

Willamette University



Summer Collaborative  
Research Program

Student Presentations

Friday 9/21/2007 – Collins 205

## Willamette SCRIP Conference

Fri., 9/21, 2-5:30pm

Collins 205

SCRIP student	Advisor	Time	Oral Presentation Title
Andy Myer	Dr. Scott Pike	2:00	Ancient Terroir: Correlating Modern Grape Growing Suitability to Historic Production on the Slopes of Monte Pallano, Abruzzo, Italy.
Jai Salzwedel	Dr. Adam Clark	2:15	Experimental Gravity Duality.
Matt Bicocca	Dr. Chuck Williamson	2:30	Phase Equilibrium Studies of the 3-Buten-2-one/Water Binary Liquid System.
Carlos Hernandez-Diaz	Dr. Chuck Williamson	2:45	Using Molecular Iodine for High Precision Spectroscopic Calibration.
Jennifer Robblee	Dr. Drew Duncan	3:00	Synthesis of Chiral Aminocatalysts and Their Application to Asymmetric Reactions.
Jacob Bard	Dr. Drew Duncan	3:15	Synthetic Progress Toward Sugar-Based Heterocyclic Organocatalysts for the Kinetic Resolution of Carbinols.
Anna Greenswag	Dr. Sarah Kirk	3:30	Progress towards the design and synthesis of a Tetracaine derivative as a bifunctional ion channel blocker.
Pete Crisalli	Dr. Sarah Kirk	3:45	Progress in Synthesizing Neomycin-dipeptides.
Lai-Chim Chan <i>and</i> Lauren Kajiura	Dr. Barbara Stebbins-Boaz	4:00	The Hormonal Herbicide, 2,4-D, Blocks Animal Cell Cycle Progression: Is Cyclin B a Target?
Anna Dennis <i>and</i> Molly Sultany	Dr. Susan Kephart	4:30	Habitat Preferences and Pollination Biology of <i>Camassia</i> (Agavaceae).
Victoria Swigart <i>and</i> Shannon Levin	Dr. Julie Abendroth-Smith	5:00	One small step for hikers but one giant leap for ecological validity: Taking research outside, a kinematic study of hiking downhill.



## **Ancient Terroir: Correlating Modern Grape Growing Suitability to Historic Production on the Slopes of Monte Pallano, Abruzzo, Italy**

**Andrew Myer and Scott Pike**

*Department of Environmental & Earth Science, Willamette University, Salem, OR 97301.*

The middle valley of the Sangro River in the southern Abruzzo is undergoing a coordinated landscape archaeology project focused on Monte Pallano. The study area is part of the ancient territory of Samnium, a federation of Italian tribes, which was absorbed by the Roman Empire in 80 BCE. Recently, the preservation of grape pips was recovered from excavation trenches on the south slope of Monte Pallano. The pips suggest that there may have been active grape harvesting on this southern slope during the Samnitic and/or Roman occupations. With the discovery of pips in an archaeological context, an analysis of the site's suitability for grape production reduces modern bias towards an interpretation of the site's ancient usage.

Soil samples were collected from sites surrounding the excavation trenches and were analyzed for texture and permeability. Climatic data over a thirty-year period was referenced to determine the maximum range of variability suitable for modern day vintners. Identification of paleoethnobotanically preserved vegetation was conducted to assist in the interpretation of local pedologic, ecologic, and climatic parameters.

Published and unpublished geologic and soil maps were consulted to obtain an overall geologic picture of the region. These physical data correlated to the archeological record to temporally contain the interpretation.

While further analysis is required, preliminary conclusions drawn suggest that no environmental factors exist that would inhibit the cultivation of grape vines during the Samnite and/or Roman occupations. This interpretation fits well with the archeological record furthering supporting the likelihood of ancient grape cultivation in the area.

## Experimental Gauge-Gravity Duality

Jai Salzwedel, Dr. Adam Clark

We explore an experimental method for testing the Maldacena conjecture, which relates the natures of quantum gravity and gauge theory (a branch of physics that deals with electromagnetism and sub-atomic forces). We show that the gravitational side of the correspondence can be modeled with fluid acoustics, and we propose an apparatus that will allow measurement of the phenomena in question.

## **Phase Equilibrium Studies of the 3-Buten-2-one / Water Binary Liquid System**

**Matt Bicocca and J. Charles Williamson**

*Chemistry Department, Willamette University, Salem, OR 97301.*

A phase diagram was determined for the binary liquid system 3-buten-2-one / water using laser light scattering. An increase in overall system solubility compared to past research was observed. This is attributed to the removal of initial impurities present in the 3-buten-2-one, notably 2-acetal-6-methyl-2,4-dihydropyran. The phase diagram itself was unstable, as transition temperatures were observed to change over time. In samples prepared in air, the system became completely soluble within 8-10 hours, with notable amounts of 3-hydroxy-2,7-octadione forming within the samples. Samples prepared under vacuum showed a decrease in solubility over time, with the system becoming completely two phase between 5-90 °C. These samples appeared more viscous and the 3-buten-2-one is suspected to have polymerized.

## **Using Molecular iodine for High Precision Spectroscopic Calibration**

**Carlos Hernandez-Diaz and J. Charles Williamson**

*Chemistry Department, Willamette University, Salem, OR 97301.*

Molecular iodine was used as a calibration source for high precision spectroscopy. Argon ion laser-induced fluorescence was used to give the molecular iodine spectra. Spectra were collected with a one-meter monochromator and a two-dimensional charge-coupled device (CCD) detector with output signal expressed in intensity vs. pixels. In order to make the conversion from pixel to wavenumber ( $\text{cm}^{-1}$ ), the peak locations of O, Q, and S branches were brought into a three-parameter calibration equation using Peakfit software to find the parameters values. To identify additional iodine peaks that would potentially serve as calibration points, a vibrational and rotational energy calculator was developed based on the work done by Gerstenkorn and Luc. These theoretical peak locations were then overlaid onto portions of the  $\text{I}_2$  spectra and inspected for perfect matches between theoretical calculations and experimental results. As an external check that the calibration equation and calibrant work as expected, a calibration test was done with well-known He-Ne laser lines. The calculated locations of the laser lines agreed with literature values to within  $0.05 \text{ cm}^{-1}$ .

## **Synthesis of Chiral Aminocatalysts and Their Application to Asymmetric Reactions.**

**Jennifer Robblee and Drew Duncan**

*Chemistry Department, Willamette University, Salem, OR 97301.*

Organocatalysis is an emerging area within organic chemistry that has blossomed in the last decade. Organocatalytic transformations utilize carbon-based compounds in lieu of metal salts to increase reaction rate and impart stereoselectivity. The focus of this project was the development of aminocatalysts based on chiral amino acids and sulfinamides. L-Proline- (S)-tert-butanesulfinamide-derived catalysts were synthesized using standard techniques and were subsequently subjected to preliminary screening for efficiency and selectivity in several transformations including carbonyl-ene and conjugate addition. To date, our catalysts have not provided the anticipated levels of reactivity; however, a number of possibilities for variation and optimization of our methods remain to be explored and will be the focus of future studies.



## **Synthetic Progress Toward Sugar-Based Heterocyclic Organocatalysts for the Kinetic Resolution of Carbinols**

**Jacob Bard and Andrew Duncan**

*Chemistry Department, Willamette University, Salem, OR 97301.*

Organocatalysts are powerful tools for synthesis, due to their cost-effectiveness and their readily availability from abundant chemical feedstocks. Sugar derivatives are particularly attractive organocatalytic platforms due to their high density of stereochemical information, structural rigidity, and ease of derivatization. Work in our group involves the elaboration of simple 2-aminosugars to nucleophilic heterocycles. These compounds will find novel application as asymmetric organocatalysts for the kinetic resolution of chiral carbinols. This presentation will describe progress toward the syntheses of several glucosamine-derived nucleophilic heterocycles, with work to date focusing on the development of an efficient sequence for the synthesis and spectroscopic characterization of a key intermediate compound.

## **Progress towards the design and synthesis of a tetracaine derivative as a bi-functional ion channel blocker**

**Anna Greenswag and Sarah Kirk**

*Chemistry Department, Willamette University, Salem OR 97301.*

Cyclic nucleotide-gated (CNG) ion channels are found in many tissues of the body. However, only those found in the eye and olfactory system are very well understood. In an attempt to gain a greater understanding of cell signaling, we have designed a CNG channel blocker. In this research, we are synthesizing a derivative of tetracaine, a known nonselective moderate blocker. Past research has shown that increasing the butyl tail to an octyl tail improved the potency by approximately 5 fold. Progress has been made on the synthesis of an aminooctyl tail with the eventual goal of creating a bi-functional blocker containing a cGMP moiety.

Herein we describe the synthetic challenges of attaching the aminooctyl tail. The original proposed synthesis called for a nucleophilic aromatic substitution of a 4-chlorobenzoic acid by a 1,8 diaminooctane. This proved to be difficult so multiple attempts of mono-protection of the 1,8-diaminooctane were preformed. As the nucleophilic aromatic substitution still proved to be ineffective and occur in low yields a new synthetic scheme was developed utilizing a 4-fluorobenzonitrile as the aromatic starting material.

## **The Hormonal Herbicide, 2,4-D, Blocks Animal Cell Cycle Progression: Is Cyclin B a Target?**

**Lai Chim Chan, Lauren Kajiura, and Barbara Stebbins-Boaz**

*Department of Biology, Willamette University, Salem, OR 97301.*

In the frog, *Xenopus laevis*, oocyte maturation is key to formation of fertilizable eggs. Meiotic maturation is stimulated by progesterone, which triggers the synthesis of new proteins, the phosphorylation of MAPK, the activation of maturation promoting factor (MPF), and germinal vesicle (nuclear) breakdown. The widely used auxin-like herbicide, 2,4-dichlorophenoxyacetic acid (2,4-D), blocks meiotic maturation *in vitro* and may contribute to worldwide amphibian decline. The present study examines whether 2,4-D adversely affects cyclin, a regulatory subunit of MPF that is regulated by cycles of destruction and synthesis. In plants, auxins have been shown to bind a receptor ubiquitin ligase, which mediates protein degradation. It was hypothesized that 2,4-D activates a homologous degradation pathway in oocytes, causing the untimely degradation of cyclin B1 and/or B2 that consequently blocks maturation. To test this, oocytes were treated with combinations of progesterone, 2,4-D, and cycloheximide, a translational inhibitor. Western blot analysis was used to determine steady-state cyclin levels in conjunction with other maturation protein markers. Preliminary data showed that cyclin B1 levels were reduced similarly in oocytes treated with cycloheximide or 2,4-D relative to progesterone, suggesting that 2,4-D-induced reduction of cyclin B1 is more likely due to translational inhibition not degradation. Levels of cyclin B2 were shown to vary widely between batches of untreated oocytes confounding the interpretation of 2,4-D effects. Nevertheless, some oocytes treated with 2,4-D showed persistence of cyclin B2, which indicates that either a pool of degradation-resistant cyclin B2 exists or 2,4-D fails to activate a cyclin-specific degradation pathway.

## Habitat Preferences and Pollination Biology of *Camassia* (Agavaceae)

Anna Dennis, Molly L. Sultany and Susan R. Kephart

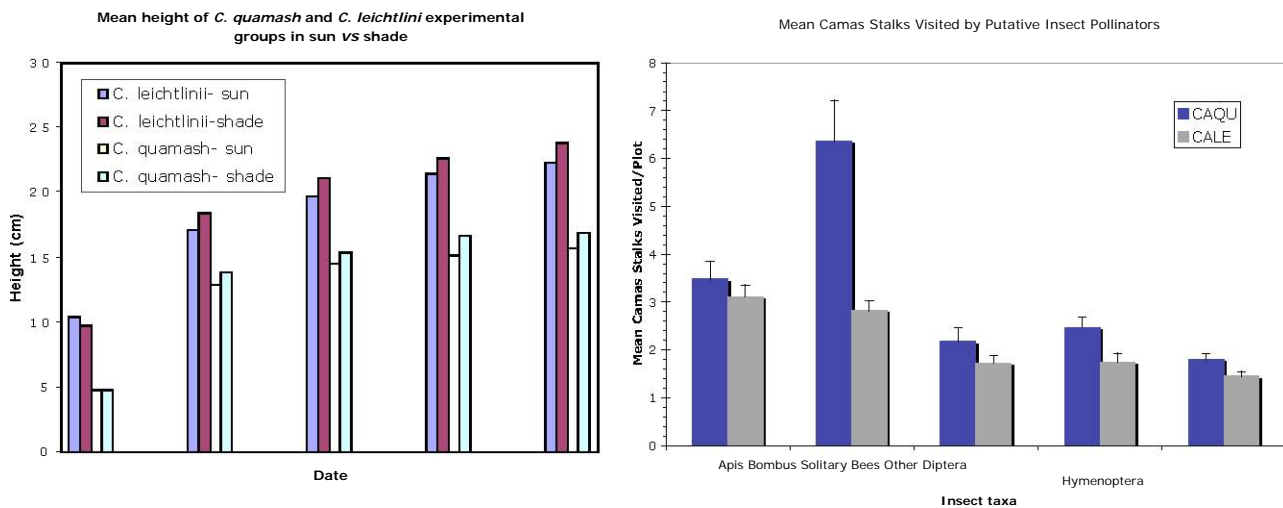
Department of Biology, Willamette University, Salem, OR 97301.

The genus *Camassia* (Agavaceae) is well suited for comparative habitat and pollination studies given the prevalence of the four western species (*Camassia quamash*, *C. leichtlinii*, *C. howellii*, and *C. cusickii*) throughout Oregon, and the extent of sympatry between common camas, *C. quamash* ssp. *maxima* and great camas, *C. leichtlinii* ssp. *suksdorfii*, west of the Cascades.

**Part 1: Habitat and species boundaries in *Camassia*.** To understand environmental variation in diverse species of *Camassia*, we conducted field studies as well as manipulative experiments in a greenhouse. We surveyed plants in their native habitats, augmenting field notes with data logging technologies to examine overall community and habitat types, light and moisture levels, and plant associates of *Camassia* at various sites. Two case studies also allowed us to evaluate the effect of light intensity on plant height and habitat preference. Data collected during a 2-year study of sympatric populations with HOBO sensors suggest that *Camassia quamash* grows at lower light levels than does *C. leichtlinii*. Greenhouse experiments using mesh screening to simulate shade imply that light is not a significant factor in modifying individual species height and that genetics may be responsible for the observable differences between the two species.

**Part 2: Pollinator effectiveness in *Camassia*.** Habitat differences may also influence plant-pollinator interactions, a mutualism of critical importance to natural ecosystems and human-dominated communities. Many insect visitors deplete floral resources (i.e. nectar, pollen), yet are not effective pollinators. Using *in situ* field observation, we compared pollinator behavior (i.e. visitation frequency, patterns of floral resource collection, effectiveness) between common and great camas. *Camassia* represents a hymenopteran dominated pollination system with a large spectrum of generalist pollinators. *Bombus* (bumblebees) and *Apis* (honeybees) displayed high visitation frequency and foraging effectiveness on both *Camassia* species. The distribution of insect visitors on flowers differed significantly between common vs. great camas ( $P < 0.001$ ,  $df=6$ ,  $X^2 = 82.7$ ), however, implying differential pollinator visitation. Pollination studies provide integral knowledge for plant reintroductions and ecosystem conservation, enabling the preservation of biodiversity in the face of habitat modification and worldwide pollinator decline.

### *Camassia* Habitat Requirements Quantifying Pollinator Effectiveness



**One small step for hikers but one giant leap for ecological validity: Taking research outside, a kinematic study of hiking downhill.**

**Victoria Swigart, Shannon Levin and Julianne Abendroth-Smith**

*Department of Exercise Science, Willamette University, Salem, OR 97301.*

Walking seems simple, but from a biomechanical perspective it is a complex process that is complicated by a gradient. Previous research has shown that trekking poles redistribute some of the forces on the lower extremities; this research has primarily been conducted in a laboratory.

**Purpose:** The purpose of this study was to determine the validity of using an indoor ramp to simulate an outdoor slope with and without the use of trekking poles. **Methods:** Ten participants walked at a self-selected speed over four counterbalanced conditions at a slope of 15 degrees (indoor and outdoor, with and without poles). Video was recorded and EMG data were collected for five muscles in lower extremity and back. **Results:** The kinematics demonstrated differences do exist when walking outdoor. Hikers remained more upright, walked with a greater knee flexion, and were more comfortable with their COM further from their base of support when outside. This was more pronounced with pole use than without poles. IEMGs demonstrated only small differences. The back musculature showed a reduction in activity with poles outside, possibly attributed to both a more upright posture, and a balance mechanism due to the use of poles. However, pole use elicited little statistically significant changes in muscle activity. Effect sizes do indicate some differences may exist. **Discussion:** Caution is warranted when examining kinematics in the lab. One factor may be the use of the poles on the ramp; the effect is not the same as on a trail. The overall muscle activity was similar enough between the inside and outside conditions to continue examining hiking in the lab. The trends noted need to be examined further, perhaps on steeper slopes. Overall, the use of poles was still shown to be advantageous in most cases.