

SCHOOL OF SCIENCE AND MATHEMATICS

Undergraduate Research Poster Display

October 16 - October 19, 2003

Caputo Hall Lobby

- **BIOLOGY**
- **CHEMISTRY**
- **COMPUTER SCIENCE**
- **EARTH SCIENCES**
- **MATHEMATICS**
- **PHYSICS**

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B I O L O G Y

1) **Localization of Oxytocin Receptors in the Male Reproductive Tract of Rat at Significant Developmental Stages**

Carozza, Desi and Cosentino, M. J.

Current literature indicates oxytocin has a role in the release of sperm into the testicular lumen and smooth muscle contraction the epididymis. The contraction of the smooth muscle surrounding the epididymis plays a key role in the dynamic exchange that occurs between the epididymal epithelium and the luminal contents. This also contributes to sperm developing the ability to swim in a forward motion as well as developing the ability to penetrate an ovum. For this reason the epididymis is a target for possible contraceptive therapies. This study was designed to localize the oxytocin receptors in rat at ages 19, 30, 35, 42, 51, and 70 days which are key points in reproductive development. Staining of frozen sections was performed with antibodies against the receptors followed by a fluorescent secondary antibody on frozen sections of corpus epididymis. The tissues were observed using fluorescence microscopy and data collected using digital photography. The results show fluorescence in the epithelium lining the lumen at all ages of the study. This suggests oxytocin has role in reproductive development. Additional studies are currently being conducted in each region of epididymis at various ages.

2) **Eastern Bluebird (*Sialia sialis*) Winter Flock Behavior**

Coster, Jessica and Boal, Jean

The eastern bluebird (*Sialia sialis*) is highly territorial in the spring breeding season, but not much is known about its behavior in the winter. This study was designed to address whether bluebirds defend group territories with greater food and nest resources more aggressively than they defend less well-provisioned sites. Playback experiments were performed twice, once in January and once in March, at four sites in Lancaster County, Pennsylvania. Each playback consisted of a two-minute clip of a bird call and song. Two of the four sites had supplemental feeding stations for the two-month interval between playbacks. The responses were compared between the sites. In the non-supplemented feeding sites bluebirds sang more in January than in March, while that pattern was reversed at the supplemented feeding sites. The difference between the two types of sites was significant. Territorial defense in wintering bluebirds appears to be related to territorial quality.

3) **Impacts of Stream Restoration on Aquatic Insect and Fish Communities on the Hammer Creek, Lancaster County, PA**

Davis, Jennifer and Wallace, John R.

Millersville University Department of Biology

From September to November of 2002, construction was initiated to restore a one-kilometer portion of Hammer Creek, located near Lititz, PA. This study examines the short-term effects of stream restoration on macroinvertebrates and fish communities. The objectives include: 1) characterize the macroinvertebrate and fish fauna prior to restoration, 2) determine if restoration influences macroinvertebrate and fish communities post restoration and, 3) examine the impact along a downstream gradient from the restoration site. Using a modified Hess sampler, macroinvertebrates (six replicate samples per site) will be sampled at five sites (Above – Control Site; Upper Impact; Lower Impact; Upper Below (250 meters below); and Lower Below (2500 meters below impact). Macroinvertebrates were identified to the generic level. Fish were sampled using a Backpack Model 12B electroshocker at about 400 volts and identified to the species level. Fish were released at the site of capture after identification. Sampling protocol for this project used the BACI (before/after, control/impact) technique to assess the quality of Hammer Creek pre and post restoration. We sampled every four months using this protocol. By improving water quality and controlling sediment runoff via restoration, we hypothesize that habitat quality as a function of macroinvertebrate and fish diversity and abundance should improve.

4) **Contribution Of Floating Detritus To The Water Column Primary Production In A Mangrove Channel**

Gregg, Tiffany and Ambler, Julie W.

Department of Biology, Millersville University

The presence of numerous filter feeders indicates that phytoplankton may play a significant role in the primary production in mangrove channels on islands offshore of Belize. Filter feeders include oysters, sponges and anemones, which are attached to prop roots and swarming crustaceans, which occur between prop roots. Benthic mats (flocs) containing single celled algae lifts off the bottom of the channel in the late afternoon and floats to the surface. Primary production of the floating detritus was compared to that of the phytoplankton present in the water in the morning when no flocs were present, using light and dark bottles and the Winkler method of titration. The floc or water samples were collected, put in BOD bottles, and incubated *in situ* at 0.5 m depth intervals. The average NPP and GPP of the floc at the surface were 0.83mg/L/hr and 0.96mg/L/hr, respectively. The average NPP and GPP of the water column (containing no floc) rarely exceeded 0.05mg/L/hr. The NPP and GPP of the floc incubated at 0.5 m were consistently higher than surface NPP and GPP floc measurements. The NPP and GPP of the floc incubated at 0.5 m reached a high of 1.46 mg/L/hr and 1.68mg/L/hr, respectively. Our studies show that algae contained within floating detritus contributes to a significant fraction of primary production in the water column and, perhaps, to the total ecosystem NPP. The research addresses the significance of an “autotrophic” ecosystem functioning within a tropical ecosystem.

5) **Effect of the Conserved Sequence IEECKTS on Attractin Activity and Behaviors of *Aplysia brasiliana***

Holm, Johanna, Nichols, A. E., Cummins, S. F., Nagle, G. T., and Boal, Jean

Aplysia remain solitary during most of the year but aggregate during the reproductive season (May-September). The aggregations include both mating and egg-laying animals. Egg cordons are the source of a water-borne peptide pheromone, attractin, that functions by attracting other *Aplysia* and inducing them to mate. This pheromone has been isolated from the albumen gland of *A. californica* while attractin-related peptides have been found in 4 other species: *A. brasiliana*, *A. fasciata*, *A. vaccaria*, and *A. depilans*. The peptides of *A. brasiliana* and *A. fasciata* have 91-95% identity to the attractin peptide of *A. californica* while *A. vaccaria* and *A. depilans* bear a 39-43% identity. The specific location of the active site remained undetermined therefore suspect residues were tested. These residues are in a conserved sequence peptide common to all 5 species. Previous studies suggest that this 7-residue sequence (IEECKTS) is responsible for the attractive behaviors in *Aplysia*. The synthetic peptide sequence was tested in T-maze bioassays to detect attractive behaviors. Various concentrations were investigated as well. There is a significant difference between concentrations of 0nmol (control) and 1000nmol therefore confirming that the peptide region tested is somehow involved with attractin activity and pheromonal attraction. The tested region contains all or some of the active site residues of the attractin peptide. Future tests will include the addition of Cys-residues involved in disulfide bonds for peptide stability and the mutation of 3 charged residues (E31Q, E32Q, and K34Q).

6) Long Term Effects of Botfly Parasitism on *Peromyscus maniculatus*, *Peromyscus leucopus*, and *Tamias striatus*
Jaffe, Glory and Zegers, David A.

We used a twenty year data set from a permanent trapping grid at Powdermill Biological Station in southwestern Pennsylvania to explore the relationship between the white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus maniculatus*), eastern chipmunk (*Tamias striatus*) and *Cuterebra* (botfly) species. Overall *P. leucopus* and *P. maniculatus* had similar botfly prevalence while *T. striatus* showed greater prevalence. Adults of *P. leucopus* and *T. striatus* had greater prevalence than juveniles. Adult and juvenile *P. maniculatus* had similar prevalence. Intraspecific males and female prevalence was similar in all three species. Botfly-infected individuals tended to remain significantly longer in the trapping area than uninfected individuals. Infected individuals were more likely to meet our criteria for “residents” than were uninfected individuals. In this report we question the relative harm of botfly parasitism to individuals of these three small mammal species.

7) Pseudouridine Synthases Do Not Play a General Role in *HOT1*-Associated Recombination in *Saccharomyces cerevisiae*

Moon¹, M.M, Fogell¹, H.E., Roff¹, A.N., Keil², R.L. and Hepfer, C.E.¹

¹Department of Biology, Millersville University, and ²Department of Biochemistry and Molecular Biology, Milton S. Hershey Medical Center, Hershey, PA

In the yeast *Saccharomyces cerevisiae*, a specific type of genetic exchange known as *HOT1*-associated recombination has been implicated in maintaining homology between repeated ribosomal RNA genes. Disruption of the *DEG1* gene reduces this type of recombination and prevents cell growth at 37°C. The mechanism by which *DEG1* impacts these phenotypes is unknown. Pseudouridine synthase 3 (Pus3p), the product of the *DEG1* gene, modifies the anticodon arm of transfer RNA at positions 38 and 39 by catalyzing the conversion of uridine to pseudouridine. These residues enable transfer RNA molecules to achieve the three-dimensional conformation necessary for their transport to the cytoplasm and efficient participation in protein synthesis. No relationship between the pseudouridylation of transfer RNAs and genetic recombination has been established. It is possible that *DEG1*'s effect on recombination is simply a consequence of slowed cellular metabolism due to the impaired functioning of unmodified transfer RNAs. If this is the case, disruption of any gene coding for a pseudouridine synthase should have a similar impact on recombination. To test this hypothesis, yeast strains deficient in four different pseudouridine synthases (Pus1p, Pus2p, Pus3p and Pus4p) were created using PCR technology. PCR products were generated that included the *kan^r* gene, coding for geneticin resistance, flanked by sequences lying immediately 5' upstream and 3' downstream of the targeted *PUS* gene. Each PCR product was used to transform wild-type yeast that contain substrates enabling quantification of recombination rates. Successful integration of the *kan^r* gene and disruption of the targeted *PUS* gene was verified by PCR or Southern analysis. Each verified transformant was evaluated for *HOT1*-associated recombination and growth at 37°C. Comparison to wild-type yeast indicated that only the Pus3p disruption reduced recombination rates. This shows that the *DEG1* gene's effect does not result from a general change in cellular metabolism. The exact mode of action of this gene is still under investigation.

8) Behavioral Studies of Molluscan Pheromones

Nichols, A. E., Painter, S. A., Nagle, G. T., and Boal, Jean

The most ancient and broadly used type of signal used in animal communication is chemical. When chemicals are secreted externally by an organism to send information to members of the same species, they are known as pheromones. Pheromones are frequently found in organisms as a “bouquet” of chemicals acting together to elicit specific behaviors. Chemical components found in one species’ bouquet could serve as components in another related species’ “bouquet of scents.” For example, a peptide pheromone, attractin, in the marine gastropod *Aplysia* contains components responsible for reproductive behavior in other mollusks. The objective of this thesis was to explore the possibility of conservative chemicals in molluscan pheromones. Pheromones in two species of mollusks, *Loligo pealei* (the long-finned squid) and *Aplysia brasiliiana* (the sea hare), were studied using behavioral assays. In *A. brasiliiana*, T-maze bioassays were used to describe the role of a conserved amino acid sequence found in the attractins of *Aplysia*. T-maze bioassays revealed that the conserved sequence, IEECKTS, is part of the active site for *A. brasiliiana* attraction. In *L. pealei*, male-male agonistic behavior was scored to investigate the function of chemical cues responsible for this behavior. Behavioral observations of male *L. pealei* demonstrated that potential peptides or proteins embedded in *L. pealei* egg capsules are responsible for agonistic behavior in this species. Further investigation into the nature and function of chemicals in *L. pealei* egg capsules could lead to the discovery of the first pheromone known in cephalopods and a common component in molluscan pheromones.

9) The Effects of UV Radiation on the Covering Behavior of *Lytechinus variegates*

Sigg, Jessica and Boal, Jean

Many species of sea urchins cover their bodies using shells, algae and other materials. It has been hypothesized that exposure to UV radiation is the reason for sea urchin’s covering behavior. In this study, the effect of UV radiation was compared to the effect of non-UV radiation on the covering behavior of the sea urchin species *Lytechinus variegates*. Twelve sea urchins were exposed to UV and non-UV light under laboratory conditions and shells used as covering materials were quantified. During UV exposure urchins used significantly greater numbers, surface areas and weights of shells as covering items than did urchins during non-UV exposure (percent increases were 144.15%, 101.52%, and 104.92%, respectively). The ability of urchins to choose covering materials based on the material’s size is discussed.

C H E M I S T R Y

10) **Fluorescence Anisotropy in Dianthracene**

Berger, Jessica and Iannone, Mark

Fluorescence spectra of dianthracene at low temperatures show a large Stokes shift. The molecular structure suggests that this may be the result of nonradiative relaxation from the initially excited state to a lower-energy state whose transition dipole moment is rotated by 90 degrees. If this is the case, the observed fluorescence should show an anisotropy of -0.2. We are measuring the fluorescence anisotropy of dianthracene in polymer films and in the solid, at 77K. We have found an anisotropy of +0.4, so the proposed explanation for the Stokes shift must be incorrect. We propose that the Stokes shift results from a geometry change.

11) **Hemoglobin Electrochemical Response at a Surfactant Covered Electrode**

Guessford, Christopher A., Neal, Colleen M., and Rickard, Lyman H.

Because many proteins function in biological systems to transfer electrons there is considerable interest in the electrochemical behavior of these proteins at electrode surfaces. Recent investigations have shown an increased electrochemical response for heme proteins at electrode surfaces that have been modified with a surfactant film. Results will be presented that compare the response of hemoglobin at a surfactant covered glassy carbon electrode to the response at a bare glassy carbon electrode.

12) **A Haptic Surgical Simulator for the Continuous Curvilinear Capsulorhexis Procedure During Cataract Surgery**

Good, Nathan¹, Shenk, Rodney¹, Sasanni, Joseph M.D.², Webster, Roger¹

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This paper describes a technique for simulating the capsulorhexis procedure during cataract surgery. The continuous curvilinear capsulorhexis technique, developed by Gimbel and Neuhann, has become the standard method of anterior capsulotomy for phacoemulsification. The capsulorhexis procedure is started by making a small incision in the center of the lens. Angled forceps are then used to pull the tissue towards the 12 o'clock position then curving the tear to the left. A flap of tissue is thus created. The surgeon then grasps the folded over flap of tissue and begins to tear in a circular motion such that the tear force vector is tangential to the circumference of the tear circle. All too often beginning surgeons attempt to complete the capsulorhexis procedure without the proper re-grasping of the flap of torn tissue close to the tear point. This can cause the tear to run "downhill". In this case the tear will resist any attempt to redirect the tear uphill possibly causing severe damage to the tissue. As the novice surgeon continues to pull, the tear gets worse and worse no matter what the direction of the pull vector. In addition, anterior bowing of the lens diaphragm as well as shallow anterior chambers can accentuate this "downhill" tear phenomenon. In younger patients the tear may also follow the radial course of the zonule rather than the desired circular pattern. Our capsulorhexis simulator models these various tear problems and provides a learning environment without the dangers of using live patients. Our simulator uses the Sensable Technologies Phantom desktop device as the haptics unit. The training software runs on a conventional Windows XP™ workstation with a 1.0 GHz Pentium™ processor (or higher) and an OpenGL graphics accelerator such as the Nvidia Geforce™ board. The application software makes calls to OpenGL™ graphics routines. The training system has a data collection module that collects various metrics such as: time spent on the capsulorhexis procedure, tissue tears, and severe tear errors. Another software module records the motions of the user. This is accomplished by recording the positions and orientations of all 3D graphics objects. Thus, the 3D graphics are used to replay the technique, showing the medical student or mentor what the user did during the training session.

13) A Virtual Reality Trainer for Operative Set-up and Exposure for Laparoscopic Cholecystectomy

Reeser, Jon ², Boyd, Joshua ², Benson, Aaron ², DeSanto, David ²,
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This paper describes a laparoscopic cholecystectomy surgical training software system we have developed using the Immersion Virtual Laparoscopic Interface™ (VLI) hardware. The trainer is designed to train and test for many laparoscopic skills such as: manipulation of the laparoscope, grasping and stretching the gallbladder to expose the cystic duct, clip application to the cystic duct, cutting the cystic duct, and removing the gallbladder from the abdomen. Simulated patient breathing is accomplished by using a texture motion algorithm. The gallbladder, cystic duct and bile ducts are stretched and compressed using Hooke's law of $F=-kx$ within a mass-springs model. The intent is to provide an effective method to learn the laparoscopic cholecystectomy procedure using a low cost surgical simulator. A port of the software to the Immersion Surgical Workstation™ with haptics is currently underway.

EARTH SCIENCE

14) Relationships Between Gulf of California Moisture Surge Events and Precipitation in the Southwestern United States

Higgins R. W., Shi W., Hain C., and Scala, John
Climate Prediction Center, NOAA/NWS/NCEP

Relationships between Gulf of California moisture surges and precipitation in the southwestern United States are examined. Standard surface observations are used to identify surge events at Yuma, Arizona for a multi-year (July-August 1977-2001) period, and CPC precipitation analyses and NCEP/NCAR Reanalysis data are used to relate the surge events to the precipitation and atmospheric circulation patterns, respectively. Emphasis is placed on the relative differences in these patterns for several classes of surge events, including those that are relatively strong (weak) and those associated with anomalously wet (dry) conditions in Arizona and New Mexico after onset. Mechanisms proposed in earlier studies, such as relationships to tropical easterly waves and to midlatitude westerly waves, are tested for the different classes of surge events. Results indicate that all classes of surge events are correlated with the passage of tropical easterly waves across western Mexico, but that the strength and location of upper-tropospheric anticyclonic circulation features in midlatitudes strongly influence whether a given surge will be associated with anomalously wet (dry) conditions in Arizona and New Mexico.

15) Fine-Scale Hydrographic Survey Of Chincoteague Inlet

Miller, Carrie J (*Department of Earth Sciences*), Soong, Yin S. (*Department of Earth Sciences*), Ambler, Julie W. (*Department of Biology*)

Hydrographic and biological parameters were collected on July 17, 2003, for a transect starting at Chincoteague Inlet, VA, and extending 42.5 km offshore. Vertical profiles of temperature and fluorescence (index of algal biomass) were measured at 14 stations with a Seabird Sealogger 25 CTD, nitrate and phosphate were measured from bottle samples, and vertical tows of zooplankton (small copepod crustaceans) were collected. The dominant feature was a deep chlorophyll maximum (DCM) layer, which extended along the entire transect at depths of 6 to 14 meters and occurred just beneath the seasonal thermocline. The 14-station transect was divided into 3 main regions: the well-mixed inlet, a frontal zone where isotherms approached the surface, and the stratified deeper ocean. Nitrate and phosphate were low at all stations, $< 2 \mu\text{M}$. Nutrients had probably been much higher, since high chlorophyll and zooplankton concentrations ($60 \text{ animals L}^{-1}$) were found in the frontal zone. Zooplankton samples included northern calanoid copepod species, which are not typically seen off Chincoteague Inlet, and probably represented significant onshore water transport prior to our sampling.

16) A Summary of the pollution events during NE-OPS DEP 2002

O'Donnell, Dennis M. Jr., Rabattin, Dan, Lowery, Evan, Brewer, Dan and Clark, Richard
Millersville University Department of Earth Sciences

During the summer of 2002 there was a variety of interesting air quality events in the Philadelphia area. Ground measurements were taken using a three wavelength total and back scattering nephelometer and multiple trace gas analyzers (CO, O₃, SO₂, NO/NO₂/NO_x). Aloft measurements up to 300m AGL were taken using a tethered atmospheric sounding system, which recorded conventional meteorological variables, ozone concentrations and particle concentrations using laser diode scatterometry. Back trajectories combined with emissions data from the Environmental Protection Agency will be used to identify the possible sources of trace gases. ArcGIS is employed to evaluate source-receptor relationships, dispersion of pollutants along trajectories, and elucidate transport mechanisms. In-depth analysis of events such as the haze event of July 1-3, the Canadian smoke event on July 5-8, the sea breeze event of July 20, and other high ozone episodes will be included.

17) Surface Water Nitrate Concentrations within a Banded Carbonate and Siliclastic Watershed, Lititz Run Pennsylvania

Ramirez, Daniel P. and Marquez, Lynn L.

Millersville University Department of Earth Sciences

Spatial and temporal variations in nitrate-N concentrations within stream and spring water from the Lititz Run watershed (Lancaster County, Pennsylvania) were measured in order to correlate nitrate levels with bedrock geology and land use. Lititz Run drains into the Conestoga River, the Susquehanna River and eventually the Chesapeake Bay. Continued restoration of the Chesapeake Bay relies upon detailed studies of and restoration efforts within these source waters. The Lititz Run watershed drains 45 km² of agricultural, suburban, natural, industrial, and rural land. Bedrock within the watershed consists of Ordovician and Cambrian carbonate (65%) and Ordovician siliclastic (35%) units. Tributaries in the watershed originate within the siliclastic units and travel over (or within) carbonate units before merging into Lititz Run. Samples were taken approximately every six weeks from 22 sites. 7 sites along Lititz Run were chosen for their relation to land use, bedrock, and/or tributary influence. Eight tributaries were sampled at their sources and their entrances into Lititz Run. Lititz Run consistently has Nitrate-N concentrations well over the EPA's maximum contamination level of 10 mg/L. Throughout the year, high alkalinity in surface water correlates with a carbonate bedrock composition due to the solubility of limestone. Throughout the summer and fall, high nitrate-N concentrations positively correlate with carbonate bedrock and suburban land use, and negatively correlate with siliclastic bedrock and forested land cover. No significant effects were related to restorative measures in the watershed.

M A T H E M A T I C S

18) **Periodic Orbits on a Triangular Air Hockey Table**

Baxter, Andrew, Weaver, Stephen, Umble, Ron, and Shao, Zhoude

This paper examines the number and types of periodic orbits on a triangular air hockey table. When the table is an equilateral, we use a tessellation of the plane to reveal a countably infinite number of infinite families of periodic orbits. We use techniques from linear algebra to define a coordinate system on the tessellation that yields new distance and angle formulas and allows us to determine the period of an orbit under certain conditions. We classify an orbit as either primitive or with duplicates and discuss the ramifications of this classification.

19) **A Modified Wading Bird SESI Model For The Everglades**

Laverty, Sean, Shao, Zhoude

Research completed at the University of Tennessee under the supervision of Louis Gross, Jane Comiskey, and Eric Carr; June 2, 2002 – July 24, 2003

Human interests in the development of agricultural, residential, and water conservation needs interfere with the historical role of the Florida Everglades that contains land that is critical habitat for many animal species. A massive project is underway to restore the Everglades to its historical conditions, concerning mainly the restoration of a natural water flow. In order to evaluate proposed water management scenarios, several models were created to indicate the quality of habitat that the scenarios offer to various species of concern, including fish and wading birds. In this project, an existing model for wading bird foraging and breeding success was modified to incorporate input from a related fish model with hopes to produce more realistic index values. While initial results indicate that the index values produced by the modified model generally agree with those produced by the existing model, differences in the reported index values are noticeable and further analysis is warranted. A noteworthy component in the design of the model, a parameter defining which size of fish to be included in the calculations, allows users to tailor the model to run the simulation for specific wading birds with a desired range of prey size.

P H Y S I C S

20) **Guided waves on a drumhead**

Marek, James, Miziumski, Conrad R.

We report on the measurement and analysis of waves on a membrane. We focus on a sequence of guided wave modes through a waveguide attached to a rubber membrane on a drum head. The guided waves exhibit a low frequency cut off that will not allow waves below the cut off to propagate in the guide. It has been found experimentally that the frequency cut off depends on the width of the waveguide. This low frequency cut off can also be understood through an analysis of the wave vectors inside the guide.

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