team mentored two AAMU REU students.

Dr. Tian Ye: Dr. Tian is from the environmental science program of the Nanjing Forestry University. He mentored one REU student.

Dr. Ben Fan: Dr. Fan is professor and researcher of molecular biology at Nanjing Forestry University. He mentored one REU student.

Dr. Wei Liang: Dr. Liang is a professor from Hainan Normal University. He provided support of a herpetofaunal research of a AAMU graduate student; a REU student particiapted the project and used it as his REU project.

Dr. Shengzhuo Feng: Dr. Fang is the Director of the Office of International Cooperation of the Nanjing Forestry University and a professor of Silviculture. He is in charge of the operation of the international program and assisted the development and implement of the AAMU REU-China program. He also mentored two REU students from AAMU.

Dr. Yongbo Wu: Dr. Wu is an associate professor of Forestry Ecological Engineering of Nanjing Forestry University. He collaborated with Dr. Chen from AAMU on research projects.

Dr. Lian Xu: Dr. Lu mentored one REU student.

Other Participants

From Alabama A&M University

Dr. Sha Li: Dr. Li is a professor from the School of Education of AAMU. He provided training for REU students on webpage development; he is also serving as an evaluator of the REU program and conducted the exit survey.

Dr. David Mays: Dr. Mays is Adjunct Professor of Agronomy in the Department of Biological and Environmental Sciences at AAMU. He visited Nanjing Forestry University while we were there with the program, and he assisted REU students with scientific writing during the final two weeks at AAMU.

Ms. Prabha Sharma: Ms. Sharma is a retired high school teacher with over 30 years' experience in teaching history and other subject areas. She provided training for REU students about the history, culture, and her personal experiences in China.

Jasmine Mitchell: Ms. Mitchell is a graduate student at AAMU. She has twice traveled to China and is familiar with the Mandarin language. She taught basic and essential language skills during the pre-travel Orientation to the REU students and mentors. She also participated in the pre-travel discussion panel on what to expect in China.

Lisa Gardner: Ms. Gardner was program coordinator and assisted Drs. Wang and Moss in coordinating the REU program on the AAMU side. She helped set up the website, created documents, organized the three-day pre-travel orientation and the two-week post-China program. She traveled to China to assist students and faculty with their needs and to act as liaison between NFU staff and faculty and AAMU staff and faculty when Dr. Wang was not available. She created the REU Proceedings, and assisted in creating and submitting the REU Annual Report.

Dawn Lemke: Ms. Lemke is a GIS specialist and adjunct professor at AAMU, in the final stages of her PhD. She traveled to China in 2010, and participated in the pre-travel discussion panel on what to expect in China.

Dr. Xiaoqing Qiang: Dr. Qiang is a professor from College of Engineering, Technology, and Physical Sciences of Alabama A&M University. During the REU program, they visited Nanjing Forestry University to explore the opportunities for collaborations.

From Nanjing Forestry University

Dr. Chaonian Feng: Dr. Feng is the Chairman of the Nanjing Forestry University. He is in charge of the operation of the university, and provided leadership role for helping AAMU REU-China program. He visited AAMU in August 2012 to promote the strengthening and expansion of collaborative efforts.

Mr. Qingyu Wang: Ms.Wang is the past director of the Office of International Cooperation at Nanjing Forestry University. She helped to develop AAMU REU-China program, and provided logistic support.

Mr. Dongrong Shi: Dr. Shi is the Deputy Director of the Office of International Cooperation at Nanjing Forestry University. He is in charge of the operation of the international program and assisted the development and implement of the AAMU REU-China program. He visited AAMU in August 2012 to promote the strengthening and expansion of collaborative efforts.

Ms. Zhiyun Wang: Ms. Wang is Director of the Office of College of International Education at Nanjing Forestry University. She provided logistic support for AAMU REU China program.

Dr. Guofen Li: Dr. Li is professor of civil engineering of Nanjing Forestry University. In August 2012, she visited AAMU to explore opportunities for further collaboration.

Dr. Jianren Ye: Dr. Ye is the Dean of the College of Forest Resources and Environment and a professor of forestry pathology. As the dean, he supervised his staff and faculty to collaborate with AAMU REU-China team. In August 2012, he visited AAMU to explore opportunities for further collaboration.

Dr. Xueqin Liu: Dr. Liu is an associate professor of the Department of Chinese Language and Literature of Nanjing Forestry University. She trained REU students for Chinese language.

Dr. Pingping Li: Dr. Li is the Vice President of Nanjing Forestry University and a professor of Agronomy. She provided guidence and support for the operation of AAMU REU program at NFU.

Dr. Yuanchun Yu: Dr. Yu is a professor of soils and environmental science. He helped mentor REU students.

Zhiyun Wang: Ms. Wang is the Director of the Office of College of International Education of Nanjing Forestry University. She provided logistic support for AAMU REU China program.

Dr. Jiangang Zhu: Dr. Zhu is the deputy dean of the College of International Education of the Nanjing Forestry University. He helped to arrange REU program and provided logistic support.

Dr. Yuanchun Yu: Dr. Yu is a professor of soils and environmental science. He helped mentor REU students.

Other Participating Institutions in China

Nanjing Forestry University

Beijing Normal University

Dafeng National Wildlife Reserve

Hainan Normal University

Beijing Forestry University

Sheyong Forestry Bureau

Cultural Experiences

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Trip and Cultural Report
Erin Brechbiel
REU China 2012

Depending on the individual in question, the thought of spending six weeks in China might afford a wide range of reactions. There are many valid reasons to be apprehensive- being subject to an unorthodox communist government, dealing with a formidable language barrier, and eating inescapable, unpalatable Chinese food. For me, it was a simple lack of knowledge about this vast and ancient place that kept me at a distance. But when the opportunity arose to spend my summer doing research in China, I immediately became captivated by everything Chinese. I was nervous about the countless uncertainties, ready to learn about both culture and science, and overflowing with the exhilaration of preparing to travel to the other side of the world. I was clueless about the relationships I would form, the depth of knowledge and experience I would gain, and the connection that would grow to so closely join me to this seemingly fortuitous place. To begin, I feel that I should describe my very first impressions of China upon arrival. Everything was different- different from home and different from anything I could have expected. Everything was new. Our first days were spent in Shanghai, where we did some sightseeing and began to get acquainted with the nuances of life in China. I ate my first Chinese meal, made my first Chinese friends, and was in awe of something new at every moment. The drive from the Shanghai airport to our hotel downtown was two hours long, and at every point for those two hours, patches of twenty-or-more-story apartment buildings lined the highway. In preparation for the trip I had been told the size of Shanghai, but to experience the magnitude first hand was a source of true amazement.

We arrived at our hotel, settling in for a few minutes before heading to a very late dinner. Our first Chinese meal was banquet style, with several dishes set out in the middle of the table to pick from. From mandatory chopstick usage and a sole drink option of tea, to unidentifiable plates of food and eating watermelon for "dessert," it was incomparable to any meal I had ever eaten before. But it was exciting, and I tried everything on the table. This type of meal recurred throughout the trip, but there did come a point at which the excitement wore off. It was almost exhausting to encounter so many different foods in one meal, and it was common that I would not like half of the plates I tried. We always had help and encouragement from our Chinese hosts, who would proudly explain the contents of a dish or where it originated from, and many times even showed us how exactly to eat something. They could be very forceful at times when they wanted us to try a special dish, sometimes even putting it on our plates for us and waiting to see us eat it.

In Shanghai, we were aided in our culinary (and other) undertakings by our tour guides and a Chinese post-doctoral student from Alabama A&M. Our tour guides were both female Chinese students, around my same age, and watching them interact was another novelty. Friends in China often like to hold hands and be very playful, hanging onto each other and being friendly. It is much different than the way I act with my best friends, so it was so strange seeing them play fight and giggle endlessly, much like younger kids in the United States. One of the tour guides, Len, became my friend while in Shanghai, and we talked about American music and Chinese history and each taught the other some things about our respective languages. Cultural differences were not subtle; I remember I was taken aback when Len told me she thought I was

beautiful and that we needed to take lots of pictures together. I would never say that to a person I just met, but statements like these were common from the Chinese to all of us students.

The morning after our arrival, a full day of touring gave us our first taste of big city living in China. There were bicyclists and mopeds filling every street shoulder, many with huge loads of unidentifiable items strapped to their back tires. Some mopeds carried sleeping children sandwiched between a mother and father. All this activity, along with cars driving in what appeared to be a quite unruly manner, created a picture of urban life that was distinctly different from American cities. This characterization spilled over into Nanjing, where bus rides sometimes had me bouncing out of my seat and gasping at close calls with other vehicles. After an adjustment period, traffic seemed much less disorderly, and it was clear that the Chinese drivers take an admirable amount of personal responsibility when it comes to driving. It felt safe and comfortable, despite the busyness.

The preparation we received before setting off to China was invaluable. As a group, professors and mentors included, all program participants gathered for lessons in Chinese language, culture, and history. These lessons continued into the first few days of our stay at NFU. Throughout the trip, this information proved to be a great asset. The Chinese citizens were always eager to tell us about China's history, and it was clear how proud they are of their country and its people. Everyone we met seemed to know something about history and wanted to share their insight. By arriving in China with background knowledge of Chinese dynasties and more current rulers, we were able to show that we too valued the long history of their country and people. Proactive language lessons were beneficial in the same way; I wasn't able to learn too much beforehand, but knowing some Chinese words and phrases opened doors to forming relationships. It was always a great bonding experience when attempting to use Chinese in conversation. There were corrections to be made, jokes to be cracked, and encouragements offered from both ends of a mixed-language conversation.

The cultural information I was given was more discreetly useful, however. One of the main differences between Chinese and American cultures is the value of independence and individuality. While individuality is celebrated in the United States, it is not a desirable trait in China. The group mentality of their culture is strong, which is apparent at dinners where dishes are ordered for the table, and not for the individual. Dinners also reflect the Chinese values of loyalty and obedience to ones parents and elders; the older males usually choose the food for the table, making this hierarchical social structure very evident. At one of the socials held for our group, we learned from students that their parents have a huge influence over their academic path. Parents choose their children's extracurricular activities, and parents can also restrict their child's activities when it comes time to focus on school or placement tests. My parents have always given me freedom to choose what I want to focus on, and it was strange to see these twenty-somethings whose lives were still in some ways run by their parents.

One of the most amazing aspects of Chinese culture is the pervasiveness of symbolism throughout life. Certain colors, animals, flowers, and even foods have significance of some sort, other than just being pretty or decorative. The color yellow symbolizes power and is worn by the emperor and his family. The symbol of the emperor is the dragon, and the empress is a phoenix. It is obvious how important symbolism is to the Chinese when learning about their written

language; every character is a compound of smaller symbols, each specifically put together to convey a certain meaning. It is beautiful and expressive, but difficult to comprehend for most English speakers. At historic sites, symbolism in design was everywhere. Sometimes I couldn't help but laugh to myself when I were told something like, "The five bats on the ceiling represent longevity, power, happiness, wealth, and peace," or that a statue was meant to guard dragons from entering the building. Culture in the States conditions us to find these kinds of connections silly or superstitious, while in China almost everything has a meaning or representation beyond face value.

The research performed on this trip allowed me to see parts of China's academic system from the inside. I was not in a lab with other students, but my specific project and mentor (from Alabama A&M University) put me into contact with faculty and graduate students from the College of Forest Resources and the Environment. I had the opportunity to watch some graduate student research presentations and learn what topics are of interest in China today. There is currently much focus on natural resources development, as China is still looking for capital and infrastructure to help support their growing population and increasing development. This focus most definitely gives science in China a different perspective from science in the United States.

The project assigned to me this summer was an assessment of soil compactness at sites of varying urbanization in Jiangsu Province, China. Jiangsu is the most developed province in all of China, and it was hypothesized that land use changes would have a significant impact on the soil properties, including soil compactness. I also focused on forested areas, as forests are currently a very valuable source of revenue in China. This project, and those helping me with it, allowed me the opportunity to travel to several sites around our host city Nanjing. The Dean of the School of Forest Resources and the Environment, Dr. Ding Yulong, escorted myself, my mentors, and another student to the University's Forest Farm. The site of many NFU graduate students' research, this was a fascinating place to learn about China's ecology and natural resources. Chinese grad students helped us collect our data in both a bamboo forest and a broadleaf forest at this location, and working with them was easy and fun. The group that I was with also had the chance to travel to some coastal regions of the province with the President of the university and his son, Dr. Lin Cao. We explored two beautiful cities, Dongtai and Changshu, collecting data in forested areas of both cities. Language barriers and cultural misunderstandings have no significance when it comes to learning in this environment; it is impossible to not be flooded with new feelings, experiences, and observations when working in such different and beautiful places.

Data was also collected around the large metropolitan area of Nanjing, as well as on the campus of Nanjing Forestry University (within the city). After soil compactness data points were collected at six sites total, data was analyzed. With the help of my mentors Dr. Chen Xiongwen and master's student Emily Summers, some simple statistical and geostatistical analysis was performed in order for me to determine the results of my study. In doing the different analytical tests, I learned valuable skills in statistics that will certainly be beneficial in my future career as a research scientist. The relevance of this project stems from the rapid urbanization of many areas in China, and the consequences this urbanization has on soil quality. Studying soil compactness can lead to better compactness management practices for both urban and forest areas, aiding in flood control and ecosystem support.

If this trip had been a vacation it might seem that the best parts would have been seeing famous landmarks and shopping endlessly, but this REU trip had more to offer than tourist glimpses of Chinese life and places. Enough time was spent in Nanjing that I became comfortable with the city, became comfortable with the people, and considered it home for the weeks we stayed there. Nanjing is a beautiful and fascinating place, and once I settled in to the dorms at Nanjing Forestry University (NFU) it became time to explore the city. On many occasions, NFU students who worked with our American REU participants offered to show us some of the interesting places downtown. The Chinese students became natural friends with every one of us, and were so generous and eager to help us experience all that Nanjing had to offer. In all interactions with the Chinese, their desire for us to enjoy China and learn about China was clear and overwhelming, and since those goals were ours as well, it proved to be a perfect match of host and visitor. After this program, a city that I had never heard of has become one of the nearest and dearest places to my heart. Without question I will return to Nanjing in the future.

Though to some it might seem trivial, the food experience was a major part of living in China. Some of the individuals in the group had a hard time accepting the type of food that was available to us; instead of adjusting they were simply resistant. This had a big impact on their entire trip experience. Those of us who experimented with Chinese food, rather than tracking down a McDonald's or Subway every day, gained so much more from the daily life connection to our host country. Often, I asked NFU students to help me choose food in the cafeteria. I occasionally found new favorite dishes (including black rice porridge and steamed buns), and at the same time learned what was popular among the Chinese students (including pickled tofu and roast duck). It would have been easy to let my comfort zone limit me to meals of chicken nuggets and rice, but by trying new things I was able to connect to many people and places through food. Additionally, repeatedly stepping out of my comfort zone led me to realize that my comfort zone is not static; it is flexible and fully capable of extending to include new things- whether those things are foods, customs, or ideas.

In the end, it is difficult to find any true negatives about the trip itself. Every experience was both an enthralling novelty and great learning experience. For instance, on our first weekend in Nanjing a group of four girls and I decided hike up Purple Mountain (or Zijin Shan, 紫金山 in Chinese). To make a long and very complex story short, we spent half a day trying to find where to hike, stumbled upon Sun Yat-sen's Mausoleum, and then spent the remaining part of the day finding our way back home. We ended up getting lost one final time while walking to the bus that would take us home, and a Chinese couple walked us fifteen minutes to the bus stop after we stopped them and asked for directions. This became a recurring event- getting hopelessly lost and then rescued by a generous local who took time out of his or her day to walk us to our destination. With one big mistake, we saw a spectacular historic landmark, were the subjects of a wonderful display of Chinese kindness, and got our much needed exercise, all in one day. Spending time out and about, whether or not a goal is in mind or reached, was always worthwhile and fun in Nanjing.

Towards the end of our trip, the Chinese professors we had been working with began trying to get us on board with the idea of coming back to China to study. They were generous with their offers of paid research positions, master's work, and PhD degrees. Science in China is just

beginning to expand and grow, and it is clear that they are looking for new ideas and innovators to help their country advance. After completing this trip, their offers seem like a viable option for continuing my studies and deepening my connection with China. I know that sometime in future, while I decide what steps to take next in my studies, I will seriously consider returning to China to live and work. I have found that there is so much to see and do, and more importantly so much to learn, from this blossoming nation.

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My Experiences in China - Trip and Cultural Report
Dustin Mielke
REU China 2012

Not often do we get time to travel. It can be life changing and eye opening to live in another country for any decent amount of time. I have heard of a world wisdom that can be gained from experiences like this and it entails a calmer, more open-minded approach to civilian life. In the summer of 2012, I was given the opportunity to join an REU research internship provided by the National Science Foundation. During six weeks, from May 27th through July 7th, I was able to travel and work in China. It has been a wonderful journey and I would like to share my adventure. In telling my story, I will be sharing my thoughts along with the experiences I have had. I would like to start with an overview of the places we traveled to put everything into context. Then I will switch to comparing and contrasting notable aspects of culture and lifestyle, including drinking, socializing, eating, and traveling.

To highlight the places my group has traveled, including some specific areas, almost our entire trip was located in the Jiangsu province. In summary, we first arrived in Shanghai and stayed there for three days. Then we took a bus to Nanjing where we stayed at the Nanjing Forestry University for a good portion of our trip. This was also the location where our research took place. At the end we took a train to Beijing and stayed there for three days before departing back to the US. There were also a few field trips during our stay in Nanjing. The first one was for work where we traveled to Dongtai, Chang Shu, and Yixing to collect data. The second trip we visited a poplar plantation, Maui deer reservation, and the Imperial Gardens for cultural education. My stay in China emphasized not only the research projects we all were working on, but also the cultural experience.

All three of the cities we stayed in were larger than any I have ever seen. Many times during a drive through a city I would be struck with awe about how many high-rise apartment complexes we could see. Just trying to imagine all of those people working and living in one city is beyond me. Not all the buildings are of a modern style though; there are traces of old architecture in city walls and buildings in parts of every city. I liked being able to glimpse at the history and culture of these buildings as a reminder of where I was. It is easy to get caught up in the events of modern times and lose sight of what past generations have gone though and believed in. I am always happy to see people hold onto their culture, especially if it has such a long history like the Chinese.

The culture is very different of course, but I keep getting the feeling that life here can be easily adapted to. For those willing to adapt, once you get used to the things that are different it may feel just as comfortable there as you are now. In the places we visited, all the basic necessities were there. They have toilets flush with the floor and boiling pots for the undrinkable tap water. This means that if I were to live in China, it would come down to whether or not I would be willing to adapt to those differences. A thing like bargaining for purchases is a totally new concept for me, and I've never had employees pulling on me to buy their stuff. Perhaps it is experiencing a different way of life that opens the door to creative thinking, or in the very least changing or appreciating the current rut we tend to create in everyday life.

The professional world in China incorporates drinking unlike what I have seen in the US. Instead of promoting inhibition, they promote drinking. I have been told that the Chinese consider drinking as a release of social pressure and a tool used for self-discovery. I believe it is not only a way to learn about oneself but also a way for fellow colleagues to learn who you really are. Being a representative of many organizations for the US to China, a major question in my head was "What values would be considered responsible to uphold?" It feels like there are two extremes in testing a person's character on this subject. First would be like the US, which would be to observe a person's decisions while being surrounded by opportunities to lose control. Second would be like China, which would be to compel people to lose control and then observe their decisions once they have lost that control. Considering how much effort people put into controlling their actions in public, it is understandable that their drinking culture involves more of a release from that expectation.

The people themselves are much more polite than those of major cities in the US in my experience. From people I would see every day to people that I will never meet again, there hasn't been any outward disaffection towards me. Our guide in Beijing explained that a possible reason for this comes from the layout of the city. The city center is Tiananmen Square, which then is surrounded by circles of districts to promote good feng shui. To relate this to social interactions: if on the inside you are a square, it is also a good practice to act like a circle on the outside. That is, suppressing personal opinions to avoid conflict in public is a practiced social norm. It may not be true that the people are better in general, but just acting like it in public makes me feel less alone in such a big city.

I have three examples of the kindness of strangers, and it is much unlike other major cities I've been in. First, on many occasions, while asking for directions in trying to find a store, I encountered someone who would show me where it is. I was looking for the Post Office one day and this young couple went out of their way and spent almost a half hour to walk me there. This came as a surprise to me because I would have never expected strangers to act like this. Second, many Chinese take an interest in seeing foreigners. They are excited to see me and my group, and the people who are not as shy try to communicate or ask to take a picture with us while the people who are shy usually just smile or giggle. The third example is during meals. I never noticed overt selfishness at a meal until I was with a group which consisted of all Americans. People would be more concerned to get what they want instead of considering everyone at the table. Without this holistic consideration, people get rushed and often times can't grab or finish grabbing some food that is currently in front of them. This may be due to the lack of experience we all had in this type of serving style, but I think a clear cultural difference can be displayed with this example.

I traveled to China with a group of foreign exchange students that included a variety of races. We called ourselves the skittle pack because of this diversity. I think it fairly describes the attention we got in both stares and genuine curiosity of seeing people from other cultures for possibly the first time. A good analogy one of the students attending our social used to describe all of this special attention. It is a great analogy and it compares us to panda bears. If you see a panda bear walking down the street, everyone will be compelled to stare right? It is a natural

reaction and it even has a positive connotation because pandas are a valued animal in Chinese culture.

The Chinese society has adopted a strong eating culture. What I have been told is that because of the long history of starvation, food was and still is a valuable gift. Recently, food become abundant and many people have adopted the saying "eat as more as possible" during meals. The meals themselves feel like feasts as there are always plenty of leftovers. When eating with a large group of people, everyone sits at a round table with every dish on a circulating platform in the center. Because there is so much food being served, the odds are in your favor of finding something you will like.

I personally enjoyed the food in China more so than other members of the group I was with. This might be because I have been surrounded by friends that share their culture with me. It is easier to try the diversity of Chinese foods when you already have a taste for eating rice and cooking unique meals. One of my favorite foods that I have tried was a veggie meat ball type looking food that is made of lotus root. I also really liked a dish that translates to "ants on a log" which is made of sweet potato noodles and various spices. There was a sweet tasting soup that was made from rice starch that I also liked. Other foods like the fish and meats tasted good too, but it really depends on the way it was prepared. My favorite drink was an iced coffee with soft serve ice cream. I could probably find that in other places of the world, but I first tried it in China! Other drinks were great to try too, especially the teas.

I got the pleasure of drinking tea in two tea houses, one in Chang Shu and another in Beijing. When people say that they don't like drinking tea I always get the urge to ask, "Have you ever tried real tea?" Granted I liked tea before visiting these tea shops, but that should only give more credit to my words when I say that these teas tasted really good. My three favorite teas that I have tried were Oolong Ginseng tea, Black lychee tea, and some type of dried Fruit tea. I definitely want to continue drinking tea because it is comforting and I like being healthy. If there is anything people need, it is something that helps them relax in this world that can be so chaotic.

There is nothing that can get on some peoples nerves more than traffic. Traffic in China appears to be more chaotic at first glance. People drive wherever they can and honk more frequently. However, even though they follow fewer rules and have less structure, the responsibility is taken upon each individual to complete a working system. In general there are more localized problems but everyone is actively willing to solve them, so it balances out. I was on a large bus that took a three point turn in the middle of a four lane street and people honk and everything but in the end everything is normal. That is one thing that really impresses me - an eagerness to solve problems. I never liked the idea of reacting emotionally to unexpected events because there was nothing that could have predicted it. I enjoy actively using my creativity to learn and solve problems.

I have summarized the places our group has traveled in China and shared my thoughts about the things I have seen. Every culture has a different lifestyle that they choose to have. Experiencing life in another country, especially one as different as China, can really make someone think twice about the different ways life can be lived. How does anyone know the right way to do things? Truth is, there isn't any right way, just a preferred way. There may be an endless amount of

things to be learned from a single event, and we are all limited in what we learn from by the ways in which we perceive our environment. My trip to China has given me many experiences to draw upon and open my mind to the world. In sharing my adventure with everyone, I can only hope to inspire a greater understanding of the world we all live in.

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Trip and Cultural Report
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REU China 2012

Early Assumptions/Expectations

I believe upon our arrival to China, we all had varying ideas and beliefs about how we thought China would be. Personally, I help several stereotypes such as: everyone will be intelligent, look very similar, and be reserved in personality. I also thought China would have any and everything, since almost every personal item any given American owes has a tag or imprint intitled "made in China". I also had personal impressions related to science and research. I thought science would be complex, intricate, technologically advanced, and highly regarded. Socially, I thought China would highly value family and therefore the divorce rate would be much lower than that of ours in the U.S. Overall, I thought science, social, and environment would be somewhat similar to that of the U.S. After being in China for six weeks, I was surprised to discover that my first impressions of China before visitation were highly flawed. The orientation before leaving for China could have never prepared me for what was to come. I feel as though many things were misinformed. Not due to error, but simply because everyone on the panel had different experiences and opinions about what China was like. Even in the U.S. lifestyles differ greatly, and taking advice from others can be somewhat misleading.

I have never traveled outside the US for an extended amount of time for research or study so I had no idea what to expect. When we arrived in Shanghi, I was amazed by the immenseness of the city. The amount of people and high rises alone intrigued and stunned me. As for society and civilization, I knew cultures varied among countries but I had no idea culture would vary so much. Being a US citizen you believe the way our society does things is somewhat the norm, but I was definitely wrong. I never knew things could be done so differently, yet work! I had a preset opinion about how civilizations are established, withstood, and developed based on my knowledge of the US. Having this experience opened up my mind in more ways than one. I realized having an open mind is the key to learning and putting yourself into another's culture. Without an open mind in China, you will fail at living there. Upon completion of the trip I gained an appreciation for America that I never knew existed. I feel like the trip to China has given me the opportunity to look into myself and my country and therefore become a better U.S. citizen. The China experience has also aided in my personal growth (spiritually, socially, and academically).

History and Culture

China's deep culture can be attributed to its history. I believe history is a good indicator of the future, and China's culture imbeds this idea as well. In history, China went through two major disappointments related to foreign relations. First the invasion of the Mongols, and second the Opium Wars with the British. Other exchanges with surrounding countries and the US contribute to their belief that foreign exchange should be avoided. Western influence into their culture is avoided at all cost. This is why their culture varies so much in relation to Europe and the US.

I noticed the maturity level within college students, solely based on my personal definition of maturity, in China to be a bit more juvenile than in college kids in the U.S. Giggling, touching, whispering, personal displays of affection, and shyness were commonly seen throughout my interactions and observations with the students. I feel this may be due to lack of social expression or independence from parents until latter years in life. The education process may account for much of the social immaturity since school is very structured and intense throughout childhood and adolescence.

I think the major differences in culture include family, food and drink, education, social expression, gender roles, and laws and policy. Chinese culture strongly encourages being highly respectful to one's elders, even to the extent that they cannot be questioned. Children are expected to strictly obey their parents and be unyielding to the parents' wishes. Bonds are formed within families which make personal independence less common than in the U.S. Most parents in the U.S. push their children out of the home by 18, and sometimes live thousands of miles apart. I see Chinese family bonds being closer knit than the average U.S. family, but of course this varies as well. It is no secret that the food is different. In general food is healthy, fresh, and very unique. It was a pleasure to sample so many different and somewhat controversial dishes including: chicken feet, pig ears, cow tendon, shark fin soup, soft shell turtle, snails, sea cucumber, goose, and eel.

Pig ear

Sea cucumber soup

Assortment of 'homestyle' foods

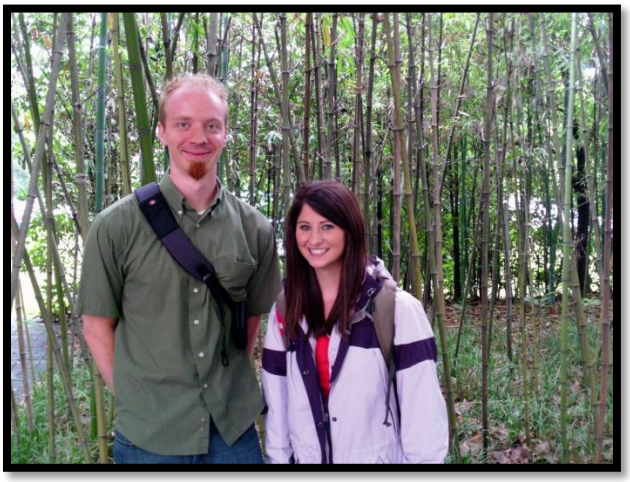
Social Connections

I met a variety of people in China: common people on the streets, professors, including two deans and the president of the university, students (undergraduates and graduates), and the U.S. students involved in the REU program. All these people in some form or fashion impacted my trip. The random people I met on the street while shopping or trying to get from point A to point B, challenged by ability to communicate the Chinese language. Usually pointing, gestures, writing in some cases, and body language could be used to communicate. The professors I met Dr. Ruan and Dr. Ding were both very polite and seemed as enthusiastic about us being in China as we were, so that was exciting to have that kind of bond. These two professors never once considered us a burden and always went out of their way to accommodate our stay and research goals. Dr. Ding even wished us a personal goodbye at the hotel as we were leaving Nanjing. Some professors were standoffish and did not have time to interact with us, but these two seemed happy to collaborate and have a good time socially with us. Another Ph.D. student accompanied my group on our research adventures and made special accommodations for us, including four star hotels. So as for my mentors, I thought things went good. I did not work directly with a group of Chinese students, therefore my interactions were limited other than one hour long socials on Friday with random undergraduate students. I found this organization very strange. Also, during these "socials" the time was limited to one hour and very structured and rushed. I had hoped we could have communicated with the students on a more personal level or outside of the university. I did have a Chinese roommate in which I was able to discuss current social issues in China. She was very interested in me and my beliefs, one of which she frowned upon (my personal eating and drinking habits). We exchanged emails and addresses so we can keep in close touch. She was very excited to meet me and discuss things she may not have been able to express otherwise such as marriage, career, religion, and children and how they differed in the U.S.

Mentoring Experience

As a graduate student in the China program, it was my responsibility to serve as a mentor to the undergraduate students. The two undergraduates I worked closely with shared my research interests, and we worked very well together. Not only did working through my own issues, but also finding solutions to their problems was rewarding. In the end, the achievement among the three of us was immense. Personally, this experience taught me the most. I taught both the

students statistical concepts and how to work in two programs. Furthermore, I helped them compose a scientific PowerPoint presentation and edited their scientific reports. I think having a graduate mentor is especially important for the undergraduates, because they can communicate more efficiently without feeling the pressure from a senior scientist. They can relate to you more and feed off of your opinions and suggestions without feeling overwhelmed, judged, or lost in translation. I think the graduate student just alike gets as much out of the experience of mentoring because they get the chance to be challenged. Teaching ecological concepts, computer programming, and scientific writing only makes the experienced participant more knowledgeable in their science. It is also very rewarding when you know you are responsible for the undergraduate students' scientific and personal growth.



Myself and the undergraduates I mentored: Dustin Mielke (left) and Erin Brechbiel (right).

Suggestions/Recommendations

With the program being relatively new it is difficult to foresee problems related to living, research, and connections. I feel with each year growth can be achieved and students therefore having more fulfilling experiences. I would suggest better communication with Nanjing Forestry University before leaving the U.S. I know much work has been done in this area to create connections, but much disconnect was still present in my experience. Since there is a language barrier, I know it is difficult for our English speaking professors to get the chance to form research goals prior to arrival but strict structure is an important component, especially when only conducting research for three weeks. Another component to help research may be contributing to a database to be analyzed at the end of the five year program. In order to get the most out of the experience, reasonable objectives and goals should be discussed and arrangements made. This does not only pertain to the research, but also to the living

arrangements. I feel like each American student should be housed with members within their group, and if this cannot be achieved then other arrangements should be made. In my personal situation, being placed in a dorm with other non English speaking foreign students created a feeling of isolation. Besides the poor sanitation, I managed well, but I feel that if an emotionally sensitive student had been placed in the same situation a problem would have definately occurred. As far as preparation goes, I had no idea what I should and shouldn't have. I thought everything would be readily available in China, but warn students that this is not always true. Sometimes carrying only one bag leaves you unprepared. There are simple necessities that China does not have. Also, do not buy an umbrella in the States! You can get one in China for a U.S. $1.50. Definitely, do not expect WiFi or internet to work fast in your dorm room! The panel should be forced to answer these kinds of questions and supply the students with much needed information.

Nanjing's rich history makes learning about China's history and culture easily accessible, however; city tours did not encompass this. Going to the Presidential Palace was historic, but the garden and City Museum could have been replaced with visiting the Ming Tombs and the rich history of Purple Mountain located in Nanjing. The first emperor of the Ming Dynasty's palace and tomb were located here! Only myself and another graduate student got to see it because we stumbled upon it ourselves, along with Sun Yet-San's Mausoleum. Having a history professor take us to these two places in Purple Mountain on a Saturday to explain history would have been amazing in my opinion. Overall, this experience was exceptional and taught me how to appreciate other cultures, work within a team setting, and grow as a person and professional.

Posing among the lotus at Mouchou Lake (Mouchouhu).

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Trip and Cultural Report
Nara McCray
REU China 2012

The acute stimulation of all five senses. The sounds, smells, sight, taste and feel of China result in an explicit sensory overload. After a month and a half of traveling and conducting research in China, I have a somewhat well-rounded viewpoint of my experience into the People's Republic of China. Prior to visiting we had Chinese language and culture classes. These extensive classes intimidated me but were predictably very helpful. Expecting unimaginable technology, delicious food and a language barrier that couldn't not be surmounted; I was shocked when most of my expectations were debunked. For me, this experience was the first of its kind. Never having been out of the United States before, let alone not having any previous research experience, this opportunity was very educational expanding far beyond the lab. Experiencing China as a tourist as well as for work allowed me to see two aspects of the country in one visit. Upon my arrival on to the campus of Nanjing Forestry University I knew the summer would a great one to remember. My interpretation of China's food, traditions, culture and social atmosphere are unique to my personal opinion and I hope my interpretations will be inspiring and intriguing to others.

One doesn't realize the significant role of silverware until one is forced to use unfamiliar utensils. As you can probably predict I am speaking of chop sticks. These simple utensils were initially a conundrum and I am proud to announce that I am now an expert. My first impression of Chinese food was made in Shanghai where we were all challenged by the unfamiliar wooden sticks. Although at some restaurants forks were available, chop sticks of course were the only way to eat the food in China. At restaurants there was also another unique aspect to Chinese meals: the lazy Susan. This large spinning disk in the center of a circular table allowed for everyone to share food easily. Sharing germs was not a concern although we used the chopsticks used to eat to pick food out of the various dishes to put on to our relatively small plate. The silverware setup usually consisted of a small plate, like an American Saucer, for one to place bits of food on, a spoon and small bowl, chopsticks, a cup for tea, glass for a drink and on special occasions a small shot glass for liquor or wine. The food was excellent, many flavors and dishes soaked in generous portions of saucy food. The only issue was the oiliness of many foods. This is better on ones stomach than grease but the oiliness of their dishes took some getting used to. Also to everyone's surprise they did not use soy sauce, but there was always a saucer of brown vinegar available. Along the duration of the meal more and more dishes would be added to the lazy Suzan. This created an excitement and anticipation at every meal! The presentation of watermelon and sometimes other fruit marked the last dish and the end of the meal, their version of desert. I not once saw a fortune cookie!

Food, as in every culture, is a big part of the Chinese tradition. Traditionally one has to wait until everyone was present to begin eating. During special meals liquor is present and everyone is strongly encouraged to have a small glass full of liquor/wine along with a separate glass with another beverage. Toasts are frequent as well as making cheers with individuals. It is considered rude to not return a toast that is individually made to you sometime before the meal is over. It

was acceptable to drink during all times of the day in China. Beer was sold in the cafeteria and could be purchased with the campus card as well as in the student store. As many know tea is a very important part of the Chinese culture and traditions. During meetings tea was always available, the locals are adamant in having very fresh tea. The tea is sold and served loose leaf, ungrounded and the leaves can be used about three to four times. During every meal tea was served. Interestingly green tea was always served during meals in Nanjing and jasmine tea was only served during meals in Beijing. Every tea served as a different remedy. The on campus clinic even provided a potent tea for pain relief; no Advil or other pain relievers were available in the store. Whether the herbs are scientifically proven to work or not I do not know but many Chinese beliefs were quite superstitious. Many occurrences such as the sight of a rare bird for example bring luck to those who lay eyes upon it. Also the numbers eight and six are lucky numbers in China. A particular tree-like plant that has eight leafs on each stem is very popular in banks because it will supposedly bring financial luck. The fish is also a positive symbol representing frugality. Many animals represent some sort of luck, for example all tombs of rulers from the Ming dynasty have a turtle near the entrance. Touching its head will bring good luck and touching its tail will bring money. Money is very important in the Chinese culture, emphasis on saving.

Aside from their traditional beliefs, their ways of life differed much from ours as well. Traffic was just unbelievably disorganized. Horns were constantly being blown and many pedestrians would fearlessly j-walk through the center of busy intersections. There were separate bike lanes for motorcycles, bikes and electronic scooters. Public transit was very intuitive, efficient and inexpensive. Taxis were inexpensive as well in comparison to the United States and I found it odd that in Nanjing it was custom that the passenger sit in the passenger seat of the taxi cab, not the back seat. Streets during the day were crowded and chaotic. Living situations were different as well. Although we were luckily allowed our own bed room with air conditioning, most students on campus lived in non-air conditioned rooms with up to eight other students. Rooms were located sometimes ten stories up with no elevator. All dormitory beds were the same however; wooden planks with a pillow-thickness sized pad and a protective blanket and comforter. The beds were hard but surprisingly comfortable. After visiting IKEA it was apparent that this extremely firm bed style is preferred in China.

I noticed that students would wear the same outfit multiple days in a row, I witnessed as much as four days. At first I was somewhat bothered by this but then when it came time to hand wash my own clothes I understood why, it is very arduous work! Washing machines were rare and dryers were very uncommon judging by the abundance of clothes hanging around the city on any given day. Things such as body lotion and deodorant were difficult to find in the stores. Body lotion wasn't necessary probably due to the humid climate and I was shocked to learn that they do not wear deodorant in China! I never was bothered by the smell of body odor so I believe their more natural and fresh food may perhaps result in the impotency of body odors.

The social constructs of China were quite intriguing to me. My initial arrival to the campus of Nanjing Forestry University was shocking when I witnessed about 70% of the student body holding hands, either opposite sex couples or pairs of female friends. The male would carry the female's purse and books! Men commonly smoked and it is considered taboo for females, representational to a prostitute. Chinese relationships are very affectionate so I was surprised to

learn that the divorce rate in China was 80%! This is apparently because men leave their wives to be with younger women who are seeking a wealthy older man. Summer is the English name of the graduate student I worked with. She and I became very good friends and she taught me loads during my stay in Nanjing. One day while walking in the park we passed a few dozen sheets of paper with writing on them. Summer informed me that they were single wanted ads! It was surprising to me that this was their version of a sort of online dating. She also unknowingly taught me more about her culture when she confessed to me how she was upset about her graduate assignment. Her mentor forced her to study infectious tree worms for her project when she wanted to study soil bacteria. The hierarchy in that country is such that even if you are unhappy with a decision someone of higher status has made for you, you need to accept that decision and be happy with it. It was apparent from conversations with my assigned mentor Dr. Fan, who was an assistant professor; I was to do what I was told and not attempt to modify what was instructed by him. I dealt with this by conforming and following the culture of the society that I was so invitingly welcomed into. Summer and other students were very friendly, insisting on paying for meals and overwhelming us with small gifts. Some students were quite shy at first but then became very boisterous after getting better acquainted. Although many were shy, often older people would stare unyieldingly on the bus or stop in the middle of the street to turn and watch us as we walked in the opposite direction. Without any discretion or secrecy we would often be stared at in the city of Nanjing. It was apparent that they did not consider this to be rude or insulting behavior. Along with that there were many things we would consider rude that they apparently did not, such as speaking while others are presenting or answering cell phones during speeches. Besides those small things I felt very welcome and safe in China. The Chinese were very quick to give compliments and say hello to us foreigners. When in search of directions many would walk us sometimes fifteen minutes with us to our destination. Their proximity to others was different, arm and shoulder bumping was unnoticed and even accidental shoving was not deserving of an apology.

The discovery of delicious food and the assimilation of a new eating utensil into my list of skills was only a small fraction of all that the People's Republic of China allowed of me. I learned to appreciate the natural remedies for our health problems and experienced what real tea tastes like. Finally experiencing lab work of my own was exciting and I anticipate conducting much more research in the future. I also aspire to travel to foreign countries. The cultural education component of this research experience has made me into a better communicator and I now know a bit of Chinese! My initial expectations were off a bit, technology not advanced as I expected; wifi was rare! The food was delicious as expected although I longed for a burger and fries about half way through the trip and thankfully majority of the young adult population spoke English making maneuvering about the city much easier than expected. Experiencing life outside of the U.S. has allowed me to question the mindless norms we all conform to and to appreciate the freedom we have. Most importantly this experience has guided me to new interests as far as my future career aspirations. After taking a class in hazardous waste management my interest was somewhat sparked in the field of remediation. Working with plant growth promoting rhizobacteria this summer has reignited that spark to possibly pursue a career in bioremediation. It was fascinating for me to experience life in a culture so ancient. My whole life has existed in a place that is relatively young, but China's centuries of history and traditions was remarkable to learn about and life changing to experience.

Climbing Purple Mountain, with Nanjing City on the horizon.

Me with Dr. Ben Fan (left) and ‘Summer’ Yongxian Xia (right).

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Trip and Cultural Report
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The Research Experience for Undergraduates program in collaboration with Alabama A & M University and Nanjing Forestry University was a success and an eye opening experience overall. Most of our trip was spent in Nanjing in the Jiangsu Province of China. This trip was an enlightening experience because I was able to better understand the Chinese culture and language while interacting with students and professors on the Nanjing Forestry campus as well as people of the cities of Beijing and Shanghai. I had so many expectations and stereotypes of China and the people of the country. I thought that China was super advanced with technology such as WiFi all over the country, they ate rice for every meal, very competitive with education, and that couples could only have one child. Going to China taught me a lot about the country as well as myself and what I am grateful to have. I had never been outside the country before so this program gave me the opportunity to travel internationally.

When I arrived to Alabama A & M University on May 23, 2012, we had preparatory classes to learn basic Chinese language and about the Chinese history and culture. This preparation was very beneficial because I was able to interpret the points of views of people who were my peers and the professors who had gone to China the year before. They gave us insight on what to expect in China such as the restrooms and the customary meals eaten in China. Once we had the cultural lessons, then we knew what to expect. I was prepared to drink bottled water and hot drinks like tea for 6 weeks. I was also prepared to bring tissue packets and hand sanitizer every time I had to use the restroom. I think that the language portion of the preparation classes should have been taught by a native of China. Sometimes dictionary definitions are not the same as custom dialect and accents for different parts of the country.

In China, there were a lot of times when I thought to myself that "this would never happen in America" or "this is different but I like it". The Chinese culture is very different from American culture but I learned to accept the Chinese culture for the way it is. When we first arrived in China, people were constantly staring in our faces and just watching us walk down the street. I knew they had never seen anyone like me before because I was an American but I was also black with long braids. People would randomly try to sneak and take pictures with their cameras or their phones. They would only sneak if they couldn't speak English very well and were scared to ask to take pictures. The people who could speak English were constantly rushing up to me to take pictures or ask to touch my hair. After a while, I got used to it - it was like being a celebrity. It was literally like paparazzi everywhere we went because most of the native people had never seen anything like us before.

Family is very important in the Chinese culture and that was one thing that I truly enjoyed learning about was Chinese families. For China to have a one child only rule, I saw a lot of children. There were children everywhere and surprisingly mostly boys. I was able to talk to some students about the one child only rule and get their perspective of the law. Most of them didn't have any personal political view on the law but they had just wished to have another sibling. Apparently, if a couple has a second child then they must pay a fine for that child. This

fine is very expensive so only the wealthy people can afford to have more than one child. Also, babies do not wear diapers in China. I found this very odd because all the babies had pants with a slit where their butt was. I am still not sure how a parent will know if their child has to use the bathroom because a baby cannot tell you when they have to go. Often I saw parents holding their children over trash cans, or even on the side of the road. I even went into a store and they sold diapers but I never saw a baby with a diaper on. This was very shocking and unusual to me. Another thing that was interesting to me in regards to children was that grandparents raised their grandchild. In America, some grandparents do raise their grandchildren but it is normally for special circumstances. In China, the grandparents watch the children until they are about six years old and then the child goes to school. The parents work and have their parents' living in the same house as them. The elderly are shown the most respect in China and I really liked that about the culture.

My first meal in China was the hardest day that I had thought I had ever lived. I am really big on sanitation and hygiene and the Chinese people did not seem to care like I did. When we arrived in Shanghai, we went to dinner and all of the food was placed in the middle of the table on a Lazy Susan. Everyone had to use chopsticks to pick up their food but people would eat with the chopsticks and put it back into the food. I thought it was very unsanitary to eat out of the same bowl or plate with people whom you didn't know and didn't know if they were sick. It took me a long time to get used to the Chinese way of eating but I couldn't stay hungry for too long.

In China, I ate foods that I had never tried before and foods that I thought I would have never eaten. I found out what I liked and didn't like because we ate at a lot of traditional Chinese restaurants and most of them served similar cuisine. I ate many different kinds of fish while I was there and my favorite was squirrelfish. Squirrelfish is somewhat similar to sweet and sour chicken just replaced with fish. It was the closest thing to American Chinese food. During this trip, I found out that American Chinese food is totally different from traditional Chinese food. Most of the Chinese food was oily and it wasn't sweet like Chinese food in America. The only thing that was exactly the same as American food was the spring rolls and I enjoyed eating those when we had them. I also enjoyed eating the lotus root and pear soup. I did have a chance to go to a Chinese buffet with my graduate students one evening for dinner and Chinese buffets are different from American buffets. At the Chinese buffet you have to grab all your raw meat and take it to your table and then boil it in a pot. Unfortunately everyone's meat is boiled in the same pot which really only came to a simmer-boil and not a full boil. I didn't like this concept because red meats and also chicken were in the same pot and I thought of that as cross-contamination. I didn't eat much that day and my graduate students wanted to know why and I tried to tell them about the contamination but they didn't quite understand.

The part of the trip that I thought was the most beneficial to me was the time I got to spend with the graduate students that I worked with in the lab for my research. I was able to talk to them and compare not only lab techniques but also how they were raised and taught in school. I really enjoyed the conversations that I had with them on a daily basis. There were times when there was a language barrier and they didn't understand my English and I didn't understand theirs but we used translators sometimes to get our points across. I loved talking to the graduate students because sometimes they would just want to hear me talk so that they could practice their English with me. They would also ask me questions about America to see if the shows that they watch

such as the Big Bang Theory were like American culture. Most of them wanted to come to America to further their education because they felt like there was so much opportunity here as far as jobs and that Americans had a lot of money. They also told me that they thought American children were more independent and had more freedom. They told me that American college students were able to have their own money, jobs and homes at a young age. In China, the parents of Chinese students pay for them to go to school out of pocket and if they ever need any money then they have to go and ask their parents. Also, since mostly all of them were the only child they told me that they wanted to leave China but they couldn't leave their parents behind because they would feel bad. I felt sorry for them in a way because they wanted to leave so bad and experience American culture but between family and financial circumstances most of them wouldn't have the chance to leave China anytime soon.

The graduate students that I met were very kind and always made me feel welcome. They gave me a Chinese name after a few days of getting to know them. My Chinese name is Tang Rui which means lucky and wealthy in Chinese. I was pretty excited to get a Chinese name because I felt like I was apart of the culture too. Also, in China everything means something. When we would go to museums and buildings, our guide would always tell us what something meant and it usually meant happiness or wealth. I enjoyed the overall cultural experience in China because it was enlightening and educational.

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Trip and Cultural Report
Jonjala Jackson
REU China 2012

Leaving for China in May, I had no idea what to expect when I arrived. I was unsure of what the environment would be like, the food, or the people. One thing is for sure, my perceptions of China have been changed forever.

You always see in the Chinese movies the temples and palaces, but there is nothing like being there in person and seeing the history and beauty in person. Being in a country and learning its history while there is so surreal. It was unbelievable. Never in my wildest imagination would I have expected the museums to be so beautiful and informative at the same time. Visiting the Presidential Palace, The Confucius Temple, gardens, silk museum and other museums were mind-blowing. I genuinely enjoyed the pictorial history and artifacts.

The China Nanjing Brocade Museum was very fascinating. It was incredible to watch authentic silk in the making. The process was a sight to see. The best part was having an opportunity to purchase the silk at the end of the tour.

The most touching museum was The Memorial Hall of the Victims in Nanjing by Japanese Invaders. This museum was so moving because of the history behind it. The exhibition of the victims' skeletal remains was the most touching aspect of the three- part museum.

On a lighter note, Duanwu or Dragon Festival was a part of a national Chinese holiday. There was a lot of fun to be had there. There were people doing Chinese dances and martial arts on the streets. There also were people dressed in dragon attire. Everyone wanted to take a picture with the "dragon" as well as the American students. For the locals, the most fun was the dragon boat races. They watched numerous races for several hours and seemed to be having a swell time.

The most remarkable area of China that I visited was the Baoyinghu Wetland Park. It was very different from the areas that I visited in Shanghai and Nanjing. It was a forest where poplar trees had been planted for research, but could no longer be cut down and used after the area was named a forest/landscape. It was so beautiful and off in the country. It was very peaceful and quiet. The air was extremely fresh. I felt most at peace the two days that I was there; it reminded me of home.

An additional aspect of China was different than I expected was the geography. The climate in China was so hot and humid, not to mention smoggy. It first, it was very difficult to breathe. After a few days there, it became better, but there is nothing like clean air. There was major pollution everywhere we went and you could smell it in the air. One more issue was the water. It was unsafe to drink and at times, I was afraid to even brush my teeth with it. Instead, we purchased bottled water for our everyday use.

Before arriving in China, I had no clue about their infrastructure and how they made it from place to place. Upon arrival, we saw some people walking, in cars, riding bikes, but mostly

riding on mopeds. The campus was filled with bicycle and moped lots as well as the sidewalks. This was the resident's main means of transportation besides walking. Some of the students told us that they sell their bikes to underclassmen when they graduate because they no longer need them. I thought of this as a very considerate gesture. We mostly traveled throughout the city by the "magic" bus #2. This bus traveled from the school, to the major shopping areas and back to the school for only 2 Yuan.

There were many interesting things about the Chinese people, but for me the most fascinating aspect of them is their love of technology. They were always chatting about the latest computer, ipad, and their favorite, cell phone. The students were very amazed with Apple products and how inexpensive they are in America.

Going into China, I was under the assumption that there was just one Chinese language. Gosh, was I wrong. At dinner one night, Dr. Ye Tian, Associate Professor and REU mentor, informed me that he was from a different area and his Chinese language is different from some of the others. I learned that the language actually varies by the area in which you come from. As it is said, "You learn something new every day."

When speaking with the students, they told us about their educational system. They informed us that their parents are very strict about their education and that they hardly had any fun when they were younger due to entrance exams they had for high school and college. They told us that they had to finish their homework before leaving school, return early the next day, and leave late at night. Sometimes, they even have Saturday classes. They stated that the exams were very difficult. Many students expressed interest in continuing their education in America, but the entrance exams proved to be difficult as well as funding.

An aspect of the Chinese people that was interesting is the things that they do for fun. They cited physical activities such as martial arts, basketball, table tennis, and badminton as things they do for fun. Students of Dr. Fang, REU mentor and Dean of Office of International Cooperation and Exchange, performed the basic martial arts moves and invited us to play badminton numerous times.

The false impression of the Americanized Chinese food was the most difficult aspect of China to adjust to. The cuisine in China is nothing like what we have in America. The food was prepared extremely different than the food in America. There was no sugar used and hardly any salt. It shocked me the kind of food that was served such as duck, whole fish and eel. I was not accustomed to that kind of food and many days I went hungry or just ate vegetables. A few dishes were tasteful such as a spicy fish dish, the flaming cabbage, and purple and green spinach dish. The Chinese people also drank a lot of hot tea throughout the day, no matter how hot the outside temperature was. For breakfast and lunch, they preferred a juice, which contained pulp most of the time. In addition, for dinner, they preferred and alcoholic beverage and it was a custom to toast with the most distinguished guest at the table.

What did not surprise me was that a large number of Chinese people actually like to dine at McDonald's. A great number of students expressed their love for hamburgers. We also found other American restaurants such as Pizza Hut, Subway, KFC, and Burger King.

The most pleasant part of my trip was the Chinese people as a whole. They were so welcoming and receiving of us. Although some of the students were given short notice of our arrival, they fit us into their busy schedules and made us feel welcomed and wanted. They always made sure that we were okay and comfortable. When out to eat, they thought about us first and made sure the eating arrangements were satisfactory for us. They were generous and helpful in every aspect of our daily routine, from ordering our food in the cafeteria to giving directions to downtown.

There were several people that we met that left an imprint on our hearts. The first student that gravitated to us was Bean, who received his nickname from the famous American basketball player Kobe "Bean" Bryant, which so happens to be most Chinese people favorite basketball player. Bean was our "guardian angel." Bean introduced us to "magic" bus #2 and to "the backstreet". Other students that made us feel at home were Victor and the other Swedish students. They introduced us to the China nightlife, which was a great getaway from the stressful week. Victor eventually became a regular and accompanied us everywhere, even out to restaurants and to Rakeyta's cake eating for her birthday.

Lastly, but certainly not least, "Sunshine" was very exciting as her nickname. I met her at the second culture party that we had. She was so happy and full of life. She mentioned that she studied in America when she was 9 years of age until age 11. She said that she loved it there and was sad when she had to return to China because the American food was so good. She mentioned that both of her parents are doctors and that she is currently a freshman, majoring in biology. She had a personality out of this world and she really was like the "sunshine" because she certainly did brighten up my day.

Overall, the trip had its pros and cons, as do any trip. However, this was an experience of a lifetime and I took so much away from the trip. In addition, I am very grateful to have had such an amazing opportunity and to be able to share this experience in the years to come.

The trip had many difficulties just as any trip. The major challenges were understanding the language and adjusting to the cuisines. The language barrier was overcome by using gestures; however, the most difficult challenge was the difference in the food. I did not overcome this challenge. It was too difficult. I really appreciated being able to have some American food while in China.

This is trip provided many of the students to experience international travel for the first time and for that, we are so grateful. However, next year I would like to see the program more organized. I would like to see everyone on one accord: AAMU and NFU. I would like for AAMU and NFU have projects prepared for the students to research according to their area of choice. I would also like to see the activities based on interests of the students, make it more about what the students like to do. I would most like to see the mentors and students be able to compromise more.

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Trip and Cultural Report
Joanna Kukla
REU China 2012

The People's Republic of China has an extensive history that dates back to 1700 BCE. To survive this long, the nation had to overcome many conflicts, internal and external. One would assume that a nation like this would be highly successful and developed. However, China has only recently been able to come into an economically stable era where it can develop into a modernized state. Many improvements have been made within the last forty years to improve the standard of living, yet the majority of its people are still living in a third world society. I was able to witness the great impact these changes have made. I believe that the country's current exponential rate of growth and progress will bring these people into a first world society. I want to explore why this culturally rich nation, with citizens that are some of the most hardworking people I have ever seen, has been slow to follow the development of Western Society. Why did China have a late start in this industrial modern age and what progress is being done currently that is making it one of the world's biggest economic superpowers?

My experiences in China for the past six weeks have included history, culture, and language lessons by Chinese professors at Nanjing Forestry University. I have also made friends and built relationships with Chinese graduate and undergraduate students, advisors, and professors. Although my time in China was not nearly long enough to allow me to gain sufficient knowledge into the extensive history, culture, traditions, and politics of china, I want to apply what I observed and learned first-hand and compare it to how China is perceived by the United States. Before proceeding further I want to clarify that I am stating my opinions with no intentions of offending or disrespecting either nation or its people.

When I learned about China in my world history and government classes, the Chinese governmental model was always viewed as a negative way to run a country. A picture was painted in my head of soldiers patrolling the streets enforcing laws with military force, very poor people that had physical jobs involving manual labor, limited contact to foreigners, and very limited access to good education or ability to travel and acquire a degree in America. What I found when I traveled to various cities in China was not accurate to my preconceived notions. All the while, I am aware that what I did observe during my brief exposure to china was just a very limited and small part of the country's diverse culture and lifestyle.

The people I met were not unhappy with the way their country was being governed and they were actually very proud of all the new establishments and things that have made their country grow economically. I learned that the great improvements and wealth in China has all been very recently established. Just twenty years ago, the streets were filled with bicycles instead of cars and the intricate highway system was non-existent. The subway system in Nanjing that we rode is just under ten years old. The high speed rail train system that we took on our trip from Nanjing to Beijing has one of the largest networks in the world, yet has only been in operation for about 5 years. Not only did I experience this new era of wealth through the Chinese transportation systems, but also while dining in traditional restaurants.

One of the most interesting characteristics about Chinese culture that I realized almost immediately was the amount of food that was served and consumed at every meal. We were told that the Chinese thought you weren't satisfied and would pressure you to eat more if everything on your plate was finished. One of our Chinese professors told us about how when he was a student there was not enough food to feed the large and growing population and many people suffered from starvation. The Chinese are very proud now of their ability to support society and therefore they often indulge in large and extravagant potions when eating. My question still remains: why only recently is this country able to flourish and catch up to modern society?

I was not able to understand this until our Chinese history lesson with professor Hui Gui upon our arrival at Nanjing Forestry University. He took us back to the late 19th century, when the United States started its great industrial revolution. During this time China was under imperial rule and was in a state of self-isolation from the rest of the world, with almost no trading routes for goods or information. The British along with many other western nations took advantage of China's isolation and introduced various goods such as Opium to the vulnerable country. This led the country into great debt and caused other internal conflicts such as the Opium wars. After China humiliatingly lost to Japan over control of Korea there was a flood of various reforms that eventually lead to the end of imperial rule. The Republic of China (ROC) controlled the country from 1912 to 1949 and had its capitol in Nanjing. We were able to visit the presidential palace and the tomb of its main leader, Sun Yat-sen, during our stay in Nanjing. The nationalist leaders of the ROC put forth efforts to make China become more industrialized. However, it was difficult to accomplish much at this time due to delays and interruptions caused by attacks from the Communist Party of China (CPC) and invasions from Japan. Stability was not established until the communist party was in power and started the People's Republic of China (PRC) in 1949. Great advances in industry and technology were able to flourish after the death of the PRC's first leader, Mao Zedong in 1976.

During the rule of Mao Zedong, he put forth numerous revolutions and policies because he believed they would help China become a dominant nation. In the process he executed hundreds of thousands of citizens and brought upon starvation to a million others. I believe that his policies were very counterproductive towards China's modern progress. Even so, there is still much respect for this leader throughout the country. When we visited Beijing, we saw Tiananmen Square and The Forbidden City with his picture proudly displayed in the entrance. The Chinese people look up to him because he was the one that led to the creation of the PRC. A student I talked to shared with me about how he grew up learning that Mao Zedong was a great war hero and the founding father of their government. He is viewed as one of the most important leaders in their history. How can a person that did so much harm to a country be viewed in such a high regard? Or does the rest of the world only emphasis the negative things that have come from Mao Zedong's rule?

Propaganda plays a big role in any government. I believe that China's propaganda is aimed to shed a positive light on communism and the many actions that its government has enacted and enforced. However, in the United States, any governing state related to communism is portrayed in a negative light and automatically associated with a ruthless dictatorship. I was taught in my school about the casualties, mistreatment, and malnourishment that came out of Mao Zedong's ruling. The American media also broadcasted the protests in the 1990s at Tiananmen Square. In

contrast, the Chinese government has full control over the media and limits freedom of speech. Therefore, the Chinese people may be misinformed or completely naïve in regards to the negative things that have come from their government's actions. Not only is there a curtain between the leaders and the people, there is also a barrier preventing the people from speaking out against the government.

Students that I interacted with would ask me questions about my family and in return they told me they didn't have any siblings and it was just them and their parents. They described what it was like growing up and how much pressure was placed upon them to succeed. A lot of their free time as children was spent taking summer classes or studying for entrance exams. However, when having this conversation with me, they were always very careful not to give any negative opinions in direction to the government, parents, professors, or anyone in a position of leadership and seniority above them. One student I met said they didn't mind how their parents treated them or how the government enforces law, they prefer to have that form of order. I agree with this student in some regards, there are many things about this communist nation that I experienced to be very beneficial and that would do a great deal of improvement if carried out in the United States.

The first night in Shanghai I was sitting just outside the hotel after dark and I saw various women walking home alone from either work or the grocery store. As an American female I was always taught never to walk around by myself at night especially in such a large city. The crime rate throughout all of China is much lower than the United States. I experienced the same sense of security in all the cities I visited. The only form of crime I felt threatened by was having my purse or wallet stolen in large crowds.

Upon our arrival we were told that giving money to beggars and homeless people was illegal. I was told more than once that China has done a lot to eliminate the amount of unemployed homeless people in its country and that almost everyone has some form of job. I believe this initiative is very beneficial for the country and can be compared to efforts made in the U.S to help people in poverty. However, the poverty level in China is well below the level in the U.S. There is also a much wider gap between the social classes in China. It is difficult for a person born into poverty to have even close to the same opportunities as someone born in the upper class. There needs to be many more efforts to make that gap smaller in order to bring the entire Chinese nation into a first world society.

The biggest difference I observed between the culture in the United States and in China was how homogeneous or uniform the culture and people were in China. Although China has many ethnicities, it appeared to me that they were all very similar. We couldn't travel anywhere in China without being stared at because of how different we looked. In the U.S there is a "melting pot" of many different cultures from all over the world. The uniformity in China does have its strengths. In the case of China's history, the people were able to unify under attack. It also allowed for greater predictability and created a society that is much easier to govern and control. Then again, the diversity in the U.S has its strengths because the different cultures are combined together to form a strong union yet each individual is able to preserve the independent mind and allowing for the "rebel" or individual thinking. I believe that the nature of a particular governing body is what creates and shapes a society.

My time in China allowed me to experience a society that is very rich in their culture and tradition but also has a fast paced and exponentially growing economy. The people I met were some of the most polite and generous locals I have interacted with in a foreign country. They were very open to conversation and to practice their English. I learned a lot about this great nation and some of the significant events that shaped their future and contributed to their modern society today. I believe that their slower start to modernization was due to struggles with isolation and imperial rule in the 18th and 19th centuries. It was interesting to be able to compare how history is taught in China versus how I learned it in the U.S. I became more aware of different propaganda that is used by both nations as a method of persuasion. With all the progress that has come from the past forty years, I think China is on a steep and rapid curve, well on its way to more and incredible advances. I will be watching with a new insight on how this country will grow in the next few years and possibly become the number one superpower in the world.

My new REU friends and I with a group of graduating seniors from NFU. Me (left), Emily Summers (middle), and Erin Brechbiel (right).

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Trip and Cultural Report
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REU China 2012

China is a beautiful country full of exciting places, vibrant landscapes, interesting food and generous people, possessing all of these great attributes gives this country the name it truly deserves, "China the beautiful." To be granted an opportunity to study abroad in any country is considered a privilege, but I was especially excited and honored to have the chance to study in China for it has been a dream of mine since childhood, that has truly been fulfilled thanks to REU. I must say I had many expectations upon arriving to China, some which were confirmed and some demolished. These expectations helped build my China experience. They gave me a sense of the differences and similarities that I share with the people I encountered. I feel sometimes it can be difficult to see how similar you are to a person when the world has classified them as being different. The only way to break these stereotypes is to go interact with people of the world and form an opinion for your own. While in China I had the chance to see some amazing historical attractions, meet some great people and eat some interesting food, it was truly an experience.

China is a country with five-thousand years of history, making it one of the oldest civilizations known to man. This gives China a rich culture that citizens are very proud of. While in China I had the opportunity to visit, temples, gardens, and ancient royal burial grounds. The Forbidden City was one of these fascinating places that we visited. It is one of the best preserved imperial palaces in China. The Forbidden City was breath taking. It is full of massive halls, elaborate offices, flawless statues, and intricate artifacts. As we walked through the palace it gave a sense of time travel, it's just that elaborate. It made me feel as if I was a member of the royal family. In ancient times the inside of The Forbidden city was only viewed by the emperor, his family and his workers, so being able to go inside and view things of royalty was an unbelievable experience for me.

Another beautiful place we visited was The Great Wall. The Great Wall is truly unbelievable. It is five thousand and five hundred miles of breath taking scenery and brick work. It was amazing how far it stretched and how high it was. While walking along the wall there were times I felt as if I was walking vertically upward. This was because the wall is built on a very mountainous terrain. The Great Wall is one of China's major tourist attractions, so there were tons of people there. This gave us chances to not only interact with natives but also other foreigners like ourselves. The wall was obviously too long to climb it entirely but that didn't stop us, we wanted to climb it all. While walking along the wall I began to notice carvings of Chinese characters within the bricks, I didn't understand what they meant so I just dismissed them. I later found out they were carvings from the workers that helped built the wall. It wall is truly a work of art, with just one look you can easily see the hard work, dedication, and pride put into building it. It was just amazing to see something that old that was not in a history book.

We also held the chance to visit an ancient royal tomb. It was the tomb from the Ming Dynasty called the Dingling tombs, also known as the Tomb of Stability. It is the tomb of Emperor Wanli and his two Empresses. This is an underground tomb so we had to travel down many stairs to

reach the doorway. As we walked across the threshold of the tomb we began to see piles of Chinese money thrown in one particular spot. We were told that particular spot was where the empress coffin would sit in ancient times for the public. After entering we went down a long drafty hallway that opened up into this large room with three thrones inside. These thrones were for the Emperor and his two Empresses. We were told that Emperor Wanli loved his tomb so much that while he was alive he would use it as his office and sometimes have parties there. The amazing artwork on the thrones really fascinated me. After leaving the throne room we entered into the largest room of them all the coffin room. This room had three coffins in it, one for the Emperor and his two Empresses, alongside these coffins were tons of small boxes made of wood that held all their belongings. This was truly a burial ground different form the ones that I'm use to seeing, it was truly amazing.

China is not only a country rich in history, but it is also a country filled with beautiful landscapes and terrains. While in China we had the chance to visit three places, and each place offered a different type of scenic terrain. We started off in Shanghai, which the largest city in the world. It has a population of about 19 million, so the landscape was for the most part flat. Even though that was the case the massive skyscrapers and fancy restaurants made up for the lack of natural beauty. We only stayed in Shanghai for two days, but those two days were full of excitement and entertainment. While we were there we went to an acrobatic show. It was amazing. The acrobats did intricate and sometimes dangerous stunts that really had the crowd excited. After we left Shanghai it was time for business we went to Nanjing where we spent six weeks, conducting scientific research. Nanjing was full of lust poplar forests, rice farms and beautiful gardens. It also had a city aspect that was busy and sometimes chaotic. Driving for me would have been impossible in Nanjing but somehow the native managed. After six weeks of research we left Nanjing and went to Beijing. Beijing is the capitol of China and it's also a massive tourist destination, so this city was constantly packed with people. While in Beijing we had the chance to visit many temples and historical attractions. It was amazing.

The Great Wall is not only one of the biggest tourist attractions in the world; it is also surrounded by some of the most beautiful mountains I have ever seen. The wall is built along the Yuanshan mountain range where it creates a dividing line from northern invaders in ancient times. The landscape around China is stunning, the mountains are full of green vegetation, and the lakes seem as wide as oceans. While in China we had the privilege to see a plethora of natural beauty. Even though China has many different types of landscapes the most common type I got a chance to see were mostly forests, lakes, and mountains. That was especially important to me because I am a biology major. To have the opportunity to explore and see new plants and trees that I have never seen before and to learn how some plants we may use for one particular job can be used in so many others. The one plant that really stuck out in my memories from my visit to China is the poplar, or as we may know it as the cottonwood. The people of Nanjing really take pride in the Poplar. It has been the backbone of most of their city's economy. In Nanjing the poplar has many different uses, such as medicine, wood products, shelter, oriental, perfume and it is even planted to stop erosion. We were told when the poplar was introduced to Nanjing, the city's economy sky-rocketed. The reason this tree is in such high demand is because it makes strong lumber and produces beautiful long-lasting panels for flooring. This is especially important because construction is constantly going on in China, and strong wood is always needed. While in

Nanjing we had the chance to visit a poplar forest. They were beautiful lush trees with wide leaves great for shade.

The food was also a major part of my experience in China. The food was definitely different from the food that I'm custom to eating, but I must say for the most part it was delicious. Chinese people find it extremely important to share meals with their love ones and converse while eating. Every meal that we had was prepared beautifully with garnishes, and decorations on the plates. We would all sit down at a large circular table with about eight chairs. First we were served a drink of our choice; your drink order could range from tea to hard liquor at any time of the day. That was one thing that I definitely found to be different. People in China do not mind having alcoholic beverages for lunch or dinner. It's a part of their culture to drink with their guests. I was told that drinking with meals makes for a better conversation. I really found that to be interesting and sometimes entertaining to watch. After the drinks were poured the feast would begin, and literally I mean feast. The waiters would always bring so much food out to the table; everyone would be stuffed before dessert. Even though eight people shared a meal there was always enough food and there was always a variety of food. A typical meal for us in China would have about eight to ten different dishes such as beef and vegetables, steamed shrimp, dumplings, different types of soup, and of course rice. Even though the main courses would vary one thing definitely remained the same, the dessert. Each meal would end with a plate of fresh fruit, sometimes it would be sliced watermelon, cherry tomatoes, cantaloupes, or honeydew melon.

The food was definitely a major aspect in building my experience, but the people helped build memories I will never forget. I have to say at the beginning I thought the language barrier was going to be a major problem, and at times it was, but the people were so patient and generous the barrier just faded away after a while. I had the privilege to come in contact with some really great people in China. The generosity and hospitality was genuine in every person I met. I really did not expect that from people who I did not know, but it was refreshing to experience it. While living on the campus of Nanjing Forestry University for six weeks, I had the chance to interact with some of the students there. They were all kind of quiet for the most part but it was obvious from the blank stares that they wanted to ask questions. Working in the lab was also a major part of my life in China. My lab mentor was a graduate student at the university. She barely spoke English but she was very helpful with explain things to me whether nonverbally of through Google translate; which we used a lot. The students would always say they rarely see foreigners from America, so they would ask questions about America and what it is like. They seemed very interested in learning about my culture and the things that I was interested in. While walking through the city people would constantly stare and take pictures of us. It was a little frightening at first, but I learned to just go with it. That part was definitely out of my normal life. It made me feel like somewhat of a celebrity. It was fun to help fuel their curiosity if only just for a little while.

To have an opportunity like this is once in a life time. I am truly honored to be a part of a program like REU that allows young people that are preparing to start a career to experience firsthand all the aspects of their career field. I believe programs such as this one are important in making a career choice because it gives you insight on what trainings are needed and what is expected from you in your field of interest.

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Trip and Cultural Report
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Socialism: A simple toilet?

Days had passed since our arrival in Shanghi without a single overt sign of communism; especially not a third world country. I was in awe of the manicured flowers along the highways, tallest skyscrapers I had ever seen, and friendliness of our tour guides. The magnitude of population size, for an introvert, was a bit unnerving. And I began to wonder under what circumstance could a set of collective ideas be readily accepted by so many people. From the beginning, I wanted to know were these ideas of socialism so beneficial to the people or were they just too powerful for the average person to ponder escaping; that collectively the Chinese people accepted communism without obvious opposition.

Typical Chinese toilet.

We were just outside the city limits at a rest stop when I first experienced the Chinese toilet; later named the porcelain hole. I remember the shock of seeing the toilet and wondering how could

anyone be used to this. I continue to rationalize that if Chinese people were using a western toilet they would be equally as disgusted. And perhaps the idea of wanted to sit on a toilet is so repulsive that even in their own homes they would find it repulsive to sit. But these stated thoughts are completely opposite of what I had seen in hotels and nice banks. Western toilets were obvious not repulsive to upscale businesses or wealthier people in China.

Of course in private homes, no style of toilet is better or more sanitary than another; it is only a matter of cultural preference. But I was struck by the common logic rationalizing the Chinese toilet that uniformly changed if you are wealthy. More interesting, China has found western like toilets, on which you sit, in a Han Dynasty tomb dated back over 2000 years. Why then are the essentials of the elite in China considered 'unsanitary' by the common majority? Symbolism is very important in China. I was amazed at how a simple toilet could say so must about the socialist strength over a people. A toilet is a toilet; but I was really saddened by the concept of teaching an idea of sanitation as a pure truth to the majority, so that only the wealthy upper class maintain their symbol (western toilet) of power. Even in my apartment at NFU, with the western and Chinese toilet, my Korean and Chinese roommates would not even try it! Instead they used it as a broom and mop closet. Even after I cleaned it, they would not try a western toilet in their own apartment; they insisted that sitting is nasty and would only use the traditional toilet. Who knew that a toilet was such a big deal?

Traditional Values and Personal Conviction

During our weekly social events, a common topic was cultural differences, which were often discussions of parental roles and how they shape a child's future. A strong inference was but on following parents instruction absolutely. Chinese students seem to have the impression that American young people disregard parental instruction and have the freedom to live as they choose. Coming from a conservative background, I also grew up under the traditional views that parents' views are absolute. Most of the Chinese students, I think, were very shock to hear that such conservative views exist in many different cultures without the U.S.

Additionally, I was most appreciative to have light conversation with some of the female Chinese students at NFU. We were very intelligent and bursting with energy about theirs' and China's future. I was impressed by their independent thinking and personal conviction to pursue majors in Environmental Ethics and Conservation. They share stories with me about their drive to travel and views about delaying marriage. And I shared my drive for a doctorate in genetics and how I could not wait to become a mother; they laughed and seemed a little relieved. Perhaps they were afraid that by yearning for a career somehow might automatically morph them into a woman that did not desire a family.

Listening to them reminded me of listening to my grandmother tell stories about the difficulty of seeking education and redefining being successful as becoming more than a Mrs. I felt so honored just to be there and listen to their dreams, as they poured them out unapologetically. I could feel from tones of their voices, they were desperate to be heard - appreciated and applauded for having a dream beyond what has been designed for them. More than the Great Wall and the first Ming Dynasty Tomb—which were amazing—I appreciated the beautiful opportunity to share my believes of what it means to be an modern woman; education, family values, independence, personal moral conviction is always more important than obedience, and respect for tradition - is it not just a fallacy. The great part of China for me was learning to admire the strength and perseverance of Chinese women; I am very thankful to National Science Foundation, Alabama A&M University and Nanjing Forestry University and all who contributed, for this eye opening opportunity.

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Trip and Cultural Report
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REU China 2012

China is a country with over 1 billion people, a cultural and history that dates back further than most other countries can even trace back, and food that can be tasty, strange, enjoyable, greasy, healthy, not so healthy, and perhaps not suitable for some people's taste. Traffic in the major cities could seemed to be disorganized as truck, car, and bus drivers had to share the road with people on bikes, mopeds, and on foot. Even with the chaos, there were never any serious accidents, though a few fender benders here and there. There were both upsides and downsides to going to China, but for anyone that likes to travel and experience a new place with little western influences, China is one of the places to be.

Comparing the Major Cities We Saw

Shanghai is the biggest city in China by population, but when you look at the building styles compared to Beijing and Nanjing, you can see (or at least I did) more of an international influence. As the financial capital of China, it seems this city has seen a growth within the last decade that few other cities in China (and even the world) have seen. I went to Shanghai last time I was in China, but seeing it once was not enough to keep me from being in awe of the size and beauty of this city, and I say this living very close to New York City. Visiting the Bund was still an awesome experience and seeing the different buildings shows the incredible growth in such a short time a major city can undergo. Traffic in Shanghai can best be described as organized chaos. It was loud and constantly moving with beeping horns, ringing bike bells, moped engines, and pedestrians waiting for the right time to cross, more so than another city I have been too. One thing I am still impresses me are the small things in the city. For example the express ways for the city are all lined with flowers, and the number of parks you can see while driving through city.

The main city the REU group stayed in Nanjing, which was completely new to me. Nanjing might be much smaller than Shanghai, but it is in its own right a major city. Land area is about six times larger than New York City, but the population is about equal—with little over a 8 million people. The city was large enough to keep people busy, and had a life of its own. Exploring the city, one of China's historical capitals showed the difference between modern China and China that was from the 50s and 60s. The city seems less use to having foreigners, to me, because there were fewer translations than more touristy cities like Shanghai and Beijing. A In most cases the translations are understandable, but there a few times I had to scratch my head and other ones I just laughed and took a picture.

Nanjing also shows many different types of land use practices, because my project was surveying birds in different types of habitats, I got to see forest, park, and agricultural types of land use around the city. I feel really lucky I got to visit parts of the city the other students did not get the opportunity too. This included seeing the slums and people making make shift homes under bridges, growing their own food (either for sale or to eat themselves or possibly both. Nanjing although a land-- locked city, is on one of the most important river deltas in China, the

Yangtze River. I got to cross one of the oldest suspension bridges in the world over the Yangtze and see how important the river was to transport goods via ships; the number of barges that I saw using the river was breath--taking.

The historical sites were also cool to visit. Two tombs, the city wall, Purple Mountain, the downtown area, the Confucius Temple are all places that were fun to explore. Dr. Sun Yat-sen's Mausoleum and the first Emperor of the Ming Dynasty's Tomb are both located in Nanjing and are both very beautiful. It was a mountain-a green oasis in the middle of the city. The highest peak, which I went up to twice, is 438 m above sea level. My favorite path ways to take up the mountain were the smaller, little used, non-paved ones because of less people and disturbance. The Confucius Temple has a huge shopping area, but my favorite part (because I do not like shopping) was the actual temple with the statues of Confucius and his students. I went to the temple with Erin (another student on the trip) and Victor (a foreign exchange student from Sweden, studying at NFU); I was most impressed by the traditional, live Chinese music show that was performed.

Besides the historical places around Nanjing there are also urban centers. Nanjing 1912, Xinjiekou, and Hunan Road were also fun to explore. Nanjing 1912 is a huge outdoor mall complex, with restaurants and shops—to be honest I was more interested in the restaurants. Xinjiekou is the urban center of the city-which had shopping malls…and restaurants. Out of the three my favorite place I visited was Hunan Road, because it was completely devoted to eating and a lot of traditional Chinese food and international food is offered there. The first time I went to Hunan Road, I was with my friend that lives in Nanjing, but attends school in the US and another student from the REU program. It was fun to eat a lot of new food or even food that tasted better than the cafeteria food at NFU.

The third major city we visited was Beijing, the capital. Although we only stayed for a few days, we got to see and experience a lot. Climbing the Great Wall a second time does not make it any easier, the Summer Palace and Forbidden City were also breath-taking (I wish we had more time to explore), and the food was awesome. Beijing, in my opinion, is a cross between Nanjing and Shanghai. Although there are some signs of international influences and more tourists, Beijing has a lot of sites that show China's ancient roots. I really appreciate the history of all the cities, but Beijing is really something special, where the modern day Chinese government officials can walk to where some of the last dynasties ruled over China. It seems to be a way of the modern Chinese government keeping roots with its ancient history. The Forbidden City is also located in the center of Beijing .Also since the Olympics, the air quality was a bit better (but still smoggy) compared to Nanjing and Shanghai. Because Beijing hosted the Olympics in 2008, the government put tighter air quality regulations on the city than other places and more greenery was planted.

Life on Campus

Life at Nanjing Forestry University was to me very similar to life at my school. For instance, it took me awhile to walk around on both campuses before I stopped taking the long routes everywhere or really getting lost. The campus stores were stocked with almost anything you wanted, junk food wise (Chinese brands or selections of course), and cafeteria food ranged from delicious to "never getting that again". Although the campus did seem really big at first, like my school, it seemed to get smaller as the time passed and I became more familiar with the buildings (there are four that look very much a like). The campus was in itself very green, and seemed like an oasis in the middle of concrete jungle. To summarize what one of the other REU students said, the sidewalks were built around the trees instead of over. This really goes with being a forestry university, being a green oasis in a jungle of another type. However, the river that flows through the campus needs a lot of work; we were lucky if we could not smell them in the morning or night when we walked past.

While we stayed at NFU, we had the pleasure of meeting other undergraduate students that helped us adjust even more to living on the campus. The students and professors as well as the international staff all made sure that we had everything we needed to be comfortable and adjusted well to living on campus. They all helped and it was nice talking to them for the first couple weeks (before they went home) at the scheduled weekly parties. The parties gave us more of a chance to interact with undergraduate students and talk about culture differences and learn more about each other's ideas and countries. Just because we were on a college campus, does not mean we did not get stared at by the students or even some of the staff. The lunch ladies, when they first saw us, did not know what to make of the Americans as we attempted to order the food we wanted, mostly by pointing or guessing off of a menu. Even with the language barrier, with the little words we did learn they tried to help us. Like most schools, NFU had other international students as well. There were students from Sweden studying Urban Design as well as students from Iran and Korea. Another aspect of campus life that was new was that everyone seemed to live on or near the school during the term. The professors had their own village on the southern part of campus, while the graduate students usually stayed in one of the tallest buildings on campus, often with seven roommates each. The undergraduates did not fare much better in some cases with anywhere from four to six people sharing a room. The international dorms

were more apartment-like and only four rooms with one person to each room (they are nicer than most dorms at my school).

Food

I think if you travel outside the United States or even leave your own state, there will be food that is new and amazing. In China, the food was almost all new. Chinese food in the United States is nothing like that in China. Moreover, the types of dishes seemed to change slightly from place to place or cities all have their own specialty. For instance, the specialty of Nanjing is salted duck while Beijing is known for Peking duck, and Xi'an (a city I visited on a prior trip) is known for noodles. Rice was served with almost every meal (honestly, my family does the same thing) and most meals from restaurants were made to share. Some of my favorite food was eel, duck, anything that was spicy, sweet and sour pork, and roasted duck. Some food that was not my taste would include chicken feet, tendons of various animals, and some sort of meat jelly slices. I am not so sure a lot of Chinese people eat these dishes because they always seemed left over, even at the dinners hosted by the school's president and faculty members to welcome us and when the program had ended. Food is a big deal in China, and it seemed no matter where we went, there was always excess (it could be that our appetites were not suited for the amount of food, but I know my grandma has said she would prefer to pay my college tuition instead of my food bill). One of the reasons for the excess, I heard from more than one person was that China did not always have an abundance of food, and many people went hungry, and now that everyone can be fed they are very proud of this and present way too much food for people to possibly eat. One of the small things I will miss is getting fruit-- usually watermelon-- at the end of each meal, and eating in a group environment where you can and are expected to talk to people for a long time instead of gobbling up food and leaving within twenty to thirty minutes.

Cultural Events/ Tourist Attractions

Many of China's most famous tourist attractions are also the most historical. The two shows we attended were also influenced heavily by the culture. We saw an acrobatic show in Shanghai and a Kung Fu show in Beijing. Both exemplified two areas of physical activity that China is famous for and also value, and are very impressive. The historical sites in Nanjing and Beijing are now protected and attract tourist from around the world. My favorites were Sun Yat Sen's tomb in Nanjing and the Ming dynasty tomb in Beijing. Both were impressive and showed the history of China. Sun Yat Sen was the leader of the Republic of China (the short lived democratic government) and the Ming tomb dates back to Imperial China. Instead of covering up this part of the history, the Chinese government and people seem to treasure these and other historical sites that are also important culture wise. China is a country full of history and a culture that is tied to it. Sites like the Great Wall and Forbidden City are both culturally and historically important—and just fun to explore.

Modern China

The greatest pleasure of going to China was seeing the country as its growing and building some of its infrastructure. This makes a lot of the equipment (like metros or subways, highways, and buildings) newer than someone like me is used to (NYC can date a lot of the infrastructure back a century or more, for instance the subway lines).There are still some problems, such as the air quality that every developed nation faced during their development period, and still face today. The smog in Nanjing was thick enough to block out the sun on some days, so I can honestly say I saw the sun twice in the month I was in Nanjing, once in Shanghai, and once in Beijing. Going to a developing nation also made me a little more thankful for the little things that we have, like Wi-Fi or even internet that constantly works or seeing a blue sky instead of smog

Smile for the Camera!

As a tourist in China, I felt sometimes like I was an attraction too. Although I have been there before, I never could get used to the random people taking pictures with me or of me. It was still kind of fun though, and some of the students in the REU group had it happen to them more than I did or dragged me in the pictures with them. Some of the students at NFU were no exception; there were quite a few group pictures of us with graduating seniors and even more with random students. Going to China as a foreigner is becoming a panda and walking around--people are just amazed that someone looks so different from themselves or anyone they have seen. Although China has 56 different ethnicities, the majority- Han Chinese make up more than 90% of the population, so it is more unusual to see someone that is darker skin or different hair or eye color, especially if the people come from rural areas in China. Being the "panda" (one of the students at NFU gave us this name) was fun, a little annoying, but amusing all the same. Most people would stare even when I stared back or waved. The younger people usually waved back and giggled while the adults just stared or took picture.

Conclusion

China was as great an experience the second time as it was the first time I went and I would like to go back again one day. The culture, food, people, and history makes this a country worth

visiting for anyone that is interested in learning about different cultures and likes to travel. The cultural experience was great and seeing structures older than the United States had a great impact on me.

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Trip and Cultural Report
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My first aspirations for coming to do research in China began in late November of 2011. I received an email from a former colleague whose friend was looking for undergraduate assistants to aid him in his PhD research. I could hardly believe my luck; I thanked my buddy for recommending me, then quickly cc'ed him in an email I sent to the PhD student I would soon come to know as Kevin Messenger. The next few months were tumultuous as Kevin and I exchanged longer and longer email threads, concerning the status of his grant and other delicate logistics. In that time I began research on China's herpetofauna, I found a Mandarin Chinese tutor, and anxiously waited for a call or email guaranteeing my ticket. Finally, Dr. Elica Moss ended my torment with a phone call, and I could not help dancing around the lab as she confirmed my assigned research project.

If there was one thing I learned from this trip, it was to never check up on a destination's health risks through the Center for Disease Control (CDC) website. It may have the best intentions, but similar to the predator searches available online, it gives you nothing but needless paranoia. So for the couple of weeks prior to our flight, my worst fear was not getting envenomated by a snake, but rather getting bitten by a tainted mosquito or eating unclean meat. I welcomed Kevin's overall apathy to my fear, since his first three trips to China yielded no more than three mosquito bites and a relatively sound stomach.

Health-related issues aside, I felt relatively prepared for China before our departure. For one, I had managed to find a Mandarin tutor at the start of my spring semester. Ximing Yao was born in Northwestern China, so she possessed the fluency and Chinese culture savvy you do not expect to find in Charleston, Illinois. On top of that, Kevin introduced me to various Chinese living conditions, people and fauna he photographed and documented in long herpetofaunal forum threads. The final nail in the worry-coffin came from each of the anecdotes and bits of advice I heard from the AAMU students and faculty who've taken the trip before us. It was safe to say I was anxious but ready for what I was about to experience. But oh, how wrong I was. My first few hours in China weren't very pleasant. The first thing I noticed, even prior to landing, was the gloomy overcast that stretched across the sky. I wasn't sure whether it was some sort of pollution or simply extensive cloud cover, but it was present far more than what I was used to in the States. It was at its worst the first day I came to Nanjing, especially because it hung unusually still and gave everything a radioactive tinge. It was rarely more than a thin and dreary layer of clouds, but I still began to cherish clean sunlight whenever it came through the gloom. The second observation I made was by no means negative, but definitely unlike anything I've ever witnessed. It's worth mentioning the Chinese language does not really have an appropriate word or phrase for when trying to move through a crowd— Something analogous to "excuse me" or "coming through". My tutor explained that the closest thing to an English equivalent is an "I'm sorry" only after you've nudged someone a little too hard. So in a situation when there's a large crowd with a single destination (e.g. bus, train, plane, bathroom) you should expect to be cut in front of or shoved a little. It's not something you can be offended by, because the person most likely meant no offense at all. My favorite example of this was butting luggage with an old

woman about half of my height (and a fourth my weight) who was trying to cut me off as we scrambled to a train from Chengdu to Yichang.

Following that same logic, I would argue that Chinese people go about driving in a similar fashion. After arriving at Pudong International Airport, our first objective was to reach the train station where we would rendezvous with Dr. Wang's brother and our tickets to Wuhan. Going off of experience, Kevin found us the right bus and we got on (also my first brush with line-cutting). Since the bus was already full when it reached us, Kevin and I were forced to stand at the front against the luggage bins; from there, I had a good view of the road in front of us. The roads in Shanghai are marked to help guide traffic, but the throngs of whirling traffic pay them no heed. In China, turn signals are rare and lane changes are overly common. The only rule everyone follows is that larger vehicles always have the right of way. But however chaotic, there is a certain harmony between each vehicle, and it's built on common sense and the car horn. The big difference between the US and Chinese when dealing with the horn is that in China it is not blown out of anger, but simply to make others aware of your presence. This is more than necessary on windy mountain passes and in high traffic areas where the minimum safe following distance does not exist.

After spending a few hours searching for Mr. Wang, we retrieved our tickets and boarded our train with minutes to spare. The trains in China have three overnight sleeping arrangements. The soft-sleeper is most preferred: Two sets of bunks in a compartment with a door; the hard-sleepers are less expensive, with two sets of triple bunks, no door, and a harder mattress; less expensive still, the hard-seater have uncomfortable, economy class seats. Mr. Wang was kind enough to purchase soft sleepers for us, which I later came to realize was a very generous decision. Anyways, we arrived in Wuhan late the next morning. We were only there long enough to purchase our tickets and wait for a bus to drive us to Yichang, the largest city in such close proximity to Shennongjia. Once in Yichang, we walked a few blocks until we reached Yichang West, one of the two train stations in the city. But once we got there, Kevin directed us to a street corner where he began asking for a driver to take us into the mountains. At this point, the group of men was shouting prices at Kevin until we finally settled on one man's quote. I was already anxious because this whole deal reminded me of a bullet point in one of the REU's orientation packets which stated very clearly not to accept rides from non-taxi's. It only got sketchier when the man led us a way's down into an alley to his parked car. Then to my surprise, there was already a person in the back seat, and the driver declared we were picking up another man once we departed. Here, Kevin explained that these drivers are incredible hagglers that fit as many people into their cars before even turning the ignition. In past years, Kevin had been forced into a backseat with three other people, one sitting on another's lap. So even though I was stuck in the middle seat, I was relieved the driver didn't stop for anyone else.

The road sign heading off our destination read Mu Yu Cun. After settling into a hotel, Kevin phoned his friends Xie Dong and Mr. Yang to have dinner, and they both accepted. That night I had one of the spiciest soups of my entire life, my first flask of Chinese liquor, and "rotten" green eggs the consistency of cold gelatin. It turned out Kevin's friends were actually managers at Shennongjia National Geopark. They were Kevin's "in" into some of the best herping areas in China. Although we didn't survey the Geopark itself, we were given the right to examine specimens from their collection (many of which Kevin collected), and also tour the park's other

facilities. Although these park managers smoked like chimneys, they were the most hospitable and loyal men I've ever met.

The next day, we had secured a car and were travelling to an even more remote village about 3 hours further into the mountains. On our drive, we reached elevations of 2650m above sea level, and marveled at the magnificent views seen from such a summit. According to Kevin, our next destination, called Ping Qian, was crawling with *Rhabdophis nuchalis*, a snake in the same genus as his target species, along with the venomous Jerdon's Pit viper (*Protobothrops jerdonii)* and other species. Upon arriving, we quickly set off for my first herping trip in China. In no time, we had seen the two lizards species, as well as many snakes comprising 4 species—Not a bad catch for one hour. After lunch, we continued our search in another area. All of a sudden, Mr. Yang spotted a snake moving into a pile of rocks. As it dove into a crevice, Kevin grabbed its tail, thinking the head had descended further into the pile, a safe distance from his hand. Surprisingly, the snake's head was actually right at the entrance, where it struck at and bit Kevin on the knuckle of his right hand. This would not have been a problem, except that this particular snake was a *Protobothrops jerdonii.*

The next few minutes were quite interesting. At first, Kevin seemed fine. He had the snake safely by the nape of the neck when he mentioned the fact that he was bitten; I wouldn't have noticed if he didn't say. After a few seconds he decided to sit down and rest. Thinking it was dry bite, I grabbed at the opportunity and began photographing the snake. After about three minutes however, Kevin was to starting to feel nauseated, and was also experiencing sensation in his extremities. That was when he finally agreed with Xie Dong and Mr. Yang to go to the hospital. And that was when I got worried. The walk back to the car was over uneven ground, which did not quell the fact Kevin was slowly losing motor control in his legs. I trailed behind with our equipment, ready to catch him if he fell backwards away from the support of his two friends. In the next three minutes we had gathered our luggage and had gotten Kevin into the back seat. Despite my objections, someone had put a tourniquet on his arm. Kevin was conscious but not responding. When we were able to successfully sit him upright in the back seat, we began the long drive back to the hospital. Within minutes, Kevin had recovered enough to tear the useless tourniquet off of his arm. Five minutes later he uttered the words "I'm fine" and I started to relax. Jerdon's Pit Vipers have relatively weak hemotoxic venom that attacks the tissue cells around the bite. Somehow, the venom was able to spread throughout Kevin's body, eliminating any localized necrosis. With only two swollen arms, the only medicine he should have received was fluids and a day's rest.

Against our wishes, Kevin's friends drove us all the way to Yichang's hospital, where we spent the next four days doing our best to explain how mild the bite actually was. At one point, Kevin's official doctor called in another, someone I thought could be a snake specialist. They asked what sort of snake it was that bit Kevin, and when we presented them with photos, she said it was impossible. They actually could not believe he was still be alive after that sort of bite. When they denied the snake was actually venomous, I showed them close-up images of the fangs on my camera, and they finally conceded. Although our days at the hospital were unbearably long and wasteful, they did give me another opportunity to observe (and be observed by) the local people. The ward we were in housed a couple people who would soon become regular visitors to the foreigners' room. Many just preferred to walk in room and stare without much

talking (common among the elderly all over China), while others quickly began to talk with us. One person in particular that Kevin and I found helpful was the nurse in charge of us. I don't remember the exact Chinese name, but she laughingly translated her two-syllable name to "Cow sheep". She knew enough English that she was able to answer many questions about Kevin's "condition". She also took it upon her self to again demonstrate the extreme sense of Chinese hospitality by taking us out to dinner at her friend's restaurant. She was also able to secure us with train tickets to Chengdu, and Kevin's passport (which we accidentally left behind after the bite). Even though Kevin's life was never in danger, she was the epitome of a lifesaver.

Once Kevin was released from the hospital, we immediately took an overnight train (hard-sleeper this time) to Chengdu to attend the 5th Asian Herpetological Conference. Although I wasn't presenting at the conference, I still enjoyed attending the talks. International conferences also always push me to succeed in both higher education and my own research ventures. I envy those professors and graduate students who can sit together and discuss successes and failures. I want to have that level of respect and familiarity with the top minds of my field.

The one issue I had with the conference is that many of the presenters were not very accomplished English speakers, so the dissemination of their research often relied on the information presented on their slides. I don't mean to sound selfish; the conference made it mandatory for the talks to be given in English, and there's no way I could possibly make anyone learn English faster. There were just instances where I could tell a speaker could've made a much better presentation if allowed to speak in their native tongue. I just wish the language barrier would be less of an issue.

The one other benefit to Kevin's snakebite was it was necessary to return to Shennongjia in order to photograph the snakes we captured. When we returned to Mu Yu, we were greeted by another one of Kevin's old friends, Wong Ming, and an intern named Yang Jin. Together with a driver, we returned to Ping Qian and continued herping where we had left off. We found a few other species, including *Oligodon ningshaanensis*, a snake that Kevin had recently discovered after being lost for over twenty years. Kevin also made it clear we wanted to catch the viper that had bitten him, but we were not able to. Apart from the magnificent snakes we caught in Shennongjia, the other aspect I will also dearly miss is the people. All of the park managers, as well as Yang Jin, had become my good friends after only a time spent together. The meals (the best in China) we ate just prior to leaving for Nanjing were bittersweet, some of the best times I can say I've had in China. At this point I cannot imagine how I'll ever be able to go back, but I'll do my best to try.

The week I spent in Nanjing was quite relaxing and at times a little boring. I was at a loss at what to do for the first few days, so I watched movies and enjoyed the air conditioning in my room. Though I'm not proud of it, I there was not much I could do in terms of starting my research paper, since I had no idea what the project would end up being. Thankfully, the other students and faculty (both from AAMU and NFU) were quite welcoming and I spent time in the field or lab with a few of them. Nanjing was also the first chance I had to socialize with the other students in our REU group. With all of us together in such a big Chinese city, I relished the opportunities to explore (and get lost in) Nanjing with the all of them.

Finally, Kevin and I were on our way to Hainan. I was giddy to finally begin doing some actual research and some of the most intense herping of my life. For the first time, neither Kevin nor I had any clue what the living conditions or herping would be like at any of the field sites. You could imagine our surprise when Dr. Liang, a professor at Haikou Normal University and our primary Hainan field expert, put us in two rooms of one of the nicest hotels I've ever seen. This hotel would soon become something of a headquarters, where we could rest and recuperate between visits to different field sites. It was also there that I began gathering related articles soon to become my references.

We visited four sites while on Hainan. The first was Tong Gu Ling, located on the eastern most reaches of the island. Being so close to the coast, Tong Gu Ling was the lowest of the three sites, with elevations along our surveying path ranging from 2-35m asl. This site also presented us with the most tropical conditions out of all the sites; the humidity rarely dropped below 85%, and heat index easily reached over 32 degrees Celsius every day. We considered the disturbance level to be quite high in Tong Gu Ling. Although there were areas of forest still intact, many swathes of land had been cut down and made into rice patties. There were also a surprising number of houses, farms, cantinas, and inhabitants in the area, which most likely accounted for the numerous road-kills we found. We considered Tong Gu Ling as the least rich site, with only 16 herpetofauna found (9 anurans, 4 snakes, and 3 lizards) after three days.

The site we visited was called Mt. Li Mu (or Li Mu Shan). Li Mu Shan is located in the very center of the island at 650m above sea level. The weather was milder and far more comfortable than Tong Gu Ling, thanks to the elevation and the lower humidity. Although Li Mu Shan was not originally one of the field sites we were supposed to survey, it turned out to be one of the best. In three days, we found 22 species (13 anurans, 6 snakes, and 3 lizards). The area had moderate levels of disturbance and development, but new construction was on the rise. It would be interesting to see how this would affect richness and diversity in the next few years. For now, at least, the levels are high enough that roads have been built and have made surveying easier, but traffic and habitat destruction have not yet put a large dent in the area's ecosystem.

Diao Lou Mountain (Diao Lou Shan) was the third site we surveyed. Located only about 50 kilometers to the southeast of Li Mu Shan, Diao Lou Shan was the highest of the four sites, ranging from 750m to 980m asl. The park itself was very pristine and quite large, spanning over three counties. Due to limited access to transportation, however, we could only sample a small spatial and elevational area. Nevertheless, this cloud forest yielded 23 species (15 anuran, 1 caudate, 2 snakes, 5 lizards) in 5 days of searching. It would seem that five days were not necessary to properly survey at such high altitudes. Looking at previous surveys done in the area, herpetofaunal richness seemed to be much higher in the surrounding areas at the base of the mountain. Whatever the case, we were all very giddy to have found the only salamander of Hainan, *Tylototriton hainanensis.* Unfortunately, the snake diversity was disappointingly low.

Our final site was sort of up in the air. We had a new area in mind but there was no room for us to stay there. Finally we settled on a second trip to Li Mu Shan; we were excited to explore the areas we had yet to survey, and the previous success we had in the area gave us confidence. However, the Hainan government had other plans in mind. Dr. Liang contacted us saying that the Kevin was not allowed to legally conduct research on national park land without certain permits.

Since the law was passed recently (how recently, we don't know,) we had no choice but to descend the mountain and stay in a town outside of the preserve itself. This area was at about 180m asl and composed mostly of differing crop plantations. Surprisingly, we found 19 species (8 anurans, 9 snakes, 2 lizards) in just two days. The drawback is that many of the new snake species discovered were roadkills, due to the frequent road use by vehicles. I would recommend further surveys done at this site, and possibly some other experiments testing how such a diverse community can survive in such a terrible habitat.

If you ask any herper whether they have regrets about a recent trip, it seems they will usually say yes. It's difficult to find the theoretical maximum number of species on any single project, but you always keep that possibility at the back of your mind. This trip was no different. We found a total of 62 species of reptiles and amphibians— 2 salamanders, 24 frogs, 10 lizards, and 25 snakes. Of these, many were recently discovered (or newly split), quite rare, or just plain awesome. Since this was our first expedition to Hainan Island, we were bound to make some mistakes when choosing field sites to survey; and surprisingly, even the Hainan government was at odds with us at the end of the trip. But overall, I was absolutely satisfied with the huge range of species we found in the numerous Chinese ecosystems we surveyed.

Additionally, I could not be happier with the entire experience, herping aside. I can list many negatives about the trip, but don't those only make the trip more satisfying to live through and remember? I could never anticipate the state of my next meal, bed, or bathroom; Everywhere we went, people stopped and stared, and the bravest did their best to have conversations with us; Despite the arduous task of carrying my entire life on my back and in my arms, I was proud to say that I covered a greater proportion of that nation than I have of the United States. And I could never forget the people I've met along the way: Xie Dong, Mr. Yang and Wong Ming, the park managers in Shennongjia; Yang Jin, our lovely intern and bubbly translator from Shennongjia, along with Weigun Lucky and her adorable daughter; Drs. Liang and Wong from Hainan Normal University (HNU); Li Ming and all of the graduate students from HNU who accompanied us to each site; Mr. Chen, our fearless tea-and-cigarette-loving driver in Hainan; and everyone else who helped us and fed us along the way.

Me (left) with Kevin Messenger and Wong Ming standing on a peak overlooking Shennong Valley.


Evening festivities with (left to right): Wong Ming, another faculty from Shennongjia Geopark, Mr. Yang, Yang Jin, Kevin Messenger, and myself.

Research

AN ANALYSIS OF SOIL COMPACTNESS AT SIX SITES IN JIANGSU PROVINCE, CHINA

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Abstract

Soil compactness is an essential component of any ecosystem. Soil compaction, or an increase in soil bulk density, has been noted by the FAO as a global environmental concern due to compaction's negative effects on the environment (FAO 2005). It is feared that urbanization and forestry can cause highly compacted soils, which can contribute to city management crises and to the collapse of ecosystems and economies. In this study we assessed soil compactness levels at six sites, each representing different land use types: Bamboo Forest Farm (Site 1), Broadleaf Forest (Site 2), Poplar Plantation (Site 3), Urban Forest Park (Site 4), Campus of Nanjing Forestry University (Site 5), and City of Nanjing (Site 6). Compactness was measured in PSI of resistance to penetration by a soil penetrometer. Data collection was completed in a grid pattern at the four forested sites (Sites 1-4), and at random points in two urban sites (Sites 5 and 6). Data was analyzed using statistics and geostatistics. Mean compactness values for each site were compared using Microsoft Excel's ANOVA, and each site was found to have statistically different ($p<0.05$) compactness. Lowest compactness was found at the natural Broadleaf Forest. Variance at each site was also compared. The lowest variance was found in the Poplar Plantation, and the highest variance was found in the city of Nanjing. An analysis of semivariance using GS+ was performed on each of the gridded sites. It showed the highest semivariance in the Poplar Plantation, with negligible semivariance at the other sites. Citywide analysis of Nanjing compaction showed a centralized zone of low compactness, with more compacted soils as distance from the center increased. In order to protect the functionality of China's vulnerable forest and urban environments, soil compactness should continue to be monitored and managed.

Introduction

Soil compactness is an important component of overall ecosystem quality. It has been a widely studied topic in ecology, as compacted soils can lead to many adverse effects on the affected ecosystem. When soil particles become packed more tightly together, air and water space in the soil decreases; field studies and laboratory compaction experiments have shown that soil faunal biomass and abundance of soil animal populations decrease with increasing compactness (Beylich et al. 2010). The same pattern is found for soil microbial communities (Beylich et al. 2010). Compactness, along with penetrability, have been shown to effect biotic factors at many levels in ecosystems. High compactness has been found to lead to habitat abandonment by burrowing birds (Heneberg 2009), decreased reptile abudance (Garden et al. 2007), and reduced shooting success of barley in agricultural settings (Reintam et al. 2009), to mark a few examples. In this study, we are concerned with both forest ecosystems and urban ecosystems, and plant success is of major importance in each. Compacted soils make root and shoot penetrability more challenging and in many cases can impede plant growth (Reintam et al. 2009). This effect, along with reduced microbial communities that may support plant growth, can lead compaction to cause reduced plant success. Plant establishment is essential for ecosystem structure and function in all land use types, including agriculture, forestry, and urban green space.

As China becomes increasingly urbanized, it has become essential to study soil compactness in urban systems as well as more natural systems. High compaction is often associated with the main activities of urbanization, such as construction of buildings and roads. Soil is a major provider of ecosystem services, and compacted soils cannot perform these services in the same ways that less compacted soils can. As outlined in Dominati et al. 2010, soils play an important role in water storage for plants, in support of human infrastructures, and also in flood mitigation. These functions can all be disturbed my compaction of soil. Compaction of soils by definition is the closing of spaces in between soil particles, and this creates a soil surface that is less permeable to water diffusion (Scalenghe 2009). When compaction occurs on a large urban scale where much of the landscape is already covered in impermeable material, water is more likely to cause flooding. This is an important issue for the welfare of city dwellers and city managers alike.

Edmonson et al. (2011) compared soil compaction levels in urban systems with compactness in agricultural systems. It was found that urban soils in a United Kingdom city were less compact then soils in agricultural areas of the same region. Also, it showed that soil densities varied over a wider range in the urban area versus the agricultural areas (Edmonson et al. 2011). However, many urban areas of China are much more newly developed than the areas in the Edmonson et al. study. The urban area of Nanjing has doubled in area over the past twenty years, increasing in area by 43,544 hectares (Zhang et al. 2007). With this in mind, it has been found that newer urban soils are far more compacted than older urban soils (Scharenbroch, Lloyd, and Johnson-Maynard 2005). In this study, we aimed to quantify compactness of new urban soils in the rapidly developing city of Nanjing, China, where urbanization could conceivably have a much more negative impact on compaction. Additionally, much of the soil areas that have been or are in the process of being converted to urban land are quality agricultural areas (Zhang et al. 2007), where though soil is fertile, it is also likely that soils are already highly compacted.

In a world where over one third of all of Earth's forested areas are managed for forestry purposes (FAO 2005), it is necessary to put attention towards the effects of forestry on soil compaction as well. Many studies have shown that both plantations and bamboo farms have caused deteriorating soil conditions, including increased compactness (Liao et al. 2012, Wang et al. 2008). In this study, bamboo production forests and agroforestry were assessed for soil compaction levels. In 2008, approximately 25% of China's agricultural land area was used for forestry of different types (Wang, 2012). With over 23,000 hectares of land devoted to forest production (Wang, 2012), it is critical that China's foresters keep soils in good condition for continued yields.

Instead of investigating agricultural soils as a comparison, we will focus on forested areas of Jiangsu Province. For the purposes of our study, it is useful to measure compactness in various forested areas and compare these levels with compactness in the city of Nanjing. This study aims to assess compactness in these two ecosystems, urban and forest, as these are two of China's most vulnerable and valuable ecological and economic assets.

Materials and Methods

This study was performed in June, 2012 in Jiangsu Province, China. Six different sites in Jiangsu Province, China were chosen for analysis in this study. These six sites were labeled as followed: Bamboo Forest Farm (Site 1), Broadleaf Forest (Site 2), Poplar Plantation (Site 3), Urban Forest Park (Site 4), Campus of Nanjing Forestry University (Site 5), and City of Nanjing (Site 6). Sites 1 and 2 are located in Nanjing Forestry University's Xiashu Forest Farm, a research and forestry site for the school (Jurong, Jiangsu 31°56′N 119°09′E). Site 2 is located in Yellow Sea Forest Garden in Dongtai, Jiangsu (32°47′37″N 120°31′05″E). Site 4 is located in a city park in Changshu, Jiangsu (31°18′N 120°36′E). Sites 5 and 6 are both located in Nanjing, Jiangsu Province (32°03′N 118°46′E).

A soil penetrometer (Agriculture Solutions) was used to measure compactness at select points. The penetrometer gives a rough measurement of topsoil compactness by measuring resistance to pressure applied to a small metal cone meant to break through the soil. All soil compaction measurements were recorded as pounds per square inch (PSI) with this device.

Sites 1, 2, 3, and 4 (the forested sites) were assessed in a grid pattern. Data points were taken with the penetrometer at every meter in a grid, with the grid sizes as follows: Site 1: 8m x 30m, Site 2: 10m x 30m, Site 3: 6m x 30m, and Site 4: 10m x 30m.

At Sites 5 and 6 (the urban settings), point locations were chosen at random. At Site 5, 12 locations were assessed. At each location, between 11 and 24 compactness measurements were made randomly in surrounding soils. At Site 6, 36 locations were assessed. At each location, between 4 and 18 compactness measurements were made in the same manner as Site 5. Data was recorded and put into Microsoft Excel spreadsheets. It was later analyzed using ANOVA in Excel. The geostatistics program GS+ was then used to do a variogram analysis. Inverse distance weighted analysis was also performed with GS+ to make contour maps.

Results

Data was first analyzed using Microsoft Excel. Mean compactness, standard deviation, and variance were calculated for each site. As listed in Table 1, the highest compaction was found on the campus of Nanjing Forestry University (Site 5). Second highest compaction was found in the city of Nanjing (Site 6). Lowest overall compaction was found in the broadleaf forest (Site 1), which had a mean compaction of just 40.7263 PSI, over 21 PSI lower than the next highest site, the urban forest park (Site 4) at 62.0432 PSI. Variation is given in the form of both standard deviation (Table 1) and variance (Figure 1). Highest variation in compactness was found in the city of Nanjing (Site 6), with the second highest variation found at the urban forest park (Site 4). Lowest variation by far was found at the poplar plantation (Site 3).

Table 1. Mean and standard deviation of soil compactness values at each site in Jiangsu Province, China, 2012.

Site	Site Description	Mean ± Standard Deviation
1	Bamboo Forest Farm	67.3077 ± 24.8659
2	Broadleaf Forest	40.7263 ± 22.7598
3	Poplar Plantation	80.8333 ± 14.6698
4	Urban Forest Park	62.0432± 31.9827
5	Nanjing Forestry University	106.5722 ± 24.5894
6	City of Nanjing	84.0228 ± 33.3018

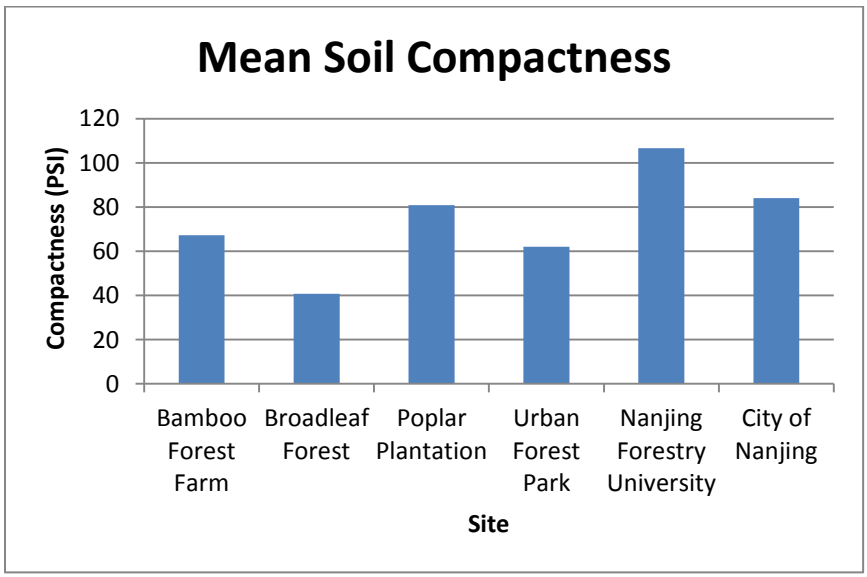

Figure 1. Graph of mean compactness at each site in Jiangsu Province, China, 2012.

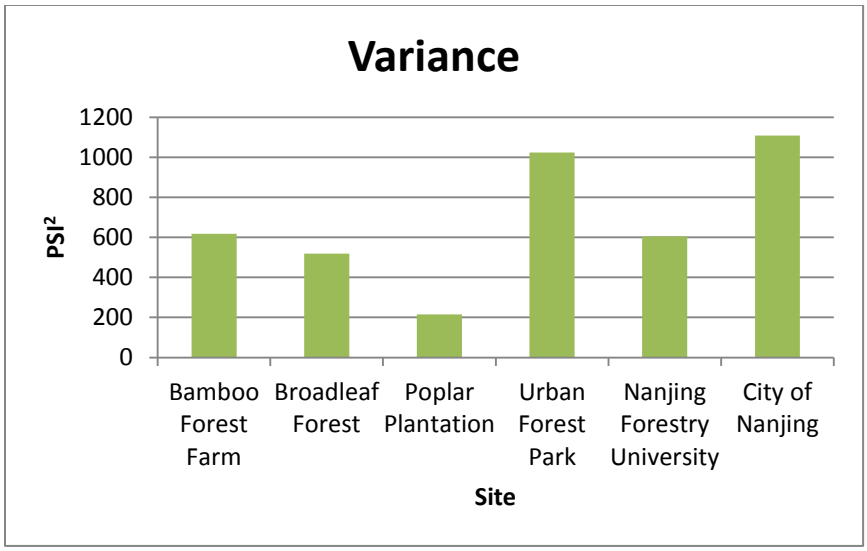

Figure 2. Graph of variance in compactness at each site in Jiangsu Province, China, 2012.

Statistical analysis of the site means was performed using Microsoft Excel's ANOVA. An ANOVA was run between each site, and in every case the site means were significantly different ($p<0.05$) from one another. An ANOVA test of all six sites was also performed, and it showed that the site means are statistically different ($p<0.05$).

The geostatistics program GS+ was then used to assess semivariance at each of the four gridded sites (Sites 1-4). Isotropic models were used in order to assess the effects of distance, not direction, on compactness. Variograms representations are shown in Figures 3-6. The r^2 value was used to determine levels of semivariance. At Site 1, r^2=0.616 and the range was calculated to be 7.35 m. At Site 2, r^2=0.605 and the range was 1.89 m. At Site 3, r^2 =0.853 and the range was 7.35 m. At Site 4, r^2 =0.290 and the range was 2.85 m.

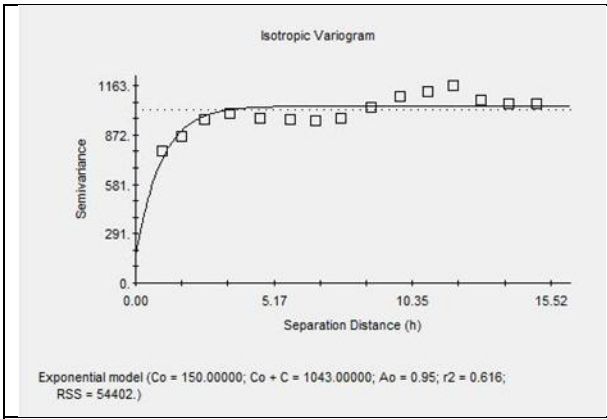

Figure 3. Bamboo forest farm (Site 1) semivariance, Jiangsu Province, China, 2012.

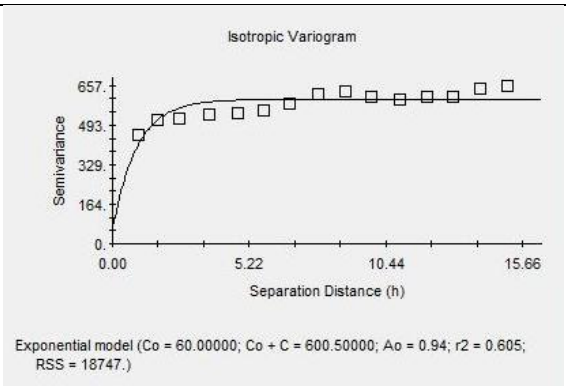

Figure 4. Broadleaf forest (Site 2) semivariance, Jiangsu Province, China, 2012.

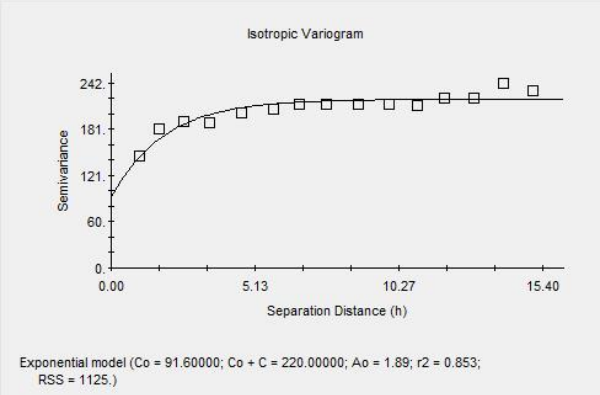

Figure 5. Poplar plantation (Site 3) semivariance, Jiangsu Province, China, 2012.

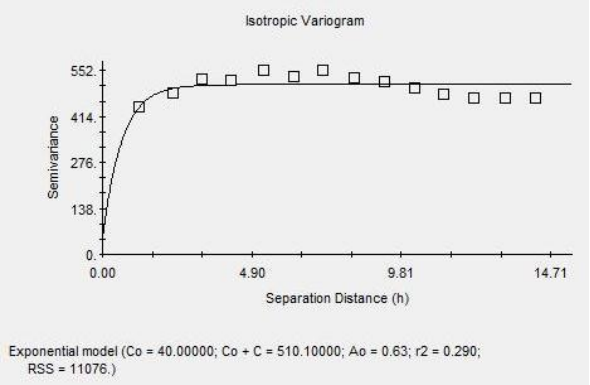

Figure 6. Urban forest park (Site 4) semivariance, Jiangsu Province, China, 2012.

GS+ was also used to make compactness scale maps of each gridded site (scale in PSI, grid measurements in meters, Figures 7-10) to help with visualization of patterns in compactness.

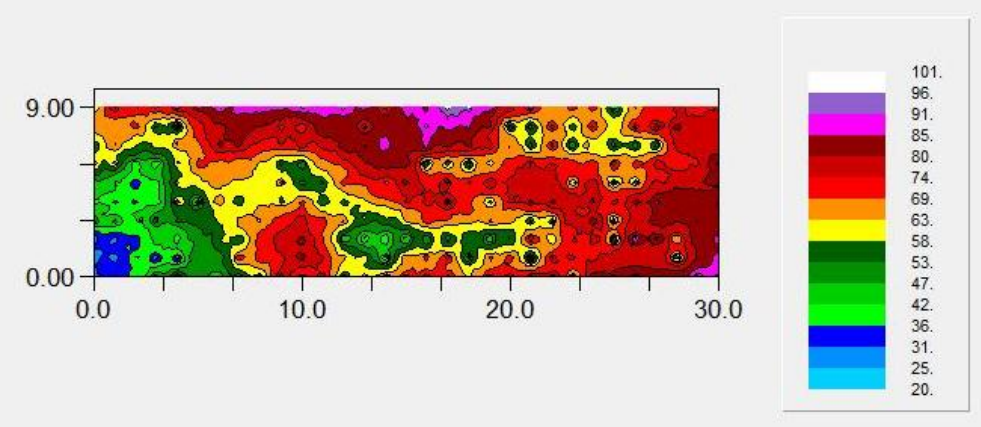

Figure 7. Bamboo forest farm (Site 1) compactness diagram, Jiangsu Province, China, 2012.

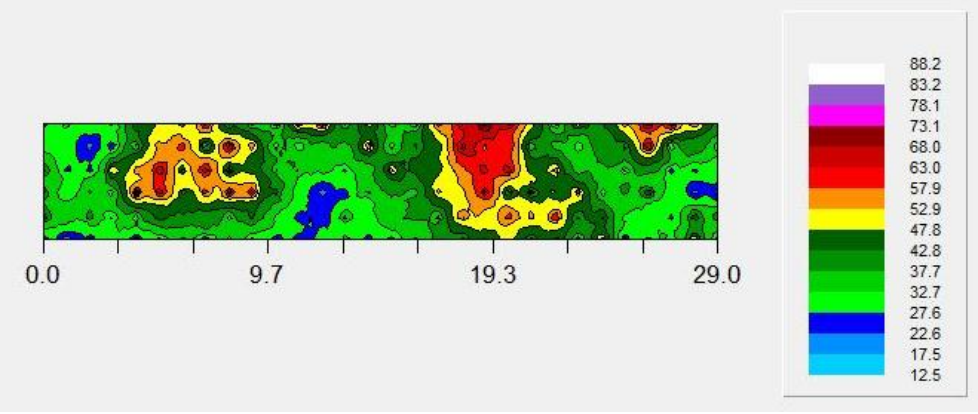

Figure 8. Broadleaf forest (Site 2) compactness diagram, Jiangsu Province, China, 2012.

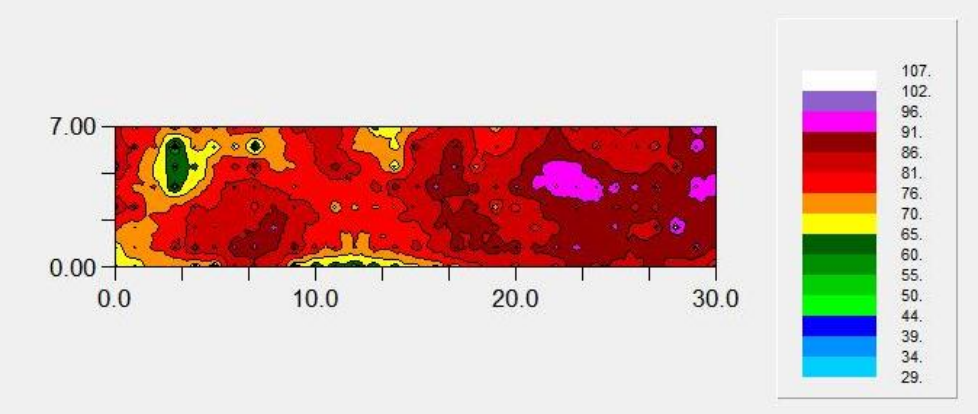

Figure 9. Poplar plantation (Site 3) compactness diagram, Jiangsu Province, China, 2012.

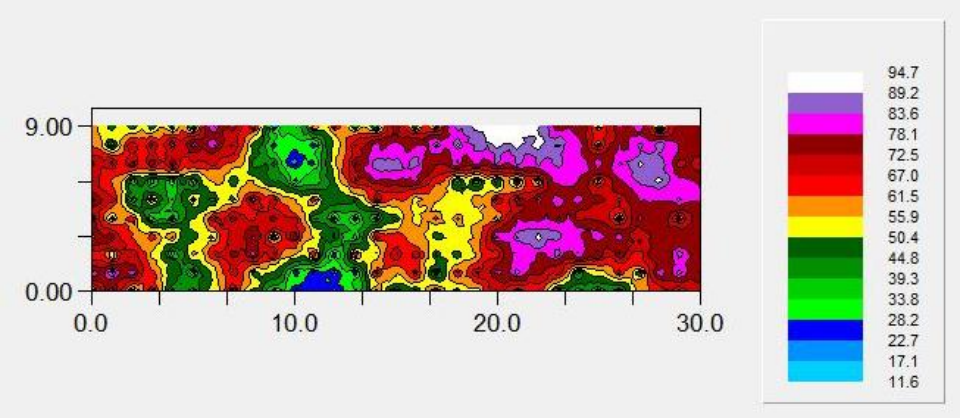

Figure 10. Urban forest park (Site 4) compactness diagram, Jiangsu Province, China, 2012.

To help visualize compactness patterns in the city of Nanjing (Site 6), a scale map was made using our data from random GPS points (Figure 11). A variogram was also created to analyze semivariance of city compactness (Figure 12). Range was 0.0360 and r^2=0.462.

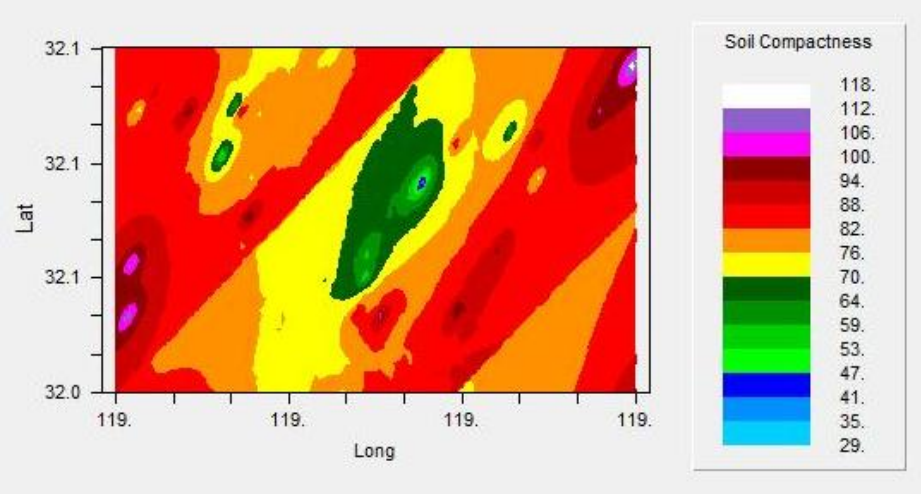

Figure 11. Soil compactness in Nanjing city (Site 6, scale in PSI) , Jiangsu Province, China, 2012.

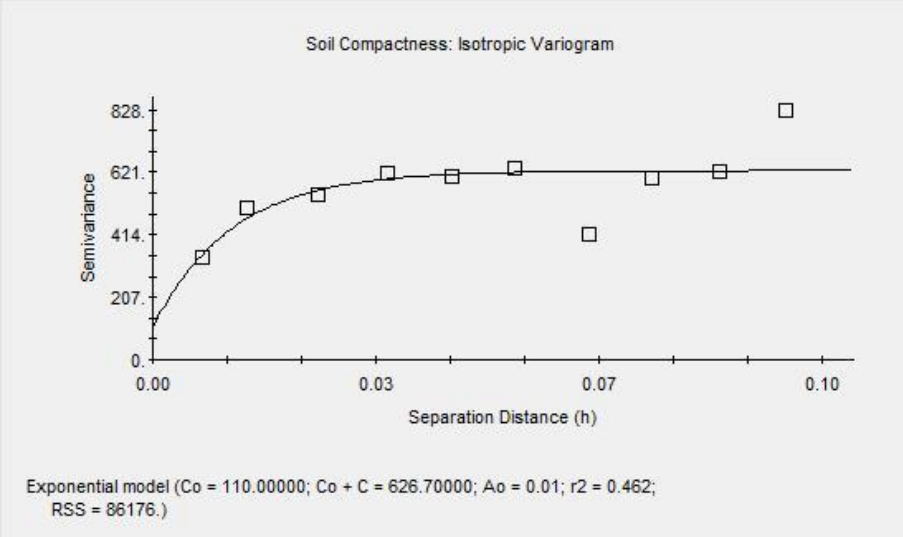

Figure 12. Soil compactness semivariance in Nanjing (Site 6) , Jiangsu Province, China, 2012.

Discussion

Because all of the site compactness means were found to be significantly different from one another ($p<0.05$), we can conclude that some difference between sites (treatment, management, conditions, etc.) is causing this difference in compactness.

The two highest compactness means were found in the two urban areas, the campus of Nanjing Forestry University and the city of Nanjing (Sites 5 and 6). This fell in line with expectations; urbanization and the activities that stem from it lead to soil compaction. However, this result is in conflict with the Edmonson et al. study, which found no support for, "urbanization causing widespread compaction in greenspace" (Edmonson et al. 2011). As discussed earlier, the high

compaction found in Nanjing could be related to the newness of the soils or the intensity of urbanization.

As depicted in the compactness diagram of Nanjing (Figure 11), the least compact soils were found in the center of the city, while soils became more compact farther away from the city center. In the GS+ analysis of semivariance, the range of the variogram was found to be 0.0360. This is the smallest range in comparison with the other sites. This indicates that our data calculated a very patchy distribution of soil compaction within the city. This was expected as well, as soil compaction is known to be influenced differently by each of the many land use types that occurs in an urban area (Scalenghe 2009).

All four forested sites had lower mean compactness than the urban sites, and the lowest mean compactness was found at the broadleaf forest (Site 2). This result is probably due to the fact that this was the most natural site. Site 4 (Urban Forest Park) was highly trafficked and managed for recreational purposes. The other two forested sites (Site 1 and 3) were both managed for forestry purposes. Harvesting and other labor intensive practices were put into effect at these two sites. A recently published meta-analysis comparing natural soils with plantation soils (at 73 sites in around the world) showed that soil bulk density was 12.5% higher in plantations than in neighboring natural forests (Liao et al. 2012). Our data support this finding, as the more natural broadleaf forest was ~50% less compact than the poplar plantation and ~40% less compact than the bamboo forest farm.

More specifically, at Site 1 (the bamboo farm) management for bamboo growth and harvest was being undergone. According to data from bamboo studies in Southern China, traditional bamboo farm management techniques have led to erosion of soils (Wang et al. 2008). Because many cultivation practices like digging, weeding, and harvesting are performed in the spring rainy season, soil degradation is even more pronounced and soil depth has been found to decrease over time (Wang et al. 2008). The erosion/compaction feedback loop is implicated in this system, with one process inciting the other and vice versa. These practices in this case have most likely led to the levels of compactness found in the bamboo forest.

The analysis of semivariance at each of the gridded sites showed only weak semivariance at each site. However, semivariance was strongest in the poplar plantation (Site 3, $r^2 = 0.853$), as can be seen in Figure 6 in comparison with r^2 values from Figures 4, 5, and 7. This relationship is also reflected in the result that the Site 3 had the lowest variance in compactness overall. This even compactness characteristic could be the result of forest management practices that perhaps offer low compaction techniques, low disturbance overall, or very evenly compacting forestry methods.

Patch size, or scale of the change of compactness can be assessed using the semivariance range values for the mapped sites. Among the forested sites, patch size was smallest at the broadleaf forest (Site 2). The range of the variogram at this site was calculated to be 1.89 meters, and beyond this point spatial correlation is essentially zero. It is speculated that patch size is smallest in the broadleaf forest due to the more natural, undisturbed state of this forest in comparison with the other managed sites.

Due to the time restrictions of our study, compactness was measured in PSI of resistance with a soil penetrometer. In order to allow for more direct comparison with other compactness studies, it is desirable to measure soil bulk density, a component more widely used in soil science. Also, in our assessment of compaction in Nanjing city, all data points were collected along the roadside. Edmonson et al. (2011) speculate whether roadside compaction is representative of compaction in city wide green spaces, as the roadside is just one subset of soils found throughout a large urban area. With more time and resources, it would be beneficial to sample wholly random points throughout the city, rather than use only those accessible by road. For the forested sites, limited time and resources also restricted the grid size that could be assessed, and the number of total grids as well. Ideally, multiple grids at each site could be measured and included in the analysis.

Conclusions

This study showed a clear difference in soil compaction between each of the study sites. The most urban areas had the highest compaction, and the most natural site had the lowest compaction. Urban areas and forests are two of China's most important land uses, and both are vulnerable to the impacts of soil compaction. In order to keep both of these ecosystem types healthy and functional, city land managers and foresters should monitor soil compactness and manage for less compacted soils. As China becomes more and more developed, increasing stress will be put on forest resources and on urban areas alike, so this issue will only continue to grow in importance. Research on soil compaction should increase with the increasing significance of its implications.

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DISTRIBUTION PATTERNS OF PLANT BRANCHES IN DONGTAI, JIANGSU PROVINCE, CHINA

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Abstract

Power laws are used to describe patterns in the natural world. They can be used to sort through the chaos and complexity of nature to find ecological order. Four tree species native to China were measured in this short term study, the Poplar (*Populus*), Ginkgo (*Ginkgo*), Willow (*Salix*), and Bamboo (*Bambuseae*), to see if they followed a power law. Two different analysis were used on the same data and they reveal a confounding variable. Differences in results show that neither can be trusted. Two possible reasons for this may be the variations in the quantity of branches measured and different strategies of growth between species.

Background

In viewing the world in all its complexity, one might think it a daunting process to look for patterns. Attempting to understand earth's natural diversity brings us to the study of power laws. They can be used to describe anything from population size to solar flares. Power laws can characterize ecological patterns that repeat themselves over broad scales, so they are considered as "general features of complex systems" (Brown et al., 2002). This study will focus on relationships between distribution patterns for branching patterns.

Since plants cannot move to suitable environments, they must modify their growth and development to suite the prevailing environmental conditions (Yang and Midmore, 2004). Most species can modify their crown shape and root architecture to favor the growth of their growing parts sited in resource-rich patches in heterogeneous environments (Hutchings and de Kroon, 1994). Despite this change in growth, it could be possible that there is a fundamental mechanism within a regulatory pathway that follows a power law.

Power law distributions have been largely reported in modeling real life phenomena (Pinto et al., 2012). Power laws are usually displayed in a rank/frequency log-log plot. Power laws tell us that the size of the event is inversely proportional to its frequency, however; some scientists dismiss power laws as a statistical phenomenon (Pinto et al., 2012). To cross check the method of statistical input for possible error, a comparison of two types of rank/frequency log-log plots were created.

A few tree species were tested for power law relationships in a recent study in Huntsville, Alabama (see Chen and Burton, 2010). Their study found that two of the most common tree species in North America, loblolly pine and the sugar maple, follow the same power law and immature trees of red maple do not follow the power law (Chen and Burton, 2010). In this paper, the power law relationships were tested in trees in other parts of the world. The tree branches of poplar (*Populus*), ginkgo (*Ginkgo*), willow (*Salix*), and bamboo (*Bambuseae*) were tested in China to see if these power law relationships are possibly universal worldwide, or localized based on environmental conditions or the species of tree.

Methods and Materials

Location and Trees

Data was taken at the Yellow sea forest garden in Dongtai, China (32.47'37"N, 120.31'05"E). Dongtai is a land of coastal plains which were mostly comprised of old tidal flats (Chung et al., 2004). Tree branches of four ginkgo, four poplar and two willow trees were measured. Trees were selected at random at the tree plantation based on height and accessibility. Juvenile trees ranging from 250-450cm in height were preferred because they are a manageable height and already display reasonable growth. Since these heights were used error was avoided by not selecting smaller trees. Data derived from bamboo individuals was measured in a previous experiment by students at Nanjing Forestry University.

Measurements

Trees were bent down for better access of every branch. Measurements were taken with a measuring tape to the nearest centimeter for every branch. The tree height was measured first followed by tree branches measured from top to bottom. All measurements were recorded into a lab notebook.

Data Analysis

Data from these measurements was processed using excel and ANOVAs data analysis. First the branch lengths were sorted into length categories and the logarithm was taken of those values to make the x-axis. Then the number of branches that fell into the categories was counted into a frequency. The logarithm of each frequency was calculated to make the y-axis. A best fit linear regression line was added and R-squared values of each data set were analyzed.

Two data analysis were used, the only difference in setup is the categories for the y-axis. In the first analysis, length categories included all previous consecutive branches that were shorter (for example, <20cm, <30cm). In the second analysis, branch length categories were mutually exclusive to other lengths (for example, 10-20cm, 20-30cm).

Results

Figure 1 through figure 4 show the power law relationships for different tree species by using the first analysis, and figure 6 through figure 9 show the power law relationships for different tree species by using the second analysis. Ginkgo and poplar trees' have an R squared value of 0.671 and 0.679 respectively (fig. 1 and fig. 2) in the first analysis and drop to 0.477 and 0.368 respectively (fig. 6 and fig 7). Bamboo species (fig. 4) plateau at a branch length much faster than other species. Willow trees have the greatest R squared value of 0.826 (fig. 3) in the first analysis and 0.691 in the second analysis. Bamboo trees have the smallest R squared value of 0.358 (fig. 4) in the first analysis but it is 0.690 (fig. 8) in the second. All tree species' graphs display outliers due to the inclusion of the trunk measurement, which was counted as one of the branches. Figure 5 compares the R-squared values of each tree species and compares them to the two different analyses.

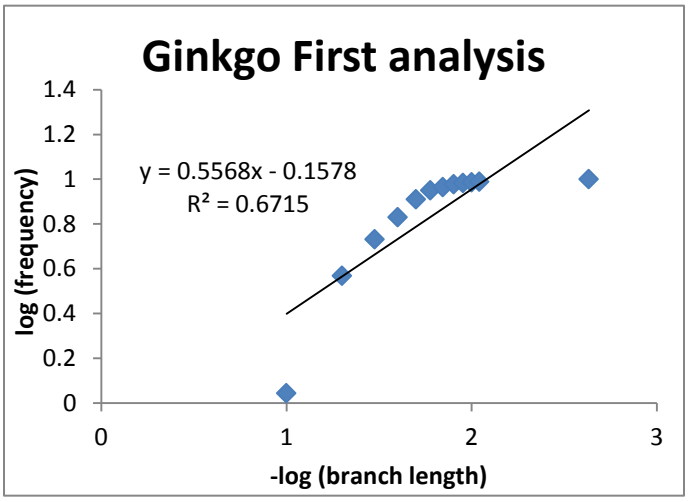

Figure 1. Power law relationship in Ginkgo tree branches, first analysis.

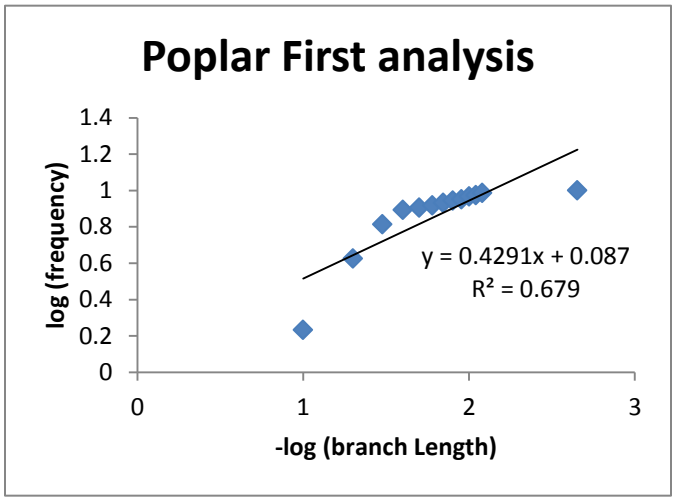

Figure 2. Power law relationship in Poplar tree branches, first analysis.

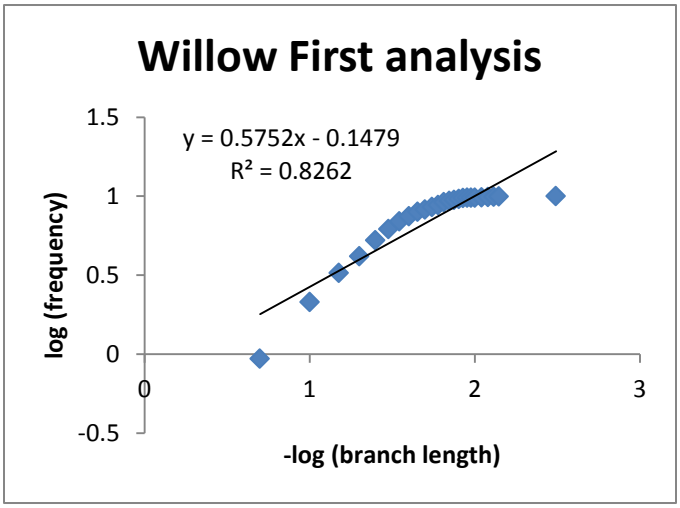

Figure 3. Power law relationship in Willow tree branches, first analysis.

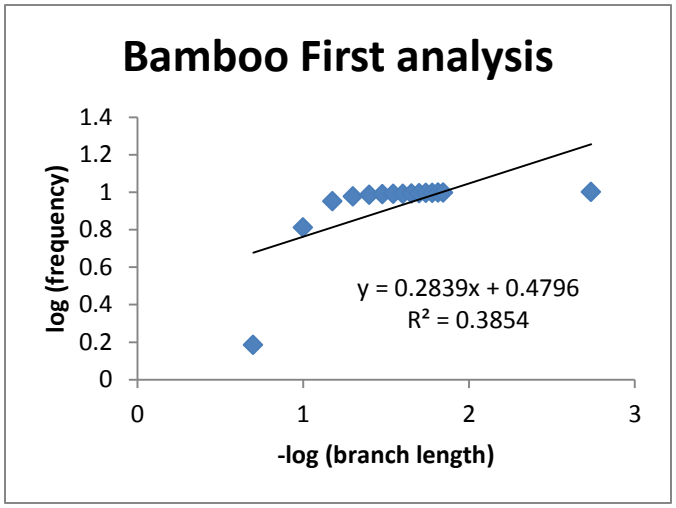

Figure 4. Power law relationship in Bamboo tree branches, first analysis.

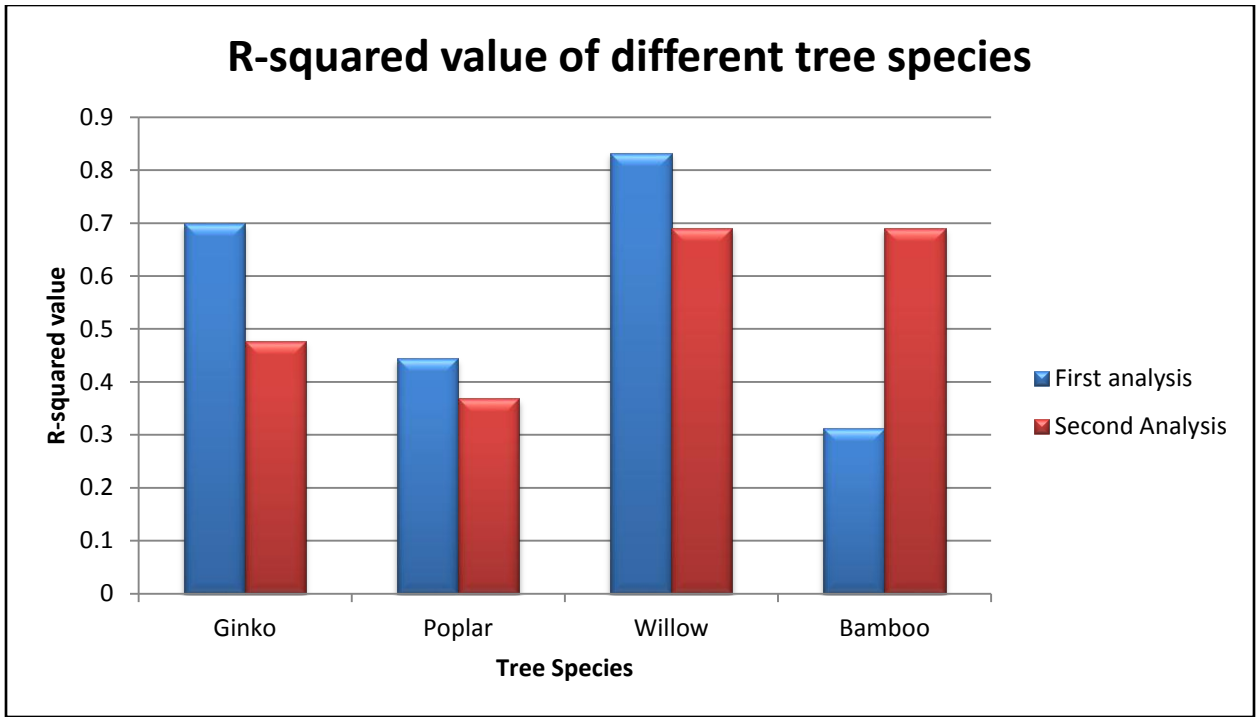

Figure 5. R-squared value of four tree species, comparing two analyses.

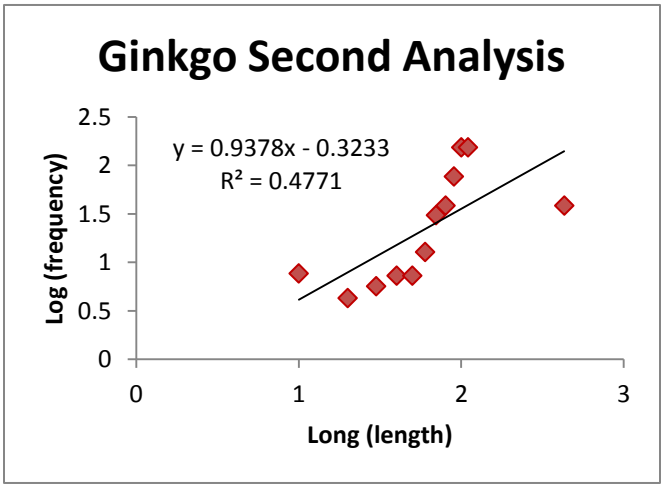

Figure 6. Power law relationship in Ginkgo tree branches, second analysis.

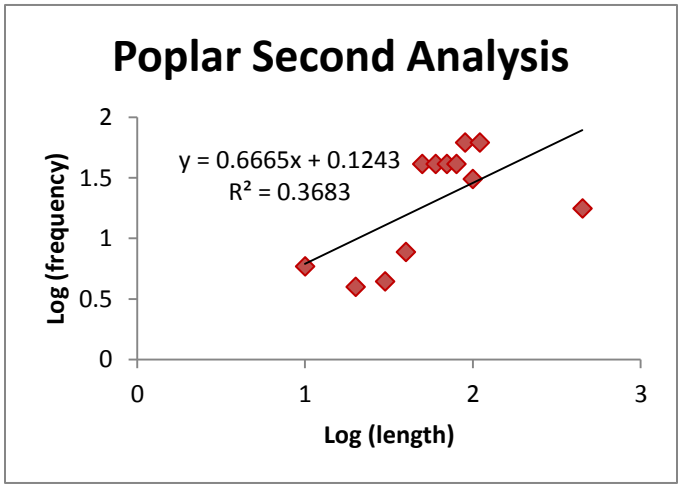

Figure 7. Power law relationships in Poplar tree branches, second analysis.

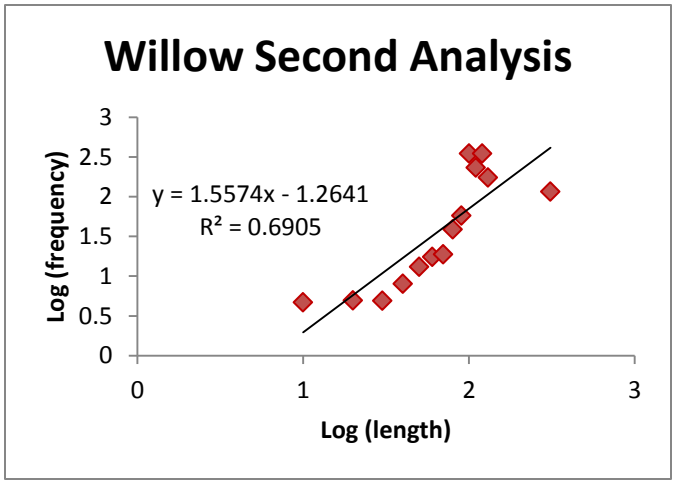

Figure 8. Power law relationship in Willow tree branches, second analysis.

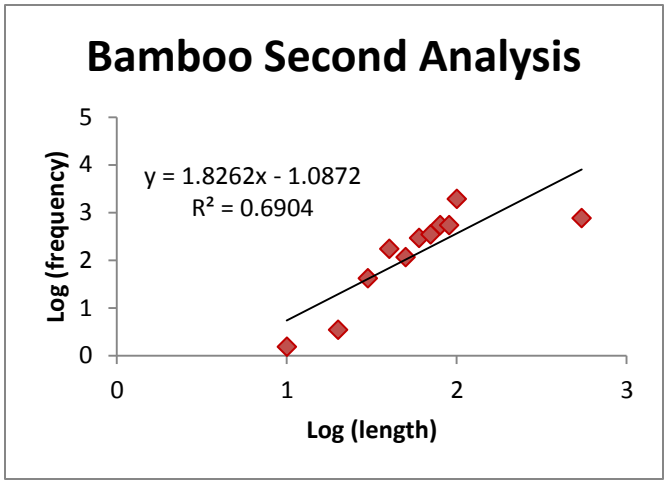

Figure 9. Power law relationship in Bamboo tree branches, second analysis.

Discussion

Different tree species may have different strategies of growth. Even within the same species, there is some variance. According to the first analysis, ginkgo and poplar trees show a moderate correlation to the power laws. Willow trees follow a substantial correlation in the first analysis, and a moderate correlation using the second analysis. Further speculation might include the sample size. The branch quantity for the willow tree was very high compared to the ginkgo and poplar and this could lead to a higher R squared value. Perhaps further measurements of poplar and ginkgo trees may improve the correlation to the power law.

Bamboo species didn't display any significant correlation to the power law in the first analysis, but a moderate correlation by using the second analysis. Bamboo species were assumed to be different initially because it is a grass, and bamboo is known to utilize their energy differently. They use rhizomes and combine energy for new shoots through an established network. Bamboo reaches their maximum height after 3-5 years.

More factors that may contribute to the distribution patterns of plant branches are evolutionary processes and resource competition. Since the trees were located at a tree plantation, they display even spacing and have minimal competition. Although those variables were excluded, different tree species may have different strategies for success. Considering the findings about other tree species in Alabama (Chen and Burton, 2008), only the trees free from competition and well into their growth display correlations to a power law.

Depending on what stage of growth an organism is in, it may be capable of a range of proportional growth. Makarieva et al (2003) suggested that bioenergetics can be based on either primary or secondary processes within an organism. This can be seen in the graphs as the first half and last half of each data set seem to follow separate lines. After a certain point the plots

seem to become saturated. With more understanding of chemical pathways of regulatory systems, there could be countless additional factors that contribute to the discrepancies between analyses.

Conclusion

Limiting conditions such as tree height and accessibility may have created more uncertainties when comparing branch lengths because other possible growth factors were not included into the sample size. There are many differences between species and sometimes within the same species. Power laws in the branching patters of the trees in this study seem contradictory if you compare both types of data analyses, but there is some correlation within all species depending on which data analysis is used. Given the differences by using the two different types of data analyses, neither data analysis can be trusted. It is much more complex and perhaps some confounding variables are affecting these results. No correlations should be pointed out with and certainty under these conditions.

Acknowledgements

Emily Summers.

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SPATIAL DYNAMICS OF AIR QUALITY IN THE JIANGSU PROVINCE OF CHINA

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Abstract

China has become most impacted by environmental issues, chiefly due to a dramatic rise in urbanization within the past fifteen years. We want to explore the ecosystem service of air quality and how urbanization and forest cover may impact the value of air quality. Our research aims to access the severity of the issue of air quality, report variation within a province in southeast China, measure daily temporal dynamics, and determine the main sources of these pollutants. This research took place within and around the Jiangsu providence including: Nanjing City, Changsu, Dongtai, and Yixing. Five categories of land use were represented by these sites: urban, urban forest, plantation, bamboo forest, and mixed bamboo/broadleaf forest. Particulate matter and negative ion concentrations were measured to analysis air quality. Regular statistics and geostatistical techniques were used in data processing. Results show high negative ion concentrations can be seen in the natural or more forested areas, while low concentrations are seen in the more urban areas. No clear pattern was shown in the city when observing aerosol, but relationships between particulate matter were seen based on the diameter of the pollutant measured. Air quality was also shown to be the worst between 10 am and 2 pm daily. We can conclude that episodes of poor air quality in the Jiangsu province can be attributed to a variety of sources, but during the month of June agricultural burning may be the main cause of unhealthy air quality. Air quality follows a landscape gradient from greater concentrations of negative ions in natural or forested areas to less concentrations of ions in urban areas. Variation within the city of Nanjing was random, with little variation between land use types as we may have originally thought would be impactful. This may be due to the large turnover rate and transport of small particles. Even in the areas of less human disturbance and vehicle emissions, large amounts of particulate matter where observed. Especially when surveying the smallest particle size, $PM_{1.0}$.

Introduction

Ecological services are those services and products produced directly from sound and function ecosystem processes. As human population growth rises so does the increased need for more ecological services provided by ecosystems, but ironically the exploitation of ecosystems by growing populations and human activities leaves ecosystem service management a more difficult task. Natural resources are not invincible or infinitely obtainable; environmental impacts of anthropogenic actions are becoming more perceptible with obvious proof of compromised air and water quality, declining species, increased geographical ranges of pests and diseases, and rising levels in atmospheric CO_2 and many other pollutants. In 2005 the Millennium Ecosystem Assessment was commissioned, and they found that currently 60% of the world's ecosystem services are being degraded or being used unsustainably; furthermore, they predicted degradation of ecosystem services to worsen into the century, considerably affecting human well-being (Collins and Larry 2007). The main problem ecosystems face is these drivers causing global environmental change: CO_2 enrichment, nitrogen deposition, climate change, biotic invasions, and land use choices (Tylianakis et al. 2008). Each driver affects the components of the ecosystem in complex and various ways. Every driver can be influenced in some way by air quality, the topic of choice in this study. The ability of forests to provide ecological services has been studied consistently in the last several years. Economic stimulus has lead to emergence of a number of mega cities since the 1990. Nanjing has been categorized as a megacity, this is a city with a population of 10 million or more because of its high peak in urbanization. This urbanization trend is likely to continue into the future for Nanjing and other megacities in China. Air quality in most Chinese cities has improved, but particulate concentrations such as PM2.5 in most Chinese cities are still far above the World Health Organization Air Quality Guidelines. Over 70% of energy comes from coal combustion, creating SO_2 emissions; 2.55107 tons was emitted in 2005.

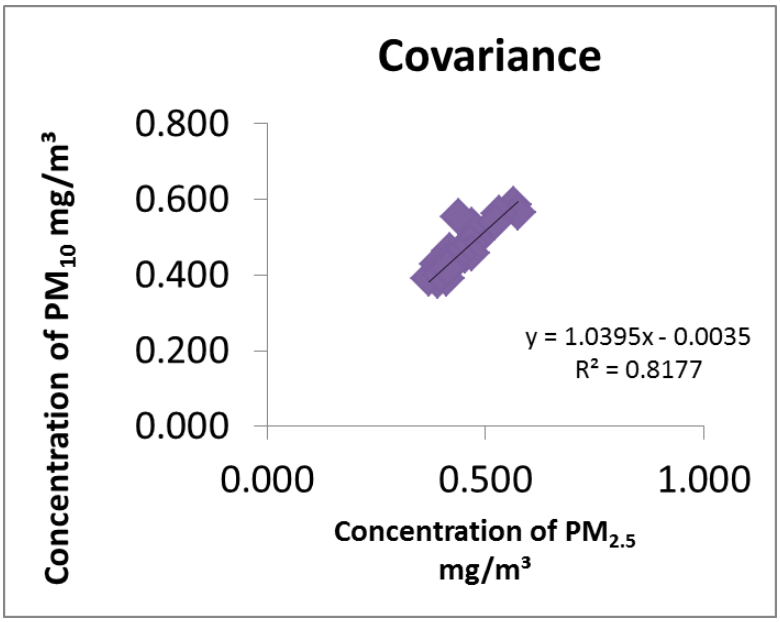
Methods

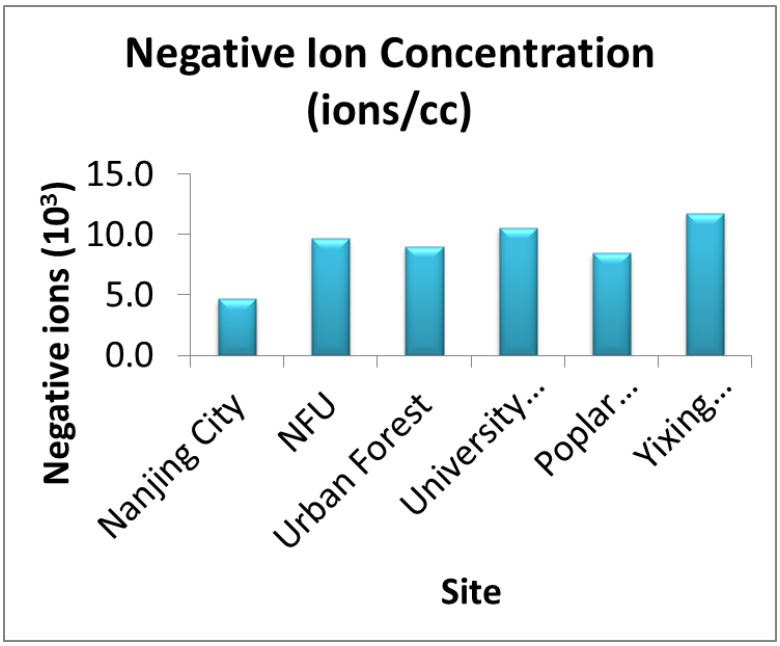
This research took place within and around the Jiangsu providence including: Nanjing City, Changsu, Dongtai, and Yixing. Five categories of land use were represented by these sites: urban, urban forest, plantation, bamboo forest, and mixed bamboo/broadleaf forest. Particulate matter and negative ion concentrations were measured to analysis air quality. To measure aerosol concentrations in the air the TKI Model 8520 DustTrak aerosol monitor will be used. The meter range for particle detection is 0.001 – 100 mg/m^3 capable of the detection of both fine particulate matter ($PM_{2.5}$) and large particulate matter (PM_{10}) and having the ability to detect airborne contaminants such as dust, smokes, fumes, and mists. Along with aerosol monitoring, the amount of negative ions in the air will be measured giving us an estimate of how fresh and pure the air at each field site is.

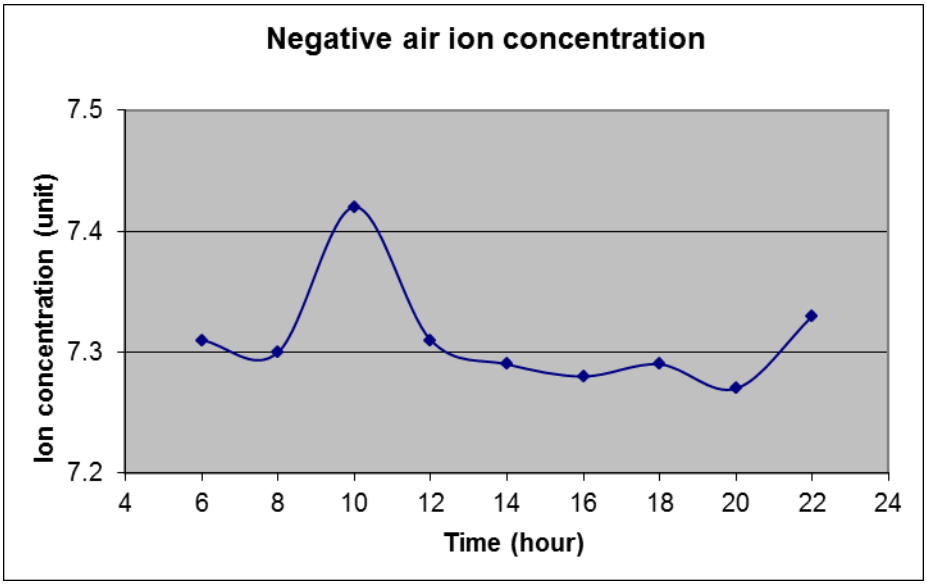
Regular statistics and geostatistical techniques were used in data processing. Geostatistical analysis within the program GS+ will be used to determine any spatial or temporal variation in air quality between sites. Using the sampled points, I will interpolate and apply the simple

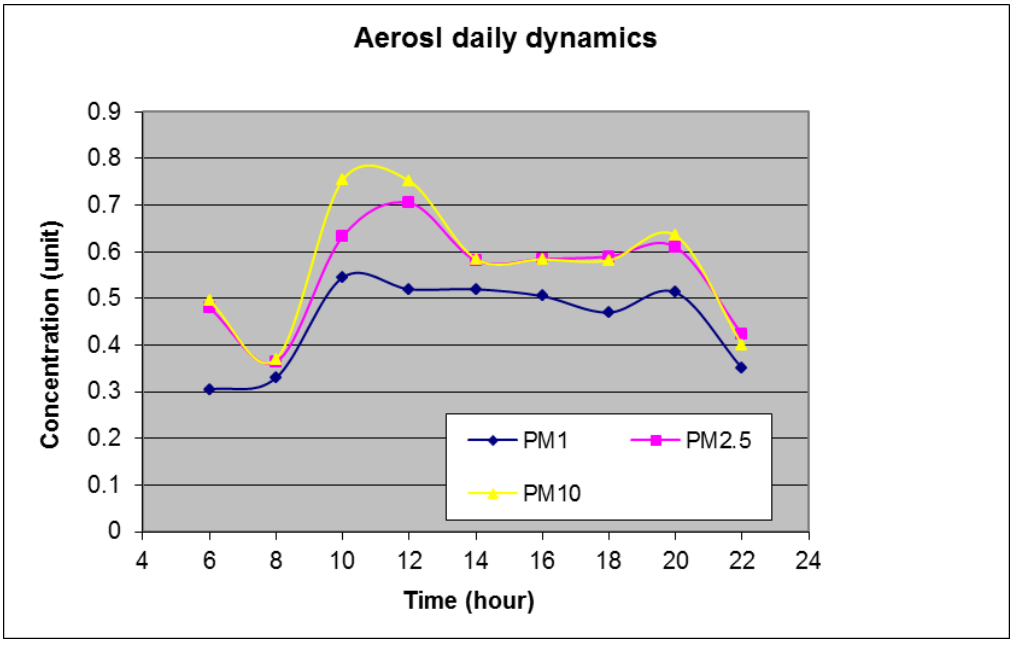
kriging method to approximate the various air quality parameters' values at areas between sites not directly measured.

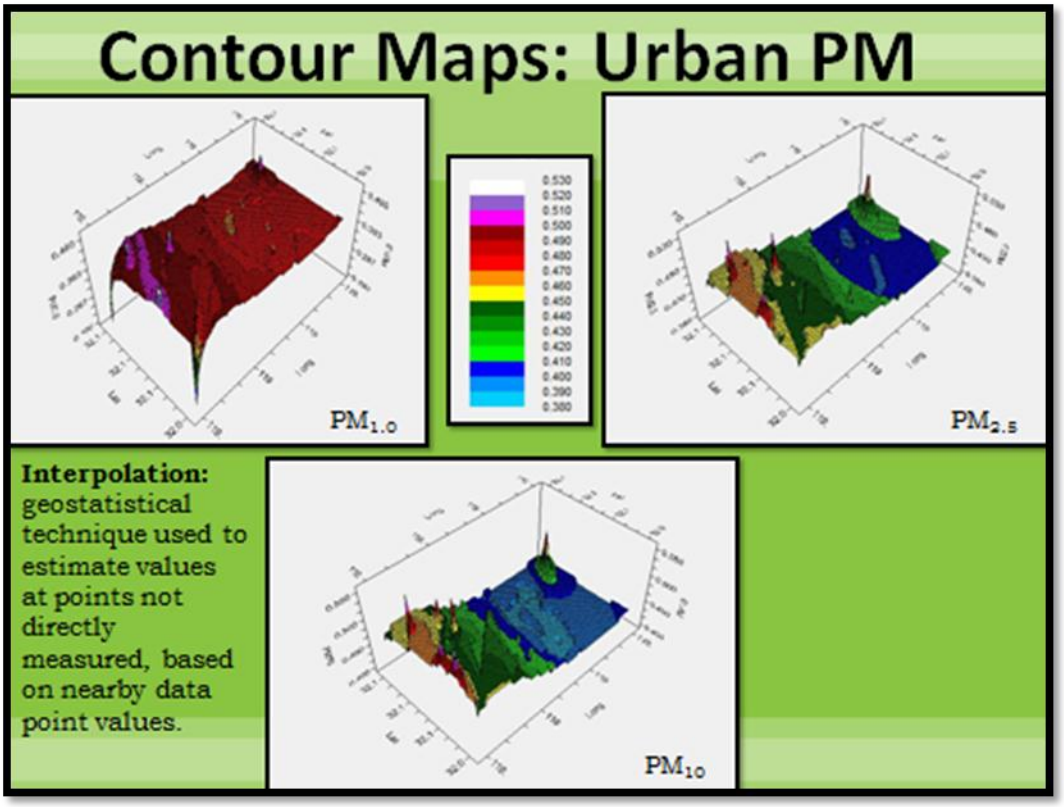
Results






Negative air ion concentration
Ion concentration (unit)
7.5
7.4
7.3
7.2
4
6
8
10
12
14
16
18
20
22
24
Time (hour)


Aerosl daily dynamics
Concentration (unit)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4
6
8
10
12
14
16
18
20
22
24
Time (hour)
PM1
PM2.5
PM10



Discussion

$PM_{2.5}$ and PM_{10} were shown to have a positive correlation in occurrence. With a high concentration of PM_{10}, we should also be aware of the presence of fine PM and their associated health concerns. PM increase dramatically from 10:00-14:00(mid-day). Possible causes of high particulate matter include traffic, temperature, humidity, and agricultural burning. $PM_{1.0}$ shows uniformity throughout the city and is not correlated to $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ and PM_{10} have show random distribution throughout the city with higher concentrations associated with the center of the city and lower values along the mountain and to the west, but few extreme values. We can conclude that episodes of poor air quality in the Jiangsu province can be attributed to a variety of sources, but during the month of June agricultural burning may be the main cause of unhealthy air quality. Air quality follows a landscape gradient from greater concentrations of negative ions in natural or forested areas to less concentrations of ions in urban areas. Variation within the city of Nanjing was random, with little variation between land use types as we may have originally thought. Variation in air quality are low in a fine grain landscape, since air pollutants are generally widely distributed throughout the entire landscape and this factor should be explored and considered in this study (Forman 1995).

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DETERMINING PLANT GROWTH PROMOTING EFFECT OF POTENTIAL PGPR (PLANT GROWTH PROMOTING RHIZOBACTERIA) STRAINS

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Abstract

This experiment was conducted to test the hypothesis that the bacterial strains N-6, N-12 and X are Plant Growth Promoting Rhizobacteria (PGPR). PGPR can promote plant growth through phytohormone excretion, nitrogen fixation, compound solubilizing mechanisms, or displacement of detrimental organisms (biocontrol). The bacterial strains, X, N-12 and N-6, were isolated previously from the rhizosphere of plants and selected for their potential PGPR characteristics. N-12 and N-6, primarily identified to be Paenibacillus spp/ Bacillus mucilaginosous, showed potent silicate-solubilizing activity. The strain X has not been tested previously but exhibited biocontrol characteristics in a petri dish which could possibly characterize it as a plant growth promoting rhizobacteria. To test for plant growth promoting ability of the strains, thirty-six maize seeds were inoculated with each strain. They were planted in sterile soil placed in pots and allowed to grow outdoors for twenty-five days before cropping for measurement. Preliminary data received seven days prior to cropping did reveal N-12 to significantly promote plant growth. However, the results of 25 days after inoculation revealed that inoculation with the three bacteria did not promote growth in a statistically significant manner. Further experimentation will still be required to test the are plant growth promoting activities of N12, N6 and X. All strains if proven PGPR could be mass produced as biofertilizer to increase growth of crops inoculated. Bacterial strain X has potential as an antibiotic as well as a biofertilizer because of its biocontrol abilities.

Introduction/Background

The growth of plants is dependent upon the environment including the basic oxygen, water and sunlight. Less obvious factors such as minerals, nutrients and microorganisms significantly impact plant growth as well. A classification of bacteria known as plant growth promoting rhizobacteria (PGPR) may colonize in the rhizosphere, the surface of the root, or even superficial intercellular spaces of plants and result in stimulated plant growth due to a symbiotic relationship with the plant roots(Vessey, 2003),(McCully, 2001). Kloepper (1980) stated that PGPR are hypothesized to stimulate plant growth through nitrogen fixation, phytohormone secretion, solubilizing compounds, and mineralization of phosphates as well as biocontrol mechanisms. Rhizobacteria may use more than one of these mechanisms (Further research is being done to determine what mechanisms newly discovered rhizobacteria use to stimulate plant growth.

Three bacterial strains which were isolated by Dr. Ben Fan from Nanjing Forestry University are currently being tested for their plant growth promoting mechanisms; N6, N12, and X. N6 and N12 have been previously experimented with and thought to be non-legume, free-living bacteria (Dr. Ben Fan). It has been shown that even non-legume bacteria may have nitrogen fixing abilities (Doebereiner and Pedrosa, 1987). Previous experiments indicate that N6 and N12 could possibly be the PGPR *Bacillus mucilaginosus*, but require more evidence; this is one reason for this experiment. The soil bacterium *Bacillus mucilaginosus* has the ability to degrade soil mineral compounds that are sparingly soluble (silicates, apatites, and phosphorites) with the release of mobile potassium and water-soluble phosphorous, thereby improving plant nutrition. They are characterized by their exopolysaccharide producing activity (Nyanikova, 2002). N12 and N6 are hypothesized to be this type of bacterium because of they also display exopolysaccharide producing abilities when cultured in a petri dish. The third bacterial strain, X, was discovered in Dr. Fans soil bacterial isolation procedure by accident. It was left aside in a petri dish and was later observed displaying obvious biological control characteristics. This experiment will reveal whether this strain is a phytopathogen or a PGPR. Plant growth is enhanced due to biological control of plant pathogens therefore benefitting the plant (Weller and Thomashow, 1993). Rhizobacteria can influence plant growth by a variety of biological control mechanisms such as detoxification of virulence factors, lytic enzyme production, antibiosis, and production of iron limiting siderophores (E. Baraka, 2005). The main objective of this research is not to determine how they promote growth but is to determine if strains N6, N12 and X are PGPR using maize plants as a test model.

Materials and Methods

In order to test if the three different strains were PGPR or not the strains were grown in cultures in a sterile environment. Maize seeds were surface sterilized with 2% sodium chlorite prior to germination. The seeds were allowed to germinate for approximately 48 hours in petri dishes (lined with filter paper), ten seeds per dish. This experiment was conducted in sterile soil. The soil was autoclaved twice to ensure that endospores and all other organisms were destroyed. Roots of germinating corn seeds where then dipped into culture masses to inoculate with the strain. Out of 400 germinated seeds, 144 were chosen to inoculate. Thirty-six seeds were inoculated for each strain as well as thirty six control maize seedlings. Forty-eight pots were

carefully filled with the sterile soil and labeled with the strains. Seeds were then planted three per pot. The pots were organized using the Latin Square method (Fig. 1) made famous by Leonhard Euler to reduce bias due to sun exposure, rain fall and shadow (Kumar, 2012). The pots were placed and allowed to grow on the roof of a tall building on campus of Nanjing Forestry University in Nanjing, China due to convenience. This experiment was conducted from June 10th to July 5th with temperatures ranging from 95-75 degrees Fahrenheit. The seeds were watered daily. Preliminary data was taken on June 27th and maize plants were cropped on July 5th. After cropping the fresh weight and physiological height data was obtained, the plants were then dried for four days at 60°C and the dry weight data was obtained.

X	CK	N6	N12	N12	X	CK	N6
CK	N6	N12	X	N6	N12	X	CK
N6	N12	X	CK	CK	N6	N12	X
N12	X	CK	N6	X	CK	N6	N12
X	CK	N6	N12	N12	X	CK	N6
CK	N6	N12	X	N6	N12	X	CK

Figure 1. Latin square method to reduce potential bias due to sun exposure, rain fall, and shadow.

Results

Inoculation of maize seeds with the three strains of bacteria did not significantly enhance plant growth. The preliminary data was more promising than the final data.

Figure 2 shows the physilogical height averages of the maize plants on June 27th. This data was preliminary data obtained to gauge the effect of the bacteria thus far in the experiment. The graph shows the average plant height for each experimented strain as well as the control. N12 is the only rhizobacteria that resulted in plant growth that was significantly greater than the control. This data is not consistent with the final data. Figure 3 shows the averages of the final physiological height of the maize plants. None are statistically significant in increasing plant height. This means the apparent increase that seedlings inoculated with rhizobacteria have in height can be attributed to random plant variability.

Figures 4 and 5 show maize plant average fresh weight and dry weight respectively. The results of the study showed that inoculation of maize seeds with these particular bacterial strains did not affect fresh or dry weight. This is the opposite of the expected result. Strain X had the greatest effect on fresh weight and the least effect on physiological plant height. These results do not show evidence of X being a PGPR. Figure 4 shows maize seedlings inoculated with N-12 to generally have a greater dry weight than that of the control plants but this is not statistically significant so it proves nothing. Across all three unidentified strains the null hypothesis was not able to be rejected.

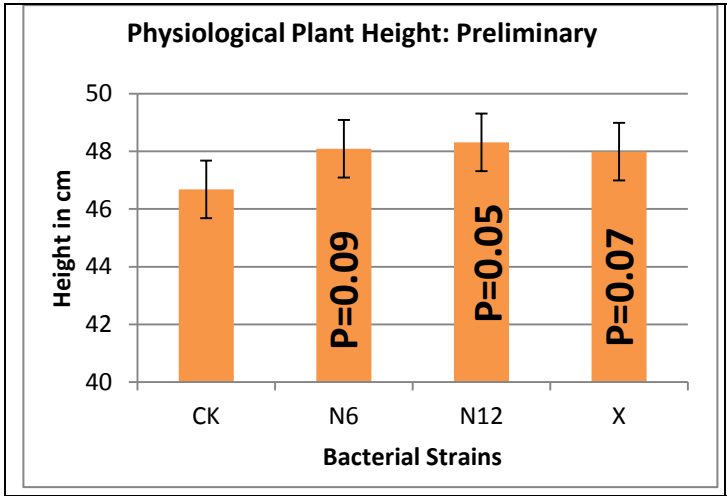

Figure 2. Preliminary physiological height data of maize inoculated with different bacterial strains, obtained June 27, 2012. CK = ; N6 =

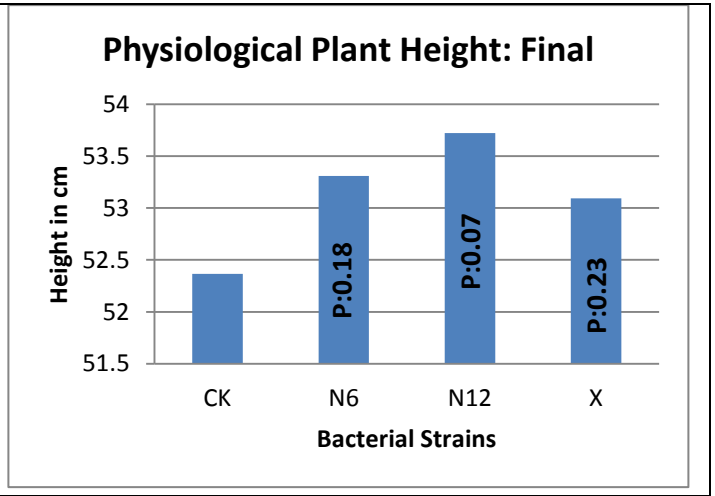

Figure 3. Physiological height data obtained July 27, 2012.

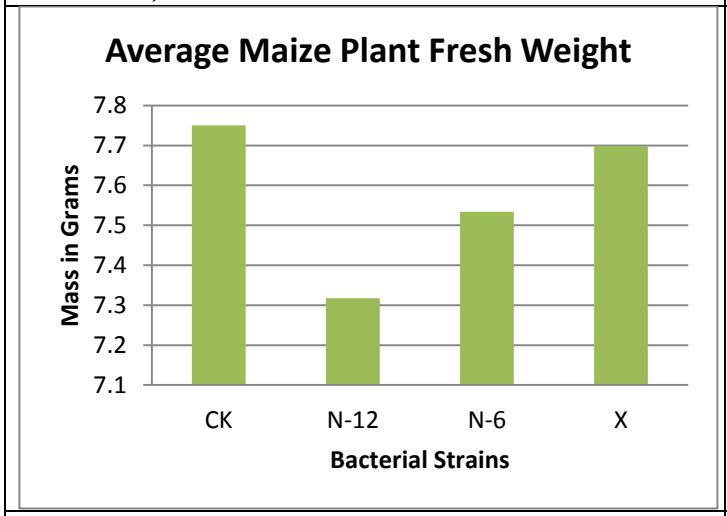

Figure 4. Average fresh weight of maize plants.

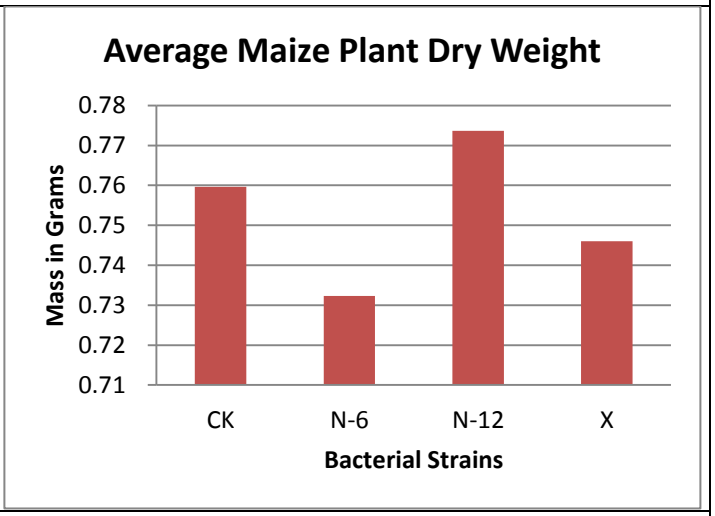

Figure 5. Average dry weight of maize plants, by bacterial strains.

Discussion

The contention that plant growth promoting bacteria increase fresh and dry weight as well as overall plant growth were not supported by this experiment. Many experiments prove that various strains of rhizobacteria do indeed promote plant growth evident from fresh/dry weight and plant height experimentation. In some cases significant increases up to 100% greater than controls were found (Gholami, 2009). This present investigation was focused on discovering new PGPR, the data did not prove or disprove exactly what was sought. Further experimentation will be necessary to prove that X, N-6 and N-12 are PGPR. Reasons for no evidence of plant growth promotion can be because the strains are not actually PGPR, the maize was not a suitable model or because the experiment was not well performed. The latter two are most likely. The germinating seeds were not homogenous, so majority of the best seeds for example may have been used as control therefore biasing the final results. The growth condition was subject to heavy rain throughout the last week before cropping which may have gradually caused the control to have a similar environment to the treatment plants. Although maize is commonly used in other experiment testing for plant growth promotion perhaps another such may be better suited for these particular strains. This experiment will be modified and performed again with dicotyledon.

Conclusion

This experiment is part of a larger project which is to discover and genetically sequence new plant growth promoting rhizobacteria so that they can potentially be mass-produced and used in agriculture as biofertilizer in increase crop yields. This experiment did not give enough evidence to prove or disprove x, N-12 or N-6 to be PGPR. But due to previous experiments which showed PGPR potential for these strains, further experimentation will be done to provide conclusive evidence supporting the growth promoting abilities of strains X, N-12 and N-6.

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SOIL NUTRIENT AVAILABILITY AT THE CHENWEI FOREST RESEARCH STATION IN JIANSU PROVINCE, CHINA

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Abstract

This research analyzes the availability of nitrogen in the soil after thinning a poplar plantation in the Chenwei Forest Research Station in Jiangsu Province, China. The study of nutrient cycles in the environment is important because it focuses on the biological and chemical processes in the environment and how it affects plants, animals, and humans. The nitrogen cycle is one of the most important cycles in an ecosystem because it is the central role in the production of food. This research will focus specifically on the mineralization process of the nitrogen cycle. In this biological process, organic nitrogen, NO_3^-, is converted into inorganic nitrogen, NH_4^+ for plant nutrient uptake and consumption by microorganisms. Thinning is the selective removal of trees within an area of the forest to promote healthy growth of plants and trees. The methods used in this research study were thinning of the forest, soil collection, DNA extraction, determination of nitrate & ammonium, and a statistical analysis. In this study, soil samples were collected after an application of thinning in March of 2012 and DNA from each sample was extracted. The concentration of nitrate and ammonium were analyzed using the Auto Analyzer 3 to determine the soil nutrient availability in the rhizosphere of the soil. Nitrate and ammonium were both actively present in the 0-5 cm layer of the soil but there is no significant difference in the thinning practice effects on the soil.

Introduction

Soil nutrients are vital to environmental sustainability in forests ecosystems. The study of nutrient cycles in the environment is important because it focuses on the biological and chemical processes in the environment and how it affects plants, animals, and humans. Plant nutrient uptake is important in order to sustain adequate growth in plants (Dong Liu, 2012).
The nutrients that are most important in plant growth are nitrogen, potassium and phosphorus. The analysis of the concentration of nutrients in the soil will explain the diversity of microbial activity, soil chemical processes, mineralization rates and the accumulation of organic matter in the soil. The excess or depletion of nutrients in the soil profile affects the surrounding environment as well. If there is an excess of nutrients in the soil, then that will effect plant growth. Also, the leaching of nutrients into a waterway will produce eutrophication. The depletion of nutrients in the soil will also affect how plants grow and the amount of microorganisms in the soil to carry out life processes. Soil nutrients are very important in the forest ecosystem because they ultimately affect biological and chemical processes.

The carbon and nitrogen cycles play an important role with microbial activity in the soil profile especially in the rhizosphere. The rhizosphere is the zone of soil surrounding a plant root in which soil microorganisms and nutrient activity are abundant (Shengzuo FANG, 2010). In the rhizosphere, nutrients are mineralized, plant nutrient uptake and growth occurs, and microorganisms are actively engaged. The nitrogen cycle is one of the most important cycles in an ecosystem because it is the central role in the production of food. There are four different processes in the nitrogen cycle which include nitrogen fixation, mineralization, denitrification, and nitrification (Manao, 2012). This research will focus specifically on the mineralization process of the nitrogen cycle. In this biological process, organic nitrogen, NO_3^-, is converted into inorganic nitrogen, NH_4^+ for plant nutrient uptake and consumption by microorganisms.

Wood production, thinning, burning, and soil erosion are significant in conserving the aesthetics and developmental expansion of forests. Thinning is the selective removal of trees within an area of the forest to promote healthy growth of plants and trees (Forest Thinning, 2012). There are many types of thinning practices which include low thinning and mechanical thinning. Low thinning removes trees from lower canopy positions. Mechanical thinning involves removing trees within a fixed spacing interval or removing all trees in strips with fixed distances between them. The purpose of thinning is to promote tree growth, increase understory diversity, soil microbial activity, and soil nutrients. The production of wood products increases as a result of thinning because trees are able to grow faster and stronger; and therefore produce more materials.

Soil erosion is the degradation of soil by wind, water or human activity such as tilling. The soil structure is loosened or broken down and the soil loses its nutrients and organic matter (Why Thinning Won't Prevent Forest Fires, 2012). When this occurs soil can run off into a nearby stream or waterway and contaminate the water by excessive nutrients.

The goal of this research is to analyze the effects of thinning practices on the soil nutrient of the poplar plantation. This will be accomplished by determining the concentration of nitrogen ($NO3^-$ & $NH4^+$) in the soil profile of plots in a poplar plantation

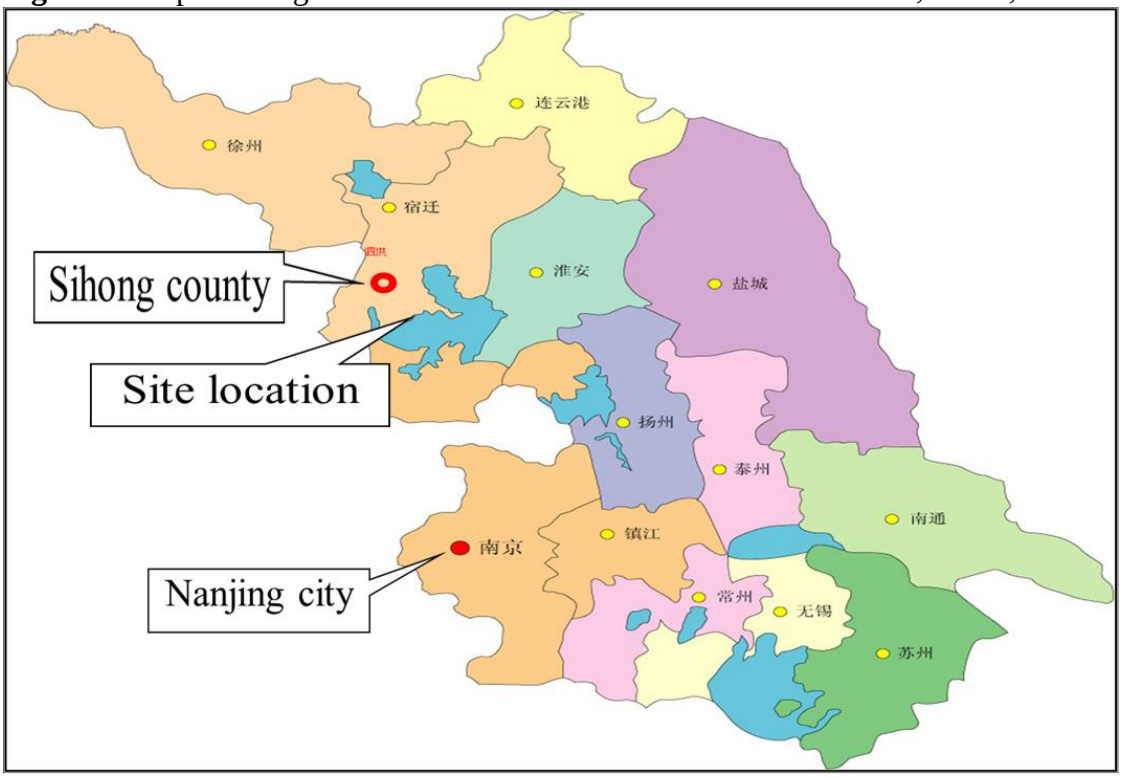
Materials and Methods

Experimental Site

The Chenwei Forest Research Station is located in Yangzhou city, Jiangsu Province at the Baoyinghu Lake Wetland Park (33 ° 22′N latitude, 119°15′E longitude). It is a state - owned forest farms which is in a north subtropical monsoon - humid climate. The experimental site is a poplar plantation site has three poplar species: Nanlin 895, Nanlin 95, Nanlin 797 and they are four spacings on each plot of 3m×8m, 4.5m×8m, 5m×5m, and 6m×6m. There are 12 treatments and 3 replications which total to 36 plots.

Study Site – Chenwei Forest Research Station

Figure 1. Map showing locations in China where we collected our data, China, 2012.



797 spacing 4.5m×8m	895 spacing 4.5m×8m	95 spacing 4.5m×8m
797 spacing 3m×8m	895 spacing 3m×8m	95 spacing 3m×8m
797 spacing 5m×5m	895 spacing 5m×5m	95 spacing 5m×5m
797 spacing 6m×6m	895 spacing 6m×6m	95 spacing 6m×6m
95 spacing 6m×6m	797 spacing 6m×6m	895 spacing 6m×6m
95 spacing 5m×5m	797 spacing 5m×5m	895 Spacing 5m x 5m
95 spacing 3m×8m	797 spacing 3m×8m	895 spacing 3m×8m
95 spacing 4.5m×8m	797 spacing 4.5m×8m	895 spacing 4.5m×8m
895 spacing 4.5m×8m	95 spacing 4.5m×8m	797 spacing 4.5m×8m
895 spacing 3m×8m	95 spacing 3m×8m	797 spacing 3m×8m
895 spacing 5m×5m	95 spacing 5m×5m	797 spacing 5m×5m
895 spacing 6m×6m	95 spacing 6m×6m	797 Spacing 6m x 6m

Thinning

There were two types of thinning practices performed on the experimental site; low thinning and mechanical thinning. There were two intensities for the low thinning; 30% and 50% in which 30% of the selected trees were removed and 50% of the trees were removed on the other plot. In the mechanical thinning process, the intensity was 50%. The thinning was performed by manually removing trees from the plots in march of 2012.

Soil Collection

Field trips were arranged to collect soil samples from the Chenwei Forestry Research. The soil samples were taken from the upper 0–5, 5-10 and 10-20 cm soil layers. Soil augers were used to collect soil samples at three different depths. The collected samples were brought to the laboratory and refrigerated at 4 °C until the time of the analysis.

DNA Extraction

SDS-based DNA extraction method (Zhou, 1996) (SDS)-based DNA extraction. Soil samples of 5 g were mixed with 13.5 ml of DNA extraction buffer (100 m Tris-HCl [pH 8.0], 100 m sodium EDTA [pH 8.0], 100 m sodium phosphate [pH 8.0], 1.5 M NaCl, 1% CTAB) and 100 ml of proteinase K (10 mg/ml) in Oakridge tubes by horizontal shaking at 225 rpm for 30 min at 37°C. After the shaking treatment, 1.5 ml of 20% SDS was added, and the samples were incubated in a 65°C water bath for 2 h with gentle end-over-end inversions every 15 to 20 min. The supernatants were collected after centrifugation at 6,000 3 g for 10 min at room temperature and transferred into 50-ml centrifuge tubes. The soil pellets were extracted two more times by adding 4.5 ml of the extraction buffer and 0.5 ml of 20% SDS, vortexing for 10 s, incubating at 65°C for 10 min, and centrifuging as before. Supernatants from the three cycles of extractions were combined and mixed with an equal volume of chloroformisoamyl alcohol (24:1, vol/vol). The aqueous phase was recovered by centrifugation and precipitated with 0.6 volume of isopropanol at room temperature for 1hour. The pellet of crude nucleic acids was obtained by centrifugation at 16,000 3 g for 20 min at room temperature, washed with cold 70% ethanol, and resuspended in sterile deionized water, to give a final volume of 500 ml.

Determination of nitrate & ammonium

The amount of nitrate and ammonium was determined by placing each DNA extraction of each sample into the AutoAnalyzer3.

Statistical Analysis

The mean of the samples was calculated for the control, the 30% low thinning intensity, 50% low thinning intensity, and mechanical thinning in each of the three depths of the soil profile. Using the sample data, a statistical analysis was performed using the ANOVA test to find out the standard deviation for each sample. The Tukey test was also performed to find out if there is a significant difference between the means.

Results/Discussion

The nitrogen levels within soil depths were analyzed at the Chenwei Forest Research Station in June of 2012. Plants uptake inorganic forms of nitrogen such as nitrate and ammonium for food consumption. There is a pattern in the concentrations of nitrate and ammonium in the soil. Organic matter accumulates in the top layer of the soil from decomposed leaves, grass, and branches For nitrate, the highest concentration is in the 0-5 cm range of the soil profile. The soil samples tested for nitrate had decreased levels of nitrate the deeper within the soil profile. The average nitrate concentration in the 0-5 cm range was 13.43 mg/kg for the control, 12.32 mg/kg in the 5-10 cm range, and 8.98 mg/kg in the 10-20 cm range. For ammonium in the 0-5 cm range of the soil profile, the average was 2.75 mg/kg for the control, 3.05 mg/kg for 30% intensity, 2.82 for 50% intensity, and 2.87 mg/kg for mechanical. The ammonium levels stayed constant within the 0-5 cm range of the soil profile. Although there was a small increase of ammonium concentrations in the 10-20 cm range of the soil profile.

Organic matter moves vertically down the soil profile. The conversion of nitrate to ammonium may be a longer process to complete since the thinning took place in March and the samples were collected in April. The decomposition of organic matter will cause for an increase in ammonium further deep in the soil profile. An increase in ammonium in the soil means an increase in microbial activity. Also, the seasonal change with temperature and the pH of the sol may affect the conversion process of nitrate to ammonium.

Conclusion

The statistical analysis was performed and showed no significant difference between the thinning practices and the concentration of nitrate and ammonium in the soil. A further analysis should study the seasonal change affects on the concentrations of nitrate and ammonium over a year time. Also further analysis should identify the carbon to nitrogen ratio for soil microbial activity and soil nutrients such as carbon, phosphorus and potassium.

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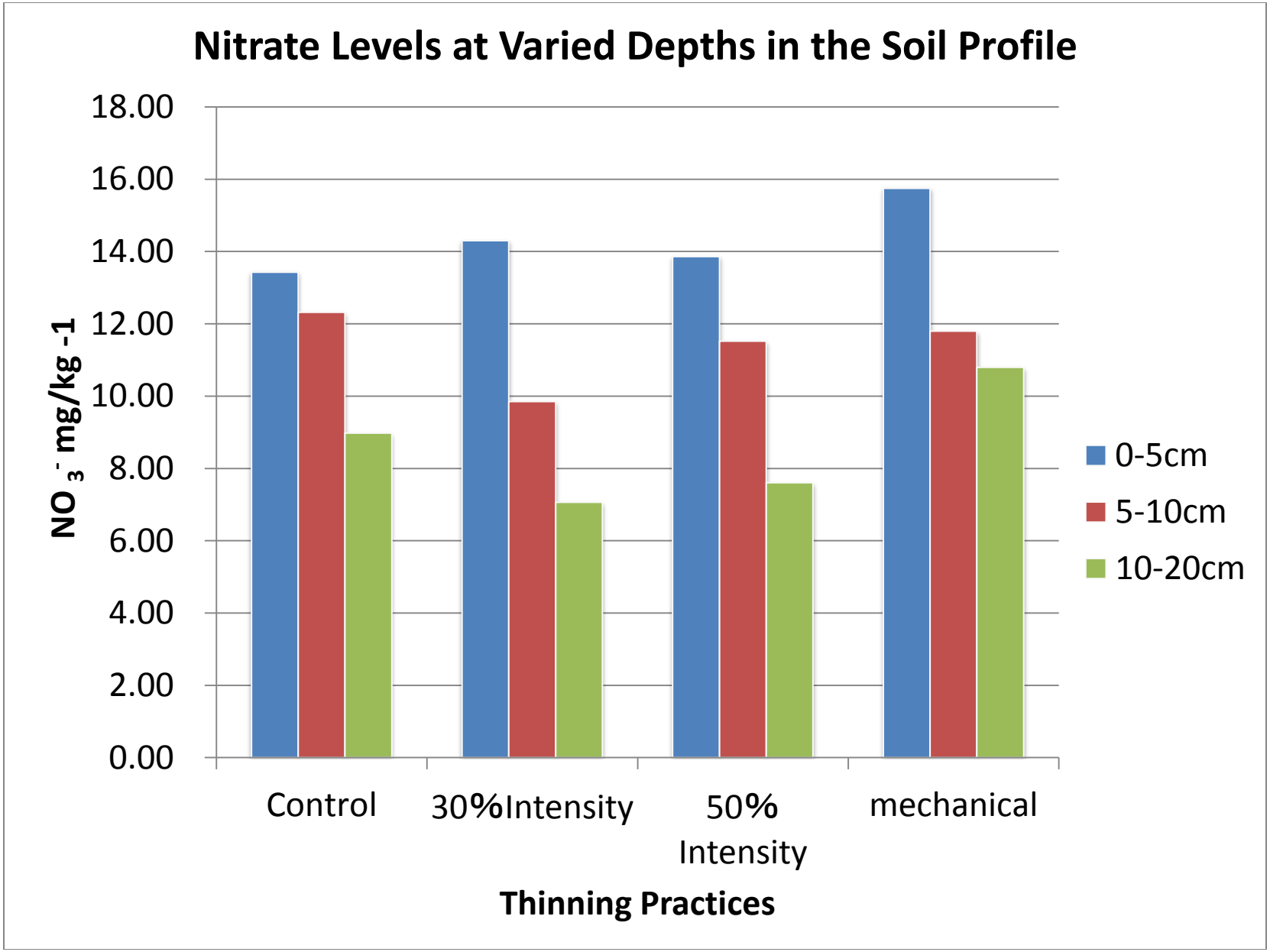
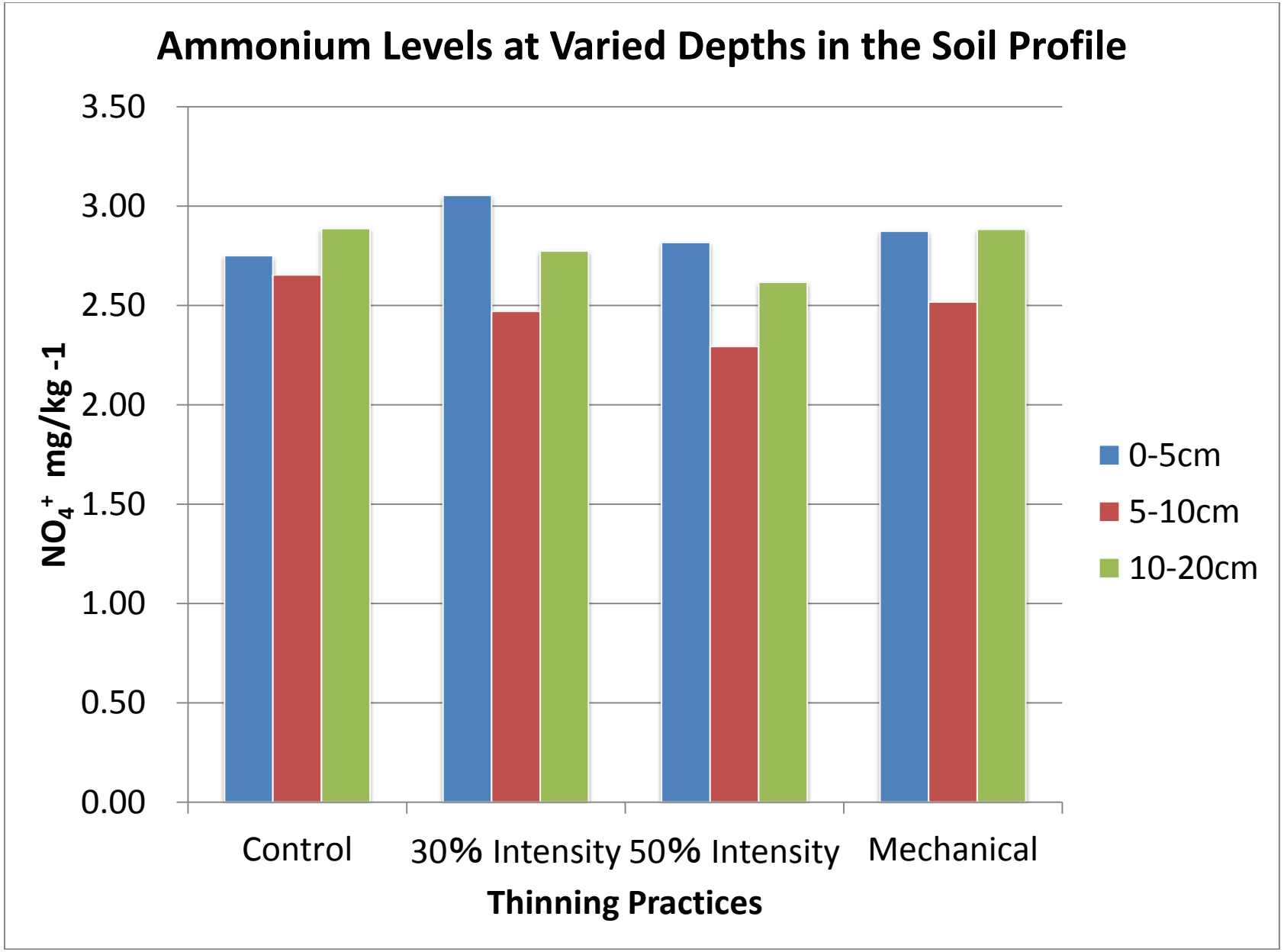
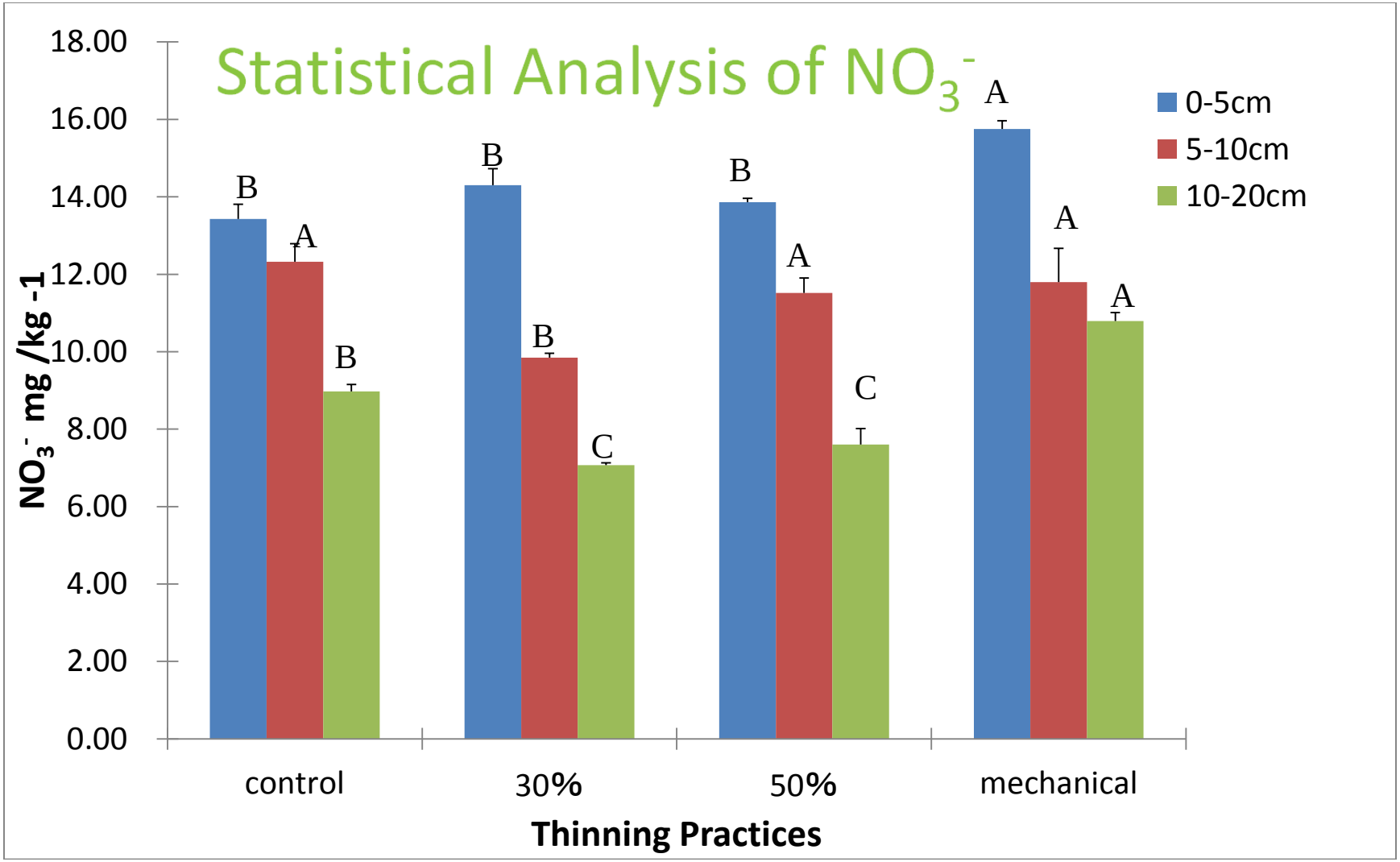
Concentration of Nitrogen in Varied Depths of the Soil Profile					
	Sample 1	Sample 2	Sample 3	Average	Standard Deviation
0-5cm					
Control	13.15	13.27	13.86	13.43	0.380044
30%	14.15	14.78	13.96	14.30	0.429224
50%	13.81	13.98	13.79	13.86	0.104403
Mechanical	15.98	15.55	15.72	15.75	0.216564
5-10cm					
Control	12.14	12.85	11.97	12.32	0.466798
30%	9.73	9.85	9.96	9.846667	0.115036
50%	11.65	11.82	11.09	11.52	0.381969
Mechanical	11.91	10.87	12.61	11.79667	0.875519
10-20cm					
Control	9.12	9.03	8.78	8.976667	0.176163
30%	7.12	7.08	7	7.066667	0.061101
50%	7.7	7.15	7.96	7.603333	0.413562
Mechanical	10.87	10.96	10.55	10.79333	0.215484


Nitrate Levels at Varied Depths in the Soil Profile
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
NO 3 - mg/kg -1
Control
30%Intensity
50% Intensity
mechanical
Thinning Practices
0-5cm
5-10cm
10-20cm


Ammonium Levels at Varied Depths in the Soil Profile
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
NO_4^+ mg/kg -1
0-5cm
5-10cm
10-20cm
Control
30% Intensity
50% Intensity
Mechanical
Thinning Practices


Statistical Analysis of NO_3^-
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
NO_3^- mg /kg -1
B
A
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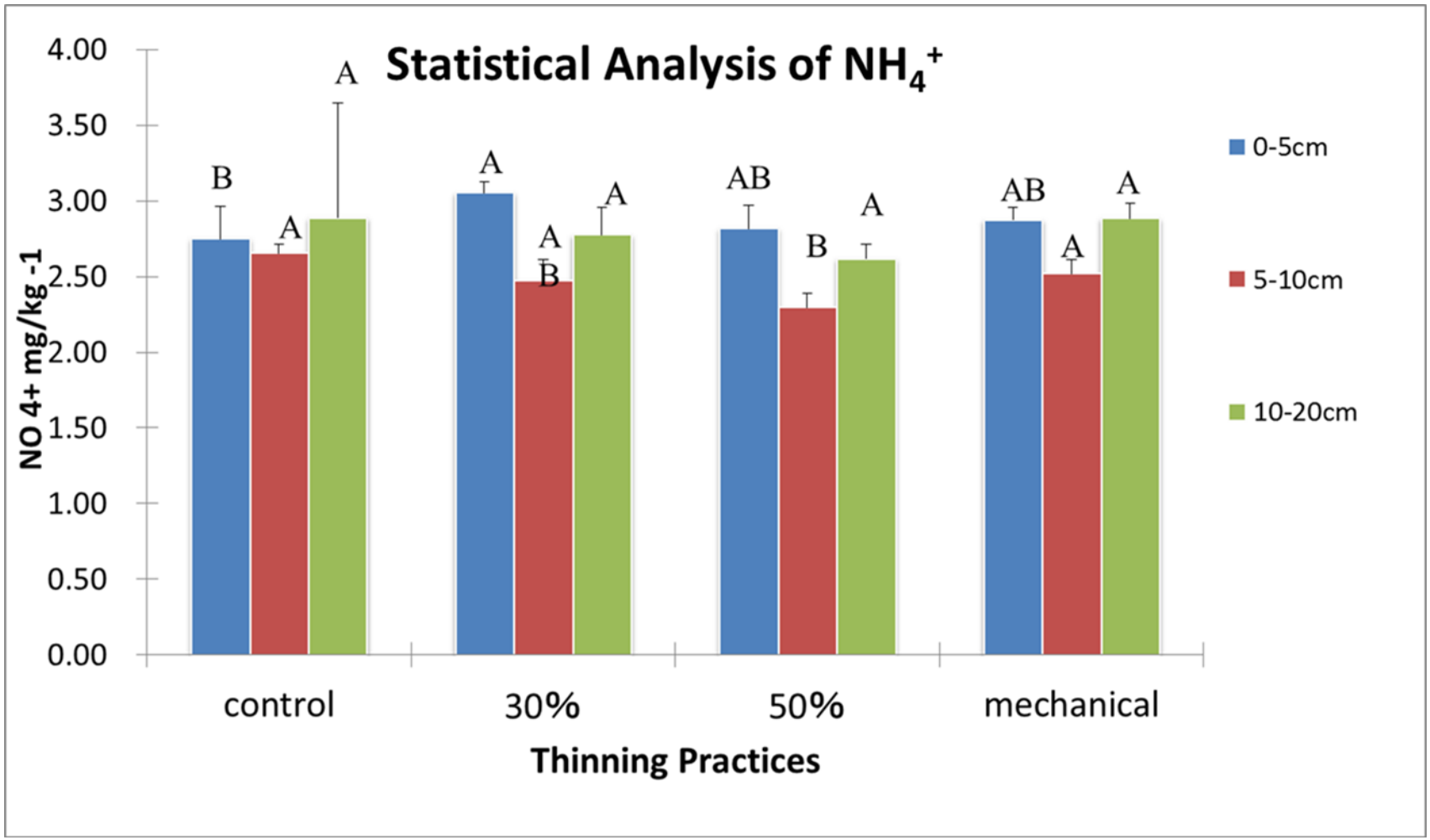
0-5cm
5-10cm
10-20cm
control
30%
50%
mechanical
Thinning Practices


Statistical Analysis of NH_4^+
NO 4+ mg/kg -1
4.00
3.50
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10-20cm
control
30%
50%
mechanical
Thinning Practices

EFFECTS OF THINNING ON SOIL MICROBIAL DIVERSITY BY DNA ANALYSIS

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Abstract

We studied the effects of thinning on soil microbial characteristics around the Chenwei Forestry Research Station, located in Sihong County, Jiangsu Province. The goal of this research is to analyze the effects of thinning practices on the soil microbial characterizes of the poplar plantation. This was accomplished by determining the soil microbial diversity by using the DNA analysis method. The initial analysis shows that after thinning, significant amounts of DNA appears to be present in samples 11-17 and that there are only small amounts in 18-20. Future analysis will include DGGE to determine the presence of ammonium oxidizing bacteria. The gel also shows several very bands, which could indicate a particularly high amount of DNA in the samples. The impacts of thinning on selected soil ecological properties could be seen through DNA extraction analysis, but further research is required with respect to microbial activity and community structure. This preliminary analysis could lead to the identification of ammonium-oxidized bacteria through DGGE.

Introduction

With the economic incentives and interests in fast- growing poplar hybrids for short-rotation production for fiber and veneer, poplar plantations have been recently established in southwestern upland areas of China. However, poor site conditions limit the growth and ecological function of newly established poplar plantations (Fang et al. 2007, 2008).

Thinning practices of poplar plantations are being studied at the Chenwei Forestry Research Station. Thinning is the cutting down and removal of a section of trees in a forest crop. Thinning is done to provide more growing space for the remaining trees, which in turn leads to an increase in volume of individual trees. The objective of thinning is to concentrate the volume increase in a smaller number of trees and a greater portion of sawlog.

There are numerous methods of thinning which includes selective and systematic thinning. Selective thinning involves trees being removed or retained on their individual value. Systematic thinning requires the removal of trees according to a predetermined system, such as line thinning. Line thinning, which is a combination of both systems, proves to be the most efficient management method.

This research is being conducted at Nanjing Forestry University to determine what direct effects thinning has on nutrient cycling, tree growth, forest microclimate, undergrowth plant diversity, amount and nutrient of litter, and soil microbial characteristics. The goal of this research is to analyze the effects of thinning practices on the soil microbial characteristics of the poplar plantation. This will be accomplished by determining the soil microbial diversity through DNA analysis.

Forest management practices such as thinning can have significant effects on soil moisture, temperature regimes and the amounts and composition of organic matter inputs. The aim of this study was to examine the effects of thinning on soil microbial activities and thus affect soil organic matter turnover.

Materials and Methods

Several methods have been developed for the assessment of microbial community structure and identification of species within the community. Most common are methods that rely on extraction of DNA from soil and subsequent characterization of DNA sequences. Several protocols for extraction of soil DNA suitable for further molecular analysis have been developed, which includes direct extraction of DNA from soil, PCR amplification of rRNA genes, followed by DNA sequence analysis by denaturant gradient gel electrophoresis (DGGE). Polymerase Chain Reaction (PCR) is a widely used laboratory technique to amplify DNA. DNA amplification is a form of replication, or copying, in which multiple copies of a particular DNA species are replicated to create many more copies of a particular DNA sequence. Denaturing gradient gel electrophoresis (DGGE) is a molecular fingerprinting method that separates polymerase chain reaction (PCR)-generated DNA products. The polymerase chain reaction of

environmental DNA can generate templates of differing DNA sequence that represent many of the dominant microbial organisms.

Experimental Site

The Chenwei Forestry Research Station is located in Sihong County near Jiangsu Province. The latitude of the experimental site is 33°32N, the longitude is 118°36E. The mean annual precipitation is 972.5 mm, more than 80% of which falls during June to August. The mean annual temperature is 14.4℃.

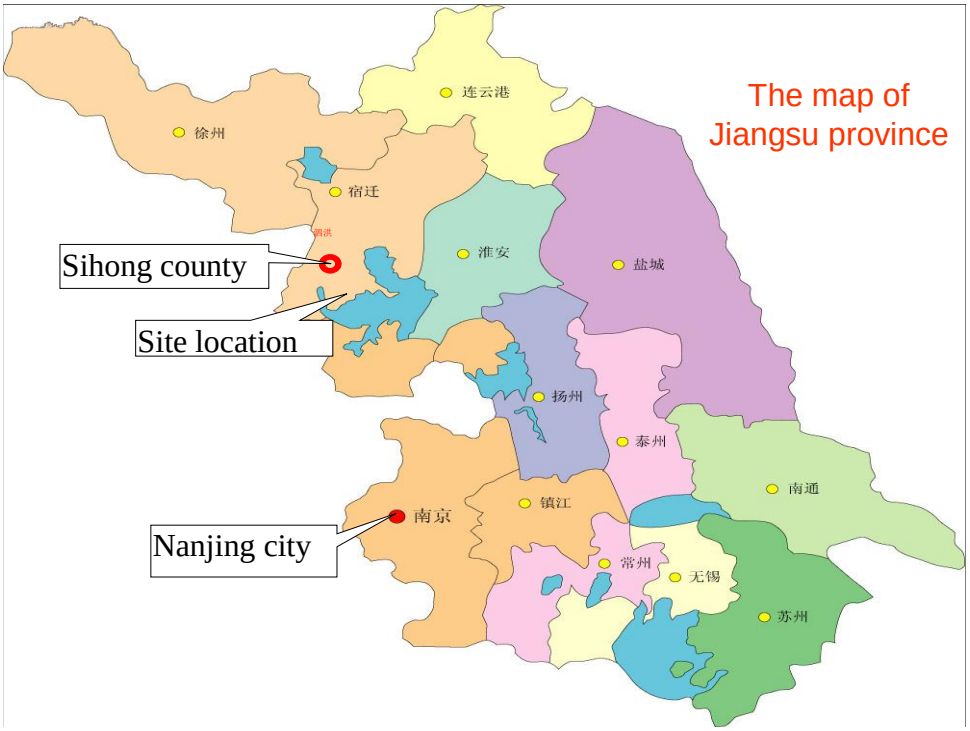

Figure 1. Location of Chenwei Forestry Research Station Located in Sihong County, Jiangsu Province.

Field Work

Field trips were arranged in April 2012 to collect soil samples from the Chenwei Forestry Research Station. The soil samples were taken from the upper 0–5, 5-10 and 10-20 cm soil layers. Soil augers were used to collect soil samples at three different depths. The collected samples were brought to the laboratory and refrigerated at 4 °C until the time of the analyses.

Figure 2. Graduate students from Nanjing Forestry University collecting soil samples.

Soil Preparation

Soil samples were prepared for analyses by grinding the samples with a mortar and pestle. Then, the samples were made to pass a 2mm-sieve. The samples were then bagged in plastic bags for analyses. The soil samples were refrigerated at 4 °C until the time of the analyses.

Laboratory Work/Procedure

SDS-based DNA extraction method. Since Cetyltrimethylammonium Bromide (CTAB) performed better in reducing humic contamination, it was used in the buffer for sodium dodecyl sulfate (SDS)-based DNA extraction. Soil samples of 5 g were mixed with 13.5 ml of DNA extraction buffer (100 mM Tris-HCl [pH 8.0], 100 mM sodium EDTA [pH 8.0], 100 mM sodium phosphate [pH 8.0], 1.5 M NaCl, 1% CTAB) and 100 ml of proteinase K (10 mg/ml) in Oakridge tubes by horizontal shaking at 225 rpm for 30 min at 378C. After the shaking treatment, 1.5 ml of 20% SDS was added, and the samples were incubated in a 658C water bath for 2 h with gentle end-over-end inversions every 15 to 20 min. The supernatants were collected after centrifugation at 6,000 3 g for 10 min at room temperature and transferred into 50-ml centrifuge tubes. The soil

pellets were extracted two more times by adding 4.5 ml of the extraction buffer and 0.5 ml of 20% SDS, vortexing for 10 s, incubating at 658C for 10 min, and centrifuging as before. Supernatants from the three cycles of extractions were combined and mixed with an equal volume of chloroform isoamyl alcohol (24:1, vol/vol). The aqueous phase was recovered by centrifugation and precipitated with 0.6 volume of isopropanol at room temperature for 1h. The pellet of crude nucleic acids was obtained by centrifugation at 16,000 3g for 20 min at room temperature, washed with cold 70% ethanol, and re-suspended in sterile deionized water, to give a final volume of 500 ml.

Gel Electrophoresis. 1% agarose gel was made with wells for sample placement. 1 g of agarose powder was placed into XTBE buffer and microwaved. 1 µl Ethium Bromide was added to solution and mixed/swirled. A comb was placed into the electrophoresis tray and the hot agarose mixture was poured into the tray. The agarose mixture cooled with comb inside (to make wells). 2 µL of Bromophenol Blue was added to 7µL of each DNA sample (after PCR testing) and placed in a well. The electrodes were attached and electrophoresis ran at 80 volts for 120 minutes. The gel was removed from the solution and placed in Bromophenol Blue staining solution for 30 minutes.

Figure 3. Performing DNA Analysis Method.

Results and Discussion

The initial analysis shows that after thinning, significant amounts of DNA appears to be present in samples 11-17 and that there are only small amounts in 18-20. Future analysis will include DGGE to determine the presence of ammonium oxidizing bacteria. The electrophoresis gel shows a single band in each well (except for a faint set of bands in wells 18-20). This indicates any combination of things: there were several different sized DNA molecules in each sample but only 7 particular sizes had enough to fluoresce brightly enough to detect with the naked eye or the gel ran too long and all the DNA traveled to the end of the gel. This idea is countered by what looks like several (faint) bands in the last 3 wells. If the gel was on too long, we would expect the ladder to also show only a single band at the end. The gel also shows several very bright samples. This could indicate a particularly high amount of DNA.

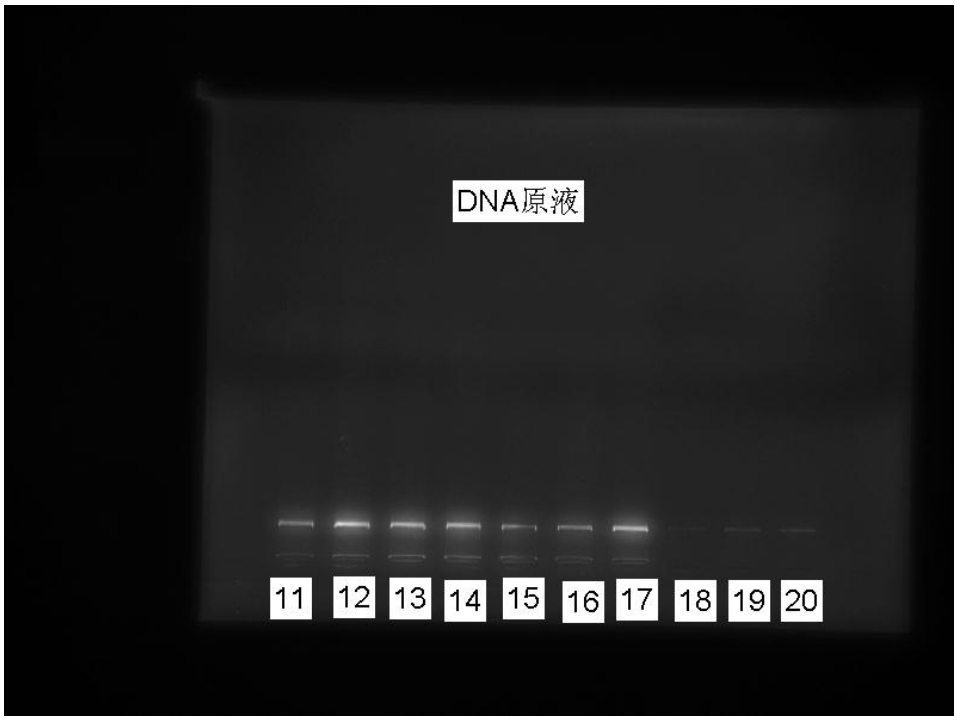

Figure 4. The picture depicts an image of the agarose gel used to verify results obtained from the PCR.

Conclusion

First indications of impacts of thinning on selected soil ecological properties could be found but further research is required with respect to microbial activity and community structure. With culture-independent methods, we are starting to get a better picture of the enormous biodiversity

of microorganisms in soils. New primers are constantly being developed, allowing the amplification of specific microbial groups. However, there are a number of limitations to DNA-based methods: (a) due to amplification bias during PCR, the abundance of a DNA sequence in a sample and band intensity may not be directly related; (b) most methods can only detect the most abundant species/DNA sequences present and may therefore underestimate biodiversity. Despite these limitations, DNA-based methods such as DGGE are powerful tools that can provide insight into microbial community composition.

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GENE CLONING AND IDENTIFICATION OF THE FATTY ACID BIOSYNTHETIC PATHWAY IN *CAMILLIA CHEKIANGOLEOSA*

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Abstract

Gene cloning and identification plays an important role in creating a transgenic plant that expresses certain genes conferring tolerance to abiotic stresses. *Camellia chekiangoleosa* is a species native to eastern Asia that is used to produce tea oil. Tea oil holds much economic value in eastern Asian countries, especially China. Research involved with this species or species similar to it is very slim and specific to planting/breeding and characteristic analysis of its products (Zhang, D. Q. et al 2008). The focus of this study is to identify the molecular mechanisms of fatty acid synthesis that will yield the best quality and most efficiently made tea-oil. All the key genes involved with the fatty acid biosynthetic pathway of *C. chekiangoleosa* will be cloned and identified. For this particular study only the following six were studied: stearoyl-ACP desaturase (SAD), palmitoyl thioesterase (PT), acetyl-CoA carboxylase (ACC), biotin carboxylase (BC), 3-ketoacyl- CoA synthase (KCS), and acyl-acyl carrier protein thioesterase type B (FatB). A full-length cDNA sequence for each gene was amplified using PCR and cloned in E.coli by a pMD 19-T Vector (Takara Bio Inc., Japan). Sequencing was contracted out to BGI LifeTech Co. (Beijing, China). The BLAST analysis of each gene's sequence showed which species had highest similarities with *C. chekiangoleosa* based on protein sequences and structure. SAD, ACC, BC, KCS, and FatB were all successfully cloned and identified. Suitable primers were not successfully designed to initially amplify PT and therefore, it was unable to be cloned. Once all the genes of interest are cloned and identified, the level of fatty acid synthesis at different developmental stages of *C. chekiangoleosa* seeds will be quantified. The overall objective of this study is to observe and measure the roles that each gene has in the production of fatty acids to produce a transgenic plant that will incorporate the most valuable characteristics to produce the best camellia oil.

Introduction

The genus *Camellia*, belonging to the family Theaceae, is native to eastern Asia. There are over 3,000 cultivated varieties of ornamental Camellia worldwide. About 90% of its species originated in Southeastern China (Mondal 2011). Camellia has great economic importance to many Asian countries due to its ability to produce tea, oil, ornamental flowers, and pharmaceutical products. *C. sinensis* is the most common species to prepare tea because of its containment of caffeine (2.78%) and its ability to stimulate the central nervous system (Mondal 2011). *Camellia chekiangoleosa*, also known as cháhuā or flowering tea, is very effective at producing oil with a kernel whose oil-yield rate is 55% (Zhang, D. Q. et al 2008). Camellia oil's composition is made up of mostly oleic acid and low polyunsaturated fatty acids (Haiyan et al 2006). It serves as a healthy alternative to other oils due to its ability to prevent cardiovascular cirrhosis, lower blood pressure, reduce body fat, and even prevent cancer (Wu et al 2005). Hong (1988) found that young men who had camellia oil in their diets compared to beef tallow had higher levels of HDL-cholesterol levels.

Camellia holds the largest annual oil yield of all the other woody oil plants in China and has the largest plantation areas (Haiyan et al 2006). Tea oil is also the main cooking oil used in China, particularly in the Hunan province where 50% of their vegetable cooking oil is from camellias (Ruter 2002). The need for tea oil in China for the year 2000 was estimated to range from 485,000 to 551,000 metric tons (Fang 1994). Camillia oil has been used in cosmetics and derma-pharmaceuticals as well as pesticides, feeds and fertilizers (Sabetay 1972). A component of camellia oil called triterpenoid saponin has been shown to improve immune function by enhancing antibacterial and antiviral activities as well as having autoxidation properties in humans and animals (Zhan 1999). The majority of research and oil produced by camellia species comes from *C. oleifera*. Since not much is known about *C. chekiangoleosa*, this research is valuable to expand the use of camellia oil.

This study focused on cloning and identifying the genes that are expressed in *C. chekiangoleosa's* fatty acid biosynthetic pathway. The ultimate goal is to produce a transgenic plant that will express specific genes conferring tolerance to abiotic stress conditions. The six genes that were tested include: Stearoly-ACP desaturase (SAD), Palmitoyl Thioesterase (PT), Acetyl-CoA carboxylase (ACC), Biotin carboxylase (BC), 3-ketoacyl-CoA synthase (KCS), and Acyl-acyl carrier protein thioesterase type B (FatB). Each gene plays a key role in coding for an enzyme or protein that is involved with the fatty acid synthesis of *C. chekiangoleosa*. Identifying and cloning each gene is the first step in the process of transformation. It will allow further work to be done to study the mechanism of gene expression in the seeds of *C. chekiangoleosa* and also quantify the level of fatty acid synthesis at different developmental stages of the seeds.

Samples were taken from *C. chekiangoleosa* and the RNA was extracted and purified using a CTAB-based protocol that allows rapid isolation of high-quality RNA from many woody species (Gambino et al 2008). The genes were then identified by designing specific primers to locate the target region of RNA and amplify it using polymerase chain reaction (PCR). Three different steps were then taken to verify that the amplified cDNA was the correct fragment of the desired gene. The simplest method of verification utilized was gel electrophoresis with a ladder to

identify the base pair (bp) length of amplified fragments. If the gel was successful then the cDNA was recovered using a TIANgel midi Purification Kit (Tiagen, China). The fragment that coded for a particular gene was then introduced to *E.coli* to see if the gene could be replicated correctly. For the *E.coli* to accept the foreign cDNA it was first ligated to a pMD 19-T vector (Takara Bio Inc., Japan). Once the genes were allowed to replicate in the *E.coli*, electrophoresis using 1% agarose TAE gel was performed to determine whether the cloned DNA was correct. If these two steps were successful, the ultimate verification is conducted by sequencing the DNA. Sequencing was contracted out to BGI LifeTech Co. (Beijing, China) and a bioinformatics analysis was carried out on the results.

These steps were implemented for each gene. Once all the genes involved in fatty acid synthesis, including the six utilized in this experiment, have been successfully cloned and identified their expressions will be studied in the seeds of *C. chekiangoleosa*. The seed is the specific part of the plant that is used to produce oil. Every ten days of the seed's development, samples will be taken and processed through an HPLC machine to quantify the level of fatty acid synthesis. The specific gene expressed and how much fatty acid it produces at each stage will also be determined. These genes will then be observed in a transgenic plant to see how they are expressed when exposed to different abiotic stresses including: physical wounds, heat, and drought. Understanding *C. chekiangoleosa's* responses to these stresses is key to engineering better and stronger crops (Xiong and Zhu 2001). Currently in the tea-oil production economy, provinces or regions may not have enough tea-oil genetic resources and the amount of superior clones available are not enough to meet the need of production (Zhang, R. et al 2008). The objective of this study is to observe and measure the roles that each gene has in the production of fatty acids to produce a transgenic plant that will incorporate the most valuable characteristics to yield and produce the best camellia oil.

Methods

RNA Extraction and Purification

RNA purification allows for pure RNA from the seeds of a mature *C. chekiangoleosa* specimen to be utilized in order to identify specific genes. The process to purify the RNA was followed from cetyltimethylammonium bromide (CTAB) based protocol. Fresh plant tissue (0.3g) was ground to a very find powder in liquid nitrogen using a precooled (with liquid nitrogen) mortar and pestle. The powder was transferred to 500µl of extraction buffer (100mM, Tris-HCl (pH 8.0), 2.0M NaCl, 25mM EDTA, 2% CTAB, 2% PVP, and 3% β-mercaptoethanol just prior to use) and incubated at 65°C for 30 minutes. After an equal volume of chloroform was extracted, the upper aqueous phase was transferred to a new tube. Ethanol was added slowly to a final concentration of 20% and precipitated for 30 minutes. The supernatant was transferred to another tube. One-third of the volume of 10M LiCl was added and precipitated for 4 hours at 4°C. The tube was centrifuged at 14000xg for 20 minutes at 4°C. The supernatant was discarded and the spare pellets were re-suspended in 250µl of SSTE buffer (1M NaCl, 0.5% SDS, 10mM Tris-HCl (pH 8.0), 1mM EDTA). The suspension was transferred to a new tube and extracted with PCI and chloroform. The supernatant was then transferred to 2 volumes of precooled absolute ethanol. RNA was precipitated at -20°C for 2 hours. After the tube was centrifuged at 14000xg at

4°C for 20 min, the pellets were washed twice with 1ml of precooled 70% ethanol by centrifuging at 10000xg at 4°C for two minutes. Dried at room temperature, the pellets were dissolved in 50µl DEPC-treated water. The rough RNA was then treated with DNase I (Takara Bio Inc., Japan). RNA yield was measured with the ND 1000 UV-Vis Spectrophotometer (NanoDrop Technologies, New Zealand) and checked by electrophoresis in 1% agarose TAE gels.

Amplification of Full-Length cDNA

Forward and reverse primers were designed specifically for each gene to amplify the full length cDNA. Designed primers for each gene are shown in Figure 1. First the sequence was found using BLAST. Primer Premier 5 software was used to design primers to amplify each gene. Oligo 6 software was then used to analyze the primers. This software chooses the primers to have the proper characteristics. They are unique with minimal amounts of hairpins, mismatch, and chance of primer dimer. This program also analyzed the ΔG value and annealing temperature.

Gene	Primer
SAD	5’ ACACAGTTCCATCAGGGTCAATCTCAAAGAGCTT 3’
	3’ ATCTACACTTCGTTTCAAGAGAGAGCAACCT 5’
PT	5’ CGCCTTCTTGCTCGCCACCTGAGAAAGTCC 3’
	3’ AGTGAAGGTTACAACATAGTTGGACTTTCTCAGG 5’
BC	5’ GTTCAATAGCTCTCTCTCTTGTTGGAGCCCATAC 3’
	3’ TTGTATGGGCTCCAACAAGAGAGAGAGCTATT 5’
CS	5’ TCCACATGAATTGGCAGCAGCTGCAAATTCTTCT 3’
	5’ ACGCTTGCATTTGATCATTTCTGCATACATGC 3’
ACC	5’ TCAGCAAATATGAGCTCTGTGACTTTAAGAACT 3’
	3’ GGATTCAAAGATTGCGGAAGGCAGAGAAGAT 5’
FatB	5’ CATCTGGTATCTTAGATAACCTCCGTGTCTCT 3’
	3’ GAATGGTATGCGGCGTGATTGGATTGTCCAT 5’

Figure 1. Designed Primers. Forward and reverse primers were specifically designed to amplify the entire cDNA for each gene. Each PCR amplification was conducted using a 60 C annealing temperature.

PCR was conducted using a common cocktail for each gene. This cocktail consisted of 2.5µl RNA template, .3µl LA-Taq polymerase, 2µl each of the forward and reverse primers, 4µl of $MgCl_2$ and DNTPs, 5µl LA- buffer, and 30.2µl of nuclease-free water. Initial denaturation was conducted at 94°C for 3 minutes followed by 30 cycles of 94°C denaturation, 60°C annealing, and 72°C elongation at 30 seconds each. The cycles were followed by a final elongation at 72°C for 4 minutes. Results were observed using electrophoresis in a 1% agarose TAE gel. Each successful amplification in the gel was cut and the cDNA was recovered using a TIANgel midi Purification Kit (Tiagen, China). CDNA yield was measured with the ND 1000 UV-Vis Spectrophotometer (NanoDrop Technologies, New Zealand).

E.coli cloning by pMD 19-T Vector

Once the cDNA has been successfully amplified to only encompass the target gene it can be introduced to *E.coli* and allowed to clone. For the gene to be cloned in *E.coli*, it must first be ligated to a vector. Figure 2 shows the pMD 19-T vector produced by Takara that was attached to the amplified cDNA using PCR. The cocktail included: 2.5µl of PCR buffer, 0.5µl of the vector, and 2.0µl of the gene cDNA. The solution was placed in the PCR machine for 3 hours at 16°C.

Top Ten *E.coli* produced by Tiagen, was first added to 2.5µl of each gene and let sit for 20 minutes. It was then shocked by a 42°C water bath for one minute followed by 3 minutes in ice. The solution was then added to 800µl of SOC culture medium and centrifuged at 3000xg for 4 minutes. 600µl of SOC was abandoned. The remaining solution was pipetted onto a petri dish made of LB with ampicillin.

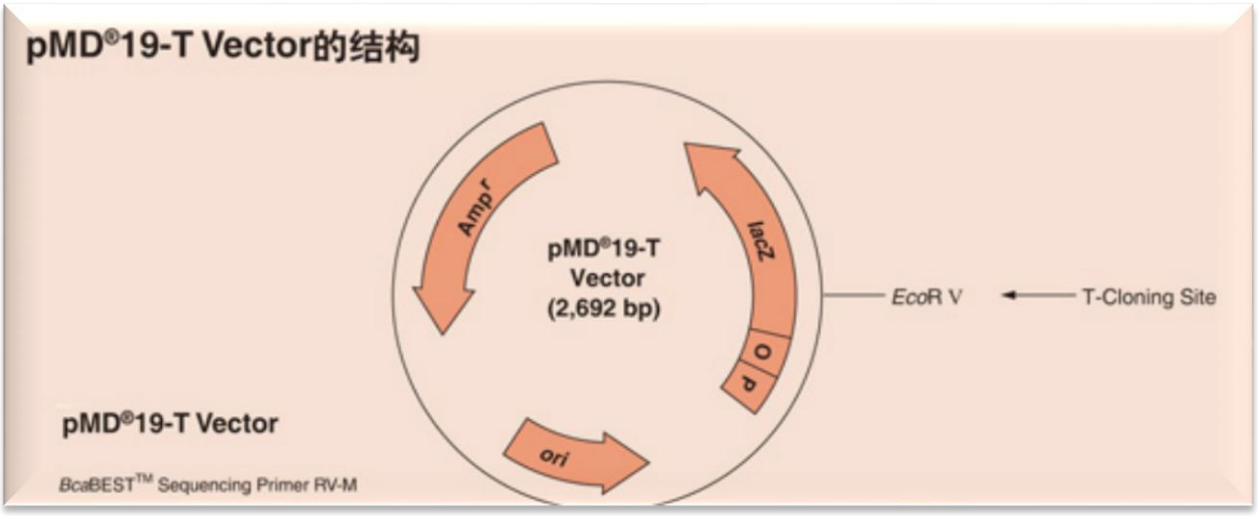

Figure 2. pMD 19-T Vector. The pMD 19-T vector produced by Takara (Takara Bio Inc., Japan) was used because it would allow for each gene to become cloned in E. coli. The EcoR V location labeled above indicates where the gene would be ligated to the vector.

To verify that the cloned DNA was the correct gene, PCR was conducted. The cocktail consisted of 2µl of DNA and buffer, 0.3µl of taq, 0.5µl of forward and reverse primers, 1.6µl of $MgCl_2$ and DNTPs, and 11.5µl of Water. The same PCR thermo-cycler conditions were used as before except the annealing temperature is 55°C. Gel electrophoresis was conducted to verify the PCR results using a TAE 1% agarose gel.

Sequencing and Bioinformatics Analysis

If the amplification was successful, then the DNA was sent to the company BGI LifeTech Co. in Beijing, China to be sequenced. This company used an ABI 3730 DNA analyzer to obtain the nucleotide sequence of the gene. The obtained sequences were checked and edited manually by using BioEdit 5.0.9 software.

Once the cloned DNA had been sequenced, a bioinformatics analysis occurred to identify the genes and find similarities between *C. chekiangoleosa* and other species. The known primers within the sequence were removed and it was processed through BLAST. If BLAST recognized that the sequence was the same as the gene in a similar plant then the cloning was successful. Similar protein sequences of each gene were examined using Clustal X software to find similar species. A phylogenetic tree was then created using Mega 5 software to illustrate the similarity among species.

Results

Amplification of Full-Length cDNA

Figure 3 shows the amplifications of each gene from the designed primers. All the genes were successfully amplified except for the PT gene. Since the entire cDNA sequence of PT could never be isolated, further cloning of this gene was not possible. The cocktail was held constant for each gene with the same PCR thermo-cycler conditions as explained above.

***E.coli* cloning by pMD 19-T Vector**

Figures 4 and 5 shows PCR amplification of samples taken from each gene cloned in *E.coli*. Each gene had a petri dish that was used for its specific cDNA. Every petri dish had many locations of *E.coli* development and cloning. The different lanes in the gel represent a different sample of that particular gene taken from an independent location in the petri dish. Each gene was successfully amplified in at least one location of each petri dish. That successful sample was then sent off for sequencing.

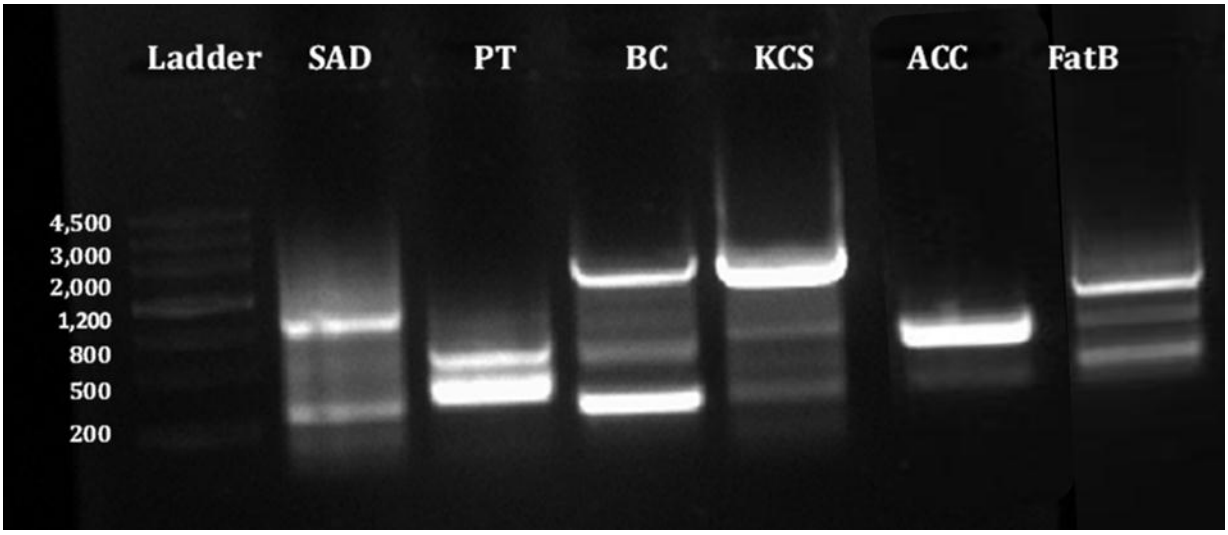

Figure 3 Amplification with designed primers. After running gel electrophoresis on a 1% TAE gel, an analysis of bands amplified through PCR was conducted. Lane 1 showed a DNA marker III ladder with the corresponding bp lengths. Each lane contained specific designed primers to amplify each gene. The amount of primer added to the cocktail remained consistent at 2µl each for forward and reverse. The same amount of RNA template was also held constant at 2.5µl per trial. Annealing temperature for each PCR cycle was 60°C. Each gene was amplified successfully if the band corresponded to the correct amount of bp in relation to the ladder. Every gene was successful except for the PT gene in lane 3.

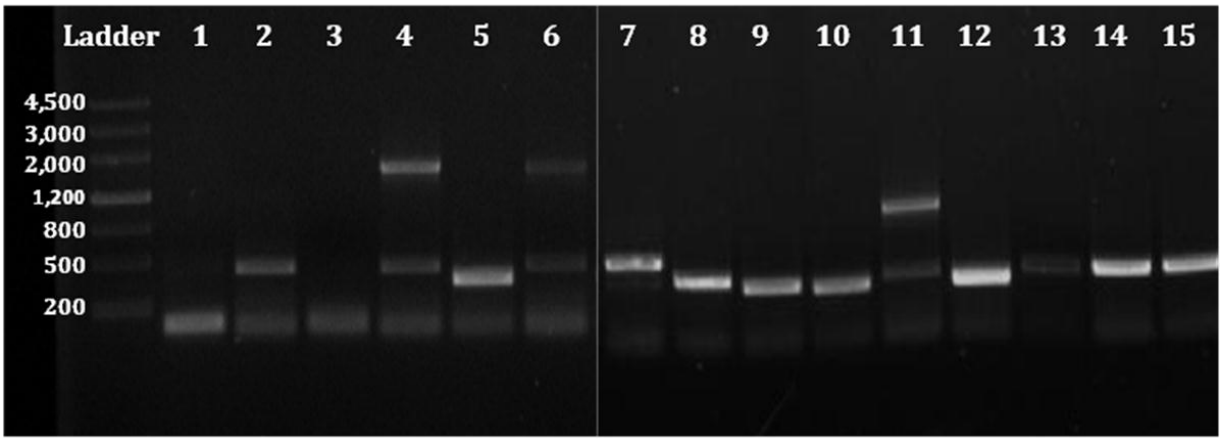

Figure 4. KCS, SAD, and ACC cloned results. Gel electrophoresis was conducted on samples taken from cloned colonies in *E.coli* to verify that the genes were cloned correctly. Each lane holds an independent sample taken from different location on the *E.coli*. Equal amounts of primer was used for each gene at 0.5µl of forward and reverse primers. cDNA template was also kept constant at 2µl for each gene. Lanes 1-6 showed cloning of KCS with successful amplification in lanes 4 and 6. Lanes 7-12 showed SAD with successful amplification in lane 11. Lanes 13-15 showed ACC with successful amplification in all of them.

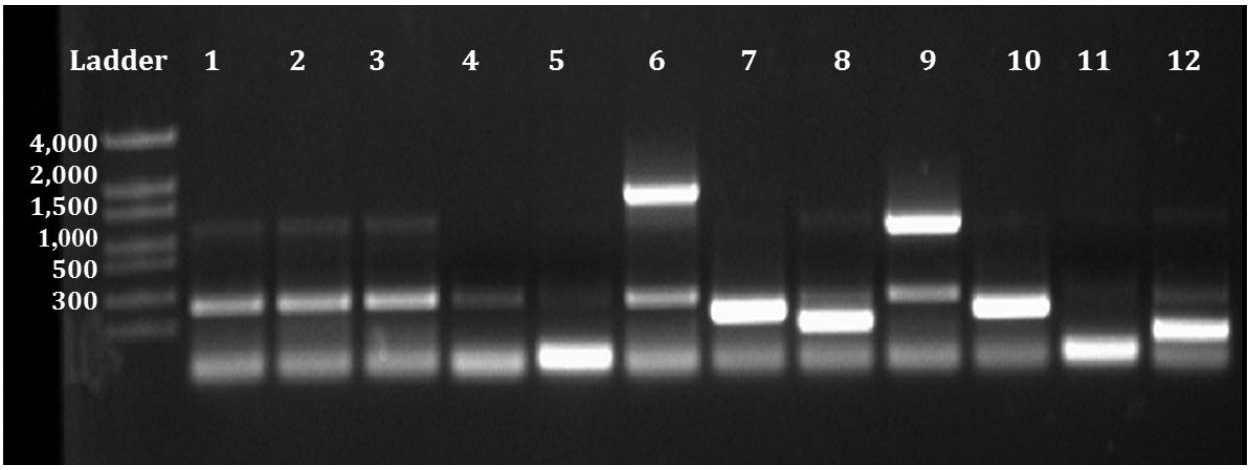

Figure 5 BC and FatB cloned results. Gel electrophoresis was conducted on samples taken from cloned colonies in E.coli to verify that the genes were cloned correctly. Each lane holds an independent sample taken from different location on the E.coli. Equal amounts of primer was used for each gene at 0.5µl of forward and reverse primers. cDNA template was also kept constant at 2µl for each gene. Lanes 1-6 showed cloning of BC with successful amplification in lane 6. Lanes 7-12 showed FatB with successful amplification in lane 9.

Sequencing and Bioinformatics Analysis

Sequencing was contracted out to BGI LifeTech co. The BLAST results of these sequences provided species that had similar protein sequences as *C. chekiangoleosa*. A phylogenetic tree was created among the species that were similar. Protein structures of each gene were also constructed. These figures were unable to be displayed but will be published later by Ph.D. student, Mr. Zhongwei Wang at Nanjing Forestry University.

Discussion

The results from this study found the complete cDNA sequence for SAD, BC, KCS, ACC, and FatB genes in *C. chekiangoleosa*. It also identified species that have similar protein sequences to *C. chekiangoleosa*. Methods used in this experiment are very standard and can be compared to other experiments with similar objectives. Elrobh et al 2011, used the same techinique of isolating the gene's complete cDNA through PCR amplification. They also carried out similar bioinformatics analysis by comparing their species to many similar ones by their protein sequences. From this information they constructed a phylogenetic tree. Chen et al 2010, also produced gene specific primers using the same method as this study. They verified the PCR using a 1% agarose gel and purified the results using the TIANgel midi Purification Kit (Tiagen, China) and followed by attaching it to a similar vector to allow for cloning in *E.coli*. There results also showed success from these protocols.

Further experimentation will be done to try and identify the failed gene, PT. Numerous possibilities could have accounted for these failed results. The primers that were made to amplify

this gene could have been incorrect with great probability of dimers and mismatch. The PCR cocktail could also be modified slightly to allow for more accurate results by increasing the concentration of RNA template and taq-polymerase. PCR thermo-cycler annealing temperature could be adjusted to increase primer annealing specificity.

Conclusion

The complete cDNA sequence for the following genes involved in fatty acid synthesis for *C. chekiangoleosa* were cloned and identified: SAD, BC, KCS, ACC, and FatB. The findings in this experiment are a very limited amount of information that will be incorporated to produce a transgenic plant. The next step will be to clone and identify all the genes involved with fatty acid synthesis of *C. chekiangoleosa*. Being able to identify these genes is key to measuring the amount of fatty acid they produce. There expressions will then be studied in seeds of different ages. Collectively this data will allow each gene's expressions to be observed in a transgenic plant that will be engineered to confer to abiotic stresses. The entire process will create a plant that can produce Camellia oil more efficiently and at a better quality.

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GENETIC MAP CONSTRUCTION OF THE *SALIX INTEGRA*

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Abstract

Poplar and willow both belong to the family Salicaceae, and thus their chromosomes sequences are very similar. Genetic mapping for poplar has been completed, so its chromosome sequence can be used to the study that of the willow tree species *Salix integra*. *S. integra* blossoms in one or two years, grows very fast, and is smaller than poplar, which makes it a good species for which to create a genetic map and build up a chromosome skeleton, allowing us to lay the foundation for gene location. Taking *S. integra* F1 progeny, including 92 progeny and 2 parents as experimental material, the genomic DNA was extracted from the leaves by modified CTAB extraction method. There are 192 pairs of primer combinations, composed with 16 EcoRI and 12 MseI selective amplification primers respectively. One hundred five pairs of primer combinations with high polymorphism were selected from the 192 pairs of AFLP primer combinations for AFLP analysis of *S. integra*. The 105 pairs of primer combinations were also used to population this includes 92 *S. integra* F1 progeny and 2 Parent amplification, the amplification products were detected by ABI 3730 electrophoresis and the clear and repeatable gel profiles were obtained. After the correct pairing is achieved data statistics, can then be used in the mapmaker 3.0 to AFLP Data analysis, finally we can get genetic map.

Introduction

The knowledge of genetic maps of plants have led to the development of agricultural crops and trees that are more nutritious, productive and can better resist diseases, insects and drought. This allows researchers to breed hybrid plant with combined genotypes and phenotypes of both the mother and father specimen.

Many studies have been conducted using gene mapping on plants. For example, scientists mapped the key genes in a group of trees that includes poplars and aspens, a result that could enable scientific rescues of all kinds of trees from drought and pests (Lloyd, 2004).

The genus *Populus* includes about 35 tree species worldwide. It is the most commonly studied tree by forest researchers because it often show genetic comparison with other trees. This knowledge gives a great advantage to researchers aspiring to create hybrid trees that have poplar features. Biologists like working with poplar because the trees in this group grow fast and their cells are easy to clone for research purposes. They are often among the first trees to sprout up after a fire or other environmental devastation (Lloyd, 2004).

Scientist use genetic maps of specific plants as information to put in a database. They used this genetic information for future use, so other scientists can possibly use the currently researched specimen in their own experimental projects. While making gene maps you find out genetic sequences responsible for such functions as bark, leaf, root, and wood formation and responses to environmental stresses. Scientists can use the database to quickly find specific genes in a matter of minutes using computers. In the past, such discoveries would have taken decades (Strauss, 2011).

Materials and Methods

Before constructing a genetic map, there a list of steps that should be completed prior to map construction. The samples are first collected from the specimen of focus. These samples can be bark, leaves or roots.

Amplified Fragment-length Polymorphism

Amplified fragment-length polymorphism (AFLP ™) is a patented technology developed by KeyGene, Wageningen, The Netherlands (Vos, 1995). In this procedure (Fig. 1), the genomic DNA is digested by two different restriction enzymes, a rare cutter and a frequent cutter. Adapters are then ligated to the ends of the restriction fragments. The fragments are then amplified by PCR using primers that correspond to the adapter and restriction site sequencers. PCR is a method to analyze a short sequence of DNA even in samples containing small quantities of DNA. PCR is used to reproduce selected sections of DNA. These primers have additional nucleotides at the 3' ends extending into the restriction fragments, in order to limit the number of fragments that will be amplified. The AFLP products are detected by labeling one of the two primers, and the labelled DNA fragments are separated by electrophoresis in denaturing

polyacrylamide gels.Typically, 50 to 100 amplification products are detected in a single lane. Polymorphic bands can be identified by comparing the amplification products derived from two lines. For this research the Salix Integra was selected as a focus subject.

Two restriction enzymes, *Eco*RI, and *Mse*I, were used to prepare the DNA by enzyme digestions. Adapters for ligation reactions were then prepared. The protocol for preparing DNA using *Eco*RI is common to all the restriction enzymes. Genomic DNA (0.3ul) was digested using 20U *Eco*RI enzyme. At this stage, experiments were conducted to evaluate the quality of the final products as influenced by restriction digestion and ligation in one reaction, and restriction digestion followed by ligation reaction in two steps. The latter was implemented based on the quality and the number of bands amplified. A total volume of 20uL digestion mixture consisted of *Eco*RI (2uL), 10xreaction buffer 2 uL and DNA solution that contained approximately 0.5g DNA. The digestion mixture was incubated at 37ºC for 6 h, followed by the addition of DNA ligase 2 uL, 10x reaction buffer 2uL and *Eco*RI adapter (1 uL) to the same digestion mixture, making a total volume of 25 uL.. Following digestion/ligation, DNA was purified from excess adapters, enzymes and other contaminants using 95% ethanol precipitation.

PCR Amplification and Gel Electrophoresis

Polymerase chain reaction (PCR) is a biochemical technology in molecular biology to amplify a single or a few copies of a piece of DNA across several orders of magnitude, generating thousands to millions of copies of a particular DNA sequence. Developed in 1983 by Kary Mullis, PCR is now a common and often indispensable technique used in medical and biological research labs for a variety of applications (B.Kiss, 2004).

In a series of beginning experiments, PCR amplification conditions were optimized for Mg, *Taq* DNA polymerase and DNA concentrations. Based on these results, the final amplification reaction conditions included DNA, 0.2 U *Taq* DNA polymerase, 40pmol primer, 25 mM Mg^{+2} ,0.25ul BSA, in a total volume of 15 uL. The optimized thermal cycling conditions were 2 min at 94ºC, followed by 40 cycles of 94ºC for 25 s, 56ºC for 25 s, 72ºC for 25s and a final extension at 72ºC for 7 min. Primers were then synthesized. Each primer consisted of DNA sequences complementary to a major part of the adapter sequences containing a specific restriction site plus randomly assigned bases to the 3end of the primer. Two sets of primers were designed based on the number of random nucleotides used: two bases 18-mers and three bases 19-mers. PCR products were electrophoresed using an agarose (1:2) gel mixture in 1.5g agarose powder and 40mL TPE buffer. Heat the mixture for 1minute and 26 seconds and add 5ul of Ethiduim Bromide, pour it in the tray add the comb and allow gel to rest until solidified. Place gel in the buffer inside the electrophoresis machine. Add DNA mixture and run the gel for 20 minutes on 120v. After gel is out of the electrophoresis machine and place it in the amplifying machine for picture of the DNA and its quality. Collected data is then sent the analyzed by a genetic analyzer. A collection of these genetically analyzed data sheets make up the gene map.

Results and Discussion

A genetic map of a specific plant can take years. It differs based on the number of primers you have. This particular project had 105 different primers to be tested.

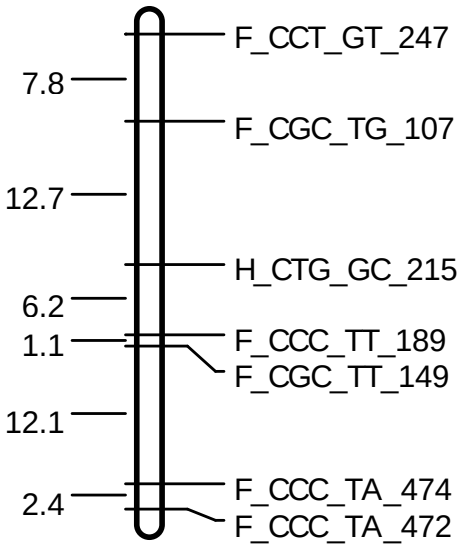

Figure 2. Sample chromosome that is normally cut by enzymes in the AFLP process.

AFLP primer codes and the corresponding selective nucleotides of *EcorI* primer and *MseI* primer. Internal standard used is determined due to the range of band size produced by each primer combination. For the sequence of the *Eco*RI and *Mse*I-primer, see Vos *et al*. (1995).

Table 1. Codes of the Selective Internal standard number of markers used AFLP Prime nucleotides of *EcoRI* primer *MseI* primer gel.

Marker Codes - used AFLP Primer combination	Selective nucleotides of EcoRI primer	Selective nucleotides of Msel primer	Internal standard used for running gel	Number generated
S1	AG	CAT	450ROX	31
S2	AG	CGA	450ROX	36
S3	AG	CTG	450ROX	30
S4	CA	CAC	450ROX	51
S5	CC	CCT	450ROX	39
S6	CC	CTA	450ROX	25
S7	CT	CAG	450ROX	34
S8	TA	CGA	450ROX	33
S12	AA	CGT	450ROX	27
S13	CT	CTC	450ROX	39
S15	AG	CTT	450ROX	22
S17	CA	CTG	450ROX	42
T3	CC	CAT	450ROX	38
T12	CG	CCA	450ROX	25
T1	CC	CTT	Mapmaker 1000	32
T2	CC	CTC	Mapmaker 1000	31
T4	CC	CAC	Mapmaker 1000	11
T5	TC	CGT	Mapmaker 1000	25
T6	CT	CGT	Mapmaker 1000	11
T7	CC	CGA	Mapmaker 1000	16
T8	CC	CGT	Mapmaker 1000	18
T9	CG	CAG	Mapmaker 1000	14
T10	CG	CAC	Mapmaker 1000	12
T11	CG	CGA	Mapmaker 1000	11

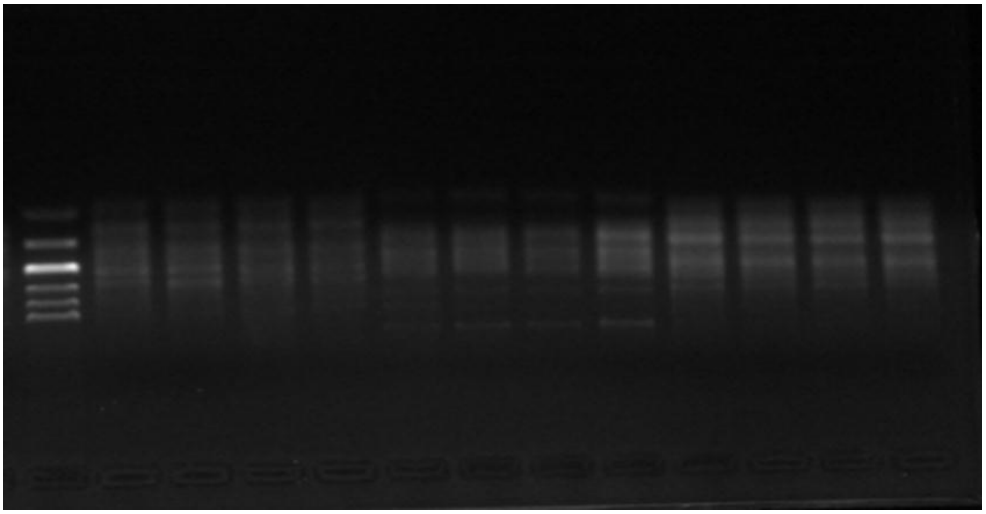

Figure 2. After the chromosome was cut and the DNA was put in the PCR machine, the agarose gel was made and these were the results from that gel. This gel shows the quality of the DNA that came from the samples. 2012.6.5 amplification.

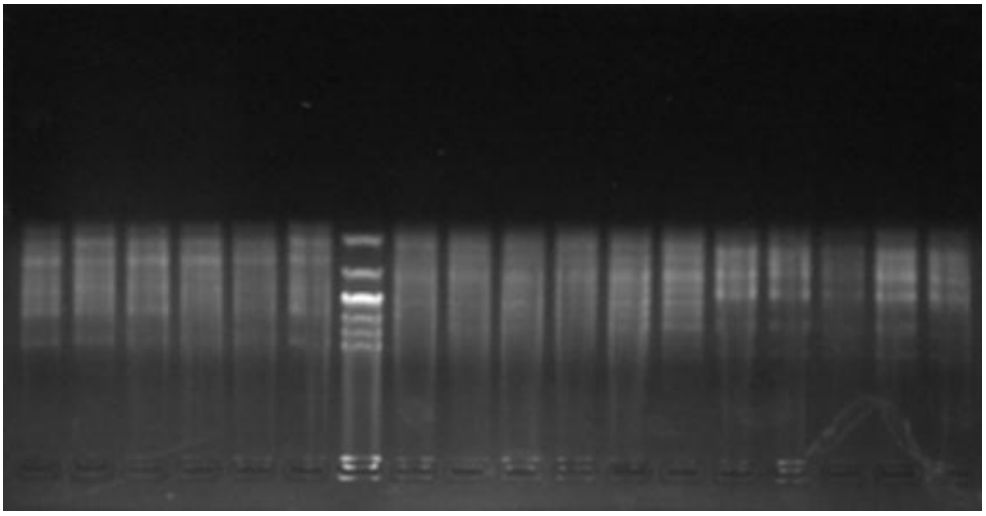

Figure 3. This is another agarose gel in which the primers TAG-GT, TAG-GA, TAG-CG

These are agarose gels that hold the DNA that is later sent to the genetic analyzer. The Genetic analyzer uses capillary electrophoresis to separate DNA fragments based on size, then excites a fluorescent dye bound to the DNA fragments to make them visible. When they pass by a camera at the end of the instrument, it records how long it took the fragment to get there and what color it was. With this data, genetic analysis software can determine where the DNA fragments came from and can assign a specific DNA genotype to the sample. After DNA has been analyzed it comes up with graphs such as these

These graphs help show the genotype similarities between the two parent specimens and their genetically modified offsprings.

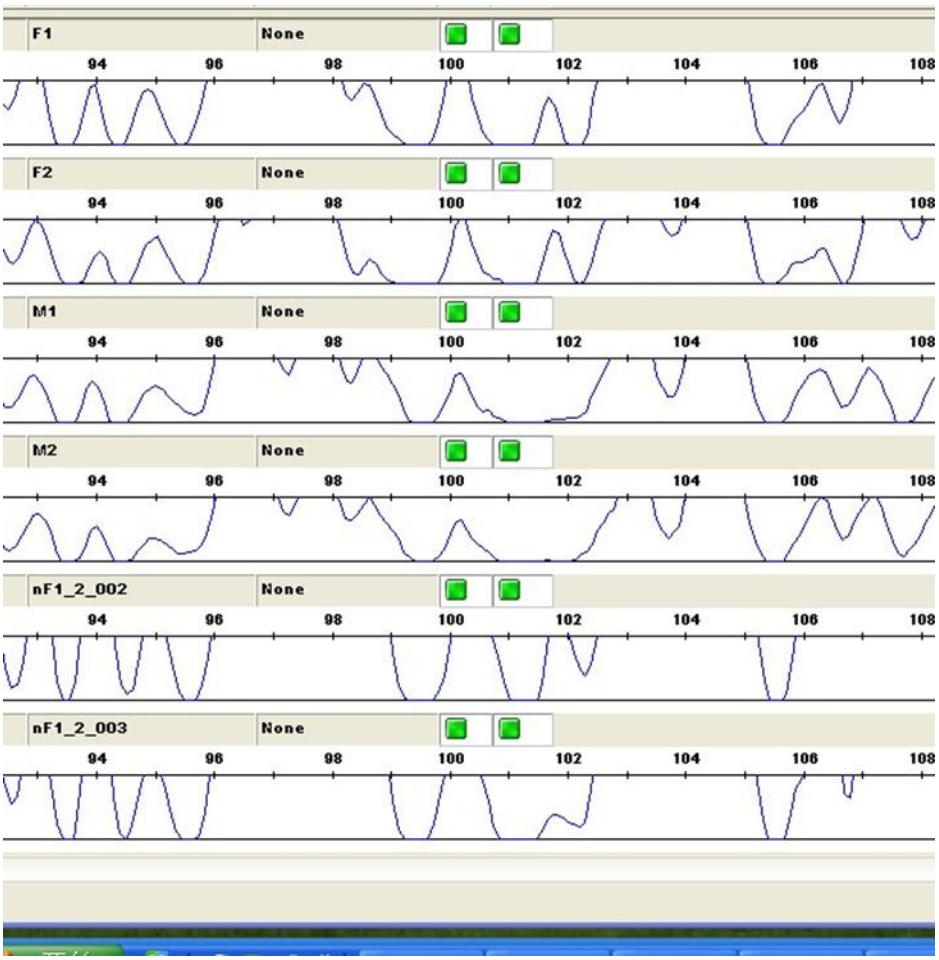

Figure 4. A collection of these graphs help to construct a gene map.

Conclusion

Gene mapping is beneficial in plants because allows researchers to quickly access information that is vital to the making of hybrid plants that may one day play an important role in our society. It gives information that will be vital for gene transfer and specie variation.

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ANTHOCYANIN PATHWAY GENE EXPRESSION IN PEACH (*PRUNUS PERSICA*) FLOWERS

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Abstract

Peach flowers have both economic and cultural significant in China. Anthocyanins are a group of reddish-blue, water-soluble pigments responsible for most coloration in many flowers, fruits and vegetables. Bright coloration attracts insects and is therefore essential to pollination. In recent years, researches have begun to study possible health attributes of anthoyanins, such as reduction of coronary heart diseases, antioxidant properties, and anti-cancer activities. Varying environmental factors can affect the concentration of anthocyanins including: pH, light exposure, temperature and oxygen. Dual color flower mutant, such as those found in the peach flower, are related to the changes of genetic material, some of them may be related to the genes involved in flower color formation. The purpose of this research project was to determine whether there is a difference in anthocyanin pathway genes expression that distinguish red color from white color in peach flowers; focused on six genes: ANS, CHS, CHI, DFR, F3H, and UFGT.

Introduction

The major pigments that cause flower color are carotenoids, flavonoids and betalains. Although other pigment types such as chlorophylls, phenylphenalenones and quinochalcones can generate flower colors, they are rare examples (Davies, 2004). The flavonoids are phenylpropanoid compounds of great variation in structure and function (Bohm, 1998). Those involved in flower color are water-soluble and generally located in the vacuole, with by far the most common type being the anthocyanins. Anthocyanins are the basis for nearly all pink, red, orange, scarlet, purple, blue and blue-black flower colors (Davies, 2009). In the peach flower, *Prunus persica*, pigments range from a dark pink or red to white (Fig. 1). Anthocyanins in peach flowers also produce an unique split coloration pattern (Fig. 2).

Figure 1. Range of peach flower coloration, from red to white (D.H.).

Figure 2. Split color formation; gene mutation (D.H.).

LIU Chang-ming (2009) found that dual color flower mutants were related to the changes of genetic material, some of them may be related to the genes involved in flower color formation. This research project objective is to determine which gene/s of anthocyanins pathway genes expression that distinguish red color from white color in peach flowers; mainly focusing on six genes: ANS, CHS, CHI, DFR, F3H, and UFGT. As a summer assistant, my primary objective was to assist in optimizing PCR primer amplification procedures; under the leadership of PhD candidate Danial Hassani and his advisor Dr. Tomgming Yin.

Methods

Initially, PCR product yields undistinguishable bands and primers appeared to be poorly designed, as they were unable to anneal to the target genes. From the gel below (1% agarose at 120 v for 30 minutes), we deduced that the annealing temperatures, specificity of polymerase and total value of DNA were likely contributors to the lack of clear bands. The primers were

originally grouped in total with a calculated average annealing temperature set at 58ºC. We re-configured the grouping of primers based on the prescribed annealing temperatures, with temperature fluctuations of no more than 0.5 ºC (Figure 4). We also used a higher specificity Taq Enzyme and optimized the total DNA concentration to 50ng per reaction. Modifications are summarized in Figure 5.

Identification of Problem

Amplification failed for primers ANS_2, CHI_1, CHS_1, DFR_2, $F_{3'5'}H_1$, $F_{3'5'}H_2$, F_3H_1, $UFGT_1$, CHS_2, DFR_1, and DFR_3. Likewise, amplification failed for R_2 in reverse, in the same order.

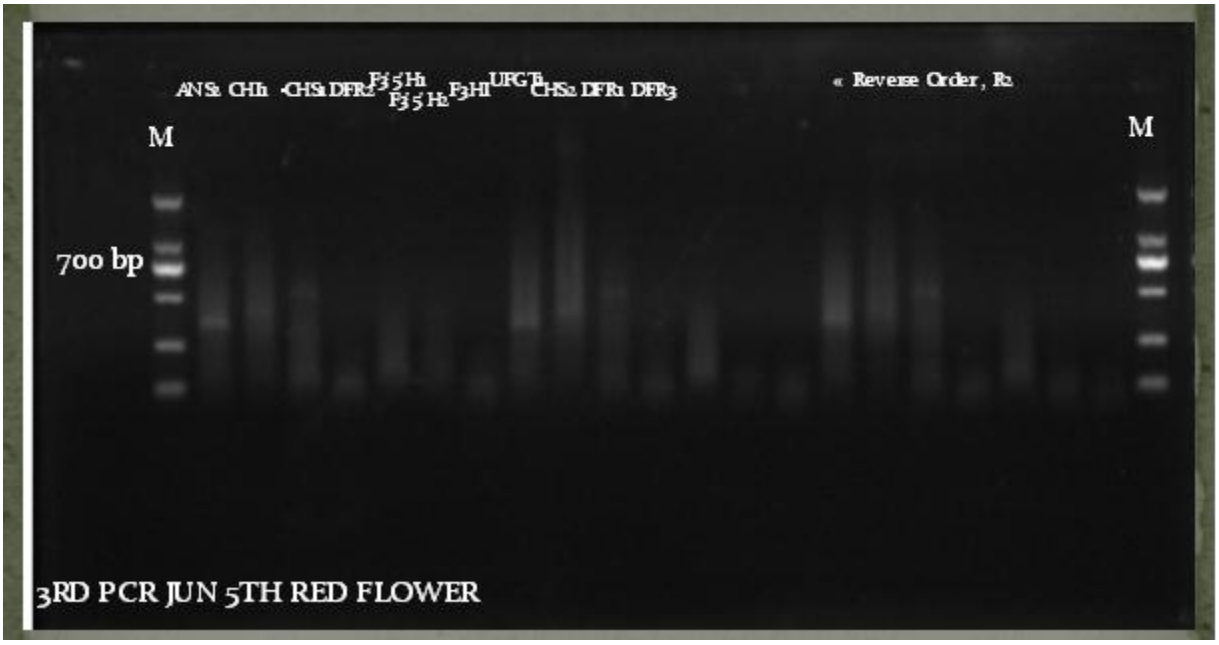

Figure 3. Amplification failed for primers ANS_2, CHI_1, CHS_1, DFR_2, $F_{3'5'}H_1$, $F_{3'5'}H_2$, F_3H_1, $UFGT_1$, CHS_2, DFR_1, and DFR_3. Likewise, amplification failed for R_2 in reverse, in the same order.

Primer Annealing Temperature
Taq Enzyme Specificity

Primer Name	Forward Sequence	Primer Name	Reverse Sequence
ANS-1F	5′ GTGCTGTCACTTGGGTTGG 3′	ANS-1R	5′ TCTTCTCCTTTGGTGGCTC 3′
ANS-2F	5′ GCGTGCTGTCACTTGGGTT 3′	ANS-2R	5′ TCTTCTCCTTTGGTGGCTC 3′
ANS-3F	5′ GTTGAAGAAGGCAGCAGTG 3′	ANS-3R	5′ ACGCTTGTCCTCAGGGTAT 3′
ANS-4F	5′ AGCGACATTACCAATACAC 3′	ANS-4R	5′ CTGCTGCCTTCTTCAACTC 3′
CHI-1F	5′ CGTTTCCACCGTCAGTCAA 3′	CHI-1R	5′ GATCACCACGTTCCCAGCT 3′
CHI-2F	5′ AACGATACTGCCACTAACC 3′	CHI-2R	5′ TTCCCATTTCCTGCCTCAT 3′
CHI-3F	5′ AACGATACTGCCACTAACC 3′	CHI-3R	5′ CTACACTCTGCCTTGCTCC 3′
CHI-4F	5′ AACGATACTGCCACTAACC 3′	CHI-4R	5′ AAACGCCGTGCTTTCCTAT 3′
CHS-1F	5′ CCCAGTGACACCCACCTTG 3′	CHS-1R	5′ TTCTTCGTAGCCCTCTTCC 3′
CHS-2F	5′ CACCCACCTTGACAGTTTA 3′	CHS-2R	5′ CTTTCTTCGTAGCCCTCTT 3′
DFR-1F	5′ CGAAGAGCACCAGAAGTCA 3′	DFR-1R	5′ GGGAAGAACAAATGTAGCG 3′
DFR-2F	5′ TGACGAAACCGACTGGAGC 3′	DFR-2R	5′ ATCGAACTTTGTGGGAATA 3′
DFR-3F	5′ GAACCGTGAATGTCGAAGA 3′	DFR-3R	5′ GGGAAGAACAAATGTAGCG 3′
F3′5′H-1F	5′ TTCTCCAACCGTCCACCTA 3′	F3′5′H-1R	5′ CAACATCTCCGCCACCACA 3′
F3′5′H-2F	5′ TTCTCCAACCGTCCACCTA 3′	F3′5′H-2R	5′ ATCCCTTGTAAATCCATCC 3′
F3′5′H-3F	5′ CTCCAACCGTCCACCTAAT 3′	F3′5′H-3R	5′ ATCCCTTGTAAATCCATCC 3′
F3H-1F	5′ TCATCGTCTCCAGCCATTT 3′	F3H-1R	5′ CAGCATTCTTGAACCTCCC 3′
F3H-2F	5′ GTTCTTCGCTCTGCCCTCG 3′	F3H-2R	5′ CGCCTTTGTCAATGCCTCT 3′
F3′H-1F	5′ TCCCAGTTCCTGAAGACCC 3′	F3′H-1R	5′ CACTCCTGCCAACACCATC 3′
F3′H-2F	5′ CCAGTTCCTGAAGACCCAC 3′	F3′H-2R	5′ AACACTCCTGCCAACACCA 3′
UFGT-1F	5′ TATCATTCGGCAGTTTCGC 3′	UFGT-1R	5′ GGAGCTGTGAGCCCTATTT 3′

Figure 4. Example of Study primers grouped by annealing temperature.
Green = 56.5°C; Orange = 51°C; White = 58°C.

Final Modifications

RT-PCR total volumen of 50 µl consisted of the following:

- 3 µl of cDNA (50 ng) *Changed to 1 µl cDNA*
- 3 µl of primer (1.5 µl F/R) *Changed to 2 µl primer*
- 30.7 µl of H20 *Changed to 33.7 µl H20*
- 5 µl of 10x Ex Taq Buffer *Changed to La Taq Buffer*
- 4 µl of dNTP mix
- 4 µl of MgCl2 (25mM) *Changed to 0.3 µl La Taq*

Annealing temperatures 56.5°C, 51°C, or 58°C.

Results

Our team was successful in optimizing the PCR productivity. As a result of the modifications, primers produced clear bands of the expected genes. The bands were then extracted for gene cloning and later sequencing. Bands shown in Figure 6 are of the expected gene size between

400-600 bp. Further details of methods and results are not report as they are the unpublished work of Danial Hassani.

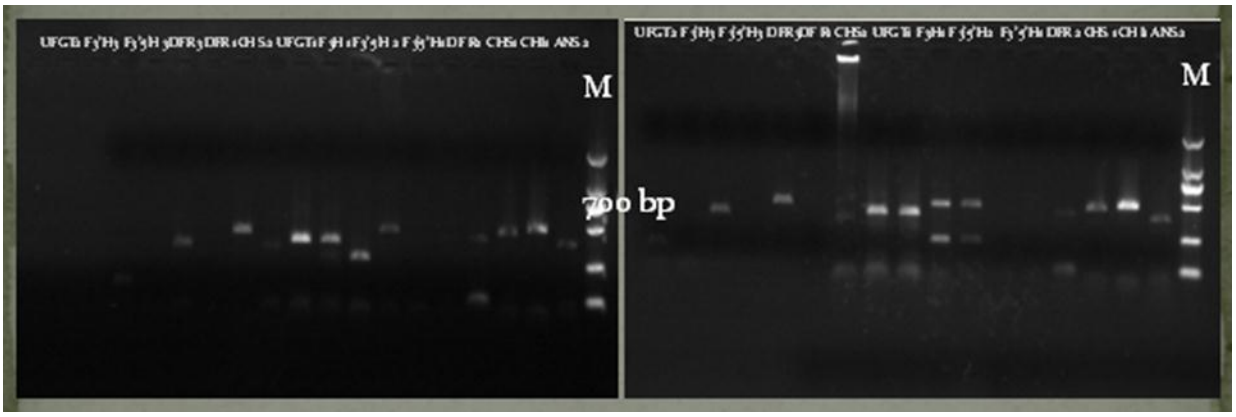

Figure 6. Results from the modified RT-PCR: ANS_2, CHI_1, CHS_1, DFR_2, $F_{3'5'}H_1$, $F_{3'5'}H_2$, F_3H_1, $UFGT_1$, CHS_2, DFR_1, DFR_3, f3'5'h3, F3'H3, and UFGT2. White: June 7th new cDNA exact TM for primers; red: June 7th new cDNA exact TM for primers.

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THE EFFECTS OF DIFFERENT LAND USE PRACTICES ON THE AVIAN POPULATION IN NANJING, CHINA

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Abstract

Urbanization, a human induced change in the environment, can greatly affect plant and animal populations, and the biodiversity of a given area. Although cities take up a small percentage of the worlds, and the urban environment can both local and global scale effects. The goal of this study was to examine how different land use practices affect the avian community in Nanjing, China. Nanjing is the capital of the Jiangsu Province of China and is a fast growing city both economically and in urbanization. Birds were surveyed using a point count method. A total of 106 points were randomly selected and grouped into four categories: urban (52), forest (27), agriculture (15), and park (12). A total of 53+ species were found. Urban points had lower diversity, but birds associated with an urban environment tended to be more abundant re prevalent throughout the study, when compared to species that are associated with green space environments. We found that some species were more resilient to human induced change and could thrive in an urban habitat, and different land use types had different avian community structures.

Introduction

As the human population continues to grow, urbanization and anthropomorphic land use affects species living in their historical ranges by changing the habitat in a way that there is a loss of ability to regain. Urbanization can produce many changes that present problems to some vertebrate species. Urbanization is becoming a global issue, as more of the population moves into more urban environment. The Population Division of the United Nations estimated that close to 50% of the world's population is living in an urban environment with the most rapid development happening in less developed regions (Chen 2006, Leveau and Leveau 2012). Even though cities cover only a small, but growing percentage of the global land, they can still have impacts on both the surrounding area and global scale by affecting the structure of pristine habitat, rural landscape, and induces changes in biogeochemical scales (Leveau and Leveau 2012). As urban areas grow, there are many effects on plants and wildlife as well as people. This has especially been demonstrated by studying bird communities, which will shift as some species are favored over others by the land use changes (Marzluff et al. 2001).

Another effect of urbanization on bird communities includes overall changes in structure due to introduction to new stimuli. Species such as the House Sparrow, Rock Dove, and pigeons have been introduced worldwide due to the human population. Furthermore, with the change in habitat, food, predators, climate, and disturbances other species can go into a decline (Marzluff et al. 2001). Even if there is a higher species diversity than expected in an urban environment similar to the results of the Pautosso et al. (2011) study, different and sometimes exotic species will be present instead of species found in a natural environment, or the natural species that can adopt to an urban environment better will dominate (Marzluff et al. 2001, McKinney 2005). A reason why certain species thrive and others decline is that urban environments and human activities are very similar. Cities can promote homogenization through the expiration of local species and the introduction of non-native species (McKinney 2005). The trend can epically be seen in birds around an urban core (any references???).

Birds and plants have long been used to study the effects of urbanization around the world, but most notably in the Americas and Europe (Rottenborn 1999, Marzluff et al 2001, McKinney 2005, Pautasso et al 2011). In their study, Pautosso et al. (2011) examined the difference between bird assemblages in urbanized and semi-natural environments by using a database of bird surveys. While they found some macro ecological relationships such as species-area and species abundance were conserved in urbanized environments, they did find that there was a difference in productivity and assemblage. In urban environments, both evenness and abundance become independent of productivity variation. They believe the lack in differences of species-area relationship between urbanized and more natural ecosystems is due to the areas suitable for human habitation also coincides with places that have higher biodiversity. They concluded that the number of species living in urban environments could be used to better educate the public about the importance of protecting biodiversity.

Urban environments can also affect the surrounding area or habitat. Rottenborn (1999) found that bird richness in riparian woodlands increased the further the habitat was from urban environments such as buildings and streets near his study site in California. The species that were not negatively impacted by an urban environment included the mourning dove (*Zenaida*

macroura) and northern mockingbird (*Mimus polyglottos*) , but most species showed a decline in population if the habitat was closer to a city.

The urban environment can also impact a bird's behavior, including predator defense behavior. Birds in urban environments have been shown to show differences in defense behavior (more alarm calls and less wriggling, for instance), than birds in rural communities. Raptors such as sparrowhawks were more common in rural communities than in urban, while house cats where more common in urban environments (Moller and Ibanez-Alamo 2012). Moller and Ibanez-Alamo found that urban birds had a higher frequency of alarm calls and fear screams, which may be attributed to warning closely related due to low genetic differences found in urban birds. When caught, the same birds bit and struggled less, which could point to a lower predation risk. Other behavior that was studied to change has been studied in robins. Light and noise pollution from an urban environment can cause some birds adopt new habits, such as night time singing (Fuller et al. 2007) and singing earlier if a place contains artificial lights (Miller 2006).

China is the world's most populous country with over 1.3 billion people, and rapid urbanization has been a notable feature of the past decade in China (China Daily, April 29, 2011). Nearly half of the 1.3 billion people now live in urban areas, rising from 26% in 1990 and up 13.46 percentage points from 2000. China's land cover has also changed quickly. For examples, between 2000-2005, China's cultivated land decreased by 6.9×10^5 hm^2, while the built-up land increased 1.7×10^6 hm^2, of which 75% were converted from cultivated land, and the expansion of built-up land concentrated in eastern China (Liu et al. 2010).

The study site, Nanjing, the capital of Jiangsu Province is a growing city that shows a wide range of land use types. Because of government laws pertaining to movement to the cities, China has at the same time the most populous urban centers, but relatively low levels of urbanization. China is often looked at as a case study for under urbanization because the rates of urbanization lag far behind its industrialization (Chen 2006).

The objectives of the study are to study how the avian community in Nanjing, China is affected by the ongoing urbanization process of the city, and to see how different land use practices will affect the bird community. Even though Nanjing is an urban environment, it still contains green space habitat (forest, agriculture, and parks).

Hypothesis

1. The birds detected will be affected by the type of land use: urban, park, forest, or agriculture.
2. The most common species will be those that can survive or thrive with a human presence.
3. Urban areas would have the least amount of species than the other habitats and transitional habits will have more diversity.

Methods

The Study Area

Nanjing is the capital city of Jiangsu Province in China, with a population of more than 8 million people. The latitude is 32.05° N and latitude is 118.77°E. Located in the lower Yangtze River Delta, it is one of China's most important cities and longest inhabited cities, and one of the many cities that are exhibiting rapid growth and urbanization. The Yangtze River flows past the west side of the city. The population of the city is about 8 million, and total land area is 6,598 km^2. Nanjing has a humid subtropical climate, with four distinct seasons and is influenced by the East Asia Monsoon. There are cold, damp winters and hot muggy summers, and spring and fall seasons that fall in between. Humans have long inhabited this area, and the city has served as capital of China throughout its long history; the last time being before the Republic of China was replaced by the People's Republic of China. Figure 1 shows the study area and points are color coded: red is urban, blue is wetland, yellow is agriculture, olive green is park, and dark green is forested area.

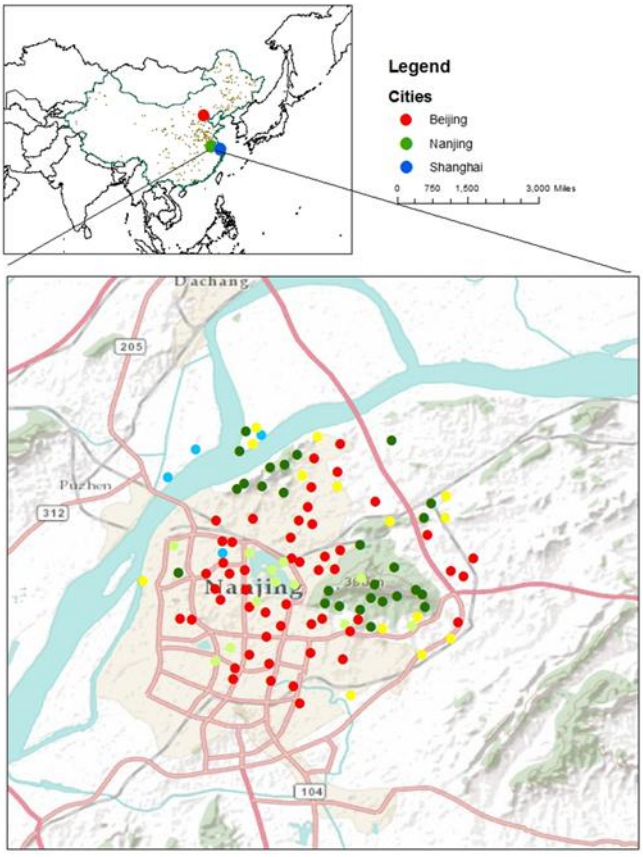

Figure 1. Map of Nanjing, China with survey point locations (simplified) shown.

Point Selection

Two hundred random points were derived in the study area using create random data points from the data management tool box in ArcGIS 10.0. This tool creates a specified number of random point features. Random points can be generated in an extent window, inside polygon features, on point features, or along line features. These points were defined with in an area 10km from Nanjing Forestry University and at least 100m apart. Land use was determined for each point using aerial photography from accessed through ESRI servers and supplied by Microsoft Bing maps. Land use was stratified selection (urban, park, agriculture, and forest). Urban points were selected to so a range of urbanization: inner city, suburbia, and commercial. One hundred points were selected to represent a range of land uses with distribution though out the study area for field visits, a further 40 were selected as back up sites to be sampled if there were access issues or extra time allowed. Points were converted to latitude and longitude and uploaded to a Garmin GPS unit. A GIS research assistant picked the initial points.

Bird Survey

The bird survey was done at 108 of the selected points and one new point. The 108 points consisted mostly of category one points, but some back up points were used if getting to the preferred point was not a possibility. A new point was done to replace another point that could not be reached. We chose to add a new point because the habitat matched the initial habitat (forest) of an original point. The survey was done from June 6th, 2012 to June 19th, 2012. Coordinates were later changed or kept depending how far we were from the initial points. The Points were done during two times of the day, early morning (from 5:00 a.m. to 12:00 p.m.) and late afternoon (from 3:00 p.m. to 6:00 pm). Points were abandoned if the area was restricted access or deemed difficult to get too. An example would be if points were on a military base or property we did not have permission to access. Each point was surveyed for a ten minute interval. Behavior information (calling, singing, flying, foraging, roosting, and any other behavior), distance from point (1 if <10m, 2 if between 10m and 25m, 3 if between 25m and 50m, 4 if between 50m and 100m, 5 if >100, and 0 if the bird was a fly over), and sex/age information (male, female, juvenal, sub- adult, adult, and unknown) were recorded. How each bird was first detected (audio or visually) was also recorded. Birds that exhibited multiple behaviors were assigned one behavior, based on their first observed behavior.

Statistical Analysis

Data was analyzed using Microsoft Excel (Microsoft) and SPSS (IBM). The distance from each point (0-5) system was examined as well as the bird's behavior noted at each point. How the birds were detected was also measured. To compare the number of birds detected at each habitat type, we took the average number of detections at each point type. In order to compare the species richness of the area, the average of species per point was measured against land type. The top twenty most abundant species from each land use types (urban, agriculture, park, forest, and wetland) to see if there were any similarities between species found at the different types, and to see if any species will persist in all types of land use types. Analysis of variance (ANOVA) was used to examine if there were differences in species richness and relative abundance among

different land use types. Relative abundance was calculated using the number of individuals of a species counted in the habitat type divided (n) by all the individuals counted in the habitat (N). Tukey test was followed for multiple comparisons when ANOVA test was significant ($P<0.05$).

Diversity and Habitat Similarity

In order to measure how similar the bird communities were in different habitats, proportional similarity was calculated. The equation used was percent similarity=lowest percent values of a species between communities added together. The Simpson's Index was used to calculate evenness of the habitats. The equation used: Ds = 1 - Sum1i [ni*(ni-1)]/[N*(N-1)].

Results

Species and Site Analysis

The different sites varied in both average detections and species richness (Figure 2 and Figure 3). Figure 2 shows the average number of species per point at different habitat types. Agricultural points had the highest range of variability, but about an equal average with forest and park habitats. Urban habitat points had the lowest, and wetland habitat points had the highest species per point average. The detection average was about the same for the urban and forest habitat. Park points had the lowest average of detection. Agricultural points had the most variability in detections (Figure 3). The ANOVA test: F=12.72, DF=4, p< .001. Since p< .001 variability is significant between the different habitat types when it comes to detection.

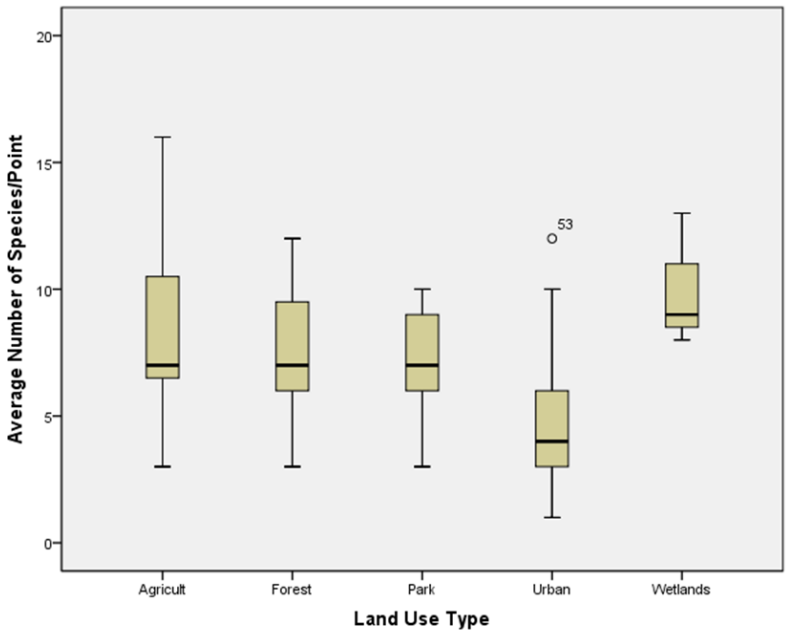

Figure 2. Average number of bird species encountered per point for each land use type.

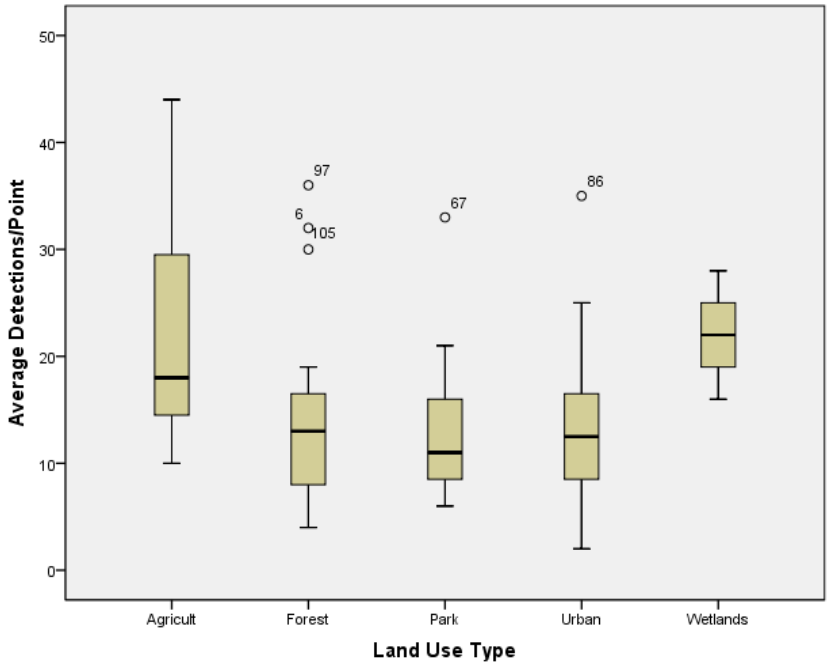

Figure 3. Average number of bird species detected per point for each land use type.

A total of 109 points where surveyed—27 forest, 15 agricultural, 12 park, 52 urban, and 3 wetland points. The wetland points were initially marked as agricultural points, but were later changed when we arrived to the site. Three points that were originally agriculture were changed to wetland habitat. We detected a total of 1595 individuals and 53+ species during the survey. Eight individual woodpeckers were only heard, and could not be identified to the species. Audio detections made up 39.5% while visual detections made up 60.5% of the birds recorded. The top twenty species for the point counts were Tree Sparrow (489), Light-Vented Bulbul(220), Black-billed Magpie (133), Red-rumped Swallow(110), Turtle Dove(69), Eurasian Blackbird(63), White-Cheeked Starling(53), Spotted Dove(45), Myna(41), Masked Laughingthrush(39), Azure-wing magpie(28), Large Hawk Cuckoo(28), Great Tit(27), Barn Swallow(26), White Wagtail(19), Indian Cuckoo(18), Vinous-throated Parrotbill(16), and Common Koel(15) (Table 1 and Fig. 4). The top twenty species accounted for about 90% of the total detections while there were more than 25 species that were detected 5 or fewer times (Table 1).The average number of detections per point was 14.6±8.2 and the average number of species detected per point was 6.2±3.1.

Species Composition

The top species for agriculture land use is the Tree Sparrow (93), Light-vented Bulbul (38), Black-billed Magpie (28), Red-rumped Swallow (23), Turtle Dove (23), Spotted Dove (14), Common Koel (14), and Barn Swallow (10). The top species for forest: Light vented-Bulbul, Black-billed Magpie(44),Tree Sparrow(37), Red-rumped Swallow(23), Turtle Dove(23), Great Tit (20), Eurasian Blackbird (19), and Large Hawk-Cuckoo(17); the top species for park: Light-

vented Bulbul (23), Tree Sparrow (19), Black-billed Magpie(17), Myna(14),Red-rumped Swallow (13), Masked Laughingthrush (12), Eurasian Blackbird (11), and Barn Swallow (11);the top species for urban: Tree Sparrow (93), Light-vented Bulbul (96), Black-billed Magpie (44), Red-rumped Swallow (43), White-cheeked Starling (27), Eurasian Blackbird (26), Spotted Dove (25), and Turtle Dove (14) (Table 1).

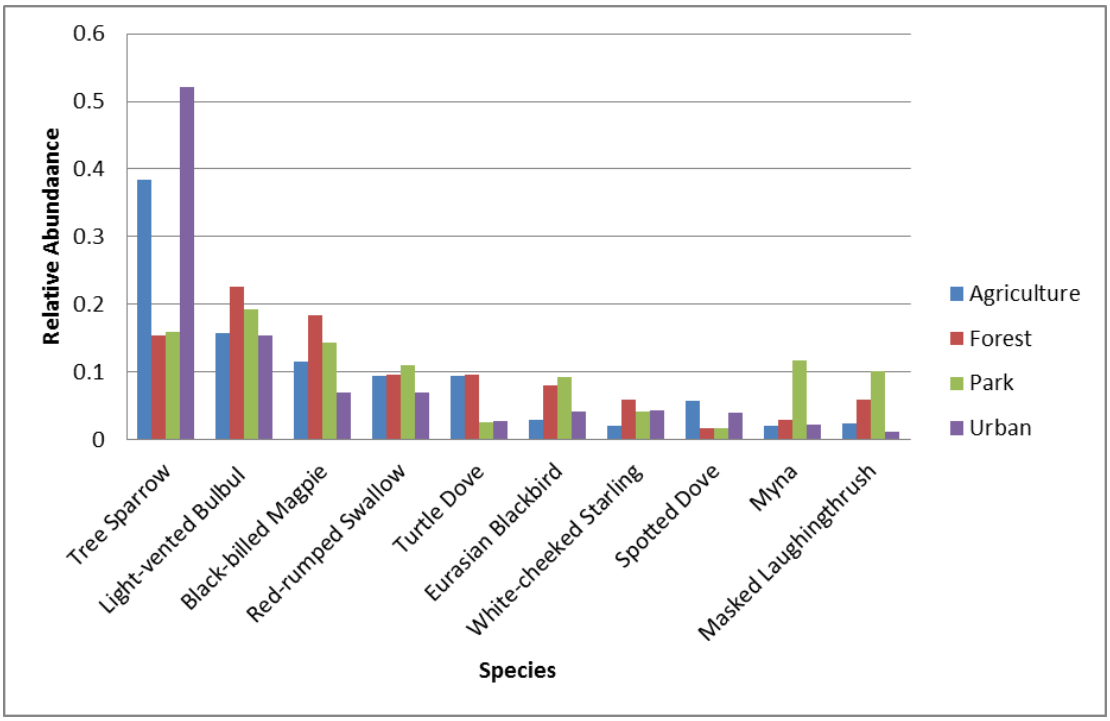

Figure 4. The relative abundance of the top ten bird species for each habitat type surveyed in Nanjing, China, 2012.

Figure 4 shows the relative abundance of the top ten species of the study, in the different habitat types. Wetland land type was left out because there were only three points, and the sample size is considered too small. The Tree Sparrow had the highest abundance in an urban setting (Fig. 4, > .5), and second highest in agricultural land use (~ .4), but the species declined in both a park and forest setting (both values ~ .15). The second most abundant bird, the Light-vented Bulbul showed an opposite pattern, it has the highest relative abundance values for both park and forest land use, but slightly lower abundance in urban and agricultural settings. The Myna, Masked Laughingthrush, and Red- rumped swallow all had a higher relative abundance in park land use types. The Black-billed Magpie and White-cheeked Starling both had higher relative abundance in forest, while the Turtle Dove had about even abundance in both agricultural and forest. The Eurasian Blackbird had about even relative abundance in forest and park habitat.

Behavior

The most common behavior recorded was calling followed by flying. The least seen behavior noted was swimming (Fig. 5).

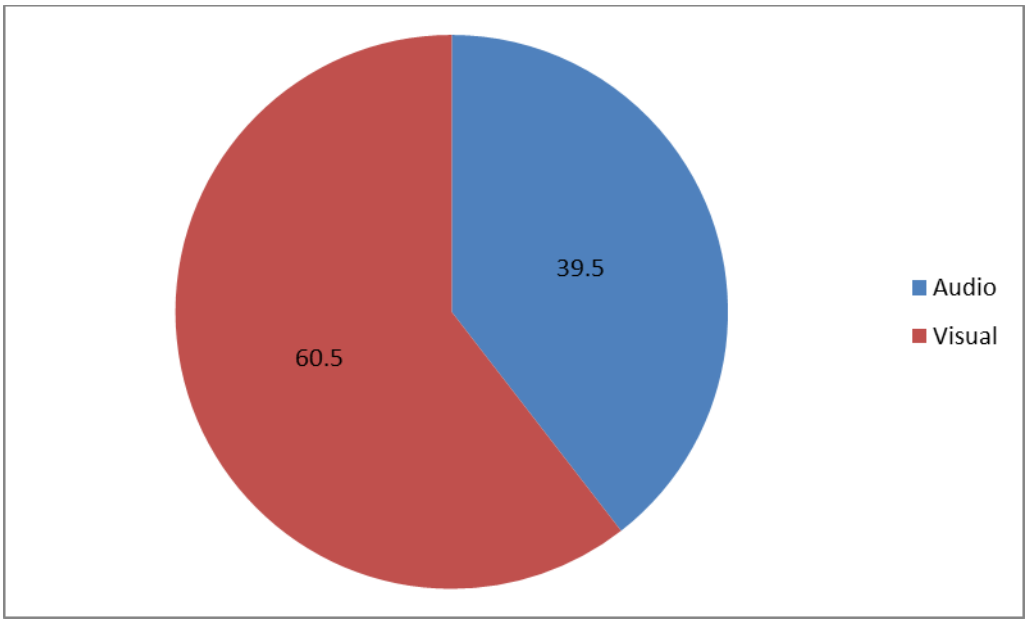

Figure 5. Percentage of birds that were initially detected, either aurally or visually, for all habitat types combined in Nanjing, China, 2012.

Distance

Most birds detected fell into the 50-100m range (category 4), followed by flyovers (category 0); the majority of birds were observed at distances > 10m of the observation point (category 1) (Fig. 6).

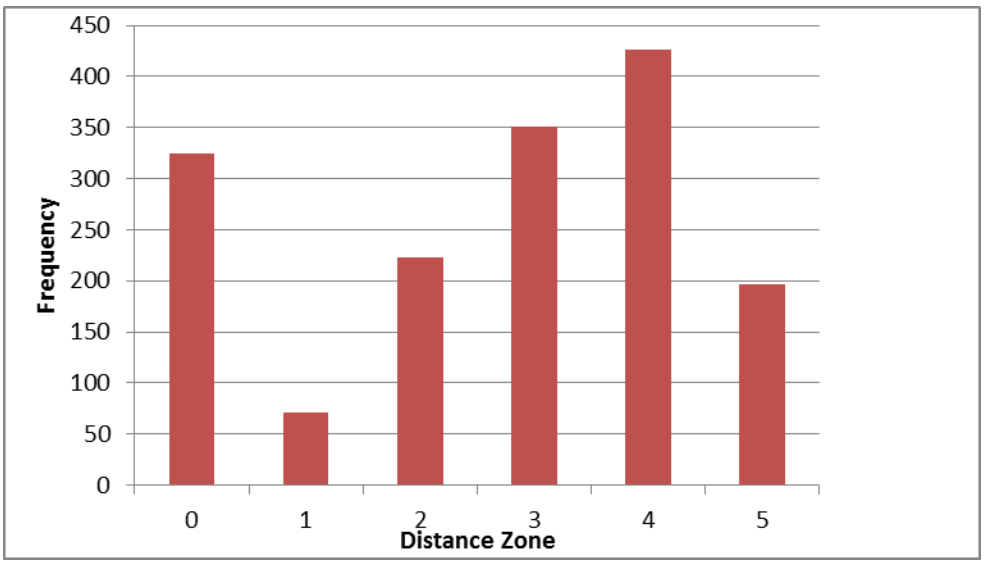

Figure 6. Distances within which birds were detected, for all habitat types combined in Nanjing, China, 2012. 0 = flyover, 1 = < 10 m, 2 = 10 – 25 m, 3 = 25 – 50 m, 4 = 50 – 100 m, 5 = > 100 m.

Diversity and Habitat Similarity

Agricultural and urban habits had the highest similarity (.71), while forests and parks had about the same amount of similarity (.70). (Fig. 7)

	Forest	Agriculture	Urban	Park
Forest	---	0.61	0.55	0.7
Agriculture	---	---	0.71	0.62
Urban	---	---	---	0.57
Park	---	---	---	---

Figure 7. Similarity between different habitat types for bird species and numbers detected, based on proportional similarity between habitat types. Nanjing, China, 2012.

By using the Simpson Diversity Index, it was determined that the lowest diversity seen was in the urban type points (Fig. 8). Forest and park points tied with a high value of .93, agriculture had a value of .88, and urban had the lowest value of .73. Forest and agricultural had a similarity of .61. Urban compared with park and forest had two of the lowest values of similarity.

Agriculture	Forest	Park	Urban
0.88	0.93	0.93	0.73

Figure 8. Simpson's Diversity Index of habitat types in Nanjing, China, 2012.

Discussion

The study supports the idea that land use, especially urbanization will affect avian communities, and while some species will thrive in an urban environment, other species will decline (Marzluff et al.2001, McKinney 2005). The most common species found in the survey were also the ones that were well suited for an urban environment, or are considered to be urban avian species.

Site and Species Analysis

The results for variability of the land use types are not all that surprising. Agriculture had the largest variability for both the number of detections and the number of species detected at each point. Agricultural land has the most variability in use, size, surroundings, and environment. Since it was a big category, many different types of fields, both used and not used, what was growing, size can all affect what birds can be seen in the field. Also since agricultural land types are heavily used, the bird species that dominate this type of habitat will be used to disturbances. Urban environment had the lowest variability when it came to the number of species detected, which fits the idea of Marzluff et al. 2001, that an urban environment will have a lower biodiversity level. The variability of the number of detections for the urban points was almost equal with both park and forest. This could be possible due to the amount of disturbance at each point, noise pollution, and where the park or forest point was located. Wetlands in both case, although only had three points, were more variable then park, forest, and urban environments. This could be due to wetlands having a transitional type of habitat, rather than a stable habitat, since transitional habitats are thought to be on average more species diverse. This idea can also explain why Agricultural had the highest variability; since agricultural land use is constantly disturbed kept in a transitional state when in use, or will revert quickly into a transitional forest-type habitat when abandoned. The ANOVA test values show that there is a significant difference for the detection of the different habitats.

The species that were the top of the survey list were species that were also found on the top of the urban land use type group. The Tree Sparrow, Light-vented bulbul, Black-billed Magpie, Red-rumped Swallow, Eurasian Blackbird were the top species and they all had highest number population in the urban habitat. The other top species also had some distribution in an urban environment. These species are probable better at using resources in an urban environment and dealing with the disturbances, even in forest and park habitats.

Behavior and Distance Information

Most of the behavior of the birds were calling and flying. Behavior information will be interesting to use to see how the birds are interacting with their environment or if urbanization in Nanjing affects the behavior of birds similar to results found by Moller and Ibanez-Alamo, 2012; Fuller et al. 2007, and Miller, 2006. There cannot be much said about behavior in this survey since all behavior was recorded during daytime, and only one instance of what may have been predator defense behavior from a group of Black-bill Magpies. Since most birds were seen in the 50m to 100m range (category 4), there is a good chance the birds counted were using some aspect of the land use type we surveyed.

Diversity and Similarity

The idea that the urban environment did have a lower Simpson Index of Diversity (Ds) than the other habitats also supports the initial hypothesis, but in Nanjing the urban land use still had a value of .73, which shows some diversity. When compared to other land use types (park (.93), forest (.93), and agriculture (.88) there is still a decline in the urban environment. This could be the lost in diversity due to urbanization that is seen worldwide McKinney 2005, Rottenborn 1999, Marzluff et al 2001). Urban land use was also the least similar to both park and forest, and somewhat similar to agricultural. This could be for a number of reasons. The agricultural points were still in an urban environment, so it is possible for birds to use both habits, and species that can live with human disturbances will be the birds that make up the avian communities for both of these land use types. In all the values found comparing the habits show that there is more avian community similarity for the more disturbed land use types (urban and agriculture) and the more natural (but still somewhat disturbed) land use types (parks and forest). Wetlands could not be included in this analysis because there were too few (only 3 points were wetland points).

Further Study

This project is still on going. Since this study was done in a place that has a lot of construction going on, it will be interesting to compare the species found from the construction area points while construction was taking place with the species found when the construction is done-these were considered urban points. In the case of the wetland points, if possible there should be more points dedicated to survey the wetland habitat.

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Table 1. Species distribution by habitat type, Nanjing, China 2012.

Species	Agriculture	Forest	Park	Urban	Wetlands	Total	% total	Cum%
Tree Sparrow	93	37	19	325	15	489	30.7	30.7
Light-vented Bulbul	38	54	23	96	9	220	13.8	44.5
Black-billed Magpie	28	44	17	44	4	137	8.6	53.0
Red-rumped Swallow	23	23	13	43	8	110	6.9	59.9
Turtle Dove	23	23	3	17	3	69	4.3	64.3
Eurasian Blackbird	7	19	11	26	0	63	3.9	68.2
White-cheeked Starling	5	14	5	27	6	57	3.6	71.8
Spotted Dove	14	4	2	25	0	45	2.8	74.6
Myna	5	7	14	14	1	41	2.6	77.2
Masked Laughingthrush	6	14	12	7	0	39	2.4	79.6
Azure- winged magpie	7	6	2	13	0	28	1.8	81.4
Large Hawk-Cuckoo	6	17	4	1	0	28	1.8	83.1
Great Tit	2	20	3	2	0	27	1.7	84.8
Barn Swallow	10	1	11	4	0	26	1.6	86.5
White Wagtail	8	7	1	1	1	18	1.1	87.6
Indian Cuckoo	14	0	0	0	3	17	1.1	88.7
Vinous-throated Parrotbill	2	8	3	1	2	16	1.0	89.7
Common Koel	3	0	3	7	2	15	0.9	90.6
Chinese Pond- Heron	9	0	1	4	0	14	0.9	91.5
Black-crowned Night Heron	2	8	1	0	0	11	0.7	92.2
Brownish-flanked Bush Warbler	5	0	3	1	0	9	0.6	92.7
Ashy Drongo	1	7	0	0	0	8	0.5	93.2

Common Pheasant	0	8	0	0	0	8	0.5	93.7
Yellow-billed Grosbeak	0	8	0	0	0	8	0.5	94.2
Yellow-rumped Flycatcher	1	3	0	2	1	7	0.4	94.7
Red-billed Blue Magpie	3	2	1	1	0	7	0.4	95.1
Long-tailed Shrike	3	2	0	0	1	6	0.4	95.5
Black Bulbul	2	2	1	1	0	6	0.4	95.9
Grey-capped Greenfinch	1	1	0	3	0	5	0.3	96.2
Swinhoe's Minivet	0	3	2	0	0	5	0.3	96.5
Black-naped Oriole	1	0	0	1	2	4	0.3	96.7
Common Moorhen	0	2	1	1	0	4	0.3	97.0
Grey-capped Woodpecker	0	4	0	0	0	4	0.3	97.2
Black Drongo	0	0	0	0	3	3	0.2	97.4
Great Spotted Woodpecker	2	0	0	0	1	3	0.2	97.6
Japanese White-eye	1	0	1	0	1	3	0.2	97.8
Black-throated Tit	0	2	1	0	0	3	0.2	98.0
Eurasian Cuckoo	0	3	0	0	0	3	0.2	98.2
Hwamei	1	2	0	0	0	3	0.2	98.4
Little Grebe	0	2	1	0	0	3	0.2	98.6
Silky stanling	0	0	0	0	2	2	0.1	98.7
Black-eared Kite	0	0	2	0	0	2	0.1	98.8
Common Kingfisher	0	0	1	1	0	2	0.1	98.9
Manchurian Bush Warbler	1	1	0	0	0	2	0.1	99.1
Yellow Bittern	0	0	0	0	1	1	0.1	99.1
Brown Shrike	1	0	0	0	0	1	0.1	99.2

Cattle Egret	0	1	0	0	0	1	0.1	99.2
Dollarbird	0	1	0	0	0	1	0.1	99.3
Grey-headed Lapwing	0	1	0	0	0	1	0.1	99.4
Hair-crested Drongo	0	0	0	1	0	1	0.1	99.4
Large Egret	0	1	0	0	0	1	0.1	99.5
woodpecker-a	0	1	0	0	0	1	0.1	99.6
woodpecker-b	0	1	0	0	0	1	0.1	99.6
woodpecker-c	1	0	0	0	0	1	0.1	99.7
woodpecker-d	1	0	0	0	0	1	0.1	99.7
woodpecker-e	0	1	0	0	0	1	0.1	99.8
woodpecker-f	0	1	0	0	0	1	0.1	99.9
woodpecker-g	0	1	0	0	0	1	0.1	99.9
woodpecker-h	0	1	0	0	0	1	0.1	100.0

Appendix 1. Bird species list of detected species within summer of 2012, Nanjing, China.

Species-Common name	Scientific Name
Ashy Drongo	*Dicrurus leucophaeus*
Azure- winged magpie	*Cyanopica cyanu*
Barn Swallow	*Hirundo rustica*
Black Bulbul	*Hypsipetes leucocephalus*
Black Drongo	*Dicrurus macrocercus*
Black-billed Magpie	*Pica pica*
Black-crowned Night Heron	*Nycticorax nycticorax*
Black-eared Kite	*Milvus lineatus*
Black-naped Oriole	*Oriolus chinensis*
Black-throated Tit	*Aegithalos concinnus*
Brown Shrike	*Lanius cristatus*
Brownish-flanked Bush Warbler	*Cettia fortipes*
Cattle Egret	*Bubulcus ibis*
Chinese Pond- Heron	*Ardeola bacchus*
Common Kingfisher	*Alcedo atthis*
Common Koel	*Eudynamys scolopaceus*
Common Moorhen	*Gallinula chloropus*
Common Pheasant	*Phasianus colchicus*
Dollarbird	*Eurystomus orientalis*
Eurasian Blackbird	*Turdus merula*
Eurasian Cuckoo	*Cuculus canorus*
Great Spotted Woodpecker	*Dendrocopos major*
Great Tit	*Parus major*
Grey-capped Greenfinch	*Carduelis sinica*
Grey-capped Woodpecker	*Dendrocopos canicapillus*
Grey-headed Lapwing	*Vanellus cinereus*
Hair-crested Drongo	*Dicrurus hottentottus*
Hwamei	*Garrulax canorus*
Indian Cuckoo	*Cuculus micropterus*
Japanese White-eye	*Zosterops japonicus*
Large Egret	*Casmerodius albus*
Large Hawk-Cuckoo	*Hierococcyx sparverioides*
Light-vented Bulbul	*Pycnonotus sinensis*
Little Grebe	*Tachybaptus ruficollis*
Long-tailed Shrike	*Lanius schach*
Manchurian Bush Warbler	*Cettia canturians*
Masked Laughingthrush	*Garrulax perspicillatus*

Myna	*Gracula religiosa*
Red-billed Blue Magpie	*Urocissa erythrorhyncha*
Red-rumped Swallow	*Cecropis daurica*
Silky starling	*Sturnus sericeus*
Spotted Dove	*Spilopelia chinensis*
Swinhoe's Minivet	*Pericrocotus cantonensis*
Tree Sparrow	*Passer montanus*
Turtle Dove	*Streptopelia orientalis*
Vinous-throated Parrotbill	*Paradoxornis webbianus*
White Wagtail	*Motacilla alba*
White-cheeked Starling	*Sturnus cineraceus*
woodpecker-a	*Unknown*
woodpecker-b	*Unknown*
woodpecker-c	*Unknown*
woodpecker-d	*Unknown*
woodpecker-e	*Unknown*
woodpecker-f	*Unknown*
woodpecker-g	*Unknown*
woodpecker-h	*Unknown*
Yellow Bittern	*Ixobrychus sinensis*
Yellow-billed Grosbeak	*Eophona migratoria*
Yellow-rumped Flycatcher	*Ficedula zanthopygia*

TROUBLE IN PARADISE: EXAMINING THE IMPACTS OF HUMAN ACTIVITY AND ELEVATIONAL GRADIENTS ON THE HERPETOFAUNA OF HAINAN ISLAND

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Abstract

Hainan Island is an island directly south of Mainland China. With the ever-expanding tourism market, Hainan's enormous biodiversity could be at risk to increasing trends in human disturbance. In our study, we examined the effects anthropogenic and elevational gradients may have on herpetofaunal communities. After surveying several sites using basic opportunistic encounter methods, we determined community similarity between sites, as well as species richness and diversity using Simpson's diversity index. We discovered that neither disturbance nor elevation had significant effects on species richness ($p= 0.82$), diversity ($p= 0.72$), or community similarity.. High amphibian abundance at higher elevations skewed our results from the more commonly seen pattern that is best explained by the intermediate disturbance hypothesis. Previous studies have shown that moderate levels of disturbance may increase relative biodiversity in an area. Therefore, I would urge land managers and the Chinese government to set up more stringent conservational laws on slighty disturbed areas that may encroach more on the pristine habitat still present on Hainan Island.

Introduction

Hainan Island can be found directly south of China. Once a part of Guangdong Province, Hainan and some smaller adjacent isles are now considered Hainan Province. The main island has a land area of 34,500 square kilometers, and is separated from the current Guangdong Province by the 30-kilometers-wide Qiongzhou Strait (Hainan China 2009).

Despite its diminutive size and the rapid spread of a tourism-bolstered economy, Hainan Island still maintains large areas of protected lands that harbor an impressive number of floral and faunal species (Kadoorie Farms and Botanic Garden 2001, 2002, and 2003; Zhou et al 2004). This biodiversity can be partially explained by the island's ranging geography; Hainan's center is made up of numerous mountains that peak over 1000m above sea level (asl), while the outer areas flatten out and decline in elevation as they approach the coast (Hainan China 2009).

In recent years, Hainan has hosted numerous rapid biodiversity surveys. Kadoorie Farms and Botanic garden is an organization established in Northern Hong Kong whose main goal is the conservation of Hong Kong and South China's biodiversity. So far, they have published several biodiversity assessments on different areas of Hainan, including: Jianfengling (2001), Diaoloushan, Jianling, Shangxi, Wuzhishan (2002), and Jiaxi (2003). Each survey was extensive, with observed and captured specimens representing plant, invertebrate, and vertebrate taxa. Zhou (2004) and Zhou et al (2004) have also completed less comprehensive surveys solely on reptilian and snake clades, respectively. In addition to survey work, researchers have been busily describing countless new species records in Hainan, many of which remain endemic to the island. These include Adler's Keelback (*Rhabdophis adleri;* Zhou 1997) and Yaoshan Treefrog (*Rhacophorus yinggelingensis*; Chou et al 2007) to name a few.

Unmistakably, herpetofaunal publications coming out of Hainan in the last decade have mainly dealt with describing new species or taxonomies, when species diversity and richness studies should be receiving similar attention. Hainan is in the midst of a dynamic change towards modernizing and connecting isolated its isolated regions with each other and the rest of the world. With these disturbances on the rise, it is crucial that herpetologists strive to better understand herpetofaunal community structure and behavior prior to and after their ecosystem is impacted (Zug et al 2001).

Of all the factors that can affect community composition and species richness, either biotic or abiotic, elevation tends to be the most widely cited amongst scientific literature (Scott 1976). Poynton and others (2007) have done extensive research on the Eastern Arc mountain chain in Tanzania, Africa. He discovered that species turnover was greater along an elevational gradient than a latitudinal one. In other words, the three mountains where he focused his studies had higher species richness and diversity than the entire expanse of adjacent lowland habitat. McCain (2009) examined the untested but widely influential hypothesis stated by Daniel Janzen in 1967: That tropical mountains are physiologically 'higher' than those in temperature latitudes, thanks to the unwavering temperatures present at certain elevations on lower latitude mountains. For all vertebrates except rodents, McCain found that home range sizes were smaller on tropical mountains than on temperate mountains, where temperatures fluctuate greater within each elevation.

Rahbek (1995) reviewed 97 articles to determine frequency of different examples species richness along elevation gradients, after stating that the generalized example of a monotonic decrease in richness with increasing elevation (and decreasing temperature) had been over generalized and has resulted in "'citation inbreeding'". He discovered that the most common pattern was a mid-elevation peak in species richness and diversity, occurring in 50% of articles. The monotonic pattern of decrease was found in 25% of articles. Colwell and Lees (2005) further supported these results.

Habitat fragmentation and degradation through roads, logging and farming can have adverse effects on an area's fauna (Zug 2001). Diesmos (2008) used species-area curves to estimate the effects of clear-cutting on species richness and overall populations. He discovered that extreme deforestation practices would force over half of the herpetofaunal species of lowland Philippines into extinction. Incremental (and non- sustainable) losses would lead to similar, but slower extinctions. However, Crosswhite et al (2004) found that in some cases, habitat degradation led to higher richness and diversity in snake and lizards communities adjacent to or within newly created forest edges and clearings. However, these disturbances were negatively associated with amphibian taxa. These results seem lend partial credence to the intermediate disturbance hypothesis, which states species diversity is highest at intermediate level of human disturbance. Lepczyk et al (2008) tested this hypothesis on bird communities by measuring abundance at sites with varying land cover and total numbers of housing units present. All in all, their results supported this theory, and went so far as to recommend conservation status for similar less-than-pristine areas.

In our study, we sampled herpetofaunal taxa at numerous sites with differing disturbance levels and elevations on Hainan Island. Our main objectives were to determine whether any patterns exist in species richness and diversity along altitudinal and anthropogenic gradients. We hypothesized that species diversity and richness would reach a maximum at or near the middle of an elevational gradient, and where disturbance levels were moderate to low. Finally, we calculated community similarity between all sights, since richness and diversity indices cannot explain differences in community composition. On account of the close proximity of each of the four field sites, along with their apparent isolation on an island, I predict no significant differences in community structure between sites.

Study Site

We surveyed four different sites in the eastern, central and southern regions of Hainan. We took note of elevation and the level of disturbance at each site. Because our objective was not originally a stringent biodiversity survey, our assessment of the disturbance was based on qualitative observations. For the most part, sites were described as having a low, moderate, or high level of human disturbance. Tong Gu Ling (19°40'19.96"N 111° 0'31.50"E) is located at the easternmost edge of the island. Tong Gu Ling was the lowest site we visited, never exceeding 32m asl, and is quite small compared to the other preserves— only about 7 square kilometers. Tong Gu Ling had a high level of disturbance; the preserve was surrounded by rice patties and other crop plantations. Vehicle traffic through the park was also high, as many people lived in the area on farms. Mt. Li Mu (Li Mu Shan; 19°10'31.89"N 109°44'32.35"E) was a mid- elevation

site located at the center of the island. Altitude measurements across the site clustered around 650m asl. Due to limited access, we only managed to survey an area of 3 square kilometers, while the mountain and surrounding lands encompass about 150 square kilometers. Li Mu Shan could be considered moderately disturbed; although the town and some roads in the vicinity are under intense reconstruction, the majority of the preserve is untouched. A single cement road links the main village to our living arrangements and a smaller village further along— Traffic levels were low. Mt. Diaolou (Dialoushan; 18°43'30.49"N 109°52'7.32"E) was the largest and highest field site we visited. In the 6.3 square kilometers we surveyed, we visited areas from 780 to 960m asl. Because of limited transportation, we could not survey other areas of park that stretch over 200 square kilometers, encompassing three counties. Mt. Diaolou was by far the most pristine habitat we surveyed. Apart from a small resort and a few roads, the land is full and untouched. Finally, we visited Yaozi, a town at the base of Li Mu Shan (19°15'38.31"N 109°45'20.64"E). At an elevation of 180m, we surveyed 5.3 square kilometers of area and roads leading out of town. Yaozi village had very high disturbance overall. The roads that we surveyed separated different crop plantations for the majority of their length that we walked. Natural tree stands were uncommon

Methods

We sampled each site by road-walking and –cruising, supplemented by opportunistic visual and vocal surveys. Surveys were done at all parts of the day and at night. For the most part, we utilized park roads and paths to traverse habitat; occasionally however, we also surveyed along rivers, streams, and debris fields. Upon encountering a herp, we first identified and photographed the individual *in situ*. Then we would attempt to capture it. Most of the captured animals were quickly released; we collected an animal into a pillowcase or plastic bag only if i.) We wished to photograph it further at a later date ii.) The animal was to be preserved for use in a collection iii.) We could not identify the animal without referencing a field guide. Afterwards, we recorded the individual's position using a handheld GPS device. Since a few of the sites had never been surveyed (or not in many years) we collected and preserved a few animals representing each of the species we encountered.

We determined species richness, evenness and diversity for all four field sites. To calculate diversity, we used Simpson's diversity index. We then used Chi-squared analyses to compare richness and diversity values from all sites. We also examined species lists from each site to determine percent community similarity among the sites.

Results

Our surveying of four sites across Hainan Island, China resulted in a total of 54 herpetofauna species: 1 salamander, 24 anurans, 8 lizards, and 21 snakes (Table 1). According to the Chi-square analyses, neither elevation nor disturbance had significant effects on species richness (Chi-Square= 0.04, p= 0.82) or species diversity values (Chi-Square= 1.3, p= 0.72) at any of the four sites (Table 2). Although data were insignificant, lower diversity values were given to sites

with the highest levels of disturbance. We also discovered that none of the sites were significantly similar in terms of herpetofaunal assemblages (Table 3). These percent similarities still did vary among community couples. For example, the communities considered most similar (57.7%) were Tong Gu Ling and Yaozi, by far the two lowest and most disturbed areas; and the two communities calculated to be least similar (39.3%) were Yaozi and Diaoloushan, which found to contradict each other in both disturbance level (low versus high, respectively) and elevation (low versus high, respectively). Apart from these hypothesis questions, we also presented data on number of new species captured per day per field site (Fig. 1) and the rate of new species caught at each site (new species/day; Fig. 1).

Table 1: List and distribution of species found during Hainan survey (DLS = DiaoLuoShan, LMS = LiMuShan, TGL = TongGuLing) Species confirmed by voucher are represented by a closed circle ●. Species seen, but evaded capture or photograph, are represented by an open circle ○.

Scientific Name	DLS, resort, ~950 m	DLS, village, ~100 m	DLS, DaLi village, ~200 m	LMS, top, ~650 m	LMS, YaoZi village, ~180 m	TGL, ~30 m
REPTILIA, SERPENTES (21)						
Bungarus multicinctus		●	●			
Naja atra		●				
Sinomicrurus kelloggii				●		
Sinomicrurus macclellandi					●	
Trimeresurus albolabris				●	●	●
Achalinus rufescens				●		
Amphiesma boulengeri				●		
Amphiesma stolatum					●	
Boiga multomaculata					●	
Dinodon rosozonatum		●				
Enhydris plumbea		●	●		●	●
Oligodon cinereus		●	●			
Oligodon formosanus		●	●	●		
Pareas margaritophorus			●	●	●	●
Psammodynastes pulverulentus	●	●		●		
Ptyas korros					●	
Rhabdophis subminiatus					●	
Rhynchophis boulengeri			●			
Sinonatrix percarinata	●			●		
Xenochrophis piscator		●	●			●
Xenopeltis hainanensis					●	
REPTILIA, LACERTILIA (8)						
Acanthosaura lepidogaster				●		
Calotes versicolor	●	●	●	●	●	
Goniusaurus hainanensis		●	●			
Hemidactylus sp.	●	●	●	●	●	●
Gekko chinensis		●				
Mabuya multifasciata		●	●			●
Platyplacopus kuehnei	○					
Tropidophorus hainanensis	●					
AMPHIBIA, CAUDATA (1)						
Tylototriton hainanensis	●					
AMPHIBIA, ANURA (24)						
Amolops torrentis	●	●	●	●		
Amolops hainanensis	●	●	●	●		
Duttaphrynus melanostictus	●	●	●	●	●	●
Chirixalus doriae	●			●		●
Fejervarya limnocharis	●	●	●		●	●
Ingerophryne lodongensis				●		
Kaloula pulchra hainana						●
Kalophrynus interlineatus			●			
Kurixalus bisacculus	●			●		
Microhyla butleri		●			●	
Microhyla ornata					●	●
Microhyla pulchra	●	●		●	●	
Microhyla heymonsi	●			●		

Scientific Name	DLS, resort, ~950 m	DLS, village, ~100 m	DLS, DaLi village, ~200 m	LMS, top, ~650 m	LMS, YaoZi village, ~180 m	TGL, ~30 m
Occidozyga martensii	●	●	●	●	●	●
Philautus ocellatus	●		●	●		
Polypedates megacephalum	●	●	●	●	●	●
Polypedates mutus	●					
Rana guentheri	●	●		●	●	●
Rana taipehensis		●				
Rana rugulosa					●	●
Rana spinulosa	●			●		
Rana fragilis	●		●			
Rana versabilis	●					
Rhacophorus rhodopus	●					

Table 2. Shows elevation, disturbance, species richness and diversity values for four field sites across Hainan Island, China.

Site	Elevation (m asl)	Disturbance	Species Richness	Species Diversity
TongGu Ling	30	High	16	0.68
Limushan	650	Moderate	22	0.89
Yaozi	180	High	21	0.8
Diaoloushan	900	Low	23	0.91

Table 3. Shows every possible combination of all four sites and the resulting percent community similarity values.

Site	Tong Gu Ling	Li Mu Shan	Yaozi	Diaoloushan
Tong Gu Ling	---	39.3	57.7	41.3
Li Mu Shan	---	---	40.3	53.9
Yaozi	---	---	---	31.5
Diaoloushan	---	---	---	---

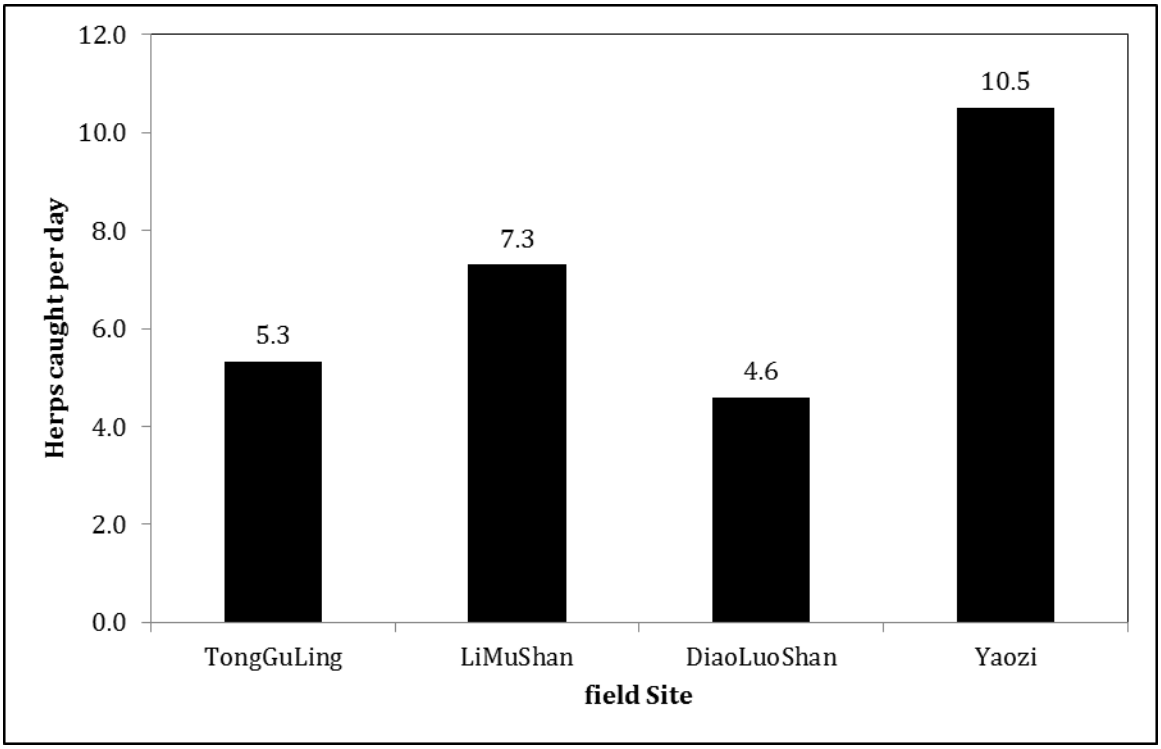

Figure 1. The number of new herpetofaunal species captured per day at each of the four sites on Hainan Island, China.

Discussion

The results from our rapid biodiversity survey of several sites across Hainan Island showed insignificant effects of elevation and disturbance level on the species richness and diversity, and overall similarity between all surveyed sites. However, due to a small time window available allotted each site (Fig. 2), the relatively small proportion of each site actually surveyed, and our general unpreparedness for conducting a conclusive herpetofaunal survey, the significance of our findings should be taken as a grain of salt. Nevertheless, some of our findings followed patterns described by researchers studying similar effects in other low-altitude mountain ranges.

Elevation was one of the variables we took into account when choosing our field sites and throughout the surveys themselves. Surprisingly, we found that species richness and diversity were positively correlated (although insignificantly) with elevation (Fig. 2). These finding went against our hypothesis that stated diversity and richness would peak at middle elevations. Although this hypothesis has been supported throughout the literature, it's possible other factors are at play and have skewed our results, especially in terms of high elevation biodiversity. Sasaki and others (2005) did similar yet more comprehensive tests on herpetofaunal communities in the Tochigi Prefecture in Japan. Their findings revealed that although elevation and climate were important factors contributing to herpetofaunal richness, it did not have equal effects on both reptiles and amphibians. Sasaki's results showed that for amphibians, climate, elevation and land

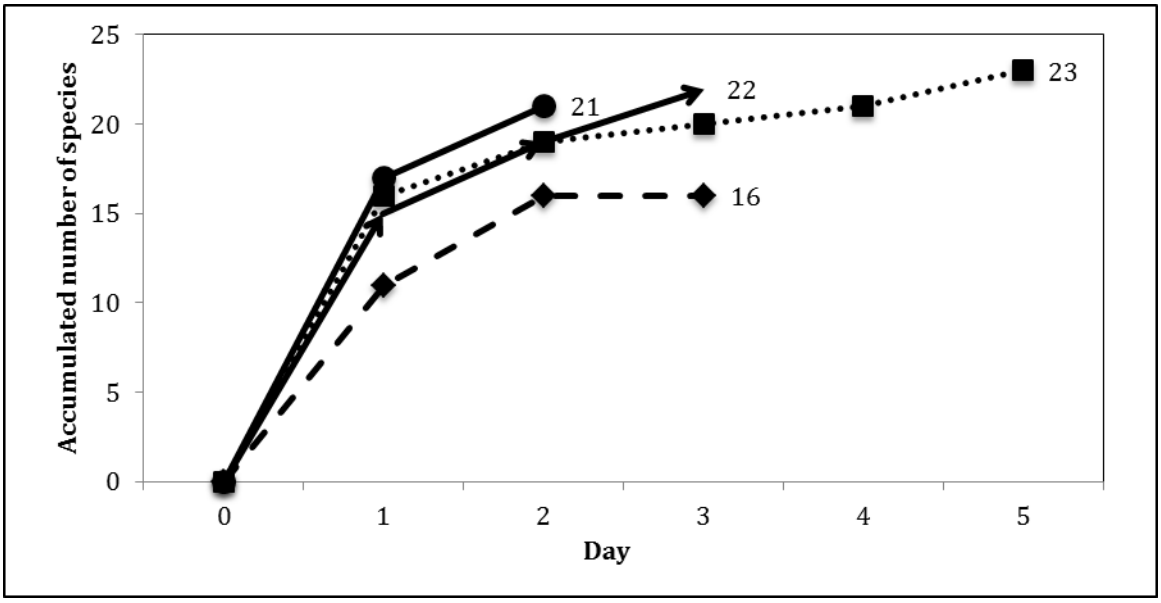

Figure 2. Species- area curves depicting the accumulated number of total species as a function of day of the four visited field sites on Hainan Island, China. Surveyed sites include Tong Gu Ling (dashed line, diamonds), Li Mu Shan (solid line, arrows), Diaoloushan (dotted line, squares), and Yaozi (solid line, circles).

cover together explained the majority of variance in habitat selection. However, results showed that land cover explained the majority of snake and lizards variance alone, meaning that elevation and climate were less of an issue for reptiles. These results make some sense, especially since amphibians are far less capable of controlling their body temperature than are reptiles (Feder 1982). In proper terms, amphibians acclimate to the temperature of their surroundings (poikilothermy,) while reptiles can reach appropriate temperature by selecting habitat/ microhabitat that best suits their current predicament (i.e. cooler temperatures for rest and hibernating, higher temperatures for hunting and digestion). With this said, the cooler and wetter climate of the higher elevations would better suit amphibians than reptiles; this was the case for diaoloushan, where we found a large number of frog species, as well as the Hainan endemic and only salamander species. Since higher elevations have been known to contain specialists or endemic species (Malonza and Veith 2012), a rise in high elevation diversity can be logically explained.

My second prediction stated that species diversity and richness would peak in areas where disturbance was moderate to low. The main source of support for this hypothesis comes from the heavily cited intermediate disturbance hypothesis (IDH). The IDH states that areas with moderate levels of disturbance can be somewhat beneficial to an area's biodiversity; in some cases, diversity is stable and may even increase after disruption (Lepczyk 2008, Rahbek 1995). As previously mentioned, Lepczyk (2008) conducted experiments on avian diversity across an anthropogenic gradient consisting of urban land cover and housing units in the Midwestern United States. Although factors like land cover and intense urban communities were negatively

correlated with avian diversity in the area, the large variability in housing units found across the land-cover gradients lent support to the intermediate disturbance hypothesis.

Rahbek (1995) discussed patterns in biodiversity along elevational gradients, both with and without disturbance. He made a point of stating that the mid-elevational peak he observed in 50% of the articles he surveyed could have been caused by uneven sampling methods and little standardization in sample plots. It's possible that a great deal of the error present in our study was due to these two factors. Although our sampling methods were similar across all sites, the proportion of each site we actually surveyed was quite small, especially in the larger parks like Diaoloushan or Li Mu Shan. I recommend that researchers wishing to conduct similar research in the future heed this warning and standardize both their sampling methods and sample plots. Apart from having proper transportation across large sites, Crosswhite et al (2004) Sung et al (2011) utilized drift fences for survey work and were quite successful. Sung and others mentioned that although transect surveys provided the highest species diversities, drift fence-pitfall arrays increase the overall number of captured individuals. In such a short time, this passive method of sampling could reduce the possibility of committing Type I errors, a common occurrence in ours and other surveys with small sample sizes. All in all, disturbance is becoming quite prevalent on Hainan Island. Although moderate levels of disturbance are capable of spurring communities' diversities forward, complete urban takeover will bring about their quick extinction (Diesmos 2008). Government agencies should consider enforcing more stringent environmental laws in areas that encroach upon the pristine habitat still present on Hainan.

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