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# *Colby Undergraduate Research Symposium 2005*

## *April 27-29, Colby College, Waterville, Maine*

### *Abstracts - Research Symposium*

#### **GROUP DELIBERATION EFFECTS ON THE ANCHORING AND ADJUSTMENT HEURISTIC**

**Gabe Adams ('06), Meridith Major-Blascovich ('07) and Steen Sehnert ('06), Psychology**

The ways in which individuals are unintentionally influenced by arbitrary numerical values in making decisions is called the 'anchoring heuristic.' We are interested in the ways in which people, once made aware that a proposed value is randomly selected, adjust for this heuristic. Group polarization refers to the effects that a group has on an individual decision. Such deliberation tends to polarize, or make more extreme, a preliminary decision. Jury decision-making, because it occurs in a group, is subject to the effects of group polarization. We examined the phenomenon of the anchoring heuristic on both individual and group levels, and due to group polarization, we hypothesized that groups would be more likely than individuals to adjust for anchoring. This heuristic was examined in the context of a personal injury trial, where participants read one of two proposed monetary awards and then made decisions about how much money to award a plaintiff. They then deliberated in a group (as a jury) and re-awarded money.

#### **NITRATE AND PHOSPHATE LEVELS IN SOIL AND WATER AND HOW THEY REFLECT PREVIOUS CROP GROWTH ON A FARM**

**Gabrielle Adams ('06) and Noah Balazs ('06), Geology**

The soil and water on ranches in the Salinas Valley of California were analyzed for nitrate and phosphate to assess the impact of agriculture. The ranches sampled had different crops growing, including spinach, lettuce, broccoli and fallow (mustard greens). Nitrate and phosphate concentrations were measured in the soil of ranches and in suspended sediments and water in runoff streams. Soil nitrate concentrations were lowest on ranches with fallow (4.8 ppm). Ranches with commercial crops had an average nitrate concentration of 10.1 ppm, with nitrate concentrations of 10.6, 6.9, and 4.7 ppm for spinach, broccoli and lettuce respectively. Ranches in which fertilizer or compost was applied had an average nitrate concentration of 13.1 ppm, while unfertilized ranches averaged 7.2 ppm. Phosphate concentrations of 0.7, 3.2 and 3.3 ppm were determined for fields of spinach, broccoli and lettuce, respectively. Results show that phosphate concentration is not as strong a function of crop type as nitrate. Fertilized fields had lower phosphate concentrations than unfertilized (2.7 vs. 3.3 ppm). High values of nitrate (50-500 ppm) were observed in water samples, indicating leaching from surrounding fields. Phosphate values were less concentrated and less variable in runoff, ranging from 1-4 ppm. These data indicate that the concentration of nitrate and phosphate concentrations in soils can be used to determine the amounts and type of fertilizer necessary to maximize crop growth and can be used in the development of crop rotation practices. They can also determine whether fertilizer or composting is necessary. Higher nitrate values in runoff are due to rainfall. Low nitrate values

for the fields with fallow can be attributed to nitrate banking..

## **THE COLVILLE COLLECTION OF CHINESE TOMB ART**

**Lena K. Bachmair ('07), East-Asian Studies**

A collection of ancient Chinese tomb art was recently lent to The Colby College Museum of Art by Colby Collectors. The collection, called the Colville Collection, consists of funerary objects from the Neolithic Period through the twelfth century. They include pottery, ceramic figures and bronze vessels. During this past Jan Plan the four students of Art 293, Asian Art Museum Workshop taught by Ankeney Weitz, performed research on the objects in the collection. We created an online exhibition to introduce the collection and showcase the objects. We arranged them within several themes to highlight interesting aspects of particular objects, including function and method of production. Additionally, we each performed more in depth research of a specific piece of our choosing. By creating this online exhibition, we hope to educate visitors about the tomb art and burial practices of ancient China, and foster a greater understanding of Chinese culture in general. For this symposium, we hope to present our work to the audience in an accessible way. We would like to have a computer available to display the website of the online exhibit we created. One of us will give a brief introduction to the exhibit and the website. The audience would then be able to ask questions and use the computer to explore the exhibit themselves. The research that the four of us completed individually would be presented in poster form. We would each create a poster, which would be presented along with the object we studied. Following the general introduction the audience would be able to approach us individually and view our posters and objects. We would then be available to answer additional questions concerning our own specific research.

## **TERRITORIALITY IN MALE NEW ZEALAND FUR SEALS (*ARCTOCEPHALUS FORSTERI*) AT A BREEDING COLONY ON OTAGO PENINSULA, NEW ZEALAND**

**Gillian Butsch ('06), Biology**

Research concerning the breeding behavior of New Zealand's most common marine mammal, the New Zealand fur seal (*Arctocephalus forsteri*) is very limited. This study was initiated to establish a detailed account of male fur seal breeding behavior by quantifying territorial aggressive behavior as the first females arrive ashore to give birth at the beginning of the breeding season. Observations were recorded for three weeks at a fur seal breeding colony on Otago Peninsula, South Island, New Zealand. The colony was divided into territories which were defended by adult males through ritualized threat displays and physical fighting, in preparation for postpartum mating with incoming females. Two hypotheses were tested: first, the largest territories have the most females, and second, the territories with the most females will have the most conflict between males, quantified by male-male interactions observed. Evidence was found to support both of these hypotheses. This research establishes a baseline for studying territoriality in male fur seals and contributes to an ongoing study of behavior patterns of male fur seals at the breeding colony at the beginning of the breeding season.

## **GENDER DIFFERENCES IN SALIVARY ESTRADIOL AND TESTOSTERONE RESPONSE TO INFANT STIMULI**

**Annette Caswell ('05), Psychology**

Salivary testosterone and estradiol concentrations were measured using enzyme immunoassays to determine if men and women of childbearing age who had never had children experience changes in reproductive hormone function in response to infant stimuli. 20 men and 17 women viewed either a 20-minute observational video of infants and toddlers or a control video. Saliva samples were obtained prior to, and after viewing the videos and changes in salivary hormone concentrations were determined. A significant main effect of gender on testosterone concentration was identified across both film conditions. Males demonstrated significant increases in testosterone concentration after viewing their assigned video while females displayed significant decreases. A significant main effect of film condition was also identified across both genders. Participants in the infant-stimulus condition experienced increases in testosterone concentration, while those in the control condition showed decreases in testosterone concentration. There were no significant effects of gender or film on estradiol concentration. The decrease in testosterone in response to the infant condition may reflect the aromatization of testosterone to estradiol to increase estradiol levels in preparation for ovulation and potential reproduction. The lack of significant effects of gender or stimulus on estradiol concentration may reflect a delay in the aromatization process such that the aromatized testosterone was in an intermediate form and had not yet been converted to estradiol. The lack of significant estradiol changes may also reflect experimental error because, contrary to experimental evidence, baseline estradiol concentrations were not significantly different between men and women in this investigation.

## **HAZARD AREAS ASSOCIATED WITH MAJOR VOLCANOES IN THE CASCADE MOUNTAIN RANGE**

### **Caitlin E. Chamberlin ('05), Environmental Studies**

**ANALYSIS OF POPULATIONS AFFECTED BY VOLCANO HAZARD AREAS IN THE CASCADE MOUNTAIN RANGE** The Cascade Mountain Range in Washington State is the site of several active volcanoes that have the potential erupt which would deeply affect the lives of those who live near them. This study explores the hazard areas associated with the five largest volcanoes in the region: Mt. Baker, Glacier Peak, Mt. Rainier, Mt. Adams and Mt. St. Helens. It was determined which geographic regions would be affected by tephra, pyroclastic blasts and lahar flows and the associated populations that live in each of these areas. The level of emergency preparedness necessary for a volcanic eruption could be better determined based on the findings of this study.

## **THE RELATIONSHIP BETWEEN WATERSHED BOUNDARIES AND ELEVATION IN MAINE**

### **Caitlin Chamberlin ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Relationship Between Watershed Boundaries and Elevation In Maine was created using watershed, river and elevation data from the Maine Office of GIS. It shows how elevation has helped shape major watersheds in the state.

## **FISH DENSITY IN MAINE LAKES**

### **Rich Crowley ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Fish Density in Maine Lakes map was created using ArcGIS and data from Public Education Access to Environmental Information in Maine (PEARL) as well as the Maine office of GIS. The map shows the abundance of fish species in the Department of Fish and Wildlife surveyed Maine lakes. The fish densities were match with their respective Maine lakes based on Maine Information Display and Analysis System (MIDAS) numbers. A hillshade background was added to provide better perspective on lake locations. Finally the Maine streams and rivers layer from the Maine office of GIS was added in order to fill in hydrological gaps in the data.

### **GULF OF MEXICO'S OFFSHORE OIL PLATFORM WIND POTENTIAL**

#### **Rich Crowley ('05), Environmental Studies**

There are over 6000 natural resource drilling platforms in the Gulf of Mexico, all of which will become obsolete once their deposits are extracted. This study examined one of the possible alternate uses for these platforms, wind power potential. Using ArcGIS the number of platforms was reduced by weighting their distance from National Data Buoy Center wind speed collection points and water depth. Calculations were done to assess the optimal sites remaining, as well as provide an estimate of the energy potential for each site. Data for this project was obtained from the Minerals Management Service (MMS), United States Geological Service (USGS), and National Data Buoy Center (NDBC). A major limitation of this project was a lack of NDBC wind speed buoys, creating large data gaps and excluding many oil rigs that have otherwise high energy potential.

### **HISTOLOGICAL ANALYSIS OF LEUKOCYTE POPULATIONS IN ANTERIOR KIDNEYS OF SMALLMOUTH BASS (*MICROPTERUS DOLEMIEU*) AND WHITE SUCKERS (*CATOSTOMUS COMMERSONI*)**

#### **Lawrence M. Dargosa ('05), Biology**

Recent flow cytometric analysis by our laboratory has shown differences in the white blood cell populations present in the anterior kidneys of smallmouth bass (*Micropterus dolemieu*) and white suckers (*Catostomus commersoni*) harvested from the Androscoggin River. To further assess the leukocyte populations of these two species, enzyme staining techniques were optimized such that kidney sections could be stained for T cells, B lymphocytes, monocytes and neutrophils. Frozen 7 micron sections of bass and sucker anterior kidney samples were then compared histochemically. Using qualitative analysis of these sections we compared differences in histological structure between the anterior kidneys of the two species.

### **ATLAS OF MAINE: BEDROCK**

#### **Sarah Dunham ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Bedrock

Geology of Maine map was created using data layers from the Maine Office of GIS, Geo Data Explorer, a United States Geological Survey interactive map, and a hillshade of the state. Data were processed using ArcGIS 9 and show the relationship of bedrock to fault direction and elevation.

## **FIRE HAZARD IN COCONINO COUNTY, ARIZONA**

### **Sarah Dunham ('05), Environmental Studies**

Fire is a major management issue in the southwestern United States. Three spatial models of fire risk for Coconino County, Northern Arizona. These models were generated using thematic data layers depicting vegetation, elevation, wind speed and direction, and precipitation for January (winter), June (summer), and July (start of monsoon season). ArcGIS 9.0 was used to weight attributes in raster layers to reflect their influence on fire risk and to interpolate raster data layers from point data. Final models were generated using the raster calculator in the Spatial Analyst extension of ArcGIS 9.0. Ultimately, the unique combinations of variables resulted in three different models illustrating the change in fire risk during the year.

## **ROCK DETECTIVE'S APPROACH TO KAOLIN FOR GRADES K-12**

### **Sarah Dunham ('05), Geology**

Rock Detective is a supplemental, hands on, investigative curriculum designed to lead students through critical components of the 1996 National Science Education Standards recommended by the NRC. Rock Detective is used nationally and internationally to introduce many of the fundamental concepts of Earth science to students in grades K-12. This curriculum is a series of mysteries that pose questions about given hand specimens. They are based on the pedagogy that students will be curious and remember things discovered. Because curiosity is encouraged during student engagement in the mysteries, the most difficult concepts become easy to understand and fun to learn about. To date, 203 grade specific mysteries have been designed and others are always being researched and constructed. Five mysteries were developed. Geography of the south eastern United States is utilized to help students understand the differences between igneous, sedimentary, and metamorphic rocks, as well as residual and sedimentary clay deposits. Each module focuses on various aspects of Kaolin including alteration of feldspars to clay, change in structure during heating, economic uses, as well as a brief conceptual introduction to X-ray diffraction. Each mystery also is an introduction to other concepts, such as geologic time and elemental composition.

## **IDENTIFICATION OF IL-4-PRODUCING CELLS IN MUTANT FSN/FSN MICE BY IMMUNOHISOCHEMISTRY AND CONFOCAL MICROSCOPY**

### **Cory Ernst ('05), Biology**

Systemic lupus erythematosus (SLE) is an autoimmune disorder characterized by the production of autoantibodies to cell-surface, cytosolic, and nuclear antigens. These autoantibodies form complexes with autoantigens that are released from dying or damaged cells. These complexes have the potential to block capillaries, causing kidney failure and death. In this study, the fsn/fsn mutant mouse is used as a model of SLE, which exhibits pathology similar to that in humans. Those homozygous for the fsn genetic mutation show a wide range of abnormalities. These include flaky skin, enlarged spleen and lymph nodes, and increased number of B cells and

macrophages. There are also significantly high amounts of IL-4, the cytokine responsible for B cell activation. Thus, the components of the fsn/fsn immune system are extremely hyperactive. The goal of this study was to locate and identify IL-4 producing cells in spleens of fsn/fsn mice at different ages using immunohistochemistry and confocal microscopy. The results indicate that fsn/fsn mice produce significantly higher levels of IL-4 than normal littermates. Usually T cells are responsible for IL-4 production in the spleen. However, these results indicate higher complexity of IL-4 production. We have identified T cells producing IL-4 as expected, but also populations of T cells clearly not producing IL-4, as well as non-T cells that are IL-4 positive. We suspect that these non-T cell areas are germinal centers containing proliferating B cells.

## **SYNTHESIS AND CHARACTERIZATION OF OXYGEN-BRIDGED MULTI-OXACALIX[4]ARENES**

### **Michael Feldman ('05), Chemistry**

Calixarenes represent a particularly interesting subset of molecules from the cyclophane family. Their unique conformational structures, easy availability, and molecular recognition properties have made calixarenes an indispensable part of supramolecular chemistry. While more traditional carbon-bridged calixarenes, as well as some hetero-atom-bridged calixarenes have been heavily studied, oxygen bridged calixarenes have to some extent been left alone. While other groups have tried to synthesize multi-calixarenes, these attempts have largely failed due to the difficulty of creating annealed carbon structures. Utilizing the nucleophilic aromatic substitution calixarene formation reactions explored earlier by the Katz group, we have successfully synthesized multiple examples of both di- and tri- oxacalix[4]arenes. These compounds were characterized by standard methods including proton NMR, carbon-13 NMR, and X-ray crystallography. The multi-oxacalix[4]arenes that we have synthesized have particularly interesting conformational properties, taking on a 1,3-alternating structure that may allow for many binding pockets to be defined by the shape of the molecule.

## **TRANSPORTATION IN MAINE**

### **Kevin W. Fritze ('07), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The Goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Transportation Map of Maine was created using data from the Maine Office of GIS, which was downloaded, converted, and in the case of the roads layer, over 600 cells had to be appended together. The main focus of the map is the road networks throughout the state, but rail lines and airports are also shown.

## **VIEWSHED ANALYSIS OF THE LANDS OF THE BELGRADE REGIONAL CONSERVATION ALLIANCE**

### **Kevin W. Fritze ('07), Environmental Studies**

The Belgrade Regional Conservation Alliance (BRCA) has acquired a great deal of land in the Belgrade Lakes region of Maine and is currently in negotiations on many pieces of land throughout the area. Data available online from the Maine Office of GIS, and data from the BRCA were used to carry out this analysis. One area of interest is Mount Phillip, the summit of

which the BRCA recently acquired. There is a good view to the south of the mountain, but the potential view to the east and north is in question. This study analyzed the view from the top of the mountain, focusing on two landmarks: Mosher Hill to the east, and North Pond to the north. The analysis shows that both Mosher Hill and North Pond can be seen well from Mount Phillip. These results could help the BRCA both by adding weight to their negotiations to protect Mosher Hill, as well as influencing their decision whether or not to thin part of the forest on Mount Phillip to open up the view of North Pond that is currently blocked.

## **DOMINANCE VS. DIVERSITY: KIN RECOGNITION AND FEMALE MATE CHOICE IN ZEBRAFISH, *DANIO RERIO***

**Rharaka Gilbert ('05), Biology**

Kin recognition functions to avoid inbreeding and to assist relatives. In some species, it has been developed through olfactory cues given off by MHC proteins. Variability in MHC genes allows the individual to target a wider variety of viruses and bacteria. Therefore, females prefer to mate with individuals with dissimilar MHC genes. Females also prefer larger males to smaller males. In this study, zebrafish, *Danio rerio*, were used to test the hypothesis that females prefer to mate with males that will result in offspring with the most genetic diversity rather than dominance. This project revealed that females didn't spend more time with smaller males of a different genetic strain. Therefore MHC diversity is not more important in mate choice than dominance. This study also concluded, as previously discovered, that females prefer larger males to smaller males.

## **THE YELLOW BANDIT: THE IDENTIFICATION AND CHARACTERIZATION OF COLDWATER DISEASE PATHOGEN**

**Rharaka R. Gilbert ('05), Noah J. Hoffman ('05) and John E. Mahoney ('05), Biology**

Maine's fresh water fishing industry is economically crucial. Recently, 200,000 lake trout fry died at the Gov. Hill Fish Hatchery in Augusta, ME due to bacterial Coldwater Disease. Bacterial samples taken upon fry necropsy were cultured and gDNA was extracted, and a hypervariable portion of the 16S rDNA was amplified. Using DGGE, 1 16S rDNA band was obtained, sequenced, and compared to known species in the BLAST database. Results indicated that the putative pathogen was *Flavobacterium* sp., which is the usual etiologic agent of Coldwater Disease. Upon subsequent observation of diseased hatchery brooding stock, lake and brook trout specimens were collected and samples were taken from the blood, slime, kidney, and spleen. *Flavobacterium psychrophilum*, cultured and identified to cause Coldwater Disease in hatchery fry, was the suspected causative agent for the diseased adults. Samples were isolated in pure culture and compared with the BLAST database using 16S ribosomal DNA sequences. The results showed several gram-neg species but not *Flavobacterium*. Previous work in our lab has shown a correlation between bacterial Hg resistance and antibiotic resistance. As a result of this selective pressure and bacterial horizontal gene transfer, antibiotic resistance can become widespread and reduce treatment options for Coldwater Disease. In order to investigate the correlation between mercury and antibiotic resistance, Hg and antibiotic minimum inhibitory concentrations were determined for each isolate. Several strains showed high levels of resistance to both Hg and several different antibiotics, suggesting a correlation between their resistance levels and either the ability for horizontal gene transfer or mechanisms used to detoxify the antimicrobials.

## **RESISTANCE OF SOIL BACILLUS FROM DIFFERENT MAINE LOCATIONS TO MERCURY AND ANTIBIOTICS**

**Justin A. Guay, Biology**

Prior research has suggested that microbial antibiotic resistance increases in parallel with mercury resistance. To explore this relationship *Bacillus* species were isolated from soil samples collected from four distinct Maine regions; Acadia National Park, Bridgton, Freeport and Greenville. Each species was identified through a combination of morphology, 16S Ribosomal DNA sequencing, and API 50 CH metabolic diagnostic testing. 16S DNA sequencing divided the 17 isolates into 4 groups of identical sequence. API 50 CH was used to further distinguish species within these groups by their ability to metabolize different carbohydrates. Each isolate was also subjected to Antibiotic MIC and Mercury resistance testing. PCR using “Mercuric Reductase A” specific primers were used to further screen for Mercury resistant isolates. Antibiotic resistance was compared as a function of mercury resistance and both traits were compared as functions of geographic origin and isolate species. From these results antibiotic and mercury resistance could be compared with regard to specific regions and species as an aid to future studies of the correlation between these two seemingly related resistance phenotypes.

## **STEREOSPECIFICITY OF THE DNA CROSS-LINKING REACTION OF DIEPOXYBUTANE.**

**Trevor C. Hanly ('07), Chemistry**

Epidemiological studies indicate excess mortality from lymphatic and hematopoietic cancers among workers exposed to butadiene industrially. The lethal effects of butadiene have been attributed to its metabolite diepoxybutane (DEB), formed during mammalian detoxification by cytochrome P450. The bifunctional alkylating agent DEB forms interstrand cross-links between the N7 positions of deoxyguanosine residues on opposite strands of DNA at the duplex sequence 5'-GNC. We are using denaturing polyacrylamide gel electrophoresis to purify products resulting from reaction with optically pure stereoisomers (S,S, R,R and meso DEB) within a 209-base pair mitochondrial PCR product. Purified cross-links are subjected to piperidine cleavage followed by sequencing gel analysis to map the sites.

## **DEVELOPMENT OF MICROSATELLITE MARKERS IN *MEPHITIS MACROURA***

**Noah J. Hoffman ('05) and Dr. Samantha M. Wisely ('05), Biology**

*Mephitis macroura*, the hooded skunk, ranges from the southwestern United States into Mexico and Costa Rica. The goal of my research is to develop genetic markers for future population genetic studies of *M. macroura*. Specifically, I am developing microsatellite markers, which are long strings of tandemly repeated nucleotide bases. The number of these repeats at a given microsatellite loci is highly variable among individuals, meaning that there are multiple alleles for each microsatellite locus. However, the sequence on either side of the microsatellite is highly conserved allowing us to design PCR primers to amplify these loci in all individuals.

Microsatellites can be used for a variety of molecular studies including individual identification, paternity analysis, social structure, and for population and species wide genetic studies. In order to develop microsatellite markers for this species, a DNA library enriched for GT repeats was created by Dr. Samantha Wisely at Kansas State University. At Colby, I amplified DNA from 96

of the library clones using PCR. I then sequenced clones that had inserts of the appropriate size to determine whether or not the samples were positive for microsatellites. Of the samples I sequenced, approximately 40% were positive for microsatellites. After identifying positive sequences, I used the web-based Primer3 program to design primers for each positive microsatellite in this species. These markers will eventually be used in a population genetics study of *M. macroura* with the goal of understanding the population biology of an important host of rabies.

## **EFFECTS OF DIRECT AND INDIRECT CUES OF PREDATION RISK ON SMALL RODENT FORAGING BEHAVIOR**

**Laura Hudecek ('05) and Patrick Ely ('05), Biology**

**EFFECTS OF DIRECT AND INDIRECT CUES OF PREDATION RISK ON SMALL RODENT FORAGING BEHAVIOR** The foraging behavior of small nocturnal mammals may be influenced by many ecological factors such as competition and population dynamics. Among the most important and difficult to assess of these influences is that of predation risk. Indirect cues of predation risk, such as precipitation and moonlight may let prey know generally how easy they will be to detect. Direct cues, such as the odor of predator urine or the actual presence of a predator, may provide more specific information about the risk of predation. This study is an evaluation of the roles of both direct and indirect cues of predation risk on the foraging behavior of deer mice '*Peromyscus maniculatus*,' and southern red-backed voles '*Clethrionomys gapperi*.' It has been divided in to two sections. 1) Giving up densities (GUD) and the number of trips mice made to foraging trays were compared to temperature, precipitation, and moonlight intensity as indirect cues of predation risk. 2) GUD's and number of trips the mice made to each tray were compared with known predator activity by the use of motion sensitive cameras in view of the foraging trays. These comparisons allow for quantitative evaluation of the influences of both direct and indirect cues of predation risk on the foraging behavior of two small mammals, and provide insight into an important force governing community structure.

## **FORAGING BEHAVIOR OF THE GREEN ANOLE LIZARD (*ANOLIS CAROLINENSIS*) AFTER BURSTS OF EXERCISE**

**Carolyn P. Hunt ('05), Biology**

Animals make choices when presented with different food types, especially in response to environmental or internal conditions. I predicted that the effects of anaerobic exercise would influence food type choice of *Anolis carolinensis*, because of the physiological need for carbohydrates imposed by exercise. This study shows that lizard foraging behavior changes as a response to this increased need to restore glycogen levels after exercise. In a sedentary control period, lizards were given the choice of eating wax worms or meal worms. During the experimental period, lizards ran on a treadmill to simulate short bursts of activity that are typical of lizards in the wild and were given the same food choice. Under sedentary conditions, lizards had no significant preference for either wax worms or meal worms. After exercise, lizards preferred to eat significantly more meal worms than wax worms. This change in food choice might be explained by the lizards' response to the different nutrient content of meal worms.

## **THE COLBY COLLEGE GREENHOUSE GAS EMISSIONS AUDIT**

### **Carolyn P. Hunt ('05), Environmental Studies**

This study compiled and analyzed a decade of institutional emissions data to assess the impact the Colby College has on global climate change. Each sector within the college, purchased electricity, on-campus oil use, transportation, solid waste, refrigerants, emits anthropogenic greenhouse gas. The audit converted use and consumption figures for each sector into carbon dioxide equivalencies for each of the six anthropogenic greenhouse gasses. With this data, we hope to enact policy changes within the school to meet greenhouse gas emission standards, such as those enacted by the Kyoto Protocol in 2005. Colby has already purchased green electricity, which has brought our emissions down to levels approaching our emissions in 1990.

### **ATLAS OF MAINE: MOOSE-VEHICLE COLLISIONS (MVC) IN THE STATE OF MAINE FROM 1992-2004.**

#### **Alexandra Jospe ('06), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The moose-vehicle collisions map was created using data from the Maine office of GIS, the Maine Department of Transportation, and the USGS. The data were projected in UTM zone 19, NAD83.

### **ESTIMATED NUMBER AND LOCATION OF FUTURE MOOSE-VEHICLE COLLISIONS (MVC) IN MAINE.**

#### **Alexandra Jospe ('06), Environmental Studies**

Moose (*Alces alces*) are a keystone herbivore in Maine. Because of the large number of rural roads in Maine, there is a high rate of moose-vehicle collisions (MVCs), which is increasing. On-road encounters with animals resulted in 231 fatalities in the United States in 1999. Because of the fatality of MVCs, it is important to know where they are most likely to occur. I used GIS analysis to estimate where future MVCs would occur, factoring in the variables of land cover suitability for moose, distance from water bodies, locations of past MVCs, and speed limits on the roads. I ran four different analyses, each one weighting the variables equally. I also ran a regression to determine if increasing road speed was associated with the increase in the number of MVCs per length of road. There was not a strong positive relationship between the number of MVCs per length of road and the speed limit, but it was interesting to note that there were more MVCs per length of road on 35mph and 40mph roads than on 45, 50, 55 or 65mph roads. Future research on MVCs would benefit from the inclusion of include moose population density and road traffic data.

### **A SPATIAL COMPARISON OF SHORT AND LONG TERM MIGRATION TRENDS IN CHINA**

#### **Stephen A. Kasperski ('05), Environmental Studies**

China's floating population, those individuals who have migrated between counties or provinces for a period of longer than 6 months, account for 79 million individuals. If intracounty migration is also included, the number jumps to 145 million individuals or over 11% of the total

population. This study examines the geographical differences in short and long term migration using ArcGIS to manipulate the spatial GIS data. The study shows that both short and long term migration (in absolute numbers) occurs more frequently near cities and in coastal regions. However, by normalizing the data by population size, the study eliminates the problems of population size on the size of the migrants. Using this normalized data, the study finds that western and northern counties have a large number of migrants present relative to the size of the population. Determining where this floating population migrates helps explain regional inequalities in employment opportunities.

## **EDUCATIONAL ASSESSMENT OF MAINE'S 11TH GRADERS**

### **Steve Kasperski ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Educational Assessment of Maine was created using data from the Maine Office of GIS, the Maine Education Policy Research Institute, as well as the Maine Department of Education. The map shows 11th grade Maine Educational Assessment scores in 2004 for each district with a high school. The scores for each of the writing, reading, math, and science portions of the test were averaged into one score representing the district.

## **THREE-DIMENSIONAL GRAPHITIZED PLANT FOSSILS FROM THE FIRST UPRIGHT PLANTS ON EARTH: TROUT VALLEY FORMATION, NORTH-CENTRAL MAINE**

### **Newton W. Krumdieck ('07), Geology**

The early Middle Devonian Trout Valley Formation of north-central Maine is famous for well-preserved remains of the first upright land plants, including *Pertica quadrifaria*, official state fossil of Maine. It also serves as the model for early terrestrial ecosystems. The formation is predominantly sandstones and siltstones from an alluvial fan-deltaic-tideflat environment originating in the Acadian Mountains and flowing into a Devonian sea. Plant remains in the streams became deposited as part of the record; heat from underlying magma that became the Traveler Mountain Rhyolite and Katahdin Granite graphitized included fossils, a process rare without concurrent high-pressure flattening. Transported specimens from both the depositional sequence and an upstream paleosol were studied. Plant specimens were previously described from two-dimensional plate fossils, coming from split rock layers. The objective of this research was to correlate between these and new specimens which were preserved three-dimensionally. Approximately 10 kg of the Trout Valley paleosol was dissolved in 48% HF. Remaining insoluble materials were washed with water over a 0.3 mm screen, then re-sieved into discrete size classes from 0.5 mm to 2.0 mm. Samples were then inspected under a dissecting microscope and promising remains removed for further study. Potentially identifiable fragments were found from many plants, the most readily identifiable and plentiful being from four species: *Pertica quadrifaria*, *Psilophyton* cf. *P. forbesii*, *P. microspinum* and *Kaulangiophyton akantha*. Possible charcoal fragments have implications for early evolution of an oxygen-rich atmosphere. Other taxa are likely present.

## **2004 DISTRIBUTION OF BROOD TROUT STOCKINGS FOR THE STATE OF MAINE**

### **Theodore F. McDermott ('06), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES 212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. 2004  
Distribution of Brood Trout Stockings For The State of Maine was created using data from the Maine Department of Inland Fisheries and Wildlife regarding the placement of trout in ponds and lakes across Maine. The geographic distribution of four species of trout was mapped by joining the trout distribution layer to a layer that includes all bodies of water in the state.

### **ANALYSIS OF FUTURE CONSTRUCTION POSSIBILITIES ON THE COLBY COLLEGE CAMPUS**

#### **Theodore F. McDermott ('06), Environmental Studies**

With the recent construction of Colby Green and the current plans for the construction of several new buildings, the total area for future development on campus has declined. The goal of this study was to illustrate existing campus development and to determine where future growth could occur. GIS was used to in determining the different soil systems on campus, the current use of the land, and the boundaries of the Colby property. The project shows what potential obstacles the college will have in attempting to expand the campus and proposes where the best options are for construction are.

### **A PRELIMINARY HABITAT SUITABILITY ANALYSIS FOR THE RESTORATION OF SOUTH CHINA TIGERS IN THE HUPINGSHAN RESERVE, CHINA**

#### **Rob Mehlich ('05), Environmental Studies**

The South China tiger, *Panthera tigris amoyensis*, once roamed the greater part of southern China. However, expanding human populations and other anthropogenic effects have resulted in the extinction of the wild population. The Chinese government has expressed interest in a reintroduction program for this species of tigers. Recent studies suggest that the Hupingshan preserve is potentially a good candidate for a tiger reintroduction program. Hupingshan is located on the border of the Hunan and Hubei provinces in Southern China. This study was a preliminary habitat suitability analysis, for the restoration of South China tigers in the Hupingshan reserve, China. ArcGIS 9.0 was used to develop a model that combined roads, railroads, slope, land cover, park classification, and population density. The tiger habitat suitability analysis was performed by weighting and combining the various layers. Preliminary results suggest that the Hupingshan reserve is suitable habitat for the reintroduction of South China tigers.

### **ATLAS OF MAINE: USGS TOPOGRAPHIC MAPS OVER A HILLSHADED DIGITAL ELEVATION MODEL**

#### **Rob Mehlich ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The USGS Topographic Maps Over a Hillshaded Digital Elevation Model was created using ArcGIS 9.0. U.S. geologic survey 7.5 minute topographic maps at a scale of 1:24 000 for the entire state of

Maine were placed over a hillshaded digital elevation model for the entire state of Maine. The topographic maps were set at 40% transparency to allow elevational features to be more pronounced.

## **CONDITIONED TASTE AVERSION IN MICE (*MUS MUSCULUS*)**

**Julia Morrison ('05), Biology**

Taste aversion is an example of a learned behavior that enables animals to choose foods that are beneficial, while avoiding the repeated ingestion of foods that are harmful. Laboratory mice (*Mus musculus*) are known to exhibit learned taste aversions to different stimuli that are subsequently paired with nausea or illness. This study tested the hypothesis that the development of a taste aversion is influenced by the strength of the unconditioned stimulus (3% and 10% ethanol) and by the novelty of the conditioned stimulus (orange and cherry flavored water). I also studied how long the aversion to the flavor persisted after it was no longer paired with ethanol. The data supported the predictions that mice trained with 10% ethanol learn the aversion faster and maintain those aversions longer than mice trained with 3% ethanol. Statistically significant data supported the prediction that when ethanol is present at the first encounter with the flavor, rather than being delayed to later trials, the mice would develop an aversion more quickly. These mice also maintained their aversion somewhat longer after the alcohol was removed, but the differences fell short of being statistically significant. Results supported the overall hypothesis that learning a taste aversion is enhanced by the strength of the unconditioned stimulus (ethanol) and by the novelty of the conditioned stimulus (flavor).

## **ATLAS OF MAINE: A MAP OF IMPOUNDMENTS AND THEIR PRIMARY PURPOSE ON MAINE RIVERS**

**Sophia S. Newbury ('08), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Maine Impoundments and Their Primary Purpose map shows all of the dams in Maine and categorizes them based off of their primary purpose. The data was downloaded from the Maine office of GIS and classified to show the primary purpose of these dams.

## **ANALYSIS OF ANTIMICROBIAL PEPTIDES IN AMPHIBIAN SKIN SECRETIONS**

**Jillian E. Parker ('05) and J. Michael Conlon ('05), Biology**

A remarkable variety of compounds are synthesized and secreted in anuran amphibian skin. These serve primarily to protect the animal from predators and pathogens. In this presentation, we review results of studies in which skin secretions were collected from ranid frogs in the bullfrog and leopard frog species groups. Peptide components were purified using reverse-phase HPLC. Structural characterization of the peptides and antimicrobial assays have revealed several families of antimicrobial peptides. Each peptide also has a species-specific amino acid sequence. The distribution of these peptides in North American ranid frogs is important to understand for phylogenetic analyses of members of the two groups and in light of recent amphibian population declines that may be caused by diseases such as the chytrid fungus, *Batrachochytrium dendrobatidis*. For example, ranalexin is synthesized by *Rana catesbeiana*, *R. grylio*, *R.*

*clamitans*, and *R. virgatipes*, but was not found in skin secretions from *R. septentrionalis*. On the other hand, four paralogs of brevinin-1, a family of peptides widely distributed in the skins of Eurasian ranids and North American ranids in the leopard frog group, were isolated from secretions from *R. septentrionalis*. We are currently developing methods for purifying peptides from amphibian skin to further investigate interspecific and geographic variation in the peptides, and their effectiveness on local microbial fauna.

## **CHARACTERIZATION OF MERCURY AND ANTIBIOTIC RESISTANCE DETERMINANTS IN SALMONID GASTROINTESTINAL BACTERIA**

**Erin Parry ('06) and Matt Meredith ('06), Biology**

Atmospheric mercury (Hg) deposition has resulted in elevated levels of mercury in Maine rivers and lakes, and has prompted several recent fish consumption advisories by the EPA. A 2005 study on mercury in Maine conducted by the BioDiversity Research Institute in Falmouth, Maine has attracted national attention regarding mercury distribution in Maine bodies of water, soil, fish, and piscivorous birds. Bacterial isolates obtained from the gastrointestinal tracts of salmonids in the past two years have been found to show high levels of resistance to HgCl<sub>2</sub> and organic mercury (phenylmercuric acetate), as well as resistance to multiple antibiotics. Previously, these resistance patterns among bacterial isolates were documented phenotypically, although the resistance determinants had not been characterized. *merA*, the gene encoding mercuric reductase has been amplified and sequenced in some mercury resistant isolates, including a *Salmonella* sp. and *Pseudomonas* sp.. Hypothetical *merA* amplicons have been found in almost all the remaining isolates. Antibiotic resistance genes were identified via PCR and DNA sequencing. Additionally, several of these genes were found on mobile genetic elements that have been previously documented to be capable of horizontal gene transfer by the mechanism of transformation. We also report that mobile genetic elements containing antibiotic resistant genes from a gram positive donor, *Carnobacterium* sp., can be transferred through conjugation to the gram negative fish pathogen, *Aeromonas salmonicida*.

## **CHAOS AND FRACTALS: A TASTE OF NONLINEAR DYNAMICS**

**Seth Pierrepont ('05), Mathematics**

This talk provides a trip into the world of nonlinear dynamics to view chaos and fractals in both continuous and discrete systems. The talk starts along a path of simple definitions and concepts that will provide the necessary background to understand chaos and fractals in a general sense. The talk then comes to a fork, a bifurcation perhaps, as it splits from a general overview into two specific examinations of chaos and fractals in two different types of systems: continuous and discrete. For continuous systems, the focus will be on the Lorenz equations and the notion of a strange attractor, looking at the butterfly effect in three dimensional space. For discrete systems, the goal is to comprehend the magnificent Mandelbrot set and its index of Julia sets through a series of interactive applets and pictures. In short, this talk will trace the mathematical path that leads to some of the most beautiful geometric shapes in mathematics.

## **SYNTHESIS AND CHARACTERIZATION OF PYRIDINE-BASED BICYCLOOXACALIXARENES**

**Kevin J. Selby ('05), Chemistry**

Novel bicyclicoxalixarenes were synthesized in high yield via a selective, room temperature SNAr reaction of phluoroglucinol with 2,6-dichloropyridines. Functionality on the 2,6-dichloropyridine was varied by changing the electron-withdrawing groups in the 3 and 5 positions (using chlorine, nitro groups, and cyano groups) and the side-chains in the 4-position (using ethyl, butyl, phenyl and p-tolyl groups). The resulting cage-like molecules were studied by X-ray crystallography and tested for metal complexation.

## **ATLAS OF MAINE - URBAN SPRAWL: POPULATION MIGRATION FROM 1990-2003**

### **Conor Semler ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Urban Sprawl map was created using population density data from the US Census Bureau from 1990 and 2003, and shows movement of population. The data indicates that central city areas declined in population, while areas on the periphery experienced the most increase.

## **MONEY AND EDUCATION: HOW ECONOMIC DISTRIBUTION CORRESPONDS TO ACADEMIC SUCCESS**

### **Conor Semler ('05), Environmental Studies**

Urban sprawl is a significant issue in the United States, one effect of which is the departure of the wealth from cities. This study examined the distribution of wealth in Erie County, New York, focused around Buffalo. The question is then raised, why do those with the money leave the city, and to where do they go? While this study does not attempt to explain all of the reasons, it does examine two significant issues: quality of public school education, and proximity to main highways with easy access to the city. Using ArcGIS, I was able to place the public high schools and their relative ranking over a distribution of per capita income. The results of this analysis show that the wealthiest areas are located within the best school districts. Moreover, the areas where the wealth accumulates are directly connected by major highways.

## **A GIS SUITABILITY ANALYSIS OF WOLF HABITAT IN MAINE**

### **Wendy A. Sicard ('05), Environmental Studies**

The range of the Gray Wolf (*Canis lupus*), once covering most of North America, has been drastically reduced by an estimated 95% due to habitat loss and extermination by humans. The wolf was extirpated from Maine in the 1800's. Wolf reintroductions have been suggested for Maine, but there is some debate about how much land is suitable for wolves. I developed a wolf habitat suitability analysis using ArcGIS and data from the Maine Office of GIS and the United States National Atlas. The model incorporates land cover, presence of major roads and railways, conservation land, industrial, non-industrial, and public woodlot ownership, distance from major points of population, deer population, and slope. The model results show areas of high and low wolf suitability in Maine. The model suggests that the best potential habitat for wolves in Maine is situated in the northwest of the state. Possible future reintroductions or natural colonization from other areas would have the highest likelihood of survival in these areas.

## **MAINE ATLAS: WILDLIFE HABITAT**

### **Wendy Sicard ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. Wildlife Habitat was created using data from the Maine Office of GIS and the United States National Atlas. The map shows the land cover characteristics of Maine, including human development and major roads. The most suitable wildlife habitat can be attributed to the areas with the most suitable land cover and the least human development. An inset map shows overall habitat values for 91 priority trust species of the U.S. Fish & Wildlife Service, within forested cover types.

## **PHYSIOLOGICAL AND BEHAVIORAL EFFECTS OF CAFFEINE INGESTION AND VOLUNTARY WHEEL RUNNING IN FEMALE MICE (*MUS MUSCULUS*)**

### **Kathryn A. Slemm ('05), Biology**

Caffeine has been shown to stimulate physical activity in mammals, and acute exercise results in stimulation of several physiological systems in males of several mammalian species. Little is known about how female mammals respond to these introduced stimuli. In this study, I tested the hypothesis that female lab mice (*Mus musculus*) exhibit changes in body condition, metabolism and biochemical characteristics of muscle and blood to a stimulant (caffeine) and exercise (voluntary wheel running). I measured body mass, resting metabolic rate, blood glucose levels, plasma hematocrit, and activity levels of aerobic and anaerobic enzymes in heart and leg muscles. I compared values in mice receiving each treatment to those maintained under controlled conditions. Few significant differences were detected in any of the six variables. Further investigation is necessary before explicit conclusions can be drawn.

## **AFFORDABLE HOUSING IN KENNEBEC COUNTY**

### **William G. Stohner ('05), Environmental Studies**

The U.S. Department of Housing and Urban Development defines affordable housing as a household paying no more than 30 percent of its annual income on housing. That is, families who pay more than 30 percent of their income on housing are considered cost burdened and may have difficulty affording necessities such as food, clothing, healthcare, and transportation. This project focused on Kennebec County, Maine. Between 1990 and 2000, market demand for housing increased at a faster rate than did the supply of housing. Despite the addition of 6,719 homes, the average home price increased faster than average household income. This raises the question of just how many households in Kennebec County are facing unaffordable housing. Using shapefiles and data provided by the US Census Bureau, a map was created with ArcGIS to illustrate the percentage of households, down to the Census Block level of detail, that are paying more than 30 percent of their income to housing. By looking at this information I was able to get a better picture of the housing situation and where in the county households are having the hardest time meeting their needs. The results indicate that households in the more urbanized sections of the county are more likely than rurally located households to be facing unaffordable housing. Namely, Waterville and Augusta held the highest percentage of households paying more than 30 percent of their income for housing.

## **CHANGES IN MAINE'S UNEMPLOYMENT RATE**

### **William G. Stohner ('05), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. Changes in Maine's Unemployment Rates was created using data and shapefiles provided by the US Census Bureau and shows changes in unemployment rates within labor market areas between January 2004 and January 2005. Overall, there has been a general decrease in unemployment rates throughout the state.

## **SEQUENCING OF A CDNA ENCODING A FULL LENGTH VERSION OF THE PKABA1 INTERACTING PROTEIN TAWD40 AND PREPARATION FOR PROTEIN EXPRESSION**

### **Natalie A. Wayne ('06), Biology**

The study of abscisic acid (ABA)-mediated gene expression is important to the understanding of plant responses to this hormone, which affects plant growth, development and responses to environmental stresses. PKABA1 is an ABA-induced protein kinase involved in ABA-suppressed gene expression in cereal grains. The study of PKABA1-interacting proteins such as TaWD40, which has previously been shown to physically interact with PKABA1, is useful in studying the effects of PKABA1-mediated signaling. Sequencing of a 1.9 Kb full-length TaWD40 cDNA clone(CK210682) has been completed. The amino acid sequence of TaWD40 was determined from the cDNA sequence. The TaWD40 protein was found to contain a N-terminal U-box and 7WD40 repeats, suggesting it may belong to the family of E3 ubiquitin ligases. Therefore, TaWD40 may be involved in regulating PKABA1 by targeting it for degradation via the ubiquitin-proteasome pathway. Now that sequencing has been completed, the CK210682 cDNA is currently being cloned into the pRSET-A plasmid for protein expression and further study of the TaWD40 protein.

## **SEX DIFFERENCES IN ENVIRONMENT-DEPENDENT ETHANOL TOLERANCE IN C57BL/6 MICE**

### **Kelly Wheaton ('05), Psychology**

Male mice which receive regular ethanol injections in a standardized environment develop environment dependent tolerance (EDT) to the hypothermic and hypnotic effects of ethanol. EDT research comparing males and females has not been conducted despite sex related differences found in initial ethanol sensitivity and tolerance acquisition. It was predicted that female mice would demonstrate EDT to a greater extent because of their faster rate of tolerance and habituation. To test this, male and female C57BL/6 mice were injected with ethanol twice a day for four days in a standardized environment. On the fifth day, mice were injected in either the cued environment or a novel environment. As previous research indicated, males injected in the novel environment slept significantly longer than males injected in the cued environment. Females injected in the novel environment slept significantly less and showed an increase in temperature when compared to those females injected in the cued environment. This suggests that female C57BL/6 mice do not demonstrate EDT to the hypnotic and hypothermic effects of ethanol. This may be attributed to an increase in locomotor activity and temperature when

presented with a novel environment. Future studies focusing on the effect locomotion and extent of environmental novelty are necessary to elucidate these findings.

## **AVERAGE ANNUAL PRECIPITATION IN MAINE**

### **Emily Wilbert ('07), Environmental Studies**

This map was developed as part of the Atlas of Maine, a project carried out by students in ES212: Introduction to GIS and Remote Sensing. The goal of this project was to develop a series of visually striking maps illustrating Maine's unique natural and human resources. The Average Annual Precipitation Map of Maine was created using ArcMap with data from the Maine Office of GIS and National Atlas websites. It shows the average annual precipitation from 1961-1990 by watershed.

## **DETAILED MAP AND RECREATIONAL SUITABILITY ASSESSMENT OF THE COLBY TRAIL SYSTEM**

### **Emily Wilbert ('07), Environmental Studies**

This map is designed as a resource for students and the public to use and develop a better understanding of the trails system on the Colby Campus. I used a Garmin GPSmap 60CS to chart all the trails on Runnals Hill and in the Arboretum. Then, using ArcGIS, I compiled the tracked trails and laid them over an aerial photo of the campus. Because many of the trails are hard to find, I took digital photos of each trail entry to help the user locate them. Then, by taking note of the grade and width of the trail, I decided which trails were suitable for certain activities. This gives users an idea of where to go for walking, running, mountain biking, cross-country skiing, and snowshoeing.

## **GEOLOGICAL AND HISTORICAL INVESTIGATION OF THE BELGRADE LAKES WATERSHED**

### **Mallory C. Young ('05), Geology**

The Belgrade Lakes watershed includes six interconnected lakes and represents an important water and recreational resource in central Maine. The present geographical configuration of this watershed has been significantly modified by the construction of seven dams for water control and the generation of hydroelectric power over the past 100 years. The purpose of this investigation was to understand and document the impacts of these dams on the evolution of this lake system. Preliminary data on each dam was obtained from the Maine Emergency Management Agency and included date of construction (1896 to 1989), length (6.7-76.1 m), structural height (0-7 m), and hydraulic height (0.3-5.5 m). Longitude and latitude of each dam was obtained in the field using GPS. These data were integrated into a GIS mapping program and depth maps for each of the six lakes were constructed. Using hydraulic height values to the closest meter for the dams the original geographic extent, volumetric changes ranging from  $1.0 \times 10^6$  to  $14.0 \times 10^6$  m<sup>3</sup> and changes in surface area percent ranging from 12 to 43 % for each lake were determined. Adding dates of dam construction, changes to aerial extent of the lakes in the watershed were mapped in a historical context. It is clear that this region would have looked significantly different had the dams, beginning in 1896, not been constructed. Results of this investigation provide a historical context and an important foundation for long-term hydrogeochemical and geochemical investigations of this watershed.

