COLLEGE OF SCIENCE AND HEALTH
WILLIAM PATERSON UNIVERSITY
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Department of Environmental Science Newsletter

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Tree Rings and Paleoclimatology

It was the fall semester of 2013 that I enrolled at William Paterson as Environmental Science Student. Throughout the many hands-on activities and lively discussions during my classes, I quickly became enthusiastic about science and the department as a whole. The following Spring I was given the opportunity to participate in student research under the advisement of Dr. Nicole Davi. This project, funded by the National Science Foundation, consists of the development of an online photo-archive that documents 30 years of tree-ring research from the scientists at Lamont-Doherty Earth Observatory (LDEO). The study of tree rings, also known as Dendrochronology, is essential to understanding Earth's climate over the past 2000 years. Paleoclimatologists at Columbia University's LDEO, utilize tree ring records in old growth forests throughout the world to extract clues about past and future climate change. Through evaluating past climate extremes and trends, tree-ring data gives scientists an opportunity to better understand temperature and precipitation variability. As science and technology evolve, effective means of educating the public about Earth's history and climate science must change as well. In order to promote public interest in scientific expeditions, the value of tree-ring-data, and paleoclimatology, we are cataloging these remarkable expeditions through a series of compelling images in an online searchable photo archive.

My involvement in this project has allowed me to participate in hands-on fieldwork as well. In the spring of 2014 environmental science students traveled to Norvin Green State forest to core chestnut oaks and build a collection for tree-ring and climate analysis for this area of Northern New Jersey. From the sample preparation in the wood shop to ring width measurements in William Paterson's Paleo-Lab, I became immersed in the logistics of paleoclimatology and enlightened on what it means to be a scientist. Studying the width of each ring in the core samples allows for the reconstruction of precipitation and temperature data for that particular locality; for example, the thinner the ring the dryer the year. As growing seasons end, the cells in the trees grow closer together forming the dark-band ring you would see in a sample. This is known as the latewood. At times, the density of latewood can provide a stronger climate signal then ring-width alone. Currently I am using a computer program to further analyze this concept in a blue-light intensity project. *By Rose Oelkers*

Rose Oelkers sanding cores in Tree Ring Lab.

Evan Gerry Finding time

In the spring of 2014 and my second semester as an Environmental Sustainability student, I began to work in the dendrochronology laboratory of Dr. Nicole Davi in the Department of Environmental Science. Dendrochronology, or the study of tree-rings, has a wide array of applications through the analyzing of widths and features of annual growth rings in trees, living or otherwise. The widths of tree-rings, being controlled by annual variations in weather such as precipitation and temperature, are generally consistent across a given region. A tree-ring chronology can be constructed from the compilation of multiple tree-ring series given that the date of those rings are known. Each successive ring is a year older than the one before it, with each ring bearing the characteristics of that year's climatic conditions. It is in this way that we can analyze tree-ring series of unknown age by comparing them to chronologies and seeking similarities between the ring widths that ought to appear in both.

Evan Gerry mounting cores in Paleo Lab.

My work with Dr. Davi has been a project at the confluence of both dendrochronology and archaeology, begetting the term *dendro-archaeology*. Our work has been focused on providing accurate calendar dates to historical structures in Rockland County, NY and, by extension, insight into the historical and archeological relevance of the structures. The two structures that have been analyzed are a saltbox and a barn, both being of estimated early-19th century construction. Cross-sections of timbers from these structures expose the tree-rings whose widths we can then carefully measure. The ring widths, with each sample's series comprising at least a hundred years, were then compared to existing local chronologies. Where the entire series of ring widths of each cross-section corresponded to those of the chronology, we were able to assign a date for each sample. Tree-rings from the saltbox structure dated between 1641 and 1834 and the barn's rings dated from 1684 to 1853. Each structure's outermost ring, in this case 1834 and 1853, show that the date of cutting could not have been any earlier than these years. Additionally, due to the technological limitations of the early to mid-19th century, it can be assumed that the structures were built shortly after the trees were felled. *By Evan Gerry*

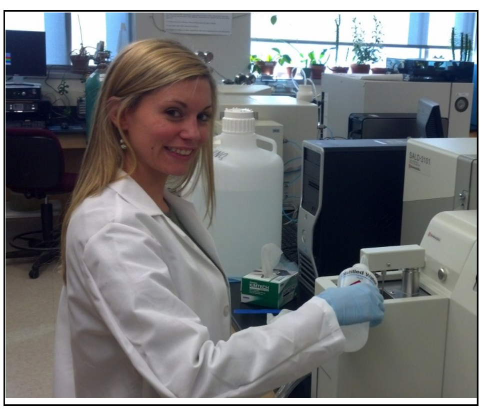
What can fossil shark teeth tell us about ancient oceans?

Constraining past seawater Sr/Ca ratios is an important and challenging task to scientists, because the chemical evolution of these two cations is fundamentally tied to various geologic and biogeochemical processes related to plate tectonics, weathering, diagenesis, and the carbon cycle. On geologic timescales, shifts in seawater Sr/Ca (Sr/Ca$_{sw}$) are thought to reflect variations in either the sources of Sr and Ca—which include riverine inputs via weathering, hydrothermal circulation, and calcium carbonate dissolution—or the output flux via carbonate sedimentation. By improving our understanding of seawater Sr/Ca evolution, we can thus potentially gain a deeper understanding of how these processes (controlling these fluxes) have operated on geologic timescales. Following a recent grant from the American Chemical Society awarded to Dr. Mick Griffiths and Dr. Marty Becker, Environmental Science major Bryan Gonzalez is (with the help of colleagues from Rutgers New Brunswick) helping to improve our understanding of the processes controlling these fluxes by reconstructing seawater Sr/Ca evolution from a host of fossil shark teeth previously collected by Dr. Becker in various regions of the US.

Ancestral sharks are unique in that they have a globally robust and continuous fossil record since the late Cretaceous. This fossil record is comprised largely of teeth due to: 1) rapid and continuous replacement throughout an animal's lifetime; and 2), their dense, biogenic apatite composition which is highly resistant to chemical and physical erosion. Over the past decade, marine biogenic apatite— specifically enameloid (comprising the dense crown tissue) in modern and fossil shark teeth—has exhibited some success in providing a new tool for reconstructing the evolution of the world's oceans. This is largely due to the fact that enameloid has been shown to accurately preserve the aqueous conditions of the seawater (i.e. isotope and elemental composition) at the time of tooth formation. Preliminary results of this study demonstrate that the Sr/Ca$_{sw}$ has overall declined since the late Cretaceous (~75 million years ago), a finding that is echoed in other marine fossil assemblages. Whilst this work is still in its infancy, we tentatively interpret the decline Sr/Ca$_{sw}$ to be a regionally (and potentially global) coherent signal, and as such, provides a new record of Sr and Ca flux to the paleo-ocean. *By Bryan Gonzalez*

Bryan Gonzalez preparing a shark tooth in Paleo Lab.

How do Forest Fires Alter Clay Minerals?



Nicole Kern running the Particle Size Analyzer.

Being able to become a research assistant in an environmental lab under Dr. Callanan was the best opportunity that had come my way during my college career. I was able to learn more about my field, about different research, and all the different machines that I may use later, when I find my career. My work in the lab consisted of many tests to continue a study that Dr. Callanan has been working on.

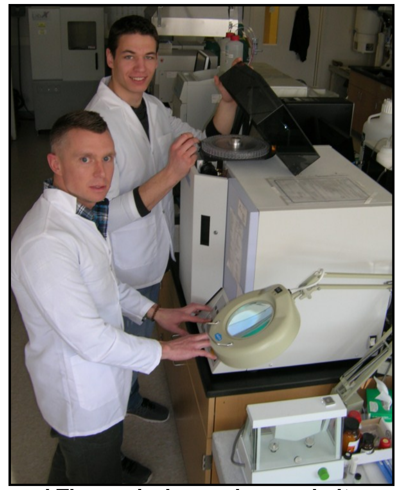
Chlorite and Smectite (montmorillonite) are clay minerals common to soil. These minerals have been shown to physically alter upon exposure to forest fire. This study aims to determine a timeframe in which physical weathering occurs following the application of fire. To do this, a laboratory experiment was created in which several weathering solutions were generated by means of vacuum filtration. These solutions included rainwater filtered through soil, through ash, and through ash over soil. Rainwater filtered through ash and soil was meant to replicate the post-fire environment. The individual minerals were then exposed to these treatments, at surface conditions, for three-week intervals for 21 weeks. The minerals were then extracted from the weathering solutions and analyzed for particle size distribution. The pH of the weathering solutions + mineral were also determined before each extraction.

The preliminary results of this study indicate an overall decrease in pH for all weathering treatments + chlorite with the lowest recorded pH at 15 weeks. Smectite shows an initial pH decrease in ash treated samples followed by an increase as 12 weeks is approached. Both chlorite and smectite show apparent physical weathering for samples replicating the post-fire environment based on particle size distribution analysis. These minerals will be analyzed for structural alteration and changes in bulk chemistry at a future time. This chemical weathering data will be compared with the current physical weathering results to determine a complete analysis of mineral weathering in the post-fire environment. *By Nicki Kern*

Glacial Lake Sediments, New Jersey's Icy Past

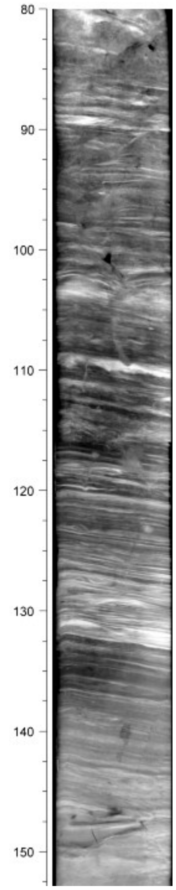
A lake sediment core was collected from Blauvelt Lake in Franklin Lakes, New Jersey, and is being analyzed to reconstruct past local climate variability in the northern regions of the state. Radiocarbon dating (^{14}C) was undertaken on organic material from three different depths (from the top of the sediment core), 140cm (3,313 years BP), 305cm (8,889 years BP), and 440cm (11,160 years BP). All radiocarbon dates were calibrated using Calib 7.1. The six meter core was preserved by dividing it into ten centimeter increments, and one gram samples were extracted at every three to four centimeters for analysis. Particle size analysis was performed on sediments using a Shimadzu particle size analyzer. To date, 375 cm of the 610 cm of core have been analyzed, with preliminary results showing environmental and climatic changes in the region over the past 9 thousand years (ka). Larger particle sizes are indicative of wetter periods and/or less ice coverage, whilst smaller particles sizes indicate drier periods and/or more extensive ice coverage. Additional analytical experimentation—including paleomagnetic analysis (already underway at Montclair State University), and elemental analysis of C/N ratios using the CHNS/O analyzer at WPU have provided additional constraints on the environmental evolution of the region and timing of the retreat of the late Wisconsin ice sheet in northern NJ. Working on this project has exposed me to an experience beyond what can be taught in any classroom.

Seth: Working with Dr. Griffiths has allowed me to understand exactly what goes into research from start to finish. Working in the lab on a daily basis with Mike DaSilva has increased my knowledge of what has been taught in my classes, and has allowed me to come up with different ideas to implement into the project. I've gained real-life work experience that will certainly make me more noticeable by future employers. I have also been able to be apart of different events such as Research and Scholarship day, which has allowed me to present our work to the University. I highly recommend taking advantage of the opportunities that are available to anyone within the Environmental Science department.



Seth and Tim analyzing carbon and nitrogen content.

Tim: The experience in the lab working under supervision of Dr. Griffiths was a very valuable aspect of my education at WPU. Gaining experience and skill using various types of lab equipment has made this research project enjoyable. As undergraduates, we have been granted the ability to work independently, with the assistance of Mike DaSilva, to develop project plans and implement them throughout this semester. Overall, the real-world experience gained in the laboratory is invaluable to my education and my future as I complete my studies at the university. *By Tim Greendyk and Seth Getch*

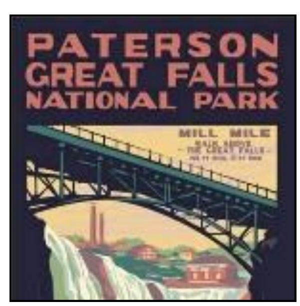


The Great Falls and Science Education

Through funding provided by The Landsberger Foundation and a partnership with the Paterson Great Falls National Historical Park and Paterson Museum, we are developing a science-based curriculum for use in the Paterson Great Falls National Historic Park. This curriculum is based on a living classroom, the Paterson Falls and Paterson Museum. This program will make it possible for students from the 4th to 8th grade to come to the falls and study a unique natural environment. The students will be given real life lessons in geology, hydrology, ecology, and the interconnectedness of the natural human environment. Lesson plans will be provided in accordance with the NJCCC curriculum standard. In addition to providing curriculum material for teachers within New Jersey, the educational material will eventually be made available to teachers across the U.S. through a "traveling-trunk" program. This partnership is very exciting because its gives urban students a chance to step outside the four concrete walls and start learning about sciences in their natural environment. A living classroom environment will allow students to interact with the program and give them a better understanding of the lessons being taught. Most urban students will not have the opportunity to see these types of natural occurrences. It will be very beneficial to show these students the process like weathering and erosion in its natural form as opposed to just seeing it in pictures in a book. It will also allow the students to step out of their daily schedules and participate in a hands-on lesson. There is nothing better than learning in a living classroom.

Randall Sanders and Elise at Great Falls.

By Randall Sanders



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William Paterson Students Attend SCA National Park Service Academy

During Spring break, students Aimee Aquino and Danielle Nichols participated in the Student Conservation Association's (SCA) National Park Service (NPS) Academy New York Harbor Orientation. NPS Academy is an internship program to encourage diversity within NPS. After completing a weeklong orientation, students are placed at summer internships all across the country at NPS sites. Within this week, students visited sites such as Jamaica Bay Wildlife Refuge, the State of Liberty, Governor's Island, and Federal Hall to learn more about career paths within the National Park Service.

Danielle and SCA and NPS students visiting Ellis Island.

After completing this program, Aimee Aquino was accepted as a biological intern at Cape Look National Seashore and will be working primarily with sea turtles. NPS Academy also focuses on career transitions from internships. Danielle Nichols, who completed an NPS Academy internship as an interpretive intern at Wind Cave National Park, will be employed as a GS-5 Visitor Use Assistant at Cape Cod National Seashore.

There are several paid internship opportunities available for WPU students. Many WPU students, such as Jessica Geary and Evan Gerry, have participated in NPS Academy and other SCA programs. For more information, visit thesca.org. Additionally, Danielle Nichols is a Partnership for Public Service NPS Ambassador and provides consultation on gaining NPS jobs and internships. If interested, please email her at: Nicholsd0212@gmail.com

By Danielle Nichols

Alumni Connections

LUISA TORO, 2014'
Environmental Scientist
Environmental Medicine, Inc.

RALPH SCIMECA, 2014'
Earth Science Teacher
Randolph High School

ALEXANDRA LUCAS, 2014'
Project Manager
QC Laboratories, Inc.

MARTINE POPE, 2014'
Earth Science Teacher
West Orange High School

JOHN DORVAL, 2012'
Earth Science Teacher
Sterling Education East,
Pascack Valley Campus

DOM STOCKTON-ROSSINI, 2015'
Graduate Student, Legal Studies
Rutgers University

DANIELLE NICHOLS, 2015'
National Park Service
Cape Cod National Park

EVAN GERRY, 2015'
National Park Service
Grand Tetons National Park

ROSE OELKERS, 2015'
Research Assistant
Lamont Doherty Earth Observatory

ANTHONY SCALERA, 2015'
Laboratory Director
Passaic valley Sewerage Comm.

MATT BEAUPRE, 2015'
Environmental Scientist III
TRC Companies

STEPHANIE FRANK-VIRGIN, 2013'
Staff Scientist
Langan Engineering, Inc.

DAN PAGANO, 2015'
Student Teacher
Paramus High School

MELISSA MARTE, 2014'
Environmental Assistant Project Manager
IVI International

JENN CRAPELLA, 2015'
Environmental Scientist I
TRC Companies

SARAH MIRANDA, 2015'
Education Intern
Duke Farm with SCA

AMANDA SWITZER, 2011'
Environmental Scientist
US Army Corp of Engineers