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**SESSION 1**  
**CELLULAR AND MOLECULAR BIOLOGY**  
**ROOM 201**

8:30 YEAST VMA MUTANTS LOSE GROWTH ABILITY AS pH EXCEEDS 6.4

*Rob Gilkerson, Dept. of Biology, Hamline University 1536 Hewitt Ave., St. Paul, MN 55104*

In the yeast *Saccharomyces cerevisiae*, acidification of the vacuole is important to the growth and reproduction of the cell. A proton gradient across the vacuolar membrane is maintained by a multi-subunit V-type ATPase. In yeast Vacuolar Membrane ATPase (*vma*) mutants lacking one or more subunit, the enzyme fails to assemble in functional form. As a result, the vacuole is unable to acidify and the vacuolar lumen pH falls to equilibrium with the cytoplasm. Whereas Wildtype cells are able to grow over a wide range of pH conditions, *vma* mutants display a pH-sensitive growth phenotype. We wished to more carefully examine the effect of pH on yeast culture growth rates. Cells of Wildtype and *vma6*, *vma2*, and *vma25* mutant strains were grown in YEPD culture at pHs ranging from 4.5 to 8. Growth was measured by monitoring the absorbance of the cultures. Wild type strains displayed a slight gradual decrease in growth as pH increased. The mutant strains all showed a sharp drop in growth at pH 6.5; *vma6* showed a more dramatic cessation of growth. The data suggests a regular relationship between v-ATPase proton gradient maintenance and the growth of the culture.

8:50 SEQUENCE HOMOLOGY STUDIES OF THE YEAST VMA6 GENE PRODUCT

*Chris J. B. Frandrup, Hamline University, Department of Biology, 1536 Hewitt Ave., Box #681, St. Paul, MN 55104*

The yeast vacuolar membrane proton-translocating ATPase (V-ATPase) is a multi-subunit complex comprised of peripheral catalytic, and integral membrane domains. At least eight protein subunits comprise the V-ATPase with molecular weights of 100-, 69-, 60-, 42-, 36-, 32-, 27-, and 17-kDa. The VMA6 gene codes for the 36-kDa subunit (Vma6p) that is essential for V-ATPase function and is tightly associated with the V0 domain. The purpose of this study was to identify homologs of the VMA6 and VMA2 gene products and to determine functional characteristics of Vma6p. Database analysis revealed four homologs of Vma6p from four distinct species, representing three different kingdoms. Overall sequence identity was calculated to be 41%. In comparison, sequence identity with the VMA2 gene product (60-kDa V1 ATP-binding regulatory subunit) from the same four species was calculated to be 80%. Thus, Vma6p has not been as highly conserved as the V1 ATP-binding regulatory subunit across species examined. A myristyl chain consensus sequence two residues from the amino terminus of Vma6p suggests that it may be anchored to the membrane by a

myristate moiety. Further experiments may determine whether Vma6p is myristylated in vivo.

9:10 MUTANT ALLELE FREQUENCY VARIATIONS IN THE COAT PATTERN OF *FELIS CATUS* IN MINNEAPOLIS-ST. PAUL.

*Erik Swanson, Hamline University, 1536 Hewitt Avenue, St. Paul, MN 55104*

Mutant allele frequencies present in the coat patterns of 501 cats representing the Minneapolis-St. Paul area were determined. The study, conducted in the summer of 1994, revealed the following mutant allele frequencies: p(O)= 0.253, q(a)= 0.852, q(d)= 0.509, p(S)= 0.277, q(tb)= 0.326, q(TA)= 0.00, p(W)= 0.013.

The mutant allele frequencies of cats located within the metropolitan region of Minneapolis-St. Paul were previously calculated in 1984 and were surveyed again during the summer of 1994. Comparisons could then be made to reveal any trends between these two studies and another study conducted during 1992 on neighboring Polk County, Wisconsin.

9:30 CYTOSOLIC CALCIUM REGULATION IN VMA YEAST MUTANTS

*Emil Velthuisen, Hamline University, 1536 Hewitt Ave., St. Paul, MN 55104*

The V-type proton-translocating ATPase (V-ATPase) of *Saccharomyces cerevisiae* is a multi-subunit enzyme responsible for maintaining a proton gradient across the vacuolar membrane. In Vacuolar Membrane ATPase (*vma*) mutants lacking one of the enzyme subunits, the ATPase is inoperable and vacuolar acidification does not occur. Yeast *vma* mutants are pH sensitive for growth and display hypersensitivity to Ca<sup>++</sup>, an important secondary messenger in eukaryotic cells. We speculated that vacuolar Ca<sup>++</sup> uptake via proton antiport may be compromised by the loss of V-ATPase activity, affecting the cell's capability to regulate cytoplasmic calcium levels. To further examine the Ca<sup>++</sup> hypersensitivity in *vma* mutants, we performed growth curve analysis of WT & *vma* cells to determine the effects of increasing [Ca<sup>++</sup>]<sub>i</sub> on cellular growth rates. Whereas the growth rate of wildtype cells was unaffected by [Ca<sup>++</sup>] as high as 200 mM *vma6* growth rates declined dramatically as [Ca<sup>++</sup>] increased, and cells failed to grow at concentrations higher than 150 mM. These results are consistent with the hypothesis that the proton-pumping V-ATPase is all integral part of the mechanism by which cells regulate intracellular [Ca<sup>++</sup>]

9:50 PRE- AND POST-ZYGOTIC ISOLATION BETWEEN SIBLING SPECIES OF *DROSOPHILA*

Heidi Skundberg, College of Saint Benedict, St. Joseph, MN 56374

Speciation, the process by which new species arise, is not well understood. Even less is known about the underlying genetics of this process. This study examines the level of reproductive isolation between two closely related species, *Drosophila melanogaster* and *D. simulans*. All combinations of intra- and inter-specific single-pair matings were set up in a total of 288 crosses. In all cases, intra-specific crosses (controls) were more successful than inter-specific crosses ( $P < 0.001$ ). For all matings, data were obtained on the success of sperm transfer (pre-zygotic reproductive isolation), production of viable offspring (post-zygotic), and, when possible, motility of sperm in hybrid males (post-zygotic). Competing hypotheses exist concerning the level of discrimination among females of derived vs ancestral species during inter-specific hybridization. The data obtained in this study support the hypothesis that the ancestral species (*D. melanogaster*) is the most discriminating ( $P < 0.05$ ). Furthermore, for the conditions tested, these data indicate that Haldane's rule is operating as a post-zygotic mechanism when the female of the inter-specific cross is *D. melanogaster*, but not when it is *D. simulans*.

10:10 SEX AND EXTINCTION

Jennifer Eckman, College of Saint Benedict, St. Joseph, MN 56374

Sexual reproduction, the process of generating offspring through genetic recombination, is viewed as evolutionarily advantageous to a population by enabling it to respond more readily to environmental change. Support for this hypothesis comes from the observation the majority of species employs some mode of sexual reproduction. Asexual reproduction is relatively rare, suggesting that these species reduce their chances of survival. This project examines some of the parameters that relate to a population's ability to respond to its environment. Using a program coded in FORTRAN, a Monte Carlo model has been developed to test the role of recombination on population survival in a changing environment. Two types of selection (directional and stabilizing) are investigated in concert with varying rates of recombination and environmental change. The simulation results suggest that rates of recombination play a significant role in how well a population adapts and survives. The most favorable recombination rates differ depending upon the type of environment.

SESSION 2  
CELLULAR AND MOLECULAR BIOLOGY AND  
BIOCHEMISTRY  
ROOM 201

10:50 ALCOHOL TOLERANCE AND ADH ACTIVITY IN TWO SPECIES OF *DROSOPHILA*

Randi A. Rommel and Denise A. Pagel, Winona State University, Department of Biology, Winona, MN 55987

Alcohol dehydrogenase (ADH) is an important enzyme in the degradation of ethanol. This alcohol is found at high concentrations in the natural environment of *Drosophila* species. This research project investigated the possible correlation between ADH activity and alcohol tolerance. The approach used was to study these parameters in two divergent species, *Drosophila melanogaster* (Dm) and *Drosophila virilis* (Dv), at several ages (1-16 days) in adults. ADH activity was measured using a photometric assay, while alcohol tolerance was analyzed by measuring knock down times in flies exposed to ethanol vapor. Alcohol tolerance was significantly higher in Dv ( $ET_{50}$  was four times greater). No significant differences were found in alcohol tolerance over time. ADH activity per gram of flies was also significantly higher in Dv (Wilcoxon matched pairs test,  $n = 16$ , significant for  $\alpha = 0.05$ ). Both species exhibited a general increase in ADH activity over time. Thus, the two approaches give conflicting results. The species comparison showed a positive correlation between alcohol tolerance and ADH activity, with Dv having higher values. However, no correlation existed over the life span. Old flies had a higher enzyme activity without an increase in tolerance.

11:20 COMPARISON OF GENETIC MARKERS: ISOZYMES AND RAPDs

Kristine C. Giese, Christopher T. Cole, Margaret A. Kuchenreuther, Annalisa Prabl, Department of Biology, University of MN Morris, Morris, MN 56267

Isozyme analysis using electrophoretic assays of plant material has been widely used to examine the genetic variation within and between populations. Recently, a new method of determining genetic similarities and differences has come into use. RAPDs, random amplified polymorphic DNAs, more directly detect polymorphism at the DNA level. This technique uses PCR (polymerase chain reaction) and relies on DNA amplification using a series of single primers composed of arbitrary nucleotide sequences. Because of the novelty of RAPD assays, little information is available regarding levels of variation within populations and degree of similarity between species. However, the great amount of such information available from isozyme assays can serve as the standard for evaluating variation detectable by RAPDs. We are using these methods on two species of *Aconitum*, *A. noveboracense* and *A. columbianum*, in order to compare genetic differentiation revealed by the two methods including levels of heterozygosity and population structure.

11:30 USE OF MONOCLONAL ANTIBODIES TO STUDY THE TOPOLOGY OF PHOTOSYSTEM II PROTEINS IN TRYPSIN DIGESTED THYLAKOID MEMBRANES

*Christopher J. Plambeck, Biology Department, Winona State University, Winona, MN 55987.*

The topology of photosystem II proteins in spinach thylakoid membranes was studied by use of monoclonal antibodies. The monoclonal antibodies were utilized to determine the exposure (stoma side versus lumen side) of the specific epitopes on various photosystem II proteins. Right-side-out (RSO) and mixed (RSO and inside-out) thylakoid membrane samples were digested with trypsin. Polyacrylamide gel electrophoresis was then performed to separate the proteins of the treated thylakoid samples. The profile of the electrophoretically separated proteins was then transferred to nitrocellulose by Western Blotting. Immunoblotting with monoclonal antibodies was carried out to detect specific proteins in the primary challenge. Primary antibodies were identified by challenging with a secondary antibody-peroxidase conjugate. An enzyme-catalyzed color reaction was used to visualize the proteins. Epitope exposure was determined by comparing the relative amount of trypsin digestion that occurred with RSO and mixed thylakoid membrane preparations.

11:50 A SYNTHETIC ROUTE TO *DL-MUSCONE*

*Kenneth E. Legan II, Winona State University, 1124 W. Broadway #2, Winona, MN 55997*

The purpose of this research was to improve the synthetic route to functionalized macromolecule *dl-muscone* originally proposed by Douglas Klumpp at Iowa State University. Of the points targeted for improvement we learned through experimentation that the flash vacuum pyrolysis (FVP) of *1,5-di(2-acetoxymethylthienyl-5)-3-pentanone* afforded a higher yield than the ketal form. Furthermore, we explored a *1,3-dioxane* as a protecting group for the ketone functionality in place of the *1,3-dioxolane* used previously. Lastly, the reduction of *1-methyl-3-oxo[5,2]-(2,5)thienophane* to *dl-muscone* via Raney Nickel W-2 was investigated.

12:10 TISSUE MACERATION: KOH VERSUS NaOH IN CORROSION CASTING UNDER THE SCANNING ELECTRON MICROSCOPE

*Joan M. Kennedy and Jillian L. Sharpe, Department of Biology, North Hennepin Community College, Brooklyn Park, Minnesota 55445*

This was a comparison study of maceration efficiency for corrosion casting of two skeletal and three visceral tissues from Sprague Dawley rats. The tissues were infused with Mercox, then placed in either 15% NaOH or 40% KOH solution to test the solutions corrosive abilities at different temperatures. KOH performed 24 hours faster on skeletal muscle tissue than NaOH. No visceral tissue showed complete decay in the NaOH compared to the samples in KOH. Increased temperature had no effect and there was complete

decay of the spleen and liver in KOH. Scanning electron microscope micrographs of day eight incubated samples demonstrated the KOH to be more efficient than NaOH on visceral tissue, although neither group showed complete disintegration of the kidney tissue. Previous research by Aharinejad, S. and Bock, P., Lametschwandner, A., Sims, P.A. and Albrecht, R.M., focused on various concentrations and methods with a plethora of results. Proven KOH maceration efficiency lowers cost via time reduction in vascular corrosion casting research.

**SESSION 3**  
**AGRICULTURE AND PLANT SCIENCE AND**  
**MICROBIOLOGY**  
**ROOM 206**

8:30 MODELING CHANGES IN NITRATE-NITROGEN THE NATURAL ENVIRONMENT USING FIVE COMPONENTS

*Jason Cordes, Alan Olness\*, Dian Lopez, and Ward Voorbees\* University of Minnesota-Morris, Department of Computer Science and \*USDA-ARS North Central Soil Conservation Research Laboratory, Morris, MN 56267.*

Nitrate-nitrogen ( $\text{NO}_3^-$ -N) concentrations in soils have been one of the most frustrating features to predict. Nitrogen, the major limiting element in most crop production, is necessary for sustained food and fiber production. However, the excess amounts of fertilizer-N applied to the soil are a source of  $\text{NO}_3^-$ -N pollution to ground water and represent a waste to crop producers. Therefore, a need exists for accurate prediction of the amount of nitrogen fertilizer needed for optimal crop yield. Soils have a natural potential to produce  $\text{NO}_3^-$ -N and this potential is affected by the aeration of the soil. A model has been developed to determine the coefficient of aeration for  $\text{NO}_3^-$ -N production by soil microorganisms. The model uses 5 primary components or soil characteristics; these are clay content, temperature, water content, pH, and bulk density. Each component is defined by a mathematical function using a principle of potentials. The hydrogen ion effect is described by a complex  $\text{sech}^2(\text{pH})$  function. Soil water, bulk density, and temperature are described by complex  $\tanh(x)$  functions. Clay content is as a simple variable. The program calculates a value for each component and integrates the various factors into a coefficient of soil aeration. Soil  $\text{NO}_3^-$ -N can be estimated multiplying the aeration coefficient by the soil nitrogen mineralization potential. The program was written using the language C; this allows easy access to auxiliary computer files/data bases and incorporation of the program into other software developments such as FARMBOOK. Tests of the model using a variety of soils produce results which are consistent with field observation.

8:50 ISOLATION OF HYDROCARBON-DEGRADING BACTERIA FROM GASOLINE-CONTAMINATED SOIL.

Chrisy Rogers and Michelle Dyson, College of St. Catherine, Department of Biology, 2004 Randolph Ave, St. Paul, MN 55105

Certain bacterial species can survive in gasoline-polluted environments because they have acquired new metabolic pathways for using hydrocarbons as energy sources. These bacteria can be taken advantage of to aid in the clean-up of polluted soils. This research describes isolation and identification of hydrocarbon-degrading bacteria from gasoline-contaminated soil obtained from a Minnesota Department of Transportation site in Arden Hills. Soil samples were inoculated into mineral salts broth containing saturated or unsaturated hydrocarbons at a final concentration of 7%. Once turbidity was observed, 0.1 ml of each broth was inoculated onto mineral salt agar plates spiked with the corresponding hydrocarbon. Over a period of about two months we generated several isolates by streaking for isolation, picking isolated colonies, gram staining and re-streaking. Optimal growth was observed on plates containing octane, nonane, decane, or undecane as sole carbon sources. A large gram negative rod was isolated on octane plates. Gram positive rods associated together in U and V forms grew on plates containing nonane or undecane. Once pure cultures were obtained, they were inoculated onto Biolog GN and GP microplates for species identification. Preliminary results suggest that the gram positive isolates belong to the genus *Rhodococcus*.

9:10 pH EFFECTS ON GERMINATION OF THE TRUE SLIME MOLD *DIDYMIUM NIGRIPES*

Ying Xin, Hamline University, 1536 Hewitt Avenue, St. Paul, MN 55104

Microcysts of the true slime mold *Didymium nigripes* were produced by growing and starving myxamoebae on GPY/B Agar. When transferred to thin layer SS Agar, the microcysts began to germinate. The study was designed to determine whether and how pH could change germination rate. Microcysts were plated at pH 3.6, 4.0, 4.4, 4.8, 5.2, 5.6, 6.0, 6.4, and 6.8. Microcysts in SS buffer (pH=6.5) were included for comparison. The results suggest that pH exerts strong effects on microcyst germination. As the pH decreased, so did the rate of excystment. The more acidic pH became, the greater the inhibition. The optimal pH is from 6.4-6.8.

9:30 TEMPERATURE EFFECTS ON GERMINATION RATES OF THE TRUE SLIME MOLD *DIDYMIUM NIGRIPES*

Aaron Olson, Hamline University, 1536 Hewitt Avenue, St. Paul, MN 55104

True slime molds, *Didymium nigripes*, were induced to form microcysts by growing and starving the myxamoebae on GPY/B agar. The microcysts were stored at temperatures of 0, 4, 10, 16, 21, 29 and 37 degrees Celsius. At intervals of 0, 2, 4 and 6 months, portions of the specimens were transferred to

thin SS agar to test the effect storage temperature has on germination rates. Microcysts stored at 0 and 4 degrees C displayed a low rate of germination. The microcysts stored at 29 and 37 degrees C had a slower rate of germination, up until the six month interval when their germination rates dropped. Microcysts stored at 10, 16 and 21 degrees C had the highest germination rates and were only slightly less than the control group (0 month). Their rates remained similar throughout the six month trial.

9:50 EFFECTS OF ELEVATED TEMPERATURE AND ELEVATED CO2 ON FOLIAR SENESCENCE AND GROWTH OF *ACER* SEEDLINGS

Jennifer S. Hartz, St. Olaf College, Northfield, MN 55057-1001.

An important response mechanism of trees to a warmer, CO2-enriched atmosphere could be an alteration of phenological relationships. Autumn leaf senescence, leaf areas, stem growth, and abscission were tracked in sugar maple (*Acer saccharum*) and red maple (*A. rubrum*) seedlings growing in open-top chambers in ambient or elevated CO2 in combination with ambient or elevated temperature. Leaf area and dry weight were estimated during the growing season. Chlorophyll concentration was estimated weekly with a portable reflectance meter calibrated against conventional analysis of chlorophyll in leaf extracts. In both species chlorophyll loss from mid-October to mid-November was retarded in plants grown at a mean temperature 4 C higher than ambient. Likewise, leaf abscission began later and progressed more slowly in the warmer chambers. Carbon dioxide concentration had little effect on leaf senescence or abscission. Stem growth was enhanced in plants grown at CO2 concentrations twice ambient CO2 concentrations. Temperature had little effect on stem growth. The results demonstrate the potential for climate warming to extend the growing season and increase plant productivity.

SESSION 4  
ECOLOGY (II)  
ROOM 206

Please see page 20 for Ecology I

10:10 SEM IDENTIFICATION OF CHRYSOPHYTA POPULATIONS LINKED TO EUTROPHICATION OF VADNAIS LAKE

Jim Hafner, Jr., North Hennepin Community College, 7411 Eighty-Fifth Ave. N., Brooklyn Park, MN. 55445

The St. Paul Water Utility (SPWU), St. Paul, Minnesota, experienced unpleasant odors and tastes in the drinking water supply that was associated with blue-green algae (Cyanophyta) and diatom (Chrysophyta) blooms. SPWU commissioned a watershed analysis to determine the source and levels of nutrients responsible for fluctuations in algae blooms. Lambert Creek, a tributary of Lake Vadnais, was identified as a primary source of high phosphate concentration. In order to identify species associated with

specific tastes and odors, the current independent study collected water samples from Lambert Creek and Lake Vadnais. Samples were prepared for scanning electron microscope (SEM) study using critical point drying and coating with gold-palladium in a sputter coater. Identification of several Chrysophyta species from both sources was possible via SEM micrographs. This confirmed the presence of specific problem causing organisms in both sources.

10:30 AN ECOLOGICAL IMPACT STUDY ON *FELIS CATUS* AND *HERPESTES A. AUROPUNCTATUS* ON THE ISLAND OF ST. JOHN

Erik Swanson and Fred Young, Hamline University, 1536 Hewitt Ave., St. Paul, MN 55104

The dietary habits of feral cats (*Felis catus*) and mongooses (*Herpestes a. auropunctatus*) were examined in specimens from Virgin Islands National Park on the island of St. John U.S.V.I. Stomach contents analysis was the method used to study the diets of these animals. A total of 17 feral cats and 45 mongooses were trapped during January 1995. The stomachs were collected and analyzed for the presence and volume of food items. Preliminary findings have been, in decreasing order of occurrence, arthropods, crabs, lizards, plant material, and small mammals. Once the ecological impact of these two non-native species is better understood, a program to help manage their populations can be implemented.

10:50 DISTRIBUTION OF THE BURROWING OWL (*ATHENE CUNICULARIA*) IN BILLINGS COUNTY, NORTH DAKOTA

Michelle K. Davidson and Donna M. Bruns Stockrahm, Department of Biology, Moorhead State University, Moorhead, MN 56563

Burrowing owls (*Athene cunicularia*) occur in various grassland habitats in southwestern Canada through the western United States, but their numbers are declining. In North Dakota, prime burrowing owl habitat coincides with black-tailed prairie dog (*Cynomys ludovicianus*) colonies where the owls utilize abandoned prairie dog burrows. One of the highest prairie dog colony densities in North Dakota is in Billings County. During the summer of 1994, 25 colonies in Billings County were systematically searched for burrowing owls to determine their distribution, numbers, habitat affinities, and nest burrow characteristics. Dimensions of burrowing owl nest burrows were measured, and surrounding vegetation was described. Distances between the nest burrow and the surrounding burrows were measured. A total of 29 burrowing owls were found on 7 sites. Although owl age was sometimes difficult to distinguish in late summer, age composition appeared to be 13 adults and 16 immatures. Only 5 nest burrows were found, each on the periphery of a different colony. On average, nest burrow entrances were approximately 8m from those of surrounding non-nest burrows. The vegetation surrounding each nest burrow was short and sparse. Scattered populations of burrowing owls exist in Billings County, but densities were low in all areas studied.

11:10 THE EFFECTS OF AN EARLY SEASON CLIPPING ON SEVERAL GRASSLAND SPECIES

Bradley J. Matuska, St. John's University, Collegeville, MN 56321

The study site was an old grassland within the Proposed 100-Acre Quarry Park, Stearns Co., MN. After an initial percent-cover estimation in early June 1994, the experimental plots were clipped to a height of approximately 5 cm. A final percent-cover estimation was completed in early September 1994, and the experimental plots were compared to the undisturbed control plots.

The species richness (diversity of species) showed little change in response to clipping. However, individual species responded differently to clipping. Of the dominant erect species, *Achillea millefolium* showed little change in percent-cover, while *Castilleja coccinea* decreased, and *Solidago missouriensis* increased. The dominant prostrate species *Antennaria neglecta* and *Poa pratensis* increased in percent-cover, *Fragaria virginiana* showed little change, and *Trifolium repens* decreased.

Upon the release of resources due to clipping, the species richness of the community showed little change due to species tolerance. However, the data suggest that erect species suffered a percent-cover loss due to clipping as compared to prostrate species. The resources (i.e. space and light) previously exploited by erect species were made available to the prostrate species, allowing them to increase their percent-cover.

The results from this experiment will provide insight to the park developmental personnel when devising a management scheme for this grassland.

11:30 NATAL EMIGRATION, AGGRESSION, AND EXTRA-GROUP MALES IN PRIMATES: A REVIEW

Tamara J. Martin, University of Minnesota, Department of Anthropology, 215 Ford Hall, 224 Church Street SE, Minneapolis, MN 55455

Nearly all primate species are characterized by the dispersal of males from their natal group. While the selective mechanisms driving the evolution of sex-biased dispersal, and even dispersal itself, have been widely studied, the more general selective pressures shaping the process of that dispersal have been largely disregarded. Considerable variation between species exists regarding the proximate factors affecting emigration. These may be categorized as either "push" – negative factors originating in the natal group – or "pull" – positive factors originating outside the natal group/area. These factors include aggression in the natal group, perceived aggression from a potential new group, attraction to outside individuals, peer emigration and group preference. Selection pressures have also produced more salient features of the population – habitat adaptation, group composition, mating seasonality and predation – which also may have a bearing on the patterns of dispersal. Of particular interest are differences in the developmental stage at which males emigrate. A comprehensive review of natal emigration

in 35 species, this paper demonstrates a distinct correlation between stage of maturation at emigration, the potential amount of aggression received upon immigration into a new group, and the presence of all-male bands in the population.

11:50 PATTERNS OF AVAILABILITY AND USE OF BROWSE BY WHITE-TAILED DEER IN OLD-GROWTH AND SUCCESSIONAL STANDS IN NERSTRAND BIG WOODS STATE PARK (NBWSP), FARIBAULT, MN

*Kari Bisbee, Department of Biology, Gustavus Adolphus College, St. Peter, MN 56082*

Deer browse has been found to have a major impact on forest trees both by reducing species diversity and reducing the number of seedlings in the forest regeneration layer. In recent years, several hundred deer have wintered in Nerstrand Big Woods State Park (NBWSP), Faribault, MN, which represents one of the last high-quality remnants of the Big Woods ecosystem. We quantified available and browsed tips in two successional and five old-growth stands in NBWSP for the winters of 1992-93 and 1993-94 to assess the impact of these large numbers of deer. The overall browse rate was low (3.67 in 1992-93 and 3.23 in 1993-94). Even though the overall browse rate was similar across years, the stands differed both in availability and browse patterns and direction (+,-) of change. There were species-specific preferences across and within stands. At the park level, deer browse has a low impact, but some stands with as much as 6.86%, 11.48%, and 26.50% of available tips browsed could be adversely affected.

**SESSION 5  
ECOLOGY (1)  
ROOM 259**

8:30 OSTEONAL AREA DENSITY IN FEMORAL CORTICAL BONE AS AN INDICATOR OF LOCOMOTIVE ACTIVITY IN DINOSAURS

*Stan O'Daffer, North Hennepin Community College, 7411 85th Ave. N., Brooklyn Park, MN 55451; University of Minnesota, Ecology Dept., 100 Ecology Bldg., 1987 Upper Buford Circle, St. Paul, MN 55108*

Recent studies of osteonal cortical bone indicate that one of its major functions is related to fracture resistance and repair and that osteonal tissue development may be initiated by the stress applied, as load cycles, to those bones involved in locomotion. Further research substantiates that the area density of femoral osteonal tissue is directly proportional to the number of load cycles applied to the bone. Consequently, the area density is observed through histological studies of femoral cortical bone tissue from terrestrial vertebrates known to be active. Longitudinal cross-sections of 22 femoral cortical bone samples were prepared for comparison on the SEM from eleven dinosaurs, three extant and two fossilized mammals, one fossilized and two extant reptiles, two extant birds, and one pelycosaur. The observed area density of

femoral osteonal tissue from the dinosaurs was similar to those of the active mammals, and dissimilar to those of the inactive extant reptiles suggesting that dinosaurs were active animals. The data obtained correlates with the load cycle hypothesis and suggests that it should be considered a novel method for determining the locomotive activity level of fossilized terrestrial vertebrates.

8:50 AVIAN SPECIES RICHNESS AND VEGETATION COMPLEXITY AT FOUR SITES IN THE MAHALE MOUNTAINS NATIONAL PARK, TANZANIA.

*Hunter Lowery, Macalester College, 1600 Grand Avenue, St Paul, MN 55105*

Mahale Mountains National Park in western Tanzania, consists of lowland Kasoge rainforest, riparian, lake shoreline, and Miombo woodland habitats and is home to a diverse avifauna. Monitoring the avifauna is essential to documenting long term population fluctuations that may be caused by human or natural disturbances. Prior to this study, no avifauna data was completed for this region. A census of birds in four different habitats was undertaken using ten 250 m transects that were established in each of four habitats. All species sighted within fifteen meters of the transects were recorded at the location of each siting. Percent cover of the vegetation was estimated at four heights in order to compare the species richness of the bird community with the vegetation complexity in each habitat. A total of 90 bird species were identified in the study, with the greatest number occurring in the most vegetatively complex habitat, and the lowest species richness occurring in the least vegetatively complex habitat. The results are consistent with theory suggesting that species richness in animals should be positively associated with vegetation complexity. The data should serve as important baseline data for future monitoring and conservation efforts.

9:10 DENTITION MORPHOLOGY AND FEEDING IN THE DUGONG, *DUGONG DUGON*

*Timothy Vargo, Macalester College, 1600 Grand Avenue, St. Paul, Minnesota 55105*

The dugong is the only extant mammal to feed principally on marine vegetation. Its specialized diet, long life span, and low rate of reproduction make it vulnerable to habitat loss and exploitation. The purpose of this study was (a) To determine whether the more degenerate dentition of dugongs affect their ability to macerate seagrass in comparison with manatees (b) To determine whether 'preferred' seagrass are more easily digestible, and (c) To determine implications these results would have on dugong management. The results of measuring the sizes of seagrass fragments in dugong and manatee stomachs demonstrated that dugongs were able to macerate seagrass more efficiently than manatees, and that certain seagrass species were more easily digested than others. Given the dental morphology of the animals, this finding supports the theory that highly specialized mouthparts restrict the dugongs diet, whereas dentition plays only a

minor role in seagrass consumption. The data also suggest that some species of seagrass may be preferred by dugongs because they are more easily processed. These factors combine to highlight the restrictive nature of the dugongs diet and emphasize their vulnerability to extinction through habitat loss.

9:30 FITNESS RESPONSES OF THE AQUATIC WEEVIL, *EURYCHIOPSIS LECONTEI*, REARED ON TWO MILFOIL HOST-PLANT SPECIES

Sebastian Castro, Macalester College, 1600 Grand Avenue, Saint Paul, MN 55105

Eurasian watermilfoil (EWM; *Myriophyllum spicatum*) is an exotic submersed macrophyte that is a major nuisance species in many Minnesota lakes. The aquatic weevil, *E. lecontei*, is a native specialist on milfoils and is being investigated as a potential biological control agent for EWM. In summer 1994, I analyzed the survivorship and growth of *E. lecontei* progeny from EWM-reared and Northern watermilfoil (*Myriophyllum sibiricum*, NWM)-reared weevil populations on both milfoil plant species. Successful development to adult was found on 48% of 27 EWM plants (7 from EWM parents and 6 from NWM parents) and on 28% of 28 NWM plants (3 from EWM parents and 6 from NWM parents). Fewer weevils ( $p=.086$ ) from EWM parents developed to adult on NWM than weevils from NWM parents that developed on either plant. These and other results indicate that weevils from either EWM or NWM parents do equally well on EWM (<70% developed to adult). However weevils from EWM parents did poorly on NWM (only 3 of 9 larvae developed to adult). This suggests that once on EWM, weevils acquire a preference for the exotic host and may be reduced in fitness if they return to the original native host, NWM.

9:50 A SURVEY OF THE SMALL MAMMAL DISTRIBUTION IN QUARRY PARK, STEARNS CO., MN

David Winecuff, St. John's University, Collegeville, Minnesota, 56321

This wilderness quarry area is in the process of being converted for public use by Stearns Co., and is an ideal area for ecological surveys. I assessed the small mammal distributions in the variety of habitat types within the park, from June to August 1994. The habitats included: grasslands, Oak, Aspen, and Red Pine forests, wetlands, rock tailing piles, natural rock outcroppings, and water-filled quarries. The survey was conducted using Sherman Live traps, scat boards, and pit traps. The grassland consisted exclusively of *Microtus pennsylvanicus*, except for a single *Sorex cinereus*. *Peromyscus leucopus* dominated in the forests within the park. They also had very high populations in the rock tailing piles, showing the importance of shelter in habitat selection. Other species that were found included: *Blarina brevicauda*, in the wetlands, and *Tamias striatus* and *Clethrionomys gapperi* in the forests. Each species appeared to be very habitat specific, and were never observed to venture outside of their respective environments. The main danger to these

populations in the upcoming development of the area will be the destruction of their habitat. The results from this survey will provide insight for park officials when devising a method of management for this park.

10:10 MEIOFAUNA OF THE RAINY RIVER

Mandi Gillespie, Gustavus Adolphus College, 800 West College Ave, St. Peter, MN 56082

Meiofauna are microscopic animals of various taxonomic groups that inhabit the bottom substrates of aquatic systems. Core samples of the sediments of the Rainy River, taken above and below the paper mills at International Falls, Minnesota, were analyzed for taxonomic composition, spatial distribution, and potential use as bioindicators to assess the quality of the aquatic environment. The most dominant taxonomic groups were Copepoda, Nematoda, and Rotifera but others, including Chironomidae (larvae), Cladocera, Oligochaeta, Ostracoda, Tardigrada, and Turbellaria, were also present. A greater abundance of meiofauna was recorded in the top three centimeters of the bottom substrate as compared to the next three cm. This tends to agree with freshwater studies reported in the literature. A significant difference (T-test,  $p<0.05$ ) in the total meiofauna, harpacticoid copepods, and ostracods was found between samples taken above and below the paper mills. Although this appears to suggest that meiofauna may be used as bioindicators, other variables such as habitat type, water flow, water chemistry, and sensitivity of meiofauna to environmental pollutants need to be investigated.

10:30 DISTRIBUTION AND ABUNDANCE OF MOLLUSCAN SPECIES, POMME DE TERRE RIVER, WESTERN MINNESOTA

Ann Christensen, University of Minnesota, Geology Department, 600 E 4th St. Morris, MN 56267

The Pomme de Terre River, a tributary to the Minnesota River, is located in western Minnesota. The goal of this project was to determine the water quality of the river based on the type, amount, and distribution of the bivalve and gastropod species, at 21 sites along the river. This distribution is a function of temperature, food supply, currents, and most importantly, chemical parameters. Any possible changes in the water quality throughout the reaches of the river was evaluated for its affect on mollusk distribution. The river flows through many lakes, which also may affect mollusk distribution. The invertebrates were randomly sampled at 21 sites, for a pre-determined amount of time, with classification done in the lab. The general number and distribution of the species found in the river was generally good. One pill clam species, seven gastropod species, and eleven bivalve species have been found to date, with more bivalves collected in the southern portion of the river. *Anodonta*, which only occurs in water with a pH greater than 7.0, was found. The watershed is highly agricultural, with possible water quality problems occurring in the future if the proper precautionary steps are not taken now.



**SESSION 6  
ECONOMICS  
ROOM 312**

8:30 AN ECONOMIC ANALYSIS OF EMISSIONS TRADING:  
TITLE IV OF THE CLEAN AIR ACT AMENDMENTS OF  
1990

Scott Golmen, University of Minnesota-Morris, P.O. Box 223,  
Morris, MN 56267.

The Clean Air Act Amendments, approved in November of 1990, were created to combat acid rain by reducing sulfur dioxide emissions in a cost-effective manner. Title IV of the Amendments mandates the use of economic incentives as a regulatory scheme for meeting sulfur dioxide emission limits.

Title IV will reduce sulfur dioxide emissions by ten million tons from 1980 levels. Along with a two-phase tightening of the restrictions placed on utility plants, Title IV instructed the Environmental Protection Agency to develop an emissions trading market. Utilities may trade "allowances," which are permits to emit one ton of sulfur dioxide during a specified year.

To date, the volume of trading has been limited. One reason involves the relatively small number of utilities (110) affected by Phase I. Further, the infancy of the program has forced many utilities into capital-based compliance strategies. Another factor which has impeded market progress is regulatory uncertainty.

There is, however, good reason to believe the number of trades will increase. Phase II affects 800 utilities, which will enhance the need and ability to trade. Also, the market is being extended to include non-utility emission sources. Finally, the movement towards a more competitive electric utility industry will ease the regulatory burden.

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8:50 A STATISTICAL ANALYSIS OF THE TOTAL MERCHANDISE  
TRADE BETWEEN THE UNITED STATES AND JAPAN

Amy D. Erickson, University of Minnesota-Morris, 600 East  
Fourth Street Morris, MN 56267

Current international trade statistics are underdeveloped due to a lack of uniformity in both definitions and coverage. Problems may therefore arise in their interpretation because the statistics are not as accurate or reliable as first thought. The purpose of this paper is to investigate the reported trade statistics between the United States and Japan for general trends and any statistical anomalies, while also providing plausible explanations. Initial data was obtained from several domestic and international sources, including the *Statistical Abstract of the U.S.* and the *Direction of International Trade*, among many others. The yearly reported trade of both countries was corrected for inflation using constant 1987 dollars. The observable trends seem to be directly attributable to historical events such as Japan's reconstruction after World War II and the U.S. entrance into the Vietnam war and their resulting need for supplies and materials, as well as the increasing trade friction between the United States and Japan. What was not directly attributable to any one source were the

resulting statistical anomalies, such as the differences in reported trade (i.e. Japan's exports to the U.S. as compared to the United States' reported imports from Japan and vice versa).

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9:10 ANALYSIS OF DISCREPANCIES IN REPORTED TRADE  
STATISTICS AMONG PACIFIC RIM NATIONS

Thomas J. Flottemesch, University of Minnesota-Morris, 600  
East Fourth Street, Morris, MN. 56267

Reported international trade statistics often fail to reflect the true volume and flow of trade due to a lack of uniformity in definition and coverage. As a result, large discrepancies occur between the reported figures of two partner countries. This paper analyzes the differences in reported merchandise trade figures between the nations of China, Hong Kong, Japan, South Korea, Taiwan and the United States for the time period 1950-1993. Its purpose is to identify trends, if any, and offer possible explanations. Data were first compiled from various sources such as the *Direction of International Trade* and the *Direction for Trade Statistics Yearbook*. These figures were then compared to each other in order to find the percentage difference in reported merchandise trade between these nations.

As was observed, the percentage differences ranged from as little as .33 percent to as large as 156 percent with percentage differences tending to decrease over time. Possible explanations range from accounting methods to fluctuations in the exchange rate with transient trade being the most plausible explanation for the largest discrepancies.

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9:30 SLASHING EMPLOYEES: REWARDS OF A HIGHER STOCK  
PRICE?

Candice Kollmann, University of Minnesota-Morris, Morris,  
MN 56267

The purpose of this research project is to determine if a firm's lay off announcement has a positive or negative effect on a company's stock price. The event study methodology will be utilized on approximately 56 companies that laid off either 3% of their staff or 1,000 workers during 1993. This method allows the effect of a lay off announcement to be separated from other factors that influence the stock price by using daily returns for the individual stocks and the market as a whole. First, the market model is estimated to determine the relationship between a firm's stock performance and the market performance. Firm performance is then predicted based on the market performance. An abnormal return is calculated when the predicted stock return of the firm is compared to the market return. If significance testing shows these abnormal returns to be positive companies that lay off employees are being rewarded for their decision by higher stock returns

## 9:50 AN ANALYSIS OF THE MERCHANDISE TRADE BETWEEN CHINA AND THE U.S.

Jessica L. Johnson, University of Minnesota-Morris, 600 East Fourth Street, Morris, MN 56267

The trade statistics between China and the United States have varied considerably since the decade of the 1950's, and have shown a trend of expansion in recent years. Any trends must be analyzed closely, however, for statistical inconsistencies between the two countries have grown in recent years, thus effectively negating their reliability. The purpose of this paper is to explore the reported trade statistics between China and the United States, and using constant 1987 dollars to correct for inflation, offer plausible explanations for the trends and discrepancies which emerge. The trade data was initially collected from sources such as the *Statistical Abstract of the United States*, *Direction of International Trade*, *Direction of Trade*, and *Direction of Trade Statistics Yearbook*. An observable trend, the expansion of trade in recent years, can be attributed in part to both political factors, including political corruption, as well as to economic factors. An underlying trend, however, is the growth in the discrepancies regarding Chinese exports and United States imports. These inconsistencies have increased steadily since 1976, and as of 1983, both China and the United States have recognized a trade deficit with one another.

## 10:10 THE EXCHANGE RATE AND THE JAPAN-U.S. TRADE BALANCE

Kosuke Sato, Mark Balabon, University of Minnesota Morris, 600 E. 4th St. Morris, MN 56267

The trade friction between Japan and the US has been a controversial issue in the both countries for several decades. Since the 1960s, the US balance of trade with Japan has gone from positive to negative, reaching -59 billion dollars in 1993. In 1985, the Reagan administration engineered a depreciation of the US dollar, with the hope that a strong yen would ameliorate the US trade deficit by making Japanese export more expensive and US export relatively cheaper. However, despite of the dramatic depreciation of the US dollar in the last decade, the Japan-U.S. trade still has not been balanced. Why can't the depreciation of dollar reduce the US trade deficit? It is our hypothesis that the inefficient distribution system in Japan, US multinational corporations in Japan, and the income elasticity of Japanese products in the US and products in Japan are the factors which are most important in determining this trade deficit. We used a regression analysis to see which factors influence the US trade deficit with Japan. The results supported our hypothesis. Finally, we made policy recommendations based on our study to reduce this deficit.

## 10:30 INTEREST RATE COMPONENTS

Eric Newell and Nathan Wissink, University of Minnesota-Morris, UMM #900, Morris, MN 56267

The purpose of our research concerning nominal interest rates was to determine what components influence interest

rates. This is significant because of the fundamental role nominal interest rates play in our economy affecting individual decision-making concerning investments and loans. In addition, our research examines the interaction between nominal interest rates and monetary and fiscal policy.

From our research, the variables that were significant include: the inflation rate, the unemployment rate, growth in per-capita output, money supply, total gross domestic investment, the growth in total savings, and the government deficit. These factors were considered due to their theoretical important in nominal interest rate determination. Data from 1960 through 1992 was collected for these variables and a series of regressions based on theoretical interpretations was administered. During the process, several econometric problems such as multicollinearity and serial correlation were combated.

Based on the results of our final regression, several conclusions were exacted. Specifically, our findings promote the conclusion that nominal interest rates are affected by a variety of factors, including market forces as well as economic policy tools.

## SESSION 7 MATH AND APPLIED STATISTICS ROOM 312

## 10:50 DON'T LOOK DOWN UPON NUMBER ONE

Michael J. Bennett, College of St. Scholastica, 1200 Kenwood Avenue, Duluth, MN 55811

Once again we come to one of the most dreaded words known to the human race ... ALGEBRA! But wait, there is hope in the form of number one. The paper I will present is based on the fact that some very complicated looking problems can be solved by simplifying or manipulating down to number one. Since there will be no tricks or revelations, a person with basic algebraic background will understand. The problems that I will present will be solved using basic algebraic concepts that every algebra textbook contains, but the problems themselves will be of a nature in which solving them would take a person of normal algebraic ability hours of long, tedious work. These basic algebraic concepts that I will be using are:

1.  $1 = (n+1) - n$
2.  $1 = a(1/a)$
3.  $1 = [n^{1/2} + (n-1)^{1/2}] [n^{1/2} - (n-1)^{1/2}]$
4.  $1 = (x^{-n}) (x^n)$

These concepts along with a manipulative mind can make the dreaded word that most know as algebra turn into a word, believe it or not, associated with the term FUN! I will attempt to prove that what I consider fun, is something everyone else can now also consider fun or at least not a concept to dread.

11:10 CIRCLEPACKING HYPERBOLIC CYLINDERS

Ryan Siders, University of Minnesota, Minneapolis, MN 55455; advised by Phil Bowers, Florida State University, Tallahassee, FL 32306

A circlepacking of a surface is a collection of nonoverlapping circles which meet tangentially and, together with the areas between circles, cover the surface. The nerve of a circle packing labels all the circles and records which are tangent. A nerve determines much about its circlepacking, including whether the geometry of the surface it packs is hyperbolic, Euclidean or spherical.

The 'type problem' in circlepacking is to determine, from the nerve of a circlepacking, the geometry of the surface it packs. The most difficult case of the type problem is to distinguish the Euclidean circlepackings from the hyperbolic. Treating the nerve of a circlepacking as an electric grid, I solved the type problem for layered circlepackings, including the only nontrivial examples yet discovered.

11:30 FAMILIES OF GEOMETRIC DESIGNS WHOSE GROUPS OF AUTOMORPHISMS ARE DOUBLY TRANSITIVE.

Michelle Persons, College of St. Benedict, 37 S. College Ave., St. Joseph, MN 56374

Through a combination of linear algebra, geometry, and algebraic structures, one can prove that certain families of geometric designs have groups of automorphisms that are doubly transitive. These geometric designs can be defined as edge colorings of complete graphs. Automorphisms of these geometric designs are permutations of the vertices of the graphs, which are also permutations of the colors of the edges such that given two edges of the same color, their images are also the same color. All cases considered are on the vector space  $F^n$  for a field  $F$  and the group of automorphisms is a subgroup of the affine general linear group  $AGL(F, n)$ . Three families of these designs have been explored. The first family is derived from an absolute value, the second from the addition of vectors, and the third from an inner product.

11:50 DEMOGRAPHIC AND ATTITUDINAL CORRELATES OF FEAR OF CRIME AND PUNITIVENESS TOWARD CRIMINALS

Cbad Newcomb, Richards Hall # 103, 404 Huff Street, Winona, MN 55987

This study examines the relationships between concern about crime, fear of crime, and attitudes toward crime control, as well as a number of related demographic and attitudinal variables. A model is developed according to which concern about crime leads either to a fearful or punitive response. Data were collected through a telephone survey of Nebraska residents ( $n = 632$ ). Results show that general and concrete concern about crime relate differently to fear of crime and punitive attitudes toward criminals. General concern leads to a punitive response, while concrete concern (measured by concern about community crime) leads to fear. Contrary to

common perceptions, fear and punitiveness seem to be independent of one another. In addition, most people favor prevention over stricter punishment as the best method of dealing with crime.

SESSION 8  
MEDICAL SCIENCE/PHYSIOLOGY  
ROOM 330

8:30 COLLAGEN CHANGES IN THE EXTRACELLULAR MATRIX OF THE SEVERE, CHRONIC DIABETIC HEART

Dan Donovan and Ed. W. Thompson, Department of Biology, Winona State University, Winona MN 55987

Severe, chronic diabetes mellitus detrimentally affects several components of the mammalian heart. These changes lead to decreased plasticity and contractile dysfunction. To date much study has been devoted to cardiocyte changes accompanying severe diabetes, and much less work done on the changes involving the extracellular matrix. The present study examined collagen changes of the extracellular matrix of the severe, chronic diabetic rat heart. Diabetes was induced in four of nine male Sprague-Dawley rats by intravenous injection of alloxan. The remaining five rats were injected with saline and served as nondiabetic controls. After twenty-eight weeks, all nine animals were sacrificed under full anesthesia, the heart of each animal was excised, and portions of the left ventricular free wall were harvested. These sections were frozen in liquid nitrogen for biochemical analysis using high pressure liquid chromatography (HPLC) to quantitatively assess hydroxyproline content (indicative of collagen content). A second portion of each heart was prepared for microscopy. The results of this study indicate that changes in collagen content can not fully account for the increased deposition of extracellular matrix which occurs in the hearts of diabetic animals.

8:50 CHARACTERIZATION OF NA-H ANTIPORT ACTIVITY IN CHINESE HAMSTER OVARY (WT-5) CELLS.

David D. Beck, Stefanie S. Gefroh, Jeff D. Hudson and Mark A. Wallert, Department of Biology, Moorhead State University, Moorhead, MN 56563

The activity of the Na-H antiporter in wild-type Chinese hamster ovary (CHO) cells was characterized to initiate an investigation into the functional variation between the different isoforms of the Na-H antiporter. The experiments were performed using the pH-sensitive fluorescent dye 2',7'-bis(2-carboxyethyl)-5(6)-carboxyfluorescein (BCECF) to measure changes in intracellular pH ( $pH_i$ ). The cells were acidified using the ammonium chloride prepulse technique and the initial rate of recovery of  $pH_i$  was measured. The recovery was dependent on the presence of extracellular Na and was inhibited by amiloride. The Na-H antiporter, is functionally defined as being a Na-dependent, amiloride-sensitive proton extrusion mechanism. Further characterization of the antiporter, including the  $pH_i$ -dependence of

transport and the sensitivity of the antiporter to cimetidine and clonidine, was used to determine which isoform is expressed in wild-type CHO cells. A mutant CHO cell strain (AP-I) was confirmed to be deficient of Na-H antiport activity and was used for the stable transfection of different isoforms of the antiporter. The successful transfection of the NHE-1 (Na-H Exchanger type I) isoform has been demonstrated by the presence of an amiloride sensitive recovery from an acid load.

9:10 *IN VITRO* SYNERGISTIC EFFECTS OF SIX PLANT EXTRACTS ON HSV-1 AND HSV-2 IN HEP2 CELLS

Aaron J. Johnson, Department of Biology, University of Minnesota-Duluth, 10 University Drive, Duluth, MN 55812

Omer et al. reported that a combination of *Artemisia absinthium* (absinthe), *Resin pistacia lentiscus* (mastic) and *Flores onosma brateatum* (borage), when used to treat mentally depressed patients, helped them recover from the symptoms of herpes simplex virus (HSV) infection. In addition to the three aforementioned plants, *Rosa centifolia* (rose), *Delphinium denodatum* (jadwar), and *Elettaria cardamomum* (cardamon) extracts were used *in vitro* to evaluate the toxicity of these extracts using monolayers of HEP2 cells grown in Minimal Essential Medium (MEM) with 5% Fetal Calf Serum, 1% Pen/Strep, and serial two-fold dilutions of all combinations of plant extracts. Anti-herpes activity was tested using HEP2 cells and the highest dilutions of the extracts showing cytotoxic effects. 0.1ml containing 5 virus particles was added to each well of cell monolayer previously overlaid with 0.5ml of each diluted extract, incubated at 37°C, and observed for 72 hours for cell protection, cytopathic effects and cytotoxic effects. At a 1:16 dilution, 0.5ml of the combination extract containing absinthe, mastic, rose, cardamon and borage (3:1:2:1:2) protected HEP2 cells against both HSV-1 and HSV-2. More work is in progress to determine the synergistic effects of all 57 combinations of the six extracts.

9:30 RESPONSES OF A-DELTA AND C-FIBER PRIMARY AFFERENT NOCIEPTORS IN THE RAT USING NOXIOUS COLD STIMULI

Brian J. Allen, Hamline University 264 W. Curtice St. Paul MN 55107

Most polymodal C-fiber and A-delta cutaneous nociceptors are excited by mechanical, heat and chemical stimuli. However, the responses of these nociceptors to noxious cold have been quantitatively examined in only a few studies. It has been reported that a relatively small proportion of nociceptors in rats are excited by noxious cold stimuli above 0° C. In the present study, cold stimuli were used to characterize responses of C-fiber and A-delta nociceptors to a wide range of stimulus temperatures. Electrophysiological recordings were taken from the saphenous nerve of anesthetized rats. Nociceptors were searched for by mildly pinching the skin. Once a nociceptor was isolated and its receptive field mapped, conduction velocity, mechanical

threshold and thermal responses were determined. A total of 11 C-fibers and 17 A-deltas were studied. 100% of all nociceptors were excited by noxious cold stimuli and the responses evoked by the cold stimuli usually increased with stimulus intensity (lower stimulus temperature). The cold thresholds for A-deltas ranged from -16° C to +8° C and for C-fibers -14° C to +16° C. It is concluded that all A-delta and C-fiber "mechanoreceptors" are excited by noxious cold stimuli and that these nociceptors appear to encode intensity of noxious cold.

9:50 HEMATOLOGY AND BLOOD CHEMISTRY VALUES OF SUMMER-ACTIVE RICHARDSON'S GROUND SQUIRRELS, *SPERMOPHILUS RICHARDSONII*, WITH COMPARISONS TO SPRAGUE-DAWLEY RATS AND HUMANS.

Christopher M. Nielsen, Tori F. Engesmo & Ivan M. Johnson, Department of Biology, Concordia College, Moorhead, MN 56562

Richardson's ground squirrels (RGSs) have potential as animal models for studying mechanisms of several pathological conditions, including obesity, gall stone formation, and a variety of hyperlipidemias. During the course of investigating other aspects of RGS biology, we found few references to blood values for this species. Using standard automated and manual methods, we collected data on several measurements of whole blood, serum and plasma from summer-active RGSs (n=21), Sprague-Dawley rats (n=16), and humans (n=30). Several of the measurements differ significantly between the three groups (P<0.05; ANOVA; Tukey). RGSs have high RBC counts but small cells. Hemoglobin concentrations are low compared to humans, with low mean corpuscular hemoglobins, but mean corpuscular hemoglobin concentrations are similar to humans (due to high RBC counts). Serum electrolyte concentrations differ between RGSs, rats and humans but are within normal ranges. Significant differences exist between the species for total protein, blood urea nitrogen, creatinine and uric acid. Serum lactate dehydrogenase (LDH) is especially elevated in RGSs, while serum glucose and plasma lactate exceed human values in both RGSs and rats. RGSs and humans have similar plasma cholesterol concentrations but RGS HDL-cholesterol is higher, resulting in low TC to HDL-C ratios for RGSs. The results of this study indicate that RGSs have several hematology and blood chemistry values that differ from those of rats and humans. These differences may relate to this species status as both a burrowing mammal and also an obligatory hibernator. [This study was supported in part by a grant from the Howard Hughes Medical Institute.]

10:10 METABOLIC RATES OF SUMMER-ACTIVE RICHARDSON'S GROUND SQUIRRELS, *SPERMOPHILUS RICHARDSONII*

Tori F. Engesmo, Christopher M. Nielsen & Ivan M. Johnson, Department of Biology, Concordia College, Moorhead, MN 56562

In the wild, Richardson's ground squirrels (RGSs) are "obligatory hibernators." Hibernation extends from

approximately September through March, with the "active" phase of the circannual cycle lasting about 5 months. Young-of-the-year emerge from burrows about June 1, weighing about 150 grams. During the next few months juveniles grow to their mature size while also accumulating sufficient fat stores to survive seven months of hibernation. Previous studies suggest that this task is accomplished by a combination of hyperphagia and, as time of hibernation nears, an overall decrease in metabolic rate. Empirical evidence for the latter mechanism is essentially lacking for RGSs. This study documents changes in RGS metabolic rates (MR), using an open-circuit, computerized Oxymax System (Columbus Instruments, Columbus, Ohio) to record  $VO_2$ ,  $VCO_2$  and other metabolic data of 174 juvenile RGSs from June through September. Plots of resting  $VO_2$  versus body weight and  $VO_2$  versus calendar-days reveal a negative linear relationship for both variables. Multiple regression analysis (MRA) suggests that, together, body mass and date account for 62% of the variance surrounding  $VO_2$ . Partial correlation of mass and date results in  $r^2$  values of .42 and .08, respectively, indicating that mass is a much greater contributing factor, while date plays a minor role. MRA reveals no gender differences. The mass-specific MR of the RGS data differ notably from the generalized eutherian mass-specific MR of Kleiber (1947). This may reflect the influence of other variables and/or the variability of this individual species from the generalized mass-specific relationship. [This study was supported in part by a grant from the Howard Hughes Medical Institute.]

temperature distribution of matter in the interstellar medium. This work has been supported by grant NAG5-674 from the National Aeronautics and Space Administration (NASA).

8:50 SUN SPOT CYCLES REFLECTED IN EOCENE DENDROCHRONOLOGY

Peter Rinkleff, 308 Pine Hall, 1550 Birchmont Ave., Bemidji State University, Bemidji, MN 56601

Dendrochronology of Holocene wood allows the identification of climatic signals when comparing ring widths with yearly records of climate. Analogous to this, pre-Holocene fossil wood dendrochronologies indicate contemporaneous climatic signals.

The sun is the largest influence on climate. Currently solar energy output cycles from minimum to maximum on an 11.1 year period. These cycles are reflected in analysis of Holocene dendrochronologies. The maximum and minimum points in solar energy output correspond to the maximum and minimum levels in sunspot activity. Analysis of pre-Holocene wood dendrochronologies for cyclic trends reveals similar cycles to those found in modern wood. This indicates that pre-Holocene solar activity was similar to that of the present.

Statistical analysis of 35 million year old extinct permineralized *Sequoia affinis* dendrochronologies found at Florissant, Colorado show similar cycles when compared to present day relatives. Coastal Redwood, *Sequoia sempervirens*, and Giant Sequoia, *Sequoiadendron giganteum*, were used as baselines with *Sequoia affinis* due to their similar characteristics.

9:10 DEFORMATION STRUCTURES IN THE NEW ULM TILL NEAR BRITTON SOUTH DAKOTA; IMPLICATIONS FOR LODGEMENT TILL VERSES THE DEFORMING BED MODEL

Julie Ann Fitzke, Department of Geology, Gustavus Adolphus College, 800 W College Ave, St. Peter MN, 56082

The New Ulm till is a glacial deposit laid down by the Des Moines lobe of the Laurentide Ice Sheet between 10,000 and 12,000 years ago. This till is characterized as being shale-rich. The shale is derived from the Cretaceous Pierre Formation in the eastern Dakotas. Another distinguishing feature of the New Ulm till is the presence of a boulder pavement. This boulder pavement is a concentration of boulders one stone thick which crops out as a continuous line of faceted boulders. The origin of this boulder pavement is uncertain. Several hypotheses have been suggested, among these are the settling of the boulders out of a homogenized liquidous till, and a winnowing mechanism, in which the fine sediments were removed by the glacier leaving behind the boulder pavement.

Models of till deposition compared in this study include the deforming bed model, characterized as a massive texturally homogenized till which deforms fluidly at the base of the glacier and a lodgement till model, which is characterized by textural variation and a mechanical method of deformation.

SESSION 9  
PHYSICS, GEOLOGY AND METEOROLOGY  
ROOM 335

8:30 CORRECTING SPECTROMETER DATA FOR OPTICAL DEFECTS

Huao T. Tran, Department of Physics, Astronomy and Engineering Science, St. Cloud State University St. Cloud, MN 56301

In support of our program for developing an ultraviolet spectrometer for space flight, we have developed a technique to correct for distortions in the data due to defects in its optical elements. These defects are due to the relatively poor quality of optical materials available for the ultraviolet spectral region and cause irregularities in otherwise straight fringes recorded by the instrument. These irregularities lead to distortions in spectral lines measured by the spectrometer. In practice, a calibration fringe pattern is measured an error is derived and used to correct subsequent data taken by the spectrometer. This technique will be implemented in the analysis of data obtained from a sounding rocket being developed at the University of Wisconsin-Madison and St. Cloud State University. The scientific goal of the project is to obtain a velocity-resolved map of the hot interstellar galactic medium near the Cygnus loop supernova remnant. Ultimately, we hope that these measurements will help to resolve outstanding questions in galactic evolution such as what regulates the star formation rate, the pressure and the relative

Field studies of the structural deformation of the till and sand structures in the till, and the overall textural analysis of the till support the lodgement model of deposition rather than the deforming bed model.

9:30 VARIATIONS IN WATER CHEMISTRY ON THE POMME DE TERRE RIVER, WESTERN MINNESOTA

*Amy Trisko, University of Minnesota-Morris, Geology Department, 600 East 4th Street, Morris, Minnesota 56267*

Water chemistry was evaluated throughout the length of the Pomme de Terre River. The distribution and variations in water quality were recorded over two months, at twenty-one randomly chosen sites. The purpose of such tests was to compare the results with standard limits for domestic and agricultural use and determine if the river quality fell within allowed limits. Special attention was given to sites that showed either a sudden rise or decline in a parameter to determine if it was due to the presence of a lake, or non-point/point source pollution.

Standard field tests for water quality were used which included air and water temperatures, pH, stream flow, hardness, conductivity, salinity, transparency, dissolved oxygen, and alkalinity. Parameter variations are factors of geology, land use, and human influences. Out of the nine parameters tested, there are only two immediately recognized trends. Down river there was a gradual increase in hardness and a consistent decrease in transparency. There were no noticeable trends in salinity, stream flow, pH, alkalinity, or oxygen levels. The data illustrates that the Pomme de Terre river is within the recommended limits for agricultural usage yet is borderline for domestic use at the present time.

9:50 DEPOSITIONAL ENVIRONMENT OF A STRATIFIED DEPOSIT, POPE COUNTY, WEST-CENTRAL MINNESOTA

*Jennifer M. Lien, University of Wisconsin-River Falls, Department of Plant and Earth Science, River Falls, WI 54022.*

A complex stratified deposit, located in the Blue Mounds crevasse fillings, on the Alexandria Moraine Complex, provides insight into late glacial depositional environments. The deposit, exposed by Pope County landfill excavations (loc.: 45° 31' 50" N; 95° 28' 40" W), has four distinct units: two lower sand units, a rhythmic sand and silt unit, and an upper eolian unit. The two lower sand units are composed of poorly sorted, concoidally fractured, and angular to subrounded grains. Concoidal fracturing indicates a proximal glacial origin. Both units are deltaic, deposited by meltwater streams entering a small basin.

The finely laminated sand and silt rhythmites indicative of a lacustrine environment are faulted and slumped. Deposition and faulting probably occurred on a stagnating glacier margin. The absence of clay indicates the rhythmites are not varves.

Pollen analysis revealed a few grains of pine pollen. Pine is susceptible to long distant wind transport and the low number of preserved grains suggests the absence of local

plant growth. Low numbers of pollen would be expected in lake sediments deposited during stagnation

Sometime following deglaciation, fine grained eolian sands were deposited over the rhythmic unit. Research was funded by the N.S.F.- REU Program (EAR 9322112)

10:10 USING TROPOSPHERIC THICKNESSES TO DETERMINE RAIN/SNOW LINES IN ST. CLOUD, MN

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An evolution of forecasting precipitation type was made using thickness and temperature rules at St. Cloud, MN for the cold seasons of 1969-1989. The layers used were the 1000-500 mb, 1000-850 mb, 850-700 mb, and 1000-700 mb layers.

During the twenty year period in St. Cloud the number of snow events declined from 120 to 60 at the 1290 m thickness in the 1000-850 mb layer and the number of rain events increased from 30 to 79 at the 1290 m thickness. In the 1000-700 mb layer a decrease in the number of snow events from 118 to 63 occurred at the 2820 m thickness, also at this thickness the number of rain events increased from 38 to 80. An upper threshold for snow cases in the 1000-500 mb layer was found at 5360 m and the number of rain cases increased at thicknesses above 5340 m. And in the 850-700 mb layer an upper threshold of 1540 m was found and that rain was more common at thicknesses greater than 1540 m.

10:30 A BRIEF EXAMINATION OF THE MINNEAPOLIS AND ST. PAUL URBAN HEAT ISLAND

*Eric A. Wildgrube, St. Cloud State University, Mitchell Hall Room 132, St. Cloud, MN 56301*

The urban heat island is an important phenomena of modern life. The existence of an urban heat island over the Twin Cities metropolitan area is not in dispute. However, knowledge of how the urban heat island grows as the city grows in size and population could be useful. Possible differences in the intensity of the urban heat island during the four seasons are also interesting. Monthly mean temperature data for Minneapolis, St. Paul, Chaska, Jordan, and St. Peter. were used in this analysis. Data from 1948 to 1994 were compiled for each site and for each season. Ten-year moving averages were then constructed for each site and subtracted from the St. Paul averages. These differences were then plotted for each season. Using this method, sites within the urban heat island show minimal temperature departures from the St. Paul averages. A site that has gradually become a part of the heat island displays a decreasing temperature departure with time. Sites fully outside the urban heat island show the largest constant departures (about two degrees Fahrenheit) over the period examined. These results indicate the growth of the urban heat island and also show definite seasonal differences of the intensity of the urban heat island.