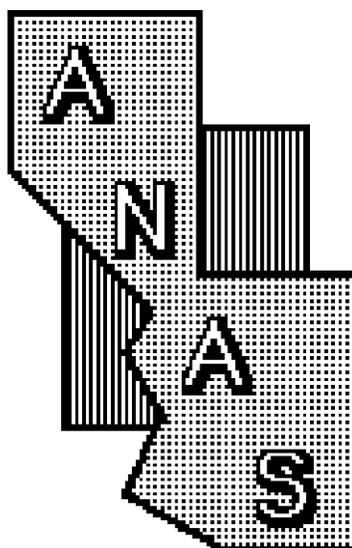


2015

VOLUME 50

**PROCEEDINGS  
OF THE  
ARIZONA-NEVADA  
ACADEMY OF SCIENCE**



**FIFTY NINTH ANNUAL MEETING**

**April 18, 2015**

**Arizona State University-West  
Glendale, AZ**

**ISSN NUMBERS**

Online ISSN: 2169-3447

Print ISSN: 2169-3455

**Proceedings of the  
59<sup>th</sup> Annual Meeting of the  
ARIZONA-NEVADA ACADEMY OF SCIENCE  
April 18, 2015  
Arizona State University-West  
Glendale, Arizona**

**Table of Contents**

<b>Abbreviated schedule and activity locations.....</b>	<b>2</b>
<b>Summary of section meetings.....</b>	<b>3</b>
<b>Sponsor.....</b>	<b>4</b>
<b>Luncheon speaker.....</b>	<b>4</b>
<b>Biology/Biotechnology Session.....</b>	<b>5</b>
<b>Geography session.....</b>	<b>13</b>
<b>Hydrology session.....</b>	<b>15</b>
<b>Poster session.....</b>	<b>20</b>
<b>Academy business and annual reports.....</b>	<b>42</b>
<b>Officers 2014-2015.....</b>	<b>42</b>
<b>President’s Report.....</b>	<b>43</b>
<b>Membership Report.....</b>	<b>44</b>
<b>Nominating Report.....</b>	<b>44</b>
<b>Necrology Report.....</b>	<b>45</b>
<b>Minutes of the Annual Business Meeting.....</b>	<b>46</b>
<b>Outstanding Service Award.....</b>	<b>48</b>
<b>Outstanding Teacher Award .....</b>	<b>49</b>
<b>Outstanding Leadership in Science Education Award.....</b>	<b>50</b>
<b>Science Olympiad Liaison’s Report.....</b>	<b>51</b>
<b>Treasurer’s Report.....</b>	<b>53</b>

## ABBREVIATED SCHEDULE AND ACTIVITIES LOCATIONS

Friday, April 17

Board of Governor's meeting: 6:30-8:30 pm  
Fajardo's Cafe  
Glendale, AZ

Saturday, April 18

All section meetings on Saturday will take place in the SANDS building on the campus of Arizona State University-West, Glendale, AZ

7:00-8:30	Registration: Lobby UCB (University Center Building)
8:00-10:00	Paper Sessions: See section schedules: SANDS
10:00-11:00	Poster Session and Coffee Break: LaSala, UCB
11:00- 12:00	Paper Sessions continue: SANDS
12:00-1:30	Annual ANAS Awards Luncheon, Annual Business Meeting and Guest Speaker: LaSala, UCB
1:30-2:15	Paper Session-Biology/Biotechnology: SANDS

## SUMMARY OF SECTION MEETING

<b>Section</b>	<b>Time</b>	<b>Room</b>
*Biology/Biotechnology	8:00	SANDS 133
*Geography	11:00	SANDS 131
*Hydrology	8:00	SANDS 135
Poster Session	10:00	LaSala

\*All rooms are in the SANDS building except Posters in the University Center Building (UCB)

## **SPONSOR**

The Academy would like to thank the following for supporting this year's annual meeting:

School of Mathematical and Natural Sciences and New College of Interdisciplinary Arts and Sciences, Arizona State University

## **LUNCHEON SPEAKER**

**Lara Ferry, Ph.D.**

Associate Professor,  
School of Math and Natural Science, ASUW

### **“The Evolution of Jaws and the Role of Functional Novelty in Species Diversification”**

Jaws are thought to be an important trait facilitating the radiation and success of the vertebrate lineage. Jaws first appeared in the group known generally as the ‘fishes’. Fish have been the ecological dominants in aquatic habitats pretty much since complex life evolved on this planet, boasting roughly 32,000 known species. Aquatic habitats are diverse, and as a consequence, fishes as a group exhibit an incredibly rich suite of traits as necessary to meet the varied challenges associated with feeding. Among these is a novel joint within the lower jaw, termed the intramandibular joint (IMJ). Although the majority of fishes possess a fused lower jaw (or mandible), multiple independent lineages have acquired this secondary lower jaw joint. The IMJ is a new module that has formed within the already exceptionally complex teleost head, and disarticulation of two bony elements of the mandible potentially creates a ‘double-jointed’ jaw. The apparent independent acquisition of this new functional module in divergent lineages raises a suite of questions. (1) Does the IMJ serve the same purpose in all teleosts? (2) Is the IMJ associated with altered feeding kinematics? (3) Do IMJ-bearing fishes experience trade-offs in other aspects of feeding performance? (4) Is the IMJ used to procure prey items that are otherwise unavailable thereby expanding the ecological niche of species that possess this novelty? The ecological and evolutionary consequences of such novelties are explored in the context of the challenges of feeding in a dense and viscous aquatic medium.

Despite a stunning morphological diversity, most fishes (and other aquatic vertebrates) use a single behavior, suction, to capture food. Suction is used to draw viscous water, and the prey, into the jaws, and is effective on a wide array of prey items. However, because of water viscosity, suction really only works over a very small distance from the fish, and it is completely ineffective on large or attached prey that cannot be drawn into the mouth. We hypothesize that much of the morphological diversity seen in fishes is due to the need to get the jaws close enough to the prey to make suction work, or to work around the constraints of a dense and viscous aquatic medium when suction fails. We suggest that the aquatic realm has driven the evolution of trophic morphologies, like the IMJ, along very particular axes of diversification, rendering theoretical areas of an evolutionary landscape realistically unobtainable.

## BIOLOGY/BIOTECHNOLOGY SESSION

**SESSION: 8:00**

**ROOM: 133**

**CHAIRPERSON: Robert Bowker**

### **8:00-8:15 \*RESVERATROL AND SIRT1 ARE NOVEL POSITIVE MODULATORS OF VITAMIN D SIGNALING VIA APPARENT DEACETYLATION OF VDR**

Marya S. Sabir<sup>1</sup>, Zainab Khan<sup>1</sup>, Christopher M. Dussik<sup>1</sup>, Angelika Dampf Stone<sup>1</sup>, Shane F. Batie<sup>1,2</sup>, Michael A. Galligan<sup>1</sup>, G. Kerr Whitfield<sup>2</sup>, Mark R. Haussler<sup>2</sup>, and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

The vitamin D hormone, 1,25-dihydroxyvitamin D (1,25D), initiates its bioeffects by binding to the nuclear vitamin D receptor (VDR) and driving heterodimerization with retinoid X receptors (RXRs). Liganded VDR-RXR modulates gene transcription in 1,25D target tissues, including the colon and kidney, thus regulating epithelial cell proliferation, differentiation, and effecting chemoprevention. The significance of vitamin D in numerous facets of health stresses the importance of elucidating the molecular mechanism of 1,25D-VDR signaling modulators (e.g., resveratrol and sirtuin-1). Resveratrol (Res) is a potent activator of NAD-dependent deacetylase sirtuin-1 (SIRT1), an enzyme associated with longevity in animal models. The current study employed mammalian-two-hybrid (M2H) and vitamin D responsive element (VDRE)-based transcriptional assays to investigate the potential effects of Res and SIRT1 on VDR signal transduction. Results from VDRE-based assays indicated that Res and SIRT1 potentiate 1,25D-VDR activity via cell and promoter-specific pathways. In addition, 1,25D displacement experiments revealed an increase in VDR-bound radiolabeled 1,25D in the presence of Res, suggesting that Res may potentiate VDR transactivation by stimulating 1,25D binding. M2H assays in HEK293 cells were utilized to assess levels of interaction between VDR and VDR comodulators, including RXR, SRC-1, and DRIP-205. Both Res and SIRT1 increased the ability of VDR to associate with RXR; however, SRC-1 and DRIP-205 interactions were not enhanced. To analyze the acetylation status of VDR, the activity of a novel, non-acetylatable VDR mutant, K413R, was probed in VDRE-luciferase assays, revealing that K413R possesses amplified transactivation capacity in comparison to WT VDR in the presence of 1,25D. A specific SIRT1 inhibitor, EX-527, was also used to suppress endogenous SIRT1 levels, resulting in significantly decreased VDR transactivation. Finally, qRT-PCR in HEK293 cells was employed to examine how the 1,25D-dependent expression of an endogenous VDR target gene, CYP24A1 is affected by Res, SIRT1, and Res+SIRT1. Results revealed that 1,25D induction of CYP24A1 expression

was further enhanced (185%) by co-expression of SIRT1, while Res increased 1,25D-dependent CYP24A1 expression by 394%. In the presence of 1,25D, SIRT1, and Res, CYP24A1 expression increased by 426% over 1,25D alone. We conclude that acetylation of VDR comprises a negative feedback loop that attenuates 1,25D/VDR signaling. This negative loop is suppressed by resveratrol/SIRT1-catalyzed deacetylation of VDR, restoring full VDR activity. These influences of 1,25D and Res on VDR may possibly benefit healthspan. In summary, this study illuminates a coordinated interaction between two nutritionally-derived lipids, vitamin D and resveratrol, thereby identifying a link between 1,25D-VDR signaling and SIRT1 function

**8:15-8:30 \*COMPARISON OF WILD BEE SPECIES DIVERSITY AND RELATIVE ABUNDANCE IN FRAGMENTED URBAN AND DESERT LANDSCAPES**

Adam D. Lowe and J.L. Foltz-Sweat, (Arizona State University, Glendale, AZ),

Wild bee populations in disturbed urban fragments and semi-natural desert habitats were sampled every week from September 2014 through October 2014. The objectives were to collect baseline wild bee diversity and relative abundance data for Phoenix urban and semi-natural areas, to compare bee species diversity and relative abundance in these areas and to record bee-floral host relationships. We used aerial netting and pan-trapping to sample wild bee populations. Alpha and beta diversity indices indicated that urban fragments possessed greater bee species diversity than nearby desert landscapes and that bee community composition differed between sites. Plant pollinator networks illustrated communities dominated by generalist plant and bee species at the various sites. *Leucophyllum frutescens* proved to be attractive forage for many bee species in one urban site. *Larrea tridentata* attracted a wide range of bee species in both semi-natural habitats that were sampled.

**8:30-8:45 \*ENVIRONMENTAL AND SOCIO-ECONOMIC FACTORS FOR UTILIZING MICROALGAE PRODUCTION FOR WASTEWATER TREATMENT**

Shahrzad Badvipour (Arizona State University, Mesa, AZ)

Global pressure on water resources has created large demand for wastewater reuse and different applications. World-wide access to sufficient and cost effective treatment technologies are global hurdles, especially in under-developed countries. Wastewater treatment services in developed economies are also facing problems of handling and treatment of large amounts of wastewater near highly populated areas where old facilities and outdated wastewater treatment systems exist. Despite recent advancements in treatment technologies, conventional activated sludge and tertiary treatment continue to contribute to direct and indirect environmental impacts. Selection of appropriate technologies and energy production pathways for utilizing microalgae production in wastewater requires evaluation of geographical needs and local economies such as Arizona. Sustainability return on investment provides the environmental and economic metrics that are necessary to assess technologies based on criteria such as location, current market demand and economy.

**8:45-9:00 \*IMPROVING ALGAL CULTIVATION ON WASTEWATER: KEY VARIABLES LIMITING PRODUCTIVITY**

Everett Eustance (Arizona State University, Mesa, AZ)

Algal cultivation can bioremediate wastewaters while providing desired products including biofuels and/or animal feed. However, there are several problems that limit algae productivity on wastewater. With Arizona's hard water and the alkalinity associated with organics in wastewater, the pH of municipal wastewater, anaerobic digestate, and dairy lagoon effluent tends to be between 8.5 and 9. This can be artificially lowered during the day by providing CO<sub>2</sub> for growth. High pH at night causes two problems which limit algal productivity: 1) ammonia toxicity and 2) ammonia volatilization. The pH of cultivation systems can be lowered by providing CO<sub>2</sub> during the day and maintaining it at night by minimizing gas transfer with the atmosphere. Another key limitation in algal cultivation is optimal temperature. Low morning temperatures from nighttime heat loss limits productivity. The ARID system minimizes the impact of night temperature by creating a central storage area to minimize surface area to volume ratio.

**9:00-9:15 \*OUT OF THE DARK AND INTO THE LIGHT: THE IMPORTANCE OF LIGHT IN ALGAE GROWTH ON WASTEWATER**

Joshua Wray (Arizona State University, AZ)

*Scenedesmus acutus*, a common green microalgae isolated from wastewater, was mass cultured in flat panel photobioreactors with varying thickness to access the importance of light penetration into wastewater media on growth performance. Serial dilutions of dairy wastewater and municipal effluent were used to establish baseline growth data for the organism for comparison with growth on standard artificial culture medium (BG-11). The wastewater dilution rate was optimized for a given bioreactor thickness. Nutrient depletion rates were established for the algae strain growing on different dilutions of the wastewaters with differing bioreactor thicknesses. Measurements of total photosynthetically active radiation (PAR) and photochemical efficiency (fv/fm) were obtained to demonstrate the importance of light in algae cultivation in wastewater. Culturing recommendations, including optimal cell density and nutrient level for a given bioreactor and culture thickness, were developed for the algal strain on various wastewaters.

**9:15-9:30 \*USE OF ALGAE AS A FEED SOURCE IN COMMERCIAL AGRICULTURE**

Haley Cooley (Arizona State University, Mesa, AZ)

Algae can offer many nutritional benefits to commercial feeding operations and biomass can be produced on site using the nutrients from wastewaters produced from normal operations. With an average of 299 sunny days in Phoenix, AZ and 294 in Las Vegas, NV, algaculture could become a feasible feed/food production method in the sunny Southwest. One of the untapped markets for algae biomass products is the agriculture industry, particularly the feeding of animals raised for commercial use. Algae biomass can be fed as a nutritional supplement included in the diets of farm

animals with the added benefit of the oils in the algae biomass replacing the current use of fish oil supplements. This presentation provides an overview of how algae can be successfully used to supplement a commercial agricultural operation feed plan and summarizes previous studies that have shown the benefits of algae biomass as a feedstock.

### **9:30-9:45 ISOLATING AND SELECTING FRESH WATER ALGAE FOR GROWTH IN SALINE ENVIRONMENTS**

Melissa Schonauer, Terry E. Baxter, Emily Day, and Karen Van Winkle-Swift (Northern Arizona University, Flagstaff, AZ)

One aspect of work being conducted at Northern Arizona University is to seek favorable native freshwater algal strains that can demonstrate tolerance or adapt to growing in salty waters. Using salty waters for algae production is a strategy that not only maintains growth environments to reduce the likelihood of predator and bacterial infestations but also can increase the accumulation of certain bio-products, such as lipids, in some algal strains. Typical open-air algae production systems have a disadvantage in that over the long term they are vulnerable to invasion by native algae, and infestation by predators and bacteria. Each of these can devastate the population of a specialized strain being grown. Samples were collected from a variety of waters in Arizona and two approaches were used for isolating algae with tolerance for growing in salty waters. A "screening" approach and a "selection" approach both yielded salt-tolerant strains. Out of about 250 different strains handled, 18 were selected to be salt-tolerant. Results from the tests to determine overall tolerance to salt are presented showing qualitatively how various strains responded to increasing levels of NaCl. General result from using these two approaches found that strains growing in presence of salt on a solid media will also grow in the presence of salt in a liquid media and that the type of liquid medium effects growth in presence of salt. A collection of native strains has been generated, with a few of these native strains able to grow in different harsh conditions and some strains are tolerant to salt.

### **9:45-10:00 EVALUATING NATIVE FRESHWATER ALGAE FOR GROWTH AND DISSOLVED SOLIDS REMOVAL IN SALINE ENVIRONMENTS**

Emily Day and Terry E. Baxter (Northern Arizona University, Flagstaff, AZ)

Water resources that have acquired or concentrated significant levels of dissolved minerals are generally considered less desirable for further use and are discharged as a waste. One strategy for possibly recovering these waters is to integrate algal production processes such that they mutually benefit from the higher salinity growth condition to avoid bacterial or predator invasion and to increase bio-product accumulation, while also providing some capacity for removing dissolved minerals. This basic strategy is currently being investigated with the use native freshwater strains of algae that have demonstrated tolerance for growth in salty waters. This work evaluates the ability of two algal strains to grow in two different salty waters and to remove dissolved minerals. A laboratory method developed to screen a wide variety of growth conditions is described and

results from growth screening tests in the two waters evaluated are presented. Additional tests results on the ability to remove dissolved minerals or solids under the more favorable growth conditions obtained from the screening tests are also presented. Overall, the removal of dissolved solids is occurring and there is evidence that allowing the pH to increase as the non-diatom type algae grow can provide conditions favorable for a biologically-mediated removal of silica. Results from this work also demonstrated that freshwater algal strains selected for salt-tolerance in the laboratory cannot be assumed to grow well in actual salty waters and that the growth performance of mixed communities of freshwater algae in salty waters must be considered as potentially performing better than individual strains.

**10:00-11:00 POSTER SESSION AND COFFEE BREAK: LaSala, UCB**

**11:00-11:15 STRAIN-LEVEL CHARACTERIZATION OF BIOFUEL MICROALGAE AND SIMPLE MIXTURES USING MALDI-TOF MS**

Duane L. Barbano<sup>1</sup>, Henri Gerken<sup>3</sup>, Thomas Dempster<sup>3</sup>, Regina Diaz<sup>1</sup>, Lin Zhang<sup>2</sup>, Todd R. Sandrin<sup>2</sup> (<sup>1</sup>Arizona State University, Tempe, AZ, <sup>2</sup>Arizona State University, Glendale, AZ, <sup>3</sup>Arizona State University, Mesa, AZ)

Microalgae cultures grown and harvested for biofuel production are extremely susceptible to contamination when produced in open cultivation systems. Methods for algal species identification are currently expensive in terms of time, resources, and finances. Current identification methods include microscopic examination, 18S rRNA sequencing, polymerase chain reaction (PCR), and pulse field gel electrophoresis (PFGE). Matrix assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS) is considerably more affordable and less demanding in terms of time and resources. The primary objective of this study was to determine if MALDI-TOF MS can be used to identify microalgae commonly used in biofuel production. This study investigated whether MALDI was able to differentiate between: 1) a wide variety of microalgae species, 2) algal strains of the same species, and 3) different populations in simple algae mixtures. A protein extraction method was used to prepare 33 algae samples for analysis using a Bruker Microflex MALDI-TOF MS. Mass spectra were then analyzed using FlexAnalysis 3.0 (Bruker Daltonics) and BioNumerics 7 (Applied Maths) software. Algae species identifications were confirmed using 18s rRNA gene sequencing. Results showed that MALDI-TOF MS was capable of distinguishing between algae species at the genus, species, and strain levels. The 18s rRNA gene sequences supported the MALDI identifications of microalgae at the genus, species, and strain levels. Additionally, MALDI-TOF MS analysis of simple mixtures revealed that the mixture spectra contained peaks characteristic of the constituent pure samples and peaks not found in pure algal isolates were observed.

### **11:15-11:30 NASUA: A TRI-UNIVERSITY COLLABORATION ON USE OF WASTEWATERS FOR MASS CULTURE OF ALGAE**

Milton Sommerfeld (Arizona State University, Mesa, AZ)

The Arizona Board of Regents through its Research Innovation Fund (RIF) provided funding to engage the three State universities, its students, and local municipalities in a collaboration to effectively utilize the diverse wastewater resources available for the cultivation of algae for fuel, feed and food. The sunlight, climate, and wastewater resources, as well as the abundant non-arable land in the State, provide excellent resources and the opportunity to exploit algae as a new crop. By Arizona State law, “algaculture” is considered agriculture. The project focused on algae strain selection, use of different wastewaters in algae cultivation, and cultivation systems. An additional goal of the project was to educate students across multiple scientific and engineering disciplines at the universities on the potential of algae to produce diverse products and to improve the quality of wastewater.

### **11:30-11:45 USING ALGAE TO IMPROVE THE QUALITY OF DISCHARGE WATERS FROM POWER PLANTS**

Emil Puruhito, Sasha Sypkens, Ciara Westbrook and Milton Sommerfeld (Arizona State University, Mesa, AZ)

Contaminant levels entering water resources are monitored and regulated by Arizona Department of Environment Quality. Discharge water streams from different industrial processes often contain contaminant levels that may either approach or exceed current water quality standards. As a result, industry continuously seeks innovative or improved solutions for treatment of discharge waters prior to their release. This project focuses on selecting and utilizing algae strains to remove chemical elements/contaminants from discharge waters from two power plants. Two algae strains were selected and compared for their ability to remove multiple elements from the discharge waters. The elemental removal, and absorbance and adsorption characteristics of the algae strains were determined. This project was supported by the ASU-SRP CREC Program.

### **11:45-12:00 \*A PROPOSED RELATIONSHIP BETWEEN OXIDATIVE STRESS, CARDIOLIPIN AND THE WARBURG EFFECT.**

Rana Mekha and Ramia Mekha (Glendale Community College, Glendale, AZ)

Oxidative Stress is known to create an imbalance between Reactive Oxygen Species (ROS) and antioxidant defense enzymes in the body. ROS accumulation progresses through the superoxide anion ( $O_2^{\cdot -}$ ) hydroxyl radical ( $OH\cdot$ ); and hydrogen peroxide ( $H_2O_2$ ) compromising macromolecules such as DNA, proteins and lipids. Here we focus on the mitochondrial phospholipid cardiolipin, which is rich in polyunsaturated fatty acids (PUFA) and therefore a major target for oxidation. This molecule plays an important role in mitochondrial integrity, function, and cell apoptosis. The Warburg effect is a poorly understood adaptation of cancer cells

that provides ATP by fermentation instead of oxidation phosphorylation (OXPHOS) even though oxygen is present. We propose a possible mechanism that implicates oxidized cardiolipin in the Warburg Effect and this mechanism suggests hypotheses for future work

**12:00-1:30 AWARDS LUNCHEON AND BUSINESS MEETING: LaSala, UCB**

**1:30-1:45 WHY DO COLUMBIAN GROUND SQUIRRELS GIVE A MATING CALL?**

Theodore G. Manno, (Tuscon, AZ)

Male Columbian ground squirrels (*Urocitellus columbianus*, herein “CGSs”) sometimes emit a repetitive postcopulatory “mating call” that sounds similar to the alarm calls they discharge if attacked by terrestrial predators. Females are highly promiscuous during their single annual day of estrus, and to outweigh the cost of broadcasting a receptive female to competing males, there should be a consequence of mating calls on which sexual selection would act to favor expression of the trait. During 2005-2006, I observed the breeding behavior of over 100 CGSs to investigate the acoustic structure and environmental context for these mating calls and test between the following non-exclusive hypotheses: (1) the call reduces female aggression and increases sexual receptivity; (2) the call induces ovulation; (3) the call protects a male’s “investment” by helping to guard an inseminated female; (4) the call is a generalized “desist contact” signal that renders a male less vulnerable to invasions by his conspecifics; and (5) the call advertises to females that have not yet mated. Males were most likely to emit a mating call if they were the first to copulate with an estrous female (and the most likely to benefit from mate guarding because of the first-male sperm precedence recorded for this species). Mating calls usually occurred in concert with the male attempting to prevent the just-inseminated female from leaving the copulation site, and these guarded females experienced delays before subsequent copulations. Although sound characteristics of mating calls and alarm calls did not differ significantly, squirrels became vigilant and sought protection upon hearing alarm calls, but continued feeding during mating calls. Taken together, these results support the hypothesis that the male mating call is an intrasexual signal that announces postcopulatory mate guarding, and suggest that contextual information is important for assessing the message of mating calls.

**1:45-2:00      DAMAGE TO SALIVARY GLANDS IN *DROSOPHILA MELANOGASTER*  
AND ITS EFFECT ON OVERALL DEVELOPMENTAL TIMING**

Alicia Ripperre and Jennifer Hackney (Arizona State University, Glendale, AZ)

Virtually all animals require relatively predictable developmental schedules in order to fulfill the cycle of life. Cell death and severe inflammation alter steroid hormone production and can disrupt the timing of developmental transitions such as puberty. In the fruit fly, *Drosophila melanogaster*, injury to wing precursor tissues has been shown to result in decreased steroid hormone levels and delay development. The effects of damage to other tissues have not yet been explored. Here, the larval salivary glands were damaged in order to observe how injuring these specific tissues affect the timing of developmental transitions. Damage was induced by tissue-specific, temperature sensitive activation of cell death genes. The results indicated that death to salivary gland cells accelerates the *Drosophila* time to adult eclosion and that the observed acceleration of development is age-dependent. Insight into the effects of injury on development in *Drosophila* can potentially lead to information about development in other organisms, including humans, following injury or chronic inflammation.

**2:00-2:15      MEASURING THE LIFETIME OF COSMIC RAY MUONS**

Ian Brubaker, John Dallyn and Jasmine Gill (Embry-Riddle Aeronautical University, Prescott, AZ)

In this experiment cosmic rays create scintillation light as they pass through a 5 gallon mineral oil/scintillator detector. Some of the low-energy cosmic muons come to rest in the detector and their subsequent decays ( $\mu^+ \rightarrow e^+ \nu_\mu \bar{\nu}_e$ ) are observed as a second burst of light. The decay lifetime of 10,392 stopping muons were measured and the mean muon lifetime  $\tau_\mu$  was calculated. The composition of cosmic muons includes both positive and negative muons; however, a small fraction of the  $\mu$  cosmic rays are captured by hydrogen atoms in the mineral oil ( $CH_2$ ) thus affecting the accepted lifetime of muon decays (2.197  $\mu$ S). The muon lifetime measured in this experiment,  $\tau_\mu = (2.092 \pm 0.019)\mu$ S, does not differentiate between positive or negative muons and is consistent with the occurrence of  $\mu^-$  capture on hydrogen.

## **GEOGRAPHY SESSION**

**SESSION: 11:00**

**ROOM: 131**

**CHAIRPERSON: Anthony Brazel**

**10:00 - 11:00 POSTER SESSION AND COFFEE BREAK: LaSala, UCB**

### **11:00-11:15 AN AGGREGATED CLIMATE TELECONNECTION INDEX LINKED TO HISTORICAL EGYPTIAN FAMINES OF THE LAST THOUSAND YEARS**

Michael M Santoro (Arizona State University, Tempe, AZ, Fekri A. Hassan French University in Egypt, Egypt, MM Abdel Wahab Cairo University, Egypt, Randall S. Cerveny and Robert C. Balling Jr. Arizona State University, Tempe, AZ)

Nile River variability has been associated with the social and cultural development of Egyptian civilization. This is particularly true of famine in the Nile River Valley. Additionally the Nile River levels have been associated with climate teleconnections such as El Niño/Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO), and the Pacific Decadal Oscillation (PDO). This paper demonstrates that the cumulative effects of these three climate teleconnections are strongly linked to the occurrence of famine in Egypt. A climate composite index created from the reconstructions of the climate teleconnections using Principal Component Analysis (PCA) explains 61% of the variance in these three datasets. Analysis of the composite reveals that 8-10 major famines since AD 1049 correspond to minimums or downward trends in the detrended eigenvector.

### **11:15-11:30 REGIONAL VARIABILITY IN CARIBBEAN DROUGHT AND THE ATLANTIC MULTIDECADAL OSCILLATION**

Renée C. Elder, Robert C. Balling, Jr., Randall S. Cerveny and Daniel Krahenbuhl (Arizona State University, Tempe, AZ)

Many of the nations in the western, tropical North Atlantic are developing countries with economies that are heavily dependent on water, resulting in heightened sensitivity to droughts on all temporal scales. Drought, in the Caribbean, Central America and equatorial South America area, is influenced by the Atlantic Multidecadal Oscillation (AMO) with significant spatial variability observed across this region. Using exploratory spatial data analyses with the AMO index and the Standardized Precipitation Evapotranspiration Index, we identify an inverse relationship between the effects of the AMO between northern Mexico and equatorial South America. Generally, there is a negative (positive) relationship between northern Mexico and the Atlantic side of Central America (the Pacific side of Central America, the Caribbean and equatorial South America) and the AMO. These relationships are clearly observed through comparison of strong, positive and negative phases of the AMO. Countries in the region should consider these

relationships when forecasting upcoming droughts to minimize the negative effects on their developing economies.

### **11:30-11:45 LANDSCAPE GEOCHEMISTRY INTERPRETATION OF GEOGRAPHICALLY WEIGHTED REGRESSION ANALYSIS OF ELEMENTAL SOIL CHEMISTRY IN ARIZONA**

Tyler J. Thompson and Ronald I. Dorn (Arizona State University, Tempe, AZ)

Geographically weighted regression (GWR) analysis of the USA National Geochemical Survey's 517 soil collections in Arizona reveals previously unrecognized regions of significant relationships among the major elements of aluminum, calcium, magnesium, iron, sodium, potassium, and titanium. GWR output pseudo t-statistics highlight regions where the geological parent material, ecoregion processes, and changes in hydrology do serve as plausible explanations for the scaling relationships between the regressed elements. Areas of significant regression coefficients for Fe and Ti likely relate to parent material influence. Significant regression coefficients between Mg and Al in the model appear in Sonoran Desert clusters, where the Mg released by wildfires can be worked into carbonates while other nutrients such as K do not remain in the soil, perhaps reabsorbed by plant material. Other areas show significant positive regression coefficients between K and Al potentially due to pinyon and juniper burning releasing K. A large cluster of significant positive regression coefficients between Ca and Al likely relates to the distribution of calcium-rich lake beds – exposed to deflation when the Gila River drainage system integrated. While the GWR-identified patterns are striking, a full assessment of the proposed hypotheses would be the next step in a more detailed research agenda. These findings illustrate the exploratory power of GWR within the framework of landscape geochemistry, the branch of physical geography championed by A.I. Perel'man in the Soviet era and born from the thoughts of V.V. Dokuchaev and V.I. Vernadski.

### **11:45-12:00 EVIDENCE OF EQUIFINALITY IN TAFONI DEVELOPMENT**

Emily Kaba (Arizona State University, Tempe, AZ)

The most commonly invoked process to develop caverns of tafoni involves the precipitation of salts. Backscattered electron microscopy, in tandem with energy dispersive X-ray analysis, reveals evidence that multiple processes appear to be involved in tafoni development in Oman, Papago Park and Picketpost Mountain, AZ. Carbonate precipitation into Papago Park sedimentary breccia wedges apart the host rock, and then dissolves to leave behind uncemented fragments. Oman tafoni also show evidence of carbonate precipitation as a wedging agent, in addition to dissolution of the host carbonate rock and a possible role for organics that occupy some pore spaces. Tafoni in Picketpost Mountain welded tuff displays evidence of multiple processes including: dissolution of glassy groundmass; biotite splitting surrounding minerals; reprecipitation of a variant of silica glaze; and erosion of the tuff after the rock weakens sufficiently. The execution of multiple processes is evidence that equifinality plays a major role in tafoni formations.

### **12:00-1:30 AWARDS LUNCHEON AND BUSINESS MEETING: LaSala, UCB**

## HYDROLOGY SESSION

**SESSION: 8:00**

**ROOM: 135**

**CHAIRPERSON: Gerald Gottfried**

**8:00–8:20 \*THE PHOENIX RIO SALADO RESTORATION PROJECT: A SUCCESSFUL MODEL FOR THE ROLE OF NON-GOVERNMENTAL STAKEHOLDERS IN WETLAND RESTORATION**

Carlyn H. Schmidt (Northern Arizona University, Flagstaff, AZ)

This paper uses the Phoenix area Rio Salado restoration project to demonstrate the successful design and implementation of urban wetland restoration projects. The Rio Salado Restoration Project is the first successful urban program of its kind in the United States. It created a 5 mile lake along a section of the Salt River in downtown Phoenix. The lake, which has been used for recreation and aesthetic purposes, is a part of a 40 year effort that has already shown success during its first 15 years. The success can be attributed to innovative strategies that include well designed structure, and very good public outreach and inclusion. Such a design enables it to withstand major flood events while also minimizing public scrutiny. This can serve as a good example for developing a successful stream restoration projects in flood-prone urban areas anywhere. It can also be used by restoration planners and practitioners to design failure-proof urban wetland and stream channel restoration project. Other valuable lessons learned that can help advance the emerging restoration science are appropriate use of social dynamics to inform the public and garner their goodwill and participation in planning, design and project implementation.

**8:20–8:40 \*WATERSHED RESTORATION EFFORTS AT HART PRAIRIE IN NORTHERN ARIZONA**

Joshua Kursky and Aregai Tecele (Northern Arizona University, Flagstaff, AZ)

This paper explores the restoration efforts that have been made in the Nature Conservancy's Hart Prairie Preserve in Northern Arizona. Hart Prairie has a unique ecosystem of wet meadows surrounded by arid mountainous terrain. The dominant vegetation there is Bebb Willow (*Salix Bebbiana*). Fire suppression, and other human-induced impacts as well as increased ungulate herbivory rate and conifer encroachment into historically short-grass prairie have characterized the area's watersheds since Euro-American settlement. Some of the human-induced activities are constructions of stock tanks, earthen dams with associated diversion channels and a road crossing that cuts perpendicular to the direction of streamflow. Such conditions have altered the area's drainage patterns resulting in increased erosion and decreased water availability for the unique

floral ecosystem in the area. Restoration efforts have been undertaken on The Nature Conservancy's Hart Prairie Preserve and the USFS Fern Mountain Botanical Area since the mid-1990s. This paper summarizes the efforts made so far and describes those that can be undertaken in the future to rehabilitate the area to pre-disturbance geomorphologic and stream flow patterns.

**8:40–9:00 \*WATER QUALITY RESTORATION IN THE SAN PEDRO RIVER WATERSHED**

Jason Klotz and Aregai Tecele (Northern Arizona University, Flagstaff, AZ)

This paper is concerned with restoring the quality of water in some portions of the San Pedro River. There are high concentrations of the indicator bacteria, Escherichia Coli, in some parts of the San Pedro River. Our aim is to find ways of improving the situation. Specifically, there are two objectives in the study. The first one attempts to identify the possible sources of the E. coli and assesses its trends within the watershed. The second objective is determine appropriate methods of restoring the water quality. The main water quality problem is nonpoint source pollution, which enters the stream and moves along with it. The magnitude of the problem is affected by the size and duration of the streamflow, which brings bacteria-laden sediment. The amount of sediment brought into the system is large during the monsoonal events. At this time, the streamflow becomes highly turbid in response to the organic and inorganic sediments entering the system. Based on research done for this paper, the amount of E. coli concentration is strongly related to turbidity. Best management practices (BMPs) have been designed and implemented to restore the water quality problem in the area. The BMP's consist of actions such as monitoring, educational outreach, proper signage, and other range/watershed related improvement practices. Other issues that contribute to the increasing amount of E. Coli that are briefly addressed in this paper are bank and gully erosion, flood control, and surface water and streamflow issues that occur on the stream headwaters.

**9:00-9:20 \*RESTORATION OF THE LAS VEGAS WASH AND ASSOCIATED WETLANDS IN LAS VEGAS, NEVADA**

Megan A. Burke (Northern Arizona University, Flagstaff, AZ)

This paper evaluates the historical growth of the Las Vegas Wash, its subsequent degradation and the efforts currently being made to stabilize it. The Las Vegas Valley Metropolitan Area is located in the Mohave Desert in a drainage basin surrounded by mountain ranges. This drainage basin and its dynamic system of stream channels constitutes the Las Vegas Watershed in which the Wash is located. The state of the Las Vegas Wash is unique since it is a perennial stream that evolved from an ephemeral wash in response to the rapid urbanization and subsequent production of large amounts of treated wastewater input into the stream. The situation has created wetland ecosystems with a valuable riparian habitat in an arid environment. The system provides a variety of ecological services to the City of Las Vegas. The services include storm water conveyance, wastewater effluent filtration, flood protection and a green space for residents to enjoy. However, the continuous increase in amount and intensity of the flow has resulted in severe channel degradation

and bank erosion in some place. Under these conditions, our intention is to evaluate the status of the Wash, the efforts currently being made to rehabilitate it, and then make recommendations regarding any strategic adjustments that may be needed to produce the desired stream conditions.

### **9:20-9:40 PROTECTING WATER QUALITY ON NATIONAL FORESTS IN THE SOUTHWESTERN U.S. WITH BEST MANAGEMENT PRACTICES**

Roy Jemison (USDA Forest Service, Southwestern Region, Albuquerque, NM)

High-quality water is one of the most important natural resources that come from the national forests and grasslands. National Forest System (NFS) lands, which represent about 8 percent of the land area of the contiguous United States, contribute 18 percent of the Nation's water supply. About 124 million people rely on NFS lands as the primary source of their drinking water. In addition to drinking water and other municipal needs, water on NFS lands is important to sustaining populations of fish and wildlife, providing recreation opportunities, and providing supplies to meet agricultural and industrial needs across the country. Forests and grasslands generally produce high-quality water, especially when the ecosystems are healthy and functioning properly. Water quality is influenced by the pattern, intensity, and location of land use and management activities. Some land uses can protect or restore water quality, while others may degrade or pose risks to clean water. Excess sediment (turbidity and bedload), nutrients, temperature, hazardous chemicals, and their resulting effects on water chemistry and aquatic habitats, are the most significant water quality issues resulting from land uses and management activities on NFS lands. Preventing negative water quality impacts is more efficient and effective than attempting to restore the damage. To ensure water quality is protected, the Forest Service, an agency of the U.S. Department of Agriculture (USDA), has developed procedures, methods, and controls, consistent with Federal and State requirements, to address potential pollutants and pollution at their sources. Implementation and monitoring of these Best Management Practices (BMPs) is the fundamental basis of the Forest Service water quality management program to protect, restore, or mitigate water quality impacts from activities on NFS lands. In this presentation, the use and effectiveness of BMPs employed on national forests and grasslands in the Southwestern Region of the U.S. will be shared and discussed.

### **9:40-10:00 RESTORATION CASE STUDIES (URBAN, AGRICULTURAL, GRAZING, AND FISH HABITAT)**

Christopher MacDonald (Northern Arizona University, Flagstaff, AZ)

This report reviews three stream and watershed ecological restoration projects and the monitoring and evaluation methods employed to evaluate project successes or failures. Baxter Creek is small, urban stream located in El Cerrito, California. In the 1940s, a 70-meter-long segment was culverted to address flooding and sanitation issues. In 1992 the El Cerrito City Council implemented restoration treatments on this segment. The restoration involved opening the previously culverted channel, planting riparian vegetation, and adding in-stream step-pool sequences and sinuosity. A survey of the neighborhood residents indicated that overall they were pleased with the results.

Scientific goals and social perceptions of restoration projects are often separate. However, consideration of both results in a comprehensive overview of restoration projects. Lake Champlain is the sixth largest freshwater lake in the U.S. It is partially located across the Canada-United States border. Eutrophication was a problem due to excessive phosphorus loads. Restoration efforts included installation of riparian fencing, protected stream crossings, and streambank bioengineering. The Lake Champlain Basin Agricultural Watersheds Section 319 National Monitoring Program quantified the effectiveness of these practices as tools for reducing sediment, nutrient, and bacteria runoff from agricultural land through water quality monitoring. Sucker Creek is located east of Cave Junction, Oregon. It supplies approximately 80% of the drinking water for the City of Cave Junction. Aquatic resources were degraded by historic timber harvesting, road construction, and placer mining operations. Restoration projects have included large wood placement, stream bank stabilization/revegetation, side channel habitat development, riparian vegetation planting, riparian thinning, culvert replacement, road stream crossing stabilization, road decommissioning and subsoiling, and slope stabilization.

**10:00 – 11:00 POSTER SESSION AND COFFEE BREAK: LaSala, UCB,  
Hydrology Session Business Meeting**

**11:00-11:20 RIPARIAN PHOTOPOINT PROGRAM ON THE TONTO NATIONAL FOREST**

Patti R. Fenner (Friends of the Tonto National Forest, Phoenix, AZ)

A Tonto Forest Hydrologist began taking benchmark photos along important stream reaches in the mid-1980. With succeeding hydrologists, this project grew to a program that involved dozens of volunteers and over 1000 permanent riparian photo points. With recent budget and staffing reductions, the program was handed off to the new non-profit Friends of the Tonto National Forest in 2014. We have posted an interactive map on our website, where you can see locations of all the points, and also all photos for every year they have been repeated for that site. Permanent riparian photo points are used for environmental assessments for such projects as range management planning, travel management, and Forest plan revision. They often display dramatic changes in these dynamic ecosystems – changes that are brought about by management of permitted and non-permitted activities, flood, drought, and fire. Most of all, they help us to learn more about the relationship of riparian areas to uplands, and how riparian ecosystems function. We are training new volunteers in April for the 2015 spring photo point season.

**11:20-11:40 DOWNSTREAM IMPACTS OF DAMMING THE COLORADO RIVER**

Aregai Teclé (Northern Arizona University, Flagstaff, AZ)

This paper examines the impacts of damming the Colorado River on the riparian environments along the river. The dams were built in an era which may be referred to as the Age of Impoundment during

the fifty years ending in the 1970s. During that period close to 35,000 dams were built around the world, to divert and obstruct the natural flow of rivers. Two of the first biggest of such dams, Hoover Dam and Glen Canyon Dams were built in the Colorado River. There are twelve other dams built for various purposes in the Colorado River basin. The construction and operation of Hoover and Glen Canyon dams alone provide a large portion of the energy and water responsible for transforming the arid southwest into a national breadbasket and one of the fastest booming urban areas in the USA. In spite of such benefits, however, there are critical social, cultural and environmental issues that have risen from the construction and operation of these dams. Many large fertile agricultural areas, invaluable cultural remains, areas of natural beauty, and valuable environmental treasures along and away from the river are inundated and covered by lakes that backup for hundreds of kilometers upstream from the dams. Aquatic and terrestrial habitats are altered to the extent that many native plant and aquatic animal species have become endangered and even extinct due to submergence under water or change in habitat characteristics. Damming the river and extensive diversion of its water for irrigation and water supply purposes have prevented the river water from reaching the coastal lowlands for many months in the year significantly affecting communities like the Cocopa Indians that depended on it for their survival. These and many other effects will be examined and possible alternative solutions presented in the paper.

#### **11:40-12:00 THE SIERRA ANCHA EXPERIMENTAL FOREST OF CENTRAL ARIZONA**

Gerald J. Gottfried (U.S. Forest Service, Rocky Mountain Research Station, Phoenix, AZ)

The sustained production of high-quality water has been a concern in Arizona since early European settlements were established. The Forest Service's Southwestern Forest and Range Experiment Station instrumented the Summit Watersheds in 1921 to study landscape erosion in the lands surrounding the Theodore Roosevelt Lake. Research was expanded to the Parker Creek area in the Sierra Ancha Mountains in 1932 and the area was designated as the Parker Creek Experimental Forest. The Forest was expanded to 12,820 acres in 1938 to include adjacent watersheds, and the area was re-designated as the Sierra Ancha Experimental Forest. The purpose is to conduct systematic research on the influence of forests and rangelands on erosion, streamflow, plant and animal ecology, and water cycle relationships Arizona's important ecosystems. The Forest encompasses lands from 3,550 to 7,724 feet in elevation which support vegetation representing eight vegetation types from desert scrub to mixed conifer forests. A large number of experiments have been conducted on the Forest to ascertain evapotranspiration of common plant species, the dynamics of soil erosion, and of how land management options influence water yields and erosion in the forests and chaparral woodlands. Studies at in the higher elevation Workman Creek Watersheds evaluated the effects of several forest management treatments on water yield augmentation. The Forest is administered by the Rocky Mountain Research Station. Recent studies are examining the effects of the 2000 Coon Creek Wildfire on the hydrology and sedimentation from ponderosa pine-mixed conifer forests. Newer research is studying air pollution and large woody debris decomposition. The presentation will review some of the history and research on the Sierra Ancha Experimental Forest since 1921.

#### **12:00 1:30 AWARDS LUNCHEON AND BUSINESS MEETING: LaSala, UCB**

## POSTER SESSION

**SESSION: 10:00-11:00**

**ROOM: La Sala**

**CHAIRPERSON: Pamela A. Marshall**

**CO-CHAIRPERSON: Jennifer Hackney**

### **\*DETERMINATION OF EVAPORATION RATES AND ENVIRONMENTAL EMISSIONS OF THE PESTICIDE CHLORPYRIFOS FROM PLASTIC BAGS USED IN COMMERCIAL BANANA PRODUCTION**

RussL. Altabtabae, Oshea M. Chaudhary, Cassandra Clement, Veronique Back, Josue Esqueda Serna, Tran Thuan, Dominic Sanchez, and Beth Polidoro (Arizona State University, Glendale, AZ)

O,O-diethyl O-3,5,6-trichloropyridin-2-yl phosphorothioate (Chlorpyrifos, brand name Dursban) is a wide spectrum organophosphate pesticide that is used in Costa Rica and around the world in commercial banana production. Chlorpyrifos is an acetylcholinesterase inhibitor that can be hazardous to humans and animals causing overstimulation of the nervous system, muscle weakness and even paralysis. Chlorpyrifos is impregnated into plastic bags which are placed over ripening bananas for about three months to prevent cosmetic damage from the insect thrips (*Chaetanaphothrips orchidii* Moulton, *C. signipennis* Bagnall). As the majority of the already known chlorpyrifos environmental behavior data is based on direct application to the soil, little is known about chlorpyrifos environmental behavior when applied in plastic bags. To determine the quantity and how quickly chlorpyrifos was volatilized from plastic bags, total chlorpyrifos within bags was quantified and three volatilization experiments were conducted in September 2014, November 2014, and February 2015. Overall, chlorpyrifos concentrations within each bag were found to be very heterogeneous, with an average concentration  $38.5 \mu\text{g}/\text{cm}^3$  and a standard deviation of  $\pm 15.7$ . Based on these measurements, each bag or banana plant is estimated to emit approximately 450 mg of chlorpyrifos into the atmosphere each year. Approximately 90% of chlorpyrifos was volatilized or lost from the plastic bags within the first week of each experiment despite the varying temperatures of 15 – 35°C. Due to these rapid evaporation rates and high emissions, these results imply that chlorpyrifos is a potential environmental and health hazard, and may be unnecessary for preventing cosmetic damage to bananas.

## **\*ANTI-ESTROGENIC ACTIVITY OF BEXAROTENE AND NOVEL RXR AGONISTS**

Supreet Bains<sup>1</sup>, Pritika Shahani<sup>1</sup>, Carl Wagner<sup>1</sup>, Pamela A. Marshall<sup>1</sup>, Ichiro Kaneko<sup>1,2</sup> and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Estrogen receptor alpha (ER $\alpha$ ) is one of two primary types of nuclear receptors that are activated by estrogens. Elevated levels of estradiol (E2), a form of estrogen, can drive tumorigenesis in ER $\alpha$ -positive breast cancers. In contrast, another member of the nuclear receptor superfamily, the retinoid-X-receptor (RXR), is activated by retinoids. One example of an RXR-selective agonist is bexarotene (Bex), an FDA-approved drug useful for the treatment of cutaneous T-cell lymphoma (CTCL). Bex binds with high affinity to RXR, which is involved in many biological pathways, although the anti-cancer mechanism of Bex has not been fully elucidated. Several experiments were conducted to study the potential for bexarotene to act as an ER $\alpha$  functional antagonist. Novel RXR analogs that express the same or higher levels of anti-cancer activity as Bex, but with fewer side effects, were also tested. The anti-estrogenic potential of these RXR agonists was examined using an ER $\alpha$ /ERE-luciferase based reporter assay. All experiments were initially conducted using a human colon cancer cell model (HCT-116). In experiments where analog potency was tested, E2 was the positive control. In other groups, both Bex and the analog were combined with estradiol separately to examine their effects. Results revealed that when cells are transfected with human RXR $\alpha$ , 10<sup>-6</sup> M Bex significantly inhibited ER activity under all conditions tested. Most of the analogs evaluated were demonstrated to be more effective at lowering estrogen-mediated transcription at a lower concentration in comparison to Bex. These results implicate RXR as a novel drug target for Bex, and for our novel RXR analogs, in squelching estrogen-dependent ER signaling.

## **\*HIERARCHICAL RESTREAMING GRAPH PARTITIONING**

Kreg Barnes and Joel Nishimura (Arizona State University, Glendale, AZ)

As social networking and blogging websites grow in size, and graph based computation schemes such as Google's Pregel become more popular an important question arises: what is the best way to divide graph information across multiple servers or machines. Often it is desirable to divide the graph into partitions such that there is as little interaction between partitions as possible. Restreaming graph partitioning was recently proposed as an effective low resource framework to partition graphs, but can lead to solutions where individual partitions are made of many disconnected components. We propose a hierarchical restreaming graph partitioning algorithm that creates and merges partitions at multiple resolutions with the goal of reducing the number of components inside each partition.

## **\*FLOCCULATION IN SACCHAROMYCES CEREVISIAE**

Brianna Bates and Pamela A. Marshall (Arizona State University, Glendale, AZ)

*Saccharomyces cerevisiae* (yeast) usually obtain the property of flocculation. Flocculation is the asexual, calcium dependent process in which yeast cells group together to form flocs. Yeast flocculation is mostly used in beer brewing but because of this property it may be a useful organism for bioremediation. Some research has been said to that yeast can bind to toxins and sequester them away. 500 $\mu$ L of brewer's yeast was put in a microcentrifuge tube and rinsed three times with DI water to remove the media through being centrifuged. The yeast was then put into cuvettes and the original amount of cells in solution was measured using a spectrophotometer. The metal solutions, nickel chloride, lithium acetate, cadmium chloride, and magnesium chloride, were then added in the proper amounts to create the right dilution, 0.25M or 0.5M and the cells sat in solution for ten minutes, then measured again to find the percent of cells flocculated. Nickel chloride had a minimal effect on yeast sedimentation, while lithium acetate, cadmium chloride, and magnesium chloride had a greater effect. The 0.5M concentration in general had a more effect on yeast sedimentation than 0.25M. Cadmium chloride had the greatest effect out of all of the metal solutions. All the metal solutions caused the yeast to react at some level. This study will be further researched to better see the effects of metal solutions on the *Saccharomyces cerevisiae* to evaluate the possibly of yeast being used as a bioremediation tool.

## **\*DIGITAL DISTRACTIONS IN THE CHEMISTRY CLASSROOM**

Meghan Belmares, Alexander Ollerton, Brandon Cruickshank, and Jennifer Duis (Northern Arizona University, Flagstaff, AZ)

Digital devices (smart phones, tablets, laptops, etc.) have become a nearly constant part of college students' lives, including the use of these devices in the classroom for personal or course related activities. Several research studies have suggested that use of these devices in class may negatively impact student grades, however, the impact of attempts to control digital device use in classrooms has not been published. Comparisons will be made between a number of different chemistry courses, instructors, syllabus policies, and classroom management styles to examine differences in classroom digital device use, correlations between frequency of use and course grade, and student perceptions.

## **\*COMPARING QUALITY OF SERVICE AMONG US AIRLINES IN THE AVIATION INDUSTRY**

Michelle Bennett, Jaqueline Luedtke and Brent Bowen (Embry-Riddle Aeronautical University, Prescott, AZ)

This research compares the quality of US airlines and identifies what economic factors influence the performance of each airline. By identifying variables that directly affect the level of service using data from Airline Quality Rating (AQR), benchmarks for the airline industry can be established. Analyzing the data over a ten year period (2004-2013), this research utilizes the application of a comparable trend analysis methodology resulting in both industry wide and airline specific benchmarks. Financial decisions, policies, technology and flight services are analyzed to determine what business strategies provide the best service to consumers, and in result, the highest ratings in the annual AQR report. Industry standard is set by AQR providing consumers and analysts objective performance-based data to compare the quality of service among different US airlines. The AQR weighted average formula highlights criteria including on-time arrivals, denied boarding, baggage handling, and other customer complaints. Through the analysis of the strategies of top performing airlines, other airline operators can improve their service. Data used in this research are readily available from the Department of Transportation and are considered important to the consumers regarding airline quality. Through the collected data and analysis, the traveling public and airlines will be able to make better decisions and develop best practices.

#### **\*WILD BEE SPECIES DIVERSITY AND RELATIVE ABUNDANCE AT A *VITEX* CULTIVAR AT ARIZONA STATE UNIVERSITY, WEST**

Shelby Botello, Savannah Farley, Aleksandra Grozic, Amy Jicha, and Jennifer Foltz-Sweat (Arizona State University, Glendale, AZ)

Identification of target plant species used in the assessment of wild bee communities are useful tools for determining bee species richness and relative abundance. We sampled *Vitex* cultivars between September 2014 and October 2014 using aerial netting. Our objective was to collect baseline data on the bee community in this area and to compare the bee fauna sampled on *Vitex* to that sampled at nearby transects in degraded desert remnant fragments. Bee species composition on the *Vitex* cultivar was different than that sampled in the adjacent transects. *Bombus sonorus* was present in higher abundance at *Vitex* as was *Megachile*, *Hoplitis*, *Perdita*, and *Xylocopa californica*. Species such as *Bombus sonorus*, whose numbers may be declining, can benefit from increased use of this landscaping plant in future urban developments as a floral resource for urban bee populations.

#### **\*SUPPRESSION OF THE IMMUNE RESPONSE FOLLOWING TISSUE DAMAGE IN *DROSOPHILA MELANOGASTER***

Bree Caldera, Hailey Brabentz, and Jennifer Hackney (Arizona State University, Glendale, AZ)

A variety of human disorders such as Inflammatory Bowel Disease are associated with tissue-specific inflammation, cell death, and an abnormal immune response. The interactions between inflammatory factors and the innate immune system that occur during these disorders have not been clearly defined. The fruit fly, *Drosophila melanogaster*, is a good model organism to study

immune system changes in response to localized tissue damage. Two pathways that make up the fly innate immune system response include Toll and IMD. Analysis of Toll and IMD pathways was completed through the use of Quantitative Real-Time PCR to amplify and detect changes in gene expression following damage to wing precursor tissues. It has been determined that there was a widespread suppression of certain immune response genes following localized tissue damage to the *Drosophila* wing pre-cursor tissues. This knowledge can be used to further understand the relationship between damaged or inflamed tissues, and the innate immune system.

### **\*A COMPARATIVE STUDY OF EXTRACELLULAR PROTEASES AND GLYCOSYL HYDROLASES FROM THREE SPECIES OF *DEINOCOCCI***

Artemio Chaves and James Tuohy (Glendale Community College, Glendale, AZ)

Numerous microorganisms have been harnessed for their ability to detoxify or immobilize a variety of pollutants. However, most of these microorganisms are sensitive to the damaging effects of ionizing radiation. This limits the applicability of these organisms for bioremediation. Some of the most radiation resistant organisms yet discovered exist within the genus *Deinococcus*. For instance, *D. radiodurans* is a nonpathogenic, solvent tolerant soil bacterium that can grow continuously in the presence of high levels of ionizing radiation with little or no effect on its growth rate. It can similarly withstand desiccation and oxidizing agents. These are characteristics found across the *Deinococcus* genus which makes the group as a whole suitable for a host of bioremediation challenges. However, an ideal bioremediating organism should also have a well characterized extracellular proteome. Although the extracellular proteome of *D. radiodurans* has been extensively studied, much less is known about the secreted proteins of the 47 or so other species within the genus. The present study looks at secreted proteases and glycosyl hydrolases (amylases) from two other *Deinococci*: *D. gobiensi* and *D. hopiensis* and compares them to the best know representative of the genus, *D. radiodurans*.

### **IDENTIFICATION OF BIOCHEMICAL AND GENETIC MECHANISMS FOR THE DIAGNOSIS AND POTENTIAL TREATMENT OF IBS: A MULTIFACETED APPROACH**

Christopher M. Dussik<sup>1</sup>, Maryam M. Hockley<sup>1</sup>, Marya S. Sabir<sup>1</sup>, Ichiro Kaneko<sup>1,2</sup>, Lin Zhang<sup>1</sup>, Michael A. Galligan<sup>1</sup>, Connie Borrer<sup>1</sup>, Todd R. Sandrin<sup>1</sup> and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Irritable Bowel Syndrome (IBS) is classified as a functional gastrointestinal disorder due to its enigmatic pathological foundation. As a direct consequence, the diagnosis of IBS is an expensive and laborious process. The identification of the biochemical patterns characteristic of IBS would be invaluable in improving current diagnostic practice. Serum and tissue samples from eleven IBS and thirteen asymptomatic patients were analyzed to uncover physiological imbalances that may

be associated with IBS. Serum vitamin D levels within IBS and non-IBS populations were measured as a potential biomarker for IBS. This analysis did not reveal a statistically significant difference between average serum vitamin D concentrations, although a trend of vitamin D deficiency was observed. As a surrogate for intestinal cell-derived serotonin levels in IBS/control patients, qRT-PCR was used to assess tryptophan hydroxylase-1/2 (TPH1/2) expression. Data from this experimentation indicated that the majority of the IBS cohort likely displayed decreased gastrointestinal serotonin levels. Additional qRT-PCR analysis of RNA derived from HCT116 cells indicated that TPH2 expression is induced by the presence of vitamin D. These observations suggest potential therapeutic utilities if serotonin imbalance is determined to be a factor in IBS pathophysiology. Three separate DNA microarrays were utilized to compare the transcriptomes of both the IBS and non-IBS populations. Statistical analysis of this data set revealed a series of genes with differential expression patterns across the two populations. Genes within this data set may include biomarkers indicative of the IBS disease state and could prove useful in the development of a diagnostic assay.

#### **\*MODULATION OF MONOAMINE OXIDASE (MAO) AND THE SEROTONIN TRANSPORTER (SERT) IN HUMAN INTESTINAL EPITHELIUM BY VITAMIN D**

Aleksandra Grozic<sup>1</sup>, Christopher Dussik<sup>1</sup>, Marya Sabir<sup>1</sup>, Ichiro Kaneko<sup>1</sup>, Connie Borrer<sup>1</sup>, Todd Sandrin<sup>1</sup>, G. Kerr Whitfield<sup>2</sup>, Mark R. Haussler<sup>2</sup>, and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Gastrointestinal serotonin plays a significant role in modulating a variety of functions including muscle contractility and inflammatory responses. A recent report suggests that vitamin D increases the synthesis of serotonin by inducing the expression of tryptophan hydroxylase 2 (TPH2), the rate-limiting enzyme in serotonin production (Ames & Patrick, 2014). In our current study, the effect of vitamin D on alternative gene products involved in serotonin metabolism was investigated. Quantitative reverse-transcription PCR (qRT-PCR) was utilized to measure the effect of vitamin D on the expression levels of the serotonin transporter (SERT), monoamine oxidase alpha (MAO-A) and monoamine oxidase beta (MAO-B) in human colon tissue, and in cell lines derived from human colorectal adenocarcinoma (HT-29) and human colorectal carcinoma (HCT-116). Preliminary analysis of the influence of vitamin D on SERT expression suggests a potential dose-dependent repression of SERT in HT-29 cells. Moreover, expression of MAO-A and MAO-B was shown to be induced at  $10^{-8}$  M 1,25D and repressed at  $10^{-9}$  M and  $10^{-10}$  M in both HCT-116 and HT-29 cells. These results provide preliminary evidence for a novel pathway of intestinal serotonin regulation by vitamin D, and suggest that vitamin D status may influence the etiology of gastrointestinal disorders dependent on optimal serotonin signaling.

## **HYDROGEOMORPHIC AND BOTANICAL ASSOCIATIONS OF BAJADA EPHEMERAL DRAINAGES IN THE WHITE TANK MOUNTAINS, SONORAN DESERT**

Matt Haberkorn (Phoenix College, Phoenix, AZ)

Three ephemeral drainages proceeding from the White Tank Mountains of the Sonoran Desert were examined for hydrogeomorphic and botanical associations. Within these drainages it was found that soil development of the various geomorphic surfaces composing the mountains and bajadas strongly influenced these associations. Each geomorphic surface found along these bajadas had an associated ephemeral drainage channel morphology, hydrology and plant community. A total of four major associations between the two sites were identified. (1) Within the mountains, soils were undeveloped and rocky. Here channels were characterized by bedrock, irregular and discontinuous flow patterns and a plant community dominated by *Parkinsonia microphylla*. (2) On upper bajadas, highly developed caliche soil horizons strongly constrained deeply incised channels. These channels contained a lower frequency of ephemeral flows compared to other channel types and also were dominated by *P. microphylla*. (3) Lower bajadas contained weakly developed caliche soil horizons and channels of moderate to minimal incision. These channels had the most frequent ephemeral flows compared to other channel types and were dominated by *Larrea tridentata*. (4) Furthest away from the mountains, bajada toeslopes had no soil development and contained channels of minimal to no incision. Flow frequency was variable between differing drainages of this channel type and plant communities were dominated by *Parkinsonia florida* or *Prosopis velutina*. Upland plant communities adjacent to these drainages as a whole were also found to follow similar patterns corresponding to geomorphic surfaces composing the mountains and bajada.

## **\*THE EVOLUTIONARY DYNAMICS OF BALANCING LONGEVITY AND EVOLABILITY**

Minette Herrera, Aaron Miller and Joel Nishimura (Arizona State University, Glendale, AZ)

In an evolutionary context, cooperation is typically associated with traits or behavior that benefit the population, but are costly to the individual. From a classical viewpoint, cooperative behaviors seem as though they should be maladaptive, but their prevalence across the biome has motivated significant research into scenarios which can select for cooperative behavior. We investigate the possibility that mortality by old age can function as a cooperative behavior when the environment is rapidly changing. According to numerical simulations of our agent based model, while long lived individuals can outcompete their short lived peers, populations composed of long-lived individuals are more likely to go extinct during periods of rapid environmental change. This work poses mortality as a new avenue of cooperation against the prospect of rapid environmental change.

## **\*OPEN, CLOSE, OPEN, CLOSE: CYCLING STATES OF YEAST CALCIUM CHANNELS**

Han Hoac, Sandra Luu and Francisco J. Solis (Arizona State University, Glendale, Arizona)

Calcium homeostasis is a fundamental process in yeast where the cytosolic calcium concentration is regulated against changes in environmental calcium concentration and other externally changing conditions. We describe the experimentally determined response of yeast to non-monotonic changes in environmental calcium concentration: an increase followed by a decrease in the concentration. In our experiments, cytosolic calcium abundance is determined by luminometric techniques. As the external calcium concentration is first increased, a fast rise in cytosolic calcium followed by a slower decrease is observed. This process requires that the calcium influx channel be initially open and to be closed after a period of calcium influx. The concentration decrease is the result of sequestration of cytosolic calcium into the vacuole and other organelles. When the external calcium concentration is afterwards reduced it is observed, paradoxically, that the cytosolic calcium raises again. We interpret this result as evidence of the voltage-gated nature of the yeast calcium influx channel. Namely, the reduction in external calcium concentration is able to reopen the channel and temporarily increase the cytosolic calcium concentration.

## **\*ISOLATION AND CHARACTERIZATION OF CAROTENOIDS FROM *DEINOCOCCUS RADIODURANS* AND *DEINOCOCCUS HOPIENSIS***

Reese Huish, Regan Huish, Joseph Springer and James Tuohy (Glendale Community College, Glendale, AZ)

The prokaryotic genus, *Deinococci* is known for its ruggedness. Members of this genus are commonly resistant to extreme levels of ionizing radiation, oxidative stress and dessication. The *Deinococci* synthesize carotenoids, forty carbon, organic pigments and as a class these are known to be potent anti-oxidants. It may well be that the effectiveness of the *Deinococcus* in quenching reactive oxygen species and combating oxidative stress in general is derived from their synthesis of carotenoids. The *Deinococcus* carotenoid most studied to date is Deinoxanthin, derived from the well-studied species *D. radiodurans*. This study looks to isolate carotenoids from *D. hopiensis*, a more recently discovered and thus less characterized member of the genus, and compare those carotenoids with Deinoxanthin.

## **\*A COMPARISON OF ARRAYSTAR AND THE OPEN-SOURCE SOFTWARE R FOR THE STATISTICAL ANALYSIS OF MICROARRAY DATA**

Julia Jamison, Jennifer Broatch, and Jennifer Hackney (Arizona State University, Glendale, AZ)

The fruit fly *Drosophila melanogaster* is among one of the most extensively studied organisms in genomic history serving as a robust model in studying human biology. Microarray technology and development has proven to be an efficient and cost effective method of gene expression analysis. An analysis of microarray data showing the most differentially expressed genes in the fruit fly following tissue injury was performed using both R and DNASTar's Arraystar software package in order to identify differences between a freely available, open-source software, and a licensed gene expression analysis software. We compared the RNA of non-injured flies (control) to the RNA of flies that were injured prior to their pupic state (ablated). In the analysis, we aimed to detail which, if any, genes had been differentially expressed. Two samples of *D. melanogaster* microarray data, each containing 14,973 genes, were analyzed in Arraystar and using Bioconductor's Limma package in R. This comparison of open-sourced statistical software and specifically developed, licensed software for the analysis of these microarray data aims to increase the feasibility of rapid and efficient identification of differentially expressed genes in many fields of study, as open-source software suites such as Bioconductor are readily available to those with limited budgets and resources. Moving forward, the developed process can be applied to study the gene expression response to other types of tissue damage using either software.

#### **\*KLOTHO AND $\beta$ -CATENIN: AT THE CROSSROADS OF AGING AND CANCER**

Zainab Khan<sup>1</sup>, Sameera Khan<sup>1</sup>, Ruby Sandoval<sup>1</sup>, G. Kerr Whitfield<sup>2</sup>, Mark R. Haussler<sup>2</sup>, and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Klotho, an anti-aging protein, is thought to be involved in the aging processes in humans due to its interactions with multiple molecular pathways, potentially including the Wnt/ $\beta$ -catenin and the vitamin D signaling pathways. In the  $\beta$ -catenin signaling pathway, overexpression or mutation can lead to numerous cancers, especially colorectal neoplasia, through increased cellular proliferation. In fact, over 90% of human colon cancers are known to originate from mutations in components of the  $\beta$ -catenin pathway. In the vitamin D signaling pathway, chemopreventative activities of vitamin D are thought to be elicited by the up-regulation of anti-cancer genes, such as the tumor suppressor p21. Activated 1,25-dihydroxyvitamin D (1,25D) binds to and activates the nuclear vitamin D receptor (VDR). VDR is known to respond to "nutritional modulators". One such potential VDR modulator is resveratrol, a plant-derived polyphenol and potent antioxidant nutrient that also functions as a chemopreventative agent. Functioning collectively, the vitamin D pathway and klotho may possess tumor-suppressing qualities via inhibition of the  $\beta$ -catenin pathway. Thus, we employed transcriptional assays to assess the influences of sKlotho, 1,25D, and resveratrol on the vitamin D signal transduction pathway and the Wnt/ $\beta$ -catenin pathway in embryonic kidney (HEK293) and colon cancer (HCT116) cell lines. The results revealed an increase in transactivation of the VDR pathway in the presence of sKlotho, 1,25D, and resveratrol in HEK293 cells. Additionally, sKlotho and 1,25D were shown to independently inhibit  $\beta$ -catenin activity, while resveratrol had stimulatory effects in HEK293 and HCT116 cell lines. In conclusion, our results illustrate the putative role of sKlotho as a tumor suppressor as well as the potential nutritional applicability and significance of vitamin D and resveratrol to optimal human health.

## **\*A STUDY OF THE PREY CAPTURE KINEMATICS IN THE RAINBOWFISH, *MELANOTAENIA SPLENDIDA***

Sarahi Lerma and Lara Ferry (Arizona State University, Glendale, AZ)

Rainbowfish, *Melanotaenia splendida*, are a common freshwater species in tropical regions of the world. They are members of the Atheriniformes (Atherinomorpha), the silverside fishes. The Atheriniformes are known for some unusual feeding behaviors, though very few members of the group have been studied quantitatively. Their close relatives, the Cypriniformes, such as mollies, guppies, and mosquitofish, are well studied and possess a suite of fairly radical morphologies associated with feeding and breeding. The third member of the Atherinomorphs, the Beloniformes, contains the recognizably odd needlefish, halfbeaks, and flying fishes. As a group, it is fair to say that the Atherinomorpha contain some pretty unusual fishes. The purpose of this project was to gain a further understanding of the unique feeding kinematics of Atheriniform fishes using the rainbowfish as an exemplar species. We further sought to compare our data with a large Cypriniform dataset. Feeding kinematics were quantified using high speed video recording unrestrained feeding events. Three feeding events from five individuals were analyzed frame by frame, from the time of the mouth opening to mouth closing. The X,Y coordinates of seven specific points were used to calculate the following kinematic variables: premaxillary protrusion, hyoid depression, cranial elevation, and gape distance. The contribution of cranial elevation to the strike was inconsistent. At times the fish raised the head as they expanded the mouth for prey capture, and at other times they did not. Cranial elevation is theoretically important for expanding the head during suction prey capture. Hyoid depression was more consistent, and clearly contributed to expansion of the head elements. Premaxillary protrusion contributed strongly to the event, and the jaws are closed with the premaxilla still protruded, facilitating a ‘nipping’ style jaw closure. A nipping style of prey capture is much like the Cyprinodontiforms, however, in rainbowfish, the event was much more rapid, and appeared to have a stronger contribution of suction to the event. We used both cleared and stained specimens as well as CT scans to investigate the underlying morphology of rainbowfish. These images revealed nearly microscopic teeth on the exterior of the jaws, and other features associated with feeding on highly elusive prey (i.e. prey that are mobile and likely to be able to escape predation). Further examination revealed a surprisingly well developed set of pharyngeal jaws, secondary to the oral jaws. The structure of the pharyngeal jaws suggested that much of the prey processing occurred within the pharynx.

## **\*THE POSSIBILITY AND FORENSIC USE OF DISTINGUISHABLE HORIZONTAL GENE TRANSFER BETWEEN GONORRHEA AND HUMANS**

Cody Little and Kimberly S. Kobjek (Arizona State University, Glendale, AZ)

Scientific works were evaluated regarding horizontal gene transfer, the human body, and the bacteria *Neisseria gonorrhoeae*. The obtained information was condensed into a literature review paper and corresponding poster. The purpose of the literature review was to determine if the was

any significant gene transfer between *Neisseria gonorrhoeae* and humans that could be relevant to forensic science. These bacteria had been recently determined to be the only bacteria able to acquire the human L1 gene. That ability could allow for traceable evidence that might be forensically significant in narrowing down suspects in sexually related cases. Within the literature review horizontal gene transfer was outlined. Following that, the conditions within the human body that could interfere with or increase the chances of HGT were summarized. Additionally the possible variables regarding restrictions to HGT, such as pH levels, viral infection, and exons, were explained. Finally, the forensic significance of these discoveries and their suggested uses were assessed. Further physical lab research should be conducted in order to verify the hypothetical concept described within the review.

### **\*A COMEBACK FOR THE COMBI CARRIER**

Lucas Mackey and Cindy Greenman (Embry-Riddle Aeronautical University, Prescott, AZ)

The Combination aircraft, or the Combi for short, is a multimodal type of aircraft used in airline and military operations. There is typically a cargo hold in the front half of the plane, depending on the variant, and the other half is reserved for a traditional type of passenger cabin. Currently, the variant is stuck between a complete retirement and a major comeback in the airline industry. This tri-semester research project aims to prove that when using the combination aircraft on routes involving fluctuating passenger demand, this variant will produce higher profit margins than the implementation of a freighter or pure passenger airliner. A formal analysis of the benefits and drawbacks of the combi carrier will allow airlines to better assess their network planning strategies. From this research, airlines can pinpoint on which routes a combi aircraft will have a better operating margin, and will be better informed on the predicted effects of the use of the combi carrier.

### **\*PARENT BEHAVIORS TOWARD ELEMENTARY SCHOOL-AGED CHILDREN DURING SCIENCE ACTIVITIES**

Kayla Messinger, Susannah Sandrin (Arizona State University, Glendale, AZ), and Katherine Short-Meyerson (University of Wisconsin Oshkosh, Oshkosh, WI)

Women continue to be underrepresented in the physical sciences and engineering fields, despite many efforts to attract more women to these majors and fields of employment. Indeed, children tend to identify with some science fields more than others, as a function of their gender, as early as the elementary years. This in-depth study examined the behaviors of parents as they worked with their children on hands-on science activities. A sub-sample of 32 parent-child dyads (balanced in terms of parent and child gender and ethnicity) were selected randomly from within each gender/ethnicity group for in-depth content analysis of transcript and video data. A total of 154 fourth-grade students and their parents were recruited from elementary schools, community

recreation centers, and public libraries for the larger study in which this study is situated. Each parent-child dyad participated in six science activities, equally balanced between life and physical science (3 of each), while researchers audio and video recorded sessions, which were then transcribed and coded for expressions (from the parent) of encouragement and discouragement. Parents also filled out questionnaires while their children were interviewed, and some of their questionnaire responses were compared with their observed behaviors. Parents did not report that science was more important for one gender over the other. A significant difference in encouragement and discouragement based on child gender was not found. A significant difference in encouragement based on parental beliefs was not found, but a significant difference in discouragement based on parental beliefs was found. Neither parental beliefs nor parental behaviors predicted how children rated interest in the science activities they participated in. The implications and limitations of this study will also be presented.

### **\*ANALYSIS OF CYTOSOLIC CALCIUM IN *SACCHAROMYCES CEREVISIAE***

Javon C. Oliver and Pamela A. Marshall (Arizona State University, Glendale AZ)

We are interested in studying the response of a budding yeast strain, *Saccharomyces cerevisiae*, to extracellular calcium pulses to study the process of yeast calcium homeostasis. Previous work in the lab has shown that after a single extracellular pulse of calcium, cytosolic calcium rises and then returns to baseline after less than a minute (Kepler et al. 2014. Fungal Genom Biol 2014, 4: 114). This calcium is being sequestered away in the yeast vacuole and endoplasmic reticulum and is stimulating long term changes including gene expression. The plasma membrane calcium channel that is transporting the calcium into the cytosol in our assay is unknown. We were interested in trying to determine what channel it might be. Previously, researchers determined that one of the yeast calcium channels on the plasma membrane is sensitive to caffeine (Courchesne, Ozturk. 2003. Mol. Micro. 1:223) and so we set out to determine if the channel we are studying is also sensitive to this chemical. We showed that caffeine seems to inhibit the calcium channel. Further work will characterize the channel, its features, and function.

### **\*GROWING ALGAE ON DIVERSE WASTEWATERS: AZCATI SITE VIEW AND ALGAE GROWTH PHASES IN PANEL PHOTOBIOREACTOR**

Emil Puruhito, Martha Kent, Joshua Wray, Everett Eustance, Shahrzad Badvipour and Milton Sommerfeld (Arizona State University, Mesa, AZ)

Algae are cultivated in multiple types of wastewaters from diverse sources in pond and panel photobioreactors at the Arizona Center for Algae Technology and Innovation (AzCATI). Cultivation stages are readily demonstrated in panel photobioreactors since growth is fast and biomass composition changes rapidly. Increases in algal cell density and biomass accumulation is readily apparent as the contents of the panel photobioreactor changes from light to dark green, and

by the change from dark green to greenish brown. This color or pigment change indicates a shift from growth or increasing cell density to storage product accumulation. The color changes illustrate that different biomass compositions can be obtained over a short time period. The light or bright green algal culture is high in protein, the dark green culture is high in carbohydrates (starch), and the greenish brown culture is high in lipids (oils). In algae cultivation it is possible to obtain “fit for purpose” biomass for different products such as food/feed or fuel.

### **\*ELUCIDATION OF THE “REPAIR RESPONSE” INDUCED BY LOCALIZED TISSUE DAMAGE IN *DROSOPHILA MELANOGASTER***

Jesús Contreras Rodríguez, Ty Leek, Sabahat Hussain, Teresa Lupone, Tyler Marsh, Ashley Almajan, Jennifer Broatch, and Jennifer Hackney (Arizona State University, Glendale, AZ)

The effects of damage during development in model organisms can be used to model the effect of disease and injury throughout development in humans. Humans and the common fruit fly, *Drosophila melanogaster*, have a 75% genetic similarity indicating evolutionarily conserved pathways many of which are implicated in homologous disease states. Studies on *D. melanogaster* have shown that localized tissue damage accrued by developing larvae before the mid-third instar transition significantly delays the onset of pupariation and adult eclosion, whereas damage after the mid-third instar transition accelerates developmental progression. It is expected that damage during development will involve a variety of molecular pathways that promote tissue and organ repair constituting a systemic “repair response”. Using microarray studies and validation via real-time PCR of whole-body RNA, we identified a diverse set of genes that are differentially expressed as a response to localized tissue damage that may be critical to repair the insults accrued by the damage. Further studies will aim to elucidate the specific role of these genes during the injury response.

### **\*REGULATION OF SEROTONIN SYNTHESIS AND REUPTAKE BY VITAMIN D: POTENTIAL RELEVANCE FOR AUTISM SPECTRUM DISORDERS AND DEPRESSION**

Marya S. Sabir<sup>1</sup>, Christopher M. Dussik<sup>1</sup>, Ichiro Kaneko<sup>2</sup>, G. Kerr Whitfield<sup>2</sup>, Mark R. Haussler<sup>2</sup>, and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, Arizona; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

The two hormones, 1,25-dihydroxyvitamin D (1,25D) and serotonin, are proposed to play a significant role in abnormal social behavior associated with psychological conditions including autism spectrum disorders (ASDs) and depression; however the mechanism underlying these associations has yet to be established. Hormonal deficiencies in 1,25D and serotonin have been linked to the increased incidence of ASDs as vitamin D is hypothesized to oppositely regulate two isoforms of tryptophan hydroxylase (TPH), the initial and rate-limiting enzyme in the biosynthetic

pathway of serotonin. Vitamin D is proposed to activate the gene responsible for the production of tryptophan hydroxylase 2 (TPH2) in the central nervous system and suppress tryptophan hydroxylase 1 (TPH1) expression in peripheral tissues. Major characteristics associated with autism include low concentrations of serotonin in the CNS and elevated levels of serotonin in the periphery; thus, examining the modulation of TPH1 and TPH2 is fundamental in linking 1,25D levels to increased incidence of psychiatric disorders. In this study, quantitative reverse-transcription PCR (qRT-PCR) was utilized to examine TPH1 and TPH2 in cultured human embryonic kidney (HEK-293), human colorectal carcinoma (HCT-116), human glioblastoma (U-87) cells, and rat serotonergic neurons (RN46A-B14; B-14). TPH1 induction in U-87 and B-14 cells was approximately 1.8-fold and 24.6-fold at 10 nM 1,25D, respectively; however, TPH1 was not upregulated in HEK-293 nor HCT-116 cells. Human TPH2 mRNA in HCT-116 and U-87 was induced dose-dependently resulting in a 4.3-fold and 2.4-fold increase at 10 nM 1,25D, respectively. TPH2 was also induced by 2.4-fold at the same 1,25D concentration in HEK-293 cells. Strikingly, TPH2 mRNA in rat medullary raphe neuronal (B-14) cells was observed to be 26-86-fold (average of 47.8-fold) upregulated specifically at 10 nM 1,25D; however, 1 nM and 100 nM 1,25D elicited significantly smaller inductions (8-fold and 1.2-fold, respectively). In all experiments, CYP24A1 was utilized as a positive control yielding a classical dose response. The biphasic dose response of TPH2 expression in B-14 cells may signify the existence of an optimal level of circulating vitamin D for behavioral health corresponding empirically to 10 nM 1,25D in the case of B-14 treatment thus, this effective level of 1,25D may elicit normal neurotransmission and development. Finally, the mRNA expression of the serotonin transporter (SERT) which regulates the entire serotonergic system and its receptors via modulation of extracellular fluid serotonin concentrations, and also exists as a target for the SSRI-class of antidepressants, was examined in the context of B-14 cells. Significantly, SERT expression was repressed in 1nM and 100 nM 1,25D- treated cells. In summary, this study illuminates a coordinated interaction between two hormones, vitamin D and serotonin, thereby identifying a potential link between 1,25D levels and incidence of psychiatric disorders including autism and depression.

#### **\*CROSSTALK BETWEEN ANTI-AGING KLOTHO AND ANTI-OXIDATIVE FOXO IN HUMAN KIDNEY AND COLON**

Ruby Sandoval<sup>1</sup>, Zainab Khan<sup>1</sup>, G. Kerr Whitfield<sup>2</sup>, Mark R. Haussler<sup>2</sup> and Peter W. Jurutka<sup>1,2</sup>  
(<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Klotho, a trans-membrane protein (m-klotho) also found in a secreted form (s-klotho), has been linked to anti-aging actions in the kidney. Through possible alternative splicing or cleavage of the m-klotho protein, secreted klotho can be formed and may act as a putative circulating hormone with diverse action in target cells, including inhibition of insulin/insulin-like growth factor-1 (IGF-1) signaling. Klotho protein may also increase resistance to oxidative stress at the cellular level in mammals. One potential mechanism for this effect is through s-klotho-mediated activation of the Forkhead box protein O (FOXO). The active hormonal form of vitamin D (1,25D), acting via the

vitamin D receptor (VDR), can also induce the expression of s-klotho in the kidney. Thus, we utilized luciferase assays to probe the effect of klotho expression on VDR and FOXO pathways. We observed that s-klotho increased the transactivation of 1,25D-VDR with various vitamin D responsive elements (VDREs) in transfected human colon cancer cells (HCT116). This effect was more pronounced with CYP24 and PER6, but not with XDR3 or ROC VDREs, suggesting partial DNA responsive element specificity. A synergistic increase in VDR activity was evident with all VDREs when the assays contained s-klotho and were dosed with 1,25D and resveratrol, a hypothesized vitamin D modulator. In contrast, s-klotho did not mediate an increase in FOXO activity in HCT116 and HEK293 (kidney cells) under the specific conditions tested in our assays. M-klotho, on the other hand, was in fact a potent inhibitor of FOXO activity. These results suggest that there is significant crosstalk between the two klotho isoforms, 1,25D, and the FOXO signal transduction pathway that may explain some of the anti-aging and anti-cancer effects of klotho, vitamin D, and FOXO.

### **\*THE MIT GENE "SWITCH": A FRAMEWORK IN UNDERSTANDING INJURY RESPONSE**

Audrie Santa Cruz, Matthew Burch, Yesica Enciso, and Jennifer Hackney (Arizona State University, Glendale, AZ)

Infections, disease, inflammation, and other injuries to specific tissues can cause delays in development and the onset of puberty. In the fruit fly, *Drosophila melanogaster*, damage to imaginal discs, which give rise to adult appendages, triggers developmental delays (e.g. prolonged larva/pupal stages), the extent of which is influenced not only by the amount of tissue damage but also the age at which damage occurs. The aim of our research is to elucidate the mechanism behind injury-induced developmental delays in specific tissues and at different developmental stages. Tissue damage was induced via temperature-sensitive expression of cell-death genes in various tissues in *D. melanogaster* and the rate of adult eclosion was monitored. We observed two types of developmental timing defects (acceleration or delay) with respect to various tissue types and stages of development. Additionally, we observed a marked modification in the response to injury beginning at a developmental time point called the Mid-Third Instar Transition (MIT), suggesting a relationship between the injury response and genes that are differentially expressed during MIT. Upon selective removal of specific chromosomal regions, three separate MIT genes have been identified that play a role in the injury response. Our results indicated that multiple MIT genes are required to mediate the highly complex injury response. Understanding the relationship in *D. melanogaster* injury response could provide valuable insight into the mechanisms behind inflammation and disease-induced defects in the onset of puberty in humans.

## **\*BIOLOGICAL EVALUATION OF NITROGEN SUBSTITUTION IN THE FDA-APPROVED DRUG BEXAROTENE AND NOVEL RXR SELECTIVE AGONISTS**

Pritika Shahani<sup>1</sup>, Carl Wagner<sup>1</sup>, Pamela A. Marshall<sup>1</sup>, Ichiro Kaneko<sup>1,2</sup>, Michael Heck<sup>1</sup> and Peter W. Jurutka<sup>1,2</sup> (<sup>1</sup>Arizona State University, Glendale, AZ; <sup>2</sup>University of Arizona College of Medicine, Phoenix, AZ)

Retinoids are a group of compounds that are derived from vitamin A and have a vital role in epithelial cell growth. Retinoids are often used in the clinical treatment of cancers as they prevent the proliferation of tumors. Bexarotene (Bex) is a retinoid analog currently used in the treatment of cutaneous T-cell lymphoma (CTCL) and breast cancer. Studies have shown that Bex binds to retinoid X receptors (RXRs) and stimulates RXR homodimerization and expression of RXR target genes. In the present study, we synthesized novel RXR analogs that were modeled after the parent structure of Bexarotene. These compounds included various structural modifications in an attempt to create synthetic ligands that have high affinity for RXR and thus promote the activation of RXR-RXR-controlled genes for anti-cancer action. In addition, RXR forms a heterodimer with LXR, which has been shown to induce expression of ApoE and reduce A $\beta$  plaques in Alzheimer's dementia. Some of the structural modifications included the addition of nitrogen to the parent structure (Bex). The synthesis and testing of these high affinity, nitrogen-substituted analogs allows for an assessment of their activity at lower concentrations, thus potentially reducing some of the side effects associated with high-dose Bex therapy. The preliminary testing of these novel analogs involved the use of two screening assays to assess their potency. The first was the mammalian two-hybrid assay (M2H), which determines if the analogs can bind RXR and induce subsequent RXR homodimerization, a prerequisite step in the activation of RXR genes. This assay is followed by a second test that employs an RXR responsive element DNA sequence (RXRE), which determines analog activity in the more natural setting of the RXRE DNA platform. Results from these assays revealed that our new generation of analogs consists of a spectrum of activities, with some compounds binding to RXR with higher affinity while others bind with lower affinity. After analyzing the trend in activity with their respective structures, we found that an increase in the amount and position of nitrogen added to the structure also increases the activity. To further test this hypothesis, we performed M2H assays and calculated the EC<sub>50</sub> of each analog, which is a more quantitative measure of overall activity. All analogs possess measurable EC<sub>50</sub> values that are consistent with their potency in RXRE and M2H analyses. These results suggest that further modification of Bex may produce additional rexinoids with potentially enhanced biological profiles to combat cancer and Alzheimer's disease without dramatic side effects.

## **\*SAFEGUARDING MARINE RESOURCES FOR FOOD SECURITY: A COMPREHENSIVE ASSESSMENT OF EXTINCTION RISK FOR MARINE FISHES OF THE EASTERN CENTRAL ATLANTIC**

Sarah Smith, Amanda Bubnash, Brenna Corley, Nathan Muniz, Bria Pogue, Audrie Santa Cruz, Susan Soto, Kyle Strongin, Samantha Weller, and Beth Polidoro (Arizona State University, Glendale, AZ)

The marine resources of West Africa form the foundation for food security and coastal livelihoods for the 300 million people that inhabit this impoverished region. The status of these marine resources, especially coastal and pelagic fishes, is of great concern due to overexploitation, pollution, coastal development and habitat modification, and the increase in destructive fishing practices such as the use of explosives and chemicals in inshore areas, and the use of small-sized trawl, beach and purse seine nets in offshore regions. In collaboration with the International Union for the Conservation of Nature (IUCN), ASU researchers and students have been working to quantify the extinction risk for the 1,407 marine bony fish species (Class Actinopterygii) present in the Eastern Central Atlantic, defined as extending from Mauritania to Angola along the western coast of Africa. Over the past 3 years, data on each species taxonomy, distribution, population trends, habitat, ecology and impact of major threats were researched and entered into the IUCN Species Information Service (SIS) database. These data were verified and reviewed in 3 expert workshops held in Dakar (July 2012), Accra (May 2013) and Libreville (July 2014). These data were then used to apply the Categories and Criteria of the IUCN Red List of Threatened Species ([www.iucnredlist.org](http://www.iucnredlist.org)) to assign each species a level of extinction risk, expressed as a Red List Category. After extensive editing, textual coding, and external peer-review with experts around the world, all data and corresponding species extinction risk assessments are set to be published on the IUCN Red List of Threatened Species in November 2015. Of the 1407 marine fishes present, 69 species (5%) are at elevated risk of extinction and are listed in threatened or Near Threatened categories due to the impacts of overfishing and/or habitat loss. Approximately 1,170 species (83%) are listed as Least Concern and 168 species (12%) are listed as Data Deficient. Spatial analyses of results show areas of high threatened species richness and patterns of threat along the coast of West Africa. These results will form the foundation for improved management practices and policy to more effectively safeguard marine resources of this region.

## **\*CHARACTERIZATION OF LATE EMBRYOGENESIS ABUNDANT PROTEINS FROM *DEINOCOCCI***

Erica Soboslay, Artemio Chaves, Danielle Brokaw, Robert Ziemba, and James Tuohy (Glendale Community College, Glendale, AZ)

*Deinococci* are known for their ability to resist extreme environmental challenges such as radiation, oxidation, and desiccation. Resistance to desiccation, in *Deinococcus radiodurans* is attributed to the expression of countless proteins, one such being the Late Embryogenesis

Abundant Protein (LEA). LEA is commonly found in plants and phylogenetic studies suggest LeA genes were inherited by *Deinococcus* via horizontal gene transfer. Little else is known about LEA proteins in *Deinococci*, but their role in desiccation resistance may be related to the structure of the protein or modification of the structure during desiccation. Several new species of *Deinococcus* have been discovered in the Sonoran and Gobi deserts. The functional role of LEA proteins in these species is not clear; however, the extreme nature of their native habitat suggests these species may share similar desiccation resistance strategies to that of *D. radiodurans*. This study is aimed at cloning and characterizing LEA proteins from *D. radiodurans* (DR\_1172) and *D. hopiensis* (Deiho\_01242) as well as other desert *Deinococcus* species. In order to investigate the role of LEA proteins in the desiccation tolerance of *Deinococci*, the LeA gene was isolated, cloned into an expression vector, and transformed into *E. coli*. Sequencing results have verified the successful cloning of lea from both *D. radiodurans* and *D. hopiensis*. Expression studies of the LEA protein are in progress to determine the role of the protein in desiccation resistance in *Deinococci*.

## **USING WASTEWATER FOR MASS CULTURE OF AGAE FOR FUEL, FEED AND FOOD**

Milton Sommerfeld (Arizona State University, Mesa, AZ), Kim Ogden, Randy Ryan (University of Arizona, Tucson, AZ), Terry Baxter and Karen Van Winkle-Swift (Northern Arizona University, Flagstaff, AZ)

With the assistance of the Arizona Board of Regents through its Research Innovation Fund (RIF), faculty and students from the three State universities with diverse backgrounds and experiences were brought together to collaborate with wastewater treatment facilities, power generating stations, fish farmers and dairies to use wastewater to cultivate algae for food, feed and fuel and to produce cleaner water. The efforts included collection of wastewater, selection of algae strains, cultivation of algae on wastewater, harvesting, extraction and processing of the algal biomass, and evaluating the biomass for possible products. An important aspect of the project included the training of the next generation of scientists and engineers in sustainable practices that utilize a renewable resource such as algae for bioproducts and for water quality improvement.

## **\*BLACK WIDOWS AND THE URBAN HEAT ISLAND: THE EFFECTS OF TEMPERATURE AND BODY CONDITION ON BLACK WIDOW SPIDER WEB-BUILDING BEHAVIOR**

Dale R. Stevens II, Annika Vannan and J. Chadwick Johnson (Arizona State University, Glendale, AZ)

Urbanization has been deemed a leading cause in global species extinction and the primary mechanism driving global species homogenization. This specific form of anthropogenic change not only eliminates the native landscape, but also results in an increase in nightly temperatures as

a result of the Urban Heat Island effect (UHI). While most species are unable to adjust to these sudden changes, some species, termed urban “exploiters” experience rapid population growth in these highly disturbed environments. The western black widow spider, *Latrodectus hesperus*, is an urban pest who thrives under these harsh, urban environmental pressures. In this experiment, we examine the effects of UHI temperatures on the condition-dependent web building behavior of the black widow spider. Thus, we tested the hypothesis that UHI temperatures interact with the black widow’s body condition to influence their web-building behavior. Our results suggest that UHI temperatures have a consistent, negative influence on the web-building behavior of high-condition black widow spiders. However, the effects of UHI temperatures on poor-condition spiders was inconsistent across our repeated measures. These results suggest that black widow spiders with poor body conditions are better able to deal with UHI temperatures than black widows with high body conditions.

### **\*PARENT QUESTIONING DURING SCIENCE PROBLEM SOLVING OF ELEMENTARY SCHOOL-AGED CHILDREN**

Alyssa Trudel, Teena Manuel, Susannah Sandrin (Arizona State University, Glendale, AZ), and Katherine Short-Meyerson (University of Wisconsin Oshkosh, Oshkosh, WI)

Parents are the primary influence on most children in influencing how they learn to solve problems and to persist with challenging problems in their early years. One way in which parents can instill curiosity and encourage independent problem solving is through the types of questions that parents ask as they help their children. For this study, the questioning behavior of 32 parents with their 4<sup>th</sup> grade children as they solved six developmentally appropriate science problems, was analyzed. The populations of parents and children were balanced in terms of both child and parent gender (so an approximately equal number of mother-daughter, mother-son, father-daughter, father-son dyads were included). Additionally, the sample included almost equal numbers of Hispanic and non-Hispanic families. This study is part of a larger study that included 154 families from the Phoenix metropolitan area. Each family completed a science assessment, and were video and audio taped as they completed the six hands-on science activities. Then the parent filled out an extensive questionnaire (with questions about their attitudes toward science, and family demographic information) while their child was interviewed about their interests and ideas about science. This study will focus on the content analysis of the transcripts from the sub-sample of 32 families, but it will also present limited findings from the larger study for context. In particular, the findings about the frequency of parent questioning overall and by parent and child gender will be assessed. The common questioning coding categories include 1) child’s understanding of the topic, 2) the problem-solving procedure, 3) child’s past experiences and knowledge and 4) child’s likes and dislikes.

## **\*HANDLING THE HEAT: PLASTICITY OF AN ARTHROPOD PEST IN RESPONSE TO THE URBAN HEAT ISLAND**

Annika Vannan, Dale R. Stevens II and J. Chadwick Johnson (Arizona State University, Glendale, AZ)

In recent years, ecologists have begun to study the effects of urbanization on species diversity. While urban areas generally suffer decreased biodiversity, some species, termed “urban exploiters”, not only live in the city but depend on urban resources to thrive. It is hypothesized that urban exploiters may succeed in part due to phenotypic plasticity, in which organisms rapidly adjust their physiology or behavior to adapt to novel environmental contexts. In the city, it may be adaptive to display thermal plasticity, as the urban heat island effect caused by concrete and asphalt infrastructure prevents cooling at night. In this study, we observe the decorated cricket *Gryllodes sigillatus*, an invasive urban exploiter found in metropolitan Phoenix, in two separate experiments. We hypothesize that heat tolerance and activity are both plastic traits. In Experiment 1, we predicted that knock-down time, a measure of heat tolerance, would be negatively affected by acclimation to a laboratory environment. Our results suggest that heat tolerance is affected by recent thermal regimes and that laboratory acclimation decreases knock-down time. In Experiment 2, we predicted that activity would increase with temperature until a point of extreme heat, at which point activity would decline. Statistical analysis for the second experiment reveals that activity decreases at 33°C, a natural urban extreme. This suggests either that 33°C is a thermal limit to physiology or that *G. sigillatus* is able to alter its behavior to exploit local thermal heterogeneity.

## **\*ANALYSIS OF BEXAROTENE ANALOG-DRIVEN RXR HOMODIMERIZATION BY YEAST TWO HYBRID**

Julia Varkey, Cindy Hum, David Seto, Peter W. Jurutka, Carl E. Wagner and Pamela A. Marshall (Arizona State University, Glendale, AZ)

An FDA approved drug, bexarotene (Targretin ®), is a retinoid used to treat cutaneous t-cell lymphoma (CTCL) and off label treatments of other cancers. Bexarotene is known to regulate RXR and modify cell differentiation and proliferation. Based on previous studies, this occurrence is caused by the specific affinity that bexarotene has for the retinoid X receptors (RXR). Despite the advantages of bexarotene, hypothyroidism and high toxicity levels of the drug limits its potential in clinical use. In this study, we use yeast two-hybrid analysis to study RXR homodimerization driven by novel bexarotene analogs in *Saccharomyces cerevisiae* L40. Our results suggest there to be several compounds with higher protein activity than bexarotene. The higher affinity for RXR may help scientists identify a more efficient compound that reduces the side effects of bexarotene and can be considered for an alternative cancer treatment

## **\*PYRIMIDINE BEXAROTENE (16) AS A NOVEL THERAPEUTIC TO TREAT ALZHEIMER'S DISEASE**

Carl E. Wagner, Peter W. Jurutka, Pamela A. Marshall, Ichiro Kaneko, Mairi MacNeill, Joanna Yang, Jaskaran S. Bhogal, Johnathon C. Swierski, Crista R. Tabacaru (Arizona State University, Glendale, AZ); Joseph W. Ziller (University of California, Irvine, Irvine, CA); Ning Ma, Geoffrey M. Gray and Arjan van der Vaart (University of South Florida, Tampa Bay, FL)

Analogues of 4-[1-(3,5,5,8,8-pentamethyl-5-6-7-8-tetrahydro-2-naphthyl)ethynyl]benzoic acid, otherwise known as bexarotene, substituting pyrimidine for an aromatic ring or possessing both a fluorine atom and an unsaturation in the aliphatic ring system, as well as four novel analogues of (*E*)-3-(3-(1,2,3,4-tetrahydro-1,1,4,4,6-pentamethylnaphthalen-7-yl)-4-hydroxyphenyl)acrylic acid (CD3254) are described, and evaluated for their potential to treat Alzheimer's via retinoid-X-receptor controlled pathways. Bexarotene has FDA approval as a treatment for cutaneous T-cell lymphoma (CTCL); though, treatment with bexarotene can elicit side-effects by disrupting other receptor pathways in which RXR participates to form heterodimers, such as the liver-X-receptor (LXR) or the peroxisome proliferator-activated receptor (PPAR). Interestingly, in the brain, the LXR:RXR and PPAR:RXR pathways contribute to the synthesis of a critical protein, the apolipoprotein (ApoE), that is believed to assist in the clearance of toxic amyloid beta from the brain. The novel analogues in the current study were modeled and then evaluated in several experimental systems. Bexarotene is currently in clinical trials in human for Alzheimer's based on observed cognitive improvement and amyloid beta reduction in an Alzheimer's mouse model. In an array of more than 20 compounds, pyrimidine bexarotene (**16**) outperformed bexarotene in several experimental systems. Indeed, further improvements in biological potency and selectivity of bexarotene can be achieved through rational drug design.

## **\*THE OPPORTUNITY FOR POST-COPULATORY SEXUAL SELECTION IN THE ECTOPARASITIC PEA CRAB, *DISSODACTYLUS PRIMITIVUS***

Robert Brent Prather and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ)

Pea crabs, *Dissodactylus primitivus*, inhabit multiple echinoid (heart urchin) hosts. Male and female crabs move among hosts in search for mates, and both sexes mate multiple times, creating opportunities for post-copulatory sexual selection. For such selection to occur, only a fraction of the males who succeed in mating can also succeed in siring progeny. Jossart et al. 2014, used four microsatellite loci to document parentage and mating frequencies of both sexes in *D. primitivus*. From these data we identified the mean and variance in female offspring numbers, as well as the proportions of the male population who (1) mated and sired offspring, (2) mated but failed to sire offspring, and (3) failed to mate altogether. We partitioned the total variance in male fitness into pre- and post-copulatory components and identified the fraction of total sexual selection occurring in each context. Our results show that 37% of the total opportunity for selection on males occurs in the context of post-copulatory sexual selection. Although our results do not distinguish between

sperm competition and cryptic female choice, they provide the first estimate of the intensity of post-copulatory sexual selection in crustaceans using this approach.

### **\* FLESH FLY PUPAL WEIGHT PREDICTS VIABILITY**

Jeffrey Baranowski, Shay S. Allred, Kayla N. Ochoa and Stephen Shuster (Northern Arizona University, Flagstaff, AZ)

The flesh fly, *Sarcophaga bullata* is well known as an indicator organism in forensic entomology and because it is easily reared under laboratory conditions; it is often used to illustrate holometabolous insect life cycles. Flesh fly pupae are also widely used as hosts for laboratory cultures of parasitoid insects such as jewel wasps, *Nasonia vitripennis*. The success of wasp cultures depends on fly pupa viability, but fly pupa condition is difficult to assess in commercially available supplies. Unviable fly pupae appear to die and dry out during development and become conspicuously lighter than viable pupae by the usual time of eclosion (14 days). To determine whether weight predicts fly pupal viability we collected daily weights to the nearest ten thousandth mg for lab-reared pupae (N=110). We calculated the daily weight change for viable and unviable pupae and compared them using a 2 way ANOVA. Although pupae in both groups lose weight during development, we found that unviable pupae lost weight faster than viable pupae, with average unviable pupal weight becoming distinct from viable pupal weight as early as four days after pupation.

## ACADEMY BUSINESS AND ANNUAL REPORTS

### OFFICERS 2014-2015

#### ELECTED

Pamela Marshall.....	President
Theodore Manno.....	President-Elect
Angela Schwindeman.....	Membership Secretary
Pedro Chavez.....	Permanent Secretary
Karen Conzelman.....	Treasurer
Robert Bowker.....	Recording Secretary
Theodore Manno.....	Director, Southern Arizona
Aregai Teclé.....	Director, Northern Arizona
Jennifer Hackney.....	Director, Central Arizona
Boris Poff.....	Director, Nevada
Brian Wainscott.....	Director at Large

#### APPOINTED

Robert McCord.....	Editor, Journal
Florence Slater.....	Editor, Proceedings
Karen Conzelman.....	Science Olympiad Liaison
Theodore Manno.....	Editor, Newsletter
Karen Conzelman.....	Webmaster

#### SECTION CHAIRS

Robert Bowker.....	Biology/Biotechnology
Anthony Brazel.....	Geography
Robert McCord.....	Geology
Gerald Gottfried.....	Hydrology
Shafiu Jibrin.....	Mathematics/Statistics
Pamela Marshall.....	Posters

## PRESIDENT'S REPORT

It has been another excellent year for the Arizona Nevada Academy of Science. We have published one volume of the journal and co-sponsored the Arizona Science Olympiad. Your Board has been hard at work this year modifying the bylaws so that we can bring you the proposal for voting at this annual meeting. As I step down as President, I am pleased that during my tenure as a member of the Academy we have produced the Proceedings of the ANAS, Hydrology Proceedings, Journal of the ANAS and archived online Journals. I encourage you to visit our website: [www.aznvas.org](http://www.aznvas.org) and read our publications.

This meeting at ASU-West is an excellent opportunity for the Academy to showcase science in the southwest and there are many excellent posters and presentations to accomplish this. I am especially excited because the students represent many different universities this year.

I encourage each Academy member to embrace our mission and consider how you might get more actively involved. Some suggestions are to recruit members, submit a manuscript to the journal, suggest the journal to a colleague, apply for one of our grants, volunteer to play an active role in the Academy (just email me, and we'll find a place for you to help the Academy), and/or run for a board position in the Academy. We are always looking for people who want to assist in the Academy.

I also encourage those of you who are just now becoming familiar with all the good work of ANAS to become a member (<https://www.aznvas.org/2joinanas.html>). In addition to becoming part of this historic institution (the Academy was founded in 1956!), membership affords you several benefits including a subscription the journal as well as discounted meeting registration and publication page charges.

**Pamela A. Marshall**  
President

## **MEMBERSHIP REPORT**

We currently have a total of eighty two ANAS members that includes thirty seven dues-paying members and forty five emeritus or life members.

**Angela Schwendiman**  
Membership Secretary

## **NOMINATING REPORT**

The following members have been nominated to serve as officers on Board of Governors:

President-Elect: Brian Wainscott (2015-2017)

Recording Secretary: Robert Bowker (2015-2016)

Membership Secretary: Angela Schwendiman (2015-2016)

Treasurer: Karen Conzelman (2015-2016)

Director, Southern Arizona: Ty Ferre (2015-2017)

Director at Large: Paula Rivadeneira (2015-2017)

The Directors from the other geographical areas have another year remaining on their current two year term.

## **NECROLOGY REPORT**

### **PETER F. FFOLLIOTT**

On December 14, 2014 Peter F. Ffolliott passed away in Tucson, Arizona. He will be remembered for his professional commitment and contributions to national and international sustainable natural resource management. He was an active, committed member of the Hydrology section of the ANAS. He presented at and brought many students to the annual meeting each year. In addition to serving as Hydrology session chairperson, he was a dedicated president of the Academy from 2005-2006. In 2012 he was honored with the Outstanding Service Award by ANAS. Peter was instrumental in helping the academy to capture the complete archives of “Hydrology and Water Resources in Arizona and the Southwest” in digital format. These volumes are indexed and available as open source documents as part of the University of Arizona's Library electronic repository.

The Society of American Foresters awarded him the Barrington-Moore Memorial Award in 2012 in recognition of his career of outstanding research, technology transfer and education in the management and sustainable utilization of renewable natural resources, including forestry, hydrology, watershed management, sustainable agriculture, agro-forestry practices, economic and policy issues and fire management. Dr. Ffolliott was a Fellow of the Society of American Foresters, the Indian Association of Hydrologists and the Arizona-Nevada Academy of Science.

Dr. Ffolliott earned his bachelor and master's degrees from the University of Minnesota and then served for two years in the army stationed in Korea. In 1960 he began his career as a research scientist with the US Forest Service in Flagstaff, Arizona. In 1970 he received a Ph.D. in watershed management from the University of Arizona and was asked to join the faculty of the Watershed Management Department where he remained until his retirement in 2012. He taught undergraduate and graduate classes at the University and guided numerous students toward successful careers including many who are now leaders in forestry and natural resource management within the United States and worldwide. His research and teaching spanned a broad range of subjects including fisheries and wildlife, dry land forestry, snow hydrology and forest and watershed management. He conducted over 50 international training courses that had immeasurable impact on managers and scientists in developing countries in Africa, Asia, Latin America and the Middle East. His research and insights, which were reported in more than 615 authored and co-authored books, journal articles, Forest Service research papers and conference proceedings, have aided public and private land managers to conduct their duties based on the latest science. Dr. Ffolliott is a co-author of “The Hydrology and Management of Watersheds” one of the most widely used watershed management textbooks in the United States and worldwide and “Fire's Effects on Ecosystems” which is a standard text and reference book.

He will be sorely missed by his colleagues, students and friends.

**Gerald Gottfried and Florence Slater**

Necrology Report

**MINUTES OF THE ANNUAL BUSINESS MEETING  
AND AWARDS LUNCHEON  
APRIL 14, 2014**

The annual business meeting of the AZ NV Academy of Science was called to order at 12:25 pm in the Forestry Building lobby at Northern Arizona University, by President Pamela Marshall. She acknowledged and thanked the meeting organizers, Aregai Tecele and Shafiu Jibrin, for their help in making the local arrangements, and the sponsors (listed in the Proceedings) for their monetary contributions to the meeting. Other board members in attendance were: Robert Bowker, Pedro Chavez, Karen Conzelman, Theo Manno, Robert McCord, Boris Poff, Florence Slater, and Brian Wainscott.

Marshall called attention to the reports of the officers in the Proceedings and called for a vote to approve these reports. The motion was approved. The announcement of the Tony Brazel as the individual selected by the Outstanding Service Award Committee as the recipient of this year's award was made by Karen Conzelman. Conzelman described the critical role Tony has played as Editor of *the Journal of the Arizona-Nevada Academy of Science* for the last several years. Tony was instrumental in getting the journal back into a more regular publication cycle. Conzelman pointed out that this is the first time the committee has made the award to same individual, but Brazel's exemplary contribution to sustaining *JANAS's* over 50 year legacy warranted the double recognition. The Editorship of the journal has been passed to former Past-President Robert McCord.

Slater announced that Stephen Schuster, chair of the Scholarship Committee, selected Taylor Schwartz as the Ellis Scholarship winner. Taylor plans to attend University of Nevada at Reno to study civil or biomedical engineering. President Marshall introduced the two students selected by the judges for the Best Student Posters Award. The recipients were Christopher M. Dussik for his research on the "Identification of differentially expressed genes as biomarkers for diagnosis of irritable bowel syndrome" and Jesus Contreras whose work described the "Elucidation of changes in metabolism and gene expression in response to localized tissue damage in *D. melanogaster*." Both Christopher and Jesus are students at Arizona State University at the West Campus. Ian Dai and Jason Klotz, from Northern Arizona University were recognized as the Best Student Papers for their presentations on "Hydrological modeling efforts of Chevlon Canyon, Arizona" and the "Effects of climate change on land use and land cover on the San Pedro River, Arizona" respectively.

The slate of nominees for elected officers for 2014-2015 was announced. President Marshall called for nominations from the floor particularly for the Southern Arizona Director position for which there were no nominees. Without any nominees from the membership, Manno indicated that he was willing to serve as interim Director until someone else could be found. The proposed officers were approved by acclamation. They are as follows:

President-Elect: Theodore Manno  
Recording Secretary: Robert Bowker  
Membership Secretary: Angela Schwendiman  
Treasurer: Karen Conzelman  
Director, Nevada: Boris Poff  
Director, Northern Arizona: Aregai Teclé  
Director, Central Arizona: Jennifer Hackney  
Director, Southern Arizona: Theodore Manno

Brian Wainscott continues in the second year of his term as Director at Large.

In the absence of any other business, the meeting was adjourned at 12:50 pm by President Marshall and the group was directed to another room for the presentation by the keynote speaker Dr. Paul Keim, on “Plague and its Expansion around the Globe.”

**Karen Conzelman**  
(for the Recording Secretary, Rob Bowker)

## **OUTSTANDING SERVICE AWARD**

### **PAMELA MARSHALL**

This year's recipient of the Outstanding Service Award is Dr. Pamela Marshall. She is Associate Professor at Arizona State University, West campus. Pam was initially drawn to the West campus of ASU in 2003 because of its commitment to students. It is clear from Pamela's professional accomplishments that that institutional mission aligns very closely with her own. In addition to her teaching responsibilities, Pam actively engages undergraduate students in her laboratory research and was recognized in 2008 with the ASU Faculty Achievement Award for Excellence in Student Mentoring and in 2013 was named the Faculty Women's Association Faculty Mentor of Year. Since coming to ASU, West campus, she has mentored over 80 undergraduate students, many of whom have gone on to medical school. Each year at the Annual Meeting of the ANAS, she is instrumental in bringing many students to present paper or posters on their research.

Pam attended the University of Texas Southwestern Medical School in Dallas, TX, studying yeast peroxisomes in the laboratory of Joel M. Goodman, earning her Ph.D. in Cell Regulation at UT Southwestern. In addition to scientific research she has always had an interest in service to the community. She was recognized while still at UT for her outstanding service to the graduate student community. In 2012, she was named Volunteer of the Year at Copperwood Elementary School (Peoria USD) for her work bringing science activities to their classrooms. In addition to mentoring her own students, Pam has been actively involved as an instructor and mentor in ASU's TRiO Programs (federal programs designed to identify and provide services to individuals from disadvantaged backgrounds).

Pam has been a member of the Academy's Governing Board since 2008. As Membership Secretary Pam helped to better organize the Academy's database of members and institutional subscribers. For the past two years Pam has served as President of the ANAS. Under her leadership the Academy now has a presence on Facebook. She also has facilitated the transition of our geographically scattered board members meeting by conference call rather than in person. Pam continues to serve as chairperson of the Poster session for the ANAS Annual Meetings. This year we are anticipating almost 40 poster presentations! For all she has done for the organization and her contributions to the research experiences of many undergraduate students, the Academy is proud to honor Pamela Marshall as this year's Outstanding Service Award recipient.

## **OUTSTANDING TEACHER AWARD**

### **CHRISTOPHER BRANDT**

Chris Brandt is this year's winner for Outstanding Science Teacher. He is a chemistry instructor and science safety specialist at Saguaro High School in Scottsdale. In addition he is science department chairperson and coordinator at the Scottsdale Math and Science Academy

He has been in the classroom at Saguaro High School for over 20 years.

In his roles at Saguaro High School, he has been successfully engaged with the students in many ways including as coach of a variety of athletic teams, the Science Olympiad, Arizona FIRST and VEX Robotics, as well as the Chemistry Challenge Team. He is the sponsor of three teams right now (Science Club, Robotics Club, and Science Olympiad). He has been recognized by the Science Olympiad for exceptional service, by the City of Scottsdale for outstanding service, and has been chosen as Arizona FIRST Teacher of the year, along with many other honors and awards.

Congratulations Chris!

## **OUTSTANDING LEADERSHIP IN SCIENCE EDUCATION AWARD**

### **PATRICIA TATE**

Patricia Tate has been a guiding force in transforming the Osborn Elementary School District (OESD) into a nationally recognized center of educational excellence despite the fiscal and social challenges faced by this inner city school.

Patty began teaching in Osborn in 1978. She stepped away in 1982 to stay at home with her young sons, returning in 1988 as a parent volunteer with her kindergartener Luke. With younger son Ben in tow, Patty brought her passion for the natural world and science to classrooms as "Ms. Wiz." She cultivated the children's curiosity with hands-on activities and encouraged their awareness and observations of nature in their urban environment. As student and teacher interest in science grew, Patty worked with several grant-funded initiatives to develop a cohesive inquiry-based K-8 science curriculum and provide materials and teacher training to support its implementation. In 1993 a National Science Foundation grant helped expand inquiry-based classroom instructional support across nine districts, cultivating 42 Collaborative Peer Teachers in mathematics and science. Osborn continues to use this research-based model of teacher support today, with two full-release Master Teachers at each school co-planning, co-teaching and coaching their colleagues towards instructional effectiveness in all content areas.

Osborn teachers own their curriculum. Early implementation of the Common Core Standards (now AZ College and Career Ready Standards) and a highly-collaborative work environment has fostered their creativity and integration of science, social studies and the arts. Osborn students are challenged to be creative and critical thinkers, consumers of information and independent problem solvers. And this strategy has worked -- all of the OESD's schools are ranked as high achievers on AIMS tests. This accomplishment is amplified when one considers that children from minority families make up over 90% of Osborn's students, 30% are English Language Learners and 90% are on Free or Reduced Lunch -- populations that are typically underachieving.

Recently, the National Institute for Excellence in Education recognized Osborn as a District of Distinction, one of only six districts nationwide to receive the \$10,000 award. NIET President Gary Stark noted that Osborn's commitment to advancing educator effectiveness and student achievement "has been embedded into the fiber of the district." The high teacher and administrative turnover typical of other districts with Osborn's profile is not seen here; instead OSD's culture attracts and retains outstanding people.

The Osborn Elementary School District's 16-year iTeach partnership teacher preparation with ASU is recognized as an exemplary model throughout the state and nation. Currently, forty percent of Osborn's teachers are graduates of their iTeach Master's program. In addition to this and other strong partnerships, Osborn's success stems from an unwavering focus on individual student achievement, a system-wide commitment to collaboration, highly effective teachers, and the trailblazing leadership of Superintendent Patricia Tate. In Osborn, staff truly believe anything and everything is possible!

Congratulations Patty!

## ARIZONA SCIENCE OLYMPIAD LIAISON REPORT

The 2015 state tournament was held on Saturday March 7th at Glendale Community College. Thirty-six teams from 27 high schools competed in the 25 different events that comprise the tournament at state and national level. The breadth of disciplines represented by these events makes the Science Olympiad program a perfect fit for the Academy.



*Students test the weight bearing capacity of their “Bridge.” ROTC cadets along with ANAS and community volunteers supervised and assisted with running the 25 tournament events.*

In addition to several ANAS members helping out as event supervisors and assistants (Pamela Marshall, Florence Slate, Pedro Chavez, Rob Bowker), the Academy also donates funds annually to recognize the top teams in two natural history-related events in memory of Bud Ellis and towards the supply costs of teams participating in two new events (Protein Modeling and Air Trajectory in 2015).

The day culminates with the Awards Ceremony; ribbons and medallions are awarded to the top seven places in each of the events as well as plaques and trophies to the

What distinguishes the Science Olympiad from other academic competition is the large number of students on each team (up to 15) and how much time the students must invest to prepare for the state tournament. The events of the Science Olympiad truly engage students in the process of science with intriguing challenges and cutting edge topical foci.



*Science Olympiad participants prepare to demonstrate their “Mission Possible” device.*

top teams overall. This year the individual awards went to many different teams so the overall rankings were not at all obvious. In the end, Desert Mountain High School from Scottsdale Unified school district (coached by Joshua Pantier) was named as the team that will be representing Arizona at the National competition at the University of Nebraska in mid-May. Joshua has been bringing a team for over a decade; while they have placed in the top tier for a number of years but this is their first time at #1. We look forward to seeing how they do against the 59 other state and regional teams competing at Nationals.



*Desert Mountain High School team members from both Maroon (1<sup>st</sup> place overall) and Gray teams and their coach, Joshua Pantier (center back)*

**Karen Conzelman**

Arizona Science Olympiad State Site Director and ANAS Liaison

**Treasurer's Report  
2014**

**Operating and Short Term Reserve Fund (Vanguard Prime Money Market Fund)**

Account Value on 12/31/13	\$27,019.48
Dividend Deposits	\$2.70
Account Value on 12/31/14	\$27,022.18

**Goethe Educational Endowment Fund (Vanguard Index 500 Mutual Fund)**

Account Value on 12/31/13	( 241.712 shares at \$170.36/share)	\$41,178.06
Deposits (Contributions) +0 shares	Total: 241.712 shares	
Dividends +4.723 shares	Total: 246.435 shares	
Account Value on 12/31/14	( 246.435 shares at \$189.89/share)	\$46,795.54

**General Fund**

December 31, 2013 Balance	\$22,667.82
Deposits	\$19,657.48
Expenses	(\$6,291.09)
December 31, 2014 Balance	\$36,034.21

**Science Olympiad General Fund**

December 31, 2013 Balance	\$73,620.01
Deposits	\$40,264.52
Expenses	(\$18,758.79)
December 31, 2014 Balance	\$95,125.74

**Science Bowl General Fund**

December 31, 2013 Balance	\$1,114.12
Deposits	\$0.00
Expenses	(\$1,114.12)
December 31, 2014 Balance	\$0.00

**Market Value of Assets (as of December 31, 2014)**

**204977.67**

**General Funds Details**

<b><u>Deposits</u></b>		<b><u>Expenses</u></b>
\$1,570.00	ANAS Membership dues	75.00
	PayPal charges	43.94
	Postage	
	Journal:	
320.00	Subscriptions	
	Refunds	
11,718.30	BioOne/JSTOR/CCC Royalties	
7.00	Sale of Back Issues	
785.00	Reprints/Page Charges	
	Printing	1,321.27
	Typing	750.00
	Postage	268.62
3,022.66	Hydrology Proceedings	
	Other	
54.52	Royalties from book	
	Web hosting fee	234.82
	Scholarships:	1,000.00
	Grants-in-Aid, High School:	100.00
	Grants-in-Aid, Graduate	
	Grants-in-Aid, Undergraduate	200.00
	Science Olympiad awards	1,100.00
	Annual Meeting:	
2,180.00	Registration Fees	
	PayPal Charges	59.45
	Sponsor donations	
	Proceedings, Printing	671.46
	Proceedings, Postage	140.04
	Coffee Breaks	
	Friday Reception	
	Saturday Luncheon	
	Meeting Rooms/Equipment	
	Awards	
	Outstanding Service	50.00
	Outstanding Teacher	
	Outstanding Students	200.00
	Printing/Postage	
	Plaques	20.75
	Goethe Endowment Fund Contributions	
	AZ Corporation Commission	10.00
	NAAS Dues	0.00
	Supplies	25.72
	Postage/Office	4.06
	Printing/Office	15.96
	Board Meeting Refreshments	
	Bank Charges	
	Interest	
	Other	
\$19,657.48	<b>SUBTOTAL</b>	<b>\$6,291.09</b>

<u>Deposits</u>		<u>Expenses</u>
	Science Olympiad	
\$14.52	Interest	
32,415.75	Sponsor donations	
7,228.00	Membership dues	2,100.00
	Tournament	
	Awards and Prizes	4,613.93
	Scholarships	
	Team Travel	2,400.00
84.00	T-shirts	5,473.21
	Supplies	752.07
522.25	Lunches	1,238.83
	Coaches gifts	
	Office Expenses	
	Copying and Postage	362.92
	Office supplies	17.83
	Bank Charges	
	Outreach	
	Workshop stipends	
	Seed money	1,800.00
	Brochures/PR	
	Mileage	
	Travel to Nationals (State Director)	
	Other	
\$40,264.52	<b>SUBTOTAL</b>	<b>\$18,758.79</b>
	Science Bowl	
	Sponsor donations	
	School registration fees	
	Scholarships	
	Room rental fees	
	Photographers	
	Food	
	Supplies	357.44
	Printing	289.84
	Trophies and prizes	466.84
	Interest	
	Bank credits/charges	
\$0.00	<b>SUBTOTAL</b>	<b>\$1,114.12</b>
<b>\$59,922.00</b>	<b>TOTAL</b>	<b>\$26,164.00</b>

*(Please note that the Science Olympiad is held in February or March of each year and this report is based on the calendar year. Some sponsorship dollars are received in the fall in anticipation of the upcoming year's tournament).*

**Karen Conzelman**  
Treasurer





