PROCEEDINGS
OF THE
ARIZONA-NEVADA
ACADEMY OF SCIENCE

FORTY-SEVENTH ANNUAL MEETING

April 12, 2003
Northern Arizona University
Flagstaff, Arizona
2002-2003 Annual Reports
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## SUMMARY OF SECTION MEETINGS

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* Indicates a paper to be considered for the Best Student Paper Award or Best Student Poster Award
** School of Forestry
***Ponderosa Room USFS
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The Academy would like to thank the following sponsors for their generosity in supporting the annual meeting in Flagstaff this year.

Watershed and Riparian Ecosystems of Forests and Woodlands in the Semi-Arid West Project RMRS-4302
Rocky Mountain Research Station
Flagstaff, AZ 86001

Contributors from Northern Arizona University, Flagstaff AZ:
Office of Grants and Graduate Studies
School of Forestry
College of Ecosystem Science and Management
College of Social and Behavioral Sciences
College of Arts and Sciences

LUNCHEON SPEAKER

Regents Professor William Wallace Covington

Dr. Covington is the Executive Director of the Ecological Restoration Institute and a Regents’ Professor in the School of Forestry at Northern Arizona University. He has been at the NAU since 1975. He has a Ph.D. in Forest Ecology from Yale University, a Master of Science in Ecology from New Mexico University, and B.A. in Biology/Chemistry from the University of North Texas. Professor Covington is well known both at the national and international level in the areas of integrated ecosystem science and management and forest fire protection. At the moment, Professor Covington is serving as Chair of the Governor’s Forest Health/Fire Plan Advisory Committee, and as member of the National Commission on Science for Sustainable Forestry. Professor Covington also served as chair of the Research Working Group and co-chair of the Science and Policy Working Group of the Society for Ecological Restoration. In addition, Dr. Covington has given many invited testimonies to Congressional Committees since 1994 and was a winner of the Governor’s Pride in Arizona Award for Environmental Leadership in 1999. Professor Covington will speak on Wildfire Hazards in U.S. Forest Systems and What Can be Done to Prevent Them. The talk will be between 12:15 and 1:15 p.m.
BIOLOGY SECTION

SESSION I  8:00

ROOM: 17

Chairperson: Robert Bowker

8:00 - 8:15  *FEEDING AND RESPIRATION IN TRINECTES MACULATUS: HALF A HEAD IS BETTER THAN ONE

Matthew W. O’Neill and Alice C. Gibb (Northern Arizona University, Flagstaff, AZ)

Flatfishes have evolved a benthic lifestyle, where both eyes are present on one side of the head as adults. This results in marked morphological asymmetry, especially in the head and mouth. Hogchokers, Trinectes maculatus (Achiridae), live in both fresh and salt water in soft bottom habitats. We recorded hogchokers feeding on bloodworms using a Redlake PCI 1000S digital-video system, and analyzed images using a custom digitizing program. The animals required training to feed in bright lights, suggesting that they may be nocturnal feeders that use both visual and chemical cues. A hogchoker is only able to take prey from the substrate, not from up in the water column. Buccal cavity expansion enhances suction feeding, and a fleshy flap covering the eyed side of the mouth helps direct suction toward the substrate. Ventilation appears to occur through the eyed side of the mouth and is regulated by a flap extending from the lower jaw. Prey capture is very rapid and highly asymmetrical. During feeding, the blind side portion of the mouth projects toward the substrate at approximately 75° from the midline of the animal, and prey is captured within 10ms of mouth opening. Major bones of the jaw are also highly asymmetrical, especially the premaxilla and dentary, and may be involved in producing kinematic asymmetries. These results suggest the mouth is divided into two functional units: the blind side is used for feeding and the eyed side is used for respiration.

8:15 - 8:30  *THE CIRCULATORY SYSTEM OF DECAPOD CRUSTACEANS, OPEN OR CLOSED?

Jennifer Bernatis and Iain McGaw (University of Nevada Las Vegas, Las Vegas, NV)

Historically, the decapod crustacean circulatory system has been regarded as a relatively simple open circulatory system. The system consists of a single chambered heart, pumping hemolymph into several arterial systems. These arteries split into smaller vessels then ramify within each organ system. However, hemolymph bathes the tissue via irregular inter-tissue spaces known as sinuses. Eventually, all hemolymph collects in a large ventral sinus from where it flows through the gills and back to the heart. We have used corrosion
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enrichment and AM fungi. C-3 forbs that are not mycorrhizal hosts responded similarly to N, but showed reduced biomass with AM fungi. Biomass of mycorrhizal C-3 grasses also increased with elevated CO₂. C-4 grasses only responded to AM fungi with increased biomass. AM spore community analysis is in progress. We anticipate that the species composition of the AM fungal community will be responsive to CO₂ and N enrichment as well. My results indicate that C-3 and C-4 plants react differently to CO₂, N and AM fungi. These results also indicate that AM fungi play an important role in plant communities and must be a part of any research determining impacts of changing global C and N cycles.

9:00 - 9:15

*SEXUAL SELECTION IN A GULF OF CALIFORNIA MUD SHRIMP, NEOTRYPAEA UNCINATA*

Emily M. Arnold, Helen C. Dyer, Laura D. Galati, Nicholas S. Ireland, Steven A. Vuturo, Courtney E. Wilson, and Stephen M. Shuster (Northern Arizona University, Flagstaff, AZ)

Sexual selection occurs when receptive females are clumped in space and dispersed in time. Under these circumstances, few males mate, characters that enhance male mating success are favored, and sexual dimorphism evolves. Mud shrimp (Thalassinidea) are among the most dimorphic decapod crustaceans, yet little is known of their sexual behavior. We investigated the potential for sexual selection in a breeding population of Neotrypaea uncinata, a mud shrimp inhabiting Estero Morua near Puerto Penasco, Sonora, Mexico. We examined the morphology and spatial distribution of males and females in 30, 10 cm diameter cores collected every meter along 2 transects at 2 different locations within the Estero. In our collections, males possessed larger dominant chelae than females. Females were spatially aggregated in both locations. Both gravid and receptive females were collected, thus females were clearly asynchronous in their sexual receptivity. Within cores, males were closer to burrow entrances than receptive females, while gravid females were deepest. The sex ratio was female-biased in both locations, and we collected fewer, larger males where receptive females were most spatially concentrated. Our results suggest that males defend and mate sequentially with aggregations of receptive females in burrows, and support the hypothesis that sexual dimorphism has evolved in mud shrimp by sexual selection.

9:15 - 9:30

TRAITS OF PLANTS THAT LIVE AND DIE DURING A RECORD DROUGHT: IMPORTANCE OF BELOWGROUND INTERACTIONS

Theresa A. McHugh and Catherine A. Gehring (Northern Arizona University, Flagstaff, AZ)

Factors contributing to the differential mortality of pinyon pine following drought are poorly understood. In order to determine the factors that contributed to pinyon mortality during the 2002 drought, I looked at δ13C values, stem lengths, needle lengths, and belowground root biomass of live and dead pinyons using a paired design. From this study, five patterns emerged. 1) Average δ13C values for live and dead trees were exactly the
same, suggesting that this measure was not a good indicator of plant water stress for 2000, the year analyzed. 2) The stems of dead trees were significantly shorter (3mm shorter) than the stems of live trees. 3) The needles of dead trees were significantly longer (6mm longer) than the needles of live trees. 4) Live trees had 3X more pinyon roots beneath them than dead trees. 5) Juniper root biomass was 5X greater under dead trees than live trees. These results indicate that stem length, needle length, and root biomass can be used as predictors for pinyon mortality and suggest that competition for belowground resources may contribute to pinyon mortality.

9:30 - 9:45 HERBIVORY ALTERING NITROGEN DYNAMICS THROUGH SOIL CARBON INPUTS

Brent Oerther (Northern Arizona University, Flagstaff, Z)

Insect herbivory may alter soil carbon inputs in ecosystems by increasing litterfall quantity, litter chemistry, and litter quality. Located within the Sunset Crater National Park, we examined how chronic insect herbivory by the pinyon needle scale (*Matsucoccus acaleyptus*) and the stem-boring moth (*Matsuccoccus acaleyptus*) affect microbial carbon utilization patterns in pinyon-juniper woodland (DeMarco et al. *Inprep*). We measured soil carbon inputs by incubating 120 pinyon-junipers, in the lab, under each tree type (susceptible, resistant, and removed) in sealed containers to simulate field conditions. We found that soil carbon inputs increased over a 64-day incubation period for the susceptible trees, while both the resistant and removed trees had a gradual increased over the same period.

9:45 - 10:00 *DROUGHT STRESS AND COMPETITION WITH A CO-DOMINANT CAN ALTER THE ESTABLISHMENT AND PERFORMANCE OF PINYON PINE.*

Kristin E. Haskins and Catherine A. Gehring (Northern Arizona University, Flagstaff, AZ)

The increased occurrence of drought predicted for the American southwest could have major impacts on vegetation boundaries due to variation in the ability of dominant plant species to compete for water. We examined the impact of drought stress and competition with juniper (*Juniperus monosperma*) on pinyon (*Pinus edulis*) performance focusing on belowground processes. We determined the potential for competition by examining rooting density in the field and by trenching to reduce juniper roots from the rooting zone of pinyons. Because juniper forms beneficial root-fungal associations (mycorrhizae) with arbuscular fungi, while pinyon forms similar associations with ectomycorrhizal (EM) fungi, we conducted an EM inoculum assay to determine if lack of EM inoculum inhibited pinyon colonization of juniper-dominated areas. Two findings emerged. First, trenching to reduce competition by junipers resulted in a doubling of pinyon root biomass and 4X increase in EM root tips, demonstrating that the presence of juniper limits pinyon root establishment. Second, pinyons grown in soil from pinyon and p-j zones had 12X more EM and
significantly greater EM morphotype richness than those grown in soil from juniper zones. Our results indicate that junipers may outcompete adult pinyons and that young pinyons attempting to re-colonize juniper zones following drought will be less able to acquire EM, thus reducing the probability of successful re-establishment.

10:00 • 10:30  COFFEE BREAK IN FOYER

10:30 • 10:45  *OFF-ROAD VEHICLES INHIBIT PONDEROSA PINE (PINUS PONDEROSA) RECRUITMENT

Karla J. Kennedy, Thomas G. Whitham, and Catherine A. Gehring (Northern Arizona University, Flagstaff, AZ)

The consequences of off-road vehicle (ORV) recreation on the recruitment and establishment of dominant tree species in recreation areas are poorly understood. We examined the effects of extensive ORV use on ponderosa pine growing environment and recruitment in the cinder hills of northern Arizona. We compared soil moisture, water infiltration time, litter cover and depth, frequency of recruitment and establishment in ORV-present and control areas. Four patterns emerged in the ORV area: 1) soil moisture was lower 2) water infiltration time was longer, 3) recruitment of young seedlings was 9X lower, and 4) there were fewer juvenile plants <20 years old. These results suggest that ORVs are altering the area in which they operate, creating a negative feedback cycle that will decrease tree density, and lead to further degradation of the environment.

10:45 – 11:00  *MOTH RESISTANCE NEGATIVELY AFFECTS SURVIVORSHIP OF PINYON PINE DURING RECORD LEVEL DROUGHT

Christopher M. Stulz and Thomas G. Whitham (Northern Arizona University, Flagstaff, AZ)

Few studies have demonstrated a metabolic cost of resistance associated with the defense against herbivore attack. We examined the cost of defense shown by mature Pinyon pine (Pinus edulis) to the keystone herbivore Dioryctria albovitella, a stem-and-cone boring moth, during a record level drought. Trees in three populations were distinguished as moth resistant or moth susceptible based on architecture and the mortality status of each tree was classified along twenty 50M transects. We found that genetically moth resistant trees that have outperformed susceptible trees for over 20 years of study, have now suffered about 3 times greater mortality during the current drought. Two strong patterns emerged. 1) Initially in the high mortality areas moth resistant trees dominated the stand 3 to 1 over moth susceptible trees. 2) During the 2002 drought 60% of resistant trees died, while only 20% of susceptible trees died resulting in a post mortality stand density of approximately 1 to 1. We conclude that the cost of resistance during extreme drought conditions may have direct and
same, suggesting that this measure was not a good indicator of plant water stress for 2000, the year analyzed. 2) The stems of dead trees were significantly shorter (3mm shorter) than the stems of live trees. 3) The needles of dead trees were significantly longer (6mm longer) than the needles of live trees. 4) Live trees had 3X more pinyon roots beneath them than dead trees. 5) Juniper root biomass was 5X greater under dead trees than live trees. These results indicate that stem length, needle length, and root biomass can be used as predictors for pinyon mortality and suggest that competition for belowground resources may contribute to pinyon mortality.

9:30 - 9:45

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9:45 - 10:00

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provide a simple, nondestructive method for collecting and studying marine invertebrates in this unique, man-made environment.

11:30 - 1:40
ANNUAL ANAS AWARDS LUNCHEON AND BUSINESS MEETING: BALLROOM DUBOIS CONFERENCE CENTER

SESSION II  1:45
ROOM: 17

1:45 - 2:00
THE EFFECT OF CONVENTIONAL AND NATIVE AMERICAN AGRICULTURE PRACTICES UPON MYCORRHIZAL INOCULUM POTENTIAL IN SOILS.

Theodore N. Martinez, (Northern Arizona University, Flagstaff, AZ)

Arbuscular mycorrhizal fungi (AMF) form symbiotic associations within the roots of vascular plants. These associations provide improved water relations and enhance nutrient uptake to the host plant. The goal of this study was to examine the mycorrhizal inoculum potential (MIP) of soils in a gradient of crop management practices. Management practices in this study were high input conventional agriculture practices, traditional Native American agriculture practices, and non-managed wild-lands. It was predicted that the MIP would be lower under conventional agricultural practices as compared to non-managed wild-lands. Results show that the MIP of wild-land soils were significantly greater (P=.001) than soils under conventional agriculture practices. It was also hypothesized that crop history would have a significant effect upon the MIP of conventional agriculture soils. Results show that the interaction of crop history with the number of years a field has been in cultivation have a significant effect (P=.009) upon MIP. These data show that crop management practices can have the effect of either sustaining or reducing mycorrhizal inoculum potential in soils.

2:00 - 2:15
DECOMMISSIONING THE FOSSIL CREEK DAM IS PREDICTED TO REDUCE SUITABLE TYPHA HABITAT

Charles E. Jones Jr. and Nancy C. Johnson (Northern Arizona University, Flagstaff, AZ)

In 1916, the Fossil Springs dam was built near Strawberry, Arizona leaving the stream channel nearly dry and ecologically degraded, but an agreement has been reached to decommission the dam on December 31, 2004. Macrophytes provide many ecological services and *Typha domingensis*, cattail, was found to be the dominant macrophyte in Fossil Creek. The goals of this study were to 1) measure the habitat requirements of *Typha* in...
Fossil Creek and 2) develop a spatial model to predict Typha distribution following the decommissioning of the dam. Habitat requirements of Typha were assessed by comparing flow rate, water depth, sediment depth and canopy cover in areas with and without Typha. In Fossil Creek, Typha prefer areas with low canopy cover (0-20%), low water velocity (< 0.107 m/s) and water depths in the between 40 and 80 cm. Landsat images, digital elevation models and hydrologic modeling software were used to model Typha habitat in Fossil Creek. This model predicts that dam removal will reduce suitable Typha habitat by 21%. Spatially, the habitats were found in vastly different areas under the low water and re-watered scenarios. Models that predict the outcome of alternative re-watering scenarios will aid reestablishment of desired macrophyte communities and the critical habitats they provide. Many dams were constructed with ignorance of their ecological effects; these same dams should not be removed with similar ignorance of the ecological consequences.

2:15 - 2:30

PREDICTING THE POTENTIAL COVER, COMPOSITION, AND FUNCTION OF BIOLOGICAL SOIL CRUSTS IN GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT

Matthew A. Bowker (Northern Arizona University, Flagstaff, AZ) and Jayne Belnap (US Geological Survey, Moab, UT)

Biological soil crusts are a common soil surface community in semi-arid lands that perform numerous important ecosystem services. To determine if the potential biological soil crust cover and composition could be predicted for a large area based on geology and precipitation geographic information system (GIS) data layers, we sampled 109 relatively undisturbed sites in Grand Staircase-Escalante National Monument. We found that a model of moderately high mean accuracy and precision, 67% and ±10% respectively, for percent cover of five crust types (light cyanobacteria, dark cyanobacteria, moss, lichen, and moss + lichen) could be achieved using classification and regression tree (CART) models using a relatively parsimonious set of predictor variables. The R^2 values for the five models were 0.44, 0.53, 0.56, 0.66, and 0.46. We also attempted to determine the relationship between chlorophyll a (a proxy for cyanobacterial biomass) and the slake test (a measure of soil aggregate stability). We found two major patterns: 1) On sandy non-calcareous soils, cyanobacterial biomass appears to be the primary soil stabilizer (R^2 values up to 0.90), and 2) The relationship between chlorophyll a and soil stability differed greatly between major soil types. Data layers generated in this fashion may allow land managers to better evaluate rangeland health by comparing the modeled potential soil crust condition of a site with actual condition.

2:30 - 2:45

DO MUDSKIPPERS “SKIP” UNDERWATER?

Cydney Landels and Alice C. Gibb

Periophthalmus argentineus, also known as the mudskipper, is an amphibious fish species. Because members of this species are amphibious, they produce both aquatic escape
responses ("C-starts") and terrestrial ones ("skipping") when fleeing predators. Both responses begin with extreme lateral bending, and thus appear to be superficially similar. We recorded aquatic escape responses at 500 frames per second using a Redlake PCI 1000S high-speed, digital-video system and analyzed images using a custom digitizing program. Several sequences for each of six mudskippers were used to calculate timing and bending variables, including the curve coefficient (the ratio of the distance between the two ends of the vertebral column when the fish is maximally bent versus straight). These variables were compared with similar variables measured from previously collected terrestrial escape responses for the same individuals. We found that relative to terrestrial responses, aquatic responses were slower and produced less bending. For instance, it took the mudskippers twice as long to achieve maximum curvature in water. In addition, maximum curvature, as measured by the curve coefficient, was greater on land than in water. In summary, although there were similarities between aquatic and terrestrial escape responses, they were quantitatively different. These differences may be due to the higher viscosity of water; alternately, the nervous system may trigger a different behavior in each of the two habitats.

2:45 - 3:00 COMPETITION REDUCTION AND THE MAINTENANCE OF POLYMORPHISM IN HERICHTHYS MINCKLEYI

Brook O. Swanson (Northern Arizona University, Flagstaff, AZ)

Polymorphic species provide a system to study the evolution and maintenance of diversity. At least two distinct prey processing morphotypes occur in the Cuatro Ciénegas cichlid (Herichthys minckleyi). One morphotype has gracile pharyngeal jaws with papilliform pharyngeal teeth. The other morphotype has robust pharyngeal jaws and molariform pharyngeal teeth. We conducted two field competition experiments to examine competitive interactions at different densities and test the hypothesis that the morphotypes reduce intraspecific competition. Competitive interactions were examined within and between the morphotypes using enclosures. High-density and low-density cage treatments containing a single morphotype were used to quantify within-morph competition. Cages containing both morphotypes were used to quantify between-morph competition. Results indicate that intraspecific competition is reduced but not eliminated by the presence of two morphotypes. Experiments at lower overall densities indicate that resource partitioning is more pronounced under periods of resource limitation.

3:00 - 3:30 COFFEE BREAK IN FOYER

3:30 - 3:45 A PROMISING MICROALGAL CANDIDATE FOR BIOLOGICAL CO₂ SEQUESTRATION AND HIGH-VALUE CAROTENOID PRODUCTION

Mike Bellefeuille, Qiang Hu, and Milton Sommerfeld (Arizona State University, Tempe, AZ)
Fossil Creek and 2) develop a spatial model to predict *Typha* distribution following the decommissioning of the dam. Habitat requirements of *Typha* were assessed by comparing flow rate, water depth, sediment depth and canopy cover in areas with and without *Typha*. In Fossil Creek, *Typha* prefer areas with low canopy cover (0-20%), low water velocity (<0.107 m/s) and water depths in the between 40 and 80 cm. Landsat images, digital elevation models and hydrologic modeling software were used to model *Typha* habitat in Fossil Creek. This model predicts that dam removal will reduce suitable *Typha* habitat by 21%. Spatially, the habitats were found in vastly different areas under the low water and re-watered scenarios. Models that predict the outcome of alternative re-watering scenarios will aid reestablishment of desired macrophyte communities and the critical habitats they provide. Many dams were constructed with ignorance of their ecological effects; these same dams should not be removed with similar ignorance of the ecological consequences.

2:15 - 2:30  
PREDICTING THE POTENTIAL COVER, COMPOSITION, AND FUNCTION OF BIOLOGICAL SOIL CRUSTS IN GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT

Matthew A. Bowker (Northern Arizona University, Flagstaff, AZ) and Jayne Belnap (US Geological Survey, Moab, UT)

Biological soil crusts are a common soil surface community in semi-arid lands that perform numerous important ecosystem services. To determine if the potential biological soil crust cover and composition could be predicted for a large area based on geology and precipitation geographic information system (GIS) data layers, we sampled 109 relatively undisturbed sites in Grand Staircase-Escalante National Monument. We found that a model of moderately high mean accuracy and precision, 67% and ±10% respectively, for percent cover of five crust types (light cyanobacteria, dark cyanobacteria, moss, lichen, and moss + lichen) could be achieved using classification and regression tree (CART) models using a relatively parsimonious set of predictor variables. The $R^2$ values for the five models were 0.44, 0.53, 0.56, 0.66, and 0.46. We also attempted to determine the relationship between chlorophyll $a$ (a proxy for cyanobacterial biomass) and the slake test (a measure of soil aggregate stability). We found two major patterns: 1) On sandy non-calcareous soils, cyanobacterial biomass appears to be the primary soil stabilizer ($R^2$ values up to 0.90), and 2) The relationship between chlorophyll $a$ and soil stability differed greatly between major soil types. Data layers generated in this fashion may allow land managers to better evaluate rangeland health by comparing the modeled potential soil crust condition of a site with actual condition.

2:30 - 2:45  
DO MUDSKIPPERS "SKIP" UNDERWATER?

Cydney Landels and Alice C. Gibb

*Periophthalmus argentilineatus*, also known as the mudskipper, is an amphibious fish species. Because members of this species are amphibious, they produce both aquatic escape
*Pseudomonas putida*. Another protein exhibited no homology to known proteins but had an unusual amino acid sequence structure containing a very high content of alanine, threonine and arginine. The remaining two proteins exhibited homology to known membrane proteins. One protein, designated Pha27, showed significant to homology to OmpC, whereas the other protein, designated Pha35 exhibited excellent homology to a number of different porins. The gene for Pha35 was cloned and the regions upstream and downstream were subjected to sequence analysis. In a 7.2 kb sequence there were 9 genes, all of which had significant homologues in other species. Pha35 was inactivated by inserting a chloramphenicol resistance gene into it and the resulting strain was tested for its ability to produce PHA. The pha35 mutant was unable to accumulate PHA using a variety of growth conditions that facilitated PHA accumulation in the wild type strain. Because Pha35 has high homology to porins, and because porins have recently been imaged using atomic force microscopy (AFM), we conducted preliminary AFM studies on isolated inclusions. The AFM images suggest the presence of a globular structure on the surface of the inclusion with an internal channel. These data suggest that Pha35 is functionally linked to PHA synthesis and may act as a porin.
CHEMISTRY SECTION

SESSION 1  8:00

ROOM: 135

Chairperson: Richard Foust

8:00 - 8:15  * INHIBITING PROTEIN EXPRESSION OF HER2/neu(erbB2) TYROSINE KINASE VIA THE NOVEL APPROACH OF 2-5 A-ANTISENSE

Daniel L. Saxelby, Linda Powell and Paul F. Torrence (Northern Arizona University, Flagstaff, AZ)

Cancer is the second leading cause of death in the United States. 2-5A-antisense is a novel approach to destroying genetic messages that specify for disease proteins; previously it has been demonstrated to effect the degradation of virus mRNA messages. This strategy has been adapted to target the HER2/neu (erbB2) tyrosine kinase that is a specific proto-oncogene with cancer causing potential. HER2/neu (erbB2) is a gene found in the membrane of cells. It plays a key role in regulating cell growth. Dis-regulation and over-expression of HER2 causes increased cell growth and reproduction, often resulting in more aggressive tumor cells. By harnessing one arm of the interferon natural defense system (2-5 A) and linking it to a molecule called antisense, which possesses a high affinity for messenger RNA, HER2/neu(erbB2) can be targeted for destruction by the natural cellular enzyme RNase L. This new method is being investigated for possible application in prostate cancer human cell lines (PC-3) which show a 30% increase in expression of the mitogenic cell signaling receptor HER2/neu(erbB2). By investigating the protein expression of HER2 by Western blot and RNA levels by Southern blot, the effectiveness of the target molecule can be determined. This could provide a new lead molecule of 2-5 A-antisense as an effective anti-prostate cancer drug. This work is supported by US Army CDMRP award # PC010582.

8:15 - 8:30  * IN VITRO ANTICANCER DRUG SCREENING: COMPARISON BETWEEN MITOCHONDRIAL DEHYDROGENASE AND COLONY FORMATION AS ASSAY TECHNIQUES

Ambar Faridi and J. Abiodun Elegbede (University of Nevada Las Vegas, Las Vegas, NV)

Screening compounds for anticancer activity requires use of reliable and physiologically relevant in vitro assays of cell survival and proliferation. Two commonly used techniques are the mitochondrial dehydrogenase activity (MTT) and colony formation
assay (CFA). In this report, we studied the effect of exposure of human carcinoma cell lines A549 and HTB-54 to 5-Fluorouracil (5-FU) for 3, 6, or 24 hours using MTT and CFA techniques. In both cell lines, cytotoxicity of 5-FU (by MTT assay) was limited, with a maximum inhibition of 20% observed after 24-hr exposure. Using CFA, 5-FU showed dose and kinetic-dependent effects in both cell lines. Inhibition of proliferation by 50% (IC$_{50}$) was observed with 75 mcg/ml for HTB-54 (3 hr) and 80 and 190 mcg/ml for A549 cells exposed for 3 and 6 hr respectively. Exposure for 24 hr resulted in no colony formation in either cell line. CFA assay was more effective than MTT at measuring the efficacy of 5-FU on A549 and HTB-54 cell lines.

8:30 - 8:45 *APPLICATIONS OF PARAMAGNETIC NANOPARTICLES IN DIAGNOSTICS

Lindsey Bradley and Timothy Vail (Northern Arizona University, Flagstaff, AZ)

The absence of an effective, rapid, and sensitive assay for food borne pathogens such as Listeria monocytogenes contributes to thousands of cases of food poisoning each year in the United States. Utilizing paramagnetic iron oxide nanoparticles, a rapid assay can be devised. Previous research has shown that nanoparticles can be coated with silica and functionalized via a silanating agent such as aminopropyltriethoxysilane (APTES). Incorporation of APTES leaves an amino group extending through the surface of the silica matrix, providing a site for the covalent attachment of antibodies specific for L. monocytogenes. The additional incorporation of a fluorescent reporter, fluorescein isothiocyanate (FITC), into the silica matrix will allow for detection of antibody-antigen coupling, signaling the presence of L. monocytogenes. Refinement of prototype assays will result in a fluorescent nanoprobe that will find application in various in vitro diagnostic fields.

8:45 - 9:00 *PLANT STRESS HORMONES INHIBIT PROLIFERATION OF PROSTATE CANCER CELL LINE CULTURED IN VITRO

Daniel Ezekwudo and J. Abiodun Elegbede (University of Nevada, Las Vegas, NV)

The jasmonate family of plant stress hormones include cis-jasmone (CJ), methyljasmonate (CJ), and jasmonic acid (JA). In plants, these compounds function as activators of cellular responses to diverse situations including cell death. Using mitochondrial dehydrogenase activity (MTT) assay, we investigated the effects of the jasmonate family of compounds and the monoterpenes on the proliferation of human prostate carcinoma cell line, (PC-3), cultured in vitro. MJ significantly inhibited proliferation of PC-3 in dose- and kinetic-dependent manners and was a more effective inhibitor of proliferation than JA or CJ. The monoterpenes, perillyl alcohol and perillic acid, also inhibited the proliferation of PC-3 cell line in both dose- and kinetic-dependent fashions. Using the concentration of agent that inhibited proliferation of PC-3 by 50% (IC$_{50}$) after 24-hr exposure, we found the relative efficacy of the compounds to be POH>PA>MJ>>JA & CJ.
CANCER is the second leading cause of death in the United States. 2-5A-antisense is a novel approach to destroying genetic messages that specify for disease proteins; previously it has been demonstrated to effect the degradation of virus mRNA messages. This strategy has been adapted to target the HER2/neu (erbB2) tyrosine kinase that is a specific proto-oncogene with cancer causing potential. HER2/neu (erbB2) is a gene found in the membrane of cells. It plays a key role in regulating cell growth. Dis-regulation and over-expression of HER2 causes increased cell growth and reproduction, often resulting in more aggressive tumor cells. By harnessing one arm of the interferon natural defense system (2-5 A) and linking it to a molecule called antisense, which possesses a high affinity for messenger RNA, HER2/neu(erbB2) can be targeted for destruction by the natural cellular enzyme RNase L. This new method is being investigated for possible application in prostate cancer human cell lines (PC-3) which show a 30% increase in expression of the mitogenic cell signaling receptor HER2/neu(erbB2). By investigating the protein expression of HER2 by Western blot and RNA levels by Southern blot, the effectiveness of the target molecule can be determined. This could provide a new lead molecule of 2-5 A-antisense as an effective anti-prostate cancer drug. This work is supported by US Army CDMRP award # PC010582.
nitroxides spread throughout the Laponite matrix. Angle dependent ESR show a linewidth dependence of \( |3\cos^2\theta - 1|^{43} \) which is the angular dependence of theoretical single crystal one-dimensional Heisenberg antiferromagnets. XRD shows a 1.54 nm spacing between clay layers and an interstratified phase with spacings of 0.9 nm. The evidence supports a non-covalent assembly of nitroxide radicals in the Laponite film into structures that act as one-dimensional Heisenberg antiferromagnets.

9:30 – 9:45
* SITE CHARACTERIZATION OF GRAND CANYON SPRINGS WITH MAJOR ION CONSTITUENTS AND URANIUM ACTIVITY RATIOS

Van S. Blackwood (Northern Arizona University, Flagstaff, AZ)

During the period from June to November of 2002, several springs along the central section of the south rim of the Grand Canyon were sampled for major ion constituents and trace constituents of uranium. These springs and seeps have been studied in order to characterize base chemical constituents at the origin of discharge, including changes downstream as a result of rock/water interactions. Uranium concentration and activity ratios were analyzed using MC-ICPMS to further characterize these springs and seeps. The research using uranium activity ratios and concentrations focused on the Horn Creek east and west drainages because of potential contamination from the Orphan Load mine. Contamination was found at sources of springs and seeps in both Horn east and west drainages. The elevated concentrations and activity ratios close to unity suggest a potential tracer study to determine the range and mobility of the contamination as a result of transitions from drought to monsoon season.

9:45 – 10:00
SYNTHESIS OF THIOL LIGANDS AS MODELS FOR BIOLOGICAL CHROMIUM (III) CHELATORS

Fei Huang, Edgar R. Civitello and Diane M. Steams (Northern Arizona University, Flagstaff, AZ)

Chromium is a known occupational carcinogen, yet the mechanism of Cr induced cancer remains poorly understood. Cr (VI) is metabolized to Cr (III) in cells, however the coordination sphere of the final Cr (III) products are still unknown. Our ultimate goal is to determine if Cr (III) is scavenged by sulfur-coordination, given that other metals such as arsenic, mercury and cadmium are scavenged by thiol-containing bio-molecules. In this work, a series of sulfur compounds were synthesized as ligands to combine with chromium salts. The resulting Cr-S complexes will be used as models in cellular assays.

10:00 - 10:30
COFFEE BREAK IN FOYER
10:30 - 10:45

* THE DETECTION OF PESTICIDE RESIDUES BY INDUCED FLUORSCENCE EXCITATION EMISSION MATRIX FLUORIMETRY

William Kunkel, James A Jordan and Karl Booksh (Arizona State University, Tempe AZ)

This study examines the application of excitation-emission matrix (EEM) fluorimetry to monitoring of agricultural anthropogenic activities. The focus of experimentation will examine EEM spectral profiles of non-natively fluorescent DDT type pesticides by the addition of a highly fluorescent solvochromic dyes. It is noted in preliminary trials that when Nile Red (a solvochromic dye) is added to a sample matrix containing Methoxychlor, a dramatic shift in the EEM spectral profile of Nile Red occurs. It is postulated that the complexation of the solvochromic dye with Methoxychlor and other DDT type pesticides is responsible for the shift in the EEM spectrum. The observed shift in the EEM spectrum can then be exploited to determine the concentration of the pesticide residue in the sample through the application multivariate regression statistics. Detection limits in the low ug/L (ppb) should be realized by this indirect method. In further investigation, a simplified separation procedure for the extraction of pesticide residues from plant materials using C18 affinity capture is performed. The use of solid phase micro-extraction (SPME) technology is performed to determine the efficacy of employing a new Fiber Optic Chemical Sensing Excitation Emission Matrix Fluorimeter (FOCS-EEM) instrument to quantify pesticide levels in-situ.

10:45 - 11:00

* MODELS FOR CR (III) - DNA ADDUCTS

Tim Cain, Edgar Civitello and Diane Stearns (Northern Arizona University, Flagstaff, AZ)

Hexavalent chromium (VI) (Cr (VI)) was found to be a lung carcinogen over 100 years ago with its industrial application. To date the carcinogenic pathways have yet to be fully elucidated. It is known that Cr (VI) is actively transported into cells as it is isosteric with sulfate and phosphate. Once in the cell Cr (VI) is reduced to Cr (III) resulting in covalent adducts between Cr (III) and DNA. Previous studies have characterized metal-DNA adducts with metals such as platinum, nickel and cobalt showing preferential binding to the N7 position of the purine bases. However, all previous attempts to fully characterize Cr (III)-DNA adducts in vivo have failed presumably due to the lability of Cr (III) as well as its paramagnetic property. To this end we plan to synthesize small oligonucleotides appended with peptides known to bind Cr (III). The addition of these peptide tethers is expected to yield a more stable complex facilitating characterization via x-ray crystallography. These models will help us understand where Cr (III) binds and aid in elucidation of its carcinogenic pathway. The necessity for several derivatives of these models, as well as the relatively large amount of material needed for x-ray crystallography, requires a large-scale solution-phase approach to synthesis. This method has proposed a surfeit of challenges that will be presented along with preliminary results.
**11:00 - 11:15  *2’5’A ANTISENSE CHIMERA***

Manu Robertson, Paul Torrence and Edgar Civitello (Northern Arizona University, Flagstaff, AZ)

Interferons are participants in a key natural antiviral defense mechanism. Interferon stimulated genes encode proteins which mediate all of the biological effects of these interferons. 2’5’riboadenosine (2’5’A), is a key mediator of interferon’s actions, and has been found to promote dsRNA decay in mammalian cells. This is achieved through 2’5’A activation of the enzyme Ribonuclease L (RnaseL). The use of the 2’5A system alone however is unspecific in its degradation of mRNA. In order to specify its degradation of mRNA, a peptide nucleic acid (PNA), morpholino, or RNA will be conjugated to the 2’5’A, via a “linker” piece. We call this complex a “chimera.” Through the specific binding of complementary base pairs, from one of the chosen means, the viral sense strand will form a double stranded complex. Upon activation from the complex, 2-5A will activate RNase L which will then degrade the sense strand of the viral RNA, thus inhibiting translation. One such application of this antisense technology is the degradation of telomerase. Telomerase (hTR) is an enzyme complex made up of both protein and RNA. Telomerase activation is needed in order to sustain the life of tumor cells. The 2-5A-antisense molecule has been shown to suppress tumor cell growth and survival in nude mice by inhibiting the hTR RNA complex. Our recent advances toward the synthesis of these chimeras will be presented.

**11:15 - 11:30  *NON-REDUCIBLE ANALOGS OF CYSTINE SUITABLE FOR SOLID PHASE PEPTIDE SYNTHESIS***

Malachi I.C. Keddington and Edgar R. Civitello (Northern Arizona University, Flagstaff, AZ)

Somatostatin, vasopressin, and calcitonin represent a group of naturally occurring peptides that display a diverse capacity to be used as therapeutic and diagnostic imaging agents. In order to develop such peptides into drugs it is often necessary to synthesize structural analogs to control certain key properties such as biodistribution and metabolic stability. The labile disulfide bond of cystine, common to these peptides, is often a target for derivatization. Replacing the disulfide with a more stable moiety, is expected to increase bio-stability while maintaining conformational activity. We have proposed a series of cystine analogs for this purpose. Herein we report our first analog in which one of the sulfur atoms of the disulfide bond is replaced with a methylene group. This thioether, (2,7-diamino-4-thiasuberic acid) (Dtsa), is designed to be enantiomerically pure and regiospecifically protected for Fmoc solid phase peptide synthesis. Future plans will include the incorporation of Dtsa into the peptide oxytocin in order to test the validity of our protecting groups as well as our solid phase techniques. This will be the first known synthesis of a cystine analog using solid phase methods. This research will open the door for the development of conformationally constrained peptide analogs to be used in the treatment of disease.

**11:30 - 1:40  ANNUAL ANAS AWARDS LUNCHEON AND BUSINESS MEETING: BALLROOM DUBOIS CONFERENCE CENTER**
10:30 - 10:45  * THE DETECTION OF PESTICIDE RESIDUES BY INDUCED FLUORESCENCE EXCITATION EMISSION MATRIX FLUORIMETRY

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Available nitrogen and phosphorus were measured in semiarid grassland plots exposed to three treatments of livestock grazing, to include: livestock exclosure, moderate intensity grazing and very high intensity grazing. After three years of treatment, ion-exchange resin probes were used to measure available soil nitrogen and phosphorus. Very high intensity grazing showed 145% more available nitrogen than the livestock exclosure. In contrast to this pattern, available phosphorus was greatest in the moderate intensity treatment (p=.10), but no statistically significant difference was found between the livestock exclosure and high-intensity grazing treatments. Increased availability of both nutrients with greater grazing intensity was expected due to nitrogen and phosphorus inputs associated with livestock urine and feces. However, the long-term implications for nitrogen and phosphorus cycling in this semiarid grassland are not yet known.

8:30 – 8:45 EXOTIC ANIMAL CARE CENTERS IN ARIZONA AND THAILAND

Meghan Kokal (Northern Arizona University, Flagstaff, AZ)

Exotic animal care centers are run differently all around the world depending on governmental laws, funding, and the treatment of the animals. After spending time volunteering at the Wildlife Friends of Thailand Rescue Center in the summer of 2002, an interest in how animal care centers were ran in the United Sates compared to Thailand lead to research of animal care centers in Arizona. Keepers of the Wild and Southwest Wildlife rehabilitation and education foundation are two exotic animal care centers in Arizona that take care of many different species of animals. In Thailand the Phuket gibbon rehabilitation project is founded by The Wildlife Animal Rescue (WAR), and this project rehabilitates gibbons to be re-released into their natural habitat or ongoing care for those not able to be re-released. All of these animal care centers are no kill centers and if any of the animals are non-releasable they provide ongoing care for these animals through donations. Educating tourists and society about the effects of having exotic animals as pets or why society should leave wild animals wild is one of the major goals. These centers have to worry about many issues not directly dealing with the animals’ health, but dealing with legal and economical matters. A look into how each center operates, and deals with these legal and economical matters will determine if one country has a better animal care system than the other.

8:45 – 9:00 STUDIES OF HEMORRHAGIC DISEASE VECTORS (Genus Culicoides) IN SOUTHWESTERN ARIZONA

Steven S. Rosenstock, (Arizona Game and Fish Department, Phoenix, AZ), Frank Ramberg, (University of Arizona, Tucson, AZ), and James Collins, (University of Arizona, Tucson, AZ)

Biting midges (genus Culicoides) transmit viruses causing bluetongue (BTV) and epizootic hemorrhagic disease (EHDV), hemorrhagic diseases affecting wild and domestic ruminants. Because larval Culicoides require moist soil environments, it has been suggested that man-made wildlife waters may increase midge distribution and opportunities for viral infection. From 2001-2002, we sampled Culicoides at watered and unwatered sites in the
Sonoran Desert of southwestern Arizona and screened captured midges for BTV and EHDV. We also collected, reared, and identified larval Culicoides collected from suspected development sites. To assess virus prevalence among susceptible wildlife, we collected and analyzed blood samples from mule deer and desert bighorn sheep on the study area. Two species of Culicoides were common, even in areas far from water; the known vector C. sonorensis and a little-studied species C. mohave. BTV was largely absent, however a large proportion of C. mohave tested positive for EHDV. Larval Culicoides were not found in wildlife waters, however large numbers of C. sonorensis were collected from water treatment brine ponds. Preliminary analyses of blood samples suggest that exposure to EHDV may be fairly common among mule deer. Additional studies are needed to assess the vector capacity of C. mohave and the effects of hemorrhagic diseases on wildlife in southwestern Arizona.

9:00 – 9:15 ELEPHANT TRANSLOCATION IN MALAYSIA

Kate Jacobs (Northern Arizona University, Flagstaff, AZ)

The increase of the human population in Malaysia led to the demand for more food, which resulted in the increase of agricultural expansion. This had profound effects on the Asian Elephant, which suffered the decrease of its habitat as well as an increase in habitat fragmentation. Crops were often planted in the elephant’s home range in which extensive crop damage occurred because the elephants were either in search of food or they were trying to get thru to the other side of their range. This led to farmers killing the elephants at an alarming rate and eventually resulted in a slow decrease of the elephant population. In 1974, the Department of Wildlife and National Parks of Malaysia (DWNP) introduced the elephant capture and translocation program to help reduce man-elephant conflicts, to help maintain a viable elephant population, and to remove elephants whose habitats were being threatened. DWNP hopes to use radio telemetry collars for post-released monitoring, which has just recently been funded for in the last year. This would make tracking easier and would also aid in the knowledge of the elephant population and their ecology.

9:15 – 9:30 THE HHPCC OF FLAGSTAFF: PROMOTING A CLEAN AND SAFE ENVIRONMENT

Devon Davia (Northern Arizona University, Flagstaff, AZ)

Since 1993, Coconino County and the City of Flagstaff have been dedicated to reducing the amount of household hazardous waste (HHW) being discarded into the environment and Cinder Lake Landfill. Improper disposal of HHW can pollute the environment while presenting severe health risks. Products that are considered HHW possess toxic, corrosive, ignitable, and reactive properties such as automotive fluids, pesticides, gasoline, and oil based paints. With overwhelming public participation during annual HHW collections, which were held in downtown Flagstaff for nine years, the Arizona Department of Environmental Quality was encouraged to award a grant in Dec. 2001 to the City of Flagstaff to build a Household Hazardous Product Collection Center (HHPCC). The
facility was constructed next to the Cinder Lake Landfill and was collecting all categories of HHW by Oct. 2002. In addition, the HHPCC offers a Drop & Swap area in the facility where unused products that residents have dropped off are made available to the public for free. The purpose of the HHPCC is not only to keep HHW from contaminating the pristine environment of Flagstaff, but to educate the public on the dangers associated with using these products while recommending environmentally safe alternatives. The first several months of operation have been a success with 15 tons of HHW collected and the outlook for the HHPCC is optimistic.

9:30 – 9:45

LONG-TERM RESTORATION EFFECTS ON SOIL RESPIRATION IN A PONDEROSA PINE-BUNCHGRASS ECOSYSTEM

Jennifer Thomas (Northern Arizona University, Flagstaff, AZ)

Following European-American settlement in the western United States, livestock grazing, logging, fire suppression, and climatic events resulted in an unprecedented eruption of pine in ponderosa pine-bunchgrass ecosystems. Forests became congested with small, tightly-packed pines and little understory diversity. This contributed to a dramatic change in forest structure and fire regime. A large-scale restoration project was conducted near Flagstaff, AZ in 1993. The treatments included complete restoration, which included the use of prescribed burning and thinning, partial restoration, which was thinned, and a control. This study addresses the long-term effects of restoration on soil respiration. Respiration measurements from 2000 and 2001 indicate that no differences exist in soil respiration among treatments and the control. The lack of any relationship between soil respiration and soil microclimate measurements (temperature and moisture) suggests that restoration will not contribute to an increase in CO₂ efflux in ponderosa pine-bunchgrass ecosystems.

9:45 – 10:00

CREATING AND PROMOTING ENVIRONMENTAL EDUCATION IN USFS INTERPRETATION: A NEW MEDIUM TO REFLECT THE MISSION & POLICIES OF THE AGENCY

Ryan Tunseth, (Northern Arizona University, Flagstaff, AZ)

To advance environmental education in United States Forest Service interpretation, one must have an understanding of environmental education, interpretation, and the USFS mission. Definitions, principles, and goals of both interpretation and environmental education will be presented. Creating an understanding of both methods of delivering information will enhance interpretation and environmental education programs. The political aspects of interpretation have been identified, ensuring that both environmental education and interpretation reflect the goals and missions of the United States Forest Service.
Sonoran Desert of southwestern Arizona and screened captured midges for BTV and EHDV. We also collected, reared, and identified larval Culicoides collected from suspected development sites. To assess virus prevalence among susceptible wildlife, we collected and analyzed blood samples from mule deer and desert bighorn sheep on the study area. Two species of Culicoides were common, even in areas far from water; the known vector C. sonorensis and a little-studied species C. mohave. BTV was largely absent, however a large proportion of C. mohave tested positive for EHDV. Larval Culicoides were not found in wildlife waters, however large numbers of C. sonorensis were collected from water treatment brine ponds. Preliminary analyses of blood samples suggest that exposure to EHDV may be fairly common among mule deer. Additional studies are needed to assess the vector capacity of C. mohave and the effects of hemorrhagic diseases on wildlife in southwestern Arizona.

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ELEPHANT TRANSLOCATION IN MALAYSIA  
Kate Jacobs (Northern Arizona University, Flagstaff, AZ)

The increase of the human population in Malaysia led to the demand for more food, which resulted in the increase of agricultural expansion. This had profound effects on the Asian Elephant, which suffered the decrease of its habitat as well as an increase in habitat fragmentation. Crops were often planted in the elephant’s home range in which extensive crop damage occurred because the elephants were either in search of food or they were trying to get thru to the other side of their range. This led to farmers killing the elephants at an alarming rate and eventually resulted in a slow decrease of the elephant population. In 1974, the Department of Wildlife and National Parks of Malaysia (DWNP) introduced the elephant capture and translocation program to help reduce man-elephant conflicts, to help maintain a viable elephant population, and to remove elephants whose habitats were being threatened. DWNP hopes to use radio telemetry collars for post-released monitoring, which has just recently been funded for in the last year. This would make tracking easier and would also aid in the knowledge of the elephant population and their ecology.

9:15 – 9:30  
THE HHPCC OF FLAGSTAFF: PROMOTING A CLEAN AND SAFE ENVIRONMENT  
Devon Davia (Northern Arizona University, Flagstaff, AZ)

Since 1993, Coconino County and the City of Flagstaff have been dedicated to reducing the amount of household hazardous waste (HHW) being discarded into the environment and Cinder Lake Landfill. Improper disposal of HHW can pollute the environment while presenting severe health risks. Products that are considered HHW possess toxic, corrosive, ignitable, and reactive properties such as automotive fluids, pesticides, gasoline, and oil based paints. With overwhelming public participation during annual HHW collections, which were held in downtown Flagstaff for nine years, the Arizona Department of Environmental Quality was encouraged to award a grant in Dec. 2001 to the City of Flagstaff to build a Household Hazardous Product Collection Center (HHPCC). The
Temperature and dew points were recorded for one week during the prime tourist season at seven exclusive resorts in the Phoenix metropolitan area. Weather recording devices were placed within or immediately adjacent to the pool areas - the prime recreational site utilized by guests on most resort properties. This data was compared to that of the official data collected from the National Weather Service’s official site at Phoenix’s Sky Harbor Airport – the weather information accessible to potential tourists to assess predicted weather for vacation planning. Results were analyzed for possible correlation of the resorts’ microclimates geographic variables: elevation, topography, rural versus urban setting; landscape type and density. Landscape type and density was the most influential factor. More importantly, with a single exception, Sky Harbor’s recorded temperatures and dew points were consistently higher than those of the resorts.

CAP-LTER (Central Arizona Phoenix Long-Term Ecological Research) is one of the key LTER monitoring sites in the world ecological network and is one of the two urban sites. The metropolitan area of Phoenix has experienced rapid growth since WW II, and as a result local particulate levels have a human and natural root related to disturbances of the desert, and city functions. Spatial attenuation effects on one of the major driving forces of the climate system- solar radiation- are presented in this presentation. Two specific clear winter days are compared and contrasted in terms of synoptic factors and local processes affecting attenuation by way of modeling and field mobile transect observations to diffuse and global radiation. Overall the attenuation of Phoenix is comparable to some other urban/rural comparisons of solar differences, and must be further analyzed in order to aid in additional explanations of the urban ecological conditions.
8:30 – 8:45

EVAPO-SUBLIMATION LOSS FROM WINTER SNOWCOVER IN A NORTHERN ARIZONA PONDEROSA PINE FOREST SETTING

Paul Lauck (Northern Arizona University, Flagstaff, AZ)

This presentation previews a study that uses energy balance data collection methods and GIS modeling to evaluate evapo-sublimation of snow cover in a homogeneous Ponderosa pine forest setting. Evapo-sublimation of snow cover variables include snow density, snow age and structure, humidity, temperature and vapor pressure gradients, near surface wind speed and duration, and net radiant energy variables. Base data research has shown differences in sublimation rates depending on canopy cover and in shaded vs. unshaded open sky conditions. This study uses four observational treatment settings, each based on its potential solar radiation availability; a) full day, b) morning only, c) afternoon only, and d) no potential direct solar radiation due to canopy cover. Seven sampling sites are used per treatment, with data being collected in approximately 48-hour continuous periods. The sampling is repeated at each site on a monthly basis from November through April. Analysis of variance between like treatment sampling sites will determine the correlation of data per treatment, and analysis of covariance between sample data and energy balance data gathered simultaneously will determine overall site homogeneity. A predictive model, consisting of a similar forest landscape, will then be constructed in a GIS and the predictive values for random site evapo-sublimation will be cross validated with empirically collected data.

8:45 – 9:00

DISCUSSION AND BREAK

9:00 – 9:15

ARCHAEOLOGICAL GIS: AN APPLICATION OVERVIEW AND SITESCAPE INVESTIGATION.

Vince Warner (Northern Arizona University, Flagstaff, AZ)

The use of Geographic Information Systems (GIS) in the United States found its origin in predictive modeling projects initiated by government agencies for the purpose of managing large amounts of land in the western United States. Archaeological GIS in the United States is still focused on regional or large-scale modeling and not site-specific applications. In contrast to the large-scale emphasis of the United States, most European countries focus their GIS analysis on inter or intra-site spatial relationships and theorize about the cognitive significance behind certain prehistoric decisions. The reason for the lack of GIS in American site-specific spatial analysis is the focus of this research. The research consists of a site-specific application and comparison of multiple GIS software packages to evaluate the inherent costs, necessary data conversion and cleaning, and required training in order to employ GIS in site-specific spatial analysis. A quantification of archaeological GIS use in the literature will illustrate the actual GIS applications employed during the past ten
years. Finally, a survey of professional archaeologists in the United States and their opinion on GIS use in archaeology will illustrate the current perceptions and concerns surrounding archaeological GIS.

9:15 – 9:30
THE NEXT FRONTIER IN VEGETATION MAPPING: USING CLASSIFICATION TREES

Sarah Falzarano and Kathryn Thomas (USGS Southwest Biological Science Center, Flagstaff, AZ)

A new technique of using classification trees to model vegetation types is being explored in the Gap Analysis Project in Arizona. This method takes advantage of associations between vegetation types and numerous variables like elevation and derived layers (like slope, aspect, and soil moisture), satellite imagery and derived layers (like NDVI, and tasseled cap indices), and ancillary variables (like geology, precipitation, and temperature). Rules from the classification trees are implemented in a GIS to produce a land cover map. Preliminary results in the Sonoran Desert will be discussed.

9:30 – 9:45
TRACKING THE MOVEMENT OF FOUR PINYON-JUNIPER WOODLAND DOMINANTS OVER THE LAST 30,000 YEARS

John A. Cannella (Northern Arizona University, Flagstaff, AZ), Kenneth L. Cole (U.S. Geological Survey, Flagstaff, AZ), and Samantha T. Arundel (Northern Arizona University, Flagstaff, AZ)

The Pinyon-Juniper Woodland (PJW), covering more than 17 million hectares, is a dominant physiographic unit of landscapes in the Southwestern United States today. Several species dominate this PJW association today, including Colorado Pinyon (Pinus edulis), Single-Needled Pinyon (Pinus monophylla), Utah Juniper (Juniperus osteosperma), and One-Seeded Juniper (Juniperus monosperma). Macrofossil evidence indicates that these woodlands have not always existed in the locations where they are found today and that individual dominant species have migrated from different glacial ranges to their current distributions rather recently in terms of geological time. Our research objective was to explore how these four dominants of contemporary PJWs have migrated since the last glacial maximum. We developed a spatial database documenting all published packrat midden macrofossil records; ca. 400 sites, ca. 2000 radiocarbon dated assemblages, and ca. 20,000 macrofossil records. Using a GIS, we mapped the past distributions of the four species and their migrations over the last 30,000 years before present (yr B.P.). Contrary to the current PJW dominant species’ distributions and associations, our results reveal a series of individualistic shifts and associations of these species over the past 30,000 years. For example, P. edulis was restricted to central/southwestern New Mexico and Northeastern Texas ca. 30,000 yr B.P. while J. osteosperma, its contemporary co-dominant juniper, was restricted to sites in Utah Arizona, Nevada, and California. The earliest that both species
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anthropogenic and natural hydrologic regimes within the valley. It also provided a valuable framework for organizing subsequent analysis of six aerial photograph series dating from the period 1935–1996. The photo analysis quantified change in vegetated floodplain surface, irrigated land areas, and relative frequency of channel avulsion along leveed and vegetated banks. Study methods and results from analysis of a four-mile subreach of the river corridor will be presented.

11:00 – 11:15  BEYOND DEVIL’S HOLE AND CAPPART: PRAXIS AND PROSPECT

Frances R. Peck (Arizona State University, Tempe, AZ)

In the mid-to-late 1960s, scientists and conservationists concluded the Ash Meadows ecosystem in Nevada was being harmed by the over pumping of groundwater for crop irrigation in the surrounding area, and the water level in Ash Meadows springs, and specifically in Devil’s Hole, was dropping dramatically. In a precedent-setting decision in *Cappaert v U.S.*, 426 U.S. 128 in 1976, the United States Supreme Court upheld the decision by the lower court to rescind state-granted water rights to Cappaert, and effectively the community, in order to ensure adequate water levels for fish habitat, specifically in Devil’s Hole in Ash Meadows. Local opinion of this decision was extremely negative, and there was concern that this decision would severely impact the growth and development of the area. This paper traces the impact this decision has had on the community of Pahrump, NV using a variety of indicators of community development. While agriculture has decreased over the past 30 years, the population has substantially increased. Additionally, Pahrump is touted as a “bedroom community” of Las Vegas. Pahrump and the surrounding area still have serious water issues to be addressed. However, while the Cappaert decision may have altered the type of development, it appears to have had little impact on the actual growth of the community.

11:15 – 11:30  DISCUSSION

11:30 – 1:40  ANNUAL ANAS AWARDS LUNCHEON AND BUSINESS MEETING: BALLROOM DUBOIS CONFERENCE CENTER

SESSION II

1:45 – 2:00  GUATEMALA: IMPRESSIONS OF A DEVELOPING NATION

Christina Kennedy, (Northern Arizona University, Flagstaff, AZ)

A country slightly smaller than Tennessee in size, Guatemala has a rapidly growing population, high poverty level, and environmental issues that include deforestation, soil erosion and water pollution. The capital city, Guatemala City, is a textbook example of burgeoning third world cities with their surrounding squatter settlements. Recovering from a
thirty-year war, Guatemala is turning increasingly to tourism as a source of income. In recent years, Antigua, Guatemala has become world famous as a center for Spanish Language Schools.

In his paper I first present a brief “factual” overview of Guatemala. I then report on experiences and impressions gained from observing with a “naïve eye”, during a two month period, the cultures and key tourist locations of Guatemala. Antigua, Lake Atitlan, Monterico, and the Peten are discussed. Finally, I compare the sense of “aliveness” in Guatemala and the United States.

2:00 – 2:15  CLIMATE AND ITS ROLE IN THE CAP-LTER STUDY

Anthony J. Brazel (Arizona State University, Tempe, AZ)

CAP-LTER (Central Arizona Phoenix Long-Term Ecological Research) is one of the key LTER monitoring sites in the world ecological network and is one of two urban sites (funded through the National Science Foundation). The choice of Phoenix as one of the urban sites (Baltimore, MD is the other) is key, because all growth issues, coupled with much temporal and spatial environmental variability issues in this supposed constrained human ecosystem, are illustrative of rates of change that are rapid, have a relatively short history, and potentially an explosive future. One story is one of the most rapid and intense urban climate changes on earth. Researchers in CAP-LTER are focusing on ENSO-CAP-LTER relationships, MM5 meso-scale numerical modeling, paleoclimate, climate-productivity relations, and urban heat island modeling/mitigation.

2:15 – 2:30  HAS URBANIZATION DECREASED DAILY TEMPERATURE RANGE IN METROPOLITAN PHOENIX?

Talbot J. Brooks, Brent Hedquist, Gregory Goodrich, Adam Kalkstein, Shouriseni San Roy, and Nirmala Palicherla (Arizona State University, Tempe, AZ)

Increased urbanization of Metropolitan Phoenix is known to have created an urban heat island. Formation of the heat island is primarily attributed to changes in surface albedo and increased heat storage in man-made structures. The existence of a heat island suggests a potential delay in nighttime cooling that would significantly decrease daily temperature range. This study compares the expansion of the urban fringe with yearly average temperature range. Minimum and maximum daily temperature for 14 Arizona Meteorological Network recording stations were used to create annual average daily temperature range for a 12-year time span. The geographic location of each station was plotted using GIS software. Annual average daily temperature range was extrapolated to grid and rate of change per year calculated. Results indicate that urbanization significantly decreases daily temperature range for Metropolitan Phoenix.
We posit that rock glaciers can be formed, maintained and grow via "Balch ventilation" in a self-enhancing positive feedback loop. The constituents of this are: 1) Balch ventilation: In all seasons, denser colder air sinks into the rock matrix while warm air rises and is displaced upwards leaving the coldest air at the rock-ice interface. 2) Even on the warmest days, rock glaciers will nearly always exhibit a net heat loss. 3) The conduction of heat through the rock mantle will be slow and at a level exceeded by Balch ventilation. A pilot study is presented comparing two 24 hour energy balance runs, one run over an active rock glacier and the other run over an inactive rock glacier. The active rock glacier is located immediately north of Engineer Pass in the San Juan Mountains of Colorado. The inactive rock glacier is located .25 km northwest of Fremont Peak in the San Francisco Mountain group of northern Arizona. Both rock glaciers are instrumented with a full array of energy balance sensors. The instrument array is sampled every minute and averaged or totalized every ten minutes for 24 hours. Results show a remarkably steep near surface temperature gradient of 2.40°C cm⁻¹ during the warmest part of the day for the active rock glacier compared to 1.62°C cm⁻¹ during the warmest part of the day for the inactive rock glacier. Overall ground heat flux was slightly negative for the active rock glacier and slightly positive for the inactive rock glacier. Both of the characteristics found on the active rock glacier should be present if Balch ventilation is operating.
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Valley during the late Wisconsinan period. It expanded northward up the Colorado River Valley and adjacent valleys during the early Holocene, reaching the Marble Mountains (southern Mojave boundary) by 8780 yr B.P., and the western Grand Canyon (eastern Mojave) by 7860 yr B.P. By the middle Holocene it had expanded as far north as the Sheep Range of southern Nevada and grew at higher elevation than today. Yet it did not approach its northern extreme limits at Eureka Valley, CA, Whitmore Wash, AZ, and Verde Valley AZ, until between 4000 and 2000 yr B.P. A digital map of the modern range of creosote was produced (http://www.usgs.nau.edu/global_change/RangeMaps.html) and compared to modern climatic values. Spatial analysis between the two confirms prior research suggesting that the northern boundary of creosote bush is controlled by minimum winter temperature. Extrapolation of these modern climatic values to the projected middle Holocene northern geographic limit of creosote suggests an improbable winter minimum temperature of at least 4°C less than today. Because other proxy indicators indicate higher than current temperatures during the middle Holocene, these data suggest that creosote was still migrating, and in disequilibrium with climate, in response to a climate change that had taken place 5000 to 8000 years earlier.

9:30 – 9:45  
MIDDLE WISCONSINAN VEGETATION HISTORY OF THE COLORADO PLATEAU, UTAH AND ARIZONA, USA

Larry L. Coats (Northern Arizona University, Flagstaff, AZ), Kenneth L. Cole (USGS-CPFS, Flagstaff, AZ) and Jim I. Mead (Northern Arizona University, Flagstaff, AZ)

We report the results of paleoenvironmental studies using packrat middens collected from the Colorado Plateau in Canyonlands and Grand Canyon National Parks. Sixteen of the sixty middens analyzed yielded a middle Wisconsinan age, dating from ca. 27,000 to 46,000 yr BP. These are the oldest midden series yet discovered on the Colorado Plateau. A striking difference in climatic signals is apparent in the middle Wisconsinan records from the various localities, depending upon location and elevation. Xeric/warm vegetation is recorded in middens from Canyonlands at middle elevations (1359 to 1505 m) in east-central Utah, while mesic/cool vegetation is recorded from low elevations in the eastern Grand Canyon (1150 m) and high elevations (1706 m elevation) in Canyonlands. The mid-Wisconsinan middle elevation records from Canyonlands are particularly unusual in that they contain fossils of Arizona single needle pinyon (Pinus edulis var. fallax), a species that today is more typical of areas in central Arizona with monsoon precipitation. The presence of this species, and the absence of most montane species, contrasts sharply with the mesic late Wisconsinan assemblages from nearby localities. During an interstadial climate regime, with temperatures only slightly below modern temperatures, a weak monsoonal flow probably was present during summer months, contributing to increased availability of moisture at Little Nankoweap, and possibly influencing the vegetation as far north as central Utah.

9:45 – 10:00  
*THE POSTGLACIAL-PALOEKOLOGICAL RECORD FROM LITTLE MOLAS LAKE, SAN JUAN MOUNTAINS, CO

Jaime L. Toney and R. Scott Anderson (Northern Arizona University, Flagstaff, AZ)
The paleoecological record developed from a ~4.5m sediment core from Little Molas Lake (LML), San Juan County, CO, has a basal date of 11,203±360 cal yrs B.P. Poorly-sorted sediment at the base of the core suggests LML was formed at the end of the LGM. The transition to turbated clay and gyttja with lower MS and higher organic carbon (TOC) indicates a sediment source from in-lake productivity and outwash sediments from ~11,100 cal yrs BP until ~10,200 cal yrs B.P. After 10,200 cal yrs B.P., the transition to gyttja indicates the end of glacially derived sediment. Background levels of TOC and MS remain stable until 5700 cal yrs B.P., when TOC rises and MS declines due to increased charcoal. Fire was a part of the ecology around LML from ~11,200 cal yrs B.P. until ~1953 AD, after which fire suppression occurred. The largest charcoal peaks occur at ~11,200, 9100, 7600, and from ~5000 cal yrs B.P. until 47 cal yrs B.P. (1953 AD). Ratios of Spruce/Pine, Spruce/Artemisia, and Conifer/Non-arboreal Pollen (C/NAP) indicate that spruce surrounded the lake from 11,100-10,800, 10,200, 9500-9100, 8700-7900, 6750-6100, 5400-5000, 3500-2900, and 1805-1400 cal yrs B.P. Conifer stands occurred around the lake from: 10,800-10,600, 10,500-9000, 7300-6750, and 6700-6200 cal yrs B.P. Spruce dominated the conifer stands from 5400-5000, 3500-2900, and 1805-1400 cal yrs B.P., which are contemporaneous with high fire frequency.

10:00 – 10:30 COFFEE BREAK IN FOYER

10:30 – 10:45 HOLOCENE STRATIGRAPHY AND GEOCHRONOLOGY OF SMALL ALLUVIAL FANS IN THE PONDEROSA PINE FOREST ECOSYSTEM OF NORTHERN ARIZONA

Robert Duncan Richardson, (Northern Arizona University, Flagstaff, AZ) and Diana Elder Anderson, (Northern Arizona University, Flagstaff, AZ)

Present within much of the limestone lithology of the high-elevation ponderosa pine forest of northern Arizona are small drainages (<5km²), many producing single alluvial fans. Alluvial fan stratigraphy and radiocarbon chronology provide insight into the cause and timing of erosion from the fan’s corresponding drainage basin. Five alluvial fans were chosen for this study based on the presence of at least 1m subsurface exposure, fan location within limestone lithology, and drainage basin size <5km². Hand-auger cores taken at 10cm increments below the deepest exposure of each fan extend sample depths. Fourteen radiocarbon dates were used to construct fan geochronologies. Two auger cores from separate fans reached bedrock, and record stratigraphic sequences spanning the entire Holocene. Fan aggradation from these two cores initiated at the Pleistocene-Holocene boundary and was marked by the highest sedimentation rates of the study (>100cm/1000yr). The lowest recorded sedimentation rates (<10cm/1000yr) and possibly a depositional hiatus correspond with the previously documented dry middle Holocene (8-4 ka B.P.). Lastly, fan aggradation during the past 4000-years was characterized by moderate sedimentation rates (~50cm/1000yr) and approximately 1m of cumulic soil development. Preliminary analyses suggest hillslope
erosion and subsequent alluvial fan aggradation is a result of climate change and possibly fire.

10:45 – 11:00 ENDOSKELETOZOAN TRACE FOSSIL FROM THE PENNSYLVANIAN NACO FORMATION AT KOHL RANCH, CENTRAL ARIZONA

Helen C. Dyer and David K. Elliott (Department of Geology, Northern Arizona University, Flagstaff, AZ)

Studies on brachiopods from the Naco Formation (Desmoinesian) have revealed the presence of a variety of endo- and episkeletozoans. These include encrusting bryozoans and attachment points for crinoids and branching bryozoans together with a variety of borings, some of which have been made by acrothoracid barnacles. Ramifying burrows are present in a significant proportion of the shells of the most common brachiopods, Composita subtilita, Anthracospirifer occiduus, and Derbyia crassa, and are the microborings of an unknown organism. These borings are 0.1-0.2mm in diameter and form a ramifying network that is often matted in appearance. Although the organism is unknown this endoskeletozoan is identified as the trace fossil Conchotrema.

It is assumed that the borings represent the living chambers of a colonial organism that filter-fed from the openings on the shell. Studies of the proportions of valves of each species that have been bored show that the smooth shelled Composita has the highest proportion of infested valves (67 %) compared to the ridged shells of Anthracospirifer (32 %) and Derbyia (23 %). This may relate to the difficulties of developing a ramifying burrow system in a shell that is ridged and folded. Additionally, the fact that borings are equally common on dorsal and ventral valves in Composita corroborates the view that they were moored by the pedicle above the sea floor, while the discrepancy between numbers of borings in the dorsal and ventral valves of Derbyia and Anthracospirifer indicates that they lay on one valve with the other exposed.

11:15 – 11:30 *SEGMENT LINKAGE AND STRAIN PARTITIONING IN THE SOUTH VIRGIN-WHITE HILLS DETACHMENT, NW ARIZONA

Kristi L. Ross and Ernest M. Duebendorfer, (Northern Arizona University, Flagstaff, AZ)

A major, 55 km-long, low-angle normal (detachment) fault in northwestern Arizona, the South Virgin-White Hills detachment (SVWHD), exhibits variable displacement along its strike. The SVWHD strikes north-south and comprises three segments; the Lakeside Mine, Salt Spring and Cyclopic Mine faults, respectively, from north to south. The linkage of normal fault segments in extensional regions is often facilitated by extension-parallel strike-slip (transfer) faults. These transfer faults separate the footwall of the major, extension-accommodating detachment fault into areas of relatively high and relatively low amounts of extension. Preliminary field work near the segment boundary between the Salt Spring and Cyclopic Mine faults suggests that such a mechanism may have served to partition strain
The paleoecological record developed from a ~4.5m sediment core from Little Molas Lake (LML), San Juan County, CO has a basal date of 11,203±360 cal yrs B.P.. Poorly-sorted sediment at the base of the core suggests LML was formed at the end of the LGM. The transition to turbated clay and gyttja with lower MS and higher organic carbon (TOC) indicates a sediment source from in-lake productivity and outwash sediments from ~11,100 cal yrs BP until ~10,200 cal yrs B.P. After 10,200 cal yrs B.P., the transition to gyttja indicates the end of glacially derived sediment. Background levels of TOC and MS remain stable until 5700 cal yrs B.P., when TOC rises and MS declines due to increased charcoal. Fire was a part of the ecology around LML from ~11,200 cal yrs B.P. until ~1953 AD, after which fire suppression occurred. The largest charcoal peaks occur at ~11,200, 9100, 7600, and from ~5000 cal yrs B.P. until 47 cal yrs B.P. (1953 AD). Ratios of Spruce/Pine, Spruce/Artemisia, and Conifer/Non-arboreal Pollen (C/NAP) indicate that spruce surrounded the lake from 11,100-10,800, 10,200, 9500-9100, 8700-7900, 6750-6100, 5400-5000, 3500-2900, and 1805-1400 cal yrs B.P.. Conifer stands occurred around the lake from: 10,800-10,600, 10,500-9000, 7300-6750, and 6700-6200 cal yrs B.P. Spruce dominated the conifer stands from 5400-5000, 3500-2900, and 1805-1400 cal yrs B.P, which are contemporaneous with high fire frequency.

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HYDROLOGY SECTION

Session I  8:00

ROOM:  117

Co-chairpersons:  Roy Jemison
Gerald Gottfried

8:00 – 8:15  *GIS-BASED ANALYSIS OF MOUNTAIN BLOCK RECHARGE FOR OWENS LAKE PLAYA, CALIFORNIA

Anna Draa and Richard L. Orndorff (University of Nevada Las Vegas, Las Vegas, NV)

Owens Valley has supplied Los Angeles, California with fresh water since 1913, yet recharge values for the confined aquifers in the valley are not known. Development of this region as a fresh water source has altered surface and groundwater hydrology; Owens Lake, once covering 270 km², is now completely desiccated. Management of the Owens Valley hydrologic system has always relied on an assumption of equilibrium with modern climate. This study quantifies mountain block recharge (MBR) for the Owens Lake Playa aquifers at the southernmost end of Owens Valley. Mountain block recharge is the amount of inflow a drainage basin receives from the surrounding mountains by infiltration of water through bedrock.

We use ArcView GIS to create climate surfaces for the bounding mountain fronts from climate station data. We then determine the fraction of annual precipitation that is MBR using the methodology of Maxey and Eakin (1949) and Donovan and Katzer (2000). Our results suggest that water managers may have overestimated the amount of modern groundwater recharge to the Owens Lake Playa by 50%.

8:15 – 8:30  HUMAN MODIFICATION OF THE UPPER MIDDLE RIO GRANDE: USING GIT TECHNIQUES TO MEASURE CHANGE BETWEEN ALBUQUERQUE AND COCHITI DAM, NEW MEXICO

Joseph J. Fluder III (Earth and Planetary Sciences, University of New Mexico, SWCA Environmental Consulting, Albuquerque, NM)

Human modification of the middle Rio Grande has been occurring intensely since the 1930s, including the construction of dams, levees, and canals. The alteration of the river disrupts natural flow regimes, impacting the river channel, island formation, and riparian vegetation of the Rio Grande. Using geographic information technologies (GIT), mainly GIS and image processing techniques, researchers are able to measure spatial changes temporally. Aerial photographs from 1935, 1954, 1975, and 1996 were used to analyze changes in channel and vegetative boundaries, vegetation cover, and island formation at six sites.
between Albuquerque and Cochiti Dam. Cochiti Dam is located 80 kilometers (50 miles) upstream of Albuquerque. The vegetal measurement techniques focused on overall changes within the riparian communities instead of changes in composition between dominant deciduous communities: cottonwoods, willows, tamarisks, and Russian olive. Results indicate a decrease in channel area and an increase in island formation, vegetative area and vegetative cover. Measuring these changes using GIT techniques, and understanding competitive and historical development, allows resource managers, planners, and scientists, among others, to comprehend the effect human modification has on a natural system.

8:30 – 8:45  
RIPARIAN AND HYDROGEOMORPHOLOGIC CHANGES IN RESPONSE TO LAND USE AND CLIMATE CHANGE IN THE VERDE VALLEY OF ARIZONA

Sharon Masek Lopez, Abraham Springer, and Diana Anderson (Department of Environmental Sciences and the School of Forestry, Northern Arizona University, Flagstaff, AZ)

Researchers compared the historical riparian system with the modern system to determine changes in woody riparian vegetation (cottonwood-willow and mesquite). Historic aerial photographs were interpreted in the Verde Valley from 1940, 1954, 1968, 1977, 1989, and 1995. Aerial photos were scanned and georeferenced to create digital images that were used to map historic riparian vegetation, land use and river morphology in ArcView. Linear regression analysis revealed significant relationships between land use change and high-density mesquite coverage and between river morphology change and high-density cottonwood-willow coverage. In this study, climate and flooding appear to have had the greatest influence on changes in riparian vegetation distribution. However, future research is planned to create a spatial statistical model of the study area to determine the portion of riparian change attributable to land use changes. Using the generated model, we will also attempt to predict hydrogeomorphologic and riparian vegetation distribution changes as responses to various climate and land use change scenarios. This information will be useful for land use planning to protect the river corridor, taking into consideration population growth and global climate change.

8:45 – 9:00  
VARIATIONS IN RIPARIAN AREA VEGETATION CHARACTERISTICS ALONG THE WET BEAVER AND BEAVER CREEKS OF NORTH CENTRAL ARIZONA

Patrick Phillips and Aregai Tecle (School of Forestry, Northern Arizona University, Flagstaff, AZ)

This study evaluates riparian vegetation species diversity and variation along a tributary stream to the Verde River in North Central Arizona. The stream is Beaver Creek and its perennial tributary, Wet Beaver Creek. Wet Beaver Creek originates in the ponderosa pine forest area along the southern edge of the Colorado Plateau and flows for about 32 kilometers (20 miles) before it is joined by the Dry Beaver Creek to form the Beaver Creek.
The latter flows for another 14 kilometers (9 miles) to join the Verde River near the town of Camp Verde. A long history of human activities such as irrigated agriculture along the floodplains, removal of beaver, intense ranching and grazing, residential development, and recreation have affected the composition and distribution of the riparian vegetation along the study stream. These effects may be assessed in terms of biological diversity indices, successional stages of riparian forests, and presence of non-native invasive species. We measured different aspects of these indicators at sixteen randomly selected transects in the study area to determine the effects of human settlement impacts on the riparian vegetation. The results of this study will be useful to watershed resource managers and other interested parties for the evaluation of riparian vegetation conditions in the Beaver Creek area and other similar watersheds.

9:00 – 9:15 THE AFFECTS RESTORATION HAS ON SOIL COMPACTION IN THE MIDDLE RIO GRANDE BOSQUE OF NEW MEXICO

Cody L. Stropki (Water Resources Program, University of New Mexico, Albuquerque, New Mexico) and Roy Jemison, USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM)

The increase of exotic fuels in the Middle Rio Grande Bosque (riparian forest) can be attributed to several changes in the ecosystem, mostly the introduction of non-native flora such as *Tamarix chinensis* (salt cedar) and *Elaeagnus angustifolia* (Russian olive) in the early 1900’s and the channelization and damming of the Rio Grande. Starting in 2002, restoration projects were begun to reduce fuel loads that could lead to catastrophic fire in the bosque. Part of the process involves removing non-native vegetation and dead and downed woody materials. Heavy machinery and vehicles are often driven in the bosque to assist with this removal. If we are not careful, while attempting to solve one problem we could be creating others. The question is, “Are the methods and equipment used during fuel reduction treatments in the bosque having an effect on soil compaction?” For restoration projects to be successful in these unique and limited ecosystems, information is needed to prevent unwanted changes. To address this issue, we are measuring soil bulk density and moisture before and after treatments to determine changes that occur. This information will be beneficial to agencies and individuals involved in management and restoration projects on the Rio Grande bosque, as well as others working in similar ecosystems.

9:15 – 9:30 THE RE-INTRODUCTION OF FOSSIL SPRINGS’ FLOW TO FOSSIL CREEK IN THREE POSSIBLE SCENARIOS

Cory Helton (Civil and Environmental Engineering Department, Northern Arizona University, Flagstaff, AZ)

The decommissioning of Irving dam, just below the Fossil Creek Springs in central Arizona presents a unique and important opportunity to watershed restoration. These springs are nestled in the rugged wilderness of the Mogollon Rim just west of the small town of Strawberry, and they are one of the few springs in Arizona that has mineral calcite. Calcite is
between Albuquerque and Cochiti Dam. Cochiti Dam is located 80 kilometers (50 miles) upstream of Albuquerque. The vegetal measurement techniques focused on overall changes within the riparian communities instead of changes in composition between dominant deciduous communities: cottonwoods, willows, tamarisks, and Russian olive. Results indicate a decrease in channel area and an increase in island formation, vegetative area and vegetative cover. Measuring these changes using GIT techniques, and understanding competitive and historical development, allows resource managers, planners, and scientists, among others, to comprehend the effect human modification has on a natural system.

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Sharon Masek Lopez, Abraham Springer, and Diana Anderson (Department of Environmental Sciences and the School of Forestry, Northern Arizona University, Flagstaff, AZ)

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This study evaluates riparian vegetation species diversity and variation along a tributary stream to the Verde River in North Central Arizona. The stream is Beaver Creek and its perennial tributary, Wet Beaver Creek. Wet Beaver Creek originates in the ponderosa pine forest area along the southern edge of the Colorado Plateau and flows for about 32 kilometers (20 miles) before it is joined by the Dry Beaver Creek to form the Beaver Creek.
area near Flagstaff, Arizona. Flagstaff is a water-deficient area with plans of augmenting its water supply with reclaimed water reuse. At the moment, the City produces about 4 million gallons (15.1 million liters) per day of treated wastewater with 1.6 million gallons (6.1 million liters) of it tertiary treated in its Rio de Flag wastewater treatment facility. In 2002, the City Council approved a decision to sell up to 1.5 million gallons (5.7 million liters) per day of its tertiary treated reclaimed water for snowmaking on Snowbowl. Recently, the facility has been operating intermittently due to lack of snow and wants to augment winter snowfall with artificial snowmaking to have a continuously reliable operation during the skiing season. However, the proposal has become controversial with serious desirable and undesirable issues. The benefits to the local community from uninterrupted operation of the facility are in the form of some 400 permanent and temporary jobs, a $20 million per year addition to the local economy when fully operational, and having a nearby recreational facility for many local residents. But, selling the reclaimed water would also have some undesirable effects. It reduces the amount of water recharging the local groundwater system and the available water to maintain the perennial wetlands downstream from the treatment plant. Other prominent concerns on the proposed snowmaking project are desecration of Native American sacred areas and possible introduction of chemical contaminants into the pristine environment around the skiing area. This paper considers all these issues to evaluate the viability of the proposed project in the Flagstaff area.

10:00 – 10:30 COFFEE BREAK IN FOYER

10:30 – 10:45 ESTABLISHING SATURATED CONDITIONS IN SOILS: A REVIEW OF CURRENT METHODS AND AN INTRODUCTION TO VACUUM SATURATION AS AN AFFECTIVE ALTERNATIVE METHOD

Kyle Roseborrough (School of Forestry, Northern Arizona University, Flagstaff, AZ)

Establishment of saturated conditions is a fundamental step when evaluating many hydraulic properties of soils. A review and comparison of current methods to saturate soils will be explored in this paper. Although saturating poorly consolidated or sandy soils is relatively easy, as clay content or the degree of compaction increases, attaining complete saturation becomes more difficult. Typical laboratory methods for saturating soils with low hydraulic conductivity rates rely upon large amounts of time or pressure to force the movement of water through a sample. In this paper, the concept of saturating soils using a vacuum saturation method is introduced as an alternative to existing saturating methods. The vacuum saturation method utilizes equipment typically found in a laboratory and may be a quick, simple, and affective method to saturate soils.

10:45 – 11:00 IMPACT OF SLASH PILE SIZE AND BURNING ON SOIL PHYSICAL CHARACTERISTICS IN THE PONDEROSA PINE (PINUS PONDEROSA) FOREST TYPE
Slash pile burns associated with restoration thinning treatments may change soil characteristics resulting in broad implications for ecosystem functions, processes, and management. In this study, we performed an experiment to explore the impacts of slash pile size and burning on various soil physical characteristics. The specific soil characteristics measured in experimental plots at the Arboretum in Flagstaff, AZ, include soil moisture content, rates of water infiltration into soil, bulk density and porosity. The experimental plots consist of burned and unburned plots crossed with large and small slash piles. The slash from the unburned plots was removed and chipped for disposal elsewhere. The results show no differences of water infiltration rates in the soils under the different treatments, leading us to assume that burning slash piles did not form a hydrophobic layer in the soil. However, bulk densities are higher in burned pile plots than in unburned pile plots. Unburned slash pile sites indicated having lower soil bulk density than control sites. The conclusion from this study is that there are not significant changes in soil characteristics following burning hand piled slash.

11:00 – 11:15  
**SOIL WATER IMPACTS OF FOREST TREATMENT TO PREVENT CATASTROPHIC WILDFIRES IN APONDEROSA PINE FOREST ECOSYSTEM**

Boris Poff and Aregai Tecle (School of Forestry, Northern Arizona University, Flagstaff, AZ)

Severe fire seasons such as those of 2000 and 2002 have led communities with a large Wildland-Urban Interface (WUI) to develop programs that reduce the risk of catastrophic wildfires. Flagstaff, Arizona is such a community that has been conducting different levels of fuel reduction treatments within its WUI for a number of years. However, though these treatments reduce the risk of wildfires, there is not enough information to know all the possible effects of such treatments on southwestern ponderosa pine forest ecosystem functions. For example, the effects of reduction in forest density on water infiltration rate and soil moisture conditions, the subjects of this study, are not well known. There are many factors including post treatment tree density and distribution, understory vegetation cover, soil, precipitation and topographic characteristics that influence water infiltration rate and soil moisture conditions. Hence, this study explores the effects of restoration treatments on these conditions. The study consists of selecting measurement plots at sites that vary with respect to treatment levels and time of treatment periods. The preliminary results show that soil moisture is higher in treated sites compared to adjacent control/untreated sites, and the amount seems to increase with length of time since treatment. The results for infiltration rates are less conclusive, and we are conducting more tests to arrive at a definite conclusion in this case.

11:15 – 11:30  
**BUSINESS MEETING**

11:30 – 1:40  
**ANNUAL ANAS AWARDS LUNCHEON AND BUSINESS MEETING: BALLROOM DUBOIS CONFERENCE CENTER**
SESSION II

1:45 – 2:00 SOIL CONDITION OBJECTIVES FOR ECOSYSTEM MANAGEMENT

George T. Robertson (USDA Forest Service, Tonto National Forest, Phoenix, AZ), Wayne A. Robbie and Steve H. Strenger (USDA Forest Service, Southwestern Region, Albuquerque, NM)

Management activities create various degrees of disturbance which influence basic soil functions that include potential changes in stability (erosion), hydrologic function (infiltration) and nutrient cycling. Soil quality is assessed in the Southwest as soil condition and is evaluated by using soil indicators to determine the status of the three vital soil functions. Through the use of soil condition objectives, thresholds are determined that indicate when changes in soil properties (indicators) would result in a reduction or loss of soil functions. Soil condition is rated as satisfactory, unsatisfactory or impaired based upon the degree of change for soil indicators and evaluating the spatial and temporal extent of the disturbance.

Soil condition objectives assist managers in designing land management prescriptions that ensure long-term soil productivity and sustainability of terrestrial ecosystems. Soil condition becomes integrated into environmental assessments and monitoring plans through the NEPA process. Soil condition is determined, objectives are established, and any management actions responsible for a decline in soil condition are identified. Alternatives are developed to identify appropriate management practices that are designed to restore soil function and enhance soil productivity. Soil quality monitoring plans ensure that ecologically sustainable land management prescriptions and practices are being applied and that soil condition objectives are being met.

2:00 – 2:15 LIVESTOCK GRAZING, WILDFIRE AND FISHERIES MANAGEMENT: RELATIVE IMPACTS ON SUSTAINABILITY OF NATIVE SOUTHWESTERN FISHES

John N. Rinne (USDA, Forest Service, Rocky Mountain Research Station, Flagstaff, AZ)

Livestock grazing has been a land use in parts of the Southwestern United States since European settlement in the mid-1500s. The U. S. Forest Service has managed much of this landscape for approximately 100 years. In the last century, a major component of fisheries management in the waters of the Southwest has been to introduce nonnative, primarily sport fish species. All these management activities affected both the landscapes and riparian stream areas that were inhabited by a specialized native fish fauna. Grazing and nonnative fishes have been implicated as negative impacts on native fishes. Recent data on wildfires in the Southwest has demonstrated the impact of this component of forest management on this same suite of fish species, many of which are threatened, endangered, and sensitive. The question could be phrased, “What are the relative impacts on sustainability of native fishes by these land and water uses as affected by past and current management strategies?” The paper will present 1) data on the three potential impacts, 2)
delineate the relative impact of each on a rare, declining native fish fauna, and 3) make recommendations for possible future management considerations for each.

2:15 – 2:30  GROUND WATER – WOODY PLANT RELATIONSHIPS IN THE MIDDLE RIO GRANDE BOSQUE OF NEW MEXICO

Roy Jemison (USDA Forest Service, Rocky Mountain Research Station, Albuquerque, NM)

The Rocky Mountain Research Station is working with other federal, state, and city agencies to determine management strategies that can be used to reduce the risk of catastrophic wild fires in the Bosque (riparian forests) bordering the Middle Rio Grande in NM. The Bosque, one of the longest and most contiguous riparian zones in the western US, developed under a much different river flow regime and land uses than exist today. Present day regulation of the river and flood control, with diversion dams and levees, and fire suppression, have decoupled the self-perpetuating and self-sustaining terrestrial biotic community of the Bosque from the water on which it depends. Elimination of flooding, lowered water tables, and the lack of naturally occurring cool fires have allowed exotic plants to establish and thrive in monotypic vegetation types as well as beneath the cottonwood overstories. Salt cedar (Tamarix ramosissima) and Russian olive (Elaeagnus angustifolia) have formed thickets that are almost impassable and they have increased the risk of fire near the river communities of Albuquerque, Socorro, Bernalillo and several Pueblos. In addition, the thickets of exotic plants reduce opportunities for recreational use of the riverside woodlands and contribute to the loss of desired and beneficial native plants. For example, woodlands dominated by a cottonwood overstory and exotic understory, when burned, typically return as pure stands of exotics. This paper will describe the relationships between water management, exotic and native plant distributions, and fuel loads on the middle Rio Grande. In addition, it will address current research and management being implemented to correct the problems created by past management decisions.

2:30 – 2:45  INITIAL ASSESSMENT OF THE RODEO-CHEDISKI FIRE IMPACTS ON HYDROLOGIC PROCESSES

Peter F. Ffolliott (University of Arizona, Tucson, AZ) and Daniel G. Neary (USDA Forest Service, Flagstaff, AZ)

An opportunity to study the impacts of a watershed-scale fire on hydrologic processes in a ponderosa pine forest ecosystem of the Southwest presented itself following the devastating Rodeo-Chediski fire of June-July 2002, which burned 475,000 acres (192,232 hectares) in north-central Arizona. Streamflow regimes, erosion-sedimentation processes, and other hydrologic characteristics are being evaluated on the Stermer Ridge watersheds, located in the headwaters of the Little Colorado River, to assess the short- and long-term impacts of this historical fire. While these watersheds had been moth-balled after earlier watershed research studies were completed, the control sections were re-instrumented and a weather station on the site was re-established immediately following the suppression of the wildfire to provide a basis to study the relative impacts of varying fire severities on the hydrologic processes mentioned. Findings to date with respect to changes in soil resources
and vegetation will be reported upon in this paper. Information of this kind is needed by managers to plan and manage for on-site post-fire watershed rehabilitation and to understand the impacts of fire on downstream riparian habitats and anthropological infrastructures.

2:45 – 3:00

**POST-WILDFIRE PEAK FLOWS IN ARIZONA: SOME CASE STUDIES**

Daniel G. Neary (USDA Forest Service, Rocky Mountain Research Station, Flagstaff, AZ), Peter F. Ffolliott (The School of Renewable Natural Resources, University of Arizona, Tucson, AZ), and Gerald J. Gottfried (USDA Forest Service, Rocky Mountain Research Station, Phoenix, AZ)

Opportunities to study the impacts of watershed-scale fire on hydrologic processes in forest ecosystems of the Southwest presented themselves following two historical wildfires in north-central Arizona. Stormflow regimes, erosion-sedimentation processes, and other on-site hydrologic characteristics are being monitored and evaluated on the Workman Creek and Stermer Ridge watersheds following recent large and devastating wildfires on these sites. The Coon Creek fire in 2000 burned 9,300 acres (3,764 hectares) on the Tonto National Forest including the three Workman Creek Watersheds on the Sierra Ancha Experimental Forest, while the Rodeo-Chediski fire of 2002 burned 475,000 acres (192,232 hectares) on the White Mountain Apache Reservation and Apache-Sitgreaves National Forest. The two Stermer Ridge Watersheds are located on the Apache-Sitgreaves National Forest south of the towns of Heber and Overgaard. While the watersheds on each site had been moth-balled after earlier watershed research studies were completed, the control sections were left in place. These control sections were re-instrumented and the weather stations on each of the sites were re-established following the respective wildfires to provide a basis to study the relative impacts of light, moderate, and severe wildfire severities on the hydrologic processes mentioned. Findings to date with respect to changes in peak stormflows and on-site soil resources and vegetation will be compared to the impacts of earlier fires on these processes and resources and reported upon in this paper.

3:00 – 3:30

**COFFEE BREAK IN FOYER**

3:30 – 3:45

**PRELIMINARY ASSESSMENT OF SEDIMENT MEASUREMENTS AT WEIR BASINS FOLLOWING THE COON CREEK FIRE IN CENTRAL ARIZONA**

Gerald J. Gottfried and Daniel G. Neary (USDA Forest Service, Rocky Mountain Research Station, Phoenix and Flagstaff, AZ)

The Coon Creek wildfire burned more than 9,000 acres (3,642 hectares) in the Sierra Ancha Mountains of central Arizona in the spring of 2000. The three long-term experimental watersheds at Workman Creek were burned at different intensities, but the untreated, old-growth stand on Middle Fork sustained the greatest damage. Workman Creek contains three
weirs and a flume; the Main Dam weirs measure flows from all watersheds. The installations were reopened after the fire to determine the effects of wildfires on stream peak flows, streamflow quantities, and sedimentation. The settling basins behind the weirs were cleaned to make room for post-fire sediment accumulations and channel cross-sections were established above the weirs. Several high intensity storms crossed the area during the summers of 2000 and 2001. The 15-minute storm of July 8, 2000 produced the equivalent of 2.64 in/hr (6.7 cm/hr) of rainfall and resulted in a peak flow that was seven times greater than recorded in the 40 years of record. The storm moved large quantities of sediment refilling the settling basin at Main Dam. The storms of August 2001 also refilled the basins. Main Dam has been cleaned six times since the installation was reopened, although some activities were to increase capacity prior to anticipated events. A true picture of post-fire erosion and sedimentation requires a combination of sideslope, channel, settling basin and suspended sediment measurements. This paper will assess the volumes of bedload and coarser suspended sediments collected at the weirs from June 2000 through June 2002.

3:45 – 4:00
THE ROLE OF MULTICRITERION DECISION-MAKING IN MANAGING AND RESOLVING CONFLICTS IN ECOSYSTEM MANAGEMENT

Aregai Tecle (School of Forestry, Northern Arizona University, Flagstaff, AZ)

Ecosystems consist of a complex array of commodity resources, amenity values, and many other components and processes essential to the integrity and sustainability of the system. Hence ecosystems have enormous social, environmental and cultural values, and the diversity of components gives rise to a multitude of interest groups with varying and sometimes conflicting wishes and aspirations in the way the ecosystem components should be managed or used. This paper points out some of the conflicting objectives different interested parties like to see ecosystems be managed for, and the use of a multicriterion-analysis process to resolve conflicts among the various interested parties. The process involves formulating the complex ecosystem management problem in a multiobjective framework, and analyzing it using a selected multicriterion decision-making (MCDM) procedure to arrive at a preferred solution. Also in this paper, various MCDM types are identified and their applicability to solve management problems summarized.
POSTER SESSION

SESSION I  10:00

ROOM:    FOYER

Chairperson: Robert Reavis

10:00 • 10:30  HANDS-ON FLUORESCENT KARYOTYPE ANALYSIS

William P. Baker and Carleton 'Buck' Jones (Midwestern University, Glendale, AZ)

Understanding of techniques used in karyotype analysis is an important part of instructional units in Biology, Microbiology and Biotechnology. Experience, however, indicates that the topic is a difficult one for many students. We have developed a simple activity for an undergraduate biology class that effectively simulates the technique of Fluorescence In Situ Hybridization (F.I.S.H.) using a paper model and fluorescent dyes. This hands-on procedure is suitable as either a laboratory or classroom exercise. Instructors may use the templates provided or create their own. Research has shown that adapting manipulatives to fit topics being presented enhances instruction and student satisfaction.

10:00 • 10:30  ARIZONA PUFFBALLS AND EARTHSTARS

(LYCOPERDACEAE AND GEASTRACEAE, BASIDIOMYCOTA, FUNGI)

Scott T. Bates (Arizona State University, Tempe, AZ), Dr. R. W. Roberson (Arizona State University, Tempe, AZ) and Dr. D. E. Desjardin (San Francisco State University, San Francisco, CA)

The importance of studying biodiversity across the globe is widely recognized. However, fungi are often overlooked in such studies even though they are essential components of the Earth's ecosystems. In Arizona, vascular plants found throughout the state have been well documented in many publications; however, only a few mycologists have systematically collected, described, and reported on groups of fungi found here. This poster presents preliminary results from a continuing investigation of the Lycoperdaceae and Geastraceae (i.e. puffballs and earthstars) as they are found within the diverse biotic communities of Arizona. Classical taxonomic methods are employed in studying specimen of these fungi collected in the field as well as herbarium material. Examples of taxonomic treatments are presented here that include standard macroscopic and microscopic morphological descriptions and distribution maps. As part of the larger investigation, a study of spore morphology is undertaken using scanning electron microscopy (SEM). This aspect of the study will contribute to taxonomic knowledge of these families as spore morphology is
a conserved character and, therefore, phylogenetically informative. Examples of SEM micrographs exhibiting various spore morphologies are also included. Overall, data collected in this ongoing study will help in establishing baselines of fungal biodiversity in Arizona and tools for discovering additional diversity can be developed.

10:00 - 10:30  A PROMISING MICROALGAL CANDIDATE FOR BIOLOGICAL CO₂ SEQUESTRATION AND HIGH-VALUE CAROTENOID PRODUCTION

Mike Bellefeuille, Qiang Hu, and Milton Sommerfeld (Arizona State University, Tempe, AZ)

Global climate changes may be occurring due to increased CO₂ emissions worldwide from fossil fuel-based energy systems. Unless atmospheric CO₂ concentrations are stabilized, detrimental effects to human health and world economic prosperity may occur. There is an urgent need to develop and apply CO₂ sequestration technology that is efficient, affordable and sustainable. We introduce the use of photosynthetic microalgae as an advanced strategy to meet these demands for CO₂ sequestration technology. In this study we investigated a newly isolated unicellular chlorococcalean green alga that possesses the ability to not only thrive at high CO₂ concentrations (>15% CO₂) but also accumulate large amounts of high-value secondary carotenoids (mainly astaxanthin and astacene) under laboratory conditions. A series of experiments were conducted to optimize the culture parameters of this organism (i.e., light intensity, temperature, CO₂, NaCl, and Fe²⁺) to achieve maximum potential for CO₂ fixation and carotenoid production. Our results suggest that mass cultivation of green microalgae in an engineered industrial-scale photobioreactor utilizing high CO₂-containing flue gases will not only remove substantial quantities of CO₂ but also produce high-value renewable algal biomass for various commercial applications.

10:00 - 10:30  ARSENIC IN MONTEZUMA WELL

Laona Burk and Richard D. Foust, Jr. (Northern Arizona University, Flagstaff, AZ)

Environmental Arsenic is an important environmental topic. High levels of arsenic found in Montezuma Well is due to ground water being in contact with the Supai and Verde formations. Developing procedures to test the levels of arsenic is the important part of this study. In the Consensus values, for NIST biological and environmental Standard Reference Materials it was found that out of 227 trials only 66.25% arsenic recovery was obtained from Orchard leaves using graphite furnace atomic absorption spectroscopy, GF-AAS. This low percent recovery was obtained with the first trial performed in this study using the Orchard leaves as a standard reference material. The furnace settings on the GF-AAS will be changed to accomplish the optimum percent recovery of arsenic to further the study in Montezuma Well.
10:00 - 10:30  

ELEMENTAL COMPOSITION OF PM-2.5 COLLECTED DURING PRESCRIBED FIRES IN THE COCONINO NATIONAL FOREST IN FLAGSTAFF, AZ

Jesus Chavez, Michael Ketterer, and Marin Robinson (Northern Arizona University, Flagstaff, AZ)

The fire-suppression policy of the past century has left forests overgrown with heavy duff and litter layers, increasing the likelihood of catastrophic fire. Prescribed fire, in combination with mechanical thinning, is a preferred method to reduce this fuel load; hence, the use of prescribed fire is expected to increase in the next decade. Fine particulate (PM-2.5) is produced in forest fires, both natural and prescribed. In this work, we examine the chemical composition of PM-2.5 generated during prescribed fires of the Coconino National Forest during October 2001 and October 2002. All fires studied are broadcast burns (as opposed to pile or slash burns) in areas with a 9-12 year accumulation of duff and litter. Particulate is collected using a battery-operated chemical speciation PM-2.5 monitor (MetOne SuperSASS). Smoke is sampled during the ignition, combustion, or smoldering phase of the prescribed fire, as well as during laboratory burns of litter, duff, and soil taken from the prescribed fire site. PM-2.5 in the wood smoke is collected simultaneously on four filters. Three of the filters (PTFE, nylon + MgO denuder, and quartz) are analyzed at Research Triangle International for total mass and 48 elements (sodium through lead); ions (anions and cations); and total, organic, and elemental carbon, respectively. The fourth filter (PTFE) is analyzed for S, K, As, Cd, Mo, Pb, and Hg using a Sector ICP-MS instrument at Northern Arizona University. A description of the sampling method, analysis procedures, and results will be presented.

10:00 - 10:30  

PRELIMINARY ANALYSIS OF POLYHYDROXYALKANOATE INCLUSIONS USING ATOMIC FORCE MICROSCOPY

Douglas Dennis (Arizona State University West, Phoenix, AZ), Caroline Liebig, Tara Holley, Kara Thomas, Ahmit Khosla, Douglas Wilson, and Brian Augustine (James Madison University, Harrisonburg, VA)

Atomic force microscopy was employed to analyze the surface structure of polyhydroxyalkanoate (PHA) inclusions. PHA inclusions exhibited two types of surface structure. In the first, inclusions were rough and ovoid in shape. In the second, the surface was smoother, the shape more spherical, and the height not as high. The smooth inclusions possessed linear structures that were in parallel arrays with 7 nm spacing. In some cases, cracks or fissures could be seen on the surface of the rough inclusion, which allowed a measurement of 4 nm for the thickness of the boundary layer. Likewise, cracks could be imaged on the surface of the smooth inclusions and they thickness of the smooth inclusion layer was also measured at 4 nm. When the rough inclusions were imaged at higher resolution, globular structures that were, for the most part, spherical could be seen on the surface of the inclusion. The globular structures possessed a central pore that was, on the
average, 15 nm in diameter. The collar around this channel was about 15 nm wide, making for a total diameter of 35-45 nm for the globular structures. The collar was raised above the surface of the inclusion and this distance was somewhat variable. When the inclusions were treated with sodium lauryl sulfate at elevated temperatures, the boundary layer of the inclusion deteriorated in a manner that would be consistent with a lipid envelope. At the height of this deterioration, when the boundary layer was largely gone, 35-45 nm globular disks could be imaged laying on the surface of the filter beside the inclusions. These data have facilitated the development of a preliminary model for PHA inclusion structure that is significantly different than past models.

10:00 - 10:30 A NEW PROTEIN LINKED TO POLYHYDROXYALKANOATE SYNTHESIS IN RALSTONIA EUTROPHA

Douglas Dennis (Arizona State University West, Phoenix, AZ) David West, Douglas Wilson and Brian Augustine (James Madison University, Harrisonburg, VA)

Four proteins were isolated from polyhydroxyalkanoate (PHA) inclusions and subjected to sequence analysis. One protein was found to be a homologue of PhaF from Pseudomonas putida. Another protein exhibited no homology to known proteins but had an unusual amino acid sequence structure containing a very high content of alanine, threonine and arginine. The remaining two proteins exhibited homology to known membrane proteins. One protein, designated Pha27, showed significant to homology to OmpC, whereas the other protein, designated Pha35 exibited excellent homology to a number of different porins. The gene for Pha35 was cloned and the regions upstream and downstream were subjected to sequence analysis. In a 7.2 kb sequence there were 9 genes, all of which had significant homologues in other species. Pha35 was inactivated by inserting a chloramphenicol resistance gene into it and the resulting strain was tested for its ability to produce PHA. The pha35 mutant was unable to accumulate PHA using a variety of growth conditions that facilitated PHA accumulation in the wild type strain. Because Pha35 has high homology to porins, and because porins have recently been imaged using atomic force microscopy (AFM), we conducted preliminary AFM studies on isolated inclusions. The AFM images suggest the presence of a globular structure on the surface of the inclusion with an internal channel. These data suggest that Pha35 is functionally linked to PHA synthesis and may act as a porin.

10:00 - 10:30 *FRACTAL MODIFICATION OF TREE-RING CHRONOLOGIES FOR DISCHARGE RECONSTRUCTIONS

David E. Grow (University of Arizona, Tucson, AZ)

Fractal modification of six piñon (Pinus edulus) chronologies developed in the Paria River basin in southern Utah demonstrates the feasibility of applying fractal analysis to
dendrochronological discharge reconstructions. The fractal dimension and Hurst exponent, calculated using the roughness-length method, describe the long-term persistence of tree-ring series and the hydrologic record. The fractal dimensions are 1.802 for the annual hydrologic record, 1.819 for cool-season discharge (October 1 through May 31), and range from 1.739 to 1.939 for the tree-ring series. Modification of each tree-ring series based on the ratios of the Hurst exponent of each series forced the fractal dimensions of the tree-ring series to be closer to that of the hydrologic series. Fractal modification of the tree-ring series failed to improve streamflow reconstructions, but modification of the tree-ring series suggests a more realistic reconstruction. Fractal analysis also provides an alternate approach (as opposed to ARMA modeling) to examine the stationarity of tree-ring and hydrologic series. The fractal dimensions range from 1.862 to 1.946 for the chronology lengths (1700-1889), and range from 1.739 to 1.939 for the calibration period (1924-1998), indicating that the fractal dimension and stationarity are dependent on the segment length being examined.

10:00 – 10:30 TOXICITY OF CRHOMIUM IN CHINESE HAMSTER OVARY CELLS

Alejandro Lencinas and Diane M. Stearns, Ph.D. (Northern Arizona University, Flagstaff, AZ)

This research studies how metals cause cancer. The main focus is on one of the most important carcinogenic metals, Chromium(VI). Chromium is a compound known to be a human carcinogen for some time, therefore the risk of human exposure to this metal is very important. The people who are most affected are the people working in leather tanning, pigment and paint manufacturing. The risk of environmental exposure to this metal has also been a concern in the last three decades. There are many counties in the United States that have businesses, homes and schools on contaminated grounds. Lead and chromium are among the most common chemicals in these hazardous waste sites. Lead is also suspected to be a carcinogen. Since lead and chromium are a lot of times present in waste sites together, the hypothesis I am testing is that lead will affect chromium toxicity. Measuring the effect of lead on chromium-induced death in Chinese hamster ovary cells AA8 will test this hypothesis. This poster will describe the assay I am using and also some preliminary data obtained from treating Chinese hamster ovary cells with potassium dichromate.

10:00 - 10:30 DETERMINATION OF DNA LESIONS INDUCED BY CHROMIUM PICOLINATE


Chromium picolinate (CrPic) is a popular dietary supplement that has created a multi-million dollar industry. As a dietary supplement, the FDA does not regulate the production and use of CrPic; and therefore, the safety of this product remains in question. Previous studies have shown that CrPic is clastogenic and mutagenic in Chinese hamster ovary (CHO) cells. However, the molecular mechanisms that lead to these toxic effects are unknown. The
single cell gel electrophoresis, or comet assay, was employed to characterize the types of DNA lesions induced in CrPic treated cells. CrPic treated cells had retarded DNA migration and condensation of nuclear material in the head, which resulted in insignificant tail moments when compared to controls. However, when CrPic treated cells were subsequently treated with proteinase K or methanesulfonic acid methyl ester (MMS), cells displayed increased tail moments. This suggests that the major form of DNA lesion induced by CrPic is crosslinks. Understanding the molecular mechanisms behind CrPic-induced cellular damage will help in determining the risks to humans ingesting this dietary supplement.

10:00 - 10:30 DISTRIBUTION, ABUNDANCE, AND ORIENTATION OF THE INTERTIDAL BARNACLE TETRACLITA SQUAMOSA, AND ITS INFLUENCE ON INVERTEBRATE DIVERSITY AT PELICAN POINT IN PUERTO PENASCO, SONORA, MEXICO.

(Melissa A. May, Emily C. Omana, Jamie Rapier, Melissa Robbins, Amy Buff, Rachel M. Curmi, Kate M. Atkins, Ronald L. Ketner, Kevin M. Serrato, Micah White, Heather V. Yarbrough, Jennifer Learned, and Stephen M. Shuster, (Northern Arizona University, Flagstaff, AZ)

_Tetraclita squamosa_ is one of the most common intertidal barnacles in the northern Gulf of California. Empty tests of _T. squamosa_ provide habitat for several species of invertebrates. Using five randomly selected transects oriented perpendicular and six parallel to the shore, we investigated the distribution and abundance of live and dead _T. squamosa_ at Pelican Point. Within the tests of dead barnacles, we counted the distribution and abundance of 25 invertebrate taxa. We found that boulder size most strongly influenced the location of _T. squamosa_ using 24 transects. The abundance of _T. squamosa_ was greater lower on the water-facing side of rocks at the lowest extreme in the zone. Dead barnacles were more abundant higher in the zone on the water-facing side of the boulders. There was no correlation between mortality and the vertical distribution on the rocks. Within tests, the gastropod, _Nerita funiculata_, and the isopod, _Paradella dianae_, made up the majority of the species (76% and 13%, respectively). We found significantly greater numbers of _N. funiculata_ lower in the intertidal zone; however, _P. dianae_ showed no preference. Overall, _T. squamosa_ was the dominant species at Pelican Point. Its empty tests served as nurseries for several intertidal invertebrates in this area. We conclude that this and other barnacles the may contribute significantly to invertebrate diversity in the northern Gulf.

10:00 - 10:30 PARADELLADIANAE (CRUSTACEA: ISOPODA)

E.C. Omana and S.M. Shuster, (Northern Arizona University, Flagstaff, AZ)

_Paradella dianae_ is a sexually dimorphic sphaeromatid isopod whose distribution is becoming nearly worldwide due to transport by international shipping. Kensley and Schotte (1999) observed the presence of ovigerous females that possessed developing penes in collections made from the Indian River Lagoon in Florida. This discovery suggested that this population of _P. dianae_ undergoes protogynous sex change. Furthermore, it represented the
first time that a species of the subfamily Dynameninae was reported to undergo protogyny rather than protandry, the more common strategy in the Crustacea. We observed a similar pattern of sex change in individuals collected from the northern Gulf of California, Sonora, Mexico. However, we found a smaller proportion of hermaphrodites in our samples from the Mexico population than were reported from the Florida population. Moreover, Mexican isopods were larger than Florida isopods, and males and females were more distinct. Our results suggest that while these populations are geographically, morphologically and perhaps genetically distinct, they face similar circumstances favoring protogynous sex change, and may provide clues to understanding the rarity of this crustacean mating system.

10:00 – 10:30  PHYLOGENY OF CRASPEDACUSTA (CNIDARIA: HYDROIDOMEDUSA: LIMNOMEDUSA: OLINDIIDAE) BASED ON ITS rDNA, WITH A PRELIMINARY ACCOUNT OF LIMNOCNIDA IN ARIZONA.

Terry L. Peard and Jason A. Blair (Indiana University of Pennsylvania, Indiana, PA)

Past and present literature concerning the phylogenetic relations among the Limnomedusae (fresh and brackish water relatives of 'true jellyfish') is confusing and promotes disagreement among taxonomic specialists (Cornelius 1992, Bouillon and Boero 2000).

The intent of this study was to construct a phylogeny of the Limnomedusae based on the sequence of the internal transcribed spacer (ITS-1 and ITS-2) regions of rDNA and present molecular evidence which supported or refuted the existing taxonomies (see Bouillon and Boero 2000, Cornelius 1992).
This project provides molecular support regarding the evolutionary relationships among Limnomedusae, as well as provides the first account of Limnocnida (Cnidaria: Hydroidomedusa: Limnomedusae: Olindiidae) in the United States.

10:00 - 10:30  ATMOSPHERIC GAS TRAPPING DURING GROWTH OF WATER-ICE FILMS

Kevin Pond and Marin Robinson (Northern Arizona University, Flagstaff, AZ)

Water-ice is present both in the Earth’s atmosphere (e.g., clouds) and throughout the solar system (e.g., comets). Depending on temperature and pressure, these ices will be either amorphous or crystalline in structure. When gases trapped within these ices are released (through collisions or vaporization), they contribute to local atmospheric composition. In this way, comets are believed to have influenced the early atmosphere of Earth. Many studies have investigated the gas-trapping ability of amorphous ice. Fewer studies have examined the gas-trapping behavior of crystalline ice, the form of ice present in the Earth’s atmosphere. The amount of gas trapped within crystalline ice depends on such things as partial pressure, the amount of gas dissolved in the condensing water, the presence of a spectator gas, and the rate of crystallization. The purpose of this study was to investigate the
gas trapping of $N_2$, $O_2$, and $CO_2$ in vapor-deposited crystalline ice. In a high vacuum chamber, a thin film (365 nm) of crystalline ice (125-145 K) was grown. Water vapor was leaked into the chamber through a precision leak valve. The gases (presumably dissolved in the water) entered the chamber with the water vapor. The ice was annealed (1 K/min) through sublimation. Relative amounts of gases and water present during growth and desorption were monitored using a residual gas analyzer.

10:00 - 10:30 *POXVIRUS ANTIVIRALS AND THYMIDINE PHOSPHORYLASE ACTIVITY

Linda Powell, Paul Torrence, Allena Buchholz, Daniel Saxelby and Robert Smith (Northern Arizona University, Flagstaff, AZ)

The current threat of biological warfare has renewed the desire to obtain therapeutic leads for poxvirus infections including monkeypox, vaccinia, and smallpox. 5-substituted deoxyuridine derivatives have demonstrated antivaccinia (anti-poxvirus) activity in tissue culture. Such in vitro antiviral activity of 5-substituted deoxyuridine derivatives can be lost in vivo due to the activity of thymidine phosphorylase, a key enzyme in the pyrimidine salvaging pathway that catalyzes the cleavage of the sugar moiety from the base. Nucleosides such as thymidine (dT), 5-cyano-2'-deoxyuridine (5-CNdU), and 5-thiocyanato-2'-deoxyuridine (5-SCNdU) have been evaluated for their thymidine phosphorylase (TPase) activity. Analysis of enzyme reaction mixtures was effected using reverse phase high performance liquid chromatography (HPLC) separation. 5-CNdU showed promising resistance to base-sugar cleavage when compared to 5-SCNdU and dT. This latter finding provides a lead to the design of novel potential poxvirus countermeasures. As a further consideration, the enzyme activity, thymidine phosphorylase, resides in the identical polypeptide as does the activity known as platelet-derived endothelial growth factor, a potent angiogenic agent. Thus growth of knowledge concerning substrates and inhibitors of this protein also may be applicable to the construction of anti-tumor agents that would act by inhibition of angiogenesis.

10:00 - 10:30 A STRUCTURAL ANALYSIS OF WALNUT CANYON, HUALAPAI MOUNTAINS, NORTHWESTERN ARIZONA WITH REFERENCE TO PROTEROZOIC TECTONICS

Gwyn Rhys-Evans (Northern Arizona University, Flagstaff, AZ)

Walnut Canyon, Hualapai Mountains, in northwestern Arizona lies within a boundary zone between the Yavapai and Mojave Proterozoic crustal provinces. A controversy exists over whether this region experienced one continuous tectonic event or two discrete deformational events responsible for the juxtaposition of the Mojave and Yavapai provinces. Both the Mojave and Yavapai provinces have areas that show evidence for two deformational fabrics. The Hualapai Mountains, which lie between these provinces, have not yet been studied.
Walnut Canyon is dominated by a northeast-striking, moderate to steeply dipping foliation that probably is associated with the D₂ event. Interpretation of structural data, including stereograms, form surface maps, and geologic maps suggests preservation of a D₁ fabric thus supporting the theory of at least two regional tectonic events. North-trending, mesoscopic folds suggest a possible third event that occurred temporally between the two recognized events.

Metamorphic grade in the Walnut Canyon area is defined by the mineral assemblage: sillimanite+K-feldspar+muscovite+garnet+biotite suggesting upper amphibolite facies metamorphism. This assemblage may be associated with metamorphism during the D₁ event.

10:00 – 10:30  
**LEAD ISOTOPE RATIOS IN STANDARD REFERENCE MATERIALS**

M. B. Schafer, K. Givler, R. Foust Jr., T. Huntsberger and M. Ketterer (Northern Arizona University, Flagstaff, AZ)

Known lead isotope ratios are valuable numbers to have when measuring isotope ratios of environmental samples. Ten NIST Standard Reference Materials (2709, 2710, 2711, 1570, 1576, 1573, 1632b, 1633a, 1635 and 1648) have been analyzed for total lead content by graphite furnace atomic absorption spectroscopy. In this study, the nitric acid and hydrogen peroxide concentrations, as well as time and temperature for microwave techniques were optimized to obtain complete lead recovery with each SRM. Percent recovery for all SRMs ranged between 95-105%. Lead isotope ratios for Pb 204, 206, 207, 208 were obtained using an Axiom multi-collector ICP Mass Spectrometer. The $\frac{^{207}Pb}{^{204}Pb}$ ratio showed the greatest variance between SRMs (5.951-15.836), indicating larger variations in $^{207}$Pb than other lead isotopes.

10:00 – 10:30  
**BIOASSAY FOR 2,4-D**

Arlene Tavizon (Arizona State University West, Phoenix, AZ), Maria Arballo (Glendale Community College, Glendale, AZ), Bertina Yellowhair (Paradise Valley Community College, Paradise Valley, AZ).

The purpose of this study was to begin to quantify the ability of synthetic auxin (indole acetic acid or 2,4-D) to restrict the growth of a germinating cucumber seed. Cucumber seeds were exposed to various concentrations of synthetic auxin and allowed to germinate. Average root length for each concentration were used to generate a regression line to approximate the relationship between the synthetic hormone level of and the restriction of radicle growth. The long-term goal of this research is to develop protocols for detection of contamination in the human environment that are accurate, low-cost, and relatively simple to execute.
10:00 – 10:30  DETERMINING THE TRUE COST OF A LOWER ARSENIC DRINKING WATER STANDARD TO VERDE VALLEY, ARIZONA

Erin Tucker (Northern Arizona University, Flagstaff, AZ)

Arsenic naturally occurs in the environment and in drinking water. The arsenic drinking water standard in the United States is currently set at 10 µg/L. Many rural Arizona drinking water systems do not have enough arsenic removal to comply with the 10 µg/L standard because the systems are archaic and removal is expensive. These systems need to treat their water to meet the 10 µg/L water quality standard for arsenic by using suitable and affordable technologies. I compiled a list of Arizona’s rural water distribution systems in the Verde Valley. I possess data from the Arizona Department of Environmental Quality (ADEQ), which includes arsenic concentrations for 16 points of entry for drinking water systems in the Verde Valley. I found that many of the 16 systems in my study have concentrations that exceed the standard for arsenic in drinking water and removal is a health and environmental safety necessity. Research on methods of removal as well as some health and environmental problems associated with arsenic will be done and discussed. I will then be able to calculate an approximate cost of implementing suitable technologies on the water systems I have identified in the Verde Valley.

10:00 – 10:30  EFFECTS OF ARSENIC(III) ON CHROMIUM(VI) TOXICITY

Andreea Voichescu, Julie Brown and Diane Stearns PhD (Northern Arizona University, Flagstaff, AZ)

Mixtures of chemicals are one of the greatest challenges in assessing human risk from environmental exposures. People are rarely exposed to a toxic chemical in isolation, but rather are confronted with mixtures of substances in the home, workplace, and through lifestyle choices. Cancer risk is one of the biggest concerns when it comes to environmental exposures, and metals are one of the most important classes of carcinogenic chemicals. Chromium and arsenic are two of the top contaminants in soil and water in hazardous waste sites in the US. The hypothesis we are testing is that co-exposure to arsenic and chromium may have effects that are different from those observed with individual exposures. This hypothesis is being tested by measuring the toxicity of Cr(VI) and As(III) in Chinese hamster ovary cells and comparing results to reactions of Cr(VI) and As(M) with isolated DNA in vitro. Arsenic may make Cr more toxic if it inhibits DNA repair in cells. Results of reactions with plasmid DNA in vitro do not support the hypothesis of direct reaction between the two metals at either pH 4.5 or pH 6.5. These experiments will help us understand how metals cause cancer. Understanding the effects of one metal on the toxicity of another will help in the prioritization of contaminated sites containing As and Cr.

10:00 – 10:30  * IS OPHIODROMUS PUGETTENSIS ANDRODIOECIOUS?

Steven A. Vuturo and Stephen M. Shuster, (Northern Arizona University, Flagstaff, AZ)
Most polychaetes are gonochoristic. Hermaphrodites are comparatively rare. However, hermaphroditism is widely distributed among approximately twenty polychaete families and is thought to be a polyphyletic adaptation to conditions unique to each taxon. Here we document the direction, timing and frequency of sex change within a population of *Ophiodromus pugettensis* that are commensal within ambulacral grooves of the sea star, *Pateria miniata*. Our observations of gametogenesis in *O. pugettensis* suggest that some juveniles mature as (protandrous) males then become simultaneous hermaphrodites. However, we have found that a small portion of the population remains male and never switches sex. These results suggest that *O. pugettensis* is androdioecious, rather than sequentially hermaphroditic, a condition that may be more widespread among polychaetes than is now recognized.

10:00 – 10:30 REACTION OF URANYL ACETATE WITH ASCORBATE PRODUCES DNA STRAND BREAKS IN VITRO

M. Yazzie, S. Gamble, E. R. Civitello and D. M. Stearns, (Northern Arizona University, Flagstaff, AZ)

Exposure to uranium in the mining industry has been linked to lung cancer through uranium’s radioactive decay product, radon. Previous studies suggesting increased risks of pancreatic, stomach, colon and prostate cancers and birth defects in people exposed to uranium mine tailings may signal a non-radiochemical mechanism of uranium genotoxicity. We propose that hexavalent uranium (U(VI)) may have a similar chemistry to that of hexavalent chromium (Cr(VI)), which is a known human carcinogen that directly damages DNA. Chromium(VI)-induced DNA damage requires metabolism of the metal by biological reducing agents, (i.e. ascorbate). The goal of our research is to measure the chemical genotoxicity of U(VI) in the presence of ascorbate. Results from experiments with plasmid DNA in vitro showed that reactions of U(VI) with ascorbate produced DNA single strand breaks in a time- and concentration-dependant manner. Uranyl acetate was also more cytotoxic in the Chinese hamster ovary EM9 line, which is sensitive to DNA strand breaks, than in the parental CHO AA8 line. The presence of catalase decreased DNA strand breaks in vitro, suggesting a Fenton-type mechanism of free radical generation. An alternative hypothesis may be that a uranyl ascorbate complex catalyzes the hydrolysis of the DNA phosphate backbone by a mechanism similar to that known for the lanthanide metals. 1H NMR spectroscopy supported this hypothesis and showed the formation of a stable uranium-ascorbate complex. These are the first experiments to demonstrate direct DNA damage induced by uranium and ascorbate. Understanding the metabolism of uranium and its reactivity with DNA may help to elucidate mechanisms of lung and other cancers in Native American populations exposed to uranium.
The fire-suppression policy of the past century has left forests overgrown with heavy duff and litter layers, increasing the likelihood of catastrophic fire. Prescribed fire, in combination with mechanical thinning, is a preferred method to reduce this fuel load; hence, the use of prescribed fire is expected to increase in the next decade. In this work, we examine the organic fraction of fine particulate (PM-2.5) generated during prescribed fires of the Coconino National Forest (October 2001 and 2002). PM-2.5 was collected using a chemical speciation air monitor (MetOne SuperSASS) during the ignition, combustion, or smoldering phase of the prescribed fire, as well as during laboratory burns of litter and duff taken from the prescribed fire sites. The PM-2.5 was analyzed at Research Triangle International for percent carbon (total, elemental, and organic). Preliminary efforts are underway at NAU to measure concentrations of selected polyaromatic hydrocarbons (PAHs) and mutagenic activity in the particulate. PAHs will be identified using GC/MS (EPA Method 8270C). Mutagenic activity will be measured by monitoring mutations at the hprt locus of Chinese hamster ovary AA8 cells with and without S9 activation. Results of these combined efforts will be presented.
ELECTED

Aregai Tecle ................................................................. President
Jim de Vos ................................................................. Past President
William Perry Baker ............................................... President Elect
Betsy Cooper .............................................................. Recording Secretary
Ingrid Novodvorsky .................................................. Membership Secretary
Karen Conzelman .................................................. Treasurer
Owen Davis .............................................................. Director, Southern Arizona
Robert Scarborough .................................................. Director, Southern Arizona
Robert Reavis ............................................................ Director, Central Arizona
Martin Wojciechowski .............................................. Director, Central Arizona
Jim de Vos .............................................................. Director, Central Arizona
Stephen Shuster ......................................................... Director, Northern Arizona
Kathy Lauckner .......................................................... Director, Nevada
Carl L. Reiber ............................................................ Director, Nevada

APPOINTED

Owen Davis ................................................................. Permanent Secretary
Tony Brazel ............................................................... Editor, Journal
Stephen Williams ..................................................... Editor, Newsletter
Florence Slater .......................................................... Editor, Proceedings

SECTION CHAIRS

Michael Vasquez ......................................................... Anthropology
Robert Bowker ........................................................... Biology
Richard D. Foust .......................................................... Chemistry
Jim de Vos ............................................................... Conservation
Anthony Brazel and Lee R. Dexter ................................. Geography
Kenneth Cole ............................................................. Geology
Roy Jemison and Gerald Gottfried ................................. Hydrology
Science Education ..................................................... William M. Stone
Robert Reavis ............................................................. Poster Session
COMMITTEE ROSTER

BUD ELLIS SCHOLARSHIP
Stephen M. Shuster

MEMBERSHIP
Ingrid Novodvorsky

R. M. HARRIS AWARD
Tony Brazel

OUTSTANDING SCIENCE TEACHER
William Perry Baker

GRANTS-IN-AID
GRADUATE
Aregai Tecle

BUDGET
Karen Conzelman

FELLOWS, NOMINATING
Vic Baker
Jan Bowers
Owen Davis
Don Post

BEST STUDENT PAPER
Aregai Tecle

NOMINATING
Owen Davis
Don Young
Jim deVos

NECROLOGY
Ingrid Novodvorsky

PUBLICITY
Robert Reavis

PROGRAM
Aregai Tecle

GRANTS-IN-AID
HIGH SCHOOL
Paul Smolenyak

BUD ELLIS OUTSTANDING SERVICE AWARD
Karen Conzelman
Gordon Johnson
Bud Ellis
Stephen Williams
Eleanor Davey
Sandra Woodward

BEST STUDENT POSTER
Aregai Tecle
REPORT OF THE PRESIDENT

Almost a year has passed since I accepted the presidency of our Academy. During this time many things have happened at the national, regional and organizational levels that directly or indirectly affect members of the Academy. At the national level, we have the war with Iraq in which citizens are divided on its justification. However, there is unity in wishing the safe return of all members of our armed forces, who are doing their job. Personally, I wish that decisions on such vital and crucial issues as war and peace were based on scientific research and rigorous discussions among academicians, politicians as well as all other sectors of society to ensure their appropriateness. It is too bad that there has not been adequate venues for us to play active roles on developing and proposing alternative solutions and discussing their merits or demerits with respect to national security, economic and social stability, cultural heritage and the environment, world peace and their overall impacts on the changing world that is rapidly shrinking to make communities around the world much closer together.

At the regional level, we have had many things happened that affect our personal, professional and social state, some of which we don’t have any control. Yet, as scientists, we can have many avenues to make a difference. For example, recently we have had three important events in the Southwest that have serious implications on both society and the environment. One is the lingering drought, which is affecting our lives in so many different ways. The other two are the biggest wildfire in Arizona history and the budworm infestation of our forests. These two have decimated a large portion of our precious natural resources. The only solace from the situation is that scientists, and many governmental and public organizations are collaborating to find solutions, and our Academy could and should play a significant role as a medium to bring different scientific disciplines together for interdisciplinary research and other activities to alleviate any environmental, economic or social problems. This is a potentially important role of our Academy we should cherish and develop.

However, to realize our potentials, we need to grow and become strong and proactive. Our membership at the moment is small and begs proactive participation of all current members to promote the Academy’s ideals and the different benefits it provides as well as to recruit new members. With an insignificant membership fee, the academy provides members with many important benefits. We publish the multidisciplinary Journal of the Arizona Nevada Academy of Sciences and provide it to members free of charge. There has been a significant recent improvement in the journal, thanks to the untiring efforts of its editor-in-chief, Professor Anthony Brazel and the editorial board. We have also the Newsletter and Proceedings which provide different perspectives on the state of our Academy. The Newsletter updates members on on-going Academy activities while the Proceedings provide a detailed description of the Academy’s annual meeting. Recently, the academy has developed another medium of communication, the web, thanks to the Academy’s Permanent Secretary and web manager, Professor Owen Davis. The web permits scientists and other interested parties around the world to download and see what we have been doing in the Arizona-Nevada Academy of Sciences.

During this past year, the Academy has taken a number of important steps to streamline and improve its structure and functions. One key element of this improvement is a
seconded motion from the Academy’s Board of Directors on a sweeping amendment of the Academy’s Bylaws that will be presented to the general membership for voting at the 47th Annual Meeting on April 12, 2003 in Flagstaff, Arizona. Among the proposed amendments are changes in the number and type of the voting members of the Board of Directors. The membership of the Board will consist of the President, the Past President, the President-elect, the Corresponding Secretary, the Membership Secretary, the Treasurer, Regional Directors consisting of one Director from each of the four Regions (Southern Arizona, Central Arizona, Northern Arizona and Nevada), plus the editor-in-chiefs of the Journal, the Newsletter, the Proceedings, and the Permanent Secretary for a total of fourteen voting members. Other proposed amendments are remove the Director of the Junior Academy and anything pertaining to the Junior Academy from the Bylaws and decreasing the number of permanent committees of the Academy from 16 to 7. These are important changes designed to help the efficiency and effectiveness of the Academy, and I hope that all members present at the annual meeting will vote in favor of these changes.

We are looking forward to a great meeting this year in Flagstaff, Arizona. There will be more than 98 papers and posters presented at the meeting. The different disciplines that have organized sessions consist of Biology, Chemistry, Conservation, Geography, Geology, Hydrology and Anthropology. The Office of the Vice Provost for Academic Affairs and Dean of Graduate Studies, the College of Arts and Sciences, the College of Social and Behavioral Sciences, the College of Ecosystem Science and Management, the School of Forestry at Northern Arizona University and the Watershed and Riparian Ecosystem of Forests and Woodlands in the Semi-Arid West Project (RMRS – 4302) of the USDA Rocky Mountain Research Station sponsor the meeting.

In closing this report, I like to acknowledge and thank all members of the Academy’s Board of Directors for their tireless efforts that made my tenure as President of the Academy easy. Particular thanks go to Dr. Stephen Williams, who after many years of diligently serving the Academy in many different capacities, the last one as editor-in-chief of the Newsletter, is stepping down this year. I also like to thank Kathy Lauckner for accepting the charge to serve as the new editor-in-chief of the Newsletter. I am certain that Kathy will do a marvelous job in this responsibility. Serving the Academy is very satisfying and has the reward of knowing and gaining many friends, and I hope that readers will volunteer to run for election to any of the offices in the Board of Directors. Again, I salute all members of the Academy for renewing their membership and remaining active, and I hope to see you all at the Annual meeting in Flagstaff on April 12, 2003.

Aregai Tecle
The meeting was called to order by at 12:10 P.M. Jim deVos introduced the guest speaker, Dean Burdick of Midwestern University who spoke about the history of bioterrorism. Jim then thanked Perry Baker for his efforts in setting up the meetings and thanked Karen Conzelman and Owen Davis for their assistance throughout the year.

Everyone was invited to read the minutes from last year's meeting. Florence moved and Owen seconded that the minutes be accepted. The motion was passed.

Steve Shuster announced the Bud Ellis Scholarship award that is given each year to an outstanding high school senior planning to major in science at one of the state universities. The award will go to Sarah Megan Ramirez, who is graduating from Douglas High School in Douglas, AZ. Sarah plans to major in electrical engineering at the University of Arizona.

Jim noted that there are 274 members of the Arizona Nevada Academy of Sciences. He encouraged all attending the meetings to spread the word about the value of the ANAS and the improvements that have been made to the Journal of the ANAS. Karen Conzelman moved that the membership committee report be accepted. Kathy Lauckner seconded the motion. The motion was passed.

William Perry presented the Outstanding Science Teacher Award. Carrie Cunningham of Sonoran Sky Elementary in Scottsdale, AZ. was the recipient of the award at the elementary level. The middle school winner was Janice Larson, Crismon Elementary School in Mesa, AZ. The high school winner was David Meisner of Elko High School in Elko, NV.

Jim invited attendees to read the Treasurer's Report in the Proceedings. Robert Reavis moved and Florence Slater seconded that the Treasurer's report be accepted. The motion carried.

One of the important interests of the ANAS is to encourage student participation in the society. Jackie Marlette from Northern Arizona University who presented a paper on The Power of Drainage Systems in Minnesota: The Necessity of Storm Water was one winner. Amanda Coleman of Arizona State University who presented a paper on Taxodiaceous Conifers from the Middle Miocene Yakima Canyon Flora, Washington State was the second winner.

Kathy Lauckner announced the recipient of the Best Student Poster Award. The award goes to Stefanie Ickert-Bond of Arizona State University.

The slate of officers was read. From the floor, Karen Conzelman nominated Steve Shuster as Director for Northern Arizona. Owen Davis moved and Florence Slater seconded that the slate be accepted. The motion passed.

The Academy lost a leading scientist this year with the death of Dr. W. L. Minckley, a premier ichthyologist in Arizona.

Steve Williams presented the Bud Ellis Outstanding Service Award to Karen Conzelman for her manifold contributions to the Arizona Academy of Sciences over the past 6 years. She has acted as treasurer for those 6 years and has made major contributions in all facets of the Academy.

Jim deVos turned over the meeting to Aregai Tecle, incoming President. Aregai presented a certificate of appreciation to Jim as the past president. Aregai then spoke of the
importance of ANAS to Arizona and Nevada and to the universities in the two states. He challenged members of the Academy to recruit new members as one of the particular values of the state academies of science is to permit scientists in one discipline to learn what scientists in other disciplines in the state are working on and what colleagues on other campuses are doing.

Aregai commended Tony Brazel on the Journal and challenged members to submit papers for publication in the Journal and to encourage other science faculty to contribute to the Journal as well. Aregai further commended the work done by the web master (Owen Davis) and the Newsletter Editor (Steve Williams) both of which help publicize the Academy. Students can greatly benefit from the Academy that serves as a forum for making contacts, oral presentations and poster presentations. Aregai encouraged students to join and participate in the Academy as well.

The next Annual Meeting will be held in Flagstaff on April 12th, 2003. Volunteers for section chairs were requested so that planning can begin for next year. The meeting was adjourned at 1:45 P.M.

Respectfully submitted,

Betsy Cooper
Recording Secretary

REPORT OF THE PERMANENT SECRETARY

The regular duties of this office are providing a permanent mailing, phone, and email address anas@geo.arizona.edu for the Academy; filling out reports to various governmental and academic societies; maintaining the ANAS archives; hosting the ANAS listserv; editing the electronic version of the ANAS newsletter; and serving as webmaster for the ANAS web page http://geo.arizona.edu/anas/. I provide copies of the Proceedings Volumes and “reprints” from our archives upon request.

This year, the Academy began providing to its members an electronic format for the newsletter, in addition to the ANAS listserv. Ninety-seven of our current 187 members now receive the newsletter electronically, a savings of $600 annually for the Academy. I exhort the ANAS membership to provide me with email addresses, and to receive the newsletter electronically. Save a tree! Keep your dues low!

Respectfully submitted,
Owen K. Davis
Permanent Secretary
REPORT OF THE FELLOWS COMMITTEE

The ANAS Fellows Committee has no nominations to put forward this year. We are currently updating our files of ANAS Fellows and ask for the assistance of the membership in this task. Our list of fellows contains 65 persons, for whom we know the date of induction for only 22 persons. Based on our initial survey, there are actually more than 65 living fellows in the association. We solicit your help in 2 ways.

1. If you are a Fellow drop us a line, including your date of election. Our records are particularly bad prior to 1983.

2. If you know of an ANAS member of long standing, worthy of this honor, please contact us! (To our knowledge, there are no Fellows from Nevada Universities!) The criteria are, “Any member who has been a regular or sustaining member of the Academy for not less than five years and who has successfully engaged in recognized scientific work or who has made significant contributions to the Academy may be nominated as a Fellow by the Fellows Committee.”

Respectfully submitted,
Owen K. Davis
Roy R. Johnson

REPORT OF THE MEMBERSHIP SECRETARY

Renewal notices for 2003 were sent out in early November 2002. As of mid-February 2003, 124 members have renewed. Including our emeritus members, we have a total of 191 members, who live in 20 difference states and Mexico. Fifteen of our members are students.

At its January meeting the Board of Governors approved a request to mail renewal notices in late summer each year. Renewals will still be due by the end of December each year, and the membership year will follow the calendar year. However, by mailing the notices at a less-busy time, we hope to make it easier for members to renew. We will provide regular renewal reminders via the listserv throughout the fall.

Invoices to our institutional members were also sent out in November 2002. As of mid-February, 37 institutions (mostly libraries) have renewed their subscriptions. Our institutional subscribers are in 19 different states, as well as Mexico and Canada. As per directive of the Board of Governors, I will send letters to the 13 additional institutions who currently receive complimentary copies of JANAS to let them know that we will discontinue these complimentary subscriptions in most cases, and invite them to become paying subscribers.

Respectfully submitted,
Ingrid Novodvorsky
Membership Secretary
REPORT OF THE NECROLOGY COMMITTEE

During this past year, we lost one of our members, Malchus Baker, who died in September 2002. Malchus was one of the key scientists who kept the Hydrology and Water Resources section of the Academy running. For many years, he spearheaded the publication and distribution of the Hydrology Section proceedings, Hydrology and Water Resources in Arizona and the Southwest. In 2002, he also accepted the challenge of serving as one of the two northern Arizona directors of the Academy.

Malchus was a hydrologist with the USDA Forest Service's Rocky Mountain Research Station. He joined the Station in 1969, as a Research Hydrologist working on the Beaver Creek Experimental Watershed project. As a young scientist, he was key in the design, operation, monitoring and studying the Beaver Creek Experimental Pilot Project in Arizona during its active years. Since then, Malchus has been involved in numerous regional and international (for example, Mexico) studies. His most recent work involved natural processes that govern properly functioning riparian ecosystems, and the interrelationships between the aquatic, biotic, and upland watershed components of the system. A major aspect of the riparian work is developing or adapting methodology and techniques for assessing riparian conditions and for restoring degraded systems. Malchus authored or co-authored a number of books and nearly 80 other publications on the influence of vegetation manipulation on water yield, storm flow, riparian assessment and condition, and watershed hydrology. His works are widely published in Forest Service professional papers and many journal articles. He is survived by his wife Linda, their two daughters and a son.

Respectfully submitted,
Ingrid Novodvorsky
Membership Secretary

OUTSTANDING SERVICE AWARD COMMITTEE

This year’s Outstanding Service Award is presented to Milton R. Sommerfeld, one of the academy’s staunchest of supporters over the last 34 years. Dr. Sommerfeld has been a member of ANAS since 1969 and was elected a Fellow in 1981. He served as the academy’s President from 1990-1991 and Acting President 1991-1992. His leadership in the organization has also extended to chairing committees and serving as section chair at numerous annual meetings. Over the course of his membership, Dr. Sommerfeld has demonstrated the highest of caliber support for activities of the association not only by his strong year in and year out service to the academy but also by encouraging the involvement of many students and faculty in the academy’s activities. For example, he has supervised 38 students, most of whom have presented papers at the annual meeting and many of whom have published in its journal. He has blended a strong career as a research scientist, teacher and mentor with vital service to the organization. Dr. Sommerfeld is currently an Associate Dean in the College of Liberal Arts & Sciences at ASU and a member of the Plant Biology faculty. His area of research involves algae-related problems, physiological ecology of endolithic algae, lakes and sinks for biohazardous chemicals, and aquatic ecology of Southwestern streams and lakes.
OUTSTANDING SCIENCE TEACHER AWARD

Here are the selections for the ANAS 2003 Outstanding Teacher Award competition—congratulations to our winners!

Middle school:
Bonnie Darrell
Kathleen and Tim Harney Middle School

High school:
J-Petrina McCarty-Puhl
Robert McQueen High School

Respectfully submitted,
William Perry Baker

REPORT OF THE GRADUATE STUDENTS GRANTS-IN-AID COMMITTEE

There are two periods of application for the graduate students grants-in-aid, fall and spring. I just received the spring applicants and I have not sent the applications for evaluation to the Graduate Students Grants-in-Aid Committee yet. However, there are two winners from the fall applicants I would like to report. The committee members responsible for evaluating the application materials are Dr. Owen Davis from the University of Arizona, Dr. Anthony Brazel from Arizona State University and myself. The spring application materials from the spring applicants will also be evaluated soon for presentation at the Annual Meeting on April 12, 2003.

The winners are Rebecca Suzanne Beard from Arizona State University in Tempe, Arizona and Kathryn Mauz from the University of Arizona in Tucson, Arizona.

Respectfully submitted,
Aregai Tecle

HIGH SCHOOL GRANT’S-IN-AID COMMITTEE

Three high school students were awarded $100 grants for research they are doing.

Andrew Gorzalski of Silverado High School, Las Vegas is working on a project studying coliform bacteria in Las Vegas Wash.

Jodie Scribner of Smith Valley High School is doing research on soil pH and plant growth.

Cole Gansburg also of Smith Valley High School is doing research on fish growth and the environment.

Respectfully submitted,
Paul Smolenyak
REPORT OF THE BUD ELLIS SCHOLARSHIP AWARD COMMITTEE

The winner of the Bud Ellis Scholarship for 2003 is Nicole Corcoran from Coconino High School in Flagstaff, AZ. Among the outstanding candidates, Nicole is exceptional indeed. She is second in her class of 296 students, has a perfect 4.0, an SAT math score of 680, and ACT scores that place her among the top 3% of students in the nation. She has taken every regular and AP science course at her school. She is an accomplished student leader and athlete. She is an active member in her community, participating as a science tutor to elementary school students and on the science curriculum planning committee for her school. She has received several state and regional academic awards as well as the enthusiastic support of instructors, coaches, counselors and employers. Nicole plans to attend the University of Arizona, concentrating her studies in neuroscience. Congratulations, Nicole Corcoran.

In addition to the winner, four students deserve Honorable Mention. These students include: Daphne Bateman and Devon Bateman, both of Douglas High School, Las Vegas, NV, Kristopher Smith, of Yerington High School, Yerrington, NV and Megan Danser, of Mojave High School, Las Vegas, NV.

Respectfully submitted,
Stephen M. Shuster
## TREASURER'S REPORT
### 2002

### Operating and Short Term Reserve Fund (Vanguard Prime Money Market Fund)
- **Account Value on 12/31/01**: $13,471.52
- **Dividend Deposits**: 174.15
- **Transferred to ASU General Fund**: -1000.00
- **Account Value on 12/31/02**: $12,676.18

### Goethe Educational Endowment Fund (Vanguard Index 500 Mutual Fund)
- **Account Value on 12/31/01** (155.564 shares at $105.89/share): $16,472.67
- **Transferred Donations**: + 3.029 shares (Total: 158.593 shares)
- **Dividends**: + 2.499 shares (Total: 161.092 shares)
- **Account Value on 12/31/02** (161.092 shares at $81.15/share): $13,072.62

### General Fund
- **December 31, 2001 Balance**: $6,882.99
- **Transferred to Goethe Educational Endowment Fund**: – 270.00
- **Deposits**: +$11,290.00
- **Expenses**: – 9233.66
- **Transferred to ASU General Fund**: – 2500.00
- **December 31, 2002 Balance**: $6124.33

### ASU General Fund
- **December 31, 2001 Balance**: $413.45
- **Transfer from General Fund**: + 3500.00
- **Expenses**: – 3097.92
- **December 31, 2001 Balance**: $815.53

### Market Value of Assets (as of December 31, 2002)
- **$32,688.66**
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82  Southwest Forest Science Complex
68  Rolle Activity Center
65  Social and Behavioral Sciences
70  Business Administration
73  Walkup Skydome