School of Science and Mathematics

Student Research Poster Display

Caputo Hall Lobby

May 1 – May 8, 2013

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Note: The names of Millersville University faculty advisors are designated by an asterisk (*) in the abstracts.

Biology

1. Comparative Pectoral Fin Anatomy of Skates and Rays: Superorder Batoidea

*Garten, Jennifer (MU 2012); and Didier, Dominique A.**
Department of Biology, Millersville University, Millersville, PA 17551

Batoid fishes are characterized by enlarged pectoral fins fused to the head and trunk, dorsoventrally flattened bodies, ventral gill slits, and a cartilaginous skeleton, and batoids are related to other cartilaginous fishes, the sharks and chimaeras. The skeletal anatomy of three species of batoid fishes, of a variety of stages of development, was analyzed to determine if there were intraspecific differences in anatomy. The differences in anatomical patterns related to the musculature and skeleton, primarily of the pectoral fins and pectoral girdle were described. The species under investigation exhibit a great deal of variability in the cephalic and pectoral fin structure and the differences in anatomy seen in the pectoral fin structure are related to the mode of swimming, whether oscillation, undulation, or body-caudal.

2. Local and landscape effects on the population dynamics of the invasive European crane fly (*Tipula paludosa* Meigen) and entomopathogenic nematodes

*Yocom, Suzanne[1];Petersen, Matthew[2]; and Wallace, John R.[1]**
[1] Department of Biology, Millersville University, Millersville, PA 17551
[2] Department of Entomology Cornell University, New York State Agricultural Experiment Station, Geneva, NY 144562

Tipula paludosa is an invasive species of crane fly that has quickly become established as a major pest in North American turfgrass, causing economic loss across both commercial and residential settings. Current patchy local (i.e., within a site) and landscape (i.e., among sites) distributions displayed by *T. paludosa* suggest factors operating at multiple scales are impacting the spatial organization of *T. paludosa*. Our objectives were to determine which local and landscape factors impact *T. paludosa* abundance at sites located along a gradient of urbanization; understand the local soil factors that influence entomopathogenic nematode distribution; and the understand the effect of soil texture and moisture on entomopathogenic nematodes ability to seek a host. We used a generalized linear model with a negative binomial error distribution to explain *T. paludosa* abundance in relation to local and landscape factors. Local factors included field capacity and the presence of endemic entomopathogenic nematodes found at each site; landscape factors of percent impermeable surfaces and Land Shape Index surrounding each site was also included. Results indicated that local factors of field capacity, acting as bottom up effects, and the presence of endemic entomopathogenic nematodes, acting as a top down effect, are the best predicators of *T. paludosa* abundance. To better understand the role of entomopathogenic nematodes in the field, we used a generalized linear model to evaluate the effects of pH, presence of *T. paludosa* and field capacity to *Steinernema spp*. distribution. Finally, a laboratory study was done to further elucidate the effects of soil texture and moisture on the ability of entomopathogenic nematodes to find a host. The findings of this study can be used to create effective control programs for *T. paludosa* and underlines the importance of scale in invasive species management.

3. Detection of Human Baiting Activity for White-tailed Deer Using Fecal Analysis

*Nauman, Teah and Haines, Aaron M.**
Department of Biology, Millersville University, Millersville PA, 17551

Due to the potential negative impacts of baiting on white–tailed deer, and the philosophy of fair chase, many of the United States have outlawed or restricted the use of hunting over bait. In addition, the issue of illegal take of wildlife (i.e., poaching) has been increasing in the United States as well as internationally. The objective of this study was to determine whether baiting activity on white-tailed deer can be determined by analyzing the chemical composition of deer feces and determine if unique chemical signatures are left by commercial baits (i.e., baits purchased at a local retailer). This information can then be used to identify areas where illegal baiting for white-tailed deer has occurred. In addition, our goal was to use a diversity of different chemical tests and identify one that can easily be used in the field. We believe the results from this research will allow conservation officers to determine if illegal baiting activity is occurring in an area by simply testing deer feces. This could help in the prosecution, and hopefully the reduction, of individuals who illegally use baits to poach white–tailed deer.

4. Yawning as an Indicator of Well-Being in Vertebrates

*Votta, Veronica and Boal, Jean G.**
Department of Biology, Millersville University, Millersville, PA 17551

Mammals, birds, and many other vertebrates yawn, yet the function of yawning has yet to be determined. If the function of yawning were understood, yawning frequency could provide a helpful indicator to animal husbandry specialists and other animal caretakers. Six common hypotheses for when animals yawn were evaluated using humans as subjects. The hypotheses tested were (1) animals yawn more when sleepy than awake, (2) animals yawn more when bored than excited, (3) animals yawn more when they are hot than cold, (4) animals yawn more when seeing individuals in their social group (in-group) yawn than when they see individuals not in their social group (out-group) yawn, (5) animals yawn more when inactive than active, and (6) animals yawn more when breathing stale air than when breathing fresher air. Ten subjects were tested for each hypothesis; each subject participated in both of test conditions so as to act as their own control. The results showed that subjects yawned significantly more (1) when sleepy than awake and (2) when bored than excited. Subjects did not yawn more (3) when hot than cold, (4) when seeing an individual in their in-group yawn than their out-group yawn, (5) when they were inactive than active; however, there was a strong trend in each of these cases suggesting that these factors may be important. No evidence was found for more yawning (6) when breathing stale air than fresher air. Results suggest that a high frequency of yawning in captive vertebrates can serve as an indicator of suboptimal housing conditions.

5. The Need to Incorporate Uncertainty into Recovery Goals for Endangered Species

*Zak, Matthew and Haines, Aaron M.**
Department of Biology, Millersville University, Millersville PA, 17551

The purpose of the Endangered Species Act (ESA) of 1973 is to preserve both endangered and threatened species and their ecosystems. Since its enactment, over 1,350 species have been listed under the ESA. Over a thousand of these species have recovery plans specifically written to help in delisting or downlisting the species, over 200 of those have a population size stipulated as a benchmark for recovery. We discuss whether uncertainty associated with population estimates is commonly reported in these recovery documents as a measure of precision. Tentatively, we found that prior to 2006, < 6% of all recovery plans reported uncertainty for population estimates. This number is subject to change with the drafting of both new and revised plans, which we are currently evaluating. The failure to evaluate and quantify uncertainty associated with population estimates could lead to species being downlisted or delisted before benchmarks are achieved. In order to avoid premature changes in species status we recommend more rigorous approaches when specifying recovery criteria for endangered species.

6. Detection of Deer Urine-based Lures to Mitigate Spread of Chronic Wasting Disease

*Strauser, Kenneth and Haines, Aaron M.**
Department of Biology, Millersville University, Millersville PA, 17551

Chronic Wasting Disease (CWD) is a dangerous transmissible disease. There are no known treatments for CWD and the spread of this disease can negatively impact wild populations of white-tailed deer. In the summer of 2012, a pen-raised white-tailed deer infected with CWD was found in Pennsylvania. In response the Pennsylvania Game Commission established a Disease Management Area (DMA) around the area where the infected deer was located and an executive order was given that established several restrictions within the DMA. One restriction was the prohibition of deer urine-based lures within the DMA. Deer urine-based lures are used by white-tailed deer hunters to attract deer for harvest. However, deer urine-based lures have been known to be collected from domestic white-tailed deer herds, with the potential of an animal infected with CWD residing within these domestic herds. Thus, urine-based lures can cause the spread of CWD into wild deer populations. The objective of this study was to determine if there are reliable field based tests to enforce the current prohibition of deer urine-based lures as part of a CWD prevention strategy. We used the following forensics test kits to test for the presence of deer urine-based lures: Nite-site luminol kit, Hemascein blood kit, Uritrace and Urine Stain Ultraviolet Light. Results of all 4 forensics test on the deer urine-based lures were compared to a control lure (i.e., water) to determine if these forensics tests can detect lures directly, on clothing, on boots or on the forest floor. Tentative results suggest that Ultraviolet Light and, to a lesser extent, Uritrace can detect urine-based lures, but not on clothing. Research is still being conducted.

Biology

7. Macroinvertebrate Community Response to a Restored Stream in Lancaster County, PA

Rittle, Alex M and Wallace, John R[*].
Department of Biology, Millersville University, Millersville, PA, 17551

Big Spring Run (BSR), a tributary of the Conestoga River, is a heavily incised, agriculturally-impaired stream located in Lancaster County, PA. Specifically, BSR has been influenced by historic mill dams constructed in the 18th century, prompting the restoration effort to remove such legacy sediments that were immobilized within the bank. During the summer of 2011, a 300 meter section of BSR was restored to reflect conditions prior to human impairment. The purpose of this study was to determine the impact of stream channel redesign and riparian buffer rehabilitation on structure. A BACI (Before/After/Control/Impact) sampling design was implemented to sample macroinvertebrates from three control reaches and one impact (restored) reach. Macroinvertebrates were collected using a Surber Sampler and returned to the laboratory for sorting and identification. All invertebrate samples to the generic (Genus) level and a Macroinvertebrate Aggregated Index for Streams (MAIS) were used to determine impact within all study reaches. Preliminary post-restoration analysis shows that there is not a significant difference between the pre- and post-restoration MAIS scores.

8. Floristic Inventory of a Hydrosere Community in Safe Harbor, Lancaster County, Pennsylvania

*Hartley, Nathan P.; and Hardy, Christopher R.**
James C. Parks Herbarium, Department of Biology, Millersville University, Millersville, PA 17551

Ranatra Pond is the unofficial name for a small perennial dystrophic waterbody that was formerly the site of a quarry used to build the nearby Safe Harbor dam in the lower Susquehanna River. Named after the genus of water-scorpion found abundantly within, this site is an ecological refugium for all walks of life. We are conducting the first floristic inventory of the pond, involving multiple surveys of the site from Summer 2012 through Summer 2013. Each plant species observed thus far has been vouchered once, and each species's distribution in the community is being mapped at a ½ x ½ second geocoordinate frequency using a geographic grid overlay of the area containing seventy-two ½ x ½ second (180 m^2) quadrants for a total survey area of 12,960 m^2 (3.2 acres). Innovative aspects to this survey are the precision of mapping of the plants as well as the construction of an online atlas to the project, called *Flora of Ranatra Pond* (www.wikiplantatlas.org/ranatra/), and it is here where all plants found at this unique habitat will be listed and mapped. The end result will be a complete digital, interactive representation of this unique habitat on the Web, which can serve as a baseline dataset for future successional studies of this area. To date 87 species, 80 genera, 51 families and 31 orders of vascular and non-vascular plants have been observed. Notable finds thus far include four populations of the S2-ranked orchid *Aplectrum hyemale*, an occurrence of the infrequently seen *Quercus muhlenbergii*, two gentian species (*Gentianopsis crinita* and *Sabatia angularis*), and the phylogentically interesting algal genus *Chara*.

Chemistry

9. Fluorescence of Dye Molecules

*McClure, Eric and Elioff, Michael S.**
Department of Chemistry, Millersville University, Millersville, Pa 17551

Dye molecules are known to be important in such diverse fields as bioanalytical chemistry, photometrics, health care, ecological preservation, and forensics. Fluorescein, in particular, exhibits fluorescence under ultraviolet light and has been used to model various physical and biochemical phenomena. We have investigated the effects of solvent pH and solvent polarity on the absorbance and fluorescence spectra of fluorescein. The absorbance spectrum of fluorescein exhibits a shift to longer wavelengths as solvent pH is increased. For fluorescein excited at a wavelength of 475 nm ($^1A_g \leftarrow {}^1X_u$), the emission spectrum exhibits a shift to longer wavelengths as solvent pH is increased. This result implies that the excited state is stabilized in more alkaline solvents. Our results seem to indicate a solvent dependence as well. In particular, the fluorescence of fluorescein excited at a 475 nm exhibits a shift to shorter wavelengths as solvent polarity is increased. This implies that the excited state of fluorescein has a lower polarity than the ground state. Additionally, unnormalized emission spectra show that fluorescein has a tendency to self-quench.

Computer Science

10. Developing a Web Application for an Online Ordering System

*Consylman, Ryan; Van Hine, Josh; Wright, Brian; Zoppetti, Gary**
Department of Computer Science, Millersville University, Millersville, PA 17551

In today's society web applications are becoming increasingly important, but also more complex and costly to implement. Large businesses devote considerable resources to create intricate web applications, but even small businesses are finding a minimal web system can save them time and money. Therefore, web development skills are a valuable asset for a Computer Science major, and learning these skills was the goal of this project.

Over the 2012 academic year, our three-member team designed and developed a complex online ordering system for the York-based Alpaca Yarn Company (AYC). Our software development lifecycle started with assessing client requirements and resulted in a system that met those requirements. The system includes account creation and management, an ordering system, and interfaces for information management in the database for both users and administrators. To accomplish this, we learned and developed skills in HTML5, CSS3, JavaScript, jQuery, PHP, MySQL, and relational database management.

Earth Sciences

11. StormReady Initiative at Millersville University and the Improvements in University Member Emergency Preparedness, Training, and Education

*Bamper, Carrie; Berndt, Daniel; Fitch, Ann Marie; and Yalda, S.**
Department of Earth Sciences, Millersville University, Millersville, PA 17551

In recent years, Millersville University and the surrounding community have experienced numerous situations in which severe weather and other unforeseen hazards have affected the area. Such events as a gas leak and subsequent explosion, several flooding events, and even a brief weak tornado touchdown on the outskirts summarize just a taste of that experienced in Millersville. In addition, it has become apparent that many students are not properly educated about the hazards of severe weather and other potential dangers. Moreover, many individuals have expressed a lack of proper education referring to the meanings of National Weather Service hazard messages and severe weather safety in general. Because of this, we desire to improve the knowledge base of students and faculty for times of precarious weather or other dangerous situations. Our current objective outlook begins with gathering information about the level of emergency preparedness among members of Millersville University. In the end, the information obtained will be used to better inform and prepare individuals for an approaching hazard. In addition, the information will identify the level of emergency preparedness among all university members. It will aid in improving and better targeting preparedness training for the university community. Moreover, the results will help in discovering what emergency information alert services are most effective for the majority individuals and identifying what areas need to be improved. Lastly, we hope to significantly increase the level of confidence among university members through future emergency warnings and response procedures. The scope of the project will hopefully span well across the campus and into the Millersville Borough. We will branch out as we look to aid in keeping the area safe in times of natural hazards through improvements and more thorough education and training of all individuals.

12. Precipitation Characteristics of Mesoscale Open-Cell Convection

*Wendoloski, E. B.; Marter, R. E.; Sikora, T. D.**
Department of Earth Sciences, Millersville University, Millersville, PA 17551

This poster presents the month-by-month frequency of precipitating and non-precipitating mesoscale open-cell convection over the northeast portion of the Gulf of Alaska for a five year period (2002-2006). The research employed previously-documented observations of open-cell convection signatures within satellite synthetic aperture radar-derived wind speed (SDWS) images. And, it employed corresponding surface weather radar images. The results show that both precipitating and non-precipitating open-cell convection are cold-season phenomena, consistent with previous studies. Moreover, the results show that open-cell convection is apt to be associated with precipitation. Overall, 60% of the open-cell convection observed within SDWS images and within range of a surface weather radar were associated with precipitation. Thus, the results support the hypothesis posed in previous studies that open-cell convection can be maintained by cold pool dynamics. That is, by the interaction of precipitation-driven cold pools and the vertical wind shear of the environment.

Mathematics

13. Periodic Orbits on a 120°-Isosceles Triangle

*Baer, Ben; Brown, David; Gilani, Faheem; and Umble, Ronald**
Department of Mathematics, Millersville University, Millersville, Pa 17551

Consider a frictionless billiards table T in the shape of an 120°-isosceles triangle. A periodic orbit on T is a trajectory of a billiard ball that begins and ends at some point on a side of T with the same initial and terminal angles. The period of an orbit is the number of times the ball strikes a side as it traverses its orbit. In this project, we study periodic orbits on T by applying techniques used previously by Baxter and Umble to study periodic orbits on an equilateral triangle. The main difference between these two settings is that all periodic orbits on an equilateral triangle with the same initial angle have the same period, while those on a 120°-isosceles triangle may have different periods. When this occurs we call such an orbit *unstable*. All unstable orbits with the same initial angle have one of two periods period m or n, where $n=2m+2$ or $n=2m-2$. Given an initial angle θ, we derive a general formula that produces the period(s) of all orbits with initial angle θ.

Physics

14. Surface Plasmon Resonance and Its Sensor Applications

*Geiger, Sarah J. ; and Dushkina, Natalia**
Department of Physics, Millersville University, Millersville, PA 17551

Surface plasmon resonance is an excitation of oscillations in the free electrons of a metal at, for example, an air-metal interface. This excitation can occur when a p-polarized laser shone through a prism interacts with the metal surface at a certain angle. An experimental setup was designed and built that was able to detect surface plasmon resonance off of a thin film of gold. The mathematical theory of these excitations were studied, as were the possible applications of this setup as a sensor. The unusual experimental results were analyzed.

15. Return Probabilities of Two Dimensional Lattice Random Walks

*Heldt, Karl and Nolan, Michael**
Department of Physics, Millersville University

In 1912, the Hungarian mathematician George Polya famously proved that a random walker on a lattice in one and two dimensions will eventually return to the starting point with probability one if the step probabilities are chosen to be isotropic. In three dimensions and above, the probabilities of return are less than one. With non-symmetric probabilities, the particle will have a probability of return less than one even in one and two dimensions. In one dimension, the probability of returning to the origin in exactly N steps is known for all step probabilities. For two-dimensions, we present computational results for a particular choice of non-isotropic step probabilities. Computer simulations confirm the theoretical results. Other interesting aspects of the research are appended and include the slow convergence of Polya's case in two dimensions and a result in combinatorics.

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